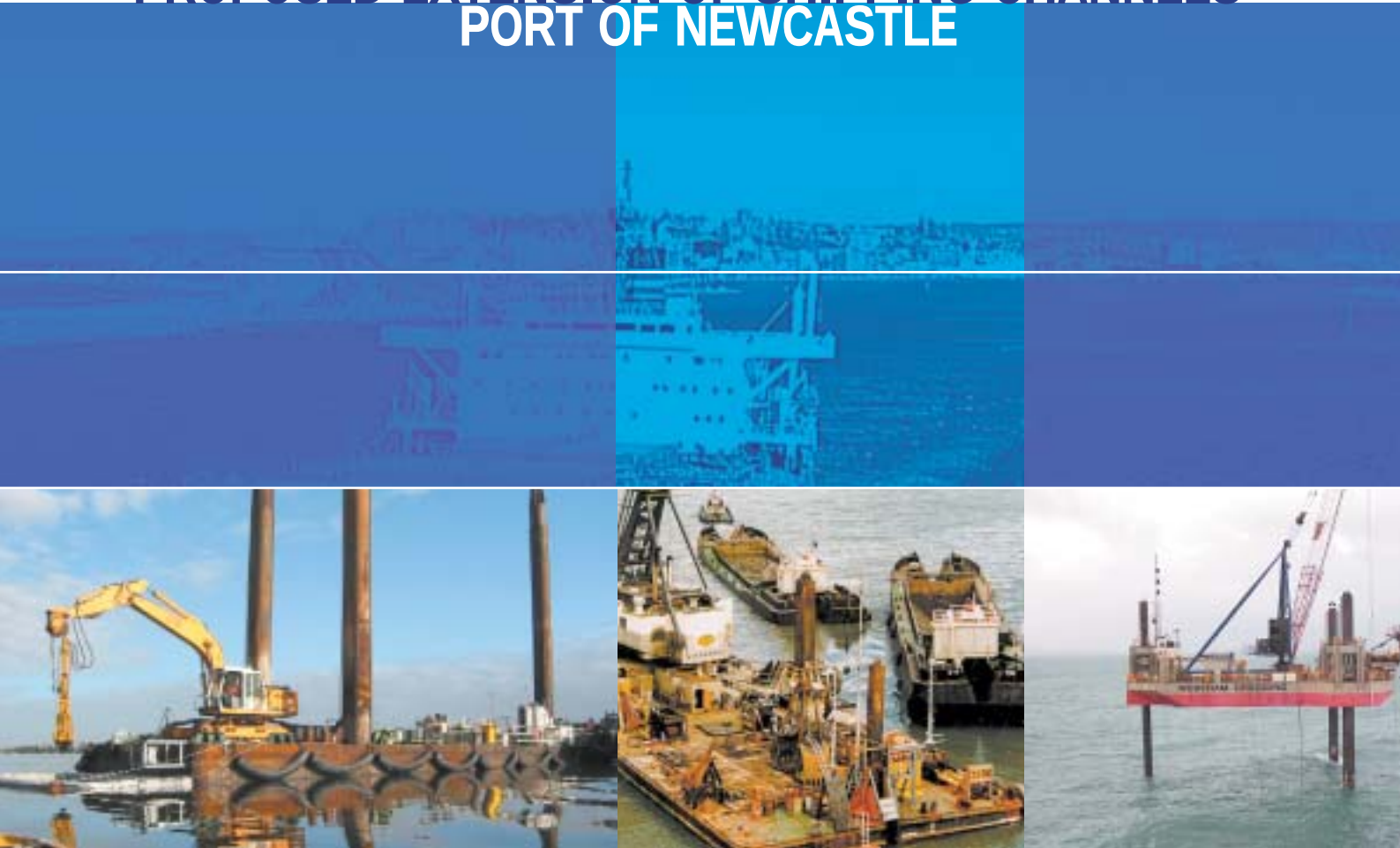




PROPOSED EXTENSION OF SHIPPING CHANNELS PORT OF NEWCASTLE



ENVIRONMENTAL IMPACT STATEMENT



MAIN REPORT



PROPOSED EXTENSION OF SHIPPING CHANNELS PORT OF NEWCASTLE

1

VOLUME

**ENVIRONMENTAL IMPACT STATEMENT
MAIN REPORT**

**APPENDIX A
DIPNR Director-General's requirements for the EIS**

**APPENDIX B
Correspondence from statutory agencies**

**APPENDIX C
Engineering concept plans**



**GHD Pty Ltd
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Sydney NSW 2000**

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November 2003

FORM 2

Submission of Environmental Impact Statement (EIS)

Prepared under the Environmental Planning and Assessment Act 1979 Section 78A(8)

EIS prepared by

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GHD Pty Ltd

Qualifications: Bachelor of Engineering (Chem.) Grad.Dip.Mgt
MIEAust.

Address: 10 Bond Street
Sydney NSW 2000

In respect of: Proposed extension of shipping channels, Port of Newcastle

Development Application

Applicant name: Waterways Authority

Application address: Level 11
207 Kent Street.
Sydney NSW 2000

Land to be developed: The proposal is to be carried out on land as shown in the EIS

**Lot no. DP/MPS, vol/fol etc
proposed development:** Refer Chapter 10 of EIS

Environmental Impact Statement

An environmental impact statement (EIS) is attached

Signature



Name

David Waddell

Date

13 November 2003

I certify that I have prepared the contents of this Statement and to the best of my knowledge

- It is in accordance with clauses 54A and 55 of the Environmental Planning and Assessment Regulation 1994, and
- It is true in all material particulars and does not, by its presentation or omission of information, materially mislead.

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Glossary of terms

Acid sulphate soils (ASS)	Soils containing pyrite, which produces sulphuric acid when exposed to oxygen.
Acoustic	Pertaining to the sense or organs of hearing, or to the science of sound.
Ambient	Surrounding or existing.
Amphipod	A member of the Amphipoda, an order of terrestrial, marine and freshwater crustaceans, having a laterally compressed body, elongated abdomen and no carapace, e.g. sand hopper.
Anaerobic	Anaerobic conditions are environments containing no oxygen.
Aquatic biota	The sum total of the living organisms in or near water.
Aquatic ecology	The interrelationships between organisms, their environment and each other, in or near water.
Artefact	Something that has been made by a person.
Barnacle	Common name for a member of the Cirripedia, which are aquatic, sessile crustaceans that feed by drawing a current of water towards the mouth with their whip-like appendages.
Benthic	Referring to organisms living in or on the sediments of aquatic habitats (lakes, rivers, ponds, etc.).
Benthos	The sum total of organisms living in, or on, the sediments of aquatic habitats.
Bioaccumulation	General term describing a process by which chemical substances are accumulated by aquatic organisms from water, either directly or through consumption of food containing the chemicals
Biota	The sum total of the living organisms of any designated area.
Bivalve	A mollusc with a hinged double shell.
Bund	A barrier designed to contain liquids within a defined area.
Cape class vessels	A vessel that is too large to navigate the Suez Canal to and from the Arabian Gulf, therefore being forced to voyage around the Cape of Good Hope. It has a capacity of approximately 80,000 – 175,000 dead weight tonnes. Typical dimensions are a length of approximately 280 metres and a beam of approximately 45 metres.
Cement stabilisation	A process where contaminated material is mixed with cement to immobilise the contaminants.
Closure area	Refers to the remaining section of the former BHP Steelworks site on the south bank of the south arm, not to be confused with any of OneSteel's operations further to the west

Confined disposal facility	A facility designed to contain contaminated materials over the long term.
Consent	See development consent.
Crustacean	A diverse sub-phylum of Arthropoda, comprising animals which have a hard exoskeleton, two pairs of antennae, one pair of mandibles, and two pairs of maxillae. The limbs are adapted for a wide range of functions. Small crustaceans include amphipods, isopods, cladocerans and copepods.
Cumulative impact	An impact created by accumulation or successive additions of individual impacts, which may not in themselves be significant.
dB(A)	The most common measurement of environmental noise (A level weighting) – measured using a simple sound level meter, to simulate the subjective response of the human ear.
Designated development	According to Section 77A of the Environmental Planning and Assessment Act 1979, designated development is defined as ‘development that is declared to be designated development by an environmental planning instrument or the regulations’. The Environmental Planning and Assessment Regulation 2000 declares designated development to be those described in Part 1 of Schedule 3 to the Regulation. An EIS is required to accompany a development application for a designated development.
Development consent	Approval to undertake a development received from the consent authority. Also referred to as a development approval.
Dispersion model	Mathematical model used to estimate concentration profiles of gases or particles suspended in air at various distances from the initial point of release.
Ecologically sustainable development	Development that meets the needs of the present without compromising the ability of future generations to meet their own needs.
Effluent	Liquid industrial waste or wastewater, which may or may not have been passed through some purification processes.
Emission	The release of material into the atmosphere (eg gas, noise).
Environmental management plan	A document setting out the management, control and monitoring measures to be implemented during construction (a construction environmental management plan) and/or operation (operational environmental management plan) of a development, to avoid or minimise the potential environmental impacts identified during an environmental assessment process (such as an EIS).
Ephemeral	Lasting only a short time.
Estuary	The tidal mouth of a river.
Ethnography	The scientific description and classification of the various cultural and racial groups of mankind.
Flora and fauna	Plants and animals.
Geobags	Bags constructed from geotextile materials, which when filled with river sediments with a high water content, allow slow water percolation while retaining the solids.
Geochemical	Relating to the chemical structure of geology, soils, rock etc.
Geotechnical	Relating to the form, arrangement and structure of geology, soils etc.

Hazardous Waste	Waste classified as Hazardous in accordance with the 'Environmental Guidelines: Assessment, Classification & Management of Liquid & Non-Liquid Wastes (NSW EPA, 1999)'.
Hydrology	The science dealing with water on the land or under the surface, its properties, distribution etc.
Inert Waste	Waste classified as Inert in accordance with the 'Environmental Guidelines: Assessment, Classification & Management of Liquid & Non-Liquid Wastes (NSW EPA, 1999)'.
Intertidal	Applies to the area between the high and low water marks.
Inversion	Reversal of the usual temperature gradient in the atmosphere, with the temperature increasing with height, rather than decreasing with height.
Invertebrate	An animal without a vertebral column or backbone.
Isopod	A group of marine, freshwater and terrestrial crustaceans, including woodlice and water slaters, having a dorsoventrally flattened body and no carapace.
Level of service (LOS)	A qualitative measure describing operational conditions within a traffic stream, and their perception by motorists and/or passengers.
Mangroves	A name given to a group of ecologically related plants from many different plant families. They are usually defined as the trees and larger shrubs that normally only grow in plant communities that are periodically flooded by tidal waters.
Multiplier	Multipliers, such as those produced by the Australian Bureau of Statistics, which estimate the effect direct investment in a particular industry will have on the economy as a whole.
Panamax class vessels	Panamax class vessels are the largest vessels that can pass through the Panama Canal. Typical length is approximately 240 metres, with a beam of approximately 30 metres. It has a capacity of approximately 50,000 to 75,000 dead weight tonnes.
Particulate	Small particles, usually occurring in suspension.
Perennial	Lasting or continuing throughout the year.
PM10	Particles of size equal to or less than 10µm in diameter.
Potable water	Water suitable for drinking.
Preliminary hazard analysis	A hazard analysis is used to develop an understanding of the hazards and risks associated with an operation or facility and of the adequacy of safeguards. A preliminary hazard analysis occurs at an early stage of a project.
Preliminary risk screening	An assessment of the likelihood of risk, required under State Environmental Planning Policy No 33, to determine the need for a preliminary hazard analysis.
Ramsar wetland	A wetland recognised under the Convention of Wetlands of International Importance (also known as the Ramsar Convention) as being of international significance or a wetland declared to be a Ramsar wetland by the Commonwealth Environment Minister.
Revetment	Strictly speaking a lining to a sea-wall – in this EIS used interchangeable with seawall.
Rushes	Monocotyledons that live mainly in wet habitats, with small flowers having a perianth of six brown or green segments.

Salinity	The amount of salt dissolved in water.
Saltmarsh	The intertidal area on sandy mud in sheltered coastal areas and in estuaries, supporting characteristic plant and animal communities.
Sapling	A young tree arising from a seed or sucker.
Seagrass	Small rhizomatous marine and/or estuarine perennial plants.
Sedimentation basin	A basin in which stormwater, wastewater etc is temporarily stored, so that suspended matter may sink to the bottom, from which they can be removed.
Settlement	The subsidence of a structure, mass etc.
Sewer	A conduit for the carrying of wastewater (sewage).
Siltation	The accumulation of fine sediments in a river bed which fills spaces between rocks, fills holes and decreases the volume and depth of the river.
Sleep arousal	Disturbance of sleep.
Solid Waste	Waste classified as solid in accordance with the 'Environmental Guidelines: Assessment, Classification & Management of Liquid & Non-Liquid Wastes (NSW EPA, 1999)'.
Spoil	Materials such as earth, rocks, sediments thrown up or brought up in excavating, dredging, etc.
Spud	Large diameter piles that can be lowered/raised.
State Environmental Planning Policy (SEPP)	A planning instrument made by the State dealing with matters of significance for environmental planning in the State.
State significant development	The means by which a development can be described as 'State significant' are listed in Section 76(A)(7) of the Environmental Planning and Assessment Act 1979. The Minister for Planning, Industry and Natural Resources is the consent authority for State significant development.
Substrata / Substratum	The bases/base to which sedentary animals or plants are fixed.
Subtidal	The sea-shore area lying immediately below the intertidal area and extending to about 200 metres depth or to the edge of the continental shelf.
Temperature inversion	An inversion is formed when the cooler surface layer of air is trapped by a ceiling of warmer air. This hinders the ability of the pollutants to be dispersed in the atmosphere.
Thermal desorption	A process where contaminated material is heated to remove organic contaminants. The contaminants removed are then destroyed in the off gas stream.
Threatened species	Species of animals or plants that are at risk of extinction (also know as 'endangered species') or becoming endangered within the next 25 years ('vulnerable species'), defined by the Threatened Species Conservation Act 1995.
Turbidity	The term used to describe water that is not transparent. Water is often turbid because fine particles of sediment are suspended in it. Sediment washing off the land increases the turbidity of receiving waters.

Wetland

An area habitually saturated with water, which may be partly or wholly covered permanently, occasionally or periodically, by fresh or salt water up to a depth of six metres. It includes bogs, fens, flood meadows, marshland and salt marshes, shallow ponds, river estuaries, and intertidal mudflats, but excludes rivers, streams, lakes and oceans.

List of abbreviations

°C	Degrees Celsius
AEP	Annual exceedance probability
AHD	Australian height datum
ANZECC	Australia and New Zealand Environment and Conservation Council
AQIA	Air quality impact assessment
AS	Australian Standards
ASS	Acid Sulphate Soils
ASSMAC	Acid Sulphate Soil Management and Advisory Committee
BTEX	Benzene, Toluene, Ethylbenzene and Xylene
CAMBA	China-Australia migratory bird agreement
CBD	Central business district
CEMP	Construction environmental management plan
CO	Carbon monoxide
CO₂	Carbon dioxide
CSIRO	Commonwealth Scientific & Industrial Research Organisation
DA	Development application
DB	Decibels
DCP	Development control plan
DG	Director General
DIPNR	Department of Planning Industry and National Resources
DLWC	Department of Land and Water Conservation
DPWS	Department of Public Works and Services
DTD	Direct thermal desorption
EA	Environment Australia
EIS	Environmental impact statement
EMP	Environmental management plan

EPA	Environment Protection Authority (NSW)
EP&A Act	Environmental Planning and Assessment Act 1979
EPBC Act	Environment Protection and Biodiversity Conservation Act 1999
ESD	Ecologically sustainable development
HAZOP	Hazardous on-site operations and processes
HCMT	Hunter Catchment Management Trust
HDPE	High density polyethylene
JAMBA	Japan-Australia migratory bird agreement
KW	Kilo watts
L10	Average maximum noise level - the noise level exceeded for 10% of a sampling period.
L90	Background noise level - the noise level exceeded for 90% of a sampling period.
Leq	Equivalent continuous noise level
LALC	Local Aboriginal Land Council
LEP	Local environmental plan
LGA	Local government area
LOS	Level of service
ML	Mega litre
mtpa	Million tonnes per annum
NCC	Newcastle City Council
NEHF	National Environmental Health Forum
NHMRC	National Health and Medical Research Council of Australia
NHTG	Newcastle Harbour Tide Gauge
NOx	Nitrous oxide
NPC	Newcastle Port Corporation
NPWS	National Parks and Wildlife Service
OHS	Occupational Health and Safety
OU	Odour units
PAHs	Polycyclic aromatic hydrocarbons
PASS	Potential acid sulphate soils
PHA	Preliminary hazard analysis
PWCS	Port Waratah Coal Services
QA	Quality assurance
RAP	Remedial action plan

REP	Regional environmental plan
RIC	Rail Infrastructure Corporation
RL	Relative level
ROTAP	Rare or threatened Australian plant
RTA	Road and Traffic Authority
SEDA	Sustainable Energy Development Authority
SEPP	State environmental planning policy
SIS	Species impact statement
TOC	Total Organic Carbon
TPH	Total petroleum hydrocarbons
TSC Act	Threatened Species Conservation Act 1995

Notes on the text

Would/will

As a determination on the proposal will only be made after the environmental impact statement has been on public display and submissions considered, the future conditional tense is used throughout this environmental impact statement when describing the proposal and alternatives and assessing impacts. 'Would' is therefore used throughout the text in preference to 'will'.

Executive summary

1 Overview of the proposal

1.1 Introduction

This EIS has considered the potential impacts of the proposed dredging and excavation of the South Arm to facilitate the extension of shipping channels in the Port of Newcastle. It has been prepared by GHD Pty Ltd (GHD) on behalf of the Waterways Authority to assist the Minister of Infrastructure Planning and Natural Resources in assessing the proposal. This EIS has been prepared in accordance with the provisions of Part 4 of the EP&A Act; and with regard to the requirements of the Director-General of DIPNR and issues raised by other statutory agencies.

The EIS considers an assessment of the potential environmental impacts of the proposal, considering both the potential positive and negative impacts of the proposal, and recommending mitigation measures to protect the environment where required.

The Waterways Authority (the proponent) proposes to dredge the South Arm of the Hunter River in Newcastle NSW to provide for future expansion of port facilities. The area proposed to be dredged is in the South Arm of the Hunter River and extends for approximately three kilometres from the end of the existing shipping channel to the Tourle Street bridge. The work would include the construction of a swing basin near the western end of the area to allow large ships to turn around.

A significant amount of the material to be dredged is clean sand and the EIS considers various options for the beneficial reuse of this material. The final option(s) chosen would depend on which of the associated land based developments proceed and their construction schedules. The remainder of the dredged material is unsuitable for reuse and it is proposed to transfer this material to an approved offshore disposal area.

An associated benefit of this proposal would be the removal and remediation of contaminated river sediments in the South Arm. Some of the sediments are highly contaminated. The NSW Environment Protection Authority (EPA) has declared these sediments a 'remediation site' under the *Contaminated Land Management Act 1997*. As a result, treatment and disposal of some of the dredged and excavated material is also required in line with the EPA's declaration.

The proposed works described above are referred to collectively as 'the proposal' for the purposes of this environmental impact statement (EIS).

Newcastle Port Corporation is managing the EIS and contracting processes on behalf of the proponent, and would be responsible for future vessel operations in the South Arm.

GHD was commissioned to undertake an assessment of the potential environmental impacts of the proposal, and to prepare an EIS summarising the results of this assessment as part of the development consent requirements for the proposal.

1.2 Why is the proposal needed?

In recent years, public and private sector trade initiatives have seen an increased interest in, and demand for, port facilities. The Waterways Authority and Newcastle Port Corporation wishes to attract new business to the port. There have been a number of recent proposals from industries interested in having access to deepwater berths in the South Arm. As a result, the Waterways Authority and Newcastle Port Corporation seeks to ensure that a sufficient supply of serviceable port land is available to meet future demand.

The South Arm has been identified as the most suitable location for port expansion in Newcastle, mainly because of the South Arm's proximity to transport infrastructure, its lower potential for significant environmental impacts (particularly to the Kooragang Nature Reserve) and its more passive hydraulic characteristics (compared to the north arm of the Hunter River).

The future development of port facilities within the South Arm would be dependant upon the provision of a dredged navigation channel, swing basin and berthing trenches designed to accommodate Panamax class and Cape class vessels.

1.3 What are the objectives of the proposal?

The first objective of the proposal is to extend the shipping channels in the Port of Newcastle in order to provide adequate deep water access to future berth sites. This would secure the potential for the continued sustainable economic growth of this, the maritime gateway to the Hunter Region.

A benefit of the proposal is to achieve the removal and remediation of the large quantity of contaminated river sediments that have the potential to pose a significant ecological and health risk.

1.4 How does the proposal fit in terms of regional development?

Future development of the Port of Newcastle is consistent with the NSW Government's strategic direction for Ports in NSW. In March 2003 the NSW Government released the 'Newcastle Port Environs – concept proposal' (the concept proposal). This was presented as one of the first steps in providing for the sustainable growth of Newcastle Port and its environs. The concept proposal provides a strategic overview of the likely future development of the Newcastle Port environs by identifying key developmental and environmental issues and categorising land areas for the potential use of the area.

The concept proposal is intended as a starting point for a consultation process on which future strategies for conservation and development in the area will be based.

In terms of development, the concept proposal aims to facilitate and encourage:

- the use of port-front land by port-related industries;
- land that is suitable for port-related industrial development being made available for such uses; and
- opportunities to build upon the competitive advantages evident in the Newcastle Port environs for economic growth, including potential for deep water access, proximity to a major airport, and potential for infrastructure links.

The above objectives are balanced against conservation objectives also provided within the concept proposal report. The channel extension proposal has been developed within the framework of the concept proposal.

1.5 What would the proposal involve?

The proposal would involve three main elements:

- Dredging and land-based excavation to form the channel and swing basin;
- Treatment of the contaminated sediments; and
- Disposal of materials by various means.

The methods of dredging, transportation, treatment and reuse/disposal of the dredged material would be determined by the relative quantities and qualities of the material encountered, as well as other factors such as staging.

The proposal may be undertaken as one single dredging campaign over a period of approximately 48 months or may be developed in stages to correspond with development of associated land-based facilities. It may be possible to undertake the work over a shorter timescale, however this would involve additional cost.

The estimated capital cost of the complete proposal is approximately \$300 million to \$400 million.

An overview of key activities involved in the proposal is provided below. Detailed descriptions are provided in individual chapters of the EIS.

Materials and quantities

A detailed assessment of materials found in the South Arm has been undertaken. The materials likely to be found during dredging are varied, and range from rock to soft silty clays.

The total volume of material involved is estimated at 13.6 million m³. This includes 7.6 million m³ of materials to be beneficially reused on land and approximately 6 million m³ of material to be disposed of offshore. Approximately two percent of the total volume of material has been identified as requiring some form of treatment before its disposal or reuse.

This figure has been determined through a significant amount of testing, analyses and consultation with both the EPA and Environment Australia. It should be noted that further site investigation and analysis could possibly reduce the volume of sediment that requires treatment on land. The factors that determine final volumes suitable for sea disposal are subject to approval of the NSW EPA and Commonwealth Minister for the Environment.

In general terms, the level of contamination in the majority of the South Arm sediments is low – the large quantity of sand in the South Arm is suitable for beneficial reuse in its current state.

The dredging and excavation process

The proposed channel would extend along the South Arm of the Hunter River. It would start at the end of the existing channel (adjacent to the Kooragang Island coal loader and the former BHP wharves) and finish just east of the Tourle Street bridge.

The channel would be dredged and excavated and the banks left in a stable configuration as shown by figures contained within the EIS. The development of the berths along the channel would then occur over time, as the associated land-based developments are approved and built. These berths and any land-based development would be subject to separate assessment and approval processes.

Dredging and excavation would involve the removal and handling of material of many different types, in varying quantities, and from different locations within the area to be dredged. As a result, the materials would need to be removed by use of different technologies, and handled in a manner that would facilitate reuse, treatment and/or disposal at different locations.

The proposed strategy for achieving the removal of the materials in an efficient, cost-effective and environmentally sound manner is described in the EIS.

A description of the operation of the different dredges and other equipment (such as excavators) is also provided in the EIS.

The swing basin

To ensure that shipping vessels can navigate safely, a swing basin is required towards the upstream end of the proposed channel. This would enable vessels to turn, or swing around on arrival, before their return journey downstream.

The swing basin encroaches a significant distance into the OneSteel site, along a portion of the south bank. The materials to be excavated potentially include tar, rock, soil, building rubble, steelworks waste, slag and coal washery rejects.

Other activities

Prior to dredging and excavation it would be necessary to:

- establish the contractors designated work and storage areas;
- identify and remove artificial obstructions from the site; and
- install a temporary steel sheet piled wall to separate the more contaminated sediments from the main channel.

Treatment of sediments

The removal and subsequent treatment of the contaminated sediments in the Hunter River is an integral part of the overall proposal. This material could represent a long-term health and ecological hazard and due to this, the former BHP closure area site and a portion of river sediments have been declared a 'remediation site' under the *Contaminated Land Management Act 1997* and falls under a voluntary remediation process currently under assessment by the NSW EPA.

It is not feasible to leave these sediments in place, as the spatial extent is significant and the proposed extension of the shipping channel requires all of the available area.

The materials present vary considerably. In some locations, concentrations of contaminants such as PAHs are elevated. These materials would require specialist treatment technologies to bring the levels of contaminants below acceptance criteria.

The sediments would be treated on the BHP closure area site. Several treatment and disposal process configurations could be adopted, depending on the level of contamination. Methods of treatment could include cement stabilisation technology, thermal desorption technology or an equivalent technology approved by the NSW EPA. The preferred technology assessed in this EIS is that of cement stabilisation. It has been shown through extensive testing as part of the EIS process, that the sediments when mixed with cementitious material can be classified as inert waste in that contaminants do not leach out of the treated material, rather are bound in a matrix. The testing program carried out as part of the EIS also has proven that the treated stabilised material has excellent engineering properties and can be used as fill and capping.

Disposal of materials

As far as possible, the aim would be to beneficially reuse the material resulting from dredging and excavation. However, not all materials (for example, silty muds or soft marine sediments) can be reused. In addition, as described above, some material needs to be treated before it can be reused.

The means of disposal proposed for materials from the dredging and excavation process are:

- offshore disposal of materials according to the provisions of the *Environment Protection (Sea Dumping) Act 1981*;
- beneficial reuse of suitable material; and
- disposal of treated materials on the closure area or other licensed sites on Kooragang Island.

Options for beneficial reuse considered within this EIS include the use of sediment as:

- fill at the proposed Tomago industrial area;
- fill along the proposed multi-user port and transport corridor to the Tomago industrial area once the route is determined;
- fill at the Protech site and any other industrial site in the area requiring clean fill;
- engineered fill (untreated and treated sediments) on the closure area site or licenced disposal sites on Kooragang Island; and
- potential renourishment of Stockton Beach using clean sands.

Fill would be transported to the Tomago industrial area by means of the proposed multi-user port and transport corridor. While the EIS considers various options for reuse of the clean dredged sand, the final options chosen would depend on the requirements of other projects and on these projects being separately approved. One of the options for reuse would involve filling of a proposed industrial area at Tomago. To establish that this concept would be feasible, the EIS has reviewed the environmental impacts of a temporary discharge pipeline from the port area to Tomago. Development consent for such a pipeline would, however, be the subject of a separate application, which may also review other options for the route of the pipeline.

2 Scope of the EIS

2.1 What development consent requirements apply to the proposal?

Development consent from the Minister for Infrastructure Planning and Natural Resources (under Part 4 of the *Environmental Planning and Assessment Act 1979* (EP&A Act)) would be required for the proposal as a whole. This EIS addresses the issues identified in DIPNR's Director-General's Requirements for the EIS, as well as issues raised by statutory agencies consulted during preparation of the EIS.

This EIS supports the proponent's application for development consent under Part 4 of the EP&A Act.

The proposal is also classified as a controlled action under the Commonwealth *Environment Protection and Biodiversity Act 1999* (EPBC Act). As a result, approval from the Commonwealth Minister of the Environment is required. Environment Australia has accredited the NSW development assessment process.

The EIS assesses the key potential impacts of the majority of the activities associated with the proposal, as described above.

2.2 What is the proponent seeking development consent for?

Development consent is sought through this EIS for:

- the dredging and excavation of the South Arm of the Hunter River as described in this EIS and as shown in the engineering drawings contained in Appendix C;
- transfer of significant quantities of clean sand to the proposed Tomago industrial area;
- the handling and treatment of treated sediments onto the closure area site; and
- the transport and subsequent disposal of treated and untreated material on the BHP closure area site or to licenced sites on Kooragang Island.

There are a number of projects within the Newcastle and Hunter region that are either proposed or have development consent. These include the Protech Cold Mill facility on Kooragang Island, and the Multi-purpose Terminal facility on the closure area site. Separate approval processes apply to these projects and other proposed developments. The proponent is seeking consent, as part of the current proposal, to supply fill to any project, subject to the relevant approvals being gained for the transport and use of such fill, by the proponents of other projects.

The following are not considered in detail within this EIS:

- The disposal of material offshore which is subject to a separate Commonwealth approval process, under the *Environment Protection (Sea Dumping) Act 1981*. This activity is subject to a separate application to the Commonwealth Minister for the Environment;
- The EIS does not consider the development of sites and facilities that would be facilitated by the proposal (including future port facilities along the South Arm). These developments would be subject to separate parallel assessment and approval processes;
- Construction of any new infrastructure used to transport material to other sites for reuse. This infrastructure would be subject to separate approval and assessment processes. One possible method of transfer of the clean sand to Tomago is, however, examined within the scope of this EIS, a broad description of this process and its potential impacts is provided;
- Any future site development activities involving the reuse of material gained as a result of the proposal. These activities would be subject to separate assessment and approval processes;
- The treatment of contaminated sediments on any Kooragang Island sites; and
- Renourishment of Stockton Beach with clean sand.

It should be noted that the proposed offshore disposal of sediments that cannot be reused would be assessed by Environment Australia through a separate application process for a permit under the *Environment Protection (Sea Dumping) Act 1981*. More detailed information on the assessment of this component of the proposal is included in the formal application to Environment Australia. An approval is not sought from the NSW Minister for Infrastructure Planning and Natural Resources for this component of the proposal. It is expected that the Minister's consent would be conditional on the granting of that approval from the Commonwealth Minister of the Environment.

2.3 What is the study area for the EIS?

The areas that would be affected by the proposal are outlined below.

- Dredging would involve the bed and banks of the South Arm below the high water mark, extending downstream for approximately three kilometres east of the Tourle Street bridge. The eastern boundary is located south of the intersection between Egret Street and Cormorant Road, near the Kooragang number 6 berth. The western boundary of the proposal is approximately 50 metres east of the Tourle Street bridge;
- Excavation of areas above the high water mark (adjacent the South Arm) would impact upon:
 - The site for the proposed swing basin, located approximately 1000 metres east of the Tourle Street bridge. Excavation for the swing basin would impact on land on both banks of the South Arm, including a portion of the OneSteel site (to the south) and an area of mangroves on the north bank;
 - Land on the north bank to the south of Cormorant Road – the road corridor itself would not be impacted; and
 - The stretch of sandy foreshore on the north bank.
- The closure area, located adjacent the South Arm to the south, is one of the sites proposed for the storage, treatment and disposal of approximately 250,000 to 300,000 cubic metres of contaminated sediments; and
- Sites on Kooragang Island which are owned by Regional Land Management Corporation have existing use rights as disposal sites for inert material and could be used for disposal.

3 Results of the environmental assessment

An assessment of the potential impacts of the proposal on the environment was undertaken in accordance with the requirements of the Director General of DIPNR. The assessment undertaken provided information on:

- the existing environment of the study area;
- potential impacts of the proposal; and
- recommended safeguards to mitigate these impacts.

A team of engineers and scientists led by GHD prepared the concept design for the proposal and undertook the environmental assessment presented in the EIS. Engineers from Newcastle Port Corporation provided the design requirements and engineering guidance to the team. This approach enabled an integrated approach to environmental assessment, allowing the EIS to present and assess a proposal that contains many in-built environmental management measures.

3.1 Landuse and infrastructure

The majority of works associated with the proposal would occur in an area that is dominated by port and industrial land uses.

The areas affected by activities that form part of the proposal are located just to the west of the existing Port of Newcastle. The majority of port and industrial activities are located in the vicinity of the South Arm, and the river mouth to the east (downstream). Port activities are concentrated to the east of the dredging site.

Landuse impacts as a result of the proposal include:

- physical impact on the site owned by OneSteel, and impact on activities occurring on the site, as a result of the proposed swing basin;
- temporary occupation of the closure area;
- permanent loss of access along the northern banks of the South Arm;
- temporary loss of waterborne access to the South Arm itself;
- disruption to access along the South Arm (once berth development takes place); and
- the need to relocate some public utilities and services.

The potential for impacts to operations on the OneSteel site would need to be carefully managed during the implementation of the proposal.

Management and mitigation measures are proposed to reduce the potential for these impacts. These include developing a plan to detail the management measures necessary to minimise the potential for impact on the operations of businesses on the OneSteel site. Surrounding land users, including commercial and recreational users of the Port, would be notified of the operating hours and duration of the dredging operations. A comprehensive program of community consultation would be implemented prior to the implementation of the proposal.

3.2 Hydrology and water quality

One of the most important assessments in this EIS has been the work undertaken in terms of potential impacts of the proposal on flooding, salinity and sediment dispersion in the Hunter Estuary. A key issue raised during development of the proposal was the potential for impact on the estuary processes, including flooding, intrusion of salinity and widespread dispersion of sediments, once dredging began.

The potential impacts of the proposed South Arm dredging on hydrodynamics, flooding and water quality were assessed. It was found that there would not be significant impacts on tidal hydrodynamics.

With regard to flooding, it was found that the general flood flow distribution, volumes and duration would not be altered by a significant amount. It was estimated that there would be a localised and substantial reduction in peak flood levels in the South Arm in the vicinity of Tourle Street bridge (0.6m in the 1 percent AEP event), and a slightly reduced flood risk throughout the lower Hunter estuary. These benefits were not expected to cause significant impacts on ecosystems relying on flood inundation.

Flood velocities in the South Arm upstream of the dredged area were predicted to increase, with the recommendation that bank stability be monitored, particularly between Tourle Street bridge and the railway bridge. Tidal and flood velocities in the dredged area were estimated to substantially reduce, providing benefits in terms of ease of navigation and reduced bank erosion.

Flood levels upstream of the railway bridge were predicted to marginally increase as a result of the installation of a temporary sheet piled wall (for a period of about one year) to contain contaminated sediments in the vicinity of the former Steelworks site during the dredging activities. This slight increase in flood levels was not expected to lead to significant flood damages.

With the temporary sheet piled wall in place, mean tidal and flood velocities would be expected to increase by about 15 percent in the vicinity of the wall, with the highest velocities against the northern bank. It is recommended that the stability of this bank be monitored while the wall was in place.

Assessment of the effect on flooding of the temporary discharge pipeline delivering sand to Tomago was also undertaken assuming a westerley route for the purpose of establishing a worst case. For the one percent AEP event, increases in peak water levels in the Hexham and Tomago area were found to only be 10 – 30 millimetres higher due to the construction of the proposed permanent transport corridor to Tomago, also on a westerly route.

Salinity intrusion was predicted to slightly reduce, although not to the extent of significantly impacting on mangroves, saltmarsh and fish.

It was also envisaged that there may be a greater tendency for stratification and depletion of dissolved oxygen concentrations at depth in the deepened areas, although the available evidence suggested that this does not occur in the existing dredged areas of the port. The existing dredged areas have some of the best water quality results in the estuary, most likely since the downstream areas of the estuary have the greatest tidal flushing.

During dredging operations, it was predicted that elevated suspended sediment concentrations might potentially harm aquatic life such as fish, although the Hunter estuary was noted as already having high suspended sediment concentrations. Turbidity curtains would be used in conjunction with various dredging operations, to minimise the dispersion of suspended sediment if expected levels of turbidity result. Dispersion of pollutants in the sediments suspended as part of the dredging operations was not considered to be a significant issue.

Deposition of sediment in sensitive areas such as mangroves south of Ironbark Creek was also considered to be around the magnitude at which concerns may be raised.

It was envisaged that Newcastle Port Corporation would need to make allowance for additional sedimentation in the port (during the proposal) as part of their regular maintenance dredging operations.

An appropriate allowance for maintenance dredging of the areas deepened as part of the channel extension for the South Arm needs to be made. While this would result in an increase in sedimentation in this area, as the total volume of sediment in the South Arm of the Hunter River would remain unchanged, there would be a commensurate reduction in the maintenance dredging requirements within the port area, downstream of the project area. The future maintenance dredging in the South Arm would be expected to be particularly concentrated to areas just downstream of the Tourle Street bridge.

Onshore stormwater management plan

The onsite areas associated with the proposal would need to be subjected to rigorous stormwater planning and management. The principles of the stormwater plan would centre on the need for very strict separation of 'clean' and 'contaminated' materials to avoid the contamination of rainwater runoff by sediments as well as prevention of sediments washing back into the river.

The contractor would be expected to adhere to the requirements of Newcastle Council's Stormwater Management for Development Sites (DCP No. 50).

Water treatment plants

It is expected that the bulk of waters associated with the highly contaminated sediments would be taken up by the cement stabilisation process. Any remaining waters would require treatment before their discharge to the South Arm. There is however expected to be contaminated groundwater arising from the swing basin on the OneSteel site that requires treatment. Water treatment plants would be provided on the OneSteel site and on the closure area remediation site.

Any water treatment plant associated with the onshore activities would need to be the subject of a licensing process with the NSW EPA before any discharge were allowed.

3.3 Aquatic ecology

An aquatic ecology impact assessment was undertaken for the EIS. No threatened species, populations or ecological communities or key threatening processes as specified under the Threatened Species Schedules of the *Fisheries Management Act 1994* were present or are considered likely to occur at the study site. Consequently, it is considered that the proposal would be highly unlikely to impose a significant threat to threatened aquatic biota.

The study area has been disturbed by industrial and port activities over a long period. The aquatic habitats and communities present in the study area are typical of disturbed estuarine environments. In addition, the communities that may potentially be disturbed are not unique to the site being widely distributed throughout the study site and the surrounding area.

Whilst no significant direct impacts are anticipated as a result of the proposal, there is the potential for indirect impacts unless appropriate mitigation measures are implemented, particularly during dredging. Such mitigation measures mainly relate to controlling the potential for impacts to water quality. As with all other projects occurring at the land-water interface, the control of erosion, sedimentation and other water quality impacts is a key issue.

3.4 Terrestrial flora and fauna

The proposal involves the removal or alteration of all vegetation in the study area on the north bank of the South Arm, between the Tourle Street bridge, to just south of the intersection of Cormorant Road and Egret Street. Vegetation communities identified in this area were modified grassland, plantings of native species, mangrove forest, saltmarsh vegetation and freshwater swamp vegetation.

It is estimated that the proposal would involve the removal of 5.7 hectares of mangrove forest and 0.9 hectares of saltmarsh vegetation on the north bank of the South Arm.

The removal of this vegetation is not considered to be significant from a local or regional perspective as a result of its small size, prior disturbance, and the proximity of larger areas of protected mangrove and saltmarsh vegetation in the Kooragang Nature Reserve.

The removal of fauna habitat in the study area is not considered to be significant from a local or regional perspective. Substantially larger areas of less disturbed habitat occur nearby the Kooragang Nature Reserve and are to be found in surrounding areas.

No currently listed endangered populations, endangered ecological communities, or areas of critical habitat were recorded in the study area. No threatened flora species were identified in the study area.

While many of the migratory bird species listed under the EPBC Act may occur in the study area, it is considered that the study area is unlikely to provide an area of 'important habitat' for any of these species. Habitat available in the study area is highly disturbed, and restricted to small areas of sandy shoreline, mangrove forest, saltmarsh and modified grassland. Larger and less disturbed areas of similar habitat are commonly available on Kooragang Island and in surrounding areas.

The proposal is not expected to alter the natural flow regime of the river to an extent that would have a significant impact on surrounding wetland areas.

It is recommended that habitat compensation be undertaken to compensate for the loss of the mangrove and saltmarsh vegetation.

3.5 Geology and soils

Disturbance of the ground surface during earthworks exposes unprotected soil surfaces and has the potential to increase erosion and release of contaminants to the Hunter River and associated groundwater systems. The design of land based excavation would incorporate drainage systems to limit overflow of run-off and direct stormwater into drainage systems that discharge at appropriate locations.

River areas

There is a minor risk of potential acid sulphate soils (PASS) being excavated from river areas. However, test data indicates that almost the entire the bulk of the proposed dredge materials are not PASS. Any minor PASS volumes exposed are expected to be buffered by the surrounding excavated material with which they are stockpiled.

Cement stabilisation of the sediments would further neutralise (buffer) such sediments. Further PASS investigations would be conducted around the few points where PASS has been indicated, and the mixing/neutralisation aspects checked to ensure that the ASS conditions did not develop.

An acid sulfate soil management plan would be prepared as part of the EMP, in accordance with the New South Wales Acid Sulfate Soils Management Advisory Committee publication, Acid Sulfate Soils – Assessment Guidelines (1998).

Swing basin area

If significant contamination exists within the swing basin site, excavation and treatment of soils would further reduce the potential risk to the surrounding environment. Procedures for excavation, handling, remediation, disposal and/or re-use of the excavated material would be prepared prior to construction of the swing basin. These procedures would be based on operational, construction and environmental considerations as well as the final design of the swing basin, and the interrelated requirements of other activities involved in the overall South Arm dredging proposal.

While a sheet pile wall with a buried tie back anchorage system within the swing basin site may reduce the amount of soils to be excavated from the site and increase the contamination migration path lengths (reducing any potential impacts to the Hunter River), the difficulties of construction of such a wall through variable fill with slag inclusions may be significant. Moreover, the potential environmental benefits are likely to be minimal.

3.6 Groundwater systems

In general terms no alterations in groundwater flow direction have been predicted for any of the groundwater bodies in the study area.

The proposed excavation and construction of the swing basin is considered to have the greatest potential for impact on groundwater. As a result of the historical filling within the vicinity of this area, and the presence of the Mill Scale Storage Transition Area and Pit, there could be groundwater impacts related to the proposed excavation in these areas. Potential impacts include contamination of groundwater and surface water from the proposed excavated soil material (i.e. slag, steelworks refuse etc.)

As a result of historical filling and waste residue disposal in the vicinity of the swing basin footprint, there is also the possibility of encountering TPH, BTEX, PAH, heavy metal, cyanide and phenol contamination during the excavation works.

If such contamination is uncovered, there could be environmental impacts from a reduction in the length of time this contaminated material takes to enter groundwater and discharge offsite. Alternatively, groundwater may be directly impacted through seeps of contamination.

These issues would need to be addressed in detail by the project environmental management plans for the proposal. Management procedures (outlined within the EIS) would be implemented to protect groundwater quality from any potentially contaminated excavated material from the proposed swing basin and from dredging of potentially contaminated sediment from the Hunter River itself.

With respect to the contamination potential of the proposal from the temporary storage of excavation and dredging wastes on land, no significant alteration in groundwater quality is expected.

3.7 Noise and vibration

Noise level criteria for the proposal were determined based on measuring existing background noise levels at the nearest potentially affected receptors. The nearest potential noise sensitive receptors to the site are located in the suburb of Mayfield, approximately one to two kilometres to the south of the South Arm. These included residential dwellings at selected locations in Mayfield, and the Mayfield East Public School.

A computer model was used to predict noise levels at the nearest sensitive receptors, under calm and prevailing weather conditions, based on noise emissions estimated to result from the proposal.

The results of the modelling of dredging noise under calm weather conditions show that all predicted noise levels at the nearest sensitive receptors would be below the site specific noise criteria.

The results of the modelling of dredging noise under temperature inversion weather conditions show that all predicted noise levels at the nearest sensitive receptors would be below the site specific noise criteria, except at North Arthur Street, Mayfield and Mayfield East Public School.

At these locations, the amenity criteria would be exceeded by 1 dBA and by 2 dBA respectively. However, it is considered unlikely that this small change in noise level would be detectable by the residents of the area.

The results of the modelling of remediation work operational noise show all predicted noise levels at the sensitive receptors would be below the project specific noise criteria.

The results of the modelling of the combined dredging and remediation noise show that, during these periods of combined operation, predicted noise levels at the sensitive receptors are all below the project specific noise criteria.

The results of the modelling of cumulative noise levels from the proposal, the Protech Steel Mill and the construction of the Multi-purpose Terminal show all predicted cumulative noise levels at the nearest sensitive receptors to be below the project specific noise criteria.

The dredging methodology may include blasting to remove rock. Predicted air-blast and ground vibration levels would meet the EPA guidelines for residences and other sensitive structures surrounding the proposal site.

A number of measures are recommended in the EIS to mitigate the potential for noise impacts. These include detailed management measures (considering the relative timing and phasing of activities in different areas) to be defined by the project EMPs.

3.8 Air quality and odour

Potential impacts on air quality impacts as a result of odour could occur as a result of exposure of sediments containing odorous compounds such as naphthalene.

An odour modeling exercise was carried out as part of the EIS. The results of the modeling were used to adjust the design of the proposal and to predict the potential for impacts. It was found that the potential for generation of odours during dredging activities could be controlled, so as not to create significant odour impacts at the closest sensitive receptors.

Dust suppression measures have also been built into the design of the proposal to minimise the potential for impacts to air quality as a result of dust. In addition, the EIS recommends measures to further minimise the potential for dust generation.

Although cement stabilisation is recommended as the preferred treatment technology for contaminated sediments, it is recognised that thermal desorption technology may be considered by the successful Contractor.

The EIS identifies that the potential for impacts on air quality as a result of air emissions from the unit would be minimal, provided contaminant removal efficiencies exceed those calculated, and throughput of material is limited correspondingly.

Concentrations of contaminants in the air should meet the air emission criteria (which have been set by the EPA and other statutory authorities) at the boundaries of the closure area, if the thermal desorption unit is correctly operated.

3.9 Cultural heritage and archaeology

Aboriginal heritage and archaeology

The banks of the South Arm are likely to have been used and occupied by Aboriginal people prior to occupation by European people. The area would have provided rich plant and food resources. However, it is likely that any evidence of this occupation has been destroyed by the extensive reclamation and development of the area, which has occurred since the mid-nineteenth century.

The majority of the area that would be impacted by the proposal consists of imported fill and the natural ground surface is at least two metres beneath the current surface.

No Aboriginal archaeological evidence was identified during the current survey.

As a result, no impacts on Aboriginal archaeology and cultural heritage are anticipated as a result of the proposal.

Non-Aboriginal heritage and archaeology

The heritage assessment determined that there is no known potential for heritage resources to be located within the study area. The assessment concluded that the proposal would have no impact on any known heritage resources and is considered to pose no threat to the heritage values of the locality or region.

3.10 Transport, traffic and access

With respect to external road impacts, the worst case scenario is to transport all treated material to the waste emplacement areas on Kooragang Island. For this worst case scenario, traffic generation rates during the material disposal and handling phase of the proposal, would be as follows:

- some 20 truck movements per hour during transport of treated material;
- some 20 truck movements per hour during transport of inert material; and
- some 40 truck movements per hour during periods of concurrent transport of both treated and inert materials.

Assuming the worst case, a concurrent transport scenario of 40 truck movements per hour would constitute 1.7 percent and 1.4 percent of Industrial Drive traffic in the AM and PM peak periods respectively. Furthermore, this trucking rate would constitute 2.3 percent and 1.8 percent of Tourle Street AM and PM peak period traffic respectively. Both Industrial Drive's and Tourle Street's current levels of service would remain unchanged. While these levels are relatively low, there is the potential for trucking associated with the development to affect intersection operations along the truck route.

With respect to waste emplacement areas on Kooragang Island, the major potential impact is loaded truck access off Tourle Street and empty truck access back onto Cormorant Road. For the latter, while adequate gaps in traffic are available during non-peak background traffic periods, during peak periods, it would be difficult to turn right from the National Power access road at the eastern end of landfill onto Cormorant Road. It is considered that the provision of a temporary signalised intersection would address potential safety issues for vehicles wishing to access the site.

With respect to internal site movements (ie. off public roads), there would be potential conflicts in a limited area along the internal site road network. These conflicts would occur between haul truck movements, vehicle movements relating to operations on the OneSteel site, and internal rail movements, which cross the internal site road network at various locations. While conflicts between existing vehicle movements relating to operations on the OneSteel site and internal rail movements, are currently adequately managed, it is envisaged that additional internal traffic management in the form of traffic controllers and/or temporary signals (or similar) would be used to control and manage the addition of haul truck movements onto the internal site road network.

It is assumed at this stage that there would be minimal overlap of the various deliveries and as a result, cumulative traffic generation would be negligible.

In light of this, the major traffic generator is the delivery of rock material. This activity would also generate the maximum peak rate of traffic and thus, it is assumed, would create the greatest potential traffic impact on the surrounding road network.

Assuming the worst case, for rock material delivery, a transport scenario of 18 truck movements per hour would constitute less than one percent of Industrial Drive's total traffic during either peak period. Furthermore, this trucking rate would also constitute less than one percent of Industrial Drive's total traffic during either of its peak periods. Both Industrial Drive's and Tourle Street's current levels of service would remain unchanged.

With respect to site access, the major potential impact is access off and across Cormorant Road, particularly for delivery of rock material to the northern bank area. It is considered that the provision of a temporary signalised intersection would address potential safety issues for vehicles wishing to access the site.

The other main access is via the existing Bull Street / Ingall Street access to the OneSteel and closure area. It is considered that access to these sites via the existing site accesses would be adequate in view of the relatively light traffic generation for delivery activities to these areas.

With respect to special deliveries that may be required (e.g. large plant or materials using wide or long vehicles), these would be delivered at night when traffic impact would be minimised.

Impact on the Tourle Street bridge

There are current capacity issues (during peak periods in particular) of the Tourle Street bridge and adjacent two-lane section of Cormorant Road. The duplication of Tourle Street bridge is currently in its design phase and is anticipated to be completed by 2006. This would significantly increase traffic capacity across Hunter River South Arm in the area.

Physical impact on the Tourle Street bridge and Cormorant Road

The western limit of the proposed extended channel is relatively close to the location for the new Tourle Street bridge (proposed by the RTA). As a result, measures to limit the potential impacts of a ship colliding with the bridge have been considered, and are incorporated into the design of the proposal.

The proposal would not impact on the existing or proposed future alignments of Cormorant Road.

3.11 Socio-economic factors

The proposal has the potential to give rise to both positive and negative socio-economic impacts. Negative impacts would generally be restricted to the construction phase and would be related to the use of heavy machinery, which would impact on the amenity of the environment. These potential impacts would be associated with noise, air and water quality, odour and health risk. These issues are addressed in specific chapters within this EIS.

Other potential negative impacts include impacts on commercial fishing and impacts on recreational use of the South Arm.

Potential positive impacts include:

- the generation of jobs in the short term;
- the generation of jobs in the long term as the deepened waterway would ensure that industries in the vicinity that rely on the port are able to continue to operate and expand;
- Stimulation of the economy through the flow-on effects of investment in the area; and
- Long-term environmental benefits and improvements in amenity that would stem from the remediation of the contaminated material which is present in the South Arm's sediments.

The port is of national importance and the proposal would ensure that its position is not only maintained but enhanced.

Mitigation measures recommended by the EIS include development of:

- a commercial fishing protocol in consultation with the Newcastle Commercial Fishermen's Co-Operative;
- a South Arm public access protocol detailing measures to be employed to minimise conflicts; and
- a consultation and communication plan covering local businesses, surrounding residents and the wider community. The plan would detail activities to be implemented in the lead up to, and during, implementation of the proposal.

Whilst the sources of funding are not the subject of assessment in this EIS, it is expected that the contributions of developers would significantly contribute to the capital cost of the proposal in the long term.

3.12 Landscape and visual quality

The proposed activities associated with the dredging operation are consistent with that of a working port. As a result, visual impacts are not considered to be significant, given the context for the proposal.

3.13 Waste management

Waste materials would be generated during most phases of the proposal. The actual dredged sediments and treated sediments are not considered wastes in the context of this proposal.

The volumes of wastes that would be generated during implementation of the proposal are expected to be minimal. A number of waste disposal and recycling facilities are located within close proximity to the site and this would facilitate collection of recyclable materials. Disposal of wastes to landfill would be in some cases unavoidable but would be avoided and minimised where possible for economic reasons.

The EIS provides a preliminary waste management plan which describes the proposed means of handling wastes. A detailed waste management plan would be prepared for the proposal as part of the project EMPs.

3.14 Hazards and risk

A hazard and risk assessment was undertaken for the proposal. It addressed:

- the nature and level of environmental risk associated with dredging, transport, sediment transport and treatment, and on-site disposal activities;
- potential health impacts arising from commercial and recreational fishing undertaken on the Hunter River, and consumption of Hunter River seafood; and
- public health risks associated with the movement of materials, unauthorised access and accidental spillages.

The risk assessment demonstrated that the risk levels during and after the proposal are tolerable in relation to the surrounding land use, and that any risks identified could be appropriately managed.

The EIS identifies control measures, safeguards and procedures that would be implemented to further reduce the potential level of risk associated with the proposal.

3.15 Cumulative impacts

The EIS identifies that the dredging proposal in isolation would be unlikely to lead to significant environmental degradation in the long term.

Potential cumulative impacts, however, may arise through the facilitation of infrastructure development opportunities arising as a result of the extension of the port.

Extension of the shipping channels would provide the basis for further development of port facilities. It could be argued that this could, in turn, facilitate the further development of other infrastructure in this area. The development of such infrastructure, if not adequately managed, may result in cumulative impacts on the significant environmental features of the area, including Kooragang Nature Reserves and wetlands to the north of Kooragang Island.

Another potential cumulative impact of this proposal, if it occurs at the same time as other developments in the area, may result from inadequate sequencing of the construction activities of all developments. This could result in conflicts, for example, in terms of material supplies, access impacts, other logistical problems and so on.

4 Approach to environmental management

Environmental management plans (EMPs) would be produced for the proposal once development consent has been obtained. Two separate EMPs would be produced: one for the dredging operations, and the other for the remediation of the dredged contaminated sediments.

The EMPs would serve two functions. They would:

- provide guidance during the final detailed design of the proposal. This would enable all safeguards, environmental goals and consent conditions to be considered and incorporated during the design phase; and
- instruct contractors of the measures and standards required when undertaking activities on site (including monitoring and performance requirements). The EMPs would form the basis for environmental specifications in any contractual agreements between the proponent and the contractor.

5 Conclusion

The EIS has considered the potential impacts of the proposed dredging and excavation of the South Arm of the Hunter River to facilitate the extension of shipping channels in the Port of Newcastle.

It is considered that the proposal would:

- improve the current operational viability of the Port of Newcastle;
- allow for the future expansion of shipping channels, providing for future growth and capacity in the Hunter and in NSW; and
- remove contaminated material from the aquatic environment.

A number of potential negative impacts have been identified, as outlined in the sections above.

It is recognised that the design of the proposal incorporates a range of management mechanisms and design features to minimise the potential for negative impacts on the environment. In addition, the EIS recommends measures to further reduce the potential for negative impacts, and maximise the potential positive impacts.

6 How can I comment on the proposal and the EIS?

6.1 Consultation during EIS exhibition

Initial community consultation was conducted in 2001 as part of the initial stages of development of the proposal. Consultation activities included advertising and distribution of a newsletter to interested parties. This early consultation enabled the proponent and the EIS team to gain an understanding of the issues that would be important to the community.

6.2 Proposed Consultation activities

Whilst typically there is a focus on community consultation during the preparation of the EIS, in this case the proponent is proposing various community and stakeholder consultation activities whilst the EIS is on exhibition.

Consultation on the proposal and the EIS will be conducted to complement community consultation that is being undertaken for the Newcastle Port Environs Concept Proposal. Consultation for the proposal and EIS will include activities such as the following:

- Newsletters;
- Public displays;
- Community and stakeholder meetings and briefings;
- Media releases and advertising;
- Establishment of community contact facilities, including a free call number; and
- Project web page.

6.3 Information on public exhibition

As outlined in Chapter 2, under section 79 of the EP&A Act, the consent authority (in this case DIPNR) is required to place the DA and EIS on public exhibition and invite public comment.

The EIS and DA documentation will be exhibited for at least 30 days in the following locations:

- Newcastle Port Corporation (at the corner of Newcomen and Scott Streets, Newcastle);
- DIPNR in Newcastle (251 Wharf Road, Newcastle);
- Newcastle City Council (282 King Street, Newcastle)
- DIPNR in Sydney (20 Lee Street near Railway Square, Sydney);
- Waterways Authority (Level 11, 207 Kent Street, Sydney);
- Nature Conservation Council of NSW (Level 5, 362 Kent Street, Sydney); and
- Newcastle Library (Laman Street, Newcastle).

A copy of the EIS can also be viewed on the internet at www.waterways.nsw.gov.au, www.newportcorp.com and www.ghd.com.au/southarm.

Copies of the EIS are available for purchase from DIPNR in both Newcastle and Sydney, and the Waterways Authority in Sydney. Printed copies of the EIS can be purchased at a cost of \$27.50 each. CD copies are also available at a cost of \$11 each.

6.4 Making a submission

During the public exhibition period, written submissions on the EIS can be forwarded to DIPNR at the following address:

DIPNR

Major Development Assessment

GPO Box 3927

SYDNEY NSW 2001

DIPNR will examine the DA, EIS and submissions received, and prepare a report to the Minister for Infrastructure Planning and Natural Resources. The Commonwealth Minister of Environment and Heritage will also receive submissions and DIPNR's reports to inform his decision.

Note: Formal submissions must be directed to DIPNR. Waterways, Newcastle Port Corporation and GHD are not able to accept submissions

6.5 Obtaining further information

Information on the public exhibition, submission and decision making process can be obtained by contacting DIPNR in Sydney or Newcastle.

PART A

INTRODUCTION



1 Introduction and Guide to the EIS

This chapter provides an introduction to the proposal, the environmental impact assessment and a guide to the contents and scope of the EIS.

1.1 Overview

The Waterways Authority, on behalf of the NSW Government, proposes to extend the shipping channels in the Port of Newcastle to provide deep water access to future berth sites along the South Arm of the Hunter River. The proposed channel would enable Panamax and Cape class vessels to travel up the South Arm of the Hunter River.

The channel would be dredged and excavated, and the banks left in a stable configuration. The development of the berths along the channel would then occur over an extended period of time, as the associated, land-based developments were approved and built. These berths and any land-based development would be subject to separate assessment and approval processes.

The proposed channel would extend along the South Arm of the Hunter River (referred to as the 'South Arm' for the purposes of this EIS). It would start at the end of the existing channel (adjacent to the Kooragang Island coal loader and the former BHP wharves) and terminate just east of the Tourle Street bridge.

To ensure that shipping vessels could navigate safely, a swing basin is required towards the upstream end of the proposed channel. This would enable vessels to turn, or swing around, before they were being moored or returned to sea.

It is estimated that approximately 13.6 million cubic metres (m³) of material would need to be removed by dredging and land-based excavation to form the proposed channel and swing basin; of this amount, approximately two percent has been identified as material requiring some form of treatment before its disposal.

This figure has been determined through a significant amount of testing, analyses and consultation with both the EPA and Environment Australia. It should be noted that further site investigation and analysis could possibly reduce the volume of sediment that requires treatment on land. The factors that determine final volumes suitable for sea disposal are subject to approval of the NSW EPA and Commonwealth Minister for the Environment.

An associated benefit of this proposal would be the removal and treatment of contaminated river sediments in the South Arm. The former BHP closure area site and a portion of river sediments have been declared a 'remediation site' under the *Contaminated Land Management Act 1997* and falls under a voluntary remediation process currently under assessment by the NSW EPA.

The disposal options for dredged and exacted material include ocean disposal, beneficial reuse and treatment followed by reuse.

The proposed works are referred to collectively as ‘the proposal’ for the purposes of this environmental impact statement (EIS).

GHD Pty Ltd (GHD) was commissioned to undertake an assessment of the potential environmental impacts of the proposal, and to prepare an EIS summarising the results of this assessment.

1.2 Who is the proponent?

The proponent of the proposal is the Waterways Authority. The majority of the work would involve dredging the bed of the river in an area that is owned by the Waterways Authority.

The NSW Government established the Waterways Authority (referred to as ‘the proponent’ for the purposes of the EIS) as a statutory authority in July 1995, under the *Ports Corporatisation and Waterways Management Act 1995*. This Act also created the Newcastle Port Corporation, the Sydney Ports Corporation and the Port Kembla Port Corporation as well the Marine Ministerial Holding Corporation. The Waterways Authority is responsible for the management of commercial and recreational vessels on the navigable waters of NSW as well as the appropriate development and use of wetland areas owned by the Authority.

Newcastle Port Corporation is managing the EIS preparation process on behalf of the proponent and would be responsible for future vessel operations in the South Arm.

1.3 How will the proposal be assessed?

The EIS has been prepared in accordance with the requirements of Part 4 of the *Environmental Planning and Assessment Act 1979 (the EP&A Act)*. As a result of the significance of the proposal, and to simplify the development approval process, the Minister for Infrastructure Planning and Natural Resources would declare the proposal to be a ‘State significant development’, in the *Government Gazette*. This would occur in conjunction with consideration of the development application.

Development consent from the Minister for Infrastructure Planning and Natural Resources (under Part 4 of the EP&A Act) would be required for the proposal as a whole. This EIS addresses the issues identified in the DIPNR NSW’s Director-General’s Requirements for the EIS, as well as issues raised by statutory agencies consulted during preparation of the EIS.

This EIS supports the proponent’s application for development consent under Part 4 of the EP&A Act.

The proposal is also classified as a controlled action under the *Commonwealth Environment Protection and Biodiversity Act 1999 (EPBC Act)*. As a result, approval from the Commonwealth Minister of the Environment is also required. The minister has formally accredited the NSW assessment process for this EIS.

Further information on the decision-making process and legislative framework for the EIS is provided in Chapter 2. Information on the consultation process and the issues identified is provided in Chapter 3.

1.4 What is the purpose of the proposal?

The need for the proposal relates to the fact that there is insufficient capacity to allow for future expansion of the port and the provision of facilities and berths for currently proposed, and potential future developments in Newcastle, particularly in the vicinity of Kooragang Island.

The removal and treatment of the contaminated sediments located within the South Arm is seen as an associated benefit the proposal would provide.

Information on the need for the proposal is provided in Chapter 4.

1.5 Context of the proposal

1.5.1 General

Future development of the Port of Newcastle is consistent with the NSW Government's strategic direction for ports in NSW. In March 2003 the Premier of NSW, on behalf of the Department of Infrastructure Planning and Natural Resources, released the 'Newcastle Port Environs – Concept Proposal' (the concept proposal). This document was presented as one of the first steps in providing for the sustainable growth of Newcastle Port and its environs. The concept proposal provides a strategic overview of the likely future development of the Newcastle Port environs by identifying key developmental and environmental issues and categorising land areas for the potential use of the area. The concept proposal is intended as a starting point for a consulting process on which future strategies for conservation and development in the area will be based.

In terms of development, the concept proposal aims to facilitate and encourage:

- the use of port-front land by port-related industries;
- land that is suitable for port-related industrial development being made available for such uses; and
- opportunities to build upon the competitive advantages evident in the Newcastle Port environs for economic growth, including potential for deep water access, proximity to a major airport, and potential for infrastructure links.

The above objectives are balanced against conservation objectives also provided within the concept proposal report.

The concept proposal recognises that:

- traditional and emerging industrial uses continue to drive a level of demand for port-related land;
- the port environs have the potential to attract a variety of uses provided there is some certainty in terms of outcome and supply;
- the availability of deep water access provides significant opportunities in terms of attracting further, heavy port-related industry requiring such access;
- the port is seeking to diversify and attract a range of non-bulk port-related industries focussed on the export and import of manufactured products and containers, rather than solely on the bulk handling of coal and wheat; and
- expansion of the port along the South Arm is the most viable option.

1.5.2 Other projects

Other currently approved and proposed projects, which are important in the context of the concept proposal report and the proposal being considered by this EIS, are:

The (proposed) Austeel Steel Mill Facility: The facility would receive hot briquetted iron and convert it into various finished steel products. Preliminary investigations in terms of site selection and environmental impacts are currently underway. It is proposed that the plant would be located at Tomago (approximately five kilometres northwest of the South Arm) in an area identified in the concept proposal as port related industrial land.

The (proposed) multi-user port and transport corridor: A transport corridor (traversing Kooragang Island) and berth(s) within the South Arm are being investigated to provide access between the port and proposed industrial developments at Tomago.

The (approved) Former BHP Steelworks site: In 1999, BHP ceased iron and steel making operations on the site. In July 2002 the eastern steelworks area of the site (approximately 156 hectares, referred to as the 'closure area' site for the purposes of the EIS) was transferred to the NSW Government. An environmental impact statement for the remediation of the closure area and construction of a Multi-purpose Terminal was prepared in August 2000. The proposed Multi-purpose Terminal consists of a container terminal, general cargo handling facility and a bulk-handling terminal on a 45-hectare site adjoining the South Arm. Under the terms of the consent, remediation of the closure area is required prior to redevelopment.

Development consent was given in April 2001 for stage 1 of the Multi-purpose Terminal project. Stage 1 comprises site remediation of the entire closure area, construction and operation of a container terminal and general cargo handling facility and associated dredging for the construction of a berth.

BHP-Billiton is currently undertaking demolition of the former steelworks structures at the site. In November 2002, Newcastle Port Corporation called for expressions of interest (currently under consideration) for the design, construction, financing and operation of the Multi-purpose Terminal.

These projects are being considered separately from the Channel Extension proposal, which is being assessed on its own merits. The Channel Extension proposal is a stand-alone project that is based on the need to facilitate the expansion of the Port of Newcastle.

As discussed in this EIS however, should the development of the Tomago Industrial area and/or the proposed multi-user port and transport corridor not proceed then an alternative reuse capacity for the sands made available from the Channel Extension would need to be sourced. This EIS is predicated on the basis that the approvals process for any site or ventures requiring the use of materials from the channel extension would need to be the responsibility of that proponent.

1.6 What would the Channel Extension proposal involve?

The proposal would involve three main elements:

- Dredging and land-based excavation to form the channel and swing basin;
- Treatment and reuse of contaminated sediments; and
- Reuse or disposal of materials by various means.

An outline of these elements is provided below.

1.6.1 Dredging and excavation

Dredging and excavation would include:

- dredging of the South Arm, generally below the high water mark, to provide a navigable channel;
- excavation of the banks of the South Arm where required. This includes excavation towards the western end of the area that would be dredged, to provide a swing basin allowing large ships to turn. The excavation would impact on the OneSteel site which adjoins the south bank of the South Arm; and
- once the channel and swing basin have been dredged and excavated, the banks would be stabilised to prevent erosion and slumping.

The nature of the materials within the bed and banks of the South Arm determines the proposed method of dredging and excavation. The material to be removed would include soft silty clays, sand, stiff clay, gravel and rock. In some instances the material is contaminated and would require treatment. The estimated total quantity of material that would be dredged and excavated is approximately 13.6 million m³.

Further information on this work element is provided in Chapter 6.

The remaining work elements involve handling and disposing of these materials, as outlined in the following section.

1.6.2 Treatment of contaminated sediments

The upper layers of sediment in the area immediately adjacent to the former BHP Steelworks closure area (now owned by State Government) are contaminated.

The contaminated material would first be isolated within a sheet piled wall to prevent migration of contaminants within the South Arm. The material would then be transferred to the closure area. This area adjoins the southern bank of the South Arm, and is located to the east of the site owned by OneSteel. This material would be treated on the closure area using a variety of techniques, principally cement stabilisation.

Various treatment alternatives for the contaminated sediments located in the South Arm have been considered and, where possible, tested during the preparation of the EIS.

The stabilisation treatment methods proposed in this EIS are based on the results of a sampling, analysis and testing program carried out as part of the EIS studies. This program was undertaken to validate the technologies and methods proposed in the EIS. The treatment options explored include thermal desorption and cement stabilisation. Actual testing focussed on stabilisation and has proven the technology to be feasible.

The EIS considers the need to provide flexibility within the development consent in order to allow the proposal to be contracted out to private sector firms. Consent is thus sought for a range of workable technologies to be involved in the treatment process. It is acknowledged however that the use of thermal desorption technology would require a further approvals step.

Further information on this work element is provided in Chapter 7.

1.6.3 Disposal of materials

The proponent is committed to the concept of beneficial reuse of dredged and excavated material where practicable. Material such as clean sand and rock would be reused where possible. Material that cannot be reused would be disposed of either at sea or at suitable land disposal sites.

This work element includes:

- transfer of approximately 6.4 million m³ of clean sand to the Tomago industrial area and the proposed transport corridor to this estate;
- beneficial reuse of treated material on land sites within the region if suitable uses can be found;
- beneficial reuse of treated material either on the closure area site or on licenced sites on Kooragang Island; and
- offshore disposal of materials unsuitable for reuse.

The commencement the proposed works would depend on the progress of nearby land based industrial developments and the resulting demand for deep-water port facilities. Similarly, the demand and opportunity for reuse of the dredged sand would also be a factor influencing the timing of the proposal.

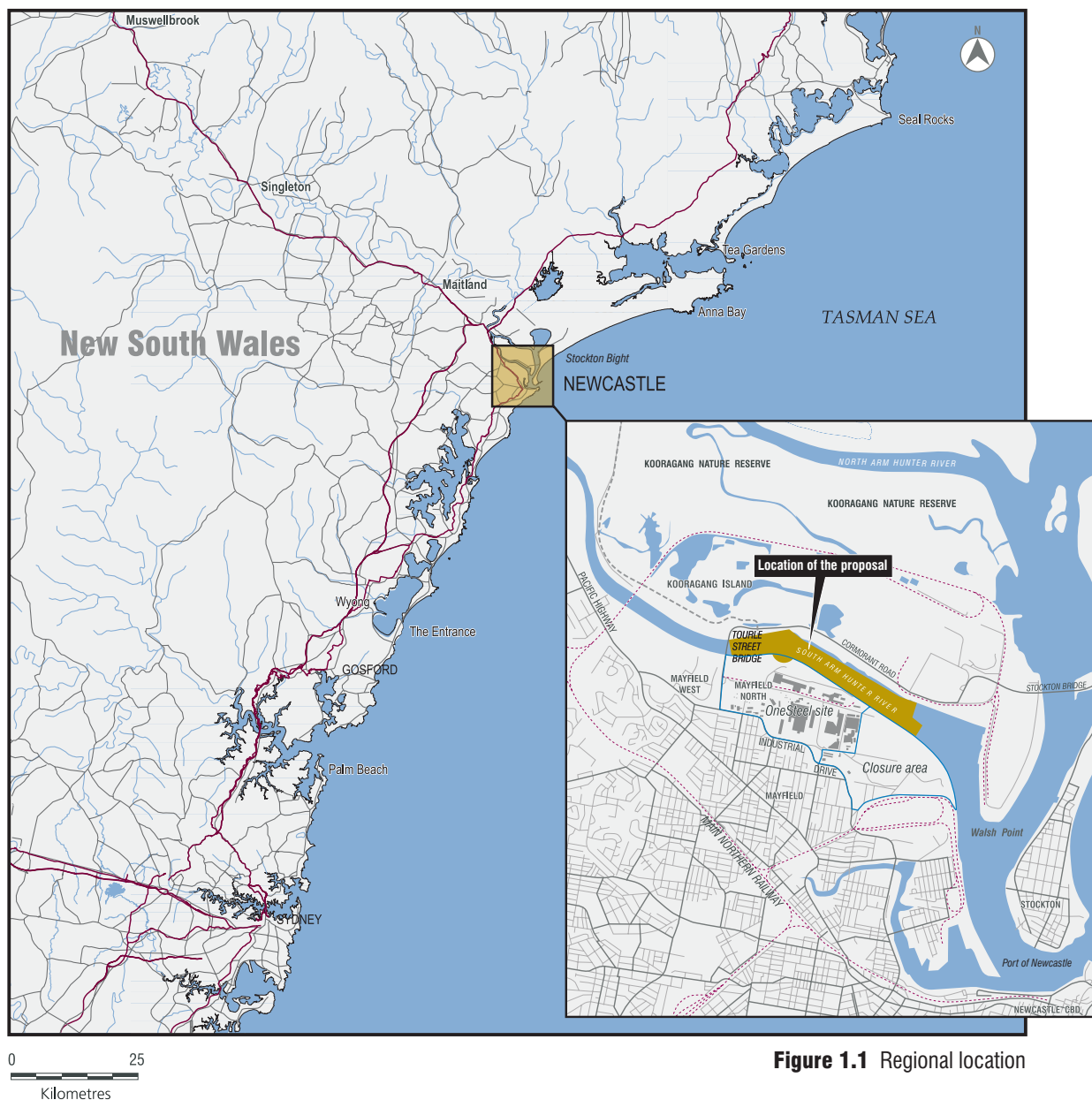
For reasons of economy, it would be preferable for the proposed work to be carried out in one continuous operation. However, if it is determined that there may be significant delays to some of the land-based developments, then the dredging may be carried out in stages and initially to lesser depths if it is determined that smaller vessels may be used.

1.7 What is the study area for this EIS?

The regional location of the study area for the proposal is shown in Figure 1.1.

The areas that would be affected by the proposal are indicated in Figure 1.2 and described below:

1. Dredging would involve the bed and banks of the South Arm generally below the high water mark, extending downstream for approximately three kilometres, from approximately 50 metres east of the Tourle Street bridge. The eastern boundary is located south of the intersection between Egret Street and Cormorant Road, near the Kooragang Number 6 berth;



2. Excavation of areas generally above the high water mark (adjacent to the South Arm) would have an impact on:

- the site for the proposed swing basin. Excavation for the swing basin would impact on land on both banks of the South Arm, including a portion of the OneSteel site (to the south) and an area of mangroves on the north bank; and
- the stretch of foreshore on the north bank.

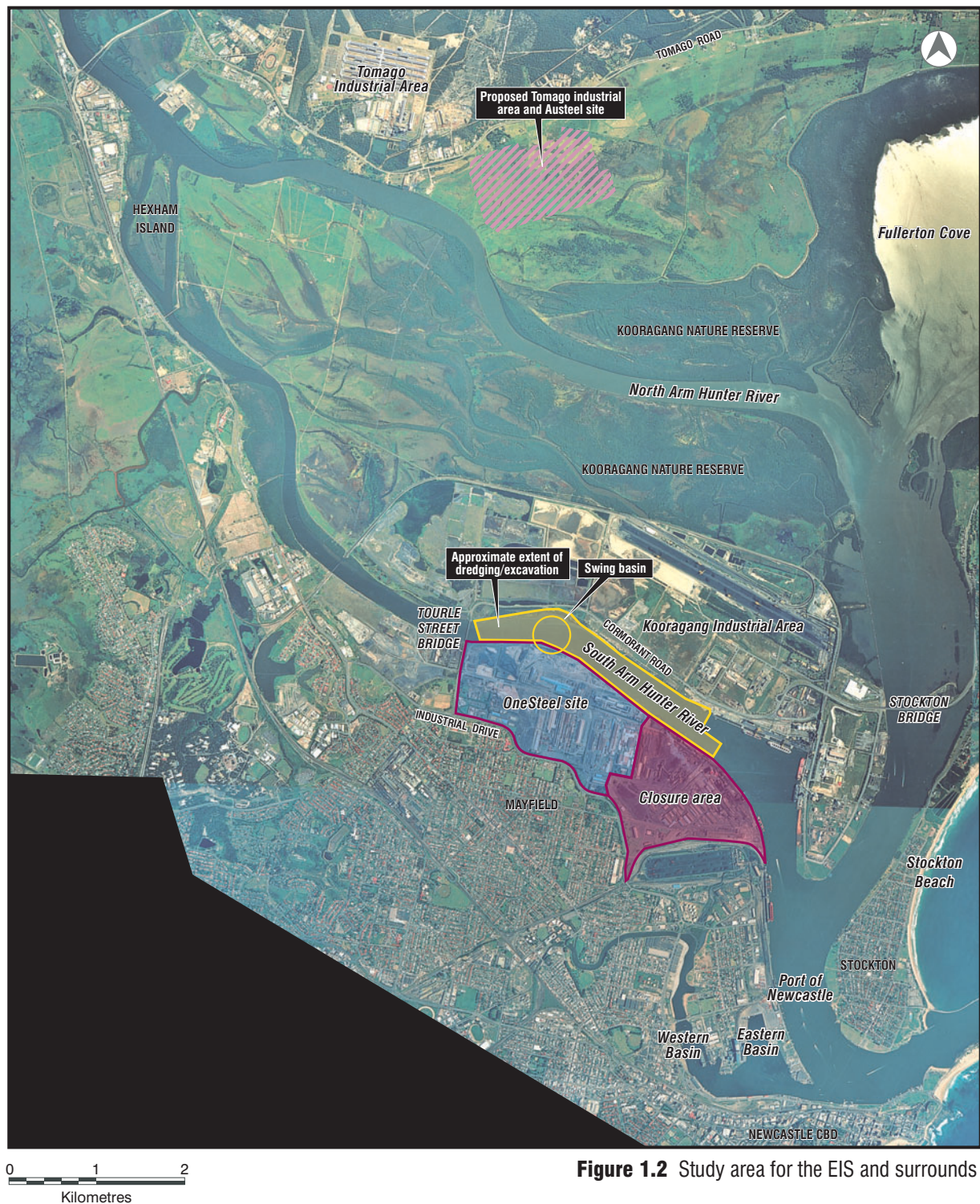


Figure 1.2 Study area for the EIS and surrounds

3. A portion of the closure area as the site proposed for the treatment and disposal of contaminated sediments; and
4. Licenced disposal sites on Kooragang Island would be utilised for treated material disposal.

These areas form the main study area and the focus of investigations for the EIS. The majority of detailed investigations undertaken as part of the EIS are concentrated on these areas and their immediate surrounds. The EIS does, however, consider the implications of the proposal on the wider surrounding environment. The 'study area' considered for the purposes of detailed investigations may vary in extent, depending on the environmental issue considered, and the nature of potential impacts.

A description of the existing environment of these areas, with respect to the various environmental aspects considered by the EIS, is provided in Chapters 10 to 25 (Part C).

1.8 What are the key issues for this EIS?

Potential environmental issues associated with the proposal include:

- Impacts on water quality as a result of the dredging and excavation process;
- Impacts on aquatic ecology as a result of disturbance of the environment and/or a temporary decline in water quality;
- The means of handling and disposing of the large quantity of material obtained through the dredging and excavation process;
- Disturbance of contaminated materials located in the South Arm, and the treatment and disposal of this material;
- Impacts on the physical form and stability of the South Arm, and impacts on tidal movements, water flow and flooding;
- Impacts on nearby facilities and infrastructure (such as Cormorant Road, the south bank and revetment walls and the OneSteel operation);
- Impacts on the surrounding road network from the significant amount of truck movements required to supply rock for the proposed final channel construction and to transport treated material to Kooragang Island;
- Impacts on significant habitat on Kooragang Island, including the Kooragang Nature Reserve;
- Impacts on migratory wader birds and other significant species in the area;
- Dust generated from large areas of stockpiled sand or fine-grained materials;
- Noise and vibration impacts as a result of the operation of the dredging and excavating machinery;
- Air quality impacts (particularly odour impacts) as a result of the dredging and excavation process; and
- Cumulative impacts, taking into account other developments proposed for Kooragang Island.

These issues, together with other potential environmental impacts, are considered in Chapters 10 to 25 of the EIS.

1.9 What are the aims and scope of the EIS

Aims

The aims of the EIS are to:

- describe the proposal;
- describe the environment of the area that would be affected by the proposal;
- identify and assess potential environmental impacts of the proposal;
- describe the practices that would be undertaken to manage and, where possible, mitigate any adverse environmental impacts; and
- enable the public and government authorities to consider the potential environmental consequences of proceeding with the proposal.

Scope of the EIS

The EIS assesses the key potential impacts of the majority of the activities associated with the proposal (listed in Section 1.6).

Development consent is sought through this EIS for:

- the dredging and excavation of the South Arm of the Hunter River as described in this EIS and as shown in the engineering drawings contained in Appendix C;
- the handling, treatment and subsequent disposal of a portion of treated and untreated sediments onto the closure area site; and
- the transport and subsequent disposal of treated and untreated material on to licenced sites on Kooragang Island.

There are a number of projects within the Newcastle and Hunter region that are either proposed or have development consent. These include the Protech Cold Mill facility on Kooragang Island, and the Multi-purpose Terminal facility on the closure area site. Separate approval processes apply to these projects and other proposed developments. The proponent is seeking consent, as part of the current proposal, to supply fill to any project, subject to the relevant approvals being gained for the transport and use of such fill, by the proponents of other projects.

The following are *not* considered in detail within this EIS:

- The disposal of material offshore is subject to a separate Commonwealth approval process, under the *Environment Protection (Sea Dumping) Act 1981*. This activity is subject to a separate application to the Commonwealth Minister for the Environment;
- The EIS does not consider the development of sites and facilities that would be facilitated by the proposal (including future port facilities along the South Arm). These developments would be subject to separate parallel assessment and approval processes;
- Construction of any new infrastructure used to transport material to other sites for reuse. This infrastructure would be subject to separate approval and assessment processes. As the method of transfer of the clean sand is, however, within the scope of this EIS, a broad description of this process and its potential impacts is provided. A separate EIS will need to be prepared by government for any multi-user transport corridor to service the Tomago industrial area – the pipeline approval is expected to be dependant on the outcome of the corridor EIS and approval process;

- Any future site development activities involving the reuse of material gained as a result of the proposal (including filling at the Tomago industrial area and along the proposed multi-user port and transport corridor). These activities would be subject to separate assessment and approval processes;
- The treatment of contaminated sediments on any Kooragang Island sites; and
- Renourishment of Stockton Beach with clean sand.

It should be noted that the proposed offshore disposal of sediments that cannot be reused would be assessed by Environment Australia through a separate application process for a permit under the *Environment Protection (Sea Dumping) Act 1981*. More detailed information on the assessment of this component of the proposal is included in the formal application to Environment Australia. An approval is not sought from the NSW Minister for Infrastructure Planning and Natural Resources for this component of the proposal. It is expected that the Minister's consent would be conditional on the granting of that approval from the Commonwealth Minister of the Environment.

1.10 How is the EIS structured?

The EIS comprises two volumes: the EIS itself and its associated technical reports.

Volume 1 – The EIS

Volume 1 contains the EIS document, which is divided into five parts:

- **Part A – Introduction:** provides an introduction to the proposal and the environmental impact assessment process. It also includes information on the factors that provide the framework and background for the EIS and the issues considered, including the statutory framework and the consultation process;
- **Part B – Information on the proposal:** provides a description of the need and objectives for the proposal, a description of the proposed dredging and excavation process, information on the treatment of highly contaminated materials and the disposal of materials, and a description of alternatives;
- **Part C – Assessment of potential environmental impacts:** provides an assessment of the potential environmental impacts of the proposal. The chapters include a description of the existing environment, against which potential environmental impacts are considered and assessed. Measures are recommended to mitigate the potential impacts identified;
- **Part D – Environmental management:** provides information on the recommended environmental management and monitoring requirements for the proposal, and a summary of the mitigation measures and approvals required; and
- **Part E – Summary of EIS findings:** provides a summary of the findings of the EIS, outlining the justification for the proposal and provides the conclusion.

Volumes 2 to 5 – Specialist technical reports

Volumes 2 to 5 contain specialist technical/background reports, prepared as part of the EIS process. These include:

- Sediment quality data (Patterson Britton);
- Results of bulk sampling and testing program (GHD);
- Tidal hydrodynamics, flooding and water quality (Patterson Britton);
- Aquatic ecology impact assessment report (The Ecology Lab);

- Terrestrial ecology impact assessment report (Umwelt Australia);
- Groundwater and geotechnical report (GHD);
- Noise impact assessment (Richard Heggie Associates);
- Air quality and odour report (UNSW);
- Cultural heritage (Aboriginal and non-Aboriginal archaeology) impact assessment reports (Umwelt Australia); and
- Hazards and risks assessment (Advitech).

2 The legislative framework

This chapter provides information on the legislative framework for decision making with respect to the proposal. The decision making (development consent) process according to the *Environmental Planning and Assessment Act 1979* is described. Other statutory requirements for the EIS are also outlined.

2.1 Summary of development consent requirements

2.1.1 Is development consent required?

The proposed dredging works do not require development consent under Part 4 of the *Environmental Planning and Assessment Act 1979* (EP&A Act). As a result, the dredging component alone would be subject to assessment under Part 5 of the EP&A Act.

Other elements of the proposal, however, would require development consent under the provisions of the existing Newcastle Local Environmental Plan 1987 (Newcastle LEP), including the excavation of the banks of the South Arm above the mean high water mark, and the treatment and reuse of contaminated material in the closure area. These elements would be subject to assessment under Part 4 of the EP&A Act.

As a result of the significance of the proposal, and to simplify the development approval process, the then PlanningNSW (now Department of Infrastructure Planning and Natural Resources – DIPNR) advised (by letter dated 9 October 2002, in Appendix A) that the Minister for Infrastructure Planning and Natural Resources would declare the proposal to be State significant development, by declaration in the Government Gazette (under section 76A(7)(b)(iii) of the EP&A Act). This declaration would occur in conjunction with consideration of the development application (DA).

Section 76A(8)b of the EP&A Act provides for the Part 5 elements of a State significant development (that is, those parts that do not require development consent) to be considered under Part 4 of the Act.

As a result, development consent under Part 4 of the Act would be required for the proposal as a whole.

2.1.2 Who is the consent authority?

The NSW Minister for Infrastructure Planning and Natural Resources is the consent authority for State significant development (according to section 76A(9) of the Act). As the proposal has been declared to be State significant, the Minister for Infrastructure Planning and Natural Resources is the consent authority.

An outline of the legislative framework for development consent is provided below.

2.2 The NSW legislative framework for development consent

NSW environmental planning legislation comprises three elements, which determine development consent requirements for projects in NSW. These are:

- The EP&A Act;
- The Environmental Planning and Assessment Regulation 2000 (the Regulation); and
- Environmental planning instruments made under the Act (including Local Environment Plans (LEPs), State environmental planning policies (SEPPs) and regional environmental plans (REPs)).

Information on the relevance of these elements to the proposal is provided below.

2.2.1 Environmental Planning and Assessment Act 1979

The EP&A Act provides the statutory basis for planning and environmental assessment in New South Wales. The Minister for Infrastructure Planning and Natural Resources, statutory authorities and local councils are all responsible for implementing the EP&A Act.

As stated above, the proposal as a whole requires consent under Part 4 of the EP&A Act. Part 4 of the EP&A Act establishes the requirements for the development consent. These assessment provisions are incorporated into the process of obtaining consent.

The proponent is required to submit a DA to DIPNR, and the provisions of Part 4 would apply to the assessment of this application.

As the DA is a Crown DA (that is, a DA submitted by a government agency) the integrated development provisions of the EP&A Act do not apply.

Requirement for an EIS – designated development

If a development for which consent is required is listed as ‘designated development’ (either in the Regulation or an environmental planning instrument) then an EIS must accompany the application for development consent.

Various elements of the proposal are considered to fall within the following classifications of designated development, as listed in the Regulation:

- ‘Extractive industries’; and
- ‘Waste management facilities or works’.

As a result, an EIS needs to be prepared in accordance with Schedule 2 and Clauses 71 to 73 of the Regulation. The EIS must have regard to the requirements of the Director-General of DIPNR under Clause 73 of the Regulation. The Director-General’s Requirements set out both general and specific matters the EIS must consider.

The DIPNR Director-General’s Requirements for the EIS were requested and received. Further information on the Director-General’s Requirements is provided in Chapter 3.

Public exhibition and notification

Public participation, exhibition and notification procedures are set out in section 79 of the EP&A Act. Lodgement and exhibition of the DA and EIS involves the following:

- The DA and EIS are lodged with DIPNR;

- A copy of the DA and supporting documentation are lodged with relevant government agencies;
- DIPNR (acting on behalf of the Minister) will place the EIS on public exhibition for a minimum of 30 days at DIPNR offices and other appropriate local venues;
- Placement of a notice on the site;
- DIPNR will place advertisements in the local papers advising of the exhibition and submission period;
- Provision of written notice to adjoining landowners and occupiers;
- Written submissions from public authorities, interested groups and organisations and the general community will be invited; and
- Submissions will be received and considered by DIPNR.

Assessment of the DA and EIS

DIPNR will examine the DA, EIS and submissions received, and prepare a report to the Minister for Infrastructure Planning and Natural Resources. The report will address matters such as:

- The issues that a consent authority must consider when determining a DA (listed in Section 79C of the EP&A Act);
- The information contained within the EIS;
- Issues raised by submissions;
- Any new information on the proposal;
- Any modifications to the proposal;
- Proposed conditions of approval, should the proposal proceed;
- Proposed mitigation measures; and
- Advice from other approval bodies.

Acting on that report, the Minister will decide whether to grant approval to the proposal. The Minister may attach conditions to the approval.

The proponent will then be advised of the Minister's decision, whether it is approval subject to conditions or the application is refused.

2.3 Statutory planning

2.3.1 Local environmental plans

The Newcastle LEP 1987 is the principal environmental planning instrument for the Newcastle Local Government Area. It is noted that Council propose to replace the current LEP with a new LEP to be known as the Newcastle LEP 2002. Provisions relevant to the proposal are outlined below.

Newcastle Local Environment Plan 1987

Reference was made to Newcastle Local Environmental Plan 1987 published in the NSW Government Gazette on 5 June 1987 and amendments gazetted as of 18 May 2001.

The South Arm below mean high water mark is not zoned. As a result, Newcastle City Council is not a consent authority for works within South Arm and development consent under Part 4 of the EP&A Act is not required.

The closure area, where the treatment works are proposed, and the banks of the South Arm, where excavation for the swing basin and bank rehabilitation works are proposed, are zoned 4(b) General Industrial. The proposal is not a prohibited use and is permissible with development consent.

(Draft) Newcastle Local Environmental Plan 2002

The Local Environmental Plan was adopted by Council at the end of June 2002 and is awaiting gazettal by the Minister for Infrastructure Planning and Natural Resources.

The South Arm, below mean high water mark, is not zoned. Therefore Newcastle City Council is not a consent authority for the proposed dredging works within the South Arm and development consent under Part 4 of the EP&A Act is not required.

The closure area, where the treatment of the contaminated sediments is proposed, and the banks of the South Arm, where excavation of the swing basin and bank rehabilitation works are proposed, are zoned 4(b) Port and Industry zone. The proposal is not a prohibited use in this zone and would be permitted with development consent.

However, Clause 13 of LEP 2002 describes development that does not require development consent as follows:

‘Except as otherwise provided in this Plan, development for the following purposes does not require consent:

- (a) exempt development identified in Clause 10; or
- (b) utility undertakings by a public authority referred to in Schedule F of this Plan; or
- (c) subdivision of land defined under Section 4B(3) of the Act; or
- (d) development below mean high water mark for purposes related to the operation of the Port of Newcastle by the Newcastle Port Authority; or
- (e) environmental protection works.’

The proposal involve items (b) and (d) of clause 13 of the LEP. As a result, the dredging component of the works would not require development consent under LEP 2000.

Relevant utility undertakings referred to in Schedule F of the LEP are as follows:

‘Port, wharf and river undertakings

The carrying out of any development required for the purposes of shipping or in connection with the embarking, loading, discharging or transport of passengers, livestock or goods at a wharf, or the movement of traffic by a railway forming part of the undertaking, including the construction, reconstruction, alteration, maintenance and repair of ways, buildings, works and plant for those purposes, excluding development involving:

- (a) the construction of bridges and the erection of any other buildings; or
- (b) the reconstruction or alteration of existing bridges or buildings so as to materially affect their design or external appearance; or
- (c) the formation or alteration of any means of access to a road.’

2.3.2 Regional environmental plans

Hunter Regional Environmental Plan 1989

The Hunter Regional Environmental Plan (REP) applies across the Newcastle area. The REP provides strategic guidelines and a policy framework for the treatment of regionally significant matters in the form of local planning documents. The aims of the REP are to:

- promote balanced development of the region;
- coordinate activities related to development in the region; and
- continue a regional planning process that will serve as a framework for identifying priorities for further investigations.

The REP provides details of numerous policies to be considered when preparing plan and assessing development proposals. The then Planning NSW's (now DIPNR) plan First Regional Strategy for the Hunter will eventually replace the REP.

2.3.3 State environmental planning policies

State Environmental Planning Policy No. 14 – Coastal Wetlands

SEPP 14 aims to ensure coastal wetlands are preserved and protected in the environmental and economic interests of the State. SEPP 14 wetlands within the study area are located immediately east of the Tourle Street bridge.

SEPP 14 does not prohibit development in an identified wetland. However the proponent must undertake a comprehensive environmental impact assessment regarding any direct impact on the wetland. Consent would be required for any works taking place within SEPP 14 wetlands areas.

State Environmental Planning Policy No. 71 - Coastal Protection

The Policy has been made under the EP&A Act 1979 to ensure that development in the NSW coastal zone is appropriate and suitably located, to ensure that there is a consistent and strategic approach to coastal planning and management and to ensure there is a clear development assessment framework for the coastal zone.

State Environmental Planning Policy No. 55 – Remediation of Land

SEPP 55 gives direction to councils on development of contaminated land. It aims to promote the remediation of contaminated land for the purpose of reducing the risk of harm to human health or any other aspect of the environment. The SEPP specifies considerations that are relevant in rezoning and in determining DAs.

Clause 7 of SEPP 55 requires that contamination and remediation of land be considered by a consent authority in determining a development application.

SEPP55 divides remediation works into two categories. Category 1 works require development consent, while Category 2 works do not. Excavation of contaminated soils as part of the swing basin is considered to be Category 1 remediation according to Clause 9 of SEPP 55 (as the proposal is designated development). A remedial action plan (RAP) is required for all Category 1 remediation work. In the case of the proposal, the contractor for the works would prepare this, following approval of the proposal, and once the treatment technology is finalised.

The *Contaminated Land Management Act 1997* is triggered when land is contaminated in such a way as to present a 'significant risk of harm to human health or the environment'. The EPA makes this decision.

2.3.4 Development control plans

Contaminated Land Management and Remediation Development Control Plan ((DCP) No. 43)

Planning principles, procedures and requirements relevant to development and use of contaminated land in the Newcastle City Council area are outlined in the DCP.

These include:

- Identification of contaminated land;
- Determination of zoning and rezoning applications;
- Recording and use of information to the community; and
- Remediation work.

The framework of the DCP is based on SEPP 55 and the *Contaminated Land Management Act 1997*.

Part 4 – Remediation work is of particular relevance to this proposal. Remediation of land in general should:

- be carried in accordance with DCP No. 43 unless specific Council consent is granted for the remediation proposal which allows a variation from this policy;
- aim to remediate land to the highest land use possible under the current or proposed zoning, with the need for site-specific ongoing management controls (such as capping);
- be carried out in a manner which will not result in an unacceptable level of risk to human health or the environment; and
- aim to remediate groundwater to a level that allows the maximum reuse of the resource in future.

Stormwater Management for Development Sites (DCP No. 50)

The DCP outlines standards relevant to stormwater management including:

- the requirement for a soil and water plan;
- provision of stormwater management information in a DA; and
- issues to be considered in designing stormwater management infrastructure.

Chapter 15 and describes the proposed stormwater management measures that would occur on the land sites associated with the proposal.

Waste Minimisation (DCP No. 56)

The DCP outlines requirements relevant to waste minimisation, including a requirement that a waste management plan be submitted with all DAs. Issues relating to waste minimisation are considered in Chapter 21. This chapter outlines a waste management plan and includes recommended mitigation measures to ensure the proposal is consistent with Council's requirements (as outlined in the DCP).

2.3.5 Other plans and policies

Newcastle City Council Social Impact Assessment Policy for development applications

The aim of the policy is to 'facilitate the preparation and assessment of DAs with respect to social considerations in the interests of the developer, the broader community and the future of Newcastle'. For major development a social impact assessment may be required. Potential social impacts of the proposal are considered and assessed in Chapter 20. The assessment undertaken has considered the requirements of this policy.

2.4 Commonwealth requirements

2.4.1 The Commonwealth Environmental Protection and Biodiversity Conservation Act 1999

Under the *Environmental Protection and Biodiversity Conservation Act 1999* (EPBC Act) EPBC Act, any 'actions' which are likely to have a significant impact on matters of national environmental significance ('NES matters'), or a significant impact on Commonwealth land, require approval from the Commonwealth Minister for Environment and Heritage. An 'action' is considered to include a project, development, undertaking, activity or series of activities.

A referral was sent to Environment Australia in February 2003 to determine whether or not approval would be required under the EPBC Act. On 19 February 2003, Environment Australia advised that the proposal was considered to be a 'controlled action' pursuant to section 75 of the EPBC Act. This means that approval is required under part 9 of the EPBC Act before the proposal can proceed. The controlling provisions are:

- Sections 16 and 17B (Wetlands of international importance);
- Sections 18 and 18A (Listed threatened species and communities); and
- Sections 20 and 20A (Listed migratory species).

As part of the Commonwealth assessment process, preliminary information was provided in February 2003 to assist the Commonwealth in determining the level of assessment that would be required. Based on this information, Environment Australia advised, by letter dated 17 March 2003, that the Commonwealth would accredit the NSW assessment process, and that a separate Commonwealth assessment would not be required for the proposal.

Copies of correspondence received are provided in Appendix B.

2.4.2 Environment Protection (Sea Dumping) Act 1981

The disposal of material offshore is subject to a separate Commonwealth approval process, under the *Environment Protection (Sea Dumping) Act 1981*.

Although briefly described within this EIS, this activity is subject to a separate application for approval to the Commonwealth Department of Environment and Heritage. Further information is provided separately to support that application for approval.

The Environment Protection (Sea Dumping) Act provides for the environmental assessment of the disposal of dredged material in Australian waters. Additional assessment may be required under the EPBC Act 1999, however both assessments are generally undertaken together.

2.5 Other legislative requirements

Other potentially relevant legislation is described below, with comment on relevance to the proposal.

Ports Corporatisation and Waterways Management Act 1995

The NSW Government created the Waterways Authority as a statutory authority in July 1995 under the *Ports Corporatisation and Waterways Management Act 1995* (the Ports Act). This Act also created the Sydney Ports Corporation, the Newcastle Port Corporation and the Port Kembla Port Corporation as well the Marine Ministerial Holding Corporation (MMHC).

All assets, rights and liabilities of the former Maritime Services Board (MSB), which were not transferred to the Waterways Authority or to the Port Corporations, were transferred to the MMHC. The assets transferred to the MMHC included the beds of the major ports of Sydney Harbour, Botany Bay, Newcastle and Port Kembla.

In June 2000, the *Statute Law (Miscellaneous Provisions) Act 2000* abolished the MMHC and amended the Ports Act by the insertion of section 40A which transferred the assets, rights and liabilities of the MMHC to the Waterways Authority. In addition, Clause II of Schedule 1 to the Ports Act was amended to identify the Waterways Authority as the legal successor to the MMHC.

Other marine legislation

The Ports Act establishes and confers waterways management responsibilities on the Waterways Authority. These relate to functions conferred or imposed on it by, or under, marine legislation or any other Act or law, for example the *Marine Pollution Act 1987* and the *Marine Safety Act 1998*. Marine legislation is directed at the promotion of safety on NSW navigable waters as well as the protection of the marine environment and foreshores, and development of land vested in the Authority. The Ports Act permits the Authority to carry out any activity or business on its land, including dredging.

The *Marine Safety Act 1998* has yet to be fully proclaimed. On proclamation, a number of other Acts will be repealed. This will include the *Maritime Services Act 1935*. Until such time as it is repealed, sections 13D, 13F and 13N of the Maritime Services Act are relevant to the proposal. These sections require that:

- in this portion of the Hunter River, no person shall carry out any dredging operations without the consent of the Minister for Transport;
- there should be regard to the likely effect of the proposal upon the river control and flood problems of the Hunter River; and
- the Minister for Transport may carry out dredging or deepening of the bed of navigable waters and cleanse the bed for the purposes of improving the river channel for navigation.

In addition, Clause 66 (1) of the Management of Waters and Waterside Lands Regulations – NSW (under the Maritime Services Act) provides that a person shall not, except with the prior permission of the Minister for Transport and in accordance with any conditions deemed appropriate, remove from any special Port Area (which includes the Port of Newcastle) any soil, sand, rock, stone, shale, slate, shingle, gravel or similar.

In relation to the above references to the Minister for Transport, it should be noted that all powers of the Minister to administer the land formerly owned by the Maritime Services Board and the MMHC have been delegated to the Chief Executive of the Waterways Authority.

The above approval would be sought from the Waterways Authority following determination of the DA/EIS by DIPNR.

Threatened Species Conservation Act 1995

The *Threatened Species Conservation Act 1995* (TSC Act) lists a number of factors to be taken into account in deciding whether there is likely to be a significant impact on threatened species, populations or ecological communities or their habitats.

In accordance with the TSC Act a 'species impact statement' is required when it is determined by the 'eight part test', undertaken in accordance with section 5A of the EP&A Act, that there is likely to be a significant impact on a threatened species, population or ecological community.

No significant impacts on threatened species were identified. An SIS is not required.

Potential impacts on threatened species are considered in Chapters 12 and 13.

National Parks and Wildlife Act 1974

The *National Parks and Wildlife Act 1974* provides the basis for legal protection and management of Aboriginal sites in NSW. The implementation of the Aboriginal heritage provisions in the Act are the responsibility of the National Parks and Wildlife Service (NPWS).

This Act, together with the policies of the NPWS, makes certain provisions:

- It is an offence to knowingly disturb an Aboriginal artefact or site without an appropriate permit;
- Prior to instigating any action which may conceivably disturb a 'relic', archaeological survey and assessment is required; and
- When the archaeological resource of an area is known or can be reliably predicted, appropriate land use practices should be adopted to minimise the necessity for the destruction of sites/relics, and prevent the destruction of sites/relics that warrant conservation.

Potential impacts on Aboriginal heritage are considered in Chapter 18.

Heritage Act 1977

The *Heritage Act 1977* identifies and protects heritage items and is administered by the NSW Heritage Council and NSW Heritage Office. Under the Act it is an offence to disturb an item of heritage significance without the consent of the Heritage Office. Any work which will impact on an item listed on the State Heritage Register requires approval from the Heritage Council under section 60 of the *Heritage Act 1977*. Approval may also be required from the Heritage Council under section 139 of the *Heritage Act 1977* if it is proposed to disturb a relic.

A heritage 'item' is defined as 'a place, building, work, relic, moveable object or precinct'. Environmental heritage is defined as places, buildings, works, relics, moveable objects, and precincts of State or local heritage significance.

The relics provisions in the *Heritage Act 1977* require an excavation permit to be obtained from the Heritage Council prior to commencement of works if disturbance to a site with known or potential archaeological relics is proposed.

The *Heritage Act 1977* defines items of environmental heritage to be 'those buildings, works, relics or places of historic, scientific, cultural, social, archaeological, architectural, natural or aesthetic significance for the state of New South Wales'.

The Act defines a *relic* as:

'Any deposit, object or material evidence:

- (a) which relates to the settlement of the area that comprises NSW, not being Aboriginal settlements; and
- (b) which is 50 or more years old.'

Potential impacts on heritage items are considered in Chapter 18.

Water Management Act 2000

The Water Management Act will eventually incorporate the provisions of the Rivers and Foreshores Improvement Act 1948 and the Water Act 1912, both of which will be repealed. However, at the time of preparation of this EIS, approvals are still being assessed under the old Acts.

Section 22H (1) (b) of the *Rivers and Foreshores Improvement Act 1948* states that Part 3A does not apply to 'any public or local authority'. A Part 3A permit would, therefore, not be required for the proposed work. It should be noted that, as the river bed is vested in the Waterways Authority, the appropriate Construction Authority for that part of the proposal on the Authority's land, is the Minister for Transport (Section 224 of the Act). The Waterways Authority acts as a delegate for the Minister for Transport.

Fisheries Management Act 1994

Section 199 of the Fisheries Management Act requires that the Minister for Fisheries must be notified prior to a public authority undertaking or authorising any dredging or reclamation activities. Such works include construction of temporary crossings/sidetracks, bridges, creek diversions, geotechnical investigations, excavating or reclaiming the bed or banks of a waterway.

Any works involving 'harm' to marine vegetation (seagrass, mangroves or seaweeds) require a permit under sections 204 and 205 of the Act.

A permit is also required under section 219 of the Act for any works that may result in the temporary or permanent blockage of fish passage within a watercourse.

Contaminated Land Management Act 1997

The general objective of this Act is to establish a process for investigation and (where appropriate) remediation of land areas where contamination presents a significant risk of harm to human health or some other aspect of the environment.

The Act establishes the powers and duties of the EPA. Under Section 15(1) of the Act, the EPA may declare land to be an investigation area 'if it has reasonable grounds to believe that the land is contaminated with a substance in such a way as to present a significant risk of harm'.

Under Section 21(1) the EPA may declare land to be a remediation site if the land has 'been found to be contaminated in such a way as to present a significant risk of harm'. SEPP 55 deals with development consents required for remediation of contaminated land.

In the case of this proposal it should be noted that the closure area has been declared a remediation site by the EPA under the Act and Lot 222 of the OneSteel site and a portion of river sediments adjacent the site has been declared an investigation area. It is expected that the EPA will be required to consider the three areas in an integrated fashion.

3 Consultation

This chapter provides a summary of the results of consultation undertaken during preparation of the EIS, including statutory consultation with relevant agencies and authorities. An outline of the DIPNR Director-General's Requirements for the EIS is provided. Information on the public exhibition process for the EIS and associated consultation activities is also provided.

3.1 Statutory agency consultation

3.1.1 Planning focus meetings

The purpose of a planning focus meeting is to provide statutory agencies (including government departments) with information on a proposal, and seek their comment with respect to issues that should be addressed by an EIS.

Two planning focus meetings were organised and chaired by DIPNR during development of the proposal and preparation of this EIS.

The first was held on 23 April 2001 at the offices of the Newcastle Port Corporation. The meeting consisted of a briefing by the proponent and GHD's EIS team, and was followed by a site visit.

Following the meeting, DIPNR issued draft Director-General's requirements for the preparation of the EIS. These requirements were superseded by the final Director-General's requirements for the EIS (refer section 1.1.2 below).

The second planning focus meeting was held on 6 November 2002, at the offices of DIPNR (Wharf Road, Newcastle). The meeting involved the provision of updated information on the proposal.

Representatives of the following statutory agencies attended the second meeting:

- Department of Land and Water Conservation (DLWC)
- Department of Public Works and Services (DPWS)
- Environment Protection Authority (EPA)
- Waterways Authority
- National Parks and Wildlife Service (NPWS)
- Newcastle City Council (NCC)
- Newcastle Port Corporation
- NSW Fisheries
- Premiers Department
- Road and Traffic Authority (RTA)

Issues raised during the meeting contributed to development of the Director-General's Requirements for the EIS.

3.1.2 DIPNR Director-General's Requirements for the EIS

The matters raised by the Director-General for consideration in the EIS are outlined in Table 1.1, together with the relevant section of the EIS that addresses the matter. A more detailed summary of the Director-General's requirements, together with an unabridged copy of the requirements (dated 14 March 2003) is included in Appendix A.

The Director-General's requirements, summarised in Table 1.1 incorporate issues raised in written responses to DIPNR by:

- EPA;
- DLWC;
- NSW Fisheries;
- Waterways Authority;
- Newcastle City Council;
- RTA;
- NPWS; and
- Environment Australia.

Table 3.1 Summary of matters to be addressed by the EIS

Issue category	Matter to be addressed by the EIS	Reference in EIS
Description of the proposal	Matter to be addressed by the EIS	Reference in EIS
	Purpose of the proposal	Chapter 1
	Information on future berths	Chapters 5, 6 and 10
	Proposed staging of the works	Chapters 5 and 6
	Dredging methodology, types of dredges and environmental controls proposed.	Chapters 5, 6 and 26
	Material to be dredged/excavated	Chapters 5, 6 and 7
	Plans and drawings	Chapter 6, Appendix C
	Vessel information	Chapter 5
	Timetable for the proposal	Chapter 5
	Temporary structures	Chapters 6 and 7
Contamination	Types of materials	Chapters 5, 6 and 7
	PAHs and TPHs	Chapters 5 and 7
	Declared treatment site and investigation area	Chapters 2 and 7
	Thermal desorption and potential emissions	Chapters 7 and 17
	Mobilisation of sediments	Chapters 6 and 11
	Remediation or disposal strategies	Chapters 7 and 8
Spoil disposal	Disposal options	Chapters 6, 7 and 8
	Disposal methods	Chapter 8
	Impacts on other sites	Chapter 10

Table 3.1 continued.

Issue category	Matter to be addressed by the EIS	Reference in EIS
Planning instruments and guidelines	Including relevant SEPPs, REPs, LEPs and DCPs	Chapter 2
Aquatic ecology	Impacts of the proposal on aquatic flora and fauna	Chapter 12
	Impacts of contaminated sediments on aquatic fauna	Chapter 12
	Endangered species	Chapter 12
	Impacts of blasting on marine fauna	Chapter 12
	Habitat loss	Chapter 12
	Impact of potential hydrological changes	Chapter 12
	Fish habitat and commercial fishing	Chapter 12
	Oyster lease areas	Chapter 12
Terrestrial flora and fauna	Impacts of the proposal on terrestrial flora and fauna	Chapter 13
	Estuarine ecosystems	Chapter 13
	Compensatory habitat	Chapter 13
	Wetlands	Chapter 13
	Mangroves adjacent to Tourle Street bridge	Chapter 13
	Types of habitat	Chapter 13
	Commonwealth issues, including wading and migratory birds	Chapter 13
	Threatened species, eg green and golden bell frog and the Australasian bittern.	Chapter 13
Air quality and odour	Air quality impact assessment	Chapter 17
	Cumulative impacts	Chapter 17
	Odours	Chapter 17
Noise and vibration	Noise impact assessment	Chapter 16
	Blasting/vibration	Chapter 16
Water quality	Potential for water quality impacts	Chapter 11
	Risk of sediment mobilisation	Chapter 11
	Impact of contaminated sediments	Chapter 11
	Stormwater	Chapters 6, 7 and 11
	Consider relevant reports and legislation	Chapter 11
Groundwater	Impacts of shore based activities	Chapter 15
	Impacts on groundwater	Chapter 15

Table 3.1 continued.

Issue category	Matter to be addressed by the EIS	Reference in EIS
Hydrology	Impacts on tidal range and the affects of this on wetlands	Chapter 11
	Hydrology of the south and the north arm of the Hunter River	Chapter 11
Soils	Consider recent reports on the Hunter Estuary	Chapter 11
	Types of materials	Chapters 7 and 14
	Acid sulfate soils	Chapter 14
	Sedimentation and erosion	Chapters 11
	Stability of banks and structures	Chapter 6
Traffic/transport	Traffic impact study	Chapter 19
	Cormorant Road	Chapter 19
	Traffic management	Chapter 19
	Transport of materials	Chapter 19
	Impact on Tourle Street bridge	Chapters 10, 19 and 14
Social and economic impacts	Impact on fishing and oyster leases	Chapters 20 and 16
Land use	Status of any Crown land	Chapter 10
	Impact on other land uses	Chapter 10
	Public recreation land	Chapter 10
Indigenous heritage	Aboriginal heritage value	Chapter 18
Non-indigenous heritage	Assessment of impacts	Chapter 18
Risk	Environmental risk	Chapter 23
	Health risks	Chapter 23
Waste management	Details of the proposed waste management strategy	Chapter 22
Public utilities and service infrastructure	Assessment of impacts	Chapter 10
Landscaping and visual quality	Proposed landscaping	Chapter 21
Ecologically sustainable development	Financial valuation of the environment	Chapter 28
Environmental management and approvals	Outline environmental management plan	Chapter 27
	Approvals	Chapters 2 and 27
	Monitoring and maintenance	Chapter 27

3.1.3 Consultation with other agencies

In addition to those agencies contacted by DIPNR, other agencies were contacted in writing to seek comment in terms of issues to be addressed by the EIS. These included:

- Department of Transport
- Department of Public Works and Services (DPWS)
- State & Regional Development
- Healthy Rivers Commission
- Rail Infrastructure Corporation (RIC)
- Sustainable Energy Development Authority Australia (SEDA)
- Ambulance Service of NSW
- NSW Fire Brigades
- NSW Police
- Hunter Water Corporation
- Electricity and gas providers
- Energy Australia

Table 3.2 provides an outline of the issues raised (by those agencies/groups who responded), and where the issue is addressed in the EIS. A full copy of the responses received is provided in Appendix B.

Table 3.2 Results of statutory consultation - summary of matters to be addressed by the EIS

Agency	Issue identified	Reference in EIS
Healthy Rivers Commission	Refer to <i>Independent Inquiry into the Hunter River System (May 2002)</i> by the Healthy Rivers Commission	Noted
NSW Department of Transport	Input into separate EIS for transportation and reuse/disposal of dredged material to sites other than the closure area	Outside scope of work
	Evaluation of road and rail options if removal of spoil from the closure area site is proposed	Outside scope of work
	Long term impacts of current transport infrastructure	Chapter 19
RIC	Appears to be no direct impacts on RIC infrastructure	Noted
NSW Ambulance Service	No Issues raised	-
NSW Police	Site safety plan would be submitted through Workcover	Chapter 23
	Traffic Management Plan to be developed	Chapter 27
	Safety and security appears to be managed by other agencies therefore little impact on NSW Police	Noted
DPWS	Treatment processes and timeframe of proposal noted	Chapter 7
	Plan for fill on areas of Kooragang Island, 'Fill Plan' (separate from the EIS)	Outside scope of work
	Consideration of location stockpiling and management	Chapter 8
	Potential relocation of Cormorant Road to be assessed in 'Fill Plan'	Noted
	Consideration of surrounding tenants throughout development of proposal	Chapter 3 and 10
	EIS to consider issues such as transport and reuse	Chapters 8 and 19

Table 3.2 continued.

Agency	Issue identified	Reference in EIS
DPWS, continued...	Consider barge and traffic movements, visual impacts	Chapters 19 and 21
	Treatment of spoil from closure area	Noted
	Fill Plan to include recommendations from Master Plan for lower Hunter estuary lands	Noted
	Consider Healthy Rivers Commission Report on Hunter River	Chapter 11
	Commercial arrangement between government and OneSteel to recognise potential change in liabilities	Noted

3.2 Consultation during EIS exhibition

Initial community consultation was conducted in 2001 as part of the initial stages of development of the proposal. Consultation activities included advertising and distribution of a newsletter to interested parties. This early consultation enabled the proponent and the EIS team to gain an understanding of the issues that would be important to the community.

3.2.1 Proposed Consultation activities

Whilst typically there is a focus on community consultation during the preparation of the EIS, in this case the proponent is proposing various community and stakeholder consultation activities whilst the EIS is on exhibition for at least 30 days.

Consultation on the proposal and the EIS will be conducted to complement community consultation that is being undertaken for the Newcastle Port Environs Concept Proposal. Consultation for the proposal and EIS will include activities such as the following:

- Newsletters;
- Public displays;
- Community and stakeholder meetings and briefings;
- Media releases and advertising;
- Establishment of community contact facilities, including a free call number; and
- Project web page.

3.2.2 Information on public exhibition

As outlined in Chapter 2, under section 79 of the EP&A Act, the consent authority (in this case DIPNR) is required to place the DA and EIS on public exhibition and invite public comment.

The EIS and DA documentation will be exhibited for at least 30 days in the following locations:

- Newcastle Port Corporation (at the corner of Newcomen and Scott Streets, Newcastle);
- DIPNR in Newcastle (251 Wharf Road, Newcastle);
- Newcastle City Council (282 King Street, Newcastle)
- DIPNR in Sydney (20 Lee Street near Railway Square, Sydney);
- Waterways Authority (Level 11, 207 Kent Street, Sydney);
- Nature Conservation Council of NSW (Level 5, 362 Kent Street, Sydney); and
- Newcastle Library (Laman Street, Newcastle).

A copy of the EIS can also be viewed on the internet at www.waterways.nsw.gov.au, www.newportcorp.com or www.ghd.com.au/southarm.

Copies of the EIS are available for purchase from DIPNR in both Newcastle and Sydney, and the Waterways Authority in Sydney. Printed copies of the EIS can be purchased at a cost of \$27.50 each. CD copies are also available at a cost of \$11 each.

3.2.3 Making a submission

During the public exhibition period, written submissions on the EIS must be forwarded to DIPNR at the following address:

DIPNR
Major Development Assessment
GPO Box 3927
SYDNEY NSW 2001

DIPNR will examine the DA, EIS and submissions received, and prepare a report to the Minister for Infrastructure Planning and Natural Resources. The Commonwealth Minister of Environment and Heritage will also receive submissions and DIPNR's reports to inform his decision.

Note: Formal submissions must be directed to DIPNR. Waterways, Newcastle Port Corporation and GHD are not able to accept submissions.

3.2.4 Obtaining further information

Information on the public exhibition, submission and decision making process can be obtained by contacting DIPNR in either Sydney or Newcastle.

PART B

INFORMATION ON THE PROPOSAL



4

Need and objectives

This chapter provides information on the need for and purpose of the proposal. The objectives of the proposal are also listed.

4.1 Need for the proposal

The need for the proposal relates to the fact that there is insufficient capacity to allow for future expansion of the port and the provision of facilities and berths for currently proposed, and potential future developments in Newcastle, particularly in the vicinity of Kooragang Island.

The removal and treatment of the contaminated sediments located within the South Arm is seen as an associated benefit the proposal would provide. Further information is provided below.

4.1.1 The future of the Port of Newcastle

The port as it is now

The Port of Newcastle is a river port located near the entrance to the Hunter River. It has an entrance depth of 17.7 metres and a main channel depth of 15.2 metres, and is protected by two breakwaters.

The port is Australia's second largest in terms of throughput handling approximately 75.5 million tonnes of cargo in the 2001/2002 financial year. It accommodates in excess of 3,000 shipping movements annually.

The port is the economic and trade centre for the Hunter Valley region, as well as for much of north and north-western NSW. It is the key export centre for the NSW coal industry. The port provides both general and bulk cargo facilities, although coal makes up more than 96 percent of total exports.

Information on port facilities is provided in Chapter 10.

The port is managed by the Newcastle Port Corporation, which is a statutory, State-owned corporation created under the *Ports Corporatisation and Waterways Management Act 1995*. Newcastle Port Corporation is charged with the responsibility of managing commercial shipping activities as well as promoting and facilitating trade through the port, and thus has the charter to develop and diversify the port's operations in a fiscally responsible manner.

Providing for future growth

Increasing demand for port facilities and services is currently occurring as a result of:

- diversification of cargo handled by the port;
- planned development of new port facilities such as the Multi-purpose Terminal; and

- the demands for berth access as a result of expansion of existing activities on Kooragang Island, and new developments (such as the proposed Protech Steel's Cold Mill facility and the proposed Austeel project).

The port experienced a 13 percent increase in container trades throughout the 2001/02 financial year, and was visited by a total of 1,473 vessels. The number of vessels visiting the port is expected to continue to increase, and is forecast to increase to approximately 1,520 by 2007/08.

During recent years there has also been growth in general cargo movements, such as aluminium, mineral sands and timber. In addition, public and private sector trade initiatives have seen an increased interest in, and demand for, port facilities. There have been a number of recent proposals from industries interested in having access to deepwater berths in the South Arm. As a result, the proponent seeks to ensure that there is sufficient supply of serviceable port land is available to meet future demand.

In addition to responding to existing demand and levels of growth, the proponent would also like to attract new business to the port.

Significant progress has been made recently on major projects to enhance the port and improve its facilities. These include the proposed multi-purpose terminal on the closure area site. A harbour deepening and improvement project is also being developed to allow larger ships to carry more coal from the port.

The South Arm has been identified as the most suitable location for port expansion, mainly because of the South Arm's proximity to transport infrastructure, its lower potential for significant environmental impacts (particularly to the Kooragang Nature Reserve) and its more passive hydrodynamic characteristics (compared to the north arm). Further information on alternatives is provided in Chapter 9.

Provision of a dredged navigation channel, swing basin and berthing trenches, designed to accommodate Panamax class and Cape class vessels, is required to enable the future development of port facilities within the South Arm.

The proposal would allow for the progressive establishment of future port and navigation facilities in the South Arm, upstream of the existing K6 berth, up to the Tourle Street bridge.

Possible facilities include berths capable of accommodating Cape class vessels along the northern bank, and berths for smaller Panamax class vessels along the southern bank. Further information on proposed facilities is provided in section 10.5.1.

The Newcastle Port Environs Concept Proposal – the government position

As one of the first steps in providing for the sustainable growth of Newcastle Port and its environs, DIPNR recently commissioned Kellogg Brown & Root Pty Ltd (KBR) to develop the 'Newcastle Port Environs Concept Proposal' (KBR, 2003).

The concept proposal provides a strategic overview of the likely future development of the Newcastle Port environs by identifying key developmental and environmental issues and categorising land areas for the potential use of the area. The concept proposal is intended as a starting point for a consulting process on which future strategies for conservation and development in the area will be based.

In terms of development, the concept proposal aims to facilitate and encourage:

- the use of port front land by port-related industries;
- land that is suitable for port-related industrial development being made available for such uses; and
- opportunities to build upon the competitive advantages evident in the Newcastle Port Environs for economic growth, including potential for deep water access, proximity to a major airport, and potential for infrastructure links.

The above objectives are balanced against conservation objectives also provided within the concept proposal report.

The concept proposal recognises that:

- traditional and emerging industrial uses continue to drive a level of demand for port related land;
- the port environs have the potential to attract a variety of uses provided there is some certainty in terms of outcome and supply;
- the availability of deep water access provides significant opportunities in terms of attracting further, heavy port-related industry requiring such access;
- the port is seeking to diversify and attract a range of non-bulk port-related industries focussed on the export and import of manufactured products and containers, rather than solely the bulk handling of coal and wheat; and
- expansion of port along the South Arm is the most viable option.

4.1.2 Addressing the contamination of river sediments

Contaminated material, located in sediments along the southern bank of the South Arm, has been present for over 30 years. Contaminants recorded in the soft silty clays include polycyclic aromatic hydrocarbons (PAHs), total petroleum hydrocarbons (TPHs) and metals (cadmium, chromium, copper, lead, mercury, nickel, and zinc). The removal and treatment of these sediments represents one of the positive benefits of the overall proposal.

Sediments within 120 metres of the closure area site have been declared a remediation site under the *Contaminated Land Management Act 1997*. There is a requirement under legislation that these sediments be remediated or at least rendered safe. As the extension of channels required deepening of the South Arm to 15 or more metres, any option of leaving the material in situ is not feasible as the area occupied by this material is significant and would preclude a working channel to be constructed.

In some locations concentrations of contaminants such as PAHs are elevated, and would require specialist remediation technologies to bring levels below acceptance criteria for either land or sea based disposal.

4.2 Goals and objectives of the proposal

4.2.1 Objectives

The objective of the proposal is to extend the shipping channels in the Port of Newcastle in order to provide adequate deep water access to future berth sites. This would secure the potential for the continued sustainable economic growth of this, the maritime gateway to the Hunter Region.

4.2.2 Goals of the proposal

The goals of the proposal (the means by which the objectives are to be achieved) are to:

- search for and design an approach that incorporates best practice techniques in terms of methodology, technology and design;
- achieve the maximum possible beneficial reuse of dredged and excavated material;
- return the contaminated Hunter River sediments to an acceptable state with possible water quality improvements occurring as a consequence;

- avoid impact to Kooragang Nature Reserve and significant wetlands to the north of Kooragang Island;
- protect the health of workers and of the community during implementation of the proposal; and
- minimise the potential for impacts on adjoining landowners and the community (during implementation of the proposal).

5 Overview of the proposal

This chapter provides an overview of the four main elements of the proposal. These include dredging and excavation, embankment protection works, treatment of contaminated sediments, and the disposal of materials. Other information on the proposal is also outlined, including the proposal cost, duration of the proposed works, physical constraints and hours of operation. More detailed information on the proposal is provided in Chapters 6-8.

5.1 Scope of the proposal

The scope of the proposal includes:

- Dredging and excavation of the South Arm and embankments as shown;
- Disposal of a portion of the sediments to an approved offshore disposal site;
- Beneficial reuse of material where possible at various land sites in the region;
- Treatment of a portion of the sediments on the closure area site; and
- Disposal of treated sediments on the closure area site or licenced disposal sites on Kooragang Island.

The methods of dredging, transportation, treatment and reuse/disposal of the dredged material would be finally determined by the relative quantities and qualities of the different material types, as well as by other factors, such as staging.

5.2 Materials involved

5.2.1 Types of materials

The materials that comprise the bed and banks of the South Arm are varied, and range from rock to soft silty clays and marine sediments. An overview of the materials that would be dredged and excavated is provided below.

River bed

The types of materials present vary along the length of the area to be dredged. In general, the following strata are encountered with increasing depth:

- Fine grained marine silts/clays;
- Sand, some with a higher content of fine material;
- Stiff clay; and
- Rock, varying from soft to hard.

In some locations the fine-grained marine sediments are contaminated with heavy metals and Polycyclic Aromatic Hydrocarbons (PAHs).

North bank of the river

The upper two to three metres is generally sand fill, which was placed during the reclamation and formation of Kooragang Island. This sand overlies the original silty/clay estuarine 'mud flats'. The mud flats in turn overlie a sand, clay and rock strata, similar to the main river course.

South bank of the river

The upper four to six metres of the embankment immediately adjacent to the river form a sea wall. This consists of a combination of rock and building rubble and possibly steelworks waste products in the more upstream areas. The sea wall generally lies on top of the original estuarine mud flats, which in turn overlies the typical river sub-surface strata of sand, clay and rock. Due to the coarse nature of these materials, it is expected that any contaminants present would be at low concentrations.

Further inland from this sea wall it is expected that the filling over the mud flats includes sand, soil and steelworks and building rubble. These materials possibly contain contaminants.

OneSteel site

The geology of the swing basin site is dominated by fill used during the reclamation of Platts Channel and Spit Island between the 1950s and 1970s. The depth of fill ranges between five and twelve metres. This fill overlies the natural estuarine sediments that once formed Platts Channel and Spit Island.

Results of previous investigations at the proposed swing basin site indicate that the fill is generally coarse in consistency, dominated by grey cobbles, gravel, steel making slags and sand sized particles from blast furnace slag, coal washery fines and minor amounts of dark brown soil.

Fill material used on site generally included wastes from plant operations and steel works refuse. Large volumes of river silt and white beach sand dredged from the remaining section of the South Arm channel have also been reported.

5.2.2 Quantities of material

Estimates of the quantities of the different types of material present that are proposed to be removed, and the proposed means of handling these materials, are provided in Chapter 6 and 8 of this EIS. The total volume involved is approximately 13,600,000 m³ that includes approximately 7.6 million m³ of materials to be beneficially reused on land and approximately 6 million m³ of material to be disposed of offshore.

5.2.3 Types of contaminants present

The level of contamination in the majority of the South Arm sediments is low; the large quantity of sand in the South Arm is suitable for beneficial reuse in its current state.

Sediment quality testing and analyses indicates that the soft silty clays found in a location adjacent to the south bank of the South Arm offshore from the closure area site contain varying levels of contaminants. In general, the depth of sediment contamination is limited to the interface between the silty clays and the underlying estuarine sands. Contaminants recorded in the soft silty clays include PAHs, Total Petroleum Hydrocarbons (TPHs) and metals (cadmium, chromium, copper, lead, mercury, nickel, and zinc). Contamination levels generally increase towards the southern foreshore of the South Arm and are highest at the eastern end of the southern foreshore.

Further information on the sediments of the South Arm is provided in Appendix D.

Table 5.1 provides a summary of the chemical constituents of the sediments.

Table 5.1 Key Contaminants

Key Contaminants	Contaminated Sediment		Environment Australia	Environment Australia
	Mean (mg/kg)	95% UCL (mg/kg)	Screening Level (mg/kg)	Maximum Level (mg/kg)
Metals & Metalloids				
Arsenic	11	13	20	70
Cadmium	2.6	5.7	1.5	10
Chromium	59	70	80	370
Copper	60	76	65	270
Nickel	30	36	21	52
Lead	226	283	50	220
Zinc	1176	1459	200	410
Mercury	0.81	1.05	0.15	1
Silver	below laboratory detection	below laboratory detection	1.0	3.7
Organics				
Total PCBS	below laboratory detection	below laboratory detection	23 g/kg	
Pesticides	below laboratory detection	below laboratory detection	0.02-2 g/kg	1-46 g/kg
Naphthalene	539	1707	0.16	2.1
Acenaphthylene	9	20	0.044	0.64
Acenaphthene	31	79	0.016	0.50
Fluorene	24	62	0.019	0.54
Phenanthrene	71	196	0.24	1.5
Anthracene	20	49	0.085	1.1
Fluoranthene	80	216	0.6	5.1
Pyrene	61	158	0.665	2.6
Benzo(a)anthracene	16	37	0.261	1.6
Chrysene	12	26	0.384	2.8
Benzo(a)pyrene	19	44	0.430	1.6
Dibenz(ah)anthracene	0.98	1.68	0.066	0.26
Total PAHs	2028	6932	4	45

Note:

1. All values for organic contaminants are normalised to 1% total organic carbon
2. Environment Australia (2002) screening and maximum levels are the same as ANZECC/ARMCANZ (2000) ISQG Low and ISQG High guideline levels
3. The 95% UCL of the mean is the upper bound estimate of the mean contaminant concentration of the sampling area

5.3 The dredging and excavation process

The channel would be dredged and excavated and the banks left in a stable configuration. The development of the berths along the channel would then occur over time, as the associated land-based developments are approved and built. These berths and any land-based development would be subject to a separate assessment and approval processes.

The proposed channel would extend along the South Arm. It would start at the end of the existing channel (adjacent to the Kooragang Island coal loader and the former BHP wharves) and terminate just east of the Tourle Street bridge.

To ensure that shipping vessels can navigate safely, a swing basin is required towards the upstream end of the proposed channel. This would enable vessels to turn, or swing around, before their return journey downstream.

As indicated earlier it is estimated that approximately 13.6 million m³ of material would need to be removed by dredging and land-based excavation to form the proposed channel and swing basin; of this amount, approximately two percent has been identified as material requiring some form of treatment before disposal.

5.4 The swing basin and the OneSteel site

The swing basin encroaches a significant distance into the OneSteel site, along a portion of the south bank. The materials to be excavated potentially include tar, rock, soil, building rubble, steelworks waste, slag and coal washery rejects.

OneSteel has made available a considerable amount of historic data, reports and photographs relating to the development and potential contamination of their site.

The potential environmental contamination issues associated with this proposed work are considered further in this EIS. There are a number of environmental issues that need to be addressed, including the need to limit the potential for:

- impact on the groundwater equilibrium of the OneSteel site; and
- discharging of potential contaminants exposed in the batters into the South Arm.

The temporary and permanent batters proposed, are within an operating industrial plant and the area of encroachment needs to be minimised. A bulkhead wall or thick rock berm/revetment are the two most likely alternative dredged batter treatments. It is difficult to select one of these alternatives at this stage, as further investigation of the contamination, and groundwater, engineering, construction and impact on existing operations issues is required.

5.5 Treatment of sediments

The removal and subsequent treatment of the contaminated sediments in the South Arm that are not suitable for disposal untreated is an important part of the overall proposal. The contaminated material located in sediments along the southern bank of the South Arm has been present for some time. In this present location and form, this contaminated material could represent a long-term health and ecological hazard. The NSW EPA has declared these sediments a 'remediation site' under the *Contaminated Land Management Act 1997*. The removal and treatment of these sediments represents one of the benefits of the overall proposal. To proceed with the proposed works, it is not feasible to leave these sediments in place, as the spatial extent is significant and the proposed extension of the shipping channel requires all of the available area.

The nature and concentration of contaminants in the sediments vary considerably. In some locations, concentrations of contaminants such as PAHs are elevated. These materials would require specialist treatment technologies to bring the levels of contaminants below acceptance criteria for either land or sea-based disposal. Some spoil from the excavation

also can be classified as 'hazardous' waste, meaning that once removed it must be either placed in a hazardous waste landfill or treated. There are currently no hazardous waste landfills available in NSW, and so it has been assumed that this material must be treated.

The proposed treatment process

Chapter 7 provides a detailed description of the proposed treatment strategy that has been arrived at through the testing and investigation process associated with the EIS.

The main steps are as follows:

- The contaminated zone in the South Arm would be surrounded by a sheet piled wall to prevent migration and cross-contamination and to prevent movement of suspended solids contained within the water column to other parts of the river (fully described in Chapter 6);
- Excavation of the contaminated zone using a grab excavator discharging to a tethered barge (fully described in Chapter 6). This excavation would be carried out within a turbidity curtain;
- Transfer of excavated material to a temporary transfer facility built for the purpose in front of the closure area site. Unloading of the barge to a truck and transfer of the material to a temporary lined storage area to act as a buffer storage for the treatment process;
- The treatment of the stored material by stabilisation (a process of fixing the contaminants in a solid matrix that does not allow leakage to occur), or other approved technology;
- If dewatering were required as an intermediate step, provision would be made for dewatering using geobags. This need may arise due to the low moisture levels required in thermal treatment processes. The dredged material would be retained in geobags until the required moisture content was obtained;
- If dewatering were required, the containment of water discharging from the geobags and subsequent treatment prior to its return to the Hunter River or through reuse in the stabilisation process; and
- The subsequent disposal of treated sediments through their use as engineered fill on the former closure area site or licenced Kooragang Island sites within the constraints of the development consent for those sites.

Several treatment and disposal process configurations could be adopted, depending on the level of contamination. It should be noted that as tenders would be invited for the proposed works, including the treatment and disposal options for contaminated sediments the successful contractor must comply with a number of post treatment standards and objectives and would employ a combination of methods consistent with the findings of this EIS, the development consent and the EPA licence for the proposal.

For example, it is likely that, once the dredging takes place, some of the material may be found to be suitable for immediate dewatering and disposal onto the closure area.

It is also envisaged that a significant proportion of the material, once it undergoes stabilisation, would be able to be used as engineering fill on the closure area or on licenced sites on Kooragang Island.

Contaminated sediments with a high moisture content may be treated using thermal desorption, a well established treatment technology, with the treated materials disposed of within the closure area, or to offshore disposal. The use of thermal desorption technology however would require a further approval step as the proponent does not seek approval at this stage.

5.6 Disposal of materials

As far as possible, the aim would be to beneficially reuse the material resulting from dredging and excavation. However, not all materials (for example, silty muds or soft marine sediments) can be reused. In addition, as described above, some material needs to be treated before it can be reused.

The means of disposal proposed for materials arising from the dredging and excavation process are:

- offshore disposal of materials according to the provisions of the *Environment Protection (Sea Dumping) Act 1981*;
- beneficial reuse of suitable material; and
- disposal of treated materials on the closure area or licenced sites on Kooragang Island.

5.6.1 Offshore disposal of sediments

Materials that cannot be beneficially reused consist of soft marine sediments, stiff clays, weathered rock and potentially sound rock. Some of the materials that are contaminated by PAHs, TPHs, and heavy metals would either be disposed of at sea, or on land after treatment depending on the level of contamination.

An extensive investigation has been undertaken as part of this EIS, with the involvement of the CSIRO, EPA and Environment Australia, to determine the level at which sediments could be disposed of offshore without presenting a toxicity risk. Chapters 7 and 8 and Appendix D present the results of the testing undertaken to arrive at this determination.

There is an existing approved disposal site off Newcastle Harbour that has been used by Newcastle Port Corporation for disposal of dredging material derived from maintenance dredging (as opposed to capital dredging). Previous disposal sites also existed for capital dredging, such as the major port deepening undertaken between 1978 and 1983. Use of the existing approved disposal site would depend on the total quantity and rate of material to be disposed of at sea, the rate of dispersion of material from the disposal site and the degree of contamination of the materials.

The disposal of material offshore is subject to a separate Commonwealth approval process, under the *Environment Protection (Sea Dumping) Act 1981*. Although briefly described within Chapter 8 of this EIS, this activity is subject to a separate application to the Commonwealth Department of Environment and Heritage.

5.6.2 Beneficial reuse of clean material.

As far as possible, an aim of the proposal would be to beneficially reuse the material resulting from dredging and excavation. However, not all materials (for example, silty muds or soft marine sediments) can be reused. In addition, as described above, some material needs to be treated before it can be reused.

Options for beneficial reuse include materials used as:

- Fill at the proposed Tomago industrial area;
- Fill along the proposed multi-user port and transport corridor to the Tomago industrial area;
- Fill at the Protech site and any other industrial site on Kooragang Island requiring clean fill;
- Engineered fill on the closure area site or on licenced sites on Kooragang Island; and
- Potential renourishment of Stockton Beach using clean sands.

These options are discussed in detail in Chapter 8. It should be noted that there are a number of projects within the Newcastle and Hunter region that are either proposed or have development consent. These include the Protech Cold Mill

facility on Kooragang Island, and the Multi-purpose Terminal facility on the closure area site. Separate approval processes apply to these projects and other proposed developments. The proponent is seeking consent, as part of the current proposal, to supply fill to any project, subject to the relevant approvals being gained for the transport and use of such fill, by the proponents of other projects.

5.6.3 Disposal of treated sediments

Following treatment on the closure area site, materials would be used as either capping or engineering fill on the closure area itself or on licenced sites on Kooragang Island.

5.7 Channel design

5.7.1 Overview

There have been a number of alternative berth and channel extension layouts developed as part of the planning for future port options. In addition, consideration has been given to minimising the encroachment of the swing basin into the OneSteel site and minimising impacts on the existing alignment of Cormorant Road. These considerations have also included an allowance for a future replacement of the existing two-lane Tourle Street bridge with a new four-lane structure, downstream of the current bridge location, if required.

The final layout adopted by the proponent in consultation with Newcastle Port Corporation allows for:

- berthing of future Cape class vessel along the northern bank, downstream of and adjacent to the proposed swing basin. These berths would be dredged to a declared depth of 16.5 metres below Newcastle Harbour Tide Gauge (NHTG) datum;
- berthing of future Panamax class vessels along the northern bank, alongside and upstream of the proposed swing basin. These berths would be dredged to a declared depth of 14.5 metres NHTG datum;
- a swing basin to allow the turning around of lightly laden Panamax class vessels and Cape class vessels. These criteria result in a swing basin that varies in depth from 10.0 metres below NHTG datum adjacent to the OneSteel site, to 15.2 metres below NHTG adjacent to the future Cape class vessel berth; and
- a shipping navigation channel that would allow tide assisted departure and arrival of fully laden Cape class vessels downstream of the proposed swing basin and tide assisted departure and arrival of fully laden Panamax class vessels from upstream of the proposed swing basin. The channel would extend upstream from the port navigation areas which are currently dredged to -15.2 metres NHTG, to a location just downstream of the proposed new Tourle Street bridge. The channel would be dredged to a declared depth of 15.2 metres below NHTG datum up to the swing basin and to a declared depth of 14.5 metres below NHTG datum, upstream of the proposed swing basin.

5.7.2 Vessel types

Two principle vessel types would principally use the South Arm: Panamax and Cape class vessels:

- Panamax class vessels are the largest vessels that can pass through the Panama Canal. Typical length varies but is approximately 240 metres and a maximum beam of 32.2 metres; and
- Cape class vessels are larger than Panamax and are those that can pass around the Cape of Good Hope and exceed the dimensions of the Panamax class. Typical lengths of the vessels vary between 280 – 320 metres approximately and a typical beam of approximately 50 metres.

5.7.3 Banks and foreshore design

The bank and dredge batter slope configurations that are described in Chapter 6 take account of short and long-term stability and erosion protection issues and the need to optimise construction costs. Different dredge batters have been detailed at the following locations, with due considerations to long term stability and erosion control:

- the south bank of the swing basin;
- the western submerged batter within the river bed that is in front of the existing and proposed Tourle Street bridge;
- the north bank upstream of the proposed swing basin for Panamax class vessel berths;
- the north bank immediately adjacent to the proposed swing basin for the Cape class vessel berth; and
- the north bank south of the proposed swing basin both for the final development and for an interim staged development within berths and its location.

All of these dredge batters require erosion protection works on the surface, the extent and details of which depend on the relative exposure of that part of the batter to erosion arising from either natural environmental events or proposed operations.

Rock protection as further detailed and described further in this EIS, placed on the prepared channel batter slopes is proposed to comprise the erosion protection works to the dredged batters. This would involve the supply, delivery and placement of up to 1.0 million tonnes (i.e., 1.8 million m³) of selected armour stone rock. It is likely that this rock would be obtained from existing local quarries within a 25 km radius of the site located at either Seaham or Koruah. This rock would be placed progressively as the dredging activities in the particular area have been completed.

5.7.4 Navigation aids

Navigation aids in the form of channel lead lights and daytime lead markers would be required. These devices would be mounted on towers located close to the bank of the South Arm. The two primary directional lead light towers are likely to be approximately 50 metres in height, while the other secondary lead light towers are likely to be approximately 20 metres in height.

Floating red (port) and green (starboard) channel marker buoys, located at the edges of the channel, would delineate the limits of the navigation area. These marker buoys would display either a red or green flashing light at night.

5.8 Workforce and labour implications

A peak workforce for works within the scope of this EIS is estimated at up to 150 people over three shifts. Final workforce numbers would be up to the successful works contractor.

5.9 Hours of operation

5.9.1 Construction

In general, dredging, excavation and treatment activities would be undertaken on a 24-hour basis, seven days per week. It is expected that some activities (such as blasting) and driving of sheet piling may be restricted by the development consent to daylight hours.

5.9.2 Channel operation

There would be no change to the current operational schedule of the port of Newcastle although there would be a need to restrict vessel and public access to the South Arm at times over the life for the duration of the dredging work.

5.10 Staging

The commencement of the proposed works would depend on the progress of nearby land based industrial developments and the resulting demand for deep-water port facilities. Similarly, the demand and opportunity for reuse of the dredged sand would also be a factor influencing the timing of the proposal.

For reasons of economy, it would be preferable for the proposed work to be carried out in one continuous operation. However, if it is determined that there may be significant delays to some of the land-based developments, then the dredging may be carried out in stages and initially to lesser depths if it is determined that smaller vessels may be used.

Some of the possible development scenarios are described as follows:

- Eastern Berth Development – if only the eastern-most berths were required, then the section of the channel adjacent to these berths would only need to be dredged as vessels could be manoeuvred in the existing swing basin near the coal loading berths and be essentially reversed upstream. The extent to which this navigation method could be used would depend on the proposed vessels and would be confirmed when specific requirements of land based developments are known;
- Central Berth Development – if berths are required toward the middle of the South Arm (toward the swing basin), the channel up to and including the proposed swing basin would need to be dredged to meet navigation requirements;
- Western Berth Development – if the section of channel between the proposed swing basin and the Tourle Street bridge is required (as proposed for the multi-user port and transport corridor) dredging would be required for the full extent of the South Arm including the swing basin; and
- Deferment of the Northern Channel Berths – dredging of the proposed berths along the northern side of the channel from the swing basin down to the eastern end of the project may be deferred until the berths are required for the adjacent shore side development. This would provide some initial cost benefits at the major dredging phase of the project.

The removal and treatment of the contaminated sediments would be carried out under all of the above possible options.

More detail in regard to the methodology and the proposed sequence of dredging is included in Chapter 6.

5.11 Timing

For the total scope of work, the duration of the construction works could possibly be up to 48 months if all the activities required for total project development are undertaken in the most cost effective way. It may be possible to complete the proposed work within a lesser time, however this would involve additional cost.

Overall channel extension

A number of activities need to be undertaken simultaneously. These are:

- excavation of the northern and southern shorelines;
- creation of a navigation channel and swing basin; and
- installation of sheet piled walls.

The critical path for the proposal would involve:

- site establishment;
- removal of marine silts and clays to create the temporary access channel and associated swing basin, using a backhoe dredge in conjunction with barges;
- removal of the remaining marine silts and clays located outside of the sheet pile wall, using two small trailer suction hopper dredges;
- removal of sand using a large cutter suction dredge;
- removal of stiff clays and underlying softer sandstone, using a large cutter suction dredge in conjunction with a large trailer suction hopper dredge;
- drilling and blasting of hard rock;
- subsequent removal of fragmented hard rock using a backhoe dredge; and
- supply and placement of erosion protection works to the exposed batters.

Treatment processes

Timing of the treatment works for the contaminated materials that required treatment would be influenced by:

- the time taken for the dredging/treatment activities and thus the rate at which the contaminated material is removed and transferred to site where it would be treated; and
- the need to restrict use of temporary storage of contaminated materials to not more than 24 months.

5.12 Cost and funding methods

5.12.1 Cost

The estimated capital cost of the proposal is approximately \$300 to 400 million based on the scope of works as described in this EIS. A more precise figure would be developed during the detailed design stage. The proposal would be largely contracted out to the private sector.

5.12.2 Funding

The proponent would investigate the most appropriate funding model for the proposal, which would ultimately be determined by the Budget Committee of the NSW Cabinet. Consistent with all commercial navigation channels in NSW, it is likely that the cost of channel development would be recovered through charges applied to vessels that traverse the channel or contribution made at the time berth facilities are developed.

6

Description of the dredging, excavation and bank protection processes

This chapter describes the dredging excavation and bank protection processes that would be implemented to deepen the South Arm; create the swing basin; and protect the river banks. Information is provided on the types of dredges that would be used to dredge the river below high water mark, and the means of excavation above high water mark. The methods of dredging and excavation depend on the types of materials within the bed and banks of the South Arm.

6.1 Overview

The Hunter River is relatively shallow (existing sea-level depths generally varying between 1 and 2 metres below NHTG datum), upstream of the existing shipping channel and berths. The existing riverbed requires dredging to allow safe navigation to future new berths.

The proposed new channel in the South Arm would be dredged and excavated to a navigable depth and the banks sloped back and protected with a rock revetment to prevent scour and erosion. The development of the berths adjacent to the shipping channel would occur over time as required by associated land-based developments. These new berths, and any land-based development, would be subject to separate assessment and approval processes.

The proposed channel extension would extend along the South Arm for a distance of approximately 3,300 m. It would start at the end of the existing channel (adjacent to the Kooragang Island coal loader and the former BHP wharves) and terminate just east of the Tourle Street bridge.

To ensure that shipping vessels could navigate safely, a swing basin would be required toward the upstream end of the proposed channel. This would enable vessels to turn, or swing around, before their return journey downstream.

It is estimated that up to approximately 13.6 million m³ of material would need to be removed by dredging and land-based excavation to form the proposed channel and swing basin; of this amount, approximately 250,000m³ or around two percent of the total volume has been identified as material requiring some form of treatment before disposal or reuse.

The layout of the proposal is shown in Figure 6.1 and 6.2. More detailed plans are provided in Figure C.1 in Appendix C.

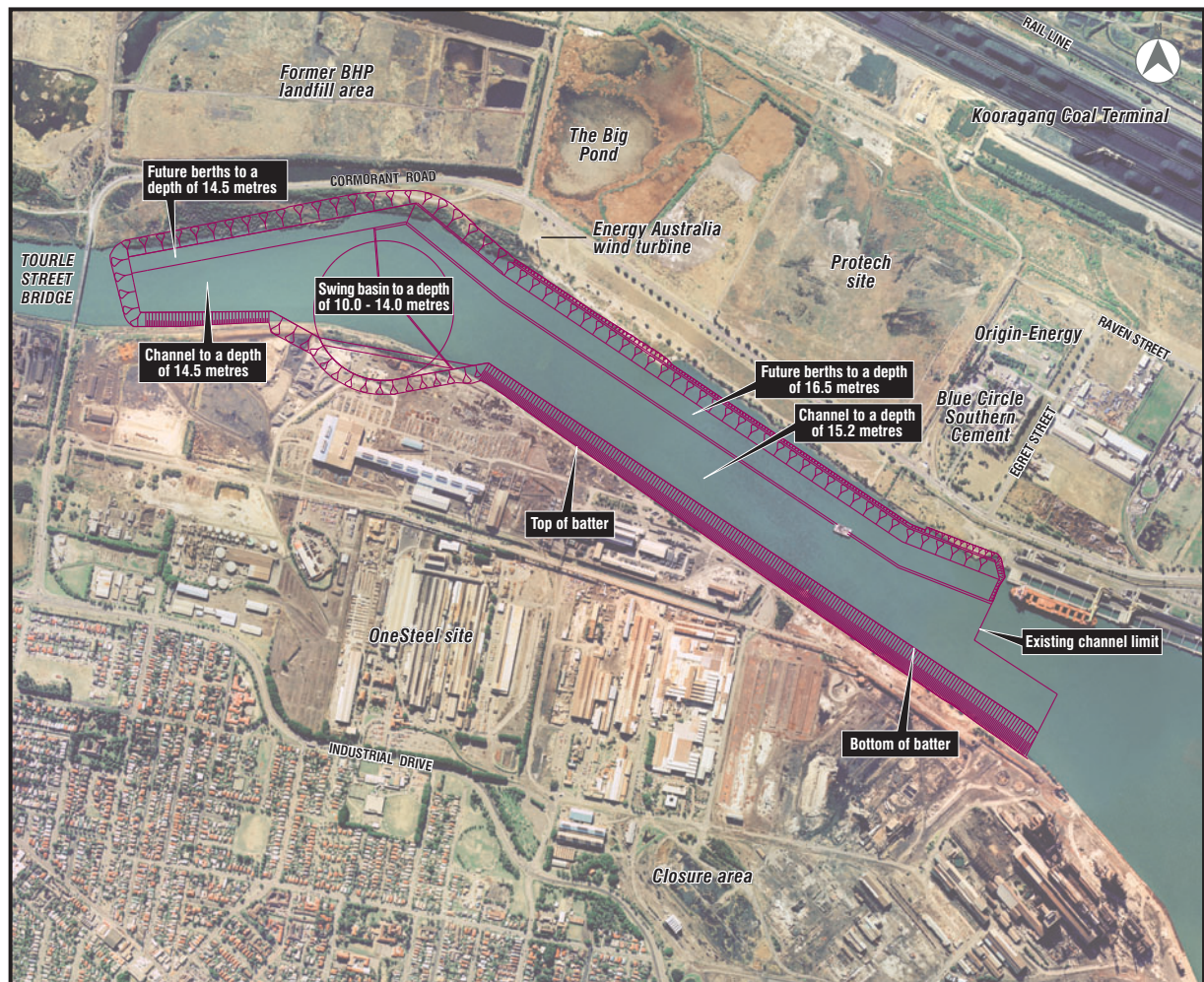


Figure 6.1 Proposed layout

0 1
Kilometres

Note: Refer to figures in Appendix C for more detail

-  Uniform batterslope
-  Variable batterslope

6.2 Navigation requirements

There have been a number of alternative berth and channel layouts developed and considered as part of the overall planning of the port to accommodate proposed and future developments. Allowance has been made for the minimising of the encroachment of the proposed swing basin on to the OneSteel site and minimising impacts on the existing alignment of Cormorant Road. These considerations have also included an allowance for a future replacement of the existing two-lane Tourle Street bridge with a new four-lane structure, downstream of the current bridge location.

The proposed channel details are shown in Figure C.1 in Appendix C and allow for:

- Cape class vessel berths along the northern bank, downstream of the proposed swing basin. These berths may be dredged as part of the initial dredging works, or at a later stage, depending on particular berth requirements. These berths would be dredged to a declared depth of -16.5 metres relative to the Newcastle Harbour Tide Gauge (NHTG) datum;

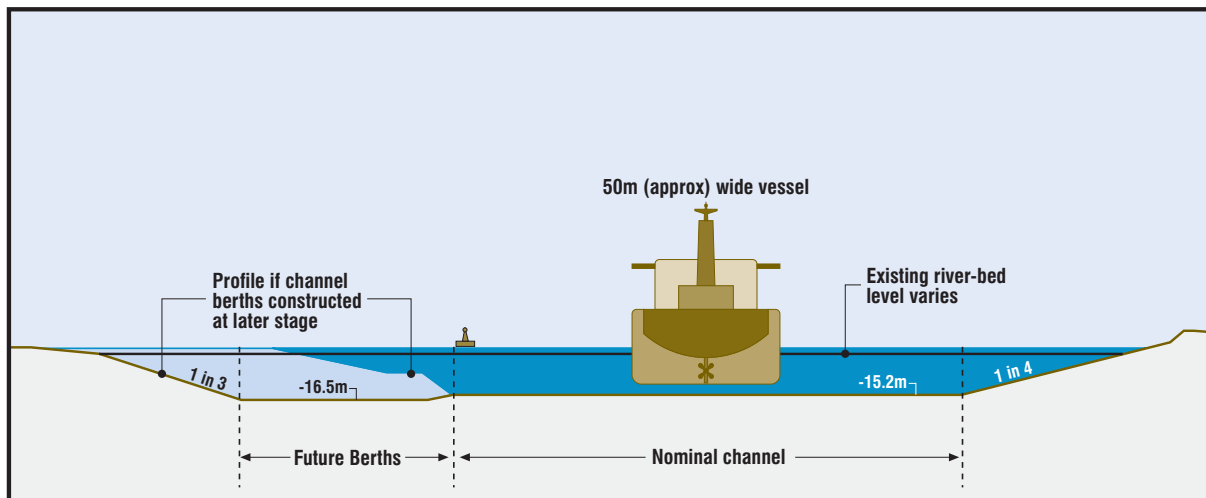


Figure 6.2 Typical cross-section of the south arm

- Panamax class vessels along the northern bank, upstream of the proposed swing basin. These berths would be dredged to a declared depth of -14.5 metres NHTG;
- A swing basin to allow the turning around of lightly-laden Panamax class and Cape class vessels. These criteria result in a swing basin that varies in depth from -10.0 metres NHTG adjacent to the OneSteel site, to -15.2 metres NHTG adjacent to the proposed Cape class vessel berths; and
- A shipping navigation channel that would allow tide-assisted departure and the arrival of laden Cape class vessels downstream of the proposed swing basin and tide assisted departure and arrival of fully laden Panamax class vessels from upstream of the proposed swing basin. The channel would extend upstream from the port navigation areas currently dredged to a declared depth of -15.2 metres NHTG, to a location just downstream of the proposed new Tourle Street bridge. The channel would be dredged to a declared depth of -15.2 metres NHTG downstream of the swing basin and to a declared depth of -14.5 metres NHTG, upstream of the proposed swing basin.

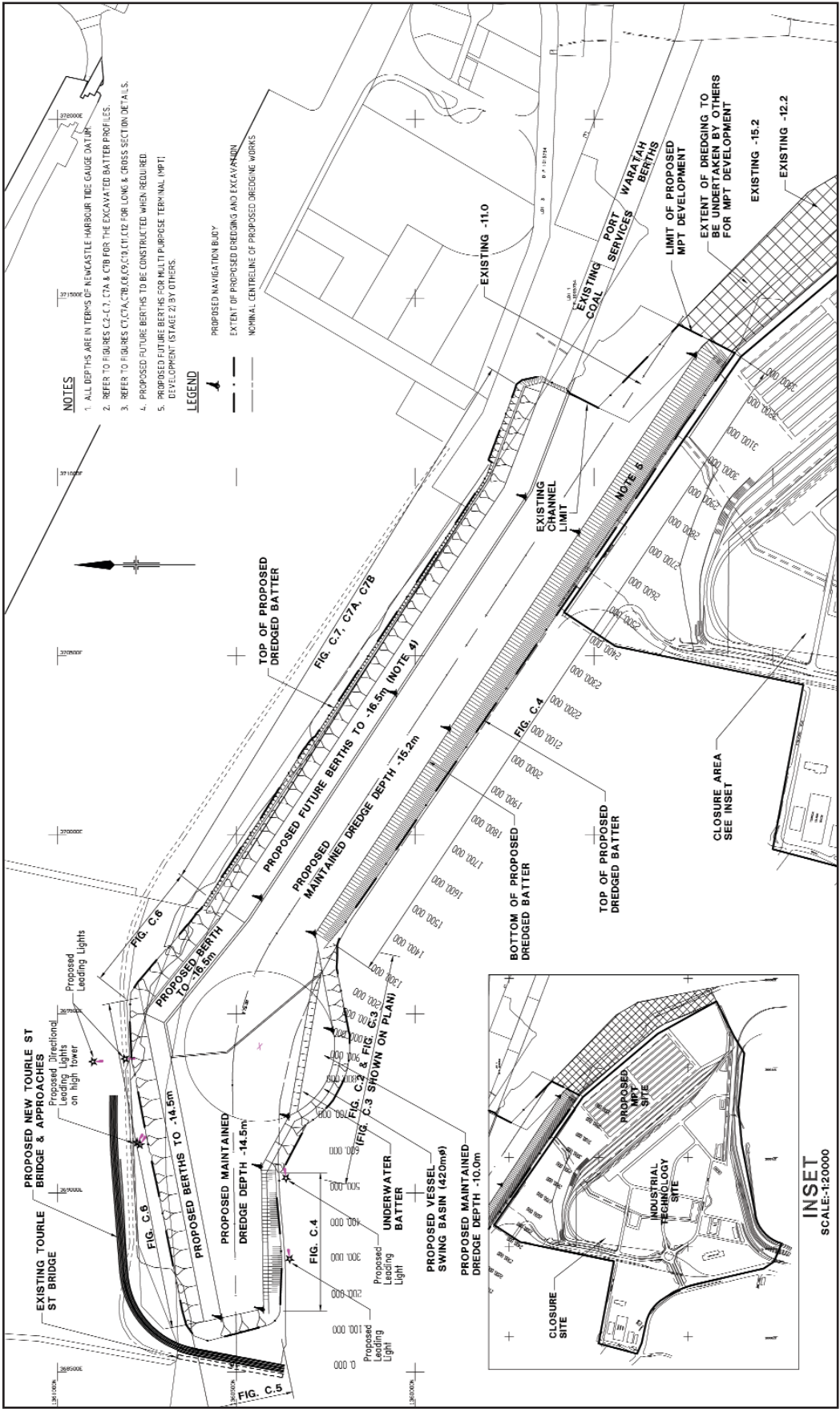
6.2.1 Proximity to Tourle Street bridge

The western limit of the proposed channel is relatively close to the area that would be occupied by the proposed widening of the existing Tourle Street bridge. As a result, measures to limit the potential for accidental ship impact on both the existing and the proposed new bridge have been considered.

A submerged dredged batter slope, incorporating a thick submerged rock berm is proposed that would bring a moving vessel to rest before impacting with the bridge. (Refer to Figure C.5 in Appendix C). This configuration moves the outer face of the proposed rock berm downstream as far as possible and, combined with the increased thickness of rock, would offer more resistance to any accidental vessel impact. This issue is dealt with in more detail in subsequent sections of the EIS.

6.2.2 Navigation aids

Newcastle Port Corporation has advised that channel lead lights and daytime lead markers would be needed. The location of each device is shown in Figure C.1, in Appendix C. They would be mounted on towers near the extended channel. The two primary channel directional lead light towers are likely to be approximately 50 metres in height, while the other, secondary, lead light towers are likely to be approximately 20 metres in height. The light emitted by the primary lead towers is directional in nature, with a relatively narrow focus, rather than for general area illumination,



and they are unlikely to have a significant impact on general lighting levels in the vicinity of the towers. The light emitted by the secondary lead lights is not directional, but illuminates only the tower marker: this lighting is unlikely to have a significant impact on general lighting levels around the towers.

The limits of the navigation area would be delineated by floating red (port) and green (starboard) channel marker buoys, which would be located at the edges of the channel, as shown in Appendix C, Figure C.1. These marker buoys would display either a red or a green flashing light at night, similar to the existing marker buoys that define the extent of the Channel in other areas of the port.

Examples of navigation aids are shown in plates 6.1 and 6.2.



Plate 6.1 Example of navigation aids
- main channel leads



Plate 6.2 Example of navigation aids - floating bouy

6.2.3 Future berths in the South Arm

While new berth infrastructure does not form part of the proposal being considered by this EIS, factors impacting on their general location and arrangement have been considered as part of the development of the proposal. It is expected that the berths would comprise two main elements:

- a wharf approximately 850 metres long located at the north-western end of the development, catering for three Panamax class vessels with a minimum maintained berth depth of 14.5 metres below NHTG datum; and
- a wharf approximately 350 metres long, catering for a Cape class vessel with a minimum maintained berth depth of 16.5 metres below NHTG datum.

The north bank of the South Arm has been identified as the most suitable location for these future new berths (refer section 9.2 for alternatives considered).

An area downstream of the swing basin, adjacent to the northern side of the proposed shipping channel, measuring approximately 1700 m x 70 wide, is proposed to provide berths for Cape Class vessels. These berths may be provided either as part of the major channel extension developing works, or at some time in future as and when required to support adjacent shore-side development.

If a staged development approach is undertaken for the development of the berths located on the north side of the channel downstream of the swing basin, it is proposed that the northern batter slope of the channel would be unprotected. This is due to the location, extent and grade of the proposed channel batter slope that is located within the existing river channel and the undeveloped nature of the adjacent shore-line. (Refer to Figures C.7A and C.7B in Appendix C). When the berths at this location are developed, the bank protection works would be constructed, as shown on Figure C.7 and as discussed in the EIS.

6.3 Existing river depths and sub-surface ground conditions

The existing river and channel depths, existing port dredged berths and the proposed channel extension is shown on Figure C.25, in Appendix C.

There have been a number of historical investigations of the materials in the banks and bed of the South Arm, to determine the geotechnical and geochemical nature of the materials to be dredged. Considerable additional drilling, sampling and testing has been undertaken as part of this EIS to supplement the earlier testing. A comprehensive description of the sub-surface ground conditions is provided in Chapters 7 and 14.

A typical long section and a number of cross-section profiles of the river showing material layering and dredging limits are included as Figures C.8 to C.13 in Appendix C. Typically the river bed consists of fine grained, soft silty clay sediments overlying sand. The sand contains some lenses of clay and overlies deeper layers of clay, soft rock and hard rock.

The soft, silty clay sediment contains varying levels of contaminants that have washed into the sediment layers over an extended period of time from industrial developments in the region. Geochemical and ecotoxicity testing of the sediments have demonstrated that the majority of these sediments are suitable for disposal at sea. However, some of the sediment would need to be treated before it is suitable for disposal or reuse. The relevant characteristics of the contaminated sediment chemistry and treatment processes are described in Chapters 7 and 8.

The sand, clay, soft rock and rock are not contaminated and do not require treatment before reuse or disposal. The physical properties of each of these materials considerably influences the method of dredging/excavation and reuse/disposal.

The majority of the bank excavation work is within the encroachment into the OneSteel site. There is some information available on the history and characteristics of fill on the OneSteel site and this is described in Chapters 7, 8 and 14.

6.4 Dredge depth and batter design philosophy

The geotechnical characteristics of the materials that would form the batters of the channel along with the geometric constraints of the site, determine the type of batter adopted.

The primary design philosophies for the excavated and dredged channel and associated batters are:

- that the nominated minimum declared depths for each of the new navigation areas are to be achieved, along with an over-dredging allowance (specified by Newcastle Port Corporation) of an additional 0.5 metres in depth in all proposed dredging areas, which would be provided as a buffer to provide for sedimentation that may occur between maintenance dredging programs;
- that the batters are stable during construction until temporary or more permanent batter protection can be put in place;
- that temporary or more permanent batter erosion protection is provided that is designed to resist geotechnical bank failures and erosion from tidal flows, flood flows, vessel bow thrusters and propeller wash and vessel wake; and
- Submerged slopes would be designed not to excessively slump and/or create excessive maintenance dredging requirements. In particular, dredged batters in or close to contaminated sediments would be designed so that they do not result in contaminated sediment entering the navigation areas.

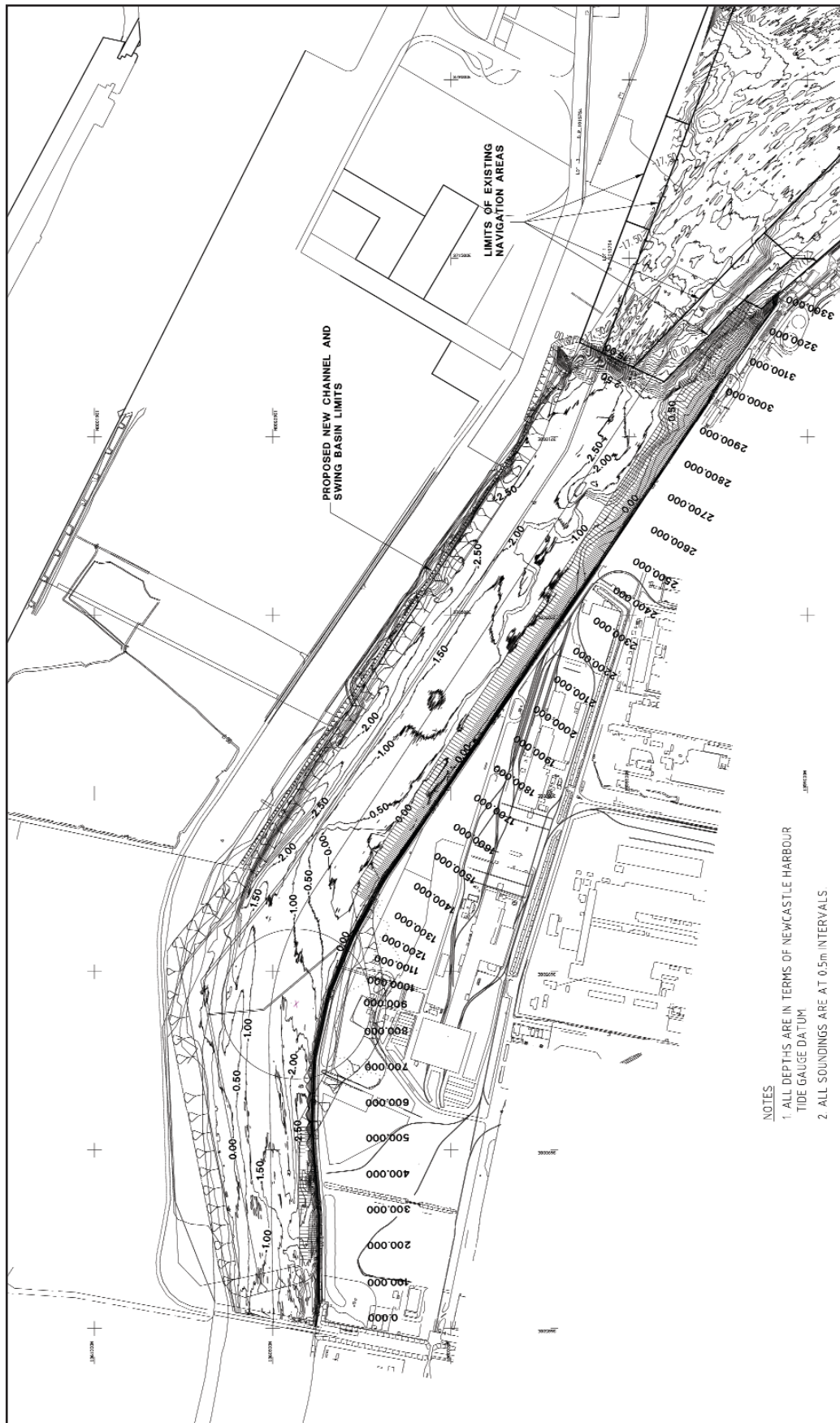


Figure C.25 Existing Surface Contours Proposed Extension of Shipping Channels

6.4.1 Dredge batter design criteria

To ensure that the design philosophy is achieved, the primary design criteria adopted is:

- Adequate factors of safety against slip circle and wedge type batter failures for normal conditions;
- Adequate factors of safety against slip circle and wedge type batter failures for seismic events;
- Extent, size and grading of revetment rock to provide protection against erosion from a two percent annual exceedance probability flood event (i.e., 1 in 50 years) and from propeller wash and vessel motion, in accordance with Permanent International Association of Navigation Congresses (PIANC) guidelines; and
- Maximum permanent submerged unprotected dredged batter slope of 1:5, as specified by Newcastle Port Corporation, based on its past experience. This requirement allows for appropriate management of future maintenance dredging. This is a maximum requirement; flatter batters may be required in soft sediment layers.

6.4.2 Unprotected dredge batter slopes

Past experience with dredging of the sediments, sands, clay and rock in the South Arm, which have similar properties to materials that are proposed to be excavated, has shown that:

- the sound rock would be stable in the short term at near-vertical slopes. However, an assessment of bedding plane or jointing orientation would normally be undertaken to confirm the engineering feasibility of flattening of the batters in order to ensure long-term slope stability;
- the stiff marine clays and weathered rock would be stable in the short term at near-vertical slopes. However, with time, both classes of material are likely to form a stable long-term slope of approximately 1 vertical to 1.5 horizontal (1:1.5);
- the sands would be stable in the short term for submerged batter slopes at approximately 1:2.5. However, the unprotected sand slopes would gradually flatten with time and, for submerged slopes, this may result in a batter slope as flat as 1:5. In the tidal/wave zone the unprotected sand slopes may flatten to less than 1:10; and
- the newly dredged slopes in the soft silty clay sediments might initially stand up at quite steep batter slopes. However, with time, these slopes would flatten out to be much less, for example, 1:20.

6.4.3 Permanent dredged river batters

In a river environment, it is usually not practical to design for unprotected dredged batters in the medium to long term, as the relatively flat batters inherent in this approach would result in excessive encroachments into the banks. As a result, it is common practice to provide some form of revetment protection in the form of rock rip rap, rock within PVC encased wire baskets, concrete filled mattresses or other protection systems. The presence or likely future presence of a berth structure on top of the slope and the potential risk of damage to that structure would also influence the batter protection method finally selected.

In this case, the proposed dredged depths are relatively deep, which limits the number of dredge batter options that are economically feasible. The final options adopted, depend on location, ground conditions and expected future development and can generally be categorised as either permanent or temporary batters.

Permanent batters

The typical types of permanent revetment batters are described below. The stand-alone cost of these batter treatments varies greatly and alternatives are listed in decreasing cost per lineal metre of batter protection. Often these permanent batter protection works are incorporated into berth and wharf developments:

- Bulkhead wall berth structure. A vertical sheet piled, or similar wall with associated bank anchorage systems provides the batter protection;
- Suspended deck berth structure on widely spaced piles with a requirement for vehicle access all along the rear of the berth, such as a container or general purpose berth. The batter slope would have a thick combined rock berm at the toe of the batter and rock revetment, with a typical final riverside batter slope of 1:1.5;
- Open suspended deck berth structure on widely spaced piles, with limited vehicle access requirements, such as a bulk materials berth. The batter slope would have a thinner rock revetment with a typical riverside batter slope of 1:3; and
- River bank with no proposed berth: thinner rock revetment with riverside batter slope of 1:3. The rock revetment batter may not extend to the toe of the slope and is dependent on propeller and vessel wash, tide and flood current and slope stability considerations.

Temporary batters

Temporary batter protection is usually adopted when it is envisaged that there would be subsequent re-construction of the batter in the short to medium term, usually to accommodate a new berth. The typical types of temporary revetments are described as follows:

- Batters excavated in rock would be left near vertical or slightly battered back, depending on bedding plane/joint orientation. No revetment protection would be required;
- Slope battered to, for example, 1:3 for sand and clay, protected by a relatively thin layer of revetment rock, from, for example, five metres below low water up to the top of the bank; or
- Slopes of finer grained sediments would need to be assessed depending on the particular circumstances at that location of the site. The solution finally adopted would depend on a number of factors, including the thickness of the sediment layer, whether the layer was submerged and the geotechnical properties of the material. Typically, the presence of a fine sediment layer within a batter would require a flatter slope or berm at that location within the batter to maintain stability, followed by a relatively thin layer of rock on the exposed surfaces of that layer.

As with any unprotected batter profile in a marine environment that is affected by environmental factors and vessel operations, the risk and consequence of localised slip circle batter failure needs to be carefully evaluated against the cost of revetment works and the significance of structures and/or the existing environment adjacent to the unprotected batter slope.

6.4.4 Encroachment on the southern bank as a result of the swing basin

Along a portion of the south bank, the swing basin would encroach a significant distance into the OneSteel site. The materials to be excavated potentially include rock, soil, building rubble, steelworks waste, slag, tar and coal washery waste. The potential environmental contamination issues associated with this proposed work are dealt with in Chapters 7, 10, 14 and 15. There are a number of environmental issues considered for the dredge batters in this location, including:

- the need to limit the potential impacts on the current groundwater equilibrium on the OneSteel site; and
- the need to limit any potential leaching into the Hunter River of any potential contaminants found and exposed in the batters, during the excavations into the OneSteel site.

The proposed temporary and permanent batters would be within an operating industrial park and the area of encroachment also needs to be minimised. A bulkhead wall or a thick rock berm/revetment are the two most likely alternatives to achieve the objective. It is difficult to select the optimum solution at this stage, as contamination and

groundwater issues would need to be assessed further during detailed design. The advantages and disadvantages associated with each option are listed below.

Bulkhead wall

This alternative would involve a vertical wall with a buried tie-back anchorage system. The wall would be located part-way up the dredge batter slope, as shown in Figure C.2 (Appendix C). This configuration provides the required navigation clearances and minimises the cost of this bulkhead wall option. There are a number of alternative construction methods for this anchored bulkhead wall, including:

- driven steel or concrete sheet piles combined with an anchorage system;
- driven steel soldier piles with infill precast concrete panels combined with an anchorage system; and
- in situ excavated diaphragm wall type construction constructed with an anchorage system.

Use of driven piles is preferred; however, the final construction method would depend on the nature of the materials that the piles would be driven through and the likely presence of obstructions, such as waste steel slabs. A better understanding of the sub-surface ground conditions is required and this would assist with the selection of the preferred piling method. This would be undertaken as part of subsequent ongoing studies, investigations and detailed design. Depending on the detailed design a bulkhead wall would have a typical life in the order of 50 – 100 years.

Advantages

- Low permeability, which would inhibit leaching of any exposed contaminants;
- Low permeability, which would inhibit any potentially contaminated groundwater flows from the site into the Hunter River. The full impacts on the groundwater equilibrium would need to be assessed;
- Least encroachment into the OneSteel site; and
- Wall and anchorages can be installed substantially in the dry before excavation/dredging.

Disadvantages

- High cost of construction;
- Ongoing maintenance of the steel piles and anchorages; and
- Low permeability may result in adverse impacts on the groundwater regime. This issue would need to be studied further during detailed design.

Rock revetment

This alternative would involve initial construction of a temporary batter at a slope, for example, of 1:2.5, but ultimately the initial slope would depend on materials encountered during the excavation. This slope would then be built up into a rock berm with a final front batter slope of 1:1.5, which in turn would be protected by a rock revetment layer, as shown in Figure C.3 (Appendix C).

Advantages

- Lower cost than the sheet piled alternative;
- Higher permeability should not result in any significant adverse impacts on the groundwater regime; and
- Lower long-term maintenance cost than for the sheet piled wall alternative.

Disadvantages

- Higher permeability that would have little effect in inhibiting the leaching of potential contaminants into the Hunter River.
- Greater encroachment on to OneSteel, than the bulkhead wall option.

It might be feasible to use a flatter, thinner rock revetment batter, for example with a slope of 1:3, which would encroach further into OneSteel. This alternative would have similar advantages and disadvantages to those described above, except that the costs would be lower. The final details of this option would be determined during detailed design.

Bank Protection Works

A number of alternative bank protection systems have been considered. Due to the nature and extent of the site and the materials that are required to be protected, only flexible methods of protection to the sloping batters are considered to be appropriate. These include graded armour rock or rock-filled PVC encased wire "reno-mattress" type systems.

For the purpose of the EIS, it has been assumed that the typical bank protection works proposed for the slopes of the channel would consist of a graded rock armour system comprising the following elements:

- A geotextile membrane placed on a prepared batter slope;
- A rock underlayer consisting of selected durable igneous rock with a minimum total layer thickness of 350 mm; and
- An outer rock armour layer, consisting of selected igneous rock, a minimum of two layers thick, providing a total minimum thickness for this layer of 700 mm.

As the majority of the batter slope is underwater, appropriate techniques and methods would need to be adopted to place these materials underwater.

6.4.5 South bank of the South Arm

The existing south bank seawall and revetment batter adjacent to the Closure Area site and the OneSteel site is of variable configuration. It has been reported to be unstable in some areas. It is understood that this seawall and revetment batter may be constructed from rock, soil, building rubble, steelworks waste products, slag and coal washery waste. The existing seawall may contain contaminants like tar and PAHs and may be providing a barrier to such contaminants migrating into the Hunter River from the fill behind the wall. To minimise the potential environmental impacts of dredging, the dredging works would be designed to limit any impacts on the integrity of the existing seawall and revetment batter. In addition, the existing sea wall and revetment batter should remain intact, except in the vicinity of the proposed swing basin, where such an approach is not possible.

The lower sections of the existing revetment batter have eroded in some areas and these would be locally reinforced with additional rock to provide a stable batter for the long term.

There are no berths currently proposed adjacent to the south bank of the shipping channel, although it is possible that the existing revetment batter would require reconstruction or need to be redeveloped in the future. The lower levels of the proposed south bank batter below the toe of the existing seawall and revetment batter within the proposed excavation area, would be within sand and clay.

It was initially proposed that medium-to long-term batter protection be provided, consisting of an unprotected batter slope of 1:5 below low water and a slope of 1:3 above low water. This batter slope would be covered by a rock revetment, from approximately five metres below the low water level up to the top of the batter.

However, the existing seawall and revetment batter is too close to the proposed channel edge to allow this profile to be constructed and to enable the channel to be dredged in the proposed location. As a result, the batter is required to extend from the at the base of the shipping channel, at a single gradient to intersect with the toe of the existing revetment batter. The resulting dredge batter slope varies between 1:3.3 and 1:4.9 along the length of the south bank. As the submerged portions of this batter are steeper than that recommended for an unprotected batter, batter is required to be protected by a relatively thin rock revetment down to the toe of the batter.

However, as it would be as difficult to construct this profile so that it is geotechnically stable, both in the short and long term, it is proposed that a relatively short steel sheet piled wall (approximately 10 metres long) be permanently installed immediately at the toe of the existing seawall and revetment, before dredging commences. This configuration of the batter profile for the southern bank of the South Arm is shown in Figure C.4, in Appendix C. This may have some impact on the current groundwater equilibrium on the closure area and OneSteel sites. This issue is dealt with in Chapter 15.

6.4.6 Western batter and protecting the Tourle Street bridge

The western batter is in the middle of the riverbed. If an unprotected, submerged 1:5 batter slope is provided, it is expected that in time, this slope would erode to a much flatter profile that would result in bed erosion beneath both the existing and future Tourle Street bridge. To prevent this occurring, it is proposed that a submerged rock revetment be used to protect this batter slope.

In addition, as outlined above, the western limit of the proposed channel extension and berth is relatively close to the existing and proposed new Tourle Street bridge, however the potential for accidental ship impact to the bridge would be addressed by a substantial submerged rock berm. A submerged dredged batter slope of 1:3 has been chosen, protected by a relatively thick rock berm which is approximately 25 metres wide at the crest, giving a final batter slope of 1:1.5, as shown in Figure C.5 (Appendix C). This proposed layout would move the dredge batter and river bed intersection point downstream. In addition to protecting the batter from erosion forces; this arrangement provides a relatively steep and wide rock batter with a high crest elevation relative to the berth depth.

Calculations have been prepared which show that a fully laden, Panamax class vessel, travelling at up to 0.2 metres per second would be brought to rest by this batter detail, before the vessel impacts on the bridge. A speed of 0.2 metres per second is consistent with the likely tug assisted berthing speeds for vessels of this size in this berthing situation.

6.4.7 Northern bank upstream of the swing basin

It is currently proposed that sheet piled wall-type berths be built in this location to provide a cost effective wharf structure that it is anticipated would be built in conjunction with the proposed dredging works. However, details of this wharf structure are being assessed by others and are not part of this EIS. The vertical wall structure would also provide the bank protection and only limited rock revetments would be required at the ends of the sheet piled wall and the toe of the wall for protection against localised erosion. The revetment batters at the ends of the bulkhead wall would consist of a dredged batter slope of 1:3 protected by a relatively thin rock revetment that would run from the finished surface level of the surrounding berth hardstand areas down to the toe of the batter. In conjunction with the sheet piled wall, the placement of some rock armour material would also be required in front of the sheet piled wall to prevent localised bed scouring by propeller action.

However, there is some uncertainty in relation to the exact nature of berth structures proposed in this location and an alternate batter configuration has also been assessed, which provides greater flexibility to accommodate other types of berth structures. This alternate configuration would consist of a dredge batter slope of 1:3 protected by a rock revetment as described for the south bank of the South Arm, that would run from the top of the existing bank down to the toe of the batter, as shown in Figure C.6 in Appendix C. However, the proximity of Cormorant Road and the risks of undermining

the road would need to be carefully considered during detailed design. As a consequence it may become necessary to incorporate a thicker and steeper rock berm or sheet pile wall as part of the revetment batter.

6.4.8 Northern bank adjacent to the swing basin

It is currently proposed that, in the future berths on a suspended deck on widely spaced piles would be built in this location. However, details of the wharf structures would be assessed by others and are not included in this EIS. A dredged batter slope of 1:3, protected with a rock revetment extending from the top of the bank down to the toe of the batter is proposed, as described for the south bank of the South Arm as shown in Figure C.6 in Appendix C. This configuration would be suitable both in the short and long term. However, similar concerns exist in relation to the proximity of Cormorant Road, as for the upstream northern bank and detailed design may require the incorporation of a thicker rock berm or sheet piled wall into the batter profile.

There is some uncertainty in relation to the exact nature of berth structures proposed in this location. However, the batter configuration as described would allow flexibility in the type of structure ultimately built.

6.4.9 Northern bank downstream of the swing basin

At this stage it is not clear what the extent and nature of the shore-side wharf developments that are adjacent to the proposed berths at the location would finally take. However a dredged batter profile at a gradient of approximately 1:3 is proposed with a narrow 5 m wide bench at approximately 5 m below low water, to satisfy geotechnical and erosion considerations. This is as shown in Figure C.7 in Appendix C. The dredge batter profile would be protected with a rock revetment, as described for the south bank of the South Arm. This design minimises expenditure on bank protection works that may or may not be incorporated into the final adjacent wharf development at this location.

However in the short term, if it is decided to defer the development of the northern berths downstream of the swing basin until they are required, it would be possible to provide an unprotected batter slope, providing that some erosion of the batter profile can be tolerated.

Two typical profiles of the unprotected batter slopes are provided in Appendix C in Figures C.7A and C.7B, depending on whether the batter profile is constructed in sand only, or in a combination of sand and rocks. This design allows for some erosion of the unprotected batter slope and accumulation of the eroded material outside of the dredged channel to minimise the maintenance dredging requirements. It should be noted that the top of this batter is located substantially within the existing river bed. Consequently minimum adverse effects should occur as the top of the batter erodes. It should also be noted that there is considerable width of buffer zone between the proposed top of the bank of the excavated profile and the base of the river bank, which contains no structures or services.

As expected, significant cost savings result in the initial major capital dredging works if expenditure for dredging of the berths pockets and associated bank protection works is to be deferred until it is required.

6.5 Preliminary activities prior to dredging and excavation

Prior to dredging and excavation it would be necessary to:

- establish the contractors; designated work and storage areas on the site;
- identify and decommission services;
- identify and remove artificial obstructions from the site; and
- install a temporary steel sheet piled wall to separate the contaminated sediments from the main channel.

Information on these preliminary activities is provided below.

6.5.1 Establish contractors' designated land based work areas

As a result of the large extent of the site, it is proposed that a number of contractors' designated land based work areas would need to be provided near the particular area of activity. Each site would probably require vehicle access, an area for the contractors' offices and buildings, storage areas for construction materials including rock stockpiles and plant maintenance and associated storage areas. Some of the sites may also require temporary facilities for marine access.

The proposed contractors' work areas are shown on Figure C.24 (Appendix C). It is proposed that the contractors' designated work area on the northern bank would be accessed from Cormorant Road, via a temporary signalised intersection. All other contractors designated work areas would be accessed from existing public connections to the road network.

6.5.2 Identification and Removal of Services

Prior to implementation of the proposal, the proponent would negotiate any relocation of utilities required with the relevant utility provider or private landholder and obtain any approvals required. Relocation of any utility would be completed to meet the requirements of the relevant utility provider and/or private landowner.

6.5.3 Identification and removal of artificial obstructions

As a result of the past uses of the land surrounding the South Arm, it is anticipated that artificial obstructions may be encountered during the dredging. These obstructions could include objects such as old anchors, cables, chains and building materials and sunk vessels. Other materials that may be encountered include rock and/or building refuse.

To minimise lost time and damage to plant and equipment it would be necessary to identify and remove as many as possible of these obstructions before the start of dredging.

A number of underwater technologies can be used to identify the location and nature of the artificial obstructions. These comprise:

- detailed hydrographic survey;
- magnetometer survey;
- side scan survey;
- continuous seismic profiling; and
- underwater seismic refraction.

This investigation would be completed during the detailed design phase of the proposal. The obstruction would be subsequently disposed of off site at an approved disposal site.

Once identified, the location of any artificial obstruction would be charted and divers would confirm the position of the obstruction and nature of the object. A buoy would mark the position and, if needed, lifting equipment would be attached to facilitate the obstruction's removal by a lifting device such as an A-frame crane mounted on a barge.

6.5.4 Temporary offshore steel sheet piled wall

Purpose of the wall

All material with a total PAH concentration greater than 75 mg/kg, normalised to 1 percent total organic carbon (TOC) has been determined to be unsuitable for disposal at sea. This material would require treatment onshore prior to its disposal.

Before dredging activities commence, if it is proposed that a continuous barrier be installed to separate the soft silty clays unsuitable for sea disposal from the remaining soft sediment. The barrier would prevent migration and cross-contamination of materials. It would also prevent movement of suspended solids contained within the water column during dredging to other parts of the river. It would be capable of withstanding both tidal and freshwater flood flows as well as the surface level differential between the materials on each side of the barrier.

To satisfy these requirements, it is proposed to install a temporary physical barrier in the form of a cantilevered steel, sheet piled wall. The location of the wall is shown on Figure C.24, in Appendix C.

Location and extent of the wall

The alignment of the sheet piled wall has been based on existing sediment contamination levels. A contour line delineating the sediment suitable for offshore disposal has been established, based on the results of a number of sampling and analysis programs undertaken in the South Arm, which included an intensive vibrocoreing, sampling, testing and analysis program undertaken during the last 12 months.

The proposed location and alignment of the sheet piled wall is shown in Figure C.14 (Appendix C). It extends over a length of approximately 1.2 kilometres, approximately 100 metres from the south bank of the South Arm, in the vicinity of the closure area site.

Design considerations

The sheet piled wall would extend from the shore, along the established contour line and back to the shoreline, ensuring that the material is encapsulated. Inside the sheet piled wall, the soft silty clay would need to be dredged to a level approximately 0.5 metres below the interface between the soft silty clay and underlying sand. This corresponds to a maximum dredged level of around four metres below the existing bed level. To meet the proposal timing, it may be necessary to remove the material inside the sheet piled wall, and then remove the wall, prior to the dredging of material on the outside. On this basis, the wall would be designed to support a maximum soft sediment differential of around four metres.

To ensure that water would not flow over the top of the sheet piled wall during a significant freshwater flood event and/or as a result of wave activity, it is envisaged that the top of the sheet piled wall would need to extend to a level of around three metres above NHTG.

The sheet piling would also be designed to accommodate the hydrodynamic loadings generated by an average maximum tidal current of around one metre per second and a freshwater flood flow of around two metres per second. The sheet piling would also be designed to accommodate hydrostatic loadings resulting from water level variations between the inside and outside of the wall.

Based on preliminary design work, it has been estimated that a relatively lightweight steel sheet pile section is required. The pile lengths would vary depending on the depth of water and thickness of the soft sediment layer. The pile lengths required along the western, central and eastern portions of the wall would be approximately 14 metres, 16 metres and 23 metres respectively.

Method of installation and removal

Installing the sheet piled wall on two fronts at the same time would minimise construction time.

The sheet piling could be installed at each end (within 20 metres of the shoreline), using land-based plant. The sheet piling would be installed most efficiently with a vibratory hammer. The hammer could be supported from an excavator (100 tonne) or mobile crane (50 tonne). In the case of the excavator, the hammer could be coupled to the excavator's hydraulic power pack. For the mobile crane, a separate power pack would be required.

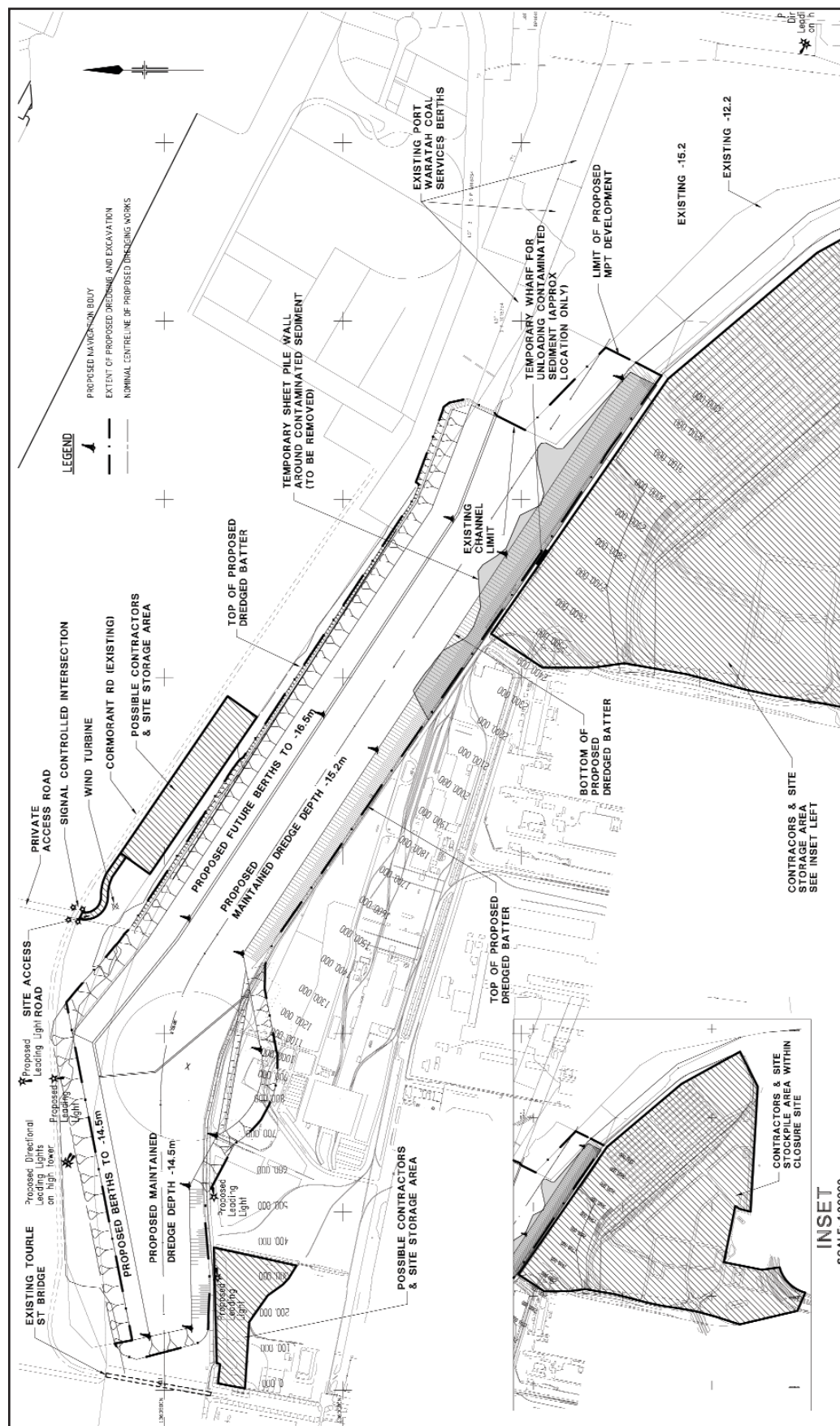


Figure C.24 Location of Temporary Construction Facilities Proposed Extension of Shipping Channels

At the point where the line of the sheet piled wall extends beyond the reach of a crane, it would be necessary to continue driving the piles from over the water. In shallow areas, this could involve using a spudded barge or self-elevating platform, which enables the operation to be completed accurately and independent of the tide. The barge/platform would support an excavator or mobile crane with vibratory hammer similar to that described above.

All piles, irrespective of their overall length, would be driven approximately 10 metres into the river bed. This could be achieved relatively easily through the upper three to four metres of soft silty clays, but some of the material at the greater depths through which the piles are to be driven is stiff clay, which would be more resistant to penetration. This would need to be more closely investigated as part of the detailed design phase.

It has been estimated that each pile-driving rig would install approximately 30 piles per day. At this rate the wall would take approximately 40 days or eight weeks to complete, if advanced on two fronts.

The piles would be removed using the same plant and equipment described for their installation.

The extraction rate would be slightly faster than installation. It has been estimated that, on average, each rig would extract 40 piles a day. At this rate the wall would take around 35 days or 6 weeks to remove, if advanced on two fronts.

6.5.5 Permanent sheet pile wall at toe of sea wall adjacent to contaminated sediments

In addition to the temporary offshore steel sheet pile wall, the permanent sheet steel pile wall that is proposed at the toe of the sea wall in the vicinity of the material that is unsuitable for unconfined sea disposal, would need to have a greater capacity than that shown on Figure C.4 (Appendix C). The wall at this location would need to be designed and constructed to enable the contaminated sediments located adjacent to the sheet pile wall, down to the sand/silt interface to be removed.

This may require the embedment length and the structural capacity of the cantilevered sheet pile wall to be significantly increased to ensure the structural stability of the existing adjacent sea wall. Alternatively temporary additional tie-back anchorage systems at the top of the sheet pile system may also be required when the contaminated material adjacent to the sheet pile wall has been removed, prior to being backfilled with approved granular material. Further investigation and design of this wall and or additional anchorage systems would be required at the preliminary design stage to confirm details of the permanent steel sheet pile wall at this location.

6.6 Strategy for the removal and handling of materials

Dredging and excavation would involve the removal and handling of approximately 13.6 million m³ of material of many different types, in varying quantities, and from different locations within the area to be dredged. As a result, the materials would need to be removed by use of different technologies, and handled in a manner that would facilitate reuse, treatment and/or disposal at different locations.

The proposed strategy for achieving the removal of the materials in an efficient, cost-effective and environmentally sound manner is outlined below and summarised in Table 6.1.

This strategy may be subject to some refinement following completion of more detailed geotechnical investigations of the dredge area, confirmation of the requirements for reuse of materials and detailed design.

A description of the operation of the different dredges and other equipment (such as excavators) is provided in the following sections.

Table 6.1 Summary of excavation and disposal requirements

Material type	Quantity to be excavated (m ³) ¹	Excavation and transport method ³	Proposed receiving location and capacity (m ³)	Comments
Contaminated sediments not suitable for ocean disposal: (river silty clays)	Approximately 250,000	Backhoe excavator on barge and barge transport to shore, or cutter suction dredge.	Closure area <i>Capacity: More than 250,000</i>	Contaminated area confined by temporary sheet piling. Material treated onshore to EPA requirements and disposal at closure area site or licenced sites on Kooragang Island.
Sediments suitable for ocean disposal: (river silt and clays)	1,870,000 river bed 280,000 north and south banks	Backhoe excavator on barge into hopper barges and/or trailer suction dredges.	Offshore ocean disposal <i>Capacity: More than 2,150,000</i>	Proposed offshore disposal site is the former NPC disposal site (used 1989-1997), which is 5.8 kilometres southeast of Nobbys Head.
Sand (and associated fines): Sand has a grain size varying from 0.2 mm to 0.4 mm, with a D50 grain size of 0.275 mm. Approx 5% fines (less than 75 microns) and up to 10% shell.	7,050,000	Cutter section dredge and pipeline to onshore disposal locations. Trailer suction dredge to offshore locations for beach renourishment.	Austeel product storage: 650,000 Proposed Multi-user port & transport corridor: 550,000 Tomago industrial area: 4,500,000 Adjacent land storage 1,350,000 sites or nourishment of Stockton Beach <i>Total sand: 7,050,000</i>	Quantities subject to the final design of the dredge batter profiles. Quantities provided are the maximum envisaged. Possible disposal locations for 1,350,000 m ³ excess excavation include: Adjacent land storage for beneficial re-use for civil engineering works. Beach nourishment of Stockton Beach (subject to further investigation).
Clay lenses and fines within the sand matrix.	200,000 fines within the sand	Rehandling of fines at land disposal sites, barge to offshore disposal	<i>Offshore: 200,000</i>	Excavate/dredge from settling ponds, truck and barge to offshore disposal.
Bank excavation: Primarily granular fill materials (including some contaminated), above RL 1.0 metres (mainly at the OneSteel site)	330,000 south bank of swing basin for revetment batter option.	Excavator (land based) and truck.	Closure area 300,000 'clean' fill 30,000 requiring treatment <i>Capacity: More than 330,000</i>	Up to 10% of this material may need to be treated, prior to final placement. (Actual quantities of material to be treated would be determined during excavation).

Table 6.1 Continued.

Material type	Quantity to be excavated (m ³) ¹	Excavation and transport method ³	Proposed receiving location and capacity (m ³)	Comments
Sand	20,000 north bank of swing basin	Excavator and truck	Austeel port site 20,000	
Clay - both within the sand matrix and at the bottom of the idealised sand strata.	1,450,000	Cutter suction and/or trailer suction dredge.	Offshore disposal. <i>Capacity: More than 1,450,000</i>	Insufficient land available for processing economically on shore. The proposed offshore disposal site is the former NPC disposal site (as above).
Soft rock: From class 5 grading to class 2. Consisting of alternating weathered sandstone, siltstone, shale and occasional minor coal seams.	1,550,000	Cutter suction and/or trailer suction dredge.	Offshore ocean disposal <i>Capacity: More than 1,550,000</i>	After excavation and transport, soft rock would be unsuitable for civil engineering purposes, without significant reprocessing. Insufficient land available for reprocessing economically on shore. Offshore disposal site is former NPC disposal site (as above).
Hard rock: Consisting of hard sandstone, with a minimum unconfined compressive strength of 16 MPa.	600,000	Drill and blast in conjunction with large backhoe excavator and barges	Offshore disposal <i>Capacity: More than 600,000</i>	After excavation and transport, soft rock would be unsuitable for civil engineering purposes, without significant reprocessing. Insufficient land available for reprocessing economically on shore. Offshore disposal site is the former NPC disposal site.
	13,600,000		13,600,000	

Note:

- Quantities are based on the following:
 - Subject to the final design of the dredge batter profiles.
 - Quantities provided are the maximum envisaged.
 - General arrangement of the excavation and dredge areas for the South Arm, as shown on Figure C.1 (Appendix C), which is based on a sloping batter rather than a sheet pile wall on the northern bank, upstream of the swing basin.
 - Long and cross-section details as shown on GHD Figures C.7 to C.13 (Appendix C).
 - Batter profiles as shown on GHD Figures C.2 to C.7 (Appendix C).
 - Sub-surface investigation report in Appendix E.
- Proposed dredging, excavation and transport methodology is based on a report prepared by Baggerman Associates (dated May 2001) and subsequent work undertaken by Patterson Britton & Partners, and GHD which is summarised in a technical paper titled "Strategy for Removal and Handling of Materials" dated April 2003.

6.6.1 Stage 1 - Removal of marine silty clays to create temporary access channel and temporary swing basin

A temporary access channel and manoeuvring area is required parallel to the northern shoreline of the South Arm, to facilitate early access for larger dredging equipment. This channel would be approximately 45 metres wide and approximately 4.0 metres deep to provide an interim temporary access depth of –6.0 metres NHTG. A temporary manoeuvring area, with a turning circle diameter of around 90 metres to the same interim access depth level, would also be needed to enable a small trailer suction hopper dredge to turn around. The channel and swing basin would incorporate stable side slopes.

The extent of this dredging work is shown in Figure C.14 (Appendix C).

Approximately 1 million m³ of soft marine silty clay sediments overlying sand are required to be removed to construct the temporary access channel and temporary manoeuvring area. Disposal of this material to the offshore disposal ground (subject to approval from Environment Australia (EA) – refer Chapter 8) is proposed. The soft silty clays are considered to be unsuitable for reuse.

A large backhoe or grab dredge, operating in conjunction with two or more barges, would remove the soft silty clay sediments. The dredge would advance upstream. This type of dredge removes material efficiently at close to its in situ density, thereby maximising the load placed into the barges. A turbidity curtain placed around the backhoe dredge would be used to minimise impacts on water quality.

The anticipated removal rate would be around 400 m³/hr. The barge size would be compatible with this production rate and could be either self-propelled or moved around using a workboat. It is estimated that this activity could be completed within 30 weeks.

6.6.2 Stage 2 - Excavation of fill within the upper portion of the southern bank

Approximately 330,000 m³ of various fill materials (some of which could be contaminated) are required to be excavated from the south bank using land-based earth moving equipment, to accommodate the swing basin.

The extent of this excavation work is shown in Figure C.15 (Appendix C).

The swing basin encroaches a significant distance into the OneSteel site, along a portion of the south bank. The materials to be excavated potentially include rock, soil, building rubble, steelworks waste, slag, tar and coal washery waste.

The potential environmental contamination issues associated with this proposed work are considered in detail in Chapters 7, 8, 10, 14 and 15. There are a number of environmental issues that have been addressed, including:

- The need to limit the encroachment of the excavation onto the existing OneSteel site;
- the need to limit the potential for impact on the groundwater equilibrium of the OneSteel site; and
- the need to limit any potential leaching into the Hunter River of any potential contaminants found and exposed in the batters into the South Arm.

OneSteel has made available a considerable amount of historical data, reports and photographs relating to the development and potential contamination of their site. Although this documentation is comprehensive, it is not sufficient to fully characterise the fill materials and the extent of potential contamination for a large-scale excavation. The information does give an indication of the nature of potential contamination. It would be difficult even with a comprehensive sampling and testing program to fully characterise the site, due to its varied history of filling. Therefore, it is proposed that the following strategy be adopted:

- Excavate all fill materials by land based earth moving equipment;
- The excavation is to be isolated from the South Arm of the river as much as is possible, to prevent potentially contaminated groundwater flows into the excavation from reaching the river. This would be achieved by retaining the existing sea wall and revetment in the same position and level for as long as possible;
- Excavated fill material is to be transported to the closure area for classification and if necessary treatment before reuse;
- Water within the excavation is to be tested and if necessary treated before being discharged to the South Arm;
- Any contaminants exposed within the final batter would be appropriately treated to mitigate potential environmental impacts;
- Groundwater monitoring wells would be installed landward of the excavation and monitored at regular intervals to identify any changes in groundwater levels and quality during excavation. Appropriate measures would be implemented to manage any adverse impacts on groundwater both during construction and in the longer term; and
- The final batter treatment would be determined during detailed design and if necessary would include strategies for dealing with exposed contamination and contaminated groundwater flows.

The temporary and permanent batters are within an operating industrial plant and the area of encroachment needs to be minimised. A bulkhead wall or thick rock berm/revetment are the two most likely alternative dredged batter treatments. The most appropriate treatment would be selected following further investigations and detailed design.

There is limited information available on the nature of the fill materials. In the area of the proposed excavation, the fill has been placed on top of the former Spit Island. This former sand island has limited the depth of fill, which means that the fill can all be excavated using land based equipment. It is anticipated that the majority of the fill material would be suitable for reuse and it is proposed that this material be temporarily stockpiled in the closure area. The location of the former Spit Island is shown in Figure C.23 in Appendix C.

A minor portion of the fill material may require treatment prior to its temporary stockpiling on the closure area and subsequent reuse. A very small portion of the fill material might be scrap steel, which would be taken to a recycling depot.

It is proposed that all fill material be excavated by land-based equipment and due to tidal and groundwater level influences and existing groundwater surface levels, it may be necessary to carry out some of this excavation below the prevailing water level. Trucks would transport the excavated material to the closure area, where it would be sorted into separate stockpiles of particular classes of material, using front-end loaders. Steel scrap would be trucked off site.

Where required, it is anticipated that contaminated materials from the OneSteel site would be treated at the closure site, as discussed in Chapter 7.

It is proposed that the following construction sequence would be followed to satisfy construction, operational and environmental considerations (Refer to Figure C.22 in Appendix C):

- Remove and relocate existing structures, services and infrastructure that lie within the footprint of the proposed temporary and permanent works;
- Establish a perimeter boundary fence that is located approximately 15 metres south of the final top of the dredge batter. This would enable an access road, screening mound and a surface water interceptor drain to be provided between the top of the batter and the fence. The interceptor drain would collect surface water run-off from the adjoining OneSteel site areas before it is able to flow into the excavation or the South Arm;

- Establish stormwater detention ponds to collect surface water run-off from the interceptor drains. These ponds are shown on Figure C.22 (Appendix C) and would be unlined and act as a soakage pit, both during construction and in the longer term;
- Establish lined treatment ponds for the temporary storage of contaminated groundwater pumped out of the excavation. These ponds are shown in Figures C.22 and C.23, in Appendix C. Figure C.23 also shows the current groundwater contours beneath the site, which indicate that potential groundwater inflows would be greatest at the western end of the site. The treatment ponds would only be used if it is determined that, after testing of the water in the excavation, treatment is required. If this water contains hydrocarbons it is proposed that an oil containment boom be provided close to the embankment and an oil-skimming machine be used to collect the hydrocarbons. The resultant material would subsequently be taken to a trade waste disposal site. In conjunction with the treatment ponds, a mobile water treatment plant may also be provided to improve water quality prior to final discharge of water from the water treatment detention ponds into the Hunter River. It is proposed that water storage and treatment facilities would be provided at each end of the excavation;
- The fill materials would be excavated using large civil engineering earth moving equipment and off-road trucks. It is proposed that the existing riverside sea wall would be left in place as long as possible to form a barrier between the excavation and the South Arm. It is likely that excavation would commence on the western side, where the highest risk of uncovering contamination exists. This approach would minimise the size of the excavation void available to pond potentially contaminated groundwater and would provide the maximum time to treat any exposed contamination. The excavation would progress west to east and south to north, behind the temporary bund formed by the existing riverside sea wall. If it is assumed that a fleet of eight trucks and two large excavators would undertake the excavation, transport and disposal of the material to the closure site, working six days a week for 10 hours a day, it is estimated that the land based excavation work would take between 20 and 24 weeks to complete;
- The off-road trucks would use the gravel road on top of the existing riverside sea wall as a temporary haul road. Appropriate management practices would be implemented to minimise environmental impacts. These practices could include:
 - pavement maintenance to avoid pot holing which would reduce truck noise and potential spillage;
 - silt fences between the road and the South Arm to limit any spillage of pavement materials washing into the river;
 - spillage management on the haul road using graders, front-end loaders and street sweepers; and
 - dust suppression using water carts.
- At one portion on the proposed trucking route to the closure site, the trucks transporting the excavated material would be required to share a 300 metre length of the existing private road with other vehicles from the OneSteel operation. It is considered that the best way to effect this is to install a temporary traffic management system, including devices (such as lights and signs) and personnel over this area, for the duration of the works;
- The existing perimeter riverside sea wall would remain until the final stages of the excavation, when two excavators would progressively remove it, down to as low a level as possible. The subsequent removal of material in this area is proposed to be undertaken using marine-based plant and equipment;
- When the perimeter wall is being removed, a floating silt curtain would be placed at the bottom of the batter within the Hunter River to reduce the potential for turbid water to enter the river; and
- The temporary fence, screening mound, interceptor drains and stormwater detention ponds would remain in place in the long term.

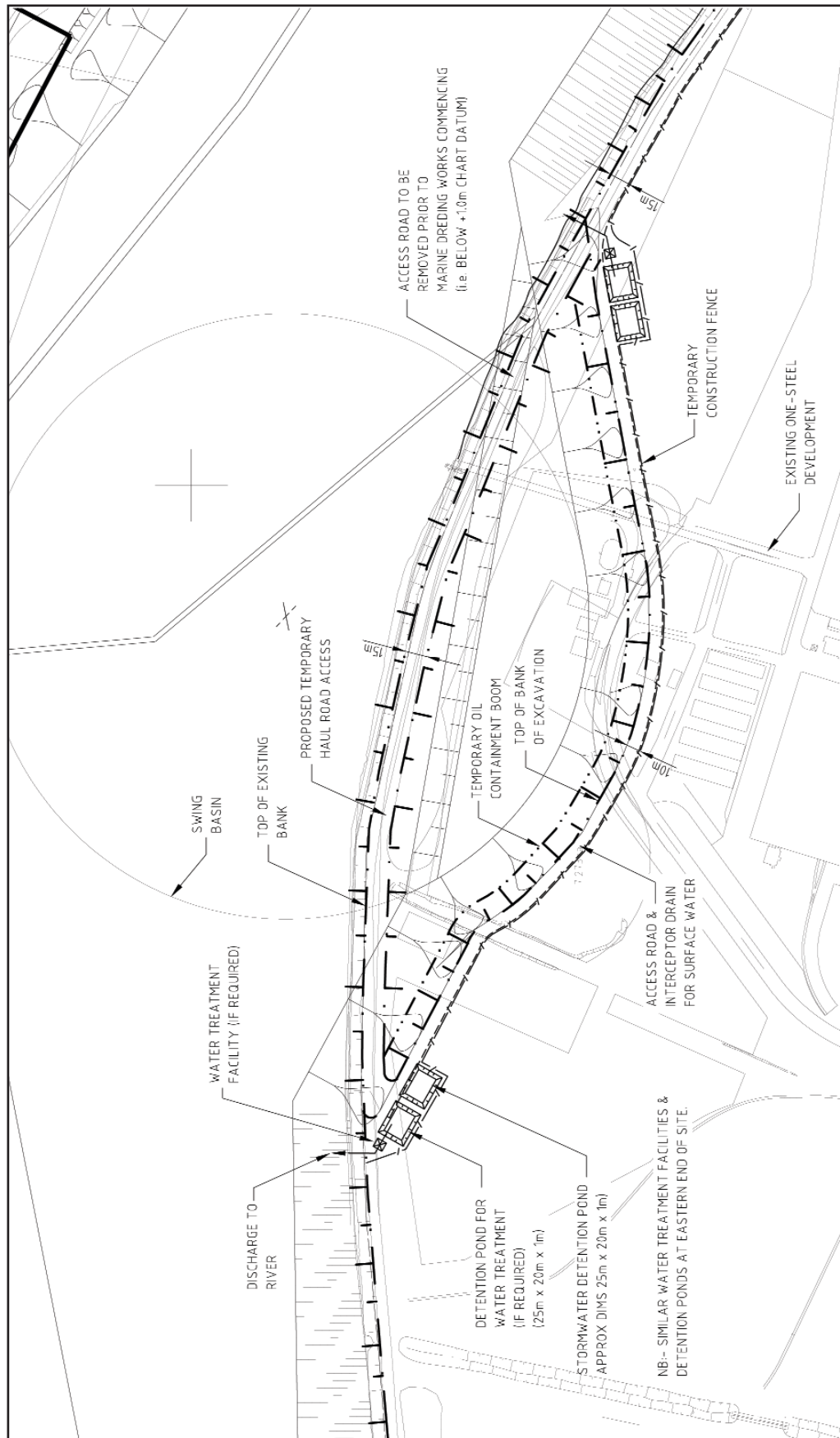


Figure C.22 Proposed Excavation Extent and on Shore Facilities for Water Detention and Treatment at One-Steel

6.6.3 Stage 2 - Removal of marine silty clays within the lower portion of southern bank

Up to approximately 20,000 m³ of soft marine silty clays contained within the lower portion of the southern bank would need to be removed from the proposed swing basin. This material is considered to be unsuitable for beneficial reuse and it is proposed to dispose of it to an offshore disposal ground (subject to approval from EA).

The extent of this dredging work is shown in Figure C.15 (Appendix C).

Water-based plant, such as a large backhoe dredge operating in conjunction with two barges, would remove the soft silty clays. This dredge could be the same as that used to create the temporary access channel and associated swing basin (described above).

It may be necessary to truck a small volume of the material to the closure area to be used as impermeable lining material for sediment storage ponds. The trucks would only operate within the OneSteel and closure area sites.

The duration of this activity would be approximately four weeks.

6.6.4 Stage 2 - Excavation of sands within the upper portion of northern bank

There is a need for up to approximately 20,000 m³ of sandy material, contained within the upper portion of the northern bank, to be removed for the proposed swing basin. The material is considered suitable for beneficial reuse.

The extent of this dredging work is shown in Figure C.15 (Appendix C).

Land-based plant would remove this material in a manner similar to that described for the southern bank. This would involve a number of large excavators working in conjunction with front-end loaders and on-road trucks.

The most likely fill site for this material is the proposed adjacent multi-user port and transport corridor; reaching it would involve a short haul of approximately 500 metres along Cormorant Road, with the balance of the haulage on dedicated private haul roads.

The duration of this activity would be approximately four weeks.

6.6.5 Stage 2 - Removal of marine silty clays within the lower portion northern bank

Up to approximately 260,000m³ of soft marine silty clays, contained within the lower portion of the northern bank, would need to be removed for the proposed swing basin. This volume would reduce if sheet pile type wharves are constructed upstream of the swing basin, in conjunction with the dredging. This material is considered to be unsuitable for beneficial reuse. Disposal of it offshore is proposed, subject to EA approval.

The extent of this dredging work is shown in Figure C.15 (Appendix C).

Water-based plant (such as a large backhoe dredge), operating in conjunction with two barges, would remove the soft silty clays. This dredge could be the same as that used to create the temporary access channel and associated swing basin.

The duration of this activity would be approximately ten weeks.

6.6.6 Stage 3 - Removal of marine silty clays within the remaining area

The area outside the sheet piled wall and temporary access channel turning basin contains approximately 870,000 m³ of soft marine silty clays, which are considered to be unsuitable for beneficial reuse. It is proposed to dispose of this material to the offshore disposal ground (subject to Environment Australia approval).

The extent of this dredging work is shown in Figure C.16 (Appendix C).

Two small trailer suction hopper dredges, each with a capacity of between 1,500 m³ and 2,500 m would remove this material. Each trailer suction hopper dredge would progressively widen the channel by dredging initially along the southern edge and then up and down the channel.

This dredging would be undertaken in conjunction with the dredging inside of the sheet piled wall that encapsulates the contaminated material, so that there would not be a significant difference in the level of dredged material on either side of the wall.

In order to dredge effectively, it would be necessary for each trailer suction hopper dredge to utilise its overflows for a time to displace a low density sediment/water mixture from its hoppers. Due to the nature of the marine silty clays, the use of the overflows has the potential to generate turbidity. Numerical modelling has been undertaken to simulate the turbidity generated by the trailer suction hopper dredge and this is summarised in Chapter 11. In summary, it has been established that there would be an increase in turbidity due to this activity. Although the majority of the suspended sediment would settle within and downstream of the site, some sediment has been predicted to move upstream of the Tourle Street bridge. Monitoring and mitigation measures, such as deployment of a floating turbidity boom in the vicinity of the Tourle Street bridge and alongside mangroves that may be affected are discussed in Chapter 11.

The duration of this activity would be approximately 25 weeks.

6.6.7 Stage 4 - Removal of marine silty clays unsuitable for unconfined sea disposal

Approximately 250,000 m³ of soft marine silty clays, located immediately adjacent to the closure area, are unsuitable for unconfined sea disposal. As noted above, a steel sheet piled wall would be used to prevent migration of these contaminated materials.

The extent of this dredging work is shown in Figure C.17 (Appendix C).

It is most likely that a large backhoe dredge, operating in conjunction with two shallow draft flat top barges, would remove this material. This plant is preferred on the basis that it would minimise the potential for adverse environmental impacts such as:

- the presence of artificial obstructions;
- odour generation;
- offshore dewatering;
- pump and pipeline blockages/breakdowns; and
- turbidity generation.

The dredge would move upstream. The shallow-draft, flat-topped barges would incorporate an above-deck hopper (with a capacity of around 500 m³) and primary dewatering provisions. These provisions would enable excess water to drain and return to the waterway within the sheet piled wall. The material would then be unloaded at a temporary transfer facility, constructed on the shoreline within the sheet piled wall area, using excavators to load trucks for transport of the material to the treatment facility.

The temporary transfer facility would consist of a small wharf deck supported on piles. The deck would be large enough to accommodate a large excavator. Berthing piles would be provided by each side of the platform to allow the barges to be moved along side of the deck in front of the excavator, to facilitate unloading. The facilities would be removed upon the completion of dredging within the sheet piled wall.

The duration of this activity would be approximately 25 – 35 weeks.

6.6.8 Stage 5 - Removal of sands located beneath the entire dredge footprint

Approximately 7.05 million m³ of good quality sand with minor clay inclusions (estimated to be a volume of approximately 200,000 m³) are located beneath the marine silty clays. This sand is suitable for beneficial reuse. This volume would reduce by approximately 130,000 m³ if sheet pile type wharves were constructed upstream of the swing basin, in conjunction with the dredging.

The extent of this dredging work is shown in Figure C.18 (Appendix C).

A large cutter suction dredge would remove this material. The dredge would work its way downstream in such a way that it did not interfere with the operation of other dredging plant and equipment.

Use of this dredge would require installation of a discharge pipeline and onshore containment ponds (dewatering facility) for the capture of material and removal of excess water. The discharge pipeline would consist of a section of floating pipeline from the dredge to the shoreline and then a temporary, land-based pipeline to dewatering and fill site/s. There are three proposed main fill sites currently being considered: the multi-user port and transport corridor, the Tomago industrial area and the Austeel product storage area. The assessment and approval of the filling of these sites is being undertaken by others and is not included in this EIS. In addition, there could be a surplus of up to 1,350,000 m³ of sand available after the filling of these three sites. This sand could be temporarily stockpiled on Kooragang Island and used for other beneficial reuses or possibly used to renourish Stockton Beach.

The route that the discharge pipeline would follow to supply sand to these fill sites has been studied and the results of this assessment are summarised in Chapter 8.

The sand would contain a minor percentage of fine-grained material that would be removed from suspension in the dredge water prior to this water returning to the surrounding water courses. This process typically involves a series of sedimentation ponds and, in some instances, flocculation and filtration prior to overflow of the surplus water. The assessment of these processes is being undertaken by others and is not included in this EIS.

The fine-grained product of these processes would be unsuitable for beneficial reuse due to its poor engineering properties and high moisture content. It is estimated that up to 200,000 m³ of this material may need to be trucked to a wharf facility for transfer to a barge for disposal at sea. Alternatively, this material could be dredged by a small cutter suction dredge within the sedimentation ponds and pumped to barges for disposal at sea. The assessment of these processes is being undertaken by others and is not part of this EIS.

The duration of this activity would be approximately 50 weeks.

6.6.9 Stage 6 - Removal of stiff clays located beneath the dredge footprint

Approximately 1.45 million m³ of stiff clay is located beneath the sands. The stiff clays are considered to be unsuitable for beneficial reuse. It is proposed to dispose of this material to the offshore disposal ground.

The extent of this dredging work is shown in Figure C.19 (Appendix C).

A large cutter suction dredge, working in conjunction with a trailer suction hopper dredge, would remove this material.

The cutter suction dredge would remove the stiff clay and place it back on the dredged bed of the South Arm within a turbidity curtain, prior to its subsequent removal by the trailer suction hopper dredge.

In order to dredge effectively it would be necessary for the trailer suction hopper dredge to utilise its overflows for a time. Due to the potential fine nature of the stiff clays, the use of the overflows has the potential to generate turbidity. This is discussed in more detail in Chapter 11.

The duration of this activity would be approximately 30 weeks.

6.6.10 Stages 7 and 8 - Removal of rock

A ridge of rock lies beneath the stiff clays in the central portion of the proposed dredge area. Approximately 1.55 million m³ of weaker rock is required to be removed, which consists of residual stiff clays, sandstone with some siltstone, shale and occasional coal seams, along with approximately 600,000 m³ of harder underlying sandstone rock.

The extent of this dredging work is shown in Figures C.20 and C.21.

The weaker rock is considered unsuitable for beneficial reuse. It is proposed to dispose of this material to the offshore disposal ground (subject to EA approval). The weaker rock would be removed in a similar manner to that of the stiff clay: that is, by using a large cutter suction dredge working in conjunction with a trailer suction hopper dredge. The cutter suction dredge would remove the soft rock and place it back on the dredged bed of the South Arm within a turbidity curtain prior to its removal by a trailer suction hopper dredge.

It is estimated that in total it would take approximately 46 weeks to remove the weaker rock.

The most efficient method of removing the harder rock would be by drilling and blasting. The harder rock is considered unsuitable for removal by a large cutter suction dredge, owing to the potential for significantly reduced production rates, wear and tear on the equipment, and a corresponding significant increase in costs.

Following blasting, a large backhoe dredge would remove the fragmented rock and load it onto barges for offshore disposal. Section 8 details an assessment of why this material is considered unsuitable for beneficial reuse. The drilling and blasting operation would commence at the downstream face of the rock ridge and progress upstream. This would enable material to be removed and disposed of immediately following a blast, with minimal interference to other dredging activities.

The drilling, blasting and removal of blasted rock would be completed over a total duration of approximately 45 weeks.

6.6.11 Alternative strategies for removal and disposal of hard rock

As an alternative to the method described above for the removal and disposal of the rock, the following options have also been considered which may realise considerable cost savings to the project. These are described as follows:

- permanent river bed storage at the base of the shipping channel, located between the Tourle Street bridge and including most of the swing basin; or
- deposition on the excavated shipping channel bed and removal by trailer suction hopper dredge to offshore disposal.

These options are described in further detail as follows:

Permanent storage in the bed of the shipping channel extension

A cutter suction dredge would excavate a cavity approximately 4 m deep, with side batters of five horizontal to one vertical beneath the proposed final dredge depth of the shipping channel. The top of the bank of the excavation would be approximately 25 m away from the toe of the batter of the completed dredge profile. Approximately 600,000 m³ of sand would be dredged from this location and pumped to an appropriate shore location on Kooragang Island.

The hard rock that has been dredged, using a combination of large cutter suction dredger and drilling/blasting and backhoe dredging techniques, would be deposited into the excavation designed to accommodate this material. The transport methods proposed to be used would involve a hydraulic pumping system from the cutter suction dredger, with the excavated rock being placed at the base of the excavation using a sub-aqueous diffuser. In addition, split-dump hopper

barges would also be used to deposit material excavated from the drill/blast and excavator process. Silt curtains or other appropriate mechanisms may be used to minimise the extent of the turbidity generated during the deposition process if required. The relatively shallow depth of the excavation is unlikely to have any adverse effects relating to geotechnical stability of adjacent structures and topography or the existing groundwater regime.

Bottom Deposition and Trailer Suction Hopper Dredge to Offshore Disposal

In this case the large cutter suction dredge would deposit the dredged rock by a sub-aqueous diffuser on the bed of the excavated river channel at an appropriate location within the project area, where it can be picked up by a large trailer suction hopper dredge for offshore disposal at the disposal site. As for the other option, a silt curtain or other appropriate mechanisms may be used to minimise the extent of the turbidity that may be generated during the deposition of the rock on the excavated channel bed using the sub-aqueous diffuser. As for the other alternate option, a small volume of the material may be required to be drilled and blasted and removed by back-hoe dredge. In a similar manner, this material would also be deposited at suitable locations on the excavated river bed within the project area, using hopper barges, for subsequent removal by a large trailer suction hopper dredge.

Bottom deposition outside of the project area and trailer suction dredge to offshore disposal

In this option an area is required to be dredged in sand downstream of the project area, that would be able to accommodate a minimum of 150,000 m³ of hard rock. This would require excavation by a trailer suction hopper dredger with the following appropriate dimensions; base plan area 250 m long x 125 m wide, depth of 4 metres and side batter slopes of 5 horizontal to 1 vertical. There are no suitable locations in close proximity to the project area that would not significantly intrude into the present Kooragang Swing Basin shipping area. Consequently this work would need to be undertaken with due regard to shipping and navigation safety requirements.

Once the dredging has been completed a cutter suction dredge would discharge the rock to the base of the dredged area using a sub-aqueous diffuser. The rock would then be picked up by a large trailer suction hopper dredge for offshore disposal. As for the other options, drilling/blasting and back-hoe excavation may still be required to excavate the very hard rock, which would be deposited within the designated dredged area by spilt-dump hopper barges. The last 150,000 m³ of the hard rock may also be permanently left in the dredged area to avoid the cost of the offshore disposal of this material.

While this option is technically feasible, the activities would be subject to stringent requirements and approval of the Newcastle Port Harbourmaster regarding overall safety and navigation. This may result in significant additional delays and costs.

6.7 Batter protection works

It is proposed that the dredged batters would be protected with rock as detailed earlier in this chapter. It is estimated that approximately 1.0 million tonnes of rock would need to be transported to site by trucks from local quarries most likely in the Seaham and Karuah areas, where good quality rock suitable for extended exposure in a marine environment is available.

The rock would be transported to the site as required and temporarily stockpiled at the designated contractor storage areas. The rock would be subsequently transported to the placement location and placed on the dredged batters by:

- land-based excavators and grab cranes working from the top of the river bank. Rock would be loaded onto trucks by front-end loaders working from the temporary stockpiles, for progressive delivery to these machines. The machines would place the rock directly onto the dredged batter, to the final profile. Due to the reach limitations, it is envisaged that rock would be able to be placed only on the top end of the sloping dredge batters on the north and south banks using these techniques;

- excavators or grab cranes mounted on floating barges. Rock would be loaded onto top barges by land-based excavators working from the temporary stockpiles. The top barges would travel to the site of the excavator/grab crane barge with the assistance of workboats. The floating excavator/grab crane would place the rock directly from the barges onto the dredged batter, to the final profile; and
- bottom disposal from hopper barges. Rock would be loaded into bottom dump barges by land based excavators working from the temporary stockpiles. The bottom dump barges would be manoeuvred over the dredge batter by workboats and the material placed onto the batter by opening the barge or its doors, (depending on the particular barge type). For this method, it is likely that the placed rock would need to be finally trimmed by either land based or floating excavator/grab crane.

It is possible that the rock placement could be by one or a combination of these methods. The rock should not contain significant fine grained materials and it is not envisaged that a turbidity curtain would be required to control river water quality.

It is envisaged that the largest volume of rock would be handled on the closure area site where it may be possible to use the existing wharves for loading the rock onto the barges.

6.8 Order of activities

To implement the removal and handling of materials as proposed, a number of activities need to be undertaken concurrently. These are:

- excavation of the northern and southern shorelines;
- creation of a temporary navigation channel and swing basin; and
- installation of the sheet piled wall for the contaminated materials.

The general sequence of events for the program of the proposed works would involve:

- site establishment;
- removal of marine silts and clays to create the temporary access channel and associated manoeuvring area, using a backhoe dredge in conjunction with barges;
- removal of the remaining marine silty clays located outside of the sheet piled wall, using two small trailer suction hopper dredges;
- removal of the contaminated marine silty clays, inside the sheet piled wall, in parallel with the removal of the other marine silty clays;
- removal of sand using a large cutter suction dredge;
- removal of stiff clays and underlying softer rock, using a large cutter suction dredge in conjunction with a large trailer suction hopper dredge;
- drilling and blasting of hard rock;
- subsequent removal of fragmented hard rock using a backhoe dredge; and
- progressive placement of batter protection rock.

6.9 Potential Staging of Development

It is possible that the dredging of the proposed 70 m wide x 1,700 m long berths for Cape-Class vessels on the northern side of the channel, downstream of the swing basin may be deferred until a stage when the berths are actually required to support the adjacent shore-side development. In this case the typical channel cross-section would be as shown on the lower cross-section in Figure C.28 in Appendix C. This would significantly reduce the initial cost of the major capital dredging works due to the following:

- An approximate reduction in volume of material to be excavated of approximately 1.66 million m³, including a significant reduction on the volumes of soft and hard rock to be excavated. (These volumes reduce by approximately 480,000 and 280,000 m³ respectively); and
- Not providing any protection work to the excavated batter slope, as shown in Figures C.7A and C.7B in Appendix C. The channel batter slopes are able to be unprotected, as they can be dredged to a flatter batter profile and are largely located within the existing river bed. A horizontal berm has also been provided within the batter profiles to accumulate some of the anticipated erosion materials outside of the main shipping channel, where it can be regularly dredged without affecting the shipping channel.

6.10 Overview of equipment used for dredging and excavation

The operation of the equipment that would be used to remove the material from the bed and banks of the South Arm is described below.

6.10.1 Backhoe dredge working in conjunction with barges

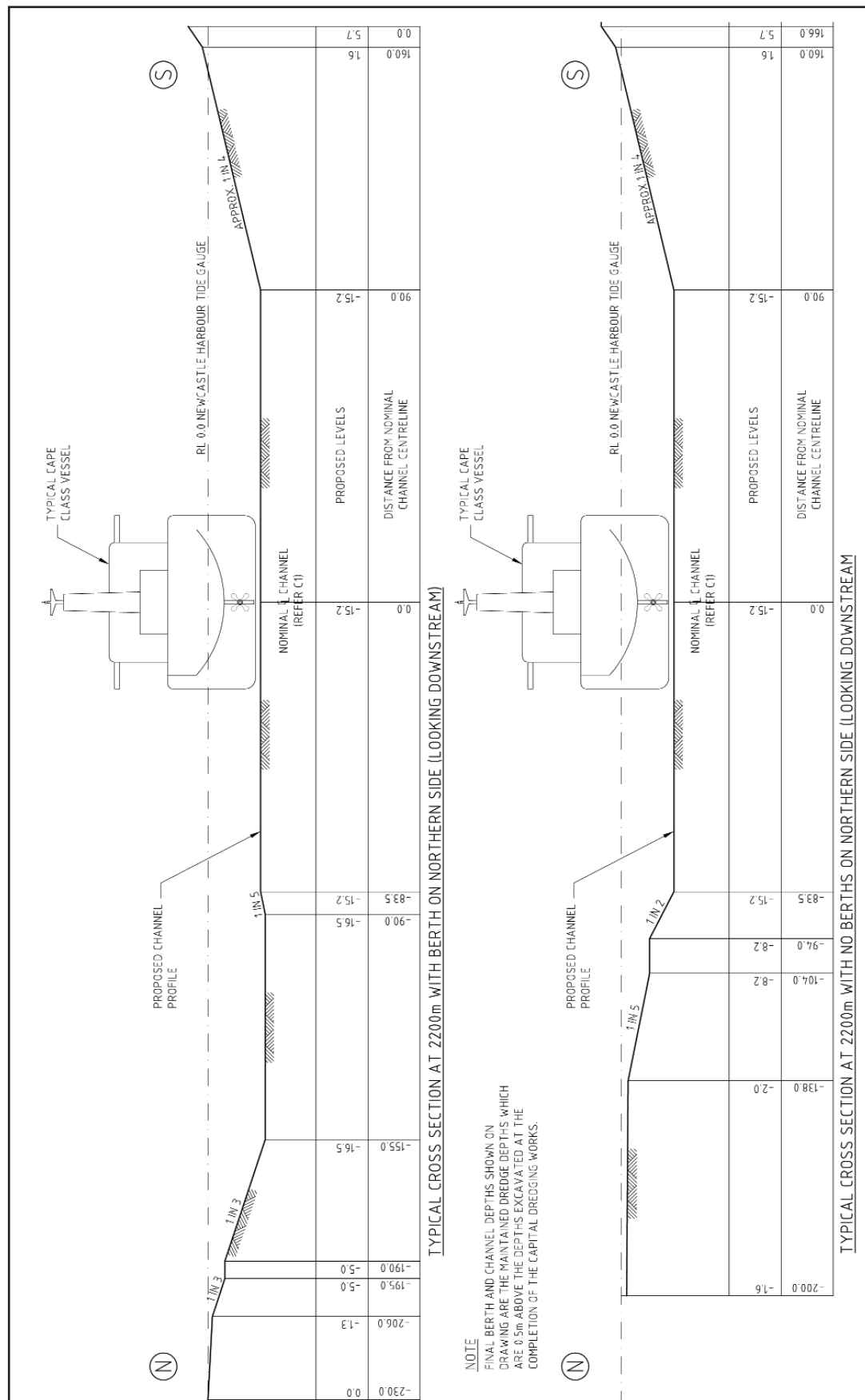
A backhoe dredge is an excavator mounted on a purpose-built barge (refer to plates 6.3 to 6.5).

The barge would be supported by three 'spuds' (large diameter piles that can be lowered or raised). The spuds can be lowered into the seabed and hold the position of the barge. Two spuds are located at the bow and a single spud is located at the stern of the barge. The spuds provide a stable, working platform that facilitates excellent control during the completion of the dredging activities. The stern spud can also incorporate a ram against which the barge can push itself forward (with bow spuds raised) in steps. The barge is not self-propelled and would be moved around the site by work boats when all the spuds have been raised.

The backhoe dredge would be fitted with a specially designed grab or bucket that minimises turbidity in the water column during dredging operations. The material would be raised slowly within a turbidity curtain prior to its placement in a hopper barge anchored adjacent to the backhoe dredge. The use of the specially designed grab or bucket would significantly reduce the amount of material put into suspension. It also has the advantage of minimising the water content of the material.

The excavator can be fitted with position-fixing equipment (both spatially and with depth). This would allow the operator to selectively remove material from the bed of the river and accurately control the operation.

In the case of material unsuitable for offshore disposal located inside the sheet piled wall, shallow-draft, flat-topped barges incorporating an above-deck hopper would most likely be used to transport the material as these craft are more easily unloaded at the temporary unloading wharf facilities. It is possible that the sediments could emit odours during this phase of the process. Odour testing trials have been undertaken and are fully described in Chapter 17. It is unlikely that odour would be an issue during dredging or transport of the contaminated sediments to shore. However, mitigation measures to reduce odour could involve the addition of lime or the placement of covers over the barge hopper. The loading and transportation phase also provides an appropriate opportunity to undertake some primary dewatering of the



material. This would be achieved by the incorporation of underdrainage provisions beneath the sediment and above the deck of the barge. This water would be returned to the river (refer to Chapter 11).

To accommodate the barges, a temporary unloading wharf would be constructed immediately adjacent to the dredge area, within the sheetpile wall. A similarly-sized and configured excavator to that mounted on the backhoe dredge would operate from the unloading wharf to ensure that the target production rates were achieved. Material could then be transferred from the barge to trucks for subsequent transport to temporary stockpiling and treatment areas.

In the case of the material suitable for offshore disposal, the two barges would be split hopper barges with a hopper capacity of around 750 m³. These barges would be ocean-going vessels that could be self-propelled or supported by a tug. A typical split hopper barge is shown in plate 6.6.

6.10.2 Trailer suction hopper dredges

A trailer suction hopper dredge is usually a self-propelled, ocean-going vessel with its own onboard hopper for carrying sand or other materials that can be readily loosened and agitated from the harbour bed. A small trailer suction hopper dredge is shown in plate 6.7. It is envisaged that a trailer suction hopper dredge with a typical hopper capacity of between 1,500 and 2,500 m³ could be used on this project. The dredge would operate 24 hours per day, seven days per week with some delays due to equipment maintenance, refuelling and staff changes. The trailer suction hopper dredge would be supported by at least one work boat.



Plate 6.3 Medium sized backhoe dredge



Plate 6.4 Example of dredge in operation - excavator on a barge

During dredging operations, materials are removed from the seabed by trailing a draghead along the seabed. The draghead agitates the seabed as the dredge pulls it along. Agitated material is transported up the suction pipes in the form of hydraulic slurry (a mixture of removed material and seawater) and into the hopper by large inboard pumps. Trailer dredges may be fitted with one or two suction pipes, depending upon the size of the vessel.

In the hopper of the dredge, the sand (or coarser grained) particles settle out and the excess water and fine particles pass through a hopper overflow system back into the sea through a discharge outlet normally located at the keel level of the vessel. This reduces the potential for disposal of fine grained sediments in the upper level of the water column encouraging sedimentation of suitable overflow sediments.

Once the dredge has loaded its hopper it ceases dredging by raising its dragheads off the seabed and travelling to the nominated disposal area.

Discharge can be by one of three methods. The first of these is bottom dumping, a method in which the dredge hoppers split or the bottom doors open, allowing the material to fall to the sea floor. It is envisaged that this would be the method used to dispose of the materials at the proposed ocean disposal site.

The second method, pumping ashore, would be carried out when material is fluidised in the hopper prior to it being pumped onshore through a discharge pump, outlet and pipeline. Typically, the solids concentration of the slurry would be 10 to 15 percent by volume. This would normally involve the dredge anchoring in a mooring area within the safe operational limits of the vessel and the coupling of its discharge outlet to the discharge pipeline intake manifold supported by a floating buoy anchored to the seabed. The intake manifold would be connected to a discharge pipeline, which would comprise sections that are floating, submerged and onshore. A discharge outlet would be located onshore, from which deposited material would be reworked by an onshore crew including bulldozers and front-end loaders. The onshore outlet can be moved by extending sections of pipeline.

The third method, 'bow casting', is similar to the pump-ashore method of discharge, except that, rather than coupling the pump ashore discharge outlet to the discharge pipeline, material is pumped out of the pump ashore outlet onto the water surface some 50 metres or so in front of the bow of the dredge.



Plate 6.5 Example of dredge in operation - excavator unloading flat topped barges



Plate 6.6 Split hopper barge

6.10.3 Cutter suction dredge

Cutter suction dredges are designed to remove material ranging from silt to hard clays and soft rock. The ability to dredge harder materials is a function of the power of the cutter head, the power of the side winches and the physical construction of the dredge.

A cutter suction dredge is generally not self-propelled. It is generally a floating barge with a number of major elements that include a cutter, ladder, onboard pipework and pumps, an onboard power plant, control room and anchoring system (comprising spuds, swing wires and anchors). A large cutter suction dredge is shown in plate 6.8. A large cutter suction dredge that has the capacity to dredge and pump onshore an average of 210,000 m³ of material per week is required. This would have typical dimensions as follows: length 100 metres; beam 170 metres; and a depth of 4 metres.

During dredging operations the cutter, located at the end of a ladder, is lowered to the seabed. The cutter revolves through the bed material and in so doing loosens material. Agitated material in the form of a hydraulic slurry is sucked up into the pipe intake, which is located behind the cutter by the onboard pumps. Typically, the solids concentration of the hydraulic slurry would be 10 to 15 percent by volume. The slurry would then be pumped through a discharge pipeline to the nominated disposal area.

This type of dredge works in a controlled manner with the vessel's pontoon normally held in position at the stern by a spud, which is dropped into the seabed. The cutting action is then facilitated by swing the forward end of the pontoon in an arc across the seabed between two anchors set in front and to the side of the dredge. The dredge works on a fixed centreline. The cutterhead is lowered below water to the required dredging depth. Once the dredge face is cut down to the required depth, the dredge (and hence the cutterhead) is advanced along the centreline by means of moving the carriage in which the spud is mounted. To move forward the dredge is pushed against the spud by a hydraulic ram at a predetermined step size. At the completion of a step an auxiliary spud is lowered and the main spud raised and returned to its starting position. The main spud is dropped and the auxiliary spud is raised prior to the recommencement of dredging operations. Small cutter dredges may not be fitted with a spud carriage and often advance by 'stepping' through the alternating use of the main working spud and the auxiliary spud.

A large dredge would, typically, have a pump on its ladder and at least one additional inboard pump within the pump room.



Plate 6.7 Small trailing suction hopper dredge



Plate 6.8 Large cutter suction dredge

The discharge pipeline would comprise sections of floating and onshore pipeline. Typical in side dimensions of the onshore discharge pipeline envisages for this project would be approximately 750 mm – 800 mm.

Placement of the material from the discharge pipe on to the nominated onshore fill area is typically managed by controlling the direction of flow of the discharge water with conventional land-based plant and equipment such as bulldozers and front-end loaders. The material would be discharged into containment ponds. The containment ponds would incorporate dewatering provisions to collect and redirect decant supernatant and underdrainage back to receiving waters. The progress of the filling area reclamation would usually be controlled by a series of valves and pipeline off-takes to ensure that the material progresses in a prescribed manner.

For the loosening of the stiff clays and soft rock, it is proposed that the cutter suction dredge would return the material to the harbour bed. This would be achieved by using a diffuser pipe consisting of an articulated 'T-shaped' spreader pipe designed to redistribute material in an even manner to the sea-bed while at the same time reducing the discharge velocity and minimising the underwater turbulence generated. The spreader pipe would be supported from a floating barge located behind the dredge. The diffuser, when located within the water column just above the bed level, facilitates rapid settlement of material.

6.10.4 Land based excavation

Above-water excavation is often most efficiently undertaken using large, land-based earthmoving plant and equipment, such as hydraulic excavators and both on-road and off-road trucks. The proposed excavation for the OneSteel site

is described earlier in this EIS. Typical capacities for on road trucks and trailers are 10m³ and 7m³ respectively and for an off road truck is 20m³. An excavator working in conjunction with on-road trucks is shown in plate 6.9.

6.10.5 Drilling and blasting of rock

Drilling and blasting is most efficiently undertaken using a stable, above-water working platform. In the case of the terminal depths which are proposed for this project, this is usually provided through the use of a self-elevating platform, which enables the operation to be completed accurately and independently of the tide. A self-elevating platform is shown in plate 6.10.

The platform is typically made up of a hull, which supports three or four 'spuds', and onboard plant and equipment. The platform is generally not self-propelled and would be moved around the site by a workboat.

Once in position the platform would lower its spuds and then elevate itself out of the water, on its spuds, using its onboard winch system.



Plate 6.9 Excavator working in conjunction with trucks



Plate 6.10 Self elevation platforms

The entire area to be drilled would be divided into blast areas. Within each blast area drilling would be undertaken on a pre-determined grid pattern (spacing and level) to achieve the size of blasted rock required. The depth of drilling would be such that it would extend below the desired dredged level. The blasting removes material in a 45-degree cone around the core. It is therefore necessary for cores to extend at least half the width of their spacing below the design level. Explosives are placed from the bottom of the core to within 0.5 or 1 metre of the top. The top of the core would then be plugged. The type and quantity of explosives would be determined to establish a particular fragmentation result (rock size) in the material. Typically, a field of cores would be set off with a delay between each core of approximately 100 milliseconds. This delay would ensure that any vibration effects were not cumulative.

It is important to note that it is not always the case that the largest possible charge is the most effective in removing material. In particular, a maximum size of charge may be limited by the proximity of the operation to noise and vibration sensitive receivers. In addition, the spacing of the holes and the size of the charge must match the material to be blasted and the fragmentation result required. The size of the charge also determines the diameter of the core that is to be drilled.

The rate at which drilling and blasting progresses is dependent on factors such as:

- the strength of the rock;
- the volume of material to be removed; and
- the area over which the work is to be completed.

7 Treatment processes

This chapter provides a description of the processes that would be used to treat river sediments and embankment materials with elevated levels of contaminants. The sampling and testing that were used to characterise the material is described, together with the result of trials of a stabilisation process and a dewatering process. The preferred method of treatment is then detailed. Removal, handling, transport and disposal technologies, environmental management controls and monitoring are outlined.

7.1 Introduction

7.1.1 Overview

Preliminary estimates of the total volume of river sediments and embankment materials that would be removed as part of the proposal are provided in Chapters 6 and 8. It has been estimated that approximately 13.6 million m³ of material would be removed by dredging/excavation procedures. Of this total, it is estimated that approximately 2% or 250,000 m³ of sediments from the river alongside the closure area site, and approximately 30,000 m³ of embankment material from the swing basin and approaches, would be unsuitable for either unconfined sea disposal or beneficial reuse without treatment. The removal and subsequent treatment of these materials would, therefore, be an integral part of the overall proposal.

Various processes for the treatment of river sediments and embankment materials have been considered (refer to Chapter 9). Of these technologies, the two considered most appropriate to treat the sediments are considered to be cement stabilisation and thermal desorption.

Treatment of unsuitable materials by cement stabilisation has been tested using material sampled from the Hunter River. The tests have shown that contaminants can be successfully stabilised by the addition and mixing of cementitious material with the sediments.

Should sediment with significantly elevated concentrations of contaminants be encountered then treatment by thermal desorption may need to be used. It is to be noted that, based on best-practice experience on similar material, thermal desorption would be a suitable technology for the treatment of these sediments and as a result a thermal desorption testing program was not undertaken as part of this EIS. Significant outstanding technical issues would need to be resolved with the NSW EPA during the process of licensing. In summary thermal desorption is considered to have potential merit but cement stabilisation is the preferred technology for which consent is sought in this EIS.

Dewatering of sediments using geobags and settling ponds, have also been tested as pre-treatment processes. The results of these tests are described in this chapter.

The EIS presents two options for the treatment of materials unsuitable for offshore disposal or reuse. This approach has been adopted to allow the successful contractor for the treatment works flexibility in the choice of treatment methodologies.

Table 7.1 shows the proposed layout of the treatment site (located within the closure area).

Table 7.1 Testing and analysis of sediments

Sampling Exercise	Purpose	Testing and Analysis
South Arm vibrocoring (GHD-Longmac, 2001)	Assessment of sediment contamination levels and toxicity within the South Arm Dredging EIS study area with a view to establishing contamination levels acceptable for sea disposal	Chemical analysis of sediment samples from cores together with toxicity testing by CSIRO of selected samples. CSIRO toxicity testing documented in a report titled 'Chemical and Ecotoxicological Testing of Dredged Sediment from Newcastle Harbour: South Arm Master Plan Dredge Area' (CSIRO, June 2001)
Multi-purpose Terminal Stage 2/K7 Area vibrocoring (GHD-Longmac, 2001)	Assessment of sediment contamination levels and toxicity within the Multi-purpose Terminal Stage 2/K7 Area with a view to establishing contamination levels acceptable for sea disposal	Chemical analysis of sediment samples from cores together with toxicity testing by CSIRO of selected samples. CSIRO toxicity testing documented in report a titled 'Chemical and Ecotoxicological Testing of Dredged Sediment from Newcastle Harbour: Multi-purpose Terminal Stage 2/K7 Area' (CSIRO, June 2001)
Surface sampling adjacent to closure area site (PBP, 2001)	Collection of samples for toxicity testing to more accurately identify the toxicity causing contaminants and determine the levels of contaminants which could be tolerated by organisms, thereby deeming the sediments suitable for unconfined sea disposal	Chemical and toxicity testing of sediment by CSIRO. CSIRO toxicity testing documented in a report titled 'Relationship Between Chemical Contaminants and Ecotoxicological Effects for Dredged Newcastle Harbour Sediments' (CSIRO, October 2001)
Surface sampling adjacent to closure area site (PBP, 2002)	Algae, amphipod and bivalve toxicity testing of samples to better confirm the relationship between total PAH concentrations in the sediments and toxicity	Chemical and toxicity testing of sediment by CSIRO. CSIRO toxicity testing documented in a report titled 'Relationship Between PAHs and Ecotoxicological Effects on Algae, Amphipods and Bivalves for Newcastle Harbour Sediments' (CSIRO, December 2002)

7.1.2 Framework for the sediment removal and treatment strategy

The framework that forms the basis for the removal and treatment strategy is described below. This framework was developed in consultation with NSW EPA:

- The river sediments and embankment materials that are unsuitable for unconfined sea disposal or beneficial reuse without treatment should be removed from the South Arm and treated to a satisfactory level on the closure area site;
- When treated, the material should be suitable for,
 - placement on the closure area site;
 - placement on the former BHP waste emplacement area on Kooragang Island; or
 - placement on the former BHP waste emplacement area on Kooragang Island.

- A long term confined disposal facility solution without treatment of sediments is not acceptable to the NSW EPA, and a period limited to two years would be acceptable for any temporary holding facility proposed; and
- The removal and treatment processes selected would be the result of the selection of the best available technology not entailing excessive cost.

7.2 The nature of the sediments to be treated

The contaminant affected riverbed sediments that are unsuitable for unconfined offshore disposal and beneficial reuse without treatment have been fully characterised to aid the planning of the treatment process. The characterisation of the sediments is essential as options for treatment and disposal, once sediments are removed from the river, are largely depend on the geological properties of the sediments and the concentration of contaminants in the sediment.

Characterisation of the sediments has been based on the following:

- previous studies that were undertaken for other various projects and investigations; and
- additional studies commissioned as part of this EIS to provide essential data not contained in the previous studies.

7.2.1 Previous testing of riverbed sediments

There have been numerous studies undertaken on the riverbed sediments.

Studies in recent years have included:

- The EIS for the Multi-purpose Terminal (URS, 2000), which supported a development application for the dredging of these sediments to facilitate a berth and access to the proposed terminal. The development application sought consent to pump the dredged sediments to the existing BHP Billiton landfill sites on Kooragang Island for 'treatment' by contained disposal. However, Stage 2 of the Multi-purpose Terminal project, which included the dredging of contaminated sediments, was taken out of the development application, leaving the future of these sediments undetermined;
- GHD-Longmac's various reports on the testing and disposal of these sediment types for the now completed Port Waratah Coal Services' (PWCS) Stage 2A (1993-95) and Stage 3A (1997/98) expansions on Kooragang Island; these reports cover simulation modelling for environmental and treatment facility design aspects;
- A report for the Premiers Department (Maunsell, 2002) which describes the options available for treatment of unsuitable materials including cement stabilisation, bioremediation and thermal desorption;
- A report prepared by URS titled 'Sediment Remediation Options Study' (URS, 2002); and
- Work by Patterson Britton and Partners (PBP) and GHD on dredging processes and their effects (PBP and GHD, 2002). The aim of this work was to describe the materials to be excavated, the most likely excavation methods, the constraints on and impacts of these methodologies and any additional studies or testing that might be required to address these matters within this EIS.

7.2.2 Additional studies of river sediments

The previous studies described in Section 7.2.1 have been reviewed and additional studies were undertaken as part of this EIS to provide essential data for planning the proposed treatment process.

Table 7.1 contains a list of the additional testing and analysis work that has been undertaken as part of this EIS.

7.2.3 Characterisation of the sediments

General characterisation

A review of all the available sediment quality data indicates the sediment (soft silty clays) found in the South Arm contains varying levels of contaminants. The studies show that in general, the contaminants are present from the riverbed surface down to the interface between the silty clays and the underlying estuarine sands.

Contaminants identified in the soft silty clays include PAH, TPH and heavy metals (cadmium, chromium, copper, lead, mercury, nickel, and zinc). Contaminant concentrations generally increase towards the southern foreshore of the South Arm adjacent to the closure area site. Concentrations of Total PAH and benzo(a)pyrene in the silty clays vary according to depth and location.

Characterisation for land-based disposal

For land-based disposal, classification of the sediments would need to be undertaken using the *Environmental Guidelines: Assessment, Classification and Management of Liquid and Non liquid Wastes* (EPA, 1999). These guidelines classify wastes into four categories – inert, solid, industrial and hazardous waste. The concentrations of contaminants and/or the leachability of these contaminants generally determine the waste classification category.

The sediments have been classified based on the chemical analyses undertaken. Table 7.2 provides the approximate volume of sediment in each waste classification.

Table 7.2 Classification of sediments

Waste classification (according to Environmental Guidelines ¹) before treatment	Volume of Material (m ³)
Inert waste	Minimal
Solid waste	Minimal
Industrial waste	75,000
Hazardous waste	175,000
TOTAL	250,000

¹ Environmental Guidelines: Assessment, Classification and Management of Liquid and Non liquid Wastes (EPA, 1999)

The Draft Environmental Guidelines for Industrial Waste Landfilling, (EPA, 1998) summarise disposal options for the classifications of wastes.

Inert wastes can generally be disposed of in an (unlicensed) inert waste landfill. Alternatively, if the inert waste comprises soil or other geological based material it may be suitable for use as general fill on some sites. The suitability for reuse on other sites is dependent on the concentration of any contaminants present in the waste. If the concentrations of contaminants meet nationally established health-based soil investigation levels, the waste is generally suitable for use as fill. For commercial and industrial sites, such as the closure area site, health based soil investigation levels (NEHF F) have been defined in the *Guidelines for the NSW Site Auditor Scheme* (EPA, 1998).

Any material classified as solid waste must be disposed of in a licensed solid waste landfill, and cannot generally be used as fill material, unless treated to reduce leachability. When treated and the waste is a suitable fill material, it may be use as fill if it meets the appropriate health-based soil criteria referred to above. Industrial waste classified materials can also be treated to reduce leachability, which enables their placement in specific areas of industrial sites. Locations where this material is placed normally need to be recorded, as the material may not meet the appropriate health based

soil investigation levels (NEHF F). Records of disposal locations would ensure that if any future works disturb this material, appropriate occupational health and safety (OHS) procedures are followed.

As there are no hazardous waste landfills in NSW, any material classed as hazardous must be treated to reduce leachability before being disposed of in an environmentally responsible manner. Such material can be placed on industrial sites, under the same conditions as previously described for material classified as industrial waste.

Characterisation for unconfined ocean-based disposal

For ocean-based disposal, the toxicity of the contaminants to ocean organisms is the determining factor. The Commonwealth Scientific and Industrial Research Organisation (CSIRO) has undertaken extensive toxicity testing of riverbed sediments. The investigations undertaken include the following:

- 'Ecotoxicological testing of Dredged Sediment from Newcastle Harbour: Multi-purpose Terminal Stage 1 Capital Dredging' (CSIRO, June 2001);
- 'Chemical and Ecotoxicological testing of Dredged Sediment from Newcastle Harbour: South Arm Master Plan Dredge Area' (CSIRO, June 2001);
- 'Chemical and Ecotoxicological testing of Dredged Sediment from Newcastle Harbour: Multi-purpose Terminal Stage 2/K7 Area' (CSIRO, June 2001);
- 'Relationship Between Chemical Contaminants and Ecotoxicological Effects for Dredged Newcastle Harbour Sediments' (CSIRO, June 2001); and
- 'Relationship Between PAHs and Ecotoxicological Effects on Algae, Amphipods and Bivalves for Newcastle Harbour Sediments' (CSIRO, October 2002).

The background to each investigation and the main study findings are provided in Appendix D.

The main findings of the CSIRO investigations were:

- Toxicity of the sediment contaminants to bioassays (samples of ocean organisms) was observed;
- Sulphide, ammonia, heavy metals, organochlorine (OC) pesticides and benzene, toluene, ethylbenzene and xylenes (BTEX) are not contributing to the toxicity of the Hunter River sediments, according to CSIRO and previous studies (Simpson et al., 2001a-d);
- Polycyclic aromatic hydrocarbons (PAH), total petroleum hydrocarbons (TPH) and other non-characterised hydrocarbon residues in the sediments may contribute to the toxicity observed in bioassays;
- Although PAH and TPH are considered to be the likely cause of toxicity in the Hunter River sediments, the correlation between the bioassay responses and PAH and TPH concentrations is poor. The physical properties of the sediments may affect bioassay responses;
- The lowest total PAH concentration for which any toxicity was observed in two or more bioassays was 75 mg/kg. No toxicity was consistently observed for any bioassay with total PAH concentrations less than 75 mg/kg;
- There is a strong relationship between total PAH and TPH concentrations in the sediments). The lowest TPH concentration for which toxicity was observed in algae and either amphipod or bivalve bioassays was 450 mg/kg;
- As the bioassays were tested for acute toxicity, chronic effects at lower PAH or TPH concentrations cannot be definitely discounted. If chronic effects were considered likely at the ocean disposal site, sediments with total PAH greater than 15 mg/kg, should be considered unsuitable for ocean disposal;

- Bioaccumulation of PAH could be expected in any organisms that inhabit the dredge spoil. However, no firm guidance is currently available as to how to regulate sediment contaminants for ecosystem protection based on bioaccumulation data. Photo-induced toxicity of bioaccumulated PAH should be considered as unlikely due to low light intensities expected at sea disposal sites;
- Although fish are unlikely to spend sufficient time in the dredge spoil to be affected by PAH concentrations, worse-case calculations indicate that ocean disposal of sediments with a total PAH concentration of less than 6 mg/kg, would provide minimal risk to human health; and
- Based on the available data concerning the protection of ecosystem and human health, it was recommended that sediments with a mean total PAH concentrations of greater than 15 mg/kg, should be considered unsuitable for ocean disposal. Even though the human health risk from fish consumption are considered minimal, it is recommended that fishing be restricted during the disposal period to eliminate risk to human health through the ingestion of contaminated fish.

In summary, toxicity testing has indicated that sediment that contains a PAH concentration of less than 15 mg/kg would be suitable for unconfined ocean disposal.

As a result of these investigations and through consultation with the NSW EPA and Environment Australia, a 'contour line' has been identified which delineates an area of riverbed in which the sediments are suitable for unconfined sea disposal. Where sediment quality data exists with depth, the mean depth concentrations of PAH at each sampling location was calculated before finalising the contour.

A 75 mg/kg total PAH concentration contour line was developed by linear interpolation between the mean concentration of PAH at each sample location. The mean of the sediment PAH concentrations outside of this line was then calculated and confirmed to be less than the 15 mg/kg, the PAH concentration that is required to ensure suitability for unconfined sea disposal.

7.2.4 Characterisation of fill materials in the swing basin area

OneSteel site

Stratigraphy of the OneSteel site shows an estuarine channel, similar to that of the river delta, but covered with an extensive fill layer. The swing basin area is dominated by fill used during the reclamation of Platts Channel and Spit Island between the 1950s and 1970s. The depth of fill ranges between 5 and 12 metres. This fill overlies the natural estuarine sediments that once formed Platts Channel and Spit Island.

Previous investigations at the proposed swing basin site have reported the fill to be generally coarse and dominated by grey cobbles, gravel, and sand particles from blast furnace slag, coal washery fines and minor amounts of dark brown soil. Based on the relative proportion of slag and coal in the material, two general fill units have been identified: a slag/sandy gravel, and coal washery rejects containing slag/coal with gravel, sand and clay. Fill material used on site generally included wastes from plant operations and steel works refuse. Large volumes of river silt and white beach sand dredged from the remaining section of the South Arm channel have also been noted. The main type of fill materials used during the reclamation of Platts Channel include:

- slag from blast furnaces, steel making and open hearth operations;
- slurry from coal washery plant, including shale (coal washery reject);
- flue and sinter plant dusts;
- fly ash and ash from the locomotives;

- steelworks refuse (including old bricks, ashes, shale and refuse from the coal cleaning plant);
- river silt and sand dredged from the remaining section of the South Arm channel;
- waste from coke ovens by-products (including sludge from the rectification stills, tar from the decanters, oil and tar from the drains, tar from spills occurring from the tar tanks at the tar plant and acid sludge from the benzol plant tar); and
- wastes from the finishing and rolling mill operations (including spilt oil and lubricants from mill floors and spent acid from pickling plants).

Little information is available on the disposal of wastes during the reclamation of Platts Channel. Photographs of the reclamation of Platts Channel show that slag materials were used (ranging from fine-grained pieces to those the size of boulders) as well as indiscriminate placement of drums, bricks, building materials, pipes and iron. However, based on the current data it is unlikely that dredging and land based excavation of the swing basin area would encroach into the filled areas of Platts channel.

Swing basin site

Three areas within the vicinity of the proposed swing basin site have been identified as areas potentially used for the disposal of waste tar and grease over the period of reclamation. These potential disposal areas were further reclaimed after the tar was disposed of and, as a result, the level of tar is unknown. The presence of the southern tar pit was noted in 1968 during the construction of the Bar Mill¹. No details of the nature and extent of the tars encountered during construction are available.

Other waste materials reported to be disposed of at these sites include fly ash, general work refuse, blast furnace slag, basic oxygen steelmaking slag, coal washery refuse, grease and oil. The amount of material deposited in these areas is unknown. Due to the limited information on waste disposal areas, it is likely that waste is present in other areas of the fill material.

Based on the history of filling at the site it is likely that soils within the swing basin contain some form of industrial residues. Contaminants of concern that may be encountered in soils at the site include TPH, BTEX, PAH, heavy metals (aluminium, manganese, lead, arsenic, iron), cyanide and phenols.

Declared investigation area

In terms of the proposed swing basin area on the OneSteel site it is important to note that Lot 222 is a declared investigation area under the *Contaminated Land Management Act 1997*. The declaration occurred in June 2001 after OneSteel submitted a Voluntary Investigation Proposal to the EPA in March 2001. Lot 222 is one of the OneSteel lots and runs along the southern OneSteel river foreshore.

Under the Voluntary Investigation Proposal OneSteel have undertaken a two-year assessment in liaison with the EPA. The assessment report produced (CH2Mhill, 2002) concludes that Lot 222 does not represent a significant risk of harm as defined under the *Contaminated Land Management Act (1998)*. The EPA accredited site auditor agreed with this finding. It is understood that the EPA is currently assessing the report.

7.3 Treatment targets

7.3.1 Objectives of the treatment of river sediments and embankment materials

The main objectives for the treatment of these materials are:

- to protect the environment by ensuring that contaminated material in the South Arm is treated so as not to constitute a continuing contamination source for the estuary;
- to ensure that the closure area site remains suitable for the proposed use as envisaged by the consent issued for the Multi-purpose Terminal; and
- to maximise the beneficial reuse of excavated materials.

The treatment targets for river sediments and embankment materials have therefore been selected to allow the placement of these materials on the closure area site, or the former BHP waste emplacement area on Kooragang Island which is classified as a Class 2 Solid Waste Landfill.

7.3.2 Treatment criteria for the closure area site

The treatment criteria for the closure area site are set out in Section 6.2.1 of the Multi-purpose Terminal EIS (URS, 2000). The stated objective of the treatment is to ensure that contaminants in surface soils (soils in the top 0.5 metres) are below site-specific criteria, which include:

- the absence of free tar at the surface (top 0.5 metres);
- total PAH concentration of less than 400 mg/kg (top 0.5 metres); and
- the concentration of benzo(a)pyrene below 15 mg/kg (top 0.5 metres).

It is noted that these concentrations are higher than the health based soil criteria for commercial or industrial sites which are defined in the *Guidelines for the NSW Site Auditor Scheme* (EPA, 1998). The maximum concentrations for total PAH and benzo(a)pyrene are 100 mg/kg and 5mg/kg respectively.

The treatment strategy with respect to the site regrading and capping is set out in Section 6.5.1 of the Multi-purpose Terminal EIS. The closure area site is to be recontoured and capped in order to:

- provide a physical barrier against human contact with the treated materials; and
- improve surface water drainage to minimise flooding and reduce infiltration of the underlying shallow groundwater table.

The Multi-purpose Terminal EIS states that the physical barrier would be formed from some 750,000 m³ of coal washery reject material, which would be imported from Teralba, NSW. The coal washery rejects would consist of clay, silt, sand, gravel, coal fines and floatation agents. It is understood that the coal washery rejects would be emplaced and compacted to achieve a permeability of less than 10⁻⁸ m/s over the majority of the site and less than 10⁻⁹ m/s over the five site locations that contain elevated contaminant levels.

7.3.3 Proposed treatment standards

River sediments

Sediments dredged from the river would be treated to the standards consistent with those specified in the Multi-purpose Terminal EIS for the closure area and would be placed in accordance with the treatment strategy for the site.

The proposed treatment standards for river sediments are based on leachability criteria set out in Table A4 of the NSW EPA Environmental Guidelines: 'Assessment Classification and Management of Liquid and Non-liquid Wastes' (EPA 1999).

Treatment of the sediments would ensure that the materials do not present a significant risk to health or the environment.

Environmental and health based criteria for river sediments that would be re-used on the site as general fill, or buried in defined areas after suitable treatment, are set out in Table 7.3.

Table 7.3 Proposed treatment standards for river sediments

Contaminant	General Fill (used at or near surface)		Material placed in defined areas (below surface)	
	Maximum concentration (mg/kg)	Maximum leachability (mg/L)	Maximum concentration (mg/kg)	Maximum leachability ³ (mg/L)
Total PAHs	100 ¹	NA ⁴	NA ⁵	NA ⁴
Benzo(a)pyrene	5 ¹	0.004 ²	NA ⁵	0.004 ³

¹ Based on health criteria from EPA Guidelines for the NSW Site Auditor Scheme: Commercial or Industrial National Environmental Health Forum F.

² Based on standard toxicity characteristics leaching procedure for un-bound materials, and leachability requirements for Inert Waste as defined in the EPA Environmental Guidelines, Assessment Classification and Management of Liquid and Non Liquid Wastes, Appendix 1 Table A4.

³ Based on a modified toxicity characteristics leaching procedures, which takes into account the final form of the material: a compacted solid mass, with lower leachability than un-bound materials.

⁴ The EPA Environmental Guidelines, Assessment Classification and Management of Liquid and Non-Liquid Wastes, Appendix 1 Table A4 do not specify any leachability criteria for total PAHs.

⁵ Only compressive strength and leachability are relevant criteria. Therefore maximum concentrations are not shown.

It should be noted that the 100 mg/kg PAH concentration target assumes the treated sediments would be used as a surface layer i.e., would not be covered by a clean capping layer as was the case in the Multi-purpose Terminal EIS.

Swing basin embankment materials

Of the 330,000 m³ of material that would be removed from the swing basin and embankments, it is estimated that approximately 300,000 m³ would likely be classified as inert (in terms of the soil contamination guidelines) as it would meet the criteria outlined in Table 7.3 for general fill. Approximately 30,000 m³ of material may require treatment as described earlier, to permit placement and use as engineered fill on the closure area site, or on the former BHP waste emplacement area on Kooragang Island.

7.4 Treatment alternatives

Chapter 9 describes alternative technologies available for the treatment of contaminated materials, options available for disposal of sediments and the 'no development' option.

The treatment alternatives considered as part of the EIS were:

- incineration;
- destruction in cement kilns;
- solvent extraction/thermal oxidation;
- supercritical fluid extraction/thermal oxidation;
- thermal desorption/oxidation;
- pyrolysis;
- immobilisation/stabilisation, including treatment by cement stabilisation; and
- bioremediation.

Chapter 9 presents the case that, of these technologies, the two most appropriate technologies to treat the sediments are cement stabilisation and thermal desorption.

Cement stabilisation

Cement stabilisation is a simple mixing process, in which the contaminated material and cement or other stabilisation agent are mixed together in a facility that is very similar to a concrete batching plant.

At the completion of the mixing process the treated material is placed in a storage area for curing, or placed and compacted in its final location. Placement and compaction directly from the mixer would be the preferred option.

Thermal desorption

Thermal desorption is a technology for the treatment of materials that are contaminated with various organic compounds, such as petroleum based products and PAHs. The thermal desorption process involves heating contaminated material so that the contaminants volatilise into a gas. The gas is then treated to capture or destroy the contaminants before being discharged to the atmosphere. This technology has been demonstrated overseas on a number of soil remediation projects, and with success in Australia by ADI Ltd during the remediation of the Mortlake Gasworks site, near Sydney's Parramatta River.

7.5 Pilot Scale testing of treatment alternatives

A bulk sampling and testing program was undertaken to provide data required for the evaluation of the most effective process for dredging and processing of the contaminated sediments.

Dredging and treatment

The two most appropriate processes to treat the contaminated sediments had been identified as cement stabilisation and thermal desorption. The dredging process options had been identified as:

- Removal by barge mounted excavator fitted with a clam-shell bucket; and
- Removal by cutter-suction dredge and pump via a pipeline to shore.

However, testing had shown that the return of water from the dredging process could be toxic without treatment, and therefore the use of a cutter-suction dredge would necessitate the provision of a large capacity water treatment plant at significant cost. The provision of such a plant was not considered viable and, as a result, the test program of dredging was based on the use of a barge mounted excavator fitted with a clam-shell bucket.

Dewatering

When designing the test program it was identified that it may be necessary to dewater the dredged material prior to treatment by cement stabilisation or thermal desorption. Two temporary dewatering facilities were thus tested:

- Confined Disposal Facility (CDF) – temporary lined storage facility for sediment dewatering purposes; and
- Temporary Treatment Facility (TTF) – temporary lined facility utilising large, porous, circa 2m diameter polypropylene tubes (Geotubes) filled with sediments for dewatering purposes.

Water quality

On order to assess the potential impact of the proposed South Arm dredging on the Hunter River water quality, surface water samples were taken from the Hunter River for water quality testing at the bulk sampling zones. Samples were

collected prior to, during, and after bulk sampling from a location immediately outside the turbidity curtain. An additional surface water sample was taken inside the turbidity curtain during sediment removal by the excavator in order to assess the worst-case water quality conditions likely to be encountered during the proposed dredging. The samples were tested for a suite of analytes recommended by the EPA.

Water quality testing was also carried out on the water collected from the dewatering test units.

Odour trials and assessment

In order to identify the composition and concentrations of gases that are likely to be emitted during the proposed dredging of the South Arm, the University of New South Wales Environmental Odour Laboratory carried out an odour impact assessment. The assessment involved:

- Identification of odour emission sources and concentrations;
- Estimation of odour emission rates for each possible odour source;
- Odour dispersion modelling; and
- Assessment of mitigation measures.

7.6 Results of the pilot scale testing

The full report on the results of a bulk sampling and testing program is provided in Appendix E. The results are summarised below.

7.6.1 Cement stabilisation

Results of the stabilisation tests using Portland Cement and a commercial stabilisation agent 'Dolocrete' indicate that the contaminated river sediments can be stabilised at the excavated moisture content, without prior dewatering pre-treatment. The water within the sediment is combined in the stabilisation process to produce a stabilised 'dewatered' product that does not produce seepage and is of very low to extremely low permeability. The stabilised product meets the permeability requirements for capping of containment areas.

Different addition rates are required for Dolocrete and Portland Cement to achieve stabilisation of contaminants and low permeabilities, i.e. permeabilities less than 10^{-9} m/s. The products from the two stabilisation agents have different physical characteristics:

- Dolocrete, when added at concentrations 5% to 8%, produces a very stiff/hard material of very low permeability, which is capable of being remoulded and compacted, similar to a very stiff to hard clay. When compacted, strengths of 0.4 MPa to 0.6 MPa are obtained with permeabilities less than 10^{-9} m/s; and
- Portland Cement achieves greater strength but is not remouldable. Typically a minimum 10-20 percent additive rate might be expected to immobilise the contaminants and achieve the required permeabilities for use as a capping material, i.e. permeabilities less than 10^{-9} m/s.

Once the contaminants are stabilised, and the compacted material is capable of achieving a suitable unconfined compressive strength (UCS), of nominally 0.4 Mpa or greater, the materials would have low leachability and could be disposed of in accordance with the stabilisation scheme outlined in the NSW EPA *Environmental Guidelines: Assessment, Classification and Management of Liquid and Non-liquid Wastes*, subject to EPA approval.

7.6.2 Dewatering of river sediments using Geotubes

The use of geotubes contained within shallow bunded and lined facilities (temporary treatment facilities) would likely be restricted to slurried material (cutter suction dredge) where they allow a secure confinement and a controlled rate of seepage for return water treatment purposes.

Once dewatered, the material would need to be removed from the geotubes, the geotubes disposed of and the material treated. The size of such a facility for untreated sediment may be limited by odour constraints, which would place a restriction on the amount of untreated sediment able to be stored at any one time, without other odour management procedures being implemented.

There appears to be little advantage in the use of geotubes with sediments at the moisture content resultant from mechanical excavation, as such material would produce only relatively small amounts of leachate, which would likely be handled by evaporation processes or used up in the stabilisation process. Moreover, it was noted in the odour trials that there appears to be only marginal benefit, if any, from using the geotubes in odour control.

Based on toxicity tests using the 'first flush' from the geotubes appears acutely toxic, the return water requiring some 100 times mixing/dilution to drop below the 'no affect' level for acute toxicity. This may place a significant constraint on the process as there would be some 1.3 m³ to 2 m³ of return water produced per bank m³ of sediment removed by cutter suction dredge (at 25 percent to 30 percent solids), which would potentially require treatment. This figure excludes rainfall run-off, which it is assumed may also require treatment.

7.6.3 Dewatering using a Confined Disposal Facility

The mechanically excavated material would likely be contained in a bunded lined facility (a confined disposal facility), similar to but deeper than a temporary treatment facility, and the stockpile profiled by managed deposition practices to allow rainfall run-off to collect in a lower level sump for pumping to a holding tank, from where it could be used as make up water for stabilisation, treated or discharged (dependent on water quality). Such a facility is envisaged for temporary/contingency storage purposes associated with mechanically excavated sediments in the stabilisation process. It should be noted that the size of the facility would be subject to restrictions for odour control purposes similar to those for the geotubes.

7.6.4 Water quality

In order to assess the potential impact on Hunter River water quality of the proposed dredging inside the sheet pile wall, a water quality sampling and testing program was undertaken during a bulk sediment sampling exercise.

The water quality testing program involved testing of surface water samples taken inside and outside of a turbidity curtain surrounding three zones of sediment removal (representing high, medium and low sediment contamination).

The sediment removal was undertaken using a barge mounted excavator.

Comparison of the water quality results from the samples taken immediately outside of the turbidity curtain prior to, during and after bulk sediment sampling indicate that all contaminants except total zinc are below ANZECC/ARMCANZ (2000) high reliability trigger values. There is, however, some evidence that background levels of total zinc are elevated at concentrations close to the ANZECC/ARMCANZ (2000) high reliability trigger value.

Total zinc concentrations inside the turbidity curtain were found to be particularly elevated corresponding to the elevated levels of suspended solids. The impact of elevated levels of total zinc at the dredge site are considered minimal as the turbidity curtain significantly reduces the levels of zinc and other contaminants in the surrounding waters; that is, levels of zinc recorded inside the turbidity curtain are up to 16 times higher than these outside the curtain. In the physico-chemical environment of the river, zinc would generally be adsorbed to suspended solids and dilution with surrounding

waters would occur. In addition, chemical analysis and toxicity testing of sediment with comparable levels of zinc has shown that zinc is of low bioavailability and is not toxic to sediment-dwelling organisms (CSIRO, 2001a).

If geobags were used then the seepage water would require treatment prior to its return to the Hunter River. In addition, as discussed in Chapter 6, there may be a significant quantity of contaminated groundwater from the OneSteel excavation requiring treatment and discharge.

A water treatment plant would thus be required on the OneSteel site and possibly on the closure area site.

7.6.5 Odour testing and modelling

The main findings of the odour sampling and analysis program were as follows:

- PAH compounds would cause the majority of odours;
- Odour measured at the water-air interface and in the barrel samples was found to reflect the level of contaminants in the sediments;
- Geotubes were found to provide only marginal benefit in odour reduction over exposed sediments;
- The odours generated in the pens was found to generally diminish with time;
- The odour emissions from the slurried sediments were greater than for those at 'excavated' moisture contents; and
- The 3.5% Dolocrete mix was found to perform marginally better at suppressing odours than the 20% Portland cement mix.

The main findings of the Ausplume dispersion modeling to which the test results were applied, were as follows:

- Odour generated by each of the dredging technologies proposed would be acceptable and the barges used to transfer the sediment would not need to be covered to meet the EPA requirements; and
- Odour emissions from the onshore dewatering facility whether using a temporary treatment facility, of a temporary confined disposal facility, are dependent on the area of the facility. If large facilities were proposed then odour management would be required.

Air quality and odours are discussed in detail in Chapter 17.

7.7 Preferred process

7.7.1 Overview

Based on the testing undertaken, the preferred process for the removal of river sediments is by barge mounted excavator fitted with a clam-shell bucket; the preferred treatment process is the stabilisation option involving a Dolocrete mix that would remain workable (equivalent hard/very stiff soil at UCS 0.4 – 0.6 Mpa) and can be remoulded and compacted into position.

It would be possible to submit a permit application for offshore disposal if the material satisfied the sediment quality criteria detailed earlier in this chapter and there was an acceptable case to be made that other disposal options had been considered and ruled out.

Treatment and reuse options for the various material classifications that would be generated by dredging are tabulated in Table 7.4.

Table 7.4 Proposed treatment and re-use options

Classification according to Environmental Guidelines ¹ before treatment	Proposed treatment	Potential disposal/reuse method
Inert waste	None required	General fill as surface - if health guidelines ² met or placement below surface if health guidelines ² not met
Solid waste	Cement stabilisation to reduce leachability	Medium Compressive Strength (typically 0.4 – 0.6 MPa) - Emplacement in defined areas as capping, or as fill below the capping where high strength is not a requirement (e.g. in car parks).
		High Compressive Strength (Minimum 1 MPa) - Emplacement in defined areas as capping, or as fill below the capping where high strength is a requirement (e.g. in railway corridors).
Industrial waste	As per solid waste	As per solid waste
Hazardous waste	As per solid waste but thermal desorption may be required	As per solid waste

¹ Environmental Guidelines, Assessment Classification and Management of Liquid and non Liquid Wastes, Guidelines, Appendix 1 Tables A3 and A4 (EPA, 1999)

² EPA Guidelines for the NSW Site Auditor Scheme: Commercial or industrial (NEHF F) levels (EPA, 2000)

7.7.2 Proposed treatment by cement stabilisation

The preferred treatment strategy has been developed through a review of past work, worldwide examples of similar processes and is based on the treatability testing program carried out as part of this EIS.

Figure 7.1 provide an overview of the proposed process for the extraction and treatment of sediments from the river, the main steps of which are as follows:

- Transfer of the material to a temporary, lined storage basin, which would act as a buffer storage for the treatment process; alternatively the barge would be unloaded directly to the treatment facility;
- Treatment of the stored material by cement or other stabilisation agents;
- If dewatering were required as an intermediate step, provision would be made for dewatering in geobags, or by solids/water separation in a temporary lined holding basin;
- The temporary containment of the dredged material in geobags would allow slow water percolation through the bags; when the moisture content reached the required level the geobags would be opened and the material treated. Odour testing has indicated that the potential odours from geobags would have a significant impact if the area covered by the geobags is large. The use of geobags would require odour management to ensure that odour nuisance does not occur;
- Containment of water seeping through the geobags (if used) and subsequent treatment prior to return to the Hunter River; and

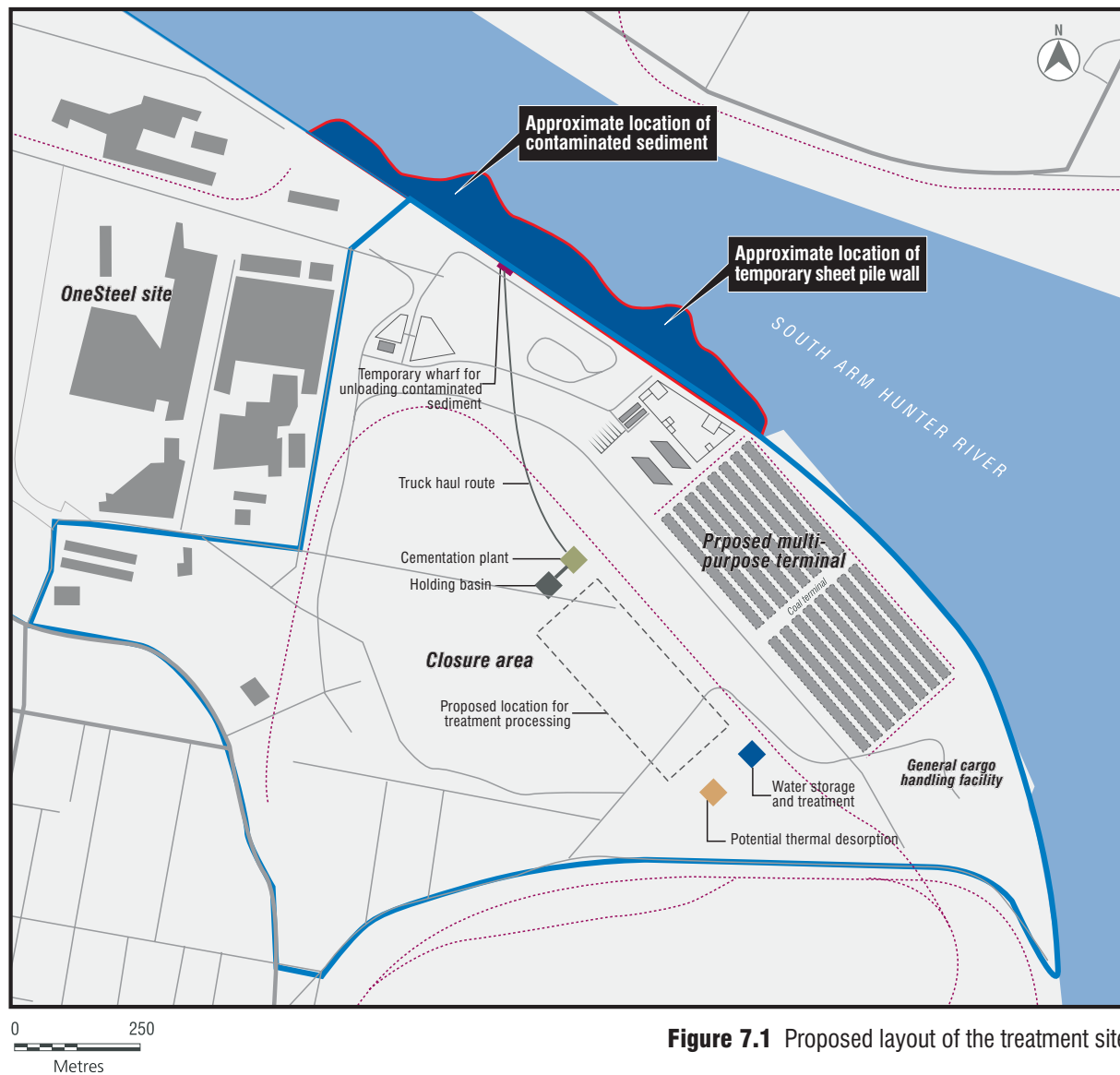


Figure 7.1 Proposed layout of the treatment site

- The subsequent offshore disposal of the treated material through:
 - beneficial reuse on the closure area site;
 - beneficial reuse on the former BHP waste emplacement area on Kooragang Island; or
 - landfilling on the former BHP waste emplacement area on Kooragang Island.

Table 7.5 summarises the expected volumes of materials that would be dredged and treated.

Table 7.5 Preliminary production/treatment rates

In situ materials	Sediments	250,000 m ³
Cement stabilisation in batching plant	Production rate	200 m ³ /hour
	Storage capacity (two days storage at 200 m ³ /hour)	5,000 m ³
Dewater in Geobags, if required	Geobags (200 metres x 10 metres x 2 metres)	40,000 m ² maximum surface area

7.7.3 Cement stabilisation batching plant details

Cement stabilisation is a simple mixing process in which the contaminated material (containing the required water content) is mixed with cement or other immobilisation agents. The process is normally undertaken using equipment similar to that of a standard concrete batching plant.

One alternative would be to locate the stabilisation batching plant centrally on the site, to the south of the multiple railroads as identified in the Multi-purpose Terminal EIS. Alternatively this treatment facility could be located on the riverbank adjacent to the unloading wharf for the river sediments.

If material is to be emplaced on the former BHP waste emplacement area on Kooragang Island, the treatment plant could be located on Kooragang Island. However, this EIS does not address the environmental approval issues required to establish a treatment facility on any other site. The NSW EPA has advised that a detailed environmental approval process would be required for the authorisation of the treatment of sediments on any alternative sites.

Key operational aspects of the cement stabilisation batching plant are outlined below.

Operation	12 hours a day
	6.5 days per week
	These times may vary depending on dredging rates and production rate requirements
Production	200 m ³ per hour
	280,000 m ³ of in-situ materials
Employment	Up to 6 operators would be employed during operation

A modern, fully computer automated batching plant would be used. Advanced features of such batching plants include:

- negligible dust emissions as the plants are fitted with filters, enclosures and a dust extraction system;
- low noise generating through utilisation of electrical power; and
- modern warning devices and controls for the identification of potential spills, fires and silo overfills.

Batching plant components and infrastructure

The stabilisation batching plant would likely comprise the following components:

- Sediment retrieval bins;
- Material transfer conveyors and weigh hoppers;
- Overhead bin platforms and bin houses;
- Batch conveyor;
- Mixing tank;
- Mains water system;
- Storage silos and support structures for cement or other immobilisation agents;
- Discharge hopper;

- Dry dust collection system;
- Truck loading bay enclosure;
- Air system and electrics for plant operation;
- Truck washdown bay;
- Cement stabilisation admix storage;
- Vehicle access and egress; and
- Monitoring office block.

Environmental protection features incorporated in the stabilisation batching plant

The stabilisation batching plant would contain the following environmental protection features:

- The stabilisation batching plant would be powered by electricity and therefore emit very little noise;
- A dust extraction hood would be used to collect any dust generated during loading of the mixer tanks;
- A water spray system would be installed to minimise dust generation;
- All working areas would be sealed with a concrete hardstand;
- All conveyors would be fully enclosed;
- The transfer of sediment to the mixing tank would be enclosed;
- The dispatch area would be enclosed; and
- The dust collection system would recycle collected dust back into the batching process, and vacuum air would be filtered prior to release to the atmosphere.

Batch production process

The process used to produce immobilised material can be divided into several sub-processes as follows:

- Sediment storage and handling;
- Possible dewatering of sediments;
- Cement or immobilisation agent retrieval, storage and handling;
- Batching; and
- Product dispatching.

Sediment storage and handling

A temporary lined storage basin would be built to store dredged sediments adjacent to the batching plant. Trucks would transport dredged sediments from the temporary wharf to the temporary lined storage basin, which would act as a buffer storage for the treatment process. The temporary lined storage basin would consist of embankments constructed from engineered fill and lined with a compacted low permeability clay. The basin would have a ramp at one end to facilitate back dumping from trucks and other ramps to facilitate access by front-end loaders retrieving the material for charging of the treatment plant. The basin would be designed to contain the sediments for approximately two to four days prior to treatment. The approximate storage volume of the facility would be 5,000 m³.

Possible dewatering of sediments

The excavation process has been designed so as to minimise the amount of water removed with the river sediments. This design was motivated by the results of toxicity testing, which show that any water returned to the river could be extremely toxic without treatment. As discussed elsewhere in the EIS, the moisture content of the dredged sediment would enable treatment by cement stabilisation without the requirement for dewatering.

However, some portion of the dredge sediment could contain a water content in excess of that required for optimal stabilisation. In this case dewatering of the sediment would be required as an intermediate step prior to treatment. Similarly, if treatment by thermal desorption is required, dewatering would be essential prior to treatment by this method. If dewatering were required, provision would be made for dewatering in geobags, or by solids/water separation in a temporary lined holding basin.

Geobags are elongated tubes made of woven or non-woven geosynthetic textile that trap granular material but allow water to permeate through the tube. Geobags can be manufactured to specific dimensions that typically depend on the volume of material that requires dewatering. The dimension and the number of geobags that would be required would be determined on site and would depend upon the amount of sediment requiring dewatering. Odour modelling has shown that in order to avoid odour impacts, the surface area of geobags should be limited to 40,000 m² (see Chapter 17). The likely dimensions of the geobags are provided in Table 7.6.

Table 7.6 Likely dimensions of geobags

Geobag	Parameter
Length	200 m
Height	2.0 m (nominal)
Width (foot print)	10.0 m
Maximum total surface area	40, 000 m ²

Source: www.badgeraap.org/sites/grubers/grubers3.htm



Plates 7.1 and 7.2 show typical applications of geobags.

The geobags would be placed in a bunded area that would be lined with an impermeable liner. The liner would ensure all seepage water from the geobags would be collected and pumped to the onsite water treatment plant.

Retrieval, storage and handling

Dry and liquid chemicals (i.e. principally cement) would be delivered to the batching plant by trucks and stored in a dedicated storage area. The storage area would be enclosed and secure to safely store bulk and containerised chemicals. Bulk chemicals would likely be stored in overhead silos or tanks, while containerised chemicals would be stored in enclosed sheds. The storage silos would be sealed and any escaping air would be cleaned by fabric filters.

The storage area would have a concrete hardstand to prevent the migration of any spillage of chemicals, and a surface water drainage system that would collect surface water for treatment prior to discharge or for reuse in the batching process.

When required for batching, the cement and various additives would then be transferred into overhead silos.

Batching

The batching process involves the mixing of the dredge and excavated material with cement and other additives. Mixing would be undertaken in mechanical mixer tanks.

The transfer of chemicals into the mixer would occur from an enclosed chute that would prevent the generation of dust. The batching area would also have a surface water collection system that would collect surface waters for use in the treatment process.

Product dispatching

The treated material would be discharged from the mixer and loaded onto trucks that would transport the material to various final deposit sites for placement and compaction, including:

- the closure area site; or
- the former BHP waste emplacement area on Kooragang Island.

Loading of the trucks would be done with the aid of a dry dust collection system, which collects any dust without the use of water and returns it to the silo.

After loading, the rear of the trucks would be checked for any spillage. Any spilt material would be washed into grated pits connected to a water drainage system for recycling.

Transit trucks that have completed their deliveries would be cleaned in a truck washdown area. All water used in the washdown area would be collected for reuse in the batching process.

7.8 Thermal desorption systems

7.8.1 Overview

As discussed earlier the testing program has provided confidence that the sediments could be treated successfully by stabilisation. However, it may be decided in the future that some of the sediments be treated using thermal desorption. For example the successful contractor may find this method more convenient for treating some of the sediment stockpile.

For a relatively short duration project, a thermal desorption unit comprising a series of modular units of equipment mounted on separate trailers which are transportable from site to site would likely be used. For a longer duration project, or higher throughput situation, equipment would be installed in a concrete floored building. For this project, the former (portable unit) approach is expected.

A thermal desorption system is comprised of multiple components which heat soils and sediments, to volatilise contaminants such as hydrocarbons and treat the gases, to extract or destroy the contaminants.

There are two main types of thermal desorption systems – direct contact and indirect contact systems.

In a direct contact thermal desorption unit, the soil/sediments are directly exposed to hot combustion gases from an external source eg natural gas in a combustion chamber. The volatile compounds contained in the soils/sediments enter the hot gases, which then pass through a thermal oxidiser, or afterburner unit that destroys these compounds. After cleaning and cooling, the gases (consisting mainly of carbon dioxide and water), are discharged to atmosphere.

In contrast, an indirect thermal desorption unit heats the soil/sediments in an oxygen deficient chamber, which is physically separated from the source of combustion/flare. Heat is transferred through the walls of the vessel. The low levels of oxygen present avoid formation of dioxins and furans during the gas cooling process (PBP, 2002).

Cooling and filtration of particulates from the hot gases containing volatilised hydrocarbons from the soils/sediments results in the hydrocarbons being contained in the condensate. The condensate is then treated using another proprietary liquid waste treatment technology. The cleaned gases then pass to atmosphere.

A comparison of some of the main characteristics of direct and indirect thermal desorption technologies is provided in Table 7.7.

Table 7.7 Comparison of thermal desorption technologies

Parameter	Direct/destructive	Indirect/recovery
Maximum soil temperature	800°C	500°C
Processing rate	30 to 50 t/hr	5 to 20 t/hr
Treatment cost (> 50,000 t)	\$100/t	\$200/t
Residuals for offsite disposal	None	Liquid waste containing hydrocarbons
Emissions of dioxins	low	Very low
Maximum contaminant concentration in feed	2-4%	50-60%
Utility requirements	Fuel for primary heater	Fuel for desorption chamber
	Fuel for afterburner	Water for gas cooler/scrubber
	Water for gas cooler/scrubber	Water for soil cooler
	Water for soil cooler	Electricity
	Electricity	Fabric filter (particulates)
Typical off gas treatment systems use	Afterburner (thermal oxidiser)	Condenser (scrubber)
	Fabric filter (particulates)	Carbon absorber
	Condenser (scrubber)	

Source: PB (2002)

It should be noted that the treatment temperature range for polycyclic aromatic hydrocarbons is in the range of 180°C to 450°C (US Navy, 1998). While direct thermal desorption processes have temperatures in excess of these levels, the soils/sediments in some indirect thermal desorption systems, such as those heated using steam or hot oil, may not be reach a sufficiently high temperature to desorb all polycyclic aromatic hydrocarbon compounds. However, rotary drum type indirect systems, using combustion of natural gas as the heat source, are likely to be suitable for this purpose.

7.8.2 Direct thermal desorption system

A typical direct thermal desorption system consists of a number of specialised components:

- a materials infeed system;
- a directly heated desorption chamber to remove contaminants from feed soil;
- an afterburner/thermal oxidiser to destroy volatile contaminants;
- a baghouse to collect fine particulates;
- a vapour treatment system to filter contaminants from the vapour stream; and
- a materials discharge system.

A common type of direct thermal desorption system is the Rotary Dryer type, as described by the United States Environment Protection Agency (USEPA, 1994). Rotary dryer systems use a cylindrical metal reactor (drum) that is inclined slightly from the horizontal.

A burner located at one end provides heat to raise the temperature of the soil sufficiently to desorb organic contaminants. The flow of soil may be either concurrent with or countercurrent to the direction of the purge gas flow.

As the drum rotates, soil is conveyed through the drum. Lifters raise the soil, carrying it to near the top of the drum before allowing it to fall through the heated purge gas. Mixing in a rotary dryer enhances heat transfer by convection and allow soils to be rapidly heated. Rotary desorber units are manufactured for a wide range of treatment capacities and these units may be either stationary or mobile.

The maximum soil temperature that can be obtained in a rotary dryer depends on the composition of the dryer shell. The soil discharge temperature for carbon steel drums is typically 150°C – 310°C. Alloy drums are available that can increase the soil discharge temperature to 650°C.

After the treated soil exits the rotary dryer, it enters a cooling conveyor where water is sprayed on the soil for cooling and dust control. Water addition may be conducted in either a screw conveyor or a pugmill.

An afterburner is located upstream of the baghouse ensuring that fine particles are decontaminated. For a concurrent system, purge gas first enters an afterburner to decontaminate the fine particles, then goes into a cooling unit prior to introduction into the baghouse. In concurrent systems, the purge gas is hotter than the soil discharge temperature and cannot go directly to the baghouse.

It should be noted that variations to the above-mentioned processes and equipment occur depending upon the technology supplier.

7.8.3 Indirect thermal desorption system

A typical indirect thermal desorption system would consist of:

- a materials infeed system;

- an indirectly heated desorption chamber to remove contaminants from feed soil;
- a baghouse;
- a vapour treatment system to filter contaminants from the vapour stream;
- a liquids treatment system to collect and treat contaminants from the liquid stream; and
- a materials discharge system.

A common type of indirect thermal desorption system is the thermal screw type, described by the United States Environment Protection Agency (USEPA, 1994). This typically consists of a series of 1–4 augers, which convey, mix, and heat contaminated soils to volatilize moisture and organic contaminants into a purge gas stream. Augers can be arranged in series to increase the soil residence time, or they can be configured in parallel to increase throughput capacity.

Most thermal screw systems circulate a hot heat-transfer oil through the hollow flights of the auger and return the hot oil through the shaft to the heat transfer fluid heating system. The heated oil is also circulated through the jacketed trough in which each auger rotates. Thermal screws can also be steam-heated.

Systems heated with oil can achieve soil temperatures of up to 260°C, and steam-heated systems can heat soil to approximately 180°C. Most of the gas generated during heating of the heat-transfer oil does not come into contact with the waste material and can be discharged directly to the atmosphere without emission controls.

The remainder of the flue gas maintains the thermal screw purge gas exit temperature above 180°C. This ensures that volatilized organics and moisture do not condense. In addition, the recycled flue gas has a low oxygen content (< 2 percent by volume) which minimizes oxidation of the organics and reduces the explosion hazard. If pretreatment analytical data indicates a high organic content (> 4 percent), use of a thermal screw is normally recommended.

After the treated soil exits the thermal screw, water is sprayed on the soil for cooling and dust control. Thermal screws are available with soil treatment capacities ranging from 3–15 tons per hour.

The following process description has been taken from the Remedial Action Plan for the Lednez site at Rhodes NSW (Egis, 2002). It describes the operation of a particular Indirect Thermal Desorption Unit proposed to be used on that site.

The description of the various components is more detailed than would normally be provided if the technology were discussed generically, but it is valuable to describe the details of “real life” technology, rather than just provide a generic description.

The sequence of processes is as follows:

- PAH affected sediment from the pre-treatment facility is conveyed to the thermal desorption system via a feed hopper and pugmill. From the feed pugmill, contaminated soils are fed into the thermal desorber;
- The desorber comprises an inner rotating shell surrounded by an outer drum. Burners along the outside of the shell send flames into the space between the inner shell and outer drum, indirectly heating the soil/sediments through the walls of the shell. The steel outer drum is insulated to minimise heat losses. Temperatures throughout the length of the desorber are carefully controlled. In the desorption chamber, the temperature is sufficient to ensure that volatile contaminants are desorbed from the soil/sediment;
- Contaminants contained in the hot gases are filtered and condensed from the vapour phase gas into a liquid stream. The residual vapour phase gas stream then enters a quench, where it is water cooled, to enable contaminants to be further removed in subsequent condensers. The gas stream then exits the condensers and passes through the air pollution control system for further contaminant removal;

- Suspended oil mist and particulates are then be removed from the gas stream by coalescing filters and high efficiency particulate air filters. Following these filters, the gas stream passes through vapour phase activated carbon for further treatment and is recycled to the burners;
- Soil leaving the desorption chamber passes to the treated soil handling system, consisting of several components to cool, remoisturise and stockpile the treated soils without generating dust. These components include a bucket elevator, soil cooling silo, discharge pugmill, and radial stacking conveyor;
- As treated soil exits the indirect thermal desorption system, the bucket elevator lifts the soil in small batches to the top of a soil-cooling silo. As the soil falls through the soil-cooling silo, it is indirectly cooled by heat transfer of air tubes within the silo structure. Separate tubes, with ambient air flowing through them, are arranged in the silo to facilitate soil cooling;
- From the soil-cooling silo, the treated soil enters the discharge pugmill, a variable speed, hydraulically powered, single shaft device used to mix and re-moisturise the soil. Water sprays in conjunction with the mixing action of the pugmill allow for thorough re-moisturisation of the soil; and
- A radial stacking conveyor transports the soil from the discharge pugmill to the post treatment stockpile area for verification testing. After cooling and re-moisturising, treated soils are then be stockpiled in the post treatment stockpile area.

It should be noted that variations to the above-mentioned processes and equipment occur depending upon the technology supplier.

The description provided above is for a system to treat high levels of intractable contaminants such as PCBs and dioxins from the Homebush Bay area. The requirements for this project are different from this i.e. less severe.

7.8.4 Location and licensing issues

The location of any thermal desorption unit for the duration of the proposal would be selected in consultation with the technology providers and all other interested stakeholders, but, in any case, would be situated on the closure area site, and within a bunded and lined area having its own surface water drainage controls. A location adjacent to the cement stabilisation batching plant would be preferred.

Routine thermal treatment would not commence on the PAH-contaminated sediments until the technology provider is granted a Pollution Control Licence and Permit by NSW EPA. It is most likely that a separate EIS would be required to gain approval to use this technology.

7.9 Disposal of inert and treated materials

The embankment materials and treated sediments would be disposed of:

- on the closure area site; or
- on the former BHP waste emplacement area on Kooragang Island; or
- through offshore disposal if the material satisfies the ocean disposal guidelines.

The Closure Area

The closure area site on which the Multi-purpose Terminal is to be constructed is a flat, triangular portion of land lying between the Port Waratah Coal Terminal, the OneSteel site and the Hunter River. The physical features of the developed

site would be the long, deep-water wharves, the multiple railroads running parallel to the wharves, and flat, sealed hardstand areas between the rail facilities and the wharves for truck movements, and the storage of containers and cargo. Figure 10.3 shows the closure area and the Multi-purpose Terminal site.

The proposed use of the area to the south of the Multi-purpose Terminal is industrial and commercial/technology. The layout of the industrial and commercial/technology estates has not been finalised, as it would depend on the size and number of industries that are anticipated to be attracted to the area. Lot sizes in these areas would be a function of demand, but can be anticipated to range from one to ten hectares. Ideally, individual lots would be level to minimise the earthworks when the lots are developed; deep excavation for construction should be avoided because of the nature of the existing soils.

To facilitate the emplacement of materials on site, it would be necessary to prepare a master plan for the development of the area in such detail that removal of emplaced materials would not be necessitated by design changes. A construction program would also be required to allow the work to proceed in an ordered and timely manner.

Irrespective of the final layout, the developed closure area would have the following features:

- Extensive road and railroad areas;
- Paved areas for shipping containers and the marshalling of general cargo; and
- Lots for industrial and commercial/technology development.

Finished surface levels throughout the closure area would be raised above existing levels as a result of:

- the capping layer proposed for the site;
- the construction of the Multi-purpose Terminal at levels between 1.5 and 2 metres higher than existing levels – these higher levels are required because of the size of the vessels that would use the terminal;
- the regrading of the site to ensure the proper drainage of the site; and
- the provision of level building lots.

The fill materials that would be generated by the excavation of the river banks, and the excavation and treatment of river sediments, are discussed in Section 7.3, Treatment targets. Three types of material have been identified that would be disposed of on the closure area:

- General fill;
- Immobilised materials, 0.4 – 0.6 Mpa; and
- Immobilised materials, 1 Mpa.

The characteristics of these materials would influence the selection of sites for the disposal of the material, as follows:

- Immobilised materials, 1 MPa, would be placed in areas where a high strength foundation is required, and the future excavation of the material is not anticipated, e.g. beneath roads and railways; the higher strength of this material is achieved by the addition of greater quantities of cement which increases the cost of the material;
- Immobilised materials, 0.4 – 0.6 MPa, would be placed in areas where a medium strength foundation is required, and the future excavation of the material may occur, e.g. as a general capping layer and beneath paved areas; this material would be produced at a lower cost than the 1 MPa immobilised material; and
- General fill would be placed in areas where a medium strength foundation is required, and the future excavation of the material is anticipated, e.g. on industrial development lots.

Fill types that are most suitable for the identified fill areas are provided in Table 7.8.

Table 7.8 Properties of suitable fill

Area	Fill type
Roads and railroads	Immobilised materials, 1 MPa
	Immobilised materials, 0.4 – 0.6 MPa
Paved areas	Immobilised materials, 0.4 – 0.6 MPa
Industrial/technology lots	Immobilised materials, 0.4 – 0.6 MPa, covered by General Fill

It is to be noted that preliminary estimates indicate that up to 600,000 m³ of embankment and treated materials could be disposed of on the closure area.

Kooragang Island

The sites available for the disposal of material on Kooragang Island lie to the northwest, north and north east of the Tourle Street bridge, see Figure 8.3 and C.26 (Appendix C). This land was formerly owned by BHP and was used for the disposal of inert and solid waste, comprising coal washery reject and BHP byproducts.

The coal washery rejects were placed in the southern portion of Area C. The finished ground level in this area is around RL 20 (local datum), some 7 metres above the adjacent mangrove swamp. The steel making byproducts, such as fly ash, were placed into cells located in Areas E, G, I and J. The walls of the cells were constructed from blast furnace slag; each cell has a plan area of around two to three hectares, and a depth of 5 to 7 metres. This area is very flat with a finished ground level of around RL 22 m (local datum).

Material placed in the cells was not compacted and is still consolidating. The water in the cells is contaminated with various contaminants and it would therefore be desirable to cap the cells to prevent rainwater entering the cells, and reduce the potential for the migration of the contaminants. The capping would be graded to direct rain water from the site, and would need to be flexible to allow for the continuing consolidation of the material in the cells.

The following options are available for the disposal of inert or cement stabilised materials. These have been obtained from the landowner, RLMC.

Inert waste

The inert waste excavated from the river embankment could be emplaced,

- In **Area I**: Volume required: 300,000 m³; cf available 265,000 m³; or
- In **Area G**: Volume required: 300,000 m³; cf available 380,600 m³; or
- In **Area C** to the south of Areas A and B: Volume required: 300,000 m³; cf available 500,000 m³ to 1,000,000 m³.

Cement stabilised river sediments

Cement stabilised river sediments could be used as capping,

- On **Area J**: Volume required: 280,000 m³; cf available 300,000 m³; or
- On **Area C** to the south of Areas A and B: Volume required: 300,000 m³; cf available 500,000 m³ to 1,000,000 m³.

NB. The “volume required” referred to above is an in-situ volume. Excavation, treatment, transfer and placement would result in bulking of the material, and the actual volume required would be at least 10% greater than specified.

Environmental Issues

The areas under consideration have been used by BHP for many years for the disposal of inert and solid wastes. BHP has existing rights to continue to dispose of these wastes at this site, particularly as the waste to be disposed of was generated on the BHP site.

Two endangered species habitats have been identified in the Kooragang Island landfill area. The endangered species habitats identified are those of *Zannichellia pallustris* and the green and gold bell frog. The former is located at the western end of Area D, and immediately north east of the Tourle Street bridge, and the green and gold bell frog habitat is located primarily in Area H. The habitats in Areas D, H and J would be avoided during any landfilling, as would the small habitat for green and gold bell frogs located within Area C.

Transportation

The most practical mode of transportation from the Closure Area to Kooragang Island would be by road. Trucks would exit the Closure Area via Steel Works Road and Ingall Street to Industrial Drive, and thence to Tourle Street and the Tourle Street Bridge. Access to the former BHP waste emplacement area on Kooragang Island is gained immediately north of the Tourle Street bridge.

There is no existing safe return access to Cormorant Road. A candidate access point to Cormorant Road is via the Ready Power access road at the eastern end of the waste emplacement area. Temporary signals would be required at this intersection.

Alternative transportation modes evaluated included,

- Rail and truck;
- Barge and truck; and
- Pumping.

None of the alternatives offered real advantages over transportation by trucking.

7.10 Wastewater Treatment systems

As discussed earlier, the testing program has revealed two important aspects concerning water associated with the sediments:

- that they would be highly toxic; and
- that the stabilisation process would be able to fix all the water associated with the sediments.

Thus, it is clear that treatment would be required however for a potentially low volume stream.

It is envisaged that the water treatment process for contaminated water would involve the following steps:

- Contaminated water would be directed to an on-site settling pond/tank; the storage capacity of this tank would be such to provide sufficient emergency storage as well as some settling capacity;
- To remove the suspended sediments, the wastewater would be treated by gravitational sedimentation (occasionally with a flocculation agent) and then sand filtration;

- Metals may be removed either by ion exchange, or by precipitation using a chemical additive;
- Water that has been treated by chemical addition would proceed through a sedimentation and filtration sequence to remove the precipitated compounds;
- Organic compounds would be removed by carbon adsorption (or granulated activated carbon). This method is capable of removing organic substances including chlorinated solvents, phenols, PCBs, PAHs, and pesticides; and
- Ultraviolet oxidation may also be necessary to assist in the breakdown of PCBs and PAHs.

It is envisaged that the contractor could utilise other water treatment processes such as evaporation or membrane filtration.

The contractor would need to negotiate with the EPA the terms of the licencing requirements. Further discussion of water treatment is presented in Chapter 11.

7.11 Remedial action plan

A remedial action plan would be prepared by the successful contractor once the final treatment process is selected and would form the basis of the EPA Licensing process.

The remedial action plan would address the following key areas:

- Scope of work;
- Site conditions;
- Treatment objectives;
- Project schedule;
- Chemical contaminant criteria;
- Public consultation strategy;
- Site establishment/facilities;
- Materials handling/dewatering;
- Interim storage on site;
- Treatment/processing of materials;
- Management of contaminated water;
- Removal and ultimate disposal of materials;
- Environmental management;
- Occupational health and safety; and
- Contingency and emergency response planning.

The remedial action plan would be finalised as part of the EPA licensing process and the tender process for the overall proposal. Nonetheless, the key elements of environmental management would remain unchanged.

8 Disposal of materials

This chapter provides information on the proposed disposal locations for the materials dredged and excavated from the South Arm. These locations include the closure area site, other licenced sites on Kooragang Island, the Tomago industrial area and the proposed multi-user transport corridor across Kooragang Island. The option of using material to nourish Stockton Beach is also discussed. A mass balance for all materials is presented. The offshore disposal of sediments (the subject of a separate application for approval) is also briefly described.

8.1 Overview of material disposal options

As far as possible, the aim would be to beneficially reuse the material resulting from dredging and excavation. However, not all materials (for example, soft silty clays) can be reused. In addition, approximately 2.0 percent of the total volume of materials that are to be excavated, need to be treated before it can be reused.

Three basic means of disposal are proposed for materials resulting from the dredging and excavation process:

- Offshore disposal of sediments according to the provisions of the *Environment Protection (Sea Dumping) Act 1981*;
- Beneficial reuse of material; and
- Treatment of contaminated sediments and subsequent re-use or disposal.

The proponent has requested that beneficial reuse where possible be adopted as one of the principles of the proposal. To achieve this objective, several possibilities for land based disposal sites exist, including:

- The proposed Tomago industrial area;
- The proposed multi-user port and transport corridor to the Tomago industrial area;
- The proposed wharf and product storage areas associated with the proposed Austeel development;
- Reuse of treated sediments and excavated fill from the OneSteel site as engineered fill on the closure area site;
- Reuse of treated sediments and excavated fill from the OneSteel site as engineered fill on licenced waste emplacement areas on Kooragang Island;
- Stockton Beach – for beach nourishment using clean sand; or
- The Protech site and any other industrial site on Kooragang Island requiring clean fill.

Land based disposal sites are indicated in Figure 8.1.

8.2 Material balance

A summary of the overall excavation and disposal requirements has previously been presented in this EIS in Table 6.1 (Chapter 6). A further simplified tabulation of the material quantities is present in Table 8.1. It should be noted that this table is based on the same assumptions previously presented in conjunction with Table 6.1.

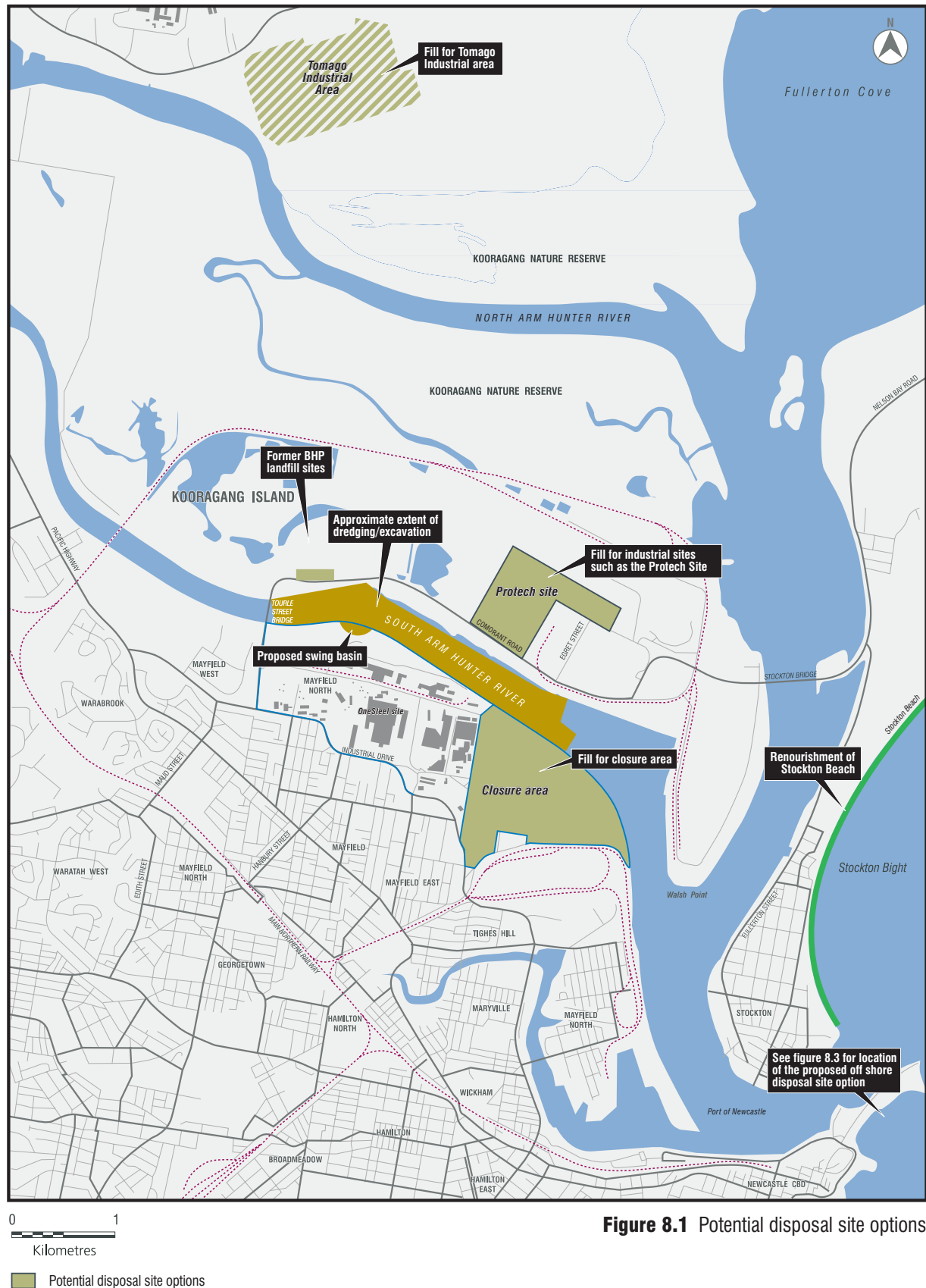


Table 8.1 Material quantities

Item	Material type	Excavation volume (m ³) ¹	Proposed disposal site & available capacity (m ³) ¹
1	Contaminated materials not suitable for offshore ocean disposal	250,000 river sediment 30,000 (assumed) granular OneSteel	Closure area - >280,000 or KI WEA
2	Contaminated materials suitable for offshore ocean disposal	2,150,000	Ocean disposal - >2,150,000
3	Sand with some minor clay	River bed sand: 7,050,000 Clay: 200,000 Nth Bank Sand: 20,000	Tomago site and associated Austeel developments - 5,720,000 sand Stockton renourishment or stockpiled - >1,350,000 sand Offshore - >200,000 clay
4	Granular filling materials above RL:1.0 metres	300,000 OneSteel	Closure area - >300,000
5	Clay	1,450,000	Offshore disposal - >1,450,000
6	Soft rock	1,550,000	Offshore disposal - >1,550,000
7	Hard rock	600,000	Offshore disposal - >600,000
	Total:	13,600,000	13,600,000

1. Quantities are estimates based on studies to date.

8.3 Material properties and disposal options

8.3.1 Contaminated dredged sediments not suitable for offshore disposal

Approximately 250,000m³ of contaminated river sediments not suitable for offshore disposal are required to be excavated, transported, treated and finally disposed of either at the closure area or on licenced sites on Kooragang Island. This material comprises approximately two percent of the total volume of material to be dredged. These materials generally consist of fine-grained silty clays that are contaminated with a variety of substances that require treatment prior to disposal or reuse. They are generally located along the southern bank and are surface sediments that have been contaminated from industrial developments along the south bank of the South Arm over approximately the last 100 years. The treatment of these sediments is more fully described in Chapter 7.

The sand from the north bank may be used on site at the Austeel Port site or trucked a short distance along Cormorant Road to the Austeel Product Storage Area or to the proposed multi-user port and transport corridor.

8.3.2 Contaminated dredged sediments suitable for land or offshore disposal

Approximately 2,150,000 m³ of low contamination river sediments, or approximately 15 percent of the total volume of material to be removed, are proposed to be dredged, transported from the dredge site and disposed of at sea. These materials are located in the upper profile of the materials to be dredged and like the contamination sediments unsuitable for offshore ocean disposal, have accumulated contaminants from nearby industrial activities over the last 100 years. These materials would be excavated down to the interface with the underlying sands.

The physical properties of these sediments including, their fine grain size (which is mainly silt and clay size), their high plasticity and moisture content, combined with the significant disturbance to the sediment matrix that occurs during the dredging and transport process, dictates that this material is unsuitable for all but ocean disposal.

If beneficial reuse of this material was considered, these materials would need to be processed to improve their engineering properties, and even then the uses for the fine-grained material are very limited. Processes would include sedimentation and drying. The area of land required for these processes would be in excess of 200 hectares, to accommodate the volumes of material to be dredged. There is no suitable land of this area available in this location. In addition, the drying processes may take up to five years to complete, would be very expensive and would produce a low value material with a high salt content, which would have limited uses or market value.

8.3.3 Contaminated excavated sediments suitable for land or offshore disposal

It may be necessary to excavate small volumes of silt or clay layers from within the north and south banks using land based earthmoving equipment. This material could be remnants of old fines settling ponds from previous dredging and reclamation activities in the 1960s and 1970s, which were typically often close to the river bank, or the river delta estuarine mud flats. There is a low risk that this material has some level of similar contaminants to the current main river sediments, because of the materials' possible origin. Geochemical testing of this material has not been undertaken because of the difficulty in locating the potentially isolated pockets of this silty clay. However, during excavation the material would be temporarily stockpiled and tested before being reused/disposed of in an acceptable manner. This material would have a relatively high moisture content. However, previous experience on similar sites on Kooragang Island has shown that this material can be safely transported in road trucks with tight fitting tailgates or water sealed.

The material may have a beneficial reuse as an impermeable lining for any temporary storage ponds used to contain contaminated material that is not suitable for offshore ocean disposal. If a suitable reuse for the material cannot be found then it is proposed to be disposed of offshore.

Alternatively, any of this class of material excavated from the southern bank could be blended with other OneSteel excavation material or the treated sediments and used as an engineering fill material.

8.3.4 Dredged sand

Approximately 7,050,000 m³ of sand or approximately 54 percent of the total volume of material to be dredged, is proposed to be dredged, transported from the dredge site and potentially reused. Much of this material is located within the proposed swing basin and the proposed channel and berth areas to the west of the swing basin.

Previous geochemistry testing by GHD LongMac and Patterson Britton & Partners has demonstrated that sand in the river bed does not contain significant levels of any contaminants. The relatively clean nature and medium grain size of the sand (which generally varies from 0.2 millimetre to 0.4 millimetre) makes this material suitable for a number of land based site development works, that are located within close vicinity of the dredging works. A more detailed description of the transport and reuse of the sand is given elsewhere in this chapter.

There are some clay lenses and inclusions within the sand matrix that would be dredged, transported and deposited with the sand at the various development sites. The estimated volume of this material is 200,000 m³. Appropriate management techniques are required to be incorporated at each of the disposal sites to ensure that the clay material is separated from the sand to satisfy both engineering and environmental considerations. This clay has not been exposed to potential contaminants during historical industrial development and would not contain levels of contaminants that would preclude offshore disposal.

It is anticipated that this material would be collected in settling ponds and a small dredge used within the ponds to transfer the material to barges for offshore disposal. Alternatively, the material in the ponds could be allowed to dry and

then loaded into trucks using excavators, trucked to a wharf facility and loaded onto barges for disposal offshore. The land based activities would be addressed by others in a separate EIS(s). However, it is anticipated that all the required approvals from the appropriate regulatory authorities would be able to be achieved, using a combination of proven disposal methods, management techniques and monitoring procedures. The offshore disposal of the clay material is covered in subsequent sections of this EIS.

8.3.5 Excavated sand

Approximately 20,000 m³ of sand from the north bank may be excavated by land-based earthmoving equipment and trucked to fill or stockpile sites. This material is predominantly previously dredged river sand used in historical reclamation work and should be suitable for reuse as general fill. The north bank material is very unlikely to be contaminated because of its granular texture and lack of contact with contaminants both in its current and possible historical location.

8.3.6 Clay overlying the rock

Approximately 1,450,000 m³ of clay is required to be dredged using a combination of trailer suction cutter suction dredging techniques. The volumes of these materials to be dredged are relatively large, comprising about 15 percent of the total material to be dredged. Like the low contamination dredged sediments, the physical properties of the clays, including their fine-grained nature, combined with the extensive disturbance of the clay matrix that occurs during the dredging process, dictates that the only practical method to dispose of this volume of clay material is by ocean disposal. However, unlike the contaminated sediment, this clay has not been exposed to potential contaminants during historical industrial development and would not contain levels of contaminants that would preclude offshore disposal. The very significant cost, space and program requirements associated with any proposed land based beneficial use of this material would render these options completely impractical.

If beneficial reuse of this material were considered, these materials would need to be processed to improve their engineering properties, and even then the uses for the fine-grained material are very limited. Processes would include sedimentation and drying. The area of land required for these processes would be in excess of 150 hectares, to accommodate the volumes of material to be dredged. There is no suitable land of this area available in this location. In addition, the drying processes may take up to five years to complete, would be very expensive and would produce a low value material with a high salt content, which would have limited uses or market value.

8.3.7 Soft rock

Approximately 1,550,000 m³ of various materials that have been classified as 'soft rock' are proposed to be disposed of by using a combination of cutter suction/trailer suction dredging methods. This represents almost 12 percent of the total volume of material to be dredged. This material classification includes: residual stiff clays, weak sandstones, siltstones and shale with occasional minor coal seams. This soft rock has not been exposed to potential contaminants during historical industrial development and would not contain levels of contaminants that would preclude offshore disposal.

Preliminary assessment of the properties of this material based on the geotechnical investigations undertaken to date indicates that, once these materials have been excavated and have been transported from the dredged site, their physical and engineering properties would be significantly affected.

Once dredged, the soft rock would consist of predominantly fine-grained clay, with some gravel and sand sized fractions. The high proportion of clay size particles would make this material difficult to reuse. These materials would also be dredged at relatively high moisture contents and would need to be reprocessed to improve their engineering properties before being considered for beneficial reuse. The sedimentation, drying and possible size separation along with other

possible reprocessing would be very expensive and require in excess of 150 hectares of land. There is no such suitable area of land available in this location. Again, it is anticipated that reprocessing could take up to five years to complete.

For the reasons detailed, it is proposed to dispose of this material offshore.

8.3.8 Hard rock

This material consists mainly of relatively hard sandstone, with an unconfined compressive strength which may exceed 20 MPa, although a large proportion of the rock is of lower strength and could include some minor siltstone, gravel and fines. This hard rock has not been exposed to potential contaminants during historical industrial development and would not contain levels of contaminants that would preclude offshore disposal.

Approximately 600,000 m³ of hard rock is required to be removed by drilling, blasting and excavation with a large backhoe dredger and barges. This represents almost four percent of the total volume of material to be excavated. Beneficial reuse of this material on land would be possible providing that sufficient space is available adjacent to the dredging site to store and possibly re-process the excavated rock. Preliminary calculations indicate that a minimum area of 20 hectares would be required, assuming that any land based processing and transport from the site (if required) is undertaken in conjunction with the dredging of the hard rock. If this is not possible and all of the material was to be stockpiled on site then up to a 100 hectares site would be required. There are currently no such sites available on Kooragang Island, although a suitable site may be able to be identified on the closure area.

However, the possible reuse of the hard rock would depend on the physical and engineering properties of the rock, once it is transported to any land-based disposal site. The material is unlikely to have the required size, shape and durability to allow it to be incorporated into the proposed revetment works on the dredge batter profiles. In addition, it has poor weathering characteristics and would disintegrate to gravel, sand and clay, rendering it ineffective as a revetment material. However, as an alternative, the rock may be re-processed at land-based disposal sites for other civil engineering uses, such as a general or select fill material. This would require drying, crushing, screening and blending. The cost of these processes is estimated to be up to two times the cost of comparable material from nearby quarries, without any allowance for the land cost and lost opportunity costs of extended occupation of a very large tract of land.

On this basis, it is also proposed to dispose of this material offshore.

8.4 Tomago industrial area

8.4.1 General

Approximately 7.05 million m³ of good quality sand will be dredged, and one of the proposed development sites that requires up to 4.5 million m³ of good quality sand before it can be developed, is the proposed industrial area at Tomago.

The dredge spoil would be pumped to the site by a relatively large pipeline (refer Chapter 6). The handling of the sand, fine grained materials and dredging return waters on the industrial site is being assessed by others and is not part of this EIS.

Preliminary investigations have been undertaken to determine alternative routes for a discharge pipeline from the dredged area to Tomago. These are discussed further in this chapter.

8.4.2 Pipeline routes to Tomago

Although six alternative routes were initially considered in the options analysis carried out as part of this EIS, it was concluded that only three alternative routes for the pipeline to Tomago should be considered further. The three feasible routes are briefly described as follows:

Alternative 1 follows the northern foreshore from the shore connection, beneath the Tourle Street and rail bridges, to a power line easement that runs north to Tomago;

Alternative 2 follows the Pacific National private access road and Railway Causeway access road before following the power line easement proposed in Alternative 1; and

Alternative 3 is the most westerly route.

The investigation and evaluation of the alternative routes considered a number of factors including the shore connection, types of discharge pipeline required (i.e. land based, floating or submersible), routes across existing structures, vegetation, foreshores, inter-tidal and riverbed areas, installation, maintenance, operational and removal considerations, reinstatement of vegetation (where required) and cost.

The preferred alternative is route 3. This route was assessed to have the lowest overall cost and the least environmental impact. However if this route is not available at the time, an alternative would be route 1 which has similar costs and environmental impacts.

8.5 Multi-user port and transport corridor and Austeel product storage site

In addition to the filling of the proposed industrial area at Tomago, large volumes of clean sand are required for various associated developments, particularly the proposed multi-user port and transport corridor and the development of the proposed Austeel product storage site. If development of the multi-user port and transport corridor proceeds, fill material could be required as follows:

- Site development of proposed product storage areas adjacent to the proposed Austeel port site in the South Arm (approx. 650,000 m³); and
- Site development and pavement formation for the potential multi-user port and transport corridor to Tomago (approx. 550,000 m³ based on Alternative 3 route).

The required volumes of sand would be pumped to these sites. The onsite handling of the sand, fine-grained materials and dredging return waters is being assessed by others and is not part of this EIS.

8.6 Reuse of treated and untreated material on the Closure Area Site

This section describes the reuse or disposal of treated sediments from the South Arm and untreated material from the OneSteel extraction that would occur on the closure area site.

The closure area on which the Multi-purpose Terminal is proposed to be constructed is a flat, triangular portion of land lying between the Port Waratah Coal Terminal, the OneSteel site and the Hunter River. The physical features of the developed site would be the long, deep-water wharves, the multiple railroads running parallel to the wharves, and flat, sealed hardstand areas between the rail facilities and the wharves for truck movements, and the storage of containers and cargo.

The proposed use of the area to the south of the Multi-purpose Terminal is industrial and commercial/technology. The layout of the industrial and commercial/technology estates has not been finalised, as it would depend on the size and number of industries that are anticipated to be attracted to the area. Lot sizes in these areas would be a function of demand, but can be anticipated to range from one to ten hectares. Ideally, individual lots would be level to minimise the earthworks when the lots are developed; deep excavation for construction should be avoided because of the nature of the existing soils.

To facilitate the emplacement of materials on site, it would be necessary to prepare a master plan for the development of the area in such detail that removal of emplaced materials would not be necessitated by design changes. A construction program would also be required to allow the work to proceed in an ordered and timely manner.

Irrespective of the final layout, the developed closure area would have the following features:

- Extensive road and railroad areas;
- Paved areas for shipping containers and the marshalling of general cargo; and
- Lots for industrial and commercial/technology development.

Finished surface levels throughout the closure area would be raised above existing levels as a result of:

- the capping layer proposed for the site;
- the construction of the Multi-purpose Terminal at levels between 1.5 and 2 metres higher than existing levels – these higher levels are required because of the size of the vessels that would use the terminal;
- the regrading of the site to ensure the proper drainage of the site; and
- the provision of level building lots.

The fill materials that would be generated by the excavation of the riverbanks, and the excavation and treatment of river sediments, are discussed in Section 7.3, Treatment targets. Three types of material have been identified that would be disposed of on the closure area:

- General fill;
- Immobilised materials, 0.4 – 0.6 Mpa; and
- Immobilised materials, 1 Mpa.

The characteristics of these materials would influence the selection of sites for the disposal of the material, as follows:

- Immobilised materials, 1 MPa, should be placed in areas where a high strength foundation is required, and the future excavation of the material is not anticipated, e.g. beneath roads and railways; the higher strength of this material is achieved by the addition of greater quantities of cement which increases the cost of the material;
- Immobilised materials, 0.4 – 0.6 MPa, should be placed in areas where a medium strength foundation is required, and the future excavation of the material may occur, e.g. as a general capping layer and beneath paved areas; this material would be produced at a lower cost than the 1 MPa immobilised material; and
- General fill should be placed in areas where a medium strength foundation is required, and the future excavation of the material is anticipated, e.g. on industrial development lots.

Fill types that are most suitable for the identified fill areas are provided in Table 8.2.

Table 8.2 Properties of suitable fill for designated uses

Area	Fill type
Roads and railroads	Immobilised materials, 1 MPa
	Immobilised materials, 0.4 – 0.6 MPa
Paved areas	Immobilised materials, 0.4 – 0.6 MPa
Industrial/technology lots	Immobilised materials, 0.4 – 0.6 MPa, covered by General Fill

It is to be noted that preliminary estimates indicate that up to 600,000 m³ of embankment and treated materials could be disposed of on the closure area.

8.7 Reuse of treated material onto Licenced Kooragang Island Sites

8.7.1 Overview

This section describes the reuse or disposal of treated sediments from the South Arm and untreated material from the OneSteel excavation that would occur onto licenced sites on Kooragang Island. The Regional Land Management Corporation (RLMC) owns these sites.

The Kooragang Waste Emplacement Facility is licensed by the EPA (licence Number 6437) as a Solid Waste Class 2 Landfill. This means that the landfill can accept wastes, excluding putrescible waste, that are assessed as *inert waste or solid waste* following the technical assessment procedures outlined in Technical Appendix 1 of the EPA's Waste guidelines or that is specified as *inert waste or solid waste* in Schedule 1 of the *Protection of the Environment Operations Act, 1997*.

The sites available for the disposal of material on Kooragang Island lie to the northwest, north and north east of the Tourle Street bridge as shown in Figure 8.1. This land was formerly owned by BHP and was used for the disposal of inert and solid waste, comprising coal washery reject and BHP by-products.

The coal washery rejects were placed in the southern portion of Area C. The finished ground level in this area is approximately 7 metres above the adjacent mangrove swamp. The steel making by-products, such as fly ash, were placed into cells located in Areas E, G, I and J, refer Figure 8.2 and C.26 (Appendix C). The walls of the cells were constructed from blast furnace slag; each cell has a plan area of around two to three hectares, and a depth of 5 to 7 metres. This area is very flat with a finished ground level.

Material placed in the cells was not compacted and is still consolidating. The water in the cells is contaminated with various contaminants and it would therefore be desirable to cap the cells to prevent rainwater entering the cells, and reduce the potential for the migration of the contaminants. The capping would be graded to direct rainwater from the site, and would need to be flexible to allow for the continuing consolidation of the material in the cells.

The following options are available for the disposal of inert or cement stabilised materials:

Inert waste

The inert waste excavated from the river embankment could be emplaced,

- In **Area I**: Volume required: 300,000 m³; cf available 265,000 m³;
- In **Area G**: Volume required: 300,000 m³; cf available 380,600 m³; or
- In **Area C** to the south of Areas A and B: Volume required: 300,000 m³; cf available 500,000 m³ to 1,000,000 m³.

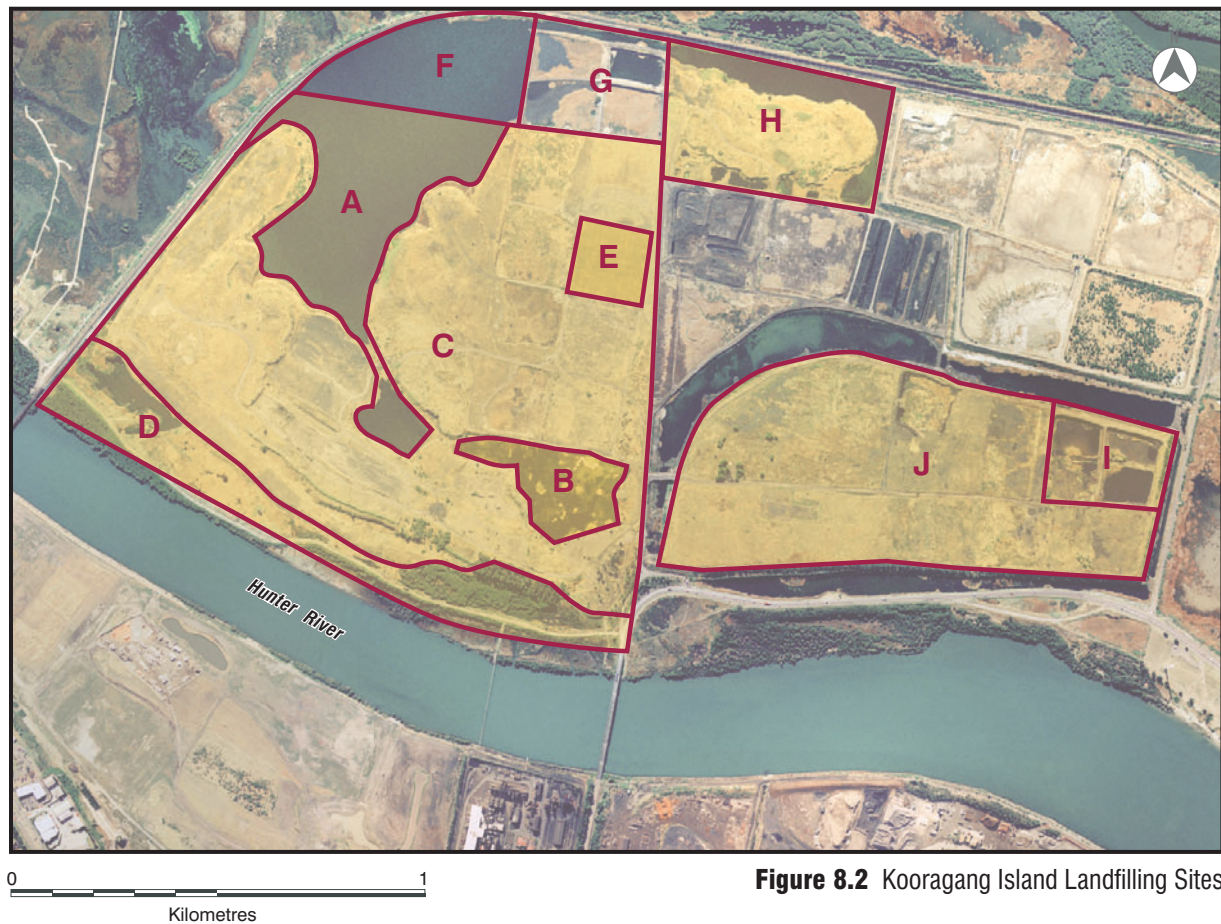


Figure 8.2 Kooragang Island Landfilling Sites

Note:

Cap Area A includes sub-areas A-H

Cap Area B includes sub-areas J and I

Cement stabilised river sediments

Cement stabilised river sediments could be used as capping,

- On **Area J**: Volume required: 280,000 m³; cf available 300,000 m³; or
- On **Area C** to the south of Areas A and B: Volume required: 300,000 m³; cf available 500,000 m³ to 1,000,000 m³.

NB. The “volume required” referred to above is an in-situ volume. Excavations, treatment, transfer and placement would result in bulking of the material, and the actual volume required would be at least 10% greater than specified.

8.7.2 Transportation Methods

The most practical mode of transportation from the Closure Area to Kooragang Island would be by road. Trucks would exit the Closure Area via Steel Works Road and Ingall Street to Industrial Drive, and thence to Tourle Street and the Tourle Street bridge. Access to the former BHP waste emplacement area on Kooragang Island is gained immediately north of the Tourle Street bridge.

There is no existing safe return access to Cormorant Road. A candidate access point to Cormorant Road is via the private access road at the eastern end of the waste emplacement area. Temporary signals would be required at this intersection.

Alternative transportation modes evaluated included,

- Rail and truck;
- Barge and truck; or
- Pumping.

None of the alternatives offered real advantages over transportation by trucking so for the purposes of the EIS, consent is sought for the trucking of material.

8.7.3 Environmental Issues associated with the Kooragang Island Sites

The areas under consideration have been used by BHP for many years for the disposal of inert and solid wastes. RLMC has existing rights to continue to dispose of these wastes at this site, particularly as the waste to be disposed of was generated on the BHP site.

The endangered species habitats identified are those of *Zannichellia pallustris* and the Green and Gold Bell Frog. The former is located at the western end of Area D, and immediately north east of the Tourle Street bridge, and the Green and Gold Bell Frog habitat is located primarily in Area H. The habitats in Areas D, H and J would be avoided during any landfilling, whilst a small habitat for green and gold bell frogs located within Area C may have to be managed or relocated.

The Green and Golden Bell Frog population on Kooragang Island has been estimated to number several thousand. Consequently, it is the largest known population in the Hunter Region and has been identified as a significant population in the draft recovery plan for the species.

Environmental Resources Management Australia (ERM) studied the Green and Golden Bell Frog population on Kooragang Island from December 2002 to January 2003 (ERM 2003). This work was designed to provide information on the status of the population over the 2002/03 breeding season. The study area included Ash Island, the industrial area, and one waterbody in the Kooragang Nature Reserve at the eastern end of Kooragang Island.

ERM surveyed 36 waterbodies during two study periods, each of three weeks duration. Surveys included listening for calling frogs and searching for visible frogs. For surveys conducted during the day, a search for tadpoles was conducted using a dip-net, while for nocturnal surveys tadpole searches were conducted by illuminating areas of open water to locate swimming tadpoles.

The survey period was generally dry, with the exception of a brief period of heavy rain during December 2002. Most waterbodies were dry or had substantially reduced water levels during early December and January.

Green and Golden Bell Frogs were found in 19 of the 36 waterbodies surveyed, while calling was recorded at 11 waterbodies. Tadpoles were not found during the study. Calling aggregations generally involved fewer than five male frogs, except during the brief period of heavy rain when aggregations of approximately 15-20 frogs were heard calling. Frog activity was strongly influenced by water level, with the highest number of frogs recorded when water levels in the waterbodies were at their maximum.

The occupancy of waterbodies in the study area by Green and Golden Bell Frogs during the 2002/03 breeding season was lower than those recorded by another study for the 1999/00, 2000/01 and 2001/02 seasons. This is most likely related to the drought conditions that prevailed during the 2002/03 season. The waterbodies with the highest abundance were either permanent or semi-permanent, as they tended to maintain water when more ephemeral waterbodies dried out.

Following relatively high rainfall between February and April 2003, ERM conducted further tadpole surveys in May 2003. No tadpoles of the Green and Golden Bell Frog were found. It is therefore likely that the population skipped breeding in

the 2002/03 season. This is not surprising given the drought conditions that prevailed, whereby many of the waterbodies remained dry throughout summer. Although conditions for breeding became more favourable when waterbodies were partially filled with water in March and April, breeding may not have occurred because it was too late in the season.

ERM (2003) concluded that as the population of Green and Golden Bell Frogs is currently reduced in size and range, any loss of occupied waterbodies is likely to adversely affect the remainder of the population. Consequently, if any breeding sites are lost due to land-use requirements, breeding sites need to be created close by to offset the impact to the population.

8.8 Other disposal and reuse sites

There is a possibility that there would be up to a 1,350,000m³ excess of sand after the filling of the Tomago industrial area and other known sites. This material could be made available for other beneficial reuses. Temporary dewatering and stockpiling of the entire volume would require approximately 45 hectares of land. However, progressive reuse of the sand could significantly reduce this land requirement.

There are a number of projects that are either proposed or have development consent for the Newcastle and Hunter region. These include the Protech Cold Mill facility on Kooragang Island and the multi-purpose terminal facility on the closure area site. The drying, temporary stockpiling and transport of this material to alternative sites, or the direct pumping and handling of the material at these alternate sites, is to be assessed by others and is not part of this EIS.

8.9 Nourishment of Stockton Beach

Another potential beneficial reuse option for the possible 1,350,000 m³ of excess sand, could be beach nourishment of nearby Stockton Beach. Periods of severe erosion (particularly during major storms) have resulted in significant sediment losses from the sub-aerial (onshore) and near shore beach profile along much of the beach. A seawall has been constructed along the central portion of the beach to prevent erosion of Mitchell Street, although toe scour has affected the wall's structural stability in recent years (Umwelt Pty Ltd, 2002).

The placement of that component of the dredged material having suitable physical characteristics (i.e. matching or complementing those of the existing beach sand) would be a beneficial reuse of the material, introducing a significant volume of sand into the sub aerial and near-shore Stockton Beach profile.

The beach is shown in plate 8.1.

A brief engineering analysis was undertaken by the GHD engineering team to ascertain whether the Stockton Beach option was feasible.



Plate 8.1 Stockton Beach

Placement proposal

The placement area for the sand would need to be located adjacent to the northern breakwater and extend approximately 250 metres across the beach profile and some 1.0 kilometre along the beach. A buffer distance of 100 metres would need to be provided to ensure a safe operational distance between the dredging plant and the northern breakwater.

The coastal processes affecting Stockton Beach are not fully understood and thus the indicative placement areas would need to be confirmed by further investigations prior to any beach nourishment work being undertaken.

However, the following comments present a preliminary review of the present understanding of the suitability of sand to be dredged as part of this proposal, for nourishment of Stockton Beach.

Material suitability

Ideally, the material used for beach nourishment would need to be compatible with the native beach material. In particular, it should have a similar:

- size (or slightly coarser) and grading;
- composition (quartz and shell content);
- angularity (angular or well rounded); and
- colour.

Poorly matched beach nourishment material can result in undesirable changes to beaches such as:

- material which is too fine is likely to be moved seaward more quickly under wave action;
- material which is too coarse is likely to result in a steeper beach profile;
- finer and poorly sorted material (wide range of particle sizes) is likely to result in the redistribution of coarser fraction over the upper portion and finer fraction over the lower portion of the beach profile; and
- aesthetic alterations (e.g. colour).

A 1978 Department of Public Works feasibility study for renourishing Stockton Beach identified a median grain size at Stockton of approximately 0.26 millimetre diameter, grading to 0.7 millimetre approximately 10 kilometres north. The report concluded that the median grain size for nourishment sand for Stockton Beach should range between 0.3 millimetre and 0.5 millimetre; i.e. a medium to coarse grained sand. Although the profile of Stockton Beach has altered significantly through loss of material since 1978, possibly changing sediment characteristics along the beach, it is still expected that the medium to coarse-grained sand that would be made available as a result of the proposal would be suitable for addition to the sub aerial and near-shore profile.

A number of geotechnical investigations have been undertaken in the South Arm to determine the material types, layer depths and approximate volumes of materials to be dredged (Douglas Partners (2001), GHD-Longmac (2002) and Vibrosed Analytical (2003)). Analyses indicate the clean sands proposed for nourishment of Stockton Beach have a median grain size of approximately 0.33mm.

Dredging / Placement Procedures

The beach nourishment option would involve completion of the following key activities:

- dredging of clean sand utilising a trailing suction hopper dredge;
- transfer of sand from the site via trailing suction hopper dredge to the Stockton Beach near-shore area;
- placement of the sand within the sub aerial and near-shore areas potentially using a variety of methods:
 - bottom dumping sand in the near shore area;
 - bow casting (i.e. pumping/'spraying') sand off the bow of the vessel into the shallower 'surf zone'; or
 - pumping sand via constructed pipeline directly to the sub aerial beach profile, and spreading of the material using suitable land-based plant.

Electronic position fixing systems enable accurate positioning of the vessel during dredging and discharge activities. The volumetric model developed for the proposal has identified locations (extent and depth) of suitable types of sand to be dredged and beneficially utilised along Stockton Beach.

As noted above, within the placement area the vessel would discharge its load of sand by bottom dumping, pumping ashore or bow casting. Detailed design for the proposal would likely involve all three methods to ensure total nourishment of the full beach profile is achieved.

Bottom dumping involves the dredge and/or barges approaching the near-shore portion of the active beach profile to within the safe operational limits of its navigable depth. The doors or valves constructed on the bottom of the hull of the dredge are opened and the load is dumped onto the beach profile. During this process, because the vessel actually rises out of the water as the load is dumped, the navigable depth is maintained.

Some dredges and/or barges are fitted with pump ashore capability. Pumping ashore comprises the fluidising of material in the hopper and pumping of material from the hopper to the sub aerial (onshore) portion of the beach profile via a discharge pump, outlet and pipeline. Typically the solids concentration of the slurry would be in the order of 10 percent to 15 percent by volume. The pump ashore operation would normally involve the vessel anchoring in a mooring area that is located within the safe operational limits of its navigable depth and the coupling of its pump ashore discharge outlet to a discharge pipeline intake manifold attached to a floating buoy anchored to the seabed. The discharge pipeline would comprise sections of floating, submerged and onshore pipeline. A discharge outlet would be located onshore from which deposited material would be reworked by an onshore crew using land based plant and equipment such as bulldozers and front-end loaders. The onshore outlet can be moved by extending sections of pipeline.

Bow casting is similar to the pump ashore method of discharge except that rather than coupling the pump ashore discharge outlet to the discharge pipeline, material is simply pumped or cast out of the pump ashore outlet some 50 metres or so in front of the bow of the vessel.

The trailing suction hopper dredge and/or barges selected would need to be ocean going, incorporate a reasonable sized hopper with bottom disposal capability and an accurate navigational system. It would be advantageous if they incorporate self-propulsion, a shallow draft and good manoeuvrability (with forward and aft thrusters).

Summary

Should sufficient quantities of clean sand be available after other beneficial reuses have been considered, the use of clean sand for renourishment of Stockton Beach would appear to be feasible.

However, it should be reiterated that the coastal processes affecting Stockton Beach are not fully understood and would need to be confirmed by further investigations and approvals prior to any nourishment work commencing. These activities are beyond the scope of this EIS.

8.10 Offshore disposal of sediments

8.10.1 Volumes for disposal

The materials that are proposed to be dredged and subsequently disposed of offshore to approved dump grounds include:

- low contamination sediments (2.15 million m³);
- clay from sand dredging (0.2 million m³);
- clay (1.45 million m³);
- the soft rock (1.55 million m³); and
- the hard rock (0.6 million m³).

8.10.2 Sea Dumping Act Permit Application

Any component of the proposal that involves sea disposal would be assessed by Environment Australia through a detailed application process for a Permit under the *Environment Protection (Sea Dumping) Act 1981* to dispose of dredge or excavation material at sea. More detailed information on the assessment of this component of the proposal is included in the formal application to Environment Australia (refer www.ea.gov.au). The following section is intended to provide background on the rigorous process that is currently being followed in parallel to this EIS to obtain a sea-dumping permit.

8.10.3 Material for offshore placement

Surface sediments that are proposed to be dredged have been subjected to extensive physical, chemical and ecotoxicological analyses, to ensure their suitability for unconfined sea disposal (refer Chapters 6 and 7).

The volume of material to be disposed in the offshore disposal ground may be up to 5,950,000 m³, depending on the suitability of the hard rock for beneficial reuse on land. This represents about 42 percent of the total volume of material to be dredged.

The significant amount of investigation and testing of the contaminated sediments undertaken as part of this EIS, concluded that polycyclic aromatic hydrocarbons (PAHs) and total petroleum hydrocarbons (TPHs) are considered to be the most likely cause of toxicity in some of the Hunter River sediments. Based on the available data, CSIRO (2002) recommended that sediment with total PAH concentrations greater than 75 mg/kg (normalised to 1 percent Total Organic Carbon) (TOC) and TPH concentrations greater than 450 mg/kg (sum of C₆-C₃₆, normalised to 1 percent TOC) are considered unsuitable for ocean disposal. This investigation has also confirmed the aerial extent and depth of the contaminated surface sediments that are required to be remediated.

In addition, based on the available data concerning the protection of ecosystem and human health, it was recommended that sediments with 95 percent upper confidence level mean total PAH concentrations of greater than 15 mg/kg (normalised to 1 percent TOC) should be considered unsuitable for ocean disposal.

As a result of these investigations and through a consultation process with Environment Australia, a 'contour line' delineating sediments, that are suitable for unconfined sea disposal, has been identified.

8.10.4 Location and characteristics of the proposed ocean disposal site

Four ocean disposal sites can be distinguished offshore from Newcastle, based on their dates of use:

- Prior to 1989;

- For major port deepening 1978 – 1983;
- 1989 – February 1997; and
- February 1997 – present.

For more information please refer to Figure 8.3 and Figure C.27 (Appendix C).

The proposed offshore disposal site corresponds to the area used as a disposal site by NPC between 1989 and February 1997. It is located in NSW State Waters offshore of Newcastle, approximately 3.8 – 5.8 kilometres southeast of Nobby's Head. The disposal ground falls just inside the 3 nautical mile State / Commonwealth waters boundary, and has an area of approximately 2 kilometres by 2 kilometres or 4km².

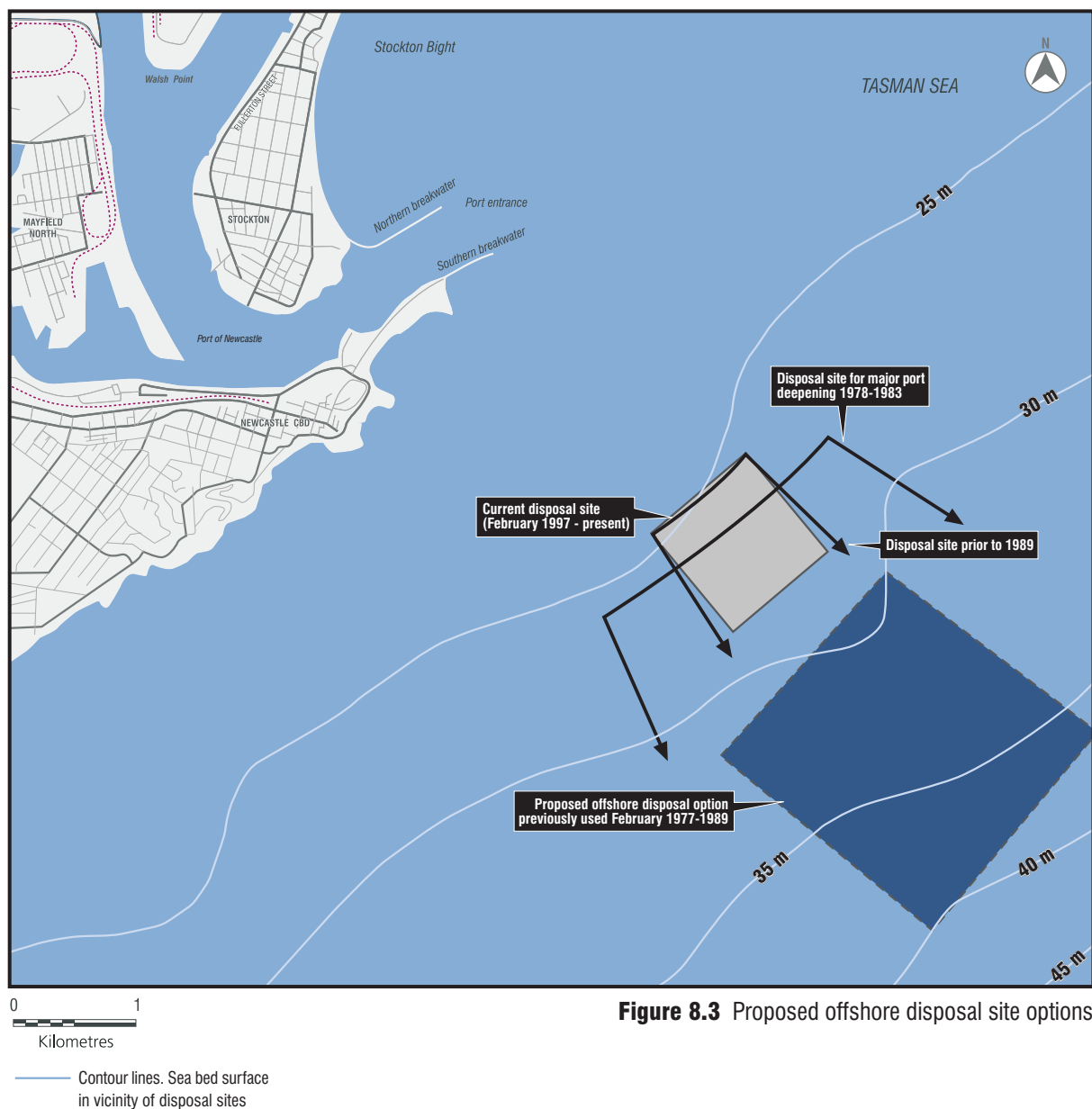


Figure 8.3 Proposed offshore disposal site options

This disposal ground has been selected ahead of the three other disposal ground locations for the following reasons:

- It has been successfully used in the past for capital development and maintenance dredging projects undertaken by Newcastle Port Corporation, with minimal apparent adverse environmental effects;
- There is a significant amount of information relating to this existing disposal ground and the behaviour of similar materials deposited at this location;
- This disposal site is larger and located in deeper water than other disposal sites, and accordingly can accommodate greater quantities of material, particularly material that would not readily disperse from the disposal site, such as rock; and
- The transport and disposal activities at the disposal site for this proposal would not interfere with the maintenance dredging activities currently undertaken by Newcastle Port Corporation, which deliver materials to another disposal site closer inshore.

As noted above, the proposed disposal site was used as the formal disposal ground between 1989 and February 1997, during which time over 2.5 million m³ of capital and maintenance dredging material (*ranging from 100,000 m³ to 900,000 m³ per annum*) was placed in the area.

8.10.5 Characteristics of the disposal ground

A number of studies have been undertaken since 1989 to characterise the offshore area and to ascertain the fate of material placed in the disposal ground over time. Studies have included chemical and physical sediment analyses, sidescan sonar, biological sampling and Remotely Operated Vehicle (ROV) video surveys.

Water depth at the proposed disposal ground ranges from 35 to 45 metres below Chart Datum, and the seabed generally exhibits low relief and a gentle slope away from land. Sidescan sonar work undertaken in 1992 identified features including muddy mounds (*roughly 40 to 60 metres in diameter and having approximately 1 metres relief*) and areas of rock just inshore of the disposal ground, most likely attributable to disposal of rock from the major port deepening dredging over the period 1978 to 1983.

Analysis of sediment data undertaken for the Stage 2 Mobility Study for Dumped Dredge Spoil (PBP, 1992) and for the Offshore Sediment Sampling and Testing exercise (PBP, 2002) indicates a strong sedimentological signature in the offshore disposal grounds. The sediments exhibit a pronounced lithic character, i.e. high proportion of rock fragments, which is different to the sedimentological characteristics of the sediments in the same water depths away from the disposal area. The latter comprise more typically highly iron stained, quartzose marine sand. The sediments within the disposal area also have higher mud content, consistent with the convective descent processes for bottom disposal of dredge material.

Chemical testing of the sediment samples retrieved from the current spoil ground and surrounding offshore area included:

- a suite of heavy metals (arsenic, cadmium, chromium, cobalt, copper, lead, mercury, nickel, selenium, silver, zinc);
- TOC; and
- PAHs.

Within the proposed disposal ground, levels of contamination were below laboratory detection limits for the following contaminants:

- Total PAHs (<0.8 mg/kg);

- Cadmium, Cd (<0.2 mg/kg);
- Mercury, Hg (<0.05 mg/kg);
- Selenium, Se (<0.5 mg/kg); and
- Silver, Ag (<0.5 mg/kg).

Levels of all other contaminants were below Environment Australia (EA) screening levels.

Searches of available published literature indicate the existence of various protected / migratory species in the region; in particular whales, seabirds and numerous species of pipefish / seahorses. The latter would most likely be contained in near shore habitats that provide access to seagrass and marine algae beds.

It is expected that the proposed disposal grounds use as the formal disposal ground between 1989 and 1997 resulted in some alteration of the physical characteristics of benthic habitat (*i.e. sediment types and grain size*) and may have therefore altered the benthic faunal assemblages to some degree.

Prior this EIS, little information existed on the biological characteristics of the proposed disposal site, although significant work has previously been undertaken just inshore of the area, namely ROV video (PBP, 2001) and macroinvertebrate investigations.

A study was commissioned as part of the separate offshore permitting process to assess benthic macro invertebrate populations at the proposed disposal site and two nearby control sites in similar water depths.

A grab sampler was used to collect 4 replicate samples at each of 2 sites, within 3 depth strata (30 m, 35 m and 40 m) at the proposed dump ground and at each of two control locations, yielding a total of 72 samples. Fieldwork was carried out in February 2003. Samples collected for sediment analysis were un-sieved. In the laboratory they were classified according to grain size and sediment type. The samples collected for analysis of benthic invertebrates were sieved (1 mm mesh), preserved and stained on the research vessel prior to processing in the laboratory. Invertebrates were identified to family level and data were analysed using a variety of multivariate and univariate statistical procedures.

The proposed dump ground had a different sediment composition compared to the control locations, particularly in the shallow depth stratum. It is noteworthy that there was little mud in these samples; this was probably redistributed away due to re-suspension and transport by wave and current action. Furthermore, according to Vibrosed Analytical (pers.comm. 2003) the sediments in the proposed dump ground have showed little change since 1992, when they were last investigated. Compared to the control locations, the proposed dump ground had a very different composition of benthic invertebrates, both in terms of assemblage structure and biodiversity, total abundance and the abundance of common families.

As part of the approvals process for the project, NPC is required to obtain a permit under the *Environment Protection (Sea Dumping) Act 1981* to dispose of material at sea. To better understand the physical and environmental condition of the proposed dump ground, The Ecology Lab Pty Limited and Vibrosed Analytical were engaged to assist in a survey of the seafloor at the proposed dump ground, using sediment characteristics and benthic macroinvertebrates as indicators of seabed condition.

Field work was carried out in February 2003. A grab sampler was used to collect 4 replicate samples at each of 2 sites, within 3 depth strata (30 m, 35 m and 40 m) at the proposed dump ground and at each of two control locations, yielding a total of 72 samples. Samples collected for sediment analysis were un-sieved and were classified in the laboratory according to grain size and sediment type. The samples collected for analysis of benthic macroinvertebrates were sieved (1 mm mesh), preserved and stained on the research vessel prior to processing in the laboratory. Macroinvertebrates were identified to family level and data were analysed using a variety of multivariate and univariate statistical procedures.

The proposed dump ground had a different sediment composition compared to the control locations, particularly in the shallow depth stratum. It is noteworthy that there was little mud in these samples; this was probably redistributed away from the dump ground due to re-suspension and transport by wave and current action. Furthermore, according to Vibrosed Analytical (pers.comm. 2003) the sediments in the proposed dump ground have showed little change since 1992, when they were last investigated. Compared to the control locations, the proposed dump ground also had a very different composition of benthic macroinvertebrates in terms of assemblage structure and biodiversity, total abundance and the abundance of common families.

Whilst the study design used here was appropriate to achieve the aims of this study (i.e. to compare sediments and macroinvertebrate assemblages of the proposed dump ground with control areas of similar depth unaffected by sea dumping), an alternative strategy for any required future monitoring would be to adopt a gradient approach. This would involve sampling within the dump ground and at fixed distances to the north, south and east of it. This approach would address two objectives: to determine how closely the disposal operation is confined to the designated area (by evaluating sediment characteristics); and to determine the spatial extent of impacts on benthic ecology (using benthic macroinvertebrates as an indicator).

8.10.6 Placement of dredged material

The trailing suction hopper dredges that would transport material to the proposed disposal site would have hopper capacities between 1,500 to 2,500 m³. The vessels would be expected to undertake the dredging on a continual basis transporting up to about five loads to the disposal site per day.

The duration over which material would be placed at the disposal site would vary depending on the nature of the materials being dredged. The total duration of the dredging program would extend over 40 months. However, there would be periods within this program when the disposal ground would be frequently used for disposal and other periods when it would not be used.

The vessels would take the most direct route from the dredge area along the South Arm to the port entrance. Once out of the port entrance, the vessels would turn southeast and travel directly to the disposal site.

During the transport of the dredge material from the dredge site to the offshore disposal area, and on the return journey, the vessels would observe all requirements of the Harbour Master in terms of vessel speed and other navigation requirements.

The trailing suction hopper dredges would navigate along the prescribed route and once at the disposal site would open the hopper (*'doors' on vessel's hull*) to release the dredged material over the disposal site.

The vessel would have a Global Positioning System that would ensure the vessel is located within the prescribed disposal area when the disposal operation takes place. Also, a detailed plan for material placement would be followed and records of actual placement and kept to ensure that the material is spread across the defined disposal site in a prescribed manner.

A management plan for the disposal of the material at the disposal site would be prepared as part of the permit application for approval by Environment Australia. This would cover the nature and volume of each of the materials, the extent of initial deposition and the anticipated long-term aerial extent of the deposited materials.

There is an opportunity to create beneficial rock-reef habitat with the approximate 2 million m³ of rock-like materials to be dredged from the South Arm, if both the soft rock and the hard rock are selected for ocean disposal. Any reef would be formed so that it would not adversely impact on coastal processes such as wave action and sediment movement.

8.10.7 Physical behaviour of disposed sediments

The physical behaviour of the disposed material in the water column and on the seabed is well understood. In terms of the water column, the main points are described below:

- disposed material descends through the water column at a speed of up to 5 to 6 m/s (termed 'convective descent');
- for the 35 to 45 metres depths at the proposed disposal site, the disposed material would be largely intact when it impacts with the bed;
- only one percent to five percent of the material remains in the water column – this remnant is termed the 'advection cloud' (alternatively some 95 to 99 percent of the material falls rapidly to the seabed).
A negligible amount of the suspended material which is advected away from the disposal site is likely to return; and
- the dynamic collapse process is characterised by a so-called 'impact cloud' at the seabed comprising partly disposed material and partly resuspended bed sediment.

It follows that only a very small quantity of the disposed material is available in the water column to create turbidity and to disperse.

The fine fraction of the sediment deposited at the offshore disposal site (sediment in the silt and clay size fraction, i.e. mud, and some very fine sands) would eventually be expected to disperse from the disposal site in the manner described in previous mobility studies (PBP; 1989, 1992) and confirmed during recent offshore sampling exercises (PBP, 2002). In summary, the dispersion pathway of mud from the disposal site was found to be relatively contained, bounded generally within a zone five kilometres north and south of the disposal site and out to a water depth of 60 to 100 metres.

The majority of the sand and the stiff to very stiff clay lumps (*until such time as this material broke down*), all of which are uncontaminated, would be expected to be locally redistributed but generally remain in the disposal site. The rock would not move from the location of its impact on the seabed but would self-bury to a degree. The quantities of the above materials compared to the physical dimensions of the disposal site (2 kilometres by 2 kilometres) are such that only relatively small depth changes over the disposal site would occur, providing individual hopper loads are distributed across the disposal site to ensure local build up of material does not occur and having regard to the dispersion over time of the muds.

In summary, based on the monitored distribution of previous similar materials deposited at the proposed disposal ground, it is anticipated that:

- the rock and any clay lumps would be retained largely in the zone where they are deposited;
- any sand placed at the disposal ground would generally be retained within the disposal site; and
- silt and clay fines would be dispersed over and beyond the disposal site into deeper water.

8.10.8 Potential impacts

The physical impacts from the dredged material disposal also need to be considered in the context of the relatively high natural sediment supply from Hunter River at times of flooding. Estimates prepared by Patterson Britton Partners (1989) indicate that in a major flood, e.g. March 1977 (*50 year return period*), the river can discharge approximately 25-30 times more sediment than that associated with the current average annual maintenance dredging i.e. about 8,000,000m³. The average annual sediment discharge from the river due to flooding is some 10 times greater than the current average annual maintenance dredging. It follows that the marine ecosystem generally in Stockton Bight has adapted over time to episodes of sediment loading.

Sediment types for this proposed disposal program are similar to those disposed in the area in the past and are therefore not expected to significantly alter the substrate to which the marine organisms have adapted. Light attenuation is not expected to occur for near shore habitats such as seagrass beds (*which would only be present significantly shoreward of the proposed disposal site*).

As stated above, it is expected that the organisms residing in the offshore disposal area would have adapted to a certain degree of periodic disturbance from both dredge material placement and sediment loads from flooding events. Due to this expected adaptation and the limited impacts discussed above on the physical and chemical characteristics of the disposal site, it is not expected that the proposal would significantly impact on the region's biological communities. Further details are provided in the permit application to Environment Australia.

It is also expected that the proposal would result in an overall increase in rocky habitat; rock would be placed to maximise the effectiveness, or useability of the habitat for example by providing the greatest length of rock/sediment interface practicable (such interfaces being known to provide valuable habitat).

It is intended that a comprehensive monitoring program be undertaken during the ocean disposal of the dredged materials. The nature, extent and details of this program would be agreed with all regulatory authorities prior to any disposal works being undertaken. The results of this monitoring program would be progressively re-evaluated against anticipated distribution patterns and effects and, if necessary, the disposal program modified to minimise any adverse environmental effects.

8.10.9 Other users of the area

The offshore disposal locations are apparently highly regarded by recreational line fishers, based on discussions with NSW Fisheries. Particularly sought after are immature reef species such as young snapper. It is thought that the success of the disposal site for recreational fishing is due to the existence of 'solid' objects on the seabed, being the rock from the harbour deepening project undertaken over the period 1978 to 1983, which was evident in the sidescan sonar records as noted above. Commercial fishermen operating in trawl fisheries avoid the proposed disposal site due to the higher risk of damage to nets and other trawl gear in this area. It has been noted in correspondence with the Newcastle Commercial Fishermen's Cooperative that commercial fishers only utilise areas offshore of the proposed disposal site.

Aside from some use as a recreational fishing ground and an area that recreational boaters and commercial shipping may traverse, the proposed disposal site is not utilised by others. It is not expected that the proposed disposal of dredged material would adversely affect the above users, except over the short term during the disposal activities when access to the area would be restricted. It is probable that recreational fishing may be enhanced in the future by the creation of new rocky offshore habitat.

9

Overview of alternatives

This chapter describes alternatives to the proposal, including the 'do nothing' option and alternatives to port expansion in the proposed location; and alternative technologies available for the treatment of contaminated materials.

9.1 The 'do nothing' option

A broad assessment of the option of not going ahead with the proposal is required in the EIA process. When linked with the need, objectives and justification of the proposal it brings perspective to the decision-making process.

The 'do-nothing' option in the case of the proposal raises two major key issues:

- No expansion to the infrastructure of the current Port of Newcastle would be possible; and
- Around 200,000 m³ to 300,000 m³ of contaminated materials would be left indefinitely in the South Arm.

It is considered that the implications of the do-nothing option would be as follows.

9.1.1 No expansion to the infrastructure of the current Port

There are no obvious or direct benefits to not expanding port infrastructure in the South Arm. The significance of the Port to the State's economic development is well recognised, as is the statewide shortage of suitable deepwater port land. Without the deepening of the South Arm, the Hunter would not be well equipped to meet the forecast growth in port-related industry and marine activity.

If the proposal does not proceed, other non-port related use of adjacent land and the waterway may be considered. The highly developed nature of the proposed dredge area and industrial surroundings does not readily lead to any obvious conservation or alternative development potential. Some benefit may result from the fact that there would be no modification of the current environment, such as removal of the small area of mangroves adjacent to the Tourle Street bridge. Similarly there would be no temporary environmental risk associated with the dredging such as turbidity or noise. However, even if the proposal proceeds, these environmental impacts are considered manageable, as is described elsewhere in the EIS.

Potential concern

If the proposal does not proceed, there is concern that the Port of Newcastle and the surrounding region would not be in a position to meet future demand for deepwater port land for industrial and marine development. This is likely to result in reduced economic growth of the region. If the proposal does not proceed, future industrial and marine development may relocate to other states with resultant potential losses to NSW.

9.1.2 Leaving contaminated materials in the South Arm

It is often preferable to leave contaminated sediment in a body of water to avoid potential environmental damage that may result should contaminants become mobilised during dredging or removal. Preventative methods have been developed to

isolate and/or remediate in-situ contaminated sediments. The three common approaches are:

- In-situ capping;
- In-situ containment; and
- In-situ treatment.

If the contaminated sediments were to be left in their current condition they would be relatively contained. However, the continual risk and uncertainty of potential environmental damage would remain should the contaminants become mobilised.

This EIS has not considered the case of leaving the sediments in the South Arm as it would not be possible to achieve the primary aim of the proposal – to provide deep water access to Cape class and Panamax class vessels – without disturbing the sediments.

9.2 Alternative locations for port expansion

The South Arm has been identified as the most suitable location for future port expansion (including new berths), mainly because of its proximity to transport infrastructure and its more passive hydraulic characteristics (compared to the north arm).

9.2.1 The north arm option

The north arm is considered a less viable option, as there are a number of potential environmental impacts on surrounding land uses and hydrology. SMEC Pty Ltd was commissioned by the Premier's Department in 2002 to undertake environmental studies for a north arm dredging option and port expansion. SMEC identified a number of potential impacts on the Kooragang Nature Reserve, Fullerton Cove and the estuarine environment, some of which are outlined below:

- The Kooragang Nature Reserve is a significant habitat for migratory waterbirds and is protected under several international agreements to which the Australian Government is a contracting party. Potential negative impacts on the wetlands would include the demise of habitat conditions and possible loss of significant wader birds and other threatened species;
- Dredging of the north arm and associated ship movements have the potential to impact on the estuarine environment, including the intertidal feeding areas to the north;
- The north arm channel option could potentially lead to an increase in tidal discharge from 80 percent to 95 percent. Changes to tidal discharge may affect sediment transport processes at the inlet, although this is not considered a major constraint. The South Arm velocities and tidal discharges are much lower than those in the north arm; and
- There is likely to be further penetration of salinity into the estuary and all commercial oyster leases in the Hunter are in the north arm. Bioaccumulation of contaminants in oysters and increased turbidity is likely to result in a negative impact on the local fisheries.

SMEC (2002) also identified the following factors, which indicate that the South Arm option would be the most viable:

- The need for maintenance dredging would be considerably higher in the north arm than the South Arm;
- Sediments in the Hunter River are contaminated with the greatest concentrations of pollutants in the southern section of the South Arm;

- Contamination levels in the north were typically well below background levels; and
- Removal of the contaminated sediments from the river would be beneficial to the estuarine environment.

9.2.2 Providing future berths along the south bank of the South Arm

No suitable locations for future berths are available along the south bank. The majority of land adjacent to the south bank is subject to existing and/or proposed commercial and industrial activities.

In addition, berths located along the south bank would be further away from the industries they would be servicing (in the Tomago industrial area and on Kooragang Island). This would require materials and product to be transported a greater distance, including a need to cross the South Arm (potentially by road). These factors would result in the need for additional infrastructure development and the potential for disruption to users of existing facilities.

9.2.3 Alternative berth locations along the north bank of the South Arm

There is no land available further to the east. Other land adjacent to the South Arm further to the east has been identified by Newcastle Port Corporation for port and industrial development projects, including expansion of existing port related facilities, which are related to the adjacent land use.

Land to the east would also be further away from the proposed multi-user port and transport corridor to the Tomago industrial area.

9.2.4 Locating the swing basin on the north bank of the South Arm

Locating the swing basin to the north would require relocation of Cormorant Road. While it is understood that relocation of Cormorant Road is being considered in the long term, the timing of this is not compatible with the proposal.

The proposed arrangement of the swing basin is considered the most appropriate, in terms of the existing geometry of the river, vessel navigation requirements, land available, the available area, time constraints, and the location of Cormorant Road.

9.3 Remediation technologies available for treatment of sediments

There are a number of techniques for managing contaminated sediments, and the technique employed normally depends on the situation, as well as other factors such as cost, availability of technology, and potential environmental benefits and impacts.

A number of treatment technologies are available for treating sediments containing PAHs. Many of these technologies have been used for remediation of PAH contaminated soils in Australia and overseas, but remediation of contaminated sediments is a relatively new field in Australia.

The primary technologies that have been used overseas for sediments containing PAHs are as follows:

- Thermal desorption/oxidation;
- Incineration;
- Cement kiln destruction;
- Solvent extraction/thermal oxidation;
- Supercritical fluid extraction/thermal oxidation;
- Pyrolysis;

- Immobilisation; and
- Bioremediation.

Within each of these technologies there are a number of variations. For example, thermal desorption can be undertaken by direct or indirect means. Bioremediation can be undertaken by a number of methods, such as land farming, biopiles or remediation within a slurry reactor. Brief descriptions of each technology are provided below.

9.3.1 Thermal desorption/oxidation

Thermal desorption is a generic description of a process that is used to physically separate volatile and semi-volatile compounds by heating a material (soil or sediment) to temperatures between 90°C and 540°C, depending upon the process used. Generally, water, organic compounds, and some volatile metals are vaporised from the soil or sediment in this first stage of the process.

The volatilised gases can be combusted with fuel in a thermal oxidation unit or 'afterburner', which converts the volatile hydrocarbons into carbon dioxide and water. Alternatively, the volatilised contaminants can be condensed from the hot gases, and the condensate can be treated to destroy the contaminants.

Thermal desorption/oxidation processes can be used to treat waste streams containing chlorinated hydrocarbons, organochlorine pesticides, organic and/or inorganic material with combined contamination of organics and heavy metals.

All thermal desorption technologies consist of two steps:

- Heating the contaminated material to volatilise the organic contaminants, and
- Treating the exhaust gas stream to prevent emissions of the volatilised contaminants to the atmosphere.

The main differentiating factors between the various thermal desorption systems are the methods used to transfer heat to the contaminated materials, and the gas treatment technologies used to treat the off-gases. Systems where heat is applied directly by radiation from a combustion flame are known as direct-fired thermal desorption systems.

Heat can also be transferred by convection from direct contact with the combustion gases. Systems employing this type of heat transfer are referred to as direct-contact thermal desorption systems. In all types of thermal desorption units, external fuel such as natural gas, liquid propane gas, diesel is needed to heat the soil or sediments. For wet sediments, a lot of this energy would be required to heat the material sufficiently to evaporate the water, before volatiles are driven off.

Heat also can be applied indirectly by transferring the heat from the source (e.g., combustion gases, steam or hot oil) through a physical barrier, such as a steel wall, that separates the heat source from the contaminated materials. Systems employing this type of heat transfer are referred to as indirect-contact or indirect-fired thermal desorption systems. They generally operate at lower temperatures than direct fired or direct contact systems.

Example of use

A thermal desorption unit is being used in Kwinana, Western Australia to clean soils and sludges containing hydrocarbons and hazardous chemicals such as PCBs and PCEs. The contaminants released from the thermal desorption process are subsequently destroyed by gas phase reduction. The products of this reduction are primarily methane and hydrochloric acid gas, which is further neutralised with a caustic solution.

Indirect thermal desorption is proposed to be used to treat soils and sediments at the Lednez site at Homebush Bay in Sydney. This approach is favoured due to the presence of persistent organic contaminants such as PCBs and dioxins. The recovered condensate (containing the desorbed contaminants) is intended to be treated onsite at a purpose built plant using a process called Base Catalysed Decomposition (Egis, 2002). Any condensate not suitable for BCD treatment will be transported to an existing facility in Queensland for treatment using plasma arc technology.

9.3.2 Incineration

Sediments are fed into an incinerator at a high temperature (usually between 760 to 1550°C) where in the presence of oxygen, organic components are converted into carbon dioxide and water. Depending on the type of contaminants present in the sediment, other gases that can be formed include nitrite oxides, nitrates, and ammonia (for nitrogen-containing wastes); sulphur oxides and sulphate (for sulphur-containing wastes); and halogen acids (for halogenated wastes).

Typical incinerators contain two combustion chambers with the second chamber operating at a higher temperature to ensure maximum combustion of organics. All units need to be fitted with an air pollution control system. This system may need to be quite complex if flue gases contain volatile heavy metals or toxic compounds. The ash produced may also need further treatment prior to disposal in a landfill.

Although commonly used in the U.S.A and Europe, incineration has generally not been accepted by the Australian community as a means of dealing with hazardous waste and as a result this method is unlikely to be seriously considered as a remediation option.

9.3.3 Cement kiln destruction

Contaminated wastes have been combined with the raw materials used to manufacture cement and burnt in a cement kiln. The high temperatures and alkaline conditions within the kiln lead to the decomposition of chlorine and sulphur contaminants into neutral forms. No chemical residues or solids are produced during the process as all matter is incorporated into the cement product (clinker). The integrity of the clinker however may be affected if large quantities of solid waste are introduced with the cement raw ingredients (*Environment Australia, 1997, p.38*).

9.3.4 Pyrolysis

This pyrolysis process involves heating solids in the absence of oxygen and under pressure at temperatures typically above 430°C. The process vaporises complex molecules into simpler combustible gaseous molecules such as carbon monoxide, hydrogen, methane and other hydrocarbons. The resulting gas requires further treatment, such as destruction in a 1200°C afterburner. If the emitted gases are cooled without further treatment they form contaminated water precipitate that also requires treatment prior to disposal.

This process can achieve greater destruction and removal efficiencies than incineration. It is also able to produce an inert slag by-product that is resistant to leaching. The inert slag can then be used to immobilise residual metal contaminants.

Drying and screening of the contaminated material is generally required prior to treatment. Most pyrolysis technologies are still in a development stage. Emissions controls are required for pyrolysis facilities. The cost of pyrolysis is high due to facility and energy needs.

9.3.5 Wet air oxidation

Wet air oxidation can be used to treat hazardous waste waters and sludges containing PAHs. The process is based on a liquid phase reaction in water using dissolved oxygen to oxidise contaminants so that they are destroyed or reduced to less harmful components. It is a commercially proven technology, and operates at temperatures of between 150 and 325°C and at one-tenth the pressure of supercritical oxidation. Further treatment of off-gases and liquid streams from the process may be required.

9.3.6 Electrochemical oxidation

Electrochemical oxidation involves both the destruction of volatile organic compounds and the separation of heavy metal contaminants. An electric current is passed between two electrodes immersed in the contaminated material, which

stimulates reduction-oxidation reactions. These break down the organic contaminants into carbon dioxide and water. Heavy metals are transformed into ionic complexes which collect on the electrodes and which can be easily removed once remediation is complete.

The process has low energy requirements and generally produces no regulated waste streams (Doering et al; 2001). The metals collected at the electrodes can be recycled or disposed.

Example of use

Electrochemical oxidation has been used successfully in Europe both in-situ and ex-situ. It is currently being trialled for use in the U.S. A joint project between the U.S. Army Corps of Engineers, the Natural Resource Research Institute, the Minnesota Pollution Control Agency and Weiss Consulting was recently carried out to demonstrate the use of this technology in treating PAH contaminated sediments drawn from Duluth Harbour in Minnesota.

9.3.7 Bioremediation

Bioremediation uses microbiological activity to destroy organic contaminants, or to remove inorganic contaminants. Contaminants are converted to less toxic or non-toxic forms by microbial populations utilizing substances in the material as food sources. In recent years, bench scale testing has indicated bioremediation to be effective in destroying some organic compounds.

Bioremediation is a complex process involving factors such as microbial selection for the target contaminants and simulation and maintenance of optimum environmental characteristics for the host microbial population (temperature, pH, oxygen concentration, nutrient levels). This process has been in situ tested and proven to yield greater results in engineered treatment systems.

Heavy metals cannot be treated using bioremediation and may need to be removed prior to processing if their presence would affect microorganisms. Some bioremediation methods may also not be suitable for sediments with very high concentrations of contaminants.

Example of use

There are a number of patented bioremediation processes in use throughout the world. One such example is the FORTEC process that is used to remediate sediments taken from the port of Amsterdam. Bioreactors were used to treat contaminated sands that were first separated out from the sediment using hydrocyclones. Hydrocyclones were used in order to reduce the particle size to less than 20 μm . After 15 days 85 percent of the PAHs had been removed.

9.3.8 Solvent extraction

A solvent is employed to separate contaminated sediments into particulate solids, water, and concentrated organic compounds. Recovery rates are dependent on the difference between the solubility of the contaminant in the sediment and of it in the solvent. Solvents require regeneration, which can be energy intensive. The toxicity of the solvent needs also be considered as traces of it may remain in the treated sediment.

9.3.9 Soil washing

In soil washing a water-based fluid containing agents such as surfactants, acids, or chelating agents is applied to the material, which separates contaminants from sediment. The solution needs to be recovered and the contaminants separated and controlled. This process is commonly used in combination with another remediation technique such as bioremediation, incineration or stabilisation.

This process has been proven to be most effective on sand particles and is used primarily to treat halogenated and non-halogenated semi-volatile organic compounds and polychlorinated biphenyls (PCBs) (US Naval Facilities Engineering Service Centre). It can also be used to remove metals and inorganics. It should be noted that the extraction techniques that use solvents, agents or fluids for extraction might require multiple stages due to the nature of contaminants in the sediments. Many solvents can only be used for one type of contaminant (US Corps of Engineers).

9.3.10 Stabilisation

Stabilisation (sometimes referred to as solidification or immobilisation) is achieved by altering the physical and/or chemical characteristics of the sediment by stabilising it in a solid matrix and by encapsulating it within a binder material. Stabilisation reduces the potential for contaminants to be released from the sediment into the environment of the final disposal site. Stabilisation technology has been applied in Japan to sediments containing toxic substances and in the United States to industrial wastes (Fleming et. al: 1991).

Binder materials can include cement, kiln dust, lime/fly ash, silicates, bitumen, or thermoplastics. Addition of some binder materials such as cement can increase the physical strength of the waste material, as well as minimising leachability of contaminants. This enables it to be used as an engineering fill material.

Example of use

In December 2002, coal tar contaminated soils excavated from a site in Hickson Roadway, Sydney were treated using a commercially available binding agent. Following treatment to contaminated soil was suitable for disposal to a licenced landfill, after receiving an immobilisation approval from NSW EPA.

9.3.11 Comparison of sediment treatment options

Based on a literature review of possible suitable treatment technologies, an overview of treatment option has been compiled and is provided in Table 9.1. This overview allows a general comparison of alternative technologies to be made. The overview in Table 9.1 provides the following information:

- Typical operating parameters;
- Typical process by-products;
- Process advantages;
- Process disadvantages; and,
- Known successful application of the technology to PAH contaminated sediment or soil.

From Table 9.1 it can be seen that:

- There are limited examples in the literature of cement kiln destruction, pyrolysis, supercritical fluid extraction technologies being utilised to treat PAH contaminated material;
- Although a number of treatment technologies, such as incineration wet air oxidation, electro-chemical oxidation, bioremediation (bioslurry) and solvent extraction, have been applied to soils and sediments containing PAH contamination, their full-scale use for the treatment of PAH contaminated material is currently unproven;
- Some technologies such as soil washing and bioremediation have been used overseas to treat PAH contaminated soil however their application to this type of contaminated medium in Australia has not been tested; and
- Other technologies, such as thermal desorption and stabilisation have been used in Australia and therefore it can be considered that their application was generally accepted by the approval bodies.

Table 9.1 Overview of alternative treatment technologies

Treatment technology	'Typical' operating conditions	By products	Advantages	Disadvantages	Examples of use on PAH contaminated sediments/soils
Thermal Desorption	320 – 560°C (high temperature process) 90–320°C (low temperature process)	Hot gas stream containing low levels of contaminants (direct thermal desorption) Liquid waste requiring secondary treatment (for indirect thermal desorption) Solid residues from gas treatment system	Broad applicability Success on similar projects Local availability of both direct and indirect thermal desorption technology	Contaminants are not destroyed – secondary process required Costs increase with increasing moisture content High clay and humic material can require longer reaction times as contaminants are bound in material	Buffalo River, New York, (full scale application) AGL site Sydney, NSW (soils, sludges)
Incineration	760 – 1550°C	Gas stream containing CO ₂ , H ₂ O, particulates, ammonia (for nitrogen-containing wastes, HCl (for feed streams with chlorinated contaminants), NO _x , SO _x Ash	Reduction in volume of waste streams High destruction efficiency Broad applicability	Difficult to obtain community acceptance Ash may contain heavy metals and require further treatment Volatile heavy metals can be present in flue gases and require removal Potential for undesired by-products to be formed from reaction of metals with other elements to form volatile and toxic compounds High temperature operation High capital and operating costs	Bayou Bonfouca Los Angeles (pilot scale)
Cement Kiln destruction	1450°C – 2000°C	Off gases containing particulate matter Cement clinker	Can process large volumes of waste containing high calorific value No chemicals or solid residues requiring disposal	Large soil quantities cannot be treated in one stage Off gas processing required Exhaust gas volumes can be greater than other treatments	No examples found for treatment of PAH contaminated material

Table 9.1 continued.

Treatment technology	'Typical' operating conditions	By products	Advantages	Disadvantages	Examples of use on PAH contaminated sediments/soils
Pyrolysis	> 101.3 kPa > 430°C	Gas stream containing CO, H ₂ , CH ₄ , organics and possibly volatile heavy metals	Can achieve greater destruction and removal efficiencies than incineration. Also able to produce an inert slag end-product which is resistant to leaching. Inert slag is then able to immobilise residual metal contaminants.	Sediments need to be dried to achieve low moisture content prior to treatment Off gas stream requires further treatment (would form contaminated water if cooled) Treatment not suitable for inorganics Residual sediment/soil may contain heavy metals and other contaminants that require secondary treatment prior to disposal	No examples found for treatment of PAH contaminated material
Wet Air Oxidation	150 – 325°C > 2-20 MPa	Off gases (CO ₂ , H ₂ O) and potential NH ₃ , HCl, SO _x Contaminated liquid	Oxidises contaminants so that they are destroyed or reduced to less harmful components Commercially proven technology	Further treatment of off-gases and liquid streams from the process may be required	Elburg, Netherlands (pilot scale)
Electro-chemical Oxidation	Low temp Ambient pressure	CO ₂ , H ₂ O vapour, potential volatile contaminant gases Solid residue (treated sediment, solids collected on anode and cathode)	Low cost No additives required	Treatment of off gases may be required Disposal of heavy metals required Not suitable for metals	Minnesota, USA (pilot scale)
Bio-remediation (bioslurry)	Slurries typically 10 –40% w/w solids 25°C < T < 50°C	Residual solids Air emissions Waters removed from final dewatering after treatment	Less expensive than thermal treatment technologies	More suitable for treating small volumes Not suitable for high concentrations of contaminants Duration required for remediation is greater than for chemical/thermal methods Residual sludge may require further treatment prior to disposal Treatment effectiveness dependent on presence of particular micro-organism Final dewatering step may be costly and waters may require further treatment	Port of Amsterdam Toronto Harbour, Ontario, Canada (pilot scale)

Table 9.1 continued.

Treatment technology	'Typical' operating conditions	By products	Advantages	Disadvantages	Examples of use on PAH contaminated sediments/soils
Bio-remediation (landfarmin g/soil piles)	40 – 55°C	Off gases (potentially with volatile contaminants) Solids (bulked with organic materials)	Simple process, involving relatively low capital expenditure, and using common earthmoving equipment Able to be undertaken at remote locations	Degradation rates affected by temperature Large areas required Duration required for remediation is greater than for chemical/thermal methods Slow process Leachate collection systems may be required	Zeelands, Netherlands (pilot scale) Hamilton River, Ontario, Canada
Solvent Extraction	Varied according to solute /solvent relationship	Solid residue Contaminants dissolved in gas/liquid solvent	High extraction efficiency Low temperature and pressure operation	Contaminants are not destroyed – secondary process required May require multiple treatments if certain solvents remove one sort of contaminant Volatile metals can be extracted with other contaminants & require separate treatment	Great Calumet, Indiana (pilot scale)
Supercritical Fluid Extraction	Temperature & Pressure > supercritical Temperature and Pressure of solvent	Contaminants in fluid stream Residual solids	Supercritical fluids have higher ability to dissolve organic compounds than most other solvents Commonly used super-critical fluids are CO ₂ and H ₂ O which are non-toxic, non-flammable, readily available, inexpensive	Second stage cleaning of fluid and destruction of contaminants required Process is still relatively new and not as commercially developed as other technologies	No examples found for PAHs

Table 9.1 continued.

Treatment technology	'Typical' operating conditions	By products	Advantages	Disadvantages	Examples of use on PAH contaminated sediments/soils
Soil Washing	Varied, generally ambient	Wash solution Residual solids	Good for remediating soils with mixture of organics, inorganics, metals	Aqueous by-product stream requires treatment Soil particles need to be cleaned of wash fluid Complex solid waste mixtures to dispose More suited to granular soils	Hamburg Germany (full scale application)
Immo-bilisation	Varied according to binding material	Solid	Contaminants bound within stable solid matrix	Long term effectiveness of some binding materials unknown Increase in volume of solids to dispose of Certain wastes may not be able to be treated using this method Pretreatment of sediments /waste may be required prior to mixing with binders	Coal tar contaminated soils with high PAH concentrations treated at Hickson Rd, Sydney.

9.4 Preferred treatment option

9.4.1 Discussion of determining factors

A preferred alternative treatment technology was deduced following consideration of a number of critical operating and technological determining factors. The determining factors considered critical to the proposed operation of a treatment facility at the closure area site included:

- Proven full-scale utilisation to treat PAH contaminated soil or sediment;
- Requirement for sediment pre-treatment;
- Production of by-products that are not suitable for beneficial reuse;
- Likelihood of treatment success (i.e. technology would allow treatment targets to be met);
- Timeframe for successful treatment;
- Previous extensive use in Australia (which would indicate a degree of operational knowledge and available technical support);
- General community acceptance and confidence in the technology; and
- Financial viability.

Analysis of each of the alternative treatment technologies described in Section 9.3 was undertaken with respect to the above determining factors. The analysis is provided below.

9.4.2 Analysis of alternative technologies with respect to determining factors

Process	Discussion of determining factors
Thermal Desorption	Thermal desorption has previously been used in Australia to treat soil and sediment containing similar contaminants to those encountered in the South Arm of the Hunter River. It is thus a proven technology on full-scale applications.
	The treatment technology would remove contaminants from the sediment and therefore it would allow the sediment to be reused elsewhere. Emissions and by-products would be controlled within the process and therefore the technology would not create other waste disposal issues.
	This technology however, is relatively expensive and requires the sediment to be pre-treated (dewatered) prior to treatment. The toxicity of the waters associated with the sediments however would necessitate treatment to a significant level – this may alone preclude the use of the technology on a large volume of material.
	Overall, it is considered that there is merit in adopting thermal desorption as a treatment option but it would only be applicable to a small volume of highly contaminated sediments.
Incineration	Incineration facilities have been proposed for used in Australia on previous occasions and operation of this technology has received strong and wide spread resistance from the general community. It is for this reason that incineration is not considered to be a suitable treatment option for use at the closure area.

Process	Discussion of determining factors
Cement kiln destruction	Although the use of cement kilns has been evaluated to be relatively safe if it is properly designed and operated (Environment Australia, 1997), their use might not be accepted by the wider community. Consideration of use of this technology to remediate soils and sediments from the East Perth Gasworks in Western Australia was abandoned after significant community concerns (Environment Australia, 1999). It is for this reason that cement kiln destruction is not considered a suitable treatment option for use at the closure area.
Pyrolysis	Although treatment of sediments may be technically viable by pyrolysis, the technology is not known to have been used to treat PAH contaminated materials. Also, the technology requires that the input material be relatively dry and therefore a large amount of energy would be required to drive off excess moisture from the river sediments prior to treatment. It is for these reasons that pyrolysis is not considered a suitable treatment option for use at the closure area.
Wet Air Oxidation	This technology is a relatively new technology that has not been applied in Australia nor has it been proven on a full-scale project. It is therefore considered that wet air oxidation is not a suitable treatment option for use at the closure area.
Electro-chemical Oxidation	Although this technology is relatively low cost, there appears to be no literature regarding its use in a full-scale capacity. Furthermore, the technology does not appear to have been used in Australia on similar projects. For these reasons, electro-chemical oxidation is considered inappropriate for use at the site.
Bioremediation	Bioremediation is a technology typically applied to relatively small volumes of materials. This technology may also create water treatment issues and odour impacts. Furthermore, the timeframe for treatment is difficult to estimate and the residual concentration of contaminants may not meet treatment targets. It is for these reasons that bioremediation is not considered a suitable treatment option for use at the closure area.
Stabilisation	This technology has been successfully used in Australia for treatment of organic contaminated soils. The process binds contaminants within a matrix rendering them immobile and preventing the contaminants from causing harm. The resultant treated product can be used as a fill material of certain sites. Since the water content of the sediment is used in the process, this technology is considered particularly suited to use at the site.
Solvent Extraction	As discussed above, the solvent extraction remediation technique separates the contaminants from the soil medium and therefore requires a further process to treat the separated contaminants. Sufficient separation of contaminants from the sediments may be achieved after numerous treatment runs that might take some time. Again, there appears to be little information in the literature regarding use of this technology in a full-scale capacity. Furthermore, the technology does not appear to have been used in Australia on similar projects. For these reasons, solvent extraction is considered inappropriate for use at the site.
Supercritical Fluid Extraction	The supercritical fluid extraction process is still relatively new and not as commercially developed as other technologies. The literature reviewed does not describe its use for the treatment of PAH contaminated soil. Therefore this treatment technology is considered inappropriate for use at the site.
Soil Washing	Although soil washing has been successfully used overseas for the treatment of PAH contaminated soils, the technology is more suited to granular soils and less suited to treating sediments. The process also creates a complex solid waste by-product that must be disposed. Therefore this treatment technology is considered inappropriate for use at the site.

9.4.3 Preferred option

Based on the analysis of the alternative treatment options, it is considered that stabilisation would be the most suited technology for treatment of contaminated sediment from the Hunter River and other fill materials excavated from the proposed swing basin area.

Stabilisation is considered the most appropriate technology for the following reasons:

- it is a proven technology previously used in a full scale capacity in Australia;
- the technology uses a simple mixing process, similar to that used to produce concrete at a concrete batching plant, and of utilising common materials, such as cement or fly-ash;
- as sediments are to be extracted from the river, it is expected to have a relatively high moisture content. The stabilisation technique utilises the water content to bind the contaminants into a matrix;
- the resultant product would be suitable for use as a fill material on the closure area site maximising the beneficial reuse of the dredge and excavated materials; and
- the technology would be cost effective.

In summary, stabilisation is considered to be the most suitable treatment technology for the treatment of sediment and other fill materials, primarily based on its simplicity, previous use and cost efficiency. However, the successful remediation contractor may wish to utilise another treatment technology to achieve the desired treatment outcomes. In this case, thermal desorption is recommended as an alternative to stabilisation.

Thermal desorption/oxidation has been used both in Australia and overseas for treating a variety of organic substances on specific projects, including PAHs in sediments. This technology is favoured for use at the Lednez site at Homebush Bay, Sydney, where dioxins and other organic substances are present in soils and sediments. It is also proven to be suitable for treatment of large quantities of material.

PART C

ASSESSMENT OF POTENTIAL ENVIRONMENTAL IMPACTS



10 Land use and infrastructure

This chapter provides information on the land use environment of the study area, and describes infrastructure located in the study area. Land uses and infrastructure in the vicinity of the South Arm are described. The potential impacts of the proposal are identified and mitigation measures recommended.

10.1 Location and context

The South Arm, and adjoining areas affected by activities are part of the proposal, are located approximately five kilometres northwest of the Newcastle CBD.

Kooragang Island is located to the north of the South Arm, with the Kooragang Coal Terminal to the northeast and Kooragang Nature Reserve located further to the north.

The OneSteel site and the closure area site adjoin the South Arm to the south. Residential areas in the suburb of Mayfield are found further to the south.

A variety of industrial and port-related land uses are located to the east. Further to the east, the Hunter River discharges to the sea, to the south of the suburb of Stockton.

The Tourle Street bridge is located to the west. The Hunter River divides into the north and South Arms further to the west, approximately 10 kilometres upstream of the Tourle Street bridge. The South Arm extends approximately 12.5 kilometres, before rejoining the north arm and discharging to the sea. The topography of the area surrounding the river is generally flat. The environment in the vicinity of the site is disturbed as a result of previous industrial activities at the port, and those associated with the historical operations of BHP Billiton on the southern bank of the South Arm. The southern bank primarily consists of artificial walls (rock rubble). The northern bank consists of mangroves at its western end, and grassed areas adjoining a narrow sandy beach to the eastern end.

Further information on the main land uses, both current and proposed, in the vicinity of the study area is provided in section 10.2 (below) and indicated in Figures 10.1 and 10.2.

10.2 Existing land use environment

10.2.1 Kooragang Island

Kooragang Island lies between the north and South Arms of the Hunter River, covering approximately 2,560 hectares. The island stretches for approximately 11 kilometres from east to west.

The area originally consisted of a series of deltaic islands (including Ash, Dempsey and Moscheto Islands, which formed part of an area known as the Hunter River delta).



Figure 10.1 Land uses in the wider area

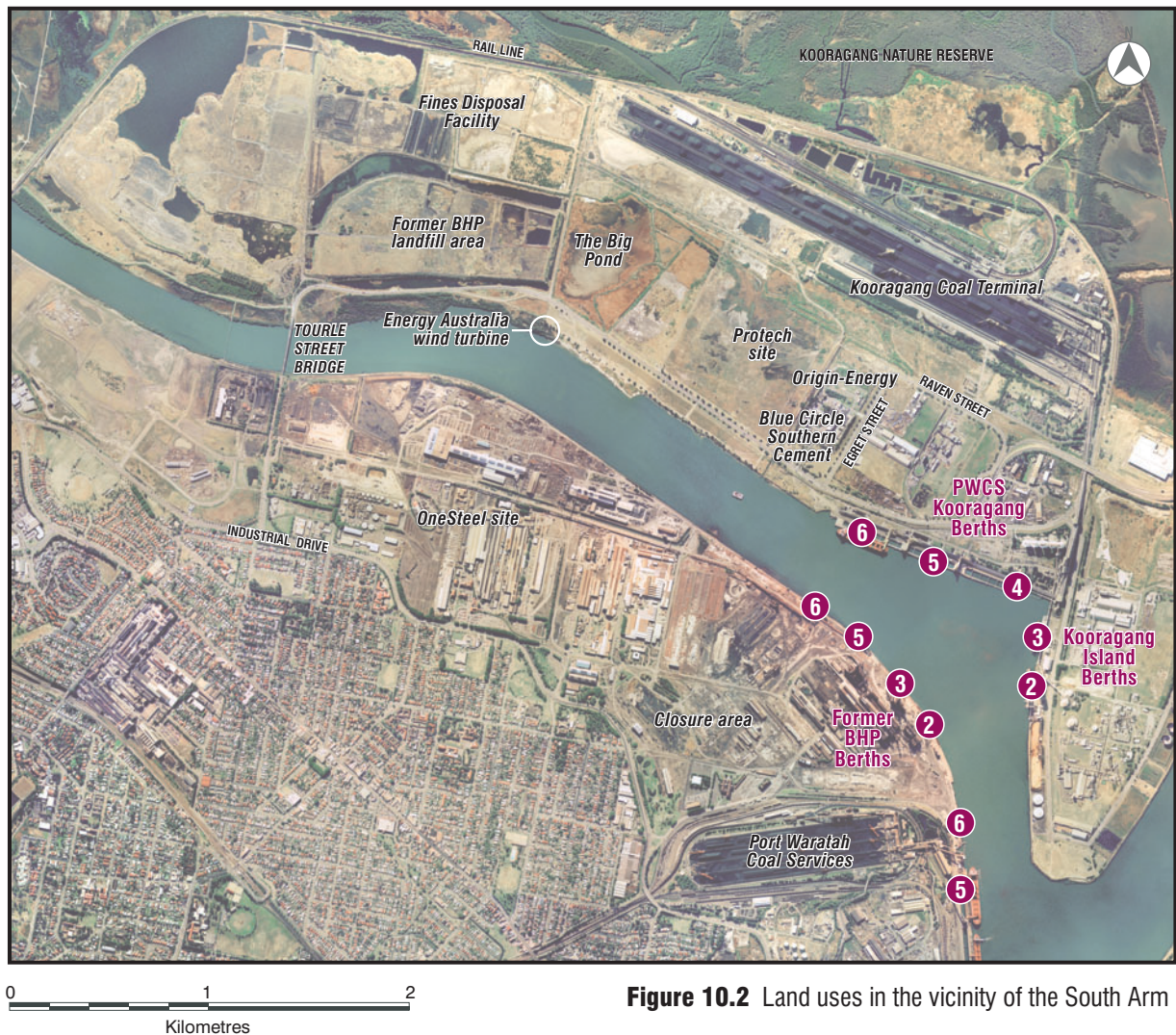


Figure 10.2 Land uses in the vicinity of the South Arm

6 Berths

Kooragang Island was created over a number of years through the deposition of dredge spoil from the Hunter River and fill from the surrounding area.

In 1951 the Public Works Department began a new program of dredging and land filling in response to increased demand for industrial land in the area. These activities were supported by the passage of the Newcastle Harbour Improvements Act in 1953, one of the main aims of which was to create a single land mass of the islands of the lower Hunter. The NSW Geographical Names Board applied the name 'Kooragang Island' in 1968. Reclamation activities were completed in 1977.

Further information on the history of the island is provided in Chapter 18.

The Kooragang Island industrial area occupies approximately one third of the island, to the southeast. Kooragang Nature Reserve (refer section 10.2.5) occupies a similarly-sized area to the north of the island.

10.2.2 Overview of land uses surrounding the South Arm

The majority of works associated with the proposal would occur in an area that is dominated by port and industrial land uses.

Land uses immediately surrounding the South Arm (the area that would be dredged/excavated) include (refer to Figure 10.2):

- undeveloped land along the river bank to the north between the South Arm and Cormorant Road – used intermittently for access to the river and recreation (such as fishing from the banks) and the location of the EnergyAustralia Kooragang Wind Turbine;
- a small area of mangroves adjacent to the banks to the northwest;
- Cormorant Road, located to the north, which runs parallel to the riverbank (approximately 200 metres from the bank in most areas);
- a natural feature known as the Big Pond, located to the north. The Big Pond is an unfilled drainage depression which functions as a wetland intermittently fed by rainwater. It is recognised as having habitat value for migratory wader birds;
- former BHP landfill areas located to the north of Cormorant Road and to the west of the Big Pond; and west of Tourle Street bridge;
- the site subject to the Protech Steel proposal, located to the north of Cormorant Road;
- other industrial activities to the north of Cormorant Road (including Blue Circle Southern Cement and Origin Energy);
- port activities, including berths, to the east;
- the former BHP Steelworks site to the south; the portion of this site to the south west is now owned by OneSteel, and the closure area occupies the remaining area. (refer section 10.2.7 for more information); and
- the Tourle Street bridge to the west.

The South Arm itself currently experiences the following uses:

- prawn trawling (6 am – 6 pm, October to May);
- recreational fishing on the north bank of the South Arm;
- shipping movements containing bulk cargo; and
- ship berths.

An overview of specific land uses in the wider area is provided below.

10.2.3 Newcastle Port

The areas affected by activities that form part of the proposal are located just to the west of the existing Port of Newcastle.

The majority of port and industrial activities are located in the vicinity of the South Arm, and the river mouth to the east (downstream). Port activities are concentrated to the east of the dredging site.

Newcastle Port provides for the needs of a variety of importers, exporters, ship owners and operators using the Port. Facilities within the port include:

- modern berths including:
 - five bulk berths owned by PWCS;
 - two Kooragang Island bulk berths;

- berths, including:
 - four former BHP bulk berths;
 - one bulk berth (Steelworks channel);
 - two tie-up berths;
 - two general cargo berths at the eastern basin and two at the western basin;
- high performance coal loaders;
- vacuum unloaders for dry bulk products; and
- storage areas for an array of cargo types.

All wharves have road access and most wharves are equipped with rail access on the berth apron or at the rear of the berth.

Operational services provided by Newcastle Port Corporation include:

- 24-hour pilotage services;
- management of port safety and shipping movements;
- provision and maintenance of navigational aids;
- maintenance of navigational channels, including dredging activities;
- environmental management;
- leasing and hiring out of wharves, berths and port land;
- development of common-user port infrastructure; and
- trade development and promotion of the port.

10.2.4 Industrial land uses

There is a wide range of industrial land uses in the vicinity of the South Arm requiring access to port facilities. These include:

- coal receiving, stockpiling and loading;
- steel processing;
- scrap metal processing;
- cement production;
- wood chip handling;
- grain handling;
- a terminal for LPG storage and distribution;
- liquid waste management facilities;

- emplacement of waste from steel processes;
- oilseed processing plant;
- fertiliser production and storage;
- carbon dioxide plant;
- grain terminal; and
- rail stabling area.

10.2.5 Environmental protection land uses

Integrating the industrial needs of the local region and the State with conservation of the environment on and around Kooragang Island has been a concern for both government and the community over the last couple of decades.

In 1983 the NSW NPWS gazetted the Kooragang Nature Reserve. The main function of the reserve was to protect the wintering habitat of migratory shorebirds (an overview of the reserve is provided below, with further information provided in Chapter 13). Subsequently, the Newcastle Local Environmental Plan 1987 created two major zones on Kooragang Island – Zone 4(b), a General Industrial zone covering the south and west, and Zone 7(b), an environmental protection (wetlands) zone for the Kooragang Nature Reserve.

In 1990, based on the observation that over 1000 hectares of fisheries habitat had been lost in the Hunter estuary due to draining and filling, NSW Fisheries initiated the Kooragang Island Wetland Compensation Project. It was thought that rehabilitating degraded but still functional fisheries habitat, as well as creating wetlands, would not only help redress this loss but provide a model on which other projects could be based.

NSW Fisheries initiated the Kooragang Wetland Rehabilitation Project in 1993, to investigate and implement various ways of compensating for the loss of fish and other wildlife habitat due to years of clearing, draining and filling in the Hunter River estuary. The project area covers some 1,560 hectares on three sites in the Hunter estuary, on and around Kooragang Island. These sites include:

- Ash Island Site: approximately 750 hectares on the western end of Kooragang Island. Most of this site is owned by NSW Public Works and Services and is leased to the Hunter Catchment Management Trust (HCMT) for the purposes of the project. About 100 hectares are part of the Kooragang Nature Reserve (owned by the NSW National Parks and Wildlife Service);
- Tomago Site: approximately 800 hectares in the Tomago-Fullerton Cove area. Half of the site is owned by Tomago Aluminium Co. Pty. Ltd. and half is part of the Kooragang Nature Reserve; and
- Stockton Site: approximately 10 hectares near Stockton Bridge. Most of the site is part of the Kooragang Nature Reserve.

The project is funded mainly from Department of Land and Water Conservation's (DLWC's) Estuary Management Program, supplemented by other major sponsors from both the public and private sectors.

Kooragang Nature Reserve

The Kooragang Nature Reserve and nearby Fullerton Cove are located along the north arm of the Hunter River, approximately 2.5 kilometres north of the proposed South Arm dredging site.

Kooragang Nature Reserve is approximately 2,926 hectares in area and includes:

- approximately 7 kilometres of the north arm upstream of Stockton Bridge;
- Fullerton Cove;
- areas to the west of Fullerton Cove; and
- the northern area of Kooragang Island (extending to just west of the 132 kilovolts (kV) electrical transmission line which travels through the east of the island).

The reserve was established, and is protected under, the *NSW National Parks and Wildlife Act 1974*, as a 'nature reserve'. Nature reserves protect an area of special scientific interest, and are usually established to conserve native plant and animal communities.

As stated above, the Kooragang Nature Reserve is a significant habitat for migratory waterbirds. Migratory wading birds and their habitat are protected under several international agreements to which the Australian Government is a contracting party:

- Japan-Australia Migratory Bird Agreement;
- China-Australia Migratory Bird Agreement;
- Convention on the Conservation of Migratory Species of Wild Animals (Bonn Convention); and
- Convention on Wetlands of International Importance (Ramsar Convention).

Ten species of shorebirds that meet the requirements for listing of a site under the Ramsar Convention (that is, the wetland is considered to have international significance) have been recorded in the Hunter Estuary.

In addition, the area is also significant in terms of the habitat of other birds, fish habitat and amphibian habitat. There are records of many threatened species in the area, including at least five wader species listed under the Threatened Species Conservation Act.

10.2.6 Residential land uses

The nearest residential community is the suburb of Mayfield, located approximately one to two kilometres to the south of the river. The suburb of Stockton is located approximately four to five kilometres to the east. Fern Bay is located approximately four kilometres to the northeast.

10.2.7 Current development proposals

As listed in Table 10.1, a number of significant industrial and infrastructure developments have been proposed in the vicinity of the proposal.

Table 10.1 Proposed or recently approved developments

Proponent	Proposal and status
Port Waratah Coal Services	Stage 3 Expansion of Kooragang Coal Terminal. Development Consent granted in 1996 and several elements of the development are complete. The development includes: • construction of an additional two berths (one completed); • construction of an additional two coal stockpiles (part completed); • associated infrastructure (rail coal receipt facilities, ship loading facilities); and • temporary construction areas including works area and temporary sedimentation ponds (to collect dredge return water before discharge to Hunter River).
State Government	Redevelopment of the 'closure area' of the former BHP steelworks site, including: • demolition of the former BHP steelworks ; • construction of a multi-purpose shipping terminal; • remediation of contaminated land; and • industrial/port related redevelopment of the balance of the site.
Austeel	Austeel Steel Mill Facility The facility would receive hot briquetted iron and convert it into various finished steel products. Preliminary investigations in terms of site selection and environmental impacts are currently underway. The proposed site is located at Tomago (approximately 5 kilometres northwest of the south arm).
NSW Government	Multi-User Port and Transport Corridor A transport corridor (traversing the western end of Kooragang Island) and berth (within the south arm) are being investigated, to provide access between the port and the proposed industrial area at Tomago for the transport of raw materials and finished products.
RTA	Realignment of Cormorant Road and the duplication of the Tourle Street bridge Several options have been examined in terms of the possible relocation/realignment of Cormorant Road. Duplication of Tourle Street bridge is proposed as part of RTA's 5-year rolling program, with implementation depending on traffic and land use demands.
Protech Steel	Protech Cold Mill Facility The proposed development involves the production of approximately 520,000 tonnes per annum of high value-added coated and uncoated flat carbon steel products. It is the first stage of a long-term plan that may eventually involve future development of iron-making and steel-making facilities. Development consent for the first stage was granted on 14 May 2002. Construction is expected to start in the third quarter of 2003.

Former BHP Steelworks site

The closure area of the former BHP Steelworks site is the proposed location of the temporary storage, remediation and disposal of contaminated sediments.

The establishment of the BHP Steelworks at Newcastle in 1913 led to extensive development in subsidiary plants and associated industries, including factories for the manufacture of wire products, stainless steel, steel fabrication, galvanised iron and piping, treatment and processing of by-products and chemicals.

In 1999, BHP ceased iron- and steel-making operations on the site. The former Steelworks site, as a whole, had a total area of approximately 360 hectares.

OneSteel sites

OneSteel Ltd was formed as an independent company in November 2000. The land it occupies was subdivided from the former BHP Steelworks site on the formation of OneSteel. The main uses of the site (lot 222) directly adjoining the South Arm include:

- the Newcastle Rod and Newcastle Bar Mills and associated storage areas, operated by OneSteel. The mills produce almost one million tonnes of finished product per year, and employ approximately 400 people;
- Hunter Bulk Materials (trading as Steelstone) leases a portion of the site at the northern end (adjacent the South Arm) for the recycling and processing of slag materials;
- OneSteel's scrap metal consolidation and storage area;
- OneSteel's 'industrial park', which is used by small contractors and the new OneSteel fine wire galvanising facility; and
- An area leased by BHP-Billiton Steel Transport.

Other activities undertaken by OneSteel on sites subdivided from the former BHP Steelworks site include OneSteel Pipe&Tube (lot 225) to the west of the industrial park, OneSteel Wire (lot 224) and OneSteel's engineering, maintenance and manufacturing services department (proposed lot 2212 in DP 1013964).

The closure area site

In July 2002 the eastern steelworks area of the site (approximately 156 hectares, known as the closure area) was transferred to the NSW Government.

An environmental impact statement for the remediation of the closure area and construction of a Multi-purpose Terminal was prepared in August 2000. The proposed Multi-purpose Terminal consists of a container terminal, general cargo handling facility and a bulk-handling terminal on a 45 hectares site adjoining the South Arm. Remediation of the closure area is required prior to redevelopment.

The location of the proposed Multi-purpose Terminal is shown on Figure 10.3.

Development consent was given in April 2001 for stage 1 of the Multi-purpose Terminal project. Stage 1 comprises site remediation of the entire closure area, construction and operation of a container terminal and general cargo handling facility and associated dredging for the construction of multi-purpose terminal wharves.

BHP-Billiton is currently undertaking demolition of the former steelworks structures at the site. It is expected that demolition would be completed by the end of 2003.

In November 2002, Newcastle Port Corporation called for expressions of interest (closing end February 2003) for the design, construction, financing and operation of the Multi-purpose Terminal.

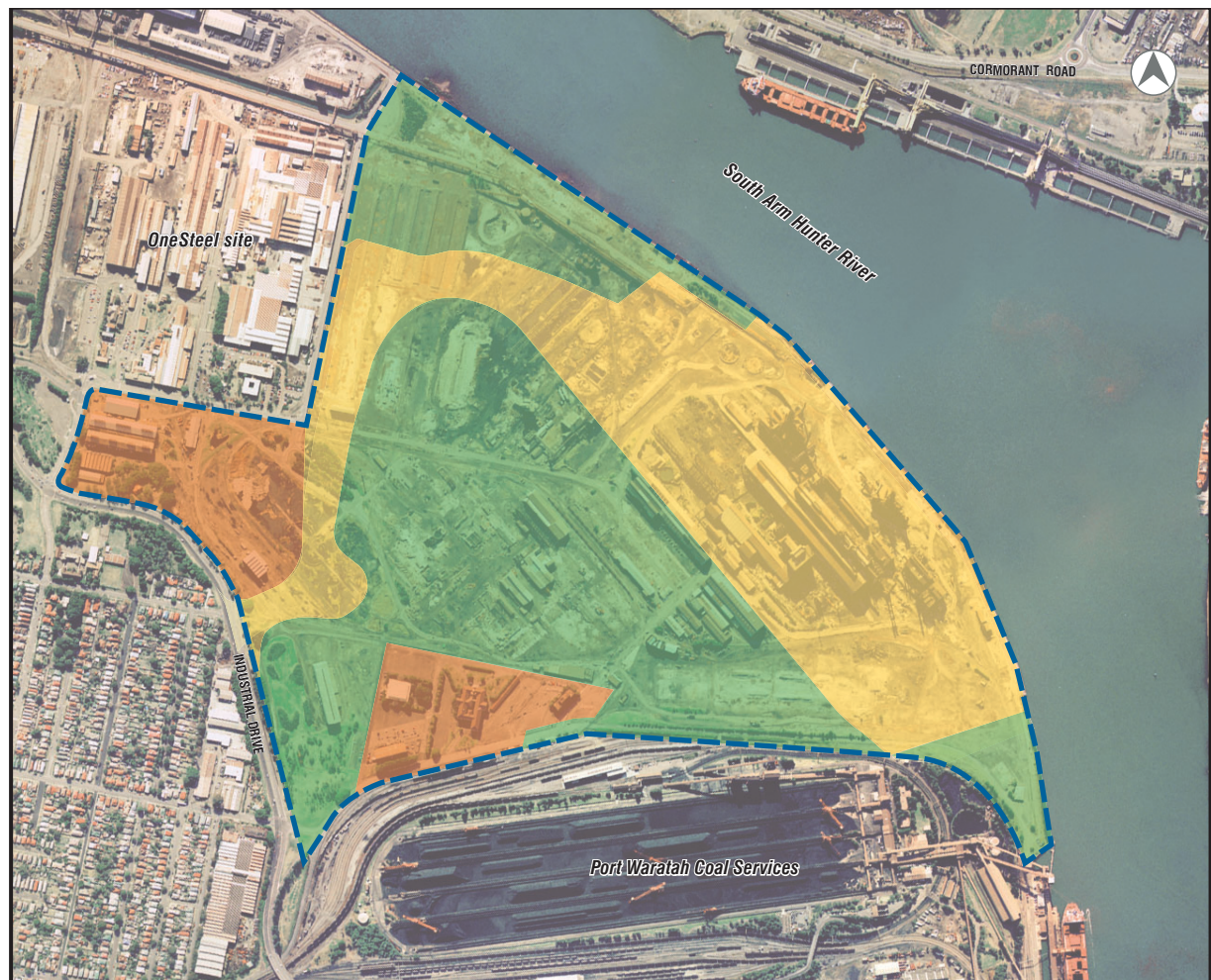


Figure 10.3 Possible future uses of the closure area

- Proposed multipurpose terminal development and access - approximately 53.4 hectares
- Future port and industrial area
- Areas not currently considered for development
- Approximate boundary of the closure area

Other activities

Other activities on the former BHP Steelworks site include the BHP-Billiton former supply precinct/lime kiln area (lot 223), Koppers Coal Tar Products, Hymix Concrete and Biospecialities Australia (ICI).

Multi-user port and transport corridor

The dredging and excavation of the South Arm involves the removal and handling of a total of 13.6 million m³ of material. This total includes around 6.4 million m³ of good quality sand, which is located within the dredge footprint beneath the marine silts and clay sediments that are located on the surface of the harbour floor. This sand is considered suitable for reclamation/filling activities associated with the construction of the proposed Austeel facility at Tomago and the multi-user port and transport corridor (dependent on the route chosen).

The sand would be delivered to the Tomago site hydraulically, through a discharge pipeline.

One of the proposals that would make use of the extension of the shipping channels is the proposed multi-user port and transport corridor, which is currently being investigated.

Part of the dredged sand volume could be used as fill to construct the transport corridor.

10.2.8 Other uses and activities

There are a number of commercial oyster leases towards the eastern end of the north arm (just over two kilometres north of where the north and South Arms of Hunter River rejoin before discharging to the sea).

Some commercial fishing takes place within both the north and South Arms.

The main recreational uses are fishing from boats and the banks of the South Arm.

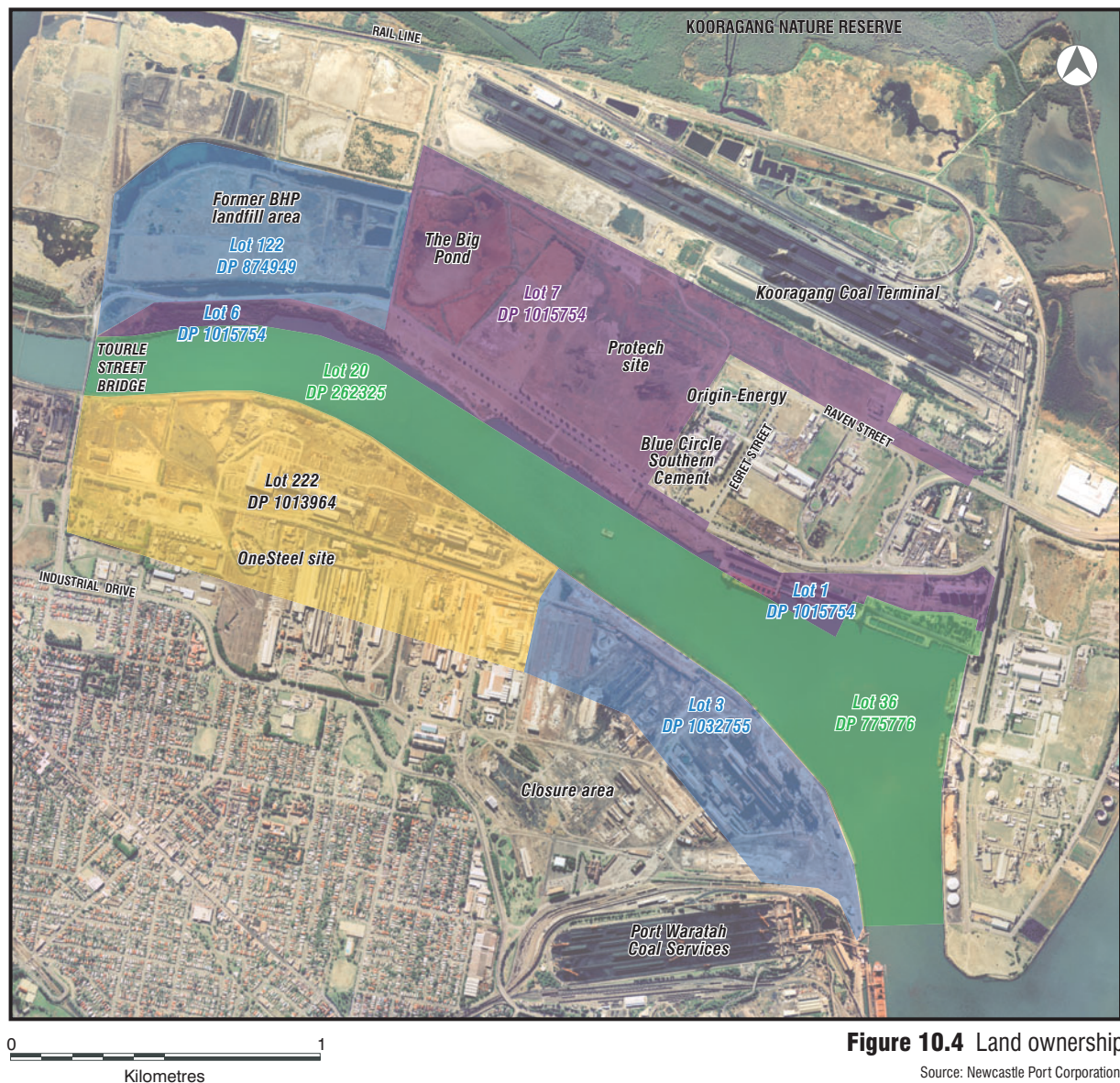
The EnergyAustralia Kooragang Wind Turbine (commissioned in 1997) is located approximately 50 metres north of the South Arm and approximately 1.3 kilometres east of the Tourle Street bridge.

10.3 Land ownership

Land ownership information is summarised in Table 10.2 and illustrated in Figure 10.4.

Table 10.2 Land ownership

Location	Description of affected land	Title reference	Land owner
The south arm	Land below mean high water mark - (eg 'river bed'/wet areas) – would be affected by dredging	Lot 20 DP 262325 Lot 36 DP 775776 NB: Newcastle Port Corporation has part ownership of lot 36 at K2 and K3 not affected by dredging)	Waterways Authority of NSW
Kooragang Island	Northern banks – affected by excavation/bank stabilisation	Lot 1, 6 and 7 DP 1015754	Minister for Commerce
		Lot 122 DP 874949	Crown Property Portfolio
Kooragang Island	Kooragang Waste Emplacement Facility	Various	RLMC
OneSteel site	Land near the southern banks to the southwest – affected by excavation for the swing basin. The total area of this lot is 119.9 hectares, with a 2.3 kilometres long northern boundary against the south arm	Lot 222 of DP 1013964	OneSteel Manufacturing Pty Ltd
Closure area	Land near the southern banks to the southeast – affected by sediment remediation activities. The site has an area of 156 hectares	Lot 3 of DP 1032755	Crown Property Portfolio



- Minister for Public Works and Services
- Waterways Authority of NSW
- Crown Property
- OneSteel Manufacturing Pty Ltd

General

Landowner's consent has been obtained and has been provided with the DA documentation. It should be noted that this does not apply to RLMC's sites, which have existing use rights as licenced Class 2 landfills (see below).

Aboriginal land claims

The Worimi Local Aboriginal Land Council (LALC) has a current claim under the *Aboriginal Land Rights Act 1983*, that includes the current study area. This claim (Claim No. 6686) covers the Hunter River and its tributaries to the mean low water mark. It extends from the inland locations of Morpeth and Clarence Town to the river outlet (entrance of Newcastle Harbour). The claim was lodged in April 2002 and is not likely to be resolved until 2004.

LALCs in New South Wales can claim unoccupied Crown land that is not needed for a public purpose. These claims do not rely on traditional affiliation with the land. Under the Act, land is granted as freehold. The current NSW government policy regarding unresolved claims is that no new interests will be granted over a claimed area until the claim is resolved (unless public safety is at issue). DIPNR is the administering authority and will consult with all known parties with an interest in the area when considering a claim.

Native title search

A search request was forwarded to the National Native Title Tribunal on 24 January 2003. A search of the Register indicated that there were no entries relevant to the current study area.

10.4 Status of Kooragang Island disposal sites

The Kooragang Waste Emplacement Facility is licensed by the EPA (licence Number 6437) as a Solid Waste Class 2 Landfill. This means that the landfill can accept wastes, excluding putrescibles waste, that are assessed as *inert waste* or *solid waste* following the technical assessment procedures outlined in Technical Appendix 1 of the EPA's Waste guidelines or that is specified as *inert waste* or *solid waste* in Schedule 1 of the Protection of the *Environment Operations Act, 1997*.

The sites available for the disposal of material on Kooragang Island lie to the northwest, north and north east of the Tourle Street bridge as shown in Figure 8.1. This land was formerly owned by BHP and was used for the disposal of inert and solid waste, comprising coal washery reject and BHP by-products.

10.5 Existing infrastructure and services

10.5.1 Water supply and sewerage

Water Supply

Kooragang Island, Stockton Peninsula and Walsh Point are serviced by trunk water mains buried underground. A 500 millimetre diameter water main crosses the Tourle Street bridge and runs in an easterly direction along the south of Cormorant Road. Approximately one kilometre from the bridge the main bifurcates and the 500 millimetre main crosses to the north side of the road and a 375 millimetre diameter main continues on the south side of Cormorant Road. The mains continue to Teal Street, where the 375 millimetre main crosses to the north side of the road and connects back to the 500 millimetre diameter main.

A 1050 millimetre diameter water main connects to the bifurcated 500 millimetre main at the rail loop access road beside the Big Pond.

Part of the route of the 500 millimetre main is located within the swing basin area and relocation along this section would be necessary.

Sewerage

Hunter Water Corporation has installed a new underground gravity/rising main transfer system from the Stockton Wastewater Treatment Plant to the Shortland Wastewater Treatment Plant and the system runs along the northern side of Cormorant Road. A 450 millimetres diameter rising main runs south along Egret Street and continues along Cormorant Road. It discharges to a pump station approximately 200 metres west of the Cormorant Road and Egret Street intersection. The outlet main from the pump station is 600 millimetres in diameter and runs in a westerly direction on the northern side of Cormorant Road and continues past the Tourle Street bridge.

There is no impact on the existing sewerage system, although, care would need to be taken not to disturb infrastructure during construction.

Stormwater drainage

There are four stormwater drains that run underneath Cormorant Road in a southerly direction and discharge into the Hunter River in the vicinity of the proposal. The first outlet is located 500 metres east of Tourle Street bridge and provides an overflow for the small ponds between the former BHP landfill and Cormorant Road. These pipes would be affected by the proposal.

The second outlet is located approximately 1.3 kilometres east of the Tourle Street bridge near the wind turbine and consists of two 1500 millimetre diameter pipes. These pipes provide an overflow from the Big Pond and could be affected by the proposal.

The third outlet into the river is located approximately 1.3 kilometres further east and consists of an open concrete drain. This drain services the land north of Cormorant Road between the Big Pond and Blue Circle Southern Cement and part of Egret and Raven Streets. This drain may be affected by the proposal.

The fourth outlet, located immediately to the west of the PWCS berth, consists of a 1050 millimetre diameter pipe and services part of Egret Street and surrounding industries. This drain would be affected by the proposal.

10.5.2 Electricity

Transgrid and Energy Australia own the electricity transmission and distribution infrastructure on Kooragang Island. Energy Australia owns and operates all reticulation on Kooragang Island. The reticulation operates at 33 kV. The Kooragang west switching station (west of the rail bridge) supplies Kooragang Coal Terminal substation via two overhead aerial 33 kV feeders. These feeders follow the rail track alignment. A substation supplies part of the other Kooragang Island industries, and forms a return loop with the third feeder.

A third overhead aerial feeder, 33kV, from the switching station supplies the remainder of the Kooragang Island industries. East of Tourle Street bridge this runs on the south side of Cormorant Road for 300 metres west, then along the South Arm bank to 300 metres west of Blue Circle Southern Cement. Part of the route is located within the swing basin area and relocation along this section would be necessary.

The Energy Australia wind turbine is located approximately 1.3 kilometres to the east of the Tourle Street bridge and adjacent to the channel bank. The site is not affected by the proposal.

10.5.3 Gas

Agility Services Pty Ltd has provided details of secondary gas mains that are located adjacent to the study area. One main runs south of the South Arm along the northern side of Industrial Drive and north along Tourle Street but terminates before the Tourle Street bridge.

The other main north of the South Arm runs on the eastern side of Heron Road, where it connects to another main running north along Cormorant Road, and then proceeds west on the northern side of the rail loop and rail line.

There are no gas lines/services in the immediate area.

10.5.4 Telecommunications

Telecommunications infrastructure on Kooragang Island is provided to and from the existing Stockton exchange. There are both underground copper cable and underground optical fibre services provided.

Telstra has both optical fibre and copper cables located in the study area. Optical fibre cables from the Mayfield exchange run on the eastern side of Tourle Street up to the southern side of the bridge. The cables turn north east and are laid beneath or on the Hunter River South Arm floor for approximately 1 kilometre. The cables leave the South Arm 400 metres east of the rail loop access road and are laid underground between the river bank and Cormorant Road up to the access road. The cable then heads north to the access road and crosses to the northern side of Cormorant Road. The cable continues along Egret, Raven and Teal Streets and then crosses the Stockton Bridge heading towards the Stockton Exchange. The optical fibre cable also branches at Tourle Street and runs east along Industrial Drive.

Copper cable runs along Tourle Street, Cormorant Road and Heron Road. There are also a number of isolated sections of copper cable running along Industrial Drive.

The optical fibre cable would be affected by the proposal and the 1 kilometre section running beneath the River (between Tourle Street bridge and Big Pond) would need to be relaid or relocated around the proposed site.

Powertel has an optical fibre cable running on the south side of Industrial Drive. There are no connections to the steelworks sites to the north. There is no impact on Powertel services.

10.5.5 Private infrastructure

There is a carbon dioxide pipeline running along the southern side of Cormorant Road between Egret Street and Heron Road. There is no impact on this service.

No public infrastructure services were found to cross the South Arm in the study area. There is evidence from a 1995 study that private infrastructure crosses the river to the west of the Tourle Street bridge (in the form of coal and slurry lines). These services could be impacted if piling is used during bridge or berth construction.

The existence of private infrastructure in the study area would be determined following consultation with owners. Potential impacts on private infrastructure would be determined following this process.

10.5.6 Road and rail

The road system in the study area is described in Chapter 19. Cormorant Road is the closest road to the north of the proposal, with Tourle Street and the bridge to the east and Industrial Drive to the south.

A rail system exists on Kooragang Island as a 'balloon loop' diverging from the Main Northern Railway near Warabrook, mainly serving Port Waratah Coal Services (PWCS) for the transport of coal from the Hunter Valley to export markets. An arrival and departure track is available and six departure sidings are located at the end of the balloon loop. The arrival track proceeds to Walsh Point as the Walsh Point Line.

The rail line servicing OneSteel and the closure area, south of the South Arm Hunter River, also divides the Main Northern Railway near Warabrook.

The proposal would not impact on rail or road infrastructure.

10.6 Impact assessment

Key potential impacts include:

- impacts on surrounding land uses, including the potential for impact on the operations of the port and impact on operations occurring on the site owned by OneSteel;
- impacts on the use of the South Arm and its banks, including use for fishing, recreation and similar activities;
- impacts on other current development proposals, including the impact of the proposed staging of the proposal on the progress of developments on the land; and
- impacts on public utilities and service infrastructure.

These are discussed below.

10.6.1 Impact on surrounding land uses

Impact on the operations of the Port

It is anticipated that construction in the South Arm would not adversely affect operations of the port. The main work area is beyond that currently used on a frequent basis by commercial shipping.

Barges and dredges transiting port working areas would be required to 'work in' with port operations. This aspect of the proposal is considered to be manageable in terms of the capacity of the port.

As outlined in Chapter 4, dredging would facilitate the progressive establishment of future port and navigation facilities in the South Arm, between the existing K6 berth, to just south of the Tourle Street bridge.

Although it is not within the scope of the EIS to consider the potential impacts of any future facilities, in broad terms, it is envisaged that future facilities in the vicinity of the South Arm would include:

- berths capable of accommodating Cape class vessels along the northern bank of the South Arm;
- berths for smaller Panamax class vessels along the southern bank;
- a swing basin immediately downstream of the Tourle Street bridge allowing ships to turn after loading/unloading at wharves and return to sea; and
- a central shipping channel to connect these facilities.

Impacts on the OneSteel site

The proponent would need to negotiate a plan of management of the OneSteel site, as there are numerous issues, both physical and operational, that would impact on the site. Potential impacts include:

- resumption of land;
- impact on services within the site;
- impact on stormwater systems;
- access and traffic impacts (trucks) impacting on OneSteel's operations, and the operations of businesses who lease land from OneSteel; and
- impact on the Lot 222 investigation process under the Contaminated Land Management Act.

Impact on closure area

There are several uses proposed for the closure area, the Multi-purpose Terminal proposal being the most current. As discussed in Chapter 7, there is a need to coordinate the on site remediation and disposal activities associated with the channel extension proposal with that of the Multi-purpose Terminal and activities approved for the closure area.

10.6.2 Impact on use of the South Arm and its banks

There is currently no public access permitted to the southern bank of the South Arm. The northern bank is used informally (where access is not restricted by the presence of vegetation such as mangroves) mainly for recreational fishing. Public access to the banks would be permanently restricted as a result of the proposal.

10.6.3 Potential impacts on current development proposals

Table 10.3 identifies potential impacts on current development proposals in the surrounding area, and the issues that need to be considered and addressed during further detailed design of the proposal.

Table 10.3 Surrounding development proposals

Project	Potential impacts/issues
Development approval for the redevelopment of the closure area including construction of a Multi-purpose shipping Terminal	Implications of any land disposal on the approval for redevelopment of the closure area.
	Ensure consistency with EPA remediation requirements.
	Need to avoid the Multi-purpose Terminal footprint.
Remediation of closure area	The dredging forming Stage 1 of the Multi-purpose Terminal is limited to the ship berthing areas containing clean sediments.
	The Multi-purpose Terminal proposal involves the use of clean sediment material as fill material on the site that would form part of the final landform on the site. Section 6.5.4 of the EIS for the Multi-purpose Terminal makes reference to the importation of fill. It specifies Coal Washery Reject from Macquarie Coal Preparation Plant at Teralba being imported by truck to the site. No reference is made to other offsite material such as the proposed dredged material, which could be used.
Protech	Construction traffic impacts
	Cumulative noise issues (for example, as a result of potential noise impacts associated with the implementation of the proposal combining with activities at the Protech site) are considered in section 10.3.6.

10.6.4 Impacts on utilities and service infrastructure

The potential impact on utilities and services is summarised in Table 10.4. The potential impact on transport infrastructure (road and rail) is considered in more detail in Chapter 19.

Table 10.4 Potential impacts on existing public utilities and services

Utility	Impact
Water supply	Relocate approximately 500 metres of the 500 millimetre diameter main on the north bank at the swing basin (located on the south side of Cormorant Road)
Sewerage	Nil
Stormwater Drainage	Cut back four drain outlets along the proposals length to new stabilised edge of channel. Construct new headwalls/outlets and provide outlet protection at each drain.
Electricity	Relocate approximately 700 metres of the 33 kV line on the north bank at the swing basin.
Gas	Nil
Telecommunications	Relocate optical fibre between Tourle Street bridge and Big Pond
Private Infrastructure	Nil
Road	Nil
Rail	Nil

10.7 Recommended mitigation measures

The following mitigation measures are recommended to minimise the impact on land use in the impacted area:

- The potential for impacts to operations on the OneSteel site would need to be carefully managed during the implementation of the proposal. A management plan would be developed as part of the project environmental management plans, in consultation with OneSteel and its leasees, to detail the management measures necessary to minimise the potential for impact on the operations of these businesses;
- Further liaison with landowners, tenants and infrastructure agencies would be carried out prior to implementation of the proposal;
- Surrounding land users including commercial and recreational users of the port would be notified of the operating hours and duration of the dredging operations;
- A comprehensive consultation program would be developed and implemented in accordance with the recommendations contained in section 20.4;
- As a result of the claim under the *Aboriginal Land Rights Act 1983* over the current study area, the Worimi LALC would be consulted throughout the planning and implementation phase of the proposal;
- Prior to implementation of the proposal, the proponent would negotiate any relocation of utilities required with the relevant utility provider or private landholder and obtain any approvals required; and
- Relocation of any utility would be completed to meet the requirements of the relevant utility provider and/or private landowner.

11 Hydrology and water quality

This chapter provides a summary of the results of the tidal hydrodynamics, flooding and water quality study undertaken by Patterson Britton as part of the EIS process. The full report is included in Appendix F. The chapter also describes the water quality mitigation measures that would be adopted as part of the proposal. Information on the existing environment in the Hunter River estuary is provided, the potential impacts of the proposal are assessed, and mitigation measures recommended.

11.1 Existing environment

11.1.1 General

Water levels, flows and water velocities vary within the Hunter River estuary due to a number of factors, including:

- astronomical tides, ocean storm surges, coastal trapped waves and potential sea level rise transferring from the ocean to the estuary;
- freshwater flow, generally from rainfall run-off; and
- local wind setup (increases in mean water level due to wind) within the estuary.

In general, in non-rainfall periods, astronomical tides are the major factor affecting the hydrodynamics of the entrance channel, the north and South Arms, and fringing mangrove and saltmarsh areas of the Hunter River. In events of sufficient magnitude, rainfall-run-off generated freshwater flow is the dominant process governing the movement of water within the estuary. Wetland areas, which are rarely or never inundated by tides, rely on flood flows to be submerged.

The annual water balance (change in volume) of the Hunter estuary is dominated by tidal inflow and outflow (85 percent of inflows and 99.9 percent of outflows). Other contributions to estuary inflow comprise catchment run-off (8 percent), groundwater flow (7 percent) and direct rainfall (0.1 percent). Evaporation makes up the other, very small proportion of outflow (0.1 percent). Note that the relative importance of tidal inflow and outflow diminishes with distance upstream in the estuary.

It has been calculated that the mean of river flows between 1975 and 2000 was 3120 ML/d, with a median of 720 ML/d. The latter value indicates that for most of the time the freshwater flow is less than its mean value.

The existing environment of the Hunter estuary is described in more detail in subsequent sections. Specifics on the tidal hydrodynamics of the estuary are given in Section 11.1.2, while the flooding regime is described in Section 11.1.3. The salinity distribution of the Hunter estuary is affected by tidal and flooding processes as outlined in Section 11.1.4.

The general water quality of the estuary is described in Section 11.1.5, including discussion of nutrients and turbidity, which are two of the major water quality issues in the Hunter. The turbidity issue is discussed further in relation to sediment transport in the estuary in Section 11.1.6, including consideration of the effect of sedimentation on mangroves.

Particular details on fish, prawns and oysters are outlined in Section 11.1.7, given the ecological and commercial importance of these species, and their sensitivity to water quality.

Finally, in Section 11.1.8, a summary of the historical modifications to the estuary that may have impacted on the tidal hydrodynamics, flooding and water quality of the estuary is provided.

11.1.2 Tidal hydrodynamics

The tides at the entrance of the Hunter River estuary are semi-diurnal with a strong spring-neap cycle. The tidal variation levels at Newcastle Harbour in the vicinity of the project proposal are as follows:

Table 11.1 Tidal level variation at Newcastle Harbour

Utility	Impact
Highest Recorded Tide	2.37 m
Highest Astronomical Tide	2.10 m
Mean High Water Springs	1.62 m
Mean High Water	1.49 m
Mean High Water Neaps	1.37 m
Mean Sea Level	0.99 m
Mean Low Water Neaps	0.62 m
Mean Low Water	0.49 m
Mean Low Water Springs	0.37 m

All the above are in terms of the Newcastle Harbour Tide Gauge (NHTG) Datum, operated by the Port of Newcastle which is approximately the lowest astronomical tide level and is 1.01 m below Australian Height Datum (AHD).

Tides in the Hunter estuary vary from the ocean entrance to the tidal limits, generally with a gradual reduction in the mean tidal range proceeding upstream (excluding slight amplification within the Williams and Paterson Rivers). The tidal limit in the Hunter River is approximately at Oakhampton (64 kilometres upstream from the ocean), with tides also intruding into major tributaries including the Paterson River (as far as Gostwyck, about 73 kilometres from the ocean) and Williams River (as far as the weir at Seaham, about 46 kilometres from the ocean).

The general reduction in tidal range moving upstream can be understood in terms of tidal excursion, the distance a water particle travels over a tidal cycle. In the lower estuary, the tidal excursion is about 10 kilometres, while at Morpeth it reduces to around three kilometres.

Numerous tributary creeks are also tidal, including Wallis, Fishery, Ironbark, Throsby, Styx and Cottage Creeks. However, floodgates at the entrance to the Wallis and Fishery Creek system, and also Ironbark Creek, significantly attenuate tidal intrusion upstream of the gates.

There is also a lag in the times of high and low water moving upstream (that is, the peaks and troughs occur later compared to the entrance), with the relative delay greater for low tides.

It has been found that the Hunter's north arm dominates the tidal prism carrying about 80% of the tidal flow at Walsh Point, with the South Arm conveying around 20%. The upstream tributaries make relatively small contributions to the tidal prism, namely about seven percent in the Williams, four percent in the Paterson and two percent in the Hunter upstream of Morpeth.

It has also been found that maximum tidal velocities are reduced to about half of the entrance values by Raymond Terrace, with the tidal prism having reduced to only about 15 percent of the entrance prism at this location (including the contributions of both the Hunter and Williams Rivers).

11.1.3 Flooding

Flooding behaviour in the Hunter estuary has been modified substantially since European settlement due to construction of levees, spillways, canals, floodgates, and diversion banks. Much of these works were undertaken as part of the Lower Hunter Valley Flood Mitigation Scheme, in almost immediate response to the largest flood that had occurred since European settlement, which took place in 1955. In total, 160 kilometres of levees and spillways, 111 kilometres of flood canals, 175 floodgates, 14 kilometres of bank protection works and 40 kilometres of control and diversion banks were built as part of this scheme.

Most of the works were constructed between Morpeth and Hexham. There was also a levee created from Tomago to the eastern side of Fullerton Cove.

In higher annual exceedance probability (AEP) flood events, the flood flow is contained within the main channel of the river and surrounding levees. As the flood severity increases AEP reduces, floodwaters begin to overtop the natural and constructed levees and flow across the floodplain. For the 20 percent AEP and rarer events, the majority of flow is across the floodplain.

In high magnitude events (one percent AEP), only about 30 percent of the flood flow is carried in the main channel upstream of Purgatory Creek (near Hexham), with 70 percent carried by the Millers Forest and Woodberry Swamp floodplains. However, floodwaters are constricted at Purgatory Creek by the New England Highway and North Coast Railway, as well as high ground at Tarro. Some flow is able to pass through culverts under the highway and railway (in particular at the Tarro control on the Highway), or pass over these in floods larger than the 10 percent AEP, with up to about 30 percent of the flow entering Hexham Swamp in the 1 percent AEP event.

Therefore, much of the overbank flow is forced back into the main channel just upstream of Hexham. This flow tends to spill over Kooragang Island and Tomago Swamp, which are both completely inundated (excluding the southern part of the Island) during moderate to major floods (exceeding 10 percent AEP). The southern part of Kooragang Island is protected from floodwaters by a large railway embankment, forcing far more floodwaters into the north arm compared to the South Arm. At Walsh Point, more than 75 percent of the flood flow is carried in the north arm. Only about six percent of the flow goes overbank at Hexham and travels through Tomago Swamp to Fullerton Cove.

The most recent flood study of the estuary was undertaken by the Public Works Department (PWD, 1994), covering the area from Green Rocks to the ocean entrance. Green Rocks is 40 kilometres upstream from the entrance and upstream of the Williams River junction. The design peak flood levels determined in this study for various AEP events are shown in Table 11.2 while the design peak discharges are shown in Table 11.3.

Table 11.2 Design peak flood levels from PWD (1994) flood study

Location	Peak Flood Level (metres AHD) for Design Event AEP				
	20%	10%	5%	2%	1%
Green Rocks	3.49	4.12	4.57	4.91	5.55
Raymond Terrace	2.12	2.71	3.12	3.70	4.76
Hexham Bridge	1.44	1.99	2.45	2.81	3.73
Stockton Bridge	1.21	1.24	1.27	1.31	1.61
Port Newcastle	1.21	1.24	1.27	1.31	1.34

Table 11.3 Design peak flood discharges from PWD (1994) flood study

Location	Peak Discharge (m ³ /s) for Design Event AEP				
	20%	10%	5%	2%	1%
Hunter River upstream of Green Rocks	1100	2000	3300	4600	6200
Williams River upstream of Raymond Terrace	400	1000	1200	1200	1100

One should note that the highest astronomical tide at Port Newcastle is approximately 1.1 metres above AHD, which would occur once every 18.6 years if there were no non-astronomical water level influences. Storm surge (barometric and wind setup), wave setup, coastal trapped waves and freshwater flow may all increase water levels above the predicted astronomical tide levels, with the maximum combination of items expected to be less than 0.4 metres. The peak water levels derived in Table 11.2 for Port Newcastle were based on an analysis of recorded water levels over a 24-year period (MHL, 2002).

Following the 1994 PWD Flood Study, Patterson Britton & Partners (1996) completed a Floodplain Management Study. One of the most hydraulically effective management options assessed for reducing flood levels was dredging the north arm to -11m AHD, which was estimated to reduce flood levels downstream of Hexham by between 0.4 and 0.6 metres over the full range of floods.

11.1.4 Salinity structure

Sanderson et al (2002) measured the vertical profiles of salinity (and temperature, turbidity and dissolved oxygen) at various locations in the Hunter estuary on 23 days between January and April in 2001. Measurements were taken at a total of 42 locations, from the entrance as far upstream as Duckenfield (about 41 kilometres upstream from the entrance).

The measurements were generally made at high tide, covering a spring-neap tidal cycle coinciding with low riverine freshwater inputs, and immediately prior to, during and following a minor flood (peak flow about 200,000 ML/d) on 9 March 2001.

The spring-neap tidal cycle was observed to play only a minor role in modifying estuarine salinities, compared to river freshwater flows. Flows of sufficient magnitude (floods) were found to discharge most of the salt from the estuary, excluding the salt in deeply dredged areas.

After floods, the salt was found to intrude slowly upstream. Turbulent mixing through the water column, as well as wind generated mixing, was found to mix the salt in the vertical. That is, water in the estuary was described as well mixed, with very little stratification during low freshwater flows.

In order to determine the position along the estuary of the 10, 15, 20 and 30 parts per thousand salinity isohalines as a function of river flow on the previous day, empirical relationships were derived for flows exceeding 200,000 ML/d.

These were then applied to the 1975–2000 flow record, and it was found that the 10 parts per thousand isohaline was most frequently found around 24 kilometres upstream. However, given that the freshwater flow is less than 200,000 ML/d for most of the time the salinity intrusion is likely to be overestimated during the most prevalent low flow conditions using these relationships.

To provide a potentially improved estimate of historical salinity intrusion, a simple advection-diffusion relationship based on an idealised channel bathymetry was applied to the 1975–2000 flow record. This predicted that the average salinity varied from 35 parts per thousand at the ocean entrance to between about five parts per thousand and 25 parts per thousand at 20 kilometres upstream of the entrance. By about 30 kilometres upstream of the entrance, average salinities were less than five parts per thousand. According to MHL (2002), salinities upstream of Raymond Terrace in the Hunter River are typically about 0.2 to 0.5 ppt.

One should also note that saline discharges from coal mines and electricity generators in the Hunter River are managed through the Hunter River Salinity Trading Scheme. Under this scheme, saline discharges are scheduled to occur during relatively high freshwater flows to minimise the salinity increases in the river, and thereby reduce impacts on the activities of irrigators and other water users, as well as on aquatic ecosystems.

11.1.5 Water quality

The processes controlling exchange and mixing within the Hunter estuary comprise (MHL, 2002):

- freshwater flows displacing the volume of the estuary, especially evident during floods;
- salt intrusion, density-driven flow and tidal pumping against the freshwater flow, evident after floods; and,
- upstream transport of salt by tidal diffusion during sustained periods of low flow.

At the mean freshwater flow rate the estimated estuary flushing time is about 32 days.

Measurements indicate that:

- temperature distributions in the Hunter estuary are usually inversely related to those of salinity (with temperature generally increasing moving upstream), except for heat fluxes associated with warm or cold weather;
- turbidity is often high in upstream areas and during increased freshwater flows; and,
- dissolved oxygen levels are often low in the upper estuary following increased freshwater flows, as material deposited in sediments oxidises.

Salinity has a much greater effect on density than temperature in the Hunter estuary. Given that temperatures generally increase (except in winter) and salinities decrease moving upstream, densities usually decrease moving upstream.

Vertical stratification may limit mixing and it also has implications for water quality, including the causing of depletion of dissolved oxygen in deep water, algal blooms in surface waters and the exacerbation of sediment deposition at the freshwater/saltwater interface. As reported in Section 11.1.4, the vertical salinity stratification of the Hunter Estuary is

generally weak; it only typically occurs for a few days after flood events. However, in backwater areas where turbulent mixing is weaker, the likelihood of vertical stratification persisting for longer is far greater.

In summary, the major water quality issues in the estuary have been found to be:

- excessive levels of nutrients;
- high turbidity levels; and
- high concentrations of chlorophyll-a.

For these variables, ANZECC and ARMCANZ (2000) water quality guidelines (aquatic ecosystem trigger levels or recreational guidelines) were exceeded.

It was considered that greater control and management of the diffuse and point source production of nutrients was required to protect the aquatic ecosystem, recreational and aquaculture values of the estuary.

It has been estimated that point sources of nutrients are far more significant than diffuse catchment run-off sources, with about 98 percent of total nitrogen mass and 97 percent of total phosphorus mass entering the estuary predicted to be coming from point sources. The point sources are dominated by the industries listed in Table 11.4. One should note that the point loading of total nitrogen into the estuary is about seven times greater than the total phosphorus load.

Table 11.4 Major point sources of nitrogen and phosphorus in the Hunter estuary (from MHL, 2002)

Industry	Percentage of total point source load	
	Total Nitrogen	Total Phosphorus
Incitec Ltd fertiliser manufacturing, Kooragang Island	63%	-
Steggles poultry processing, Beresfield	22%	33%
Morpeth Wastewater Treatment Works	11%	35%
Raymond Terrace Wastewater Treatment Works	4%	11%
Shortland Wastewater Treatment Works	-	13%
Stockton Wastewater Treatment Works	-	8%

Other observations made by MHL (2002) included that:

- dissolved oxygen levels are reduced with large freshwater flows, with concentrations also low in late summer in the upper estuary due to higher temperatures;
- mean dissolved oxygen concentrations over the river are 6.4mg/L, with increasing concentrations moving downstream;
- high turbidity values are common, with turbidity values highest during large freshwater flows; and
- the mean turbidity value is 15 NTU, with increasing values moving upstream.

Turbidity was considered to be visually unappealing, and symptomatic of land degradation; it probably also affects many benthic processes. However, it was also suggested that high turbidity limits light penetration into the water and therefore limits phytoplankton blooms and growth of undesirable plants and algae. Given the high nutrient loads in the Hunter estuary, high turbidity levels were considered to have some desirable side effects as far as phytoplankton control are concerned.

The negative impacts of high turbidity could include effects on seagrass, although there is little seagrass present in the Hunter estuary, it generally being restricted to Fullerton Cove. It has also been suggested that high turbidity is the reason for the small numbers of oysters in the Hunter. Increases in turbidity may also affect the foraging behaviour of fish, and suspended sediments may abrade the protective mucus coats of fish, thereby increasing their susceptibility to disease, clogging their gill filaments, or suffocating them (Manly Hydraulics Laboratory, 2002).

11.1.6 Sediment transport

Land clearing and flood mitigation works have altered the sediment transport processes in the Hunter catchment. In general, channel infilling has been accelerated due to the resulting catchment erosion and impedance of sediment transport, and this represents a significant threat to continued bank erosion. Bank erosion has also been exacerbated by the clearing of riparian vegetation and widespread cattle access to banks.

It has been estimated that most sediment has been deposited between Singleton and Maitland during large floods. However, it was noted that there is evidence that this sediment is moving downstream towards Raymond Terrace, with the movement manifest as erosion between Maitland and Morpeth and accretion between Morpeth and Hexham.

A comparison between 1857 and 1990 hydrosurveys, shows that the South Arm of the Hunter has become shallower between 10 kilometres (near Tourle Street bridge) and 20 kilometres (near Hexham) upstream from the entrance, the latter being the limit of the comparison.

It has also been estimated that:

- the typical suspended sediment influx to downstream of Hexham is about one million tonnes per year, with a minimum bedload sediment flux of 25,000 tonnes per year;
- the average amount of sediment accumulating in the Hunter estuary downstream of Hexham is about 100,000 tonnes per year, based on measured bed elevation increases of 2.3 millimetre/year at Fullerton Cove;
- maintenance dredging indicated that about 400,000 tonnes of sediment accumulated in the port each year; and
- about 490,000 tonnes of sediment is discharged from the Hunter estuary and accumulates in a large mud deposit offshore each year.

The effects of turbidity (related to suspended sediment concentration) on water quality, and its distribution in the Hunter estuary, are discussed elsewhere in the Section 11.1.5.

Patterson Britton & Partners (1989) described the suspended sediment concentrations in the Hunter estuary for various freshwater flow magnitudes, namely:

- Low freshwater flows, during which negligible quantities of sediment were estimated to be carried downstream. Suspended sediment concentrations were estimated to be about 4 to 30 mg/L in the port area during these periods. The highest concentrations were predicted to be in the vicinity of Hexham, near the limit of saline intrusion;
- Wet weather flows (not extreme floods), during which there is concentrated deposition of sediment in the port area. In this case, the saline limit would be in the vicinity of the port. As flows increase, a greater amount of sediment would be carried out to sea, typically in a fresh surface layer a few metres thick. For example, measurements in June 1989 indicated the suspended sediment concentration at the Hunter mouth was about 210 mg/L in the top 4 of the water column, with the lower layer at about 60 mg/L; and
- Extreme floods, during which the estuary could be purged of all saline water, and virtually no deposition would occur within it. That is, medium floods are likely to cause greater sedimentation in the port compared to large floods.

Patterson Britton & Partners (1989) devised a suspended sediment rating curve at Hexham Bridge.

Suspended sediment concentrations at Hexham predicted using the relationship are shown in Table 11.5 for a variety of flows ranging from the median flow to the peak of the large flood. Note that flow magnitudes were derived from MHL (2002).

Table 11.5 Predicted suspended sediment concentrations at Hexham for varying flows

Flow Type	Flow Value (ML/d)	Predicted Suspended Sediment Concentration at Hexham (mg/L)
Median	720	7
Mean	3,120	40
95th percentile	11,920	200
Peak of small flood	20,000	365
Peak of large flood	200,000	5,400

In some areas of NSW, mangrove areas have declined due to clearing or reclamation and changes in water flow attributable to adjacent developments. In other areas, mangroves are increasing due to colonisation on the build up of sediment.

For example, in the Parramatta River, mangroves have increased since European settlement; this is associated with sedimentation caused by urbanisation and catchment clearing. That is, the mangroves have tended to regenerate by colonising the mud flats created by increased sedimentation. There is no evidence of mangroves in the upper river from Subiaco Creek to Parramatta until the 1870s. Furthermore, landward mangrove growth has occurred in conjunction with a loss of saltmarsh communities, an established trend in south-east Australia.

In the Hunter, mangrove areas within the estuary have increased since the 1950s, outside areas that have had mangroves removed for industrial and port facilities. This is likely to be due to this same phenomenon of colonisation of sediment flats as described, and has also occurred along with the loss of saltmarsh communities. The main areas of mangrove expansion have been along the north arm near Tomago, Fullerton Cove and Stockton, and also on parts of Kooragang Island (MHL, 2002).

In the Hunter, mangrove areas within the estuary have increased since the 1950's outside areas that have had mangroves removed for industrial and port facilities. This is likely to be due to this same phenomenon of colonisation of sediment flats as described, and has also occurred along with the loss of saltmarsh communities. The main areas of mangrove expansion have been along the North Arm near Tomago, Fullerton Cove and Stockton, and also on parts of Kooragang Island (MHL, 2002).

However, it should be noted that sedimentation does not always benefit mangroves. For example, West et al (1983) noted mangrove death in the Hawkesbury River due to rapid sedimentation covering pneumatophores.

Ellison (1999) also found that excess input of sediment to mangroves could cause reduced vigour or death of trees owing to root smothering. She described 26 cases from literature where mangroves had been adversely affected by sediment burial species involved. However, there was insufficient data to establish specific tolerances.

Ellison (1999) summarised numerous measurements of sedimentation rates in thriving mangrove forests, and found that at most sites the accretion rate was less than 5 mm/year, with a maximum of 10 mm/year. She also noted 15 studies in which measurements of sedimentation depths had been made where mangroves had died or were stressed as a result of

accretion. The total depth of deposition at sites where mangroves had died was between 5 cm and 200 cm, with an average depth of about 40 cm. Two-thirds of these measurements were for *Avicennia species*. *Avicennia marina* is the dominant mangrove species in the Hunter estuary (MHL, 2002).

11.1.7 Fish, prawns and oysters

Over 100 species of fresh and saltwater fish have been recorded in the Hunter estuary since 1975, of which 32 are economically important. Mangrove areas are generally known to provide excellent fish habitat (Lynch and Burchmore, 2002), and have been specifically identified along with saltmarsh, reed beds and freshwater wetlands as being important habitat and nursery areas for fish and prawns in the Hunter.

The most commercially important fishery in the Hunter is the estuarine finfish industry ('finfish' is a term that refers to sharks, some rays and bony fishes that have gills and live in water, and are commercially harvestable), which is one of the largest in NSW. The catch is dominated by sea mullet. Fish trawling is not permitted anywhere in the estuary.

Prawn trawling is an important commercial operation in the Hunter, it being one of the few estuaries in NSW in which this is permitted. Prawns move around the estuary depending on the stage in their life cycle. Breeding takes place in the ocean, with post-larval prawns migrating up the estuary to less saline areas. The extent of migration is typically to around the 20 ppt isohaline, but some prawns travel upstream of Maitland, where salinities are less than 1 ppt (Manly Hydraulics Laboratory, 2002).

In the Hunter, school prawns enter the estuary between December and April. They grow rapidly in September, typically moving out to the ocean to breed in response to flood events from October and through the summer period. It is during this downstream movement that the largest catches are made, both in the Hunter and offshore at Stockton Bight.

Oyster leases include Fern Bay in the north arm (just north of Stockton). Oysters also colonise a variety of artificial rocks walls such as much of the southern shoreline of the South Arm, and numerous bridge and wharf piles. However, the high turbidity of the Hunter has been suggested as a factor in the relatively small numbers of oysters found in the estuary. The South Arm is closed to the taking of oysters and mussels.

The discharge of contaminants into the Hunter River has been occurring for many decades. The oyster industry was devastated in and after 1965, when oysters were contaminated by industrial pollution, and prawning has also been affected by apparent pollution from industry. Prawns caught in the South Arm are known to have a 'gassy' taste, which affects their value (Manly Hydraulics Laboratory, 2002).

11.1.8 Historical impacts

The Hunter estuary has been modified by a number of human impacts in the past. The most significant of these impacts in terms of tidal hydrodynamics, flooding and water quality are:

- entrance breakwaters constructed for navigation;
- levees constructed for flood mitigation;
- dredging of the lower estuary for port infrastructure;
- construction of floodgates and drainage channels to convert low-lying, waterlogged lands to agricultural use;
- reclamation to amalgamate up to 10 islands into the single Kooragang Island; and
- destruction of riparian vegetation.

Manly Hydraulics Laboratory (2002) attempted a harmonic analysis of water level records from Stockton Bridge to the

Paterson River junction, based on the 1955 and 2000 data sets. This was undertaken to investigate the effect of estuary changes in this 45 year period (such as dredging, levee bank construction and floodgate construction) on tidal hydrodynamics.

The analysis found that the mean spring tide range had increased by up to 0.2 metres between 1955 and 2000, with the mean neap range unchanged. The difference between the HHWS (High High Water Solstices Springs) and ISLW (Indian Springs Low Water) had also increased by up to 0.4m between 1955 and 2000. The effect on the mean spring range was most pronounced at a distance between 20 kilometres and 40 kilometres upstream from the ocean (between Hexham Bridge and Green Rocks).

The analysis led to the postulation that the alteration to the mean spring range was probably in the main due to construction of floodgates, particularly noting those in the Hexham Swamp area. However, it also referred to another report (Umwelt, 2002), which suggested harbour dredging had the dominant impact on tides at Hexham between 1950 and 1990.

The Hunter River entrance has breakwaters constructed on both the southern and northern sides. The southern breakwater was completed in 1891, with the northern breakwater completed in 1912 (Umwelt, 2002).

About 133 million m³ (in situ) of material was dredged from the port of Newcastle between 1859 and 1989. In 1961, the port was about 8m deep. From 1962 to 1967, the depth was increased to 11m. Between 1977 and 1983 it was further deepened to its present depth, that is 15.2m within the harbour extending to 18m deep at the eastern end of the northern breakwater (Umwelt, 2002).

Prior to the deepening and breakwater construction, the harbour had a central channel about 6m deep, with large areas of shallow sand shoals. There was an active alluvial bedload that was added to by flood flows.

Umwelt (2002) proposed that there were a number of factors that may have modified sediment behaviour around the Hunter mouth (particularly in relation to erosion of Stockton Beach), namely:

- construction of the entrance breakwaters;
- deepening of the harbour and entrance to accommodate ships;
- maintenance dredging of these areas;
- increased tidal volumes entering and leaving the harbour;
- changes to sediment supply to the entrance channel; and
- offshore dumping of dredge spoil.

Umwelt (2002) postulated that the harbour deepening would have the strongest link to the altered tidal behaviour and sediment movement. However, MHL (2002) considered that tidal behaviour was more likely to have been altered by the installation of floodgates.

The Department of Public Works NSW (DPW), 1967, undertook an investigation with the purpose of devising techniques to reduce the maintenance dredging requirements of Newcastle harbour as much as economically possible. At the time, between 1956 and 1960, the average rate of dredging was 2.8 million barge tons (about 1.6 million m³ of in situ sediment) per annum (15% of this quantity was estimated to be developmental dredging)¹.

¹ Newcastle Ports Corporation currently has a permit for the removal and offshore disposal of up to 500,000m³ of in situ dredged sediments per annum. In recent years the actual quantities dredged have been below the maximum allowance, reflecting the general absence of flooding (which leads to sedimentation) during this time.

The recommended scheme involved the closure of the Fullerton Cove entrance with an earth dam and controlled gate structure (the gate being about 70m wide), which would be shut during higher river flows (exceeding 280m³/s) and very windy weather (wind speeds exceeding 37km/h). This was designed to reduce the sedimentation of Fullerton Cove in floods (estimated to be accreting at a rate of 8.5mm/year), so more sediment would be discharged to the ocean, and to reduce future wind-driven resuspension and supply of sediment to downstream areas. The scheme was never implemented.

Flood mitigation works have placed considerable pressure on the river and floodplain environment by isolating the floodplain from the river by the use of levees and floodgates, and by decreasing riparian, wetland and floodplain habitat via drainage, agriculture and development. Culverts and causeways also restrict tidal inundation to some areas.

Floodgates are designed to prevent the inflow of floodwaters but also to prevent saline waters from entering wetlands and saltmarsh areas (eventually converting them from estuarine to freshwater systems), limit tidal flows and flushing, and affect the movement of aquatic fauna such as fish. Drainage works may also lead to exposure of potential acid sulfate soils. Notable floodgates include those on Wallis Creek and Ironbark Creek, the latter constructed in 1972. Seaham Weir on the Williams River also prevents access for fish to formerly tidal areas upstream. Gross pollutant traps on Throsby and Styx Creeks also limit fish passage.

At the entrance to Wallis Creek, the substantial floodgate structure consists of eight culverts, each of a 3m² cross-sectional area, of which seven are closed under tidal conditions (non-flood periods). At Ironbark Creek, a narrow gap of only 0.1 metres allows a minimal amount of tidal intrusion upstream (Evans, 2003).

There are plans for the complete opening of the Ironbark Creek floodgates in non-flood periods to allow natural tidal exchange to return to the system, with the expectation that this would be achieved by the end of 2003. Ironbark Creek links with Hexham Swamp, a noted former prawn nursery area.

The prawn trawling industry has also recommended that swamp and saltmarsh areas on the north-west of Kooragang Island, and Moscheto Creek, are rehabilitated to improve their value as habitat areas for the species. Moscheto Creek is disconnected from the South Arm as a result of past reclamation.

Drains occur throughout the Hunter estuary catchment, particularly north of Hexham and around Fullerton Cove. These drains lead to saline wetlands becoming fresh or brackish, reducing faunal diversity, or they may even eliminate or reduce the wetlands permanence.

Levees occur extensively in the upper estuary upstream of Hexham, and also around Fullerton Cove. The construction of levees has resulted in the elimination or reduction in permanence of floodplain wetlands, and an increase in river sedimentation.

The reclamation that formed the single Kooragang Island began in the late nineteenth century and was completed by 1953, destroying up to 10 km² of estuarine wetlands. It has also been estimated that 37 percent of the open waters of the Hunter estuary were lost between 1801 and 1994, mainly due to the Kooragang Island reclamation, and also sedimentation of Fullerton Cove and the north arm in general.

11.2 Impact assessment

11.2.1 General

A numerical model was developed as a convenient tool to assess the potential alteration to the Hunter estuary as part of the proposed dredging of the South Arm. The model was able to simulate tidal hydrodynamics and water quality.

Variables simulated were:

- hydrodynamics under tidal conditions, enabling assessment of any alteration to tidal ranges and phasing throughout the estuary as a result of the proposed dredging works;
- salinity, in order to assess the potential alteration to the salinity structure of the estuary as a result of the proposed dredging;
- an arbitrary conservative component, to provide a picture of any likely alteration to flushing and pollutant dispersion characteristics in the estuary due to the dredging; and
- cohesive (muddy) and non-cohesive (sandy) sediment, to assist in prediction of the transport of suspended sediment generated during dredging and likely deposition zones and hence any potential impacts on fish, prawns and oysters and their habitats.

A flood model was also developed. This was used to estimate the likely changes to flood levels and flood behaviour as a result of the dredging activities (in particular construction of a temporary sheet pile wall restricting channel flows in the South Arm), due to the installation of a temporary pipeline crossing Kooragang Island and after completion of the dredging.

11.2.2 Tidal hydrodynamics

The alteration to water levels throughout the Hunter estuary as a result of the proposed dredging of the South Arm is given in Table 11.6. It is based on a 29-day tidal simulation covering the range of spring and neap tide cycles. The tidal simulation adopted is the ocean tide (the actual recorded tide at Newcastle Pilot Station for the period 16 October to 14 November 2002).

Table 11.6 Predicted changes in water level due to dredging of South Arm under tidal conditions

Site	Average change (metres)	Maximum positive change (metres)	Maximum negative change (metres)
Pilot Station (near entrance)	0.000	0.007	-0.008
Stockton Bridge (north arm)	0.000	0.009	-0.009
Fullerton Cove (north arm)	0.000	0.005	-0.006
Moscheto Creek (north arm)	0.000	0.009	-0.007
Tourle Street Bridge (South Arm)	-0.006	0.077	-0.127
Railway Bridge (South Arm)	-0.004	0.064	-0.077
Ironbark Creek (South Arm)	-0.002	0.054	-0.050
Hexham	0.000	0.006	-0.007
Green Rocks	0.000	0.005	-0.005

It can be seen that there is likely to be very little alteration to water levels in the estuary under tidal conditions as a result of the proposed dredging. The average change in simulated water levels at most sites was essentially none. Changes to average water levels were localised to upstream of the dredged area in the South Arm, where the average changes in water levels (reductions) at Tourle Street bridge, the Railway Bridge and the entrance to Ironbark Creek were only six millimetres, four millimetres and two millimetres respectively.

The existing and post-dredging water level record at Tourle Street bridge is shown in 7.25 day increments in the set of figures in Appendix F. Tourle Street bridge was the site noted with the greatest average deviation between existing and post-dredging water levels under tidal conditions in Table 11.6.

The maximum instantaneous alterations to water level at Tourle Street bridge occurred midway along the rising and falling limbs of the tide. That is, the maximum deviations coincided with the maximum flood and ebb velocities. The post-dredging levels were lower during the ebb tide and higher during the flood at this point in time.

Based on a least squares harmonic analysis of the water level records at various sites pre- and post-dredging, changes in tidal planes were determined as shown in Table 11.7.

Table 11.7 Predicted changes (in metres) in tidal planes due to dredging of South Arm

Tidal Plane	Site				
	Pilot Station	Stockton bridge	Tourle Street bridge	Ironbark Creek	Hexham
High High Water Solstices Springs (HHWSS)	0.001	0.001	0.003	-0.003	-0.001
Mean High Water Springs (MHWS)	0.000	0.000	0.002	-0.002	0.000
Mean High Water (MHW)	0.000	0.000	-0.001	-0.002	0.000
Mean High Water Neaps (MHWN)	0.000	0.000	-0.002	-0.001	-0.001
Mean Sea Level (MSL)	0.000	0.000	-0.006	-0.002	0.000
Mean Low Water Neaps (MLWN)	0.000	0.000	-0.009	-0.002	0.000
Mean Low Water (MLW)	0.000	0.000	-0.011	-0.002	0.000
Mean Low Water Springs (MLWS)	0.000	0.000	-0.013	-0.002	0.000
Indian Spring Low Water (ISLW)	0.000	-0.001	-0.014	-0.001	0.000
Mean Spring Range (MHWS-MLWS)	0.000	0.000	0.014	0.000	0.000
Mean Neap Range (MHWN-MLWN)	0.000	0.000	0.006	0.000	-0.002
Mean Range (MHW-MLW)	0.000	0.000	0.010	0.000	0.000
Range (HHWSS-ISLW)	0.001	0.002	0.018	-0.002	0.000

It can be seen that there was virtually no effect on tidal planes in the estuary as a result of the proposed dredging. The only small effects on tidal planes were localised to the dredged area itself, with the tidal range increasing at Tourle Street bridge by six, ten, fourteen and eighteen millimetres respectively for neap, mean, spring and absolute (full range) tides. The increase in tidal range was mainly manifested as a slight reduction in low water levels after dredging, with high tide levels virtually unaltered.

Based on the 29-day tidal simulation undertaken, the alteration to total velocities throughout the Hunter estuary due to the proposed dredging of South Arm is given in Table 11.8.

Table 11.8 Predicted changes in total water velocity due to dredging of South Arm under tidal conditions

Site	Average change (m/s)	Maximum positive change (m/s)	Maximum negative change (m/s)
Pilot Station (near entrance)	0.001	0.016	-0.013
Stockton Bridge (north arm)	-0.001	0.020	-0.018
Fullerton Cove (north arm)	0.000	0.049	-0.031
Moscheto Creek (north arm)	-0.001	0.004	-0.005
Tourle Street bridge (South Arm)	-0.001	0.116	-0.095
Railway Bridge (South Arm)	0.010	0.081	-0.086
Ironbark Creek (South Arm)	0.000	0.016	-0.010
Hexham	0.000	0.006	-0.010
Green Rocks	0.000	0.007	-0.008

It can be seen under tidal conditions and as a result of the proposed dredging there is likely to be very little alteration to water velocities in the estuary. The average change in simulated velocities at most sites was negligible. Maximum changes in velocities were generally much less than 0.1 m/s (i.e. much less than 0.2 knots).

Note that velocities in the dredge area would reduce substantially after completion of the dredging. It would not be expected that there would be any significant alteration to tidal velocities (magnitude and direction) within the Port area that would affect navigation.

Based on the 29-day tidal simulation undertaken, the pre- and post-dredging flow rates throughout the Hunter estuary are given in Table 11.9 (averages) and Table 11.10 (maximums). The flows given are the averages across the channel cross-section at the locations shown. Note that the maximums given are for the 29-day simulation and are not necessarily the maximum possible tidal flowrates that would occur in the estuary.

Table 11.9 Predicted pre and post dredging average flow rates in the Hunter estuary under tidal conditions

Site	Average Ebb Tide Flow (m³/s)		Average Flood Tide Flow (m³/s)	
	Existing	Dredged	Existing	Dredged
Ocean Entrance	1122	1132	1049	1054
Entrance to Throsby Creek	47	47	45	45
Main channel at confluence with Throsby Creek	1011	1021	964	968
Downstream entrance to South Arm	191	203	180	192
Downstream entrance to north arm	751	748	741	738
North arm near Tomago	235	234	228	225
Tourle Street bridge	96	99	93	100
South arm near Ash Island Bridge	49	53	57	59
Hexham Bridge	256	255	249	249

Table 11.10 Predicted pre and post dredging maximum flow rates in the Hunter estuary under tidal conditions

Site	Maximum Ebb Tide Flow (m ³ /s)		Maximum Flood Tide Flow (m ³ /s)	
	Existing	Dredged	Existing	Dredged
Ocean Entrance	2811	2880	2680	2703
Entrance to Throsby Creek	158	159	169	156
Main channel at confluence with Throsby Creek	2531	2591	2468	2503
Downstream entrance to South Arm	571	659	509	599
Downstream entrance to north arm	1890	1887	1870	1879
North arm near Tomago	453	449	436	431
Tourle Street bridge	264	284	249	267
South arm near Ash Island Bridge	112	124	143	148
Hexham Bridge	483	484	506	506

It is evident that, post-dredging, there was generally a slight increase in ebb and flood tide flows in the South Arm, with a slight decrease in the north arm. At Walsh Point, the increase in average South Arm ebb and flood flows was about six percent, with a 0.4 percent decrease in average north arm ebb and flood flows. In terms of the average north arm/South Arm flow distribution at Walsh Point, there was only a one percent change. That is, under existing conditions the South Arm took about 20 percent of the total flow at Walsh Point (on both ebb and flood tides). After dredging, this increased to 21 percent.

Overall, the modelling results indicate that tidal hydrodynamics would remain virtually unchanged after the proposed dredging. Slightly more tidal flow would pass through the South Arm, with a slightly increased tidal range at locations near the dredged area. However, the magnitudes of these changes would be very small and would not be expected to have any measurable impacts.

The average and peak mean (cross-section averaged)² velocities at Tourle Street Bridge and four cross sections along the temporary sheet piled wall (approximately at one-third intervals along its length) over the 29 day tidal simulation are given in Table 11.11, along with corresponding values for existing conditions.

Table 11.11 Average and peak mean tidal velocities along temporary sheet pile wall location and at Tourle Street bridge for existing conditions and with wall in place

Location	Average Mean Velocity (m/s)		Peak Mean Velocity (m/s)	
	Existing	With Sheet Pile Wall	Existing	With Sheet Pile Wall
Tourle St Bridge	0.19	0.19	0.45	0.44
Upstream end of wall	0.13	0.15	0.35	0.40
One-third along the length of wall	0.13	0.16	0.35	0.42
Two-thirds along length of wall	0.05	0.05	0.13	0.15
Downstream end of wall	0.02	0.03	0.06	0.07

² In this case, the terms "average" and "peak" apply to the temporal velocity record, while "mean" refers to spatial averaging.

It is evident that increases in mean tidal velocities with the temporary sheet pile wall in place would be in the order of 15% along the wall location. Given that mean tidal velocities are less than 0.5 m/s at this location, it would not be expected that the increase in velocities would cause significant bank erosion. However, recommendations for monitoring of bank erosion are given with regard to flooding in Section 11.3 which would also enable assessment of any tidal effects.

11.2.3 Flooding

Design floods as devised in the 'Lower Hunter Flood Study' (PWD, 1994) were simulated for the 1 percent, 2 percent, 5 percent and 10 percent AEP events. Simulations were undertaken for existing conditions and with the proposed temporary sheet piled wall (to contain contaminated sediments during dredging operations) in place.

The alteration to the flood profile (peak water levels versus distance) with the temporary sheet piled wall constructed is shown in Figure 11.1 for the South Arm. Effects on the north arm were negligible.

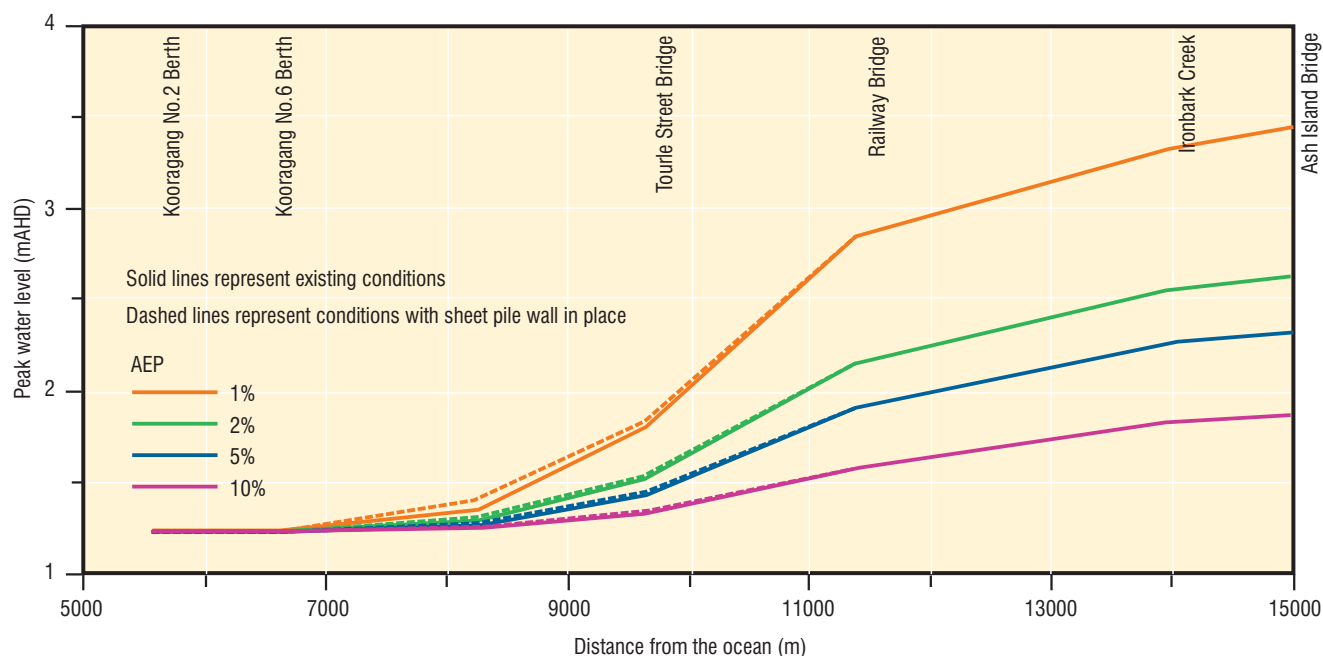


Figure 11.1 Peak water levels for various (AEP) floods under existing conditions and with temporary sheet pile wall in place (South Arm)

The effect of the proposed temporary sheet pile wall on flood levels in the South Arm would be minimal. The maximum increase in peak flood levels, midway between Kooragang No.6 Berth and Tourle Street bridge, was 50 millimetres in the one percent AEP event, reducing to 20 millimetres in the two percent event and 7 millimetres in the ten percent event. At the railway bridge, increases were no greater than five millimetres in all simulated events.

It is unlikely that such small increases in flood levels would cause significant adverse affects, such as damage to property. Flow in the reach of the South Arm affected by the slight increases in levels would continue as channel flow, with no overbank flow occurring. Further, the sheet pile wall is only expected to be in place for a relatively short period of time (approximately one year).

With the temporary sheet piled wall in place, the restriction in flow area causes increases in mean (cross-section averaged) velocity along the length of the wall. The peak mean velocities at Tourle Street bridge and four cross-sections

along the sheet pile wall (approximately at one-third intervals along its length) for the five percent AEP are given in Table 11.12, along with corresponding values for existing conditions.

Table 11.12 Peak mean velocities along temporary sheet piled wall location and at Tourle Street bridge for existing conditions and with wall in place (5% AEP flood)

Location	Maximum Mean Velocity (m/s)	
	Existing	With Sheet Pile Wall
Tourle Street bridge	1.41	1.40
Upstream end of wall	0.28	0.39
One-third along length of wall	0.18	0.20
Two-thirds along length of wall	0.81	0.97
Downstream end of wall	0.80	0.94

It is evident that increases in mean velocity with the temporary sheet piled wall in place are in the order of 15 percent at the downstream (higher velocity) end. The highest velocities would be expected to be against the left (northern) bank. It is recommended that an inspection of the northern bank is carried out, prior to the sheet piled wall being installed, with the purpose of identifying potential areas that may be susceptible to erosion as a result of increased velocities. If any areas are identified these may require protection or monitoring while the sheet pile wall is in place. However, given that this bank would be protected with a rock revetment after completion of dredging, monitoring only may be required given the temporary nature of any erosion that may occur.

The dredging and excavation of the South Arm involves the removal and the handling of an approximate total of 13 million m³ of material. This total includes around 4.5 million m³ of good quality sand, which is located within the dredge footprint beneath the marine silts and clay sediments at the bed surface. This sand is considered suitable for reclamation and filling activities associated with the construction of the proposed Austeel facility at Tomago.

This material would be provided to the Tomago site utilising a large cutter suction dredger with a production capacity of approximately 150,000 m³/week to 200,000 m³/week.

The sand would be delivered to the Tomago site hydraulically via a discharge pipeline with an estimated diameter of 750 mm. The pipeline would be a temporary structure, required for a period of approximately one year. The preferred route for the discharge pipeline would be subject to a separate approval process. For the purposes of this EIS a route has been chosen for modelling purposes based on a worst-case scenario. The pipeline would generally be placed on the existing ground surface.

A two dimensional RMA flood model covering the lower reaches of the Hunter River has previously been used by Patterson Britton and Partners to assess the effects of a potential transport corridor to be constructed across Kooragang Island on flood levels in the vicinity of the site.

The existing RMA flood model was modified to assess the effects of the discharge pipeline that would traverse across Kooragang Island. In the completion of this assessment it was assumed that the steel pipeline would be effectively impermeable to flood flows. The pipeline was simulated by raising the existing ground levels by the pipeline diameter along the length of the pipe.

Simulations were undertaken for existing conditions and with the pipeline in place for the four design floods. Note that existing ground levels were assumed at the proposed Tomago port site on the north arm (that is no port development was simulated).

To compare the sensitivity of the model results to the pipeline height, pipeline diameters of 700 mm and 900 mm were simulated. The 700 mm diameter allows for some settlement of the 750 mm diameter pipe, while the 900 mm diameter assumes the pipeline is raised above ground level. The results for the 900 mm pipe could be considered to be conservative.

The maximum increases in peak water levels as a result of the pipeline construction are shown in Table 11.13 for the four design events. These increases would be upstream of the pipeline.

Table 11.13 Maximum increases in peak water level due to discharge pipeline construction

Flood Event (AEP)	Maximum increase in peak water level (m)	
	700mm pipeline	900mm pipeline
1%	0.09	0.19
2%	0.18	0.27
5%	0.17	0.23
10%	0.09	0.10

It can be seen that over the range of events simulated, peak flood levels increased by up to between about 0.1 and 0.3m. However, the largest increases were localised to just upstream of the pipeline. To illustrate this, contour plots of the increases in peak water level for the 700 mm pipeline were generated for the four design flood events. The results for the 900 mm pipeline are provided in Appendix F. Note that positive variations represent increases in peak water level due to the pipeline.

It is evident that the largest increases in peak water level would be localised to immediately upstream of the pipeline. In the broad Beresfield, Hexham and Hexham swamp area, increases in water level were up to about 50 mm over all design events, while at Tomago and between Hexham and Sandgate the maximum increase was about 70 mm. For the 1% AEP event, maximum increases at these locations were about 30 mm and 50 mm respectively.

The potential for greater flood damages as a result of the increased water levels cannot be determined simply as information on floor levels was not obtained as part of the Lower Hunter Floodplain Management Study (Patterson Britton & Partners, 2001c). In the Patterson Britton & Partners (2001c) study, it was recognised that existing flooding problems would potentially remain for areas such as Raymond Terrace, Tomago, between Hexham and Sandgate, Beresfield, Tarro, Maryland, Wallsend, and Shortland.

Given that floor levels for habitable areas of dwellings are generally required to be 500 mm above the level of the 1% AEP flood in this area, the effect of increased flood levels is considered to be relatively insignificant for development sited according to this requirement.

Note that construction of a potential transport corridor across Kooragang Island itself, which may possibly follow the pipeline route, has been shown to increase flood levels in the vicinity of Hexham by about 20 mm for the 1% AEP event (Patterson Britton & Partners, 2003b). It is understood that this long term increase in flood levels would be considered as part of an EIS for the Tomago development. The increase of about 30 mm at Hexham due to the pipeline is a short-term effect (in the order of a year) and only marginally larger than the effect of a potential transport corridor construction at the same location.

As stated, the broad-scale increases in peak flood levels in the 1% event, due to the installation of the temporary discharge pipeline, would be in the order of 30–50 mm, with net increases only 10–30 mm above the long-term effect of the proposed transport corridor (and this conservatively ignores the reduced flood levels as a result of the South Arm dredging). If the potentially increased risk of flood damages due to this increase in levels was considered to be unacceptable, a number of mitigation measures would be possible.

One such measure would be to provide relief floodways under the pipeline at appropriate depressions along the route, for example with culverts. The pipeline could also be embedded further at critical locations to reduce its elevation relative to the ground surface.

Simulations were also undertaken for the ultimate post-dredging conditions (temporary sheet piled wall removed), for the 1 percent, 2 percent, 5 percent and 10 percent AEP events. The alteration to the flood profile (peak water levels versus distance) after completion of dredging is shown in Figure 11.2 (Entrance and north arm) and Figure 11.3 (South Arm).

It is evident that peak water levels reduce substantially immediately upstream of the dredged area. At the Tourle Street bridge, where the greatest effects were noted, the reductions in peak levels were 0.6 metres, 0.3 metres, 0.2 metres and 0.1 metres for the 1 percent, 2 percent, 5 percent and 10 percent AEP events respectively. At the Railway Bridge, the reduction was in the order of 0.1 metres for all simulated events, and at Ironbark Creek, peak levels were about 0.03 metres lower over these events.

Peak flood levels were also found to slightly reduce in the north arm and upstream to Hexham. For all simulated events, the reduction in peak levels was about 0.02 metres at Hexham and 0.03 metres near Moschetto Creek (except for the 10 percent AEP event at the latter site, for which levels were about 20 millimetres lower).

At Fullerton Cove, peak levels were about 21 millimetres and 11 millimetres lower for the 1 percent and 2 percent AEP events respectively. At Stockton Bridge, peak levels were about 15 millimetres and 7 millimetres lower for the 1 percent and 2 percent AEP events respectively. For higher AEP events, flood level reductions at these two sites were generally only a few millimetres.

The proposed dredging thus provides some benefits in terms of slightly reduced flood risk throughout the lower Hunter estuary.

11.2.4 Salinity structure

Salinity is a factor that affects the health and distribution of a number of estuarine floral species, including mangroves.

To investigate the potential alteration in salinity due to the proposed dredging, simulations were undertaken to investigate saline intrusion over a 29-day period, assuming an initially fresh estuary (0 parts per thousand) and saline oceanic waters of 35 parts per thousand, under tidal conditions. These are conservative conditions under which to investigate any changes to salinity regime, as freshwater flows (particular floods) have a more significant influence on estuarine salinities than tides and would mask any variability in salinity intrusion. It would be expected that there would be little alteration to the high freshwater flow salinity regime under post-dredging conditions.

The resulting salinity contours at the end of the simulation under existing and dredged conditions are shown in the set of figures in Appendix F.

There is slightly less saline intrusion under the dredged conditions, particularly in the South Arm. Salinity concentrations at the end of the 29-day simulations are tabulated in Table 11.14, along with the average difference in pre- and post-dredging salinities over the 29 days of the simulation.

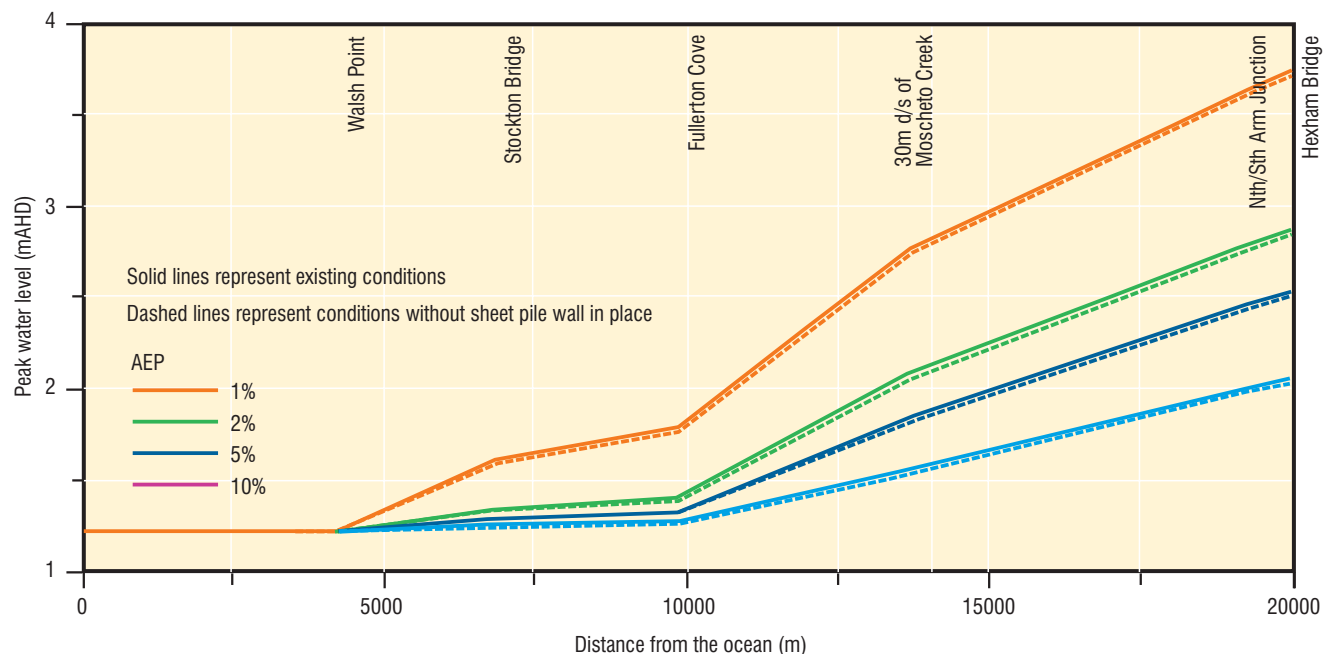


Figure 11.2 Peak water levels for various (AEP) floods under existing and post-dredging conditions (entrance and north arm)

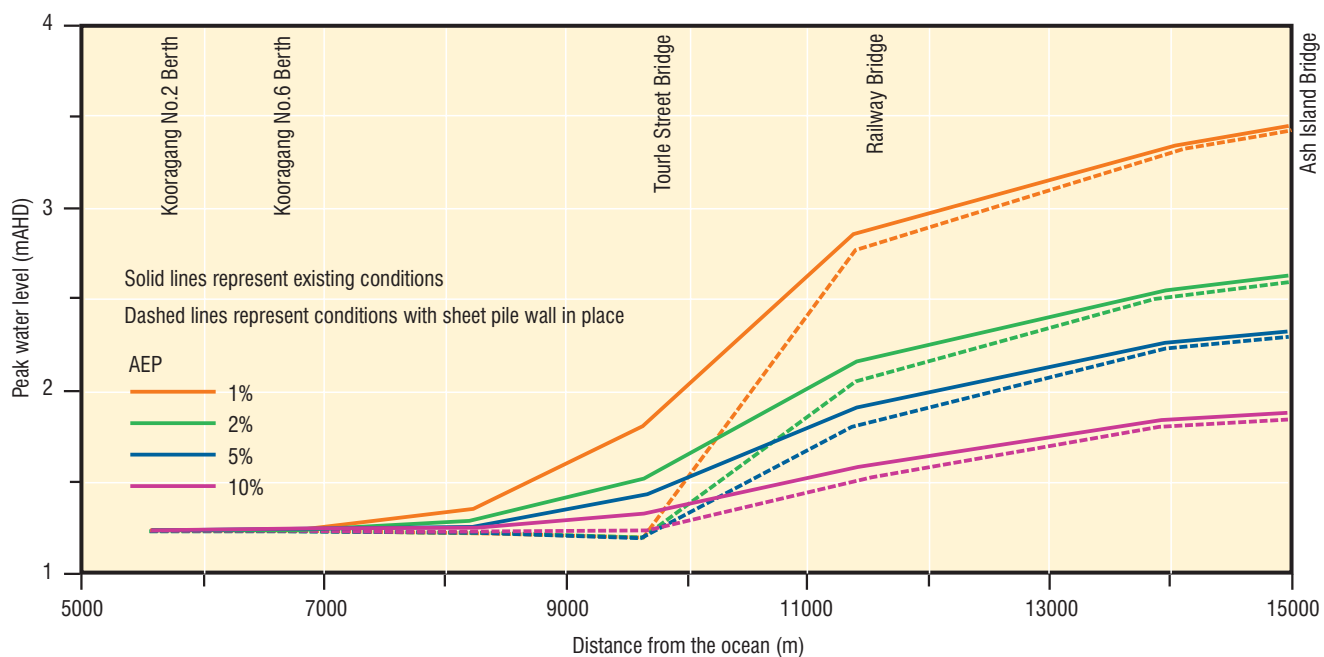


Figure 11.3 Peak water levels for various (AEP) floods under existing and post-dredging conditions (South Arm)

Table 11.14 Salinity values after 29-day simulation
at various locations in estuary for existing and post-dredging conditions

Location	Salinity (ppt) after 29 days		Average difference in salinity pre and post dredging (ppt)
	Existing	Post-Dredging	
Entrance	34.4	34.2	-0.03
Hannell St Bridge, Throsby Creek	33.6	33.3	-0.2
Stockton Crossing	31.1	30.1	-0.6
Walsh Point	29.8	28.0	-1.3
No 2 Kooragang Berth	28.2	25.3	-2.7
No 6 Kooragang Berth	28.0	24.8	-3.3
Tourle Street bridge	26.1	23.7	-2.9
Railway Bridge (South Arm)	24.1	22.3	-2.3
Ironbark Creek entrance	20.0	18.2	-1.3
Stockton Bridge	25.7	24.2	-0.8
Fullerton Cove	21.6	20.4	-0.8
Moscheto Creek	18.2	17.1	-0.6
Tomago	15.7	14.7	-0.5
North arm and South Arm upstream junction	12.8	12.0	-0.4
Hexham Bridge	10.7	10.1	-0.3
Greenways Creek	4.1	3.9	-0.07
Raymond Terrace	1.1	1.0	-0.01

The alteration to the salinity intrusion regime was found to be concentrated near the dredge footprint, from Walsh Point to Ironbark Creek in the South Arm. In this reach, salinity values were (on average) more than 1 ppt lower over the 29-day simulation after dredging. The reduction in the salinity intrusion would be mainly due to reduced tidal velocities within the proposed dredge area.

The temporal variation in salinity over the 29-day simulations is shown in the set of figures in Appendix F.

Results indicate that there are only small changes to the salinity regime outside of the Walsh Point to Ironbark Creek reach. The effect of dredging in this reach was found to be to reduce both the variability in salinity (within and upstream of the dredged area) and the upstream intrusion of salinity.

Flora sensitive to salinity include mangroves, which are mainly located south of Ironbark Creek on the right bank of the South Arm in this reach, as far downstream as the railway bridge. There is also a small stand of mangroves just downstream of the Tourle Street bridge, which are expected to be removed as part of the proposal.

Mangroves in the Hunter estuary already inhabit a wide variety of areas subject to significantly different salinity regimes, from Stockton to Hexham, indicating their tolerance to a wide range of salinities. Numerous studies of established

mangroves in NSW (Hawkesbury River, Lane Cove River, Botany Bay) have found no correlation between mangrove distribution and salinity (Clarke and Allaway, 1993).

Mangroves are tolerant of saline waters, and generally prefer estuarine environments. However, if salinity is altered dramatically, mangroves can exhibit a degree of damage. As reported by Field (1987) for the grey mangrove (*Avicennia marina*)³, various studies have indicated the optimum salinity for mangrove growth is between about 4 and 18 ppt⁴. The other species present in the Hunter, the river mangrove (*Aegiceras corniculatum*), also falls within this range for optimum growth. Therefore, as salinities increase above about 18 parts per thousand, growth rates may decline.

Given the wide range of salinities for optimal mangrove growth, it would not be expected that the relatively small predicted post-dredging alteration to salinity intrusion during low freshwater flows would cause significant stress on existing mangrove stands.

Saltmarsh is also potentially sensitive to salinity, although it would be expected to survive in higher salinities than mangroves. The main factor affecting the zonation of saltmarsh is water availability, in turn related to tidal inundation.

11.2.5 Effect of altered salinities on Biota

Flora sensitive to salinity would include mangroves, which are mainly located south of Ironbark Creek on the right bank of the South Arm in this reach, as far downstream as the Railway Bridge. There is also a small stand of mangroves just downstream of Tourle Street bridge, but these would be physically removed as part of the dredging operation.

Mangroves in the Hunter estuary already inhabit a wide variety of areas subject to significantly different salinity regimes, from Stockton to Hexham, indicating their tolerance to a wide range of salinities. Numerous studies of established mangroves in NSW (Hawkesbury River, Lane Cove River, Botany Bay) have found no correlation between mangrove distribution and salinity (Clarke and Allaway, 1993).

Mangroves are tolerant of saline waters, and generally prefer estuarine environments. However, if salinity is altered dramatically, mangroves can exhibit a degree of damage. As reported by Field (1987), for the Grey Mangrove (*Avicennia marina*)⁵, various studies have indicated the optimum salinity for mangrove growth is between about 4 and 18 ppt⁶. The other species present in the Hunter, the River Mangrove (*Aegiceras corniculatum*), also falls within this range for optimum growth. Therefore, as salinities increase above about 18ppt, growth rates may decline.

Given the wide range of salinities for optimal mangrove growth, it would not be expected that the relatively small predicted post-dredging alteration to salinity intrusion during low freshwater flows would cause significant stress on existing mangrove stands.

Saltmarsh is also potentially sensitive to salinity, although would be expected to survive in higher salinities compared to mangroves. The main factor affecting the zonation of saltmarsh is water availability, related to tidal inundation (Harty and Cheng, 2002). Given that tidal and flood-related inundation would not be expected to alter significantly after dredging, no significant impacts on saltmarsh would be expected.

The structure of fish assemblages has also been shown to be influenced by a range of environmental variables, including salinity (Bishop, 1999). However, when assessing the role of salinity, the complexities introduced by other variables such as turbidity was emphasised. It was also noted that the tolerance of fish to extremes in salinity differs considerably between species.

³ The grey mangrove is the dominant mangrove species in the Hunter estuary (MHL, 2002).

⁴ Note that Field (1987) reported optimum values as percentages of seawater NaCl concentrations, which were assumed here to be equivalent to salinities in ppt relative to an oceanic value of 35ppt.

⁵ The Grey Mangrove is the dominant mangrove species in the Hunter estuary (MHL, 2002).

⁶ Note that Field (1987) reported optimum values as percentages of seawater NaCl concentrations, which were assumed here to be equivalent to salinities in ppt relative to an oceanic value of 35ppt.

Bishop (1999) termed biota capable of withstanding wide variations in salinity as “euryhaline”, while those only able to withstand a narrow range were termed “stenohaline”. For the latter, biota only capable of withstanding a narrow range of high salinities were termed “stenohaline-marine”, while those only able to tolerate a narrow range of very low salinities were denoted as “stenohaline-freshwater” species.

Given that salinity intrusion would be expected to reduce as a result of the dredging, the species for which available habitat may reduce would be stenohaline-marine. However, since alterations to salinity as a result of the dredging would be minimal in the high salinity range, and given that there still would be abundant high salinity habitat available, the impacts of altered salinity intrusion on fish would not be expected to be significant.

11.2.6 Impact on proposed opening of Ironbark Creek floodgates

Given that the hydrodynamics and salinity intrusion into Hexham Swamp would not be expected to be altered significantly after dredging, there would be little impact from the proposed dredging on the expected outcomes from the proposed opening of the Ironbark Creek floodgates. In fact, the opening of the floodgates themselves would be expected to have substantially more influence on the hydrodynamics and water quality of Hexham Swamp than the proposed dredging.

11.2.7 Overall flushing characteristics

The potential for dredging to alter the flushing characteristics of the estuary was assessed by means of the simulation of an arbitrary conservative constituent. In this, the entire model network was assumed to have an initial concentration of 100 g/m³ of this pollutant. The reduction of the pollutant concentration over time was observed during a 29-day tidal simulation in which unpolluted oceanic waters were to mix in the estuary and dilute the pollutant.

The resulting pollutant concentrations at the end of the simulation, under existing and dredged conditions, are shown in Appendix F.

There was slightly less flushing of pollutants in the South Arm under post-dredging conditions, with most other areas of the estuary unaltered. Pollutant concentrations at the end of the 29-day simulations are tabulated in Table 11.15, along with the average difference in pre- and post-dredging pollutant concentrations over the 29 days.

Table 11.15 Hypothetical pollutant concentrations after 29 day simulation at various locations in estuary for existing and post-dredging conditions

Location	Pollutant concentration relative to initial (%)		Average difference in salinity pre and post dredging (%)
	Existing	Post-Dredging	
Entrance	2	2	-0.02
Hannell St Bridge, Throsby Creek	91	91	0.00
Stockton Crossing	40	39	-0.4
Walsh Point	48	49	-0.1
No 2 Kooragang Berth	73	74	-0.3
No 6 Kooragang Berth	82	83	0.5
Tourle Street bridge	91	96	1.6
Railway Bridge (South Arm)	90	94	1.0
Ironbark Creek entrance	89	90	0.4

Table 11.15 continued.

Location	Pollutant concentration relative to initial (%)		Average difference in salinity pre and post dredging (%)
	Existing	Post-Dredging	
Stockton Bridge	56	56	-0.6
Fullerton Cove	61	60	-0.5
Moscheto Creek	80	80	-0.1
Tomago	89	89	-0.01
North arm and South Arm upstream junction	93	93	0.00
Hexham Bridge	95	95	0.03

The alteration to pollutant flushing characteristics was localised to within the dredged area and just upstream of it, with changes of only a few percent in concentrations after the 29-day simulations.

Simulation of an arbitrary conservative constituent released at a constant rate in the South Arm into the ambient water column (assumed to be initially contaminant free) was also undertaken. The pollutant was released around 1.6 kilometres downstream of the Tourle Street bridge, at a rate of 100 g/s. The reduction of the pollutant concentration with time was observed over a 29-day tidal simulation, as unpolluted ambient waters mixed in the estuary and diluted the pollutant.

The resulting pollutant concentrations at the end of the simulation under existing and dredged conditions are shown in Appendix F.

Pollutant concentrations are higher near the source and spread further upstream under existing conditions. Under post-dredging conditions, the pollutant in the South Arm is more diluted. This would partly be due to increased water depths in the vicinity of the pollutant source.

11.2.8 Potential impacts during onshore treatment activities

One of the concerns associated with the contaminated sediments in the South Arm was to find out the level of contamination that would be linked to waters around the sediments – both during dredging and when the sediments were dewatered on land. This section looks at the waters associated with the onshore treatment activities. The issue of contaminants at the dredging site is discussed in section 11.2.8.

As part of the EIS, filtrate from six bags representing three contamination zones (high, medium and low) and 2 dredging processes (mechanical and cutter suction) was collected as part of the bulk sampling and testing program conducted during the preparation of this EIS. The filtrate from each bag was tested for a suite of contaminants recommended by the EPA. In addition, a composite of filtrate from 2 low, 2 medium and 2 high contamination bags was provided for toxicity testing.

The main findings of toxicity testing were that the acute toxicity of the filtrate to the bacteria from the high PAH contaminated sediment was greater than that of the low and medium PAH contaminated sediment. However, toxicity did not appear to correlate with any of the measured chemicals in the filtrates, i.e. the insoluble fraction.

Return waters

The remediation process has been designed so as to minimise the amount of water requiring treatment and return to the river. This has been driven by the results of toxicity testing, which show that the return water could be extremely toxic without treatment. The choice of a mechanical dredging process would ensure that the amount of return water generated is minimised. Nonetheless, if the contractor selects geotextile dewatering for the purposes of thermal desorption conditioning of the sediments then a significant amount of toxic water would require treatment prior to discharge back into the South Arm. In addition, as discussed in Chapters 6 and 7, there would be a significant quantity of contaminated groundwater from the OneSteel excavation requiring treatment and discharge.

A water treatment plant would thus be required on the OneSteel site and possibly on the closure area site.

It is envisaged that the water treatment process for contaminated water would involve the following steps:

- Contaminated water would be directed to an on-site settling pond/tank; the storage capacity of this tank would be such to provide sufficient emergency storage as well as some settling capacity;
- To remove the suspended sediments, the wastewater would be treated by gravitational sedimentation (occasionally with a flocculation agent) and then sand filtration;
- Metals may be removed either by ion exchange, or by precipitation using a chemical additive;
- Ammonia can be removed by simple air stripping processes;
- Water that has been treated by chemical addition must proceed through a sedimentation and filtration sequence to remove the precipitated compounds;
- Organic compounds are removed by carbon adsorption (or granulated activated carbon). This method is capable of removing organic substances including chlorinated solvents, phenols, PCBs, PAHs, and pesticides; and
- Ultraviolet oxidation can also assist in the breakdown of PCBs and PAHs.

It is envisaged that the contractor may wish to utilise other water treatment processes such as evaporation or membrane filtration. Consent for a number of water treatment systems is thus sought.

Stormwater controls

The onsite areas associated with the proposal would be subjected to rigorous stormwater planning and management. Since the land area layouts are not as yet finalised (Chapter 7) no definitive stormwater plan is offered in this EIS; rather, such a requirement is expected to form a condition of consent.

The principles of the stormwater plan would centre on the need for very strict separation of 'clean' and 'contaminated' materials to avoid the contamination of rainwaters by sediments.

The contractor would be expected to adhere to the requirements of Newcastle Council's Stormwater Management for Development Sites (DCP No. 50). The DCP outlines standards relevant to stormwater management including:

- the requirement for a soil and water plan;
- provision of stormwater management information in a DA; and
- issues to be considered in designing stormwater management infrastructure.

Effect of Deepening on Water Quality Processes

After dredging, the dredged area itself would be substantially deeper than under existing conditions. This would be expected to potentially alter various water quality processes in this reach, namely:

- there would be a greater likelihood for stratification to occur in the water column after high freshwater flows and as salinity intrudes upstream (before vertical salinity gradients have eroded due to mixing);
- this would coincide with relatively large organic loads depositing on the bed as the result of the freshwater flow (as they do under existing conditions);
- dissolved oxygen levels would reduce in the water column due to the breakdown of this organic material (as they do under existing conditions), potentially reducing the ability of the water column to support aquatic life; and,
- the stratification in the water column, at such times of high freshwater flows, may suppress mixing within this lower layer, exacerbating the reduction in dissolved oxygen, and potentially creating the circumstances leading to the formation of algal blooms; however, limited light penetration due to naturally high turbidity is likely to limit the formation of algal blooms in the Hunter estuary (MHL, 2002).

Dissolved oxygen measurements within the existing dredged areas of the estuary are relatively limited (Sanderson et al, 2001). However, the lower estuary generally has higher dissolved oxygen concentrations.

The measurements of Sanderson et al (2002) indicate that dissolved oxygen levels at depth do reduce substantially after floods. However, the most significant reductions in dissolved oxygen were well upstream of the existing dredged areas in the estuary. In the limited measurements of dissolved oxygen in Sanderson et al (2002), there are no examples of measurements that indicate relatively large dissolved oxygen reductions in the existing deep areas of the port.

It would be expected that the water quality of the proposed dredged area would be similar to existing dredged areas such as the entrance to Throsby Creek, although even greater mixing would also be likely in the South Arm with the higher velocities. The available evidence suggests that the existing dredged areas have some of the best water quality results in the estuary, most likely since the downstream areas of the estuary have the greatest tidal flushing.

To improve the water quality of the Hunter estuary, a total catchment management approach should continue to be emphasised, with reductions in the sources of sediments and nutrients entering the estuary being the prime focus. This should continue to be implemented in an integrated manner by the responsible authorities such as the DIPNR, DMR and the HCMT (authorities listed as funding recommendations of the Healthy Rivers Commission, 2002).

11.2.9 Transport and deposition of suspended sediment due to dredging

Sediments that are dredged may go into suspension during the dredging process and release toxic contaminants if these are already present. Fine material such as clay and silt has the greatest tendency to go into suspension during dredging, and, since the fall velocity of these materials is so slow, these particles remain suspended in the water column for a longer time compared with coarse-grained particles (such as sand and gravel) that settle relatively quickly. The issue of contaminants at the dredging site is discussed in section 11.2.8.

The type of dredge used, dredging method, sediment type, and hydrodynamics in the water column determine the degree of sediment suspension and subsequent dispersion (Herbich, 2000).

In the case of the proposed South Arm dredging operations, operation of the trailing suction hopper dredge is considered to be likely to generate the greatest amount of sediment in the water column. Other dredging operations, such as the backhoe dredge on a barge, would be able to be contained within a turbidity curtain to minimise the dispersion of sediment.

The stages of dredging with a trailing suction hopper dredge that generate suspended sediment include:

- movement of the suction pipes and suction heads through the water at a velocity in the order of 1 to 2 m/s, suspending sediments near the bed;
- return flow under and along the dredge, especially with low keel clearance;
- propeller wash during manoeuvring of the dredge (far more sediment is suspended in this operation compared to trailing);
- hopper overflows during the loading process, particularly towards the end of a dredging session when this overflowing mixture would be closer to the concentration of the pumped slurry; and
- release of any gas from the bed due to disturbance of the sediment.

Measurements of trailing suction hopper dredge and other dredging operations provide guidance on the likely mass of sediment (in kilograms of dry material) that may be resuspended in the water column per cubic metre (in situ) dredged. Most values (termed 'S') were found to be in the range from 0 to 20 kg/m³. Given that the dry density of the material to be dredged is about 700 kg/m³, an S value of 20 kg/m³ would mean that three percent of the dredged mass would enter the surface water column as suspended sediment from the above possible sources.

Given that up to approximately 1,350,000m³ of soft marine silts and clays would be dredged as part of the initial trailing suction hopper dredge operation, this is equivalent to a dry mass of 945,000 tonnes. With three percent of this mass estimated to be generated as suspended sediment, there would be about 28,400 tonnes of sediment released into the estuary. Assuming an effective dredging rate of 50,000m³ in situ per week, it would take 27 weeks to complete the dredging operation. The effective average rate of loading of sediment in the water column is thus about 1740 g/s, for 27 weeks.

For numerical modelling purposes, the suspended solids loading was distributed to four locations to represent the spatial extent of dredging. The loading areas were approximately at the upstream and downstream limits of dredging, and at distances about one-third and two-thirds along the length of the dredging. The loading at each of these four locations was thus about 435 g/s.

These loadings were applied in the model for a 29-day tidal simulation. Deposited sediment depths at the end of the simulation were scaled by a factor of 6.5 to take account of the dredging period continuing for longer (that is about 189 effective days).

The extrapolated depths of deposited sediment at the end of the dredging operation are shown in Figure 11.4.

Most of the suspended sediment would deposit in the existing port area downstream of the proposed dredged area. Newcastle Port Corporation would need to make allowance for this as part of their regular maintenance dredging operations. Sediment would also disperse upstream on flood tides, with deposition of sediment noted in the mangrove areas south of Ironbark Creek.

As discussed in Section 11.1.6, sedimentation can be beneficial to mangroves, assuming that the sediment build-up is not excessive. However, the depth of sediment build-up at Ironbark Creek is predicted to be in the order of three centimetres. Consequently, it is recommended that water quality (particularly turbidity), sediment deposition rates, and the mangrove colonies in the South Arm, particularly south of Ironbark Creek, be monitored during the dredging operation to flag introduction of mitigation measures if required. The mitigation measures would take the form of a floating turbidity barriers(s) installed across the river upstream of the dredge area.

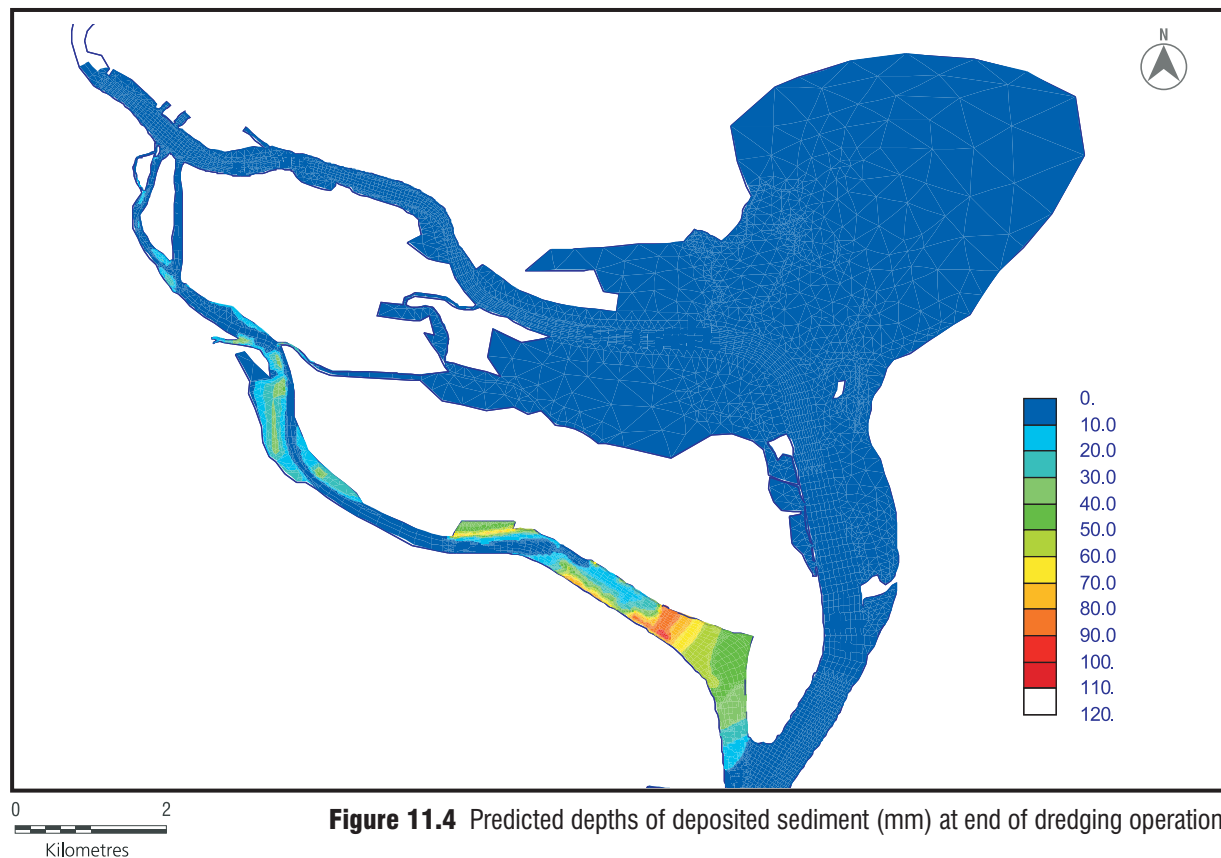


Figure 11.4 Predicted depths of deposited sediment (mm) at end of dredging operation

11.2.10 Local water quality impacts at dredging site due to contamination

General

Available sediment quality data indicates that the fine grained marine silty clays found in the South Arm are generally contaminated with heavy metals, PAHs and TPHs, with the highest concentration of contaminants located in an area immediately adjacent to the former BHP Steelworks Site. During dredging, these contaminants could potentially either disperse, remain attached to the sediment, or become disassociated from the sediment and disperse in solution.

Investigations into the contaminated sediments indicate that the sediments adjacent to the former BHP steelworks site are toxic to aquatic organisms and thereby unsuitable for unconfined sea disposal. Installation of a temporary sheet piled wall to contain these toxic sediments during dredging is proposed.

Water quality impacts during dredging inside the sheet pile wall

In order to assess the potential impact on Hunter River water quality of the proposed dredging inside the sheet piled wall, a water quality sampling and testing program was undertaken during a bulk sediment sampling exercise conducted close to the foreshore of the former BHP Steelworks Site. Details of the water quality testing program and the bulk sediment sampling exercise are provided in Chapter 7.

The water quality testing program involved testing of surface water samples taken inside and outside of a turbidity curtain surrounding three zones of sediment removal (representing high, medium and low sediment contamination). The sediment removal was undertaken using a barge mounted excavator.

Comparison of the water quality results from the samples taken immediately outside of the turbidity curtain prior to, during and after bulk sediment sampling indicate that all contaminants except total zinc were found to be below

ANZECC/ARMCANZ (2000) 95% trigger values. There is, however, some evidence background levels of total zinc elevated at concentrations close to the ANZECC/ARMCANZ (2000) 95% trigger value.

Total zinc concentrations inside the turbidity curtain were found to be particularly elevated corresponding to the elevated levels of suspended solids. The impact of elevated levels of total zinc at the dredge site is considered minimal as the turbidity curtain significantly reduces the levels of zinc and other contaminants in the surrounding waters; that is, levels of zinc recorded inside the turbidity curtain are up to 16 times higher than these outside the curtain. In the physico-chemical environment of the river, zinc would generally be adsorbed to suspended solids and dilution with surrounding waters would occur. In addition, chemical analysis and toxicity testing of sediment with comparable levels of zinc has shown that zinc is of low bioavailability and is not toxic to sediment-dwelling organisms (CSIRO, 2001a).

The PAH concentrations in all the water samples taken inside the turbidity curtain during the bulk sampling were high. However, all naphthalene concentrations were below the 95% trigger value. Other more toxic PAHs were found to exceed low reliability guidelines inside the turbidity curtain. However, these low reliability guidelines may be overly-conservative and should only be used as an indicative interim working level (ANZECC/ARMCANZ, 2000).

The results of the water quality testing program indicate that a turbidity curtain is effective in containing levels of contamination within the water column. Similarly, installation of a sheet piled wall would form a physical barrier further containing contamination levels within the wall.

Consultation with EPA indicates that provision of the temporary sheet pile wall may alone be an adequate mitigation measure to control water quality impacts during dredging of sediments within the sheet pile wall. Depending on the method of dredging used and results of water quality monitoring during the dredging activity, a turbidity curtain could also be installed if necessary around the dredging plant.

Water quality impacts during dredging outside the sheet pile wall

A series of investigations have been undertaken into the toxicity of the sediments of the South Arm. These investigations indicate that sulphide, ammonia, cyanide, heavy metals, organochlorine pesticides, benzene toluene, ethylbenzene and xylene are below guideline levels or are not bioavailable to aquatic organisms. It is concluded that these contaminants are therefore not contributing to the toxicity of the Hunter River sediments. As noted above, PAHS appear to offer the best relationship with observed toxicity.

The 95 percent upper confidence limit of the mean total PAH concentration for all sediment outside (offshore of) the 75 mg/kg total PAH contour line (normalised to 1 percent TOC), along which it is proposed to place the sheet piled wall, has been calculated to be 12.9 mg/kg (normalised to 1 percent TOC). This concentration is below a 15 mg/kg total PAH concentration limit (normalised to 1 percent TOC) recommended by the CSIRO, based on the available data for the protection of the ecosystem and human health. In addition, elutriate testing of sediment outside the sheet pile wall indicates contaminant concentrations measured in elutriate waters are generally below laboratory detection and would not be an ecological risk (Simpson et al, 2001a,b).

The sediment outside the sheet piled wall is, therefore, considered not toxic to aquatic organisms and suitable for unconfined sea disposal, which involves release of the sediment through the water column and its deposition on the seabed.

It would therefore be expected that dredging of the sediment outside the sheet piled wall, which would involve some disturbance of sediments into the water column, would not create circumstances that are toxic to aquatic organisms. It is also noted that a number of the dredging activities outside the sheet pile wall and involving the soft silty clays would include use of a turbidity curtain (in order to restrict any visible turbidity plume), which would localise any water quality issue.

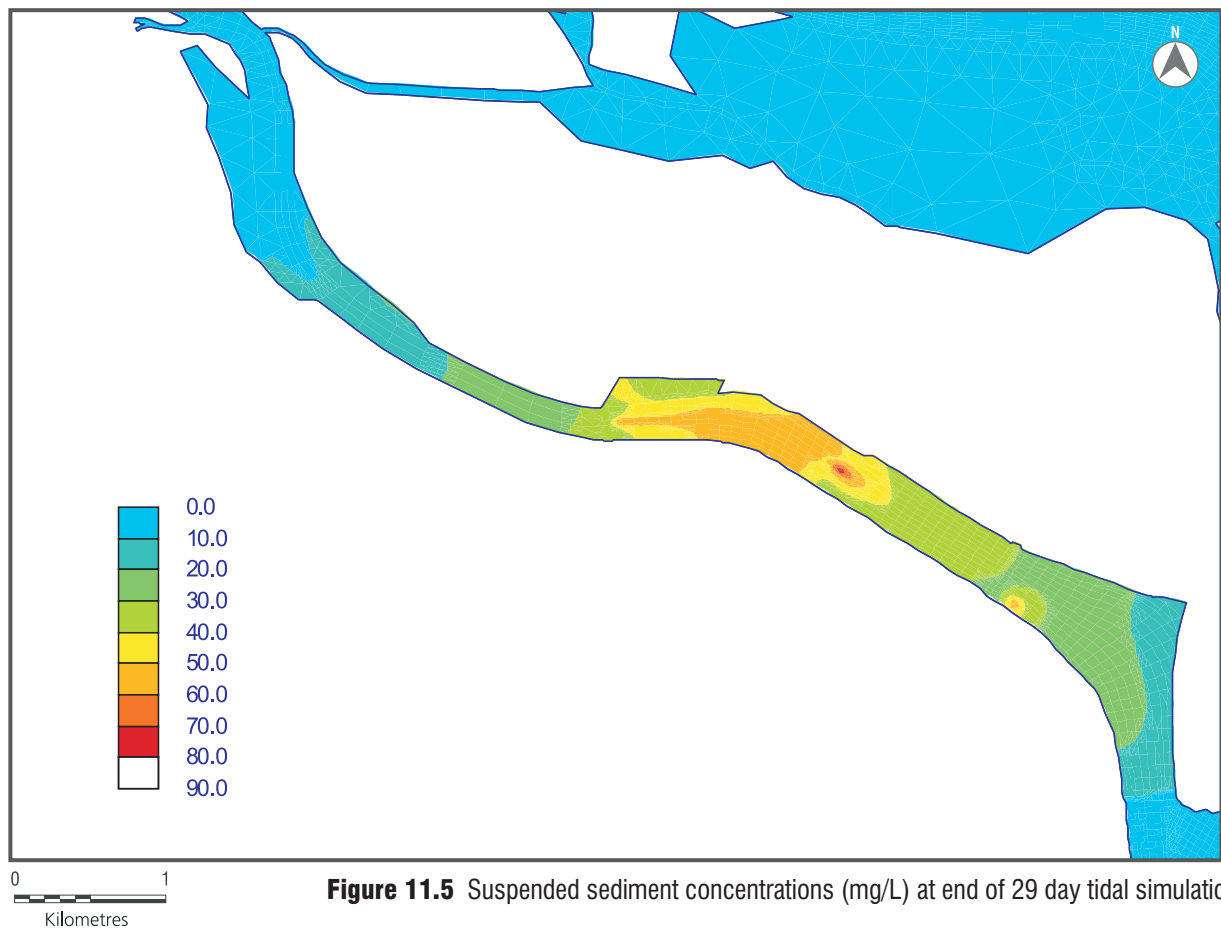


Figure 11.5 Suspended sediment concentrations (mg/L) at end of 29 day tidal simulation

Dredging has the potential to suspend sediments and increase the turbidity of the water.

The suspended sediment concentrations at the end of the 29-day tidal simulation are shown in Figure 11.5. Note that suspended sediment concentrations outside the region shown were less than 10mg/L.

It is evident that the suspended sediment concentrations in this simulation are in the order of about 40 to 90 mg/L near the dredging operation.

However, it has been observed that turbidity levels in the estuary are already high, generally related to catchment erosion. At the mean flow in the Hunter River, it has been predicted that the suspended sediment concentration at Hexham would be about 40 mg/L. This is not dissimilar to the concentrations predicted to occur in much of the dredged area during the dredging operations.

Therefore, with the understanding that suspended sediment concentrations are already high in the Hunter estuary, the approach to the uncertainty of impacts on these species would be to employ monitoring and turbidity curtains during some of the dredging operations which have the potential to cause particularly significant turbidity, and to only monitor at other times.

11.2.11 Effects of sediment transport after completion of dredging

As the South Arm would be deepened between the Tourle Street Bridge and the existing port area, water velocities would reduce relative to existing conditions. Therefore, “natural” sedimentation of this dredged area would be expected in the

future, in a similar manner to the existing deepened port area being in a zone of sediment deposition. As discussed in Section 2.6.3 of Appendix F most sediment deposition in the Hunter estuary would be expected to occur during floods.

There would be no alternation to upstream sediment concentrations as a result of the dredging operation, being affected by catchment processes and other upstream activities remote from the dredging site. Consequently, the total quantity of sediment travelling down the Hunter River would not be altered, and thus there would be little expected change to the volume of future annual maintenance dredging requirements of Newcastle Port.

However, as a result of the project development, the location and extent of the existing sediment deposition within the Port area would change, with deposition spread over a greater area than at present. As about 30% of the total flood flow of the Hunter River travels down the South Arm, it can be expected that approximately 30% of the sediment load also travels down the South Arm. At present, this sediment would mainly pass through the proposed dredge areas and deposited within the existing Port areas downstream. However, after the proposed South Arm channel extension works are complete, these deepened areas would be expected to capture most the sediment that previously passed downstream into the existing port.

11.3 Summary and recommended mitigation measures

11.3.1 Summary

The potential impacts of the proposed South Arm dredging on hydrodynamics, flooding and water quality were assessed. It was found that there would not be significant impacts on tidal hydrodynamics.

With regard to flooding, it was found that the general flood flow distribution, volumes and duration would not be altered by a significant amount. It was estimated that there would be a localised and substantial reduction in peak flood levels in the South Arm in the vicinity of Tourle Street bridge (0.6m in the 1 percent AEP event), and a slightly reduced flood risk throughout the lower Hunter estuary. These benefits were not expected to cause significant impacts on ecosystems relying on flood inundation.

Flood velocities in the South Arm upstream of the dredged area were predicted to increase, with the recommendation that bank stability be monitored, particularly between Tourle Street bridge and the railway bridge. Tidal and flood velocities in the dredged area were estimated to substantially reduce, providing benefits in terms of ease of navigation and reduced bank erosion.

Flood levels upstream of the railway bridge were predicted to marginally increase as a result of the installation of a temporary sheet piled wall (for a period of about one year) to contain contaminated sediments in the vicinity of the former BHP Steelworks site during the dredging activities. This slight increase in flood levels was not expected to lead to significant flood damages.

With the temporary sheet piled wall in place, mean tidal and flood velocities would be expected to increase by about 15 percent in the vicinity of the wall, with the highest velocities against the northern bank. It is recommended that the stability of this bank be monitored while the wall was in place.

Assessment of the effect on flooding of the temporary discharge pipeline delivering sand to Tomago was also undertaken. For the one percent AEP event, increases in peak water levels in the Hexham and Tomago area were found to only be 30-50 millimetres larger than the existing water levels.

Salinity intrusion was predicted to slightly reduce, although not to the extent of significantly impacting on mangroves, saltmarsh and fish.

It was also envisaged that there may be a greater tendency for stratification and depletion of dissolved oxygen concentrations at depth in the deepened areas, although the available evidence suggested that this does not occur in the existing dredged areas of the port. The existing dredged areas have some of the best water quality results in the estuary, most likely since the downstream areas of the estuary have the greatest tidal flushing.

During dredging operations, it was predicted that elevated suspended sediment concentrations may potentially harm aquatic life such as fish, although the Hunter estuary was noted as already having high suspended sediment concentrations. Turbidity curtains would be used in conjunction with various dredging operations, to minimise the dispersion of suspended sediment. Dispersion of pollutants in the sediments suspended as part of the dredging operations was not considered to be a significant issue.

Deposition of sediment in sensitive areas such as mangroves south of Ironbark Creek was also considered to be around the magnitude at which concerns may be raised. It was recommended that water quality (particularly turbidity), sediment deposition rates, and the mangrove colonies in the South Arm, particularly south of Ironbark Creek, were monitored during the dredging operations to prompt mitigation measures if required.

It was envisaged that Newcastle Port Corporation would need to make allowance for additional sedimentation in the port (during the proposal) as part of their regular maintenance dredging operations.

An appropriate allowance for maintenance dredging of the areas deepened as part of the channel extension for the South Arm needs to be made. While this would result in an increase in sedimentation in this area, as the total volume of sediment in the South Arm of the Hunter River would remain unchanged, there would be a commensurate reduction in the maintenance dredging requirements within the port area, downstream of the project area. The future maintenance dredging in the South Arm would be expected to be particularly concentrated to areas just downstream of the Tourle St Bridge.

11.3.2 Recommended mitigation measures

Potential impacts to water quality during implementation of the proposal would be minimised by environmental control provisions employed by the contractor. In general, implementation of the proposal would follow best practice techniques, and no appreciable impacts are anticipated.

During the implementation phase, best practice methods would be specific to the contractor chosen. It is imperative that best practice management strategies be put in place to minimise the impact and pollutant load entering the environment. To manage the potential for adverse impacts on water quality, the proposal would be subject to controls documented prior to commencement of construction in a soil and water management plan, which would form a component of the overall environmental management plan for the proposal.

Mitigation and monitoring during dredging

The selection of plant and equipment and of associated technologies has, where practicable, been undertaken to minimise potential adverse effects on water quality.

A steel sheet piled wall would be installed to provide a physical barrier to isolate material that is unsuitable for unconfined sea disposal from the other material. A backhoe dredge working in conjunction with barges would remove all of the material contained inside the sheet piled wall. The backhoe dredge would be fitted with a purpose-built clam working within a turbidity curtain. These features minimise and contain any turbidity generated.

In addition, a significant proportion of the marine silts and clays located outside the sheet piled wall would also be removed by a backhoe dredge working in conjunction with barges incorporating the same turbidity control features.

Other environmental control provisions proposed would include the deployment of turbidity curtains around the land-

based excavators, the large cutter suction dredge and the plant and equipment involved in the drilling and blasting.

A heavy-duty turbidity curtain would also be deployed, if required, across some of the South Arm upstream of the dredge area when trailing suction hopper dredges were using overflows. This would control turbidity spreading upstream beyond the disturbed waterway area.

Turbidity monitoring is proposed during the removal and handling activities. The contractor would be required to ensure that no significant or visible change in turbidity levels occurs in the surrounding waters. This would involve regular measurements and/or inspection of the area immediately surrounding the dredge by the contractor. The results of this monitoring would be recorded in a log book. Should a significant change in turbidity levels be observed, the contractor would be required to immediately contact the superintendent and cease dredging at this location until turbidity has returned to normal levels and measures had been implemented to ensure that such a change in turbidity levels does not occur again.

Onshore stormwater management plan

The onsite areas associated with the proposal would need to be subjected to rigorous stormwater planning and management. The principles of the stormwater plan would centre on the need for very strict separation of 'clean' and 'contaminated' materials to avoid the contamination of rainwater by sediments.

The contractor would be expected to adhere to the requirements of Newcastle Council's Stormwater Management for Development Sites (DCP No. 50).

Return water treatment plant

It is expected that the bulk of waters associated with the highly contaminated sediments would be taken up by the cement stabilisation process. Any remaining waters would thus require treatment before their discharge to the South Arm. There is however expected to be contaminated groundwater arising from the swing basin on the OneSteel site that requires treatment. Water treatment plants would thus be provided on the OneSteel site and on the closure area remediation site.

Any water treatment plant associated with the onshore activities would need to be the subject of a licensing process with the NSW EPA before any discharge occurred.

12 Aquatic ecology

This chapter provides a summary of the results of the aquatic ecology impact assessment undertaken by The Ecology Lab Pty Ltd as part of the EIS process. Information on the assessment methodology is provided, the existing environment is described, the potential impacts of the proposal are assessed, and mitigation measures recommended. The full report is included in Appendix G.

12.1 Assessment methodology

The aquatic flora and fauna impact assessment has involved a review of existing literature on the South Arm and surrounding areas supplemented by a targeted set of field studies as detailed below.

Literature review

The following literature on the aquatic ecology of the Hunter River was reviewed as part of the impact assessment:

- Review of historical changes to wetland vegetation in the Hunter River (Williams et al 1999);
- Description of commercial and recreational fishing (Gibbs et al. 1999, NSW Fisheries 2000);
- Review of sediment toxicity and bioaccumulation studies, findings from previous studies on marine habitats in the Hunter River (Birch et al. 1997, EPA 1994, Hutchings 1983, Simpson et al 2001, The Ecology Lab 1997, 1998); and
- Assessment of threatened species legislation with regards to marine listed species (NSW Fisheries 1999).

The findings of these reports have been incorporated into the impact assessment.

Field studies

A targeted field study was undertaken by The Ecology Lab with the primary aim of identifying the conditions existing in the South Arm. The results of the field study were used to form the impact assessment. Field tasks included:

- The existing mangrove areas in the South Arm were mapped.
- The existing mangrove areas in the South Arm were assessed for biodiversity.
- The existing mangrove areas in the South Arm were assessed for the abundance of fauna and the extent of existing damage to the wetland was determined using accepted techniques.
- The mangrove forests at the proposed dredged site were compared to other mangrove areas of the lower Hunter estuary to assess their conservation value. The locations included:
 - the mangrove forest at the proposed dredge site east of Tourle Street bridge;
 - the mangrove forest south of Ironbark Bridge; and
 - the forest east of Hexham Bridge.

Reference locations provide an indication of the normal range of habitat and conditions in the Hunter estuary.

- The habitat components of the mangrove forest were assessed along transects and in quadrats at three sites at each location.
- The abundance and distribution of animals living in soft-bottomed sediment (benthos) at each location were examined and compared to provide an indicator of diversity and spatial variability.
- In addition, a rapid assessment technique to examine physical damage in urban mangrove forests was used at three locations selected within the Hunter estuary.
- A survey of fish and mobile invertebrates was conducted to determine if fish at the proposed dredge site were similar to other areas of the estuary, including deeper waters.

Locations were sampled at low tide from 18 to 20 September 2002. There had been heavy rain and strong winds for two days prior to the sampling and, consequently, the water was very turbid.

The sampling design for fauna density and habitat components consisted of the same locations, sites and transects used in the study of damage and habitat components with another level of spatial replication, that of quadrats.

Demersal fish and invertebrates were sampled by trawling in the sub-tidal areas of the Hunter River estuary using the 28-foot prawn-trawling vessel, *Megan*. Trawling was done at two sites within the South Arm, representing the proposed dredge area, two sites within the north arm representing shallow water sub tidal habitat (1–4 metres) and two sites (one each in both the South Arm and north arm) representing deeper water sub-tidal habitat (9–16 metres). Sampling was conducted during daylight on 29 and 30 October 2002.

Further details on the methodology and statistical procedures used in the analysis are detailed in Appendix G.

12.2 Existing environment

12.2.1 Overview

The Hunter River is classed as a moderately filled barrier lagoon, permanently opened to the sea by training walls and regular dredging (West et al. 1985). It is unusual in that its aquatic habitat is dominated by mangroves, which cover 50 percent of the water area and, to lesser extent, salt marshes that cover 17 percent of the water area. There is no seagrass occurring along the main river channels. Although large areas of mangrove have been destroyed for industrial and port development, the overall extent of mangroves has actually increased since 1954, while the area of saltmarsh has decreased (Williams et al 1995). Seventy-two species of fish and twenty-six species of crustaceans have previously been identified in the Hunter River estuary. This is similar to assemblages sampled in rivers from mid-northern NSW; all show great temporal variability (Gibbs et al. 1999).

The lower Hunter supports an extensive industrial base in addition to extensive urban and commercial areas. Consequently, many of the soft sediments of the estuary are contaminated with pollutants that include heavy metals and PAHs. Previous studies indicate that contaminants have been recorded in some fish; elevated levels of lead have been detected in wild oysters on intertidal rocks adjacent to the former BHP Steelworks site (closure area) and were above the health guidelines for seafood (The Ecology Lab, 1997, 1998).

The major commercial fishery of the Hunter is the estuary prawn trawl fishery. The Hunter River is one of four estuaries in which trawling for prawns is permitted. The Hunter fishery is the ninth largest in NSW, and the oyster industry, although viable, is small. No trawling for finfish is permitted in the Hunter River but all other forms of fishing, such as mesh netting, are permitted. Currently, there are 20 oyster leases in the Hunter River, all of which are located in the north arm. There is a ban on the collection of oysters and mussels from the South Arm due to the risk of contamination.

12.2.2 Flora environment

Wetlands / mangrove forests

The wetland areas in the estuary comprise mangrove forest and saltmarsh vegetation. The total area of mangrove forest that would be removed as part of the proposal is estimated at 5.7 hectares, which is equivalent to 0.35 percent of existing mangrove habitat in the Hunter estuary. The area of saltmarsh was estimated at 0.9 hectares, representing 0.2 percent of existing saltmarsh habitat in the Hunter estuary.

The lower reaches of the South Arm are developed and subject to a variety of human disturbances. Much of the southern shoreline consists of artificial walls. East of the mangroves in the study area, the northern shoreline consists of a sandy habitat, scattered mangrove and casuarina trees and artificial rock rubble. These three habitats are very patchy and extend from the EnergyAustralia windmill downstream of the alumina berth and bulk terminal.

The mangrove forest east of the Tourle Street bridge is approximately 5.7 hectares. The forest is dominated by mature trees of grey mangroves (*Avicennia marina*) and patches of saltmarsh (*Sarcocornia quinqueflora* and *Suaeda australis*). An area of saltmarsh of approximately 0.9 hectares is situated between the bridge and mangrove forest. It is dominated by tall grasses and the introduced *Juncus acuta* (plates 12.1 and 12.2). The reference locations were composed of mature *A. marina* and occasional river mangroves (*Aegicera corniculatum*).



Plate 12.1 Summary Foreshore of mangrove forest at Tourle Street bridge location, view east



Plate 12.2 Foreshore of mangrove forest at Tourle Street bridge location, view west

The width of the mangrove forest ranged from 115 to 140 metres. The habitat components consisted of a narrow and abrupt mud flat up to two metres wide (plates 12.3 and 12.4). This was adjacent to a dense mangrove forest of mature grey mangroves (plate 12.4) and occasional river mangroves. The estuarine barnacle *Elminius covertus* occurred on the trunks of *A. marina* on the lower shore. Between 70 and 90 metres from the river was a section of saltmarsh comprising the samphire *Sarcocornia quinqueflora* and bushes of *Suaeda australis* (plates 12.3 and 12.4). The forest ended with a dense cover of grey mangrove. The steep embankment was covered with *Sporobolus virginicus* grass, other unidentified grasses and occasional pig face, *Carpobrotus glaucescens* and samphire *S. quinqueflora*.

Existing mangrove damage

Damage to mangroves was evident at all three locations. Most damage measured was composed of fallen branches, logs and tree stumps and occasional rubbish. Twenty percent of forest was damaged at the proposed dredge location and appeared to be representative of the range of conditions found in mangrove forest of the Hunter estuary. Human sources of disturbance do not appear to have caused much of the physical damage.

In assessing mangrove condition differences in levels of physical damage amongst mangroves most probably reflects the range of conditions existing in the Hunter River.



Plate 12.3 Saltmarsh near Tourle Street bridge



Plate 12.4 Mature mangrove forest of *Avicennia marina* at Tourle Street bridge location. Note dense cover on pneumatophore

Habitat components

At all transects approximately 40 percent of the forest was covered with mud. Pneumatophores, (a root rising above the level of water or soil and acting as a respiratory organ in mangrove trees), were the next most abundant cover, accounting for between 22 and 27 percent of cover. Sapling of *A. marina* covered between 6 and 12 percent of transects, while *A. marina* trees covered between 7 percent and 13 percent of transects. Most of the other habitat components, including algae, covered less than five percent of transects.

Habitat density

Assessment of habitat densities found most of the cover within quadrats was mud (49-91 percent), followed by smaller covers of leaf litter and algae. The abundances of habitat components per 0.1-m² quadrat ranged as follows: crab holes (0 to 24), pneumatophores (12 to 89) and mangrove saplings (0 to 16).

12.2.3 Fauna environment

Soft sediment benthos

Thirty-nine taxa were identified including species of crabs, amphipods, isopods, gastropods, bivalves, insects and families of polychaete worms. The gastropod genus *Tatea* sp. accounted for over 50 percent of abundance at each location. Significant differences among locations were found in the abundance and number of individual taxa.

The total abundance of benthos was 8,800 individuals at the north arm reference, compared to 3,400 and 3,200 individuals at Tourle Street bridge and the South Arm reference, respectively. The entire assemblage did not, however, differ among locations. Hence the benthic assemblage at the dredge location was represented in other mangrove forests of the Hunter estuary. Significant small-scale variation was detected in the crustacean abundance among sites at Tourle Street bridge and South Arm reference locations.

Oysters are possibly the most abundant epi-benthic organisms along the northern shoreline, and in fact, along much of the South Arm. They grow on the pneumatophores (together with epiphytic algae: that is, algae that grows on the surface of a plant, using it for support only and not obtaining food from it) and occur on most of the rocks in the intertidal region. Small gastropods (*Bembicium auratum*) and limpets (*Patelloida mimula*), (a mollusc of the class *Gastropoda*, with a locomotive organ placed ventrally), were common amongst the oysters.

Mangrove benthos

The benthic fauna sampled at Tourle Street bridge and reference locations were typical of taxa collected previously in Fullerton Cove (Hutching 1983) and other nearby estuaries (Hutching *et al.* 1977).

The present study found 39 benthic taxa in the Hunter River while 51 taxa were found in similar mangrove forests of the Hawkesbury River (Lasiak and Underwood 2002) and 26 taxa were found in Fullerton Cove mangroves (Hutchings 1983). Unfortunately, each study used different sized sieves; hence differences in the number of taxa could be due to more animals being retained in smaller sieves.

Although some benthic taxa in the present study differed significantly between locations, total species richness (total number of taxa) and benthic assemblages (refer to multivariate results) did not differ. Hence, the benthos at the Tourle Street bridge location is not unique and is similar to that found in other mangrove forests of the lower Hunter River.

Variation in the diversity and abundance of benthic macroinvertebrates collected in the present study were detected over several spatial scales. Benthic taxa at Tourle Street bridge accounted for only three of the significant differences among locations. The greater crustacean diversity at Tourle Street bridge could be due to the likely higher salinity at this location compared to the reference locations situated further upstream.

It is likely that differences in salinity or tidal flow would influence species richness and their abundance. The disturbed nature of the lower Hunter River could also affect species diversity.

Fish and invertebrates

Previous studies have found that the fish and invertebrate assemblages in the Hunter River appeared similar to assemblages sampled in the Macleay, Nambucca, Wallamba and Manning Rivers. However, it is not known if bottom-dwelling (demersal) fish are similar at different depths. The proposed dredging works would significantly deepen the South Arm channel.

Twenty-six species of fish and invertebrates were collected throughout the Hunter River estuary during sampling in late October 2002. Twenty-one species were considered of economic importance with nine species of this category being caught at the proposed dredge area in the South Arm. The most abundant species were yellowfin bream (*Acanthopagrus australis*, 35 percent of total abundance), luminous bay squid (*Lololus noctiluca*, 20 percent), school prawn (*Metapenaeus macleayi*, 13 percent), mulloway (*Argyrosomus japonicus*, six percent), tarwhine (*Rhabdosargus sarba*, five percent), sandy sprat (*Hyperlophus vittatus*, four percent) and silver biddy (*Gerres subfasciatus*, three percent).

Species such as mulloway, school prawns and luminous bay squid were characteristic of the deeper water sites, whereas tarwhine, yellowfin bream and silver biddy were more common in shallow waters. This suggests that depth may be an important factor in influencing the types of species found within these areas. Assemblages caught in the proposed dredge area were highly variable compared to those of other locations likely due to the large amounts of open weed present in the trawls. It is difficult to draw definite conclusions on patterns occurring in the dredge area without temporal replication.

Birds

The wetlands in the Hunter estuary, and those to the north of Kooragang Island in particular, are renowned as bird watching areas. It has been suggested that the mud flats around Kooragang Island and Fullerton Cove are important feeding and breeding grounds for resident and migratory wading birds (Maddock 1983).

Seagulls were the most common seabirds and there were also a number of egrets observed in the shallows of the mangroves. Pelicans and cormorants were also seen in the mangroves and along other parts of the northern shoreline.

12.2.4 Threatened or endangered species

There are provisions in both state and commonwealth legislation to ensure that threatened species, populations and communities and processes likely to threaten individuals and/or their habitats are considered in relation to the proposal. Threatened species legislation examined included the *Environment Protection and Biodiversity Conservation Act 1999*, *Threatened Species Conservation Act 1995* and the *Fisheries Management Act 1994*.

Threatened species legislation was reviewed and the green sawfish, black cod and the Indo-Pacific humpback dolphin (which spends some of its life in estuaries) were further assessed. An 8-part test was conducted and, since no known population or critical habitat of these fish exist in the Hunter River, no further consideration was required and neither an Species Impact Statement nor any special management measures are recommended.

Marine mammals such as the blue whale, sperm whale, Sei whale, fin whale, Australian fur seal and long-snouted spinner dolphin tend to occur in coastal or 'ocean' waters and rarely enter estuaries; hence they would not be affected by the proposed dredging works in the Hunter estuary. Threatened species such as the green turtle, the eastern blue devil and the giant Queensland grouper do not occur along this stretch of the NSW coast hence are not relevant.

No threatened or endangered species were caught at any site throughout the study period.

12.3 Impact assessment

The proposal could have a number of long-term and short-term effects on the aquatic ecology of the Hunter estuary. These are summarised and discussed below:

- Loss of mangroves and replacement with habitats to be removed during proposed dredging works include the foreshore mangroves, saltmarsh, sand flats and the shallow subtidal riverbed. The loss of mangrove habitat represents 0.35 percent of the existing mangrove habitat of the Hunter estuary. Hence, this loss of wetland is unlikely to have a significant ecological impact on the Hunter estuary system;
- Hard surfaces provide habitat for invertebrate communities different to those found in soft-sediments. Given that biota within the Hunter River are subjected to large scale natural disturbances due to flooding, impacts here are expected to be within the range of natural variability;
- Sediments suspended during the dredging process could be transported upstream toward Ironbark Creek and deposited on the mangroves smothering some of the small peg roots;
- Loss of shallow sub-tidal habitat and creation of deep sub-tidal habitat: benthic organisms have already been disturbed by activities such as downstream maintenance dredging of contaminated sediments. No studies have, however, sampled benthic invertebrates in the South Arm, so it is not known what species occur there, nor whether they may have been impacted by past disturbances. There is little doubt that dredging would initially totally destroy them in the dredged area. Dredging would cause complete removal of the existing channel bed, removal of bottom-dwelling fauna and could create a turbid sediment plume. Once an area has been dredged, benthic macro invertebrates would then recolonise the area, but recovery to a stable system would take longer. This concept however needs to be balanced against the benefits of the proposed dredging and the removal of all of the contaminated sediments within the South Arm;
- The dominant fish species presently found along the shallow riverbed would likely change after dredging. It is predicted that fish species would be different after dredging, but would comprise an assemblage with species of commercial and recreational value including prawns and mulloway;

- Changes to fish passage and connectivity: a turbidity gradient formed by sediments suspended in the waterway could inhibit fish passage during dredging. The proposed increase in depth of the channel from the current two to three metres to 15.2 metres would affect the type of fishes inhabiting this area. Given that large-scale flood events occur in the Hunter, such effects are predicted to be minor;
- Increases in turbidity may affect the foraging behaviour of fish and suspended sediments may abrade the protective mucus coats on fish, thereby increasing their susceptibility to disease, or clog gill filaments and suffocate the fish (Johnston 1981);
- Proposed dredging methods would generate noise during operation and this could disorient fish;
- Sound waves created during rock blasting can affect the swim bladder of fish and kill fish depending on the intensity and distance of blasting;
- Effects on commercial and recreational fishing: sediments resuspended during dredging could affect fish and prawns feeding in the dredge area. This impact may be minimised. However, given the scale of the proposal, dredging would be required year round, in which case there would certainly be local impacts on the prawn trawling industry;
- No oyster cultivation occurs in the South Arm and the proposed dredging is unlikely to affect commercial oyster leases in the north arm;
- Effects of dredging on sediment toxicity: high levels of PAH were found in sediments at the proposed dredge site. PAH have been found to bioaccumulate in wild oysters at the closure area. It can be expected after dredging is completed, this problem would be ameliorated;
- Effects of dredging on water quality (turbidity, dissolved oxygen): a turbidity gradient formed from sediment suspension in waterway could inhibit fish passage. Reduced dissolved oxygen concentrations in deeper waters could affect organisms;
- Effect of land disposal on the leaching of PAH, heavy metals and acid sulphates: Land disposal and the treatment of contaminated sediments can result in the seepage of contaminants into the environment during dewatering operation; and
- Minimal seepage of acid sulphate into the river could occur, although this is unlikely to have significant effects on the estuary ecology as the acid sulphate would be removed during tidal flushing.

All of these potential impacts, however, need to be balanced against the benefits of the proposed dredging and the removal of all of the contaminated sediments within the South Arm.

12.4 Summary and recommended mitigation measures

12.4.1 Summary

The current survey examined the existing ecological assemblages and physical environment at the site. No threatened species, populations or ecological communities or key threatening processes as specified under the Threatened Species Schedules of the *Fisheries Management Act 1994* were present or are considered likely to occur at the study site. Consequently, it is considered that the proposal would be highly unlikely to impose a significant threat to threatened aquatic biota.

The study area has been disturbed by industrial and port activities over a long period. The aquatic habitats and communities present in the study area are typical of disturbed estuarine environments. In addition, the communities that may potentially be disturbed are not unique to the site being widely distributed throughout the study site and the surrounding area.

Whilst no significant direct impacts are anticipated, there is the potential for indirect impacts unless appropriate mitigation measures are implemented, particularly during dredging. Such mitigation measures mainly relate to controlling the potential for impacts to water quality. As with all other projects occurring at the land-water interface, the control of erosion, sedimentation and other water quality impacts is a key issue. However, given the existing disturbance in the vicinity of the study area and the fact that dredging would incorporate implementation of appropriate environmental management and impact mitigation measures, the potential impacts are unlikely to be substantial or significant with regard to aquatic communities.

As assessed in Chapters 6 and 13, the proposal would result in the removal of mangrove forest and associated habitats. These amounts are relatively small, hence it is considered unlikely that their removal would have significant impacts on the Hunter estuary ecology. It is predicted that fish species found in the water column and benthic communities living in sediments would change after dredging works. Benthic invertebrates would recolonise within months, but recovery to a stable system would take longer.

Whilst there would undoubtedly be some negative impacts if the proposal goes ahead, all of these potential impacts need to be balanced against the benefits of the proposed dredging and the removal of all of the contaminated sediments within the South Arm.

12.4.2 Recommended mitigation measures

In addition to the mitigation measures relevant to protection of water quality (included in Chapter 11), the following would occur to minimise the potential for impacts to aquatic ecology:

- Dredge operations would not span the width of the waterway at any time blocking fish passage;
- A detailed turbidity monitoring program would be developed as part of the environmental management plan for the dredging operations. Development of the monitoring program would involve identification of a threshold level of turbidity. Further monitoring of nutrient levels would be undertaken if turbidity exceedances are identified. Relevant responses (such as ceasing activities in the event of exceedance of certain levels) would be specified;
- Monitoring of physical water quality parameters (both up and downstream of the dredging area) such as sediment, turbidity and nutrients would determine whether the safeguards are adequate. Threshold levels for these parameters, and responses should these levels be exceeded, would be specified within the project environmental management plans. Monitoring during construction would be particularly important during and following rainfall events;
- An emergency contingency plan for dealing with accidental spills would be developed; and
- The speed and movement of all barges and support vessels would be kept to a minimum and comply at all times with Waterways regulations.

The following specific mitigation measures are recommended:

- Where feasible, a buffer zone of at least 30 metres would be maintained around mangroves that do not need to be affected;

- Mangroves and their associated fauna upstream of the dredge site should be monitored as part of the environmental management of the proposal; and
- Habitat compensation measures would need to be discussed with NPWS in accordance with the recommendations contained in section 13.5.

12.4.3 Monitoring

An amount of baseline data on the abundance and distribution of benthic taxa and fish species was collected in the present study. There is a need to capture more of this data prior to the dredging operation. Suggested monitoring prior and post dredging include:

- at least two sampling periods before dredging commences to determine the abundance of most species – whilst the proposal would result in total loss in the area of impact – this data provides a baseline to compare recovery following dredging);
- any test for impact would require additional sampling periods during and after dredging;
- future surveys should consider a number of locations including the north and South Arms and shallow and deep areas to provide information on spatial variability;
- to assess long-term changes in aquatic vegetation, it is recommended that the distribution of mangrove and saltmarsh habitat upstream of the dredge site is mapped periodically; and
- long-term water quality measures such as upstream salinity, turbidity and changes in temperature and dissolved oxygen in the dredged section could provide evidence of effects from the proposed dredging.

13 Terrestrial flora and fauna

This chapter provides a summary of the results of the terrestrial flora and fauna assessment undertaken by Umwelt Australia as part of the EIS process. Information on the assessment methodology is provided, the existing environment is described, the potential impacts of the proposal are assessed, and mitigation measures recommended. The full report is included in Appendix H.

13.1 Assessment methodology

13.1.1 Study area

The study area for the terrestrial flora and fauna assessment is the land extending approximately three kilometres east from the Tourle Street bridge to just south of the intersection of Cormorant Road and Egret Street, along the shoreline of the South Arm. The land has been assessed from the edge of Cormorant Road to the mean high water mark. The impact of the proposal on birds utilising the South Arm was also addressed in this report.

This report also assesses the flora and fauna impacts of the proposal on two sites located on the south bank of the South Arm: the closure area, which is the site proposed for dredge spoil handling and containment; and a portion of the OneSteel site, proposed for excavation for construction of the swing basin

13.1.2 Flora assessment

The assessment of flora in the study area involved:

- a search of the National Parks and Wildlife Service Atlas of NSW Wildlife was conducted for the area within a 10 kilometre radius of the study area, to identify threatened species of flora known to occur in the local area;
- a review of literature addressing local flora was also completed, identifying general vegetation communities;
- flora field surveys were undertaken on 19 November and 3 December 2002. Five transects were undertaken throughout the study area; and
- three 20 metre by 20 metre vegetation survey plots were completed in randomly chosen areas within the study area.

In addition, aquatic vegetation surveys were completed at several points in the study area. During these surveys aquatic vegetation and fringing vegetation such as rushes were recorded, and composition, structure, and species in communities abundance were noted.

13.1.3 Fauna assessment

The assessment of flora in the study area involved:

- a search of the NPWS Atlas of NSW Wildlife database was conducted for the area within a 10 kilometre radius of the study area, to identify fauna species known to occur in the local area;

- a review of literature addressing local fauna was also undertaken, enabling a list of threatened species potentially occurring in the area to be compiled; and

Survey methods were designed to include appropriate techniques to identify any threatened species that could potentially occur in the study area. The field fauna surveys were conducted in calm and mild to warm weather conditions on the afternoons and evenings of 19 November, 3 and 11 December 2002.

Flora and fauna species lists are provided within Appendix H.

Birds

- Bird surveys were undertaken during the afternoon and evening of 19 November and 3 December 2002. Surveys were conducted in mangroves, saltmarsh, waterbody habitat, grassland, and native plantings to assess the diversity present in each type of habitat in the study area;
- Species were identified from characteristic calls and by observation;
- Opportunistic observations were recorded during other aspects of the field survey, particularly during vegetation surveys; and
- Owls were targeted during spotlighting transects undertaken throughout the study area on 3 December 2002 between 8.30 pm and 10 pm. The study area was examined for suitable hollows, owl whitewash and regurgitated pellets.

Mammals

- The small size of the study area, its highly disturbed vegetation, its severe lack of native vegetation communities, and its proximity to Cormorant Road significantly reduces the habitat for small mammals. For these reasons no small mammal trapping was undertaken; however, ground-dwelling and arboreal mammals were targeted during the spotlighting survey, and assessment of potential habitat was made.
- Spotlighting transects were conducted on 3 December 2002. Ground-dwelling fauna, arboreal fauna and megachiropteran bat species were targeted during the spotlighting survey, with time also taken to listen for noises made by mammals, birds and frogs.
- An ultrasonic bat detection transect was conducted on 3 December 2002.
- Searches for evidence of mammals use were also conducted, with scats being collected and analysed as required. Trees were also examined for scratch marks and other evidence of use by arboreal mammals.

Herpetofauna

- Targeted diurnal searches for reptile and amphibian species were conducted in likely habitat areas throughout the study area on 19 November and 3 December 2002.
- During each search, likely habitats were examined such as under rocks, logs, tree bark, ground litter and in wet soak areas. Observations of reptile and amphibian species made during all aspects of field studies were recorded.
- Nocturnal amphibian surveys targeting the threatened green and golden bell frog were undertaken on the nights of 3 and 11 December 2001.

13.2 Existing flora environmental

13.2.1 Vegetation communities

Vegetation communities identified in the study area are described below, and indicated on Figure 13.1.

Modified Grassland

The majority of the study area supports a modified grassland community, which is mowed and highly disturbed by vehicle access and rubbish disposal. The community consists of native and exotic grasses and herbaceous and woody groundcover. There is a high proportion of weed species in the community, including fireweed (*Senecio madagascariensis*), cobbler's pegs (*Bidens pilosa*) and Bitou bush (*Chrysanthemoides monilifera* ssp. *rotundata*). Dominant species in the community include African lovegrass (*Eragrostis curvula*), *Phalaris aquatica*, wire grass (*Aristida* sp.), and kikuyu (*Pennisetum clandestinum*).

Near the shoreline of the South Arm, species tolerant of salt are more common, and the dominant species include coastal pigface (*Carpobrotus glaucescens*); American pennywort (*Hydrocotyle bonariensis*); and beach primrose (*Oenothera drummondii*).

Due to the timing of the vegetation survey, in a period of summer drought, it is likely that the species composition observed differs from that found in wetter times. However, it is highly unlikely that any threatened species would occur in this disturbed community at any time.

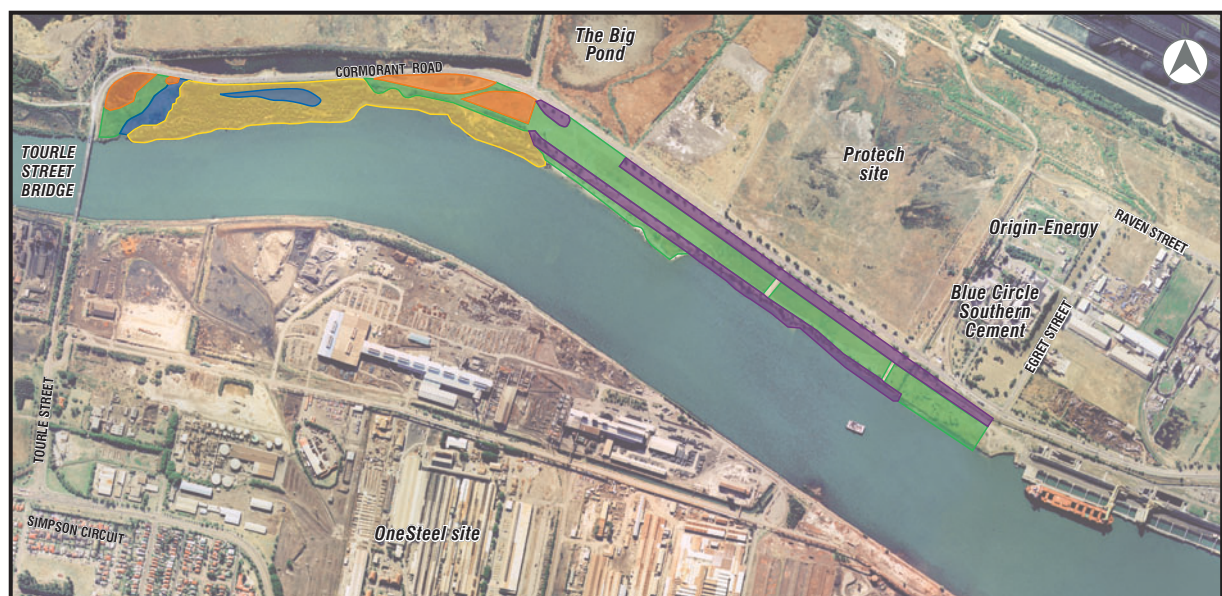


Figure 13.1 Vegetation communities

- Plantings of native species
- Wetland vegetation
- Saltmarsh vegetation
- Mangrove forest
- Modified grassland

Plantings of native species

Australian natives have been planted in mixed clumps within the modified grassland both along Cormorant Road as screens, and along the back of the shoreline. The tallest of these plantings (to 10 metres high) consists of coastal banksia (*Banksia integrifolia*), river red gum (*Eucalyptus camaldulensis*), coastal she-oak (*Casuarina equestifolia* subsp. *incana*) and umbrella pine (*Pinus pinea*). The shrub layer (to four metres high) consists of lace myrtle (*Melaleuca armillaris*), *Melaleuca nesophila*, coastal wattle (*Acacia longifolia* subsp. *sophorae*), willow wattle (*Acacia saligna*) and coastal tea-tree (*Leptospermum laevigatum*). These species have been introduced to the study area.

Mangrove Forest

The mangrove forest is located along the shoreline of the South Arm, within the western section of the study area. The area of mangrove forest in the study area is approximately 5.7 hectares. The width is approximately 115 to 140 metres (The Ecology Lab Pty Limited, 2003). It is composed of densely-growing grey mangroves (*Avicennia marina* subsp. *australasica*) and the occasional river mangrove (*Aegiceras corniculatum*).

A few scattered juvenile mangroves are located along the shoreline of the remainder of the study area.

Saltmarsh vegetation

Saltmarsh vegetation is located behind the mangrove forest, at a distance of approximately 70 metres to 90 metres from the South Arm. The area of saltmarsh vegetation in the study area is approximately 0.9 hectares. The community is dominated by the samphire (*Sarcocornia quinqueflora*) and bushes of *Suaeda australis*. Sand couch (*Sporobolus virginicus*) and coastal pigface (*Carpobrotus glaucescens*) are also common.

Freshwater Swamp Vegetation

The freshwater swamp located in the western part of the study area contains emergent and fringing vegetation. The area is dominated by the spiny rush (*Juncus acutus*), the common reed (*Phragmites australis*) and cumbungi (*Typha orientalis*).

At the time of survey, the swamp lacked standing water, and therefore no aquatic flora species were identified. During periods of more rainfall it is expected that common aquatic species would be found in this swamp.

13.2.2 Conservation significance

The conservation significance of the majority of vegetation recorded within the study area is considered to be low. This is a result of the lack of naturally-occurring remnant vegetation, the highly disturbed nature of the majority of the area (as a result of vehicle access, mowing, and rubbish disposal) and the fact that much of the study area is reclaimed.

However, saltmarsh and mangrove vegetation is important in both the local and regional context, as a result of to the extensive clearing and alteration of these communities that has occurred in the last hundred years.

Mangroves are protected under Section 205 of the *Fisheries Management Act 1994* under which the removal of mangroves requires a permit from NSW Fisheries.

Mangrove habitat is currently expanding in area in the Hunter estuary and along most of the NSW coast. Between 1954 and 1994, the area of mangrove in the lower Hunter River increased by 400 hectares (31 percent), and increased on Kooragang Island by 20 percent (Williams et al., 2000).

Unlike mangroves, saltmarsh habitat is not protected from clearance. However, it is recognised as a valuable habitat, especially for migratory wader birds.

Saltmarsh areas have decreased markedly in the last few decades. Williams et al. (2000) found that the area of saltmarsh within the lower Hunter River decreased by 1,428 hectares (67 percent) between 1954 and 1994. On Kooragang Island, 508 hectares (55 percent) of saltmarsh was lost in the same time.

Significant areas of mangrove and saltmarsh are now protected within the Kooragang Nature Reserve.

13.2.3 Threatened flora species

No threatened floral species were identified during field investigations.

Seven threatened flora species are known to occur in the wider vicinity of the study area. Six of these species are considered unlikely to occur in the study area, as potential habitat for these species is generally limited. The only species considered to have the potential to occur within the study area was *Zannichellia palustris* (a submerged monoecious weakly rhizomatous aquatic annual or perennial plant). An 'eight part test' under Section 5A of the EP&A Act was carried out for this species.

The full results are provided in Appendix H.

13.3 Existing fauna environment

13.3.1 Fauna habitat

Habitat within the study area is generally of poor quality, for the reasons described in section 13.2.2. A description of the habitat potential is provided below.

The modified grassland provides habitat for a range of bird species suited to the utilisation of degraded areas, such as the masked lapwing (*Vanellus miles*). The grassland provides potential foraging habitat for birds of prey such as the barn owl (*Tyto alba*), observed flying over the study area, and the black-shouldered kite (*Elanus axillaris*), observed roosting in a tree at the edge of the study area next to Cormorant Road. The modified grassland also provides potential foraging habitat for microchiropteran bat species.

The plantings of native species offer only limited habitat to bat, bird, amphibian and reptile species, as a result of their small size and isolated nature. No tree hollows were identified in the study area, and there is a lack of dense vegetation, leaf litter and fallen logs. As a result, habitat for small ground-dwelling mammals is limited. The only species likely to utilise the study area would be introduced rodents. Rubbish has been disposed between these plantings and the shoreline, which would provide artificial habitat for rodents, reptiles and amphibians.

The freshwater swamp in the study area provides potential habitat for a range of bird, small mammal, amphibian and reptile species. Fringing vegetation, emergent vegetation and aquatic vegetation are important habitat resources for these species. However, there are no open stretches of water in the freshwater swamp, and therefore no suitable foraging habitat for waders. Waders require open areas of water to ensure unobstructed views of their surrounds to keep watch for predators.

The mangrove forest and saltmarsh areas provide foraging habitat for a range of wading birds such as the white-faced heron (*Egretta novaehollandiae*) and white-necked heron (*Ardea pacifica*), which forage for crustaceans in the silt trapped by the pneumatophore roots of the mangroves. The mangroves are not mature enough to provide significant hollow limbs or cavities for roosting or nesting. The fauna habitat of the mangrove forest and saltmarsh areas has also been assessed from a marine fauna perspective, in the aquatic ecology assessment undertaken for the proposal by the Ecology Lab Pty Limited (refer Chapter 12 and Appendix G) for additional information.

In addition to the factors mentioned in section 13.2.2, the potential for the study area to provide quality fauna habitat is limited by its proximity to Cormorant Road. These issues, together with the presence of higher quality freshwater swamp, saltmarsh and mangrove habitat nearby (including that within Kooragang Nature Reserve) reduces the overall fauna habitat value of the study area, which in turn reduces the likelihood for threatened species to occur.

A fauna species list for the study area is included as Appendix H. The list includes all species recorded during field investigations, as well as all species recorded within a 10 kilometre radius of the study area in the NPWS Atlas of NSW Wildlife. The results of the surveys undertaken are described in the following section.

13.3.2 Survey results

Birds

Low species diversity was recorded within the study area during the two afternoon and evening surveys.

A total of 12 bird species were recorded in or flying over the study area. The most abundant species was the masked lapwing (*Vanellus miles*), with eight individuals recorded in the grassland. Other species recorded included the brown honeyeater (*Lichmera indistincta*), black-shouldered kite (*Elanus axillaris*), Australian pelican (*Pelecanus conspicillatus*) and silver gull (*Larus novaehollandiae*).

The barn owl (*Tyto alba*) was the only nocturnal bird recorded in the study area. It was observed flying over the study area twice during nocturnal surveys.

A number of bird species were recorded in or over the water in the area of the South Arm proposed for dredging. These birds included the chestnut teal (*Anas castanea*) and great cormorant (*Phalacrocorax carbo*).

No threatened or regionally significant bird species were recorded in the study area or in the area of the South Arm proposed for dredging.

A full list of the bird species recorded within a 10 kilometre radius of the study area is included in Appendix H.

Mammals

Two mammal species were recorded within the study area during field investigations. Several threatened grey-headed flying fox (*Pteropus poliocephalus*) were observed flying high over the study area. One call of the little forest bat (*Vespadelus vulturnus*) was recorded over the mangroves in the study area. The little forest bat was the most regularly recorded bat in a recent study conducted in mangrove forest on Kooragang Island (Hoye, 2002) and appears to occur in the estuary in high numbers.

A full list of the mammal species recorded within a 10 kilometre radius of the study area is included in Appendix H.

Herpetofauna

No reptile species were identified during searches of the study area.

Two amphibian species were recorded. The ornate burrowing frog (*Limnodynastes ornatus*) and the spotted marsh frog (*Limnodynastes tasmaniensis*) were both observed on grass within ten metres of the freshwater swamp.

No threatened or regionally significant reptile or amphibian species were recorded.

A full list of the reptile and amphibian species recorded within a 10 kilometre radius of the study area is included in Appendix H.

13.3.3 Threatened fauna species

One threatened species was identified in the study area: several grey-headed flying foxes (*Pteropus poliocephalus*) were observed flying high over the study area. This species is listed as 'Vulnerable' on Schedule 2 of the *Threatened Species Conservation Act 1995* (NSW) and as 'Vulnerable' under the *Environment Protection and Biodiversity Conservation Act 1999* (Commonwealth).

Forty-four threatened fauna species are known to occur in the vicinity of the study area. The full list of these species is provided in Appendix H. Some of these species are considered unlikely to occur in the study area, as potential habitat for these species is generally limited. There are 26 species with the potential to occur within the study area (as a result of the existence of potential habitat):

- green and golden bell frog (*Litoria aurea*)
- magpie goose (*Anseranas semipalmate*)
- blue-billed duck (*Oxyura australis*)
- freckled duck (*Stictonetta naevosa*)
- Australasian bittern (*Botaurus poiciloptilus*)
- black bittern (*Ixobrychus flavicollis*)
- black-necked stork (*Ephippiorhynchus asiaticus*)
- osprey (*Pandion haliaetus*)
- great knot (*Calidris tenuirostris*)
- broad-billed sandpiper (*Limicola falcinellus*)
- black-tailed godwit (*Limosa limosa*)
- terek sandpiper (*Xenus cinereus* = *Tringa terek*)
- comb-crested jacana (*Irediparra gallinacea*)
- sooty oystercatcher (*Haematopus fuliginosus*)
- pied oystercatcher (*Haematopus longirostris*)
- greater sand plover (*Charadrius leschenaultii*)
- lesser sand (Mongolian) plover (*Charadrius mongolus*)
- little tern (*Sterna albifrons*)
- grey-headed flying-fox (*Pteropus poliocephalus*)
- yellow-bellied sheath-tail bat (*Saccolaimus flaviventris*)
- eastern freetail bat (*Mormopterus norfolkensis*)
- large-eared pied bat (*Chalinolobus dwyeri*)
- little bent-wing bat (*Miniopterus australis*)
- common bent-wing bat (*Miniopterus schreibersii*)
- large-footed myotis (*Myotis adversus*)
- greater broad-nosed bat (*Scoteanax rueppellii*)

An 'eight-part test' under Section 5A of the EP&A Act was carried out for these species. The results are provided in full in Appendix H.

13.4 Impact assessment

13.4.1 Impact on flora

The proposal involves the removal or alteration of all vegetation in the study area: on the north bank of the south arm between the Tourle Street bridge to just south of the intersection of Cormorant Road and Egret Street. Vegetation communities identified in this area were modified grassland, plantings of native species, mangrove forest, saltmarsh vegetation; and freshwater swamp vegetation.

The 5.7 hectares of mangrove forest in the study area is equivalent to 0.33 percent of the area of mangrove in the lower Hunter River, and 0.90 percent of the area of mangrove on Kooragang Island, as mapped in 1994 (Williams *et al.*, 2000). The 0.9 hectares of saltmarsh vegetation in the study area is equivalent to 0.13 percent of the area of saltmarsh in the

lower Hunter River, and 0.21 percent of the area of saltmarsh on Kooragang Island, as mapped in 1994 (Williams *et al.*, 2000). Therefore, the removal of these communities in the study area would not constitute a significant loss in terms of the amount of proximate similar habitat.

The removal of this vegetation is not considered to be significant from a local or regional perspective as a result of its small size, prior disturbance, and the proximity of larger areas of protected mangrove and saltmarsh vegetation in the Kooragang Nature Reserve.

The removal of mangroves under the proposal would require a permit from NSW Fisheries in accordance with S205 of the *Fisheries Management Act 1994*.

Indirect potential impacts of the proposal on mangroves and other vegetation in the local area could include:

- changes in water flow or water quality as a result of dredging;
- groundwater changes as a result of dredging and bank excavation;
- erosion of mud or sand on river banks as a result of altered water flows;
- erosion of mud or sand on river banks as a result of bow waves of large vessels; and
- the smothering of mangrove pneumatophores by sediment disturbed by dredging.

The potential impacts in terms of water quality and hydrology are considered within Chapter 11. Groundwater is considered in Chapter 15, geology and soils are considered in Chapter 14, and potential aquatic ecology impacts in Chapter 12.

The OneSteel site on the south bank of the south arm is a highly disturbed industrial site, with no significant vegetation.

The closure area site is also a highly disturbed industrial site, with no significant vegetation.

13.4.2 Impact on fauna habitat

The proposal involves the removal or alteration of all fauna habitat in the study area, on the north bank of the south arm between the Tourle Street bridge to just south of the intersection of Cormorant Road and Egret Street. Relatively low faunal species diversity was recorded in the study area during field investigations. The faunal habitat available is highly disturbed by rubbish disposal, vehicular access, mowing, and the noise of Cormorant Road. Therefore, only a limited number of native animal species are likely to utilise the study area as primary habitat.

Habitat for waders is limited in the study area, and restricted to small areas of sandy shoreline, mangrove forest, saltmarsh and modified pasture. No important feeding or roosting habitat was identified in the study area. Waders prefer intertidal mudflats and sandflats, and isolated roosting areas, all of which are absent from the study area.

As a result, the removal of fauna habitat in the study area is not considered to be significant from a local or regional perspective. Substantially larger areas of less disturbed habitat occur nearby the Kooragang Nature Reserve and are to be found in surrounding areas.

Indirect potential impacts of the proposal on fauna habitat in the local area could include:

- noise associated with dredging, excavation works, sheet piling, onshore materials handling and treatment activities;
- groundwater impacts of dredging on habitat in Kooragang Wetlands, Hexham Swamp and other similar areas;
- impact of dredging on the opening of the estuary floodgates to allow for the inundation of Hexham Swamp; and

- changes in the hydrology of the south and the north arms (including Fullerton Cove, north west Kooragang Island and Tomago Wetlands), including the effect of enhanced tidal prism on upstream wetlands.

The OneSteel site on the south bank of the south arm is a highly disturbed industrial site with no significant fauna habitat.

The closure area site is also a highly disturbed industrial site with no significant fauna habitat.

13.4.3 Impact on threatened species

EPBC Act requirements

No threatened species of flora were identified in the study area. Several grey-headed flying foxes (*Pteropus poliocephalus*), listed as 'Vulnerable' under the EPBC Act, were observed flying high over the study area.

In addition, four bird species listed as migratory under the EPBC Act were observed in the study area: the chestnut teal (*Anas castanea*); great egret (*Ardea alba*); black-shouldered kite (*Elanus axillaris*); and masked lapwing (*Vanellus miles*).

Potential habitat for the vulnerable green and golden bell frog (*Litoria aurea*) was identified in the freshwater swamp in the study area. However, the species was not observed despite targeted surveys undertaken in optimum conditions after two days of rain in December. Therefore it was concluded that the species is unlikely to be present in the study area.

Habitat available in the study area is of a highly disturbed nature, and larger areas of similar habitat of a higher quality are present in the local area. The habitat that would be lost as a result of the proposal is not considered to be 'important habitat', (as defined under the EPBC legislation), for any migratory bird species observed in the study area. This is because:

- the habitat is not utilised by a migratory species within a region that supports an ecologically significant proportion of the population of the species;
- the habitat is not utilised by a migratory species which is at the limit of the species' range; and
- the habitat is not within an area where the species is declining.

The grey-headed flying foxes observed flying over the study area were not utilising any habitat within the area. Potential foraging habitat for the species is restricted to a few date palms in the study area, which are unlikely to comprise a significant resource for this highly mobile species.

Therefore, it is considered highly unlikely that the loss of habitat in the study area would have a significant impact on any threatened or migratory species occurring in the area.

A number of 'migratory species' (as defined by the EPBC Act) have been previously recorded within 10 kilometres of the study area in the National Parks and Wildlife Service Atlas of NSW Wildlife (refer Appendix H). The list of species represents the range of species that might potentially occur within the study area.

While many of the migratory bird species listed under the EPBC Act may occur in the study area, it is considered that the study area is unlikely to provide an area of 'important habitat' for any of these species. Habitat available in the study area is highly disturbed, and restricted to small areas of sandy shoreline, mangrove forest, saltmarsh and modified pasture. Larger and less disturbed areas of similar habitat are commonly available on Kooragang Island and in surrounding areas.

The nearby north arm and Fullerton Cove provide significant feeding and roosting habitat for many migratory bird species, and much of this habitat is protected within the Kooragang Nature Reserve. The habitat utilised in these areas consists of extensive intertidal mudflats and sandflats, and isolated roosting areas, which are much more suited to the

requirements of wading species than the limited resources of the study area. As a result, it is considered that habitat removal under the proposal is unlikely to have a significant impact on any migratory species potentially occurring within the study area.

Threatened Species Conservation Act, 1995

Threatened species

No currently listed endangered populations, endangered ecological communities, or areas of critical habitat were recorded in the study area.

No threatened flora species were identified in the study area.

One threatened fauna species – the grey-headed flying fox (*Pteropus poliocephalus*) – was observed flying over the study area.

Eight-part tests were been undertaken for the threatened species that was recorded in the study area, and those species for which potential habitat is considered to be present. Eight-part tests are included in Appendix H.

It was found, on the basis of the eight-part tests, that the proposal would be unlikely to have a significant impact on any species, population or ecological community currently listed under the TSC Act. Therefore a species impact statement is not required.

Key threatening processes

The '[l]oss of biodiversity as a result of loss and/or degradation of habitat following clearing and fragmentation of native vegetation' or the '[c]learing of native vegetation' is recognised as a major factor contributing to loss of biological diversity (NPWS, 2001).

The proposal is not expected to alter the natural flow regime of the river to an extent which would have a significant impact on surrounding wetland areas. The final dredging profile would not alter the tidal hydrodynamics of the Hunter estuary. Simulations undertaken by Patterson Britton & Partners Pty. Ltd (2003) have shown that dredging could cause a maximum change in water level at the Tourle Street bridge of -0.111 metres. Maximum water level changes in other locations in the south and north arm, such as Ironbark Creek and Fullerton Cove, were found to be smaller, in the order of -0.047 metres and -0.003 metres respectively.

As a result, the overall effect of the proposal on the flooding regime of the estuary would be minimal, with increases in peak water levels in the 10-year and 20-year ARI events in the order of a few millimetres, except for a localised increase of up to about three centimetres upstream of the sheet pile wall (Patterson Britton & Partners Pty. Ltd 2003). A range of mitigation measures would be implemented to ensure that any impact on the surrounding environment is minimised (refer to Chapters 6 to 9).

Assessment under State Environmental Planning Policy (SEPP) No. 44 (Koala Habitat Protection)

The proposed dredging of the south arm is subject to assessment as it lies in a local government area listed in Schedule 1 of the policy.

Assessment under SEPP 44 is based on an initial determination of whether the land constitutes potential koala habitat. This is determined by assessing whether the eucalypt species present in Schedule 2 of the policy constitute 15 percent or more of the total number of trees in the upper or lower strata of the tree component. If potential koala habitat is present, the area must be further assessed to determine if the land is core koala habitat.

The river red gum (*Eucalyptus camaldulensis*) is present in low numbers in the study area. The species has been introduced to the area for aesthetic purposes, planted with other Australian native species in isolated clumps. Therefore the river red gums are isolated from one another by mowed modified grassland, and do not form a potential koala pathway. The species constitutes less than 15 percent of canopy species in the study area, therefore the study area does not provide potential koala habitat and no further assessment is required.

13.5 Recommended mitigation measures

Management procedures

Dredging operations should be managed to minimise potential indirect impacts on surrounding vegetation (especially mangroves upstream of the dredging area) as a result of sediment resuspension and transport. Silt curtains should be used during dredging to reduce the amount of sediment leaving the dredge site.

The management measures that would be implemented as part of the dredging activities are described in Chapter 6.

Monitoring and maintenance

During and following implementation of the proposal, mangrove forest and associated fauna located upstream should be monitored, to ensure that the proposal does not result in impacts to upstream mangrove habitat.

Compensatory habitat

The proposal involves the removal of 5.7 hectares of mangrove forest and 0.9 hectares of saltmarsh vegetation on the north bank of the south arm. As a result, it is recommended that habitat compensation be undertaken, to compensate for the loss of both of these communities.

Habitat compensation should not be limited to mangrove replacement. One option for habitat compensation is the establishment of new areas of mangrove and saltmarsh vegetation in the local area, or the restoration of existing areas of damaged vegetation in the local area. It is recommended that augmentation of an area of existing habitat would be more valuable than the creation of an isolated area of habitat. Similarly, it is considered that habitat enhancement would be of more value than habitat creation.

The creation or maintenance of intertidal feeding areas and roosting habitat for waders in the local area are recommended as valuable contributions to the ecology of the lower Hunter estuary.

Another option is the provision of financial contributions to wetland rehabilitation projects in the local area, such as the Hexham Swamp Rehabilitation Project coordinated by the Hunter Catchment Trust, the Kooragang Wetland Rehabilitation Project, or The Wetlands Centre Australia at Shortland.

14

Geology and soils

This chapter summarises the existing geology and soil conditions in the area potentially affected by the proposal, the potential impacts of the proposal, and recommended mitigation measures.

14.1 Existing river delta environment

14.1.1 Geology

The Newcastle 1, Geological Series Sheet S1 56-2, 1966 edition shows that the estuarine sediments were formed in the Quaternary Period, and comprise fresh and marine water deposits of gravel, sand, silt and clays.

The proposed dredging area for the extension of the shipping channels at the Port of Newcastle, is situated at the southern end of the prominent Newcastle Bight Embayment, which runs north-east to south-west from Morna Point (Port Stephens) in the north to Nobbys Head in the south as shown on Geological Plan – Figure 14.1

The underlying bedrock is the Permian-aged Tomago Coal Measures, which consists of siltstone, shale, sandstone, coal and conglomerate. River processes associated with the Hunter River drainage system carved the bedrock topography during periods of low sea level. The existence of Quaternary Alluvium forming a sand barrier north of the current mouth, suggests the Hunter River originally followed a more northerly course and passed beneath the present day coastline midway along the Newcastle Bight at a depth of about 120 metres.

A rise in sea level of some 120m associated with a decrease in glaciation about 120,000 years ago culminated in a sea level about 6 metres above that currently observed. Estuarine sedimentation of fine-grained material occurred during the Pleistocene epoch (1.6 M to 11,000 years ago) behind a landward migrating sand barrier that eventually traversed the mud basin to form deposits of inner barrier sand. Beach deposits of marine sand moved onshore, but were later eroded by renewed erosion processes associated with the Hunter River.

During the period of the last glaciation, some 18,000 years ago, the sea level fell to about 120m below the current level, and the erosional processes associated with the Hunter River became important. The Hunter River flowed beneath Fullerton Cove (refer Figure 14.1) and eroded the edge of the inner barrier and cut into the lower estuarine clay unit. During such low sea level periods, the Hunter River has eroded a valley up to 90m deep and 5 km wide, the river valley/channels into the bedrock extending some 35 km inland and 20 km outside the current coastline.

The sea level rose back to its current level over the period approximately 18,000 to 6,000 years ago. Deposits infilling the abovementioned channels form an “upper river sand unit”. Modification to the Pleistocene Inner Barrier sands occurred by the introduction of organic materials at or near the water table in certain areas. This build-up probably related to rising groundwater levels accompanying the post-glacial era.

These ‘indurated sand’ or ‘Waterloo rocks’ are partially cemented generally dark deposits, which appear to be confined to the Inner Barrier sands and extend to a maximum depth of some 20 metres. In dredging terms they would be equivalent to say a very dense sand.

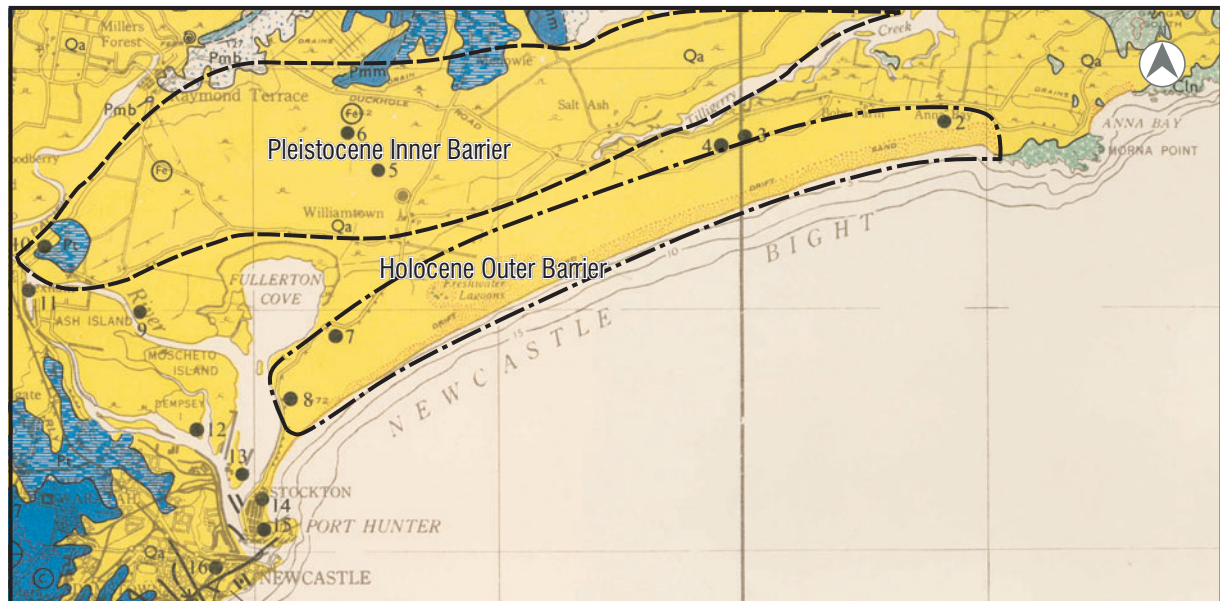


Figure 14.1 Geological Plan of Hunter River Estuary

- Quaternary Alluvium (Gravel, sand, silt, clay, "Waterloo Rock" marine and freshwater deposits)
- 5 Boreholes used for generation of geological plan
- Tomago Coal Measures (Shale, mudstone, sandstone, tuff, coal)
- Mulbring Siltstone (Siltstone, sandstone, conglomerate)

Towards the end of this last glaciation (in the Holocene epoch 10,000 to 6,000 years ago), a shoreward migrating marine sand accumulated at the south of the embayment to form the outer barrier (refer Figure 14.1). Estuarine sedimentation has continued, as have riverbed and flood plain deposits.

Platts Channel, now infilled, was a deltaic channel formed to the south of Spit Island in the South Arm of the Hunter River (refer Figures 14.1 and 18.1). Spit Island was one of a number of islands which geographically lay between Hexham and the mouth of the Hunter River (refer Figure 14.1 and 18.1). In 1849 it was being used as a place of ship repair.

From the 1950's onwards Platts Channel, Spit Island and the foreshore of the South Arm were covered by 'reclamation' filling to form/extend industrial development areas (including BHP's Onesteel site), while Ash Island, Dempsey Island, Moschetto Island and Walsh Island were filled (using largely dredged sediments) to form Kooragang Island. As a result of this reclamation, the channel for the South Arm has shifted further north (into Kooragang Island).

Mud flats and some sand filled (reclaimed) areas exist on the north bank. In recent decades, the south bank shoreline has been armoured for erosion protection using rock, building rubble and steelworks by-products (slag). The zone immediately behind the shoreline in this area has been used for industrial and material stockpiling purposes.

14.1.2 Geotechnical conditions

Previous and current geotechnical investigation data and reports have been used to produce a "geotechnical model", in the vicinity of the proposed dredging areas.

An idealised section across the river at Chainage (Ch) 1560 is given on Figure 14.2, and an idealised long section is provided on Figure C.8 (refer Appendix C).

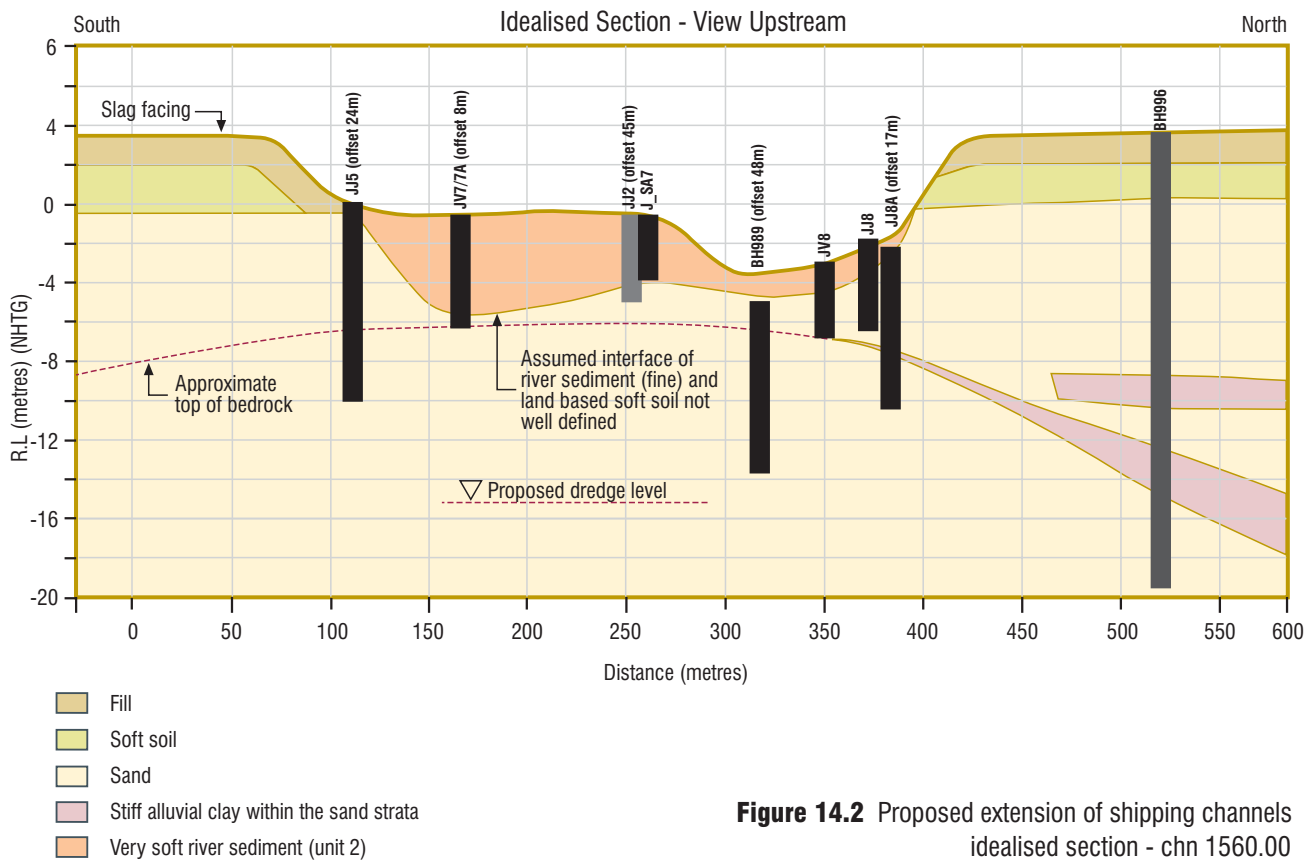


Figure 14.2 Proposed extension of shipping channels
idealised section - chn 1560.00

The generalised geotechnical model comprises:

- Variable fill from dredging and industrial activities placed for reclamation purposes outside the current river channel profile;
- Soft soil including very soft river-bed sediments and soft alluvial (non-river) clay;
- Marine sands, typically fine to medium grained with occasional alluvial clay lenses/layers; and
- Bedrock comprising sandstone, siltstone, shale and minor coal seams.

Soft Soils

The uppermost sediment within the Hunter River, very soft clay, is geologically a very recent sediment (last 10,000 years). Typically it comprises mainly clay and silt size particles with a minor (about 15 percent average) fine to medium fine sand content.

The thickness of the very soft sediment, from the Tourle Street bridge (Ch 0) to Ch 800, appears to be generally deeper on the northern side of the river (where it is found to a depth of 3 metres) and generally thin or absent on the south. Further downstream (Ch 800 to Ch 2900) the unit thickens to over 7m and appears to deepen from the banks toward the centre of the river. Beyond Ch 2900 the thickness of soft clay appears affected by dredging for the existing navigational areas and it becomes locally thin or absent.

Soft alluvial (non-river) clay represents the surface of the previous island/mudflat landform adjacent to the Hunter River South Arm that is now covered by dredged sand and (in parts) fine sediment and fill material. This sediment can be subdivided into soft sandy clay and soft clay which are two different sub-units in terms of classification and behaviour which are described as follows:

- The soft sandy clay component is generally dark grey in colour and of low plasticity. It exists generally immediately below the fill stratum and can be up to 4 metres thick. Apart from localised buried channel areas, the soft soil consists predominantly of this soft sandy clay material.
- The soft clay sub-material generally comprises wet, dark grey, high plasticity clay. This soft clay unit exists in infilled gullies/channels and has been identified to depths of up to some 15 metres on Kooragang Island within the buried Moscheto Channel, just west of the Port Waratah Coal Services Ltd KCT Stage 2 coal stockyard.

The soft alluvial clays are low permeability, low strength deposits that provide hydrogeological and geotechnical constraints to development. In particular, the non-river soft soils effectively form a 'leaky' aquitard to groundwater flow between the overlying fill material and the underlying lower sands, providing an 'upper' and 'lower' aquifer. Within the river, these clays appear to have been eroded and replaced with the very soft (river) clay referred to previously. The clays, both river-bed and non-river, are susceptible to large settlements on loading and due to their low strength, require special consideration for dredge batter design and on-shore development.

Moreover, the very soft river-bed sediments are known to contain elevated concentrations of polynuclear aromatic hydrocarbons (PAH) and heavy metal contaminants that may affect their ultimate disposal/use.

Soft clays have also been identified at up to 1.2m thickness as discontinuous layers within the underlying alluvial sands.

Alluvial Sand

Alluvial sand exists beneath the Hunter River South Arm and is continuous beyond the banks. This sand is typically in a dense state apart from an upper loose to medium dense transition zone beneath the very soft to soft alluvial clays. Some discontinuous, thin, alluvial clayey bands exist within the dense sand unit. These clayey bands may be up to about 1.2 metres thick. This sand has been dredged in the past for engineered fill platforms and reclamation purposes. It is also likely suitable for beach nourishment. The sand is predominantly quartzose, though the presence of significant amounts of feldspars and other materials is to be expected. Shells and shell fragments provide a source of calcium carbonate in the sand, and since the sand is situated within a saline environment, return waters from dredging and the dried sand can be expected to be saline.

Residual Clay/Bedrock

Residual clay/bedrock generally comprises stiff to hard, medium to high plasticity clays overlying shales, alternating siltstones and sandstones and occasional minor coal seams. The transition zone between residual clay into bedrock is variable in thickness and quality.

Previous studies indicate a variable thickness of stiff to hard residual clay ranging from zero to about five metres.

The inferred 'averaged' bedrock profile grades from Class 5 as classified under the Australian Geomechanics Society system (Foundations on Sandstone and Shale in the Sydney Region, AGS Journal, December 1998) to Class 1 bedrock over an average thickness of about 5m as inferred from limited borehole and jetting information. Unconfined compressive strengths (UCS) correspondingly are expected to range from < 1MPa to 16MPa within this transition zone and to be generally > 16MPa below.

Difficult dredging may be expected within the residual clay/bedrock. Dredging refusal and any requirement for hard rip, blasting of the bedrock will be dependent on lithology, rock strength, structure (joints/laminations) and the type of dredge used.

A bedrock 'high' requiring up to some 9m depth of excavation below Class 5 material has been identified between approximately Ch 1300 and Ch 2400, as shown on Figure C8 (refer Appendix C).

Artificially accelerated weathering tests indicate that the bedrock would deteriorate rapidly on exposure to fresh water/air and thus could not be considered as a 'durable' material.

14.2 Existing OneSteel site/swing basin

The following assessment of the site has been based on existing data and reports on the historical development of the site that have largely been provided by OneSteel.

14.2.1 Geology

Stratigraphy of the OneSteel site comprises a channelised estuarine setting, similar to that of the river delta, but recently covered with an extensive fill platform. The swing basin area is dominated by fill used during the reclamation of Platts Channel and Spit Island between the 1950s and 1970s (refer to Figure C.23 in Appendix C).

The depth of fill ranges between five to 12 metres with an average depth of eight metres. This fill overlies the natural estuarine sediments that once formed Platts Channel and Spit Island. Figure C.23 indicates that the majority of the recently deposited fill materials required to be excavated, are those that have been placed on top of the former Spit Island, which has a depth of approximately only five metres. The materials placed in the former Platts Channel will not be excavated.

14.2.2 Fill types

Fill material used on the site generally included wastes from plant operations and steel works refuse. Large volumes of river silt and beach sand dredged from the remaining section of the South Arm channel have also been reported to have been used as fill. The main type of fill materials potentially used during the reclamation of Platts Channel and Spit Island included:

- Slag from blast furnaces, steel making and open hearth operations;
- Slurry from coal washery plant including shale (coal washery reject);
- Flue and sinter plant dusts;
- Fly ash and ash from the locomotives;
- Steelworks refuse (including old bricks, ashes, shale and refuse from the coal cleaning plant);
- River silt and sand dredged from the remaining section of the South Arm channel;
- Waste from coke ovens by products (including sludge from the rectification stills, tar from the decanters, oil and tar from the drains, tar from spills occurring from the tar tanks at the tar plant and acid sludge from the benzol plant tar); and
- Wastes from the finishing and rolling mill operations (including spilt oil and lubricants from mill floors and spent acid from pickling plants).

14.3 Potentially contaminated areas

Little information is available on the disposal of wastes during the reclamation of Platts Channel and Spit Island. Photographs of the reclamation of Platts Channel show that slag materials predominately were used (ranging from fine grained material to the size of boulders) as well as indiscriminate placement of drums, bricks, building materials, pipes and iron.

Three areas within the vicinity of the proposed swing basin site have been identified as areas potentially used for the disposal of waste tar and grease over the period of reclamation. However, recent ground water and soil investigation bores undertaken on the site have not encountered these potential tar pits. If the tar pits do exist, it is likely that they may have biodegraded to some degree over the last 30 years. These potential disposal areas were further reclaimed after the tar was disposed and as a result the level of tar is unknown. The presence of the southern tar pit was noted in 1968 during the construction of the Bar Mill¹. No details on the nature and extent of tar encountered were available. Other waste materials reported to be disposed at these sites included fly ash, general work refuse, blast furnace slag, BOS slag, coal washery refuse, grease and oil. The volume of material deposited in these areas is also unknown. Due to the limited information on waste disposal areas, it is likely that waste is present in other areas of the fill material.

An unlined pit which forms part of the Mill Storage and Transition area is currently located within the swing basin site. This pit has been in existence since the 1980's and was used to collect oily run-off from the adjacent millscale storage area. This pit was also used to capture oily run-off from the Bar Mill and Rod Mill backwash sludge. Elevated concentrations of metals, cyanide, ammonia and TPHs are likely to be associated with drainage of oily water from these operations. All waters collected in the Millscale Transfer and Storage Pit area are contained so that discharge offsite via stormwater is limited. The Mill Scale Pit is unlined, and hence there is a potential for groundwater contamination. However OneSteel have investigated groundwater quality in this location and found that there has been no discernable impact on downgradient groundwater monitoring wells associated with this area to date (CH2MHill, 2002). It is understood that OneSteel have plans to upgrade the millscale/backwash pit sludge handling system which was temporarily stored adjacent to the pit.

14.3.1 Contamination levels

The former Environment Department at BHP Newcastle Steelworks undertook a limited contamination investigation between 1996 and 1999. This investigation included the M2 and M6 areas of Lot 222 in which the proposed swing basin is situated. A total of four boreholes were located within the proposed swing basin site. Samples were collected throughout the fill and natural soil profile. A summary of results for the swing basin site is presented in Table 14.1 in comparison with standard Health Based Investigation Levels and site specific health based criteria from the OneSteel site, developed as part of criteria for the whole BHP Newcastle Steelworks Site.

¹ Woodward Clyde, 1999, BHP Newcastle Steel Works, Closure Area, Soil Site Assessment Report

Table 14.1 Summary of results – swing basin contamination levels

Analyte	Concentration Range of Soils within Proposed Swing Basin Site ^a (mg/kg)	Developed Site Specific Health Based Criteria ^b (mg/kg)	Health Based Investigation Levels (HIL F ^c or TC) (mg/kg)
Aluminium	4300-54400	-	-
Arsenic	1.3-12	500 ^c	500
Cadmium	<1-2	100 ^c	100
Chromium	6-1360	22000 ^d	500
Copper	4-130	5000 ^c	5000
Iron	11000-600000	-	-
Lead	<20-460	1500 ^c	1500
Manganese	200-64000	300000 ^b	7500
Mercury	<0.01-0.2	75 ^c	75
Nickel	<10-120	3000 ^c	3000
Tin	<20 - <40	-	-
Zinc	34-680	35000 ^c	35000
Cyanide	1-10	-	1250
Phenols	<0.5-3.1	42500 ^c	42500
TPH C ₆ -C ₉	<2- <20	-	65 ^e
TPH C ₁₀ -C ₁₄	<10-410	11500 ^b	1000 ^e
TPC ₁₅ -C ₂₈	<30-3600		
TPH C ₂₉ -C ₃₆	<30-259		
Benzene	<0.2- <20	-	1 ^e
Toluene	<0.2- <20	-	130 ^e
Ethyl benzene	<0.2- <20	-	50 ^e
Total xylene	<0.2- <50	-	25 ^e
Total PAH	<1-101	320 ^b	100
Benzo(a)Pyrene	<1-9	16 ^b	5

Notes

1. BHP Steelworks Site Assessment Report (draft) circa 1998 –Soil Data Extracts M2 and M6. Note: The analytical results associated with BHP Steelworks investigation during 1996 to 1999 are not associated with quality control documentation that OneSteel possesses, and laboratory detection limits for some samples may exceed the guidelines (mainly regarding groundwater results in those studies).
2. Woodward Clyde, 1999, Human Health and Environmental Risk Assessment, BHP Steelworks site – Final Draft June, Newcastle.
3. NEPC, 1999, NEPM schedule B(1), Health Investigation Levels, Exposure Setting F: Commercial/Industrial
4. Total Chromium
5. NSW EPA, 1994, Threshold Concentrations (TC) Guidelines for Assessing Service Station Sites .

The investigations identified some concentrations of Total PAHs, benzo(a)pyrene, TPH, chromium and manganese either at or above the HIL F or TC guidelines. However no concentrations in the samples analysed from these investigations within the swing basin site exceeded the site specific health based criteria.

Geotechnical logs for these boreholes located within the proposed swing basin area reported various fill materials such as slag, coke, coal washery reject, bricks, shale, coal and wood. An oily odour was noted in one borehole at depth.

OneSteel have noted two diffuse seeps flowing from the fill aquifer within the swing basin site at approximately 1 to 2 metres below low tide level during 2001 and 2002. No sheens or odours were noted from these two seeps. Seepage water collected from an area outside of the proposed swing basin (within the OneSteel site) reported minor concentrations of TPH, copper and manganese in excess of the ANZECC 2000 Marine Ecosystems Trigger Values⁵.

Based on the history of filling at the site it is likely that soils within the proposed swing basin site contain some form of industrial residues. Based on previous investigations, contaminants of concern that may be encountered in soils at the site include TPH, BTEX, PAH, heavy metals (aluminium, manganese, lead, arsenic and iron), cyanide and phenols. It was noted in the photographs of the site that indiscriminate filling of areas occurred and as a result wastes may also be encountered on the site including demolition waste and storage drums. As such contaminants such as asbestos, OCPs, and PCBs may also be present in the fill materials.

The construction of the swing basin would require the removal of up to 320,000 m³ of fill materials to form the swing basin. Underlying this is a further 530,000m³ of predominantly uncontaminated clean sand materials required to be excavated to form the swing basin. Procedures for excavation, handling, remediation, disposal and/or reuse of the excavated material should be outlined in a detailed management plan prior to construction of the swing basin. These procedures should be based on the results of the final design of the swing basin and the interrelated requirements of other activities involved in the overall proposal.

The management plan should address a number of environmental issues including:

- The need to limit the potential for impact on the groundwater equilibrium of the groundwater within the excavation area;
- The need to limit potential discharging of potential contaminants exposed in the batters into the South Arm.
- Appropriate management of stockpiled soils on the closure area site; and
- Appropriate remediation strategies for the excavated material.

To minimise the risk of contaminated materials being released to the South Arm, it is proposed that the existing perimeter reclamation wall would remain in place during the excavation of soils within the swing basin. Upon completion of excavation works the perimeter reclamation wall would be removed. During the removal of the perimeter wall, a floating silt curtain would be placed at the bottom of the batter to reduce the potential for any turbid water entering the South Arm.

It is proposed that fill materials lying above the marine sediments and sand within the swing basin area would initially be removed and transported to the closure site where the material would be sorted into separate stockpiles of particular classes of material. Fine grained sediments lying below the fill materials would then be removed using water based equipment, such as large backhoe dredges operating in conjunction with barges or cutter suction dredges.

The suitability of the marine sediments for beneficial reuse or marine disposal will be assessed at the time of excavation, depending on the levels of contamination.

⁵ ANZECC 2000, Trigger values applying to typical slightly – moderate disturbed systems except for TPH (Crude Oil – Crustaceans low toxicity value used) ; refer to table 3.4.1 of ANZECC 2000.

Options for disposal of this material include:

- transport;
- treatment and disposal at the closure area or licenced sites on Kooragang Island; or
- disposal to an off-shore disposal site (subject to EPA approval).

Outcomes of this material are difficult to determine, but if it is assumed to be an average of 1 metre thick over the area of excavation, it would have a volume of approximately 50,000 m³.

The remaining uncontaminated sediments, which compose the majority of the excavation would be removed by dredging and beneficially reused.

If the water contained within the excavation area is found to be contaminated with hydrocarbons, it is proposed that an oil containment boom be provided close to the embankment and oil skimming equipment used to collect the containment water. This water would then be taken to an approved trade waste disposal site or other approved processing facilities.

Soils stockpiled on the closure site should be appropriately banded to minimise the potential for contamination of the underlying soil and the groundwater.

Soils samples would be collected from the stockpile and analysed for analytes including TPH, BTEX, PAHs and heavy metals. Results from the analysis would allow for the assessment of the most appropriate remediation treatment option for the soil.

The decision of the best soil remediation technology to be used on any contaminated soils excavated during the construction phase would depend on a variety of factors including: consistency of material excavated; concentration and type of contaminants; time to remediate; volume of material to be remediated; and cost of treatment.

14.4 Impact assessment

14.4.1 River areas

General

Dredging and removal of the soft sediments from the South Arm area would have a net benefit on the environment through the removal and treatment of contaminated material from the river bed. This would minimise the long-term impacts of contaminants on the surrounding environment.

Potential acid sulphate soils

Potential acid sulphate soil (PASS) is soil that could develop acid sulphate soil (ASS) condition when exposed to air, resulting in a decrease in pH (below a pH of 4) from the oxidation of pyrite, which forms sulphuric acid.

The formation of ASS depends on oxidation, which requires prolonged exposure. Usually, if materials are to be submerged within 24 hours, ASS conditions are not expected to occur.

To date, except for a few 'very occasional' results within the soft sediments, test data indicates that almost the entire the bulk of the proposed dredge materials are not PASS. Thus any, minor PASS volumes exposed on-shore, would be expected to be buffered by the surrounding material with which they are excavated/stockpiled.

14.4.2 Site for the swing basin – the OneSteel site

Construction of the swing basin could result in potential seep faces of contamination adjacent to the swing basin site being exposed. Two potential tar pits and the Mill Scale Storage and Transition Area Pit may be located within the swing basin site.

Two wall options are considered appropriate for the “batters” of the dredging within the OneSteel site, either a sloping rock revetment or a vertical sheetpile wall combined with a smaller sloping type revetment, seaward of the sheet piles wall (refer to Figures C.2 and C.3 in Appendix C). The final option adopted would be dependent on the results of more extensive site investigations undertaken during the detailed design stage of the proposal.

Construction of a sheet pile wall with a buried tie back anchorage system within the swing basin site may reduce the amount of soils to be excavated from the site and decrease the risk of intrusion into potential tar pits and the Mill Scale Storage and Transition Area Pit. However, the sheet pile wall option may be difficult to construct through the slag fill and is likely to only marginally decrease any contamination migration to the Hunter River.

The rock revetment option would require excavation of a larger volume of soils and may involve excavation into potentially tar-impacted areas. With this option, there is less of an opportunity to incorporate a contamination barrier between potentially contaminated fill materials and the rock wall than the sheet piled wall options.

The proposed swing basin design ensures that no excavation would occur within the benzene-impacted area identified to the east of the Tourle Street bridge. The plume associated with the benzene - impacted area is reported to be currently stable and is considered to present no significant risk to the surrounding environment in its present state. In fact the proposed sheet piling wall located at the base of the batter may encourage encapsulation of the benzene contaminated materials. Based on this, the construction of the swing basin would have no impact on the benzene plume area.

The construction of the swing basin may cause a reduction of contamination migration path lengths and result in exposure of potential seep faces of contamination adjacent to the swing basin site. In particular care must be taken with regard to the two potential tar pits and the Mill Scale Storage and Transition Area Pit that are located within the swing basin site.

However if changes are made to the swing basin design to include some form of excavation within the vicinity of the plume, destabilisation of the plume may occur, which may impact negatively on the surrounding environment. If significant contamination is found to exist within the swing basin site, the excavation and remediation of soils would have a net benefit on the environment by further reducing the potential risk to the surrounding environment.

Procedures for excavation, handling, remediation, disposal and/or re-use of the excavated material would need to be prepared prior to the excavation of the swing basin. These procedures should be based on the final design of the swing basin, and the interrelated requirements of other activities involved in the overall South Arm dredging proposal.

14.5 Recommended mitigation measures

The following mitigation measures would be implemented to minimise the potential for impacts to the environment. These would be implemented in conjunction with the soil and water management plan developed as part of the EMP.

Disturbance of the ground surface during earthworks exposes unprotected soil surfaces and has the potential to increase erosion and release of contaminants to the Hunter River and associated groundwater systems. The design of land based excavation should incorporate drainage systems to limit overflow of run-off and direct stormwater into drainage systems that discharge at appropriate locations.

General recommendations include:

- Implement erosion, sediment and pollution control measures and practices during site preparation works and construction;
- Monitor erosion and contaminant discharge levels at appropriate locations during site preparation works and construction;
- Construct the dredge batter profiles and revetments as described in this EIS;
- Develop maintenance programs for long-term steep batters;
- Where appropriate, embankment walls should be considered that minimise the encroachment of the embankment onto land areas that are potentially contaminated;
- Installation of drainage measures and foundation replacement may be required where seepage and soft/weak strata are present; and
- Use best practice construction techniques to minimise disturbance to the existing environment.

Other recommendations include the following:

River areas

There is a minor risk of potential acid sulphate soils being excavated from river areas. However, test data indicates that almost the entire the bulk of the proposed dredge materials are not PASS. Any minor PASS volumes exposed are expected to be buffered by the surrounding excavated material with which they are stockpiled.

Cement stabilisation of the sediments would further neutralise (buffer) such sediments. Further PASS investigations would be conducted around the few points where PASS has been indicated, and the mixing/neutralisation aspects checked to ensure that the ASS conditions did not develop.

An acid sulfate soil management plan would be prepared as part of the EMP, in accordance with the New South Wales Acid Sulfate Soils Management Advisory Committee publication, Acid Sulfate Soils – Assessment Guidelines (1998).

Swing basin area

If significant contamination exists within the swing basin site, excavation and treatment of soils would further reduce the potential risk to the surrounding environment. Procedures for excavation, handling, remediation, disposal and/or re-use of the excavated material would be prepared prior to construction of the swing basin. These procedures would be based on operational, construction and environmental considerations as well as the final design of the swing basin, and the interrelated requirements of other activities involved in the overall South Arm dredging proposal.

While a sheet pile wall with a buried tie back anchorage system within the swing basin site may reduce the amount of soils to be excavated from the site and increase the contamination migration path lengths (reducing any potential impacts to the Hunter River), the difficulties of construction of such a wall through variable fill with slag inclusions may be significant. Moreover, the potential environmental benefits are likely to be minimal.

15 Groundwater systems

This chapter provides a summary of the results of the existing groundwater systems in the area potentially affected by the proposal, the potential impacts of the proposals and recommended mitigation measures. The report was undertaken by GHD and the full report is included in Appendix I.

15.1 Overview

The potential impact on existing groundwater systems of the proposal has been considered with respect to three main areas:

- The area to the north of the South Arm of the Hunter River, including reclaimed land constituting Kooragang Island;
- The area of the Hunter River itself; and
- The area is land to the south of the Hunter River, including reclaimed land constituting the OneSteel Rod and Bar Mills site (Lot 222) and extending into the Closure Area.

From a hydrogeological perspective, the proposed excavation and construction of the swing basin that would encroach on reclaimed land currently occupied by OneSteel Rod and Bar Mills (Lot 222) would potentially alter the groundwater equilibria. Due to historical filling and historical process waste residue disposal within the swing basin excavation area, there may be some potential groundwater impact from the disturbance of potentially contaminated fill material.

In addition, due to the close proximity of the swing basin excavation area to the Mill Scale Storage and Transition Area, there may be some potential groundwater impact if this area is breached, or through alteration of the groundwater equilibria through a reduction in the groundwater transport pathway length to the Hunter River.

There may also be potential groundwater impact from the short term storage of contaminated dredged or excavated material on land prior to treatment. However, engineered structures such as lined storage basins and associated water collection systems with specific surface water drainage controls would all serve to minimise the potential for groundwater impact.

Groundwater impact from the emplacement of immobilised contaminated sediment and excavated material as engineered fill or for landscaping on the Closure Area site within the constraints of the DA for this site, is considered unlikely.

As discussed earlier in this EIS, the immobilised treated material produces a stabilised 'dewatered' product that does not produce seepage and is of very low to extremely low permeability (less than 1×10^{-9} m/s), significantly limiting any potential groundwater impact through leaching.

The treated material would be of sufficiently low concentration leachability to meet the proposed treatment standards for the project as presented in Chapter 7.

Treated sediment or excavated material is to be placed above the water table and below the 0.5 metre physical barrier meeting the MPT consent conditions for use as a separator/buffer in areas of very low to negligible surface infiltration (such as underneath car parks). It is noted that the 0.5 metre physical barrier meeting the MPT consent conditions would

have very low permeability (possibly less than 1×10^{-7} m/s) It is also noted that this permeability is approximately two orders of magnitude (i.e. 100 times) more permeable than the permeability proposed for the immobilised sediments.

In addition, the improvement of the surface water drainage system within the Closure Area, including recontouring and capping, would further reduce infiltration to the underlying shallow groundwater table, further reducing potential mobilisation of contaminants from emplaced treated material from this proposed project. As a result of the proposed treatment and selective emplacement procedures, leaching of contaminants to groundwater from immobilised or thermally desorbed sediments and excavations is highly unlikely. No discernable environmental impact upon groundwater is hence expected from this aspect of the proposed project.

Areas of OneSteel located beyond the proposed swing basin area, including the closure area site, Kooragang Island and the river itself, may have minor impacts on groundwater flow arising from proposed dredging of river sediments and clays and bedrock along the river, to approximately -15.2 metres NHTG, in areas that have not been previously dredged to this level.

The Hunter River is tidal and would continue to be the local groundwater discharge zone for parts of the hydraulically connected aquifers south and north of the river after the proposed dredging operations. From a hydrogeological perspective, the proposed dredging operations represent a continuance upstream of historical and ongoing dredging undertaken for current port operations.

The Hunter River is an active shipping port. It is understood that NPC continues to conduct periodic maintenance dredging in areas adjacent to and downstream of the subject site (to depths of -16.5 metres NHTG) for ship navigation purposes. In addition, the channel southeast of the closure area has been dredged to approximately -15.2 metres NHTG, to allow access by bulk carriers. The potential development of the closure area for the proposed Multi-purpose Terminal would also require continued dredging of sediment to facilitate navigation of ships (URS, 2001a).

Removal of sediment, clay and bedrock during the course of the proposal would likely result in minor reductions in the length of time for historically-occurring contaminated groundwater to discharge into the surface water of the river. However, this is not considered to be a significant issue. Dredging is considered only to represent a very minor potential hydrogeological impact on Kooragang Island, on OneSteel areas outside the proposed swing basin footprint and on the closure area.

The proposed excavation and construction of the swing basin represents the largest potential hydrogeological impact due to the considerable alteration of the river foreshore. As a result, the main focus of the hydrogeological assessment has been on the proposed swing basin.

15.2 Existing environment

15.2.1 Information sources

Details on the existing hydrogeology in the vicinity of the proposal were obtained from a review of geotechnical and geochemical investigations, undertaken for a variety of historical projects and ongoing environmental monitoring programs.

15.2.2 Discrete aquifer units

The land originally present in the area of the proposed swing basin that is to be excavated adjacent to the OneSteel was known as Spit Island. Platts Channel originally separated Spit Island from the southern shore. In 1950, after NSW State Government approval, reclamation of Platts Channel and Spit Island commenced using steel making process materials and associated wastes. Reclamation was completed by the 1970s.

As a result of reclamation, three main aquifer units (including four geological layers) might be encountered on land south of the Hunter River. These are described as follows:

Fill aquifer

The first fill aquifer layer encountered generally consists of fill material. This layer generally consists of a mixture of steelworks process slag, process by-products and residues. In addition, minor quantities of waste building materials (bricks, wooden beams, metal girders etc.), general waste materials and previously dredged sands may also be encountered within this layer (CH2MHill, 2002, OneSteel 2002). Depending upon the water table depth, this layer can be referred to as 'the fill aquifer'.

Estuarine aquifer

The estuarine aquifer underlying the fill layer/aquifer is a second aquifer unit generally referred to as 'the estuarine aquifer'. This aquifer unit can be generally described as a grey/white, fine-to-medium sand.

It is noted that a layer of dark grey/brown silty sands or clays can be encountered overlying the estuarine aquifer. This layer is considered representative of the previous island/mudflat landform, which has subsequently been covered by reclamation works (GHD-LM, 2001). This layer has variable consistency, ranging from silty sand to silty clay. There is evidence that this layer is semi-confining and not of uniform thickness across the area under consideration. It is considered likely that hydraulic connections exist between the fill aquifer and the underlying estuarine aquifer.

Bedrock aquifer

The third and final unit is referred to as the 'bedrock aquifer'. This bedrock aquifer comprises the Tomago Coal Measures. It is described as a sequence of mudstones, siltstones and shales (URS, 2001; GHD-LM, 2001). The topography of the bedrock surface is variable, which reflects erosion and drainage patterns prior to deposition of the estuarine sands. The depth to bedrock tends to increase from the south heading towards the river (GHD-LM, 2001).

The groundwater system of Kooragang Island north of the South Arm of the Hunter River is influenced by the historical filling of low-lying delta islands (ERM, 1996). Generally, two aquifer units (including three geological layers) are prevalent. These are described as follows:

- The first unit is an unconfined watertable aquifer of reclaimed dredged river sediment (sand) and former Steelworks process wastes (i.e. slag). Underlying this first aquifer is a clay confining layer, which is representative of the natural ground surface prior to reclamation; and
- The second aquifer is a silty sand aquifer, which extends from the bottom of the clay confining layer down to the final bedrock aquifer.

Four cross-sections of the existing hydrogeology across the South Arm of the Hunter River have been developed from available groundwater monitoring well and geotechnical investigation data. These cross sections feature indicative groundwater flow directions, marked by plain blue arrows. A plan view of these cross sections is featured in Appendix I.

Five geological layers/aquifer units are featured in the cross-sections of the existing hydrogeology (Appendix I). These geological layers correspond respectively to the predicted ground surface (labelled as 'ground surface'); the fill aquifer (labelled as 'fill'); the semi-confining silty sands/clay layer associated with the underlying estuarine aquifer, which also includes river sediments and clays (labelled as 'estuarine clay'); the estuarine aquifer (labelled as 'estuarine') and, finally, the bedrock aquifer (labelled as 'bedrock').

It is noted that much more detailed and accurate geotechnical modelling has been undertaken associated with the actual design of the proposal (GHD-LM, 2001), than shown in the conceptual cross-sections (Appendix I). These long and cross-sections are featured in Figures C.1, and C.8 to C.13.

15.2.3 Hydrogeology

On a regional basis, groundwater to the south of the Hunter River typically flows in a north-easterly direction towards the river. This groundwater flow is influenced by a combination of the river, the former Platts Channel, the original Spit Island and the prevalent regional groundwater flow heading towards the river, originating from the residential area of Mayfield.

Groundwater flow to the north of the river generally flows towards the river in a south to south-easterly direction in the upper anthropogenic fill aquifer and towards the ocean in an easterly direction in the lower silty sand aquifer (ERM, 1996). This groundwater flow is influenced by a combination of the river (mainly associated with the upper fill aquifer), the ocean (mainly associated with the lower silty sand aquifer) and the historical low-lying delta islands in this area.

With respect to vertical hydrogeology, on a regional basis on land south of the river, there is a prevalent upward hydraulic gradient from the estuarine and bedrock aquifers into the upper aquifer units and into the river (URS, 2001, RCA, 1999). On a local basis, the trend of an upward hydraulic gradient from the estuarine to the fill aquifer is less pronounced as the river is approached. From land north of the river, hydraulic connections have been noted between the upper fill aquifer and the underlying confined silty sand aquifer (ERM, 1996).

Groundwater flow in the fill aquifer in the vicinity of the proposed swing basin footprint is generally towards the river to the northeast. The hydrogeology within this aquifer is influenced by mounding of groundwater to the west of the swing basin footprint, in the Steelstone area and in the vicinity of the Mill Scale Storage and Transition Area (CH2MHill, 2002). This mounding of groundwater within the fill aquifer has also been observed in other previous studies (URS, 2000). The mounding is attributed to the collection of oily water run-off from the oily Mill Scale and other iron bearing sludge from the backwash pits from the Rod and Bar Mills in the Mill Scale Storage and Transition Area prior to recycling onsite. This pit is understood to be historically unlined and OneSteel currently has plans and budgets in place to seek and install a better alternative to the current Mill Scale and Backwash Pit sludge handling system, and would continue its ongoing liaison with the EPA regarding the current and alternative systems.

Groundwater flow in the fill aquifer towards the eastern end of Lot 222 (towards the closure area as shown in Figure 10.3) is generally either in a north-easterly direction towards the river, or in a more southerly direction towards Industrial Channel / Drain 17 (i.e. the former Platts Channel) depending upon the distance inland from the river. Some minor localised mounding of groundwater is evident at the eastern edge of Lot 222, in the vicinity of well M8/7.

Towards the western end of Lot 222, groundwater flow is clearly in a north to north-westerly direction, influenced by the mounding of groundwater to the west of the swing basin footprint in the Steelstone area and Mill Scale Storage and Transition Area.

The groundwater flow in the estuarine aquifer in the vicinity of the swing basin footprint is generally in a north to north-easterly direction. A small degree of groundwater mounding is evident within the estuarine aquifer to the west of the swing basin footprint, although it is not as pronounced as observed for the fill aquifer. This infers a hydraulic connection between the fill aquifer and the underlying estuarine aquifer in this area. Further to the south-west of the swing basin footprint, elevated groundwater levels can also be observed, which are a function of the prevalent groundwater flow from the southern residential area of Mayfield.

The groundwater flow within the estuarine aquifer is also influenced by former tributaries and estuarine mudflats present prior to development on the site for steelworks operations (BHP, 1993). These former tributaries and estuarine mudflat areas have resulted in minor preferential flowpaths existing across Lot 222, which tend to complicate localised groundwater flow patterns within the estuarine aquifer. The fill aquifer is similarly influenced.

There are only a limited number of bedrock aquifer monitoring wells installed on land south of the river. Previous investigations have highlighted the fact that the river is the dominant hydraulic control in the area and that the flow from the bedrock aquifer is towards the north-to-north east and that it discharges into the river (RCA, 1999). This conclusion is supported by the available geotechnical data (GHD-LM, 2001).

15.2.4 Groundwater quality

From a contaminant hydrogeology perspective, the proposed swing basin construction has the greatest potential for adverse effects impacting on the existing groundwater systems. The remaining minor identified potential impacts on contaminant hydrogeology in the areas of OneSteel beyond the proposed swing basin area, the closure area and Kooragang Island, would be due to a relatively insignificant reduction in the time that potentially contaminated groundwater takes to discharge into the river.

As a result, the discussion on the assessment of groundwater quality in areas north and south of the Hunter River is focussed upon data relevant to the area of the proposed swing basin within Lot 222, with only minor comments on groundwater quality within the closure area and Kooragang Island.

CH2MHill reports the results from extensive soil, groundwater and surface water sampling on behalf of BHP-Billiton and then OneSteel within Lot 222 (south of the river) from February 2000 to September 2002, as a part of a Voluntary Investigation Proposal submitted to the EPA under the NSW *Contaminated Land Management Act 1997* (CH2MHill, 2002).

For the Lot 222 assessment, CH2MHill adopted the management aim of achieving water quality consistent with a 'slightly to moderately disturbed system', and therefore the ANZECC (2000) Marine Water Quality guidelines (trigger values) were selected to provide a level of protection of aquatic ecosystems for 95 percent of species for some analytes. It is recognised that these trigger values for some particular parameters may not protect particular species against chronic effects for, or allow for, potential bioaccumulation. For these parameters, trigger values were selected to provide a level of protection for 99 percent of species. As a result, the combination of trigger values selected, were considered to be appropriately conservative for the purposes of the assessment (CH2MHill, 2002).

The groundwater quality of the fill aquifer (95 percent upper confidence limit (UCL)) in the vicinity of the proposed swing basin (along the Hunter River foreshore) generally meets the ANZECC (2000) Marine Water Quality trigger values, with some exceptions. Elevated concentrations of copper, lead, vanadium, arsenic, mercury, manganese, cyanide, ammonia, TPHs, polycyclic aromatic hydrocarbons (specifically phenanthrene, anthracene, fluoranthene, benzo(a)pyrene) above the relevant assessment criteria were reported within the fill aquifer (CH2MHill, 2002).

The groundwater quality of the estuarine aquifer (95 percent UCL) generally meets the ANZECC(2000) Marine Water Quality trigger values. Estuarine aquifer groundwater shows less exceedences of the relevant assessment criteria, than observed for the fill aquifer. This is to be expected, given that the materials used during the infilling of Platts Channel and Spit Island are likely to influence groundwater quality within the fill aquifer.

In addition, the presence of the semi-confining layer of estuarine clay above the estuarine aquifer would tend to prevent potential groundwater contamination from the fill aquifer from migrating downward into the estuarine aquifer. Nonetheless, concentrations of copper, zinc, cadmium, arsenic, manganese, cyanide, ammonia, TPHs and PAHs (specifically naphthalene, anthracene, benzo(a)pyrene) above the relevant assessment criteria have been reported within the estuarine aquifer (CH2MHill, 2002).

Although the groundwater concentrations (95 percent UCLs) of the fill and estuarine aquifers exceeded the ANZECC(2000) Marine Water Quality trigger values along the foreshore of the Hunter River for some analytes, the upgradient groundwater concentrations (95 percent UCLs) entering Lot 222 for copper, zinc, manganese, ammonia, phenanthrene, anthracene and benzo(a)pyrene are generally higher. These results imply that there are potential upgradient groundwater contamination sources of some heavy metals and PAHs that are migrating onto Lot 222.

The footprint of the proposed swing basin may partly intersect the Mill Scale Storage and Transition Area. It was reported in CH2MHill (2002) that elevated concentrations of arsenic, copper, manganese, nickel, lead, free cyanide, ammonia and TPHs, beyond the relevant environmental assessment criteria, were detected in a water sample recently taken from the pit.

The results obtained by CH2MHill (2002) were not unexpected, given the storage of oily water from the Mill Scale and Backwash Pit. Currently all waters collected in the Mill Scale Transfer and Storage Area are contained so that discharge offsite in stormwater is limited. It is understood that these materials are dispatched offsite for recycling/re-use (OneSteel, 2002). It is noted that the Mill Scale Pit is unlined, and hence there is a potential for groundwater contamination (CH2MHill, 2002; OneSteel, 2002) from that source.

However, there has been no discernable impact on downgradient groundwater monitoring wells associated with this area to date (CH2MHill, 2002). It is understood that budgets and plans have been instigated regarding an alternative materials handling process system for this area to replace the unlined pit system.

Disruption of pit through the construction of the swing basin may potentially affect groundwater quality, especially if the pit is breached. Management systems would need to be implemented to ensure that groundwater contamination and Hunter River surface water contamination does not occur during the construction of the swing basin relating to the integrity of the pit. Groundwater in this area would require ongoing monitoring to ensure there is no adverse groundwater contamination, noting that groundwater flows onto the site from upgradient industrial and residential areas.

CH2MHill (2002) considered that the application of the ANZECC(2000) Marine Water Quality guidelines to Lot 222 overall, with 'slightly to moderately disturbed system' trigger values, provided an extremely conservative assessment compared to the Hunter River, which they regarded as a 'highly disturbed system'. When this conservative approach was considered, CH2MHill concluded that groundwater, seeps and drains that are directly impacted by Lot 222 did not pose a Significant Risk of Harm (as defined under the Contaminated Land Management Act 1997) given comparison to upgradient groundwater coming onto the site, natural background concentrations, mass loadings and other contextual risk assessment.

It was noted in the Egis (2000) audit of the closure area that groundwater contaminants exceeding relevant guidelines included PAHs, ammonia, benzene, cadmium, copper, cyanide, manganese, nickel, lead and zinc. From the Egis (2000) review of the RCA (2000) report on groundwater contaminant fluxes (entering the Hunter River) post-closure of the steelworks, the most significant groundwater contaminants were found to be PAHs and cyanide.

Contaminants other than PAHs and cyanide (i.e. ammonia, benzene, cadmium, copper, manganese, nickel, lead and zinc) were noted to require only relatively minor dilution to meet environmental water quality guidelines. This infers that the latter contaminants are not likely to affect Hunter River ecosystems.

For land west of the footprint of the swing basin, within Lot 222 to the Tourle Street bridge, CH2MHill (2002) noted the presence of the small benzene impacted area (some 75 metres by 75 metres only) and a stable benzene plume which is considered to present no significant risk to the surrounding environment in its present state. The current swing basin design does not include excavation within the benzene impacted area, hence it would have no impact on the benzene plume area.

For land north of the river, the historical and current groundwater quality at the Kooragang Coal Terminal on Kooragang Island was recently reviewed (GHD-LM, 2002). The Kooragang Coal Terminal site was divided into six sub-areas in the review: Fines disposal facility; Area 4; Stage 1 Stockyard; Stage 2 Stockyard; Stage 3 Stockyard; and Northern Perimeter.

Elevated concentrations of some heavy metals and sulphides (which only marginally exceeded the relevant environmental assessment criteria) were recently recorded throughout the extensive groundwater-monitoring network at the Kooragang Coal Terminal site. It was concluded by GHD-LM (2002), that these were only temporarily elevated, and that the Kooragang Coal Terminal site did not represent a significant risk of harm to the environment or human health.

15.3 Impact assessment

From a hydrogeological perspective, the proposed excavation and construction of the swing basin is considered to have the greatest potential impact. As noted above, these excavations are to be partially undertaken on the reclaimed land constituting the OneSteel Road and Bar Mills (Lot 222) (refer to Figures C.23 and C.24). Due to historical filling within the vicinity of this area and the presence of the Mill Scale Storage Transition Area and Pit, there could be groundwater impacts related to the proposed excavation in these areas.

Predicted impacts on groundwater flow in the fill and estuarine aquifers due to the proposed swing basin excavations are in Appendix I. It is noted that the groundwater contours plotted are in terms of Australian Height Datum (AHD), not NHTG, which is a difference of 1 metre. It can be seen in these figures that no significant alterations in groundwater flow direction have been predicted for either aquifer unit resulting from the construction of the swing basin. A slight steepening of the hydraulic gradient in both aquifer units (represented by closer groundwater contour lines), can be seen as a result of moving the foreshore of the Hunter river, which is to be expected and not considered significant.

The construction of a geotechnical sheet pile wall approximately 10 metres deep, located along the southern foreshore, from the closure area to Tourle Street bridge may have a minor impact upon groundwater flow within the estuarine aquifer. This sheet pile wall would be installed from approximately 1 metre above NHTG to approximately 9 metres below NHTG, to ensure geotechnical stability of the foreshore during and post dredging within the river.

At this depth, groundwater flowing within the fill aquifer and discharging into the river would not be significantly affected. Groundwater flowing within the upper portions of the estuarine aquifer would be forced underneath the sheet pile wall prior to discharge into the river. It should be noted that the estuarine aquifer is some 30 metres in depth in some locations and the sheet pile wall would not encroach greatly into the estuarine aquifer.

From a groundwater quality perspective, it is likely that the flow path length of groundwater (with elevated concentrations of some analytes) migrating from Lot 222 would be reduced as a result of the proposal, principally in the immediate vicinity of the proposed swing basin. As there would be less time (i.e. groundwater migration pathflow length) for the potential retardation/degradation of groundwater contaminants, this could result in a minor affect upon groundwater equilibria and groundwater quality discharging into the Hunter River.

Currently, there has been no discernable impact on groundwater downgradient from the Mill Scale Storage and Transition Area (heavy metals, cyanide, ammonia and TPHs are potentially associated with this area (CH2MHill, 2002)). However, there is a possibility of a change in groundwater equilibria in the vicinity of this facility, after construction of the swing basin. It is noted that OneSteel, liasing with the EPA, has plans and budgets in place for the investigation and replacement of the current system with an alternative materials handling process.

Downgradient groundwater wells associated with monitoring the Mill Scale Storage and Transition Area would need to be replaced if destroyed during the excavation of the swing basin, to facilitate continued monitoring of groundwater in this area. It would be desirable to replace these wells as soon as practical after construction of the swing basin, to provide immediate evidence that no additional adverse impact to groundwater is occurring.

The potential impact on groundwater quality resulting from a reduction in the flow path length of groundwater migrating from Lot 222 in the vicinity of the proposed swing basin may be partly mitigated by the construction of a sheet pile wall. This may result in groundwater migrating from Lot 222 being forced to migrate underneath the sheet pile wall before discharging into the Hunter River, or alternatively migrating around the sheet piled wall to reach the discharge point (i.e the Hunter River).

Due to historical filling and waste residue disposal in the vicinity of the swing basin footprint, there is also the possibility of encountering TPH, BTEX, PAH, heavy metal, cyanide and phenol contamination during the excavation works. If such

contamination is uncovered during the excavation works, there could be environmental impacts from a reduction in the length of time this contaminated material takes to enter groundwater and discharge offsite. Alternatively, groundwater may be directly impacted through seeps of contamination. These issues would need to be addressed by management plans and systems that would be implemented during the construction of the swing basin.

For OneSteel areas outside the footprint of the proposed swing basin, the closure area and Kooragang Island, the flow path length of groundwater (with potentially elevated concentrations of some analytes) would be reduced as a result of the proposed extension of dredging upstream. However, this reduction would be much less significant than that potentially associated with the swing basin excavations and the Mill Scale Storage Transition Area and Pit. No additional environmental impacts of significance on the Hunter River are envisaged due to the dredging component of the proposal.

With respect to the contamination potential of the proposal from the temporary storage of excavation and dredging wastes on land, no significant adverse alteration in groundwater quality is expected. Management procedures (as detailed separately) would be implemented to protect groundwater quality from any potentially contaminated excavated material from the proposed swing basin and from dredging of potentially contaminated sediment from the Hunter River itself.

With respect to the potential for intercept of groundwater (and the subsequent licensing requirement under the *Water Act 1912*) raised in the director general requirements, no interception and extraction of groundwater through the drilling of bores is envisaged to be undertaken in the proposal. It is noted that any groundwater monitoring wells constructed to replace any destroyed wells would require licensing with the DLWC.

15.4 Recommended mitigation measures

For land south of the river, the groundwater quality within the OneSteel areas outside the footprint of the proposed swing basin and the former BHP Steelworks closure area would continue to be sampled and assessed as a component of the environmental monitoring programs already undertaken within these areas by others. For land north of the river, the groundwater quality at the KCT would also continue to be sampled and assessed as component of this site's environmental monitoring program by others. In summary, no discernable change in groundwater quality beyond the swing basin excavation area is envisaged from the proposed dredging component of the development.

As discussed, the largest potential for environmental impact with respect to the contamination of groundwater and surface water from the proposed excavated soil material (i.e. slag, steelworks refuse etc.) and the Mill Scale Transition Area is associated with the construction of the swing basin. These issues are proposed to be managed through the development of a specific management plan relating to the construction of the swing basin.

At this preliminary stage, a number of design options have been considered for the construction of the swing basin. Two possible options considered to date include a sloping rock revetment sea wall and a sheet pile wall. The optimal design would be finalised during the post-EIS detailed design phase of the project.

Given the logistical complexities associated with the excavation and construction of the swing basin and the uncertainties associated with the environmental data on potential soil contamination within the swing basin footprint, only preliminary details of a groundwater and surface water management plan can be given at this stage.

At this preliminary stage a number of environmental issues associated with the construction of the basin have been identified and are listed in Table 15.1 below.

Table 15.1 Preliminary groundwater and surface water management plan for construction of swing basin

Impact	Receptor	Risk Minimisation / Mitigation Measures
A number of groundwater monitoring wells installed within the footprint of the proposed swing basin would be destroyed as a consequence of the excavation works	Groundwater	A number of fill and estuarine groundwater monitoring wells are recommended to be installed at appropriate locations around the radius of the proposed swing basin to replace the destroyed wells, especially in the vicinity of the Mill Scale Storage and Transition Area.
		These new wells would enable continued monitoring of groundwater quality in the vicinity of the swing basin to provide indications of potential future groundwater impact issues. New data obtained could be compared to available historical data.
Due to historical filling and waste residue disposal in the vicinity of the swing basin footprint, there is also the possibility of encountering contamination such as TPH, BTEX, PAH, heavy metal, cyanide and phenol during the excavation works above and below the water table.	Groundwater and surface water	If such contamination is uncovered during the excavation works above the water table, then impacted material would be excavated as quickly as possible by the excavators operating within the basin and transferred to the fleet of transport trucks. The material would then be transported to the Closure Area for treatment. By excavating this material in a dry state this system should minimise potential contact of free phase with the groundwater table or surface water, thereby minimising the potential increase of dissolved phase concentrations of hydrocarbons.
		If such contamination is uncovered during the excavation works below the water table, then it is likely that dissolved phase hydrocarbon contamination is already occurring. It is acknowledged that disturbance of this material may increase the surface area of the potential free phase and may increase the rate of dissolution. As a result, it is proposed that should pockets of hydrocarbon impacted material be encountered, then a similar strategy as described above should be implemented, whereby excavators/dredgers quickly remove the material to lined trucks.
		In addition, a combination oil containment boom and oil skimmer pump system proposed to be installed at the bottom of the southern edge of the swing basin to capture any potential free phase product which may seep from the excavation face.
Breaching Mill Scale Transition Area and Pit and potentially releasing hydrocarbon impacted pit water.	Groundwater and surface water	Currently, there has been no discernable impact on groundwater downgradient from the Mill Scale Storage and Transition Area and Pit, even though heavy metals, cyanide, ammonia and TPHs are potentially associated with this area (CH2MHill, 2002).
		The swing basin footprint intercepts the northern edge of the unlined Pit area, which OneSteel plan to replace with a more suitable impervious concrete pad style system in the future.
		There may be a possibility of a change in groundwater equilibria in the vicinity of this facility, in addition to the mobilisation of hydrocarbon impacted surface water through the construction of the swing basin.
		The provision of the oil containment boom and oil skimmer pump system described above would be used to contain any hydrocarbon impacted entering the excavation area from the Pit area.

Table 15.1 Continued.

Impact	Receptor	Risk Minimisation / Mitigation Measures
		Downgradient groundwater wells associated with monitoring the Mill Scale Storage and Transition Area and Pit would need to be replaced as soon as practical after construction of the swing basin to provide immediate evidence that no additional impact to groundwater is occurring post construction.
Potentially contaminated surface water within the excavation area being released during removal of temporary haul road.	Surface water	Prior to the final removal of the proposed temporary haul road on the northern edge of the excavation area, an analysis of surface water quality would need to be undertaken.
		The surface water within the excavation area may be impacted by seepage of potentially contaminated groundwater or seepage originating from soil contamination.
		The provisions described previously are intended to minimise any additional impacts resulting from the excavation.
		If the surface water in this area is considered to be contaminated, then it would be treated prior to discharge, with various methods depending upon the nature of the contamination. More specific details would be provided in the Groundwater Management Plan to be developed when more data is available.
		The northern foreshore bank where the proposed temporary haul road would be constructed has been subject to many years of tidal flushing and as a result, is not expected to be contaminated.
Groundwater quality of any land where potentially contaminated excavations or dredging material is temporally stored may be impacted.	Groundwater	Contaminated excavations or dredged sediments temporarily stored prior to treatment via immobilisation or thermal desorption would be stored within a lined storage basin and a program of environmental monitoring would be implemented to ensure the integrity of the system.
		Treated material, depending upon engineered fill requirements and specific material engineering properties are envisaged to be emplaced on the Closure Area site above the water table and below the 0.5 metre separator/buffer barrier, underneath areas of very low to negligible infiltration or disposed of to sea, if environmental criteria are met. Due to the very low to extremely low permeability of the immobilised contaminated sediment and excavated material, coupled with permeability characteristics of the 0.5 metre covering barrier and the surface water drainage system, limited groundwater infiltration is expected within the Closure Area. As a result, leaching of contaminants to groundwater from immobilised or thermally desorbed sediments and excavations is highly unlikely. No environmental impact upon groundwater is hence expected.

16 Noise and vibration

This chapter provides a summary of the results of the noise impact assessment undertaken by Richard Heggie Associates as part of the EIS process. The full report is included in Appendix J. Information on the objectives and methodology for the assessment is provided, together with the results of the assessment of existing noise conditions. The potential impacts of the proposal are assessed, and mitigation measures recommended.

16.1 General

16.1.1 Objectives

The objectives of the noise and vibration assessment are to identify the potential impacts of noise and vibration from the following activities:

- Dredging of an access channel and swing basin within the proposed dredging area, including removal of soft sediments, sand, clay, weather rock and hard rock;
- Removal and treatment of contaminated dredged material from the riverbed;
- Driving of sheet piles; and
- Drilling and blasting rock prior to the removal of the hard rock from the riverbed.

The noise and vibration impact assessment has been prepared in accordance with Australian Standard AS 1055-1997 'Description and Measurement of Environmental Noise' with additional reference made to the EPA's Industrial Noise Policy, Environmental Noise Control Manual (1994), Australian and New Zealand Environment Council Committee (ANZECC) 'Technical Basis for Guidelines to Minimise Annoyance due to Blasting Overpressure and Ground Vibration' and the Director-General's requirements.

It should be noted that the noise assessment conducted was based on current information about the proposal at the time of modelling; it is expected that some negotiation with the EPA would be required prior to licensing and once the detailed engineering on the proposal has commenced. In addition, the noise impacts of any additional truck movements on the regional road network associated with the proposal have not been modelled.

16.1.2 Assessment methodology

The noise and vibration impact assessment involved the following tasks.

Establishment of noise level criteria

Project specific intrusiveness and amenity noise level criteria were determined based on existing background noise levels at the nearest potentially affected receptors. The background noise levels were measured at these receptors during daytime, evening and night-time periods.

Establishment of blasting noise and vibration criteria

Project specific blasting noise and vibration criteria were determined for various periods during day, evening and night periods in accordance with the EPA's Environmental Noise Control Manual.

Review of local meteorological conditions

Since noise reception can be altered by windy conditions and temperature inversions, typical local weather conditions were identified. This involved analysing historic wind speed data for Newcastle (obtained from the Bureau of Meteorology) and reviewing information regarding the frequency of occurrence of temperature inversions in the vicinity of the site, which is published in the Industrial Noise Policy.

Plant and equipment noise levels

Sound power levels for equipment and plant that would typically be used in the proposal were obtained from existing databases. This information was used as input data for modelling purposes.

Noise and vibration impact assessment

A computer model was used to predict noise levels at the nearest sensitive receptors, under calm and prevailing weather conditions, based on typical noise emissions from the proposed work activities. The proposed activities were divided into two operational categories for modelling purposes as follows:

- Dredging operations that included:
 - dredging, drilling and blasting at various locations within the dredging area; and
 - installation and extraction of sheet piles.
- Remediation operations that included:
 - loading of dredged sediments, at the temporary wharf, on to trucks;
 - transporting dredged sediments to the remediation area;
 - the operation of the cementation remediation facility and the thermal desorption facility;
 - operation of various plant such as front-end loaders, compactors and screw conveyors within the remediation area.

As these operational activities could be undertaken at the same time, modelling of noise emissions from the combined operations of these activities was also undertaken.

Additionally, cumulative noise levels from the proposal and the following other industrial noise sources were also modelled:

- Protech Steel Mill operations; and
- Multi Purpose Terminal construction.

Predicted noise levels obtained from the modelling were compared to the project specific noise criteria to determine the impact to the nearest sensitive receptors.

A three-dimensional digital terrain map giving all relevant topographic information was used in the modelling process. The model used this map, together with the noise source data, ground cover, shielding by barriers and/or adjacent buildings and atmospheric information to predict noise levels.

Airblast and vibration modelling and assessment

An assessment of potential airblast and vibration from underwater blasting was undertaken. Airblast data was obtained from databases of similar underwater blasting and harbour deepening projects. Blast emission site laws were calculated using statistical analysis techniques and used to model ground vibration and airblast levels at the various sensitive receptors, Tourle Street bridge and the Protech Steel Mill.

Recommended mitigation measures

Based on the assessment of potential noise, airblast and vibration impacts, mitigation and management measures were devised.

16.1.3 Terminology

Noise level descriptors

The assessed noise levels described in this section of the EIS are expressed in A-weighted decibels (dBA). This system simulates the response of the human ear, which is more sensitive to high-frequency sounds and emphasises lower frequency sounds. Hearing 'nuisance' for most people begins at noise levels of about 70 dBA, while sustained (i.e. eight hours) noise levels of 85 dBA can cause hearing damage.

Measured or predicted noise levels are expressed as statistical noise exceedance levels (LAN), which are the levels exceeded for a specific percentage (N) of the sampling period. For example, LA10 is the noise level that is exceeded for 10 percent of the sampling period.

Three main parameters are used in the measurement of environmental noise, namely LA10, LA90 and LAeq.

The LA10 and LA90 measurement parameters are statistical levels that represent the average maximum and average minimum noise levels respectively, over the measurement intervals (usually 15 minutes).

The LA10 parameter is commonly used to measure noise produced by a particular intrusive noise source since it represents the average of the loudest noise levels produced by the source.

Conversely, the LA90 level (which is commonly referred to as the background noise level) represents the noise level heard in the quieter periods during a measurement interval. The LA90 parameter is used to set the allowable noise level for new, potentially intrusive noise sources since the disturbance caused by the new source depends on how audible noise from that source is above the pre-existing noise environment, particularly during quiet periods, as represented by the LA90 level.

The LAeq parameter represents the average noise energy during a measurement period. This parameter is derived by averaging the noise levels measured over the measurement period. LAeq is important in the assessment of industrial noise impact as it closely corresponds with human perception of a changing noise environment.

The LA1 parameter (or the noise level exceeded for one percent of the time) is used during the night period to assess potential sleep arousal effects due to transient noise sources.

Time periods

For the purposes of assessment of noise levels, the following time periods are referred to in this section:

- Monday to Saturday:
 - Daytime (7.00 am to 6.00 pm);
 - Evening (6.00 pm to 10.00 pm);
 - Night-time (10.00 pm to 7.00 am);
- On Sundays and public holidays:
 - Daytime (8.00 am to 6.00 pm);
 - Evening (6.00 pm to 10.00 pm); and
 - Night-time (10.00 pm to 8.00 am).

16.2 Noise criteria for the proposal

16.2.1 Background noise levels

In order to establish the intrusiveness and amenity criteria for the proposal, existing background noise levels were obtained for the nearest potential receptors. The noise monitoring locations include:

- NM1 21 Crebert Street, Mayfield;
- NM2 52 Arthur Street, Mayfield;
- NM3 1 Arthur Street, Mayfield;
- NM4 Mayfield East Public School;
- NM5 Cnr Wye St and Avon St, Mayfield; and
- NM6 45 Simpson Circuit, Mayfield.

Noise monitoring locations are indicated in Figure 16.1

Background noise data at locations NM1 to NM4 was obtained from previous published environmental noise assessments undertaken throughout 2001 and 2002, while background noise monitoring was undertaken at locations NM5 and NM6 between 30 January 2003 and 6 February 2003.

An ARL Type EL215 environmental noise logger was used to monitor the ambient noise levels at all the residential monitoring locations. The noise logger was programmed to record statistical noise level indices continuously in 15 minute intervals, including the L_{Amax}, L_{A1}, L_{A10}, L_{A50}, L_{A90}, L_{A99}, L_{Amin} and the L_{Aeq}.

Weather data for the survey period was obtained from the Bureau of Meteorology weather station at Newcastle. Noise data during periods of any rainfall and/or wind speed in excess of 5 m/s (approximately 9 knots) were discarded in accordance with INP data exclusion methods.

A summary of the results of the background surveys is given in Table 16.1. The ambient noise levels for the surveys are presented in graphical format in Appendix J.

Table 16.1 Ambient noise levels

Location	Description	Background LA90 noise level	Measured existing LAeq noise level	Existing LAeq industrial contribution
		Rating Background Level		
NM1	Daytime	57	69	45
	Evening	53	63	45
	Night	48	61	45
NM2	Daytime	51	58	41
	Evening	50	56	41
	Night	43	54	41
NM3	Daytime	46	58	42
	Evening	46	62	42
	Night	43	51	42
NM4	Daytime	47	64	44
	Evening	45	54	44
	Night	42	50	41
NM5	Daytime	45	56	< 40
	Evening	45	51	< 40
	Night	42	47	< 40
NM6	Daytime	46	53	42
	Evening	49	52	42
	Night	46	51	42

16.2.2 Local meteorological conditions

Wind

Weather data was obtained from the Bureau of Meteorology from the closest weather station at Nobby's Head, Newcastle over a 12-month period. This data was analysed to determine the frequency of occurrence of winds up to speeds of 3 m/s for daytime and night-time in each season. The results of this analysis are contained within Appendix J.

Seasonal wind records indicate that winds (of up to 3 m/s) do not occur from any direction for more than 30 percent of the time in any season. Hence, wind is not considered to be a feature of the area and does not need to be considered in noise level predictions.

Temperature inversion

The predicted occurrence of temperature inversions in the residential receiver area is 30 to 35 percent and in the emission/source area is 40 to 45 percent. Since temperature inversions occur more than 30 percent of the time in winter months, they are considered to be a feature of the area in winter, and have been taken into account in predictive noise modelling for the site.



Figure 16.1 Noise monitoring locations

- NM1 21 Crebert Street, Mayfield
- NM2 52 Arthur Street, Mayfield
- NM3 1 Arthur Street, Mayfield
- NM4 Mayfield East Public School
- NM5 Cnr Wye Street and Avon Street, Mayfield
- NM6 45 Simpson Circuit, Mayfield

16.2.3 Criteria

The EPA provides guidelines for the assessment of noise impacts from industrial properties. The recommended assessment objectives (criteria) vary depending on the potentially affected receivers, the time of day, and the type of noise source. The criteria are described below, for the potentially affected receivers.

Intrusiveness and amenity criteria

In accordance with the Industrial Noise Policy, the intrusiveness criteria is set at a level which equals the background noise level plus 5 dB(A). Therefore the noise levels generated by the proposal should not exceed the background noise level by more than 5 dB(A).

The amenity noise (L_{Aeq}) criteria is set by considering the existing noise level from nearby industry, the indicative noise amenity area (described in the Industrial Noise Policy) and the recommended acceptable noise levels from industrial noise sources (also described in the Industrial Noise Policy).

Details regarding the establishment of these goals are contained in Appendix J. The resulting project specific noise design goals for the proposal are given in Table 16.2.

Table 16.2 Project specific noise design goals

Location	Period	Intrusiveness criterion L _{Aeq} (15minute) dBA	Amenity criterion L _{Aeq} dBA
NM1	Daytime	62	59
	Evening	58	53
	Night	53	51
NM2	Daytime	56	60
	Evening	55	50
	Night	48	42
NM3	Daytime	51	60
	Evening	51	50
	Night	48	42
NM4	Daytime	52	60
	Evening	50	50
	Night	47	43
NM5	Daytime	50	60
	Evening	50	50
	Night	47	43
NM6	Daytime	51	60
	Evening	54	50
	Night	51	42

Note:

* Intrusive and amenity criteria listed are for residences in the vicinity of the school. The school amenity levels are to be assessed directly against Industrial Noise Policy criteria for school classrooms.

The Industrial Noise Policy states that these criteria have been selected to protect at least 90 percent of the population living in the vicinity of industrial noise sources from the adverse effects of noise for at least 90 percent of the time. Provided the criteria in the Industrial Noise Policy are achieved, it is unlikely that most people would consider the resultant noise levels excessive.

In those cases where the Industrial Noise Policy project specific assessment criteria are not achieved, it does not automatically follow that all people exposed to the noise would find the noise unacceptable. In subjective terms, exceedances of the Industrial Noise Policy project specific assessment criteria can be generally described as follows:

- Negligible noise level increase <1 dBA – not noticeable by all people;
- Marginal noise level increase 1 dBA to 2 dBA – not noticeable by most people;

- Moderate noise level increase 3 dBA to 5 dBA – not noticeable by some people but may be noticeable by others; and
- Appreciable noise level increase >5 dBA – noticeable by most people.

Sleep disturbance criteria

For night-time periods, transient noise levels are also assessed. Transient noise is noise that is not constant but is generated for short periods. Such noise can cause sleep arousal (i.e. waking people). To avoid the likelihood of sleep disturbance the EPA recommends that the LA1 of the noise source under consideration should not exceed the background noise level (LA90) by more than 15 dBA when measured outside the bedroom window of the receiver. The appropriate night-time sleep disturbance criteria are set out in Table 16.3.

Table 16.3 Sleep disturbance criteria

Location	Period	Sleep disturbance criterion LA1(1minute) dBA
NM1	Night	63
NM2	Night	58
NM3	Night	58
NM4*	Night	57
NM5	Night	57
NM6	Night	61

Note: * Sleep disturbance criteria listed are for residences in the vicinity of the school.

Blasting noise criteria

The assessment of blast emission impacts outside the hours advocated by ANZECC remains according to the EPA's Environmental Noise Control Manual (1994) Chapter 154 Noise Control Guidelines – Blasting presented in Table 16.4.

Table 16.4 Evening and night-time blast emission assessment criteria

Time of Blasting	5% Exceedance ¹ Airblast Level (dB Linear)	5% Exceedance ¹ PPV Ground Vibration ² (millimetre/s)
Monday to Saturday 10.00 am – 6.00 pm	115	5
Monday to Saturday 6.00 am – 10.00 am and 6.00pm – 8.00 pm	105	2
Sunday, Public Holidays 6.00 am – 8.00 pm	95	1
Any Day 8.00 pm – 6.00 am	95	1

AS 2187.2-1993 nominates building damage assessment criteria as presented in Table 16.5.

Table 16.5 Blast Emission Building Damage Assessment Criteria (AS 2187)

Building Type	Vibration Level ¹	Airblast Level (dB re 20 μ Pa)
Sensitive (and Heritage)	PVS 5 millimetre/s	133 dB(Linear) Peak
Residential	PVS 10 millimetre/s	133 dB(Linear) Peak
Commercial/Industrial	PVS 25 millimetre/s	133 dB(Linear) Peak

Note: 1: PVS – Peak Vector Sum vibration velocity.

16.3 Impact assessment

16.3.1 Plant and equipment noise levels

The sound power levels of the major noise generating plant and equipment proposed for the proposal are given in Table 16.6. Sound power level details of acoustically significant plant and equipment proposed for the site were obtained from an RHA database of similar equipment. The details of the sound power levels used in the noise model are given in Appendix J.

Table 16.6 Equipment sound power levels

Equipment	Sound Power Levels (dBA)
Large cutter suction dredge	113
Small trailer suction dredge	98
Large trailer suction dredge	103
Backhoe dredge	111
Barge mounted excavator	107
Rock drill	119
30T Excavators	107
100T Backhoe Dredge	114
Off-road dump trucks	113
Piling rig	123
Concrete transit mixers	111
Thermal desorption equipment	111
Compactor	110
Front-end loader	108
6-Wheel trucks	108

16.3.2 Sleep disturbance noise

To predict the possible occurrence of sleep disturbance from operation of the South Arm dredging at night the typical LA1 levels of acoustically significant plant were measured during their operation. These levels were used as input to the acoustic model for the site and predictions were made at surrounding residences under adverse weather conditions at night. A summary of the predicted noise levels at the most affected residential locations surrounding the site are given in Table 16.7.

Table 16.7 Predicted sleep disturbance noise levels

Location	Period	Predicted noise level LAeq(1minute) dBA	Sleep disturbance design goal dBA
NM1	Night	51	63
NM2	Night	48	58
NM3	Night	50	58
NM4*	Night	51	57
NM5	Night	44	57
NM6	Night	47	61

Note: * Sleep disturbance criteria listed are for residences in the vicinity of the school.

The modelling results show that predicted maximum noise level at the sensitive receptors during night-time periods would be below the sleep disturbance noise criteria.

16.3.3 Noise from dredging operations

Noise from the proposal was modelled at the nearest affected residential locations surrounding the site for daytime, evening and night-time operations. Each stage of the proposal was assessed and the three worst-case operational stages have been used. The stages used in the assessment are as follows:

- Months 2 to 3: Sheet piling (daytime only), dredge access channel, remove fill & sand in the swing basin;
- Months 4 to 6: Dredge access channel, remove fill and sand in the swing basin, remove silt in channel;
- Months 14 to 15: Extract piles (daytime only), remove silt/ sand in channel, remove fill and sand in the swing basin; and
- Months 29 to 31: Drill and blast operations.

Noise contours were produced for the proposal and are contained in Appendix J. The noise contours represent the following:

- Worst case dredging operations;
- Activities associated with drilling and removal of rock; and
- Worst case drilling under temperature inversion conditions.

Predicted noise levels under calm weather conditions

A summary of the predicted noise levels under calm weather conditions at the most potentially affected residences for each operational stage of the development is presented in Table 16.8.

Table 16.8 Predicted dredging operational noise levels under calm weather conditions

Location	Description	Predicted Noise Level LAeq (15 minute) (dBA)				Project Specific Design Goal (dBA)	
		Dredge Access Channel and Sheet Piling Months 2-3	Dredge Access Channel and swing basin Months 4-6	Dredge and Extract Piles Months 14-15	Drill & Blast Months 29-31	Intrusiveness Criterion LAeq (15minute)	Amenity Criterion LAeq
NM1	Daytime	47*	39	46*	38	62	59
	Evening	38	39	31	38	58	53
	Night	38	39	31	38	53	51
NM2	Daytime	46*	35	46*	38	56	60
	Evening	34	35	25	38	55	50
	Night	34	35	25	38	48	42
NM3	Daytime	46*	39	46*	37	51	60
	Evening	38	39	34	37	51	50
	Night	38	39	34	37	48	42
NM4 ¹	Daytime	48*	39	47*	39	52	60
	Evening	38	39	34	39	50	50
	Night	38	39	34	39	47	43
NM4 ²	Daytime	38**	39	37**	39	N/A	40*
NM5	Daytime	38*	29	38*	29	50	60
	Evening	29	29	24	29	50	50
	Night	29	29	24	29	47	43
NM6	Daytime	38*	32	40*	29	51	60
	Evening	35	32	34	29	54	50
	Night	35	32	34	29	51	42

Notes:

* Denotes a 5 dBA penalty applied for impulsive noise character. Sheet piling not considered in evening and night-time calculations.

¹ Residences adjacent to Mayfield East Public School.² Mayfield East Public School.

* Represents internal noise level. The internal noise level was assumed to be 10dBA less than the predicted external noise level.

Predicted noise levels under temperature inversion weather conditions

Noise levels were modelled under temperature inversion weather condition at all residences surrounding the proposed dredging area. Noise modelling was conducted for prevailing atmospheric conditions that occur during winter nights. Contours of predicted noise levels were drawn and are presented in Appendix J.

Predicted noise levels at the potentially worst affected residences are summarised in Table 16.9.

Table 16.9 Predicted dredging operational noise levels under calm weather conditions

Location	Description	Predicted Noise Level LAeq (15 minute) (dBA)				Project Specific Design Goal (dBA)	
		Dredge Access Channel and Months 2-3	Dredge Access Channel and swing basin Months 4-6	Dredge Months 14-15	Drill Months 29-31	Intrusiveness Criterion LAeq (15minute)	Amenity Criterion LAeq
NM1	Night	45	43	38	41	53	51
NM2	Night	42	40	37	40	48	42
NM3	Night	43	42	41	40	48	42
NM4	Night	45	43	41	42	47	43
NM5	Night	38	35	33	33	47	43
NM6	Night	40	41	40	37	51	42

Note: Sheet piling not considered in evening and night time calculations.

Summary of impacts from dredging operations

Based on the results of the modelling of dredging operational noise under calm weather conditions (Table 16.8), it is concluded that all predicted noise levels at the nearest sensitive receptors would be below the site-specific noise criteria.

The results of the modelling of dredging operational noise under temperature inversion weather conditions show that all predicted noise levels at the nearest sensitive receptors would be below the site specific noise criteria, except at North Arthur Street, Mayfield and Mayfield East Public School (Table 16.9). At these locations, the amenity criteria are exceeded by 1 dBA and by 2 dBA respectively.

The most significant contribution to noise emissions from the proposal under temperature inversion conditions would be from the 100 tonne backhoe dredger and large cutter suction dredge, when located in the area between the swing basin and eastern extent of the dredge pattern, and rock drilling operations.

However, it should be noted that where an LAeq(15 minute) intrusive noise level exceeds the amenity criteria by 1 to 2 dBA, it is unlikely that any change in noise level would be detectable by the residents of the area. It is likely that the noise level of the contributing noise source would be at or below the background noise level during each specific period.

16.3.4 Noise from remediation activities

Predicted noise levels under calm weather conditions

Noise from the activities involved in the removal of contaminated materials and remediation activities have been predicted independently to those of the dredging and blasting operations at the nearest affected residential locations surrounding the site, during the daytime period from 7.00 am to 6.00 pm.

A summary of the predicted noise levels at the most potentially affected residences for remediation stages of the development are presented in Table 16.10.

Table 16.10 Predicted remediation work noise levels under calm weather conditions

Location	Description	Predicted Noise Level LAeq (15 minute) (dBA)	Project Specific Design Goal (dBA)	
		Remediation Works	Intrusiveness Criterion LAeq (15minute)	Amenity Criterion LAeq
NM1	Daytime	47	62	59
NM2	Daytime	30	56	60
NM3	Daytime	36	51	60
NM4 ^{1*}	Daytime	43	52	60
NM4 ²	Daytime	33*	N/A	40*
NM5*	Daytime	30	50	60
NM6	Daytime	22	51	60

Notes:

* Intrusive and amenity criteria listed are for residences in the vicinity of the school. The school amenity levels are to be assessed directly against Industrial Noise Policy criteria for school classrooms.

¹ Residences adjacent to Mayfield East Public School.

² Mayfield East Public School.

* Internal noise level.

Predicted noise levels under adverse weather conditions

Remediation activities would be carried out between the hours of 7.00 am and 6.00 pm; therefore, an assessment of prevailing weather conditions that occur during night-time, is not required.

Summary of impacts from remediation activities

The results of the modelling of noise from remediation activities show all predicted noise levels at the sensitive receptors would be below the project specific noise criteria (Table 16.10).

16.3.5 Noise from combined dredging and remediation operations

There are stages of the proposal, months 7 to 10 and 11 to 12, where the remediation works and dredging operations occur simultaneously. A study of the combined effect of these two operations has been conducted for the daytime period only, as remediation work is not being carried out during the evening and night-time periods.

A summary of the predicted noise levels at the most potentially affected residences for the combined effect of dredging and remediation operational stages of the development is presented in Table 16.11 and Table 16.12.

Table 16.11 Predicted combined noise levels during 7 months to 10 under calm weather conditions

Location	Description	Predicted Noise Level LAeq (15 minute) (dBA)			Project Specific Design Goal (dBA)	
		Dredging Months 7-10	Remediation Work Months 7-10	Combined Impact Months 7-10	Intrusiveness Criterion LAeq (15minute)	Amenity Criterion LAeq
NM1	Daytime	34	47	48	62	59
NM2	Daytime	29	30	33	56	60
NM3	Daytime	35	36	39	51	60
NM4 ^{1*}	Daytime	35	43	44	52	60
NM4 ²	Daytime	25*	33*	34*	N/A	40*
NM5	Daytime	27	30	33	50	60
NM6	Daytime	34	22	34	51	60

Notes:

* Intrusive and amenity criteria listed are for residences in the vicinity of the school. The school amenity levels are to be assessed directly against Industrial Noise Policy criteria for school classrooms.

¹ Residences adjacent to Mayfield East Public School.² Mayfield East Public School.

* Internal noise level.

Table 16.12 Predicted combined noise levels during months 11 to 12 under calm weather conditions

Location	Description	Predicted Noise Level LAeq (15 minute) (dBA)			Project Specific Design Goal (dBA)	
		Dredging Months 11-12	Remediation Work Months 11-12	Combined Impact Months 11-12	Intrusiveness Criterion LAeq (15minute)	Amenity Criterion LAeq
NM1	Daytime	36	48	48	62	59
NM2	Daytime	33	32	36	56	60
NM3	Daytime	36	37	40	51	60
NM4 ^{1*}	Daytime	37	44	45	52	60
NM4 ²	Daytime	27*	34*	35*	N/A	40*
NM5	Daytime	27	31	33	50	60
NM6	Daytime	35	23	35	51	60

Notes:

* Intrusive and amenity criteria listed are for residences in the vicinity of the school. The school amenity levels are to be assessed directly against Industrial Noise Policy criteria for school classrooms.

¹ Residences adjacent to Mayfield East Public School.² Mayfield East Public School.

* Internal noise level.

Summary of impacts from combined dredging and remediation operations

The results of the modelling of the combined dredging and remediation operational noise show that, during these periods of combined operation, predicted noise levels at the sensitive receptors are all below the project specific noise criteria (Table 16.11 and Table 16.12). This is because the major noise contributing operations associated with the dredging operation, that is drilling and sheet piling, would not occur on the same time-line as the remediation phase.

16.3.6 Cumulative noise impacts

The potential for the simultaneous operation of adjoining industrial developments to exceed the acceptable noise amenity criteria can be assessed as a worst-case scenario by adding the predicted intrusive noise levels from the proposal and the approved intrusive noise limits from the Protech Steel Mill and the construction phase of the Multi-purpose Terminal. The cumulative intrusive level is then adjusted to the equivalent amenity level for comparison with the criteria presented in Table 7.1. In order to prepare the indicative assessment the following assumptions are necessary:

- The LAeq(15minute) emission level is approximately 3 dBA less than the LA10(15minute) emission level;
- The individual LAeq(15minute) emission limits from each development are simultaneously additive to give a total LAeq(15minute) intrusive level; and
- The cumulative LAeq(period) amenity level is approximately 3 dBA less than the total LAeq(15minute) intrusive level.

It should be noted that this is clearly a worst-case assessment, as it assumes that all industries simultaneously emit their maximum noise emission to a common receiver locality during both calm and adverse weather conditions.

The indicative cumulative noise amenity levels during calm and adverse weather conditions are presented in Table 16.13 and Table 16.14 for the six assessment locations.

Table 16.13 Predicted cumulative noise levels under calm weather conditions

Location	Period	Intrusive Noise Level LAeq(15 minute) (dBA)				Amenity Noise Level LAeq(period) (dBA)	
		South Arm Dredging	Protech	Multi-purpose Terminal	Cumulative Intrusive Level	Cumulative Amenity Level	Amenity Criterion LAeq
NM1	Daytime	47	39	53	54	51	59
	Evening	39	39	N/A	42	39	53
	Night	39	39	N/A	42	39	51
NM2	Daytime	46	39	52	53	50	60
	Evening	38	39	N/A	42	39	50
	Night	38	39	N/A	42	39	42
NM3	Daytime	46	39	48	50	47	60
	Evening	39	39	N/A	42	39	50
	Night	39	39	N/A	42	39	42
NM4*	Daytime	48	39	44	50	47	60
	Evening	39	39	N/A	42	39	50
	Night	39	39	N/A	42	39	43
NM4 ²	Daytime	38*	29*	34*	40*	37*	40*
NM5	Daytime	38	32	52	52	49	60
	Evening	29	32	N/A	34	31	50
	Night	29	32	N/A	34	31	43

Table 16.13 Continued.

Location	Period	Intrusive Noise Level $L_{Aeq}(15 \text{ minute})$ (dBA)				Amenity Noise Level $L_{Aeq}(\text{period})$ (dBA)	
		South Arm Dredging	Protech	Multi-purpose Terminal	Cumulative Intrusive Level	Cumulative Amenity Level	Amenity Criterion L_{Aeq}
NM6	Daytime	38	32	N/A	39	36	60
	Evening	35	32	N/A	36	33	50
	Night	35	32	N/A	36	33	42

Notes:

* Denotes a 5 dBA penalty applied for impulsive noise character. Sheet piling not considered in evening and night-time calculations.

1 Residences adjacent to Mayfield East Public School.

2 Mayfield East Public School.

* Represents internal noise level. The internal noise level was assumed to be 10dBA less than the predicted external noise level.

Table 16.14 Predicted cumulative noise levels under adverse weather conditions.

Location	Period	Intrusive Noise Level $L_{Aeq}(15 \text{ minute})$ (dBA)				Amenity Noise Level $L_{Aeq}(\text{period})$ (dBA)	
		South Arm Dredging	Protech	Multi-purpose Terminal	Cumulative Intrusive Level	Cumulative Amenity Level	Amenity Criterion L_{Aeq}
NM1	Night	45	39	N/A	46	43	51
NM2	Night	42	39	N/A	44	41	42
NM3	Night	42	39	N/A	44	41	42
NM4	Night	43	39	N/A	44	41	43
NM5	Night	36	32	N/A	37	34	43
NM6	Night	40	32	N/A	41	38	42

Summary of impacts from cumulative operations

The results of the modelling of cumulative noise levels from the proposal, the Protech Steel Mill and the construction of the Multi-purpose Terminal show all predicted cumulative noise levels at the nearest sensitive receptors to be below the project specific noise criteria (Table 16.13 and Table 16.14).

16.3.7 Impacts of road transport

Approximately 280,000 m³ of remediated material and 300,000 m³ of inert material needs to be removed from the proposed site. The location to which this material is to be transported has not yet been fully resolved. Noise impacts of road transport were therefore assessed for the worst-case scenario, where all material is transported to Kooragang Island and both treated and inert materials are transported concurrently at certain times.

The estimated traffic movements for the duration of the project are shown in Table 16.15. The worst-case scenario would generate an additional 758 vehicles per day, representing a 3.0 % increase in traffic for Tourle St and Cormorant Drive and a 1.9 % increase in traffic for Industrial Drive.

Table 16.15 Estimated traffic movements

Activity Type	Estimated vehicle movements per day
Staff arriving on site & leaving site	90
Disposal of treated waste material	200
Disposal of inert waste material	200
Rock deliveries	180
Cementitious products	32
Delivery of dredging pipes	40
Delivery/ removal of sheet piles	6
Other	10
Total	758

The increase in noise level due to these additional traffic movements was calculated to be 0.1dB LAeq(15hour) and 0.1dB LAeq(9hour). This impact is considered negligible and would not be detectable by receivers along the roadway.

16.3.8 Impacts of blasting

Ground vibration and air-blast levels as a result of blasting were predicted using a database derived from similar underwater and harbour deepening blasting operations. These were based upon an explosive charge of 30 kg per core, which is at the upper end of the charge expected for this proposal.

The results shown in Table 16.16 indicate that predicted air-blast and ground vibration levels would meet the EPA guidelines for residences and other sensitive structures surrounding the proposal site.

Table 16.16 Predicted blasting levels South Arm dredging

Residential Location	Predicted Mine Blasting Level	
	Air-blast dB Linear	Ground Vibration millimetre/s
NM1	105.4	0.8
NM2	104.8	0.7
NM3	100.9	0.6
NM4	102.5	0.6
NM5	101.7	0.6
NM6	100.8	0.6
Tourle Street bridge	103.8	0.7
OneSteel	124.8	2.2

Note: Average MIC of 30 kg used for predictive purposes

16.3.9 Multi-user port and transport corridor noise impacts

As part of this EIS, Environmental Resources Management Australia Pty Ltd (ERM) provided a noise assessment for the booster pump stations that would service the delivery of clean sand to the Tomago industrial area.

The onshore discharge pipeline for the dredging of the shipping channel may follow several routes. It should be noted that a westerly route has been chosen for the purposes of undertaking the noise assessment as it represents a worst-case scenario in terms of noise.

Pipeline description

The pipeline would be above ground, and would generally consist of 800 millimetre diameter pipes with flange joints every 12 metres. The pipeline would be maintained by a dedicated crew, using a four-wheel drive vehicle and either a small mobile crane or an excavator (for lifting).

As a result of the length of the proposed pipeline for a westerly route (which would result in pressure loss), two booster stations would be required to augment the pumping capability of the dredge. For the preferred route, the booster stations would be located at approximately the locations shown in Table 16.17.

Table 16.17 Pipeline booster station locations

Identification	Easting (AMG)	Northing (AMG)
Booster Station 1	366671	1362826
Booster Station 2	367133	1364883

Note: Locations are approximate only.

Each booster station would consist of a 2500 kW pump driven by a diesel engine. No fan cooling systems would be required. The entire booster station would be housed in a sheet steel structure.

Assumptions

The following assumptions were made in terms of the sound output of the booster pump stations:

- The sound emission data for a Waukesha 12V-AT27GL (V12 natural gas fuelled engine) was used. This is expected to be appropriate based approximate on power output required from the engine;
- The enclosure was assumed to be constructed of 22 gauge galvanised steel sheet (thickness 0.55 millimetre). This is one of the thinnest of the commonly available sheet steels and subsequently has a lower sound transmission loss;
- Regenerated noise as a result of ground vibration passing into the structure of the booster station would be insignificant compared to airborne noise passing through the walls. That is, the equipment would be appropriately mounted for vibration isolation; and
- The enclosure was assumed to have dimensions of 10 metres by 7 metres by 5 metres.

Predicted noise levels

Single point and contour calculations were performed using an environmental noise model and digital topographical data. For consistency, the prevailing weather conditions determined by Richard Heggie and Associates and reported in their report 'Noise and Blasting Assessment for Proposed Extension of Shipping Channels, Port of Newcastle' were used.

The single point results for the Booster Stations alone are shown in Table 16.18. Note that the six receiver locations are the same as those modelled by Richard Heggie and Associates for the dredging assessment and the noise criteria for those locations have also been drawn directly from that assessment. The results indicate that noise from the booster station is insignificant at receptors and would not cause total noise levels as a result of the proposal to exceed the stated criteria.

Table 16.18 Predicted noise levels at modelled receiver locations

Location	Predicted noise level Leq dB(A)		Criteria dB(A)
	Calm weather	3°C/100 metres	
Crebert Street, Mayfield	7	7	51
North Arthur Street, Mayfield	11	11	42
South Arthur Street, Mayfield	10	10	42
Mayfield East Public School	11	11	43
Vine St, Mayfield	11	11	43
Simpson Close, Mayfield	13	13	42

Note: The predicted noise levels include a 5dB penalty for low frequency content.

Summary of impacts from the pipeline

The results of the assessment show that noise from the booster station is not expected to exceed the project specific noise limits at any residential location. Additionally, when considered in combination with the results of the assessment from the dredging performed by Richard Heggie and Associates, no extra cumulative noise effects are anticipated.

Construction of the pipeline is likely to be restricted to a small crew with a truck (carrying pipes) and a small mobile crane. Additionally, it is expected that construction of the pipeline would be completed within four weeks. Given the distance from the pipeline alignment to the nearest residential location (more than 500 metres) no construction noise impacts are anticipated.

16.4 Summary and recommended mitigation measures

Subject to implementation of the following mitigation measures, Predicted noise emission levels would comply with the EPA project specific goals under calm weather conditions at all residential locations during daytime, evening and night-time operations.

It was predicted that intrusive noise levels under adverse weather conditions (at night during winter months) would marginally exceed the amenity criterion by 1 dBA at residences at the southern end of Arthur St (adjacent to NM3) and by 2 dBA at residences in the vicinity of Mayfield East Primary School (adjacent to NM4).

The timing and type of night-time activities would need be carefully considered at the detailed design stage of the proposal. The project EMPs would include a noise management strategy, which would consider the methodology proposed by the construction contractor and the relative phasing of different activities in different areas. The timing of construction activities with respect to rise and fall of background noise levels would serve as a primary means by which impacts are managed.

It is recommended that the following measures be implemented:

- Sheet piling should only be performed during the daytime, between 7.00 am and 6.00 pm;
- Remediation activities should only be performed during the daytime where possible;
- Remediation activities and drilling should not occur simultaneously where possible;
- Remediation activities and sheet piling should not occur simultaneously where possible;
- Sirens and alarms on all equipment should be adjusted so as not to cause disturbance at surrounding residential receivers during night-time operation;
- In order to reduce the impact of ground vibration and airblast, blasting should only be conducted between 6.00 am and 8.00 pm from Mondays to Saturdays;
- The use of quietest plant available regularly maintained and fitted with appropriate mufflers. In particular, consideration should be given to the use of bored rather than driven piling where possible;
- Minimising the potential for impact type noise events during night time periods;
- Notification of residents prior to noisy or vibration generating activities; and
- Noise monitoring to ensure best practice is being implemented.

It is possible that some activities may be required beyond the EPA recommended construction hours. Contact with the EPA, Council and residents would be undertaken prior to these activities.

17 Air quality and odour

This chapter provides a summary of the air quality impact assessment undertaken for the EIS. This includes the results of the odour impact assessment undertaken by the Environmental Odour Laboratory at the University of NSW (the full report is included in Appendix K). Additional air quality issues considered include dust emissions during land transfer of dredged/excavated sediments, and air emissions from the thermal desorption use. Information on the existing environment is provided, the potential impacts of the proposal are assessed, and mitigation and management mechanisms described.

17.1 Overview

An air quality impact assessment was undertaken as part of this EIS. The primary purpose of the air quality impact assessment was to identify any potential air quality impacts that could be caused by the proposal, and to suggest mitigation and management measures that would either eliminate or minimise these potential impacts.

The scope of the air quality impact assessment included:

- a detailed odour impact assessment, which includes determining the impacts of odours that would be emitted from the contaminated dredged material during the proposed dredging (by both mechanical and cutter suction methods), transport, storage and sediment treatment operations (both cement stabilisation and thermal desorption);
- a discussion of the potential impacts and mitigation measures associated with dust generation during the land transfer of dredged sediments from the river to the temporary storage facilities; and
- analysis and discussion of the performance of the proposed thermal desorption unit, to ensure that the potential impacts associated with air emissions from the unit are negligible.

17.2 Odour impact assessment

17.2.1 Odour targets

The *Protection of the Environment Operations Act 1997* (POEO Act) and the *Draft Policy 'Assessment and Management of Odour from Stationary Sources In NSW'* (Draft Policy) establish odour emission targets for preventing and controlling odour in NSW. Schedule 1 of the POEO Act lists the proposal as a scheduled activity as discussed elsewhere in the EIS. Under Section 129 of the POEO Act, emission of an 'offensive odour' from a scheduled premises is prohibited.

As a means of predicting and assessing the impact of odour, the Draft Policy establishes two types of criteria as follows:

- Ground level concentration criteria for individual odorous pollutants - These criteria establishing what is happening at ground level for an individual pollutant and are based on published odour thresholds or toxicity thresholds, whichever is more stringent.

- Odour performance criteria for complex mixtures of pollutants – These criteria depend upon the surrounding population density and should not be exceeded at the nearest sensitive receptor (both existing and any likely future sensitive receptors).

The pollutant that would be primarily responsible for emitting odours from the dredge sediments would be naphthalene. A ground level concentration criterion has not been established for naphthalene and, therefore, the odour performance criteria have been adopted as a measure of the potential impacts of odour from the proposal.

Odour performance criteria guide decisions on odour management but are not specifically intended to achieve 'no odour'. The detectability of an odour relates to the minimum concentration that produces an olfactory sensation. This point is called the 'odour threshold' and is defined as one odour unit per cubic metre (OU/m³). Therefore, an odour criterion of less than 1 OU/m³ would theoretically result in no odour impact being experienced.

Experience gained through odour assessments for proposed and existing facilities in NSW indicates that an odour performance criterion of 7 OU/m³ is likely to represent the level below which 'offensive' odours should not occur (for an individual with a 'standard sensitivity' to odours). Therefore, the Draft Policy recommends that, as a design criteria, no individual be exposed to ambient odour levels of greater than 7 OU/m³.

However, the Draft Policy suggests that where odour may be experienced in populated areas, more stringent criteria are necessary to account for individuals with a heightened response to odours, cumulative impacts of odours and/or adverse meteorological conditions that do not favour the dispersion of emitted odours. Where a number of these factors could simultaneously contribute to making an odour 'offensive', an odour criterion of 2 OU/m³ at the nearest sensitive receptor (existing or any likely future receptor) is more appropriate.

Therefore, when modelling the dispersion of odours in the vicinity of the proposal, significant odour impacts would be expected at sensitive receptors if the maximum hourly average ground level concentration would be greater than 2 OU/m³ for more than one percent of the hours in the year.

17.2.2 Existing environment

There are a number of industrial sites located in the vicinity of the study area, and local air quality is likely to be already impacted by activities undertaken on these industrial sites. In addition transport activities on the regional and local road networks also contribute to a reduction in air quality. Activities undertaken in the vicinity of the South Arm are described in Chapter 10. Activities at nearby industrial sites include:

- coal loading;
- steel and scrap metal processing;
- cement production;
- LPG storage and distribution;
- liquid waste management;
- oilseed processing;
- carbon dioxide production;
- grain handling; and
- rail stabling activities.

The closure area is currently subject to demolition and soil remediation works and these may also contribute to the local air quality impacts in the short term.

The nearest residential community is the suburb of Mayfield, located approximately two kilometres south of the river. The suburb of Stockton is located approximately four kilometres to the east.

17.2.3 Methodology

Overview

The following methods were used to determine the potential odour impacts at the closest sensitive receptors, with the aim of optimising the process chosen:

- All potential odour sources during the proposed dredging, transport, storage and treatment of the dredged materials were identified and an estimate of their approximate emission areas was made;
- Eight sensitive receptors to potential odour impacts were identified;
- Field simulation exercises were undertaken, including mechanical dredging and sediment storage, to enable odour generation at the odour emission sources and for gas samples for subsequent composition analysis to be taken;
- Odour dispersion modelling was undertaken for the different methods of dredging and treatment of the materials, to predict the ground level concentration of odours at eight sensitive receptors; and
- Odour mitigation measures were trialled to minimise the potential impacts of odour emissions.

Potential odour sources

Odours could potentially be emitted by:

- the dredging grab/bucket;
- the interface between the water surface and air within the dredging zone contained within the turbidity curtain;
- the transfer barge for sediment transport, which would either be an open barge or a covered barge fitted with a loading chute;
- trucks that transfer dredged sediment from the barge to the temporary storage facility or that transfer contaminated OneSteel materials to the treatment facilities;
- the temporary storage facility used for dredged sediments and contaminated OneSteel materials prior to treatment;
- geobags used for dewatering of dredged sediments prior to their treatment by thermal desorption or cement stabilisation; or
- the treatment facilities.

Simulation exercises

In order to collect accurate data to determine potential odour impacts, field simulation exercises were undertaken that closely resemble the proposed dredging, transportation and sediment treatment operations. The field simulation exercises undertaken included:

- mechanical dredging to simulate odour emissions conditions from the dredge, the grab bucket and the water surface-air interface within the turbidity curtain; and

- storage of dredged sediment in tanks to simulate odour emission conditions from sediment in the barge, the transfer trucks, the temporary storage facility, the geobags and the cementation treatment facility.

Photos of the simulation exercises are provided in plates 17.1 to 17.5.



Plate 17.1 Dredging simulation process



Plate 17.2 Dredging material filling to the container

There is insufficient information available on the possible contaminants in the OneSteel fill to allow any simulations to be undertaken. However, initial indications are that odour should not be a major concern. The management plan for excavation of the OneSteel site would need to address odour issues. Contingency plans would need to be made including possible use of odour suppressants once excavation starts.

Dredging simulation

The proposed mechanical dredging method was simulated on site. This method has the potential to generate odours as dredged sediments are exposed to air during the excavation and loading activities.

Simulation of the mechanical dredging methodology involved using a barge-mounted excavator fitted with a grab bucket to excavate sediments from the proposed dredging area. The excavation was undertaken within a turbidity curtain and samples of sediment with high, medium and low contaminant concentrations were collected and placed in separate containers. The dredging was undertaken over two days.



Plate 17.3 Volatile organic compounds and polycyclic hydrocarbons, sampling from the odour pen with geobag



Plate 17.4 Hydrogen sulphate sampling from the odour pen with geobag



Plate 17.5 Odour sampling from the bucket on the dredging barge

Samples to be tested for odour were collected during the simulation dredging from the water-air interface within the turbidity curtain using a portable floating wind tunnel and from freshly dredged material in the grab bucket using a isolation chamber system.

Sediment storage and treatment simulation

Dredged sediment samples were placed in open tanks to simulate likely odour emissions from the various sediment transport methods, and the dewatering and treatment steps following excavation.

Dredged sediments with each of the contaminant concentrations (low, medium and high) and the varying moisture contents, simulating sediment material

generated by mechanical (drier) and cutter suction (wetter) dredging methods, were placed in the open tanks and odours were sampled using the isolation chamber system.

Odorous gas sampling and analysis

During the field simulation exercises, odour generation rates (in odour units per square meter of surface area e.g. OU/m²) from the various odour sources were measured. Odour generation measurements were made using one of the following in situ methodologies:

- a portable wind tunnel sampling system; and
- an isolated chamber sampling system.

Odorous gas samples were also collected for subsequent composition testing. These samples and analyses were undertaken in accordance the NSW EPA *Approved Methods for the Sampling and Analysis of Air Pollutants in New South Wales*. Hydrogen sulphide concentrations were determined using an HACH spectrophotometer, a method that is approved by the NSW EPA.

Odour dispersion modelling

The computer program Ausplume Atmospheric Dispersion Model Version 5.4 was used to predict ground level odour concentrations at the sensitive receptors located close to the proposed work sites.

Using the odour emission rates that were calculated from the field simulation exercises, the Ausplume program combined the odour emissions from each of the following to predict odour concentrations at the various receptors:

- a barge loaded on the river;
- a barge unloaded at the temporary unloading wharf;
- water surface-air interface within the turbidity curtain;
- transfer trucks;
- temporary storage facility; and
- dewatering geobags.

To account for the various dredging methods, dredging locations within the dredging area and the temporary storage and sediment treatment methodologies being proposed in this EIS, eight different operational scenarios were modelled. The scenarios modelled are summarised in Table 17.1.

Table 17.1 Modelled operational scenarios

Scenario	Dredging site on river	Temporary storage and cementation treatment facility (covered or open)	Barge (covered or open)	Dewatering with Geobags
Scenario 1	Site 1	Open	Open	No
Scenario 2	Site 1	Open	Covered	No
Scenario 3	Site 2	Open	Open	No
Scenario 4	Site 2	Open	Covered	No
Scenario 5	Site 1	Open	Open	Yes
Scenario 6	Site 1	Open	Covered	Yes
Scenario 7	Site 2	Open	Open	Yes
Scenario 8	Site 2	Open	Covered	Yes

The results of the scenario modelling are presented in the form of contours for a one hour average concentration of 2 OU/m³ as a 99th percentile (see Figures 17.1 to 17.8).

17.2.4 Assessment of potential odour impacts

Results of field simulation measurements

Odour emission rates

Based on the odour generation measurements obtained during the field simulation exercises, odour emission rates per second per square metre of area (i.e. OU/s/m²) were calculated for each odour source. Odour emission rates were as follows:

- Open area on the deck of the dredge barge: 3.357 OU/s/m²;
- Dredging water surface within the turbidity curtain: 3.357 OU/s/m²;
- Loading/unloading barge at the temporary wharf: 3.357 OU/s/m²;
- Transporting truck: 3.357 OU/s/m²;
- Cement stabilisation area: 0.7166 OU/s/m²; and
- Geobag dewatering area: 0.504 OU/s/m².

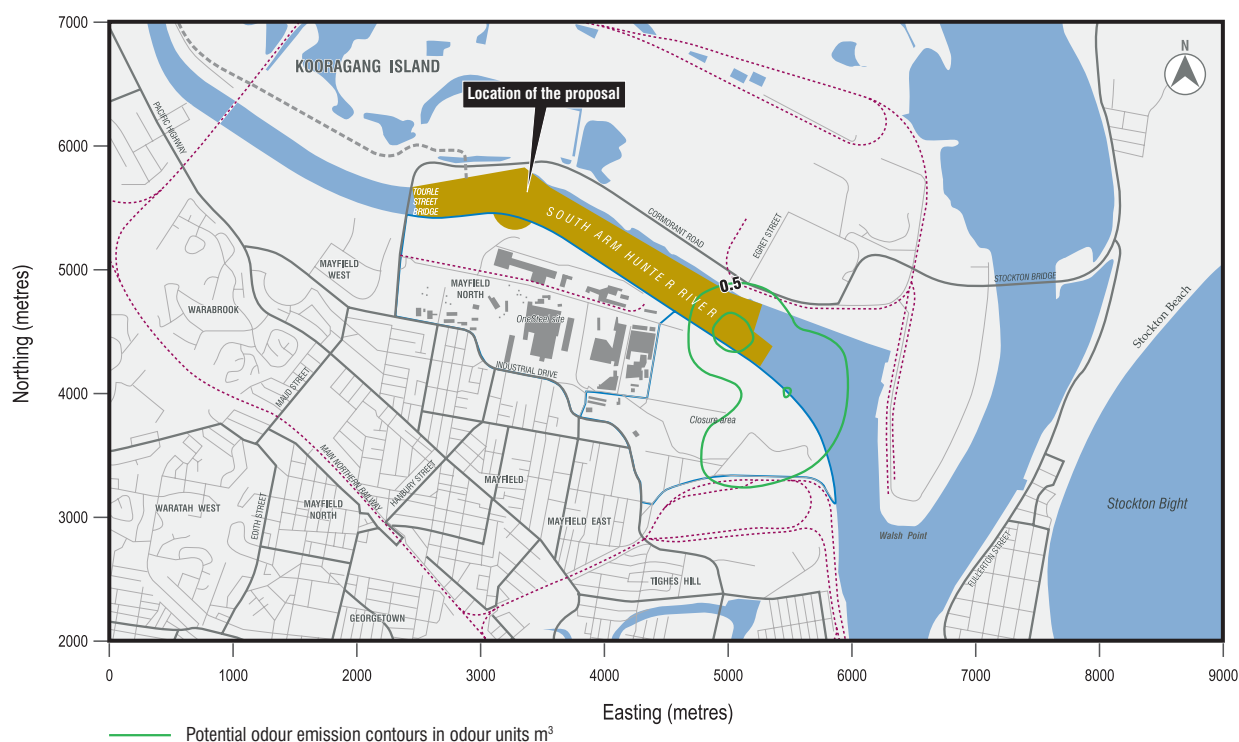


Figure 17.1 Modelling result for dredging site 1, open barge without geobag

Source: UNSW Odour Unit

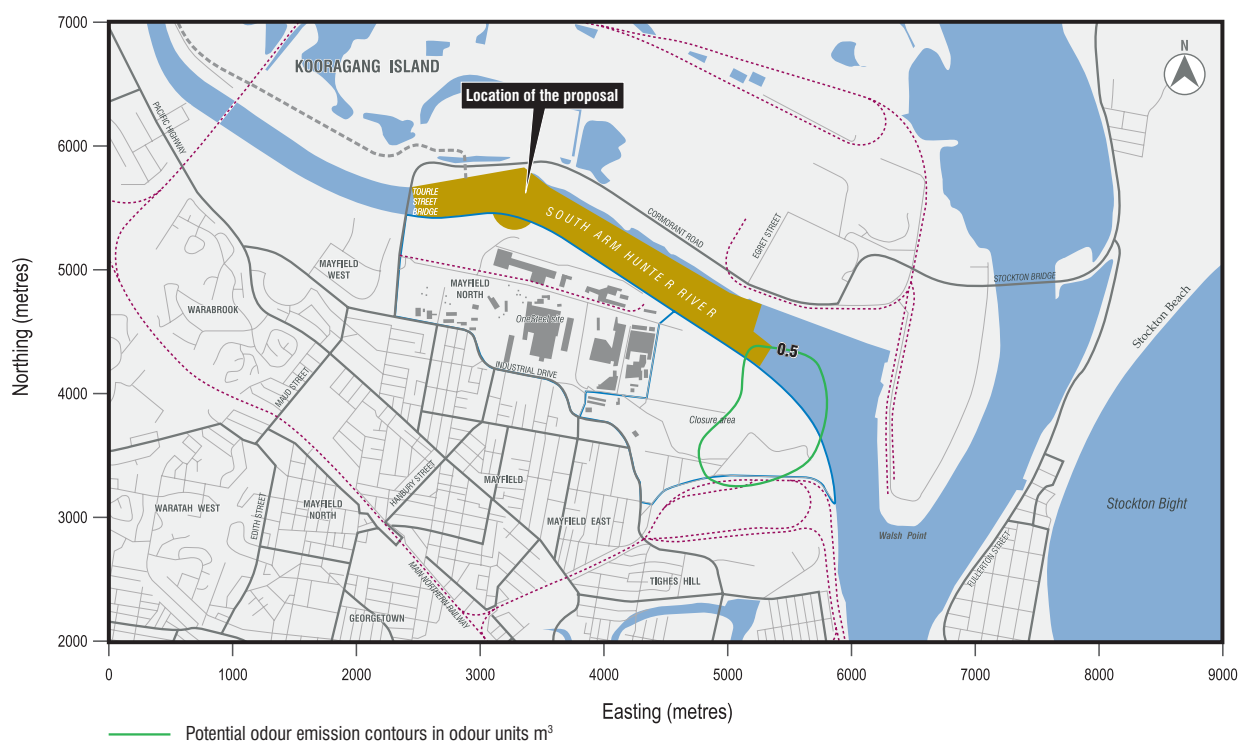


Figure 17.2 Modelling result for dredging site 1, covered barge without geobag

Source: UNSW Odour Unit

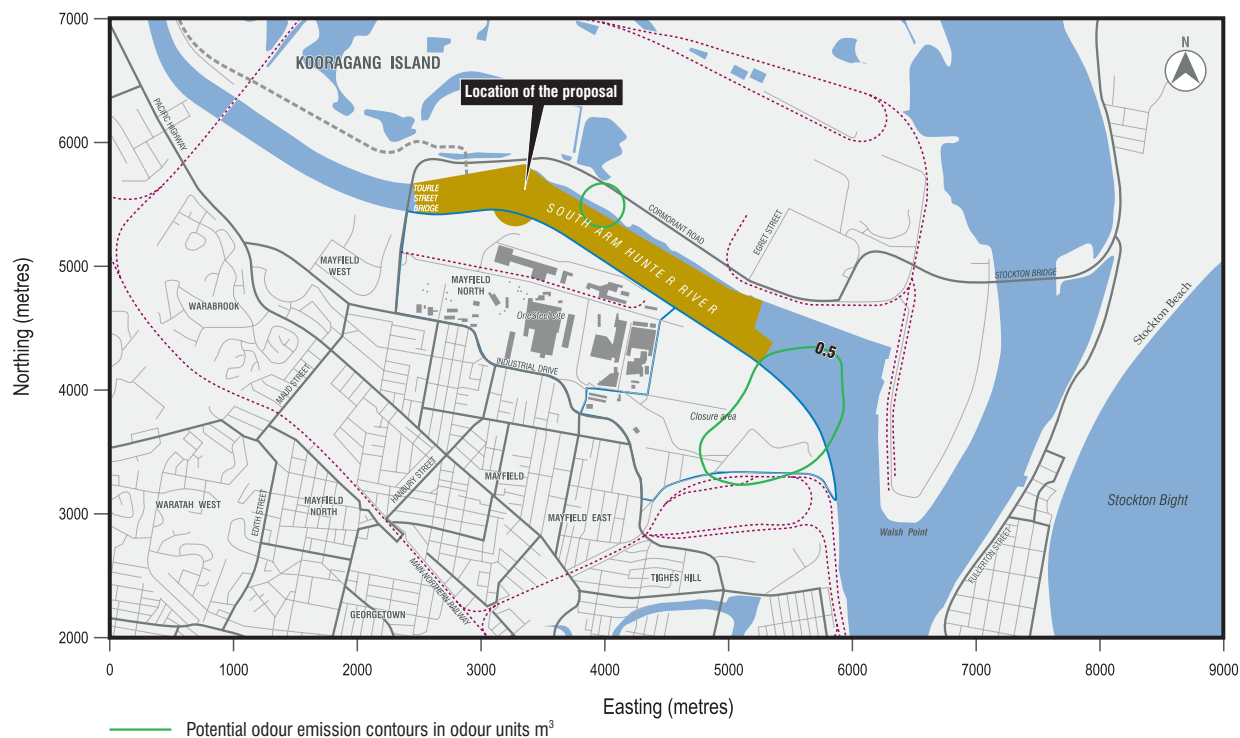


Figure 17.3 Modelling result for dredging site 2, covered barge without geobag

Source: UNSW Odour Unit



Figure 17.4 Modelling result for dredging site 2, covered barge without geobag

Source: UNSW Odour Unit

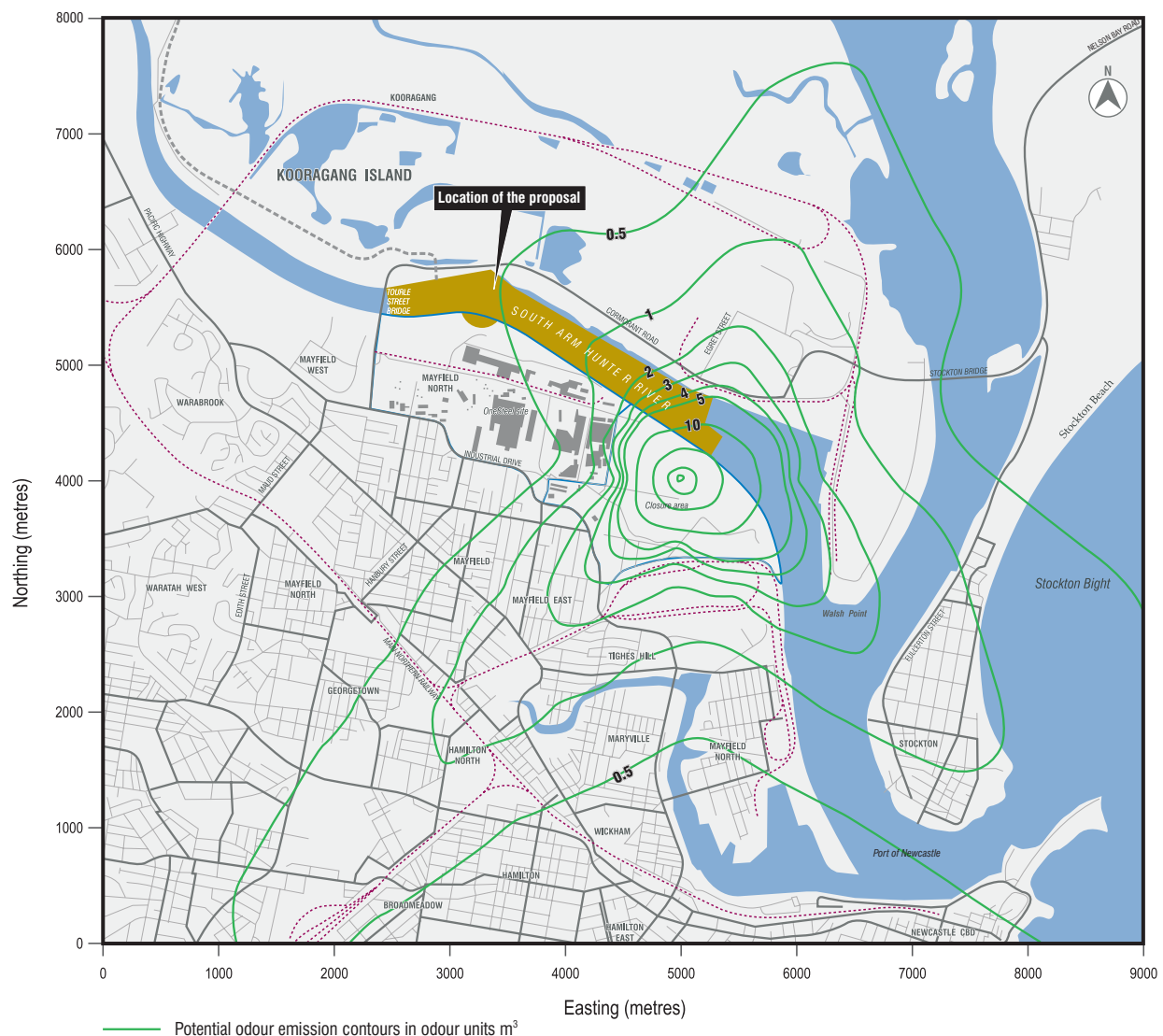


Figure 17.5 Modelling result for dredging site 1, open barge with geobag

Source: UNSW Odour Unit

Gas composition

Gas samples collected during the field simulation exercises were analysed in a NATA-registered laboratory for hydrogen sulphide (rotten egg gas), volatile organic compounds and PAHs. Analyses showed that PAHs, particularly naphthalene, were the predominant contaminants in the odorous gas. Hydrogen sulphide and volatile organic compounds were not detected in significant quantities. On this basis it was determined that naphthalene would be the major contributor to potential odour impacts.

Composition of sediments

Analysis data for contaminants in the sediments collected as a result of sampling is tabulated in Chapter 5. The 95% UCL (upper concentration limits) for key PAH compounds are as follows:

- naphthalene 1707 mg/kg

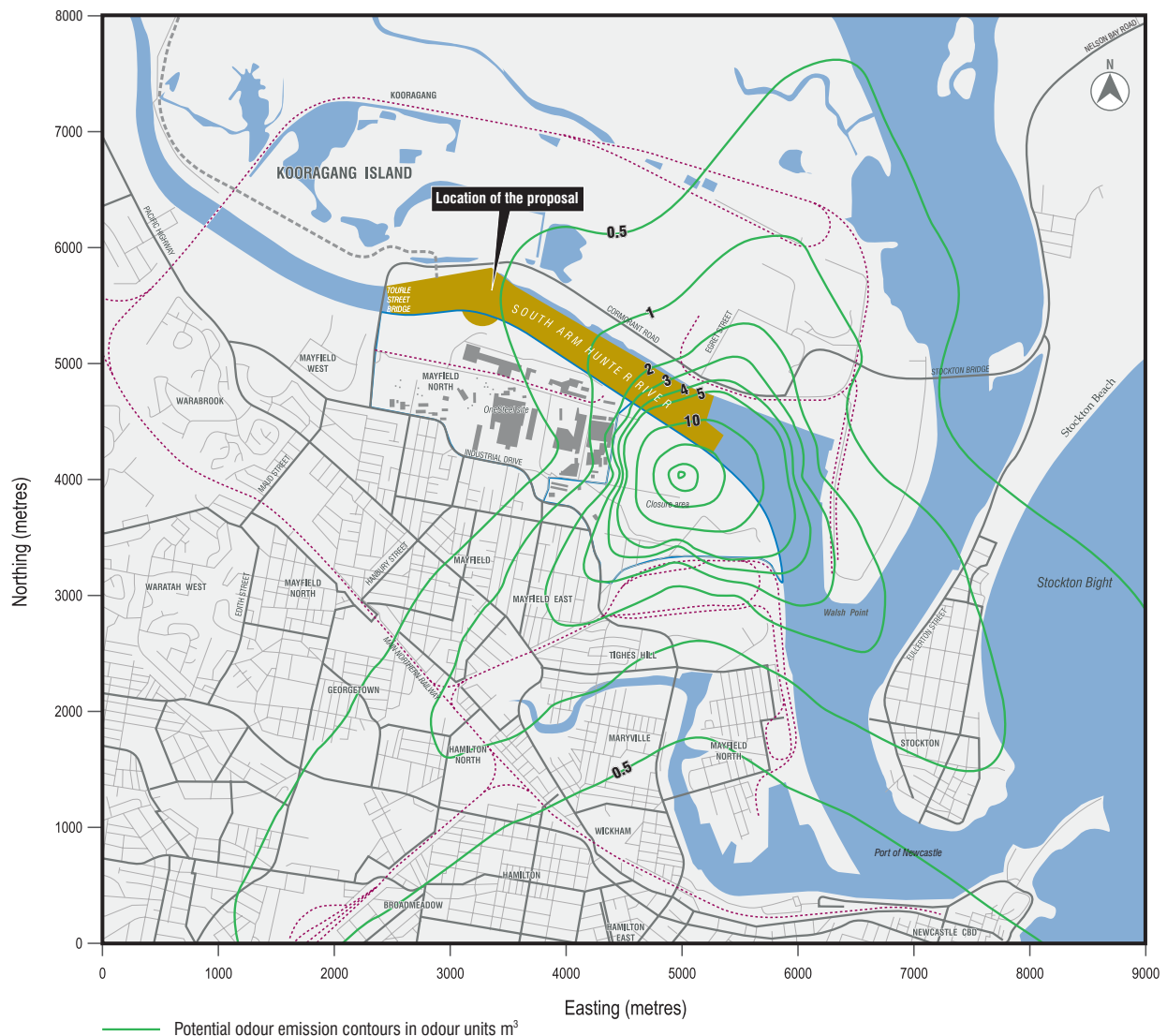


Figure 17.6 Modelling result for dredging site 1, covered barge with geobag

Source: UNSW Odour Unit

- benzo(a)pyrene 44 mg/kg

Other PAH compounds are at much lower concentrations than naphthalene, and only benzo (a) pyrene is considered to be carcinogenic. No analysis of VOCs such as benzene, toluene, ethyl benzene and xylene was undertaken.

VOC emissions

During simulation of the dredging process, from which odour emission rates from each dredging related operation were estimated, concentrations of VOCs in air were measured using charcoal tubes. In all but one case, concentrations of VOCs, including benzene, toluene and xylenes were below detection levels, but naphthalene was detected in some of the samples. On this basis, correlation of VOC concentrations with odour levels was not able to be undertaken.

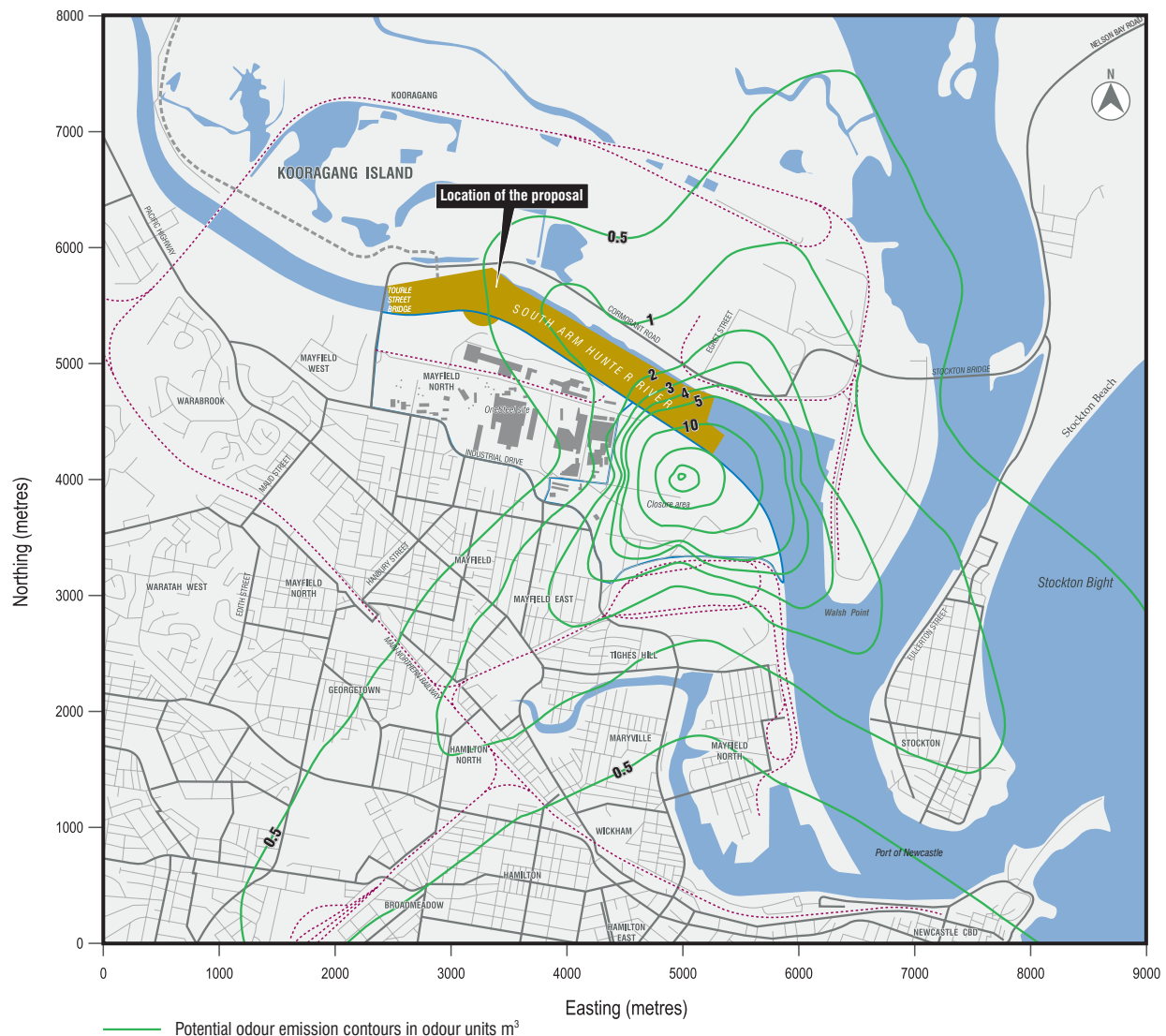


Figure 17.7 Modelling result for dredging site 2, open barge with geobag

Source: UNSW Odour Unit

Correlation analysis for naphthalene

A correlation analysis between odour concentration and PAH concentrations indicated that a direct correlation exists between odour concentrations and the concentration of specific PAH compounds such as naphthalene, and that the odour flux is directly proportional to the total PAH concentration in the sediment. On this basis an odour concentration of 1 OU/m³ would be equivalent to a naphthalene concentration of 8.8 mg/m³ in air.

While there are no air quality toxicity standards set for naphthalene in ambient air in NSW or other states, the general practice used by Victorian EPA to derive an approximate limit is to divide the occupational exposure limit by a factor of 30.

Naphthalene is listed as an atmospheric contaminant by the National Occupational Health and Safety Commission (NOHSC, 1995). For occupational exposures, the Time Weighted Average limit for exposure to naphthalene for an 8 hr

Results of odour dispersion modelling

The results of the odour dispersion modelling of all eight scenarios are shown in Figures 17.1 to 17.8 and are summarised in Table 17.2.

In general, the results of the odour dispersion modelling show that:

- the preferred operation methodology (of a mechanical dredge, sediment transfer using barges and trucks, sediment storage in an open temporary storage facility and sediment treatment at an open cementation treatment facility) would not create significant odour impacts at the closest sensitive receptors.
- significant odour impacts would occur at sensitive receptors when dredged sediments were dewatered in geobags.

A more detailed explanation of some of the odour contours shown in Figures 17.1 to 17.8 is provided below.

Scenarios 1 to 4 – Operations without the use of Geobags

Scenarios 1 and 2 involve the barge being located at Site 1. Figures 17.1 and 17.2 show that, under Scenario 1 and 2 operational conditions respectively, the maximum average ground level odour concentration at all sensitive receptors would be below 0.5 OU/m³.

Since the odour contour for 1 OU/m³ (not shown) lies inside the 0.5 OU/m³ contour (shown), odour levels at all residential areas would be below the adopted odour criteria of 1 OU/m³. Therefore, no significant odour impacts would occur at the sensitive receptors when proposed activities are undertaken in accordance with Scenarios 1 or 2.

The main difference between Scenarios 1 and 2 is that Scenario 1 uses an open barge, while Scenario 2 uses a closed barge. Comparison of contours shown in Figures 17.1 and 17.2 indicates that when the barge is located at Site 1, the odour generation is similar whether an open or closed barge is used. Therefore using a closed barge appears to make little difference to average ground level odour concentrations at the sensitive receptors.

Scenarios 3 and 4 are similar to Scenarios 1 and 2, in that open and closed barges are used, but the barge is located at Site 2. Figures 17.3 and 17.4 show that, under Scenarios 3 and 4 operational conditions, the maximum average ground level odour concentration at all sensitive receptors would be below the target concentration of 1 OU/m³. Therefore, no significant odour impacts would occur at the sensitive receptors when proposed activities are undertaken in accordance with Scenario 3 or 4.

Comparison of contours shown in Figures 17.3 and 17.4 shows that when the barge is located at Site 2, the use of a closed barge (as per Scenario 4) makes little difference to odour concentrations at the sensitive receptors.

In summary, odour modelling of Scenarios 1 to 4 indicates that dredging activities undertaken anywhere within the dredging area would not cause significant odour impacts at the nearest sensitive receptors.

Scenarios 5 to 8 - Operations with the use of Geobags

Scenarios 5 to 8 are identical to Scenarios 1 to 4 respectively, but involve the use geobags for sediment dewatering operation (with an assumed odour source area of 80,000m²). Scenarios 5 and 6 involve a barge at Site 1, while Scenarios 7 and 8 involve a barge at Site 2.

Figures 17.5 to 17.8 show that, under Scenarios 5 to 8 operational conditions, the maximum average ground level odour concentration at some sensitive receptors would be above the target concentration of 1 OU/m³. Therefore significant odour impacts could occur at the sensitive receptors located within this contour.

Table 17.2 Summary of odour dispersion modelling

Scenario	Scenario description	Dispersion modelling result	Figure showing modelled results
Scenario 1	Dredging at Site 1:	No significant odour impact	Figure 17.1
	Use of open barge		
	Open temporary storage and treatment facility		
	Geobags not used		
Scenario 2	Dredging at Site 1:	No significant odour impact	Figure 17.2
	Use of closed barge		
	Open temporary storage and treatment facility		
	Geobags not used		
Scenario 3	Dredging at Site 2:	No significant odour impact	Figure 17.3
	Use of open barge		
	Open temporary storage and treatment facility		
	Geobags not used		
Scenario 4	Dredging at Site 2:	No significant odour impact	Figure 17.4
	Use of closed barge		
	Open temporary storage and treatment facility		
	Geobags not used		
Scenario 5	Dredging at Site 1:	Odours exceed adopted odour criteria at closest receptors	Figure 17.5
	Use of open barge		
	Open temporary storage and treatment facility		
	Geobags covering 80,000m ² used for dewatering		
Scenario 6	Dredging at Site 1:	Odours exceed adopted odour criteria at closest receptors	Figure 17.6
	Use of closed barge		
	Open temporary storage and treatment facility		
	Geobags covering 80,000m ² used for dewatering		
Scenario 7	Dredging at Site 2:	Odours exceed adopted odour criteria at closest receptors	Figure 17.7
	Use of open barge		
	Open temporary storage and treatment facility		
	Geobags covering 80,000m ² used for dewatering		
Scenario 8	Dredging at Site 2:	Odours exceed adopted odour criteria at closest receptors	Figure 17.8
	Use of closed barge		
	Open temporary storage and treatment facility		
	Geobags covering 80,000m ² used for dewatering		

Comparison of dispersion modelling for Scenarios 1 and 5 (Figures 17.1 and 17.5), which are identical apart from the use of geobags in Scenario 5, indicates that dewatering sediment in geobags is the major contributor to the average ground level odour concentrations in surrounding locations. The surface area of the bags appears to be the governing factor in the level of odour emissions.

This suggests that if geobags are to be used then the surface area of the bags would need to be much less than 80,000m², to achieve average ground level concentrations at the sensitive receptors under the target concentration of 1 OU/m³.

Odour dispersion modelling conclusions

Based on the results of the dispersion modeling, the following conclusions are made:

- the preferred operation methodology (of a mechanical dredge, sediment transfer using barges and trucks, sediment storage in an open temporary storage facility and sediment treatment at an open cementation treatment facility) would not create significant odour impacts at the closest sensitive receptors;
- the use of an open barge and the location of the barge within the dredging area has little influence on the average ground level odour concentrations at the nearest sensitive receptors;
- odour levels would meet the adopted criteria of 1 OU/m³ at sensitive receptors if geobags are not used;
- significant odour impacts would occur at sensitive receptors if dredged sediments are dewatered in geobags, with the extent of the impacts depending on the odour source area; and
- a geobag area of much less than 80,000 m² would be needed to prevent odour levels from exceeding the adopted criteria of 1 OU/m³ at sensitive receptors.

17.2.5 Odour mitigation measures

The results of the dispersion modeling indicate that significant odour impacts would occur at sensitive receptors if dewatering in geobags was adopted. If mechanical dredging is used to excavate the sediments and they are remediated using cementation, it is unlikely that dewatering of the sediments would be required. No mitigation measures should be necessary for this combination of dredging and treatment methodologies.

However, if dewatering of dredged sediments with geobags is required, the following mitigation measures are recommended:

- minimise the exposed surface area of geobags to much less than 80,000 m² (the actual acceptable area would need to be determined) by limiting the number of bags in use at any one time; and
- using suitable odour masking agents.

Minor reductions in odours could also be achieved by using covered barges to transfer dredged sediments from the dredge to the temporary wharf and using trucks with rear load covers to minimise the exposure of dredge sediments during land transfer from the river to the temporary storage facility.

Odour monitoring at the sensitive receptors should be undertaken during sediment storage, dewatering (if undertaken) and treatment operations.

17.3 Assessment of potential dust impacts

17.3.1 Dust generation

As the dredged sediments would be wet upon excavation, they would not be a source of dust. However, the OneSteel swing basin excavation and general construction activities and movement of vehicles have the potential to generate dust. Rates of dust generation from construction sites can vary substantially from day to day, depending on the level of activity, the specific operations and meteorological conditions.

Proposed activities that could generate dust include:

- road transport of dredged sediments from the temporary wharf to the remediation areas;
- road transport of any contaminated soil material to the treatment area on the closure area;
- general vehicle movements within and around the remediation area on the closure area;
- stockpiling of remediated sediments prior to removal to other areas within the closure area; and
- wind erosion from exposed areas and stockpiles of treated sediments.

The nearest residential areas to the haulage roads and sediment treatment facility are not expected to be impacted by the dust due to distance to these areas (approximately one kilometre to the west) and the implementation of dust generation controls. Dust may, however, impact on site personnel.

Standard health and safety procedures for construction employees would be implemented at the construction site, including requirements for protective equipment (masks) where dust generation is unavoidable. Dust emissions during construction are not anticipated to result in significant air quality impacts if the above recommendations are implemented.

17.3.2 Dust mitigation measures

A dust control plan detailing control measures, responsibilities for implementing dust control measures and monitoring and reporting requirements would be prepared as part of the environmental management plan for the proposal. Mitigation measures to minimise the generation of dust would target dust generation by vehicle movements and dust generation from exposed remediated sediment stockpiles. Typical mitigation measures are described below.

Movement of vehicles

The following general mitigation measures would be implemented to minimise the generation of dust by vehicle movements during dredging and sediment remediation operations:

- Machinery would be kept to well defined areas and truck loading/unloading areas would be confined;
- Truck movements would be controlled by restricting movements to designated sealed roadways;
- Existing unsealed haulage roads would be upgraded to gravel/ballast covered roads or similar to ensure all weather access;
- The use of wind barriers in potential dust generating areas would be considered during site establishment design;
- Trucks used to transfer dredged materials would be maintained in accordance with the manufacturer's specification and should comply with all relevant regulations;

- ‘Smoky’ or oil-smoke emitting vehicles would be removed from service;
- Truck wheel washes or other dust removal procedures would be installed to minimise transport of dust offsite;
- On entering and leaving the site, trucks would be covered;
- Water carts would be used to dampen roadways subject to high traffic movements; and
- Inspections of haulage roads would be conducted during days on which construction activities were occurring and dust generation would be monitored visually during operations.

Stockpiling of materials

The quantity of material stockpiled would be minimised at all times. Where practicable, clean excavated materials would be loaded, hauled and placed at the designated backfill location without the need for stockpiling.

Stockpiles would only be constructed in areas of the site that have been located and prepared in accordance with the environmental requirements of the proposal. All such preparatory works would be undertaken prior to the placement of material in the stockpile. Exposed stockpile surfaces would be regularly watered to minimise dust generation.

Works would be undertaken initially to clear the area of rubbish, rubble and vegetation. The area would then be trimmed and graded, so that any local depressions or mounds are removed. The final surface of the stockpile area would then be made smooth and even. Silt fences and diversion drains would then be constructed around the perimeter of each stockpile area. The silt fences and diversion drains would be constructed in accordance with the environmental requirements of the proposal.

Signs would be erected at the entrance to the stockpile area and at locations around the stockpile specifying the material type to be stored. Buffer zones and access routes would be established around each stockpile area to prevent cross-contamination and enable access from adjoining haul roads.

All long-term soil stockpiles on site would receive surface treatments, as required, to reduce dust or odour emissions. Temporary stockpiles would be monitored to determine the need for surface treatment as per long-term stockpile applications on a regular basis. Surface treatments may include:

- spray grass seeding;
- mulch cover;
- coating materials such as PVA spray;
- non-odorous soil cover; or
- polyethylene sheet covers.

All stockpiles would be maintained in a safe condition. Batters would be formed with sloped angles that are appropriate to minimise erosion and prevent slumping of the stockpiled material.

The integrity of neighbouring stockpiles of differing materials would be maintained and all measures necessary to prevent mixing of material types would be undertaken.

17.3.3 Potential dust impacts

The nearest residential areas to the haulage roads and sediment treatment facility are not expected to be impacted by the dust due to distance to these areas (approximately one kilometre to the west) and the implementation of dust generation controls. Dust may, however, impact on site personnel.

Standard health and safety procedures for construction employees would be implemented at the construction site, including requirements for protective equipment (masks) where dust generation is unavoidable. Dust emissions during construction are not anticipated to result in significant air quality impacts if the above recommendations are implemented.

17.4 Air emissions from thermal desorption unit

17.4.1 Overview

Thermal desorption has been employed widely as a means of removing contaminants from soil. The thermal desorption process transfers contaminants from one phase (soil) to another phase (gas) by heating and agitating soil to volatilise organic contaminants. Temperatures and residence times are designed to volatilise selected contaminants but not oxidize or incinerate them.

Once the contaminants are volatilised the process gas is transported to an emissions control system. Components in the process gas may include particulates, metals, organic contaminants of concern (such as PAHs) and acid gases. An emission control system removes or destroys organic compounds, removes entrained particles and, if required, can remove acid gases.

In Australia, thermal desorption has been used or is proposed for use at various sites, including the remediation of soil at Homebush Bay and Rhodes Peninsula in Sydney, NSW. As part of preparing the EIS for the remediation of the former Allied Feeds Site, Rhodes Peninsula (in Sydney), a study of the proposed thermal desorption process was undertaken for the EPA and PlanningNSW by Earth Tech and ERM (ERM, 2002).

This study identified the extensive use of thermal desorption to remediate contaminated soils, particularly in the US where, by 1996, thermal desorption had been used to clean up over 50 significantly contaminated sites (ERM, 2002). The EIS provided data on emissions from a thermal desorption unit operated by EarthTech Engineering in the US. The emission rates of PAHs were of the order of 0.29 micrograms/sec and the consequent modelled ground level concentration of PAHs at the site boundary was 9.5 micrograms/m³.

Another EIS which includes the use of thermal desorption on contaminated sediments was prepared for the remediation of the Lednez site at Rhodes and Homebush Bay (Parsons Brinkerhoff, 2002). This provided an estimate of likely emission rates for PAHs from the proposed indirect thermal desorption treatment plant. These were 0.44 micrograms/sec. No air quality modelling was undertaken for PAHs to determine ground level concentrations.

17.4.2 Air emission criteria

Use of a thermal desorption unit would require a licence from the NSW EPA prior to any commission testing or operation on the site. This licence would specify strict air emission criteria that must not be exceeded beyond the boundary of the closure area during any operation of the unit. This is discussed elsewhere in this EIS.

NSW EPA and other statutory authorities have set air emission criteria for various contaminants at levels that protect human health, based on the most up to date toxicological information. Table 17.3 lists the ground level concentration (GLC) criteria for contaminants that must not be exceeded beyond the boundaries of the closure area.

Table 17.3 Ground level concentration criteria

Contaminant	GLC criteria (g/m ³)	Averaging period	Source
Chromium	1.7	3 minute	NSW EPA
Copper	33	3 minute	NSW EPA
Zinc	33	3 minute	NSW EPA
Mercury	0.3	3 minute	NSW EPA
Lead	0.5	Annual average	NSW EPA
Benzo(a)pyren	0.73	3 minute	Victorian SEPP Air Quality Management
Arsenic	0.167	Time Weighted Average Exposure Standard divided by 300	Victorian EPA and Worksafe Standards Australia [NOHSC:3008(1995)]
Cadmium	0.03	Time Weighted Average Exposure Standard divided by 300	Victorian EPA and Worksafe Standards Australia [NOHSC:3008(1995)]
Nickel	3.33	Time Weighted Average Exposure Standard divided by 30	Victorian EPA and Worksafe Standards Australia [NOHSC:3008(1995)]
Naphthalene	1733	Time Weighted Average Exposure Standard divided by 30	Victorian EPA and Worksafe Standards Australia [NOHSC:3008(1995)]

17.4.3 Background concentrations

Background concentrations of copper, benzo(a)pyrene and lead in the air shed of the Newcastle area were measured for a study undertaken by the University of Newcastle (University of Newcastle Research Associates, 1992). These background concentrations are provided in Table 17.4.

Table 17.4 Background concentrations in airshed

Contaminant	Background concentration (µg/m ³);
Copper:	0.44
Benzo(a)pyrene	5.7 x 10 ⁻³
Lead	0.4

University of Newcastle Research Associates, 1992

It should be noted that these background concentrations would have reduced since 1992, when industrial operations ceased on the closure area.

17.4.4 Required contaminant removal efficiencies

Overview

Concentrations of contaminants emitted from a stack in the ambient air are reduced as the contaminants disperse in the atmosphere. The concentration of an airborne contaminant at the boundary of the closure area is a function of the emission rate (e.g. tonnes per hour) of the contaminants.

GLCs of certain air pollutants in an emitted gas must not exceed specific concentrations beyond the boundary of the site from which the pollutants are emitted. To achieve acceptable GLCs at the site boundary, for a given stack configuration (location and height), the emission rate of contaminants from the stack must be restricted. This can be achieved by a combination of limiting the throughput of the thermal desorption unit, operating the process at optimum settings and the use of emission control equipment on the thermal oxidation component of the treatment system.

For a given throughput, the emission rate of a contaminant is dependent on the contaminant removal efficiency of the thermal treatment unit. This is measured in terms of the input amount of a contaminant compared to the output amount of the contaminant, and normally expressed as a percentage (e.g. a 90 percent removal efficiency).

The minimum removal efficiencies required to ensure that acceptable ground level concentrations (for a range of contaminants) are not exceeded at the boundary of the closure area, have been calculated.

Air dispersion modelling

The computer program Ausplume Atmospheric Dispersion Model Version 5.4 was used to determine:

- the location on the boundary of the closure area where the maximum GLC of an emitted gas (rather than a specific contaminant) would be measured; and
- the maximum GLC at this location (worst case scenario).

The results of the modelling indicated that the maximum boundary GLC of an emitted gas would occur at a point immediately south of the assumed stack location. At this location the maximum boundary GLC (assuming a unit emission rate of 1 g/s from the stack) would be $6.59 \mu\text{g}/\text{m}^3$ modelled on a 3-minute averaging time. The maximum GLC would be $0.383 \mu\text{g}/\text{m}^3$ modelling on an annual averaging time.

The results of the Ausplume modelling data are provided in Appendix K.

Calculation of required removal efficiencies

The minimum removal efficiency of the thermal desorption unit was then calculated for each contaminant so that the air emission concentrations were equal to the emission criteria at the point on the boundary at which the maximum concentration occurred.

The calculation was undertaken knowing the ratio between the concentration at the boundary and the emission rate at the stack. From this a 'ratio factor' was determined as follows:

- Unit emission rate at stack: 1 g/s;
- Maximum concentration at boundary: $6.59 \mu\text{g}/\text{kg}$ (3 minute average) or 0.383 (annual average); and
- Ratio factor (Unit emission rate from stack / Maximum concentration at boundary): 0.152 (3 minute average) or 2.61 (annual average).

Thus, by knowing the maximum allowable GLC of each contaminant at the boundary of the closure area (air emission criteria), the maximum allowable emission rate of each contaminant at the stack was determined as follows:

Maximum allowable emission rate from stack = Maximum allowable boundary GLC x ratio factor.

The required removal efficiency rate was calculated by comparing the feed rate of each contaminant with the maximum allowable emission rate from the stack. An assumption was made that a feed rate of 18t/hr of sediment would be used; this was based on the modelling of the proposed thermal desorption process undertaken for the Rhodes Peninsula EIS by Earth Tech and ERM (ERM, 2002).

The feed rate for each contaminant (for this specific site) was determined using the known concentration of contaminants in sediment located in Designated Area 3, as the sediment in this location contained the highest concentrations of contaminants. Feed rates were calculated as follows:

Feed rate (g/s) = Throughput rate (18 t/h) x contaminant concentration in sediment (measures as 95 percent UCL).

The required removal efficiency was then calculated as follows:

Required removal efficiency = (Maximum allowable emission rate from stack – Feed rate)/ Feed rate.

Table 17.5 shows the required removal efficiencies of each contaminant.

Table 17.5 Maximum allowable emission rate of each contaminant from the stack

Contaminant	Contaminant concentration in sediment (95% UCL, $\mu\text{g/kg}$)	Feed rate	Background ($\mu\text{g/m}^3$)	Maximum allowable boundary GLC ($\mu\text{g/m}^3$)	Ratio Factor	Maximum allowable emission rate for each contaminant from the stack (g/s)	Required Removal Efficiency
Arsenic	13	0.065		0.167	0.152	0.253	61 %
Cadmium	5.7	0.029		0.033	0.152	0.005	82 %
Chromium	70	0.35		1.7	0.152	0.258	26 %
Copper	76	0.38	0.44	32.56	0.152	4.941	0 %
Nickel	36	0.18		3.33	0.152	0.506	0 %
Zinc	1459	7.30		33	0.152	5.006	31 %
Lead	283	1.42	0.4	0.1	2.61	0.261	82 %
Mercury	1.05	0.0053		0.3	0.152	0.0455	0 %
Naphthalene	1707	8.54	0.0057	1733.33	0.152	263	0 %
Benzo(a)pyrene	44	0.24		0.73	0.152	0.110	55 %

* Maximum allowable boundary GLC = Air emission criteria – background concentration.

These calculations assume that 100 percent of each contaminant is volatilised (i.e. transferred from the sediment to a gas). This is a conservative assumption as a minor amount of contaminant would remain in the sediment and thus would not be emitted in the off gas. It should be realised that increasing the feed rate of soil to be treated would increase the efficiency required to achieve the same GLC at the boundary.

Contour plot

To enable a contour plot of benzo(a)pyrene GLCs to be produced, the Ausplume model was run using receptors in a grid pattern. This was based on the derived maximum emission rate for benzo(a)pyrene, and the required removal efficiency that was previously calculated for this contaminant (55 percent).

A GLC contour plot was produced (refer to Figure 17.9). This figure shows that GLCs of benzo (a) pyrene in all residential areas are below the nominated criteria of $0.73 \mu\text{g}/\text{m}^3$, and hence comply with NSW EPA requirements, if the removal efficiency of B(a)P is greater than 55 percent.

Results of the air emission modelling and required removal efficiency calculations

Based on the results of the air emission modelling and the calculations shown above, the following is concluded:

- The required removal efficiencies for each contaminant range between 0 percent and 82 percent (for cadmium);
- If all the naphthalene (and copper and nickel) in the most contaminated sediment were volatilised and emitted from the stack (without operation of emission control equipment) the GLC of these contaminants at the boundary of the closure area would not be above the emission criteria;
- Based on a soil feed rate of 18 tonnes per hour, the minimum removal efficiencies for each chemical is as follows:
 - arsenic: 61 percent;
 - cadmium: 82 percent;
 - chromium: 26 percent;
 - zinc: 31 percent;
 - carcinogenic PAHs (B(a)P toxic equivalent): 55 percent; and
 - lead: 81 percent.

The results indicate that a feed rate of greater than 18 tonnes per hour would be possible, provided that the removal efficiency of the proposed thermal treatment equipment is greater than the values shown for the particular contaminants shown above. The required efficiencies shown above suggest that achieving allowable cadmium and arsenic GLCs would be the limiting factors in terms of throughput, rather than benzo (a) pyrene.

17.4.5 Mitigation measures

To achieve an operational performance that meets the maximum emission criteria, a thermal desorption unit would be used that meets best-practice control technology. Best-practice control technology would not only include the use of a highly efficient air emission control system but also the adoption of sound commissioning and operational practices. These are described below (ERM, 2002).

Air emission control system components

Operation under negative pressure

The unit would be operated under a low negative pressure to ensure there are no fugitive emissions from the unit.

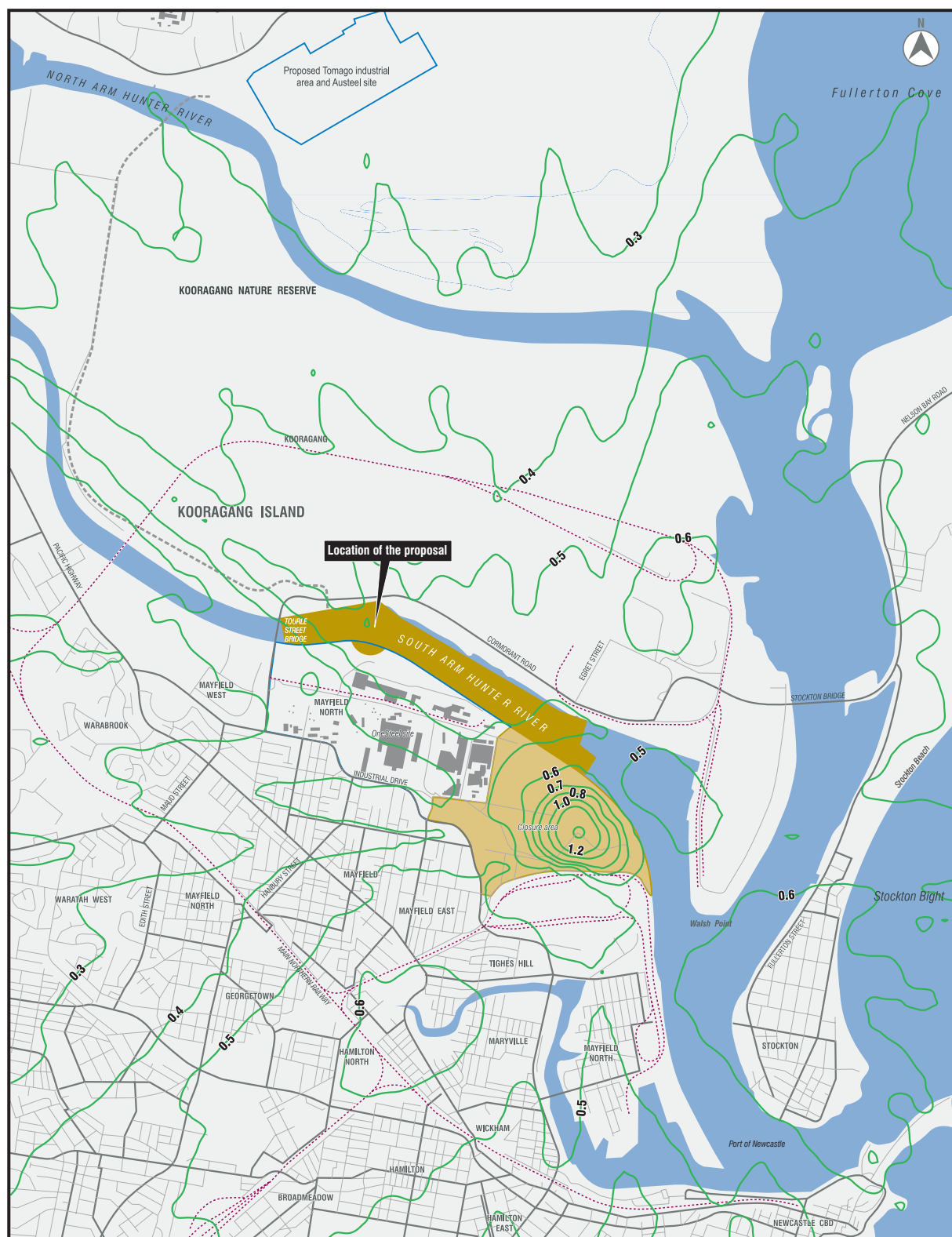


Figure 17.9 Ground level concentration of Benzo(A)pyrene during stack emission (99.9%)
(based on an off-gas treatment system with a 55% pollutant removal efficiency)

0 1
Kilometres
— Contour lines in mg/m³

Baghouse particulate filters

Particulate filters would remove particulate matter with an expected efficiency of 99 percent or more. Removing the particles is an integral part of the air emission control system as the thermal oxidiser operates at maximum efficiency with particle free vapours. Additionally, the formation of dioxins is associated with the presence of particles. Thus, best practice technology would involve highly efficient removal of particulate matter.

Thermal oxidiser (afterburner)

A thermal oxidiser would oxidise all organic compounds in the vapour stream. The efficiency of the thermal oxidiser is dependant on temperature, residence time and turbulence. A thermal oxidiser with an efficiency of approximately 99.95 percent or more would be used.

Venturi Scrubber

The remaining gas would be cleansed in an efficient high capture wet gas Venturi scrubber prior to discharge. The scrubber would be used to remove volatilised metals. Scrubber process water would be cleansed prior to discharge. The neutralized precipitate from the water treatment could then be disposed of in a licenced landfill.

Commissioning and testing

The thermal desorption unit would be commissioned prior to full-scale operation by performing a number of trials, during which air emissions would be sampled and tested. The commissioning process would confirm the ability of the thermal desorption unit to meet the maximum air emission criteria set by the EPA.

The commissioning trials would include the following operational steps:

Firstly, the thermal desorption unit would be set up on site. To ensure the unit had been assembled correctly and that all monitoring systems (temperatures and pressures) and control systems are functioning, all mechanical, electrical and thermal operational systems would be checked by running the unit without inputting any dredged sediment.

Clean soil or sediment would then be put through the unit for a period of time to further confirm that the materials handling components of the unit are functioning correctly.

Performance trials would then be conducted using dredged sediments and the required throughput rate. During these trials air sampling would be conducted and tested for the following parameters:

- Gas velocity and volume flow rate.
- Stack exhaust temperature.
- Concentrations of:
 - Moisture;
 - Oxygen;
 - Carbon Dioxide;
 - Sulphur Oxides (SO_x);
 - Nitrogen Oxides (NO_x);
 - Carbon Monoxide (CO);

- Particulate matter;
- Volatile Organic Compounds (VOCs);
- Dioxins and Furans;
- Heavy Metals; and
- PAHs.

The unit would not begin actual operation until test results from the performance trials had been received, all test results were within the nominated NSW EPA criteria, and the final EPA approval to operate had been granted.

Operational practice

Best-practice operation of a thermal desorption unit would include the following:

- Ensuring feed material is uniform and free of rocks and clumps of clay;
- Ensuring the correct moisture content of the feed material;
- Continuous monitoring of emissions from the system in accordance with EPA requirements;
- Automated operations that immediately inform operators to stop operations when continuous air monitoring detects concentrations above acceptable criteria.
- Daily checking of the unit to ensure that it is working efficiently and safely
- The use of experienced operators with strong networks to equipment suppliers;
- Support of an analytical laboratory.

An Operational Management and Quality Plan, approved by the EPA, would be developed to take account of the above operating issues before final commissioning of the thermal desorption unit.

17.4.6 Assessment of potential impacts from thermal desorption unit emissions

If a thermal desorption unit is used to remediate dredged sediments, the potential impacts of stack air emissions from the unit would be minimal, provided contaminant removal efficiencies exceed those calculated, and throughput of material is limited correspondingly.

If the thermal desorption unit is correctly operated, concentrations of contaminants in the air should not exceed the air emission criteria (which have been set by the EPA and other statutory authorities) at the boundaries of the closure area.

18

Cultural heritage and archaeology

This chapter provides a summary of the results of the Aboriginal and Non-Aboriginal cultural heritage assessments undertaken by Umwelt Australia as part of the EIS process. Information on the existing environment is provided, the potential impacts of the proposal are assessed, and mitigation measures recommended. The full reports are included in Appendix L.

18.1 Overview of methodology

18.1.1 Indigenous heritage

An archaeological desktop study and site survey were conducted to determine the presence of items of indigenous heritage and to identify items potentially of indigenous heritage significance.

The desktop study involved:

- a search of the NPWS Register of Aboriginal Sites;
- a search of the Native Title database;
- review of previous archaeological research in the region; and
- review of previous archaeological research within the study area.

Predictions regarding the presence of significant sites were made based on the findings of the desktop survey.

Discussions were undertaken with representatives of the Awabakal Local Aboriginal Land Council (LALC) and Worimi LALC. Land claims under the *Aboriginal Land Rights Act 1983* were also identified.

The portion of the study area to the south of the South Arm is within the area of interest of the Awabakal LALC. The CEO of the Awabakal LALC was informed of the proposal. It was concluded that the southern bank of the South Arm was so heavily disturbed that a survey of the area was not warranted. However, the Awabakal LALC was consulted regarding their opinion of the proposal and its potential impacts.

The portion of the study area to the north of the South Arm is within the area of interest of the Worimi LALC. The CEO of the Worimi LALC was informed of the proposal and coordinated representation for the local Aboriginal community.

A site survey of the northern bank was undertaken on 23 January 2003. Representatives from Worimi LALC and an archaeologist from Umwelt conducted the site survey.

18.1.2 Non-Indigenous heritage

The assessment was undertaken broadly within the framework of the NSW Heritage Manual of the Heritage Office and the Department of Urban Affairs and Planning, NSW. It involved the following:

- Reviewing the archaeological and historical records of the study area, including data contained in:
 - The Register of the National Estate;
 - The NSW State Heritage Register and Inventory;
 - The Hunter REP;
 - The Newcastle LEP 1987;
 - The Register of the National Trust (NSW);
 - The Register of Australian Shipwrecks;
 - The historical maps of the Parish of Newcastle, County of Northumberland; and
 - Published historical material and original unpublished historical and archaeological reports and commentaries relevant to the study area.
- Determining the spatial context of the study area by field survey, with particular attention given to previously identified elements;
- Preparation of a formal statement of heritage impact; and
- Identification of issues and recommendations for management.

18.2 Existing environment

18.2.1 Aboriginal cultural and archaeological context

Uncertainty exists regarding Aboriginal groupings in this region. As a result of Threlkeld's (an early European missionary) studies in the area, Awabakal became the name that represented the whole tribe.

Early government documents indicate this large tribe was composed of a number of clans – the Awabakal (Lake Macquarie and Newcastle region), the Five Islands clan, the Ash Island clan, the Kurungbong clan (Corranbong), and the Pambalong clan (swamps district and near Newcastle).

While the information is unclear, the broad geographical and cultural boundaries are consistent between sources. To the north of the Hunter River, the Worimi people occupied the valleys of the William and Paterson Rivers as well as the coastline and the coastal barrier systems of Stockton Bight (and associated estuarine habitats).

The historical information regarding Aboriginal occupation of the Hunter estuary region provides only a general insight into Aboriginal culture prior to the arrival of Europeans. It is difficult to determine how representative the early European descriptions of Aboriginal economic activity are of the actual lifestyle and technology.

Historical references to the environment and activities of Aboriginal people in the lower Hunter Valley during the early years of the nineteenth century include a number of descriptions of the Hunter estuary. It is noted that there was a focus on implements made of plant materials. None of these materials would survive more than a short period in open campsites.

A number of detailed descriptions of fishing in and around the Hunter estuary have been recorded. Hooks described as being made of oyster shell were in use in the Hunter at European contact, with most reports referring to women fishing from canoes with hook and line. Men used spears for fishing. Both small nets and woven weirs were also used.

18.2.2 Aboriginal sites in the surrounding area

Database records

Very few sites have been recorded in the vicinity of the study area according to current NPWS records. Two sites have been recorded on Kooragang Island.

One of these sites is within the current study area, to the southeast of the intersection of Tourle Street and Cormorant Road (near the Tourle Street bridge). This was a midden site, recorded by Moore during a survey of the lower Hunter Valley (NPWS Site No. 38-4-0041) March 1970. The NPWS site card states: 'Midden by new bridge is almost completely bulldozed. In small undisturbed parts there are very marked lines of shells. Sample of shell types collected. No artefacts'.

The fact that the site was almost completely destroyed over 30 years ago indicates that it is unlikely that any evidence of the site remains today. The area contains a vehicle track and the banks of the channel have been disturbed by this use. Additionally, the area also appears to be heavily used and trampled by fishermen.

The second site is located on Moscheto Island (which forms part of the combined Kooragang Island) near the mouth of the north arm. This site was recorded in 1970 and the relevant NPWS site card contains sparse information. The description of site no. 38-4-0050 simply consists of 'shell midden' and that it 'has been thoroughly bulldozed'. It is unlikely that any evidence of this site remains more than thirty years later.

Sites in the surrounding region appear to be concentrated along the margins of Hexham Swamp, along the coastline and estuaries of Stockton Bight and in an area immediately north of the north arm (including sites in the Tomago area).

The current distribution of sites is likely to be the result of the substantial modification to the environment and ground surface of the Kooragang Island area, and the associated destruction of Aboriginal sites once present in the area. However, the low number of recorded sites may also be due to the lack of intensive archaeological surveys undertaken in the area.

Survey results

North bank of the South Arm

No Aboriginal heritage sites were located during the survey. This result was not unexpected as a result of the fact that a large proportion of the study area appears to consist of imported fill.

An attempt was made to relocate the site previously recorded in the study area (NPWS No. 38-4-0041) without success.

South bank of the South Arm

As a result to the significant disturbances which have occurred to land in the vicinity of the south bank of the South Arm (as a result of reclamation and industrial activities), it was determined that a cultural heritage survey of this area was unnecessary. Any Aboriginal cultural heritage sites once located here would have been completely destroyed many years ago.

Archaeological, scientific and cultural significance

It is considered unlikely that site no. 38-4-0041 is still in existence, since it was almost completely destroyed more than 30 years ago by bulldozing. Alteration and use of the area in the intervening years is likely to have completely destroyed the site. The site therefore no longer has research or teaching potential, apart from the knowledge that it once existed in that location. The site has no other scientific value.

Comment from the Worimi LALC regarding site no. 38-4-0041 as well as the impact of the proposal in general was sought. The Worimi LALC advised (refer Appendix L) that they endorsed Umwelt's findings.

The Awabakal LALC advised that they have no objections to the proposal (refer Appendix L).

18.2.3 Native title search

A search request was forwarded to the National Native Title Tribunal on 24 January 2003. A search of the Register indicated that there were no entries relevant to the current study area.

18.2.4 Aboriginal land claims

The Worimi LALC has a current claim under the *Aboriginal Land Rights Act 1983*, which includes the current study area. This claim (Claim No. 6686) covers the Hunter River and its tributaries to the mean low water mark. It extends from the inland locations of Morpeth and Clarence Town to the river outlet (entrance of Newcastle Harbour). The claim was lodged in April 2002 and is not likely to be resolved until 2004.

Local Aboriginal Land Councils in New South Wales can claim unoccupied Crown land that is not needed for a public purpose. These claims do not rely on traditional affiliation with the land. Under the Act, land is granted as freehold. The current NSW government policy regarding unresolved claims is that no new interests will be granted over a claimed area until the claim is resolved (unless public safety is at issue). The Department of Land and Water Conservation is the administering authority and will consult with all known parties with an interest in the area when considering a claim.

18.2.5 Historical context (post-European settlement)

The sedimentary and geomorphic history of the Hunter estuary is complex. The most dramatic changes were brought about by the reclamation of land in the area beginning in the second half of the nineteenth century for industrial purposes.

Prior to the creation of Kooragang Island, the Hunter River (in the vicinity of what is now the South Arm) originally flowed as a broad expanse between the mainland, Dempsey Island and Ash Island. For the greater part of the length of the study area, this expanse of river was intersected by the eastern sector of Spit Island. The southern shorelines of the former Ash and Dempsey Islands are now part of Kooragang Island.

The original configuration of the study area is depicted in Figures 18.1 and 18.2.

The area proposed as the location for the swing basin was originally the northern shoreline of Spit Island.

Originally, landuse in the vicinity of the South Arm is likely to have been rural/grazing. The land was low-lying on mud flats susceptible to flooding and subject to tidal influence. East of the proposed swing basin, on the southern side of the South Arm, the bank is almost entirely artificial (created as a result of reclamation).

The first industrial development in the general area appears to have been the development of a mine and surface facilities in or about 1862, by the Waratah Coal Company.

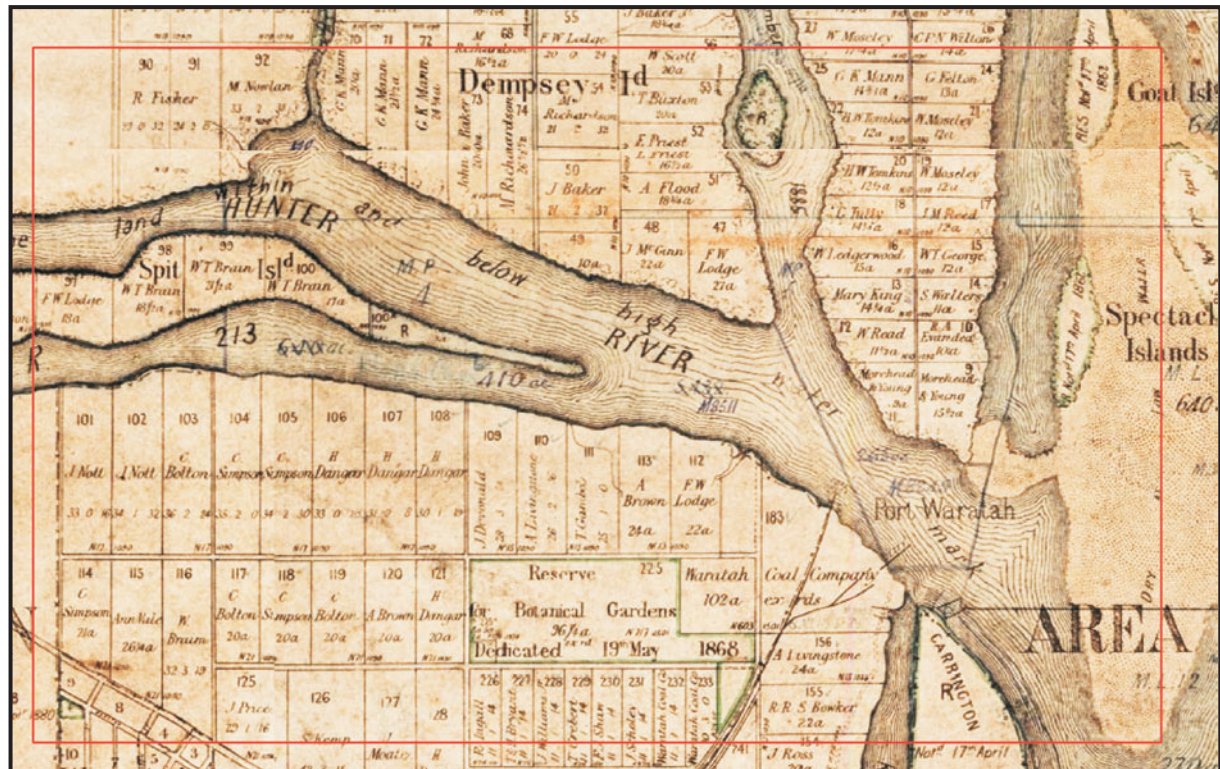


Figure 18.1 Amalgamation of islands and intertidal mudflats prior to 1950s

Source: Kingsford & Ferster Levy (1997)

After 1912, development in and around the study area involved the establishment and expansion of BHP Steelworks and associated enterprises. Prior to 1950, BHP had planned the westward extension of the existing plant, involving an ambitious plan of reclamation, and had acquired the title to land on Spit Island. In 1950, the NSW Parliament enacted the BHP Company Limited (Reclamation and Exchange) Agreement Ratification Act, which authorised the acquisition and reclamation of land in the area.

The original Platts Channel was infilled with steelworks waste material and built up to a height between approximately three and four metres above high water level. The residue of Spit Island, after excision, was completely covered by material to an equivalent height. The area easterly of the northwestern sector was reclaimed in a similar manner to Platts Channel. This had the effect of extending the northern frontage of the mainland to Platts Channel, across artificial ground, to a reconstructed stable high bank with a regularly graded frontage to the South Arm.



Source: Map Parish Newcastle Co Northumberland, Ed 2, 1/1/1912, NSW LPI

Figure 18.2 The study area locality in 1912

The reclamation program undertaken by BHP commenced in 1950. The first stage appears to have been the construction of a dyke or seawall along the proposed bank alignment, impounding the eastern and western openings of Platts Channel, at the same time changing the original landform.

Approximately 11 years later, the reclamation program was substantially completed. A building that housed the Rod Mill was constructed around late 1961. Between 1950 and 2000, the only other substantial building that appears to have been erected upon reclaimed land in proximity to the study area, is the No.2 Bar Mill, located due west of the Rod Mill.

The footprint of the projected swing basin is located on land now described as Lot 222 in DP 1013964. Previous land uses included:

- 1950 – 1970: the reclamation of Platts Channel, Spit Island and some offshore reclamation north of the eastern aspect of Spit Island was undertaken using steelmaking slag, ashes from a variety of sources, coal washery slurry, finishing and rolling mill wastes and coke oven by-products. Two tar pits were located in the swing basin footprint and one to the south of this area. The pits are said to have been used for disposal of tar, oil and grease.
- between the early 1970s and the late 1980s: the No. 5 Scrap Yard was located north of the Bar Mill, east of the existing Steelstone lease. The Scrap Yard was used to store a variety of scrap materials including slag and scrap metal.
- during the 1990s: Steelstone commenced operations, involving extracting metallic residues from slag for recycling and the preparation of residual slag for road base and clean fill. The Steelstone operations were at this time located east of its present lease area, to which it moved shortly before the closure of the BHP Newcastle Steelworks.

Summary timeline

In summary, the current character of the study area is extremely altered from its original natural state. A timeline of the main development of Kooragang Island clearly illustrates the physical changes the study area has undergone.

1801	The lower Hunter River is surveyed by Lt. Col. W. Paterson who names Ash Island (now known as Moscheto Island, which forms part of Kooragang Island) after the trees which resembled the English Ash. The area consists of up to ten islands of various sizes.
1830	First small farmers (squatters) on Dempsey Island. This would have resulted in vegetation clearance, limited drainage of wetland areas and blockage of tidal flow.
1836	First industrial works established on Moscheto Island (saltworks, and later a sulphuric acid plant).
1845	Dairy farming commences on the islands.
1859	Dredging is commenced in Newcastle Harbour and approach channels. The spoil is dumped east and west of Bullock Island. Dredging continues intermittently for many years.
1860s – 1901	Reclamation of Walsh Island and Bullock Island continues.
1896	BHP acquires 10 hectares of waterfront land at Port Waratah to be used for smelters.
1912	Newcastle Iron and Steelworks Act of 1912-13 is passed to allow the construction of heavy industrial facilities.
1915 – 1928	Production of steel by BHP commences at Port Waratah (1915). Walsh, Goat and Spectacle Islands further consolidated by reclamation.
1930	The flow regime in the South Arm changed when the Public Works Department constructed a weir upstream between Hexham and Ash Island. This probably resulted in the narrowing of the channel.
1947	Newcastle Chamber of Manufacturers proposes the extension of port facilities and new industrial sites including 'development of islands in the lower Hunter River into industrial land'.
1950	NSW Government approves BHP's application to block off Platts Channel (to the south of the South Arm, see Figure 18.1) to use as a disposal site for waste and then as an expansion site for industrial facilities.
1950s	Further reclamation and consolidation of Walsh, Moscheto and Dempsey Islands. BHP begins to fill Platts channel, ultimately connecting Spit Island to the mainland.
1965	Tourle Street bridge is constructed linking Kooragang Island with Mayfield.
1968	Kooragang Island officially named by the Geographical Names Board (in so officially recognising the amalgamation of approximately ten original islands into Kooragang Island). The construction of powerlines, railways, pipelines and service roads across the island had brought about significant changes in elevation and associated changes to drainage patterns.
1999	BHP ceased iron and steel making operations on their site.

18.2.6 Presence of sites of heritage significance

There were no known sites, relics and/or items with historic heritage values within the area that would be affected by the proposal.

The review of marine historical resources, reinforced by observations of the NSW Heritage Office indicates that there is no historical record of any vessel being lost within, or proximate to, the study area. The only maritime resource indicated to be proximate at the level of river bank is the residue, if any, of the original timber wharves of the BHP Newcastle Steelworks. This residue, if any, is located outside the study area on the southern bank at the South Arm and east of the study area.

The surface survey of the study area identified no resources or elements associated with former historical activities at or on the study area.

Although there is no surface evidence to this effect, the possibility cannot be discounted that the material evidence of an unrecorded shipwreck exists within the South Arm.

18.3 Impact assessment

18.3.1 Aboriginal archaeology and cultural heritage

The banks of the South Arm are likely to have been used and occupied by Aboriginal people prior to occupation by European people. The area would have provided rich plant and food resources. However, it is likely that any evidence of this occupation has been destroyed by the reclamation and development of the area, which commenced in the mid-nineteenth century. The majority of the area that would be impacted by the proposal consists of imported fill and the natural ground surface is at least two metres beneath the current surface.

No Aboriginal archaeological evidence was identified during the current survey. The previously recorded midden within the study area could not be relocated and it is considered unlikely that any evidence of this site remains.

No impacts on Aboriginal archaeology and cultural heritage are anticipated as a result of the proposal.

18.3.2 Non-Aboriginal heritage and archaeology

Although the study area would be substantially modified as a result of the proposal, it is considered unlikely that the proposal would result in any impact on heritage values.

The heritage assessment determined that there is no known potential for heritage resources to be located within the study area. The assessment concluded that the proposal would have no impact on any known heritage resources and is considered to pose no threat to the heritage values of the locality or region.

18.4 Recommended mitigation measures

18.4.1 Aboriginal archaeology and cultural heritage

The following mitigation measures are recommended for Aboriginal heritage:

- If the area to be affected by the proposal is changed, the Worimi LALC would be contacted and further investigations undertaken to determine the potential for Aboriginal heritage impacts;

- Section 90 of the *National Parks and Wildlife Act 1974* states that it is an offence to knowingly disturb, deface or cause or permit the destruction of relics or an Aboriginal place without the written consent of NPWS;
- Controls regarding protection of these items should be included within the EMPs for the proposal;
- The EMP should include a requirement that works associated with the proposal must cease if an Aboriginal archaeological site is uncovered during the dredging process. The Indigenous Heritage Division of the NPWS must be contacted if Indigenous artefacts are uncovered;
- The EMP should include information about the statutory legislation protecting sites and places of cultural heritage, the process required when remains are uncovered, and responsibilities in this regard;
- It is recommended that the proponent submit a 'Consent to Destroy' application for site no. 38-4-0041 at least three months prior to any works commencing. There are no other archaeological constraints to the proposal; and
- As a result of the claim under the Aboriginal Land Rights Act 1983 over the current study area, the Worimi LALC should be consulted throughout the planning and implementation phase of the proposal.

18.4.2 Non-Indigenous heritage and archaeology

It is recommended that:

- prior to commencement of the proposal, an electronic examination by sonar/side-scan should be undertaken and the results of such investigation be interpreted to determine whether there is evidence of previously unidentified archaeological material with heritage potential located underwater;
- in the event that archaeological material evidence is identified during this investigation or as a result of the implementation of the proposal, all work having the capacity to disturb, damage or destroy potential material evidence should cease, in accordance with the provisions of the *Heritage Act 1977*;
- the NSW Heritage Office must be contacted if historic remains are uncovered, and the remains be managed in accordance with the requirements of the *Heritage Act*; and
- the project environmental management plans would include information about the statutory legislation protecting sites and places of cultural heritage, the process required when remains are uncovered, and responsibilities in this regard.

19

Transport, traffic and access

This chapter provides an assessment of the potential transport, traffic and access impacts of the proposal, including a traffic impact statement. Information on the existing environment is provided, the potential impacts of the proposal are assessed, and mitigation measures recommended.

19.1 Introduction

The RTA has requested that a traffic impact study be undertaken for the proposal.

The objective of a traffic impact study is to assess any impacts a proposal may have on the surrounding road network and if required, to formulate recommended improvement works.

In general, a traffic impact study covers the following:

- proposals for improvements to the adjacent road infrastructure;
- existing road and traffic environment, including annual average daily traffic, peak period traffic and road network operations;
- existing parking supply and demand in the vicinity of a proposal (where relevant);
- existing public transport services in the vicinity of a proposal;
- traffic generation and trip distribution of as a result of a proposal;
- parking provisions appropriate to a proposal (where relevant);
- safety and efficiency of internal road layout;
- impact of generated traffic on road network operations, road safety, the environment and other major traffic generating development sites in its proximity; and
- safety and efficiency of access between a site and the adjacent road network.

As a result of the nature of the proposal, this assessment concentrates on the potential impact of heavy vehicles on the adjacent road network.

The assessment undertaken of the proposal involved the following tasks:

- the existing transport and road network environment was first assessed. This included road network operations, rail facilities, public transport facilities, and pedestrian/cyclist facilities;
- the potential traffic generation and trip distribution as a result of the proposal was then determined for each major construction phase (eg. dredging, remediation, swing basin formation, channel slope protection works); and

- the proposal's impact on the existing infrastructure was evaluated, by comparing road network operations with and without the implementation of the proposal.

The assessment does not consider any future activities that may be facilitated by the proposal, including port development or wharf construction.

19.2 Existing environment

19.2.1 Road network description

In the vicinity of the area subject to the proposal, the major road network consists of Cormorant Road, Tourle Street and Industrial Drive.

Cormorant Road is a major arterial road running along the northern side of the South Arm, near the northern bank. It is an RTA classified B-double route.

Industrial Drive is also a major arterial road, and runs essentially parallel to the southern side of the South Arm, approximately one kilometre to the south of the southern bank, on the southern side of the OneSteel and closure area sites.

Cormorant Road and Industrial Drive are connected by Tourle Street, which crosses the South Arm at the Tourle Street bridge.

Cormorant Road is a two-way road varying from two to four lanes in width. The speed limit ranges from 60 kilometres per hour in the vicinity of the South Arm, to 80 kilometres per hour towards Teal Street and Stockton Bridge. It is in a generally good condition, with sealed shoulders incorporating marked cycle lanes.

Further to the east, Cormorant Road intersects with Teal Street at a two-lane roundabout. Teal Street connects Cormorant Road to Stockton Bridge, which in turn links to Stockton, Fern Bay, Williamtown, Port Stephens and areas further north.

Tourle Street intersects with Industrial Drive at a traffic signal controlled intersection. Industrial Drive is a four-lane road (two lanes in either direction) with a general speed limit of 80 kilometres per hour. It provides access to Newcastle CBD to the east, and Pacific Highway and New England Highway to the west.

For further details, refer to Figure C.24 (Appendix C).

19.2.2 Traffic volumes

Traffic data indicates that the annual average daily traffic flow along Cormorant Road / Tourle Street was 22,565 vehicles per day in 2000. Allowing for some seasonal factoring, it is considered that a current upper limit estimate of annual average daily traffic is approximately 25,000 vehicles per day.

The annual average daily traffic in 1998 for Industrial Drive was 38,062 vehicles per day west of Tourle Street and 29,549 vehicles per day east of Tourle Street.

Peak period traffic data in 2000 indicates the morning peak hour on Cormorant Road / Tourle Street is between 7am and 9 am with some 1,800 vehicles per hour in both directions, and the afternoon peak hour is between 4.45 pm and 5.45 pm with some 2,200 vehicles per hour in both directions.

Peak hour data for Industrial Drive was estimated and interpolated from Cormorant Road/Tourle Street's peak hour to daily traffic ratios. Morning peak hour traffic along Industrial Drive west of Tourle Street is estimated at some 3,030 vehicles per hour in both directions, while, east of Tourle Street, it is estimated at approximately 2,350 vehicles per hour in both

directions. During the evening peak hour, traffic along Industrial Drive west of Tourle Street is estimated at some 3,710 vehicles per hour in both directions, while east of Tourle Street it is estimated at approximately 2,880 vehicles per hour in both directions.

19.2.3 Road network operations

A service flow rate for a road section is the maximum rate at which vehicles can pass a point during a given time period under prevailing road, traffic and control conditions while maintaining a particular level of service. It provides an indication of the operation of a road section based on levels of service from A (best) to F (worst).

Service flow rates for the two-lane and four-lane sections of Cormorant Road, as well as the four-lane section of Industrial Drive, have been based on Austroads 'Guide to Traffic Engineering Practice, Part 2: Roadway Capacity'. In assessing existing service flow rates, the following assumptions have been made:

- The terrain is level;
- For the two-lane Cormorant Road/Tourle Street section, the percentage of road length with sight distance less than 450 metres is 20 percent (approximately 20 percent of road length has double barrier lines); this factor is not applicable for multi-lane roads, i.e. Cormorant Road four-lane and Industrial Drive four-lane sections;
- Directional distribution of traffic is 60 percent (peak direction) to 40 percent (non-peak direction);
- Average 3.7 metres wide lanes with 1.0 metre shoulder areas for the two-lane Cormorant Road / Tourle Street section, and average 3.3 metres wide lanes for Cormorant Road four-lane section (undivided road) and Industrial Drive four-lane section (divided road);
- The proportion of heavy vehicle volumes is 25 percent, with bus volumes at one percent;
- Commuter driver population; and
- Rural development environment, i.e. not typical suburban environment.

Based on the above assumptions, the following total service flow rates, in vehicles per hour (vph) in both directions, at the corresponding levels of service were determined for each road section (Table 19.1).

Table 19.1 Levels of service

LEVELS OF SERVICE (LOS)					
	A	B	C	D	E
Cormorant Road/Tourle Street (two lanes):	223 vph	429 vph	697 vph	1,156 vph	2,011 vph
Cormorant Road (four lanes):	Not applicable for 80 kilometres per hour	2,670 vph	3,560 vph	4,508 vph	5,932 vph
Industrial Drive (four lanes):	Not applicable for 80 kilometres per hour	2,588 vph	3,450 vph	4,368 vph	5,748 vph

Road classification, two-way peak hour traffic flows and levels of service based on service flow rates for roads in the vicinity of the site are shown in Table 19.2.

Table 19.2 Existing road operations

Road	Classification	Two-way peak hour flow (vph)		Service flow rate (LOS)	
		AM	PM	AM	PM
Cormorant Road (four lane section)	Arterial	1,768	2,181	B	B
Cormorant Road / Tourle Street (two lane section)	Arterial	1,863	2,205	E	F
Industrial Drive (east of Tourle Street)	Arterial	2,350 ¹	2,880 ¹	B	C
Industrial Drive (west of Tourle Street)	Arterial	3,030 ¹	3,710 ¹	C	D

¹ estimated and interpolated from Cormorant Road / Tourle Street's peak hour to daily traffic ratios

The above table indicates that the four-lane road sections have adequate capacity for the current traffic flows (LOS B, C and D) and have some spare capacity for increased traffic volumes (although Industrial Drive west of Tourle Street is approaching capacity in the evening peak period). However, the two-lane length of Cormorant Road (and hence Tourle Street) between Egret Street and Industrial Drive is at or close to capacity (LOS E and F) during the peak hours and in particular during the PM peak. This would indicate that current users experience delays and congestion during the afternoon peak hour along this length of the road. Thus, it is evident that Cormorant Road may require upgrading to four-lanes in the near future (whether or not the proposal occurs).

19.2.4 Rail infrastructure

An industrial / freight rail system, which links to the State rail network, services Kooragang Island. It takes the form of a 'balloon loop', dividing from the Main Northern Railway near Warabrook. Its main function is the transport of coal from the Hunter Valley to export markets via the Kooragang Coal Loader facility. An arrival and departure track is available and six departure sidings are located at the end of the balloon loop. The arrival track proceeds to Walsh Point as the Walsh Point Line.

The rail line is located approximately 1.5 kilometres north of the South Arm.

19.2.5 Other transport facilities

Bus services

The subject area is relatively poorly served by bus services.

Newcastle Buses runs route 104 between Newcastle Rail Station and Jesmond. This circuitous route passes along Industrial Drive for a short section between Vine Street and Ingall Street, with a bus stop near Vine Street. This service runs approximately every half hour during peak commuting periods.

Toronto buses runs route 270 between Toronto-University and John Hunter Hospital via Industrial Drive. However, there is only one service each in the morning and afternoon.

Port Stephens Coaches run a service connecting Nelson Bay to Newcastle Railway Station, travelling via Newcastle Airport, Kooragang Island and Industrial Drive. This service operates every 80 minutes during its peak. There are no bus

stops along Cormorant Road, Tourle Street or Industrial Drive (in the vicinity of the Tourle Street intersection. This is most likely a result of the lack of demand due to shift working hours and abundant private car facilities in developments around Kooragang Island.

Pedestrian / cycleway facilities

There are no pedestrian facilities along Cormorant Road or along roads approaching it. This is most likely due to the area's isolation and its distance from surrounding residential land.

On-street cycle lanes exist along Cormorant Road. These are in good condition and link with cycleway facilities into the Newcastle area via Industrial Drive.

Kooragang Island is used for road cycle racing and training. The Kooragang Cycling Association holds races on the island on most weekends. The race route is mainly on the eastern area of the island, and does not include Cormorant Road in the vicinity of the area subject to the proposal.

19.2.6 Parking facilities and internal access

There are no parking facilities available. Roadside verge areas are used casually for parking. Some parking is also available within the closure area site. This is scattered in various areas around the site.

The closure area site has a dedicated internal access network that allows access to the proposal area. Main access to the closure area site is via Bull Street/Ingall Street.

19.2.7 Current infrastructure proposals

Proposed and other possible changes to the existing road network could influence the potential for road transport impacts. Consultation with RTA Hunter Region has indicated the following issues with respect to current road infrastructure proposals in the vicinity of the South Arm:

- As a result of the number of development proposals in and around Kooragang Island, road network planning will depend to a great extent on land use development proposals and long-term development scenarios. The current situation is quite fluid, in that several development scenarios are being proposed and road network infrastructure will depend on what eventuates;
- There are current capacity issues (during peak periods in particular) on the two-lane section of Cormorant Road/Tourle Street, including the Tourle Street bridge;
- Duplication of Tourle Street bridge is currently in its design phase. It is anticipated that duplication would be complete by 2006; and
- A corridor exists to the north of Cormorant Road (and running approximately parallel to it), which connects directly onto Stockton Bridge, i.e. no connection via Teal Street. The DPWS owns the corridor. It runs west off Stockton Bridge, bisecting the Kooragang Coal Loader site and the industrial area south of Raven Street, including the proposed Protech site.

19.3 Proposed transport arrangements

19.3.1 Road transport / access routes

Dredging, remediation and swing basin formation

The proponent proposes to dredge the South Arm of the Hunter River extending for approximately three kilometres east of the Tourle Street bridge. Also associated with the proposed dredging is excavation of the banks towards the western end of the area that would be dredged, to provide a swing basin allowing large ships to turn. It is estimated that approximately 250,000 m³ of contaminated river sediments require treatment before disposal. Some 330,000 m³ of embankment material is to be excavated from the swing basin and approaches. Of this 330,000 m³ of material, some 300,000 m³ is estimated to be classified as 'inert waste', and approximately 30,000 m³ is estimated to require treatment before disposal.

Therefore, approximately 280,000 m³ of remediated material and some 300,000 m³ of inert waste needs to be removed. The location to which this material is to be transported has not yet been fully resolved. Three potential transport scenarios are considered within this chapter of the EIS:

- All of the material may be transported to the Closure Site (no external road transport required);
- All material may be transported to waste emplacement areas on Kooragang Island; or
- Some material may be transported to the Closure Site and some transported to Kooragang Island.

With respect to external road impacts, the worst case is to transport all material to Kooragang Island. Therefore, this scenario will be further assessed.

Transportation of both inert and treated material would be during normal 10-hour daily working hours, eg. 7 am to 5 pm. However, there is the potential to transport the inert waste material on a continuous, 24 hour, seven-days-a-week schedule if required.

Road-based transport for the 280,000 m³ of treated material would be governed by the production rate from the treatment process that is to be located at the Closure Site. This production rate is anticipated to be in the order of 200 m³ / hour. Based on 20 m³ / truckload (equivalent to approximately 30 tonnes), this is equivalent to ten truckloads per hour (or 20 truck movements / hour). The estimated duration is 140 x 10 hour days. Allowing for start-up and some contingency, the estimated duration of this activity is six months.

For the majority of the excavation of the 300,000 m³ of inert material from the river embankments and the One Steel sites, the excavation rate would not be constrained by treatment processes. Assuming that one large excavator is used, some ten truckloads per hour (or 20 truck movements / hour) could be anticipated. Based on an average 15 m³ / truckload (equivalent to approximately 30 tonnes), this would require some 200 x 10 hour days. Alternatively, 24-hour operations would require approximately 84 days of operations. Allowing for start-up and unforeseen circumstances, the estimated duration of this activity is ten months (10 hours / day operations) or some four months (24-hour, seven day per week operations).

It is anticipated that both treated and inert materials would be transported concurrently at certain times. During these periods, it could be anticipated that twenty truckloads (or 40 truck movements) per hour would occur. Thereafter, when only inert river embankment materials are being transported, ten truckloads per hour could be anticipated, or, alternatively the rate of excavation of the inert river embankment materials could be increased to a rate equivalent to twenty truckloads (or 40 truck movements) per hour.

Deliveries

The major deliveries associated with the proposal would be rock material to be used for foreshore treatment of the dredged batter profiles. In addition, there would be major deliveries of sheet piles, dredge pipes and other miscellaneous materials and plant. Details of deliveries are as follows:

- A total of up to 1,000,000 tonnes of rock (depending on the final design selected for the foreshore treatment of the dredge batter slopes) would be transported from off-site quarries – at this stage, two quarries at Seaham and Karuah are considered the most likely rock source.
- Approximately 11,000 tonnes of sheet piles would be transported to site stockpile areas within the closure area. In addition, approximately 30 percent of imported sheet piles would need to be removed at the end.
- Approximately 11.2 kilometres of dredge pipes would be transported to the Kooragang Island area.
- Approximately 25,000 to 50,000 tonnes of cementitious material for treatment processes would be transported to the closure site
- Other miscellaneous materials and plant delivery would use the main point of site access at the existing access to the closure area site, off Bull Street/Ingall Street.

Staff

During peak construction periods, it is expected that up to 50 staff would be on-site. It is anticipated that staff would travel mainly from Newcastle suburbs to the south of the site (via Industrial Drive into the Bull Street / Ingall Street access), although some may also come from areas to the north-east (via Stockton Bridge and Cormorant Road).

19.3.2 Traffic generation

Dredging, remediation and swing basin formation

Approximately 280,000 m³ of remediated material, and some 300,000 m³ of inert waste needs to be removed. With respect to external road impacts, the worst case scenario is to transport all material to the waste emplacement areas on Kooragang Island. Trucks would travel from either the swing basin / embankment area and/or Closure Site and exit onto Industrial Drive via the main site access. Trucks would proceed west along Industrial Drive, turn right into Tourle Street, travel across Tourle Street bridge and then veer left to access the proposed Kooragang Landfill area, immediately north of the Tourle Street bridge.

Currently, trucks returning from the proposed Kooragang Island landfill areas may exit the area some 200 metres to the north-east of the northern end of the Tourle Street bridge. For these relatively high volume transport operations, an alternative access to Cormorant Road remote from the Tourle Street bridge is necessary. A suitable location for this is at the Cormorant Road / National Power access road intersection at the eastern end of landfill. This intersection currently has filter lanes for traffic turning into the National Power access road from the east and from the west. Upgrading of this intersection would be required for the traffic volumes envisaged from the proposed transport activities.

Transportation of both inert and treated material would be during normal 10-hour daily working hours (eg. 7 am to 5 pm), although, there is the potential to transport the inert waste material on a continuous, 24 hour, seven-days-a-week schedule.

The traffic generation rate would be as follows:

- some 20 truck movements per hour during transport of treated material

- some 20 truck movements per hour during transport of inert material (although this could be increased to 40 truck movements per hour if excavation rates are increased)
- some 40 truck movements per hour during periods of concurrent transport of both treated and inert materials

Deliveries

The major traffic generation associated with deliveries to the site would be the transport of rock material to be used for riverbanks. Traffic generation from these and other deliveries is detailed below:

- Rock material would be transported from off-site quarries. Potential quarry locations are still under investigation, although, likely sites include Seaham and/or Karuah. Other potential quarry sites within close proximity of the South Arm may become evident at a later date. Rock material from quarry sites would be transported to a number of stockpile areas on both sides of the river. If the Seaham and/or Karuah quarry sites are used, the haulage route would follow the Pacific Highway south and east onto Industrial Drive and then Tourle Street / Cormorant Road, depending on which side of the river the rock material is to be stockpiled for use. Assuming some 1,000,000 tonnes of rock is required, approximately 33,500 truck loads or 67,000 truck trips would be generated over a 12 to 18 month period. Assuming a 12 hour-per-day, six-days-per-week transport regime, this is equivalent to approximately one truck load every 6.7 minutes over 12 months or one truck load every 10.1 minutes over 18 months.
- Approximately 11,000 tonnes of sheet piles would be transported to site stockpile areas within the closure area. This constitutes some 365 truckloads generating 730 truck trips over an approximate six-month period. Assuming deliveries would occur over a five-day working week, this is equivalent to some three truckloads or six truck trips per day. In addition, approximately 30 percent of imported sheet piles would need to be removed at the end of dredging activities, generating a further 220 truck trips.
- Approximately 11.2 kilometres of dredge pipes would be transported to the Kooragang Island area, constituting approximately 200 truckloads, which would generate 400 truck trips. It is envisaged this delivery would be transported in a relatively short period and stockpiled for use. Assuming delivery over a two-week, 10-day period, this is equivalent to some 20 truckloads or 40 truck trips per day. In addition, the removal of the dredge pipes would be undertaken at the end, resulting in a similar number of movements to those for delivery.
- Up to 50,000 tonnes of cementitious material for treatment processes would be transported to the closure site over an approximate six-month period. This requires approximately 2,000 truckloads, generating some 4,000 truck trips. Assuming deliveries would occur over a five-day working week, this is equivalent to some 16 truckloads or 32 truck trips each day.
- The remainder of construction materials and equipment would be delivered from the east and west, via Industrial Drive. It is envisaged there would be a maximum of some 100 truckloads during implementation of the proposal, for the remainder of construction materials and equipment. It is anticipated there would be minimal deliveries from areas to north and east, via Stockton Bridge and Cormorant Road.

It is assumed at this stage, that there would be minimal overlap of deliveries and, hence, cumulative traffic generation would be negligible.

Staff

Assuming an occupancy rate of 1.1 persons per car, and that all construction staff would use private cars to travel to and from the site, there would be an average peak traffic generation of 45 vehicles to and from the site per day.

The establishment of a dedicated public transport (bus) service between Newcastle, its major suburbs and the proposed site for construction staff would provide an alternative (and more sustainable) travel mode, and reduce the reliance on private car travel. Furthermore, the use of existing cycleway facilities could also lower the above traffic generation.

19.3.3 Rail transport

At this stage, use of rail transport is not proposed for delivery of materials required for the proposal. This is mainly due to the isolated nature of available quarry sites and the subsequent lack of rail transport nearby.

19.4 Impact assessment

19.4.1 Activities associated with the proposal

Dredging, remediation and swing basin formation

With respect to external road impacts, the worst case scenario is to transport all material to the waste emplacement areas on Kooragang Island. For this worst case scenario, traffic generation rates during the material disposal and handling phase of the proposal, would be as follows:

- some 20 truck movements per hour during transport of treated material
- some 20 truck movements per hour during transport of inert material
- some 40 truck movements per hour during periods of concurrent transport of both treated and inert materials

Assuming the worst case, a concurrent transport scenario of 40 truck movements per hour would constitute 1.7 percent and 1.4 percent of Industrial Drive traffic in the AM and PM peak periods respectively. Furthermore, this trucking rate would constitute 2.3 percent and 1.8 percent of Tourle Street AM and PM peak period traffic respectively. Both Industrial Drive's and Tourle Street's current levels of service would remain unchanged. It should be noted that the Tourle Street / Cormorant Road two-lane section of road (including Tourle Street bridge) is currently at or approaching capacity and an upgrading is proposed to be completed by 2006.

While these levels are relatively low, there is the potential for trucking associated with the development to affect intersection operations along the truck route. The trucking rate is equivalent to approximately one truck trip through the Industrial Drive / Tourle Street intersection every signal cycle (assuming a 90-second cycle time). As a worst case, there could be multiple vehicles (say, three trucks) during any particular cycle period due to platooning. This would need to be controlled to avoid a platoon of trucks arriving at an intersection at the same time and creating long queues and subsequent delays to other motorists.

With respect to waste emplacement areas on Kooragang Island, the major potential impact is loaded truck access off Tourle Street and empty truck access back onto Cormorant Road. For the latter, while adequate gaps in traffic are available during non-peak background traffic periods, during peak periods, it would be difficult to turn right from the National Power access road at the eastern end of landfill onto Cormorant Road. It is considered that the provision of a temporary signalised intersection would address potential safety issues for vehicles wishing to access the site.

With respect to internal site movements (ie. off public roads), there would be potential conflicts in a limited area along the internal site road network. These conflicts would occur between haul truck movements, vehicle movements relating to operations on the OneSteel site, and internal rail movements, which cross the internal site road network at various locations. While conflicts between existing vehicle movements relating to operations on the OneSteel site and internal rail movements, are currently adequately managed, it is envisaged that additional internal traffic management in the form

of traffic controllers and/or temporary signals (or similar) would be used to control and manage the addition of haul truck movements onto the internal site road network.

Deliveries

It is assumed at this stage that there would be minimal overlap of the various deliveries and as a result, cumulative traffic generation would be negligible.

In light of this, the major traffic generator is the delivery of rock material. This activity would also generate the maximum peak rate of traffic and thus, it is assumed, would create the greatest potential traffic impact on the surrounding road network. Peak traffic generation rates for delivery activities are as follows:

- Rock material – approximately one truckload every 6.7 minutes or one truck trip every 3.3 minutes over a 12-month period
- Sheet piles – approximately three truckloads or six truck trips per day
- Dredge pipes – approximately 20 truckloads or 40 truck trips per day.
- Cementitious material – approximately 16 truckloads or 32 truck trips per day.
- Remainder of construction materials and equipment – maximum rate of less than 10 trips per day

Assuming the worst case, for rock material delivery, a transport scenario of 18 truck movements per hour would constitute less than one percent of Industrial Drive's total traffic during either peak period. Furthermore, this trucking rate would also constitute less than one percent of Industrial Drive's total traffic during either of its peak periods. Both Industrial Drive's and Tourle Street's current levels of service would remain unchanged.

In terms of impact on intersection operations, this is equivalent to approximately one truck trip through the Industrial Drive / Tourle Street intersection every two signal cycles (assuming an 90-second cycle time). As a worst case, there could be multiple vehicles (say, three trucks) during any particular cycle period. In view of the occasional nature of such an occurrence for this phase of works and its relatively low impact, this is not considered to pose a significant impact.

With respect to site access, the major potential impact is access off and across Cormorant Road, particularly for delivery of rock material to the northern bank area. While adequate gaps in traffic are available during non-peak background traffic periods, during peak periods, it may be difficult to turn right into the access off Cormorant Road and perform other movements onto and across Cormorant Road.

It is considered that the provision of a temporary signalised intersection would address potential safety issues for vehicles wishing to access the site. For proposed location details, refer to Figure C.24 (Appendix C).

The other main access is via the existing Bull Street / Ingall Street access to the OneSteel and closure area. It is considered that access to these sites via the existing site accesses would be adequate in view of the relatively light traffic generation for delivery activities to these areas.

With respect to special deliveries that may be required (e.g. large plant or materials using wide or long vehicles), these would be delivered at night when traffic impact would be minimised.

Staff

An anticipated maximum of 50 staff would generate some 45 vehicle movements to and from the site per day. Generally, work on construction sites begins prior to the adjacent morning traffic peak period and finishes prior to the afternoon/evening peak period.

The movement of some 45 vehicles into the site prior to the morning commuter peak period and 45 vehicles out prior to the afternoon peak would significantly mitigate any impacts that may occur if these movements were to occur during the commuter peaks. Outside commuter peak periods, the adjacent roads have greater spare capacity as a result of less background traffic on the road network. All staff would expect to benefit from reduced travel time in comparison to peak period travel.

19.4.2 Impact on the Tourle Street bridge

Traffic capacity

As mentioned previously, there are current capacity issues (during peak periods in particular) of the Tourle Street bridge and adjacent two-lane section of Cormorant Road. The duplication of Tourle Street bridge is currently in its design phase and is anticipated to be completed by 2006. This would significantly increase traffic capacity across Hunter River South Arm in the area. This is a positive impact with respect to the Tourle Street bridge crossing.

Physical impact

The western limit of the proposed extended channel is relatively close to the location for the new bridge (proposed by the RTA). As a result, measures to limit the potential impacts of a ship colliding with the bridge have been considered. A western dredge batter slope, at a typical submerged batter slope of 1:5, would result in the intersection point of the submerged dredge batter and the existing river bed being too close to the proposed new bridge alignment. A steeper submerged dredged batter slope has been considered, which moves the dredge batter and riverbed intersection point further downstream. This configuration provides a steeper batter, which would offer more resistance to impact from any wayward ship. This issue is dealt with in more detail in Chapter 6.

19.4.3 Impact on Cormorant Road

It is assumed that there would be no adverse impact on the existing or future alignments of Cormorant Road as a result of the proposal.

A possible future alignment may follow a corridor that exists to the north of Cormorant Road (running approximately parallel to it) and connects directly to Stockton Bridge. Because of its more direct route between the Tourle Street bridge crossing and Stockton Bridge, it is considered the permanent relocation of Cormorant Road to the northern corridor would be advantageous from travel-time, road safety and road capacity viewpoints.

As discussed previously in *Section 1.4.1*, the major issue along Cormorant Road is access to both the landfill and northern bank areas. It is considered the provision of a temporary signalised intersection would be appropriate to address safety and capacity issues for both these areas.

19.4.4 Rail transport

There would be no impact to the rail system; rail transport is not proposed to be used. The proposed pipeline route to Tomago would not affect the rail network as the pipeline would be grade separated when crossing the railway line.

19.4.5 Ferry transport

Newcastle Ferries operates a public transport ferry service running between Queens Wharf, adjacent to the Newcastle CBD, and Stockton. This service would not be adversely impacted by the proposal.

19.4.6 Other impacts

There are no other anticipated transport-related impacts associated with the proposal.

19.5 Recommended mitigation measures

There are a number of transport-related impacts associated with the proposal. However, the following general measures are recommended to minimise any impacts:

- Monitoring of traffic and intersection operations should be undertaken during the early stages of transport operations to evaluate and amend trucking operations if required.
- A temporary signalised intersection of Cormorant Road should be provided at the existing National Power access road at the eastern end of landfill, to improve Cormorant Road access from the Kooragang Island landfill sites and the northern bank of the Hunter River.
- If transportation of materials is to occur from the southern bank to the possible disposal sites on Kooragang Island, a 24-hour, seven day a week transport regime for the inert material should be adopted. This is required to reduce the traffic impact on the surrounding road network, either by reducing the total amount of time of the operations or reducing the rate of transportation.
- Where possible, concurrent transport of both inert and treated material should not coincide in order to avoid higher trucking rates, resulting in increased impact on the adjacent road network.
- While there would be some potential transport conflicts within the OneSteel site, these would be managed internally within OneSteel.
- Where possible, general deliveries to the site should occur after 9 am to reduce the impact of the delivery vehicles on the road network. Allowance should be made for any specialist deliveries if tasks are critical to the construction program.
- Delivery of inbound materials (particularly the larger quantities such as rock material for river banks) should reduce their delivery rate during or avoid background traffic peak periods (approximately 7 to 9 am and 4 to 6 pm) as far as possible, in order to reduce the impact on the adjacent road network during peak times.
- To reduce the employee traffic impact, shift change times should be aligned so that staff traffic movements do not occur during either the morning or afternoon peak periods on the adjacent road network. Peak periods on the adjacent road network are generally 7 to 9 am and 4 to 6 pm.

It should be noted that currently, even without any impacts associated with the proposal, an upgrade of the two-lane section of Cormorant Road/Tourle Street (between Egret Street and Industrial Drive, including Tourle Street bridge) to four lanes (two lanes each way) is required. The duplication of the Tourle Street bridge is in the design phase at present with a view to its completion in 2006.

20 Socio-economic factors

This chapter examines the existing socio-economic characteristics of the study area and the potential impacts of the proposal on these characteristics. Safeguards are recommended to minimise potential impacts where necessary

20.1 Introduction

The following section provides information on the socio-economic profile of residents of the Lower Hunter region and the Newcastle local government area (LGA). It considers the area's demographic, social and economic characteristics and assesses the impact of the proposal on these characteristics.

The characteristics of the existing socio-economic environment are examined from a regional perspective, as the long-term impacts in terms of providing for an expansion of port facilities, employment generation and economic stimulus are likely to be experienced at a regional level.

The Hunter region is composed of two sub-regions, the Newcastle Statistical Subdivision and the Hunter Balance Statistical Subdivision. The site is located within the statistical subdivision which includes the Newcastle, Port Stephens, Maitland, Lake Macquarie and Cessnock LGAs. These LGAs are collectively referred to as the Lower Hunter. Comparisons have also been made to NSW as a whole, to provide a context for the regional population.

The profile has been developed from the following data sources:

- *2001 Census of Population and Housing* (Australian Bureau of Statistics); and
- *Population Projections for NSW* (Preliminary) (DUAP, 1999).

The assessment of potential socio-economic impacts has also taken into account:

- Newcastle City Council's social impact assessment policy, which aims to ensure that both the positive and negative aspects of developments are considered by both the applicant and Council; and
- Results of assessments undertaken by other specialists for the EIS.

20.2 Existing environment

20.2.1 General population characteristics

The 2001 Census indicates that the Hunter region had a total population of 563,587 and represented 8.8 percent of NSW's population. The LGAs which form the Lower Hunter account for the majority of urban development within the Hunter region and collectively have a population of 470,610 which represents 83.5 percent of the population of the Hunter region.

The Lower Hunter has a history of strong population growth, increasing from 405,089 in 1986 to 470,610 in 2001. This represents an overall increase of 16.2 percent compared to 18 percent for NSW as a whole. During this time, growth has been highly variable, with coastal LGAs such as Port Stephens displaying some of the highest growth rates in the State.

The proposal would be undertaken within the Newcastle LGA, which had a population of 137,307, or 29.2 percent of the population of the Lower Hunter. The Newcastle LGA is characterised by:

- relatively even proportions of males (49 percent) and females (51 percent);
- a lower proportion of people born overseas (11 percent) compared to NSW as a whole (23 percent).

The population of the Newcastle LGA increased from 129,490 in 1986 to 137,307 in 2001. This represents a growth of approximately 5.7 percent over the 15-year period, which is well below that of NSW (18 percent) and the Lower Hunter (16.2 percent). This low growth rate indicates that the population is relatively stable and that the new residential developments have taken place within other LGAs. This is likely to be influenced in part by the large amount of industrial land that is located within the Newcastle LGA, which is used for the port, steelworks and other heavy industry, preventing it from being used for residential development.

The population of the Lower Hunter is predicted to continue to grow to 530,900 in 2026 (DUAP 1999). During this time, the annual growth rate is likely to decrease from 0.6 percent between 1996 and 2001 to 0.2 percent between 2021 and 2026.

20.2.2 Employment characteristics

Table 20.1 compares the labour force statistics of the Newcastle LGA, Lower Hunter and NSW as a whole. Both the Lower Hunter and Newcastle LGA have a lower labour force participation rate, a lower proportion of people employed on a full-time basis and a higher proportion employed on a part-time basis. Both the Lower Hunter and Newcastle LGA have a higher unemployment rate than NSW as a whole.

Table 20.1 Labour force characteristics

Characteristic	Newcastle LGA	Lower Hunter Region	NSW
Labour force participation rate	55%	58%	62%
Employed full time	31.2%	32.4%	37.1%
Employed part time	16.3%	16.4%	15.6%
Unemployed	12.4%	11.6%	8.8%

The Lower Hunter region has traditionally displayed a relatively narrow employment base, with a large proportion of people employed in the mining and manufacturing sectors.

The main industries of employment in the Lower Hunter in 2001 were retail, manufacturing, health and community services and property and business services. There have been some significant changes in industries, which employed residents of Lower Hunter between 1986 and 2001. The most notable declines in this period were in:

- the proportion of people employed in the manufacturing sector, from 18.2 percent to 12.4 percent;
- the proportion of people employed in the mining sector, from 5.7 percent to 2.2 percent; and
- the proportion of people employed in the electricity, gas and water supply sector, from 3.1 percent to 1.1 percent.

The most notable increases were in:

- The proportion of people employed in the property and business services section, from 5 percent to 9.1 percent;
- The proportion of people employed in the retail trade sector, from 14.1 percent to 17.1 percent; and
- The proportion of people employed in the health and community services sector, from 9.2 percent to 11.8 percent.

These changes are evidence of the changing trend in employment patterns in the Hunter region. The industrial base of the Hunter is diversifying and increasing numbers of people are employed in service industries (such as property, retail and community services) as opposed to primary (such as mining and agriculture) and secondary (such as manufacturing) industries. This broadening of the industrial base increases the range of employment opportunities for residents in the region and makes it less susceptible to downturns in any particular industry.

Compared with NSW as a whole, both the Lower Hunter and Newcastle LGA have higher proportions of people employed in the retail trade, education, health and community services and mining sectors. The greatest proportional difference between the Lower Hunter and NSW occurs in the mining sector where four times the proportion of people are employed (2.2 percent compared to 0.5 percent).

The most common occupations of people in the Lower Hunter are professionals (16.9 percent), followed by intermediate clerical sales and service workers (16.6 percent), tradespeople (14.6 percent), associate professionals (11.3 percent) and elementary clerical sales and service workers (11.2 percent).

Certificates (19.7 percent) were the most common form of qualification held by the workforce of Lower Hunter, followed by bachelor degree (6.8 percent) and advanced diplomas (5.4 percent). 54.6 percent of the workforce either did not have a qualification or held a qualification that was outside the scope of the Australian Standard Classification of Education.

20.2.3 Economic characteristics

Secondary industry dominated the economy of the Hunter region as a whole, with an annual turnover of \$6,408 million in 1996/97, while primary industry generated a total of \$429 million during the same period. Coal mining accounts for the majority of primary industry earnings, with the region producing 67 percent of NSW's coal. Of the 19 million tonnes produced by the Hunter region in 1999/2000 for the domestic market, 92 percent was used by the energy sector (through the use of coal fired power stations), with the iron and steel industry being the second largest consumer (two percent).

Australia is currently the world's largest coal exporter, and in 1999/2000 a total of 65.4 million tonnes was exported through the Port of Newcastle

Table 20.2 provides a breakdown of turnover within the secondary industry sector for the Hunter region as a whole.

Table 20.2 Turnover of secondary industries in the Hunter region in 1996/97

Industry sector	Turnover 1996/97 (\$M)
Food, beverages and tobacco	833.7
Textiles, clothing, footwear, and leather	168.5
Wood and paper products	116.1
Printing, publishing and recorded media	116.6
Petroleum, coal, chemical and associated products	412.7

Table 20.2 Continued.

Industry sector	Turnover 1996/97 (\$M)
Non-metallic mineral products	143.8
Metal products	3,717
Machinery and equipment	845.9
Other manufacturing	53.9
Total manufacturing	6,408.2

Newcastle Port

Table 20.3 provides a summary of the exports which passed through the port in 2000 and 2001.

Table 20.3 Exports through the Port of Newcastle

	Tonnes 2000-01	Percentage of Total Exports
Overseas		
Aluminium	258,943	0.4
Iron and Steel	71,114	0.1
Concentrates	347,442	0.5
Grain	1,595,082	2.2
Woodchips	255,366	0.4
Sands	46,854	0.1
Coal	67,218,835	95.4
Other	272,698	0.4
Coastal	401,286	0.6
Total	70,447,620	100

Source: Newcastle Port Corporation

Port throughput increased by 1.6 percent between 2000/01 and 2001/02, while imports decreased as a result of cessation of BHP's steel making activities. Exports increased by three percent, with this reflecting promising growth in the aluminium, mineral concentrates, grain and coal industries. It is also important that the Newcastle Port Corporation's trade has diversified, with a 13 percent increase in container trade through the port.

20.2.4 Commercial fishing

This section is based on data available from NSW Fisheries.

As detailed in Chapter 12, the Hunter River is a commercial fishery and the main activity undertaken is prawn trawling. The Hunter estuary is one of four in NSW in which trawling for prawns is permitted and, during 1996/97, there were 66.8

tonnes of prawns taken from the Hunter River estuary by 34 licensed operators. Estuary prawn trawling is conducted mainly between September and May, with the majority of catches landed during the 'dark' of the moon (between the last and first quarter), on either run out or 'slack' tides.

The Hunter finfish fishery is the ninth largest in NSW and there is also a small but viable oyster industry. The oyster leases are restricted to the north arm due to the potential for contamination in the South Arm. In December 1998, the Minister for Fisheries prohibited the taking of shellfish from the South Arm for a period of five years.

The Hunter River is located within a commercial fishing area referred to as Region 5 by NSW Fisheries. Region 5 includes Myall Lakes/Port Stephens, the Hunter River and Tuggerah Lakes. Commercial fishing methods include hauling, mesh netting, trapping, handling, and hand gathering. The commercial fishery is based on the catching of a wide range of finfish species as well as prawns and other crustaceans.

The annual catch of the Region 5 estuarine fisheries, not including Lake Macquarie, is approximately 1,151 tonnes, which has a value of approximately \$3.9 million to \$4.8 million at first point of sale. It is worth noting that there are undoubted multiplier effects associated with commercial fishing earnings and that, while the value of catches at first point of sale is a useful and consistent measure, it probably underestimates the total economic value. The commercial catch from Region 5, excluding Lake Macquarie, accounts for approximately one percent of total seafood consumption in NSW (which total is estimated at 129,000 tonnes). Its haul comprises around six percent of the total commercial (estuarine and ocean) catch in NSW jurisdiction (of approximately 19,000 tonnes) and around 5 percent of the total value (of approximately \$80 million). The commercial catch from Region 5, excluding Lake Macquarie, consists of around 20 percent of the total estuarine commercial catch in NSW (of approximately 5,710 tonnes).

According to information from catch returns, approximately 40 per cent of the commercial catch of fish and shellfish from the region is forwarded to the Newcastle Fishing Co-operative. The remainder is distributed directly to the Sydney Fish Market (13 per cent), fish wholesalers in New South Wales and Queensland, and other local fishing co-operatives, including the Wallis Lake, Mannering Park and Taree Fishing Co-operatives. A proportion is also sold directly to seafood outlets by the commercial fishers. Although 13 per cent of the catch from the region is distributed directly to the Sydney Fish Market, much of the catch consigned to the local fishing co-operatives is also reconsigned to the Sydney Fish Market.

20.3 Impact assessment

The proposal has the potential to give rise to both positive and negative socio-economic impacts. Negative impacts would generally be restricted to the construction phase and would be related to the use of heavy machinery, which would impact on the amenity of the environment. These potential impacts would be associated with noise, air and water quality, odour and health risk. These issues are addressed in specific chapters within this EIS.

Other potential negative impacts include impacts on commercial fishing and oyster leases and impacts on recreational use of the South Arm.

Potential positive impacts include:

- generation of jobs in the short term;
- generation of jobs in the long term as the deepened waterway would ensure that industries in the vicinity that rely on the port are able to continue to operate and expand;
- stimulation of the economy through the flow-on effects of investment in the area; and

- long-term environmental benefits and improvements in amenity that would stem from the remediation of the contaminated material which is present in the South Arm's sediments.

The port is of national importance and the proposal would ensure that its position is not only maintained but enhanced.

20.3.1 Overall social impacts

The proposal is likely to positively affect the socio-economic environment through the creation of increased long-term employment opportunities within the Lower Hunter region. An established industrial area that includes heavy industries such as steel making and manufacturing surrounds the site. The proposal would provide infrastructure that would allow for further growth of the port and thereby ensure that these industries continue to provide employment opportunities for residents of Newcastle.

Negative socio-economic impacts include community perceptions relating to potential impacts on local and regional amenity, and public health. These concerns originate from perceived increases in noise and air pollution. Disturbance of the contaminated sediments also gives rise to concerns about water pollution. The potential for these impacts has been considered in other chapters within the EIS.

Potential socio-economic impacts are examined below.

Employment generation

The proposal would generate employment during both the construction and operational phases. It is estimated that the construction workforce would range from 30 to 150 people over three shifts and would employ:

- tradespeople;
- construction workers and labourers;
- maritime transport workers; and
- engineers.

The proposal would also generate additional employment as a result of direct and indirect effects.

The only people likely to be directly employed during implementation of the proposal would be those responsible for monitoring the channel and occasional maintenance dredging. However, completion of the proposal would provide the infrastructure that is essential for further industrial development of the land adjoining the Hunter River. The proposal would as a result benefit the regional economy, and create additional jobs, by providing infrastructure that is required for the expansion of industry. This would be an indirect benefit of the proposal and is reliant on industry taking advantage of the opportunities provided by improved deep water access.

Population growth and community structure

As indicated above, the population of the lower Hunter region has been steadily increasing over the past four census periods, and this growth is predicted to continue into the future. The proposal would assist in catering for this growth by providing employment opportunities for the regional workforce. It would ensure that the port is able to continue to function and ensure that industries that rely on the port can expand in the long term.

In terms of community structure, Newcastle is a relatively close-knit community with a traditional industrial base in coal shipment and steel production. Recent significant events, such as the closure of the BHP Steelworks in 1999, have played a role in reinforcing this structure, as the community has acted to ensure that there have been positive outcomes from these events. One such example is the general desire of the community to promote cleaner industry in the region. The proposal would build upon this desire by remediating the contaminated sediment that would be dredged from the

South Arm. The proposal, therefore, has the dual benefit of providing long-term employment in the region as well as improving the existing environment by removing a source of contamination.

The proposal is likely to enhance existing community structure by providing employment opportunities during construction, and also by allowing for the continued expansion of industry in the region that would become feasible as a result of the implementation of the proposal. As the future workforce is likely to be drawn from the local population, employment opportunities would be improved and the community structure would be enhanced.

Local and regional amenity

The proposal would have both positive and negative impacts on the local and regional amenity. In the short term, during the dredging, excavation and remediation activities, negative impacts would be experienced. The presence of dredges in the river is likely to detract from the visual amenity of the area, as would the presence and operation of other machinery. This is considered to be a minor impact, as the South Arm is adjacent to industrial land and so is of limited significance in terms of visual amenity.

The proposal involves the remediation of contaminated sediment that currently pollute the Hunter River. The removal and remediation of this material would provide a significant long-term benefit to the environment through the removal of an existing pollution source.

Public health

The proposal would not involve any activities that would have a negative impact on public health. The potential impact of the works on water, noise, and air are discussed in Chapters 11, 16, and 17 respectively.

Potential benefits to public health could stem from the remediation of the contaminated sediments. Removal of contamination could improve the overall health of the marine fauna and flora in the waterways and reduce the potential for bioaccumulation in the food chain.

Community services and facilities

As the proposal would provide employment opportunities for people in both the long and short term, there is the potential for there to be an increase in the demand for human services and community facilities that are usually funded by the various levels of government. It is likely that any increase in the demand for services would be minimal, as it is anticipated that the workforce would be drawn from the existing regional population. As such, these individuals would already be using the services that they require and there is as a consequence, not expectation for a significant increase in demand.

The proposal would have flow-on effects within the economy that would generate jobs throughout the community. Although it is likely that the existing workforce would fill these positions, the potential exists for people to move into the region in search of employment, thereby increasing the regional population. Any increase is likely to be minimal and would not significantly increase the existing demands on human services or community facilities.

Crime and public safety

Potential impacts on public safety would be limited to those associated with an increased volume of shipping traffic using the waterway. Given that the waterway is currently used for shipping purposes, and that the proposal would improve the existing conditions, these potential impacts would be minimal.

Operation of the dredges has the potential to impact on public safety as the dredge could present a boating hazard. The removal of the dredged material would also increase the volume of traffic on the waterway. The potential impact of these hazards on public safety are assessed in the hazard and risk assessment detailed within Chapter 23.

The proposal would not impact on crime rates. Land-based construction sites would be fenced off to prevent the general public from entering any sites.

Other

The South Arm itself currently experiences the following uses:

- Prawn trawling (6 am – 6 pm October to May).
- Recreational fishing on the north bank of the South Arm;
- Shipping movements containing bulk cargo; and
- Ship berths.

20.3.2 Impacts on commercial fishing and oyster leases

There is the potential for the proposal to impact on the commercial use of the Hunter River fishery. Commercial fishing in the river includes prawning in the South Arm as well as oyster farming in the north arm. The waterway also provides access between fishing grounds upstream and downstream which are accessed by commercial fishermen.

The environmental impacts of the proposal on the hydrology and aquatic systems are considered in Chapters 11 and 12 respectively.

The proposal would impact on commercial fishing operations in the South Arm as a result of restrictions on access within the subject area. Commercial fishing in this section of the South Arm is limited to prawn trawling and it is anticipated that fishing activities would be restricted within the three kilometre section of the South Arm to preserve public safety. Access through the study area would therefore be restricted to minimise potential conflicts and the extent of this access would be subject to negotiation with the fishing co-operative.

There is also the potential for the proposal to impact on the fishery itself during construction. Chapter 11 indicates that activities would re-suspend sediment which has the potential to affect fish and prawn feeding habits. As the proposal is likely to occur year round, this would have a local impact on the presence of prawns in the study area. This, combined with the exclusion of prawn trawlers, would lead to an economic impact on the local fishing industry.

Oyster cultivation is restricted to the north arm and it is unlikely that there would be any impact on these commercial oyster leases (refer to Chapter 11). The proposal would therefore not have any economic impacts on the local oyster industry.

Chapter 11 also indicates that, in the long term, the proposal is likely to result in changes to the species of fish which are present in the South Arm. There would be an increase in the abundance of species such as prawns and mulloway which are of commercial and recreational value. As a result, there is the potential for commercial fishing to benefit in the long term through increasing the area of habitat that is available for target species.

20.3.3 Impacts on recreational use of the South Arm

Undeveloped land along the river bank to the north, between the South Arm and Cormorant Road, is used intermittently for access to the river and recreation (such as fishing from the banks).

Public access to the banks would be restricted during excavation of the banks. The area proposed to be excavated in currently partly vegetated with mangroves. Given the industrial nature of the surrounding area, the north bank of the South Arm in this area is not considered to be a significant recreation resource.

Public access along the South Arm is also likely to be restricted for significant periods during the dredging and excavation process. This would impact on recreational boating within the South Arm, and also affect the level of access people have between the areas upstream and downstream of the study area. Although it is possible for people to use the north arm to access areas upstream and downstream of the study area, it is understood that the north arm is significantly shallower and some vessels may only be able to navigate it at high tide. The proposal would therefore impact on the level of access people have along the Hunter River, and also the timing of that access.

20.3.4 Economic impacts

The proposal would impact on both the local and regional economy during the construction and operational phases.

The estimated capital cost of the proposal is approximately \$300 million to \$400 million, which would be composed of:

- dredging costs, such as lease of the dredge;
- bank treatments such as stabilisation and rehabilitation;
- remediation of the 250,000 m³ of contaminated material;
- offshore disposal of the dredged material;
- environmental mitigation measures such as odour control, erosion and sedimentation controls;
- compensation to public utilities who would require existing services to be relocated; and
- compensation to OneSteel for the acquisition of land and operational impacts to allow the formation of a swing basin.

Construction

Dredging

The main cost associated with the actual dredging operation would be the lease of the dredge machinery. Given the scale of the proposal and the absence of dredge of sufficient size in Australia, it is anticipated that the dredge would be leased from an overseas operator.

Operation of the dredge would also require the purchase of fuel, which would be acquired locally. This would contribute to the local economy by supporting local businesses.

As the dredge would be leased from an overseas operator, a proportion of the cost of the proposal would go offshore, and therefore not generate any flow on effects in the local economy. Money spent locally on operating the dredge would generate flow on effects in the local economy and result in indirect and induced effects, thereby stimulating the economy and generating employment.

Bank stabilisation

As detailed in Chapter 5, bank stabilisation activities would be required to construct the final form of the riverbanks and ensure that they would be stable in the long term. This would involve the use of heavy earthmoving equipment such as excavators, bulldozers and cranes, which are likely to be sourced from within the region. As all machinery and materials are likely to be sourced from within the region, this is likely to give rise to benefit the economy through direct, indirect and induced effects.

Offshore disposal

The proposal involves the offshore disposal of material that is unable to be beneficially reused. As it is anticipated that the vessel used to undertake this activity would be leased from an offshore company, the money would go overseas and would not have any impact on the economy of the Hunter region.

The fuel and materials required to operate the machinery would be sourced locally and this money would benefit the local economy.

Economic effects

Aside from expenditure associated with the hiring and operation of plant and machinery, and employment of up to 150 construction staff, the proposal would have minimal direct economic effects. However, as detailed in Chapter 4, the proposal would allow additional berths to be constructed for large vessels and this would ensure that port operations are able to expand in the future. The proposal is likely to indirectly impact on the economy by providing infrastructure that would allow port operations to expand, thereby increasing revenue and the number of jobs available within these industries.

The proposal would also generate approximately 6 million m³ of clean sand for beneficial reuse.

Continued operation of the port would also generate income in the long term through navigation and pilotage charges. As new berths would be privately owned there would not be any ongoing income from the use of the berths.

Employment generation

Construction

It is estimated that the proposal would require a construction workforce of up to 50 people on each of the three shifts, however the number of people employed at any one time would vary between 10 and 50 depending on the tasks being undertaken. Over the three shifts, there would be approximately 150 people employed. The exact number of people to be employed would also be dependent on the work program proposed by the contractor.

As stated above, it is anticipated that the majority of the workforce would be sourced from the regional labour force, however there is the potential for specialist positions to be filled from people from outside the region. As it is expected that the dredge would be sourced from overseas, it is likely that the personnel to operate the dredge would also come from overseas.

Operation

Operation of the proposal would have negligible direct impact on the regional employment market. Following completion of the proposal and construction of the new berths, existing industries would have the opportunity to expand and this may give rise to additional employment. This would be a long-term indirect effect and the number and timing of any additional employment which may be created would be dependent on subsequent development.

20.4 Summary and recommended mitigation measures

The following mitigation measures are recommended to minimise adverse impacts on the socio-economic environment:

- Prior to the commencement of the proposal, the proponent would develop a commercial fishing protocol in consultation with the Newcastle Commercial Fishermen's Co-Operative. The Protocol shall detail measures to be employed by the Applicant and the relevant groups to minimise conflicts between the activities of both parties. The Protocol is required as the South Arm is likely to be closed for significant periods of time during construction; and

- Prior to the commencement of the proposal, the proponent would develop a South Arm public access protocol. The Protocol shall detail measures to be employed by the Applicant and the relevant groups to minimise conflicts between the activities of both parties. The protocol is required as the South Arm is likely to be closed for significant periods during construction.

It is recommended that a consultation and communication plan be developed covering local businesses, surrounding residents and the wider community. The plan would detail activities to be implemented in the lead up to, and during, implementation of the proposal. Recommended consultation tools include:

- A nominated and dedicated consultation manager responsible for ongoing liaison with the community and businesses;
- A community hotline – operating 24 hours during the dredging period – to enable response to questions, complaints etc;
- Regular meetings with key stakeholders and surrounding residents. This should include discussions with surrounding businesses and landowners (including businesses on the OneSteel site and Kooragang Island) regarding access and other requirements to identify potential issues and develop appropriate management mechanisms. Other key stakeholders include residents of surrounding suburbs, environmental and other community groups, and Newcastle Council;
- Widely advertising changes to access arrangements along the South Arm;
- Project newsletters/information sheets distributed to surrounding landowners, businesses and residents;
- Regular project updates in the *Newcastle Herald*; and
- A project information signboard erected in the vicinity of the South Arm providing regular update on the progress of the proposal, contact details etc.

21 Landscape and visual quality

This chapter provides information on the existing landscape and visual quality of the area affected by the proposal. The potential impacts of the proposal are assessed, and recommended mitigation measures provided.

21.1 Existing environment

21.1.1 Relevant features of the site and surrounds

The South Arm forms the southern boundary of Kooragang Island between the suburbs of Carrington and Stockton in the east and Hexham in the west. To the south of Kooragang Island is the CBD of Newcastle. The industrial areas of Mayfield and Carrington are located immediately to the south of the South Arm.

To the east is Stockton, a predominantly residential area on a spit of land that separates Newcastle Harbour from the ocean.

To the west of the Tourle Street bridge, on the southern side of the South Arm, are the suburbs of Mayfield West and Sandgate. The area known as the Hexham Swamp occupies an further to the west.

The natural landscape of Kooragang Island has been significantly altered by human activities in the last 50 years. Up until 1950, in the area east of the Hexham Bridge, the mouth of the Hunter River was an estuarine environment. The landscape consisted of marshy banks, islands, channels, mudflats and mangroves.

As noted in Chapter 10, extensive landfilling during the the 1950s and 1960s consolidated the group of estuarine islands and a single landform, Kooragang Island, was created. The purpose of the landfilling was to establish an estate for new industries. The southern shore near Carrington and the northern shores near Tomago were also landfilled for the establishment of industry. The landfilling created a permanent terrestrial environment in place of the wetlands that previously existed.

Dredging provided fill for these operations and it also created a deep water harbour.

The river was, as a result, split into two channels: north and south. In the process some of the indefinite edges of marshes and wetlands were removed and definitive shorelines were established.

21.1.2 Existing visual quality

The distinctive character of the area surrounding the South Arm is dominated by:

- low-lying flat topography;
- wetlands with biological diversity in flora and fauna;
- large expanses of dry grasslands that are the product of landfilling operations; and
- intense industrial activity.

A brief summary of the landscape features follows.

Geology and soils

The underlying geology of Kooragang Island was laid down in the Quaternary period. This includes sedimentary deposits of gravels, sands, silts and mud that are known to be up to 75 metres deep. They overlay the Permian deposits of the Newcastle Coal seams.

Dredging of the Harbour has provided landfill that has consolidated the islands in the estuary to the single land mass of Kooragang Island.

Topography

The low-lying flat areas are typical of the surrounding area. This topography prevails in both areas to the north and south of the River and on the estuarine islands.

On Kooragang Island, the topography of the study area is flat with gradients no steeper than two percent. None of these areas are greater than five metres above AHD.

Vegetation

The main types of vegetation in the study area include both remnants of the natural vegetation and introduced plants. There is a limited amount of natural vegetation found in the general area, including:

- mangroves;
- salt marsh vegetation; and
- freshwater swamp vegetation.

The introduced vegetation that is found in the area includes:

- plantings of native trees around existing industrial development. These are predominantly eucalypts and melaleuca species that have been used as landscaping, to provide buffers between various industrial activities.
- dry grasslands. Introduced grasses have been used to stabilise landfills and are extensive in areas that have not yet been developed by industry.

Further information on the terrestrial vegetation communities is provided in Chapter 13.

Land use

The major types of land use in the immediate vicinity of the South Arm are industrial and port related activities.

Other land uses surround this area, including environmental protection, and residential (see Chapter 10 for more information).

Built form and urban activities

The settlement pattern in the area is restricted to industrial development on either side of the South Arm to the east of the Tourle Street bridge. Large blocks have been created by the street pattern to accommodate the scale of this development. Large subdivisions have been established within the blocks.

This part of the study area is characterised by intensive land use close to the waterfront. Large plant, cranes, silos, warehouses, offices, hardstand areas and stockpile areas are common throughout the study area. The scale of the buildings is large and some buildings are up to 30 metres high.

21.1.3 Visibility and visual sensitivity

Views from public areas of the section of the South Arm that would be subject to the proposal are limited.

Figure 21.1 shows the locations from which photographs were taken for the study.

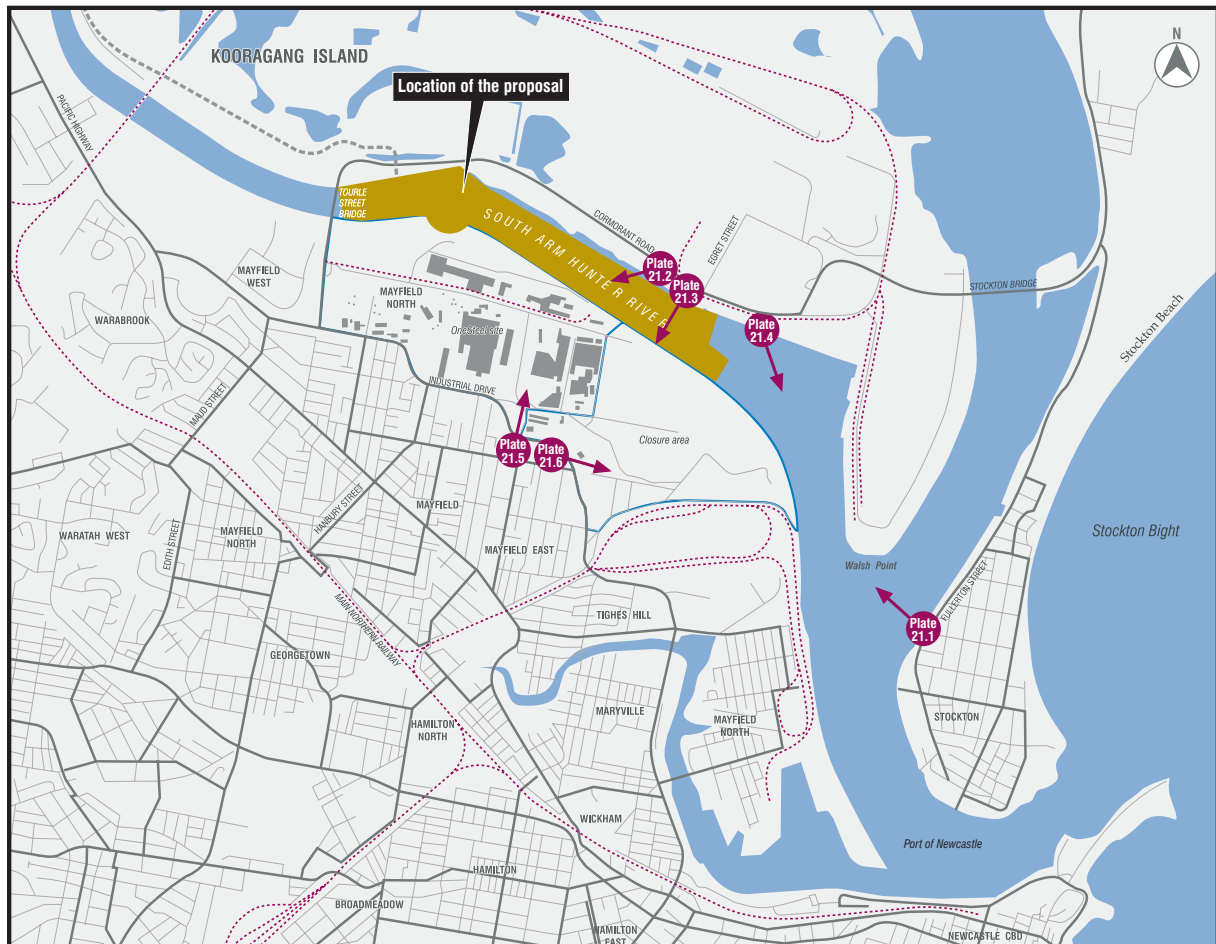


Figure 21.1 Photographic locations

From the east, the South Arm is visible from the Hunter River foreshore at Stockton between the Punt Road boat ramp and the boat harbour opposite Hereford Street. Plate 21.1 illustrates the view of South Arm from the south of the boat harbour at Stockton. Views of the South Arm can also be seen from Walsh Point Reserve on Kooragang Island.



Plate 21.1 Looking north west towards the South Arm



Plate 21.2 Looking south west over the South Arm towards the One Steel site



Plate 21.3 Looking south over the South Arm



Plate 21.4 Looking south-south east over the South Arm towards port entrance

From Cormorant Road on Kooragang Island, views of South Arm and closure area are restricted by industrial development to the east and by mangroves further west. Public access to the foreshore from Cormorant Road is possible, over an area extending for approximately one kilometre east of EnergyAustralia's wind generated turbine. Plates 21.2 – 21.4 illustrate the South Arm from this viewing point.

The South Arm is visible when crossing the Tourle Street bridge. However, due to the structure and design of the steel bridge, opportunities for uninterrupted views of this section of the river are limited for passing motorists.

Due to the presence of large industrial buildings and structures and well established perimeter landscaping, views of the South Arm from areas to the south such as Crebert Street, (an elevated location in the suburb of Mayfield), are screened from public viewing points. Plate 21.5 illustrates the view of the closure area from Crebert Street Mayfield. Plate 21.6 illustrates the view toward South Arm from Mayfield East Public School on the corner of Crebert Street and Ingall Street (note the EnergyAustralia wind generated turbine, which has a mast height of 44metres).

21.1.4 Summary of the significance of the existing visual quality of the study area

The land around the river is flat. Natural vegetation in this area is limited to small areas of remnant mangrove vegetation.

Large-scale industrial buildings are common throughout the area. Industrial development has been accompanied by changes to the natural landscape, including tree planting.



Plate 21.5 Looking east along Crebert Street



Plate 21.6 Looking north along Ingall Street

The study area has a medium level of visual quality, generated by the contrast between the natural landscape of river and remaining natural vegetation, and the industrial landscape of large and bulky industrial areas. It contains dramatic and contrasting vistas. Simple flat landscapes and strong built form are distinctive elements in this landscape.

The existing visual environment is experienced mainly by workers, passing motorists and, to a limited extent, by people boating on the South Arm and residents with views of this area.

21.2 Impact assessment

The key features of the proposal are outlined in Chapter 5. Chapters 6-8 provide more detailed information.

21.2.1 Impact of dredging/excavation and treatment activities

Of all the activities that form part of the proposal, the dredging and excavation activities are the most likely to influence the visual and landscape environment of the study area.

The dredging operations would result in an increase in the level of maritime activity within the South Arm during the dredging period.

Barging of clean material to the offshore disposal area would increase the level of maritime activity between Walsh Point and the entrance to the Hunter River.

Such activities are consistent with that of a working port. The dredges are no more visible than a large ship.

Creation of the swing basin would increase the expanse of waterway to the east of the Tourle Street bridge, representing a permanent change to the foreshore in this area.

The proposal would provide future opportunities to use the banks of the South Arm for wharf-related activities. This would result in a visual change to the South Arm in this area.

21.2.2 Impact on landscape and visual resources

The impacts of the proposal upon the landscape and visual resources of the study area are considered to be of local significance as a result of the limited number of visual receivers, including the limited number of areas from which the general public can view the study area from shore, and the highly modified nature of the existing environment.

21.2.3 Impact of channel navigation markers

As discussed in Chapter 6, there would be a requirement for channel lead lights and daytime lead markers (navigation aids) as part of the proposal. It is considered that although these would be visible, they are consistent with, and a similar height to, port and industrial facilities in the surrounding area.

The two primary directional lead light towers are likely to be approximately 50 metres in height, while the other secondary lead light towers are likely to be approximately 20 metres in height.

The light emitted by the primary lead towers is directional, rather than for general area illumination, and is unlikely to have a significant impact on general lighting levels in the vicinity of the towers.

The light emitted by the secondary towers is not directional, but is localised to illuminate only the tower marker and is unlikely to have a significant impact on general lighting levels in the vicinity of the towers.

21.3 Summary and recommended mitigation measures

21.3.1 Summary

The proposed activities associated with the dredging and excavation are consistent with that of a working port/industrial area. There would be varying degrees of impacts from these activities. The consequence of the dredging works would enable larger vessels to gain access to the South Arm.

The swing basin and bank restoration would generate longer-term impacts; mitigation measures are proposed to compensate for these impacts.

21.3.2 Recommended mitigation measures

The following mitigation measures are recommended for the proposal:

- Conduct bank restoration on either side of the South Arm by way of bank improvements and revegetation;
- A landscape management plan should be developed to guide revegetation following the dredging work. The landscape management plan should outline measures to ensure appropriate development and maintenance of landscaping on the site. The plan should address the requirements of Council, and include:
 - details of all landscaping to be undertaken on the site;
 - maximisation of flora species endemic to the locality in landscaping the site, and general consistency with any landscaping works undertaken elsewhere on Kooragang Island;
 - details of public access arrangements where appropriate, including improvements to public access to the foreshore of South Arm along Cormorant Road, near the EnergyAustralia Wind Generated Turbine; and
 - a program to ensure that all landscaped areas on the site are maintained in a tidy, healthy state.
- The landscape management plan and bank restoration works should be consistent with the relevant aims and objectives of the following development control plans:
 - DCP No. 20 - Guidelines for Industrial Development,
 - DCP No. 33 - Landscape Design Principles and Guidelines; and
 - DCP No. 41 - Kooragang Port and Industrial Development.
- Prepare and mount an information display in the vicinity of the South Arm to provide both a written and graphic description of the proposal.

22 Waste management

This chapter identifies the potential waste generating activities that form part of the proposal, and the likely wastes that would be generated. A preliminary waste management plan is also presented, aimed at avoiding, reducing, re-using or recycling wastes where possible.

22.1 Waste generated activities

Waste materials would be generated during most phases of the proposal, including: site establishment and clean up; dredging and sediment management; sediment transportation; sediment treatment and disposal of treated; and untreated dredged sediments.

The actual dredged sediments and treated sediments are not considered wastes in the context of this proposal. The handling and disposal of these materials is described elsewhere in this EIS.

22.1.1 Site establishment

Site establishment would be likely to involve erecting security fencing around the proposed sediment treatment area and possibly the temporary wharf area. Earthworks may also be required during site establishment works to enable the establishment of site offices and amenities, and connection to services such as electricity, sewerage and water.

Security fencing

Fencing quantities would be carefully planned to ensure the correct amount of materials are purchased. Any residual fence materials such as unused materials or off-cuts would either be stored for use during the proposal or collected and transferred to a metal recycling centre.

Earthworks

Excavations could be required to connect the proposed work areas to services such as electricity, water and sewerage. Should excavations be required, the volume of excavated soil is not expected to be significant. All soils excavated would either be returned to the excavation or used within the closure site.

22.1.2 Dredging, dewatering and treatment

Wastes generated during dredging, dewatering and treatment of sediments would include the following:

- rubbish and debris dredged from the harbour;
- mechanical components from the operation of dredging machines, backhoes, and fixed plant; and
- general waste and recyclables.

Rubbish and debris dredged from the harbour

Dredging would unearth any materials deposited in the sediments along the channel path. It is not known exactly the types of materials might be encountered, although they could include mixed municipal solid wastes (plastics and other non-biodegradable components), wood, and metals (scrap metal, drums, car bodies etc.), concrete, boulders or tyres.

Where possible, larger items of metal debris (such as car bodies) would be stockpiled on site for later collection by scrap metal dealers. Smaller metallic items could be collected in a skip, if sufficient quantities were identified. Scrap metals would be recycled at recycling facilities near the site. Depending upon the quantities found, large pieces of concrete might be able to taken to an offsite location to be recycled into aggregate. All other debris such as wood would be disposed of to landfill.

Mechanical components from the operation of equipment

Operation of the dredging machines, backhoes and fixed plant would generate wastes such as oil filters, fuel containers or drums and used dredging cutters. Where possible, these materials would be segregated for recycling.

General rubbish and recyclables

It is expected that general waste generated by construction workers would peak when the number of site workers is at a maximum (anticipated to be approximately 50 construction workers). Garbage and recycling bins would be provided at various locations across the site, particularly near lunchrooms, portable offices, toilets and washrooms. Recycling would include plastics, paper and cardboard, aluminium and glass.

Any timber and metals generated from building or maintenance activities would also be segregated to permit their collection by recycling contractors. Some of the general mixed waste would be unable to be segregated for practical reasons. This material would be disposed of to landfill.

22.1.3 Site clean up

Wastes generated during site clean up would include the following:

- damaged or used sheet piles;
- used and dismantled high density polyethylene (HDPE) discharge pipeline (should cutter suction dredging be used);
- used geobags (should they be used);
- general waste and recyclables.

The proposed management methods for these wastes are described below.

Sheet piles

The sheet piles used to construct the wall to isolate contaminated sediments would be removed at the completion of dredging. Sheet piles that break or bend excessively would be collected, temporarily stored and transported to a metal recycling facility. Two scrap metal recycling facilities are located nearby, one within two kilometres of the site.

HDPE pipelines

Used and dismantled HDPE discharge pipelines would ideally be collected and reused on other projects as determined by the selected contractor. Any contaminated material affixed to the pipes would be removed and disposed of accordingly. Broken pipes would be bundled up on site, and then sent to a plastics recycler for conversion into plastic flakes, which can be reprocessed into other products such as irrigation pipe and garden products.

Used geotextile bags

It is proposed to cut open the geotextile bags to recover the dredged material after it has been dewatered and, as such, the bags would not be able to be re-used for this proposal. At this time, most of the geotextile fabric of the base and sides of the bags would be clogged with sediments, and the material would not be suitable for re-use on other projects. Therefore, it is anticipated that all of the geotextile bags (numbering 40-60) would be disposed of to an appropriately licensed landfill at the conclusion of the proposal.

22.1.4 Transport and disposal of treated and untreated sediments

Wastes generated during the management, transport and disposal of treated and untreated sediments would include:

- mechanical components from vehicles used for the transport of sediments;
- excess sediment treatment agents and their packaging; and
- general waste and recyclables.

Transport vehicle components

Transport of contaminated, clean and treated sediments by road vehicles would result in some quantities of wastes such as used oil filters, fuelling containers and tyres being generated. Depending on whether such vehicles are serviced on site, there may be a need to manage such wastes. Where possible, these wastes would be segregated from other general site waste for recycling. Materials that could not be recycled would be transported put into general waste bins for eventual landfill disposal.

Excess sediment treatment agents and packaging

Sediment and water treatment would require the addition of chemical agents such as cement for stabilisation and chemicals for use in the water treatment process. Excess materials would be reused on other projects as determined by the selected contractor.

Chemical agent packaging (plastic containers) and steel containers such as 200 litre drums would be segregated for recycling where possible. Where recycling/re-use of such containers is not possible, they would be disposed of in general waste skips provided on site for eventual disposal to landfill.

22.2 Waste management

All wastes would be managed according to the 'waste management hierarchy', which ranks in order (from most preferred to least preferred) the waste management practices according to the principles of ecologically sustainable development as follows:

- avoid waste generation;
- reuse wastes generated where possible;
- recycle wastes; and
- where the above options are not possible dispose of wastes at appropriately licensed waste management facilities.

22.2.1 Waste avoidance

Wastes would be generated during the proposal. However, through careful planning and skilled operation of the dredging and treatment processes, wastes would be avoided as much as possible. Waste avoidance practices would be considered and incorporated into the final operating procedures and plans.

22.2.2 Waste re-use and recycling

Opportunities for reuse of materials would be maximised through careful planning and implementation of onsite operations. For example, treatment agents would be appropriately stored to ensure excess material can be salvaged for used on other projects, as described above.

Used materials and containers would be managed carefully on site to ensure that cross-contamination of potentially recyclable materials does not occur. Recycling bins and temporary site storage areas would be provided until sufficient materials are collected for transport to a recycling facility.

Recycling facilities are available locally for concrete, timber, green wastes, waste oils, metals and recyclable consumers goods such as office paper, glass, plastic containers and cardboard. These would be used as much as possible.

22.2.3 Disposal

Wastes generated that cannot be reused or recycled would require disposal to landfill.

The nearest public landfill facility is the Summerhill Waste Management Facility, located approximately 20 kilometres from the site. This landfill is a large Solid Waste Class 1 landfill owned and operated by Newcastle City Council and is licensed to accept the following:

- Mixed putrescible wastes;
- Mixed inert construction wastes;
- Segregated concrete, brick and tile; and
- Green waste (vegetation and timber).

If liquid wastes were generated by the proposal, disposal of this waste would be at the Cleanaway facility located within one kilometre of the site. This facility has the capacity to treat, recycle and/or dispose of sludges and liquid wastes generated by the proposal.

22.3 Preliminary waste management plan

The preliminary waste management plan (Table 22.1) lists the type and likely amounts of waste products expected to be generated from the proposal. The preliminary waste management plan also describes the expected means of on-site storage, handling, recycling and disposal. This provides a framework for the development of a detailed and comprehensive waste management plan as part of the project EMPs.

22.4 Impact assessment

The volumes of wastes that would be generated during the proposal are expected to be minimal. A number of waste disposal and recycling facilities are located close to the site and this would facilitate collection of recyclable materials. Disposal of wastes to landfill would be in some cases unavoidable but would be avoided and minimised where possible.

The impacts of wastes that would be generated by the proposal would be minimal.

Table 22.1 Preliminary waste management plan

Source	Type of materials	Storage and handling	Recycling / Reuse / Landfill disposal
Dredging	Scrap metals	Scrap steel skips	Recyclable
	Wood	Site green waste area	Landfill disposal
	Drums	Temporally bunded site area	Non-recyclable
	Plastics	Plastics skips	Recyclable
	Tyres	Segregated site storage area	Non-recyclable
	Concrete	Segregated site storage area	Recyclable
	Boulders	Segregated site storage area	Landfill disposal
	Rubbish	Covered rubbish skips	Landfill disposal
	Used dredge cutters	Scrap steel skips	Recyclable
	HDPE piping	Project infrastructure	Reuse on other project/recyclable
	Geotextile bags	Project infrastructure	Landfill disposal
Sediment treatment	Treatment agents	Dedicated, bunded and lockable onsite storage shed	Reuse of excess materials
Portable offices and amenities	Garbage	Covered rubbish skips	Landfill disposal
Portable offices and amenities	Recyclables	Local recycling depot	Paper, cardboard, aluminium cans, glass, plastics
Various	Waste Oils	Temporary bunded waste oil site storage area	Recyclable
Various	Oil filters	Covered waste oil filter bin	Recyclable

22.5 Recommended mitigation measures

The operation of the dredges and sediment treatment process would generate some wastes. Likely wastes would include waste oil, used oil filters, tyres, plastic and metal containers and other packaging wastes in addition to typical domestic recyclable wastes and garbage. Site areas and skips would be supplied to ensure any recyclable materials are segregated and stored appropriately for transportation to a recycling centre. Arrangements would be made with a garbage collection service provided to collect garbage from the site.

A detailed waste management plan would be prepared for the proposal as part of the project EMP process.

23 Hazards and risk

This chapter provides a summary of the results of the hazards and risk assessment undertaken by Advitech as part of the EIS process. This includes the results of the preliminary hazard analysis and the human health and ecological risk assessments. The full report is included in Appendix M.

23.1 Introduction

A hazard and risk assessment was undertaken for the proposal. It specifically addressed:

- the nature and level of environmental risk associated with dredging, transport, sediment transport and treatment, and on-site disposal activities;
- potential health impacts arising from commercial and recreational fishing undertaken on the Hunter River, and consumption of Hunter River seafood; and
- public health risks associated with the movement of materials, unauthorised access and accidental spillages.

The risk assessment demonstrates that the risk levels during and after the proposal are tolerable in relation to the surrounding land use, and that any risks identified would be appropriately managed.

23.1.1 Preliminary hazard analysis

State Environmental Planning Policy No.33 – Hazardous and Offensive Development (SEPP 33) requires preparation of a preliminary hazard analysis (PHA) for developments which are 'potentially hazardous', in order to determine the risk to people, property and the environment at the proposed location and in the presence of controls.

In addition to applying SEPP 33, this risk assessment was prepared in general in accordance with the Planning NSW (formerly DUAP) publications *Hazardous Industry Planning Advisory Paper No. 6 – Guidelines for Hazard Analysis (1992)* and *Multi-level Risk Assessment (1997)*.

An assessment of the proposal with the recommended fatality, injury and irritation risk criteria presented in the publication *Hazardous Industry Planning Advisory Paper No. 4 – Risk Criteria for Land Use Safety Planning (1990)* has been undertaken where relevant.

The PHA has considered risks associated with the development in terms of scenarios in which there is an accidental loss of waste and its potential for resulting in hazardous incidents. General handling of waste materials and emissions produced during normal operations is dealt with in Chapters 8 and 17.

23.1.2 Health risk assessment

While SEPP 33 primarily considers the impact off-site resulting from on site incidents such as loss of containment, fire and explosions, it was considered that a 'screening level' health risk assessment would also be of value. This would identify potential pathways that may lead to contaminant toxicity impacts on receptors that include employees involved

with the proposal, employees of surrounding industry, and commercial and recreational river users, to ensure that the exposure risk with respect to pathways such as inhalation, ingestion, and dermal contact are managed and mitigated to the greatest extent wherever and whenever possible.

23.1.3 Ecological risk assessment

An ecological risk assessment has been undertaken in accordance with the protocol outlined in the *National Environment Protection (Assessment of Site Contamination) Measure 1999 (NEPM)* and with reference to the *Australian Water Quality Guidelines for Fresh and Marine Water (AWQG)* (ANZECC, 2000).

23.2 Preliminary hazard analysis

23.2.1 Hazardous materials

A range of hazardous substances would be stored and used on site, some of which are defined as dangerous goods in accordance with the Australian Code for the Transport of Dangerous Goods by Road and Rail (ADG Code). Table 23.1 summarises the substances and proposed inventories.

Table 23.1 Hazardous substances inventories (all provisional)

Substance	Proposed inventory	DG class (subsidiary risk)	Plant area	Storage facility type
Diesel	20,000 L	C1	Machinery area	Above ground tank
Lubrication oil	1,000 L	C2	Onshore	IBC*
Hydraulic fluid	1,000 L	C2	Onshore	IBC*
Explosives – Powergel Buster	20 tonne	1.1D	Stored in a number of onshore magazines	Mounded magazine

*IBC – Intermediate bulk container

23.2.2 Preliminary risk screening

A preliminary risk screening of the proposal is required under SEPP 33 using the methodology described in ‘Applying SEPP33 – Hazardous and Offensive Development Application Guidelines’ (DUAP, 1994).

The preliminary screening methodology concentrates on the storage of specific dangerous goods classes that have the potential for significant off-site effects. For the proposal these are:

- Class 1.1D: explosives with a mass explosion hazard; and
- Class 2.1: flammable gases.

Diesel used to fuel machines involved in onshore excavation and materials handling would be stored in a bunded 20,000 litres above ground tank. Combustible liquids such as diesel do not form part of the risk screening procedure unless stored with Class 3 goods. The diesel tanks and bunds would be installed in accordance with AS 1940-1993: *The storage and handling of flammable and combustible liquids*. It has been assumed that no Class 3 dangerous goods would be stored with the diesel.

A range of oils and hydraulic fluids would be used by the on-site machines. As noted above, any such combustible liquids do not form part of the risk screening procedure unless stored with Class 3 goods. It has been assumed that no

Class 3 dangerous goods would be stored with the oils and hydraulic fluids. Therefore the risk screening was performed only on the dangerous goods listed in Table 23.2.

Table 23.2 Dangerous goods inventories for risk screening

Substance & classification	Quantity	Location	Distance from boundary	SEPP33 screening method	Breach screening threshold?
Class 1.1	Maximum of 20 tonnes	Former BHP steelworks site	At least 405 m from Class A protected works and 610 m from Class B protected works		No

Delivery frequencies have been estimated based on experience with similar industries and the proposed storage inventories and consumption rates. Table 23.3 summarises the assumed number of annual vehicle movements for the various dangerous goods.

Table 23.3 Estimated vehicle movements of dangerous goods

Substance	Annual deliveries	Breach screening threshold?
Class 1.1	45	Proponent to prepare a transport safety study once explosive source location is known.

The following conclusions can be drawn from these figures and the guidelines:

- The 'screening distance' from the boundary of the site for the 20 tonnes of Powergel Buster, Class 1.1D (explosives) is approximately 350 metres (SEPP 33 Figure 5). Since the storage area would be greater than this distance from the nearest boundary and the storage of the explosives would comply with the Australian Dangerous Goods Code (ADGC) and Australian Standards specifically the 2187 series, the proposal is not potentially hazardous on the basis of risk of explosion.
- Once the source of explosives is known, the proponent should prepare a transport safety study. The study outcomes would determine the route and relevant requirements to ensure that the delivery of explosives to the site is not potentially hazardous with respect to transportation issues.

In summary, the proposal is not considered potentially hazardous on the basis of the explosive storage risk and a preliminary hazard analysis (PHA) is not required pursuant to Clause 12 of SEPP 33.

23.2.3 Level of risk assessment

The Multi Level Risk Assessment (DUAP, 1997) guidelines indicate that a Level 1 (qualitative assessment) is appropriate as the preliminary risk screening has not identified any significant risk contributors, and the likelihood of an event with significant off-site consequences is negligible.

23.2.4 Hazard identification

The aim of the hazard identification study process is to highlight risks associated with the interaction of the proposal with the surrounding environment. A range of possible hazard scenarios was developed based on the results of previous risk assessments and analogous industrial experience. Further development and the ranking of scenarios in terms of consequence and likelihood was undertaken in consultation with relevant stakeholders.

Hazard identification tables were prepared for human and environmental receptors. These are shown in full in the Risk Assessment Report appearing as Appendix M.

Hazards to humans included hazards from contact with contaminated sediments and potentially contaminated river water, odours, dust, vibration, fire, accidental detonation of explosives, night-time river navigation, and consumption of marine organisms. Those considered include barge employees, remediation plant employees, employees of surrounding industry and the general public.

The environmental hazards include the potential release of contaminated sediments and potentially contaminated river water into the South Arm, both contaminated and uncontaminated highly turbid water, explosive residues, aquatic and terrestrial organisms, the river water and nearby aquatic ecosystems.

23.2.5 Consequence analysis

The preliminary risk screening has identified no instances in which the screening thresholds have been exceeded; consequently, there are no credible scenarios that may lead to off-site effects as a result of explosives storage. Additionally, the hazard identification study has not detailed any scenarios with significant off-site impacts. As a result a quantitative consequence analysis is not required.

23.2.6 Likelihood estimation

Since there are no credible hazard scenarios arising from the proposal with significant off-site consequences it is not necessary to provide an estimation of event likelihood.

23.2.7 Conclusions

The methodology used to review the risks associated with the proposal addressed qualitative criteria is to be found in Table 23.4:

Table 23.4 Addressing risk criteria

Qualitative criteria	How addressed by proposal
All avoidable risks have been avoided and remaining risks have been reduced to as low as is reasonably practicable.	The hazard identification study has sought to identify all avoidable risks, and proposed development works would be undertaken to minimise identified risks.
Consequences of the more likely hazardous events are where possible contained within site boundaries.	All hazardous activities are, wherever possible, contained within site boundaries.
Where there is an existing high risk, then the additional hazardous development does not add significantly to the risk.	The proposal does not result in any significant off site consequences and therefore cannot add significantly to any identified cumulative risks in the Kooragang Island industrial zone.

The area surrounding the South Arm is characterised by industrial land uses. The current population density is low due to the nature of the current land use. The nearest residential properties are located some distance away from the study area, on the opposite site of adjoining industrial operations. They are also significantly beyond the maximum fatal extent of all credible hazard scenarios considered. The risk classification and prioritisation undertaken for the proposal determined no credible off-site effects.

23.3 Human health and environmental risk assessment

23.3.1 Data

Contaminants of potential concern are those contaminants that are known, or suspected, to be present at the site in amounts or concentrations sufficient to warrant further consideration of risks to human health or the environment.

Data used to complete this component of the risk assessment was gathered from sediment sampling investigations carried out by Dames and Moore (1990), GHD (1996, 2001), Patterson Britton (2000, 2001), and Robert Carr and Associates (1995, 2000, 2002). This work included sediment sampling at various locations (Appendix D) and at a range of depths across the proposed dredging area.

It has been assumed that each company has carried out its own assessment of data quality as a part of sediment contamination investigations.

23.3.2 Nature and extent of contaminants

Contaminants of potential concern have been identified by a comparison of values of the maximum concentration across the proposed dredging area with appropriate sediment, soil and water quality guidelines based on health and environmental guidelines as shown in the Risk Assessment Report (Appendix M).

These were as follows:

- Sediment quality guidelines (ANZECC,2000);
- Water quality guidelines for human health based (recreational) use (ANZECC, 2000); and
- Environmental water quality guidelines for slightly-moderately disturbed systems (ANZECC,2000).

In addition to adopting this highly conservative approach, the results of the CSIRO toxicity impact assessments have been considered with respect to ecotoxicological effects.

Sediment

Available sediment quality guidelines do not consider protection of human health but are based on disturbances to biological receptors.

As a basis for considering human health effects where a significant pathway has been identified it was assumed that 100 percent of the contaminant would be released to the river. This enabled comparisons to be made with the human health based water quality guidelines referred to above.

This assessment focuses on identifying pathways for specific contaminants and considering the likelihood of these contaminants becoming bioavailable (in river water or attached to colloidal suspended sediment) or causing synergistic/cumulative effects.

Surface water

Environmental and health based guidelines have been used to assess South Arm river water quality impacts. The health based guidelines are relevant due to the potential recreational use of the Hunter River; the environmental guidelines are relevant to the aquatic ecosystems.

23.3.3 Contaminants of potential concern

Contaminants of potential concern have been identified using the method described earlier, and are summarised in Table 23.5. In identifying contaminants of potential concern, no distinction was made between sediment sample depths.

In addition to the ANZECC guidelines, contaminants of potential concern have been determined with reference to the ecotoxicology information presented in the CSIRO work (Simpson et al., 2001; Stauber et al., 2003) to determine site-specific impacts.

Based on the relative trigger levels provided in ANZECC (2000), the environmental receptors are more likely to be affected by the development than the human receptors.

Table 23.5 Assessment of contaminants of potential concern in different media

Species	Media		
	Sediment	River water – Relevant to the Environment	River water – Relevant to Human Health (recreational use)
Metals	None*	None*	None*
Non-metallic inorganics	None	None ^	Ammonia
Organics	PAHs	PAHs	PAHs
Pesticides	None#	None#	None#

* Whilst the concentrations of a number of metals exceed the ANZECC guidelines, CSIRO studies have indicated that the metals in these sediments would not be bioavailable to organisms (Simpson et al., 2001).

^ CSIRO ecotoxicological studies have indicated that the ammonia levels in the geobag filtrate (water removed from the sediment once it has been transferred to shore) may be acutely toxic and a dilution factor of 100 to 1 would be required to minimise the risk of impact should the water be reintroduced to the river. Based on field sampling carried out during dredging operations the levels of ammonia released into the water column during dredging within the turbidity curtain are greater than 100 times less than the toxic levels reported by the CSIRO work (Stauber et al., 2003) and an order of magnitude below ANZECC, 2000 guideline values.

Concentrations of organochlorine pesticides were below the detection limit in all sediment elutriates, indicating that these contaminants were not likely to contribute to toxic effects (Simpson et al., 2001).

23.3.4 Human health risk assessment

Introduction

This screening level human health risk assessment has been undertaken in accordance with the methodology presented in Appendix M and, where applicable, is consistent with the approach outlined in the *National Environment Protection (Assessment of Site Contamination) Measure (NEPC, 1999)*.

Contaminants of potential concern have been previously identified using an approach that employs the maximum concentration of a specific contaminant found on site and identifies potential pathways that could expose receptors to contaminants. The risk of contaminants causing harm is thus characterised. Conservative assumptions have been used to overestimate the actual risks posed, in order to clearly identify contaminants of potential concern with the potential to cause unacceptable risks to human health.

Pathways available for contaminants of potential concern are largely dependent on the nature of activities conducted on the site. In undertaking this human health risk assessment it is understood that, as a result of the proposal, the level of contamination in the South Arm would be reduced. It is understood that the risks identified are specific, and would remain current, only during implementation of the proposal.

Potential exposure pathways

A contaminant can only pose a potential risk if a complete 'exposure pathway' or route to an organism that might be affected, exists. Such a pathway usually consists of a contaminant travelling from its source by some release mechanism and/or transport medium and ultimately making contact with a receptor. On contact with the receptor there must also exist an exposure route (for example, inhalation, ingestion or dermal absorption (absorption through the skin)) for the exposure pathway to be complete. An incomplete pathway, therefore, poses no risk to humans.

The receptor groups identified for this health risk assessment include:

- barge/dredge workers;
- remediation plant workers;
- onshore machine operators;
- offsite workers (those that work in the vicinity);
- river users (recreational and professional);
- consumers of aquatic organisms taken from the development area;
- users of adjacent public roadways and the north bank of the river; and
- off site residents.

Generally, COPC would be regarded as more likely to affect those working on or close to the site rather than those off site. However, due to the ability of commercial and recreational river users (shore and water based) to obtain access to the development area, they would also be considered as among those potentially likely to be affected.

Potential pathways for this site include:

- direct contact with extracted sediment materials;
- inhalation of dusts generated from sediment stockpiles;
- inhalation of volatile chemicals present in extracted sediment and released during extraction, handling or processing;
- direct contact with a highly turbid river water plume released by an uncontrolled release from dredging the contaminated sediment area;
- direct contact with water removed from the dredged sediment; and
- consumption of aquatic organisms that have bioaccumulated contaminants.

Exposure to old potential tar pits

Contact with and exposure to old potential tar pits is most likely during shore-based earthwork activities. The excavation of the south bank swing basin may potentially expose old tar disposal pits. This may expose workers by way of ingestion, direct contact or inhalation. In considering these potential exposure routes, the entry of workers into excavations may require the application of such safety considerations as confined space regulations.

Worker exposure is considered insignificant for these shore-based activities when the relevant protocols are considered and implemented as part of the site safety plan.

Ingestion or dermal contact with sediments

Direct contact with sediment material through/by ingestion or dermal contact is considered insignificant as a result of the remote nature of the material handling techniques. Workers would generally be confined to enclosed cabins either in barge-mounted or shore-based excavators or in barge wheelhouses.

Incidents, such as truck spillage, that may require manual handling of contaminated sediments are considered insignificant due to the low frequency of occurrence and the use in such incidents of appropriate techniques and personal protection equipment to minimise exposure to the sediment. There would be no onshore manual handling of the contaminated sediment material. Machine operators transferring the material to the remediation plant would be in enclosed cabins fitted with filtered air conditioning. Driver entry and exit of the machines is not likely to be near the sediment handling area.

Inhalation of volatile contaminants

Similarly, the inhalation of volatile contaminants in the sediment would be minimised due to the remote nature of the contaminated sediment handling procedures. Odour modelling results (Chapter 17) have indicated that the odour levels at the nominated off-site receptors are below offensive levels. Sampling of volatile organics and species such as hydrogen sulphide has determined that exposure levels are below the relevant exposure standards. Personal protection equipment and procedures to mitigate impacts on workers as required would be implemented as part of the site safety plan.

Dust inhalation

The inhalation of contaminated dusts from sediment stockpiles as a result of wind, excavation and remediation activities is considered insignificant. This is due to the proposed implementation of dust suppression controls and minimisation of exposed stockpiling of either uncontaminated or contaminated sediments. Water trucks would be used throughout the works in accordance with the site environmental management plan.

The shore-based works to be carried out as part of the proposal are similarly considered an insignificant pathway and would be managed by dust suppression techniques.

Ingestion of shellfish

The human health risk due to ingestion of shellfish collected from the river that might be affected as a result of contaminants being remobilised and moving away from the development area is considered insignificant due to the proposed mitigation techniques. These techniques effectively form physical barriers to the migration of contaminants into the surrounding aquatic environment.

The clear identification and effective encapsulation of the contaminated sediment area by a sheet piled wall would effectively form a physical barrier preventing the escape of contaminated sediment and potentially affected water. Within the sheet piled wall a double turbidity curtain would be used around the dredge(s) to extract the contaminated sediment, effectively forming a second barrier. While elevated levels of contaminants have been recorded in river biota, the source of these contaminants has been generally apportioned to process water discharge from the former steelworks operations (Robert Carr & Associates 1999). Additionally, there is a ban on the taking of shellfish from the South Arm; this makes the risk of a pathway insignificant.

Consumption of fish

The likelihood of the proposal altering the levels of bioaccumulated contaminants in fish and crustaceans in the river that are then taken by recreational and commercial fisherman is considered insignificant due to the proposed mitigation barriers previously outlined (Section 23.3.2). The occasional nature of fishing in the South Arm area, the migratory movement of fish and crustaceans over the period of the development works and the scheduling of the works to minimise impact on these resources also minimises the likelihood of this pathway being significant.

Recreational use

Similarly, the effect on human health of potentially elevated contaminant levels in the Hunter River due to disturbance caused by dredging is also considered insignificant, since the South Arm is not a primary recreational area and any exposure is of a short-term, incidental nature. Those likely to be affected include fisherman (recreational and professional), other boat users and professional divers required to inspect wharfs, ships hulls, and other marine and submarine structures.

Generation of water from onshore dewatering operations would be minimised and carefully controlled. The process would consist of a holding facility that is sampled prior to specific batch treatment and discharge. As this would minimise any potential impact this pathway is then considered insignificant.

The stormwater management system for the remediation plant area would include sedimentation basins to contain run-off prior to water being discharged to existing drains and back to the river. Remediation plant process spills would be contained in separate bunded areas specific to the plant unit operations at risk. As a result the risk of contaminant release through this pathway is considered insignificant.

Conclusions

No significant human health exposure pathways were identified in the proposal area. However, potential deviations from normal operations could lead to isolated potential health impacts. The proposed techniques and barriers associated with the proposal effectively prevent the identified exposure pathways being completed. Hence the human health risk is negligible.

Direct contact with sediment and localised inhalation of volatiles from potential tar pits potentially on site were the key exposure pathways identified. These pathways are not likely to affect off-site workers or residents. On this basis the potential risks to off site humans/organisms are considered negligible.

23.3.5 Ecological risk assessment

The assessment was conducted qualitatively and in line with guidelines as applicable. The following steps have been taken:

- Identification of appropriate environmental quality guidelines;
- Assessment of the potential for contaminant migration beyond the proposal area boundaries; and
- Assessment of the potential for contaminant migration to adversely affect the quality of the river water and biota in the Hunter River.

Potential exposure pathways

It is understood that the future land use in the vicinity of the river would be industrial and that the river channel would be altered from a shallow riverbed environment to a deepwater shipping channel. Currently, the shoreline to the south does not contain significant areas of natural vegetation, and there are no on-site terrestrial environments that warrant consideration of environmental risks. The northern shoreline contains an area of mangroves and saltmarsh that would be removed as a result of the proposal. Potential ecological receptors considered include:

- river water;
- river bed;
- nearby wetlands
- aquatic organisms; and
- groundwater.

As in the human health risk assessment, a complete pathway must exist for environmental harm to occur. The pathway must contain a source from which a contaminant can be released and transported to the receptor, where, depending on contaminant concentration and form, the receptor may or may not be harmed.

The potential transport pathways for contaminants within the proposal area include direct release during dredging or discharge to the river following onshore handling and processing. The contaminants of concern may be transported in a number of forms: dissolved in water; carried on sediments suspended in water; or as airborne dried sediments.

Dried sediments may also represent a possibility for the dispersal of contaminants beyond the site boundary. However, as discussed in the health risk assessment, this pathway is considered insignificant since during onshore materials handling appropriate dust control measures would be implemented in line with the site environmental management plan; in addition, stockpiling of contaminated sediments would be minimised.

River water

The levels of contamination in the sediments in the area outside the sheet piled wall are consistent with those in the remainder of the dredged riverbed in the South Arm. Based on similar previous works an increase in the turbidity of the water column adjacent to operating dredges outside the sheet pile wall is likely. However, since the lower Hunter River is subject to large-scale natural disturbances due to flooding and artificial disturbance such as maintenance dredging and prop-wash from manoeuvring vessels, the potential impact of these short-term events are expected to be within the range of usual variability and thus insignificant.

Additionally, the impact of the identified contaminated sediments and waters would be minimised through the effective isolation of these contaminated areas of sediment by a sheet piled wall. The use of turbidity curtains would also minimise the dispersion and relocation within the sheet piled wall zone and thus the potential for release into the South Arm would be further minimised.

Surface water run-off

The remediation plant and interconnecting roadways that link the riverside unloading facility to the processing site would be located on the closure area site. The stormwater management system would include sedimentation basins to contain rainfall run-off prior to water being discharged to existing drains and back to the river. Remediation plant process spills would be contained in separate bunded areas specific to the plant unit operations at risk and recycled through the plant. Truck spills and leakage on the interconnecting roadway would be minimised through the use of watertight trucks and low

permeability roadways with contained surface water run-off drainage. Hence, as with the human health component of this risk assessment, the risk of contaminant release through this pathway is considered insignificant.

River bed

The South Arm is considered to be a highly disturbed environment. The existing riverbed adjacent to the closure area site is significantly contaminated with the remainder of the proposed dredging area demonstrating contaminant levels consistent with the remainder of the nearby harbour area. The removal of contaminated sediment as a result of the proposal would minimise the potential for remobilisation and redistribution of the contaminants within the Hunter River estuary by natural processes, thus removing any future ecological risk.

With respect to the replacement of the shallow sub-tidal environment with a deep sub-tidal environment, no prior studies have determined the ecology of the existing sediments, consequently the impact of current maintenance dredging and the existing contaminants on the existing environment is unknown. However, as the proposal would lead to the complete removal of this shallow subtidal environment, the impact on the existing environment, from a risk assessment perspective, cannot be made.

The aquatic ecology assessment (Chapter 12) suggests that previous studies of other similar dredging works have found that the re-establishment of benthic ecology occurs over a number of months to years and that the assemblage may change significantly. This receptor would not be assessed since complete removal is proposed and the removal of these organisms reduces the likelihood of bioaccumulation higher in the food chain.

Nearby wetlands

The aquatic ecology assessment (Chapter 12) detailed that the probable impacts on the aquatic environment would include the removal of foreshore mangroves, saltmarsh, sand flats and the shallow subtidal river bed.

Removal of the mangroves on the northern shoreline of the South Arm was considered to have an insignificant ecological impact in the context of the broader Hunter estuary system (refer Chapters 12 and 13). Whilst the intertidal mangrove habitats on Kooragang Island were considered potentially vulnerable due to changes in water flow or quality caused as a result of the proposal, the hydrological modelling (Chapter 15) indicates insignificant impacts.

Aquatic organisms

Organisms that move through the water column in the South Arm include fish and prawns. The aquatic ecology report suggests that, in general, the potential localised increase in turbidity and noise may lead to changes in foraging behaviour of fish, and abrasion or clogging of gills leading to an increased risk of disease and suffocation. Noise may lead to disorientation.

The generation of a turbidity gradient due to sediment suspension was suggested to inhibit fish passage, although given that the lower Hunter River experiences large scale flood events such effects are believed to be of minor significance.

The aquatic ecology report has considered the fishing industry impacts in the lower Hunter River and suggested that prawns, being benthic feeders, could potentially bioaccumulate any contaminants mobilised during the dredging operation. They suggest that the timing/scheduling of certain areas to be dredged should be co-ordinated to minimise the potential for this impact and thus the potential for contaminant transfer to consumers. This pathway was considered insignificant. Additionally, the potential impact on the prawn migration would be minimised through dredge management.

The aquatic ecology report also suggests that the proposal is 'probably unlikely' to impact on the commercial oyster industry located upstream of the Stockton bridge. The hydrological modelling of plume dispersion was limited to considering tidal effects only. The results of this modelling indicate that deposition of sediment released

during dredging outside the sheet piled wall is limited to South Arm development area. Hence the risk of impact, on the commercial oyster industry in the north arm is considered negligible.

Groundwater

Previous groundwater contaminant flux investigations (Robert Carr, 1999) have established the flow patterns for groundwater across the closure area site (Appendix I).

The aquifer system consists of an upper unconfined aquifer within the fill material, underlain by a lower partially confined aquifer located in estuarine sand and clay deposits. Sedimentary strata of the Tomago Coal Measures underlie this (Robert Carr, 1999).

Potential intrusion into the groundwater aquifer may have two effects, saline intrusion or the release of contaminants to the river. As outlined in the process description (Chapter 15) processing areas would be located on low permeability hard surface areas. The material holding basin and sediment dewatering areas would be lined with impermeable membranes with the captured water to be sampled and batch treated prior to discharge. Hence it is considered that the risk of contaminated saline process water entering the groundwater is negligible.

The works to be carried out in the proposed swing basin area are likely to penetrate two former tar waste disposal areas. These disposal areas would be managed by physical isolation from the river through the use of sheet piled walls. The potential for ongoing future discharge of the contaminants contained within these pits would then be minimised. Should the extent or expected impact of these pits be assessed to be greater than initially predicted then alternative means of containment should be implemented. This may include the complete removal of the affected area adjacent to the land water interface for remediation with the remainder of the contaminated sediments. Careful management of these pits during excavation would effectively minimise the potential ecological impact.

Conclusions

No significant transport pathways have been identified. However, a number of potential deviations from normal operations that may lead to isolated potential environmental impacts have been identified and their risk of occurrence has been assessed. In all cases the techniques, work practices and incident response procedures have been assessed to be sufficient to prevent significant harm to the identified off-site ecological receptors.

In characterising the risk posed to the environment by the development operations, a qualitative assessment of the likelihood of contaminants being transported off site and affecting humans and/or other organisms.

The risk of release of contaminants to the identified ecological receptors is low, based on adequate planning and precautionary steps being taken during the development. Further it would be expected that due to the removal of the contaminated sediments from the riverbed, the risk of release to the river water or re-deposition within the lower Hunter River estuary due to natural processes would be removed.

It is recommended that groundwater bore monitoring and river water sampling especially in the swing basin area continue to allow mapping of any potential contaminant migration towards the river. It should also be made clear that, subsequent to capping of the closure area, infiltration of surface water into the underlying aquifers would be reduced. This would further reduce the risk of contaminants present in groundwater migrating into the river water.

Based on the available data and with adequate site management it is concluded that the proposal would not have an adverse effect on the off-site physical environment.

23.4 Recommended mitigation measures

The hazard identification study and qualitative risk assessment both identified control measures, safeguards and procedures that would be implemented to further reduce the level of risk associated with the proposal. These actions are summarised in the hazard identification study tables, included in the risk assessment report (Appendix M). Generic mitigation measures may also include:

Management policies

- Health and safety plan;
- Operator training and induction;
- Standard operating procedures;
- Contractor induction;
- Dedicated smoking and non-smoking areas;
- Work permits;
- Safety audits and inspections;
- Safety procedures;
- Control of plant modifications;
- Emergency procedures; and
- Site security.

Engineering design

- Design of hardware systems;
- Use of safe electrical equipment;
- Preventative maintenance; and
- Plant monitoring.

One of the most effective means of ensuring the ongoing safe operation of a facility is through implementing a comprehensive safety management system, as recommended in the Draft National Code of Practice for the Storage and Handling of Dangerous Goods (NOHSC, 1998). Such a system should ensure that hazards associated with the site are identified and managed, so that all activities are undertaken in a safe manner.

24

Energy and resource consumption

The proposal would involve the consumption of energy for dredging, excavation, onshore treatment operations, transportation and disposal. This chapter describes the likely energy requirements and mitigation measures.

24.1 Proposed energy requirements

Dredging and excavation activities would require use of a diverse range of plant and equipment. Following the removal of sediments, equipment would be required to transport sediments, remediate contaminated sediments, return water, dispose of uncontaminated material and remove temporary equipment used as part of the dredging process. Equipment required could include those described in Table 24.1.

Table 24.1 Proposed equipment and energy source

Item	Energy source
Small cutter suction dredge (CSD) pumping to barges	Diesel
Small CSD working at Tourle Street bridge pumping to barges	Diesel
1 or 2 Medium trailer suction dredges (TSD)	Diesel
Large CSD	Diesel
Small TSD	Diesel
Large TSD	Diesel
Self propelled split hopper barge	Diesel
Heavy duty grab dredge	Diesel
Drills and explosives	Diesel
Booster pump station	Diesel
Odour treatment unit	LPG
Thermal desorption unit	LPG or Diesel
1 small CSD or excavator mounted on a barge for displacement pump via discharge pipeline for treatment onshore	Diesel
Land based excavator in conjunction with terrain trucks for filling bank material on the closure area site	Diesel and Petroleum

Table 24.1 Continued.

Item	Energy source
Filling on the closure area site by a land based excavator with terrain trucks or 1 small CSD;	Diesel and Petroleum
Barge mounted excavator or CSD for depositing uncontaminated offshore material	Diesel
Drying facility or slurry pumped to the closure area site;	Diesel or LPG
Pump to transport material along the proposed multi-user transport corridor to Tomago;	Diesel
Excavator	Diesel
3 trucks in rotation	Diesel
Concrete batching plant	Electricity or diesel
Front-end loader (2 cubic metre capacity)	Diesel
Front-end loader (1 cubic metre capacity)	Diesel
2 trucks for emplacement	Diesel
Compactor	Diesel or LPG
Screw conveyor (40 tonne per hr)	Diesel or LPG
Thermal desorption machine	Diesel or LPG

Table 24.2 provides estimates of the approximate power usage for major equipment.

Table 24.2 Major equipment and energy consumption

Item of plant	Propulsive power / enginess	Dredge power pump	Pump to shore	Cutter drive generator
Small cutter suction dredge	260 kW	520 kW	n/a	11 kW
Large cutter suction dredge	940 kW	4770 kW	n/a	1570 kW
Small trailer suction dredge	2 x 352 kW	294 kW	299 kW	n/a
Medium trailer suction dredge	2 x 2300 kW (525 rpm)	2 x 1170 kW (450 rpm)	2 x 400 kW	n/a
Large trailer suction dredge	2 x 4560 kW	2 x 1800	2 x 788 kW	n/a
Self propelled split hopper barge	2 x 270 kW	n/a	n/a	n/a
Heavy duty grab dredge				n/a

Thermal desorption units

Fuel, water, and electricity are required to operate thermal desorption systems. Thermal desorption units require a fuel supply (for example, natural gas, LPG) to heat the waste to achieve the separation process. The amount of fuel required depends on the following factors:

- Waste feed throughput;
- Heat content of the waste feed itself;
- Calorific value of the auxiliary fuel;
- Calorific value of the waste feed;
- Temperature to be attained for successful processing, which in turn depends on the properties of the contaminants to be treated;
- Moisture content of the waste;
- Other chemical and physical properties of the waste to be treated;
- Ambient conditions; and
- Thermal efficiency and burner efficiency of the thermal desorption equipment.

Accordingly, it is very difficult to provide simplified guidance on the amount of fuel needed for thermal desorption operations and to attempt to minimise the fuel consumption.

Natural gas is the most economical and reliable energy source for heating the waste.

Electricity is used to operate the pump, blower, and conveyor motors; the instrumentation; and lighting. As with the usage rate for auxiliary fuel, it is difficult to summarise electricity needs for the range of thermal desorption systems and operational factors that affect its demand. For off-site units, a representative range might be from 0.50 to 2.0 kilowatt-hour (kWh) per ton of soil fed. For in site thermal desorption designs, the amount of electricity consumed depends on the site conditions, ambient conditions, and depth and nature of the contamination, among other variables.

24.2 Potential impacts

The proposal would involve consumption of non-renewable energy sources such as diesel. This has the potential to impact on air quality and contribute to generation of greenhouse gases (that is, gases that accumulate in the earth's atmosphere).

It is difficult to calculate the total energy requirements of the proposal. It is expected that large amounts of fuel would be used. Total fuel consumption would be influenced by methods chosen, age of equipment, type of equipment used, the speed of operation and conditions encountered. Calculations for maintenance have not been considered in this EIS. Consumption of energy is necessary due to the nature of the proposal.

Safeguards would be implemented to ensure energy consuming plant, equipment and facilities are used efficiently. Optimal use of electricity and other utilities would also be encouraged.

24.3 Recommended mitigation measures

During implementation of the proposal, energy should be conserved where practicable. Measures to be implemented include:

- Improve efficiency of energy use;
- Regularly maintain equipment to ensure maximum efficiency;
- Minimise throttle use and turn off idling equipment where practical, e.g. turn off truck engines while trucks are being loaded or unloaded;
- Effective planning in terms of minimising vehicle/machinery movement and double handling of material where possible;
- Minimise use of lighting after hours; and
- Where practical, use renewable sources of energy and recycle materials.

25 Cumulative impacts

This chapter summarises the potential for cumulative impacts as a result of the proposal.

The aim of the environmental impact statement (EIS) is to identify and assess the potential impacts of the proposal on the environment, and to develop mitigation and management measures that would minimise any impacts.

While the EIS focuses on the proposal, it is important that the proposal is not considered in isolation in terms of potential impacts, including air and noise emissions, for example. The potential for cumulative impacts (that is, impacts which could not in themselves be significant, but are significant when considered in association with emissions, impacts etc., from other developments), was considered in all assessments. For example, the air, noise and water quality assessments involved in assessing the existing atmospheric, noise and water quality conditions in terms of how emissions from the proposal would interact with these conditions. Similarly, the traffic and transport impact assessment considered potential traffic generation against existing traffic levels, rather than in isolation.

The cumulative impact of the proposal on current planning for the area (including Newcastle Port planning and other local planning strategies) was also considered.

Table 25.1 presents a summary of the cumulative impacts of the proposal.

Table 25.1 Cumulative Impacts

Aspect of proposal	Potential Positive Cumulative Impacts	Potential Negative Cumulative Impacts
Port Development in general	Extension of the shipping channels would provide the basis for further development of port facilities. It could be argued that this could, in turn, facilitate the further development of other infrastructure in this area. The development of such infrastructure would provide much needed job and investment into the Newcastle region.	Extension of the shipping channels would provide the basis for further development of port facilities. It could be argued that this could, in turn, facilitate the further development of other infrastructure in this area. The development of such infrastructure, if not adequately managed, could result in cumulative impacts on the significant environmental features of the area, including Kooragang Nature Reserves and wetlands to the north of Kooragang Island.
Overall Estuary Health	The removal of the contaminated sediments from the South Arm would improve the overall health of the estuary leading to a long term improvement in ecosystem health despite the short term impacts.	Potential short-term impacts if the dredging causes excessive distribution of sediments across the estuary. Potential short to medium term impacts on aquatic ecosystems due to the significant deepening of the channel – the habitat would alter significantly but would be expected to recover in the long term.

Table 25.1 Continued.

Aspect of proposal	Potential Positive Cumulative Impacts	Potential Negative Cumulative Impacts
Social Fabric of Newcastle	Potential positive cumulative impacts include: • the generation of jobs in the short term; • the generation of jobs in the long term as the deepened waterway would ensure that industries in the vicinity that rely on the port are able to continue to operate and expand; • Stimulation of the economy through the flow-on effects of investment in the area; and • Long-term environmental benefits and improvements in amenity that would stem from the remediation of the contaminated material that is present in the South Arm's sediments. The port is of national importance and the proposal would ensure that its position is not only maintained but enhanced.	Potential negative impacts would generally be restricted to the construction phase and would be related to the use of heavy machinery, which would impact on the amenity of the environment. These potential impacts would be associated with noise, air and water quality, odour and health risk. These issues are addressed in specific chapters within this EIS. Other potential negative impacts include impacts on recreational use of the South Arm.
Hydrology and water quality	Long term benefits in water quality would result through the removal of the contaminated sediments in the South Arm and through the provision of stable batters across the front of the closure area site.	Potential short-term impacts if the dredging causes excessive distribution of sediments across the estuary. Potential short to medium term impacts on aquatic ecosystems in the project area only due to the significant deepening of the channel – the habitat would alter significantly but would be expected to recover in the long term.
Aquatic ecology	The removal of the contaminated sediments from the South Arm would improve the overall health of the estuary leading to a long term improvement in ecosystem health despite the short term impacts.	Potential short-term impacts if the dredging causes excessive distribution of sediments across the estuary. Potential short to medium term impacts on aquatic ecosystems in the project area only due to the significant deepening of the channel – the habitat would alter significantly but would be expected to recover in the long term.
Terrestrial flora and fauna	The proposal does not create any positive cumulative impacts in terms of Terrestrial flora and fauna	There would be a net loss in habitat along the northern bank of the South Arm through loss of sandy beach areas and mangrove stands. When considered with other proposed or consented development in the Newcastle area a net cumulative impact results.
Geology and soils	A net positive impact would result through the treatment of contaminated sediments.	There is the potential for ASS to occur as a result of the proposal although this is easily mitigated through best practice controls.

Table 25.1 Continued.

Aspect of proposal	Potential Positive Cumulative Impacts	Potential Negative Cumulative Impacts
Groundwater	A net positive impact would result through the treatment of contaminated sediments.	There is the potential for long-term cumulative changes to groundwater systems in the area – particularly when the depth of dredging is considered. The excavation could impact negatively through the impact on groundwater systems around the OneSteel and Closure area site if not properly managed.
Noise	The proposal would not improve the noise environment in Newcastle.	A net cumulative impact would occur – the overall long-term result of potential port developments is difficult to quantify.
Air quality	The proposal would not improve the air quality environment in Newcastle during construction.	A net cumulative impact would occur – the overall long-term result however should be neutral once construction was completed.
Transport	The proposal would facilitate the entry of large vessels in the Port and provide increased opportunities in the long term.	The construction of the proposal would add to the cumulative load on Newcastle's road system through truck haulage – the overall long-term result however would be neutral once construction was completed. The impact of potential port development is difficult to quantify as well.
Landscape and visual quality	The proposal would continue the positive visual aspect of the Port through the dismantlement of the BHP site.	The loss of beach and mangrove areas on the north bank of the South Arm would lead to a net cumulative loss of visual amenity in the area.
When assessed against the transport corridor proposal	Both projects together would allow the development of not only the South Arm and the transport corridor but also the Tomago Industrial estate – providing overall benefits to the region if industry can be attracted to the Port.	The projects together would lead to negative cumulative impacts through loss of both aquatic and terrestrial habitat on and around Kooragang Island.
When assessed against the Austeel proposal	Both projects together would allow the development of not only the South Arm and the transport corridor but also the Tomago Estate – providing overall benefits to the region if industry can be attracted to the Port.	The projects together would lead to negative cumulative impacts through loss of both aquatic and terrestrial habitat on and around Kooragang Island.
When assessed against the Protech project	The Protech project could benefit from the availability of berths in the South Arm.	The projects together would lead to negative cumulative impacts through loss of terrestrial habitat on and around Kooragang Island. The movement of trucks on the road network would be significant if both projects are run simultaneously – the long term effect however would be neutral once the Channel extension was completed.

Table 25.1 Continued.

Aspect of proposal	Potential Positive Cumulative Impacts	Potential Negative Cumulative Impacts
When assessed against the PWCS expansion	The PWCS project could benefit from the availability of berths in the South Arm	The projects together would lead to negative cumulative impacts through loss of terrestrial habitat on and around Kooragang Island. The movement of trucks on the road network would be significant if both projects are run simultaneously – the long term effect however would be neutral once the Channel extension was completed
When assessed against the MPT (Stage 2) proposal	The MPT (Stage 2) proposal would be enhanced by the development of the channel extension through providing enhanced shipping channels and attraction of industry to the port	The timing of the MPT development and the channel extension could lead to significant difficulty particularly if the onshore treatment of sediments occurs on the closure area in parallel. In addition if treated materials are reused on the Closure area and MPT site then the Channel extension project would need to be developed prior to the MPT proposal.
When assessed against Cormorant Road and Tourle Street bridge options	There are no positive cumulative impacts on the road network as a result of the proposal	Several options have been examined in terms of the possible relocation/realignment of Cormorant Road. Duplication of Tourle Street bridge is proposed as part of RTA's 5-year rolling program, with implementation depending on traffic and land use demands. There are potential negative cumulative impacts particularly noise and traffic if the Channel extension project is constructed in parallel with these developments.

The EIS team's opinion is that any potentially adverse effects of the proposal could be managed by the implementation of specific mitigation measures. That is to say, the dredging proposal in isolation would not lead to significant environmental degradation in the long term.

Potential cumulative impacts, however, could arise through the facilitation of infrastructure development opportunities arising as a result of the extension of the port.

Extension of the shipping channels would provide the basis for further development of port facilities. It could be argued that this could, in turn, facilitate the further development of other infrastructure in this area. The development of such infrastructure, if not adequately managed, could result in cumulative impacts on the significant environmental features of the area, including Kooragang Nature Reserves and wetlands to the north of Kooragang Island.

The key to managing the potential for impacts of this nature is to ensure adequate strategic planning for the sustainable management, use and development of the port and its environs as a whole. Such strategic planning would set in place an active framework for the planning and management of Kooragang Island, the port and its environs into the future. This needs to provide direction to the Newcastle community, government agencies, potential developers and users of the port regarding the appropriate uses of the area, areas to be protected, and areas suitable for development, as well as how such development should be managed.

The 'Newcastle Port Environs Concept Proposal', developed by DIPNR, is a major step in such a strategic planning exercise. This document is being exhibited at the same time as the EIS. It will provide the basis of addressing many of the potential cumulative issues that could arise from this and other proposals in the Newcastle Port environs as one of the first steps in providing for the sustainable use and development of this area.

It is recommended that this concept plan be further developed, following consultation with the community, and that it take into account the proposal considered by this EIS and other possible future infrastructure and industrial developments that have the potential to affect the significant environmental features of the area.

Another potential cumulative impact of this proposal, if it occurs at the same time as other developments in the area, could result from inadequate sequencing of the construction activities of all developments. This could result in conflicts, for example, in terms of material supplies, access impacts, other logistical problems and so on.

As part of its strategic planning process for Kooragang Island, Newcastle Port and environs, it is recommended that the NSW Government continue to provide input to, and assist in facilitating, the overall sequencing of all proposed developments in the area. This would be the first step in minimising the potential for overall negative cumulative impacts in the region.

PART D

ENVIRONMENTAL MANAGEMENT AND MONITORING



26

Compilation of environmental safeguards

This chapter provides a consolidated list of the mitigation measures recommended in part C, the impact assessment chapters, of the EIS.

26.1 Summary of the recommended mitigation measures

The mitigation measures identified by the EIS are summarised below. These mitigation measures would be incorporated into the detailed design phase of the proposal. Implementation would be guided by the EMP/s for the project, thereby reducing any adverse impacts on the surrounding environment.

26.1.1 Land use and infrastructure

The following mitigation measures are recommended to minimise the impact on land use in the impacted area:

- The potential for impacts to operations on the OneSteel site would need to be carefully managed during the implementation of the proposal. In association with the EMP a management plan would be developed, in consultation with OneSteel and its lessees, to detail the management measures necessary to minimise the potential for impact on the operations of these businesses;
- Further liaison with other landowners and tenants would be carried out during the approvals process;
- Surrounding land users including commercial and recreational users of the port would be notified of the operating hours and duration of the dredging operations;
- A comprehensive consultation program would be developed and implemented in accordance with the recommendations contained in section 20.4;
- As a result of the claim under the *Aboriginal Land Rights Act 1983* over the current study area, the Worimi LALC would be consulted throughout the planning and implementation phase of the proposal;
- Prior to implementation of the proposal, the proponent would negotiate any relocation of utilities required with the relevant utility provider or private landholder; and
- Relocation of any utility would be completed to meet the requirements of the relevant utility provider and/or private landowner.

26.1.2 Hydrology and water quality

Potential impacts to water quality during implementation of the proposal would be minimised by environmental control provisions employed by the contractor. In general, implementation of the proposal would follow best practice techniques, and no appreciable impacts are anticipated.

During the implementation phase, best practice methods would be specific to the contractor chosen. It is imperative that best practice management strategies be put in place to minimise the impact and pollutant load entering the environment.

To manage the potential for adverse impacts on water quality, the proposal would be subject to controls documented prior to commencement of construction in a soil and water management plan, which would form a component of the overall environmental management plan for the proposal.

Mitigation and monitoring during dredging

The selection of plant and equipment and of associated technologies has, where practicable, been undertaken to minimise potential adverse effects on water quality.

A steel sheet piled wall would be installed to provide a physical barrier to isolate material that is unsuitable for unconfined sea disposal from the other material. A backhoe dredge working in conjunction with barges would remove all of the material contained inside the sheet piled wall. The backhoe dredge would be fitted with a purpose-built clam working within a turbidity curtain. These features minimise and contain any turbidity generated.

In addition, a significant proportion of the marine silts and clays located outside the sheet piled wall would also be removed by a backhoe dredge working in conjunction with barges incorporating the same turbidity control features.

Other environmental control provisions proposed would include the deployment of turbidity curtains around the land-based excavators, the large cutter suction dredge and the plant and equipment involved in the drilling and blasting.

A heavy-duty turbidity curtain would also be deployed, if required, across some of the South Arm upstream of the dredge area when trailing suction hopper dredges were using overflows. This would control turbidity spreading upstream beyond the disturbed waterway area.

Turbidity monitoring is proposed during the removal and handling activities. The contractor would be required to ensure that no significant or visible change in turbidity levels occurs in the surrounding waters. This would involve regular measurements and/or inspection of the area immediately surrounding the dredge by the contractor. The results of this monitoring would be recorded in a log book. Should a significant change in turbidity levels be observed, the contractor would be required to immediately contact the superintendent and cease dredging at this location until turbidity has returned to normal levels and measures had been implemented to ensure that such a change in turbidity levels does not occur again.

Onshore stormwater management plan

The onsite areas associated with the proposal would need to be subjected to rigorous stormwater planning and management. The principles of the stormwater plan would centre on the need for very strict separation of 'clean' and 'contaminated' materials to avoid the contamination of rainwater by sediments, as well as prevention of sediments washing back into the river.

The contractor would be expected to adhere to the requirements of Newcastle Council's Stormwater Management for Development Sites (DCP No. 50).

Return water treatment plant

It is expected that the bulk of waters associated with the highly contaminated sediments would be taken up by the cement stabilisation process. Any remaining waters would thus require treatment before their discharge to the South Arm. There is however expected to be contaminated groundwater arising from the swing basin on the OneSteel site that requires treatment. Water treatment plants would thus be provided on the OneSteel site and on the closure area remediation site.

Any water treatment plant associated with the onshore activities would need to be the subject of a licensing process with the NSW EPA before any discharge were allowed.

26.1.3 Aquatic ecology

In addition to the mitigation measures relevant to protection of water quality (included in Chapter 11), the following would occur to minimise the potential for impacts to aquatic ecology:

- Dredge operations would not span the width of the waterway at any time blocking fish passage;
- A detailed turbidity monitoring program would be developed as part of the environmental management plan for the dredging operations. Development of the monitoring program would involve identification of a threshold level of turbidity. Further monitoring of nutrient levels would be undertaken if turbidity exceedances are identified. Relevant responses (such as ceasing activities in the event of exceedance of certain levels) would be specified;
- Monitoring of physical water quality parameters (both up and downstream of the dredging area) such as sediment, turbidity and nutrients would determine whether the safeguards are adequate. Threshold levels for these parameters, and responses should these levels be exceeded, would be specified within the project environmental management plans. Monitoring during construction would be particularly important during and following rainfall events;
- An emergency contingency plan for dealing with accidental spills would be developed; and
- The speed and movement of all barges and support vessels would be kept to a minimum and comply at all times with Waterways regulations.

The following specific mitigation measures are recommended:

- Where feasible, a buffer zone of at least 30 metres would be maintained around mangroves that do not need to be affected;
- Mangroves and their associated fauna upstream of the dredge site should be monitored as part of the environmental management of the proposal; and
- Habitat compensation measures would need to be discussed with NPWS in accordance with the recommendations contained in section 13.5.

26.1.4 Monitoring

An amount of baseline data on the abundance and distribution of benthic taxa and fish species was collected in the present study. There is a need to capture more of this data prior to the dredging operation. Suggested monitoring prior and post dredging include:

- at least two sampling periods before dredging commences to determine the abundance of most species – whilst the proposal would result in total loss in the area of impact – this data provides a baseline to compare recovery following dredging);
- any test for impact would require additional sampling periods during and after dredging;
- future surveys should consider a number of locations including the north and South Arms and shallow and deep areas to provide information on spatial variability;
- to assess long-term changes in aquatic vegetation, it is recommended that the distribution of mangrove and saltmarsh habitat upstream of the dredge site is mapped periodically; and
- long-term water quality measures such as upstream salinity, turbidity and changes in temperature and dissolved oxygen in the dredged section could provide evidence of effects from the proposed dredging.

26.1.5 Terrestrial flora and fauna

Management procedures

Dredging operations should be managed to minimise potential indirect impacts on surrounding vegetation (especially mangroves upstream of the dredging area) as a result of sediment resuspension and transport. Silt curtains should be used during dredging to reduce the amount of sediment leaving the dredge site.

The management measures that would be implemented as part of the dredging activities are described in Chapter 6.

Monitoring and maintenance

During and following implementation of the proposal, mangrove forest and associated fauna located upstream should be monitored, to ensure that the proposal does not result in impacts to upstream mangrove habitat.

Compensatory habitat

The proposal involves the removal of 5.7 hectares of mangrove forest and 0.9 hectares of saltmarsh vegetation on the north bank of the South Arm. As a result, it is recommended that habitat compensation be undertaken, to compensate for the loss of both of these communities.

Habitat compensation should not be limited to mangrove replacement. One option for habitat compensation is the establishment of new areas of mangrove and saltmarsh vegetation in the local area, or the restoration of existing areas of damaged vegetation in the local area. It is recommended that augmentation of an area of existing habitat would be more valuable than the creation of an isolated area of habitat. Similarly, it is considered that habitat enhancement would be of more value than habitat creation.

The creation or maintenance of intertidal feeding areas and roosting habitat for waders in the local area are recommended as valuable contributions to the ecology of the lower Hunter estuary.

Another option is the provision of financial contributions to wetland rehabilitation projects in the local area, such as the Hexham Swamp Rehabilitation Project coordinated by the Hunter Catchment Trust, the Kooragang Wetland Rehabilitation Project, or The Wetlands Centre Australia at Shortland.

26.1.6 Geology and soils

The following mitigation measures would be implemented to minimise the potential for impacts to the environment. These would be implemented in conjunction with the soil and water management plan (developed as part of the EMP) outlined in section 16.5.

Disturbance of the ground surface during earthworks exposes unprotected soil surfaces and has the potential to increase erosion. The design of land based excavation would incorporate a drainage system to limit overflow of run-off and direct stormwater into piped drainage systems that discharge at appropriate locations.

General recommendations include:

- Implement erosion, sediment and pollution control measures and practices during site preparation works and construction;
- Monitor erosion during site preparation works and construction;
- Rehabilitate exposed areas and implement the measures described in Chapters 6 and 7; and
- Use best practice construction techniques to minimise disturbance particularly for pile driving.

Other recommendations include the following:

River areas

There is a risk of potential acid sulphate soils being excavated from river areas, However test data indicates that almost the entire the bulk of the proposed dredge materials are not PASS. Any minor PASS volumes exposed are likely to be buffered by the surrounding excavated material.

Cement stabilisation of the sediments would be used to further neutralise (buffer) such sediments. Further PASS investigations would be conducted around the few points where PASS was indicated, and the mixing/neutralisation aspects checked to ensure that the ASS conditions did not develop.

An acid sulfate soil management plan would be prepared as part of the EMP, in accordance with the New South Wales Acid Sulfate Soils Management Advisory Committee publication, Acid Sulfate Soils – Assessment Guidelines (1998).

Swing basin area

Further investigation would be undertaken prior to detailed design to ascertain the status of contamination within the proposed swing basin site and whether the potential tar pits exist and extend into the swing basin area.

Procedures for excavation, handling, remediation, disposal and/or re-use of the excavated material would be prepared prior to construction of the swing basin. These procedures would be based on the results of the additional site investigations and characterisation, the final design of the swing basin, and the interrelated requirements of other activities involved in the overall channel extension proposal.

A sheetpiled wall with a buried tie back anchorage system within the swing basin site could be used to reduce the amount of soils to be excavated from the site and reduce the risk of intrusion into potential tar pits and the mill scale storage and transition area pit. In addition the sheetpiled wall option would increase the contamination migration path lengths, further reducing any potential impacts to the Hunter River.

26.1.7 Groundwater systems

For land south of the river, the groundwater quality within the OneSteel areas outside the footprint of the proposed swing basin and the former BHP Steelworks closure area would continue to be sampled and assessed as a component of the environmental monitoring programs already undertaken within these areas by others. For land north of the river, the groundwater quality at the KCT would also continue to be sampled and assessed as component of this site's environmental monitoring program by others. In summary, no discernable change in groundwater quality beyond the swing basin excavation area is envisaged from the proposed dredging component of the development.

As discussed, the largest potential for environmental impact with respect to the contamination of groundwater and surface water from the proposed excavated soil material (i.e. slag, steelworks refuse etc.) and the Mill Scale Transition Area is associated with the construction of the swing basin. These issues are proposed to be managed through the development of a specific management plan relating to the construction of the swing basin.

At this preliminary stage, a number of design options have been considered for the construction of the swing basin. Two possible options considered to date include a sloping rock revetment sea wall and a sheet pile wall. The optimal design would be finalised during the post-EIS detailed design phase of the project.

Given the logistical complexities associated with the excavation and construction of the swing basin and the uncertainties associated with the environmental data on potential soil contamination within the swing basin footprint, only preliminary details of a groundwater and surface water management plan can be given at this stage.

26.1.8 Noise and vibration

The timing and type of night-time activities would need be carefully considered at the detailed design stage of the proposal. The project EMPs would include a noise management strategy, which would consider the methodology proposed by the construction contractor and the relative phasing of different activities in different areas. The timing of construction activities with respect to rise and fall of background noise levels would serve as a primary means by which impacts are managed.

It is recommended that the following measures be implemented:

- Sheet piling should only be performed during the daytime, between 7.00 am and 6.00 pm;
- Remediation activities should only be performed during the daytime where possible;
- Remediation activities and drilling should not occur simultaneously where possible;
- Remediation activities and sheet piling should not occur simultaneously where possible;
- Sirens and alarms on all equipment should be adjusted so as not to cause disturbance at surrounding residential receivers during night-time operation;
- In order to reduce the impact of ground vibration and airblast, blasting should only be conducted between 6.00 am and 8.00 pm from Mondays to Saturdays;
- The use of quietest plant available regularly maintained and fitted with appropriate mufflers. In particular, consideration should be given to the use of bored rather than driven piling where possible;
- Minimising the potential for impact type noise events during night time periods;
- Notification of residents prior to noisy or vibration generating activities; and
- Noise monitoring to ensure best practice is being implemented.

It is possible that some activities may be required beyond the EPA recommended construction hours. Contact with the EPA, Council and residents would be undertaken prior to these activities.

26.1.9 Air quality and odour

Odour

The results of the dispersion modeling indicate that significant odour impacts would not occur at sensitive receptors if dewatering in geobags were avoided. If mechanical dredging is used to excavate the sediments and these are remediated using cementation, then it is unlikely that dewatering of the sediments would be required. No mitigation measures should be necessary for this combination of dredging and treatment methodologies.

However, if dewatering of dredged sediments with geobags is required, the following mitigation measures are recommended:

- Minimise the exposed surface area of geobags to less than 80,000 m² (the actual acceptable area would need to be determined) by limiting the number of bags in use at any one time; and
- Using suitable odour masking agents.

Minor reductions in odours could also be achieved by using covered barges to transfer dredged sediments from the dredge to the temporary wharf and using trucks with rear load covers to minimise the exposure of dredge sediments during land transfer from the river to the temporary storage facility.

Odour monitoring at the sensitive receptors should be undertaken during sediment storage, dewatering (if undertaken) and treatment operations.

Dust

A dust control plan, detailing control measures, responsibilities for implementing dust control measures and monitoring and reporting requirements would be prepared as part of the environmental management plan for the proposal. Mitigation measures to minimise the generation of dust would target dust generation by vehicle movements and dust generation from exposed remediated sediment stockpiles. Typical mitigation measures are described below.

To achieve an operational performance that meets the maximum emission criteria, a thermal desorption unit would be used that meets best-practice control technology. Best-practice control technology would not only include the use of a highly efficient air emission control system but also the adoption of sound commissioning and operational practices.

As discussed in Chapter 7, it is expected that the use of a Thermal description unit would require a further approval step.

26.1.10 Cultural heritage and archaeology

Aboriginal archaeology and cultural heritage

The following mitigation measures are recommended for Aboriginal heritage:

- if the area to be affected by the proposal is changed, the Worimi LALC would be contacted and further investigations undertaken to determine the potential for Aboriginal heritage impacts;
- section 90 of the *National Parks and Wildlife Act 1974* states that it is an offence to knowingly disturb, deface or cause or permit the destruction of relics or an Aboriginal place without the written consent of NPWS;
- controls regarding protection of these items would be included within the construction EMP;
- the EMP would include a requirement that works associated with the proposal must cease if an Aboriginal archaeological site is uncovered during the construction process. The Indigenous Heritage Division of the NPWS must be contacted if Indigenous artefacts are uncovered;
- the EMP would include information about the statutory legislation protecting sites and places of cultural heritage, the process required when remains are uncovered, and responsibilities in this regard;
- it is recommended that the proponent submit a Consent to Destroy application for site no. 38-4-0041 at least three months prior to any works commencing. There are no other archaeological constraints to the proposal; and
- as a result of the claim under the *Aboriginal Land Rights Act 1983* over the current study area, the Worimi LALC should be consulted throughout the planning and implementation phase of the proposal.

Non-Indigenous heritage and archaeology

It is recommended that:

- prior to commencement of the proposal, an electronic examination by sonar/side-scan should be undertaken and the results of such investigation be interpreted to determine whether there is evidence of previously unidentified archaeological material with heritage potential located underwater;

- in the event that archaeological material evidence is identified during this investigation or as a result of the implementation of the proposal, all work having the capacity to disturb, damage or destroy potential material evidence should cease, in accordance with the provisions of the *Heritage Act 1977*;
- the NSW Heritage Office must be contacted if historic remains are uncovered, and the remains be managed in accordance with the requirements of the Heritage Act; and
- the EMP include information about the statutory legislation protecting sites and places of cultural heritage, the process required when remains are uncovered, and responsibilities in this regard.

26.1.11 Transport, traffic and access

There are a number of transport-related impacts associated with the proposal. However, the following general measures are recommended to minimise any impacts:

- Monitoring of traffic and intersection operations should be undertaken during the early stages of transport operations to evaluate and amend trucking operations if required.
- A temporary signalised intersection of Cormorant Road should be provided at the existing National Power access road at the eastern end of landfill, to improve Cormorant Road access from the Kooragang Island landfill sites and the northern bank of the Hunter River.
- If transportation of materials is to occur from the southern bank to the possible disposal sites on Kooragang Island, a 24-hour, seven day a week transport regime for the inert material should be adopted. This is required to reduce the traffic impact on the surrounding road network, either by reducing the total amount of time of the operations or reducing the rate of transportation.
- Where possible, concurrent transport of both inert and treated material should not coincide in order to avoid higher trucking rates, resulting in increased impact on the adjacent road network.
- While there would be some potential transport conflicts within the OneSteel site, these would be managed internally within OneSteel.
- Where possible, general deliveries to the site should occur after 9 am to reduce the impact of the delivery vehicles on the road network. Allowance should be made for any specialist deliveries if tasks are critical to the construction program.
- Delivery of inbound materials (particularly the larger quantities such as rock material for river banks) should reduce their delivery rate during or avoid background traffic peak periods (approximately 7 to 9 am and 4 to 6 pm) as far as possible, in order to reduce the impact on the adjacent road network during peak times.
- To reduce the employee traffic impact, shift change times should be aligned so that staff traffic movements do not occur during either the morning or afternoon peak periods on the adjacent road network. Peak periods on the adjacent road network are generally 7 to 9 am and 4 to 6 pm.
- It should be noted that currently, even without any impacts associated with the proposal, an upgrade of the two-lane section of Cormorant Road/Tourle Street (between Egret Street and Industrial Drive, including Tourle Street bridge) to four lanes (two lanes each way) is required. The duplication of the Tourle Street bridge is in the design phase at present with a view to its completion in 2006.

26.1.12 Socio-economic factors

The following mitigation measures are recommended to minimise adverse impacts on the socio-economic environment:

- Prior to the commencement of the proposal, the proponent would develop a commercial fishing protocol in consultation with the Newcastle Commercial Fishermen's Co-Operative. The protocol shall detail measures to be employed by the applicant and the relevant groups to minimise conflicts between the activities of both parties. The protocol is required as the South Arm is likely to be closed for significant periods of time during construction; and
- prior to the commencement of the proposal, the proponent would develop a South Arm public access protocol. The Protocol shall detail measures to be employed by the Applicant and the relevant groups to minimise conflicts between the activities of both parties. The protocol is required as the South Arm is likely to be closed for significant periods during construction.

It is recommended that a consultation and communication plan be developed covering local businesses, surrounding residents and the wider community. The plan should detail activities to be implemented in the lead up to, and during, implementation of the proposal. Recommended consultation tools include:

- a nominated and dedicated consultation manager responsible for ongoing liaison with the community and businesses/clubs;
- a community hotline – operating 24 hours during the dredging period – to enable response to questions, complaints etc;
- regular meetings with key stakeholders and surrounding residents. This should include discussions with surrounding businesses and landowners (including businesses on the OneSteel site and Kooragang Island) regarding access and other requirements to identify potential issues and develop appropriate management mechanisms. Other key stakeholders include residents of surrounding suburbs, environmental and other community groups, and Newcastle Council;
- widely advertising changes to access arrangements along the South Arm;
- project newsletters/information sheets distributed to surrounding landowners, businesses and residents;
- regular project updates in the *Newcastle Herald*; and
- a project information signboard erected in the vicinity of the South Arm providing regular update on the progress of the proposal, contact details and the like.

26.1.13 Landscape and visual quality

The following mitigation measures are recommended for the proposal:

- Conduct bank restoration on either side of the South Arm by way of bank improvements and revegetation;
- A landscape management plan should be developed to guide revegetation following the dredging work. The landscape management plan should outline measures to ensure appropriate development and maintenance of landscaping on the site. The plan should address the requirements of Council, and include:
 - details of all landscaping to be undertaken on the site;
 - maximisation of flora species endemic to the locality in landscaping the site, and general consistency with any landscaping works undertaken elsewhere on Kooragang Island;

- details of public access arrangements where appropriate, including improvements to public access to the foreshore of South Arm along Cormorant Road, near the EnergyAustralia Wind Generated Turbine; and
- a program to ensure that all landscaped areas on the site are maintained in a tidy, healthy state.
- The landscape management plan and bank restoration works should be consistent with the relevant aims and objectives of the following development control plans:
 - DCP No. 20 - Guidelines for Industrial Development,
 - DCP No. 33 - Landscape Design Principles and Guidelines; and
 - DCP No. 41 - Kooragang Port and Industrial Development.
- Prepare and mount an information display in the vicinity of the South Arm to provide both a written and graphic description of the proposal.

26.1.14 Waste management

The operation of the dredges and sediment treatment process would generate some wastes. Likely wastes would include waste oil, used oil filters, tyres, plastic and metal containers and other packaging wastes in addition to typical domestic recyclable wastes and garbage. Site areas and skips would be supplied to ensure any recyclable materials are segregated and stored appropriately for transportation to a recycling centre. Arrangements would be made with a garbage collection service provided to collect garbage from the site.

A detailed waste management plan should be prepared for the proposal as part of the EMP.

26.1.15 Hazards and risk

The hazard identification study and qualitative risk assessment identified control measures, safeguards and procedures that would be implemented to further reduce the level of risk associated with the proposal. These actions are summarised in the hazard identification Study tables, included in the Risk Assessment Report.

One of the most effective means of ensuring the ongoing safe operation of a facility is through implementing a comprehensive Safety Management System, as recommended in the Draft National Code of Practice for the Storage and Handling of Dangerous Goods (NOHSC, 1998). Such a system should ensure that hazards associated with the site are identified and managed, so that all activities are undertaken in a safe manner.

26.1.16 Energy and resource consumption

During site preparation, dredging, remediation works, transportation and disposal process, energy should be conserved wherever and whenever possible. Measures to be implemented during the proposal include:

- improve efficiency of energy use;
- regularly maintain equipment to ensure maximum efficiency;
- minimise throttle use and turn off idling equipment where practical, e.g. turn off truck engines while trucks are being loaded or unloaded;
- effective planning in terms of minimising vehicle/machinery movement and double handling of material where possible;

- minimise use of lighting after hours; and
- where practical, use renewable sources of energy and recycle materials.

26.1.17 Cumulative impacts

It is recommended that the Newcastle Port Environs Concept Proposal be further developed, following consultation with the community, and that it take into account the proposal considered by this EIS and other possible future infrastructure and industrial developments that have the potential to affect the significant environmental features of the area.

As part of its strategic planning process for Kooragang Island, Newcastle Port and environs, it is recommended that the NSW Government continue to provide input to, and assist in facilitating, the overall sequencing of all proposed developments in the area. This would be the first step in minimising the potential for overall negative cumulative impacts in the region.

27 Environmental approvals, management and monitoring

This chapter provides a summary of the environmental approvals, licences and permits that may be required. An outline is also provided of the requirements for the environmental management plans that would be developed as part of the implementation of the proposal. Monitoring procedures that would be implemented are described.

27.1 Summary of approvals and licences required

Based on the information contained in this EIS, a number of environmental approvals, licences and permits may be required. These are listed in Table 27.1.

Table 27.1 Approvals, licences and permits required

Act	Administering agency /approval authority	Approval/permit/licence required
NSW legislation		
<i>Environmental Planning and Assessment Act 1979</i>	DIPNR	Development consent
<i>Environmental Planning and Assessment Act 1979</i>	Principal certifying authority	Construction certificate
<i>Maritime Services Act 1935</i>	Waterways Authority	Approval under Section 13D to carry out dredging in the Hunter River.
<i>Fisheries Management Act 1994</i>	NSW Fisheries	s205 permit to cut, remove, damage or destroy marine vegetation on public water land or on the foreshore s219 permit to create an obstruction across a waterway
<i>Protection of the Environment Operations Act 1997</i>	Environment Protection Authority	Environment protection licence under Section 48
<i>Dangerous Goods Act 1975</i>	Workcover	For keeping/storage of dangerous goods
<i>Road and Rail Transport (Dangerous Goods) Act 1997</i>	Workcover	Licence to transport dangerous goods by road or rail
<i>Environmentally Hazardous Chemicals Act 1985</i>	EPA	Licences for chemicals subject to chemical control orders

Table 27.1 Continued.

Act	Administering agency /approval authority	Approval/permit/licence required
Commonwealth approvals		
<i>Environment Protection and Biodiversity Conservation Act 1999</i>	Environment Australia	Approval under Sections 8 and 9
<i>Environmental Protection (Sea Dumping) Act 1981</i>	Environment Australia	Permit under Section 10 to dispose of material at sea & a permit under Section 12 to load a vessel for the purposes of dumping at sea

In addition to the above, approvals may be required from the relevant utility providers for connection to their systems. An approval under Section 138 of the *Roads Act 1993* may also be required from the RTA if the proponent is:

- erecting a structure or carrying out a work in, on or over a public road;
- digging up or disturbing the surface of a public road
- removing or interfering with a structure, work or tree on a public road
- pumping water into a public road from any land adjoining the road
- connecting a road (public or private) to a classified road.

The need for an approval would be determined depending on the final design of the proposal.

The works contractor would also be required to comply with all statutory requirements which relate directly to work practices such as:

- Trade Practices Act;
- Construction Safety Act; and
- Occupational Health and Safety Act.

27.2 Environmental management plans

Environmental management plans (EMPs) would be produced for the proposal once development consent has been obtained from DIPNR. Two separate EMPs would be produced: one for the dredging operations, and the other for the treatment of the dredged contaminated sediments.

The EMPs would serve two functions. They would:

- provide guidance during the final detailed design of the proposal. This would enable all safeguards, environmental goals and consent conditions to be considered and incorporated during the design phase; and
- instruct contractors of the measures and standards required when undertaking activities on site (including monitoring and performance requirements). The EMPs would form the basis for environmental specifications in any contractual agreements between the proponent and the contractor.

27.2.1 Background

An EMP is a procedural document that outlines the following:

- The environmental aspects and impacts of the proposal;
- The goals that would be set with respect to environmental protection and management;
- The detailed safeguards that would be implemented during the operations to achieve the environmental goals;
- The persons responsible for environmental management and achieving the environmental goals; and
- The actions that would be undertaken to assess and review the ongoing effectiveness of the implemented safeguards and the progress made towards achieving the environmental goals.

The EMPs would be prepared in accordance with NSW Government requirements following consultation with landowners and relevant State and local government agencies. The EMPs would be made available to government departments, statutory authorities, the community and all other interested organisations and individuals.

The EMPs would:

- ensure all safeguards outlined in the EIS and conditions of approval are implemented on site;
- ensure that all activities are carried out with due diligence; and
- ensure that all activities comply with relevant environmental legislation including Acts, regulations, Standards and best management practices.

27.2.2 General structure

The EMPs would be developed using the general structure outlined below.

Introduction and purpose

Establishes and states the environmental objectives and target. Environmental objectives and targets could be determined as part of the consent conditions.

Statutory requirements

Details all statutory requirements including the approvals, licences and permits required to undertake the proposal.

Environmental impact assessment

Identifies all operational practises that could potentially cause an environmental impact and assesses the risk of the environmental impact occurring. Environmental impacts are rank according to their risk and management procedures would be developed to eliminate or minimise these risks.

Environmental management procedures

Describes the operational procedures for eliminating or minimising environmental impacts. This section would include a description of the:

- safeguards to be implemented;
- lists of actions, timing and responsibilities;

- reporting requirements;
- specifications incorporating environmental safeguards;
- training of personnel (proponent and contractor) in environmental awareness and best practice management systems;
- environmental accident and incident reporting requirements;
- process surveillance and auditing procedures;
- environmental complaint handling procedures; and
- site management and control procedures.

Monitoring requirements

Environmental monitoring would be required for water quality, air quality, noise and vibration and aquatic flora and fauna. A monitoring plan would be included in the EMPs that would detail monitoring locations, frequency, duration and methodologies.

Monitoring requirements are outlined in Section 27.3.

Emergency response

Describes a plan-of-action that would be followed in the event of an emergency. The emergency response plan would include the following:

- The procedures to be followed to minimise environmental impacts in the event of an emergency;
- The emergency equipment that would be required on site in case of an emergency;
- The contact details of the relevant emergency authorities; and
- The responsibilities of all people on site in the event of an emergency situation.

The plan would consider the following potential emergencies:

- Fire;
- Explosion;
- Pollution incidents and accidents particularly pollution of waters and land; and
- Flooding of work areas.

The plan would be developed in consultation with local contingency authorities such as the NSW Fire Brigade, the SES and Council. The plan would also incorporate auditing and review procedures

The plan would detail the procedures that would be followed to:

- audit the proposal against the predictions made in this EIS;
- audit the proposal against the conditions of consent, the EMPs and any other conditions or requirements made under the various licences and permits; and
- amend the EMPs if shortcomings are found during the audits.

The review and auditing procedures would state audit frequencies and reporting timelines.

27.2.3 Dredging operations EMP

An environmental management plan for the proposed dredging operations would be developed. This EMP would cover all operations in the lifecycle of the dredging process including setup, operation and dismantling phases.

Specific issues that would be addressed by the dredging operations EMP include:

- **Dredged sediment management plan.**

This would describe the procedures for handling, transporting and storing of dredged sediments. As described in this EIS, sediments with varying levels of contamination would be encountered and dredged. Sediment treatment methods would depend on the levels of contamination and thus the plan would include procedures for management sediments in each of the treatment streams.

- **Flora and fauna management plan.**

This would include measures to protect flora and fauna during dredging and blasting, procedures for monitoring impacts on flora and fauna at the dredging site and nearby environmentally sensitive areas, and revegetation land based and river bed work areas.

- **Soil and water management plan.**

This would include measures to retain topsoil, prevent erosion, control and confine surface waters and river water with high sediment loads, and ensure rehabilitation of work areas is comprehensive and effective.

- **Measures to prevent erosion** would target the excavated riverbank, any temporary stockpiles of remediated dredged sediments, and the various work areas. This component of plan would be developed in accordance with the NSW Department of Housing guideline 'Managing Urban Stormwater – Soils and Construction' and other relevant documents. This plan would also describe the procedure for confining sediment laden river waters during dredging and blasting. The safe storage and handling of hazardous materials or dangerous goods that could have the potential to cause pollution would also be included in this management plan.

- **Waste management plan.**

The waste management plan would include procedures for managing and handling wastes that may be salvaged during dredging. The plan would seek to minimise to disposal of encountered wastes to landfill. Procedures for waste management including minimisation, segregation, reuse and recycling would also be addressed in this management plan.

- **Dust management plan.**

A dust management plan would include measures to control dust from exposed areas, stockpiles, truck loads and roads subject to heavy traffic.

- **Noise and vibration management plan.**

A noise and vibration management plan would detail noise and vibration control measures that would be implemented during blasting works, dredging operations and transport of dredged materials. The plan would ensure noise and vibration would comply with various EPA, ANZECC and Australian Standards guidelines and manuals.

- **Traffic management plan.**

This plan would describe the procedures for managing:

- vessel movements during dredging works; and

- truck movements during the transport of materials excavated from the banks of the river;
- parking and access requirements for construction personnel.

The plan would include the requirements for safety and hazard signs and markers, traffic detours and road maintenance.

- **Community participation management plan.**

This plan would describe the processes that would be established to allow community concerns, issues and grievances to be received, handled and acted upon. The plan would describe the methods and timing of all public communications.

- **Other environmental issues.**

Management plans for energy use, hazards and risks, geotechnical issues, visual screening would be developed.

27.2.4 Sediment treatment and disposal EMP

As for the dredging operations EMP, the sediment treatment and disposal EMP would cover all aspects over the life cycle of the sediment treatment and disposal component of the proposal.

All consent conditions relating to sediment treatment and disposal together with those conditions that may be required under a Protection of the Environment Operations Licence for the establishment of a contaminated soil treatment works would be included in the sediment treatment and disposal EMP.

Specific plans would include:

- **Water management plan.**

This plan would include procedures for the management of treatment process wastewater, erosion and sediment control, management of domestic wastewater, water reductions controls and stormwater management and reuse.

- **Noise and vibration management plan.**

This plan would include noise control measures, monitoring, remedial measures and procedures to handle complaints about noise.

- **Air quality and odour management plan.**

The plan would include procedures for controlling treatment process air emissions, odours, dust and fumes.

- **Sediment management plan.**

This plan would contain procedures for the management of remediated sediments including handling, transport, storage and disposal. The plan would include procedures for disposal of remediated sediments to land and sea.

- **Other environmental issues.**

Management plans for energy use, hazards and risks, geotechnical issues, and visual screening would be developed.

27.3 Environmental monitoring

Environmental monitoring is the collecting and interpreting of data to provide quantification of the effectiveness of the EMP and accuracy of the predictions made in this EIS. A monitoring program enables auditing of safeguards to ensure they achieve their objectives and to facilitate modification where necessary.

27.3.1 Dredging operations

The monitoring procedures that would be implemented during the dredging/excavation component of the proposal are outlined in Table 27.2.

Table 27.2 Monitoring during dredging

Issue	Requirement	Location	Frequency	Parameters
River water quality	Determination of background water quality	Upstream of dredging works	Prior to commencement of dredging	Turbidity, suspended solids, BOD5, heavy metals, PAH
	Monitor water quality	Dredging area and environmentally sensitive areas	Weekly	Turbidity, suspended solids, BOD5, Heavy Metals, PAH
	Prior to commencement of river bed dredging, ensure curtain wall is in place	Dredging area	Daily	N/A
	During dredging of river bed ensure curtain wall in intact	Dredging area	Daily	N/A
	Prior to commencement of bank excavation, ensure curtain wall is in place	Bank excavation area	Daily	N/A
	During bank excavations ensure curtain wall is intact	Dredging area	Daily	N/A
	Inspect site equipment to ensure it is in good condition and not leaking, fuel, oil or dredged sediments	Dredging works area	Daily	N/A
Noise	Conduct monitoring in response to complaints	As required	As required	N/A
Vibration	Conduct Monitoring during blasting periods	Nearby industrial buildings	As required	N/A
Air Quality	Inspect plant and equipment to ensure exhaust emissions are not excessive	Dredging works areas	Daily	N/A
	Visually monitor dust generation from site to ensure that excessive dust is not being produced	Dredging works areas	Daily	N/A
	Monitor dust generation from site using dust gauges	Sediment transport route	Monthly	Dust PM ₁₀

Table 27.2 Continued.

Issue	Requirement	Location	Frequency	Parameters
Odour	Conduct monitoring in response to complaints	As required	As required	N/A
Waste Management	Inspect waste receptacles to ensure they are not being overfilled and are being collect regularly	Waste storage areas	Weekly	N/A
	Monitor waste recycling and disposal procedures to ensure they are being complied with	N/A	Weekly	N/A
Erosion and sediment control	Prior to commencement of bank excavations ensure sediment and erosion control devices are in place	As required	As required	N/A
	Inspect erosion and sediment control devices to ensure they are installed and operating correctly	Truck loading areas	Daily	N/A
Flora and fauna	Monitor the extent of dredging works to ensure that dredging is not conducted outside of designated area	Dredging area	Daily	N/A
	Conduct monitoring on the impacts to fauna of blasting	River surrounding blasting areas	As required	N/A
Traffic	Inspect trucks to ensure they are not overloaded, they adhere to speed limits and that the load is cover appropriately	Truck loading areas	Daily	N/A
	Inspect traffic management signs to ensure they are in place and visible	Vehicle transport route	Daily	N/A

27.3.2 Sediment treatment and disposal operations

The monitoring procedures that would be implemented during the sediment treatment and disposal components of the proposal are outlined in Table 27.3.

Table 27.3 Monitoring during sediment treatment and disposal

Issue	Requirement	Location	Frequency	Parameters
Sediment Management	Monitor contamination levels of sediments prior to treatment or disposal	Temporary treatment facility	Daily extended to weekly & fortnightly to confirm deliniation of contaminated sediments	To be set by EPA and auditor
	Monitor remediated sediments for residual contamination	Remediated sediment stockpiles from thermal desorption unit	Weekly	To be set by EPA and auditor
	Monitor remediated sediments for leachability of contaminants	Cemented sediments	Weekly	TPLC PAH, Heavy metals
Water	Inspect Geotubes to ensure confinement of sediments	Sediment storage areas	Daily	N/A
	Inspect drains, sediment ponds and sediment fences to ensure drained water is not discharging to the Hunter River	Sediment storage areas	Daily	N/A
	Monitor discharge water from water treatment unit	Discharge point from water treatment unit	Daily	Turbidity, suspended solids, Heavy Metals, PAH
	Inspect site equipment to ensure it is in good condition and is not leaking fuel or oil	Treatment area	Daily	N/A
Air quality	Emissions monitoring	Thermal Desorption Unit	Trials to set baseline then weekly extending to monthly upon reliable operation	To be set by EPA and auditor
	Inspect treatment plant and equipment to ensure exhaust emissions are not excessive	Treatment area	Daily	N/A
	Visually monitor dust generation from site to ensure that excessive dust is not being produced	Treatment area	Daily	N/A
	Monitor dust generation from site using dust gauges	Treatment area	Monthly	Dust PM ₁₀
Waste Management	Inspect waste receptacles to ensure they are not being overfilled and are being collect regularly	Waste storage areas	Weekly	N/A
	Monitor waste recycling and disposal procedures to ensure they are being complied with	N/A	Weekly	N/A

Table 27.3 Continued.

Issue	Requirement	Location	Frequency	Parameters
Traffic	Inspect trucks to ensure they are not overloaded, they adhere to speed limits and that the load is cover appropriately	Truck loading areas	Daily	N/A
	Inspect traffic management signs to ensure they are in place and visible	Vehicle transport route	Daily	N/A

27.4 Environmental auditing

Independent environmental audits would be carried out twice a year. The audit report would be made available to the Director-General, Council, the EPA, NPWS, DLWC and any other interested parties.

27.5 Environmental reporting

27.5.1 Records

Full records of all environmental procedures would be kept including:

- monitoring data and analysis;
- details of quantities of sediments treated using thermal desorption and cementation;
- details of quantities of sediment disposed of at the various disposal locations off site;
- details of the quantities of sediments disposed of at sea;
- details of quantities and types of waste removed from site;
- the number of environmental complaints received, their nature and the corrective action taken; and
- details of all environmental licences and approvals applied for and obtained.

27.5.2 Reporting

An annual review would be prepared and submitted to the EPA and DIPNR. This document would include:

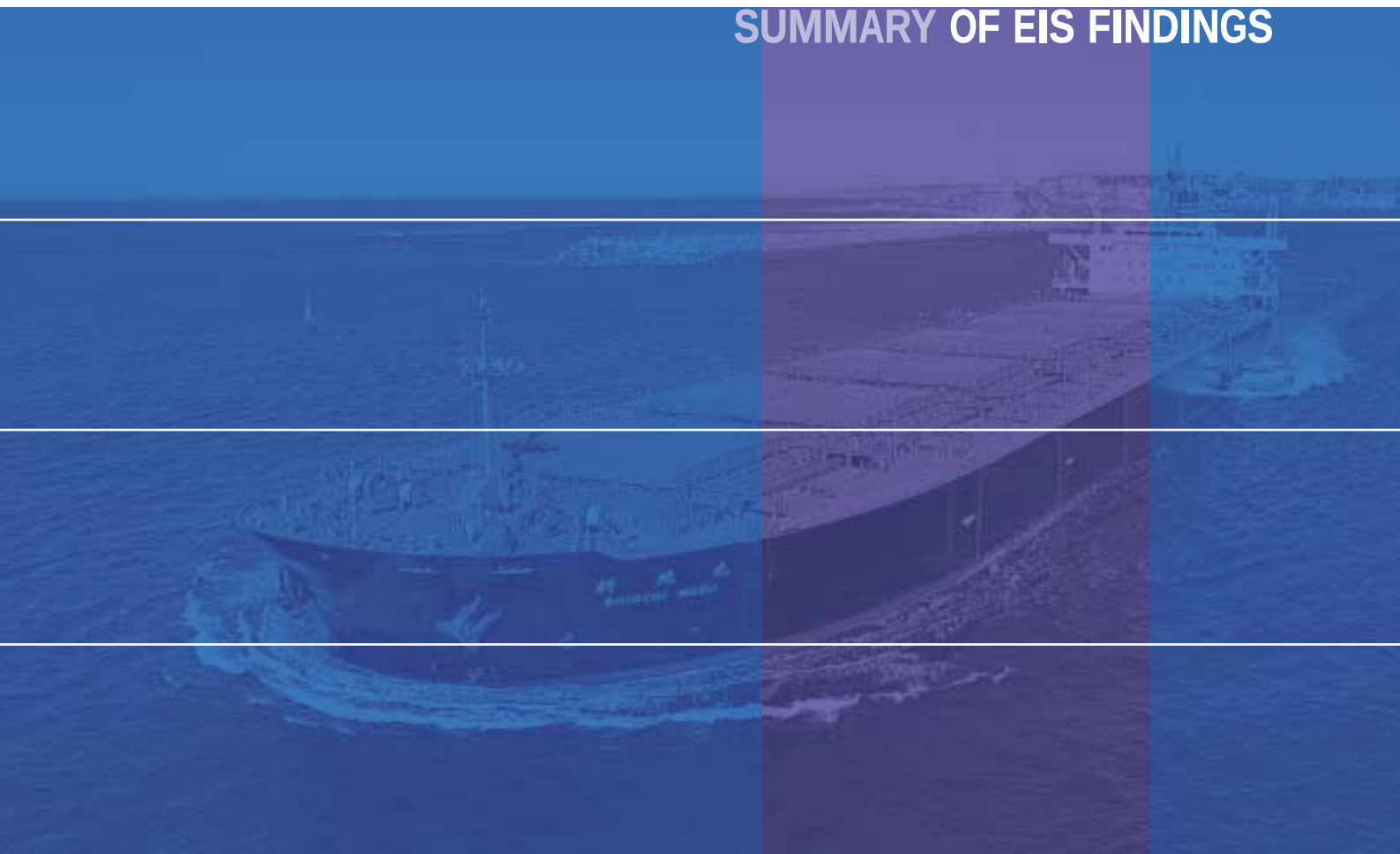
- a statement of compliance with all development consent conditions;
- a statement of compliance with all licence conditions; and
- a monitoring and complaints summary.

If any shortcomings in site activities or environmental controls were identified, the EMPs would be amended accordingly and resources would be provided to ensure compliance.

Incidents that could cause material harm to the environmental would be reported to the EPA, investigated and acted upon.

PART E

SUMMARY OF EIS FINDINGS



28 Justification of the proposal

This chapter provides a justification of the proposal according to the requirements of the Environmental Planning and Assessment Regulation 2000.

28.1 Introduction

The EP&A Regulation requires EISs to justify the carrying out of an activity, taking into account biophysical, economic and social considerations, and the principles of ecologically sustainable development (ESD).

The analysis undertaken in this chapter is based on the potential of the proposal to achieve its primary and secondary objectives, as well as the project goals (as listed in Chapter 4). These objectives and goals incorporate consideration of the desired biophysical and socio-economic outcomes. This analysis is summarised in section 28.2. The analysis of the proposal according to the principles of ESD is provided in section 28.3.

28.2 Achieving the objectives

28.2.1 Providing for the future growth of the Port of Newcastle

The main objective of the proposal is to extend the shipping channels in the Port of Newcastle in order to provide adequate deep water access to future berth sites. This would secure the potential for the continued sustainable economic growth of this, the maritime gateway to the Hunter Region.

As noted in Chapter 4, the port is the economic and trade centre for the Hunter Valley region, as well as for much of north and north-western NSW. It is the key export centre for the NSW coal industry.

There is currently insufficient capacity to allow for future expansion of the port and the provision of facilities and berths for currently proposed, and potential future developments in Newcastle, particularly in the vicinity of Kooragang Island. The number of vessels visiting the port is expected to continue to increase, and is forecast to increase to approximately 1,520 by 2007/08.

Increasing demand for port facilities and services is currently occurring as a result of:

- diversification of cargo handled by the port;
- planned development of new port facilities such as the Multi-purpose Terminal;
- the demands for berth access as a result of expansion of existing activities on Kooragang Island, and new developments proposed, requiring access to deepwater berths in the South Arm.

The proposal would ensure that there is sufficient supply of serviceable port land available to meet future demand.

The proposal would also provide for the future development of port facilities, which would assist in attracting new business to the port.

As noted in Chapter 4, the South Arm is the most suitable location for port expansion, mainly because of the South Arm's proximity to transport infrastructure, its lower potential for significant environmental impacts (particularly to the Kooragang Nature Reserve) and its more passive hydraulic characteristics (compared to the north arm).

The proposal would enable the future development of port facilities within the South Arm, without resulting in significant detrimental environmental impacts. The proposal designers have endeavoured to maximise the available area in the channel without compromising either the structural integrity of the Tourle Street bridge, riverbanks or the OneSteel site.

An associated benefit of this proposal would be the removal and treatment of contaminated river sediments in the South Arm. The former BHP closure area site and a portion of river sediments have been declared a 'remediation site' under the *Contaminated Land Management Act 1997* and fall under a voluntary remediation process currently under assessment by the NSW EPA.

The highly contaminated material would firstly be isolated within a sheet piled wall to prevent migration of contaminants in the South Arm. The material would then be transferred to the closure area site. This area adjoins the southern bank of the South Arm, and is located to the east of the site owned by OneSteel (unrelated). This material would be treated on the closure area using a variety of techniques, which may include stabilisation, thermal desorption and other methods approved by the EPA.

Various treatment alternatives for the contaminated sediments located in the South Arm have been considered and, where possible, tested during the preparation of the EIS.

The treatment methods described in this EIS are based on the results of a sampling, analysis and testing program carried out as part of the EIS's studies. This program was undertaken to validate the technologies and methods proposed in the EIS. The treatment options explored include thermal desorption and cement stabilisation.

The EIS considers the need to provide flexibility within the development consent in order to allow the proposal to be contracted out to private sector firms. Consent is sought for a range of workable technologies to be involved in the treatment process.

28.2.2 Project goals

To search for and design an approach that incorporates best practice techniques in terms of methodology, technology and design.

Various treatment alternatives for the contaminated sediments located in the South Arm have been considered and, where possible, tested during the preparation of the EIS.

The treatment methods described in this EIS are based on the results of an extensive sampling, analysis and testing program carried out as part of the EIS's studies. This program was undertaken to validate the technologies and methods proposed in the EIS. The treatment options explored include thermal desorption and cement stabilisation.

To achieve the maximum possible beneficial reuse of dredged and excavated material.

As far as possible, an aim of the proposal would be to beneficially reuse the material resulting from dredging and excavation. However, not all materials (for example, silty muds or soft marine sediments) can be reused. In addition some material needs to be remediated before it can be reused.

Options for beneficial reuse include:

- the proposed Tomago industrial area;
- the proposed multi-user port and transport corridor to the Tomago industrial area itself;
- the Protech site and any other industrial site on Kooragang Island requiring clean fill;
- reuse of unusable and treated sediments as engineered fill on the closure area site; and
- renourishment of Stockton Beach using clean sands.

It is envisaged that up to 50 percent of the material would be able to be beneficially reused.

To protect the Hunter River from environmental degradation with particular regard to water quality.

The investigations undertaken to produce this EIS have been directed at developing a methodology for the proposal that would protect the Hunter River from environmental degradation, with particular regard to water quality. The use of silt curtains and precise dredging methods in conjunction with the proposal sheet pile wall are integral components of the work.

To return the contaminated Hunter River sediments to an acceptable state.

The successful implementation of this proposal would result in the removal of a significant amount of contaminated sediments from the South Arm. While short-term ecological impacts would occur through the deepening of the channel, the long-term health of the environment in the immediate vicinity of the South Arm would be enhanced.

To avoid the potential for impacts to Kooragang Nature Reserve and significant wetlands to the north of Kooragang Island.

The technical studies undertaken for the EIS have shown that there would be minimal impact on either the Kooragang Nature Reserve or significant wetlands to the north of Kooragang Island.

To protect the health of workers and of the community during implementation of the proposal.

The investigations undertaken to produce this EIS have been directed at developing a methodology for the proposal that would protect the health of workers and of the community during implementation of the proposal.

28.3 Ecologically sustainable development

Each of the four principles of ESD, as established by the EP&A Regulation 2000, is described below, with a comment regarding how the proposal contributes towards each principle.

28.3.1 Precautionary principle

This principle states that 'if there are threats of serious or irreversible damage, lack of scientific certainty should not be used as a reason for postponing measures to prevent environmental degradation'.

The assessment of the potential impacts of the proposal is considered to be consistent with the precautionary principle. The environmental assessments undertaken for this EIS are consistent with accepted scientific and assessment methodologies. The detailed investigations undertaken have identified a range of potential impacts. A number of safeguards have been recommended to minimise potential impacts. These safeguards would be implemented during construction and operation of the proposal. No safeguards have been postponed as a result of lack of scientific certainty.

The selected contractor would be required to prepare a detailed EMP prior to commencing construction. This requirement would ensure that the proposal achieves a high level of environmental performance. No mitigation measures or management mechanisms would be postponed as a result of a lack of information.

It is recommended that environmental performance in relation to the EMP be regularly assessed through external environmental audits. The audits would also assist in assessing the adequacy of safeguards implemented to minimise environmental impacts.

28.3.2 Intergenerational equity

This principle states, 'the present generation should ensure that the health, diversity and productivity of the environment is maintained or enhanced for the benefit of future generations'. In other words, we should ensure that future generations do not inherit a degraded environment.

Consistent with this principle, the EIS has identified that the proposal would not result in significant long term impacts that would lead to degradation of the environment.

The safeguards and management mechanisms recommended within the EIS, and the design features relating to water quality, would minimise the potential for environmental impact and degradation.

28.3.3 Conservation of biological diversity and ecological integrity

This principle states that the 'diversity of genes, species, populations and communities, as well as the ecosystems and habitats to which they belong, must be maintained and improved to ensure their survival'.

The study area has been highly modified and is intensively used. The terrestrial flora and fauna assessment did not identify any significant potential impacts to flora and fauna, other than the removal of a small stand of mangroves located near the Tourle Street bridge.

Water management mechanisms during construction and operation would ensure that the potential for impacts to aquatic ecology is effectively mitigated.

28.3.4 Improved valuation and pricing of environmental resources

This principle requires that 'costs to the environment should be factored into the economic costs of a project'.

The EIS has examined the environmental consequences of the proposal and identified mitigation measures where the potential to experience adverse impacts exists. Construction of the proposal would be required to conform to a high level of environmental performance, guided by the development and implementation of a rigorous and detailed EMP. Requirements imposed in terms of implementation of these mitigation measures would result in an economic cost to the proponent and contractor. The implementation of mitigation measures would increase both the capital and operating costs of the proposal. This signifies that environmental resources have been given appropriate valuation.

The concept design for the proposal has been developed with the aim of minimising potential impacts on the surrounding environment. This indicates that the concept design for the proposal has been developed with an environmental objective in mind.

29 Conclusion

This EIS has considered the potential impacts of the proposed dredging and excavation of the South Arm to facilitate the extension of shipping channels in the Port of Newcastle. It has been prepared by GHD on behalf of the Waterways Authority to assist the Minister of Infrastructure Planning and Natural Resource in assessing the proposal. This EIS has been prepared in accordance with the provisions of Part 4 of the EP&A Act; and with regard to the requirements of the Director-General of DIPNR and issues raised by other statutory agencies.

It provides an assessment of the potential environmental impacts of the proposal, considering both the potential positive and negative impacts of the proposal, and recommending mitigation measures to protect the environment where required.

It is considered that the proposal would:

- improve the current operational viability of the Port of Newcastle;
- allow for the future expansion of shipping channels, addressing the current shortfall in terms of port capacity in NSW; and
- remove a significant quantity of contaminated material from the aquatic environment.

A number of potentially negative impacts have been identified. The main potential negative impacts relate to the dredging and excavation activities. These include:

- generation of turbidity and the potential for impacts on aquatic ecology;
- noise and blasting impacts to surrounding residents;
- loss of access to and along the South Arm during implementation of the proposal; and
- occasional odour impacts as a result of the exposure of sediments.

In addition, the potential for impacts to operations on the OneSteel site would need to be carefully managed during the implementation of the proposal.

In particular, the EIS identifies that:

- Water quality controls must be incorporated in the design, with best practice dredging and construction methods implemented to ensure that the potential for water quality impacts are adequately controlled;
- A detailed community consultation and community information program would be required prior to and during detailed design and implementation of the proposal; and
- The potential for cumulative impacts as a result of the various industrial and infrastructure proposals in the port and its environs need to be carefully considered overall, through planning processes such as that set in place by the Newcastle Port Environs Concept Proposal, developed by DIPNR.

The EIS recommends a number of measures to mitigate the potential for adverse impacts. Implementation of the proposal would be required to incorporate best practice management techniques. A comprehensive and rigorous EMP would be developed, implemented and monitored to ensure compliance with all recommended mitigation measures and consent conditions imposed. In association with the EMP a management plan would be developed, in consultation with OneSteel, to detail the management measures necessary to minimise the potential for impact on operations within the OneSteel site.

The proposal would allow significant expansion of port facilities in Newcastle through the extension of the shipping channels into the South Arm. This in turn would facilitate infrastructure development on or around the South Arm. The NSW Government, with the input of the Newcastle community, will need to balance the need for employment generating activities in the Hunter region against the potential for any adverse environmental impacts to occur as a result of the intensification of development in this area, should the proposal be approved.

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APPENDIX A

DIPNR DIRECTOR-GENERAL'S REQUIREMENTS FOR THE EIS



14 March 2003

Mr David Waddell
GHD
10 Bond Street
SYDNEY NSW 2000

Dear Mr Waddell

Proposed Dredging of the Hunter River (South Arm) - Newcastle
Our Reference: S01/00533

I refer to your request for Director-General's requirements for the preparation of an Environmental Impact Statement (EIS) for the above proposal. These requirements replace the draft Director-General's requirements issued on 29 May 2001 and 3 January 2003. Attachment No. 1 outlines the statutory matters that must be included in any EIS under clauses 71 and 72 of the *Environmental Planning and Assessment Regulation 2000* (the Regulation).

You should note however, that if the Development Application to which these requirements relate is not made within two years of the date of this letter, clause 73(6) of the Regulation requires you to consult further with the Director-General prior to lodging the application.

Specific Requirements

Through discussions at the Planning Focus Meeting (PFM) for this proposal, held on 6 November 2002, and subsequent consultation with relevant agencies, a number of key issues have been identified as being of particular relevance for the EIS to focus upon. Pursuant to clause 73(1) of the Regulation, the Director-General requires that the issues summarised below, and provided in detail as Attachment No. 2, be addressed in the EIS for the proposed development. The issues summarised below have been ranked to generally indicate those matters the Department considers should form major components of the EIS. Ranking is aimed at assisting in the focussed preparation of the EIS and is not necessarily indicative of the actual magnitude of any of the impacts listed.

Issues of Key Environmental Planning Importance for EIS Preparation:

- Contamination, including remediation and disposal strategies;
- Flora and fauna, including address of regionally significant vegetation, intertidal habitat and wading and migratory birds;
- Air quality, particularly odour;
- Hydrology; including impacts on tidal range and the affects of this on upstream wetlands;
- Water quality; and
- Spoil disposal, including address of disposal and reuse options.

Issues of Environmental Planning Importance for EIS Preparation:

- Description of the proposal;
- Soil management, including address of acid sulfate soils, sedimentation and erosion;
- Noise and vibration, including impacts of blasting activities;
- Traffic, including possible relocation of Cormorant Road; and
- Environmental risk.

Other Important Issues:

- Environmental Planning Instruments and other relevant documents;
- PlanningNSW guidelines;
- Ecologically sustainable development, including financial valuation of the environment;
- Indigenous and non-indigenous heritage;
- Waste management;
- Social and economic impacts; and
- Public utilities and service infrastructure.

During the preparation of your EIS, you should consult with the relevant local, State and Commonwealth government authorities, service providers and community groups. You should also address any issues that may arise during these consultations in your EIS.

The Director-General also requires the following for all State Significant Development Applications:

- The applicant shall nominate a contact person (and telephone number) who will be made available to answer public enquiries about the proposal.
- The applicant shall consult with the community that is likely to be affected by the proposal. A report on who was consulted must be submitted with the DA, describing how the affected community was identified, consultation methods, and key issues raised by the community.
- The applicant shall provide a disk containing an electronic copy of the Executive Summary to the EIS, in pdf format or another format that can be easily converted to pdf format.
- Electronic copies of the EIS shall be provided on CD in an appropriate format.

Requirements of Integrated Approval Bodies

The proposed development is "integrated development" since you will need to obtain approvals and/or licences from the Environment Protection Authority, the Department of Land and Water Conservation and NSW Fisheries. Requirements of these agencies for the EIS are at Attachment 3. If further integrated approvals are identified before the Development Application is lodged, you must conduct your own consultation with the relevant agencies to identify their requirements for the EIS.

When lodging your Development Application, you must provide cheques, made payable to each of the integrated approval bodies, for \$250 (GST free) in addition to development application fees.

Requirements of Other Authorities and Councils

Following on from the Planning Focus Meeting held on 6 November 2002, those agencies present at the PFM have provided their requirements for your EIS (see Attachment No. 3). You should address these requirements in your EIS.

Commonwealth Approvals

Under the Commonwealth *Environment Protection Biodiversity Conservation Act 1999* (EPBC Act), approval of the Commonwealth Minister for the Environment is required for actions that may have a significant impact on Matters of National Environmental Significance, except in circumstances which are set out in the EPBC Act. Approval from the Commonwealth is in addition to any approvals under NSW legislation. If you need approval under the Commonwealth Act, your EIS will be expected to assess the impacts on these matters.

Note: Matters of National Environmental Significance under the EPBC Act are:

- i) World Heritage properties;
- ii) RAMSAR wetlands;
- iii) threatened species or ecological communities listed in the EPBC Act;
- iv) migratory species listed in the EPBC Act;
- v) the environment in a Commonwealth marine area; and
- vi) nuclear actions.

Lodgement of your DA

When submitting your Development Application to the Department, please include at least ten copies of the EIS and any supporting documentation. At the same time you must lodge four copies of the Development Application and supporting documentation with the Environment Protection Authority, Department of Land and Water Conservation, NSW Fisheries and any other agencies from which an integrated approval is required. Additional copies may be required during the exhibition period.

DA Fees

In accordance with Part 15, Division 1 of the Regulation, the Development Application fees should be paid to the Department at the time of lodgement of the Development Application. You are advised to contact the Department with the project cost estimate to enable fees to be calculated.

Further Information

Please contact Miriam Mathew on (02) 9762 8378 if you require any further information regarding the Director-General's requirements for the EIS.

Yours sincerely



14/3/3

David Kitto
Acting Team Leader - Manufacturing and Rural Industries
Major Development Assessment
As Delegate for the Director-General

STATUTORY REQUIREMENTS FOR THE PREPARATION OF AN ENVIRONMENTAL IMPACT STATEMENT

In accordance with the *Environmental Planning and Assessment Act 1979* (the Act), an environmental impact statement (EIS) must meet the following requirements.

Content of EIS

Pursuant to Schedule 2 and clause 72 of the *Environmental Planning and Assessment Regulation 2000* (the Regulation), an EIS must include:

1. A summary of the environmental impact statement.
2. A statement of the objectives of the development or activity.
3. 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 out the development or activity.
4. An analysis of the development or activity, including:
 - (a) a full description of the development or activity; and
 - (b) a general description of the environment likely to be affected by the development or activity, together with a detailed description of those aspects of the environment that are likely to be significantly affected; and
 - (c) the likely impact on the environment of the development or activity, and
 - (d) a full description of the measures proposed to mitigate any adverse effects of the development or activity on the environment, and
 - (e) a list of any approvals that must be obtained under any Act or law before the development or activity may be lawfully carried out.
5. A compilation, (in a single section of the environmental impact statement) of the measures referred to in item 4(d).
6. The reasons justifying the carrying out of the development or activity in the manner proposed, having regard to biophysical, economic and social considerations, including the following principles of ecologically sustainable development:
 - (a) The precautionary principle - namely, 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.
In the application of the precautionary principle, public and private decisions should be guided by:
 - (i) careful evaluation to avoid, wherever practicable, serious

or irreversible damage to the environment, and

- (ii) an assessment of the risk-weighted consequences of various options,
- (b) Inter-generational equity - namely, 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,
- (c) Conservation of biological diversity and ecological integrity, namely, that conservation of biological diversity and ecological integrity should be a fundamental consideration,
- (d) Improved valuation, pricing and incentive mechanisms, namely, that environmental factors should be included in the valuation of assets and services, such as:
 - (i) polluter pays, that is, those who generate pollution and waste should bear the cost of containment, avoidance or abatement,
 - (ii) the users of goods and services should pay prices based on the full life cycle of costs of providing goods and services, including the use of natural resources and assets and the ultimate disposal of any waste,
 - (iii) environmental goals, having been established, should be pursued in the most cost effective way, by establishing incentive structures, including market mechanisms, that enable those best placed to maximise benefits or minimise costs to develop their own solutions and responses to environmental problems.

An environmental impact statement referred to in Section 78A(8) of the Act shall be prepared in written form. The prescribed form to accompany the environmental impact statement must comply with the requirements of clause 71 of the Regulation and be signed by the person who has prepared it.

Procedures for public exhibition of the EIS are set down in clauses 77 to 81 of the Regulation. Attention is also drawn to clause 283 of the Regulation regarding false or misleading statements in EISs.

SPECIFIC REQUIREMENTS FOR THE PREPARATION OF AN ENVIRONMENTAL IMPACT STATEMENT

Environmental Planning Instruments and Other Relevant Documents

Consideration of the provisions and objectives of relevant environment protection legislation, environmental planning instruments and studies including but not limited to:

- SEPP 55 – Remediation of Land;
- SEPP 33 – Hazardous and Offensive Development;
- SEPP 71 – Coastal Protection;
- Hunter Regional Environmental Plan, 1989;
- Newcastle Local Environmental Plan, 1987;
- Draft Newcastle Local Environmental Plan, 2002;
- DCP 41- Kooragang Port & Industrial Area;
- DCP 43 -Contaminated Land Management & Remediation;
- DCP 50 - Stormwater Management for Development Sites;
- Council's DA Guide; and
- Address of the Healthy Rivers Commission report into the Hunter River.

Guidelines

During the preparation of the EIS, you should consult the Department's EIS Guidelines 'Extractive Industries, Dredging and Other Extraction in Riparian and Coastal Areas' and 'Remediation Works'. These guidelines are available for purchase from the Department's Planning Centre, 20 Lee Street, Sydney, or by calling (02) 9762 8044.

General Description of the Proposal

A general description of the proposal, including:

- details regarding the purpose of the proposal;
- the likely maximum number and types of berths constructed on both sides of the river to be served by the proposed dredging;
- a description of all proposed construction, clearing, draining , excavation and filling including an evaluation of relevant methodologies;
- a description of the existing environment likely to be affected by the proposal;
- identification of all Crown land and Protected Waters likely to be affected; and
- a description of the proposed staging of the works including:
 - information as to how the various stages of the proposed dredging activities would be linked to the progress of land side developments, including consideration of the various scenarios for the location of berths and cargo handling areas; and
 - consideration of the possible need to remove and treat contaminated sediments prior to undertaking the remainder of the dredging.

Contamination

Consideration of contamination issues, including:

- declaration of the BHP closure area as a remediation site and the Onesteel site as an investigation area under the *Contaminated Land Management Act*. Any investigations in the EIS associated with these areas should be directed toward developing appropriate remediation strategies and technology.
- details of the various types of materials to be dredged, including the degree of chemical contamination of all sediments removed from the riverbed;
- an assessment of the potential for the movement and/or mobilisation of contaminated material remaining on the riverbed after dredging is completed;
- an assessment of impacts on water quality, particularly turbidity and remobilisation of contaminants into the water column following dredging, and methods proposed to protect water quality; and
- identification of feasible remediation or disposal strategies for the quantity of contaminated soil and sediments to be removed or disturbed to construct the swing basin and the navigation channel. This should include:
 - an investigation of available remediation technologies including evidence that the technology has been successfully used to treat contaminated soil in the past and is appropriate to the type and level of contamination on the development site; and
 - a comprehensive assessment of the preferred technology to be employed at the development. This assessment must focus on the ability of the technology to minimise environmental impacts, especially those relating to air quality (particularly odour) and hazards.

Flora and Fauna

- Impacts on estuarine vegetation, including:
 - the removal of mangrove and salt marsh vegetation located adjacent to the Tourle Street bridge, and the local and regional significance of this vegetation;
 - impacts of the removal of intertidal habitat on wading and migratory bird species that use the subject site as feeding and roosting areas; and
 - mitigation measures for the loss of habitat and ecological values resulting from the proposed dredging program. Consideration of appropriate compensatory habitat (not limited to replacement of mangroves) and environmental management activities.
- Impacts of the proposed dredging program on flora and fauna (marine and terrestrial), particularly critical habitats, threatened species, populations or ecological communities, or their habitats, regionally significant species and vegetation associations. The assessment should be conducted in accordance with the provisions of the *Threatened Species Conservation Act, 1995* and the *Lower Hunter and Central Coast Regional Guidelines for Flora and Fauna Assessment* and involve the following steps:
 - conduct baseline surveys, and consult relevant databases and listings by the Scientific Committee;
 - describe the types and condition of habitats in, and adjacent to, the land to be affected by the proposal;
 - prepare a list of threatened species, populations or ecological communities, or their habitats, that may occur on the site, and conduct targeted surveys for these;
 - apply the "8 part test" (section 5A of the *Environmental Planning and Assessment Act 1979*) to threatened species, populations or ecological communities, or their habitats, that may be affected by the proposal. The EIS must justify any decision to not apply the test to all of the threatened species, populations or ecological communities identified on or in the vicinity of the site; and

- prepare a Species Impact Statement (SIS) for any critical habitats, species, populations or ecological communities, or their habitats that are likely to be significantly affected by the proposal as determined in the 8 part test when all mitigation measures (not including any compensatory habitat proposals) to be implemented are taken into account. (Note: An SIS must be prepared in accordance with any requirements of the Director-General of National Parks and Wildlife Service. It is recommended that the Applicant consult with the Department and National Parks and Wildlife Service following application of the 8 part test and prior to commencing an SIS).

Air Quality

- A full assessment of air quality impacts (odour and other air pollutants), including those associated with the dredging and onshore remediation activities must be included in the EIS, including dispersion modelling where appropriate, to meet the requirements of the EPA.

Hydrology

- Potential for the proposal to alter the tidal range and extent of saline intrusion upstream, the length and duration of flooding (including changes to hydraulic volumes and velocities), and groundwater characteristics in the vicinity of Kooragang Wetlands, Hexham Swamp and other similar areas, including consideration of the impacts of dredging on the opening of the estuary floodgates to allow for the inundation of Hexham Swamp.
- Impacts of the proposed dredging program on the hydrology of the south and the north arm of the Hunter River (including Fullerton Cove, north west Kooragang Island and Tomago Wetlands), including the effect of enhanced tidal prism on upstream wetlands, and the consequent impacts on flora and fauna.
- Description of design features to be incorporated into the proposed development (construction and operation) to guard against long term environmental disturbances, including maintenance of the natural hydrological regime and sediment movement patterns.

Water Quality

- Assessment of the potential for dredging operations and land based activities to pollute waters.

Spoil Disposal

- Quantities of material to be dredged, and an assessment of the suitability of this material for disposal or re-use, including assessment of disposal and re-use options. eg. nourishment of Stockton Beach.
- Implications of any land disposal on the BHP Closure Area consent and the Multi Purpose Terminal.

Soil Management

- Details of studies undertaken to determine the effects of the proposed dredging program on:
 - siltation;
 - scouring and erosion of river banks by natural forces as well as passing vessels;
 - bank stability, including battered or retained banks; and
 - the stability of any structures adjacent to the dredge area, including the Tourle Street bridge.
 -

- An assessment of the potential for acid sulphate soils within the area to be dredged.
- Impacts of the proposal on SEPP 14 wetlands and Kooragang Nature Reserve including consideration of potential impacts of runoff from the BHP site (post disposal of dredged material on the site).

Noise

- Details of proposed blasting activities, including an assessment of the impacts of associated noise, ground vibration and overpressure, and details to mitigate for any impacts.
- Assessment of noise impacts, including emissions associated with sheet piling, dredging, onshore materials handling and remediation activities.

Traffic

- Impacts of the proposal on the local road network and Cormorant Road.

Environmental Risk

- Assessment of the nature and level of environmental risk within the various systems that interface with the project and recommendations for risk management.

Ecologically Sustainable Development

- Ecologically sustainable development, including the application of a financial value for the environment as part of the process of impact evaluation.

Heritage

- Assessment of archaeological potential and Aboriginal heritage value including details of consultation with the Awabakal Local Aboriginal Land Council.
- Assessment of non-indigenous heritage impacts eg shipwrecks.

Waste Management

- Details of the proposed waste management strategy.

Social and Economic

- Details of potential impacts on fishermen and oyster farmers.

Public Utilities and Service Infrastructure

- Consideration of disturbance of any utility installations and any required relocation or removal.

Attachment No. 3

**REQUIREMENTS OF INTEGRATED APPROVAL BODIES FOR THE PREPARATION OF AN
ENVIRONMENTAL IMPACT STATEMENT**

FAXED
29/11/02

Your Reference : S01/00533
Our Reference : 273128A1
Contact : Rebecca Scrivener, 4908 6830



Coastal Regions

Major Development Assessment
planningNSW
GPO Box 3927
SYDNEY NSW 2001

Attn: Mr Gordon Kirby

27 NOV 2002

Dear Sir

DIRECTOR GENERAL'S REQUIREMENTS: DREDGING OF HUNTER RIVER (SOUTH ARM) TO EXPAND PORT BERTHING FACILITIES

I refer to your letter of 14 November 2002 requesting the EPA to provide its requirements for the Environmental Impact Statement for this development proposal. I also refer to the planning focus meeting on 6 November 2002 to discuss the scope of this development proposal.

The requirements provided in attachment A to this letter taken into account the scope of works described in your letter and the issues discussed at the planning focus meeting. These requirements also replace the requirements submitted by the EPA on 11 May 2001 for the original project.

The proponent should be aware that the bed sediments of the Hunter River within 120 metres of the shoreline of Lot 221 DP1013964 known as the Closure Area of the former BHP steel works site are declared a Remediation Site under Section 21 of the Contaminated Land Management (CLM) Act. The whole of Lot 221 DP 1013964 and the bed sediments of the Hunter River within 120 meters of the shoreline of this land known as the Onesteel Site is declared an Investigation Area under the CLM Act. Consequently, any investigations or work proposed in the Environmental Impact Statement (EIS) that is associated with the land and the sediments described above should be directed towards developing appropriate remediation strategies.

In summary the key issues that will need to be addressed in the EIS to enable the EPA to adequately assess the proposal and if appropriate to issue General Terms of Approval include:

- Noise emissions associated with sheet piling, dredging and onshore materials handling and remediation activities;
- Noise and vibration associated with blasting of hard rock from the river bed;
- Assessment of the chemical, physical and toxicology characteristics of the soils and sediments impacted by the development works;
- Potential for dredging operations and the land based activities to pollute waters;
- Emission of odours and other air pollutants associated with the dredging and onshore remediation activities;
- Identification of feasible remediation or disposal strategies for the quantity of contaminated soil and sediments to be removed or disturbed to construct the swing basin and the navigation channel; and

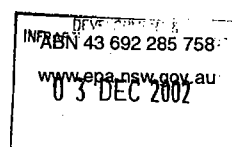
Environment Protection Authority

PO Box 488G Newcastle NSW 2300 Australia

Telephone 61 2 4908 6800

Facsimile 61 2 4908 6810

Ground Floor NSW Government Offices 117 Bull Street Newcastle West NSW 2302



- Procedures that will be implemented to mitigate significant impacts and to monitor the effectiveness of the mitigation works.

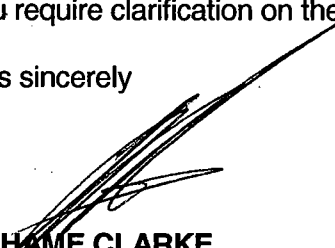
Based on the information provided the dredging works and sediment storage/treatment/remediation activities are scheduled activities under the Protection of the Environment Operations Act and as such are required to be licensed by the EPA. If development consent is granted the applicant will need to obtain the appropriate licences from the EPA before any work on these activities commences.

The EIS should not propose remediation strategies or pollution mitigation systems or procedures that are either poorly defined, impractical or beyond the financial viability of the applicant to implement and/or maintain.

The EPA requests that three (3) copies of the EIS to be provided with a copy of the development application to the EPA's Regional Manager, Hunter.

If you require clarification on the EPA's requirements please contact me on 49086815.

Yours sincerely



GRAHAME CLARKE
A/Regional Manager, Hunter

**ENVIRONMENT PROTECTION AUTHORITY REQUIREMENTS FOR ENVIRONMENTAL
IMPACT STATEMENT:- PROPOSED DREDGING OF CONTAMINATED MATERIAL IN SOUTH
ARM OF HUNTER RIVER**

GENERAL REQUIREMENTS

The EPA suggests that the Planning NSW's EIS Guideline (draft) Remediation Works be used as a guide to the preparation of the EIS.

The EIS must provide sufficient information for the EPA to be able to fully assess the development in so far as the impacts relate to the EPA's statutory responsibility under the provisions of the environmental legislation administered by the EPA and, if appropriate, to provide its general terms of approval. The requirements of Section 45 of the Protection of the Environment Operations Act (1997) must be addressed.

SPECIFIC REQUIREMENTS

Characterisation of contamination levels in the sediments

The EIS must present the results of the detailed chemical and toxicity investigations conducted on the sediments in the South Arm of the Hunter River for Newcastle Port Corporation by the CSIRO's Centre for Advanced Analytical Chemistry.

Given that the level of Polycyclic Aromatic Hydrocarbons (PAH) and Total Petroleum Hydrocarbons (TPH) in the sediments is known to vary with depth and spatially within the development site the EIS must provide a detailed analysis and description of the concentrations and distribution of PAHs and TPHs in sediments that will be disturbed or dredged. If it is proposed to vary the method of removing and/or remediating/disposing of the sediments based on a logical system of grouping the sediments according to the level of toxicity or other characteristics the EIS must explain the rationale for this procedure and clearly identify the location and estimated quantity of each group of sediments on a suitable map or diagram.

Dredging works

The EIS must include a detailed description and justification for the dredging methodology(s) proposed and the systems that will be in place to minimise any impacts associated with the operation of the dredge(s) on water quality and the emission of odours and other air pollutants.

Remediation or disposal of contaminated sediment and soil

The EIS must describe in detail the method(s) proposed to handle, store, pre-treat, remediate or dispose of contaminated soils and sediments and the extent to which the methods proposed are expected to prevent pollutants migrating either directly or indirectly from the development site to air or waters.

If a heat treatment processes such as thermal desorption is proposed the EIS must also provide an assessment of the emissions to atmosphere that could reasonably be expected to be achieved when monitored in accordance with the methods described under the air impact assessment heading of these requirements.

WATER IMPACT ASSESSMENT

If the handling, storage, pre-treatment, remediation or disposal method(s) for contaminated soils or sediments are likely to generate leachate or treated effluents the EIS must provide an estimate of the quantity and an evaluation of the physical, chemical and toxicity characteristic of the leachate or effluents that will be returned to the environment. In addition to PAH's that are known to be present in high concentrations in the sediments the analysis should consider the fate of other pollutants likely to be present in the sediments or soils. For example Petroleum Hydrocarbons (including benzene, toluene, ethyl benzene and xylene), metals, phenol, ammonia and cyanide.

The EIS must assess the potential for shore-based activities such as excavations to construct the swing basin or the storage, treatment/remediation of contaminated soils or sediments to adversely impact on groundwater quality. If the assessment predicts that groundwater quality will be significantly impacted the EIS must propose measures to ameliorate the impacts.

The EIS must describe the measures to be adopted to manage stormwater from any land based activities associated with the construction of the swing basin, bank stabilisation works or the storage and remediation of contaminated soil and sediments. The EIS should identify the pollutants and the concentration of these pollutants in stormwater that will be discharged from the stormwater system(s) to the environment.

The EPA has adopted the Australian and New Zealand Environment Conservation Council *Water Quality Guidelines for Fresh and Marine Water Quality* (ANZECC, 2000) as a guide for the assessment of environmental impacts on aquatic ecosystems.

AIR IMPACTS ASSESSMENT

The EIS must include an Air Quality Impact Assessment (AQIA). The AQIA must identify and describe in detail those activities or processes with the potential to cause point source or fugitive emissions of dust, fine particulates and other air pollutants that may be present in soils that will be excavated to construct the swing basin or in sediments to be removed from the Hunter River.

The EPA's preferred approach to the AQIA is set out in the document titled '*Approved Methods and Guidance For the Modelling and Assessment of Air Pollutants in New South Wales*'. This document is available on the EPA's website at <http://www.epa.nsw.gov.au/air/amgmaap>.

The AQIA must include a detailed odour impact assessment for all activities associated with the excavation, dredging, handling or remediation of contaminated soils and sediments with a potential to emit odours. The EPA's preferred approach to odour assessment is detailed in the document titled '*Assessment and Management of Odour from Statutory Sources in NSW*'. This document is available on the EPA's website at www.epa.gov.au/air/odour/htm.

Given that the sediments are known to contain high concentrations of naphthalene and other odour generating substances the methodology described for a level 3 assessment in the above-mentioned document should be followed. Odour source data used in the assessment should be derived in accordance with procedures described in the document titled "*Approved Methods for the Sampling and Analysis of Air Pollutants in New South Wales*" methods OM7 and OM8. This document is available on the EPA's website at www.epa.gov.au/air/amsaap/htm.

The AQIA must describe the methodology used and any assumptions made to predict the impacts and take into account cumulative impacts associated with emissions from any other industrial activities in the area including any developments that have development consent but which have not commenced construction or operations prior to the EIS for this development being exhibited. In

particular dust and particulate emissions (PM_{10}) associated with demolition and remediation activities on Lot 221 DP1013964 known as the Closure Area of the former BHP steel works site.

The EIS must describe in detail the measures proposed to mitigate the impacts and quantitatively describe the extent to which the mitigation measures are likely to be effective in achieving relevant assessment criteria.

NOISE IMPACTS ASSESSMENT

The EIS must identify all significant noise sources and describe the extent to which noise emissions associated with the activities proposed to be conducted, and in particular excavation works, sheet piling, dredging and contaminated soil or sediment handling and remediation activities are likely to impact on residential or other sensitive receivers in the vicinity of the development site. The proponent must provide this detail in the form of a noise impact assessment (NIA) prepared in accordance with the EPA's *'New South Wales Industrial Noise Policy (INP)'* (EPA, January 2000).

The NIA should include a location map of the area showing the development site, significant noise sources and residential areas and any specific noise sensitive locations that could be impacted by the development.

The NIA should clearly define the hours of operation and the duration of each noise source activity. If activities are proposed to be conducted between the hours 10pm to 7am the NIA must assess the potential for sleep disturbance in resident areas. Guidance on assessing sleep disturbance is provided in appendix B of the document titled *'Environmental Criteria for Road Traffic Noise'*, (EPA, June 1999).

Blasting vibration and overpressure

If blasting is proposed to remove hard rock from the river bed the NIA must include an assessment of the predicted noise and vibration levels. The assessment must also provide information on the period over which blasting is likely to be required, the time of day blasting will take place and the number of blasts anticipated on any day.

If blasting is proposed to be conducted outside the hours 7am to 6pm the NIA must assess the potential for sleep disturbance in resident areas.

The impacts should be assessed against the criteria recommended in the document titled *'Technical Basis for Guidelines to Minimise Annoyance due to Blasting Overpressure and Ground Vibration'* (ANZECC, September 1990.)

Noise mitigating measures

The EIS must describe in detail the measures proposed to mitigate the impacts and quantitatively describe the extent to which the mitigation measures are likely to be effective in achieving relevant assessment criteria.

WASTE ASSESSMENT

Any wastes proposed to be removed from the site must be identified in the EIS and classified in accordance with the EPA's Environmental Guideline *'Assessment, Classification and Management of Liquid and Non-Liquid Wastes'*, (EPA, May 1999).

MONITORING REQUIREMENTS

The EIS should describe the methods and procedures that will be adopted to monitor the performance of the pollution control systems or site management practices to be implemented to control or mitigate the emission of noise and emissions to air and waters for the duration of the development works.

EPA – November 2002

PlanningNSW
Level 4, 20 Lee Street
Sydney 2000

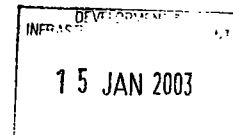
17 December 2002

Attention: Gordon Kirkby

Dear Mr Kirkby

RECEIVED AM
14 JAN 2003
CCSU RECORDS
MANAGEMENT

FAXED



Your Ref: S01/533
Our Ref: ER2619A

**S01/533 - PROPOSED DREDGING OF THE HUNTER RIVER (South Arm) -
NEWCASTLE.**

I refer to your letter of 14 November 2002 in regard to the above matter. The Department of Land and Water Conservation (DLWC) provides the following comments for your consideration.

CROWN LAND ISSUES

Status of Land

- The EIS needs to identify the location and status of any Crown land, as defined under the Crown Lands Act 1989, included or directly impacted upon by the proposed works. Crown land may include land based areas and off-shore dump grounds. That is, are the off-shore dump grounds within the State's coastal waters/ three (3) nautical mile limit.

Statutory Requirements

- The EIS needs to clarify if there are any approval requirements under the Crown Lands Act 1989 for the proposed works.

RIVERS AND FORESHORES IMPROVEMENT ACT, 1948

The proposed area of dredging is on land vested in the Waterways Authority/Newcastle Port Corporation. Therefore, the Minister for Ports is responsible for the implementation of the Rivers and Foreshores Improvement (RFI) Act in this area and should be contacted for any Environmental Impact Statement (EIS) requirements.

The area to be utilised for remediation, disposal and any other works associated with the dredging has not been identified. The following information should be addressed in the EIS for any work on freehold land outside the Waterways Authority area that is within 40 metres of a waterway. That activity will require a permit to be obtained from DLWC under the RFI act.

- A detail description of the proposed development including all proposed construction, clearing, draining, excavation and filling. An evaluation of the proposed methods of excavation, construction and material placement should also be discussed.
- A detail description of the existing environment likely to be affected by the proposed development in terms of vegetation, fauna, sediment movement, water quality, and hydraulic regime. This description should include identification of all Protected Water on site, as defined in the Rivers and Foreshores Improvement Act, 1948.

Suite 6 464 King Street Newcastle West NSW 2302 PO Box 2213 Dangar NSW 2309 DX 4335 Newcastle West

Telephone (02) 4929 4346 Facsimile (02) 4929 6364 Email www.dlwc.nsw.gov.au

- A detail description of all potential environmental impacts of the proposed development in terms of vegetation, fauna, sediment movement, water quality, and hydraulic regime.
- A description of the design features to be incorporated into the proposed development to guard against long term actual and potential environmental disturbances, particularly in respect of maintaining the natural hydrological regime and sediment movement patterns.
- A description of the measures to be implemented to guard against actual and potential environmental disturbances during the construction of the proposal, particularly in respect of maintaining the natural hydrological regime and sediment movement patterns.

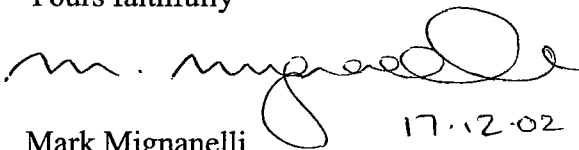
COASTAL PROTECTION ACT

Under Clause 38 of the Coastal Protection Act 1979 (amended 2002), the proponent must seek the Minister's concurrence to carry out any development within the Coastal zone that is not within a Local Government area. This would appear to be the case for the disposal of dredge spoil within the State waters (up to 3 nautical miles offshore). Issues to be addressed in the EIS to enable the concurrence to be considered include:

- Whether the proposal adversely affects the behaviour or is adversely affected by the behaviour of the sea.
- The monitoring program proposed to assess the impacts before, during and after disposal.
- The principles of Ecologically Sustainable Development.

Should there be any further enquiry in this matter, please contact Ross Cooke, Senior Natural Resource Officer (Coastal) on (02) 4929 9825.

Yours faithfully



Mark Mignanelli
Resource Access Manager
Hunter Region

17.12.02

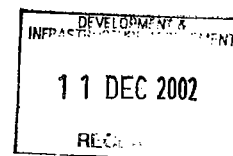


Our Ref: 02-407-RB
Your Ref: S01/00533

NSW Fisheries

5 December 2002

Gordon Kirkby
Manager Manufacturing and Rural
Major Development Assessment
PlanningNSW
GPO Box 3927
SYDNEY NSW 2001



Dear Mr Kirkby

Re: Proposed Dredging of the of the Hunter River

NSW Fisheries has previously provided comments on at least two proposals to undertake dredging works in the Hunter River relevant to the efficient provision of Port Services in Newcastle. The Departments specific items of interest remain relatively unchanged and for clarity, the items of interest are re-iterated below.

A general broad interest is held in:

- Any potential impact on the existing hydrology of the estuary.
- Any impact the proposal may have on fishermen.
- Any impact the proposal may have on oyster farmers.
- The removal or destruction of fish habitat such as mangroves and saltmarsh.
- Disturbance of acid sulphate soils.
- Disturbance of contaminated sediments.
- Any impact on threatened fish species.

These points of interest are held as;

It is possible that an alteration to the hydrology of the estuary may have an effect on vegetation types and dependant animal communities. If the works have the potential to alter the tidal range and extent of saline intrusion upstream, this should be noted and discussed in the EIS. Any alteration to the length and duration of flooding in the vicinity of Kooragang Wetlands, Hexham Swamp and other similar areas should also be considered in the same manner.

For example, currently there is a proposal to open or remove floodgates, allowing the inundation of Hexham Swamp. An alteration to the estuary's dynamics may impact on this proposal and require further modelling of tidal movements / flooding characteristics in this area.

PORT STEPHENS FISHERIES CENTRE

Taylors Beach Road Taylors Beach NSW 2316

Private Bag 1 NELSON BAY NSW 2310

Telephone: (02) 4982 1232 Facsimile: (02) 4982 1107

ABN 56 287 047 871

Commercial fishing is currently undertaken in the Hunter River and this industry is worth about \$800,000 dollars to the local economy on an annual basis. The Hunter River also has a high frequency of use by recreational fishermen. There are also oyster leases within the River.

Dredging works in either arm of the River could effect these important activities, and the extent of such impacts should be considered. For example, removal of contaminated sediment during dredging works could in theory, pose a health risk for seafood consumption or increased watercraft activity could make oyster leases unviable (from impacts such as sedimentation / smothering of stock, bio-accumulation of disturbed pollutants and associated health risks etc).

It would therefore be prudent to consider the impacts that any dredging works could possibly have on the livelihood and lifestyle of these members of the Hunter community.

In the lower Hunter estuary there are wetlands such as Kooragang subject to international conventions such as Jamba, Camba / Ramsar agreements (please confirm specifics with National Parks and Wildlife Service). Accordingly an assessment of the proposed works should be undertaken to determine if any of these areas or agreements will be effected. Wetlands are important nursery areas for fish and accordingly are valuable for sustainable fisheries management.

The removal of mangroves to create an effective navigation channel or create a turning bay for ships, will require a permit from NSW Fisheries in accordance with S205 of the *Fisheries Management Act 1994*. As the NSW Government has a general policy of no net aquatic habitat loss, if any proposed works effect marine vegetation, the creation of compensatory habitat elsewhere will be required.

Significant and high frequency water displacement events that could occur from the bow waves of vessels should be considered in the context of erosive damage to the river banks, wetland and riparian vegetation. The construction of revetments and rock walls should be carefully considered as these can smother mangrove pneumatophores and eventually kill these plants.

Due to the turbidity of the River, it is likely that the allochthonous input to the river system from these plants is a major contributor to the productivity of the system. Removal of these plants will have far reaching effects to the dependant ecosystem. If carefully designed, hard structures used to minimise erosion of the foreshore may have a place, however the design, effectiveness, costs and benefits of these should be carefully considered.

A careful evaluation of the sediment to be dredged from the channel should be undertaken. Disturbance of acid sulphate material, if present, has the potential to have an extremely adverse affect on the aquatic life in the estuary. Further, contaminated sediments in parts of the river adjacent to industrial and berthing areas, are likely to occur as noted at the most recent planning focus meeting. An appropriate strategy and careful consideration of these two points is obviously an essential component of the EIS.

Details should also be supplied of any further development of offshore dumping grounds and potential impacts relevant to sustainable fisheries management.

The department is also interested in examining the proposed movement of spoil, bank stability, transport infrastructure, disposal location, footprint, de-watering sites, discharge of waste and associated issues, particularly where relevant to the incidental loss of aquatic habitat or fragmentation.

Attention to the potential presence of endangered species in the area is also highlighted. The Black Cod (*Epinephelus daemeli*) is thought to exist in the Hunter and there is potential for the Green Sawfish (*Pristis zijsron*) to also inhabit the area. Consequently to meet the requirements of the *Fisheries Management Act 1994* and the *Environmental Planning and Assessment Act 1979* an "eight part test" would be required.

The extent and location of drilling and blasting within the river needs to be described. Details should be provided identifying the types of explosives to be used, size of charges, timing of the shots, strategies proposed to minimise harm to aquatic animals and any potential hazard to public safety. Please note that a permit to use explosives in waters will be required by virtue of Cl.112 of the *Fisheries Management (General) Regulation 1995* should the proposal proceed.

Ultimately, careful consideration of any public health issues pertinent to the removal of any contaminated sediment from the South Arm, including any special requirements to manage public access around the area, any potential impact upon recreational or commercial fishing, or aquaculture leases is a number one priority. Further, consideration should be given to some form of contingency planning being undertaken to manage accidental spillage's, slippage's or other unregulated movement of contaminated spoil.

Finally, an attachment is also included with this letter which details general requirements this Department would like to see addressed in any Environmental Impact Statement.

Although the points and concerns detailed above may appear and indeed are, substantial in nature, the Department recognises the longstanding history of the Hunter as a major port and the importance of regional economic development for the Hunter Region. Accordingly it is trusted that whatever proposals are put forward, there is room to accommodate both the regions economic prosperity and the unique environment of the area, both being of value to the local community.

If you have any questions in relation to this matter, please contact Mr Carter, Senior Conservation Manager, on 02 4982 1232.

Yours sincerely



Roland Bow
Conservation Manager (Central)
NSW Fisheries

Addendum - General Requirements for the Preparation of an Environmental Impact Statement.

Definitions

The definitions given below are relevant to these requirements:

Fish means any part of marine, estuarine or freshwater fish or other aquatic animal life at any stage of their life history (whether alive or dead). Fish include oysters and other aquatic molluscs, crustaceans, echinoderms and beachworms and other aquatic polychaetes.

Marine vegetation means any species of plant that at any time in its life must inhabit water (other than fresh water).

Waters refers to all waters including tidal waters below mean high water mark as well as flowing streams, irregularly flowing streams, gullies, rivers, lakes, coastal lagoons, wetlands and other forms of natural or man made water bodies on both private and public land.

Useful Information

To help in the preparation of an EIS, the publication "*Guidelines for the Assessment of Aquatic Ecology in EIA*" (Draft 1998) produced by the Department for Urban Affairs and Planning may prove useful in outlining appropriate procedures and methodologies for conducting aquatic surveys.

Matters to be Addressed

1. General Requirements

The EIS must include the information outlined below:

A topographic map of the locality at a scale of 1:25 000 should be provided. This map should detail the location of all component parts of the proposal, any areas locally significant for threatened species (such as aquatic reserves), and areas of high human activity (such as townships, regional centres and major roads).

A recent aerial photograph (preferably colour) of the locality (or reproduction of such a photograph) should be provided, if possible. This aerial photograph should clearly show the subject site and indicate the scale of the photograph.

GENERAL REQUIREMENTS

- Area which may be affected either directly or indirectly by the development or activity should be identified and shown on an appropriately scaled map (and aerial photographs).
- All waterbodies and waterways within the proposed area of development are to be identified.
- Description of aquatic vegetation, snags, gravel beds and any other protected, threatened or dominant habitats should be presented.
- Area, density and species composition should be included and mapped.
- Identification of recognised recreational and commercial fishing grounds, aquaculture farms and/or other waterways users.
- Presented maps or plans
- Description of proposal and study area
- Details of the location of all component parts of the proposal, including any auxiliary infrastructure, timetable for construction of the proposal with details of various phases of construction
- Size of the area affected

- Aspects of the management of the proposal, both during construction and after completion, which relate to impact minimisation eg Environment Management Plans
- Plan of study area
- Locations and types of landuses present
- Locations of streams and other waterbodies
- Land tenure details for all land parcels
- For each freshwater body identified on the plan, the plan should include, either by annotation or by an accompanying table, hydrological and stream morphology information such as: flow characteristics, including any seasonal variations, bed substrate, and bed width
- For each marine or estuarine area identified on the plan, the plan should include, either by annotation or by an accompanying table, hydrological and stream morphology information such as: tidal characteristics, bed substrate, and depth contours

DREDGING AND RECLAMATION ACTIVITIES

- Purpose of works
- Type(s) of marine vegetation in the vicinity of the proposed works
- Distance of adjacent marine vegetation from the outer boundary of the proposed works
- Method of dredging to be used
- Duration of dredging works
- Time of dredging works
- Dimension of area to be dredged
- Depth of dredging activities
- Nature of sediment to be dredged, including Acid Sulphate Soil
- Method of marking area subject to works
- Environmental safeguards to be used during and after works
- Measures for minimising harm to fish habitat under the proposal
- Spoil type and source location for reclamation activities
- Method of disposal of dredge material
- Location and duration of spoil stockpiling, if planned
- Volume of material to be extracted or placed as fill

ACTIVITIES THAT DAMAGE MARINE VEGETATION

- Type of marine vegetation to be harmed
- Amount of marine vegetation to be harmed, map distribution of marine vegetation
- Reasons for harming marine vegetation
- Methods of harming marine vegetation
- Construction details
- Duration of works/activities
- Measures for minimising harm to marine vegetation under the proposal
- Environmental measures to be employed, if necessary
- Method and location of transplanting activities or disposal of marine vegetation

ACTIVITIES THAT BLOCK FISH PASSAGE

- Type of activity eg works in a stream that change flow or morphological characteristics
- Length of time fish passage is to be restricted
- Timing of proposed restriction
- Remediation works

THREATENED SPECIES

- Threatened aquatic species assessment (Part 5C, EP&A Act 1979)
- Eight Part Test

2. Initial assessment

A list of threatened species, endangered populations and endangered ecological communities must be provided. In determining these species, consideration must be given to the habitat types present within the study area, recent records of threatened species in the locality and the known distributions of these species.

In describing the locality in the vicinity of the proposal, discussion must be provided in regard to the previous land and water uses and the effect of these on the proposed site. Relevant historical events may include land clearing, agricultural activities, water abstraction/diversion, dredging, de-snagging, reclamation, siltation, commercial and recreational activities.

A description of habitat including such components as stream morphology, in-stream and riparian vegetation, water quality and flow characteristics, bed morphology, vegetation (both aquatic and adjacent terrestrial), water quality and tide/flow characteristics must be given. The condition of the habitat within the area must be described and discussed, including the presence and prevalence of introduced species. A description of the habitat requirements of threatened species likely to occur in the study area must be provided.

In defining the proposal area, discussion must be provided in regard to possible indirect effects of the proposal on species/habitats in the area surrounding the subject site: for example, through altered hydrological regimes, soil erosion or pollution. The study area must extend downstream and/or upstream as far as is necessary to take all potential impacts into account.

Please Note: Persons undertaking aquatic surveys may be required to hold or obtain appropriate permits or licences under relevant legislation. For example:

Fisheries Management Act 1994

- Permit to take fish or marine vegetation for research or other authorised purposes (Section 37)
- Licence to harm threatened (aquatic) species, and/or damage the habitat of a threatened species (Section 220ZW).

Animal Research Act 1985:

- Animal Research Authority to undertake fauna surveys.

It is recommended that, prior to any field survey activities taking place, those persons proposing to undertake those activities give consideration to their obligation to obtain appropriate permits or licences which may be required in the specific context of the proposed survey activities.

3. Assessment of likely impacts

The EIS must:

- describe and discuss significant habitat areas within the study area;
- outline the habitat requirements of threatened species likely to occur in the study area;
- indicate the location, nature and extent of habitat removal or modification which may result from the proposed action;
- discuss the potential impact of the modification or removal of habitat;
- identify and discuss any potential for the proposal to introduce barriers to the movement of fish species; and
- describe and discuss any other potential impacts of the proposal on fish species or their habitat.

For all species likely to have their lifecycle patterns disrupted by the proposal to the extent that individuals will cease to occupy any location within the subject site, the EIS must describe and discuss other locally occurring populations of such species. The relative significance of this location for these species in the general locality must be discussed in terms of the extent, security and viability of remaining habitat in the locality.

4. Ameliorative measures

The EIS must consider how the proposal has been or may be modified and managed to conserve fisheries habitat on the subject site and in the study area.

In discussing alternatives to the proposal, and the measures proposed to mitigate any effects of the proposal, consideration must be given to developing long term management strategies to protect areas within the study area which are of particular importance for fish species. This may include proposals to restore or improve habitat.

Any proposed pre-construction monitoring plans or on-going monitoring of the effectiveness of the mitigation measures must be outlined in detail, including the objectives of the monitoring program, method of monitoring, reporting framework, duration and frequency.

In the event of a request for concurrence or consultation of the Director of NSW Fisheries, one (1) copy of the EIS should be provided to NSW Fisheries in order for the request to be processed.

It should be noted that NSW Fisheries has no regulatory or statutory role to review draft EISs unless they are accompanied by or are requested as part of a licence application under Part 7A of the FM Act. However, NSW Fisheries is available to provide advice to consent and determining authorities regarding Fisheries' opinion as to whether the requirements have been met if requested, pending the availability of resources and other statutory priorities.

Should you require any further information on these requirements please contact the Office of Conservation at Port Stephens on 4916 3835.

Attachment No. 4

**REQUIREMENTS OF OTHER AGENCIES AND COUNCILS FOR THE PREPARATION OF AN
ENVIRONMENTAL IMPACT STATEMENT**



Department of the Environment and Heritage

Ms Miriam Mathew
Planning NSW
GPO Box 3927
SYDNEY NSW 2001

RECEIVED AM

11 NOV 2002

CCSU RECORDS
MANAGEMENT

Dear Ms Mathew

I refer to your recent letter regarding a planning focus meeting on the 6 November 2002 to discuss the Hunter River South Arm dredging proposal. Environment Australia will not be represented at the meeting however I wish to comment on issues to be addressed in the Director General's Requirements for the New South Wales EIS.

The level of assessment for this proposal is yet to be determined under the EPBC Act. I therefore request that the Director General's Requirements not be formally finalised until the Commonwealth has determined the level of assessment. The Commonwealth Minister for the Environment and Heritage will determine the level of assessment after the proponent has provided preliminary information on the proposal. The NSW assessment process was accredited for two other recent proposals at Kooragang Island (the Austeel steel mill and transport corridor) so it is likely that our recommendation will be that the dredging proposal will be an accredited assessment.

The proponent recently advised Environment Australia of changes to the scope of the proposal. If the changes to the scope of the dredging proposal are restricted to those recently announced the controlling provisions under the EPBC Act, as determined by the Minister on the 22 May 2001, will remain the same and a new referral will not be required.

The controlling provisions under the EPBC Act are;

- Sections 16 and 17B (Wetlands of International Importance);
- Sections 18 and 18A (Listed threatened species and communities);
- Sections 20 and 20A (Listed migratory species); and
- Sections 23 and 24A (Marine environment).

The following potential impacts should be addressed in detail in the EIS:

Potential impacts of the proposed dredging program on the ecological character of the Kooragang Nature Reserve Ramsar site, including, but not limited to:

- The potential influence of dredging on the hydrology of the system.



- The potential physical/ noise disturbance to birds using the area, including impacts related to the modification/fragmentation/destruction of habitat (feeding and roosting sites).
- Potential physico-chemical impacts from disturbing (potentially contaminated) sediments and potential impacts related to a change in nutrients or a change in water temperature.
- Potential for establishment of invasive species.
- Potential impacts from dumping of dredge spoil in sensitive areas.

Potential impacts of the proposed activity on migratory waterbird species listed under the EPBC Act, that use the subject site as feeding and roosting areas, including the following species;

- Bar-tailed Godwit, *Limosa lapponica*
- Black-tailed Godwit, *Limosa limosa*
- Broad-billed Sandpiper, *Limicola falcinellus*
- Common Greenshank, *Tringa nebularia*
- Curlew Sandpiper, *Calidris ferruginea*
- Eastern Curlew, *Numenius madagascariensis*
- Marsh Sandpiper, *Tringa stagnatilis*
- Mongolian Plover, *Charadrius mongolus*
- Pacific Golden Plover, *Pluvialis fulva*
- Ruddy Turnstone, *Arenaria interpres*
- Terek Sandpiper, *Tringa terek*
- Whimbrel, *Numenius phaeopus*.

These impacts might, for example, include:

- The potential physical/ noise disturbance to birds using the area, including impacts related to the modification/fragmentation/destruction of habitat (feeding and roosting sites).
- Potential for establishment of invasive species.
- Physico-chemical impacts from run-off and dredging.

One of the changes to the scope of the project is the proposal to dispose of and remediate the contaminated portion of the dredged material on the BHP site. The potential impacts of runoff from the disposal area into the Ramsar wetland should be addressed in the EIS.

The potential impacts of the movement of heavy metals and other contaminants into the water column and their subsequent sedimentation elsewhere should also be addressed.

I note that one component of the proposal as previously referred, the disposal at sea of dredge material, may not be considered as part of the revised proposal. While this does not alter the controlled action status of the action in terms of the EPBC Act, there being several "controlling provisions" as noted above, it is our view that the sea dumping aspect would be better dealt with as a component of

the revised Hunter River South Arm dredging proposal. I also note that assessment may be required under the *Environment Protection (Sea Dumping) Act 1981*.

The contact officer for this proposal is Mark Jenkins on 02 62741558.

Yours sincerely

A handwritten signature in black ink, appearing to read 'Mal', with a stylized flourish at the end.

Malcolm Forbes
Assistant Secretary
Environment Assessment and Approvals Branch
6 November 2002

MARITIME PROPERTY & ASSETS DIVISION
WATERWAYS AUTHORITY
ABN 21220 712 305 002

Level 11, Maritime Trade Towers
207 Kent Street
Sydney NSW 2000

PO Box 11
Millers Point NSW 2000

Telephone (02) 9364 2111
Facsimile (02) 9364 2444

Our Ref: 01/00029/1
Contact Officer: Bill Thomson
Telephone: 9364 2418

27 November 2002

Mr Gordon Kirkby
Manager Major Development Assessment
Planning NSW
GPO Box 3927
Sydney NSW 2001

Dear Mr Kirkby

Proposed Dredging of the Hunter River (South Arm), Newcastle

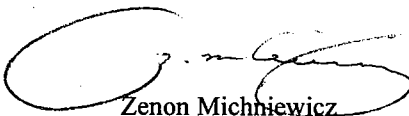
I refer to your letter of 14 November 2002 seeking a review of the issues to be addressed in the Environmental Impact Statement (EIS) for the above project.

The Authority advises that the comments contained in our letter of 10 May 2001 remain unchanged and that the following issues should now be included:

24. An outline of the proposed mitigation and management measures to address risks to water quality. This should cover issues associated with the dredging operations including return water quality as well as the transport and handling of materials.
25. A description of the proposed staging of the work including, for example, the possible need to remove and treat contaminated sediments in advance of the remainder of the dredging.

Should you have any queries regarding the above, please contact Bill Thomson on 9364 2418.

Yours sincerely



Zenon Michniewicz
Executive Director

INFRAC DEPT
28 NOV 2002

Our Ref: W00/01819
Contact officer: Andrew Morison
Telephone: (02) 9364 2036

Waterways
www.waterways.nsw.gov.au

MARITIME ASSETS DIVISION
WATERWAYS AUTHORITY
ABN 21220 712 305 002
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207 Kent Street
Sydney NSW 2000
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Millers Point NSW 2000
Telephone (02) 9364 2111
Facsimile (02) 9364 2444

10 May 2001

Mr Gordon Kirkby
Development and Infrastructure Assessment
Department of Urban Affairs and Planning
GPO Box 3927
Sydney NSW 2001

Dear Mr Kirkby

**Proposed Dredging of the Hunter River (South Arm), Newcastle.
Preparation of an Environmental Impact Statement**

I refer to your letter of 26 April 2001 requesting the Authority's requirements for the preparation of an Environmental Impact Statement (EIS) for the above project.

As you may know, the approval of the Waterways Authority is required for the proposed works as the Authority is the owner of the bed of the Hunter River from the entrance of the port to the Tourle Street Bridge in the South Arm. Accordingly, it is confirmed that provided development consent is not required for the proposed works, the Authority would be a determining authority for the purposes of Part 5 of the *Environmental Planning and Assessment Act 1979* (EP&A Act).

Part 5 of the EP&A Act precludes the Authority from approving the proposed works without first considering to the fullest extent possible all matters affecting or likely to affect the environment.

It is appreciated that details of the land side developments which would provide an economic justification for the proposed dredging are still being evaluated. In this regard, the EIS should provide as much information as possible on how the various stages of the proposed dredging would be linked to progress of the land side developments. This could be presented as various scenarios for the location of berths, cargo handling areas, etc. The information should also cover, at least in concept, the overall impact likely to occur from the full development of the South Arm as a Commercial Port Area.

To further assist the Authority's consideration of the project, it would be appreciated if the following information could be included in the EIS:

1. Purpose of the proposed dredging, including details of the likely maximum number and types of berths which may be constructed on both sides of the river and which would be served by the proposed dredging.

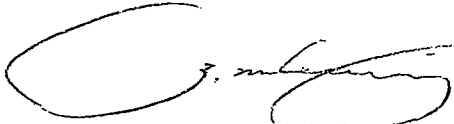
2. Plans and other drawings showing:
 - (a) The location, extent and depth of the proposed dredging (all depths should be to Newcastle Harbour datum);
 - (b) The location of the toe and the top of all battered or retained banks together with the average slope and extent of these banks;
 - (c) Current depth contours and proposed depth contours;
 - (d) Any redistribution of material within the dredged area;
 - (e) Details of the proposed disposal areas, including current and proposed contours, details of current features at the sites, details of all proposed containment and dewatering structures as well as any relevant temporary works;
 - (f) Locations of any marine and terrestrial vegetation, aquatic and animal habits, etc. likely to be affected; and
 - (g) Likely berth locations adjacent to the dredged area.
3. A general description of the proposed work including the types of dredge to be used, general methods of spoil removal and spoil disposal.
4. Details of studies undertaken to determine the effects of the proposed development in the South Arm on:
 - (a) River flows and other hydraulic effects, particularly during periods of flooding of the Hunter River;
 - (b) Siltation, particularly during periods of flooding;
 - (c) Scouring or erosion of river banks by natural forces as well as passing vessels, tugs, etc.;
 - (d) The stability of any battered or retained bank; and
 - (e) The stability of any structure adjacent to the dredged area.
5. Details of the size of vessels anticipated to use the dredged area including overall length (metres), beam (metres), draft (metres), Gross Registered Tonnes (GRT) and Deadweight Tonnes (DWT). Such details should include the maximum size vessel as well as the range of vessel sizes.
6. Details of the various types of material to be dredged (e.g.: sand, silt, rock, etc) from each location together with the quantities and the methods of removal and disposal. The details should indicate the extent of soil and rock sampling on which the analysis is based. Full details should also be provided on all disposal methods, including equipment, size and location of any pipelines, any dewatering operations and any likely interference with existing port or adjacent operations. Any assumptions made with regard to removal methods should be stated together with any alternative removal methods which may need to be employed.
7. Consideration of any potential problems such as structural damage, vibration, noise, etc. arising from any drilling and blasting associated with the proposed dredging.
8. The proposed timetable for the work including dredging rates and contingencies.
9. Range of river and weather conditions necessitating the temporary cessation of dredging operations.

10. Details of the type, quantity and location of contaminants in the material to be dredged and the suitability of the spoil for redistribution at or above the MHWL.
11. Consideration of contingency plan for treatment or disposal of the dredged spoil should degraded sand or material be found during dredging works.
12. Potential effects on vegetation (marine and terrestrial). In this regard, the location of terrestrial and marine vegetation (including mangroves and seagrasses) on and around the site and the nature of the subtidal, intertidal and supratidal zones (eg. sand, rock, beach, mangroves etc).
13. If aquatic or terrestrial fauna or their habitat are likely to be disturbed, issues to be considered include:
 - (a) Identifying aquatic and terrestrial animal habitats, ecological communities and where appropriate, populations and species in areas that may be directly or indirectly affected by the proposal;
 - (b) The incidence of threatened species, populations or ecological communities identified under the Fisheries Management Act 1994 and the Threatened Species Conservation Act 1995; and
 - (c) Potential direct and indirect impacts on fauna, including species considered to be of international, national, state and regional significance.
14. It is noted that the proposal involves removal of intertidal habitat that is potentially suitable for a number of wader species and migratory birds. Bird surveys are currently being undertaken in the vicinity and a number of studies have been carried out in the past in the area likely to be impacted by the proposal. These works should be referred to and considered in the assessment of the impact of the proposal.
15. The current proposal involves the removal of a stand of mangroves, located adjacent to the Tourle Street Bridge. Details should be provided on the significance of this stand (given a regional and local context) as well as known and likely habitat values.
16. Provide details of any mitigation measures for the loss of habitat and ecological values in the area. Consideration should be given to appropriate compensatory habitat and environmental management activities.
17. Outline results of consultation with the various agencies and stakeholders. It should be noted that the Hunter Bird Observers Club has a particular interest and knowledge of the biology of the area.
18. Provide a description of the location, type and scale of associated works such as temporary structures (site offices, lay down areas, etc), stockpiles and related activities. Outline the proposed treatment of these sites and proposed approach to managing environmental impacts.
19. Proposed mitigation and management measures to minimise potential adverse impacts. For instance, the use of a silt curtain at both the dredging site and relocation site during the works should be considered to control dispersal of sand.
20. Outline of an Environmental Management Plan for the proposed works, including transfer and disposal of dredged material.
21. Specify other approvals, which may be necessary under other legislation for the proposed dredging after consultation with relevant authorities. For instance, NSW Fisheries under Fisheries Management Act 1994 and Environment Protection Authority under Protection of the Environment Operations Act 1997.

22. Identify any proposed monitoring and maintenance programs for the dredged channel, bank stability, etc.
23. Details of any landscaping to be carried out. It should be noted that landscaping is to be comprised of locally indigenous species which represent the original plant communities which would have been found in the vicinity of the subject land.

We look forward to continued discussions on this matter. Should you have any queries regarding the above, please contact Andrew Morison on telephone 02 9364 2036.

Yours faithfully

A handwritten signature in black ink, appearing to read 'Z. Michniewicz', written over a large, loopy circular flourish.

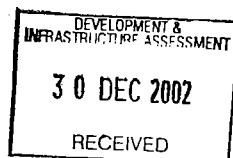
Zenon Michniewicz
Executive Director

D&E GM/KF

Phone: 0249742767

FAKED
20 December 2002

M/s M Mathew
Senior Environmental Planner
Major Development Assessment
Planning NSW
GPO Box 3927
SYDNEY NSW 2001



PO Box 489, Newcastle
NSW 2300 Australia
Phone 02 4974 2000
Facsimile 02 4974 2222
Email mail@ncc.nsw.gov.au

Dear M/S Mathew

RE: PLANNING FOCUS MEETING - PROPOSED DREDGING OF THE HUNTER RIVER (SOUTH ARM)

I refer to your letter dated 25 October 2002 concerning the above proposal.

It is confirmed that in addition to the matters raised in Council's previous letter dated 17 May 2002 the Environmental Impact Statement (EIS) address the following matters: -

1. **STATUTORY PROVISIONS**
Consideration of the objectives and provisions of the following planning instruments :
 - *Hunter Regional Environmental Plan, 1989;
 - *Newcastle Local Environmental Plan, 1987; and
 - *Draft Newcastle Local Environmental Plan, 2002.
2. **COUNCIL DOCUMENTS**
Consideration being given to the requirements of the following documents:
 - *DCP 41- Kooragang Port & Industrial Area;
 - *DCP 43 -Contaminated Land Management & Remediation;
 - *DCP 50- Stormwater management for development sites;
 - * Council's DA Guide.
- 3 **DISPOSAL OF DREDGED SAND MATERIAL**

The EIS is to identify the suitability of sand won during the dredging program for disposal on Stockton Beach to meet the beach nourishment needs for that area (draft Newcastle Coastline Management Plan and Study (Umwelt 2002). This issue should be assessed as a valid option for that part of the project.

4 FLORA AND FAUNA ASSESSMENT

It is noted that the project has direct environmental impacts including such activities as removal of mangroves and placement of pump lines and associated infrastructure. A number of recent studies and investigations have identified numerous threatened species of bats (Pilot Survey for Microchiropteran Bats of the Mangrove Forests of Kooragang Island, Hoyer 2002), migratory waders and the Green and Golden Bell Frog as inhabiting the area in association with specific habitats. The EIS should include a comprehensive flora and fauna assessment in accordance with the provisions of the Threatened Species Conservation Act and the Lower Hunter and Central Coast Regional Guidelines for Flora and Fauna Assessment (REMS 2001).

5 ESTUARINE HYDROLOGY

Recent studies (Shifting Sands at Stockton Report - Umwelt 2002, draft Hunter Estuary Process Study – MHL 2002) have identified changes to the hydraulic characteristics of the Hunter Estuary as a result of past development activities including dredging. Changes to hydraulic conditions, principally increased tidal range, hydraulic volumes and velocities and groundwater characteristics needs to be considered. Potential impacts within the Estuarine ecosystems including migratory wader habitat, on the design of proposed port infrastructure and on the stability of existing port infrastructure need to be determined in a manner that provides an appropriate level of confidence within the EIS process.

6 ECOLOGICALLY SUSTAINABLE DEVELOPMENT

The principles of ecologically sustainable development have been identified as an objective in a range of Government environmental and natural resource planning legislation and policy. The EIS is to apply these principles and in particular apply a financial value for the environment as part of the process of impact evaluation and the consideration of options.

7 ENVIRONMENTAL RISK MANAGEMENT

The EIS is to incorporate risk management study including management options that identifies the nature and levels of environmental risk within the various systems that interface with the project.

8 LOSS OF VEGETATION (REVISED)

The direct and potentially indirect impacts on mangrove vegetation are to be considered within the EIS including proposed compensation from any loss of habitat. Any compensatory habitat assessment should be done against the broader habitat management issues (Hunter Estuary Process Study draft - MHL 2002) and needs within the Estuary and not be limited to replacement of mangroves.

9 IMPACTS ON WATER QUALITY IN THE HUNTER RIVER (REVISED)

Issues associated with the dredging of the River and potential impacts on water quality and marine life are to be addressed, including risk of sediment mobilisation within the South Arm upstream of Tourle Street Bridge and proposed sea dumping of dredge material.

10 HEALTHY RIVERS COMMISSION REPORT INTO THE HUNTER RIVER (HRC2002)

The EIS is to consider the findings and recommendations of the HRC enquiry into the Hunter River as they relate to the Estuary in consideration of issues and the management options and recommendations.

11 TRAFFIC MANAGEMENT

The EIS is to address the likely impacts of any proposed changes to road and infrastructure including the capacity and design of the Tourle Street Bridge.

Should you require further clarification of any of the matters raised herein I can be contacted on 02 49742767.

Yours faithfully

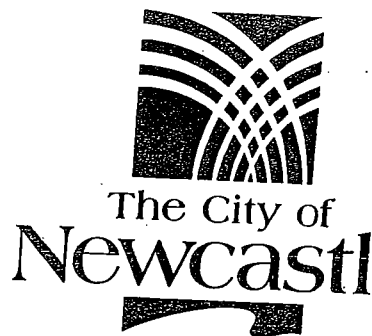
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**Geof Mansfield
DEVELOPMENT & BUILDING TEAM CO-ORDINATOR
CITY WEST**

D & E.D BRAZAITIS
Phone 4974 2747

17 May 2001

Tom Evans
Development and Infrastructure Assessment
Department of Urban Affairs and Planning
GPO Box 3927
SYDNEY NSW 2001



PO Box 489, Newcastle
NSW 2300 Australia
Phone 02 4974 2000
Facsimile 02 4974 2222
Email mail@ncc.nsw.gov.au

Dear Tom

FAXED

**PROPOSED DREDGING OF THE HUNTER RIVER (SOUTH ARM)-NEWCASTLE
YOUR REF:S01/00533**

I refer to your letter of 26 April 2001 and provide the following advice on matters which Council considers should be addressed in the Environmental Impact Statement (EIS) for the subject proposal:

1. Disposal of Dredged Material

The location of any potential landfill sites for the disposal of dredged materials within the Newcastle Local Government Area should be identified in the EIS. The use of such sites for landfill purposes, including any overland pipeline and associated infrastructures will require separate development consent from Council under the provisions of the Environmental Planning and Assessment Act, 1979.

Newcastle Council would not be in favour of sterilising further land by the disposal of contaminated material on land that is currently uncontaminated. The principles in Council's draft Development Control Plan on contaminated land should be considered in any proposal for disposal of contaminated material on land in the Newcastle Local Government area.

2. Loss of Vegetation

As the proposed development includes the removal of mangrove vegetation along northern side of the the affected river, the issues associated with the removal of this vegetation should be addressed including proposed compensation for this loss of habitat.

3. Loss of Public Recreation resource

The proposed dredging works will result in the loss of existing sandy beaches along the northern side of the river. The impact of this lost recreational resource should be addressed in the EIS.

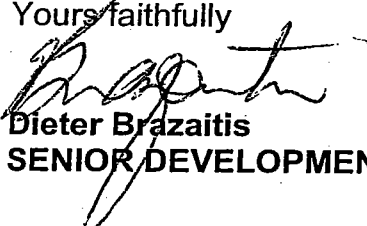
4. Impact on water quality in the Hunter River

Issues associated with the dredging of the river and potential impacts on water quality and marine life should be addressed, including the proposed dumping of material at sea.

5. Transport of materials

All issues associated the transport of dredged materials should be addressed unless subsequent DA's for the disposal of material on landfill sites are to be lodged.

Yours faithfully

A handwritten signature in black ink, appearing to read 'Dieter Brazaitis', is written over the typed name and title.

Dieter Brazaitis

SENIOR DEVELOPMENT OFFICER

File: 325.5395/01/10;1
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Mr Gordon Kirkby
Manager Manufacturing and Rural
Major Development Assessment
Planning NSW
GPO Box 3927
SYDNEY NSW 2001

**PROPOSED DREDGING OF THE HUNTER RIVER (SOUTH ARM) –
NEWCASTLE LGA**

Dear Sir

I refer to your Department's letter dated 14 November 2002 (Department reference S01/00533) regarding the above proposed activity.

The proposed dredging of the Hunter River (South Arm) could impact on the existing Cormorant Road. It is understood that the development of a swinging basin in association with the port development could necessitate the relocation of Cormorant Road.

Also, dredging and associated activities must stay clear of the Tourle Street Bridge. These activities, if carried out in close proximity to the bridge structure, may adversely affect its structural integrity and therefore is considered unacceptable. Particular attention is to be made to ensure that draw down resulting from the dredging does not affect the structural integrity of the bridge structure.

Any impacts on the traffic operation of the surrounding road network are to be assessed by the applicant. Assessment is to be provided in the form of a traffic impact study (TIS) and should be prepared in accordance with the RTA's *Guide to Traffic Generating Developments*. The TIS should follow the standard format and structure as listed in Table 2.1 of the Guide.

These matters should be examined and reported on in the EIS for the project.

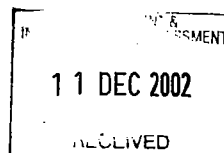
Yours faithfully

Colin Nunn
Development Manager
Hunter Region

28/11/02



6 December 2002



Mr G Kirkby
Manager Manufacturing and Rural
Major Development Assessment
Planning NSW
GPO Box 3927
SYDNEY NSW 2001

**NSW
NATIONAL
PARKS AND
WILDLIFE
SERVICE**

-ABN 30 841 387 271

Our Reference: DOC02/11503.emb.02/05595
Your reference: S01/00533

Attention: Ms Miriam Mathew

Dear Mr Kirkby,

**NPWS REQUIREMENTS FOR EIS FOR PROPOSED DREDGING OF
HUNTER RIVER (SOUTH ARM) - NEWCASTLE**

Reference is made to your letter dated 15 November 2002 in which you seek the National Parks and Wildlife Service's (NPWS) requirements for preparation of the above Environmental Impact Statement (EIS). The NPWS has a statutory responsibility for the care and protection of native flora and fauna and sites of Aboriginal heritage throughout NSW and for the management of the NPWS estate. The following comments relate to these statutory responsibilities.

A letter dated 11 May 2001 provided EIS requirements for the proposal as it was previously articulated. This letter combines previous comments with additional requirements addressing the modifications to the original proposal, and thus supersedes the previous advice.

It is recommended that the relevant issues in the attached general list of environmental issues be addressed in the EIS. Some of the issues detailed will be of greater relevance than others depending on the natural and cultural heritage values of the area involved.

Of particular interest are the following:

- Areas of significance for native vegetation, with particular reference to the value of habitat for threatened species, populations or ecological communities and their habitats, or regionally significant species and vegetation associations, including Rare or Threatened Australian Plants.
- Areas of potential significance for native fauna with particular reference to the value of habitat for threatened species, populations or ecological communities, or regionally significant species.

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- Areas of archaeological potential and Aboriginal heritage value as identified by the Aboriginal community and sites registered on the NPWS Aboriginal Sites Register.
- Areas of NPWS estate.

Impacts on wetland habitat and NPWS estate

The lower Hunter River estuary has been widely regarded as the most significant area of migratory wader habitat in NSW, and the wetlands of Kooragang Nature Reserve have been listed as a Wetland of International Importance under *the Ramsar Convention on Wetlands*. However, the wetland habitat available to waders and other wildlife has contracted substantially since European settlement, such that wildlife numbers have seriously declined.

Large-scale loss of habitat due to impacts from pollution, dredging, location of dredge spoil, flood mitigation, sedimentation, agriculture and urban development has been experienced in the estuary. A disproportionate loss of essential habitat, such as saltmarsh (potential roost sites - reduced by 67%) and intertidal foreshore habitat (foraging areas - reduced by more than 50%) has also contributed to the decline in bird numbers. There is potential for the proposal to further impact on wetland habitat, through direct loss and indirect or incremental loss through changes to wetland and in-stream ecosystems.

The EIS should be broad enough to identify any impacts on the hydrology of the north arm of the Hunter River, eg. Fullerton Cove, north west Kooragang Island, Tomago wetlands etc, as well as upstream areas of the South Arm, including the effect of an enhanced tidal prism on upstream wetlands and possible migration of the dredged area upstream. High conservation value SEPP 14 wetlands about 1.5 km upstream from the proposed dredge limit have been identified as possible additions to the Kooragang Nature Reserve. Changes in tidal regime through activities such as dredging may exacerbate subsidence effects and encourage mangrove rather than saltmarsh rehabilitation. Any impact of the port development on these wetlands should be explored in the EIS.

In addition the proposed pipeline route traverses areas of SEPP 14 wetland adjacent to Kooragang Nature Reserve on Ash Island. Any potential impacts of construction and operation of the pipeline on the wetland, and the Nature Reserve should be addressed in the EIS.

Though there has been a net increase in mangrove habitat, as stated above, there has been a loss in salt marsh. The removal of any salt marsh vegetation for the swing basin or pipeline construction should be explored in the EIS. The impact of any disturbance of contaminated sediments on aquatic fauna, including macrobenthic organisms which form part of the food chain for wetland wildlife, should be examined.

Impacts on threatened species

Historically, there has been a significant net loss in freshwater habitat in the Hunter estuary. The potential for temporary stockpiles or permanent landfill removing areas of freshwater habitat on Kooragang Island (such as the "Big Pond") should be addressed. It should be noted that the vulnerable species, Australasian Bittern *Botaurus poiciloptilus*, has been recorded in the vicinity of the subject site.

In addition, the Big Pond area and the nearby Kooragang Island Nature Reserve hold numerous records of shorebirds listed under the international agreements JAMBA and CAMBA, and Schedule 2 of the *Threatened Species Conservation Act 1995*. Migratory shorebird use of the subject site (including the pipeline route) as feeding or roosting areas should also be detailed. Amelioration measures such as potential compensatory habitat to ensure no net loss of wader habitat should be explored in the EIS. For example, any constructed replacement habitat should be in place and functioning prior to habitat being removed for this proposal. The potential use of the mangroves on the Hunter River banks as roosting sites for birds should also be investigated, and any impacts caused by removal for the swing basin or pipeline route discussed.

The endangered Green and Golden Bell Frog *Litoria aurea* is known to frequent the area and has been recorded in quite disturbed areas. It is recommended that surveys for this species and its habitat be undertaken. In particular the sites of the proposed swing basin and the pipeline route should be surveyed for Green and Golden Bell Frog and habitat. Based on the outcomes from surveys, there should be a discussion in the EIS of amelioration measures to potential impacts on Green and Golden Bell Frog populations and habitats.

Marine fauna impacts

The proposal states that blasting will be required to loosen rock prior to removal by dredge. From existing literature based on experimental studies and field observations, it is clear that fish, cetaceans (whales and dolphins) and turtles are susceptible to injury from underwater explosions. Large marine mammals and turtles may be exposed to pressure and sound damage at distances of up to 1500 metres from detonation (depending on the size of the charge, eg 65-100kg). The EIS should ascertain the size of charges to be used in the proposed blasting operations and investigate potential impacts on marine fauna, in particular dolphins and turtles which are recorded from the Hunter River. Measures to avoid injury to these species should be fully explored.

Aboriginal cultural heritage

A preliminary review of the NPWS database revealed that there may be Aboriginal objects on Kooragang Island in areas which could be considered for landfill or stockpiling of dredge spoil, or along the proposed pipeline route to Tomago. To assist evaluation of the potential impacts of the proposal on Aboriginal heritage values, it is recommended

that the proponent undertake a search of the NPWS Aboriginal Heritage Information Management System (AHIMS). Consultation with the Worimi Local Aboriginal Land Council should be undertaken to ascertain their views and provide anecdotal information on the presence or likelihood of sites or objects not recorded in AHIMS. (Since the letter of 11 May 2002, the Land Council boundaries have changed and Worimi, rather than Awabakal, should be consulted).

The results of consultation should be incorporated into any assessment undertaken for potential landfill sites and the pipeline route. Any requirement for further investigation or archaeological survey would depend on the results of the AHIMS search and consultation with the local community.

Commonwealth issues

Your attention is drawn to the new Commonwealth legislation, the *Environment Protection and Biodiversity Conservation Act 2000*.

Numerous migratory shorebird species protected under international agreements, including Latham's Snipe *Gallinago hardwickii*, Oriental Cuckoo *Cuculus saturatus*, Terek Sandpiper *Xenus cinereus*, Common Greenshank *Tringa nebularia*, Great Egret *Ardea alba*, Cattle Egret *Ardea ibis* and the White-bellied Sea Eagle *Haliaeetus leucogaster*, have also been recorded from Kooragang Island in the vicinity of the South Arm of the Hunter River.

If any species requiring consideration under this legislation may be affected by the proposal, for example threatened species and migratory shorebirds, approval for the development may also be required from Environment Australia.

In summary the areas of concern which should be addressed are as follows:

- Impacts on Kooragang NR and Hexham Swamp NR, and NPWS estate (not yet gazetted);
- impacts on hydrology and tidal prism / area of tidal inundation;
- impacts on SEPP 14 and Ramsar wetlands;
- impacts on area of saltmarsh;
- impacts on existing shorebird and waterbird foraging areas, including impacts on potential fill sites;
- potential impacts on mangrove-roosting shorebirds;
- potential impacts on threatened species such as Green and Golden Bell Frog and Australasian Bittern;
- impacts on whales, dolphins and turtles;
- potential impacts on Aboriginal cultural heritage.

Thank you for the opportunity to comment. Should you wish to discuss the matter further please feel free to contact Estelle Blair, Conservation Planning Officer, on (02) 6659 8256.

Yours faithfully,

A handwritten signature in black ink, appearing to read 'B. Diacono'.

BRENDAN DIACONO
Manager, Conservation Planning Unit
for **Director-General**

attachment

**NSW NATIONAL PARKS AND WILDLIFE SERVICE
CONSERVATION PROGRAMS & PLANNING DIVISION, NORTHERN DIRECTORATE**

ENVIRONMENTAL ISSUES TO BE ADDRESSED

INTRODUCTION

The following list is provided to assist in the preparation of environmental impact assessment reports. The list details the type of information that is recommended by the New South Wales National Parks and Wildlife Service (NPWS) for inclusion in such assessments. Please note that the provision of information in accordance with this list does not negate the applicant's obligations under any legislative or planning instruments. NPWS suggests that the applicant contact the relevant local council and the Department of Urban Affairs and Planning to ascertain these obligations.

GENERAL

1. Map(s) showing the locality of the proposed development in a regional and local context. Local context maps should be based on 1:25 000 topographic plans. Photographs of the site's key attributes may provide useful documentation.
2. A description of the existing environment on the subject land and surrounding land, the proposed development and ancillary works, and the manner in which the environment will be modified by the proposal (particularly with regard to the clearing of native vegetation and impacts on fauna habitat).
3. The area subject to development should be clearly identified on an appropriately scaled plan. This includes all ancillary works such as buildings and other structures, parking areas, loading/processing/treatment areas, access roads, and material stockpiling areas.
4. The applicability or otherwise of Local Environment Plans (LEP), Regional Environment Plans (REP) and State Environmental Planning Policies (SEPP) and Regional Vegetation Management Plans (RVMPs) to the site should be determined and detailed. In particular, your attention is drawn to SEPP No. 14 - Coastal Wetlands, SEPP No. 26 - Littoral Rainforest, SEPP No. 44 - Koala Habitat Protection and the *Native Vegetation Conservation Act 1997*.
5. Your attention is also drawn to the new Commonwealth legislation, the *Environment Protection and Biodiversity Conservation Act 2000*. The Act specifically focuses on matters of national environmental significance (NES matters) which include listed threatened species and ecological communities, World Heritage properties, Ramsar wetlands of international importance, internationally protected migratory species and Commonwealth Marine Areas. If any NES matters under this legislation may be affected by the proposal, approval for the development may also be required from Environment Australia.

FLORA

1. A comprehensive description of the vegetation on the site. This will include an assessment of the condition of the plant communities present, including the designation of conservation significance at a local, regional and State level, and an assessment of the likely occurrence of any threatened species, populations or ecological communities listed under Schedules 1 or 2 of the *Threatened Species Conservation Act 1995* and any Rare or Threatened Australian Plant (ROTAP) species.
2. A plan showing the distribution of any threatened or ROTAP species and the vegetation communities on the site, and the extent of vegetation proposed to be cleared. This plan should be at the same scale as the plan of the area subject to development in order to assist in the assessment the impact of the proposal on the existing vegetation.
3. Where the assessment concludes that threatened species, populations or ecological communities, or their habitats, exist on or in proximity to the subject land, the effect of the proposed development should be determined in accordance with the eight point test described in Section 5A of the *Environmental Planning and Assessment Act 1979*. An assessment of the impact of the development on the plant communities and/or ROTAP species should also be provided.
4. A description of the measures proposed to mitigate and/or ameliorate the impact of the development on the plant communities, threatened and ROTAP species.

FAUNA

1. A fauna survey to identify the distribution and abundance of fauna species known or likely to utilise the site, including a description of available fauna habitats and an assessment of the conservation status of each of the faunal components at a local, regional and State level.

2. A plan showing the results of the above survey. This plan should be at the same scale as the plan of the area subject to development to assist in the assessment of the impact of the proposal on fauna.
3. An assessment of the impact of the development on the identified fauna.
4. An assessment of the existence or likely occurrence of threatened species, populations or ecological communities, or their habitats on the subject land. Where the assessment concludes that threatened species, populations or ecological communities, or their habitats exist on or in proximity to the subject land, the effect of the proposed development should be determined in accordance with the eight point test described in Section 5A of the *Environmental Planning and Assessment Act 1979*.
5. A description of the measures proposed to mitigate and/or ameliorate the impact of the development on fauna.

CULTURAL

1. The presence or absence of Aboriginal sites should be identified and the significance of the area to the local Aboriginal community must be determined. Accordingly, a search of the NPWS Aboriginal sites register should be made and the local Aboriginal community should also be consulted with regard to any Aboriginal heritage issues associated with the proposed development. A survey may need to be undertaken by an appropriately qualified person in consultation with the relevant Aboriginal community group/s to identify and record any sites, places of cultural significance or other values that the place has to the Aboriginal community. The significance of any places or values that are recorded should be assessed and appropriate management options developed.
2. An assessment of the impact of the development on the Aboriginal heritage values of the site.
3. A description of the measures proposed to mitigate and/or ameliorate the impact of the development on the Aboriginal heritage values of the site.
4. A contingency plan that details the measures to be taken in the event that archaeological sites are discovered during the course of operations must be prepared.

NATIONAL PARKS ESTATE

1. Where the proposal may result in impacts on NPWS estate or is on land adjacent to NPWS estate, an assessment of the impact of the development on NPWS estate.
2. A description of the measures proposed to mitigate and/or ameliorate the impact of the development on the NPWS estate.

NOTES

Surveys and Assessments

1. Fauna, flora and cultural surveys and assessments should be undertaken by suitably qualified persons and the qualifications and experience of the persons undertaking the work detailed.
2. Dates, site locations, design, methodology, analysis techniques, and weather conditions at the time of the assessments and surveys must be described. The limitations of surveys should be identified and the results interpreted accordingly.
3. Conclusions drawn in surveys and assessments should be substantiated by evidence resulting from those surveys and assessments. The document being supported by the surveys and assessments should reflect these conclusions and clearly state where recommendations of the survey and assessments have been incorporated in the proposal.

NPWS Databases

1. The NPWS can provide records of flora and fauna held in the Wildlife Atlas and / or Rare or Threatened Australian Plants (ROTAP) databases. In addition the NPWS has an Aboriginal Sites Register of which searches can be made. These services generally attract a fee. Enquires should be made to NPWS Hurstville office, telephone (02) 9585 6444.
2. It should be noted that the above databases are not comprehensive and should only be used as a guide. They do not negate the need for specific site investigations.

APPENDIX B

CORRESPONDENCE FROM STATUTORY AGENCIES



27 March 2003

«Title» «FirstName» «LastName»
«JobTitle»
«Company»
«Address1»
«Address2»
«City» «State» «PostalCode»

Dear «Title» «LastName»,

**Proposed dredging of the South Arm of the Hunter River
Environmental Impact Statement**

Newcastle Port Corporation, in conjunction with GHD Consulting Engineers and on behalf of the NSW Government, is currently preparing an environmental impact statement (EIS) for the proposal to dredge the South Arm of the Hunter River to provide for the future expansion of port activities. It is anticipated that the EIS would be placed on exhibition in April 2003.

You are invited to provide, on behalf of your agency/organisation, comments in terms of the issues that should be addressed as part of the impact assessment process.

An outline of the proposal is attached. If you would like any further information, or if you would like to meet with a member of our team to discuss the proposal in detail, please contact David Waddell (GHD) on 02 9239 7264 or Trevor Heise (Newcastle Port Corporation) on 02 4985 8227.

It would be appreciated if you could provide your input by Thursday, 6 February 2003.

Yours faithfully,

Gary Webb
General Manager – Operations
Newcastle Port Corporation

Title	FirstNa me	LastNa me	JobTitle	Company	Address 1	Address 2	City	State	PostalCode	Country	HomePhone	WorkPhone
			Director	Energy Development Authority			Place					
Mr	Greg	Rochford	CEO	Ambulance Service of NSW	Locked Bag 105		Rozelle	NSW	2039			
Mr	Ken	Moroney	Commissioner	NSW Police Service	14-24 College Street		Darlinghurst	NSW	2010			
Mr	David	Evans	Managing Director	Hunter Water Corporation	595 Hunter Street		Newcastle West	NSW	2302			
Mr	Paul	Broad	Managing Director	Energy Australia	GPO Box 4009		Sydney	NSW	2001			
Mr	Ian	MacDougall	Commissioner	NSW Fire Brigades	PO Box A249		Sydney South	NSW	1232			

Level 2, 117 Bull Street
P.O. Box 5177
Newcastle West NSW
2302



**NSW DEPARTMENT
OF PUBLIC WORKS
AND SERVICES**

HUNTER-NEW
ENGLAND REGION
ABN 48 922 006 182
www.dpws.nsw.gov.au
Telephone 02 4908 4999
Facsimile 02 4908 4954

6 March, 2003

Mr Gary Webb
General Manager, Operations
Newcastle Port Corporation
PO Box 663
NEWCASTLE NSW 2300

Contact: Ken McCallum
Direct Line: 02 4908 4911
File: NPC_GW_PG.06.03.03.doc
Email:
ken.mccallum@dpws.nsw.gov.au

Dear Mr Webb

I refer to your letter of 20 January, 2003 concerning the proposed EIS for the dredging of the South Arm of the Hunter River.

DPWS considers the following issues relevant to the preparation of the EIS:

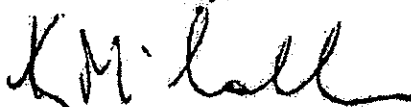
1. The intention to treat the contaminated material on the BHPB Closure site is noted. We assume that consideration has been given to the impact of these works on the proposed remediation of that site and the time frame for the development of the Multi-Purpose Terminal.
2. DPWS suggests that a plan for the sequential filling of areas on Kooragang Island will be necessary, but may not necessarily form part of this EIS process. Such a plan should include both the location and depth of fill areas, as well as the site preparation, methodology of placement and compaction of materials as filling proceeds.
3. In the event that dredged materials cannot be used in landfill projects, long term stockpiling may be required. DPWS suggests that such stockpiling should occur on Kooragang Island, rather than the former BHPB lands, so as not to limit the use of valuable waterfront lands for a long period. DPWS considers that any long term stockpile management arrangements should be dealt with in this EIS if considered appropriate.
4. DPWS notes that this project may provide an opportunity to prepare a road corridor for the future relocation of Cormorant Drive down the centre of the Island. DPWS suggests that this option should be explored in the preparation of the Kooragang Island "fill plan."

Delivering Solutions

5. The NSW government has a number of tenants on both the Kooragang Island and former BHPB lands and their interests will need to be considered as the project develops. DPWS Asset Management Services Branch (AMS) can provide details of these tenants at the appropriate time.
6. The overview document provided identifies in section 4.2 "Elements outside the scope of this proposal." It is DPWS' opinion that the EIS cannot overlook issues such as the "transport and reuse...etc" at dot point 3 in Section 4.2.
7. A further issue for consideration is the use of the dredged channel by large ships and the visual and other impacts, such as the effect on road traffic such movements may have.
8. DPWS notes that the proposed cut and fill process currently planned to set the former BHPB lands to their final levels may produce a quantity of material requiring some form of remediation. It is suggested that this material could be treated by any process established to treat the dredged material recovered in your project, if the technology is appropriate.
9. DPWS notes that the state government is developing a "Master Plan" for the lower Hunter estuary lands, and suggests that the abovementioned "fill plan" for Kooragang Island, should take any recommendations of the "Master Plan" into consideration.
10. DPWS notes that a recent Healthy Rivers Commission Report by Commissioner Peter Crawford made certain recommendations in respect to the Hunter River. DPWS suggests that the report be considered in the preparation of this EIS.
11. DPWS notes that the proposed turning circle appears to require a portion of land owned by One Steel. It seems that acquisition and dredging of this land will bring additional environmental risk to the government, and reduce One Steel's environmental liability. DPWS suggests that any commercial arrangements made between the government and One Steel should recognise any change in liabilities.

Thank you for the opportunity to provide and comment on other issues to be addressed. I would be pleased to discuss any of these issues with NPC or GHD.

Yours sincerely,



Ken McCallum
Regional Manager
Hunter-New England Region.



02/5013/A PMTH

NSW Police

www.police.nsw.gov.au ABN 43 408 613 180

**WARATAH
LOCAL AREA COMMAND
ADMINISTRATION OFFICE****30 Harriet Street
Waratah NSW 2298**

Ph: (02) 49 266515 60515

Fax: (02) 49 266511 60511

TTY: 9211 3776 (Hearing/Speech impaired only)

Our ref:

Your ref:

18 February 2003

**NEWCASTLE PORT
CORPORATION****25 FEB 2003****RECEIVED**

Mr T Heise
Newcastle Port Corporation
PO Box 663
NEWCASTLE NSW 2300

Dear Mr Heise

I refer to correspondence received from Mr G Webb of Newcastle Port Corporation relative to the proposed dredging of the south arm of the Hunter River and requesting comments in terms of the issues that should be addressed as part of the impact assessment process with regard to same.

It is understood that explosives will be used to blast rock in the channel, however, that this work will be carried out by a large accredited dredging company and the oversight of safety and security will be carried out by Workcover in line with the permit to purchase, store and use explosives.

I note your advice that emergency access into the area will be covered by a site safety plan submitted through Workcover, which is usual practice for a project this size.

I also note that a Traffic Management Plan is being prepared for submission to Council and the RTA as there will be increased heavy vehicle movements across the Tourle Street Bridge and along the Industrial Highway.

As safety and security of the proposed dredging is being managed by other agencies, it is considered the project should have minimal impact on NSW Police.

Yours faithfully

Rob Robertson
Acting Local Area Commander
jb

owner and maintainer of the new rail network
RAILINFRASTRUCTURE
CORPORATION

Our ref: 03D/00297

4926 4596
FAXED
21/2/03

12 February 2003

Level 15, 55 Market Street
Sydney NSW 2000

GPO Box 47
Sydney NSW 2001

Telephone 02 9224 2390
Facsimile 02 9224 2724

Mr Gary Webb
General Manager - Operations
Newcastle Port Corporation
Corner of Scott and Newcomen Streets
Newcastle NSW 2300

Dear Mr Webb

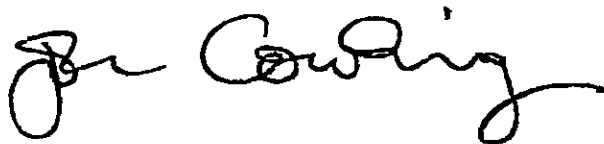
**Subject: Proposed Dredging of the South Arm of the Hunter River
Environmental Impact Statement**

Thank you for the opportunity to comment on issues that should be addressed during the environmental impact assessment process for the proposed dredging of the south arm of the Hunter River.

From the information provided it appears there are no direct impacts on RIC infrastructure. However, protection of RIC's existing assets is always of high importance and RIC will be keen to review the Environmental Impact Statement when it is completed to ensure that there are no adverse impacts on RIC infrastructure.

Should you have any questions regarding this matter, please contact Renée Zaia on 9224 2790.

Yours sincerely



JOHN COWLING
Chief Executive Officer

TRANSPORTNSW

Mr Gary Webb
General Manager Operations
Newcastle Port Corporation
PO Box 663
NEWCASTLE NSW 2300



Dear Mr Webb

I refer to your letter of 20 January 2003 regarding the proposed dredging of the South Arm of the Hunter River -- EIS.

Transport NSW would like to make the following comments in relation to the proposal to dredge the southern arm of the Hunter River:

- The potential for the transfer of spoil from the former BHP Steelworks off-site by road or rail is of concern. It is recognised that this issue is deemed to be outside the scope of the current EIS and will be subject to a separate environmental impact assessment. Transport NSW would seek to have input to the separate EIS for transportation and reuse/disposal of dredged material to sites other than the adjacent BHP Steelworks site.
- In the event of any requirement for the removal of spoil from the BHP site, Transport NSW would like to see a thorough evaluation of the options for removal by either road or rail.
- The EIS should also take into consideration the impact to current transport infrastructure of the long term, cumulative impact of developments on Kooragang Island and the former BHP Steelworks. Development at these sites will increase the volume of trade handled at the port and impact upon the capacity of road and rail infrastructure.
- Transport NSW strongly supports the comprehensive investigation of environmental issues listed at 5.1 of the EIS.

Should you wish to discuss or clarify any of the issues raised, please contact Mr Jim Glasson, Director, Ports and Freight on 9268 2258.

Yours sincerely

John Rogan
John Rogan
Deputy Director General

14 February 2003

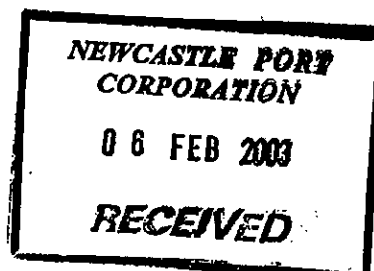


Level 18, 15 Castlereagh Street
SYDNEY NSW 2000
Tel. (02) 9231 2977
Fax. (02) 9232 5973
Website: www.hrc.nsw.gov.au

6 February 2003

General Manager - Operations
Newcastle Port Corporation
PO Box 663
Newcastle NSW 2300

Fax 4926 4596



Dear General Manager

**Re: Proposed dredging of the South Arm of the Hunter River -
Environmental Impact Statement**

I have received your letter of 20 January 2003 calling for commentary on the EIS and related documents.

As a Commission undertaking independent inquiries into river systems, it is outside the Commission's role to respond to such requests. However I am enclosing a copy of the Commission's report *Independent Inquiry into the Hunter River System* which was presented to the NSW Government in May 2002, which sets out the key actions required to achieve a healthy river system. This report may be of some use to you in your project. (by me)

Thanks again for your consideration.

Your sincerely,

Ken Roberts
Executive Officer



Department of the Environment and Heritage

Mr Chris Wilson
Director
Major Development Assessment Branch
Planning NSW
GPO Box 3927
SYDNEY NSW 2001

Dear Mr Wilson

**Newcastle Port Corporation/ Water transport/ Newcastle NSW/
Hunter River South Arm dredging
(EPBC Reference: 2003/950)**

I am writing on behalf of the Minister for the Environment and Heritage, the Hon David Kemp, MP, (the Minister) concerning the decision on assessment approach for the assessment of the above action under Part 8 of the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act).

Section 91 of the EPBC Act states *inter alia* that, within 10 business days after making a decision on the assessment approach, the Minister must give written notice of the decision to the appropriate Minister of the State or Territory, if the action is to be taken in a State or self-governing Territory, and a controlling provision applies.

On 19 February 2003 a delegate for the Minister made a decision that approval was required for the above action. In 24 March 2003 Preliminary Information for the action was received under section 86 and was accepted for decision on the assessment approach under Part 8 of the EPBC Act.

The assessment approach for the action has now been considered under the EPBC Act and I have decided, as a delegate for the Minister, that assessment by an accredited process must be conducted, that is the Environmental Impact Statement being conducted under the New South Wales *Environmental Planning and Assessment Act 1979*. In this context I thank you for your letter of 5 March 2003 describing the state EIS process and confirming that the assessment will be undertaken in accord with the draft bilateral agreement between the Commonwealth and New South Wales under section 45 of the EPBC Act relating to environmental impact assessment.

Yours sincerely

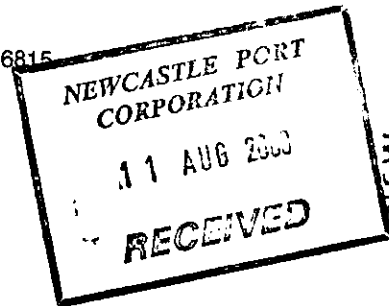
Malcolm Forbes
Assistant Secretary
Environment Assessment & Approvals Branch
17 March 2003



FXED
8-8-03

Your reference : 02/5007
Our reference : 273128A3, NEF12165
Contact : Grahame Clarke, 02 49086815

Newcastle Port Corporation
P O Box 663
NEWCASTLE NSW 2300



Attn. Mr Gary Webb (General Manager Operations)

- 8 AUG 2003

Dear Sir

**EIS for Extension of Shipping Channels – Port of Newcastle
Disposal / Use of Materials on Kooragang Island Waste Emplacement Area**

I refer to your letter of 22 July 2003 seeking advice from the Environment Protection Authority (EPA) on the following matters:

- the current classification of the Kooragang Waste Emplacement Area; and
- the type of materials that can be disposed of or used on the site under the current licence conditions.

Kooragang Waste Emplacement Facility is licensed by the EPA (licence number 6437) as a **Solid Waste Class 2 Landfill**. This means that the landfill can accept wastes, excluding putrescible waste, that are assessed as *inert waste* or *solid waste* following the technical assessment procedure outlined in Technical Appendix 1 of the EPA's Waste Guidelines or that is specified as *inert waste* or *solid waste* in Schedule 1 of the Protection of the Environment Operations Act, 1997.

The licensee of the landfill has a legal obligation to prevent unauthorised material from entering the landfill. In practice the waste generator can expect to be required by the licensee to produce the documentary evidence needed to demonstrate that sediments arising from the shipping channel expansion project meet the above mentioned classification before it enters the landfill.

If you have any questions concerning this advice please contact me on (02) 4908 6815.

Yours sincerely

A handwritten signature in black ink, appearing to read 'Grahame Clarke', written over a series of horizontal lines.

GRAHAME CLARKE
Head Regional Operations Unit

Copy to:
Regional Land Management Corporation
P O Box 1187
NEWCASTLE NSW 2300

Environment Protection Authority

PO Box 488G Newcastle NSW 2300 Australia

Telephone 61 2 4908 6800

Facsimile 61 2 4908 6810

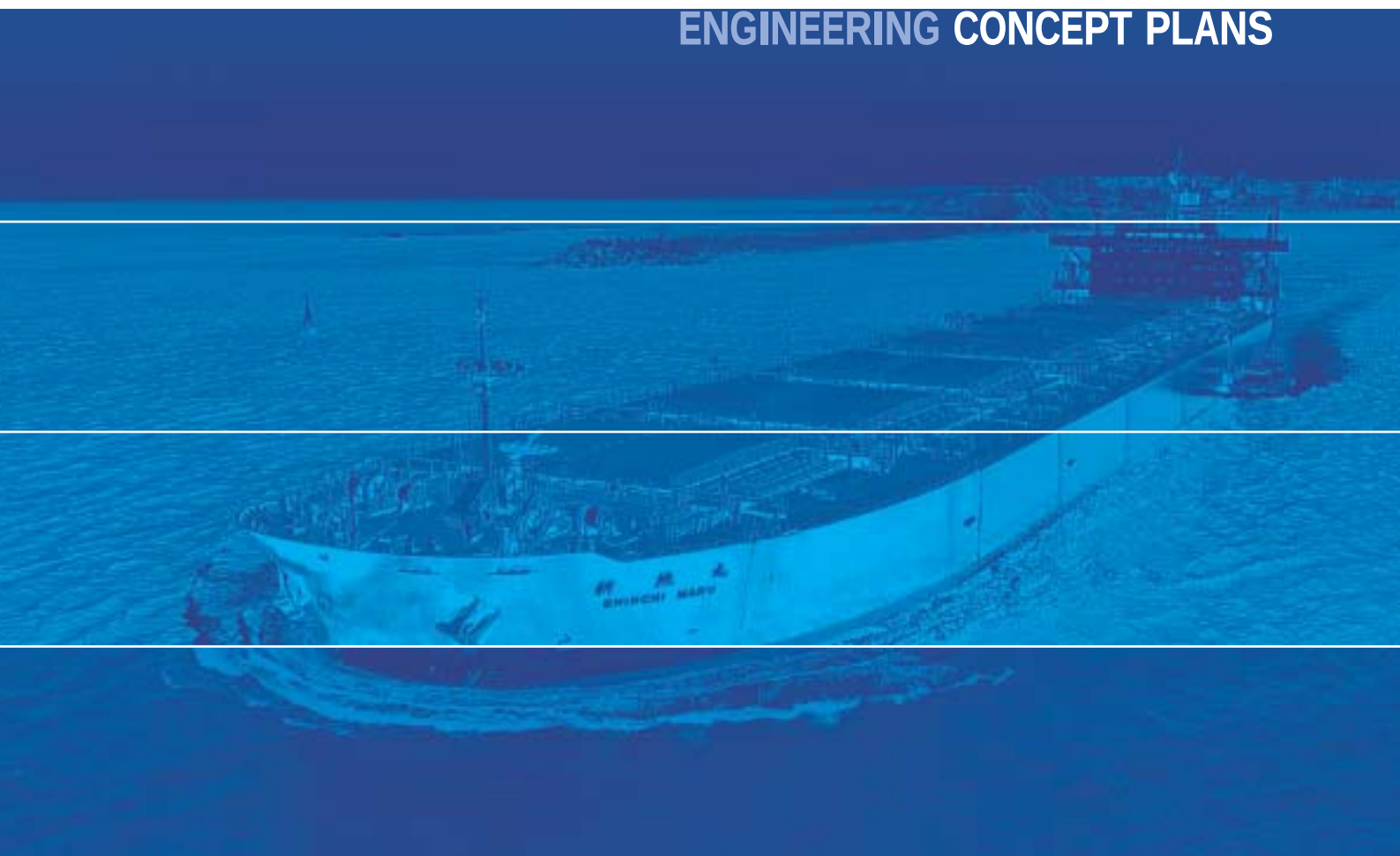
ABN 43 692 285 758

www.epa.nsw.gov.au

Ground Floor NSW Government Offices 117 Bull Street Newcastle West NSW 2302

APPENDIX C

ENGINEERING CONCEPT PLANS





PROPOSED EXTENSION OF SHIPPING CHANNELS PORT OF NEWCASTLE

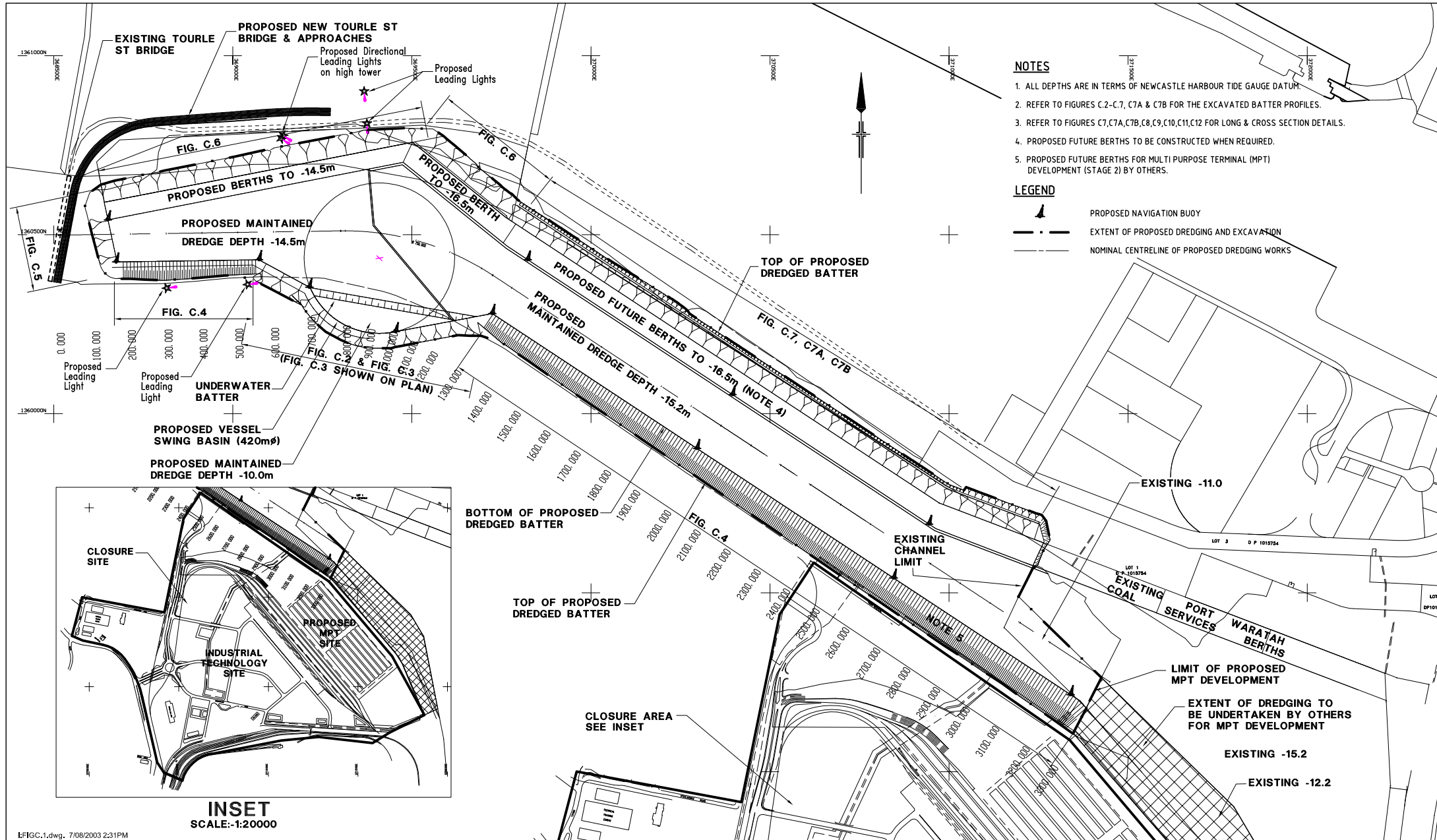
Index to figures:

Figure No.	Description
C.1	General Arrangement
C.2	Dredge Batter Profiles: Swing basin rock revetment and bulkhead wall detail
C.3	Dredge Batter Profiles: Swing basin rock berm & revetment option
C.4	Dredge Batter Profiles: South bank batter
C.5	Dredge Batter Profiles: Western submerged batter
C.6	Dredge Batter Profiles: North bank batter upstream & adjacent to swing basin
C.7	Dredge Batter Profiles: North bank batter downstream of swing basin
C.7A / C.7B	Dredge batter profiles proposed extension of shipping channels, Port of Newcastle
C.8	Longitudinal Section along nominal centreline of channel.
C.9	Cross section @ 400.00 m
C.10	Cross section @ 1000.00 m
C.11	Cross section @ 1600.00 m
C.12	Cross section @ 2200.00 m
C.13	Cross section @ 3000.00 m
C.14	Removal and Handling of Materials: Stage 1- Dredge initial access channel and temporary turning basin.
C.15	Removal and Handling of Materials: Stage 2 – Dredge swing basin and approaches upper portion (months 2 – 13 incl Stage 2).
C.16	Removal and Handling of Materials: Stage 3 – Dredge silt and silt/sand interface.
C.17	Removal and Handling of Materials: Stage 4 – Removal of contaminated marine silts and clays alongside former BHP site.



PROPOSED EXTENSION OF SHIPPING CHANNELS PORT OF NEWCASTLE

Figure No.	Description
C.18	Removal and Handling of Materials: Stage 5 – Dredge sand.
C.19	Removal and Handling of Materials: Stage 6 – Dredge Clay.
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C.21	Removal and Handling of Materials: Stage 8 – Remove hard rock.
C.22	Proposed Excavation Extent & On Shore Facilities for Water Detention & Treatment at One-Steel.
C.23	Inferred Groundwater Contours on top of fill aquifer and extent of Plats channel/Spit island in the vicinity of excavation at One-Steel.
C.24	Location of temporary Construction Facilities Proposed Extension of Shipping Channels, Port of Newcastle.
C.25	Existing Surface Contours Proposed Extension of Shipping Channels, Port of Newcastle.
C.26	Identified fill areas on closure site, Proposed Extension of Shipping Channels, Port of Newcastle.
C.27	Offshore disposal site location.
C.28	Channel cross-sections at 2200m



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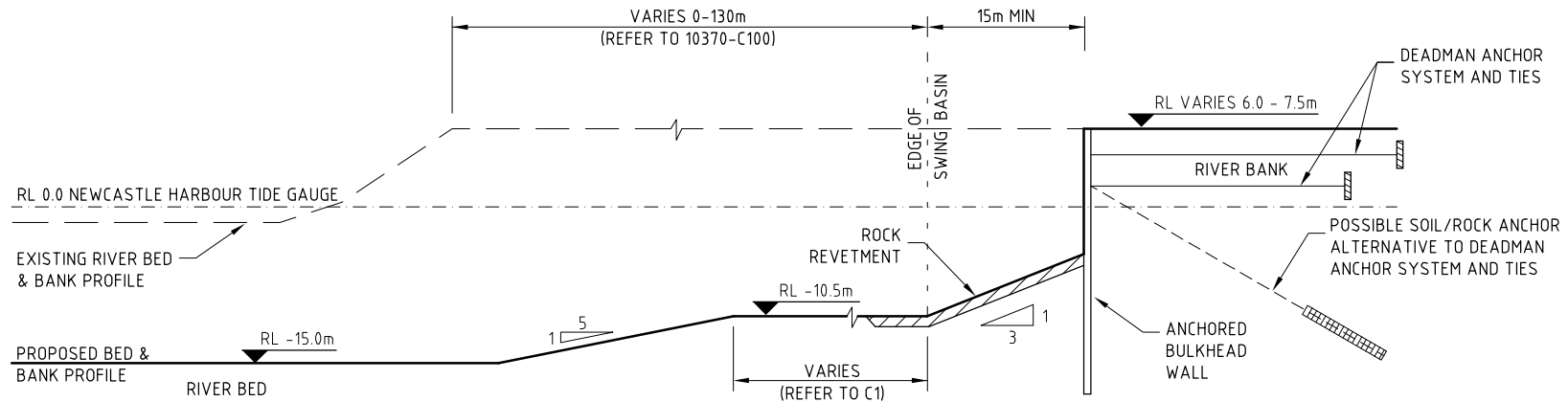


FIGURE C.2
SWING BASIN ROCK REVETMENT AND
BULKHEAD WALL DETAIL

NOTE

DEPTHS SHOWN ARE THE FINAL DEPTHS AT COMPLETION OF THE CAPITAL DREDGING WORKS WITH 0.5m ALLOWANCE FOR THE MAINTENANCE DREDGING (IE: MAINTAINED DEPTH IS 0.5m ABOVE BERTH AND CHANNEL LEVELS SHOWN)

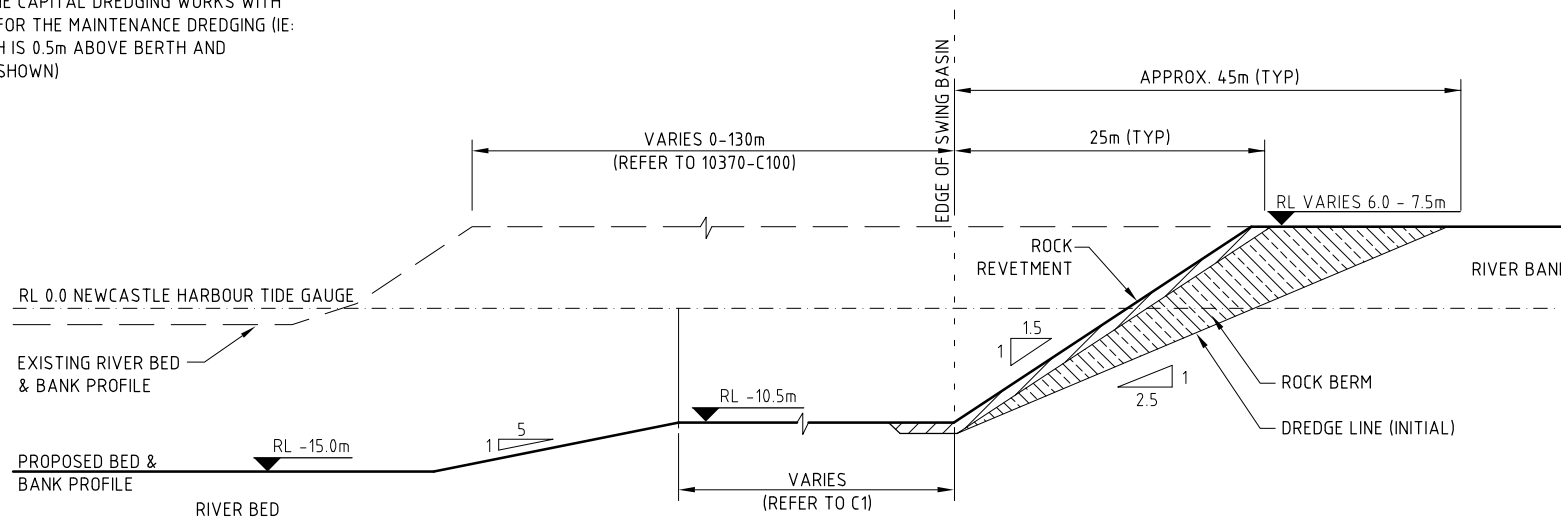


FIGURE C.3
SWING BASIN ROCK
BERM & REVETMENT OPTION

REFER TO FIGURE C.1
FOR LOCATION

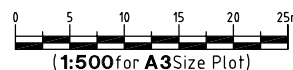


FIGURE C.2 & C.3
DREDGE BATTER PROFILES
PROPOSED EXTENSION OF SHIPPING
CHANNELS, PORT OF NEWCASTLE

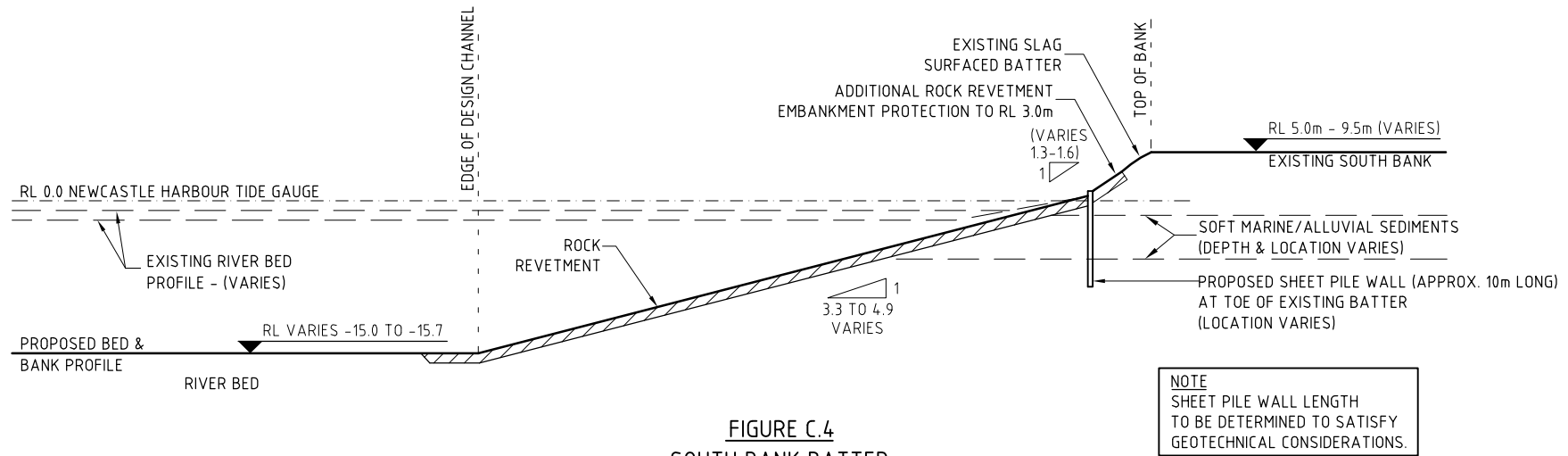


FIGURE C.4
SOUTH BANK BATTER

NOTE

DEPTHS SHOWN ARE THE FINAL DEPTHS AT COMPLETION OF THE CAPITAL DREDGING WORKS WITH 0.5m ALLOWANCE FOR THE MAINTENANCE DREDGING (IE: MAINTAINED DEPTH IS 0.5m ABOVE BERTH AND CHANNEL LEVELS SHOWN)

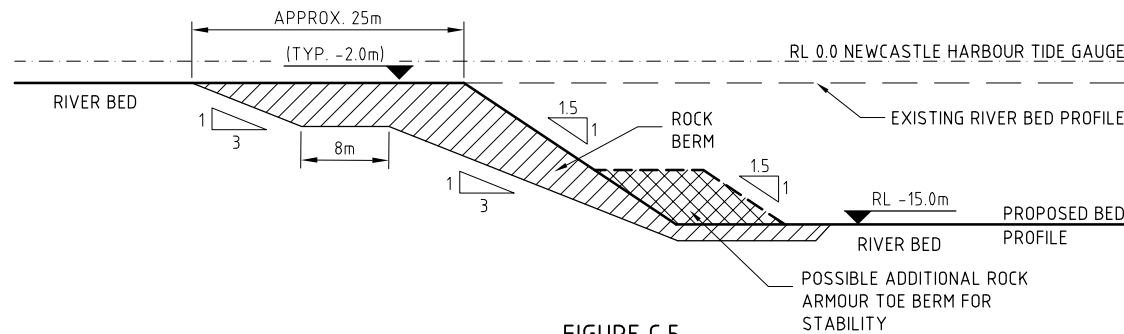
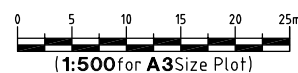


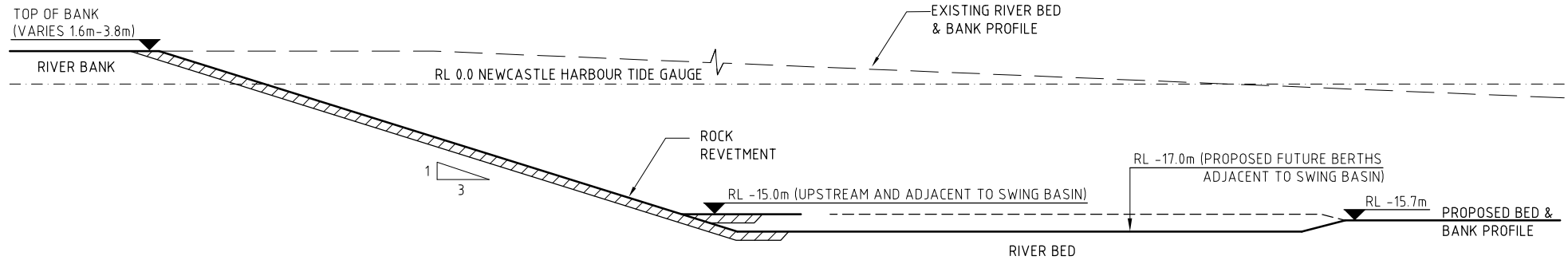
FIGURE C.5
WESTERN SUBMERGED BATTER

REFER TO FIGURE C.1
FOR LOCATION

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**FIGURE C.4 & C.5
DREDGE BATTER PROFILES
PROPOSED EXTENSION OF SHIPPING
CHANNELS, PORT OF NEWCASTLE**



NOTE
 DEPTHS SHOWN ARE THE FINAL DEPTHS AT
 COMPLETION OF THE CAPITAL DREDGING WORKS WITH
 0.5m ALLOWANCE FOR THE MAINTENANCE DREDGING
 (IE: MAINTAINED DEPTH IS 0.5m ABOVE BERTH AND
 CHANNEL LEVELS SHOWN)

FIGURE C.6
NORTH BANK BATTER
UPSTREAM & ADJACENT TO SWING BASIN

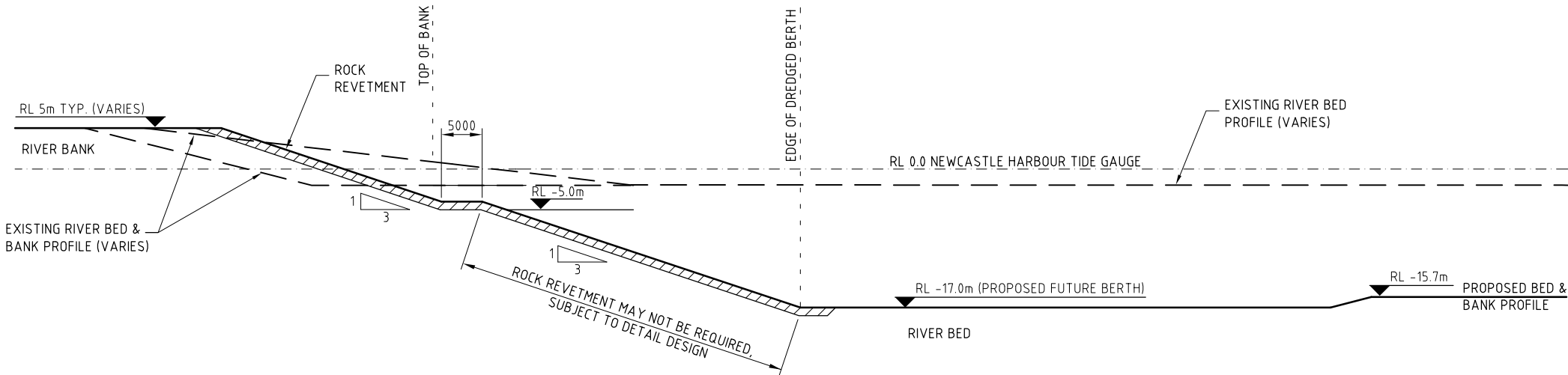
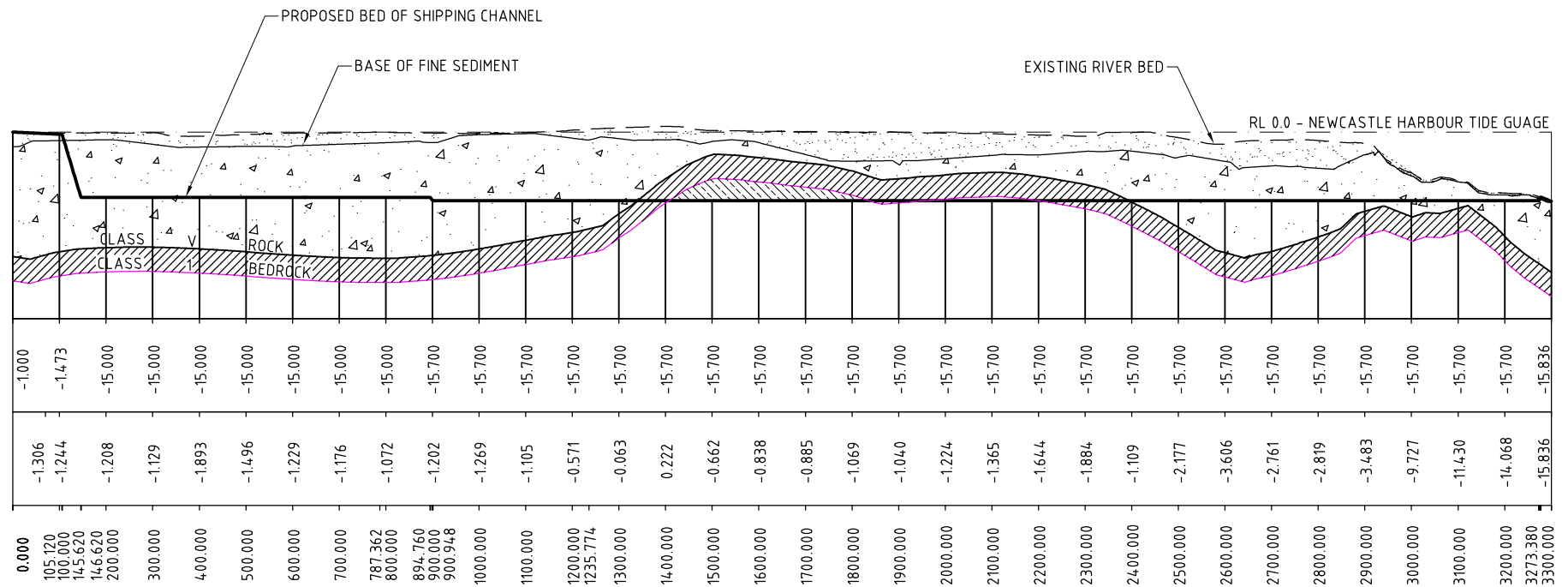


FIGURE C.7
NORTH BANK BATTER DOWNSTREAM OF SWING BASIN
WITH EXCAVATION FOR BERTH

REFER TO FIGURE C1
 FOR LOCATION



FIGURE C.6 & C.7
DREDGE BATTER PROFILES
PROPOSED EXTENSION OF SHIPPING
CHANNELS, PORT OF NEWCASTLE



IDEALISED LONGITUDINAL SECTION ALONG NOMINAL CENTRELINE OF CHANNEL

Scales Hor 1:10000 Ver 1:1000

NOTES & KEY

SURFACE RIVER SEDIMENTS. (SILT AND CLAYS)

MEDIUM TO DENSE MEDIUM GRAIN SIZE SAND, WITH APPROX. 5% FINES (< 75 MICRONS)

SOFT ROCK GRADING FROM CLASS 5 TO CLASS 2 CONSISTING OF RESIDUAL STIFF CLAYS, ALTERNATING SANDSTONES, SILTSTONES AND SHALE WITH OCCASIONAL MINOR COAL SEAMS.

CLASS 1 BEDROCK, MAINLY STRONG SANDSTONE WITH UNCONFINED COMPRESSIVE STRENGTH > 16mPa.

- NOTE DISTORTED SCALES H: 1:10000, v 1:1000 (A3 SIZE)
- THIS IS AN IDEALISED CROSS SECTION, BASED ON EXISTING SURFACE AND SUBSURFACE INFORMATION, IT ONLY SHOWS GENERAL LOCATIONS OF INTERFACES BETWEEN SUB SURFACE STRATA.

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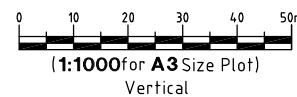
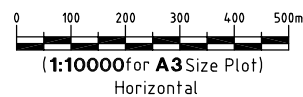
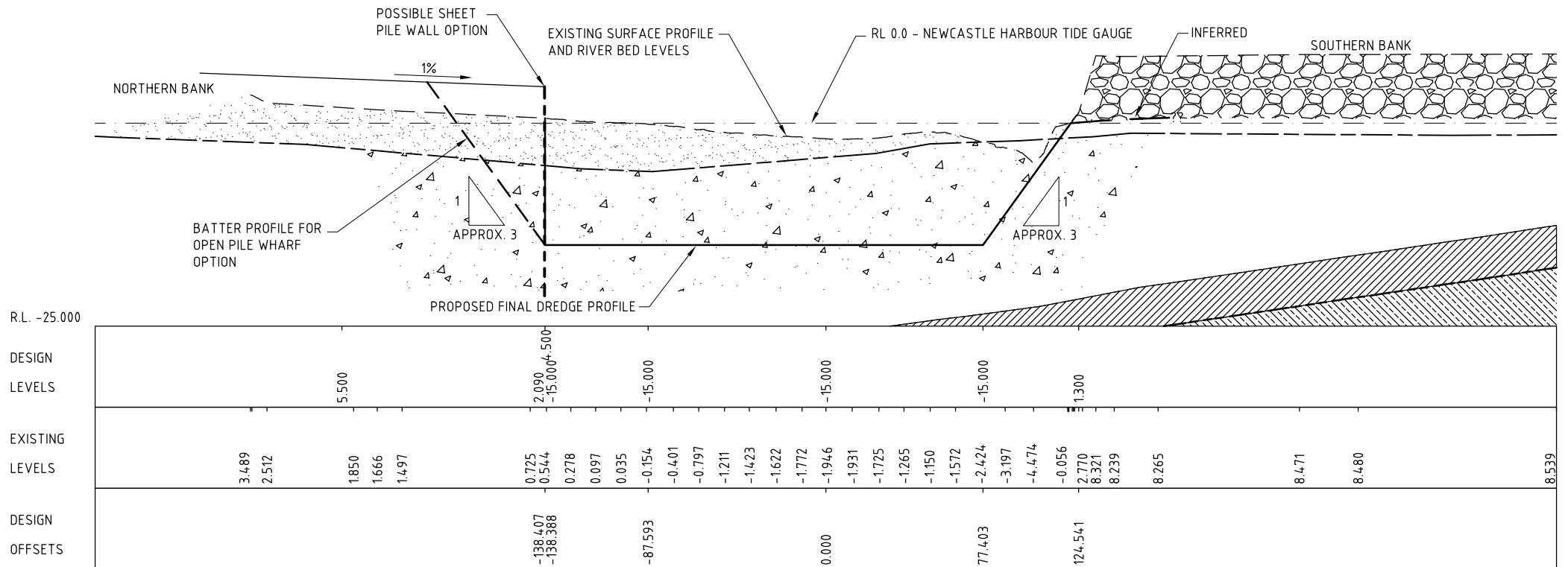


FIGURE C.8
LONGITUDINAL SECTION
PROPOSED EXTENSION OF SHIPPING
CHANNELS, PORT OF NEWCASTLE



400.000 (LOOKING DOWNSTREAM)

NOTES & KEY

SURFACE RIVER SEDIMENTS. (SILT AND CLAYS)

MEDIUM TO DENSE MEDIUM GRAIN SIZE SAND, WITH APPROX. 5% FINES (< 75 MICRONS)

SOFT ROCK GRADING FROM CLASS 5 TO CLASS 2 CONSISTING OF RESIDUAL STIFF CLAYS, ALTERNATING SANDSTONES, SILTSTONES AND SHALE WITH OCCASIONAL MINOR COAL SEAMS.

CLASS 1 BEDROCK, MAINLY STRONG SANDSTONE UNCONFINED COMPRESSIVE STRENGTH > 16mPa.

MISCELLANEOUS GRANULAR FILLING MATERIAL

- NOTE DISTORTED SCALES H: 1:2000, v 1:500 (A3 SIZE)
- THIS IS AN IDEALISED CROSS SECTION, BASED ON EXISTING SURFACE AND SUBSURFACE INFORMATION, IT ONLY SHOWS GENERAL LOCATIONS OF INTERFACES BETWEEN SUB SURFACE STRATA.
- FOR DREDGE BATTER PROFILES AND REVETMENT REFER TO FIGURES 1-6 OF THE GHD DREDGE BATTER REPORT No. 89654.

I:FIGC.9.dwg, 7/08/2003 2:36PM

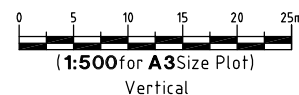
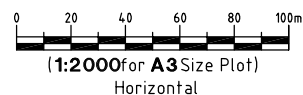
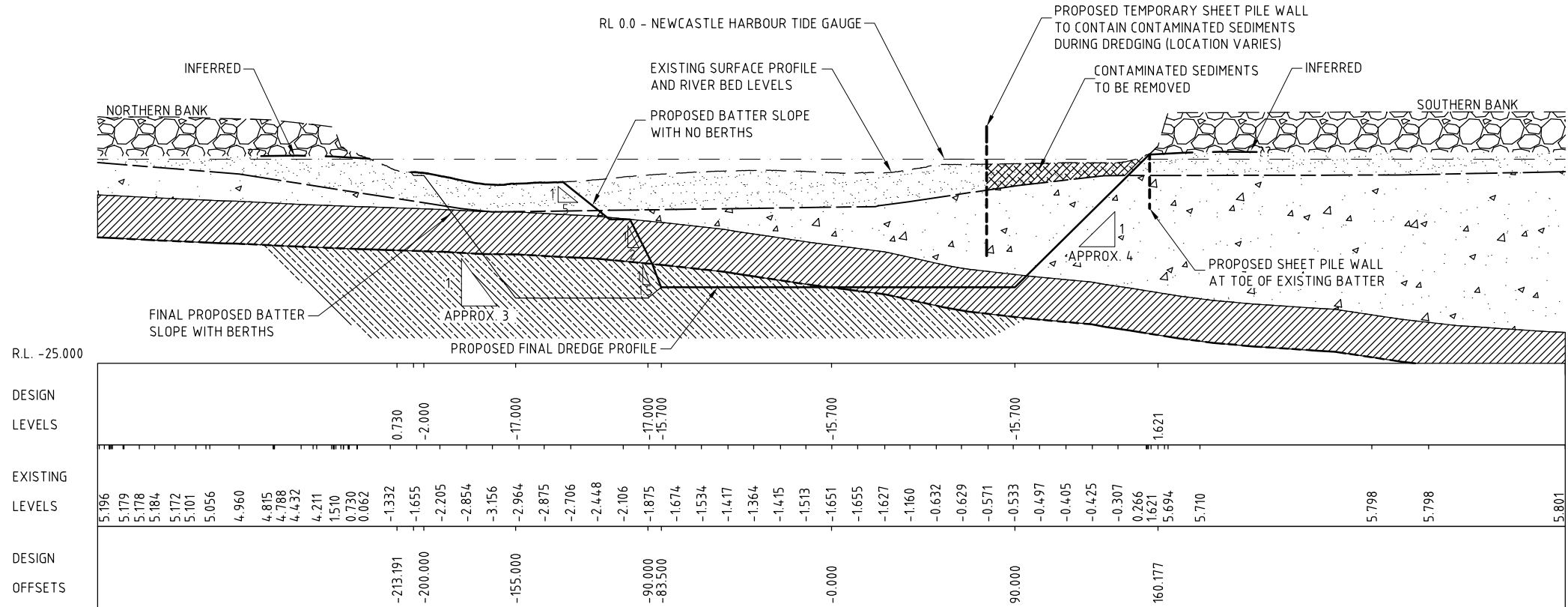


FIGURE C.9
IDEALISED CROSS SECTION @ 400.00
PROPOSED EXTENSION OF SHIPPING
CHANNELS, PORT OF NEWCASTLE



21/10370/FIGURES/FIGC.11.DWG



NOTES & KEY



SURFACE RIVER SEDIMENTS. (SILT AND CLAYS)



MEDIUM TO DENSE MEDIUM GRAIN SIZE SAND, WITH APPROX. 5% FINES (< 75 MICRONS)



SOFT ROCK GRADING FROM CLASS 5 TO CLASS 2 CONSISTING OF RESIDUAL STIFF CLAYS, ALTERNATING SANDSTONES, SILTSTONES AND SHALE WITH OCCASIONAL MINOR COAL SEAMS.



CLASS 1 BEDROCK, MAINLY STRONG SANDSTONE UNCONFINED COMPRESSIVE STRENGTH > 16mPa.



MISCELLANEOUS GRANULAR FILLING MATERIAL

- NOTE DISTORTED SCALES H: 1:2000, v 1:500 (A3 SIZE)
- THIS IS AN IDEALISED CROSS SECTION, BASED ON EXISTING SURFACE AND SUBSURFACE INFORMATION, IT ONLY SHOWS GENERAL LOCATIONS OF INTERFACES BETWEEN SUB SURFACE STRATA.
- FOR DREDGE BATTER PROFILES AND REVETMENT REFER TO FIGURES 1-6 OF THE GHD DREDGE BATTER REPORT No. 89654.
- PROPOSED FINAL DREDGE PROFILE SHOWN IS 0.5m BELOW THE PROPOSED MAINTAINED DREDGE DEPTH SHOWN ON FIG C1.

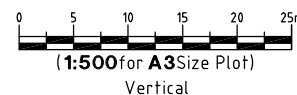
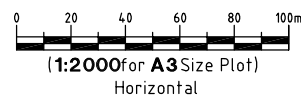
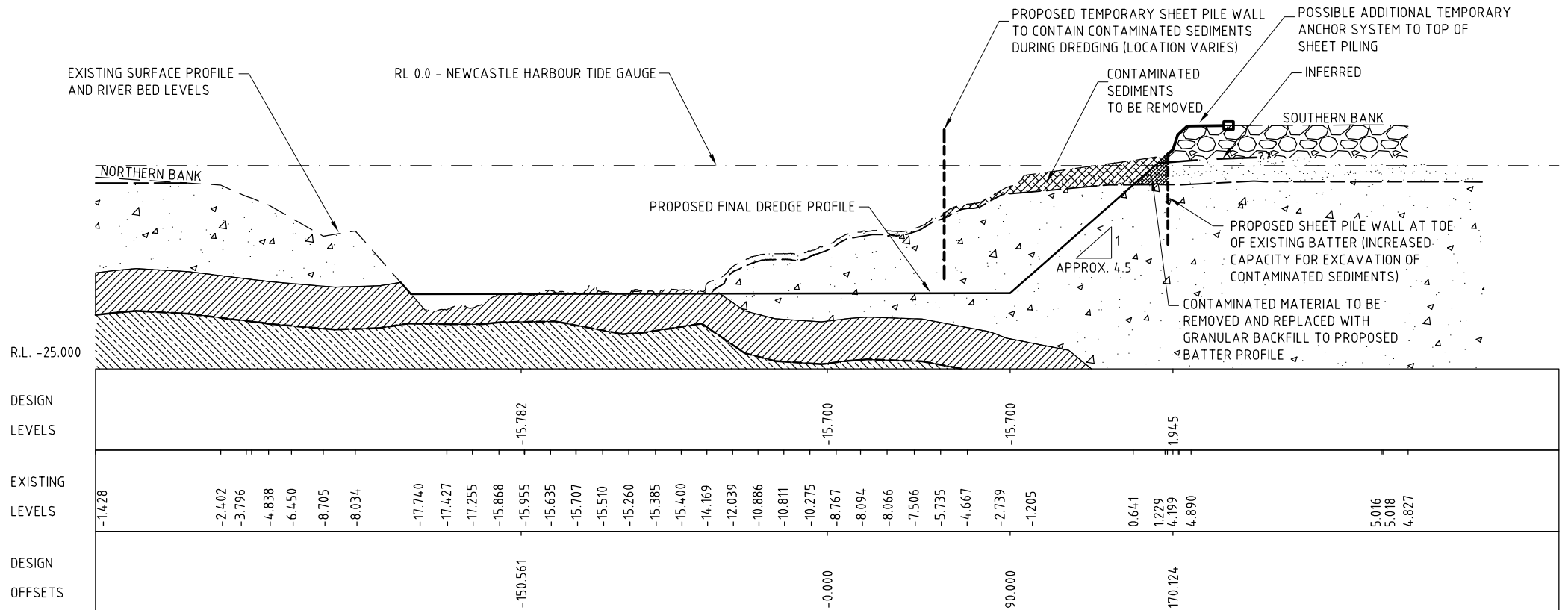


FIGURE C.12
IDEALISED CROSS SECTION @ 2200.00
PROPOSED EXTENSION OF SHIPPING
CHANNELS, PORT OF NEWCASTLE



3000.000 (LOOKING DOWNSTREAM)

NOTES & KEY



SURFACE RIVER SEDIMENTS. (SILT AND CLAYS)



MEDIUM TO DENSE MEDIUM GRAIN SIZE SAND, WITH APPROX. 5% FINES (< 75 MICRONS)



SOFT ROCK GRADING FROM CLASS 5 TO CLASS 2 CONSISTING OF RESIDUAL STIFF CLAYS, ALTERNATING SANDSTONES, SILTSTONES AND SHALE WITH OCCASIONAL MINOR COAL SEAMS.



CLASS 1 BEDROCK, MAINLY STRONG SANDSTONE UNCONFINED COMPRESSIVE STRENGTH > 16mPa.



MISCELLANEOUS GRANULAR FILLING MATERIAL

- NOTE DISTORTED SCALES H: 1:2000, v 1:500 (A3 SIZE)
- THIS IS AN IDEALISED CROSS SECTION, BASED ON EXISTING SURFACE AND SUBSURFACE INFORMATION, IT ONLY SHOWS GENERAL LOCATIONS OF INTERFACES BETWEEN SUB SURFACE STRATA.
- FOR DREDGE BATTER PROFILES AND REVETMENT REFER TO FIGURES 1-6 OF THE GHD DREDGE BATTER REPORT No. 89654.

I:FIGC.13.dwg, 7/08/2003 2:38PM

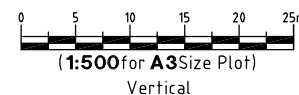
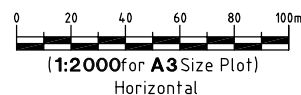
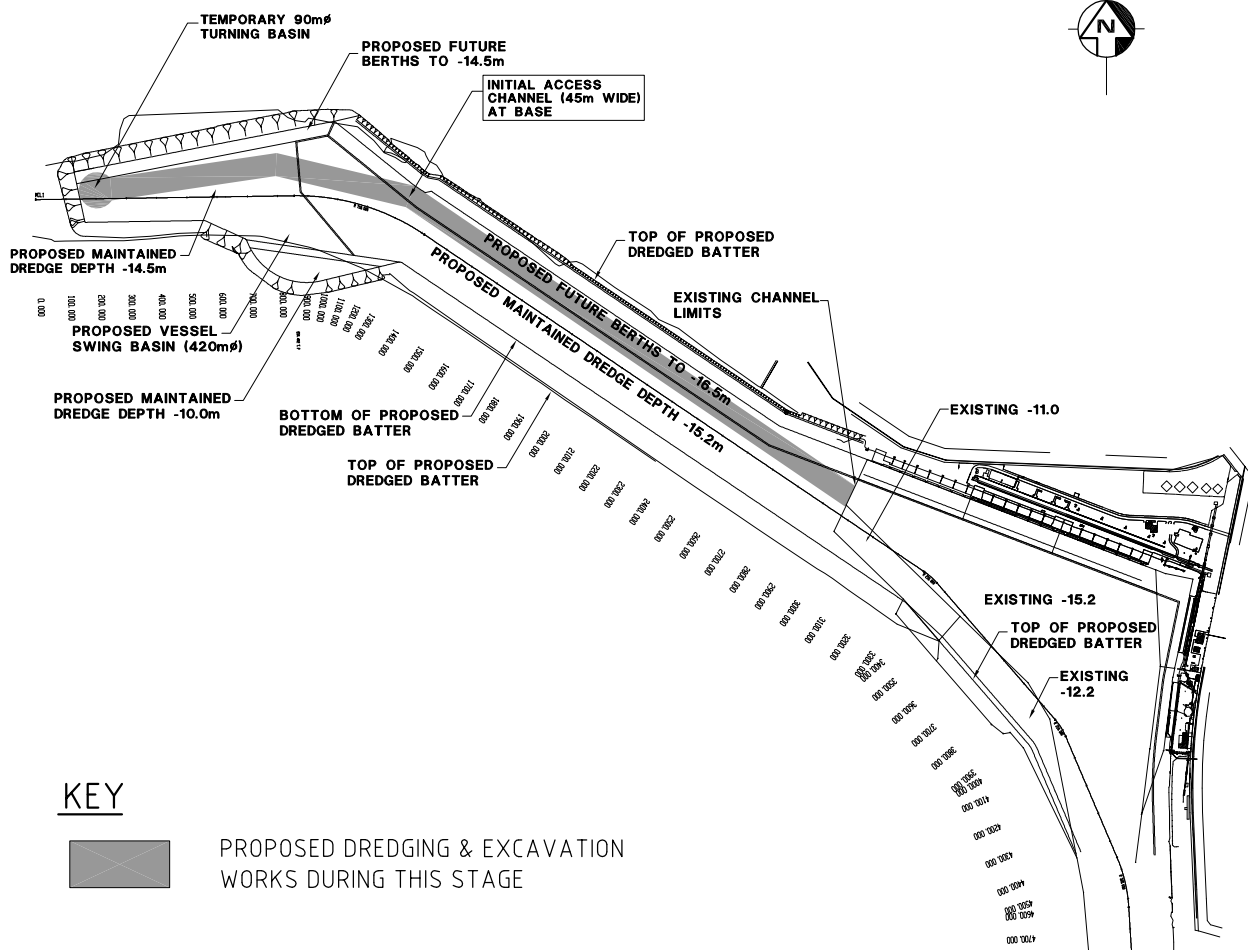
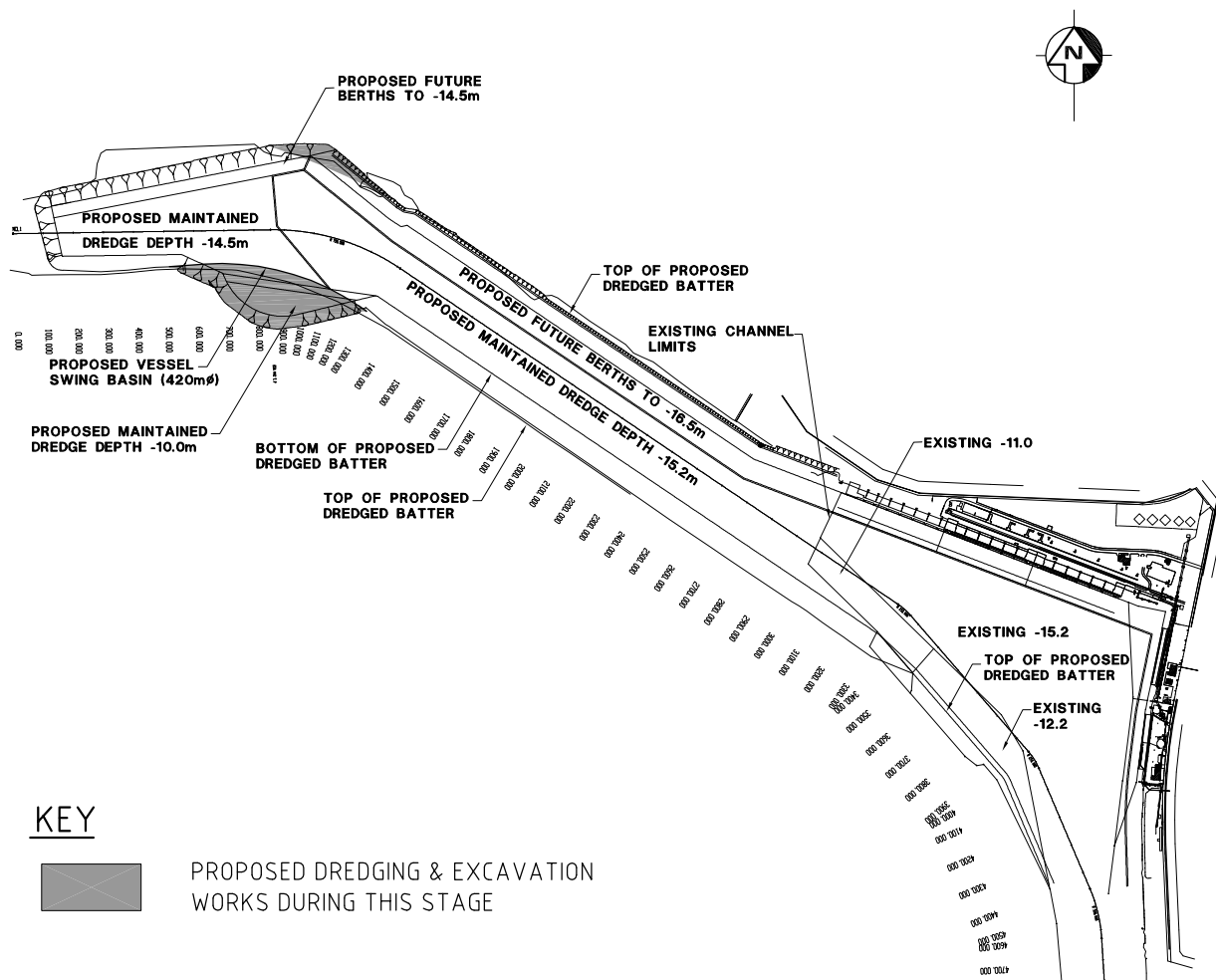


FIGURE C.13
IDEALISED CROSS SECTION @ 3000.00
PROPOSED EXTENSION OF SHIPPING CHANNELS, PORT OF NEWCASTLE



I:FIGC.14.dwg. 7/08/2003 2:39PM

FIGURE C.14
STRATEGY FOR REMOVAL AND
HANDLING OF MATERIALS



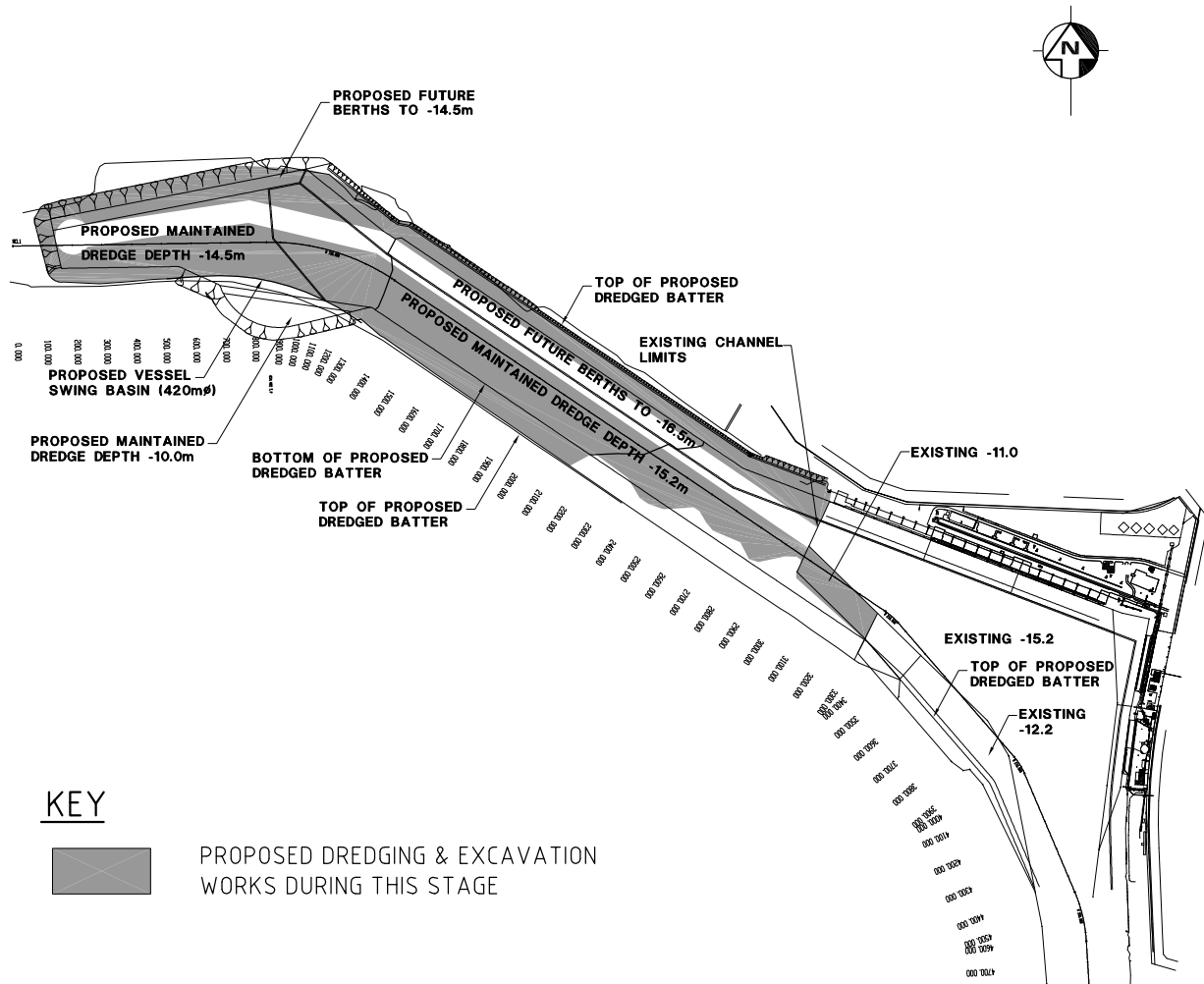
STAGE 2

EXCAVATE FOR SWING BASIN (TO RL1.0m ABOVE NTTG DATUM)
UPPER PORTION (MONTHS 2-13 INCL. STAGE 2)

0 250 500 750m
(1:25,000 for A4 Size Plot)

I:FIGC.15.dwg. 7/08/2003 2:42PM

FIGURE C.15
STRATEGY FOR REMOVAL AND
HANDLING OF MATERIALS



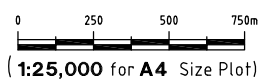
KEY



PROPOSED DREDGING & EXCAVATION
WORKS DURING THIS STAGE

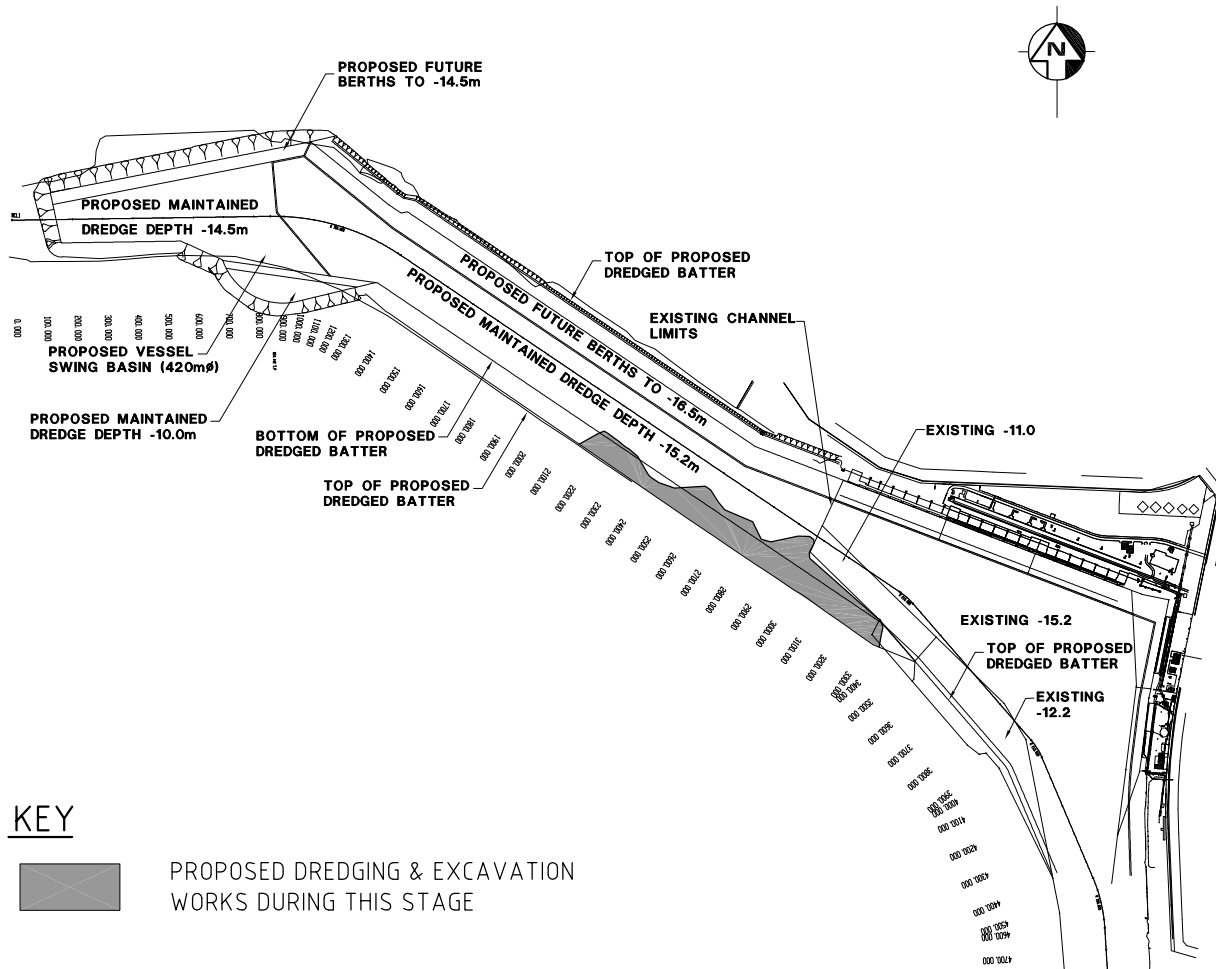
STAGE 3

DREDGE SILT DOWN TO AND INCLUDING THE SILT/SAND INTERFACE
(MONTHS 7-12 INCL.)



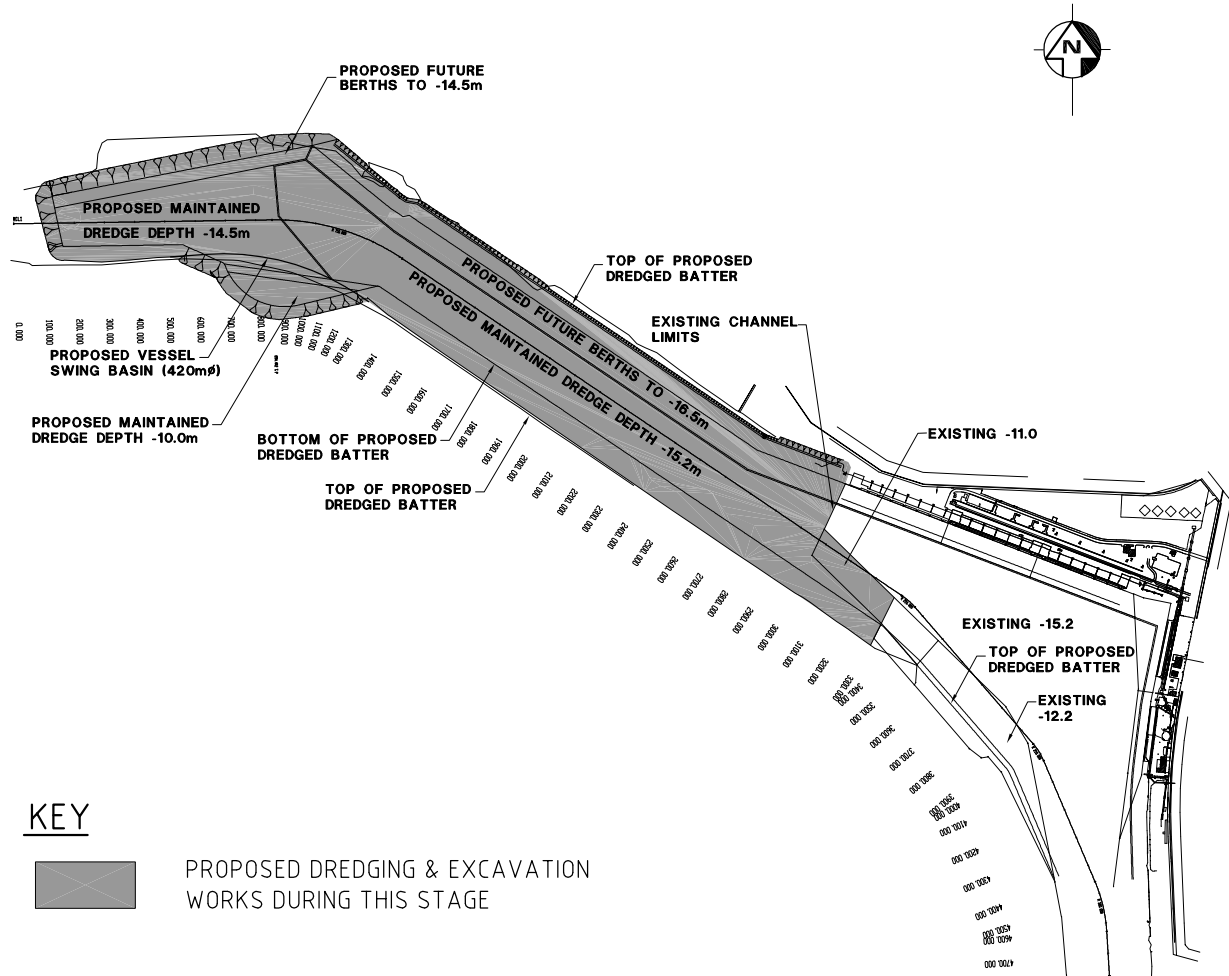
I:FIGC.16.dwg. 7/08/2003 2:43PM

FIGURE C.16
STRATEGY FOR REMOVAL AND
HANDLING OF MATERIALS



I:FIGC.17.dwg. 7/08/2003 2:44PM

FIGURE C.17
STRATEGY FOR REMOVAL AND
HANDLING OF MATERIALS



KEY



PROPOSED DREDGING & EXCAVATION
WORKS DURING THIS STAGE

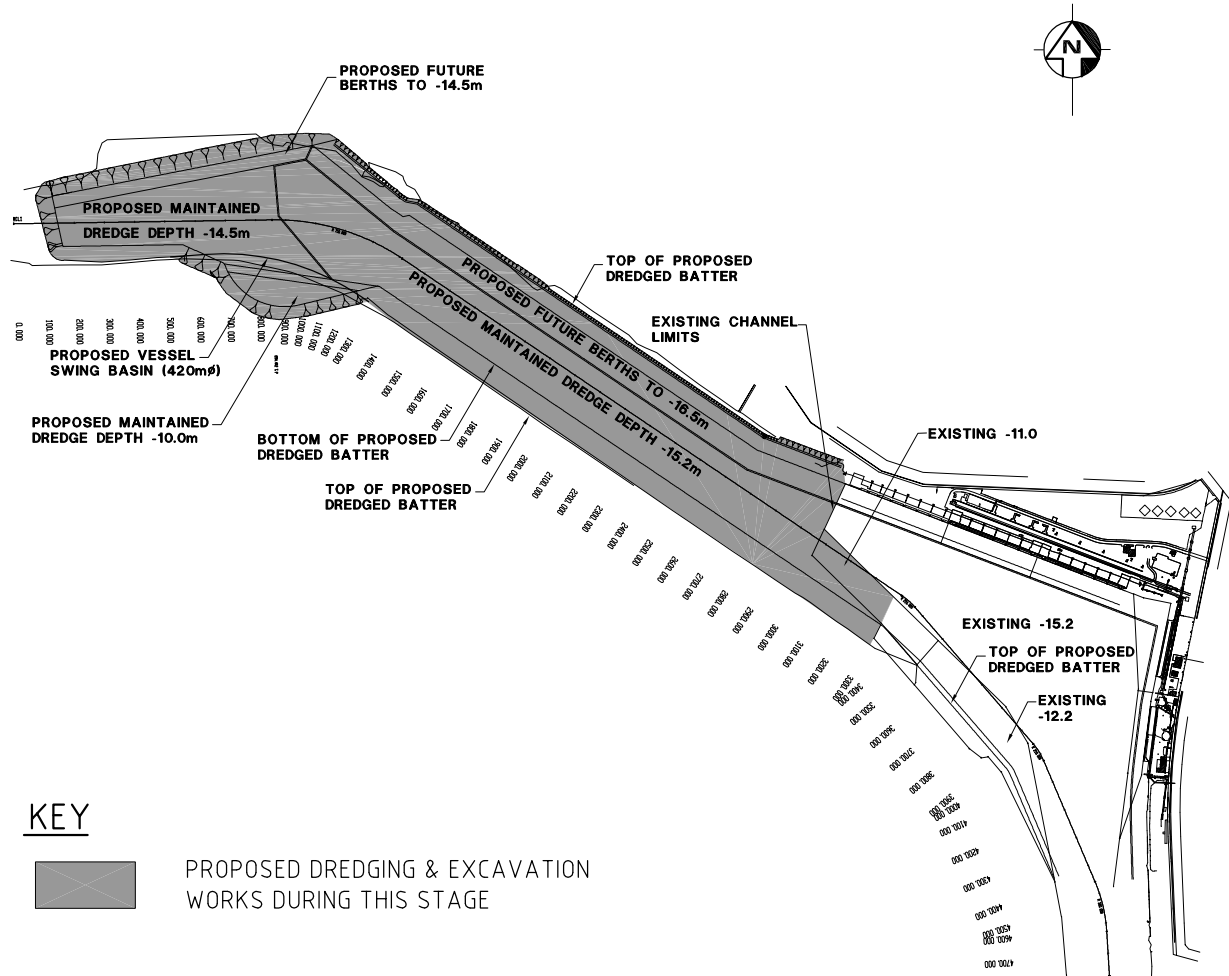
STAGE 5

DREDGE SAND DOWN TO THE SAND/CLAY INTERFACE
(MONTHS 11-18 INCL.)

0 250 500 750m
(1:25,000 for A4 Size Plot)

I:FIGC.18.dwg. 7/08/2003 2:44PM

FIGURE C.18
STRATEGY FOR REMOVAL AND
HANDLING OF MATERIALS



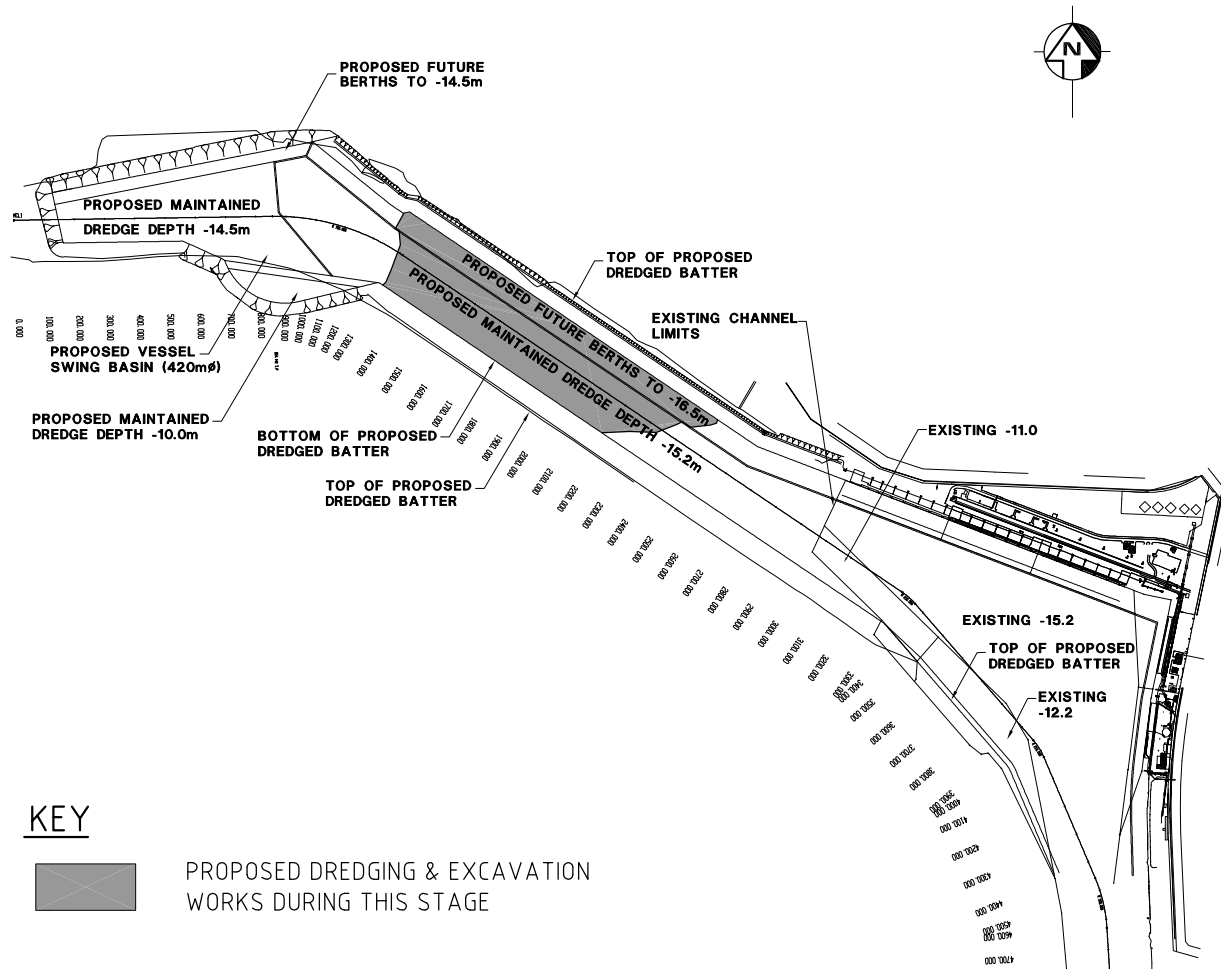
STAGE 6

DREDGE CLAY DOWN TO THE BASE OF THE CHANNEL
OR THE WEATHERED ROCK

0 250 500 750m
(1:25,000 for A4 Size Plot)

I:FIGC.19.dwg. 7/08/2003 2:45PM

FIGURE C.19
STRATEGY FOR REMOVAL AND
HANDLING OF MATERIALS



STAGE 7

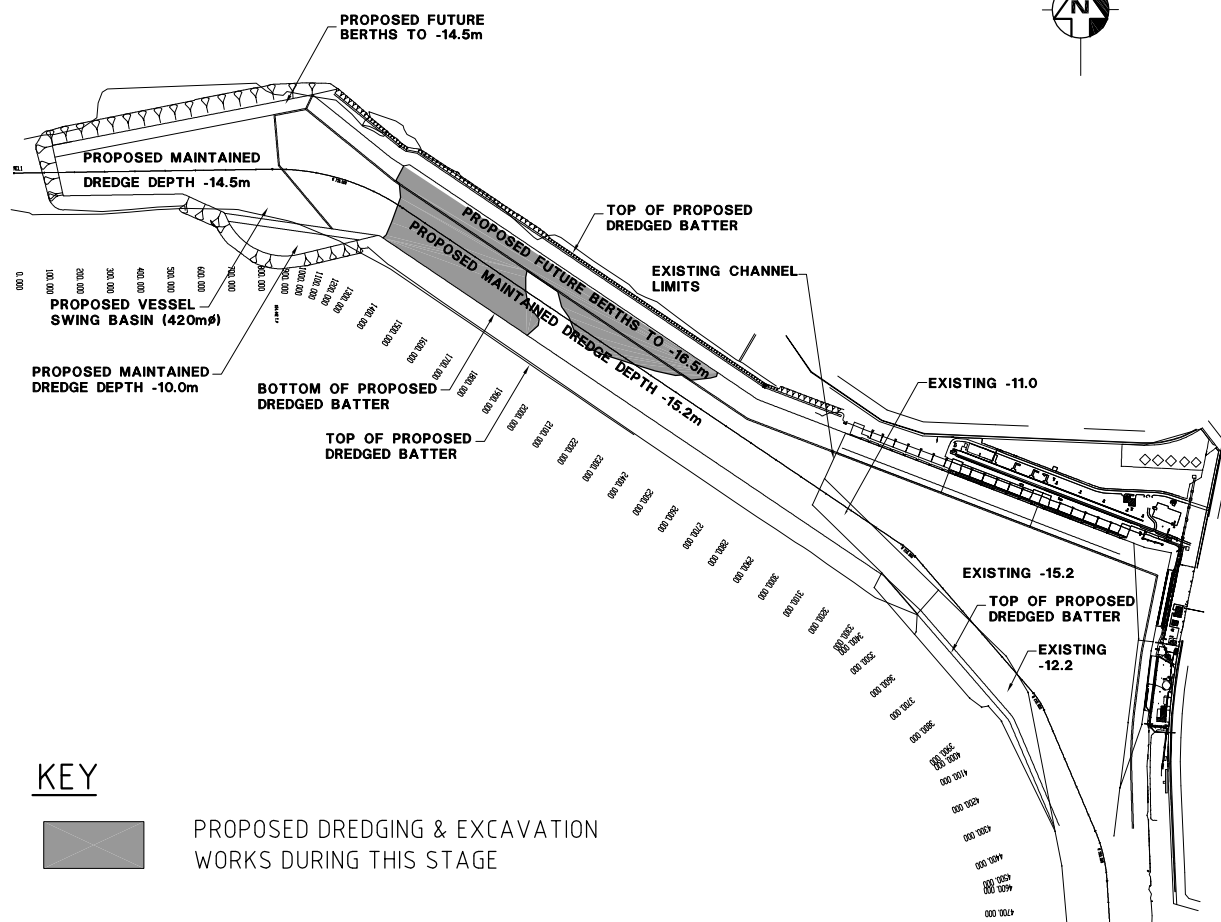
DREDGE HIGHLY WEATHERED ROCK DOWN TO THE BASE
OF THE CHANNEL OR THE HARD ROCK

(MONTHS 26-31 INCL.)

0 250 500 750m
(1:25,000 for A4 Size Plot)

I:FIGC.20.dwg. 7/08/2003 2:45PM

FIGURE C.20
STRATEGY FOR REMOVAL AND
HANDLING OF MATERIALS



KEY



PROPOSED DREDGING & EXCAVATION
WORKS DURING THIS STAGE

STAGE 8

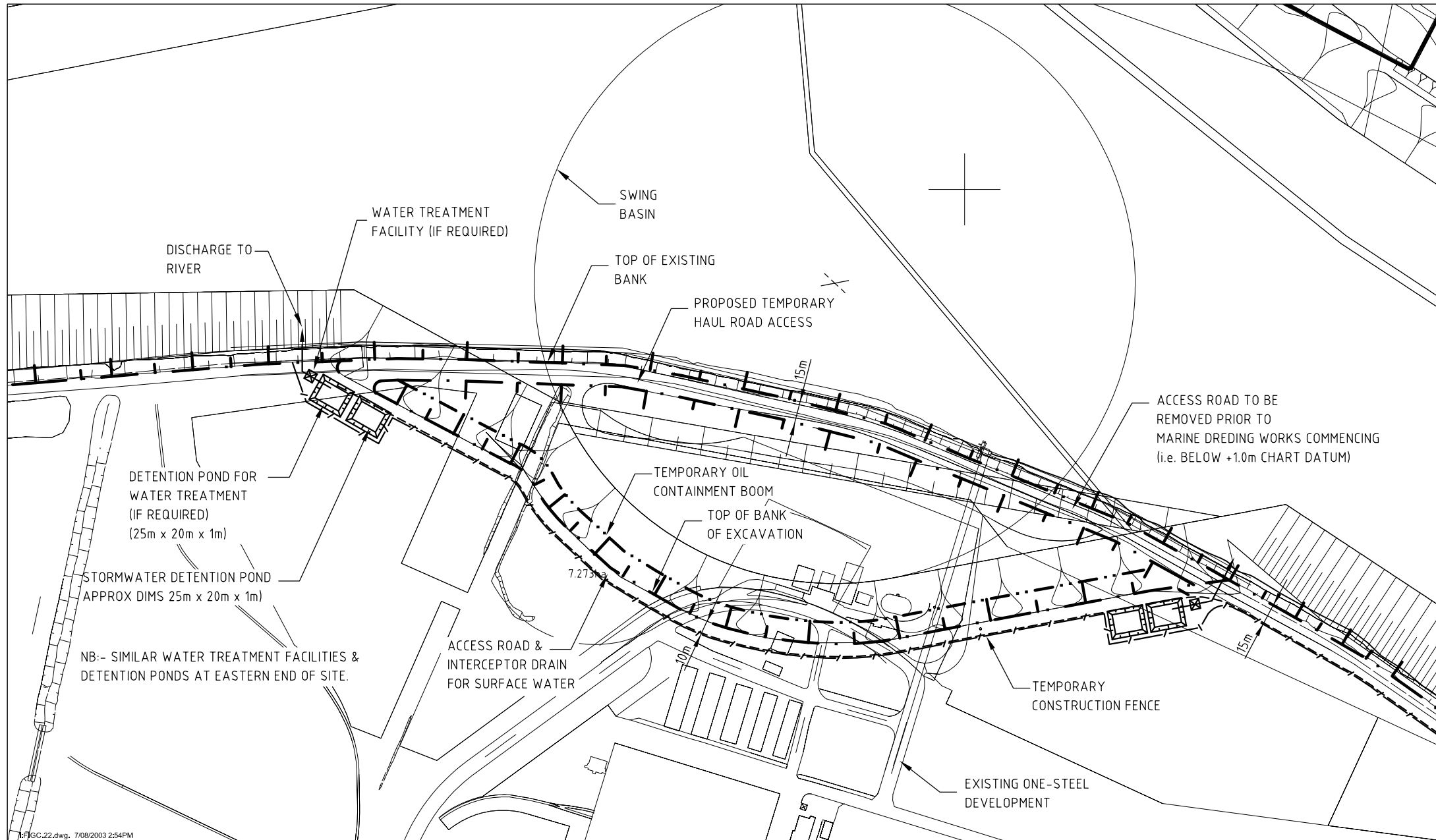
REMOVE HARD ROCK DOWN TO THE BASE OF THE CHANNEL
(MONTH 29-40 INCL.)



(1:25,000 for A4 Size Plot)

I:FIGC.21.dwg, 7/08/2003 2:46PM

FIGURE C.21
STRATEGY FOR REMOVAL AND
HANDLING OF MATERIALS



11/01/2003 2:54PM

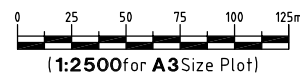


FIGURE C.22
PROPOSED EXCAVATION EXTENT &
ON SHORE FACILITIES FOR WATER DETENTION &
TREATMENT AT ONE-STEEL

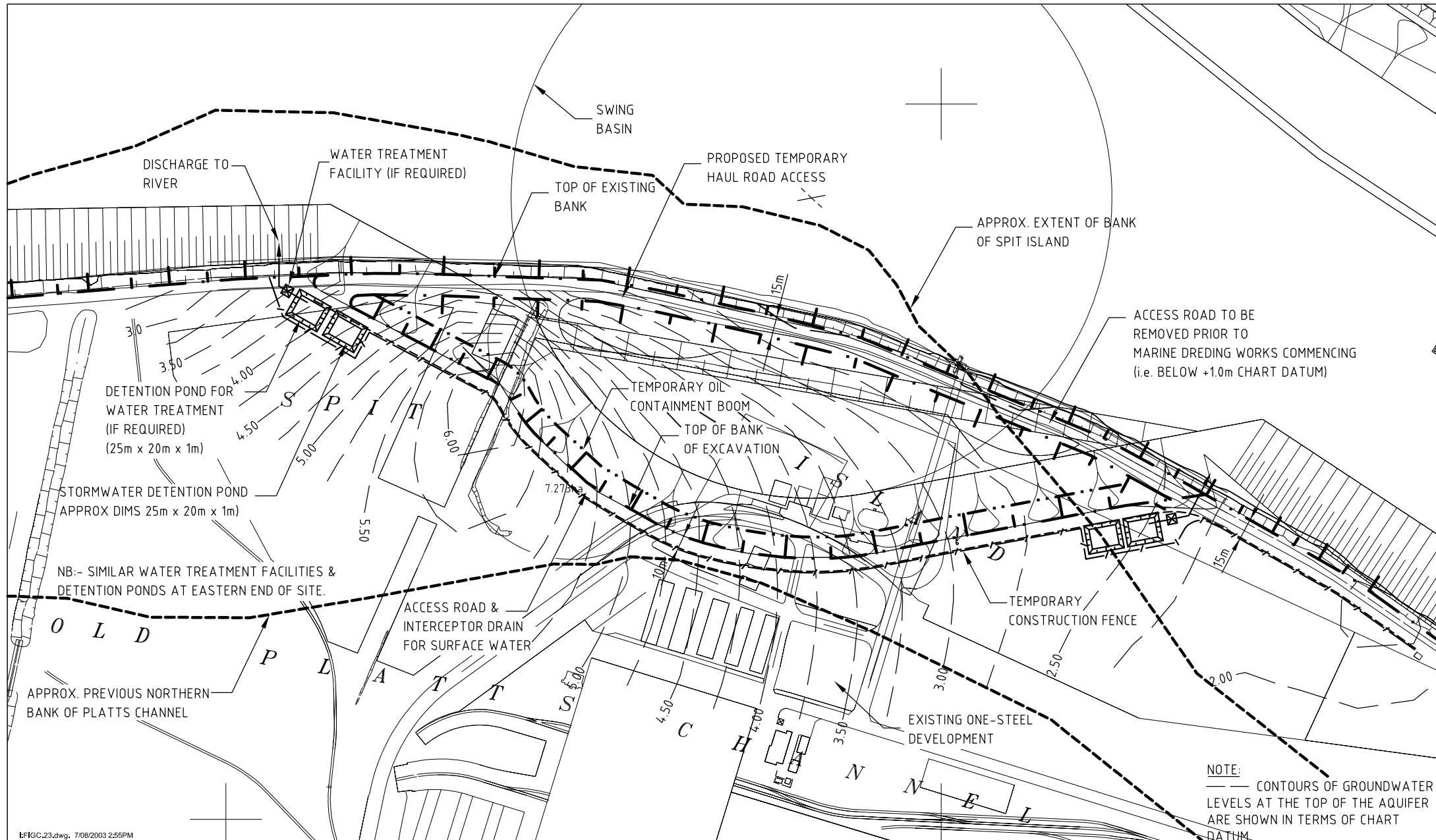


FIGURE C.23
INFERRED GROUNDWATER CONTOURS ON TOP OF FILL AQUIFER AND
EXTENT OF PLATTS CHANNEL/SPIT ISLAND
IN THE VICINITY OF EXCAVATION AT ONE-STEEL.

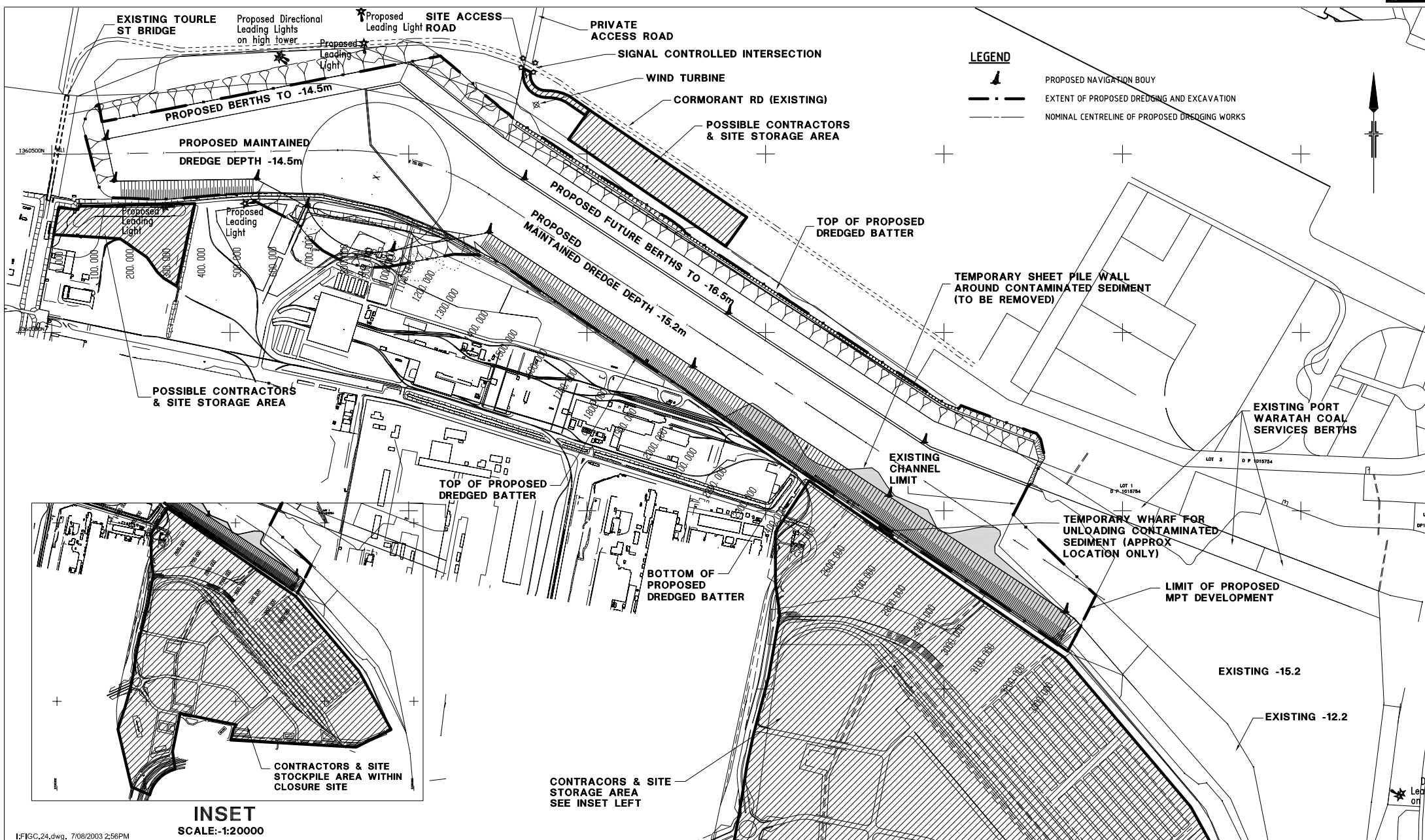
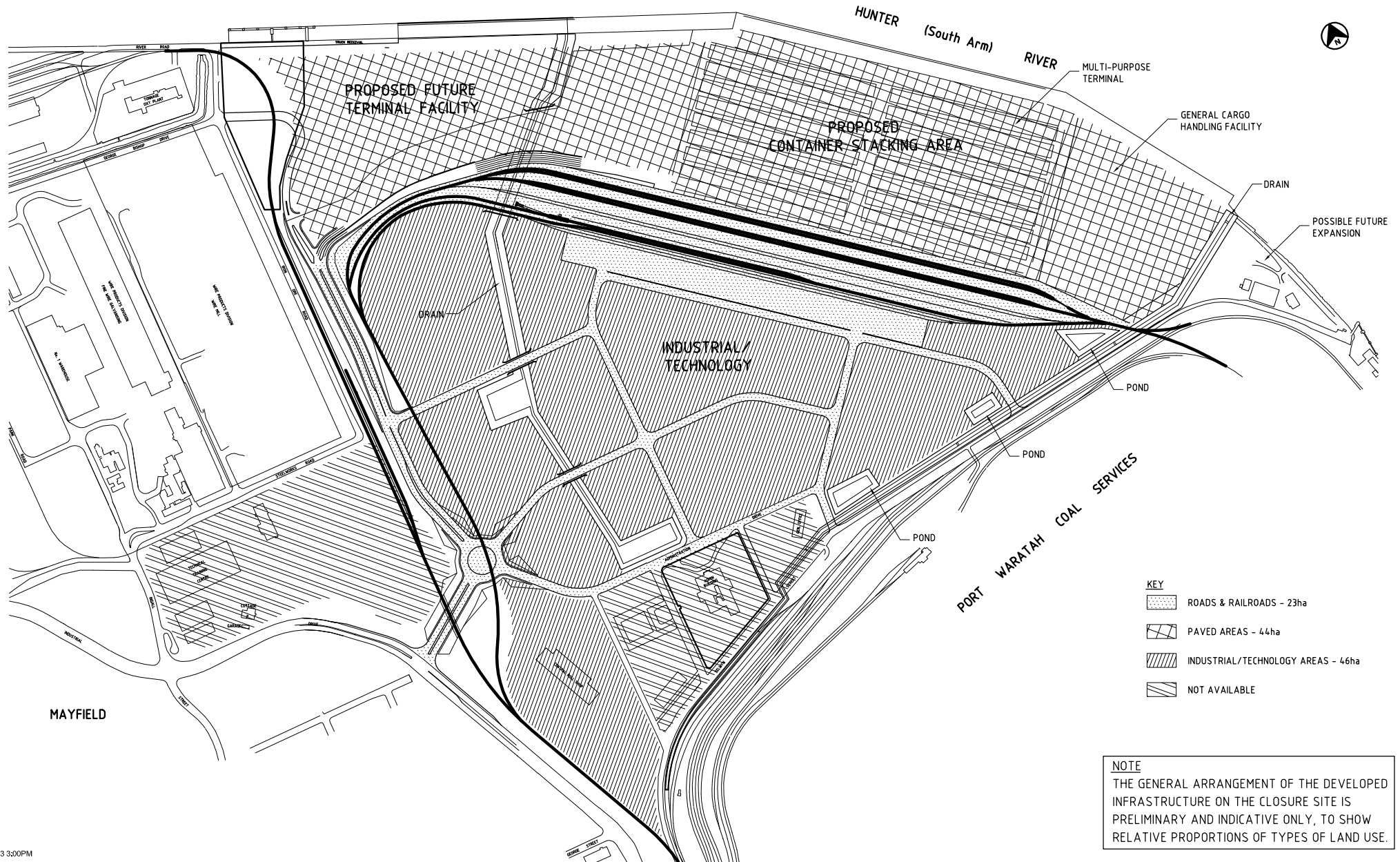


FIGURE C.24
LOCATION OF TEMPORARY CONSTRUCTION FACILITIES
PROPOSED EXTENSION OF SHIPPING
CHANNELS, PORT OF NEWCASTLE

1. ALL DEPTHS ARE IN TERMS OF NEWCASTLE HARBOUR TIDE GAUGE DATUM.
2. ALL SOUNDINGS ARE AT 0.5m INTERVALS.





I:\FIGC.26.dwg, 7/08/2003 3:00PM

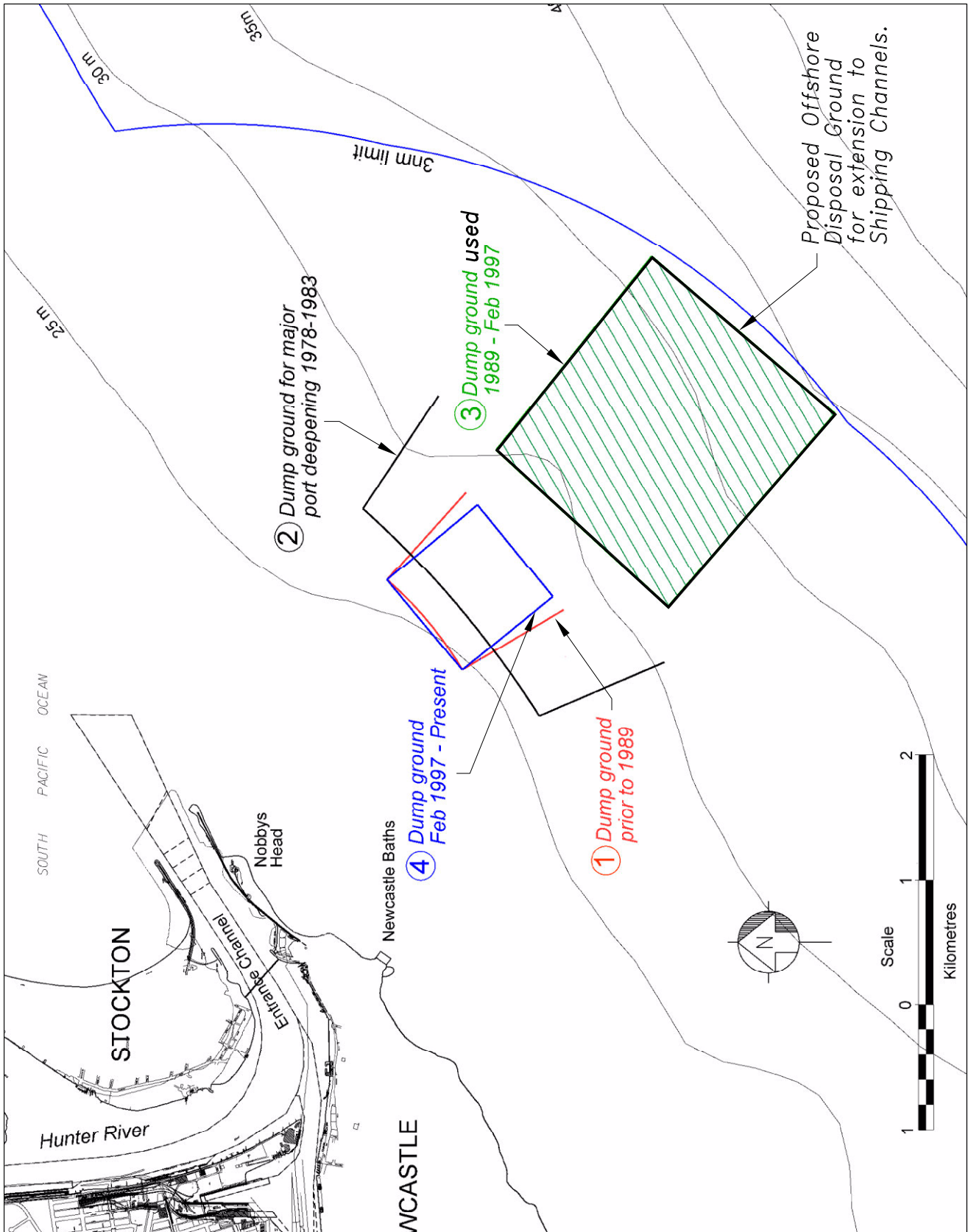
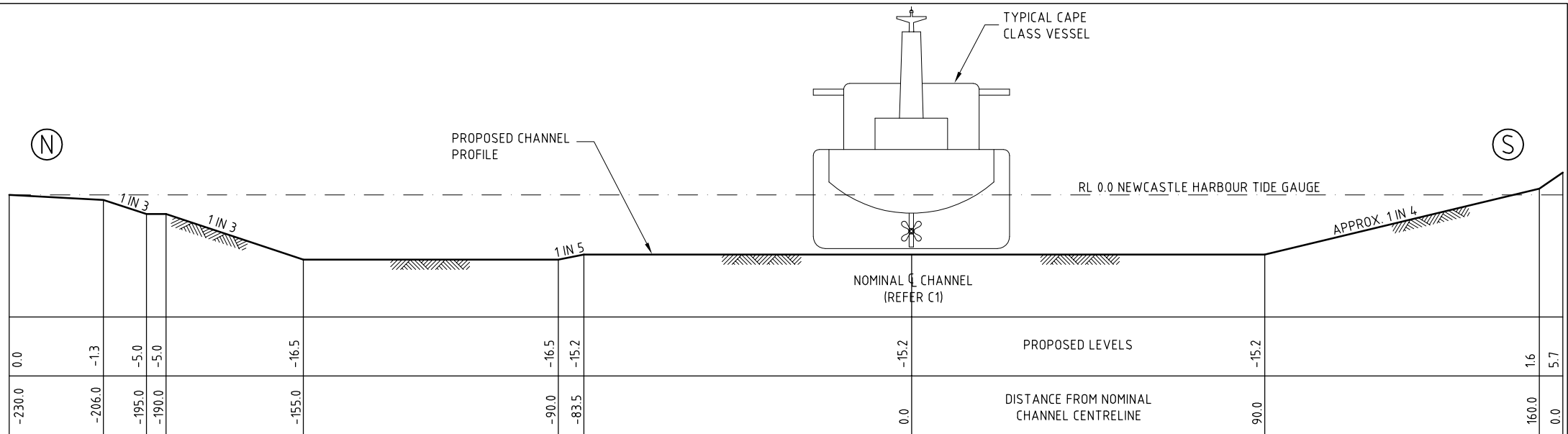


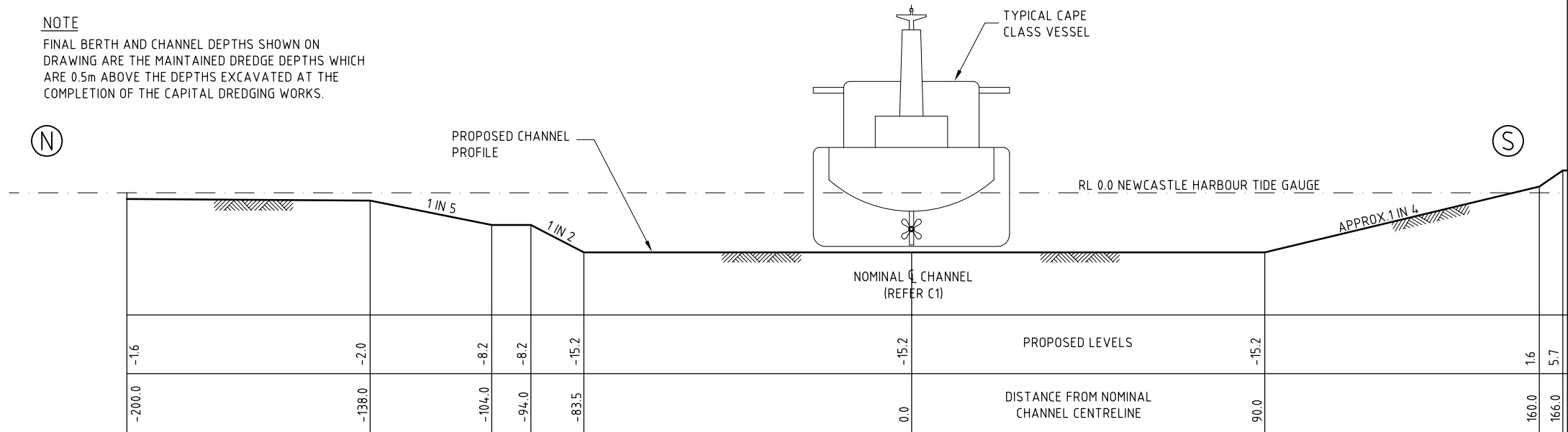
FIGURE C.27
PROPOSED OFFSHORE DISPOSAL GROUND FOR
EXTENSION TO SHIPPING CHANNELS; PORT OF NEWCASTLE



TYPICAL CROSS SECTION AT 2200m WITH BERTH ON NORTHERN SIDE (LOOKING DOWNSTREAM)

NOTE

FINAL BERTH AND CHANNEL DEPTHS SHOWN ON DRAWING ARE THE MAINTAINED DREDGE DEPTHS WHICH ARE 0.5m ABOVE THE DEPTHS EXCAVATED AT THE COMPLETION OF THE CAPITAL DREDGING WORKS.



TYPICAL CROSS SECTION AT 2200m WITH NO BERTHS ON NORTHERN SIDE (LOOKING DOWNSTREAM)