BOTANY GROUNDWATER CLEANUP PROJECT

Joint Determining Authority Report
Under Section 112
of the Environmental Planning and Assessment Act 1979

Department of Environment and Conservation
Department of Infrastructure, Planning and Natural Resources
NSW Maritime
Sydney Water Corporation
Sydney Ports Corporation

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DEC 2005/13
February 2005
ISBN 1 7413 7112 0

The EPA is a statutory body with specific powers under environment protection legislation. In September 2003, the EPA became part of the Department of Environment and Conservation (NSW).

DETERMINATION

Environmental Planning and Assessment Act 1979

DECISION OF THE DEPARTMENT OF ENVIRONMENT AND CONSERVATION, DEPARTMENT OF INFRASTRUCTURE, PLANNING and NATURAL RESOURCES, NSW MARITIME, SYDNEY PORTS CORPORATION AND SYDNEY WATER CORPORATION FOR THE BOTANY GROUNDWATER CLEANUP PROJECT

In assessing the proposal for the Botany Groundwater Cleanup project in accordance with Part 5 of the *Environmental Planning and Assessment* (EP&A) *Act 1979* and the EP&A Regulation 2000, the Department of Environment and Conservation, Department of Infrastructure Planning and Natural Resources, NSW Maritime, Sydney Ports Corporation and Sydney Water Corporation have examined and taken into account to the fullest possible extent all matters affecting or likely to affect the environment as a result of the proposal.

In preparation of the determination report under clause 243 of the EP&A Regulation the determining authorities have examined and considered:

a) the Environmental Impact Statement (EIS) for the Botany Groundwater Cleanup project dated November 2004

b) the representations made in relation to the proposed works described in the EIS

c) representations reports prepared by Orica Pty Ltd dated 24 December 2004 and 5 January 2005

d) a letter from Orica to DEC dated 17 December 2004 seeking clarification on additional information in relation to aspects of the EIS

e) a report prepared by Orica Pty Ltd entitled, *Botany Groundwater Cleanup project, A description and assessment of proposed modifications to reduce the detrimental effect on the environment,* dated 27 January 2005

f) a flow chart submitted by Orica to DEC in a facsimile dated 07/02/05 entitled *"Orica Botany GTP Schematic Incorporating Improvements – Draft for Discussion 07/02/05"*

g) the objects and requirements of various statutes including:

   a. *Environmental Planning and Assessment Act 1979*

   b. *Protection of the Environment Operations Act 1997*

   c. *Contaminated Land Management Act 1997*

   d. *Water Act 1912*

   e. *Water Management Act 2000*

   f. *National Parks and Wildlife Act 1974*

   g. *Threatened Species Conservation Act 1995*

   h. *Rivers and Foreshores Improvement Act 1948*

   i. *Sydney Water Act 1994*

   j. Commonwealth *Environment Protection and Biodiversity Conservation Act 1999.*

h) the EPA Notice of Clean Up Action issued by DEC;

i) an independent review of the project by the United States Environmental Protection Agency dated 20 January 2004

j) an independent review of air emissions, air quality and plant performance capability by John Court & Associates Pty Ltd dated 29 January 2005

k) a letter dated 17 January from Orica to DEC setting out comments on further questions raised by the Department of Environment and Heritage (Commonwealth) on alternate treatment technologies and compliance with the Stockholm Convention on Persistent Organic Pollutants.

l) letters from Department of Environment and Heritage (Commonwealth) to DEC dated 20 December and 2 February 2005 on alternate treatment technologies and compliance with the Stockholm Convention on Persistent Organic Pollutants.

m) the Healthy Rivers Commission *Independent Inquiry into the Georges River–Botany Bay System* and associated *Statement of Joint Intent*

n) the NSW State Groundwater Policy

o) the effect of the proposed activity on the environment

p) the cumulative effect on the environment of the proposed activity with other existing and likely future activities

q) other matters referred to in the determination report.

Following consideration of the above, the Department of Environment and Conservation, NSW Maritime, Sydney Ports Corporation, Sydney Water Corporation and Department of Infrastructure, Planning and Natural Resources have each decided to approve the activity subject to the conditions attached in Appendix B. The reasons for the conditions are to:

- ensure that adequate safeguards are in place to protect the environment and human health
- mitigate the potential environmental impacts of the activity
- ensure compliance with relevant statutes and statutory instruments
- restore the quality of groundwater in and around Botany Industrial Park.

Department of Environment and Conservation

NSW Maritime

Department of Infrastructure, Planning and Natural Resources

Sydney Water Corporation

Sydney Ports Corporation

EXECUTIVE SUMMARY

As a result of historical manufacturing activities at Botany Industrial Park (the former ICI site) there is a legacy of groundwater contamination that must be addressed to ensure adverse impacts to the environment and human health do not occur.

Extensive environmental investigations and groundwater monitoring undertaken by Orica since the 1980s have revealed an extensive and complex distribution of contaminated groundwater in and around Botany Industrial Park. The principal contaminants are volatile chlorinated hydrocarbons, in particular 1,2 dichloroethane (EDC) as well as carbon tetrachloride (CTC), tetrachloroethene (PCE) and trichloroethene (TCE). The groundwater does not contain dioxins or dioxin-related substances. These source areas have led to the creation of multiple overlapping plumes moving generally in a south-west direction towards Penrhyn Estuary and Botany Bay.

On 24 September 2003 the EPA became part of the Department of Environment and Conservation (DEC). However, certain statutory functions and powers, including those in the *Protection of the Environment Operations Act 1997*, continue to be exercised in the name of the EPA.

DEC (and formerly the EPA) has regulated the groundwater remediation in and around Botany Industrial Park for many years. The focus of this work has been on stopping further contamination, fixing up surface drainage, soil remediation works and investigation of groundwater contamination.

In February 2000 the EPA agreed to a Voluntary Investigation and Remediation proposal from Orica under the *Contaminated Land Management Act 1997* to formalise the existing ongoing monitoring, investigation, remediation assessment and communication activities. DEC subsequently issued an EPA Notice of Clean Up Action (NCUA) to Orica under section 91 of the *Protection of the Environment Operations Act 1997* on 26 September 2003. This notice sets a strict framework and timescale for action to contain and reduce the levels of contaminants, to the maximum extent practicable by 31 October 2005, to ensure adverse impacts do not occur.

As an initial response to the Notice's requirement to effect hydraulic containment of the contaminants, Orica implemented use of a steam stripping unit to process extracted groundwater and recover the contaminants (principally EDC) for subsequent treatment/disposal. Orica has also been exploring the feasibility of off-site treatment methods and trialling in situ methods to reduce groundwater contamination, including active and passive bioremediation and the use of reactive iron barriers. While these actions are reducing the amount of contamination reaching Penrhyn Estuary, they will not affect the areas of highest contamination closer to the Botany Industrial Park, which also need to be remediated.

In order to fulfil the EPA Notice of Clean Up Action requirement to contain the plumes, Orica proposed the Botany Groundwater Cleanup project. The key elements of the project include:

- extraction of groundwater from the wells in three containment lines (up to 15 million litres per day)
- transfer of the groundwater via pipelines to the groundwater treatment plant (GTP)
- construction and operation of the GTP
- Discharge of up to 12 million litres per day of treated water from the plant to Bunnerong Canal, although it is expected that approximately half of this treated water will be reused by industry in the Botany Industrial Park (BIP) (or other identified users) ; and
- installation of a discharge point into Bunnerong Canal.

Orica currently holds an EPA environment protection licence (no. 2148) under the *Protection of the Environment (Operations) Act 1997* for a number of existing activities. DEC determined that because the project contains activities likely to significantly affect the environment, an environmental impact statement

was required under Part 5 of the *Environmental Planning and Assessment Act 1979* before DEC could vary the existing EPA licence to permit the activity.

In November 2004, Orica submitted an environmental impact statement, also titled *Botany Groundwater Cleanup Project*. The environmental impact statement prepared by Orica proposed a strategy to contain, collect and reduce contaminants in the groundwater in and around the Botany Industrial Park to meet the requirements of the notice and prevent any adverse impacts to the environmental receptors: Penrhyn Estuary, Botany Bay and human health. Orica considers that the implementation of the project will achieve the above objectives. The capital cost of the project is expected to be approximately $102 million for all elements, including the installation of extraction wells, transfer pipelines and treatment plant.

DEC is one of a number of determining authorities whose approval is required for the project to proceed. Other determining authorities are Department of Infrastructure Planning and Natural Resources, NSW Maritime, Sydney Water Corporation, Sydney Ports Corporation and NSW WorkCover. The Minister for Infrastructure and Planning appointed DEC as the nominated determining authority in relation to the environmental impact statement for the project.

DEC, the Department of Infrastructure, Planning and Natural Resources, NSW Maritime, Sydney Water Corporation and Sydney Ports Corporation have prepared this joint determination report in accordance with the *Environmental Planning and Assessment Act 1979* (in particular clauses 228 and 243) and associated Regulation, which require a determining authority to prepare a report on any activity for which an environmental impact statement has been prepared. The purpose of this report is to review the environmental impact statement, the issues raised in representations made in response to its exhibition, the report from Orica on the representations and any other matters relevant to the potential environmental impacts of the proposal.

A total of 19 representations were received in response to the exhibition of the environmental impact statement. These raised issues and concerns related to air, water, flora and fauna and waste as well as compliance with statutory requirements and international conventions on hazardous chemicals and wastes.

A key component of the project is the construction and operation of a groundwater treatment plant (GTP). The plant will be located on Orica-owned land on the Botany Industrial Park. The GTP is designed for continuous operation, treating up to 15 million litres of groundwater per day, 24 hours a day, seven days a week, with a 95% availability for a period of up to 30 years.

The operation of the proposed GTP involves the following steps. Extracted groundwater is collected and combined into a single stream and fed to the plant and conditioned for pH. Volatile organic compounds are then removed by blowing air through the groundwater, transferring them into the air stream (the off-gas stream). Off-gases then move to a thermal oxidiser unit fuelled by natural gas for a sufficient time to enable the destruction of organic compounds to carbon dioxide, water and hydrogen chloride. The off-gases are then passed through a liquid quench to rapidly cool the gas stream and further cleaned in an absorber and scrubber prior to being discharged to the atmosphere via a single stack.

From the air stripper, the cleaned groundwater is further treated through activated carbon to remove non-volatile organic compounds before being forwarded to either of two ways to remove remaining impurities. Stripped groundwater that is to be beneficially reused in industrial processes (up to 10 million litres per day) is treated by a reverse osmosis unit to remove dissolved solids. The remaining stripped water that does not pass through the reverse osmosis unit (up to 5 million litres per day) will be combined with wastewater from the reverse osmosis unit, commonly known as ‘brine’ (up to 2.5 million litres per day) and further treated in a biological treatment unit to remove contaminants. It is then polished to remove ammonia prior to discharge to the Bunnerong Canal.

Since receiving the representations Orica has considered some minor changes to the project. These include replacement of the biological treatment unit with a second reverse osmosis unit, discharging the

excess treated water to a stormwater channel (not directly into Bunnerong Canal) and increasing the groundwater treatment plant stack height from 20 metres to 34 metres. The determination of these modifications are included in this report.

If Orica is not able to extract and provide treatment to groundwater at the rates required (up to 15 million litres per day) to contain the plumes it could result in the waters of Penrhyn Estuary and Botany Bay becoming increasingly polluted from contaminants in this groundwater. The project is required to ensure that adverse impacts do not occur and the environment and human health are protected.

A key environmental issue raised in some public representations related to emissions from the groundwater treatment plant as a result of using thermal oxidation to destroy the contaminants in the air stream. These included concerns over the pollutants believed to be discharged to air, in particular dioxins, and the efficacy of the measures in place to ensure impacts to the environment and public health did not occur.

Objections to the use of the thermal oxidation unit and the need for alternatives were received on the grounds that it was contrary to the Stockholm Convention on Persistent Organic Pollutants (POPs). In assessing the project the determining authorities have taken into account the requirements of the Stockholm Convention, in particular, its release reduction measures. The design of the GTP thermal oxidiser adopts all of the internationally recognised safeguards for dioxin minimisation. These include a high thermal oxidiser operating temperature (1000 degrees C), long off-gas residence time in the thermal oxidiser reaction chamber (2 seconds), and a quench to rapidly reduce the temperature of the treated off-gas. These safeguards have been adopted even though the contaminated groundwater does not contain dioxins and Orica has identified that the factors normally required for dioxin formation are absent from the feed stream to the thermal oxidiser, namely carbon structures and metal catalysts due to the very low level of particulate matter in the gas stream. This is supported by successful and well established use of this technology in Japan and the USA.

DEC has required Orica to design, operate and maintain the GTP to achieve international best practice emission concentration limits for dioxins, furans and other air pollutants, in accordance with conditions attached to its EPA licence. Orica is also required to undertake regular monitoring of air emissions to ensure compliance with these limits and demonstrate efficient combustion conditions leading to maximum destruction of contaminants is maintained at all times. The regular monitoring of air emissions will also ensure that the conditions conducive to dioxin and furan formation are minimised at all times.

DEC is, therefore, satisfied that Orica has addressed the requirements of the Stockholm Convention in the design, installation, operation and maintenance of the groundwater treatment system. Consistent with the convention, this will ensure the formation of POPs is prevented or avoided (particularly dioxins and furans) to the greatest extent possible, meeting applicable international standards and guidelines.

Independent assessments of the project were undertaken by John Court & Associates Pty Ltd and the United States Environmental Protection Agency on behalf of DEC. Both supported the project in terms of the appropriateness of the technology selected. The Department of Environment and Heritage (Commonwealth) has also assessed the project and advised that the proposed technology is consistent with the requirements of the Stockholm Convention.

This determination concludes that Orica's preferred strategy for the collection and treatment of the contaminated groundwater is consistent with accepted best practice and satisfies best international air emission standards. It also maximises the quantity of extracted water that can be recycled for industrial use significantly reducing the demand on potable supplies.

The project is also consistent with the aims and objectives of the NSW State Groundwater Policy and Healthy Rivers Commission Report for the Georges River–Botany Bay System and associated *Statement of Joint Intent*. Fundamentally, the project will allow Orica to comply with the Notice of Clean Up Action issued by the EPA to stop the contamination impacting on Botany Bay and protect the community.

This joint determination report has been prepared by the determining authorities in relation to each of their relevant instruments of approval. It provides the basis for:

- DEC granting a variation to the existing EPA environment protection licence held by Orica
- a permit from NSW Maritime under the *Rivers and Foreshores Improvement Act 1948* for works associated with the construction of the discharge point at Bunnerong Canal
- a water extraction licence from DIPNR
- a variation to the trade waste permit from Sydney Water Corporation
- permission from Sydney Ports Corporation for discharge to Bunnerong Canal.

For Orica to satisfy the requirements of the above legal notice and allow for construction and commissioning of the necessary works, it is seeking a variation to the EPA Environment Protection licence to allow the project to commence in February 2005.

The report concludes that the environmental impacts associated with the project can be mitigated by conditions on the design, construction, operation and maintenance of the project. Accordingly, DEC, the Department of Infrastructure, Planning and Natural Resources, Sydney Ports Corporation, Sydney Water Corporation and NSW Maritime have decided to grant approvals for the project, subject to the relevant conditions.

CONTENTS

1. Introduction

This section introduces the proposed strategy for remediating groundwater contamination as outlined in the Environmental Impact Statement submitted by Orica Australia Pty Ltd to the determining authorities. This section also outlines the key statutory approval requirements, previous regulatory action by the EPA and the assessment process.

On 24 September 2003 the EPA became part of the Department of Environment and Conservation (DEC). However, certain statutory functions and powers, including those in the Protection of the Environment Operations Act 1997*, continue to be exercised in the name of the EPA.*

1.1 Location

The Botany Groundwater Cleanup project incorporates a number of activities on and in the vicinity of Botany Industrial Park. The project area is located on lands largely enclosed within the boundary of the Department of Infrastructure, Planning and Natural Resources (DIPNR) Groundwater Extraction Exclusion Area as shown in Appendix C.

The Botany Industrial Park is located within the Botany/Randwick industrial area to the north-east of Botany Bay, east of Sydney airport and approximately 12 kilometres south of the Sydney Central Business District. Blocks of land owned by Orica, known as Southlands, are located just to the south-west of BIP. The proposed location of the groundwater treatment plant is located within BIP and is owned by Orica.

Land uses in and around the project area largely comprise:

- mixed industrial land uses (including major chemical and food manufacturing sites)
- residential areas of Hillsdale, Matraville, Maroubra, Botany and Eastgardens (including schools and other services) to the north, east and west
- various commercial areas, recreation areas (including parks and golf courses), special uses (including Port Botany to the south) and areas of environmental protection (including Botany Bay and Penrhyn Estuary to the south-west).

The site is located in an area of former sand dunes and coastal swamps within the Botany Basin but has an extensive history of land filling and reclamation. The Botany Sands Aquifer underlies the site.

1.2 Nature of the proposal

Orica submitted an environmental impact statement to DEC entitled *Botany Groundwater Cleanup project*. As a result of historical manufacturing activities at Botany Industrial Park (BIP) (former ICI site) there is a legacy of groundwater contamination in the Botany Sands Aquifer by chlorinated hydrocarbons. The objectives of the project are to meet the requirements of an EPA Notice of Clean Up Action issued by DEC and to stop the movement of contaminated groundwater in and around BIP and collect it for treatment.

The key elements of the project include:

- extraction of groundwater from the wells in three containment lines
- transfer of the groundwater via pipelines to the groundwater treatment plant (GTP)
- construction and operation of the GTP
- transfer of treated water via pipelines for reuse by process plants in the BIP (or other identified users) or discharge to Bunnerong Canal
- installation of a discharge point into Bunnerong Canal.

Orica considers that the implementation of the project will achieve the above objectives and protect the waters of Botany Bay and Penrhyn Estuary. The capital cost of the project is expected to be approximately $102 million for all elements, including the installation of extraction wells, transfer pipelines and treatment plant.

1.3 Background

Extensive environmental investigations and groundwater monitoring undertaken by Orica since the 1980s have revealed an extensive and complex distribution of volatile chlorinated hydrocarbon (CHC) contamination derived from multiple source areas in and around BIP. These source areas are small underground pools of concentrated contaminants referred to as dense non-aqueous phase liquid (DNAPL). As the groundwater flows past these pools it becomes contaminated. The source areas relate to former manufacturing sites and waste disposal areas on parts of the BIP. The principal contaminants are carbon tetrachloride (CTC), tetrachloroethene (PCE), trichloroethene (TCE) and 1,2 dichloroethane (EDC) and a product from the breakdown of these contaminants, vinyl chloride (VC).

These source areas have led to the creation of multiple overlapping plumes moving generally in a south-west direction towards Penrhyn Estuary and Botany Bay:

- The southern plume consists of up to three separate plumes, based on analysis of its composition. The contamination is derived mainly from the former solvents plant and former TCE plant and contamination consists of CTC, PCE and TCE with small amounts of EDC and VC. The front edge of the southern plume has already reached Penrhyn Estuary, resulting in low contaminants concentrations discharging to the estuary.
- The central plume consists of a single plume made up of predominantly EDC and is believed to have originated from the former vinyls manufacturing plant and EDC storage tanks.
- The northern plumes consist of up to five separate dissolved phase plumes and most of the plumes are thought to have derived from the storage of CHC waste in open-air, unpaved drum storage areas. These plumes contain predominantly CTC, PCE and EDC.

In February 2000 the EPA agreed to a Voluntary Investigation and Remediation proposal from Orica under the *Contaminated Land Management Act 1997* to formalise the existing ongoing monitoring, investigation, remediation assessment and communication activities.

As a result of high concentrations of CHCs found to be present in an off-site production bore, together with concerns regarding the movement of the high-concentration central plume and the potential for discharge of contaminants into Botany Bay, DEC issued a Notice of Clean Up Action (NCUA) under section 91 of the *Protection of the Environment Operations Act 1997* on 26 September 2003. This notice sets a strict framework and timescale for action to stop the movement of the contaminated groundwater and collect it for treatment to ensure adverse impacts to the environment do not occur.

The NCUA required the preparation and implementation of a groundwater clean up plan (GCP). Orica prepared a GCP which detailed activities and actions for containment in the short term and remediation in the longer term to achieve the timeframes defined by the NCUA. DEC issued a variation to the NCUA on 17 February 2004 requiring the implementation of the GCP.

One of the initial short-term measures presented in the GCP for hydraulic containment of the contaminants in the groundwater was the recommissioning of the steam stripping unit (SSU) on the BIP to process extracted groundwater and recover the waste CHC concentrate (principally EDC) for subsequent treatment/disposal. The SSU was recommissioned in October 2004 and this short-term measure is currently being implemented. The recovered waste CHC is transferred to Terminals Pty Ltd's existing bulk liquid storage facility at Port Botany via the existing primary and secondary pipelines. Once the GTP is commissioned, the SSU will cease operation. The recovered waste EDC liquid will be transferred to the

GTP for treatment and destruction. According to Orica's modelling, this action is reducing the amount of contamination reaching Penrhyn Estuary, however this will not reduce the areas of high contamination closer to the Botany Industrial Park, which also need to be remediated.

The EIS states that if the GTP is not able to extract groundwater at the rates required (up to 15 million litres per day) to contain the plumes and provide treatment of this volume of groundwater, it will result in the waters of Penrhyn Estuary and Botany Bay becoming increasingly polluted from contaminants in this groundwater. It further states that the project is required to ensure that adverse impacts do not occur and the environment and human health is protected.

1.4 Statutory Provisions and assessment process

1.4.1 State Environmental Planning Policy 55 — Remediation of Land

State Environmental Planning Policy 55 (SEPP 55) establishes 'best practice' for managing land contamination through the planning and development control process. The objectives of this policy are primarily implemented by planning authorities, particularly local councils.

Under SEPP 55, planning authorities are required to consider, at the development approval and rezoning stage, the potential for contamination to adversely affect the suitability of a site for its proposed use. If the land is unsuitable for the proposed use, remediation must take place before the land is developed.
The policy allows clean-up of contaminated sites by:

- making remediation permissible across the state
- defining when consent is required
- requiring all remediation to comply with standards
- ensuring land that is going through the development consent process is investigated if contamination is suspected (for example, if the site history suggests potentially contaminating land use has occurred in the past)
- requiring councils be notified of all remediation proposals.

SEPP 55 specifies (under Clause 21(2) (a)) that any development or activity carried out for the purpose of complying with a clean up notice may be carried out without development consent.

1.4.2 Environmental Planning and Assessment Act 1979

The proposed activity is permissible without development consent and subject to environmental impact assessment under Part 5 of the *Environmental Planning and Assessment Act* 1979 (EP&A Act), through the provisions of *State Environmental Planning Policy No. 55 – Remediation of Land* (see below). Orica has identified that the following approvals and determining authorities are relevant to the proposed activity:

- a licence from the Environment Protection Authority under the *Protection of the Environment Operations Act* 1997;
- a licence from the Minister for Natural Resources under the *Water Act 1912* and subsequent *Water Management Act* 2000;
- a permit from the Minister for Primary Industries under the *Fisheries Management Act* 1994;
- a permit from the NSW Maritime under the *Rivers and Foreshores Improvement Act* 1948;
- Trade Waste approval from the Sydney Water Corporation under the *Sydney Water Act* 1994; and
- approval to use land owned by the Sydney Ports Corporation.

On 22 November 2004, the Minister for Infrastructure and Planning issued an Order under section 110A of the EP&A Act making the Environment Protection Authority the nominated determining authority for the proposed activity. Notice of this Order was published in the *Sydney Morning Herald* on Friday 3 December 2004.

DEC, through the authority of the EPA and in consultation with the other determining authorities for the proposed activity, formed the view that the activity is likely to significantly affect the environment. As a consequence, an EIS was required for the activity, in accordance with section 112(1) of the EP&A Act. The delegate for the Director General of the Department of Infrastructure, Planning and Natural Resources (DIPNR) issued requirements for the preparation of the EIS on 23 July 2004, and updated those requirements on 1 November 2004. The EIS requirements were prepared in consultation with the determining authorities for the activity, relevant government agencies and the City of Botany Bay Council. DIPNR has reviewed the EIS and considers that it has been prepared substantially in accordance with the Director General's requirements.

In accordance with section 113 of the EP&A Act, the DEC as nominated determining authority caused the proposed activity and accompanying EIS to be publicly exhibited and notified. The EIS was publicly exhibited from Tuesday 16 November 2004 until Friday 17 December 2004 (31 days), with public notifications being made through the *Sydney Morning Herald* and local newspapers. A total of 19 submissions were received in response to the exhibition of the EIS. Issues raised in submissions are considered in more detail in later sections of this report, and were the subject of a Representations Report prepared by Orica.

1.4.3 Contaminated Land Management Act 1997

The EPA has determined that elevated concentrations of contaminants in groundwater in and around BIP are present in such a way as to present a significant risk of harm (SRoH) in accordance with section 9 of the *Contaminated Land Management Act 1997* (CLM Act). Subsequently the EPA agreed to a series of Voluntary Investigation and Remediation proposals from Orica between 2000 and 2004 to address the contamination.

In conjunction with requiring works through the NCUA and environment protection licence, the EPA proposes to declare approximately 200 hectares of land affected by the contamination as a remediation site under section 21 of the CLM Act. A declaration serves to 'tag' contamination as presenting a SRoH. A copy of the declaration is included in the CLM Act public register and its presence noted on planning certificates under the EPA&A Act (s149(2)).

Copies of the proposed declaration have been sent to all affected land owners and other key stakeholders. Once the declaration is made, it will be published in the *NSW Government Gazette* and advertised in the *Sydney Morning Herald* and *Southern Courier* giving all interested parties the opportunity to make submissions to DEC on matters concerning the 'remediation site', including whether or not an order should be issued or a Voluntary Remediation Agreement be entered into.

Only when DEC is satisfied that the SRoH caused by the contamination has been addressed, can the declaration be removed.

1.4.4 Protection of the Environment Operations Act 1997

The project is required as a result of a Notice of Clean Up Action issued by the EPA, under section 91 of the *Protection of the Environment Operations Act 1997*. The key elements of the notice require Orica to;

- prepare a groundwater clean-up plan for approval by the EPA by 31 October 2003
- implement the approved plan
- contain and reduce the levels of contaminants to the maximum extent practicable by 31 October 2005. This must include the use of *ex situ* treatment technology.

Orica Australia Pty Ltd currently holds an EPA environment protection licence (no. 2148) under the Protection of the Environment Operations Act.

Schedule 1 of the Act requires that Orica holds this licence for a number of existing scheduled activities:

- chemical storage facilities
- waste activities
- chemical industries or works
- waste facilities (Hazardous, Industrial, Group A or Group B wastes processing).

It is an offence against Section 120 of the Act if a person carries out an activity which pollutes waters other than in accordance with the conditions of an existing environment protection licence.

The groundwater treatment plant is a key component of the project to meet the requirements of the NCUA. It constitutes a scheduled activity within the meaning of the 'waste facility' category in schedule 1 of the Act. There is no requirement to vary the quantity or types of waste identified for processing in the existing licence. However, the project will require the installation of a new water discharge point into Bunnerong Canal and this will trigger the need for Orica to submit an application to vary the licence to permit the discharge, subject to conditions issued by the EPA.

Section 45 of the Protection of the Environment Operations Act requires the EPA to take a number of relevant issues into consideration when exercising licensing functions. The EPA must consider, among other things, the pollution caused or likely to be caused by the carrying out of the activity concerned, the impact of this pollution on the environment, and any practical measures that could be taken to prevent, control or mitigate this impact.

Other relevant considerations for the EPA are any documents that accompany the application to vary the licence, in this case the environmental impact statement as well as public submissions.

1.4.5 Rivers and Foreshores Improvement Act 1948

A permit under Part 3A of the *Rivers and Foreshores Improvement Act 1948* is required for works in or within 40 metres of a waterway. Orica will be required to obtain a Part 3A permit prior to the commencement of any works associated with the construction of the discharge from the outlet of the Groundwater Treatment Plant to Bunnerong Canal. Since Bunnerong Canal is owned by Sydney Ports Corporation, permission from Sydney Ports Corporation must also be obtained prior to issuing the Part 3A permit. Responsibility for issuing the permit will rest with NSW Maritime.

1.4.6 Sydney Water Act 1994

Orica must comply with the requirements of the *Sydney Water Act 1994*. This includes obtaining a Section 73 Compliance Certificate. In seeking the Compliance Certificate, Orica must supply to Sydney Water all information necessary for Sydney Water to assess the impacts from the proposal on Sydney Water assets and operations. Orica must comply with the requirements of Sydney Water issued as a Notice of Requirements, under Section 74 of the Act, prior to the Completion Certificate being issued. Such requirements may include, for example, relocation of existing sewer lines, payment of developer charges and adjustments to the trade waste agreement.

1.4.7 Water Act 1912 and Water Management Act 2000

The rights to control, manage and use groundwater in NSW is regulated under the *Water Act 1912*, and subsequently the *Water Management Act 2000.* The extraction of groundwater is regulated through a licensing system administered by DIPNR. A licence is required by Orica from DIPNR under Part V (Section 116) of the Water Act to authorise the extraction of groundwater for containment of contamination and groundwater remediation purposes.

The Water Management Act was passed in December 2000 and, apart from the licensing provisions, supersedes the Water Act. The principal objective of the Water Management Act is to provide for the sustainable and integrated management of the state's waters for the benefit of both present and future generations.

The Water Management Act introduces measures that:

1. provide for improved environmental health of the State's waters through equitable sharing provisions, which require water to be provided for the environment as the highest priority. The Act also allows for the regulation of activities that threaten waters and their dependent ecosystems
2. provide for shared government and community responsibility for water management, through the establishment of a comprehensive community-based planning framework
3. provide greater economic benefits for individuals and communities by clarifying and strengthening access rights, establishing water markets and introducing improved compliance tools.

Once a Water Management Plan is developed for the Botany Sand Beds groundwater source (See Section 4), the licensing provisions in the Water Management Act will be activated. This will allow licences currently issued under the Water Act to be made compliant with the provisions of the Water Management Act.

1.5 Preparation and exhibition of the EIS

1.5.1 Director General's requirements

Orica wrote to the Director General of the Department of Infrastructure Planning and Natural Resources seeking advice on requirements for the form and content of an environmental impact statement for the proposal. The Director General's requirements were issued to Orica in a letter dated 23 July 2004. Orica prepared an environmental impact statement for the project which addresses these requirements.

Orica undertook extensive consultation with relevant government agencies and the community during the environmental impact assessment development process. This included planning focus meetings and workshops.

1.5.2 Exhibition of the environmental impact statement

The Minister for Infrastructure and Planning appointed DEC as the nominated determining authority for the project. In accordance with this role, DEC advertised and placed the EIS on exhibition, received public submissions and ensured compliance with other requirements under the environmental planning legislation.

The environmental impact statement was exhibited from 16 November to 17 December 2004 inclusive. The environmental impact statement includes a certificate stating that it was prepared in accordance with clauses 230 and 231 of the Environmental Planning and Assessment Regulation 2000. The company that prepared the environmental impact statement was URS Australia Pty Ltd.

Advertisements identifying public display locations and times were published in the *Sydney Morning Herald* and in local newspapers. The advertisements also indicated that copies of the environmental impact statement were available for purchase and that the EPA would receive submissions up to the close of exhibition.

DEC forwarded copies of all representations to the Department of Infrastructure, Planning and Natural Resources and determining authorities on 22 December 2004.

Orica also provided reports to the determining authorities dated 24 December 2004 and 5 January 2005 addressing the issues raised in the representations from the public exhibition of the EIS. These reports may be obtained from Orica.

1.6 Purpose of the Determining Authority Report

Under the EP&A Act and Regulation, each determining authority must prepare a determination report. The report (under clause 243 of the EP&A Regulation) must give full particulars of the decision on the proposal and, if approval is granted, any conditions imposed.

The purpose of this Determining Authority Report is to consider:

- the environmental impact statement that set out Orica's measures to stop the movement of contaminated groundwater and remove the groundwater for treatment
- the issues raised in representations made in response to the exhibition of the environmental impact statements
- the effects of the proposed activity on the environment
- the proponent's proposals to mitigate any adverse effects of the activity on the environment.

It also provides the determining authorities' determination relating to the activity and any conditions or modifications imposed or required by the authorities in connection with the carrying out of the activity.

This joint determination report has been prepared in accordance with this requirement by the determining authorities relating to each of their relevant instruments of approval. It provides the basis for:

- DEC granting a variation to the existing EPA environment protection licence for the project
- a permit from NSW Maritime under the *Rivers and Foreshores Improvement Act 1948* for works associated with the construction of the discharge point at Bunnerong Canal for the project
- a water extraction licence from DIPNR
- defining and responding to Sydney Water's Section 73 requirements, such as a variation to the trade waste permit; and
- permission from Sydney Ports Corporation for the discharge of treated groundwater to Bunnerong Canal.

It also includes advice from NSW WorkCover, NSW Health and Department of Primary Industries.

For Orica to satisfy the requirements of the above legal notice and allow for construction and commissioning of the necessary works, it is seeking a variation to the EPA Environment Protection licence to allow the project to commence in February 2005.

2 Development Proposal

This section describes Orica's proposed strategy as outlined in the environmental impact statement.

2.1 Description of proposal

2.1.1 The EIS proposal

Orica proposed a strategy to prevent and minimise the environmental impact of contaminated groundwater in and around Botany Industrial Park. Orica's strategy has five key components:

- extraction of groundwater from the wells in three containment lines
- transfer of the groundwater via pipelines to the groundwater treatment plant
- construction and operation of the GTP
- transfer of treated water via pipelines for reuse by process plants in the Botany Industrial Park (or other identified users) or discharge to Bunnerong Canal
- Installation of a discharge point into Bunnerong Canal.

Orica has stated that treatment of contaminated groundwater is expected to cease after approximately 30 years.

Extraction of groundwater from the wells in three containment lines

The EIS describes the extensive network of groundwater wells that has been or will be installed by Orica within the Botany Sands Aquifer to extract contaminated groundwater. These form three hydraulic containment lines: along Foreshore Road, on Southlands and on BIP.

The EIS characterises the composition of the contaminated groundwater. Contaminants in the groundwater include chlorinated hydrocarbons, for example 1,2 dichloroethane (also known as EDC) and carbon tetrachloride). No dioxins are present in the groundwater.

Transfer the groundwater via pipelines to the groundwater treatment plant

The contaminated groundwater will be pumped out of the extraction wells and transferred to the groundwater treatment plant via dedicated transfer pipelines, at a maximum rate of 15 million litres per day. Three main pipelines are in existence or will be constructed, one for each of the containment lines.

Construction and operation of the GTP

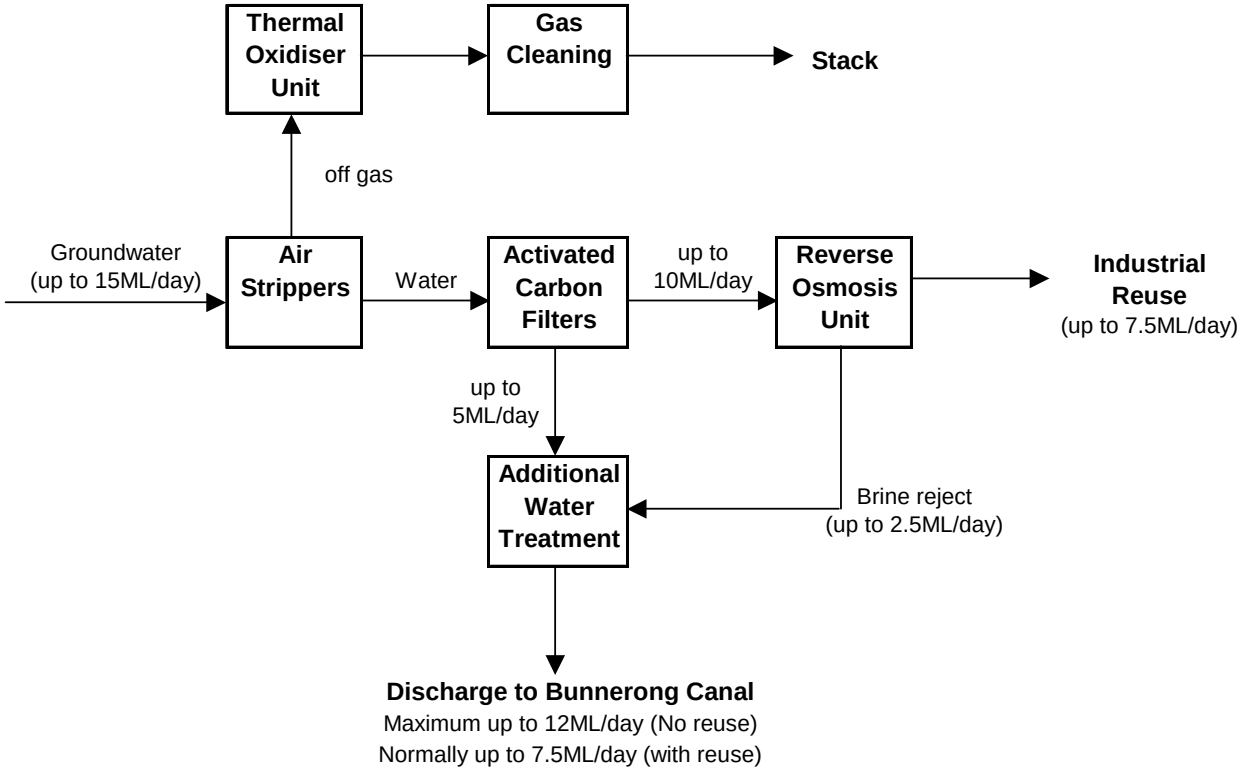
The extracted groundwater will be combined into a single stream and fed to the groundwater treatment plant on Orica-owned land on the Botany Industrial Park. The GTP is designed for continuous operation, treating up to 15 million litres of groundwater per day, 24 hours a day, seven days a week, with a 95% availability for a period of up to 30 years. The EIS describes the proposed GTP and it is outlined in the figure below. It will comprise the following steps:

- **Groundwater feed handling**. Groundwater from the containment areas (up to 15 million litres per day) is collected and combined in a feed tank prior to treatment. The pH is then adjusted with acid to prevent the precipitation of iron and biofouling.
- **Air stripping**. Volatile organic compounds are removed by blowing air through the groundwater and transferring them into the air stream (the off-gas stream).
- **Off-gas treatment (thermal oxidation).** Off-gases then move to a thermal oxidiser unit fuelled by natural gas for a sufficient time to enable the destruction of organic compounds to carbon dioxide, water and hydrogen chloride. Condensate collected from the existing steam stripping unit (around 500 tonnes)

as part of the interim containment measures will also be fed into the unit for destruction in a controlled manner.

- **Off-gas treatment (quench).** Following thermal oxidation and heat recovery the treated off-gas temperature is reduced very rapidly from about 500 °C to 100 °C by spraying weak acid through the gas stream. The rapid quench minimises the potential for the formation of dioxin.
- **Off-gas treatment (gas scrubbing).** Off-gas is further treated in an acid absorber recovery system and caustic scrubber to remove traces of hydrogen chloride and chlorine. The treated off-gases are then discharged to the atmosphere via a single 20-metre-high stack.
- **Stripped water treatment (iron removal).** From the air stripper, the groundwater is treated to remove iron.
- **Stripped water treatment (removal of non-volatile organics, such as phenol)**. The groundwater is passed through activated carbon to remove any organic compounds.
- **Stripped water treatment (reverse osmosis ie dissolved solids removal**). The stripped groundwater that it to be reused is treated by reverse osmosis unit to remove dissolved solids.
- **Treated water reuse and discharge**. The treated water from the reverse osmosis unit (up to 7.5 million litres per day) will be for industrial reuse. The remaining stripped water that does not pass through the reverse osmosis unit (up to 5 million litres per day) will be combined with wastewater from the reverse osmosis unit, commonly known as 'brine' (up to 2.5 million litres per day) and treated in a biological reactor with further polishing to remove ammonia, prior to discharge to the environment.

Groundwater Treatment Plant



Transfer of treated water via pipelines for reuse by process plants in the Botany Industrial Park

Orica has entered into agreements with other industries in the Botany Industrial Park for reuse of the treated groundwater. Orica has stated that it will provide sufficient reverse osmosis capacity and treated water distribution network for up to 10 million litres per day. Orica will also seek to identify other potential users of this water on an ongoing basis.

Installation of a discharge point into Bunnerong Canal.

Treated water that is not recycled will transferred by an existing pipeline and discharged into Bunnerong Canal. Up to 12 million litres per day (equivalent to 0.14 m^3 per second) will be discharged and approval is being sought for this amount from the determining authorities. This amount is based on the maximum hydraulic capacity of this pipeline. This canal flows to Brotherson Dock and Botany Bay. The objective however is to maximise the reuse of this high quality water (initially up to 7.5 million litres per day) and minimise discharge to waters.

2.1.2 Possible modifications to the proposal

Subsequent to the EIS exhibition and public representations Orica suggested some modifications to the proposal. These amendments were submitted in a report dated 27 January 2005. These suggestions mostly reflect the results of detailed design and consideration of representations. The proposed key changes are as follows and have also been considered by the authorities in this determination report for the project.

Replacement of biological treatment unit with second reverse osmosis unit

Orica proposes to remove the biological treatment unit and final ammonia unit from the circuit and install a second reverse osmosis (RO) unit. This will generate up to 13.5 million litres of treated water. Orica states that this will increase the robustness, reliability and effectiveness of the groundwater treatment system. It will avoid the need for solid waste management (generated by the biological treatment unit). It will also enhance opportunities to reuse wastewater and utilise the sewerage system to dispose of wastewater under trade waste agreements (see below).

Salty water discharge to sewer, not Bunnerong canal

Brine from the reverse osmosis units was to be discharged to Bunnerong Canal. Orica now propose to discharge the ‘brine’ from the reverse osmosis units (approximately 1.5 million litres per day) to sewer under an amended trade waste agreement with Sydney Water. This will reduce the quantity of treated water that will be required to be discharged to waters. It will also result in less salt being discharged to waters.

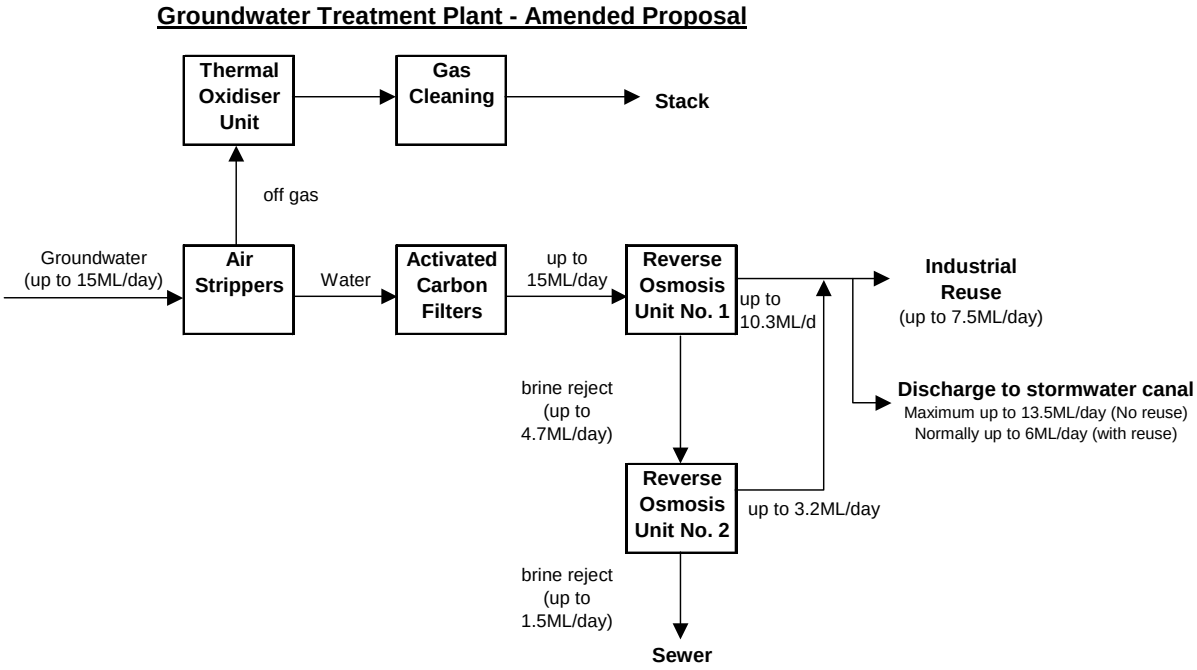
Excess water to stormwater channel, not directly into Bunnerong Canal

Orica proposes to modify the project to transport excess treated water via an existing disused pipe which feeds into the Amcor freshwater ponds (known as Long Dam) for reuse. Any excess water not reused will be discharged to the Sydney Water Bunnerong Channel. The channel continues to Brotherson Dock (and Botany Bay). Orica states that this will eliminate the need for any direct discharge to Bunnerong Canal.

Increase groundwater treatment plant stack height from 20 metres to 34 metres

Orica proposes to increase the height of the GTP stack from 20 metres (as described in the EIS) to 34 metres. There will be no additional or increased emissions from the stack. It will result in a significant reduction in ground-level concentrations. In addition Orica will introduce plume suppression. Under certain weather conditions the water vapour in the plume was predicted to create a visible plume. Plume suppression will involve slightly cooling the caustic scrubber and heating the discharge steam using recovered energy from the thermal oxidation unit. This will require no additional energy or production of greenhouse gases.

The proposed treatment process is summarised in the following diagram.



2.2 Project timing and cost

Orica has stated that construction of the project will take an estimated nine months. A target completion date of August 2005 for the construction of the groundwater treatment plant has been indicated by Orica as necessary to enable it to be commissioned and operational by 31 October 2005, to meet the requirements of the EPA notice. Within this timeframe, all other works including pipelines and groundwater wells will be constructed, commissioned and operational.

The EIS states the capital cost of the project is expected to be approximately $102 million for all elements including the installation of extraction wells, transfer pipelines and treatment plant.

2.3 Need, benefit, project justification and consequences of not proceeding

2.3.1 Proposal objectives

The environmental impact statement states that the primary objective of the project is to stop further migration of contaminated groundwater and collect it for treatment to ensure the protection of the ecological, recreational and aesthetic values of both the terrestrial and aquatic environments of Botany Bay and Penrhyn Estuary.

2.3.2 Justification of the proposal

The environmental impact statement justifies Orica's preferred strategy by outlining the outcomes that would be achieved by implementing the strategy. These are:

- achieve the required level of groundwater containment in both the Primary Containment Area and the Secondary Containment Area and prevent the discharge of contaminants at levels greater than ANZECC (2000) trigger levels into Penrhyn Estuary and Botany Bay

- achieve a reduction by 31 October 2005 in the concentration of contaminants in the groundwater at the Primary Containment Area to the maximum extent practicable, with a target of an 80% reduction in levels, as set out in the Orica 2002 Annual Report to the EPA
- clean up the contaminated plumes (by removal and treatment of the contaminants) by
    - preventing further contaminant migration through containment lines, allowing gradual clean up of up gradient areas
    - assisting DNAPL removal projects by containing potentially increased concentrations of mobilised contaminants.
- minimise air emissions and generation of waste according to best-practice design standards
- undertake monitoring to assess the effectiveness of the hydraulic containment.

2.3.3 Consequences of not proceeding

The existing steam stripping unit can process up to 2 million litres of contaminated groundwater per day. DEC has indicated to Orica that use of the SSU beyond 31 October 2005 would necessitate an upgrade to best practice with respect to air emissions. This is a requirement of the current licence. According to Orica's modelling, this action is reducing the amount of contamination reaching Penrhyn Estuary, however it will not reduce the areas of high contamination closer to the Botany Industrial Park, which also need to be remediated.

The environmental impact statement identifies the consequence of not proceeding with Orica's preferred strategy. Orica would not be able to extract groundwater at the rates required (up to 15 million litres per day) to contain the plumes and treat the groundwater to remove the contamination. As a result the identified chlorinated contaminants in the groundwater plumes would be expected to discharge into Penrhyn Estuary and Botany Bay at increasing concentrations.

The EIS states that such discharges would be likely to result in a number of unacceptable outcomes including:

- impacts on the terrestrial and marine flora and fauna in the Foreshore Beach and Penrhyn Estuary ecosystems, including migratory shorebirds identified for protection by Commonwealth legislation and international treaties
- increased risk to human health for recreational users of the foreshore and within Botany Bay
- diminished quality of life for residents and workers in the area
- failure to achieve the requirements of the EPA clean up notice and associated Groundwater Clean Up Plan through failure to contain and treat the contaminated groundwater as stated in the notice.

The EIS states that if no action is taken to contain, recover and treat the contaminants in the groundwater they will increasingly pollute Penrhyn Estuary and possibly Botany Bay. Orica states that, based on most recent monitoring, it estimates that higher concentrations of contaminants could reach the upper extent of Penrhyn Estuary in the first half of 2006. These higher levels would be likely to kill or injure marine life as well as affect the protected migratory shorebirds either directly or indirectly, for example due to a lack of food. It is also possible these high levels would present potential risks to the recreational users in that area and also potentially workers. Orica concludes that the project is urgently needed to stop this happening.

2.3.4 Alternatives considered

The notice mandates the use of 'pump and treat' technology (ie *ex situ* treatment) to treat groundwater contamination within the primary containment area and form the basis for this project. Consequently in situ processes, for example bioremediation, were not considered as part of the project. Orica is however currently trialling in situ methods to reduce groundwater contamination in other areas of the Botany Industrial Park and its Southlands site, including active and passive bioremediation and the use of reactive iron barriers.

The environmental impact statement includes a review of available treatment options, locations and emission requirements taking into account the project objectives and the requirements of the EPA Notice of Clean Up Action. An independent assessment of available groundwater treatment technologies was also undertaken by consultants engaged by Orica and included in the EIS. A summary of the treatment options considered by Orica in the EIS is provided below. These options were based on two main approaches: (1) treating the contaminants in the groundwater or (2) removing the contaminants from the water and then destroying them.

Summary of treatment technologies considered by Orica (from EIS)

Approach 1	Technique	Description	Comments
Treat Contaminants in water	Biological treatment	Similar to sewage treatment plant but using mixed culture of microbes. Variety of methods considered.	Concerns over robustness of system to handle contaminants and long lead time in developing microbe cultures. Residual biosolids (contaminated) need disposal.
	Advanced oxidation	UV light, ozone or hydrogen peroxide used to destroy contaminants.	Can suffer from fouling.
	Activated carbon	Pass water through activated carbon.	Proven technology, but requires large volumes of carbon and that carbon would still require contaminant destruction.

Approach 2	Technique	Description	Comments
Remove contaminants from groundwater …	Air stripping	Contaminants removed by blowing air stream through it.	Robust and well-developed technology. Once in off-gas, the contaminants cannot be further collected and are destroyed as a dilute mixture in air, usually by thermal oxidation (see below).
	Steam stripping	Contaminants removed by blowing low pressure steam blown through it. Steam is condensed and contaminants separate from water as a condensate.	Currently used by Orica (up to 2 ML/day) Condensate must still be destroyed. Wide range of destruction techniques available (see below).
… then destroy removed contaminants.	Gas phase chemical reduction	Treat waste using high pressure and temperature with hydrogen gas. Does not form dioxins etc due to reducing atmosphere.	Significant safety hazards (inherent safety is low in engineering classification schemes due to the danger posed by high temperature hydrogen atmosphere), poor reliability and online availability, currently no operational facilities world wide. Not achievable in required timeframe.
	Base catalysed decomposition	Treat in a reactor using high temperature, caustic soda and oil.	Not suited to destruction of EDC, a principal contaminant. Inherent safety concerns, generates significant volumes of wastes for subsequent disposal.
	Plasma arc	Pass through a high temperature plasma arc in an inert atmosphere.	Commercially available, limited throughput capacity requiring multiple units and regular operator attention. Limited reliability. High electricity consumption.
	Gas phase thermal oxidation	Use high temperature and oxygen. Can form dioxins etc but can be minimised with design.	Well proven technology and Orica's preferred option.

	Other processes	Included super critical water, molten salt oxidation and molten metal oxidation	Experimental, not proven or commercially available.

The EIS concludes that Orica's preferred strategy for the collection and treatment of the contaminated groundwater is air stripping followed by thermal oxidation.

2.3.5 Contingency measures

The EIS describes the measures that would be adopted by Orica if the groundwater treatment plant could not be operated in a proper and efficient manner and failed to meet statutory requirements. The plant, including the thermal oxidation unit, would be shutdown and groundwater treatment would cease. The system is designed to incorporate a contingency shutdown of around two weeks per year to enable maintenance and repairs. The EIS states that this length of shutdown will not adversely affect the hydraulic containment of the contaminant plumes, due to the hydraulic gradient of the groundwater and the length of time required for it to re-equilibrate after pumping.

Orica will maintain the steam stripping unit in standby mode, for recommissioning in a controlled and timely manner in the event of a long term shutdown (for example, catastrophic failure of key equipment). This unit would be used to provide ongoing containment of the highest concentration contaminated groundwater and protection of receiving environments while GTP operational issues are rectified.

3 Summary of representations

3.1 Summary of representations received

A total of 19 representations were received from the exhibition of the environmental impact statement. The category types of representations are summarised below.

Type	Number
NSW Government departments	5
Members of Parliament	1
Local council	2
Non-government organisations	7
Individuals	4
TOTAL	**19**

3.2 Overview of key issues raised in representations

3.2.1 Introduction

The general range of issues raised in representations and addressed in this report is summarised below. A more detailed summary is provided at Appendix A.

As an overall observation, representations supported the need to take action to stem the movement of the contaminated groundwater towards Botany Bay. However, a number of the representations did not support the proposal for treatment of the contaminated groundwater: issues were raised in relation to the consideration of alternatives (including storage until more appropriate treatment techniques can be determined) and in relation to the health risk potential of the proposed treatment process.

Other points raised relate to the legal position in view of Australia's ratification of the Stockholm Convention on Persistent Organic Pollutants (POPs), the need for a financial assurance (or bond), impacts of wastewater discharge and water quality impacts generally, the regulatory regime to be imposed in terms of on-going monitoring requirements, the brevity of the consultation process/lateness of regulatory clean up action, and energy use and greenhouse gas generation.

3.2.2 Overview of key issues

The issues raised most frequently in submissions related to the proposal to extract and thermally oxidise the groundwater contaminants and the assessment of potential alternative methodologies. Specifically, the key issues raised were:

- the location of an 'incinerator' for toxic chemicals in proximity to residences, schools and hospitals. A number of submissions addressed the nature of potential emissions from the proposed plant and dealt with the nature and impact of these potential emissions in considerable detail.
- the question of alternative treatment technologies and the consideration given to these alternative options in the EIS and throughout the consultation process. Several submissions raised the issue of

storage capacity on site and the ability to use this capacity to take a more considered approach to the treatment technology that might be applied. Consideration of alternatives to thermal oxidation, such as gas phase chemical reduction, were also raised in this context. The concept of establishing a waste precinct where all such wastes, including other wastes from the Orica Botany site, might be treated, was also raised in this context.

- the statutory/legal implications of the proposal. A number of the submissions raised this in the context of Australia's obligations under the Stockholm Convention on Persistent Organic Pollutants and the intent and spirit of that treaty.
- the air quality assessment and air emissions from the proposed treatment facility. In particular, submissions addressed the potential for emissions of dioxins and furans as a result of the treatment process. As noted above, this was often in the context of the proximity to local schools and residences. The issue of air quality monitoring in Banksmeadow school was also raised in this respect.
- the risk hazard analysis in the context of air emissions, but also in relation to treated water discharge. Several submissions asked what safeguards were in place to protect the community and environment in the event that the proposed treatment process failed. The particular vulnerability of children to toxic chemicals was raised in this context in several submissions. The DIPNR submission noted that a number of the assumptions on which the preliminary hazard analysis was based would need to be reviewed once the design of the facility had been finalised. Cumulative impacts and the issue of bioaccumulation were raised also in several submissions.
- The need for a bond or some form of surety to be provided by Orica (a $50 m bond was mentioned in several submissions).
- water quality and wastewater discharge was raised in a number of submissions in the context of the impact on fauna and flora and in particular, the impact on sensitive sea grass and salt marsh habitats in the locality. This was also raised in the context of the application of the *Threatened Species Conservation Act 1995* and the need to evaluate the impact.
- land use, future regulation and socio-economic considerations. These included the issue of long-term responsibility for continued compliance with the requirements of the clean up. Other submissions raised the issue of the disposal by Orica of parcels of land in order to pay for the clean up and that this should not be allowed. Another issue was the need for independent review, not self-monitoring by Orica.
- the impact of the restriction on the use of bores by residents in the affected area. This was generally raised in the context of Orica's proposal to sell treated wastewater to other industrial users. Submissions proposed Orica compensate affected residents in various ways, including by providing the treated water to the residents by way of replacement for the loss of the use of their bore, and by meeting the cost of installation of rainwater tanks.

3.3 Independent reviews and additional sources of advice

In making this determination, independent reviews of the project and advice on the technology selected were also sought by DEC. These organisations and their brief are summarised in the following table.

Organisation	**Brief**
United States Environmental Protection Agency	Independent peer review of Botany Groundwater Cleanup project
John Court & Associates Pty Ltd	Review of air emissions, air quality and the capability of the proposed plant to achieve the performance claimed.
Department of Environment and Heritage (Commonwealth)	Advice on alternate technologies and compliance with the Stockholm Convention on Persistent Organic Pollutants.

4 Strategic context and project justification

4.1 Strategic context

4.1.1 Environmental Planning and Assessment Act a related planning instruments

Under the *Environmental Planning and Assessment Act 1979* (EP&A Act), the following environmental planning instruments apply and are relevant to the proposed activity:

- *State Environmental Planning Policy No. 55 – Remediation of Land*
- *State Environmental Planning Policy No*. 33 – *Hazardous and Offensive Development*
- *Botany Local Environmental Plan 1995*
- *Randwick Local Environmental Plan 1998*.

State Environmental Planning Policy No. 55 – Remediation of Land (SEPP 55) is the key and overarching environmental planning instrument that applies to the proposed activity. The SEPP was amended and published in the Government Gazette on 31 July 2004, making specific provisions applicable to the proposed activity. In particular, clause 21 of SEPP 55 dictates that any works subject to a Notice under the Protection of the Environment Operations Act are permissible without development consent if the Notice is listed in Schedule 1 of the SEPP. In this case, the proposed activity is subject to such a Notice (No 1030236 dated 26 September 2003 and addressed to Orica Australia Pty Ltd) and therefore does not require development consent. The proposed activity does, however, still require assessment under Part 5 of the EP&A Act. It is also important to note that clause 19 of SEPP 55 provides that the SEPP prevails over local environmental plans *inter alia* to the extent of any inconsistency. Therefore, where the *Botany Local Environmental Plan 1995* would otherwise require development consent for aspects of the proposal, SEPP 55 prevails and provides that the proposal is permissible without development consent.

Clause 21 of SEPP 55 also calls up clauses 17(1)(a) and 17(1)(b), which require that the proposed remediation be carried out in accordance with the contaminated land planning guidelines and any guidelines in force under the *Contaminated Land Management Act 1997*. In this regard, the relevant guideline document is *Managing Land Contamination: Planning Guidelines: SEPP 55 – Remediation of Land* (DUAP & EPA, 1998). The proposed activity has been assessed against the relevant aspects of this guideline and determined to be consistent. Firstly, the land is known to be contaminated and the nature and extent of that contamination is generally well known from previous investigations over a number of decades. Where there is any doubt (for example, in the exact extent of some areas of free-phase contamination), it is possible to conservatively estimate the worst-case situation so as to ensure an appropriately conservative environmental planning outcome. Generally, the EIS and historical data for the land provide sufficient information for an informed merit assessment of the proposed activity. This assessment is detailed in this report, and focuses on the key question posed through the guidelines – whether the consequences of not carrying out the remediation outweigh the environmental impacts of carrying out the work.

As detailed in this report, it has been demonstrated that the proposed activity could be undertaken within acceptable environmental and public health standards, and that residual risks and environmental impacts can be reduced to as low as reasonably possible through the imposition of stringent conditions on relevant approvals, particularly the EPA licence. Furthermore, it can be concluded that the proposed activity has been assessed as having environmental, as well as human health and amenity impacts, which can be managed to meet or be more stringent than acceptable standards. In contrast, contaminated groundwater in its current state continues to pose an ecological risk, and a potential human health risk. Comparison of the risks, although not easily quantifiable, suggests that the controllable above-ground risks associated with the proposed remediation works outweigh the uncontrolled and on-going risks posed by not addressing the contamination. This balance is considered in more detail in other sections of this report, but it is apparent

that a clear outcome of SEPP 55 will be achieved through the proposed activity – the consequences of not remediating the contaminated groundwater outweigh the acceptable and manageable impacts attributable to the remediation works.

State Environmental Planning Policy No. 33 – Hazardous and Offensive Development (SEPP 33) is framed to apply to assessment of potentially hazardous and potentially offensive industry under Part 4 of the EP&A Act. SEPP 33 is therefore not directly relevant to assessment under Part 5, and there may even be some question as to whether the proposed activity could be characterised as 'industry' (noting the definition in the *Model Provisions 1980*). Notwithstanding, the principles of SEPP 33 have been applied to the proposal, with the activity established as 'potentially hazardous' as it would exert a significant off-site risk impact in the absence of all risk-mitigating measures. As would be required for assessment of a development application for potentially hazardous industry, a Preliminary Hazard Analysis (PHA) was prepared and included in the EIS for the activity. Through that PHA, Orica has demonstrated that land use planning risk could be reduced to within acceptable levels for surrounding land uses with the application of a suite of proposed risk-mitigating measures. As a consequence, the proposed activity would not be defined as 'hazardous' and, in the context of land use planning, the risk is considered acceptable. Consideration of hazards and risk issues is provided in more detail in Section 5 of this report.

The provisions of the *Botany Local Environmental Plan 1995* (Botany LEP) are largely inapplicable to the proposed activity, given that the majority of these provisions are generally phrased to apply to a consent authority's consideration of development applications under Part 4 of the EP&A Act. As the activity is subject to assessment under Part 5 of the EP&A Act, the determining authorities are not bound by the heads of consideration dictated for a consent authority. Nonetheless, it is apparent that the proposed activity would not be inconsistent with the objectives of the Botany LEP, being:

a) to recognise the importance of the local government area of Botany as a gateway to Sydney, given its proximity to Sydney (Kingsford-Smith) Airport and Port Botany
b) to ensure, as far as practicable, that land uses are compatible with each other in terms of environmental and aesthetic amenity
c) to make the local government area of Botany a more attractive and pleasant place in which to live, work and visit
d) to improve the image of the local government area of Botany by ensuring that developments are of a good standard of design, form and function
e) to protect areas from inappropriate development and to ensure that, in particular, residential amenity, health and safety is maintained or improved, where necessary
f) to provide for an appropriate balance and distribution of land for residential, commercial, retail, industrial, advanced technology enterprises, tourism, port-related and airport-related development and recreation, entertainment and community facilities.

The proposed activity would not in itself contribute directly to the achievement of the objectives of the Botany LEP, but would indirectly provide for the on-going viability of parts of the local government area for development and attainment of LEP objectives. In particular, objectives specified under b), c) and d) would be indirectly assisted by the proposed activity through removal of an existing, and expanding, threat to the local environment attributable to contaminated groundwater. In the short-term, the activity would restrict the expansion of groundwater contamination that would otherwise potentially detract from local amenity, the attractiveness of the area and the image of Botany. The longer-term result would be ultimate removal of the aspects of the existing groundwater contamination that detract from these outcomes. The objectives of the Botany LEP also provide for avoidance of potential land use conflicts, and in this regard, the proposed activity would have a positive indirect effect. Through removal of contaminant loads in groundwater, potential existing and future conflicts between contaminated groundwater and incompatible land uses would be removed, thereby permitting a more diverse (and less restricted) suite of possible land uses, consistent with the Botany LEP.

As noted above, it may not be strictly correct to characterise the proposed development as 'industry', particularly given the definition of industry in the *Model Provisions 1980* (which includes reference to a

manufacturing process and similar concepts). Notwithstanding, in terms of the nature and perception of the activity, common, everyday interpretations would suggest that the proposal constitutes industry (or industry-like works), rather than commercial, residential or other distinct land use categories. In this context, it is appropriate to consider the proposal against the Botany LEP objectives for industry, which are:

a) to restrict industrial uses to defined zoned areas
b) to encourage new developments with a high standard of design and form that are compatible with adjoining developments, whilst ensuring a high level of environmental amenity
c) to minimise the adverse environmental effects of industries
d) to restrict the development and expansion of hazardous and offensive industries
e) to improve the environmental quality of the local government area of Botany by minimising disturbances caused by any form or type of pollutant
f) to ensure that industries conform to strict hazard minimisation and environmental guidelines
g) to ensure adequate buffers between industries and other land uses, particularly residential, are provided.

In the context of objectives a) and g) above, the groundwater treatment plant component of the activity is proposed to be located on land zoned for industrial purposes. The activity is therefore consistent with the nature of other existing developments in the direct vicinity and any future development that may occur on that land. In fact, the treatment plant is located well within what is identified as the Botany Industrial Park, and is therefore not only distanced from the nearest residential and sensitive land uses, but is buffered from those land uses by an established industrial area. The proposed activity itself would not generate any land use conflict with residential or other non-industrial land uses, and is considered compatible with adjacent land uses as required by objective b).

As noted above and further considered in section 5.1.5.1 of this report, Orica has demonstrated that the proposed activity would not defined as ‘hazardous’ within the meaning of SEPP 33. In a preliminary sense, Orica has applied appropriate hazard minimisation measures, which have been complemented with the recommended imposition of conditions requiring additional hazards investigations at the detailed design and implementation stage. The proposal is also not considered to be ‘offensive’ within the meaning of SEPP 33, with the activity assessed as being able to comply with relevant environmental and human health criteria. The combination of mitigation measures proposed by Orica, and the recommended additional measures outlined in this report for imposition through the relevant approvals (particularly the Environment Protection Licence) are considered to represent all reasonable and feasible measures for minimisation of impacts to as low as reasonably possible. The proposed activity is therefore consistent with objectives c) to f).

In industrial zones, the consent authority for a development application under Part 4 of the EP&A Act is required to take certain matters into account before granting development consent. While the proposed activity is subject to assessment under Part 5 of the EP&A Act, the following heads of consideration remain relevant to the proposal:

a) a maximum floor space ration of 1:1 (clause 12)
b) the development provides adequate off-street parking (clause 17)
c) the development provides an efficient and safe system for the manoeuvring, loading and unloading of vehicles (clause 17)
d) the operations of the development will not have an adverse impact on the functions of the surrounding road network (clause 17)
e) any goods, plant, equipment and other material resulting from the operations of the development will be stored within a building or wholly within the site and screened suitably from public view (clause 17)
f) there is sufficient area on-site for the storage and parking of vehicles associated with the operations of the development (clause 17)
g) landscaping will be provided that is integral to the design and function of the building and the site to improve the appearance of the development, enhance the streetscape and add to the amenity of the adjoining area (clause 17)

h) the development is of a height, scale and design that is sympathetic to adjoining land uses and built form (clause 17)
i) the building design and finishes are sympathetic and complementary to the built form, the streetscape and the public domain in the vicinity (clause 17)
j) the design and operation of the development will protect the visual and aural amenity of adjoining non-industrial uses (clause 17)
k) any noise generated from the operation of the development is minimised (clause 17)
l) any risk to human health, property or the natural environment arising from the operation of the development is minimised (clause 17)
m) the provisions of *State Environmental Planning Policy No 55 - Remediation of Land* will be complied with in relation to the land (clause 17)
n) whether adequate water and sewerage services will be available to the land it is proposed to develop (clause 38)
o) adequate provision has been made for the disposal of stormwater from the land it is proposed to develop (clause 38).

The above matters are addressed in detail in the relevant sections of this report, however, there are a number of these heads of consideration that require specific comment. Firstly, the proposed activity has been assessed as having a floor space ratio within the limits specific under the Botany LEP (point a) above), and in the context of the immediate industrial setting, is characterised with appropriate urban design and landscaping [points e), g), h), i) and j)]. Given the nature of the proposal, it will not be associated with significant traffic generation, and as such, is considered to pose minimal potential for impact on the surrounding road network. The internal design of the activity has been assessed to be generally consistent with relevant codes and standards for parking, manoeuvring and vehicle access arrangements [points b), c) and f)]. Specific environmental impacts, including in relation to noise, land use safety planning, human health risk, and stormwater are considered in the relevant sections of this report and have been demonstrated as meeting acceptable environmental and amenity criteria.

Depending on the final detailed design of the proposed activity, off-site pipework associated with the groundwater treatment plant is likely to affect a number of different land use zones in the Botany local government area, and potentially within the Randwick area. Neither the Botany LEP nor the *Randwick Local Environmental Plan 1998* provide any requirements specific to the installation and operation of pipework in any zone. Consistency with zone objectives in each circumstance would be achieved through compliance with acceptable environmental standards during construction of the pipework, and design of this infrastructure to avoid alienation or sterilisation of land from its permitted development potential. Consideration of pipework and associated water management infrastructure suggests that these measures are minimal in both scale and impact, with well-established practices and standards available for both installation and operation. Proposed locations/routes for these aspects of the proposed activity are unlikely to affect developable land or to detract from attainment of the development potential of land in either the Botany or the Randwick local government areas.

In summary, the proposed activity is considered to be consistent with all relevant environmental planning instruments. Notwithstanding that the proposal is subject to assessment under Part 5 of the EP&A Act, and not bound to compliance with the requirements for developments under Part 4, the activity has been reviewed against the heads of consideration dictated for assessment of development applications. This consideration demonstrates that the proposal is generally consistent with the zoning requirements, planning objectives and environmental planning specifications relevant to the land and local government areas affected by the proposal.

4.1.2 NSW State Groundwater Policy

Groundwater is an essential resource for human activities and the environment. However, the quality of groundwater will influence the types of activities it can be used for. The groundwater resource of the Botany

Sand Beds is of a naturally high water quality. One public representation noted that it was once used as a source of drinking water for Sydney. Groundwater quality has deteriorated significantly over the years due to human activities, in particular historical manufacturing activities in and around the Botany area.

The government's aim is to manage the state's groundwater resources so that it can sustain environmental, social and economic uses for the people of NSW. State Government policy is to encourage the ecologically sustainable management of the state's groundwater resources, so as to:

- slow, halt or reverse any degradation of groundwater resources
- ensure sustainability of groundwater-dependent ecosystems
- maintain the full range of beneficial uses of these resources
- maximise economic benefit to the region, State and nation.

In 1997 the NSW Government released the *State Groundwater Policy Framework Document*, which aims to achieve efficient and sustainable management of groundwater resources (NSW Government, 1997). Three component policies have been written to support the framework document. To date the *NSW Groundwater-dependent Ecosystems Policy* (NSW Government, 2002a) and the *NSW Groundwater Quality Protection Policy* (NSW Government, 1998b) have been published. The *NSW Groundwater Quantity Management Policy* is still in draft stage and will provide management approaches to control groundwater extraction to within the assessed sustainable yield of a resource.

The *NSW Groundwater Quality Protection Policy* establishes four basic concepts as the foundation of groundwater management:
Beneficial use and water quality objectives: The beneficial use of groundwater systems can be one or more of: ecosystem protection, recreation and aesthetics, raw water for drinking, agricultural water and industrial water.
Groundwater vulnerability: This recognises that risks of pollution from an activity vary according to natural geological conditions including soil types, depth to groundwater and transmitting capacity of the aquifer.
The conduit effect: Aquifers not only store water, they transmit it down a hydraulic gradient. An individual particle of water will move along a flow path from the point of recharge to the point of discharge. The aquifer is in effect a conduit for carrying water. If it becomes polluted at some point then the polluted water will be transported to the discharge site.
Groundwater compatibility: When groundwater is extracted and used for irrigation, proper consideration must be given to the compatibility of the water with respect to soil and crops onto which it is to be applied. If the groundwater has excessive salt content, for example, it could cause a breakdown in soil structure, salinisation of the root zone, leaching of salts into underlying groundwater and ultimately, the movement of salts into creeks and rivers.

The policy also contains a set of principles that require management activities and plans to:

- maintain the most sensitive beneficial use of the groundwater system
- ensure town water supplies are protected against contamination
- ensure groundwater pollution is prevented so that remediation is not required
- ensure groundwater-dependent ecosystems are protected from contamination
- ensure the quality of pumped groundwater is compatible with soil, vegetation and/or receiving water
- rehabilitate degraded areas where practical
- consider the cumulative impacts of activities on groundwater quality
- consider the links between groundwater quantity and groundwater quality management.

The *NSW State Groundwater-dependent Ecosystems Policy* is a whole-of-government policy, developed by the NSW State Groundwater Policy Working Group (consisting of government and non-government representatives). This policy recognises the shared goals of government and the community in promoting the sustainable use and management of groundwater resources in New South Wales and the need for all stakeholders to work together in the protection of groundwater-dependent ecosystems. It is specifically designed to protect our valuable ecosystems which rely on groundwater for survival so that, wherever

possible, the ecological processes and biodiversity of these dependent ecosystems are maintained or restored, for the benefit of present and future generations.

The Orica Groundwater Cleanup project is in accordance with the goals and principles of the NSW State Groundwater Policy and supporting component policies. The determining authorities consider that, given the nature of the contamination present in the sand bed aquifer's groundwater system, its extent beneath and down gradient from the Botany Industrial Park as well as the high concentration levels of chlorinated hydrocarbons that occur in the system, hydraulic containment using pump and treat technology is an appropriate course of action to address the situation. This approach to an environmental problem, as presented, must be taken where it is too difficult to treat the groundwater in situ. It is also vital to stop the contaminated groundwater from further spreading while the cleanup of the groundwater resource is undertaken. It will also work towards ensuring environmentally degraded areas are rehabilitated and their ecosystem support function restored.

4.1.3 Water Act 1912 and Water Management Act 2000

The rights to control, manage and use groundwater in NSW is regulated under the *Water Act 1912* (Water Act), and subsequently, the *Water Management Act 2000* (Water Management Act). The extraction of groundwater is regulated through a licensing system administered by DIPNR.

In response to the detection of contaminants in groundwater, DIPNR established a groundwater Extraction Exclusion Area around the known contamination plumes originating from historical activity in and around Botany Industrial Park. This was undertaken as an Order under Section 113A of the Water Act, in August 2003 (refer Appendix C for locality plan). DIPNR issued notices to licensees in this area under the Water Act,1912 that instructed them to cease extracting groundwater.

DIPNR is currently working with DEC, NSW Department of Health and local government to develop a groundwater strategy for the Botany Sand Beds. The preparation of the strategy is in accordance with a recommendation of the *Healthy Rivers Commission Statement of Intent for the Georges River - Botany Bay system* (2002).

The strategy will set rules for granting licences, identify the sustainable water yield and aim to protect the environmental and economic values of the groundwater system. In particular, the strategy will stress the need for protection of groundwater-dependent ecosystems and aim to ensure that industry and the public accord higher values to protection and use of the aquifer. The Botany Groundwater Strategy will subsequently be incorporated into a Water Management Plan under the Water Management Act. It is envisaged that this will be accomplished through the Macro Water Sharing Plan process that is presently being developed by DIPNR. Macro Water Sharing Plans, once completed and endorsed by the government, will enable the Water Management Act to be announced state-wide.

The Healthy Rivers Commission *Independent Inquiry into the Georges River–Botany Bay System* (HRC, 2001) identified the need to define 'broadscale pollution risk zones' based on current knowledge of former potentially contaminating activities, current potential pollution sources and known aquifer water quality. The strategy will provide a better understanding of the groundwater system and a framework for dealing with any newly discovered contamination. It will also define broad scale 'groundwater pollution risk zones' which, when implemented, will preclude extraction from some areas and provide warnings on risks to groundwater users in other areas.

DIPNR also imposed an embargo on accepting any further applications for groundwater supply licences under Part V of the Water Act in a large area of the Botany Basin (Northern Zone) in August 2003 (see Appendix D). This embargo area was gazetted to proactively manage other sites with potential contamination, in addition to the contaminant plume from the Orica site, by restricting new access to

groundwater. The restriction placed on this area precludes any new bore licences for the extraction of groundwater from being issued, with the exception of temporary dewatering for building construction, groundwater monitoring and bores for purposes of groundwater remediation. The intent of the embargo is to not issue new licences until further assessment of the groundwater system occurs through the Botany Groundwater Strategy.

A licence is required by Orica from DIPNR under Part V (section 116) of the Water Act to authorise the extraction of groundwater for containment of contamination and groundwater remediation purposes. The lands to be authorised by the licence relate to locations at Banksmeadow, generally bounded by Foreshore Road, Botany Road and Beauchamp Road to the south, Denison Road to the East, Floodvale drain to the west and to the north in part by Ampol Terminals, Anderson Street and Corish Circuit.

The existing and proposed bore locations are within the hydraulic containment lines specified in the Notice of Clean Up Action (NCUA) issued to Orica Australia Pty Ltd by DEC and outlined in Section 2. DIPNR has already issued test bore licences under the Water Act for the works in the Primary Containment Line as well as the Secondary Containment Line to enable preliminary field testing by Orica.

At least three (3) production bore licence applications must be submitted to DIPNR for processing, commensurate with the intended licence conditions as set out in Appendix B. These licences will authorise the production water supply borefields in each containment area. The contaminated groundwater pumped out in the extraction bores is proposed to be transferred to the GTP via dedicated transfer pipelines at a total rate of up to 15 million litres per day.

The determining authorities consider that the proposed extraction borefields, once commissioned for production purposes (to deliver 15 million litres per day to the groundwater treatment plant), will achieve hydraulic containment of the plumes.

The intended conditions of the licence are set out in Appendix B, subject to a formal application being received from Orica. General and specific conditions for management of groundwater resources and dependent ecosystems in the area of the proposed groundwater clean up development are included. This includes, but is not limited to, requiring Orica to carefully monitor groundwater level behaviour with pumping, minimise any potential adverse environmental impacts and report the effectiveness of the clean up.

4.1.4 Contaminated land management

The NSW Government recognises the importance of managing contaminated sites in NSW. The *Contaminated Land Management Act 1997* (CLM Act) enables DEC to respond to contamination that is causing a significant risk of harm to human health or the environment, and sets out criteria for determining whether such a risk exists. The Act gives the EPA power to:

- declare an investigation site and order an investigation
- declare a remediation site and order remediation to take place and
- agree to a voluntary proposal to investigate or remediate a site.

The EPA has determined that the contaminants in the groundwater at Botany sourced from the Orica site present a significant risk of harm (SRoH) in accordance with section 9 of the CLM Act. The EPA proposes to declare approximately 200 hectares of land affected by the contamination as a remediation site in accordance with section 21 of the CLM Act. A declaration means that the contamination of the land is ‘tagged’ as presenting a SRoH. The copy of the declaration is placed on the CLM Act public record. Only when DEC is satisfied that the SRoH caused by the contamination has been addressed, can the declaration be removed.

The EIS states that if no action is taken to contain, recover and treat the contaminants in the groundwater at the rates required (up to 15 million litres per day) they will increasingly pollute Penrhyn Estuary and possibly Botany Bay. Such discharges would be likely to result in a number of unacceptable outcomes including:

- impacts (such as effects on growth, reproduction, abundance and diversity) on the terrestrial and marine flora and fauna in the Foreshore Beach and Penrhyn Estuary ecosystems, including migratory shorebirds identified for protection by Commonwealth legislation and international treaties
- increased risk to human health for recreational users of the foreshore and within Botany Bay
- diminished quality of life for residents and workers in the area
- increased loads of volatile organic compounds to the atmosphere which are precursors for smog formation
- failure to achieve the requirements of the EPA clean up notice and associated Groundwater Control Plan through failure to contain and treat the contaminated groundwater as stated in the notice.

DEC believes that significant adverse impacts on the environment and potentially human health will result if the project does not proceed. For these reasons the project is vital in terms of Orica's ability to meet its obligations under this legislation.

4.1.5 Protection of the Environment Operations Act

The *Protection of the Environment Operations Act 1997* supports government priorities for protecting and restoring the environment by reducing to acceptable levels the discharge of substances likely to cause harm to the environment. Recognising the potentially significant impact of chemical manufacturing and storage and waste activities on the environment, Orica is required to have an environment protection licence under the Act.

An environment protection licence issued under the Protection of the Environment Operations Act contains conditions that ensure effective and efficient management of these sorts of activities. An environment protection licence requires the licensee to operate activities competently, as well as maintain systems in such a way as to ensure ongoing environmental improvement.

Licenses also include nominated discharge points for the purposes of setting limits to, and the monitoring of, the emission of pollutant discharges to air, water and land. Limit conditions may apply to loads, concentration, volume or mass, and frequency of discharges. Conditions may also relate to waste and noise. Monitoring conditions are an important aspect of an environment protection licence. A licence also requires recording of pollution complaints, as well as reporting on licence compliance on an annual basis to the EPA. The Protection of the Environment Operations Act requires the EPA to be notified as soon as practicable of incidents that cause or threaten material harm to the environment.

Pollution reduction programs are another important component of environment protection licences. They provide the EPA with a means of requiring ongoing and progressive environmental improvements to the way in which licensed activities are undertaken. Pollution reduction programs identify activities or processes that should be prioritised for improvement, setting milestones and deliverables to be achieved. Capital works may be involved in such programs, where required to alleviate public health and environmental impacts in sensitive areas.

Environment protection licences remain in force until surrendered by the licence holder or until suspended or revoked by the EPA or the Minister for the Environment. A licence may only be surrendered with the written approval of the EPA. A licensee may request a variation to the licence, and the EPA may also vary the licence at any time.

The Act also requires the EPA to keep a public register of details and decisions of the EPA in relation to, for example, licence applications, licence conditions and variations and statements of compliance. In addition monitoring data submitted to the EPA is available to the public.

Regulating this project and other activities under the Act provides an ongoing framework for DEC to require integrated and progressive improvements to the environmental performance of Orica's operations at Botany Industrial Park.

4.2 Strategic issues raised in submissions

Representations responding to the environmental impact statement raised a range of concerns relating to the strategy as proposed by Orica. These included:

- selection of preferred technology, namely the thermal oxidation unit
- minimising dioxins formation
- compliance with International Conventions on Hazardous Chemicals and Waste
- timetable for clean up
- system maintenance
- environmental monitoring
- waste precinct
- fishing ban
- need for a financial assurance

The determining authorities have noted these concerns and have also considered whether Orica's strategy would deliver the anticipated environmental and public health benefits. These concerns are discussed below.

4.2.1 Selection of preferred technology, in particular the thermal oxidation unit

Several representations opposed the use of the thermal oxidation unit and recommended that steam stripping be used to treat the groundwater (up to 15 mega litres per day). The recovered condensate (approximately 3 tonnes per day) would be stored until an appropriate site for disposal could be found using "*non-incineration*" (sic). This would accumulate at a rate of approximately 1000 tonnes per year, noting the proposal is for treatment over 30 years. Orica has potential for some 10 years' storage capacity.

Orica is currently using a steam stripping unit to treat contaminated groundwater (up to 2 million litres per day). The collected condensate is currently being stored at a rate of around 500 kilograms a day. Since it was recommissioned in October 2004, there is an estimated 6.5 tonnes of condensate, principally 1,2 dichloroethane (EDC), stored to date and awaiting destruction.

While providing an important interim measure the use of a steam stripping unit to treat the required quantity of groundwater (up to 15 million litres per day) was ruled out in the EIS because it does not result in destruction of the contaminants. Some representations objected to any further storage of wastes at the site and raised concerns about the ongoing risks of existing stockpiled waste. For example, they cited concerns over a current stockpile of 10,500 tonnes of hexachlorobenzene wastes at the site that was awaiting determination on its disposal. Orica has funds set aside for the construction of the plant to collect and treat the contaminated groundwater. The determining authorities do not consider alternate options that concentrate, contain and store the contaminants are environmentally responsible. This is because of the legacy this approach would leave for future generations to deal with and the lack of financial certainty that it would be able to be treated later. There are also inherent safety risks associated with the storage and management of concentrates, for example accidents and spills, especially in the longer term.

A representation encouraged the use of bioremediation as an alternative to the use of the groundwater treatment plant and thermal oxidation unit. The EPA notice mandates the use of 'pump and treat' technology (ie *ex situ* treatment) to treat groundwater contamination as it is proven to be effective within the required clean-up timeframe. There are doubts over the effectiveness of the treatment of groundwater in the

ground (ie *in situ* processes) and consequently this approach was not considered as part of the project. Orica, however, continues to trial *in situ* methods, including active and passive bioremediation and the use of reactive iron barriers.

Other alternate 'pump and treat' technologies were evaluated in the EIS, summarised in Section 2.3.4 of this report. These include gas phase chemical reduction, base catalysed decomposition and the use of plasma arcs. Some public representations recommended the adoption of gas phase chemical reduction (for example 'Eco-Logic'). These were not selected by Orica because they are not able to deal with volatile chlorinated hydrocarbons but were actually designed for the treatment of POPs. There are no dioxins in the groundwater, however there is the risk that dioxins may be formed from the destruction of volatile chlorinated compounds in the thermal oxidation unit. The relevant technology must destroy volatile chlorinated hydrocarbons as well as minimising or eliminating the production of POPs. Furthermore, while appearing to be able to further minimise the potential for the unintentional production of POPs, these methods have not been successfully trailed on an industrial scale, nor do they minimise the possibility of accidents or ensure occupational health and safety to the same extent as the preferred design.

DEC considers it vital that an integrated and holistic approach be adopted for the collection, treatment and disposal of contaminants in the groundwater. DEC and other determining authorities concur that the technology proposed by Orica (air stripping/thermal oxidation) is consistent with accepted best practice and satisfies stringent international air emission standards. The pump and treat technology selected by Orica is a proven and available technology that can process the required quantity of contaminated groundwater (up to 15 million litres per day). It will reduce to a minimum the amount of POPs, including dioxins, that might be formed from the treatment of the groundwater, any releases to the environment and the associated risks. It consumes few raw materials as it is focused on destroying the contaminants in the groundwater and will be as energy efficient as possible. It is designed to minimise the possibility of accidents or failures and ensures that occupational health and safety is protected. It meets the project time constraints and is the one technology evaluated that has been tried with success on an industrial scale. It also maximises the quantity of extracted water that can be recycled for industrial use significantly reducing the demand on potable supplies.

In making this determination, an independent assessment of the technology and air emissions was undertaken by John Court & Associates Pty Ltd (on behalf of DEC). The assessment concluded that Orica's preferred technology constitutes a combination of well-known and well-proven technology. Pumping and *ex-situ* treatment of groundwater to remove contaminants has been employed at many locations in North America and Europe for clean up of contaminated groundwater. Air stripping is a well established and characterised chemical engineering process. Thermal oxidation of organic impurities in gas streams before discharge to atmosphere has been a widely used technique in air pollution control technology for over 40 years. The technology and science involved in each of these components have been refined and developed over the long period of their use, so there is no lack of experience in the technology combination proposed by Orica. Each component continues to be extensively used internationally, in jurisdictions with demanding, strict and up-to-date environmental requirements.

The assessment by Court & Associates also indicated concerns regarding gas-phase reduction process as a viable alternative treatment process. Sulfides and organic acids are present in the groundwater and processing of the groundwater by treating the organochlorine compounds with hydrogen in reducing conditions would generally result in production of more odorous materials than those already in the groundwater, due to the formation of odorous organic sulfides and aldehydes. It would be necessary to collect and withdraw a stream containing the odorous, non-condensable materials and treat them through a thermal oxidiser for discharge to atmosphere. These emission concerns, together with the hazards and difficulties associated with handling hydrogen, were also taken into account in reaching the above determination.

Independent assessments of the project undertaken by John Court & Associates Pty Ltd and the United States Environmental Protection Agency on behalf of DEC supported the project in terms of the appropriateness of the technology selected.

The Department of Environment and Heritage (Commonwealth) has also assessed the project. It advised that alternate technologies (in particular gas phase chemical reduction and the base catalysed decomposition processes) would not be appropriate for the destruction of the stripped chemicals and accepts that the thermal oxidation treatment plant appears to be the most appropriate technology for destroying these chemicals. The US EPA also concluded that the treatment technology was reasonable based on its reliability and proven capability to meet emission standards. Both agencies provided advice on elements that should be included during the implementation of this technology. These elements, including operational and monitoring requirements, have subsequently been taken into account in DEC's requirements for the project.

In summary, the determination concludes that the technology selected by Orica is consistent with accepted best practice and satisfies stringent international air emission standards and Australia's obligations for the minimisation of persistent organic pollutants under the Stockholm Convention on Persistent Organic Pollutants. It also maximises the quantity of extracted water that can be recycled for industrial use, significantly reducing the demand on potable supplies.

4.2.2 Minimising dioxin formation

The proposed design of the GTP includes a thermal oxidiser to treat the off-gas from the air strippers. Numerous representations raised objection to the thermal oxidation unit. Many stated that it was an "incinerator" and stated that the "incineration" of chlorinated compounds is widely recognised as a primary source of dioxins, furans and other toxic by-products.

The reactions that can result in the formation of dioxins and furans are complex and *de novo* synthesis is the dominant mechanism. In the *de novo* mechanism, dioxins are formed by the reaction of chlorine and macromolecular carbon structures. The EIS has identified the following necessary conditions for *de novo* formation of dioxins:

1. solid phase material containing suitable carbon structures (eg soot, charcoal)
2. organic or inorganic chlorine
3. metal catalysts (also solid particles incorporated with 1. above)
4. excess oxygen
5. a temperature window of 250 to 450 °C.

The design of the GTP thermal oxidiser adopts all of the safeguards for dioxins minimisation: high temperature of the oxidiser (1000 ^{o}C), long residence time (2 seconds), and a quench by spraying weak acid through the gas stream to rapidly reduce the temperature of the treated off-gas from 500 ^{o}C to 100 ^{o}C. A rapid quench minimises the potential for *de novo* formation of dioxins by rapidly cooling the gas stream through the optimal formation temperature range of 250 to 450 ^{o}C. These standard safeguards have been adopted even though Orica has identified that the feed stream to the thermal oxidiser is inherently less prone to *de novo* synthesis reactions. Two of the factors normally required for *de novo* dioxins formation, carbon structures and metal catalysts, are absent due to the very low level of particulate matter in the gas stream. Orica expects the contaminated air stream from the groundwater stripping columns to be free of solid particles.

As independent assessment of these design elements was conducted by John Court & Associates Pty Ltd on behalf of DEC. It states there has been extensive research and study of polychlorinated dioxins/furan formation in combustion and industrial processes over the last 20 years. A technical consensus has emerged from this research which concludes that where dioxins are not present in the materials being

oxidised, the *de-novo* formation of dioxins occurs primarily in the post combustion-zone where **all** of the following conditions apply:

- chlorine is present
- carbon and/or some form of organic precursor is present
- the gas temperature is in the range 250 to 450 ^{o}C
- there is a surface on which the reaction can be catalysed, eg particles in the gas or the surface of heat exchange or gas cleaning equipment
- there is a catalyst for the reaction, such as copper or some other metals.

The maximum dioxin formation rate occurs at about 300 ^{o}C. The assessment by Court & Associates concluded that the design features adopted by Orica meet the requirements for avoiding dioxins formation after the combustion chamber. This is because:

- Combustion of an air stream with low concentrations of organic contaminants at 1000 ^{o}C for 2 seconds with excess oxygen and turbulent flow should leave no residual gaseous organic materials (dioxin forming 'precursors') unconverted to CO_2 or CO and should not generate sooty carbon, given the gaseous flame, good mixing, preheating of combustion air and the high amount of excess air for combustion.
- Generation of the organic materials by air stripping (volatilisation) ensures that solid and inorganic materials in the groundwater will not be transferred to the gas stream, thereby eliminating the potential for solid particles formation as a surface for dioxins formation.
- Efficient mist elimination in the air strippers will effectively prevent carry-over of liquid droplets containing non-volatile material to the thermal oxidiser, thereby ensuring no inorganic solid particle formation as a surface for dioxins formation.
- Metals that are known to catalyse dioxins formation, such as copper and zinc (present in municipal waste), are unlikely to be present: the copper content of groundwater is 0.00129 mg/L and zinc 0.017 mg/L and these will not be volatilised in the stripper or carried over.
- The temperature window for dioxins formation (250-450 ^{o}C) will be rapidly traversed in the quench tower.

These conditions should avoid dioxins formation beyond trace quantities, ie well less than the internationally accepted design standard of 0.1 ng TEQ/m^3 that has been adopted for the groundwater treatment plant. One nanogram is equal to 10^{-12} grams.

Court & Associates also indicates that this is further supported by published and peer reviewed literature on the performance of catalytic and thermal oxidisers treating dilute chlorinated vapours, drawing on results from emission testing of plants operating in California desorbing vapours from contaminated soils. For thermal oxidisers the principal cogener formed was octachloro dibenzo-dioxin (OCDD), the least toxic on the TEF scale. The oxidisers operated from 773 to 927 ^{o}C and with residence times of 0.5 to 1 second, less intense than the oxidising conditions proposed for the Orica unit (1000 ^{o}C for 2 seconds). The emission rates reported for the thermal oxidiser were very low at 0.005 ng TEQ/m^3, or, expressed as a molar conversion, 10^{-12} of the feed organochlorine. For 500 ppm EDC entering the Orica thermal oxidiser this would correspond to an emission from the unit of well less than 0.01 ng TEQ/m^3. These results for thermal oxidisers are from closely comparable situations to the Orica proposal and give confidence that the manufacturer's assurances and the conclusion drawn from the engineering principles above are sound.

The independent review by Court & Associates also concluded that the predicted levels of dioxins exposure from emissions from the groundwater treatment plant are very low. The maximum predicted ambient concentration is 0.19 fg TEQ/m3 (annual average). One fentogram is equal to 10^{-15} grams or a millionth trillionth of a gram. This is several orders of magnitude lower than typical reported values in Australian urban areas of 10 to 20 fg TEQ/m3. The Victorian EPA design criteria for a 3 minute average is 3700 fg TEQ/m3. Allowing for a very conservative factor between the 3 minute average and the corresponding average, there would still be a wide margin of safety for the predicted emission for the groundwater treatment plant, namely 19 fg TEQ/m3 against 3700 fg TEQ/m3 allowed on a 3 minute average.

The determination has concluded that Orica can design and operate the GTP to achieve international best practice emission concentration limits for dioxins and furans and all air pollutants. DEC has attached conditions to the licence that require Orica to meet these best-practice emission concentration limits as never to be exceeded (100th percentile limits). The conditions also require regular monitoring of dioxins and furans in the emissions from the groundwater treatment plant. The continuous monitoring of other pollutants, (for example carbon monoxide and oxygen) and thermal oxidation operating parameters (for example temperature and residence time) will ensure maximum destruction of contaminants and conditions conducive to the formation of dioxins and furans are minimised at all times.

As a further safeguard, DEC has also required Orica as a licence requirement to:

- Regularly validate the predictions and conclusions in the EIS and demonstrate that the groundwater treatment plant can meet or perform better than the internationally recognised design standard of 0.1 ng TEQ/m^3
- Implement a Dioxin Minimisation Program to:
    - investigate technical options and scientific developments which would allow continuous monitoring and/or sampling of any dioxin that may be emitted from the groundwater treatment plant.
    - investigate chemical and/or physical parameters that are likely to correlate with the actual or potential formation of dioxins and could be used as a surrogate indicator of dioxins formation in the groundwater treatment plant; and
- regularly review monitoring programs, including substances monitored and frequency of monitoring to ensure dioxins can be detected and effective measures are in place to ensure their formation is minimised at all times.
- Undertake a Thermal Oxidation Unit Validation Program to ensure the performance of the thermal oxidation unit to ensure it achieves its stated performance and the formation of dioxins is minimised at all times.

4.2.3 Compliance with International Conventions on Hazardous Chemicals and Wastes

Several submissions objected to the project on the grounds that it was contrary to the Stockholm Convention on Persistent Organic Pollutants (POPs), particularly as the plant includes a thermal oxidation unit. Some submissions referred to the unit as a “waste incinerator” and believed it would be a significant source of dioxins.

The Stockholm Convention seeks the elimination or restriction of production and use of all intentionally produced POPs (Article 3). It requires parties to take measures to reduce or feasibly eliminate releases of by-product POPs that are produced unintentionally (Article 5). It also requires that stockpiles and wastes containing POPs are managed in a manner protective of human health and the environment (Article 6). The convention obliges parties to develop strategies for identifying POP wastes and to manage these in an environmentally sound manner. Where the POP content of wastes is to be destroyed or irreversibly transformed or otherwise disposed of, it must be done in an environmentally sound manner (Article 6). It is important to note that the contaminated groundwater does not contain dioxins, so only Article 5 and Annex C directly relate to the Orica groundwater cleanup project.

Additional information in Annex C of the Convention about aspects to be addressed when considering the possibility of unintentional production in any newly-proposed facility provides guidance to DEC in its consideration of Orica’s proposal. Part II of this Annex identifies industry source categories that have the potential for comparatively high formation and release of these chemicals, in particular dioxins and furans, to the environment. One of those source categories is waste incinerators, including co-incinerators of municipal, hazardous or medical waste or of sewage sludge. With regards to the Orica project, however, it

should be noted that air stripping of contaminants from water results in a much cleaner input to the thermal oxidation unit than does thermal desorption of contaminants in soils or the direct oxidation of wastes.

Part V of this Annex provides general guidance on best available techniques and best environmental practices to be considered when establishing a facility where dioxins may be unintentionally produced, such as a waste incinerator, identified as a source category in Part II. It provides a list of general prevention measures and guidance for determining what constitutes best available techniques. When considering what constitutes best available technique, the convention states that no specific technique or technology is prescribed or precluded, indicates that issues to be evaluated include:

- the technical characteristics of the installation concerned
- its geographical location
- the local environmental conditions
- the nature and size of the source of unintentional POPs
- how urgently the facility is required
- whether there are comparable processes or methods of operations that have been tried with success on an industrial scale
- technological advances and changes in scientific knowledge
- the need to prevent or reduce the overall impact of the releases to the environment and the risks.

Consideration of all these factors needs to occur, bearing in mind the likely costs and benefits of the measure and consideration of precaution and prevention. Priority should always be given to processes, techniques or practices that avoid the formation and release of unintentional POPs.

This part of the Annex goes on to provide a list of release reduction measures to be applied wherever possible for the source categories listed in Part II, which include:

- use of improved methods for flue gas cleaning, such as thermal and catalytic oxidation, dust precipitation or adsorption
- treatment of wastes and wastewaters, for example by thermal treatment, rendering them inert or chemical processes that detoxify them
- process changes that lead to the reduction or elimination of releases, such as moving to closed systems
- modifications of process designs to improve combustion and prevent formation of the chemicals listed, through the control of parameters such as incineration temperature and residence time.

The EIS included an assessment of possible technologies, which allow all of these issues to be evaluated for the project.

The groundwater treatment plant is being proposed to enable the collection and treatment of a large volume of contaminated groundwater as part of Orica's commitment to meeting an EPA Notice of Clean Up. This places constraints on the location of the facility and the urgency with which the facility needs to be established. It also means some of the general prevention/avoidance measures listed in the Stockholm Convention and raised in the submissions are not triggered. For example, it is not possible to use less hazardous substances or institute reuse and recycling of these waste materials or to replace feed materials with less problematic ones. As a result, the focus of the evaluation has to be on which technology best complies with the guidance on best available techniques rather than on doing something other than destroying the contaminants in the groundwater.

The plant design proposed by Orica will reduce to a minimum the amount of POPs, including dioxins, that might be formed from the treatment of the groundwater, any releases to the environment and the associated risks. It consumes few raw materials, as it is focused on destroying the contaminants in the groundwater, and will be as energy efficient as possible. It is designed to minimise the possibility of accidents or failures and ensures that occupational health and safety is protected. It meets the timing constraints for the operation and is the one technology evaluated that has been tried with success on an industrial scale, incorporating recent advances in chemical engineering and scientific knowledge.

The plant design proposed by Orica has also incorporated all relevant release reduction measures listed in Annex C to the Stockholm Convention. The plant is using thermal oxidation as a flue gas cleaning method to destroy the chemicals in the air stream prior to discharge. The process includes measures to reduce formation and release of POPs, such as operating the thermal oxidiser at 1000 °C and holding the off-gases for at least 2 seconds at this temperature to ensure efficiency of combustion. It also includes a quench to minimise the potential for *de novo* formation of dioxins by rapidly reducing the temperature of the treated off-gas exiting the thermal oxidation unit through the optimal formation temperature window of 250 to 450 ^{o}C.

Other technologies that were evaluated in the EIS fail the above evaluation in a number of ways. Some of the alternate technologies do not result in destruction of the contaminants, but instead store the condensate for a later time leaving legacy issues for future generations. Several public representations objected strongly to these 'concentrate and contain' options. Some of the alternate technologies are not able to deal with volatile chlorinated hydrocarbons but were actually designed for the treatment of other POPs, in particular polychlorinated biphenyls. The focus of this project is the destruction of the volatile chlorinated hydrocarbons so any relevant technology needs to be able to destroy these chemicals as well as minimising or eliminating the production of POPs. Some of the alternative technologies, while appearing to be able to further minimise the potential for the unintentional production of POPs, have not been successfully trialled on an industrial scale, do not provide treatment of groundwater at the required capacity and do not minimise the possibility of accidents or ensure occupational health and safety to the same extent as the preferred design.

In finalising this position DEC also sought advice from the Department of Environment and Heritage (Commonwealth). Initial advice recommended Orica further explore all alternatives for collection and treatment of groundwater contaminants, further justify the selected technology and demonstrate that it was consistent with the Stockholm Convention. DEC sought further advice from Orica and John Court & Associates Pty Ltd in relation to these recommendations and provided it to Environment and Heritage. Environment and Heritage has advised that, provided the thermal oxidation treatment plant operates in accordance with the above requirements, it holds the view that the operation would not present a problem in terms of Australia's obligations under the Stockholm Convention on Persistent Organic Pollutants.

On the basis of the above, DEC is confident that the EIS has addressed the requirements of the Stockholm Convention in the design, installation, operation and maintenance of the groundwater treatment system. Consistent with the convention, this will ensure the formation of dioxins is prevented or avoided to the greatest extent possible, taking into account applicable international standards and guidelines.

The convention states that guidance is being prepared on best environmental practices. The EIS refers to a draft document currently being developed. Some representations objected to Orica's reliance on these draft guidelines to justify the selected technology in the EIS. In assessing and determining this proposal DEC has focused on the implementation of the existing and ratified Convention, in particular Article 5 and Annex C. DEC can review and if necessary vary its licensing requirements should new information come to light following the release of the final version of these guidelines or receipt of any other relevant technical or environmental data.

One submission referred to the *Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and Their Disposal* and the *Rotterdam Convention on the Prior Informed Consent Procedure for Certain Hazardous Chemicals and Pesticides in International Trade*. It states that these conventions are inadequate in their omission of any discussion of the issues related to the destruction of hazardous wastes by any method in populated areas. These conventions relate to ensuring that the transport of hazardous wastes between countries is done safely and in an informed way. Regulation of destruction of hazardous wastes within a country are subject to the legislative framework of that country. Orica does not intend to move the wastes they have generated to another country so these conventions do

not apply. The Basel Convention (Article 4) does however require each party to minimise waste generation and to ensure, to the extent possible, the availability of disposal facilities within its own territory.

4.2.4 Timetable for clean up

Some representations raised concerns over perceived delays in DEC issuing a notice of Clean Up Action and that this resulted in a lack of duty of care by the government to address the contamination issue.

DEC (and formerly the EPA) has regulated groundwater remediation in and around Botany Industrial Park for many years. The focus of this work has been on stopping further contamination, fixing up surface drainage, soil remediation works and investigation of groundwater contamination. The Notice of Clean Up Action, while a key component, is only one aspect of these regulatory activities. Further information on DEC action to date is provided in Section 2.

Some representations stated that the amount of time (30 days) provided by DEC for public exhibition of the EIS was inadequate. Part V of the EPA and A Act requires EIS to be exhibited for 30 days. Orica undertook extensive consultation with relevant government agencies and the community during the environmental impact assessment process. This is detailed in the EIS and included planning focus meetings and numerous workshops.

Some representations raised concerns about the tight timeframe for the assessment and determination of the project. The government's priority is to ensure that the migration of contaminated groundwater is stopped and remediated as quickly as possible, subject to an adequate level of assessment and the necessary approvals being obtained. In order to satisfy the requirements of the DEC Notice of Clean Up Action and allow for construction and commissioning of the necessary works to protect the sensitive marine ecosystems of Penrhyn Estuary and Botany Bay, Orica must obtain a variation to the existing environment protection licence to allow the project to commence in February 2005.

4.2.5 System maintenance

Orica has indicated in the EIS that collection and treatment of the plume may take up to 30 years. A number of representations raised concerns about the ability of the government and Orica to maintain the system over this time and questioned who would be accountable for its reliability and ensuring its safe and effective operation.

The environment protection licence provides an ongoing framework for DEC to require integrated and progressive improvements to the environmental performance of Orica's operations at Botany Industrial Park. As part of its determination DEC has included conditions in the environment protection licence for the project that require the effective and efficient management and competent operation of the groundwater treatment system and ensure it is maintained to achieve ongoing environmental improvement.

This determination also took into account comments from John Court & Associates Pty Ltd, US EPA and the Department of Environment and Heritage on the importance of the integrity of the groundwater treatment plant, especially in the longer term. Given the anticipated long life of the plant and the importance of it operating at a high level of performance throughout its life, DEC has included a requirement in its licence for Orica to undertake periodic engineering audits to ensure the performance of the plant will not deteriorate in the longer term. These audits must occur with increasing frequency as the plant continues to operate.

4.2.6 Environmental monitoring.

Several submissions raised concerns about the adequacy of existing monitoring programs and called for a comprehensive monitoring program.

Orica has proposed extensive monitoring for the construction as well as the operational phase of the project, in particular parameters that indicate the effectiveness of the operation of the groundwater treatment plant. This includes monitoring stack emissions, water discharges and a range of other parameters to ensure proper operation of the GTP.

The determination concludes that ensuring the development of monitoring programs that can adequately demonstrate proper operation of the GTP is a critical aspect of the project and forms an important part of its approval. Consequently, conditions have been attached to the instruments of approval that require the development and implementation of comprehensive monitoring programs for both the groundwater collection and treatment system and receiving environment zones.

Representations also called for independent monitoring programs. Some expressed concern over reliance on industry self-monitoring. Monitoring by industry is required because industry has a responsibility to ensure the ongoing verification of the environmental performance of its activities. The determining authorities support measures that enhance independent audit systems. DEC has required the development and implementation of validation audits of the performance of the groundwater treatment plant by an independent expert.

Orica has indicated that it is committed to establishing an independent technical panel, which would have access to all monitoring data for the operation of the groundwater treatment plant. Orica intends to discuss the establishment of this panel with the Community Liaison Committee in early 2005. DEC has required the formation of this independent panel as a condition of its environment protection licence for the project. The panel must include community representatives and be consulted in the selection of the independent auditor to conduct the validation audits.

Some representations requested ambient air quality environmental monitoring be carried out, in particular at Banksmeadow Primary School. DEC's focus is on ensuring the groundwater treatment plant and associated infrastructure does not result in air emissions that could cause adverse impacts to the environment or human health. Our priority is to ensure stringent air emission limits and monitoring regimes at the source of potential pollution. This is because there are limitations in the effectiveness of ambient (off-site) monitoring programs to detect changes in the environmental performance of plant and equipment.

As conditions of licence DEC has required Orica to comply with strict source emission limits monitoring and reporting requirements and undertake an air, water and noise emission validation program. This program requires Orica to demonstrate that the strict emission and discharge limits of the licence have been complied with so that any discharges do not cause off-site impacts in adjoining residential or other sensitive locations.

In arriving at this position DEC has taken into account independent advice from Court & Associates. Because of this very low level of predicted contribution to ambient dioxins from the plant, it is not feasible to undertake meaningful ambient monitoring to track exposure, as desirable as this might be from the perspective of public concern. Nor is it possible to identify a marker emission from the process. The other emissions considered (CO, PM_{10}, SO_2, Cl_2, HCl and VOC) would all be present from other sources in higher concentrations at Botany. The most feasible approach for monitoring the plant is emission monitoring coupled with background odour observation and auditing.

4.2.7 Fishing ban

In September 2003, DEC collected oysters from Penrhyn Estuary. None of the solvents in the plume were expected to be accumulated by the oysters and the analysis confirmed this, however, they were found to contain mercury and hexachlorobenzene. Orica was asked to do a more thorough study of fish and shellfish, which it presented in mid 2004. DEC, NSW Health, NSW Food Authority and the Department of Primary Industries reviewed the information and decided to formalise a fishing ban in the estuary. Prior to this there were advisory signs warning the public not to swim or fish there. The fishing ban was gazetted in November 2004. The contaminants found in the fish and shellfish are believed to be from historic contamination of the sediments of Penrhyn estuary.

4.2.8 Waste precinct

Some submissions called for the establishment of a 'Hazardous Waste Precinct', along the lines of those being established by the Western Australia EPA. These submissions stated that in Western Australia the State Government has approved tougher criteria for establishing precincts containing new and better hazardous waste treatment facilities in Western Australia. This is based upon detailed technology suitability criteria and site selection criteria developed by the Core Consultative Committee (3C) on Waste. The 3C has members from community and environmental organisations, industry, union and local government.

It is important to understand the context in which the 3C and their criteria were developed. The 3C were established by the WA Waste Management Board in 2002 to promote advice and open discussion about waste management issues. During 2003 the role of the 3C was expanded to give greater attention and priority to stakeholder concerns regarding the management of hazardous waste in the state. The main trigger for this was a major fire at the waste control site in Bellevue, where hazardous wastes were inappropriately stored and managed. The 3C and the WA government saw the establishment of a specific hazardous waste treatment precinct (or a number of smaller precincts) as an opportunity for both more transparent regulation and public engagement in monitoring the management and regulation of hazardous waste treatment. The 3C's role is to facilitate stakeholder involvement to advise government on establishing new and better hazardous waste facilities in WA. The 3C has been involved in a broader framework of minimising hazardous waste generation and regulating hazardous waste more effectively. The 3C has facilitated stakeholder consultation on a technology suitability criteria and a site selection criteria.

Many submissions received referred to the 3C site and technology selection criteria. In particular, the site selection criterion, which includes a minimum three-kilometre buffer from the nearest sensitive land use, with a desirable buffer distance of six kilometres. DEC notes that the buffer zones are not areas devoid of all human activity, but areas from which sensitive land uses will be excluded. 'Sensitive land uses' are defined as "areas zoned residential, motels and hotels, caravan parks, hospitals and nursing homes, schools and other educational establishments, shopping centres and some public buildings". The 3C recommended buffer distances that are large by world standards and are larger than those routinely recommended by the WA EPA and Department of Planning and Infrastructure approvals and planning processes. This is not achievable in or around the Botany Industrial Park.

It is also important to note that the Orica project is in response to a Notice of Clean Up Action for collection and treatment of contaminated groundwater in and around Botany Industrial Park. For this reason the groundwater treatment plant must be located where the groundwater remediation will occur. The Botany project will be treating only contaminated groundwater from the site, and this is an additional plant within the facility, not an application for a new facility. The Orica example is in distinct contrast to the establishment of a new hazardous waste treatment facility where the 3C site selection criteria can be more readily and appropriately applied.

While maximising buffer distances as far as practicable is encouraged, DEC's focus is on minimising risks to the environment and human health from the source of pollution.

4.2.9 Financial Assurance

Some submissions requested DEC require the collection of a financial assurance to be maintained during the operation of the facility and thereafter until such time as all parties are satisfied that the groundwater has been appropriately remediated and is environmentally secure. These calls arise from a concern that Orica may withdraw from or not have the financial capacity to meet its responsibilities to address the contamination issues, especially in the longer term. Amounts of $50 million were suggested in some representations.

Orica has made major and public commitments to the government and community regarding the clean up of the groundwater contamination. The Orica Board of Directors has committed $167 million (before tax) of shareholders funds to the project. These funds have been allocated to the project in the statutory accounts of the company, which have been signed off by its auditors and announced to the Australian Stock Exchange. Orica is required to publish details of expenditure in its annual report (including auditor comment). For these reasons Orica did not support the lodgement of a financial assurance.

DEC has maintained a strong regulatory approach with respect to Orica to ensure groundwater is appropriately remediated. It regulates the site through an existing EPA licence and Notice of Clean Up Action issued under the POEO Act. These publicly available statutory instruments are legally binding on Orica. Should Orica fail to comply with these requirements DEC has a range of powers available to take appropriate regulatory action in accordance with the EPA Prosecution Guidelines.

The contamination is also regulated under the Contaminated Land Management Act. As stated in Section 1, the EPA agreed to a series of voluntary investigation and remediation proposals under the CLM Act and proposes to declare land affected by contamination a remediation site. This declaration serves to tag contamination as presenting a significant risk of harm (as defined under the Act). Only when DEC is satisfied that the SRoH caused by the contamination has been addressed, can the declaration be removed.

Under the POEO Act (Section 70 and Part 9.4), DEC can require a financial assurance to secure or guarantee funding for or towards remediation or pollution reduction programs from the occupier of a scheduled (licensed) premises. DEC needs to be satisfied that it is justified having regards to:

- the degree of risk of environmental harm associated with the activities under the licence
- the remediation work that may be required because of activities under the licence
- the environmental record of the holder of the licence or former holder of the licence, or proposed holder of the licence, or
- any other matters prescribed by the regulations (under the Act).

While DEC is satisfied that Orica has the funds set aside for the treatment plant, it cannot be certain about, for example, the commercial or economic factors which may affect Orica's financial or legal capacity to operate the plant for the entire period of up to 30 years. Therefore, DEC has included a condition to the licence requiring the establishment of a financial assurance to cover the operation of the plant through to completion of the required remediation. It will not cover the initial construction of the plant. The final amount will be determined by the EPA following its consideration of reports from an independent expert and may be reviewed from time to time in line with the remaining works to complete the groundwater remediation.

5 Consideration of key environmental issues

This section outlines the determining authorities' consideration of key environmental issues relating to the current proposal, having regard to information presented in the environmental impact statement and other additional information obtained. Where appropriate, conditions attached to the determining authority approvals reflect action taken to address particular issues.

It should be noted that private individuals who made representations to the environmental impact statement have not been identified in order to maintain their privacy.

5.1 Introduction

The determining authorities have reviewed the EIS and supporting information for the project and duly considered the submissions from government agencies, councils and the public. As a result, the determining authorities have identified the following key environmental issues. A full consideration of each of the issues listed is provided in sections 5.1 to 5.10 of this report.

Issues:
- air quality impacts
- surface and wastewater
- soil and groundwater contamination
- impacts on flora, fauna and heritage
- hazard and risk
- waste management
- noise impacts
- traffic and transport impacts
- socio-economic impacts
- cumulative impacts.

5.1.1 Air quality impacts

5.1.1.1 Sources of emissions.

The EIS has identified the groundwater treatment plant (GTP) as the main source of air emissions from the project. The GTP includes a 20-metre-high stack through which the air stream from the treatment process will be exhausted. DEC requested additional information on fugitive air emissions associated with the GTPt and transfer pipelines to ensure these emissions will be minimised. The EIS has identified each source of fugitive air emissions associated with the GTP and transfer pipeline and provided an assessment of the potential for fugitive emissions to atmosphere from each source. The potential for fugitive air emissions from the GTP and transfer pipelines is considered in the EIS to be negligible.

The EIS has proposed a leak detection and repair (LDAR) program as a mitigation measure for monitoring and minimising fugitive emissions. DEC considers a LDAR Program fundamental to ensure fugitive Volatile Organic Compound (VOC) emissions are minimised and has consequently attached conditions to the licence that requires a LDAR program be conducted over the lifetime of the project.

5.1.1.2 Characterisation of emissions.

Numerous representations raised a range of issues relating to emissions from the GTP as a result of using thermal oxidation to destroy the contaminants in the air stream. These included concerns over the pollutants likely to be discharged to air and a clear need for them to be fully identified and characterised. Of particular interest were pollutants known to be harmful to human health including VOCs, dioxins, furans and polycyclic aromatic hydrocarbons (PAHs).

The EIS has identified the key pollutants to the atmosphere from the proposal will include nitrogen dioxide (NO_2), sulfur dioxide (SO_2), particulates (PM_{10}), carbon monoxide (CO), chlorine (Cl_2), hydrogen chloride (HCl), hydrogen sulfide (H_2S), dioxins and furans, and the following volatile organic compounds (VOCs): 1-2 dichloroethane (also known as ethylene dichloride or EDC), vinyl chloride, trichloroethene, benzene, 1,1,2 trichloroethane, 1,1,2,2 tetrachloroethane, chloroform, carbon tetrachloride, cis-1,2 dichloroethene, tetrachloroethene and phenol.

5.1.1.3 Stack emission limits

The proposed stack emission concentration limits for the GTP are provided in Table 1 together with the corresponding 100th percentile and 97th percentile emission limits from the European Directive on the incineration of waste (European Directive 2000/76/EC). DEC considers the proposed emission concentration limits to reflect the adoption of best practice, as required by Condition 6 of the Notice of Clean Up Action, as they are equivalent to, or more stringent than, the European Directive 2000/76/EC 100th percentile limits. For pollutants not included in the European Directive 2000/76/EC, such as Cl_2 and vinyl chloride, the proposed emission concentration limits are equivalent to other international standards.

Orica has suggested that the proposed emission concentration limits are 90th percentile for pollutants that will be continuously monitored and 100th percentile for pollutants that are monitored manually. DEC does not accept this proposal and has determined that all air emission concentration limits for the GTP in the EPA licence will be set as 100th percentile, regardless of the type of monitoring. The proposed emission concentration limits are equivalent to the European Directive 2000/76/EC 100th percentile limits and were assessed as 100th percentile limits in the air quality impact assessment. DEC has set GTP stack emission concentration limits in the licence for each pollutant based on the information in Table 1.

Table 1 Summary of emission concentration limits

Pollutant	EIS Proposed			European Directive 2000/76/EC			EPA Licence
	Limit	Percentile	100th percentile 30 minute average	97th percentile 30 minute average	Averaging period	100th percentile 30 minute average	100th percentile
NO_X	400 mg/m^3 @ 11% O_2	100th	400 mg/m^3 @ 11% O_2	200 mg/m3 @ 11% O_2	1 hour	400 mg/m^3 @ 11% O_2	400 mg/m3 @ 11% O_2
SO_2	100 mg/m^3 @ 11% O_2	100th	200 mg/m^3 @ 11% O_2	50 mg/m^3 @ 11% O_2	1 hour	200 mg/m^3 @ 11% O_2	100 mg/m^3 @ 11% O_2
CO	100 mg/m^3 @ 11% O_2	**90th**	100 mg/m^3 @ 11% O_2	-	1 hour	100 mg/m^3 @ 11% O_2	100 mg/m^3 @ 11% O_2

Particulates	20 mg/m^3 @ 11% O_2	100th	30 mg/m^3 @ 11% O_2	10 mg/m^3 @ 11% O_2	1 hour	30 mg/m^3 @ 11% O_2	20 mg/m^3 @ 11% O_2
HCl	30 mg/m^3 @ 11% O_2	**90th**	60 mg/m^3 @ 11% O_2	10 mg/m^3 @ 11% O_2	1 hour	60 mg/m^3 @ 11% O_2	30 mg/m^3 @ 11% O_2
Cl_2 [1]	30 mg/m^3 @ 11% O_2	100th			1 hour		30 mg/m^3 @ 11% O_2
Dioxins/ furans [2]	0.1 ng/m^3 @ 11% O_2	100th	0.1 ng/m^3 @ 11% O_2		1 hour	0.1 ng/m^3 @ 11% O_2	0.1 ng/m^3 @ 11% O_2
VOCs	10 mg/m^3 @ 11% O_2	**90th**	20 mg/m^3 @ 11% O_2	10 mg/m^3 @ 11% O_2	1 hour	20 mg/m^3 @ 11% O_2	10 mg/m^3 @ 11% O_2
H_2S	2 mg/m^3 @ 11% O_2	100th	-	-	1 hour	-	2 mg/m^3 @ 11% O_2
Vinyl chloride monomer [3]	10 ppm @ 11% O_2, <50 g/hr	**90th**	-	-	3 hours	-	10 ppm @ 11% O_2,
1,2 Dichloroethane (ethylene dichloride)	-	**-**	-	-	-	-	8 mg/m^3 @ 11% O_2,

Notes:
1. Cl_2 limit is a significant reduction on the requirements under the Clean Air (Plant and Equipment) Regulation 1997 (200 mg/m^3) and is equivalent to the Japanese value.
2. ng/m^3 = nanograms per cubic metre. One nanogram is 10^{-9} grams
3. Vinyl chloride limit of 10 ppm is equivalent to the US limit in the National Emission Standard for Vinyl Chloride for control systems serving vents in vinyl chloride service. An emission limit for vinyl chloride of 50 g/hr is equivalent to the limit in the Californian South Coast Air Quality Management District Rule 11163 Control of Vinyl Chloride Emissions.
4. 100th percentile air emission concentration limit for ethylene dichloride based on the results of the air quality impact assessment

5.1.1.4 Assessment of air emissions and potential impacts

A large number of representations raised concerns about the impact of emissions from the GTP on ambient air quality as a result of using thermal oxidation to destroy the contaminated air stream. These concerns were heightened by the proximity of the proposed plant (and stack) to residences and other sensitive receivers, like child care facilities. Representations raised concerns about potential harmful emissions from the plant, for example dioxins and VOCs, in particular during plant upsets.

Orica has undertaken an air quality impact assessment for the project. In particular, Orica has assessed the air quality impact of the following scenarios:

- normal operation of the GTP for all key air pollutants;
- abnormal operation of the GTP for VOC key air pollutants and H_2S
- normal operation of the GTP and current Botany Industrial Park emissions for NO_2, SO_2, PM_{10}, CO, HCl and Cl_2.

Two abnormal operating scenarios for the GTP have been identified by Orica for which the event occurrence is estimated at once per 50,000 years:

- maximum dioxins concentration increases to 0.5 ng/m^3 due to a fault with the temperature control at the same time as a failure of automatic shutdown system linked to low temperature monitor and failure of other indicators of incorrect operation or not responded to by operator
- effective destruction of the contaminants minimal due to low temperatures in the thermal oxidiser at the same time as a failure of automatic shutdown system linked to low temperature monitor and failure of other indicators of incorrect operation or not responded to by operator.

DEC is generally satisfied that the air quality impact assessment has been conducted in accordance with the requirements of the *Approved Methods and Guidance for the Modelling and Assessment of Air Pollutants in NSW*. For each scenario, Orica has predicted ground-level concentrations of the key pollutants at 14 discrete receptors and outside the boundary of the premise using the CALMET/CALPUFF

atmospheric dispersion model. The discrete receptors include schools, a childcare centre, retirement village, sporting venues and residences.

Predicted ground-level concentrations are compared with DEC's impact assessment criteria as specified in the *Approved Methods and Guidance for the Modelling and Assessment of Air Pollutants in NSW*. DEC also compared the predicted ground-level concentrations for the VOC key pollutants against the impact assessment criteria in DEC's *Draft Approved Methods and Guidance for the Modelling and Assessment of Air Pollutants in NSW, 2004*. These updated impact assessment criteria were derived from the Victorian EPA's ground-level concentration criteria, based on more up-to-date information regarding the health effects of pollutants. The results of the impact assessment for each scenario are summarised in Table 2 together with the DEC and Draft DEC impact assessment criteria.

Table 2 Summary of air quality impact assessment results

Pollutant	DEC Impact assessment criteria		Draft DEC impact assessment criteria ($\mu g/m^3$)	Maximum predicted ground-level concentration		
	Averaging period	Concentration ($\mu g/m^3$)		Normal operation of GTP ($\mu g/m^3$)	Abnormal operation of GTP ($\mu g/m^3$)	Normal operation of GTP and current BIP emissions [1] ($\mu g/m^3$)
Nitrogen dioxide	1 hour	246	N/A	63	N/A	144 [2]
	annual	62	N/A	0.8	N/A	27 [2]
Sulfur dioxide	10 minutes	712	N/A	22	N/A	671
	1 hour	570	N/A	15.6	N/A	469
	24 hours	228	N/A	2	N/A	85
	annual	60	N/A	0.2	N/A	26
PM_{10}	24 hours	50	N/A	0.5	N/A	37
	annual	30	N/A	0.04	N/A	19
Carbon monoxide	1 hour	30 mg/m^3	N/A	15.6	N/A	111
	8 hour	10 mg/m^3	N/A	4.6	N/A	37
Chlorine	3 minute		N/A	3.7	N/A	15
Hydrogen chloride	3 minute		N/A	3.7	N/A	19
Hydrogen sulfide [3]	nose response	1.38	N/A	1.2	73 [4]	
Ethylene dichloride [5]	3 minute	6700	130	3.72	6426	N/A
Vinyl chloride [5]	3 minute	100	43	0.13	227	N/A
Trichloroethene [5]	3 minute	NA	900	0.16	274	N/A
Benzene [5]	3 minute	100	53	0.02	31	N/A
1,1,2 Trichloroethane [5]	3 minute	1500	1800	0.02	31	N/A
1,1,2,2 Tetrachloroethane [5]	3 minute	NA	NA	0.03	55	N/A
Chloroform [5]	3 minute	1590	1600	0.11	190	N/A
Carbon tetrachloride [5]	3 minute	1100	21	0.35	599	N/A
cis-1,2 Dichloroethene [5]	3 minute	NA	26300	0.03	49	N/A
Tetrachloroethene [5]	3 minute	NA	11200	0.30	516	N/A
Phenol [5]	3 minute	36	36	$5.1x10^{-5}$	-	N/A

Notes:
1. Concentrations are based on predicted ground-level concentrations in the EIS and so does not include the revised GTP stack design. Revised design of the GTP includes a higher stack and increased stack exit velocity, which will result in a greater dispersion of pollutants.
2. NO_2 concentrations are maximum predicted at a nearest sensitive receptor.

3. H_2S concentrations are maximum 99th percentile predicted at the nearest sensitive receptor and do not include revised GTP stack design.
4. The H_2S impact assessment criteria of 1.38 μg/m^3 is not appropriate for atypical operation of the groundwater treatment plant. Odour threshold for H_2S is 6.3 μg/m^3 and health effects (eye irritation) occur at 42,000 μg/m^3.
5. Predicted concentrations are 99.9th percentile.

The results of the impact assessment indicate:

- Normal Operation of GTP:
    - all predicted ground-level concentrations comply with DEC and Victorian EPA impact assessment criteria
    - most significant GTP air emission is hydrogen sulfide and the maximum H_2S ground-level concentration at a sensitive receptor is 87% of the assessment criterion
    - based on DEC's draft impact assessment criteria, the most significant VOC emission from the GTP is ethylene dichloride, being 3% of criterion. The air quality impact assessment in the EIS concluded that vinyl chloride was the most significant VOC emission from the GTP based on DEC's impact assessment criteria.
- Abnormal Operation of GTP:
    - predicted ground-level concentrations of vinyl chloride exceed the DEC and draft DEC impact assessment criteria
    - predicted ground-level concentrations of ethylene dichloride and carbon tetrachloride exceed the draft DEC impact assessment criteria
    - H_2S odours are likely to be detected at the discrete receptors, however, no adverse health effects would be expected.
- Normal Operation of GTP and current BIP emissions:
    - all predicted ground-level concentrations comply with DEC impact assessment criteria.

DEC is generally satisfied that Orica has undertaken an appropriate air impact assessment for the proposed development and adequately demonstrated the project can achieve DEC's environmental outcomes for air quality.

This determination is also supported by independent assessments of the air emissions by John Court & Associates Pty Ltd and the US EPA. Court & Associates states that the air quality impact has been appropriately and adequately assessed in the EIS by dispersion modelling and all relevant pollutants are within ambient guidelines and/or health criteria during normal operations.

As stated in Section 4.2.2 of this report, predicted dioxins ambient concentrations from the plant operation are very low in comparison to urban dioxins levels and ambient guidelines. The US EPA also states that the proposed selection of air stripping and thermal oxidation is based on reliable technology and a proven capability to meet emission standards. Both also provided advice on operational and monitoring requirements that have subsequently been taken into account in DEC's requirements for the project.

DEC has attached licence conditions such as emission concentration limits for the GTP stack and either continuous or periodic monitoring for all key pollutants. These conditions will ensure the plant is continually performing at or exceeding international best practice and not resulting in adverse local air quality impacts. The basis for the licence conditions are specified below:

- GTP stack 100th percentile air emission concentration limits for Cl_2, HCl, NO_X, solid particles, total VOCs, dioxins and furans, CO, SO_2, H_2S and vinyl chloride based on the proposed limits in Table 1;
- GTP stack 100th percentile air emission concentration limit for ethylene dichloride based on the results of the air quality impact assessment
- continuous HCl, total VOCs, CO, vinyl chloride and 1,2-dichloroethane monitoring to ensure the GTP is continually achieving the stated performance for these pollutants. Continuous monitoring of total VOCs and CO is also a surrogate for continuous monitoring of combustion performance and hence destruction of contaminants

- quarterly monitoring for Cl_2 , H_2S, NO_2 to ensure the GTP is achieving the stated performance for chlorine
- monthly monitoring for the first six months then quarterly thereafter for solid particles and SO_2 to ensure the GTP is achieving the stated performance for these pollutants
- monthly monitoring for the first six months and then bimonthly afterwards for dioxins and furans to ensure the GTP is achieving the stated performance for these pollutants
- Meteorological monitoring (wind speed and direction) at a representative location in accordance with recognised standards.
- lower limits on the residence time and operating temperature of the thermal oxidation unit to maximise the destruction of VOCs and related substances based on the stated operating conditions in the EIS
- continuous monitoring of thermal oxidiser operating temperature and flow rate of exhaust stream (residence time) to ensure the destruction of VOCs is maximised at all times
- implementation of a VOC leak detection and repair (LDAR) program to ensure fugitive emissions are minimised
- air emission validation program to ensure the GTP is achieving the stated performance during processing of all contaminated streams.

5.1.1.5 Preventing odours

The EIS has assessed the potential for odour formation. The raw groundwater is odorous due to the presence of sulfur compounds and organic acids. The EIS states that the off-gas treatment (thermal oxidation plus scrubbing) will remove sulfur compounds below the odour threshold. The organic acids will not be stripped out of the groundwater into the off-gas stream to any significant extent and would be treated in the groundwater treatment system, in particular capture in the activated carbon circuit.

In assessing this information DEC has taken into account an independent review by Court & Associates of the odour potential for the project. It states that the raw groundwater has considerable odour potential. While the thermal oxidiser, quench or scrubber train should not generate odour problems, care will still be needed in managing odours at every stage of pumping, processing and subsequent treatment and management of the treated groundwater. Some of the aspects that will need careful consideration include:

- minimising and testing for flange leakage
- minimising and containment of pump seal leakage
- controlling vapour and gas venting from all holding and processing vessels
- a mechanism for containing liquids and gases from maintenance operations when pipe and plant containing odorous liquids are opened
- monitoring the odour level of treated water finally released to surface waters.

The determination has concluded that the groundwater treatment system can be designed and operated to ensure it does not cause off-site odours. This performance requirement is also a condition of the current EPA licence for Orica. DEC has attached a condition requiring the odour predictions for the project to be validated after plant commissioning to demonstrate compliance with this requirement.

As a further safeguard, DEC has also attached conditions to the licence in relation to this project, including a requirement for Orica to undertake a VOC leak detection and repair program to detect and minimise fugitive VOC emissions from the groundwater treatment plant and associated plant and equipment. In addition an overall odour detection program has been required to identify and prevent unanticipated odour sources.

5.1.1.6 Greenhouse gases

Several submissions from the public raised issues associated with increases in the emission of greenhouse gases, principally carbon dioxide. This results mainly from electricity consumption required from groundwater extraction (pumping) and the operation of the natural gas burners within the thermal oxidation unit.

The EIS has assessed greenhouse emissions for the project and explored mechanisms whereby the emission of greenhouse gases could be managed and/or mitigated. This includes improvements in energy efficiency at its Botany plant and other plants in Australia, optimising pumping rates and using energy efficient lighting. The primary objective of the project is to achieve hydraulic containment and to maximise the destruction capacities of the contaminants. Orica has stated it will continue to investigate and implement measures to balance greenhouse gas savings against the requisite destruction efficiencies.

5.1.2 Surface and Waste Water Impacts

Some representations indicated concerns about the impact of discharges from the groundwater treatment plant on Bunnerong Canal, Penrhyn Estuary and Botany Bay. This included its effect on recognised environmental values like recreational water quality (Botany Bay), protection of aquatic ecosystems (Penrhyn Estuary) and resource potential (groundwater). Orica has identified a number of potential impacts during the construction and operation of the GTP.

5.1.2.1 Construction

The determination has concluded the EIS adequately identifies the potential impacts and mitigation measures to minimise the construction phase impacts to surface waters. This includes the preparation and implementation of a construction environmental management plan.

5.1.2.2 Discharge from GTP

5.1.2.2.1 Discharge to waters

Orica's preferred option for the water treatment post-air stripping, as outlined in the EIS, consists of an iron removal step; an organics polishing step; a reverse osmosis step for part of the water stream and an ammonia/organics acid removal step for the other part of the water stream.

Treated water that is not recycled (up to 7.5 million litres per day) will be transferred by an existing pipeline and discharged into Bunnerong Canal. This canal flows to Brotherson Dock and Botany Bay. The pipeline has a maximum hydraulic capacity of up to 12 million litres per day (equivalent to 0.14 metres cubed per second (m^3)). While the objective is to maximise the reuse of this high quality water, if this is not possible, Orica is seeking approval to discharge up to this capacity. There will be no discharges from the groundwater treatment plant to Penrhyn estuary.

Appropriately detailed construction drawings and associated management measures will need to be provided on the discharge. The agreement of Sydney Ports Corporation (as the affected landowner) to the design and operation of the discharge will be required. This will specify the terms and conditions by which Orica can use the canal. A permit will also be required from NSW Maritime under the *Rivers and Foreshores Improvement Act 1948* for works associated with the construction of the discharge point at Bunnerong Canal.

The EIS details the quality of water expected to be discharged to Bunnerong Canal. Both water quality modelling and monitoring studies were used to establish existing and future water quality conditions to assess the potential impacts of the plant. The predicted conditions were compared against community expectations for these waterways, using the 2000 ANZECC water quality guidelines to establish appropriate water quality objectives.

The determining authorities consider it is important to establish links between the system performance (eg discharge limits) and environmental performance (receiving water quality) so that the system can be adaptively managed for optimal performance. The following table (Table 3) lists the values DEC will establish as licence limits to meet recognised water quality guidelines.

Table 3 Water Discharge limits for EPA licence

Parameter	**Water discharge licence limits (mg/L unless otherwise specified)**
pH	7-8.5
1,2-dichloroethane	1.9
Carbon tetrachloride	0.24
Tetrachloroethene	0.07
Trichloroethene	0.33
Vinyl chloride	0.10
Benzene	0.95
Toluene	0.18
Arsenic (total)	0.023
Cadmium	0.0007
Chromium (total)	0.0044
Copper	0.0013
Iron	0.3
Lead	0.0044
Mercury	0.0001
Nickel	0.007
Zinc	0.015
Ammonia as N	0.015 (see note below)
Total Phosphorous	0.01 (see note below)
BOD	10
Turbidity	5 NTU (see note below)
Manganese	0.08
Chloroform	0.37
Total N	0.1 (see note below)
Oxidised nitrogen	0.015 (see note below)
Free reactive phosphorus	0.005 (see note below)
Temperature	15 to 25 degrees Celsius

Note These are the ANZECC ambient guidelines which should be met after the final discharges mixes with the receiving waters. Once final details on the treatment technology and the design of the discharge structure are received these will be converted to discharge limits on the EPA licence.

The EPA licence limits are based on ANZECC marine water quality guidelines, which are designed to protect aquatic ecosystems from both physical and chemical stressors. This includes Physical and Chemical Stressors (Section 3.3 of ANZECC) and Water Quality Guidelines for Toxicants (Section 3.4 of ANZECC)

With respect to nutrients the licence limits listed also take into account the relevant water quality objectives in the *Healthy Rivers Commission Statement of Intent for the Georges River - Botany Bay system* (2002).

Concentration limits for each specified pollutant have been included in the environment protection licence based on the above. DEC has also included a requirement for Orica to undertake a water discharge validation program. The program is intended to ensure that Orica demonstrate that the plant is capable of achieving the limits specified in the licence and the range of water pollutants monitored is continually reviewed and modified where necessary to ensure that Orica is capable of detecting the presence of pollutants not already specified in the licence. The program must be developed and implemented by Orica in consultation with the determining authorities.

In addition to the source monitoring outlined above, the determining authorities have required Orica to undertake ambient environmental monitoring. The program will include ambient water quality and sediment quality and distribution, including initial baseline measurements in and around Bunnerong Canal, Brotherson Dock, Penrhyn Estuary and adjacent areas of Botany Bay. The program must be developed and implemented by Orica in consultation with the determining authorities.

While the discharge flow rate is expected to be 7.5 million litres per day with reuse, the EIS states Orica is seeking approval for discharge of up to 12 million litres per day, if full reuse is not possible in and around Botany Industrial Park. The figure of 12 million litres is based on the maximum hydraulic capacity of the pipeline from the groundwater treatment plant to Bunnerong Canal. This determination concludes that approval be given for a discharge of up to 12 million litres per day (equivalent to 0.14 m^3 per second) however the objective must be to maximise reuse of this high quality water at all times (see Section 5.1.2.2.3 below). Flow limits will be included in the EPA environment protection licence and permission from Sydney Ports Corporation.

The determination has required as a condition of approval that the discharge structure and location (including initial dilution of the discharge) as well as discharge frequency and timing be designed and optimised to achieve the best environmental performance in consultation with the determining authorities. This is to ensure that discharge will result in minimal environmental impacts, for example scouring of sediments. Orica will be required to cease any discharge into the canal if it is essential for the determining authorities to conduct maintenance on the canal, maintain port operations or respond to emergencies; or in the event of pollution incidents.

DEC may vary the limit and monitoring requirements on the EPL subject to the findings and recommendations of the above program. Should this monitoring indicate adverse impacts to the environment, Orica will be required to develop appropriate mitigation and/or management measures in consultation with the determining authorities and implement these within an agreed timeframe.

The determination has concluded that the water impact assessment for the proposed development has enabled decisions to be made on the specific discharge limits for water pollutants and a water discharge validation program to ensure that the plant can be operated within the appropriate ambient environmental limits.

5.1.2.2.2 Trade waste

All industrial and commercial customers discharging trade waste into Sydney Water wastewater systems must obtain written permission from Sydney Water. Trade waste requirements help to ensure that Sydney Water can discharge or reuse wastewater in a way that protects employee safety and the environment, and complies with regulatory requirements. Depending on the type of business and trade waste, Sydney Water will either issue a trade waste permit or enter into a trade waste agreement.

Orica currently has approval to discharge 6 ML per day of trade wastewater to sewer from the Botany Industrial Park. Sydney Water has provided Orica with preliminary approval to discharge an additional 1.5 ML per day during dry weather conditions only, to be confirmed in light of any potential future demand on the carrier. Any proposals for adjustments to the trade wastewater discharges from the Orica site will be assessed by Sydney Water, in terms of wastewater quality and quantity, and its impact on the limited capacity of the Malabar Sewage Treatment System. Any adjustments to the current Sydney Water trade waste requirements will need to be met by Orica.

The EIS identifies wastes that will be discharged to the sewerage system operated by Sydney Water, principally spent caustic solution from the wet scrubbers on the GTP. Orica will need to apply to Sydney Water for a variation to this agreement to allow this project to proceed.

5.1.2.2.3 Reuse of treated water

Sydney Water and Orica are discussing options available for the potential reuse of treated groundwater from the site. Orica has advised that it has received in-principle government support for the sale of recycled water and is in the process of investigating potential markets for its use. Sydney Water has provided Orica with detailed information regarding potential recycled water options in the Botany area, including likely future demand. Further discussions between Sydney Water and Orica are anticipated on matters including timing, and the quality, volume and price of the recycled water.

Given the high quality of the treated effluent from the GTP, the determining authorities view this as a resource for utilisation rather than a waste for disposal. We encourage the reuse of this wastewater where it is safe and practicable to do so and provides the best environmental outcome. DEC has attached a condition on the licence which requires the preparation of a GTP water reuse strategy. This strategy must include investigations to beneficially reuse waters from the GTP and reduce the amount of water discharged to Botany Bay.

5.1.2.2.4 Stormwater

The determination has concluded that, on the basis of the information provided in the EIS, the proposed development would not significantly alter the quantity or nature of surface water runoff from BIP. A first flush stormwater system will be installed, designed to catch the first 15 mm of rain over the relevant hard surfaced areas. Soil and erosion control measures during construction will be addressed in more detail in the construction environmental management plan.

5.1.3 Soil and groundwater contamination

5.1.3.1 Groundwater

The project allows for the enhanced ability of Orica to clean up contaminated groundwater and meet the requirements of the EPA Notice of Clean Up and ensure the protection of human health and the environment.

Extensive environmental investigations and groundwater monitoring undertaken by Orica since the 1980s have revealed an extensive and complex distribution of volatile chlorinated hydrocarbon (CHC) contamination derived from multiple source areas. Further information is provided in Section 2. Orica has commissioned hydrogeological and surface water modelling and assessment, the findings of which are presented in the EIS. This includes Hydraulic Containment of Groundwater and Hydraulic Assessment of Bunnerong Canal (Appendices D and E of the EIS)

The determining authorities have reviewed the EIS and supporting studies including the report, *Optimal Groundwater Abstraction Rates For Hydraulic Containment Of Contaminant Plumes and Source Areas* dated October 2004 and prepared by Dr N P Merrick from the National Centre for Groundwater Management (University of Technology, Sydney). It is noted that this latter report also has been independently peer reviewed. The peer review report strongly endorses the findings of the hydraulic containment groundwater simulation study undertaken by Dr Merrick.

The primary aim of modelling was to assist in the design of the remediation system by providing best estimates for required extraction rates, bore locations and screen intervals. It also assisted in determining the capacity requirement of any treatment option. The modelling was adequate in relation to all these objectives.

The determining authorities consider that the proposed extraction borefields, once commissioned for production purposes (to deliver 15 million litres per day to the groundwater treatment plant), should achieve hydraulic containment of the plumes. Intended conditions for a licence under the Water Act have been prepared (Appendix B). They require Orica to carefully monitor groundwater level behaviour with pumping and to minimise any potential adverse environmental impacts, as well as reporting the effectiveness of the cleanup. The determining authorities consider that groundwater monitoring to determine the applicability of models to reality is critical and a comprehensive monitoring program will be an integral component water of the water extraction permit issued by DIPNR.

Some representations raised concerns about saltwater (sea water) intrusion resulting from the extraction of groundwater and its resultant impact on sensitive habitats such as Penrhyn Estuary. Orica has evaluated potential impacts of saltwater intrusion and stated they will not be significant. While the determining authorities have accepted these findings it is recognised that saltwater intrusion is difficult to estimate and model. For this reason the determining authorities have requested that saltwater intrusion be carefully monitored. The groundwater simulation study undertaken by Dr Merrick indicates that some saline intrusion into the sand bed aquifer is likely, due to pumping from the secondary containment line. This will be particularly the case when the nearby drains are dry and for any prolonged interception pumping. The deeper aquifer system is likely to be impacted due to migration and upconing of the saline interface that occurs near Botany Bay as a consequence to intensive pumping. However, careful optimisation of pumping rates will mitigate the negative impacts of saline intrusion. Monitoring of saline intrusion will be required as a condition of the Water Act licence.

The determining authorities consider that failure to contain and remediate the polluted groundwater would cause a far more serious environmental impact than any negative saline intrusion effects to the Botany Sands Aquifer that may be induced by pumping from the containment line borefields. Moreover, the impact of any saline intrusion is likely to diminish once pumping is no longer necessary.

5.1.3.2 Soils

Some submissions raised issues relating to the need for careful management of contaminated soil, in particular on the site of, and during the construction of the groundwater treatment plant.

Orica undertook a soil investigation program to collect of samples from the proposed GTP site. Contaminants assessed were those associated with historical activities on and around that part of the site, including 1,2- dichloroethane; vinyl chloride; carbon tetrachloride; tetrachlorothane; trichloroethane; hexachloroethane and hexachlorobutadiene. In addition to these chlorinated hydrocarbons, metals such as mercury and chromium as well as total petroleum hydrocarbons (TPH) were also investigated. In undertaking this assessment, Orica used the EPA's *Guidelines for Assessing Service Station Sites,* NEPM (Assessment of Contamination) Schedule B1 – *Guideline on the Investigation Levels for Soil and Groundwater, Health Investigation Level (HIL) F (Commercial/Industrial)* and the EPA's *Assessment, Classification and Management of Liquid and Non-liquid Wastes* (EPA 1999) where relevant. No

contaminants were identified above the guideline value in any of the soil samples for the proposed groundwater treatment plant plot. In all cases concentrations of identified contaminants were below the appropriate investigation levels.

It is important to note that conservative assumptions apply within these guidelines. For example, the *Guidelines for Assessing Service Station Sites* (EPA Guideline) identifies TPH concentrations for sensitive land uses such as residential development, which are therefore considered conservative for commercial/industrial land uses. The *Assessment, Classification and Management of Liquid and Non-liquid Wastes* describes the values of contaminants in materials allowed to be disposed of.

Orica states that, with appropriate dust suppression measures, potential migration of the contaminants off-site would be minimised and would not be expected to result in any significant off-site impacts. All excavated material is proposed to be tested for contamination. DEC has requested that this include hexachlorobenzene. While it is not proposed to take any soils from the site during construction, should the need arise the material would need to be tested further to ensure it met the inert classification of waste, prior to off-site disposal, in accordance with the conditions of the Orica's existing Environment Protection Licence. These aspects will be addressed in more detail in the construction environmental management plan to ensure all contaminated material is appropriately identified and managed.

5.1.3.3 Acid sulfate soils

Some submissions raised issues relating to acid sulfate, in particular in regard to Penrhyn Estuary, and the need for testing to ensure acid drainage does not occur from this project. Investigations by Orica indicate that acid sulfate soil conditions are not expected to be present. This is because the estuary was formed artificially through land reclamation in the 1970s for the port development. The EIS states acid sulfate soils are possibly present in and around Botany Industrial Park, although this is expected to be limited on the proposed groundwater treatment plant site.

The determination concludes that, as recommended in the EIS, an acid sulfate soil management plan be prepared and implemented to provide an approach for the management of acid sulfate soils during construction. As a further safeguard, Orica will maintain regular inspection of disturbed soil and groundwater quality, and inspection procedures are detailed within the construction and operational environmental management plans.

5.1.3.4 Subsidence

Some representations raised concerns about subsidence from the extraction of groundwater. The issue of groundwater pumping affecting residential properties or infrastructure was addressed in the EIS. This included a groundwater simulation report. This included the base case (ignoring prior consolidation) as well as likely and worst case scenarios (taking into account prior consolidation).

Most areas in the vicinity of the extraction borefields area are expected to have experienced consolidation of the sand bed aquifer due to prior groundwater level fluctuation, particularly in the 1960s and 1970s due to heavy groundwater pumping in the Botany area in those years. Very minor subsidence is identified in the scenarios that take account of prior consolidation.

The likely case prediction indicates a maximum of 0.9 mm on Foreshore Road and 0.1 mm on Botany Industrial Park. Hence, risk of subsidence (also termed settlement in geotechnical reports) impacting on structures including residential properties is considered to be negligible or very low.

Notwithstanding, Orica will be required as a condition under the DIPNR water extraction licence to install suitably located settlement monitoring stations to validate these predictions and ensure adverse impacts do not occur.

5.1.4 Impacts on flora, fauna and heritage

5.1.4.1 Threatened species

An assessment of terrestrial flora and fauna was included in the EIS. Additional studies were also conducted on groundwater modelling and behaviour in and around Penrhyn Estuary and the adjoining salt marsh communities to better understand the physical and chemical conditions that would be present in subtidal sand, intertidal sediments and saltmarsh and mangrove communities during the extended period of groundwater extraction. An eight-part test for the saltmarsh community at Penrhyn Estuary was also undertaken. Significant areas in the study area included:

- Botany Wetlands, including Lachlan swamps to the north and west of BIP;
- Penrhyn Estuary, including saltmarsh to the south-west of BIP
- Foreshore Beach to the west of BIP.

The potential impacts on these areas included changes to the groundwater flows from the operation of the groundwater extraction and treatment system.

There are a number of endangered ecological communities (EECs) listed under the *Threatened Species Conservation Act 1995* (TSC Act) and the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) located near BIP, however no EECs were found on the BIP or the proposed site of the groundwater treatment plant.

Thirteen species of terrestrial flora listed under the TSC Act and the EPBC Act have been recorded in the study area. However, Orica identifies that no plants would be expected to occur on the site of the proposed groundwater treatment plant and associated infrastructure, due to the lack of suitable habitat.

There are 86 species of terrestrial fauna listed under the TSC Act and the EPBC Act that have been previously recorded in the vicinity of the study area or have been predicted to occur within the study area. Of particular significance is the shorebird habitat at Penrhyn Estuary. Twenty four species of resident and migratory shorebirds listed under the TSC Act and EPBC Act are known to occur or have previously been recorded at Penrhyn Estuary. Of these seven are listed as vulnerable and one, the Little Tern, as endangered under the TSC Act.

In addition, 22 shorebird species found in the study area have been listed under international agreements (the Japan-Australia Migratory Bird Agreement and the China Australia Migratory Bird Agreement) and 23 under the Bonn Convention of Migratory Animals.

The above studies indicate that none of the listed species would be expected to occur on the site of the groundwater treatment plant and associated infrastructure due to the lack of suitable habitat, and that there are no threatening processes listed under the various Acts at the site. The determination considers that the methodology applied enabled conclusions to be made on the conservation value of the area, the extent of likely impacts associated with the proposal and the appropriate mitigation measures.

Orica concludes that the proposal would not directly impact terrestrial flora or fauna within the Botany Industrial Park due to the absence of native vegetation and suitable habitat for fauna on site. It is understood that no significant vegetation is located along the pipeline routes and existing or proposed borefields. The determination concludes that the site for the proposed groundwater treatment plant is well within the boundary of the existing Botany Industrial Park as well as being highly disturbed, so its construction will not cause any significant impacts on flora or fauna nearby to the BIP.

Several submissions raised issues associated with impacts to the flora and fauna in nearby habitats and saltwater (sea water) intrusion resulting from the extraction of groundwater extraction. The effects of groundwater extraction and risk of saltwater intrusion was assessed in the EIS and supporting documents.

It is understood that Penrhyn Estuary, the associated areas of saltmarsh and Foreshore Beach are dominated by tidal water exchange and rainwater infiltration. As such these communities are predicted to be unaffected by groundwater interception. In reaching this position, the determination has taken into account an eight-part test undertaken for the saltmarsh and Penrhyn Estuary which concluded that it would be unlikely for the works to have an adverse impact on these EECs.

The determination concludes that extracting polluted groundwater will remove the current risk of contaminant discharge to Penrhyn Estuary and the potential negative impacts on commercial, recreational and ecological activities within Penrhyn Estuary and Botany Bay.

One submission indicated the need for the proposal to be referred to Department of Environment and Heritage (Commonwealth) under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act). This issue has been addressed in the EIS and supporting information. No species listed under international agreements would be sufficiently significantly affected to warrant a formal referral to the Department of Environment and Heritage with regard to the species listed under the EPBC Act. In reaching this view, the determination has also noted that Orica referred the proposed activity to the DEH for comment. DEH has responded in writing and it is not a 'controlled action' and therefore will not require approval under the EPBC Act.

The mitigation measures proposed in the EIS to protect sensitive areas from groundwater extraction are considered appropriate for the proposed activity to ensure the potential environmental impacts are appropriately managed and that no significant impact arises. The determination recognises that salinity intrusion can be difficult to estimate due to the complex nature of these systems, and there are limitations to the models used and assumptions made. As recommended in the EIS, it is important that an extensive monitoring program be developed and implemented to enable detection of changes in the ecology of estuarine communities due to groundwater interception or saltwater (sea) intrusion, to determine the applicability to reality of the model and to ensure adaptive management so that any unforeseen environmental impacts can be prevented. This is supported by a number of submissions that encouraged regular groundwater monitoring.

The determination concludes that a comprehensive ambient environmental monitoring program and groundwater monitoring program will be an integral component of the EPA environment protection licence and water extraction permit issued by DIPNR. These programs must be developed and implemented by Orica in consultation with the nominated authorities. The monitoring programs must also take into account the potential cumulative impacts of Orica's proposal on the works proposed by Sydney Ports as part of the proposed Port Botany Expansion. Should this monitoring identify issues that require addressing appropriate management and/or mitigation measures will be developed in consultation with these agencies as required.

While the DEC consider that there are a range of management options available, for example, the refinement of groundwater extraction rates at individual extraction bores, all works should stop immediately should the project result in an unexpected and previously unidentified disturbance to a threatened species listed under the *Threatened Species Conservation Act 1995* and the DEC should be consulted immediately. Works must only proceed once DEC is satisfied that all appropriate measures have been undertaken to minimise impacts to threatened species

5.1.4.2 Aboriginal and cultural heritage

An archaeological and cultural heritage assessment for the project was undertaken and included in the EIS. No Aboriginal sites are recorded as occurring within the development site. Orica therefore asserts that, due to the extensive disturbance as a result of industrial activities and landfilling, the potential for the area to include Aboriginal archaeological sites or objects is predicted to be low.

The proposed development is expected to have a negligible impact on the industrial heritage significance of the site, as the industrial character would be maintained.

The determination has concluded that the methodology applied to undertake the Aboriginal and cultural heritage assessment for the EIS enable the above conclusions to be made.

If any Aboriginal objects are uncovered during the proposed activity, through excavation or disturbance of the area, all work likely to affect the site is to stop immediately and the DEC is to be informed.

If any evidence of previously unidentified non-indigenous heritage items and/or archaeological objects are found, all work likely to affect the site(s) must cease immediately and, in accordance with section 146(a) of the *Heritage Act 1977* the Heritage Council be notified within a reasonable time of the discovery or location of any objects.

5.1.5 Hazard and risk

5.1.5.1 Land use safety planning

The EIS for the proposed development includes a Preliminary Hazard Analysis (PHA), consistent with the requirements of *State Environmental Planning Policy No. 33 – Hazardous and Offensive Development* (SEPP 33). The requirement for a PHA was triggered by characterisation of the proposed activity as 'potentially hazardous' within the meaning of SEPP 33. That is, in the absence of all risk-mitigating measures (including separation of the proposal from other land uses), the proposed activity has the potential to exert a significant risk to human health, life or property, or to the biophysical environment generally. The purpose of the PHA was to demonstrate that sufficient risk-mitigating measures exist, and are proposed to be implemented, to reduce this potential risk to an acceptable level, thereby ensuring that the activity would not be considered 'hazardous' within the meaning of SEPP 33.

The PHA presents a screening of potential hazards on the site, and identifies that key hazards are associated with stored volumes of class 8 dangerous goods (hydrochloric acid and sodium hydroxide), the storage and handling of ethylene dichloride waste (class 3, subsidiary class 6) and the use of natural gas within the activity (only process inventories proposed). A hazard identification process is presented to consider, in a qualitative sense, the likely significance of possible incidents on the site. Of all credible incidents considered, fifteen were established as representing significant potential for off-site consequences:

- emission of dioxins from the thermal oxidiser
- failure of thermal oxidiser piping
- natural gas jet fires impinging on stored EDC
- failure of natural gas piping
- explosion within the thermal oxidiser
- incorrect operation of the thermal oxidiser
- release of EDC from the stack
- inadequate scrubber operation
- full or partial scrubber failure
- release of recovered EDC
- pipework corrosion and material release
- boiling liquid expanding vapour explosion (BLEVE)
- exposure to EDC
- sabotage/terrorism
- knock-on effects from incidents at adjacent development.

Where the above incidents posed the potential for chronic risks (human health), such as the emission of dioxins from the activity, consideration was carried forward for assessment as part of the human health risk assessment in the EIS. In the case of acute risks (those associated with a short-term event, with immediate or near-immediate effects), incidents were carried forward for further assessment in the PHA.

The off-site consequence of each of the incidents identified above is considered further in the PHA, with quantification where relevant, to establish which scenarios have the potential to generate a significant impact. In general, the PHA demonstrates that incidents involving natural gas fires and explosions would not generate a significant off-site consequence, either through heat radiation or explosion overpressure effects. In the case of scrubber failure scenarios, the most credible mode of consequence effect is fatality, injury or irritation from the release of hydrogen chloride. However, this mode of action is demonstrated to pose little consequence within the Botany Industrial Park or at the closest residential receptors.

There is potential for a BLEVE involving ethylene dichloride on the site to affect other land uses within the Botany Industrial Park through human fatality, but the heat and overpressure effects of such an event are considered unlikely to affect structural integrity. Effects out-site the Botany Industrial Park are demonstrated to have negligible consequence in terms of fatality, injury or irritation.

The most significant incidents identified through the PHA relate to leaks/releases of materials between the thermal oxidiser and the stack for the development. Under these circumstances, hot gases are released near to ground level, containing irritants including ethylene dichloride and hydrogen chloride. Consequence analysis in the PHA suggests that hydrogen chloride, in particular, would generate a significant consequence at the boundary of the Botany Industrial Park in such an event, primarily through injury or irritation. Fatality consequences are demonstrated to be negligible, as are the consequences of EDC effects at the park boundary.

Potential incidents with significant off-site consequences are considered further in the PHA through analysis of potential incident frequencies, from which ultimate risk impacts are calculated. From this analysis, the PHA demonstrates that land use safety planning criteria stipulated in *Hazardous Industry Planning Advisory Paper No. 4 – Risk Criteria for Land Use Safety Planning* (HIPAP 4) are met. In this regard, fatality, injury and irritation risk criteria are met for surrounding land uses, including residential and sensitive receptors. Fatality risk is estimated to be in the order of 1×10^{-7} at the boundary of the Botany Industrial Park (well below the most stringent criterion of 0.5×10^{-6} for sensitive receptors) and negligible at the closest off-site receptors. Fatality risk within the Botany Industrial Park is 500 times below the acceptable industrial land use criterion. Injury risks are similarly well below acceptable levels, with heat injury effects demonstrated to be negligible and toxic injury risk in the order 1×10^{-6} (one-tenth of the acceptable residential criterion). Toxic irritation is less than half the residential criterion, estimated at 21×10^{-6}.

The PHA also considers and demonstrates that risks associated with knock-on effects, property damage, societal effects, cumulative effects and transport are all negligible.

A number of submissions raise issues of concern in relation to hazards and risk impacts, and for the most part these matters concern chronic risks/human health effects and contingency risks in the event that the proposed activity is unsuccessful in halting the spread of contaminated groundwater. A single public submission raises issues associated with ‘acute’ land use safety planning risks, particularly:

- the risk assessment methodology generally, and the acceptability of the risk assessment and land use safety guidelines developed by DIPNR
- the acceptability of assumptions in the risk assessment, rather than actual data
- the need for independent review of the PHA by an expert chosen by the community.

The Preliminary Hazard Analysis included in the EIS was assessed by the Major Hazards Unit of DIPNR. The unit is the peak land use planning team within the NSW Government, and has provided independent technical review of land use safety risks to inform the decision-making process for the determining authorities.

The unit considers that the PHA has been completed in accordance with DIPNR's relevant risk assessment guidelines, particularly *Hazardous Industry Planning Advisory Paper No. 6 – Guidelines for Hazard Analysis* and *Multi-Level Risk Assessment*. The assumptions and methodology applied to the PHA are considered both robust and appropriate for the derivation of likely land use safety planning implications. While concerns raised in public submissions over the application of assumptions in the PHA are appreciated, the assumptions themselves are the result of considerable engineering and scientific experience. In particular, the assumptions applied in respect of heat and overpressure effects, the toxicity/ irritation potential of combustion products and the failure rates for common plant and equipment are well known. Although no development has been completed with exactly identical features to that proposed by Orica, the distinct components of the proposal (pipes, pumps, scrubbers, thermal oxidisers) and the effects of various hazardous incidents (fires, explosions, toxic effects) are not new. Further, the risk assessment approach applied by Orica through the PHA and advocated by DIPNR is well-known and well-developed as a result of several decades of international engineering experience.

It is noted that the proposed activity would meet relevant land use safety criteria, and in most cases by a significant degree. The dominant risk contribution relates to toxic irritation effects from certain accidental hydrogen chloride release scenarios, however this impact would be less than half of what would be considered acceptable. In the context of strategic land use safety planning, the Major Hazards Unit has assessed the proposed activity against the recommendations and findings of the *Botany/Randwick Industrial Area Land Use Safety Study* (DUAP, 2001) and considers that the proposal is consistent in that regard. In particular, it is highlighted that the proposal would exacerbate current consultation regions for the future case (2001) illustrated in the Study.

Although the proposed activity has been demonstrated as meeting relevant risk criteria, it is important that potential risks are managed in an on-going context. Particularly at the detailed design stage, it is important to fully review and consider the design and implementation of risk-mitigating measures to ensure that the predictions from the PHA are achieved. To this end, the DIPNR Major Hazards Unit has recommended that Orica undertake both a Hazard and Operability Study and a Final Hazard Analysis for the groundwater treatment plant. Both of these measures are commonly applied to potentially hazardous developments to manage risk considerations through detailed design and implementation of a proposal. The Final Hazard Analysis, in particular, provides a mechanism to confirm predictions from the PHA and establish final design for risk mitigation techniques and infrastructure to constrain potential risk impacts to as low as reasonably possible.

As the proposed activity would be implemented within an active industrial area, the Unit has also recommended the preparation of a Construction Safety Study. This Study would ensure that construction and commissioning risks are identified up front and appropriate measures implemented to ensure safe implementation of the proposal.

As a final measure, the unit has also recommended regular hazard auditing of the activity throughout its life to ensure on-going safe operation and identify issues of potential risk as the remediation process progresses. This measure is considered particularly important given the likely timeframe over which the proposal is to be implemented, and the need to ensure public safety and amenity at all times during operation.

5.1.5.2 Human health risk assessment

The EIS includes a human health risk assessment. Several submissions raised questions about the adequacy of the health risk assessment.

The HHRA is generally in accordance with the nationally accepted framework and guidelines published by enHealth in June 2002 (*Environmental Health Risk Assessment : Guidelines for assessing human health risks from environmental hazards*).

The HHRA is based on modelling the expected emission rates of various chemicals of potential concern from the GTP under normal and worst-case conditions. Calculations have been undertaken for worst-case scenarios both in terms of chemical concentration and toxicity and for potential human exposure. The modelled maximum ground-level concentrations of emitted chemicals occur within the BIP, but are used in calculating residential exposure and risk. Given this, the risk assessment is considered to be conservative.

In issuing its licence requirements for the project, DEC took into account the human health risk assessments undertaken by Orica. DEC has required Orica, as part of the notice, to validate the findings of the HHRA based on comprehensive emissions data and emissions validation programs required under the licence. This will include using representative data collected under worst-case scenario operating conditions.

5.1.6 Waste management

Several submissions raised concerns about waste management at the premises and resulting from the proposed development. Some raised concerns about the hexachlorobenzene (HCB) waste currently stored on the Orica premises and awaiting appropriate disposal. Others strongly objected to the creation of any further waste stockpiles on the site.

Key wastes that are generated as a result of the on-going operation of the proposal are provided in the EIS. DEC notes that Orica has existing waste management requirements under the environment protection licence which requires all wastes to be managed appropriately. All wastes must be managed in accordance with the EPA guidelines *Assessment, Classification and Management of Liquid and Non-liquid Wastes*. All wastes will also need to be assessed and transported in accordance with the *NSW Road and Rail Transport (Dangerous Goods) Act 1997* (which adopts the Australian Dangerous Goods Code).

If the wastes are dangerous goods, Orica will also have to comply with the NSW Road and Rail Transport (Dangerous Goods) Act and its Regulations. For example, Regulations made under the NSW Road and Rail Transport (Dangerous Goods) Act require any dangerous goods transport to be in accordance with an emergency plan required under Regulation 14.5(3) of the Road Transport Reform (Dangerous Goods) (NSW) Regulations.

5.1.7 Noise impacts

No submissions raised issues relating to noise impacts from this project.

With regard to construction noise, construction activity is to occur in the area of the proposed groundwater treatment plant (GTP) and in areas near the wells and pipelines to and from the GTP. Orica has assessed these noise impacts and indicated that these facilities are located reasonably far away from residential receivers and that noise levels from construction activities is not likely to be excessive and will meet the background plus five decibel criteria suggested in the Construction Noise Guideline, Chapter 171, *Environmental Noise Control Manual* (ENCM).

DEC has recommended that standard construction noise hours recommended in the guideline be applied, notably construction should occur between:

- 7:00 am until 6:00 pm Monday to Friday
- 8:00 am until 1:00 pm Saturdays

- no construction should occur on Sundays or public holidays.

The existing EPA licence for the premises requires Orica to not exceed a limit of 65 dB(A) daytime, 55 dB(A) evening and 50 dB(A) night-time (measured as Laeq, 15 min).

Orica has conducted a noise impact assessment for the project and it is generally consistent with the DEC Industrial Noise Policy. In particular, Orica has identified potentially affected noise-sensitive receivers at the residential areas surrounding the proposed development, identified background noise levels, determined noise criteria and assessed the predicted noise emissions from the project against these criteria.

Orica has modelled noise impacts, taking into account meteorological noise level enhancement. DEC has attached conditions to account for inversions and wind blowing from source to receiver to account for these effects.

Orica adopted a design goal of 35 dB(A) (measured as an LAeq,15 min) for the facility. DEC has concluded that the goal is reasonable and will not result in an exceedence of the current noise limits specified on the EPA licence. The level also takes into account reported ambient noise levels for other development proposals in the area, Visy Recycling at Banksmeadow and the Port Botany Container Terminal Expansion.

DEC has included the above goal as a licence limit for the project. It has also required Orica to undertake noise compliance monitoring following commissioning of the groundwater treatment plant to demonstrate that the plant it is complying with the above limits.

5.1.8 Traffic and transport impacts

Orica has predicted that the additional traffic associated with the construction and operation of the facility is likely to be minimal and that additional traffic from this development is not likely to significantly impact on the environment surrounding the proposed facility. DEC agrees with the conclusions reached by Orica. No submissions raised issues relating to traffic impacts of the proposed development.

5.1.9 Socio-economic impacts

The project allows for the ongoing ability of Orica to clean up contaminated groundwater and meet the requirements of the EPA Notice of Clean Up.

The EIS states that, while it does not include any new employment positions, it represents a major capital investment by Orica to clean up contaminated groundwater and ensure the protection of human health and the environment.

The determining authorities note the principal benefits of the project are associated with remediation of a valuable groundwater resource. As a result there are likely to be environmental benefits associated with reduced levels of contaminants in the Botany Sands and receiving systems.

There were no representations received relating to socio-economic impacts of the proposed project.

5.1.10 Cumulative impacts

Several public representations raised issues associated with the cumulative impact of the project, in particular air emissions (including dioxins and VOCs) and the project's relationship to the proposed port expansion (and vice versa).

The potential cumulative impacts of the project have been reviewed and considered as part of the EIS. These include impacts the project may have on existing and proposed developments (including the Port Botany Expansion) in and around the Botany area. They include hydrogeology, water use, hydrology, traffic and transportation, noise, flora and fauna, air quality, hazard and risk assessment and human health risk assessment. Overall the EIS concludes that the cumulative impact of the project with other developments in the area is expected to be low.

The EIS states that the predicted air emissions from the groundwater treatment plant will not be significant in comparison to current existing background levels and will meet recognised air quality goals. A cumulative health risk assessment was also completed for persistent and bioaccumuative chemicals (such as mercury, hexachlorobutadiene, dioxins and furans) associated with the groundwater treatment plant, which concluded that there was negligible incremental risk due to these emissions at the modelled receptor locations.

An independent review of air emissions information was undertaken by John Court & Associates Pty Ltd (on behalf of DEC). This review concluded that the predicted levels of dioxins exposure from emissions from the groundwater treatment plant are very low. The maximum predicted ambient concentration is 0.19 fg TEQ/m3 (annual average). This is orders of magnitude lower than typical reported values in Australian urban areas of 10 to 20 fg TEQ/m3. The Victorian EPA design criteria for a 3 minute average is 3700 fg TEQ/m3. Allowing for a very conservative factor between the 3 minute average and the corresponding average, there would still be a wide margin of safety for the predicted emission for the groundwater treatment plant, namely 19 fg TEQ/m3 against 3700 fg TEQ/m3 allowed on a 3 minute average.

The determination has taken into account the information in the EIS, representations and the design, installation, operation and management of the project itself as outlined in section 5 above. It concludes that the cumulative impacts associated with the project can be managed through the mitigation measures proposed in the EIS and subject to conditions outlined in Appendix B.

The determining authorities acknowledge that in contrast to most EIS, for a new proposal or activity, this project differs significantly in that it relates to clean up and remediation. Contaminated groundwater is already present and impacting on the environment. Therefore the consequences of not proceeding with the project or delaying its commencement are significant.

6 Consideration of possible modifications to proposal

Orica has suggested a number of modifications to the exhibited proposal which are discussed in Sections 4 to 6 of this report. These modifications have been included within the scope of this determination report for the project.

The suggestion, made by Orica subsequent to the EIS exhibition, mostly reflects the results of detailed design and consideration of representations. A summary of the changes and the determining authorities' evaluation are set out below. The key changes are:

- replacement of biological treatment unit with second RO unit
- salty water discharge to sewer, not Bunnerong canal
- excess water to Bunnerong Stormwater Channel not directly into Bunnerong Canal
- increased groundwater treatment plant stack height from 20 metres to 34 metres

Project Changes	**Reasons presented by Orica**
Replacement of biological treatment unit with second RO unit	• will further improve reliability and robustness of groundwater treatment system • increases volume of treated wastewater available for reuse • increases the suitability of discharges for direction to sewer • removes the need for dewatered solid waste management
Salty water discharge to sewer, not Bunnerong canal	• discharge of 'brine' from second RO is acceptable for discharge to sewer • discharge of 'brine' reject to Bunnerong Canal not required • reduces the volume of treated wastewater discharged to Bunnerong canal
Excess water to another stormwater channel, not directly into Bunnerong Canal	• provides an opportunity for Amcor to reuse treated wastewater.
Increase groundwater treatment plant stack height from 20 metres to 34 metres	• permits plume suppression using recovered energy from steam produced by the thermal oxidiser • further reduces ground-level concentrations from stack emissions • prevents stack plume visibility under most weather conditions.

The determination has concluded that the proposed changes are generally consistent with the existing proposal and its objectives.

On the basis of a review of the information provided by Orica and the representations on the exhibited EIS, the following determination has been made.

- The groundwater treatment plant stack height be increased from 20 metres to 34 metres. The plume suppression will reduce the visibility of the stack plume and require no additional energy or production of greenhouse gases. While the mass emission of pollutants will not change from those assessed in the EIS, reheating the plume and raising the discharge stack height will improve dispersion by increased

plume buoyancy and height of discharge. This will further reduce ground-level concentrations of pollutants. Reductions of four to eight times are predicted. It will also work towards meeting the Victorian EPA ambient air quality goal for ethylene dichloride during abnormal operations of the groundwater treatment plant, even though the human health risk assessment indicated adequate protection with a 20 metre stack.

- Replacement of the biological treatment unit with a second RO unit be supported in principle, subject to compliance with an amended trade waste requirements to be finalised by SWC. It is consistent with the groundwater treatment plant reuse strategy, which has been required as a condition of the EPA licence for the project. It will enhance opportunities to reuse treated water and utilise the sewerage system to dispose of wastewater under trade waste agreements. It will generate additional treated water for reuse and reduce the quantity of treated water that will be required to be discharged to waters. This will reduce the amount of salt being discharged to waters and solid waste management. It is also expected to improve the robustness and reliability of the groundwater treatment plant.

- The discharge of excess treated water to the Bunnerong Stormwater Channel operated by Sydney Water be supported in principle, subject to:
    - further investigations into this discharge by Orica in consultation with the relevant authorities. These authorities include but are not limited to Sydney Ports Corporation, DEC, Sydney Water, DIPNR and NSW Maritime. These investigations would include but not be limited to the channels hydraulic capacity to accept the water, flooding and sediment scouring ; and
    - Any necessary approvals being obtained prior to the commencement of this discharge.

  Discharge to this channel provides an opportunity to increase the amount of treated water that can be re-used by industry, for example Amcor. It relies on existing infrastructure and reduces the disturbances that would otherwise be required. If approvals for this discharge cannot be obtained prior to the commencement of operation of the groundwater treatment plant, then the project should proceed in accordance with the EIS proposal (namely discharge directly to Bunnerong Canal) and the conditions of approval provided for this determination in Appendix B.

7 Conclusions and recommendation

It is important that all environmental matters associated with this clean-up project are properly assessed and statutory requirements satisfied as quickly as possible. This is because, unless enhanced measures are taken to collect and treat the groundwater plume, the contamination may continue to migrate towards Penrhyn Estuary and Botany Bay. In order to fulfil the EPA Notice of Clean Up Action, Orica proposed the Botany Groundwater Cleanup project.

Orica currently holds an EPA environment protection licence (no. 2148) under the *Protection of the Environment (Operations) Act 1997* for a number of existing activities. DEC determined that, because the project contains activities likely to significantly affect the environment, an environmental impact statement was required under Part 5 of the *Environmental Planning and Assessment Act 1979* before DEC could vary the existing EPA licence to permit the activity.

In November 2004, Orica submitted an environmental impact statement entitled Botany Groundwater Cleanup project. The environmental impact statement prepared by Orica proposed a strategy to contain, collect and reduce contaminants in the groundwater in and around the Botany Industrial Park to meet the requirements of the notice and prevent any adverse impacts to the environmental receptors: Penrhyn Estuary, Botany Bay and human health. Orica considers that the implementation of the project will achieve the above objectives. The capital cost of the project is expected to be approximately $102 million for all elements, including the installation of extraction wells, transfer pipelines and treatment plant.

DEC, the Department of Infrastructure, Planning and Natural Resources, NSW Maritime, Sydney Water Corporation and Sydney Ports Corporation have prepared this joint determination report in accordance with the Environmental Planning and Assessment Act (in particular clauses 228 and 243) and associated Regulation, which requires a determining authority to prepare a report on any activity for which an environmental impact statement has been prepared. The purpose of this report is to review the environmental impact statement, the issues raised in representations made in response to its exhibition, the report from Orica on the representations and any other matters relevant to the potential environmental impacts of the proposal.

This joint determination report has been prepared by the determining authorities in relation to each of their relevant instruments of approval for the project. It provides the basis for:

- DEC granting a variation to the existing EPA environment protection licence held by Orica.
- a permit from NSW Maritime under the *Rivers and Foreshores Improvement Act 1948* for works associated with the construction of the discharge point at Bunnerong Canal for the project.
- a water extraction licence from DIPNR
- a variation to the trade waste permit from Sydney Water Corporation.
- permission from Sydney Ports Corporation to discharge treated groundwater to Bunnerong Canal.

If Orica is not able to extract groundwater at the rates required (up to 15 million litres per day) to contain the plumes and provide treatment of this volume of groundwater, it could result in the waters of Penrhyn Estuary and Botany Bay becoming increasingly polluted from contaminants in this groundwater. The project is required to ensure that adverse impacts do not occur and the environment and human health are protected.

Independent assessments of the project were undertaken by John Court & Associates Pty Ltd and the United States Environmental Protection Agency on behalf of DEC. Both supported the project in terms of the appropriateness of the technology selected. The Department of Environment and Heritage (Commonwealth) has also assessed the project and advised that the proposed technology is consistent with the requirements of the Stockholm Convention.

This determination concludes that Orica's preferred strategy for the collection and treatment of the contaminated groundwater is consistent with accepted best practice and satisfies best international air emission standards. It also maximises the quantity of extracted water that can be recycled for industrial use significantly reducing the demand on potable supplies.

The project is also consistent with the aims and objectives of the NSW State Groundwater Policy and *Healthy Rivers Commission Report for the Georges River–Botany Bay System* and associated Statement of Joint Intent. Fundamentally, the project will allow Orica to comply with the Notice of Clean Up Action issued by the EPA to stop the contamination impacting on Botany Bay and protect the community.

The determination has concluded that the Department of Environment and Conservation, NSW Maritime, Sydney Ports Corporation, Sydney Water Corporation and Department of Infrastructure, Planning and Natural Resources have each decided to approve the activity, subject to the conditions attached in Appendix B. The reasons for the conditions are to:

- ensure that adequate safeguards are in place to protect the environment and human health
- mitigate the potential environmental impacts of the activity
- ensure compliance with relevant statutes and statutory instruments
- restore the quality of groundwater in and around Botany Industrial Park.

Appendix A Issues raised in submissions

Submission	*Primary issues raised in submission*
Private submitter	• The lower quality of the product proposed to be discharged to Bunnerong Canal and the Bay is difficult to justify. • Contaminated groundwater should be treated in such a way as to restore its original quality. • Project should produce an outcome that could reuse the treated groundwater.
Private submitter	• What evidence is there that subsidence will not occur and negatively impact surrounding properties? • Will there be a Dilapidation Survey undertaken prior to extraction commencing? • What guarantees, compensation or bonds are required to ensure any negative impacts are rectified? • What will be the impact if the process fails to stop the toxic plume reaching the Bay? • What safeguards are there for residents and users of the Bay? • If Orica plans to sell treated greywater, it should offer it for free to residents who have lost the use of their bores.
Private submitter	• Siting a hazardous waste incinerator in Sydney is unacceptable. • There is sufficient liquid storage that can be used until a dedicated Hazardous Waste Precinct is established for the management and destruction of toxic wastes for all of NSW. • Australia's ratification of the Stockholm Convention requires minimisation and where possible elimination of dioxins, furans, and other hazardous by-product emissions. • EIS has not fully considered alternatives. • The proposed incinerator will emit many other pollutants to which vulnerable groups such as children will be exposed.
National NGO	• Incineration of chlorinated groundwater contaminants in an area surrounded by residences, schools, hospital is unacceptable and out of line with Australia's international obligations. • Incineration particularly of chlorinated waste is acknowledged as a priority source of dioxins, furans and other toxics by US EPA and international community. • It is inconsistent with Australia's obligations under the Stockholm Convention. • Dioxins and furans bioaccumulate, are toxic to humans and wildlife and persist. • Effects of dioxin include immune system, reproductive, development disorders and cancers. • Do not accept "bushfire argument" in EIS that uncontrolled combustion is the largest source of dioxins. • Other pollutants like VOCs, PAHs are also of major concern. • EIS does little to mitigate opposition to siting an incinerator emitting persistent bioaccumulative toxins approximately 300 metres from residents. • Orica has failed its obligations to the community and the EIS process to fully consider the alternatives to building a hazardous waste incinerator in Sydney, in particular Gas Phase Chemical Reduction (Ecologic). • Reliance by Orica on using draft Best Available Techniques guidelines (Stockholm Convention) to support preferred option is unacceptable because they have not been finalised. • The health risk assessment is meaningless because it does not include body burden testing, air monitoring data and examination of all exposures. • There is capacity to store the waste for up to a decade and ample time to locate an appropriate waste management precinct and construct a non-incineration facility – this could be combined with an appropriate destruction site for Orica's existing HCB waste stockpile.
Private submitter	• Life cycle engineering should be achieved. • All contaminated fill should be stored until an acceptable treatment technology is found. • Sewer should not be used as a receptacle for waste. • Needs a waste management plan. • Need to monitor the plume to see if it is stable or receding. • Who will decide on what ammonia treatment unit will be used? A technical committee should be developed and consulted here, including representatives from EPA, universities, local government and community etc.

Submission	Primary issues raised in submission
Local representative NGO	• Assessment of alternatives should have included Germany which is recognised as a leader in dealing with dioxins and furans emissions. • Self monitoring by Orica should cease. • Over a 30 year period how will consistency and accountability be maintained? • EIS does not state what is the best available thermal oxidiser and who is the best vendor for it? USA and Japan thermal oxidiser plants may not be good enough. • How would other chemicals discharged into Bunnerong Canal react with proposed discharges? How much monitoring and testing is undertaken? • What control systems are in place? Is a daily diary kept by operators. Who will operators report to? • Once the treatment of contaminated groundwater is complete the GTP must be decommissioned and removed. • Public comment period was insufficient; there has been a lot of public consultation but due to technical complexities the public is disadvantaged – Orica should fund an independent expert chosen by the community to assist it in understanding technologies etc. • Thorough review is required of the management plan and an update of the international and national chemical emission standards. Constant review of the procedures is required which could be antiquated in 10 years or less. • The current hazard/risk analysis is inadequate and should be reviewed by an independent expert chosen by the community and funded by Orica. • Where has the final selection been seen in operation? Has it operated for 30 years? Does it perform the same in the Australian climate? • Periodic checks of the pipe conditions must be made for leaks etc. • Recommendations made by Dr Peggy O'Donnell and Dr Marcus Lincolm Smith must be implemented in the estuary monitoring programs. • Orica should place a security bond of $50m against satisfactory clean up (first payment to be in Public Trustees). • An independent expert chosen by community members and funded by Orica must be appointed to assist community members of CLG as required. • The standards for dioxin emissions as quoted in the EIS for USA and Japan may not be good enough. Standards for Germany must be investigated. • All areas surrounding the clean up facility must be cleaned (inc Botany Industrial Park). • There is to be no stockpile remaining of chemicals used or unused or wastes resulting from the clean up stockpiles. • All compensations are to be finalised wherever necessary. • Orica's Board of Directors is to be held accountable for all mishaps, non-compliance etc. • Every section of the clean up plant is to be decommissioned, dismantled and removed from the regions of Botany Bay.
Local representative NGO	• Emissions of dioxins and furans within proximity of homes and schools are unacceptable • Not demonstrated that the levels of salinity in discharges will not impact ecology of the immediate area and beyond, particularly seagrasses. • EIS fails to examine impact on seagrass beds or salt marsh or study bird, mammal, reptile ingestion of toxins from drinking water near plume sites. • Within Botany Bay there are recognised sites and issues under Australian Oceans Policy, Ramsar Convention, marine parks, aquatic reserves, intertidal protected areas – need to clearly demonstrate that discharges will not impact these areas. • Timing of exhibition and period for comment unsatisfactory. • EIS has very little information on impacts on ecology of the bay or health of community using estuary at the discharge interface: in event proposal fails, what back up? Precautionary Principle should be applied and both containment and destruction systems should have support systems in place prior to approval. • Little or no investigation has been made of the long term issues for movement of contaminants in the aquifer beneath the Bay itself – test on fish caught in Botany Bay should be identified and NSW Fisheries should make results public. Most fish that visit Penrhyn Estuary also visit other extremes of the bay. • Dredging 7.5m m^3 sand from immediately adjacent to Penrhyn Estuary will have some effect on toxic plumes. • Orica is responding to DEC's demands as top priority but this doesn't excuse DEC delay in requiring clean up. • Support the call for a $50m security bond and the holding of Orica management responsible for mishaps.

Submission	*Primary issues raised in submission*
Global NGO	• Decision to clean up groundwater supported but not the proposal that will result in generation and release to the environment of POPs. • Other alternatives for containment and treatment need to be considered: it appears the least cost option has been chosen without due consideration of health and environmental impacts from incineration – EIS gives little consideration to VOCs and PAHs that can arise from incineration. • Orica should be seeking to reduce emissions from site not increasing them. • The proposal is inconsistent with Australia's obligations under the Stockholm Convention.
State government agency [DIPNR]	• The Preliminary Hazard Analysis is based on a number of assumed conditions due to limited design information – all these assumptions should be reviewed after finalisation of design and updated in the Final Hazard Analysis. • Impact of toxic fumes is defined as local – reasons for this conclusion should be clarified. • Statement in Consequence Analysis that groundwater is non-hazardous contradicts other information and should be clarified. • Consideration should be given to the proximity of storage tanks to the thermal oxidiser in the event of explosion. • Further information is required on the influent gas concentration to the thermal oxidiser. • Clarification of the methods used to achieve stated concentrations for Arsenic and Chromium in the treated reuse water is required.
Global NGO	• Use of incineration technology to destroy groundwater contamination is opposed when viable closed loop non-incineration technologies are available. • By own admission Orica has 10 years' storage capacity for contaminant using pumping and stream stripping – rejecting the incineration proposal will not threaten the Bay – current pumping allows time for a solution that does not negatively impact the local community. • The proposal is inconsistent with the Stockholm Convention and Australia's obligations thereunder. • The human health risk assessment is problematic re treatment of dioxins: firstly, there is no safe level for dioxins intake; secondly, ignores the fact that some segments of Australian population already receive far in excess of Australian standard tolerable daily intake. • Accepting certain levels of dioxins intake as tolerable inconsistent with rationale of Stockholm Convention; lack of endpoint analysis for endocrine disruption renders value of risk calculations questionable
State government agency [NSW Health]	• Human health risk assessment in EIS broadly in accordance with nationally accepted framework and guidelines • Estimated emissions of chemicals of potential concern under best/worst scenarios need to re-confirmed as accurate; operational status of emissions need continuous monitoring and reporting
State government agency [Sydney Water]	• Any proposals for adjustments to trade wastewater discharges from the Orica site will be assessed in terms of wastewater quality and quantity and impact on the limited capacity of the Malabar Sewage Treatment Facility
Local NGO	• The proposed treatment method will release dioxins and increase the VOCs emitted from Orica – any increase in emissions is of concern particularly with respect to the vulnerability of our children • Because of the urgency of preventing contamination reaching the Bay, there should be an alternative plan if the proposal proves unacceptable which should be activated if contamination breaches the containment lines • Not happy with current emissions from the site, much less future emissions. • Supports proposals in other submissions for alternative technologies • Resents being required to comment on the proposal in a situation of such urgency to act – the lateness of the compulsory clean up action places unconscionable pressure on the Government and community to accept whatever is proposed • The DNAPL sites are on-going sources of contamination likely to impact our grandchildren when the liner fails – consideration should be given also to the clean up of these sites • Effects of the plume on the Penrhyn Estuary not included in the EIS – these are of concern • The effect of current levels of emissions on Banksmeadow school are unacceptable, and future emissions will be much less so: there should be ambient air quality and dust monitoring at the school • Support calls for a $50m bond and moratorium on any sale of land by Orica

Submission	*Primary issues raised in submission*
Local government [Randwick City]	• Extraction and treatment of contaminated groundwater should be undertaken as soon as possible and hydraulic containment and groundwater treatment plant construction strongly supported, subject to concerns with thermal oxidation, emissions and the risk assessment process • A rigorous independent assessment of alternative technologies should be conducted – mechanisms should be put in place that ensure best practice technologies are included at a later date when suitable new destruction technology that avoids incineration and release of dioxins is developed • Purchase of GTP equipment by Orica pre-approval seems to pre-empt the consultation and EIS process outcome: it appears Orica proposal based on time and money rather than holistic environmental, social, economic assessment, especially when alternatives like biotreatment still under investigation • Use of the GTP should be restricted to the current proposal. • Contaminated water passed Foreshore Road containment is reaching Penrhyn Estuary but there doesn't appear to be a mechanism to address this: actions such as the fencing need to be clearly articulated; containment at Foreshore Road will result in salt water being drawn into the aquifer – potential ecological, environmental and infrastructural effects of this are unclear • EIS fails to have regard to the sensitive salt marsh and sea grass habitat. • Need for incineration as a treatment process is questioned, as there may still be better yet-to-be-investigated alternatives, which would be more in keeping with the Stockholm Convention • Recommended that accurate background levels be obtained to information health risk assessment process especially regarding cumulative impacts. • Recommended that an ongoing health risk assessment process be formalised with independent expert overview re bioaccumulation of contaminants in water, and re dioxins emission to air. • There should be an independent review of alternative technologies over the 30 year period with a requirement for best practice to supersede the GTP once technologies are developed. • There should be independent expert monitoring of the process at the cost of Orica.
Local government [City of Botany Bay]	• Not enough effort is being put into addressing and managing the DNAPL source areas. • Use of the GTP beyond clean up of the contaminated groundwater should be subject to extensive discussion with the community and key stakeholders. • Containment along Foreshore Road will impact the interface between freshwater and marine water – EIS does not propose any measures to continuously evaluate or mitigate. • Plant should be run on a minimum of 10% green power to mitigate greenhouse emissions. • EIS fails to recognise coastal saltmarsh communities as listed endangered ecological community under NSW Threatened Species Act – detailed monitoring regime should be implemented to ensure changes to this community are monitored, identified, reported and communicated. • Ambient air quality monitoring in Randwick LGA provides less accurate representation than monitoring in Botany; buffer distance to residences not significant compared to other sites in Australia; dioxin emissions are a concern for the local community so monitoring and reporting needs to be accessible, easily read and understood by the community.
State government agency [Department of Primary Industries]	• Return the treated water through the estuary rather than discharge through Brotherson Dock – this appears to have been treated in a cursory fashion as being too hard or too expensive. • Potential impacts on the benthic communities in Penrhyn Estuary due to changes in flow in Springvale and Floodvale Drains – reduction in freshwater inputs to the estuary has the potential to greatly influence the community structure of the aquatic community in the estuary and have a flow effect for wading bird populations. • There is a lack of specific information on the toxicity or bioaccumulation potential of the chemicals in the groundwater in the benthic organisms, fish populations and wading birds that feed on them. • There should be a monitoring program to determine the abundance and special distribution of benthos and sampling before, during and after groundwater interception. • There should also be toxicological studies using a range of indicator species.
State government agency [NSW Maritime]	• There appears to be no specification given for the salinity level of discharge water. • Water quality monitoring should be undertaken at the discharge point, namely the pipeline where it enters Bunnerong Canal in addition to at Brotherson Dock as proposed. • There is minimal detail regarding the discharge point at Bunnerong Canal – the design of the diffuser should be provided and the nature of the works required to construct and install the diffuser should be provided.

Submission	*Primary issues raised in submission*
Local State MP	• Orica should conduct Dilapidation Surveys for residents concerned about potential structural damage to their properties. • What consideration has been given to impacts if assumptions made in the EIS concerning the application of the Environmentally Hazardous Chemicals Act, Water Act, Road and Rail transport (Dangerous Goods) Act and Soil Conservation Act prove to be incorrect. • It is unclear from the EIS how the Community Relations Activities and public input will be incorporated into the project. • Orica should consider how it can alleviate the inconvenience to community and residents e.g. for those who have lost the use of bores, by meeting the cost of installation, operation and maintenance of rainwater tanks. • Orica should enter a Community Contract that goes beyond DA conditions and includes a commitment to consultation, reporting a lodgement of a security bond. • Conclusions drawn re HCB detected in oysters and fish seem inconsistent with the testing results and HCB in marine organisms is not mentioned in the Executive Summary. • The most efficient destruction technology will mean higher greenhouse gas emissions – a GHG management/offset strategy will be required. • The EIS does not mention the impact of emissions on ambient air temperature and impacts for local weather and bird flight paths.
Private Submitter	• Government and industry have a responsibility to ensure that risks are properly managed and that they are negligible compared to the risks faced during the course of everyday life. • DEC's detailed EIS guidelines and Orica's fulfilment of them are commendable • Orica has been accessible and generous with resource information. • Ongoing consultation opportunities include monitoring methods, recording and reporting to community on air emissions, groundwater, transport of chemicals, storage of chemicals, bioremediation, community emergency alarm procedures, guidelines for local developments. • There is a window of opportunity for positive proactive stakeholders to be part of a model consultative process. • Success in avoiding contingent liabilities, in this case contaminating Botany Bay, will be achieved if the persons responsible possess both the ability and the will to build the groundwater treatment plant and continue research on clean up.

Appendix B Conditions of Approval

Introduction

The Department of Environment and Conservation, NSW Maritime, Sydney Ports Corporation, Sydney Water Corporation and Department of Infrastructure, Planning and Natural Resources have each decided to approve the activity subject to the following conditions.

- General Conditions
- Conditions to vary Environment Protection Licence No. 2148
- Conditions under Part V (section 116) of the Water Act
- Conditions from DIPNR regarding land use safety planning
- Conditions for Part 3A permit under Rivers and Foreshore Act
- Conditions from Sydney Water
- Conditions from Sydney Ports Corporation for approval for discharge into Bunnerong Canal

The reasons for the conditions are to:

- ensure that adequate safeguards are in place to protect the environment and human health
- mitigate the potential environmental impacts of the activity
- ensure compliance with relevant statutes and statutory instruments
- restore the quality of groundwater in and around Botany Industrial Park.

General Conditions

1. The proposed works must be carried out generally in accordance with:
   1.1. the procedures, safeguards and mitigation measures identified in the EIS
   1.2. an environmental protection licence under the *Protection of the Environment Operations Act 1996*
   1.3. a licence under the *Water Act 1912*
   1.4. an approval under the *Rivers and Foreshores Act 1994*
   1.5. an approval under the *Sydney Water Act 1994*
   1.6. any permission from Sydney Ports Corporation; and
   1.7. this determination report and conditions of this approval.

2. 2. All necessary approvals as stated in section 1 must be obtained by Orica.

3. As far as practicable, the Environmental Management Plan for the project should combine and cover the conditions of the relevant approvals required for the project including the conditions of this approval.

Conditions to vary Environment Protection Licence No. 2148

Orica currently holds an EPA environment protection licence (no. 2148) under the *Protection of the Environment Operations Act 1997*. A copy of this licence can be accessed via the EPA Public Register at www.environment.nsw.gov.au.

This licence contains existing conditions including but not limited to:

- limits in regard to controlling air, noise, water pollution and waste

- requirements for maintaining plant and equipment in a proper manner and operating plant and equipment in a competent manner
- monitoring and reporting environmental performance
- submitting a statement of compliance with respect to licence conditions
- reporting incidents that may cause harm to DEC.

DEC has determined that it is able to vary the existing EPA licence held by Orica to incorporate the following new licence conditions for the proposed development.

NEW CONDITIONS

Discharges to air and water and applications to land

P1 Location of monitoring/discharge points and areas

P1.1 The points referred to in the following table are identified in this licence for the purposes of monitoring and/or setting limits for the emission of pollutants to the air from the point.

Air

EPA identification no.	Type of monitoring point	Type of discharge point	Description of location
9	Air emissions monitoring/ Discharge to air	Air emissions monitoring/ Discharge to air	Stack serving GTP labelled "Monitoring Point 9 (GTP stack)" on drawing number B94744 submitted to the EPA on 25 January 2005.
10	Parameter monitoring		Thermal oxidation unit labelled "Monitoring Point 10 (Thermal Oxidation Unit)" on drawing number B94744 submitted to the EPA on 25 January 2005
12	Weather monitoring		Weather monitoring station labelled "Monitoring Point 12 (Weather Station)" on drawing number B94744 submitted to the EPA on 25 January 2005.

P1.2 The points referred to in the following table are identified in this licence for the purposes of monitoring and/or setting limits for discharges of pollutants to water from the point.

P1.3 The utilisation areas referred to in the following table are identified in this licence for the purposes of monitoring and/or setting limits for any application of solids or liquids to the utilisation area.

Water and land

EPA identification no.	Type of monitoring point	Type of discharge point	Description of location
11	Discharge to waters Effluent quality and volume monitoring	Discharge to waters Effluent quality and volume monitoring	Drain outlet serving the GTP labelled "Monitoring Point 11 (GTP discharge to waters)" on drawing number B94744 submitted to the EPA on 25 January 2005.

Limit conditions

L3 Concentration limits

L3.1 For each monitoring/discharge point or utilisation area specified in the table(s) below (by point number), the concentration of a pollutant discharged at that point, or applied to that area, must not exceed the concentration limits specified for that pollutant in the table.

L3.2 Where a pH quality limit is specified in the table, the specified percentage of samples must be within the specified ranges.

L3.3 To avoid any doubt, this condition does not authorise the pollution of waters by any pollutant other than those specified in the tables.

Air

POINT 9

Pollutant	Unit of measure	100th percentile concentration limit
1,2-Dichloroethane	mg/m3	8
Chlorine	mg/m3	30
Nitrogen oxides	mg/m3	400
Volatile organic compounds	mg/m3	10
Hydrogen sulfide	mg/m3	2
Dioxins and Furans [1]	ng/m3	0.1
Hydrogen chloride	mg/m3	30
Sulfur dioxide	mg/m3	100
Vinyl chloride	Ppm	10
Solid particles	mg/m3	20
Carbon monoxide	mg/m3	100

Note: The above limits apply to the stack emissions prior to the addition of any re-heat air.

1. Polychlorinated-dibenzo-p-dioxins (PCDD) and polychlorinated-dibenzofurans (PCDF) as 2,3,7,8-tetrachloro-dibenzo-p-dioxin (TCDD) equivalent calculated in accordance with the procedures included in Part 9, Clause 19 of the Clean Air (Plant and Equipment) Regulation 1997.

POINT 11

Pollutant	Unit of measure	50th percentile concentration limit	90th percentile concentration limit	3DGM concentration limit	100th percentile Concentration Limit
1,2-Dichloroethane	mg/L				1.9
Arsenic	mg/L				0.0023
Cadmium	mg/L				0.0007
Carbon tetrachloride	mg/L				0.24
Copper	mg/L				0.0013
Iron	mg/L				0.3
Lead	mg/L				0.0044
Manganese	mg/L				0.08
Mercury	mg/L				0.0001
Nickel	mg/L				0.007
Oxidised nitrogen	mg/L				0.015 Note 1
pH	pH				7-8.5
Reactive phosphorus	mg/L				0.005
Tetrachloroethene (tetrachloroethylene)	mg/L				0.07
Nitrogen (total)	mg/L				0.1 Note 1
Trichloroethene (trichloroethylene)	mg/L				0.33
Turbidity	NTU				5 Note 1
Zinc	mg/L				0.015
Benzene	mg/L				0.95
Toluene	mg/L				0.18
Vinyl chloride	mg/L				0.1
Biochemical oxygen demand	mg/L				10
Total phosphorus	mg/L				0.01 Note 1
Chromium (total)	mg/L				0.0044
NH3-N	mg/L				0.015 Note 1
Chloroform	mg/L				0.37
Temperature	°C				15-25

For the purposes of the table above Note 1 means that concentration limits may be subject to review and change once the final details are received on the treatment technology and the design of the discharge structure.

L3.4 Reference condition

For the concentration limits specified for Point 9 (above), the following reference conditions also apply:

Pollutant	Unit of measure	100th percentile concentration limit	Reference Conditions	Averaging Period
1,2-Dichloroethane	mg/m3	8	Dry, 273 K, 101.3 kPa, 11% O_2	Rolling 1 hour average
Chlorine	mg/m3	30	Dry, 273 K, 101.3 kPa, 11% O_2	As per test method
Nitrogen oxides	mg/m3	400	Dry, 273 K, 101.3 kPa, 11% O_2	Rolling 1 hour average
Volatile organic compounds	mg/m3	10	Dry, 273 K, 101.3 kPa, 11% O_2	Rolling 1 hour average
Hydrogen sulfide	mg/m3	2	Dry, 273 K, 101.3 kPa, 11% O_2	As per test method
Dioxins and furans[1]	ng/m3	0.1	I-TEQ, Dry, 273 K, 101.3 kPa, 11% O_2	As per test method
Hydrogen chloride	mg/m3	30	Dry, 273 K, 101.3 kPa, 11% O_2	Rolling 1 hour average
Sulfur dioxide	mg/m3	100	Dry, 273 K, 101.3 kPa, 11% O_2	As per test method
Vinyl chloride	ppm	10	Dry, 273 K, 101.3 kPa, 11% O_2	Rolling 3 hour average
Solid particles	mg/m3	20	Dry, 273 K, 101.3 kPa, 11% O_2	As per test method
Carbon monoxide	mg/m3	100	Dry, 273 K, 101.3 kPa, 11% O_2	Rolling 1 hour average

Note
1. Polychlorinated-dibenzo-p-dioxins (PCDD) and polychlorinated-dibenzofurans (PCDF) as 2,3,7,8-tetrachloro-dibenzo-p-dioxin (TCDD) equivalent calculated in accordance with the procedures included in Part 9, Clause 19 of the Clean Air (Plant and Equipment) Regulation 1997.

L3.5 Thermal oxidation unit lower limits

For each monitoring/discharge point or utilisation area specified in the tables below (by point number), the parameter must be equal to or greater than the lower limits specified for that parameter in that table.

Point 10

Parameter	Unit of measure	Lower Limit	Averaging period
Residence time	s	2	Instantaneous
Temperature	°C	850	Instantaneous

L3.6 The air stripping and thermal oxidiser plant must shut down and cease all emissions as soon as safely possible, but in no case later than 10 minutes, if there is a combustion failure in the thermal oxidiser.

L4 Volume and mass limits

L4.1 For each discharge point or utilisation area specified below (by point number), the volume/mass of:

(a) liquids discharged to water or

(b) solids or liquids applied to the area,

must not exceed the volume/mass limit specified for that discharge point or area.

Point	Unit of measure	Volume/mass limit
11	kL/day	12000

Noise limits

L6.4 Noise generated by activities associated with the Groundwater Cleanup Project, other than those accepted by DEC as being 'construction' at the premises, must not exceed the noise goal level presented in Table 6.4 below:

Table 6.4 - Noise Design Goal Limits (dB(A))

Location	Day	Evening	Night
	$L_{Aeq(15\ minute)}$	$L_{Aeq(15\ minute)}$	$L_{Aeq(15\ minute)}$
Nearest affected receivers surrounding the Groundwater Cleanup Project	*35 dB(A)*	*35 dB(A)*	*35 dB(A)*

L6.5 For the purpose of Condition(s) L6.1; L6.2 and L6.4:

- Day is defined as the period from 7 am to 6 pm Monday to Saturday and 8 am to 6 pm Sundays and public holidays.
- Evening is defined as the period from 6 pm to 10 pm.
- Night is defined as the period from 10 pm to 7 am Monday to Saturday and 10 pm to 8 am Sundays and public holidays.

L6.6 Noise from the premises is to be measured at the most affected point on or within the residential boundary to determine compliance with the LAeq(15 minute) noise limits in condition L6.4.

Where it can be demonstrated that direct measurement of noise from the premises is impractical, the EPA may accept alternative means of determining compliance. See Chapter 11 of the *NSW Industrial Noise Policy*.

The modification factors presented in section 4 of the *NSW Industrial Noise Policy* shall also be

applied to the measured noise level where applicable

L6.7 The noise emission limits identified in condition L6.4 apply under meteorological conditions of:

- wind speeds up to 3 m/s at 10 metres above ground level, or
- temperature inversion conditions of up to 3 ^{o}C/100 m and wind speeds up to 2 m/s at 10 metres above ground level.

Hours of operation – construction

L6.8 All construction work at the premises must only be conducted between 7:00 am and 6:00 pm Monday to Friday, 8:00 am and 1:00 pm Saturdays, with no construction activities on Sundays or public holidays. Construction is permitted at any time if it is not audible at the nearest affected receivers. Audible means that it can be heard by a person at the nearest affected receivers.

L6.9 Activities at the premises, other than construction work, that meet the noise goal provided in L6.4 may be conducted on a continuous basis.

L6.10 The following activities may be carried out at the premises outside the hours specified in condition L6.8:

- the delivery of materials as requested by Police or other authorities for safety reasons
- emergency work to avoid the loss of lives, property and/or to prevent environmental harm.

Monitoring conditions

M2 Requirement to monitor concentration of pollutants discharged

M2.1 For each monitoring/discharge point or utilisation area specified below (by point number), the licensee must monitor (by sampling and obtaining results by analysis) the concentration of each pollutant specified in Column 1. The licensee must use the sampling method, units of measure, and sample at the frequency, specified opposite in the other columns.

POINT 9

Pollutant	Unit of measure	Frequency	Sampling method
1,2-Dichloroethane	mg/m3	Continuous	CEM-8
Carbon monoxide	mg/m3	Continuous	CEM-4
Chlorine	mg/m3	Quarterly	TM-7 and 8
Dioxins and furans	ng/m3	Special frequency 2	TM-18
Dry gas density	kg/m3	Quarterly	TM-23
Hydrogen sulfide	mg/Nm3	Quarterly	TM-5
Hydrogen chloride	mg/m3	Continuous	Method approved in writing by the EPA
Moisture content	%	Continuous	TM-22
Molecular weight of stack gases	g/g-mole	Quarterly	TM-23
Nitrogen oxides	mg/m3	Quarterly	TM-11
Oxygen (O2)	%	Continuous	CEM-3
Solid particles	mg/m3	Special frequency 3	TM-15
Sulfur dioxide	mg/m3	Special frequency 3	TM-4
Temperature	K	Continuous	TM-2
Velocity	m/s	Continuous	CEM-6
Vinyl chloride	ppm	Continuous	CEM-8
Volatile organic compounds	mg/m3	Continuous	CEM-8
Volumetric flowrate	m3/s	Continuous	CEM-6

M2.5 For the purposes of the table(s) above:

Special Frequency 2 is defined as monitoring monthly for the first 6 months and bimonthly thereafter. This monitoring frequency could be reviewed after 2 years.

Special Frequency 3 is defined as monitoring monthly for the first 6 months and quarterly thereafter. This monitoring frequency could be reviewed after 2 years.

POINT 11

Pollutant	Unit of measure	Frequency	Sampling Method
1,2-Dichloroethane	mg/L	weekly	Grab sample
Arsenic	mg/L	weekly	24 hour composite
BOD	mg/L	weekly	24 hour composite
Benzene	mg/L	weekly	grab sample
Cadmium	mg/L	weekly	24 hour composite
Carbon tetrachloride	mg/L	weekly	Grab sample
Chromium (total)	mg/L	weekly	24 hour composite
Copper	mg/L	weekly	24 hour composite
Iron	mg/L	weekly	24 hour composite
Lead	mg/L	weekly	24 hour composite
Manganese	mg/L	weekly	24 hour composite
Mercury	mg/L	weekly	24 hour composite
Nickel	mg/L	weekly	24 hour composite
Nitrate + Nitrite (oxidised nitrogen)	mg/L	weekly	24 hour composite
Nitrogen (ammonia)	mg/L	weekly	24 hour composite
Nitrogen (total)	mg/L	weekly	24 hour composite
Phosphorus (total)	mg/L	weekly	24 hour composite
Reactive Phosphorus	mg/L	weekly	24 hour composite
Tetrachloroethene (tetrachloroethylene)	mg/L	weekly	Grab sample
Toluene	mg/L	weekly	Grab sample
Trichloroethene (Trichloroethylene)	mg/L	weekly	Grab sample
Turbidity	NTU	weekly	24 hour composite
Vinyl chloride	mg/L	weekly	Grab sample
Zinc	mg/L	weekly	24 hour composite
pH conductivity temperature	pH uS/cm C	weekly continuous continuous	24 hour composite in line instrumentation in line instrumentation

M2.5 In relation to monitoring requirements at point 9, a performance specification test must be conducted for all continuous emission monitoring systems at the time of installation, or soon after, and thereafter on a quarterly basis. The quarterly tests must be conducted at least two months apart for each continuous emission monitoring system and in accordance with the requirements of the applicable CEMS protocol. The results of all performance specification tests must be submitted to the EPA within one month of completion of the tests.

M3 Testing methods - concentration limits

M3.2 Subject to any express provision to the contrary in this licence, monitoring for the concentration of a pollutant discharged to waters or applied to a utilisation area must be done in accordance with the Approved Methods Publication, unless another method has been approved by the EPA in writing before any tests are conducted.

M6 Requirement to monitor volume or mass

M6.1 For each discharge point or utilisation area specified below, the licensee must monitor

(a) the volume of liquids discharged to water or applied to the area
(b) the mass of solids applied to the area
(c) the mass of pollutants emitted to the air.

at the frequency and using the method and units of measure specified below.

POINT 11

Frequency	Unit Of Measure	Sampling Method
Daily during any discharge	kL/day	Method approved in writing by the EPA

M7 Requirement to monitor thermal oxidation unit parameters

M7.1 For each monitoring/discharge point or utilisation specified in the tables below (by point number), the licensee must monitor (by sampling and obtaining results by analysis) each parameter specified in column 1. The licensee must use the sampling method, units of measure, and sample at the frequency, specified opposite in the other columns.

Air

POINT 10

Parameter	Unit of measure	Frequency	Averaging period
Volumetric flow rate	m^3/s	Continuous	CEM-6
Temperature	°C	Continuous	TM-2

M8 Weather monitoring

M8.1 For each monitoring point specified below (by a point number), the licensee must monitor (by sampling and obtaining results by analysis) the parameter specified in column 1. The licensee must use the sampling method, units of measure, averaging period and sample at the frequency specified opposite in the other columns.

POINT 12

Parameter	Unit of measure	Averaging period	Frequency	Sampling Method
Wind speed @ 10 m	m/s	15 min	Continuously	AM-2 and AM-4
Wind direction @ 10 m	°	15 min	Continuously	AM-2 and AM-4
Sigma theta @ 10 m	°	15 min	Continuously	AM-2 and AM-4
Additional requirements				

Parameter	Unit of measure	Averaging period	Frequency	Sampling Method
Siting				AM-1 and AM-4
Measurement				AM-2 and AM-4

General conditions

Signage

G2.1 The location of EPA point number(s) 3,4,7,8,9,10,11 and 12 must be clearly marked by signs that indicate the point identification number used in this licence and be located as close as practical to the point.

Special conditions

E9 Audits and reviews

The objective of this condition is:

- to conduct a series of ongoing independent audits to validate the predictions included in the EIS and compliance with this licence, and to the extent required by any other approval, compliance with those approval conditions relating to the project
- to conduct environmental reviews with the aim of optimising performance
- to conduct engineering audits to ensure the performance of the plant will not deteriorate in the longer term
- to identify remedial measures that can be implemented in the event an audit shows a discrepancy between actual and predicted performance.

This condition comprises two parts:

- Part A – Validation audit and Environmental review
- Part B – Engineering audit

PART A - VALIDATION AUDIT AND ENVIRONMENTAL REVIEW

General

The licensee must undertake comprehensive validation audits and environmental reviews of the works undertaken in accordance with the EIS.

The auditor must prepare a written report on the validation audit and environmental review for submission to the DEC, DIPNR, Sydney Ports Corporation, Sydney Water Corporation, NSW Maritime, City of Botany Council and the Independent Monitoring Committee and make this report available for public inspection on request.

A single report must be submitted that includes all the validation audit and environmental review requirements of this licence and to the extent required by any other approval, compliance with those approval conditions relating to the project.

The report must be submitted with each Annual Return for the first two reporting periods during which the groundwater treatment plant has commenced operation. The ongoing necessity for this requirement will be reviewed in consultation with the Independent Monitoring Committee and taking into account the performance of the groundwater treatment plant.

The EPA may require the licensee to undertake works to address the findings or recommendations presented in the report as a requirement of this licence. Any such works must be completed within such time as agreed to by the EPA.

Each Validation audit and Environmental review must include the following components:

- Validation audit
- Environmental review

E9.1 VALIDATION AUDIT

The licensee must engage (and bear the full cost of) an independent and suitably qualified auditor to undertake comprehensive validation audits of the project.

The auditor must:

- be a certified environmental auditor who has gained certification from a certification body (such as Registrar Accreditation Board and Quality Society of Australasia international (RABQSA) formerly known as (QSA) who have been accredited by the Joint Accreditation Services Australia and New Zealand (JAS/ANZ);
- have Lead Environmental Auditor certification; and
- have held lead environmental certification for at least 2 years.

The licensee must consult with the Independent Monitoring Committee in the selection of the auditor.

The validation audit must:

(a) be carried out in accordance with ISO 19011:2003: Guidelines for Quality and/or Environmental Management Systems Auditing
(b) take into account representative operating conditions, including worst-case scenarios, which relate to the groundwater treatment plant
(c) assess compliance with the requirements of this licence, and to the extent required by any other approval, compliance with those approval conditions relating to the project
(d) assess the project against the predictions made and conclusions drawn in the EIS and supporting documents prepared by the licensee
(e) include the following components
    - air emission validation program
    - water discharge validation program
    - noise validation program
    - thermal oxidation unit validation program

E9.1.1 Air emission validation program

The licensee must conduct an air emissions validation program, which includes but is not be limited to the following:

(a) Ensures the range of all air pollutants monitored are continually reviewed and modified where necessary to ensure the licensee is capable of detecting the presence of all significant air pollutants not already specified in the licence.
(b) make recommendations about changes to existing monitoring, including substances monitored and

frequency of monitoring

(c) validate the conclusions of the human health risk assessment that was undertaken as part of the EIS using emissions monitoring data collected under this licence

(d) validate the conclusions of the air quality impact assessment undertaken as part of the EIS using emissions monitoring data collected under this licence

(e) prepare and implement of a comprehensive odour detection program. This must include but not be limited to:

- A leak detection and repair (LDAR) program to detect and minimise fugitive VOC emissions from the groundwater treatment plant and associated plant and equipment, in accordance with US EPA Method 21 – Determination of Volatile Organic Compound Leaks (40 CFR Part 60, Appendix A, Method 21) or such other method agreed in writing by the EPA
- An overall odour detection program, including representative off-site observations by independent and suitably qualified persons to identify and prevent unanticipated odour sources.

E9.1.2 Water discharge validation program

The licensee must conduct a water discharge validation program, which must include but not be limited to the following:

(a) Ensures the range of all water pollutants monitored are continually reviewed and modified where necessary to ensure the licensee is capable of detecting the presence of all significant water pollutants not already specified in the licence, make recommendations about changes to existing monitoring, including substances monitored and frequency of monitoring.

E9.1.3 Noise validation program

The licensee must conduct a noise validation program, which must include but not be limited to the following:

(a) identification and ranking by sound power level all significant noise sources on the premises (in 1/3 octave bands for any source with potentially undesirable noise character)

(b) identification of all noise sensitive receivers that may be affected by the operation of the groundwater treatment plant, and select an appropriate number of representative receiver locations to represent all sensitive receivers

(c) the results of all noise measurements undertaken to assess compliance with Condition L6.4 of the licence

(d) a statement of whether noise levels from all activities at the licensed premises comply with the specified noise limits at the representative receiver locations. The statement must take into account tonal, impulsive and short duration noises originating from the groundwater treatment plant

(e) where noise levels have been assessed as exceeding allowable licence limits, a statement explaining the reason why this has taken place

(f) a statement of what feasible and reasonable additional measures may be implemented to further reduce noise levels below those specified in the licence.

E9.1.4 Thermal oxidation unit validation program

The licensee must conduct an thermal oxidation unit Validation program which includes but is not be limited to the following:

(a) Ensures that all parameters monitored comply with the Thermal Oxidation Unit lower limits specified in Condition L3.5 in the licence.

(b) Reports the fraction of time the lower temperature limit specified in Condition L3.5 is not achieved

within ±50°C.

(c) Correlates all dioxin air emissions data monitored at Point 9 in accordance with Condition M2.1 with temperature and flow rate data monitored at Point 10.

(d) Quantitatively assess dioxin air emissions at Point 9 with the thermal oxidiser operating at or near 850°C.

(e) Where there are increases in dioxin air emissions at the lower temperature limit set at Point 10 (as investigated in (d) above), make recommendations to change the lower temperature limit set at Point 10 and associated operational procedures to prevent dioxin concentration increases at the recommended lower temperature limit.

Note: Quantitative assessment of dioxin at Point 9 is to be undertaken in accordance with the *Approved Methods for the Sampling and analysis of Air Pollutants in NSW, 2000, unless otherwise agreed in writing by the EPA.*.

E9.2 ENVIRONMENTAL REVIEW

The licensee must conduct an Environmental review, which must include but not be limited to the following:

(a) a review of complaints received and action taken by the licensee
(b) summary of environmental monitoring required under the licence and to the extent required by any other approval, compliance with those approval conditions relating to the project
(c) identification of trends in all monitoring data collected since the commencement of operation of the groundwater treatment plant
(d) a statement on the effectiveness of the overall environmental management and performance of the project
(e) the following programs:
- dioxin minimisation and management program
- groundwater treatment plant water
- reuse groundwater monitoring program
- ambient environmental monitoring program

E9.2.1 Dioxin minimisation program

The licensee must conduct a program that includes, but is not limited to the following:

(a) an investigation into technical options and scientific developments that would allow continuous monitoring and or sampling of any possible dioxin emissions from the groundwater treatment plant
(b) an investigation of chemical and/or physical parameters that are likely to correlate with the actual or potential formation of dioxins and could be used as a surrogate indicator of dioxin formation in the groundwater treatment plant
(c) make recommendations about changes to existing monitoring, including substances monitored and frequency of monitoring.

E9.2.2 Groundwater treatment plant (GTP) water reuse strategy

The Licensee must conduct a program that investigates opportunities to maximise the reuse of treated water from the groundwater treatment plant and reduce the amount of treated water discharged to waters provided the reuse or reduction can be achieved in a safe and practical manner and it will provides the best environmental outcome, in the circumstances.

The program must include but need not necessarily be limited to the following:

- characterisation of the treated water in terms of quality and quantity
- identification of potential sues for this treated water, taking into account relevant and recognised environmental and human health guidelines or standards to ensure it is appropriate for this use
- identification of options to beneficially reuse treated waters to minimise the amount of treated water being discharged
- assessment of the feasibility and cost of these options
- selection of options for implementation
- timetable for implementation of the selected options
- inclusion of any of potential uses of this treated water, taking into account relevant and recognised
- other relevant recommendations relating to treated water reuse.

The licensee must consult with the DEC, NSW Health Department, Sydney Water Corporation, Sydney Ports Corporation, Botany Bay Council, DIPNR and NSW Maritime on the development of the program.

E9.2.3 Groundwater monitoring program

The licensee must conduct a Groundwater monitoring program which must include but not be limited to the following:

(a) monitor groundwater to assess whether the extraction of groundwater will result in any actual or potential impacts to surface waters or habitats in the locality
(b) review the conclusions of the groundwater assessments and modelling that was undertaken as part of the EIS, including using all monitoring data collected under this licence or other approvals for this project
(c) include a mechanism to regularly review the effectiveness of the monitoring program to ensure it is effective in detecting the presence of actual or potential impacts not already identified
(d) make recommendations about changes to existing monitoring and frequency of monitoring.

The program must be prepared and implemented in consultation with the DEC, DIPNR, DPI, Sydney Ports Corporation, Sydney Water Corporation, NSW Maritime and City of Botany Council.

E9.2.4 Ambient environmental monitoring program

The licensee must conduct an Ambient environmental monitoring program which must include but not be limited to the following

(a) develop and implement a program to monitor ecological health of habitats in the locality and water quality in the receiving environment, including specification of sampling locations, sampling frequencies and parameters to be tested
(b) include quality control elements
(c) include monitoring sites at Penrhyn Estuary, Botany Bay and Bunnerong Canal as well as other relevant off-site locations
(d) assess whether the project will result in any actual or potential impacts to surface waters or habitats in the locality from the operation of the groundwater treatment plant and associated plant and equipment
(e) review the conclusions of the ecological and ambient water quality assessments that were undertaken as part of the EIS, including using monitoring data collected under this licence or other approvals for this project
(f) include a mechanism to regularly review the effectiveness of the monitoring program to ensure it is effective in detecting the presence of actual or potential impacts not already identified
(g) make recommendations about changes to existing monitoring, including substances monitored and

frequency of monitoring.

The program must be prepared and implemented in consultation with the DEC, DIPNR, DPI, Sydney Ports Corporation, Sydney Water Corporation, NSW Maritime and City of Botany Council.

E9.3 PART B - ENGINEERING AUDIT

The licensee must make arrangements for, and bear the full cost of, an independent auditor to undertake engineering audits of the groundwater treatment plant and associated plant and equipment (including all control systems) to ensure it is maintained in a proper and efficient condition and operated in a proper and efficient manner with respect to its environmental and safety capability and performance.

Matters to be addressed in the audits must include but not be limited to

(a) review of the frequency of inspections and maintenance programs to ensure they are effective in detecting actual or potential changes in the environmental and safety performance
(b) review of procedures for detecting changes to the equipment that could impact on performance, including corrosion and wear
(c) review of results of internal inspections of all equipment, using video techniques where appropriate.

The licensee must consult with the Independent Monitoring Committee in the selection of the auditor.

The engineering audits must generate a report for submission to the EPA, DIPNR, Sydney Water Corporation, City of Botany Council, Community Liaison Group and available for public inspection on request.

The report must be submitted with each Annual Return

- at end of every 5th reporting period, for the first 15 years of operation of the groundwater treatment plant and then
- every 2nd reporting period in which the plant remains in operation.

The EPA may require the licensee to undertake works to address the findings or recommendations presented in the report as a requirement of this licence. Any such works shall be completed within such time as the EPA may agree.

E10 Independent Monitoring Committee

E10.1 The licensee must establish and service an Independent Monitoring Committee with technical and community representatives. The licensee must provide monitoring information and reports and consult with this Committee as required by the relevant conditions of this licence.

Note: The Independent Monitoring Committee may be formed by the licensee by expanding the existing Community Liaison Group currently established and serviced by the licensee.

E11 Financial Assurance

Requirement for works

The licensee must construct and operate the groundwater treatment plant referred to, and required by, the EPA Notice of Clean-up Action issued on 26 September 2003 as subsequently varied, and this licence.

Purpose of financial assurance

This licensee requires construction and operation of the groundwater treatment plant to complete the Botany groundwater clean-up project. The purpose of this project is to undertake remediation work to address groundwater contamination caused by historical manufacturing activities undertaken at the Botany Industrial Park (former ICI site). The objective of this condition is to secure or guarantee funding for or towards the ongoing operating costs of the project, following construction of the groundwater treatment plant.

Due date for financial assurance

The licensee must lodge a financial assurance in the form of a bank guarantee, a bond, or in another manner acceptable to the EPA by 30 November 2006.

The financial assurance must be maintained during the operation of the groundwater treatment plant and thereafter until such time as the EPA notifies the licensee in writing that it is satisfied that the contaminated groundwater has been appropriately remediated.

Expert advice to be provided to the EPA

The licensee must engage (and bear the full cost of) independent and suitably qualified experts to:

- Review and confirm the estimated annual and total remaining net operating and maintenance costs of the groundwater treatment plant and the associated monitoring and reporting costs over the life of the project; and
- Review and advise on the risks associated with the licensee's ability and commitment to meet those costs during the life of the project and the probabilities of those risks ; and
- Review and advise on the technical and environmental risks if the licensee is unable to meet the operating costs during the life of the project and the probability of those risks.

The licence must provide the expert reports to the EPA, together with any written comments from the licensee about the appropriate form or amount of the financial assurance, by 30 June 2006.

Determination of financial assurance

The form and amount of the financial assurance will be determined by the EPA (and imposed by a subsequent licence condition), following the EPA's consideration of the expert reports on costs and risks and probabilities, and the licensee's submission on the appropriate form and amount of the financial assurance.

The EPA may require the financial assurance to be adjusted so that it keeps pace with inflation for so long as the EPA requires the financial assurance to remain in place. The EPA may review the financial assurance from time to time in light of the remaining works required to complete the remediation.

Conditions under Part V (Section 116) of the Water Act

Pursuant to Part V of the *Water Act 1912* the Department of Infrastructure, Planning and Natural Resources (DIPNR), having reviewed the documentation associated with the proposal as described in a report titled *Botany Groundwater Cleanup Project – Environmental Impact Statement* (EIS) dated November 2004 and submitted to the Department by Orica Australia Pty Ltd, proposes to grant a Licence subject to a formal application being received from the proponent for such.

In addition to the licence, DIPNR proposes general and specific conditions for management of groundwater resources and dependent ecosystems in the area of the proposed groundwater clean up development.

The general terms of approval are set out below.

A. General conditions - Water Licence (Part V Water Act)

1. Under the provisions of Part V (s116) of the Water Act, this licence shall be valid for the period of ten (10) years and may be renewed upon application.

2. The licensee shall allow the Department of Infrastructure, Planning and Natural Resources, or its authorised representatives, subject to appropriate occupational health and safety provisions, full and free access to the works (ie groundwater extraction bores and groundwater investigation/monitoring bores), during or after construction, for the purpose of undertaking inspection or test of works and its fittings, and shall carry out any work or alterations deemed necessary by DIPNR to ensure the protection and maintenance of the works, or the control of the water extracted and for the protection of the quality and the prevention from pollution/contamination of surface and subsurface water.

3. The licensee shall notify DIPNR if the works (ie groundwater extraction bores, investigation/monitoring bores) are to be abandoned and, contingent with safety requirements, seal off the works by:
   (a) backfilling the work to ground level with clay or cement, or
   (b) other methods agreed to or directed by DIPNR.

4. Prior to the construction of any bore for purposes of groundwater extraction, investigation and/or groundwater monitoring, a bore licence application shall be submitted and a licence obtained from DIPNR. Completion details (Form A - Particulars of completed bore) of all bores are required to be forwarded to DIPNR within three (3) months of completion of construction.

5. Any drilling contractor engaged to construct a groundwater extraction, investigation and/or monitoring bore must hold a current NSW Water Bore Drillers Licence, with appropriate endorsements for the proposed work, that has been issued under the Water Act by DIPNR.

6. All groundwater extraction, investigation and/or monitoring bores shall be constructed in accordance with bore construction requirement given in *Minimum Construction Requirements for Water Bores in Australia* – Land and Water Biodiversity Committee Edition No 2, September 2003.

7. Appropriate occupational health and safety provisions required by NSW WorkCover must be observed during the construction of all water bores for the project.

8. Any licence granted that authorises pumping from the specified extraction areas viz Primary Containment Area on Southlands, Secondary Containment Area along Foreshore Road and DNAPL Containment line on the Botany Industrial Park is to be used for containment of contamination and groundwater remediation purposes only.

9. All groundwater extracted for containment and remediation shall be transferred to the GPT via dedicated transfer pipelines, which should be monitored to ensure pipeline failure does not occur.

10. Works used for the purpose of conveying water taken by means of the licensed work shall not be constructed or installed so as to obstruct the reasonable passage of flood water flowing into or from a water course.

Specific conditions – groundwater management

1. The licensee shall maintain records of the gross and individual volume of groundwater extracted from all bores utilised for containment of contamination and groundwater remediation and provide this information to DIPNR on an annual basis or upon request from the Department.

2. The licensee shall install and maintain groundwater monitoring bores as part of the Environmental Monitoring Plan (EMP) and obtain the endorsement of DIPNR for the location, design and technical data to be obtained from the monitoring bore network

3. The licensee shall install automatic water-level recording devices with provision for downloading and archiving groundwater level data for the endorsed groundwater monitoring network.

4. DIPNR reserves the right to request an audit of the groundwater monitoring data and archiving quality assurance/quality control (QA/QC) procedures and request the licensee take corrective measures if found to be necessary as a consequence of the audit findings.

5. The licensee shall prepare interpreted reports on a schedule endorsed in the EMP that provides technical information about the groundwater level behaviour for the area impacted by the extraction borefields, with reference to previous groundwater simulation predictions cited in the EIS.

6. The licensee shall install and maintain a settlement monitoring network in accordance with the EMP endorsed by DIPNR.

7. The licensee shall obtain as part of the EMP groundwater quality data from both the production borefields and monitoring bore network and provide technical reports on this information, with reference to performance indicators for groundwater clean up, in accordance with the endorsed EMP.

Groundwater monitoring program

1. Orica must, as a component of the Environmental Monitoring Plan, prepare and implement a groundwater monitoring program by 30 June 2005 and prior to commencement of operation of the groundwater treatment plant.

   The objectives of this monitoring program are:

   (a) to detect groundwater flow and direction at depths relevant to the proposed extraction points
   (b) to document the effectiveness of the groundwater pumping containment activity
   (c) to assess the remediation of the sand beds aquifers groundwater system by reference to performance indicators.

   The groundwater monitoring program must be developed in consultation with DIPNR, DEC, the Department of Primary Industries and Sydney Ports Corporation.

   The groundwater monitoring program must include details on but need not necessarily be limited to the following:

   (a) location of monitoring bore holes - including the depth at which they are screened to enable access of groundwater
   (b) monitoring of the reduced level (m AHD)
   (c) monitoring the groundwater gradient and determination the direction of groundwater flow
   (d) monitoring methodologies and standards to be employed
   (e) reporting and assessment of results
   (f) opportunities to integrate the monitoring program with other monitoring requirements in the vicinity
   (g) monitoring frequency
   (h) representativeness of the sampling.

The applicant must submit a pre-extraction baseline groundwater monitoring report to DIPNR and any

other relevant government agencies by 30 September 2005 for the operation of the groundwater treatment plant.

Conditions from DIPNR regarding land use safety planning

Preconstruction

1. At least one month prior to the commencement of construction of the proposed activity (except for construction of those preliminary works that are outside the scope of the hazard studies), or within such further period as the Director General may agree, Orica shall prepare and submit for the approval of the Director General the studies set out under subsections (a) to (c) (the pre-construction studies). Construction, other than of preliminary works, must not commence until approval has been given by the Director General.

    (a) HAZARD AND OPERABILITY STUDY

    A Hazard and Operability Study for the proposed activity, chaired by an independent qualified person approved by the Director General prior to the commencement of the study. The study shall be carried out in accordance with the DIPNR's Hazardous Industry Planning Advisory Paper No. 8, *HAZOP Guidelines*. The study report must be accompanied by a program for the implementation of all recommendations made in the report. If the Applicant intends to defer the implementation of a recommendation, justification must be included.

    (b) FINAL HAZARD ANALYSIS

    A Final Hazard Analysis of the proposed activity prepared in accordance with DIPNR 's Hazardous Industry Planning Advisory Paper No. 6, *Guidelines for Hazard Analysis*.

    (c) CONSTRUCTION SAFETY STUDY

    A Construction Safety Study prepared in accordance with DIPNR's Hazardous Industry Planning Advisory Paper No. 7, *Construction Safety Study Guidelines*. If the construction period exceeds six (6) months, the commissioning portion of the Construction Safety Study may be submitted two months prior to the commencement of commissioning.

Ongoing

2. INCIDENT REGISTER

    The Applicant shall maintain a register of accidents, incidents and potential incidents with actual or potential significant off-site impacts on people, property or the biophysical environment. The register shall be made available for inspection at any time by the independent Hazard Auditor and the Director General.

3. HAZARD AUDIT

    Twelve months after the commencement of operations of the proposed development, or within such further period as the Director General may agree, the applicant shall carry out a comprehensive Hazard Audit of the proposed development and within one month of the audit submit a report to the Director General. The hazard audit may be incorporated in the overall hazard audit for Orica.

The audit shall be carried out at the applicant's expense by a duly qualified independent person or team approved by the Director General prior to commencement of the audit. Further audits shall be carried out every three years or as determined by the Director General and a report of each audit shall within a month of the audit be submitted to the Director General. Hazard Audits shall be carried out in accordance with DIPNR's Hazardous Industry Planning Advisory Paper No. 5, *Hazard Audit Guidelines*.

The audit shall include a review of elements of the site Safety Management System and a review of all entries made in the incident register since the previous audit.

The audit report must be accompanied by a program for the implementation of all recommendations made in the audit report. If the applicant intends to defer the implementation of a recommendation, justification must be included.

4. The conditions of consent imposed on the BIP (DA No 30/98, approved on 16/1/1998) include the review and update, if necessary, of BIP and Orica Site Safety Management Systems, Site Fire Safety Study and Site Emergency Plan. Any revisions of the above studies should be submitted to the Director General for approval.

5. In these conditions "Director General" means Director General of the Department of Infrastructure Planning and Natural Resources or delegate.

Conditions for Part 3A Permit under Rivers and Foreshore Act

1. Physical works at Bunnerong Canal are not to commence until such time as a Part 3A Permit under the *Rivers and Foreshores Improvement Act 1948* has been issued by NSW Maritime.

2. The permission of the relevant landowner on which the works will be undertaken is to be obtained prior to lodgement of any Part 3A Permit application with NSW Maritime.

3. Suitably dimensioned plans and elevations showing the pipeline and outlet to Bunnerong Canal in relation to Bunnerong Canal and surrounds are to be provided to NSW Maritime prior to issue of any Part 3A Permit for the works.

4. A suitable plan to manage any acid sulfate material that may be encountered during the works associated with the Bunnerong Canal discharge point is to be prepared and submitted to NSW Maritime prior to the issue of the Part 3A permit.

5. Water quality monitoring should be undertaken at the discharge point, being the pipeline where it enters Bunnerong Canal.

6. Within 2 months of achieving practical completion of the construction activities at Bunnerong Canal, the proponent must submit a report outlining its compliance with the conditions of the Part 3A Permit. The report must also outline details of environmental incidents, near incidents and remedial actions undertaken to repair any environmental damage.

7. Prior to lodgement of any Part 3A Permit application with NSW Maritime the proponent must submit in writing to Sydney Ports Corporation and NSW Maritime a Bunnerong Canal Discharge Optimisation Plan. The objective of this plan is to ensure that the discharge in Bunnerong Canal is optimised to minimise scouring of sediments and maximise the mixing of the discharge with the receiving waters. The plan must include but not be limited to:

    - a detailed design of the discharge structure demonstrating how the potential for scouring is minimised and how mixing with receiving waters is optimised.

- a description of how the operation of the discharge will be optimised (ie flow rate limitations and timing of discharge).

- protocols for handling emergency situations.

- a monitoring proposal, including initial base line measurements of the sediment levels and distribution within the canal and Orica's proposed ongoing sediment distribution monitoring program.

The plan must be developed in consultation with DEC, DIPNR, Sydney Ports Corporation and the NSW Maritime.

Conditions from Sydney Water

1. Orica must comply with the requirements of the *Sydney Water Act 1994*. This includes obtaining a Section 73 Compliance Certificate. In seeking the Compliance Certificate, Orica must supply to Sydney Water all information necessary for Sydney Water to assess the impacts of the proposal on Sydney Water assets and operations. Orica must also comply with the requirements of Sydney Water issued as a Notice of Requirements, under Section 74 of the Act, prior to the Completion Certificate being issued. Such requirements will include adjustments to the trade waste agreement.

2. In relation to the discharge of excess treated water to Sydney Water's Bunnerong stormwater channel, Orica must conduct further technical investigations (eg potential impacts on flooding and the structural integrity of the channel) and obtain appropriate agreement with Sydney Water, prior to the commencement of any discharge.

Conditions from Sydney Ports Corporation for approval to discharge into Bunnerong Canal

1. Subject to the finalisation of a formal instrument of agreement between Sydney Ports Corporation and Orica, approval shall be granted for the discharge of water into Bunnerong Canal (the Canal) at a rate not to exceed 12 ML per day, and at a flow rate not to exceed 0.14 cubic metres per second.

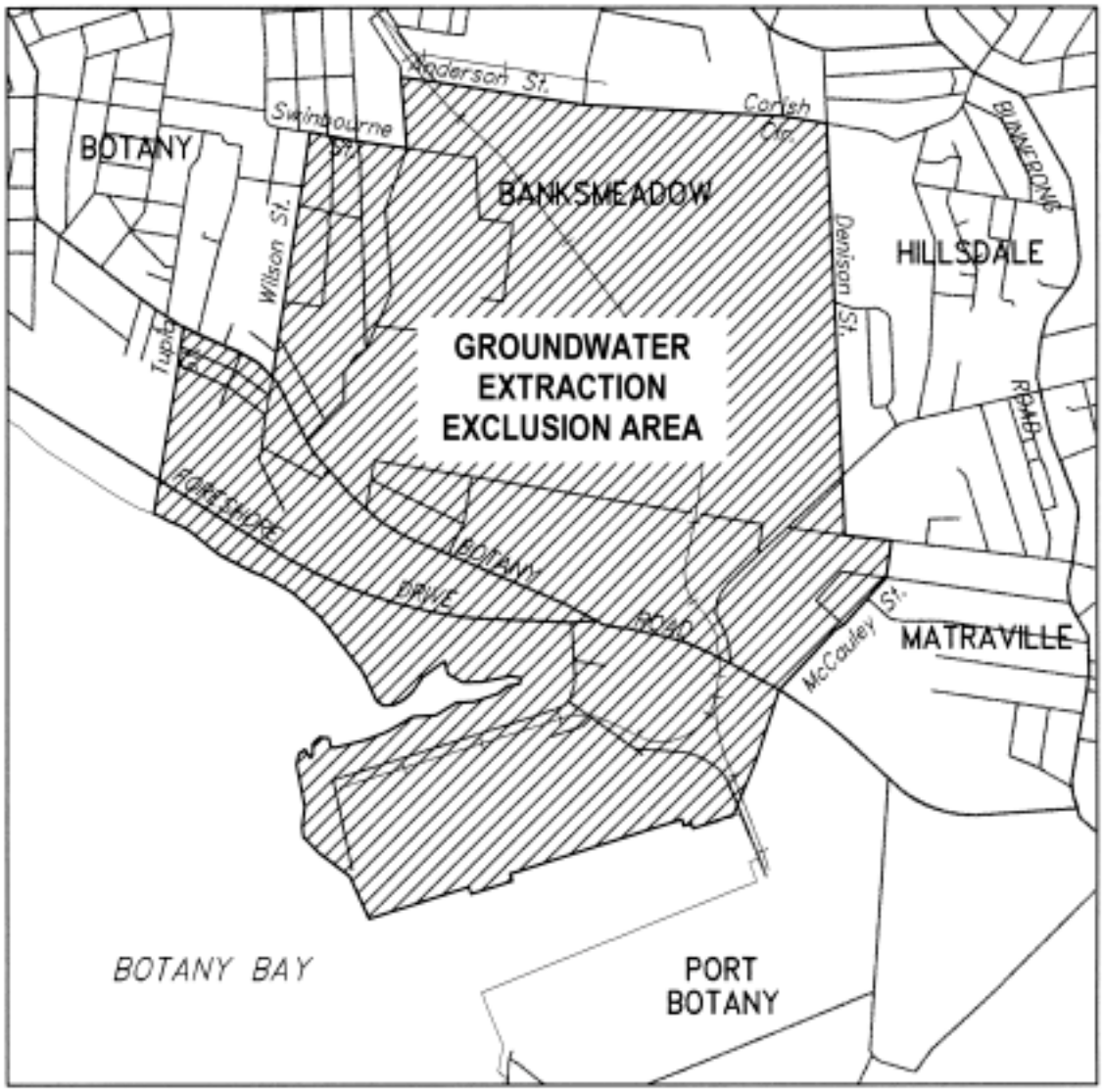
2. Prior to the commencement of any discharge into the canal, and the finalisation of the formal instrument of agreement, Orica shall submit – for Sydney Ports Corporation approval - a *Bunnerong Canal Discharge Optimisation Plan*. This plan shall contain (but is not limited to) details of the discharge structure to be installed, initial baseline measurements of the sediment levels and distribution within the Canal and Orica's proposed ongoing sediment distribution monitoring program.

3. Should monitoring indicate sediment movement to an extent that is unacceptable to Sydney Ports Corporation, Orica will be required to develop appropriate mitigation and/or management measures for Sydney Ports Corporation approval and implement these within an agreed timeframe.

4. Orica will be required to cease discharge in the canal as directed by Sydney Ports Corporation, if it is essential to conduct maintenance on the canal, maintain port operations, respond to emergencies or in the event of a pollution incident.

5. The quality of the water being discharged must meet all relevant requirements for discharge into stormwater systems. Orica is to monitor and document for Sydney Ports Corporation pollutant levels within the water to be discharged. In the event of discharge waters containing pollutant levels in excess of relevant requirements, Orica will:
   (a) immediately notify Sydney Ports Corporation
   (b) undertake appropriate action to cease the generation of the pollution and undertake appropriate clean up actions
   (c) at its expense, promptly comply with any notice, order, direction or requirement of Sydney Ports Corporation and/or of any other relevant Authority.

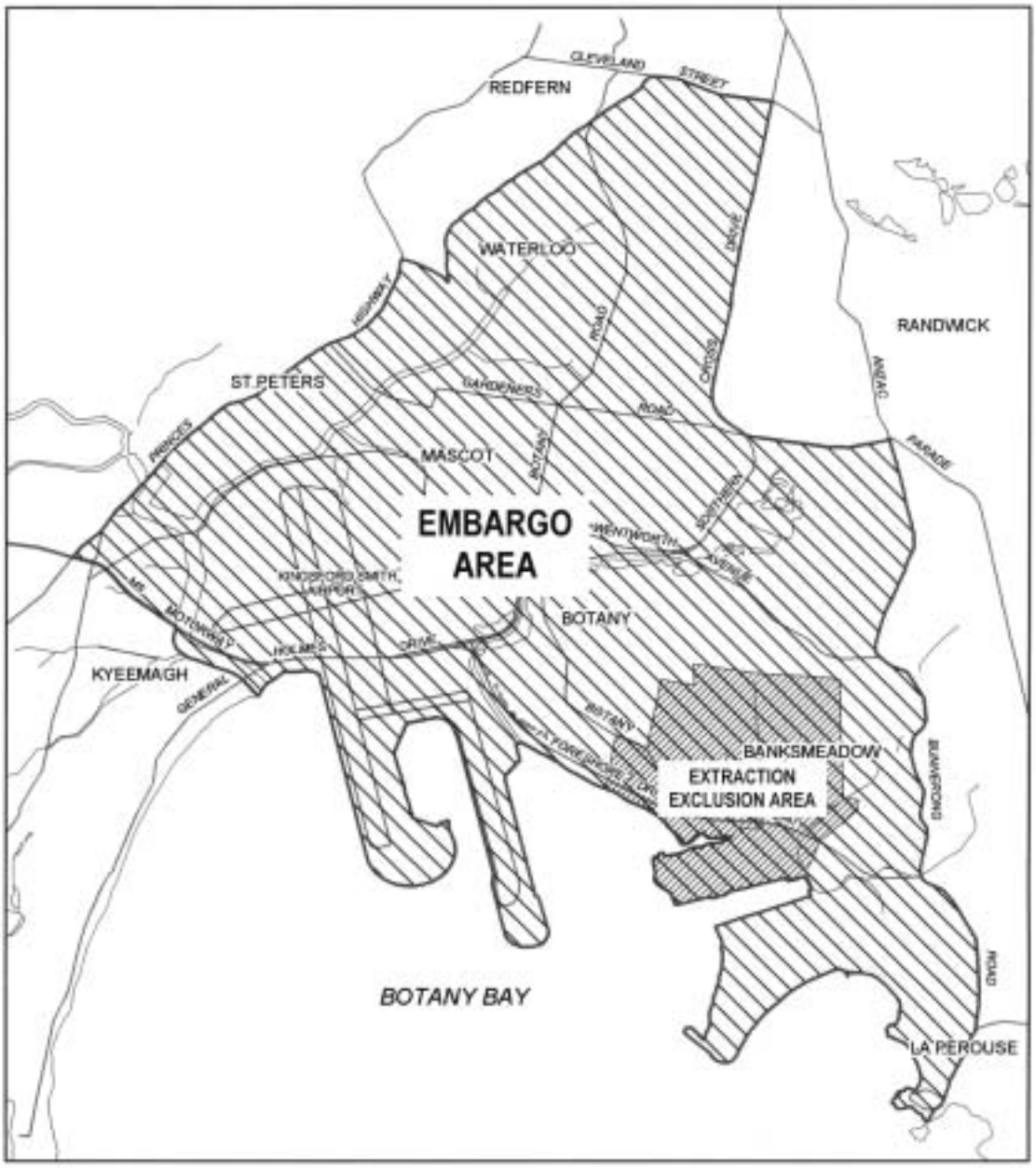
Appendix C Botany Sand Beds Groundwater Extraction Exclusion Area



The Groundwater Extraction Exclusion Area (previously Groundwater Protection Zone 1) is an area around the known contamination plumes originating from historical activity at the former ICI Petrochemical Complex (now Orica). The exclusion area has been implemented in response to the detection of contaminants in groundwater downgradient of the Orica Complex.
This area occupies parts of East Botany and Banksmeadow, and is defined by cultural features as follows: Tupia Street, Botany Road, Wilson Street, Swinbourne Street, Stephen Road, Anderson Street, Corish Circle, Denison Street and McCauley Street.

In the Groundwater Extraction Exclusion Area, the Department of Infrastructure, Planning and Natural Resources has issued notices to licensees under the *Water Act 1912* not to extract groundwater. Unlicensed bore owners are advised not to extract groundwater within this area.

Appendix D Botany Sand Beds Groundwater Embargo Area



The Groundwater Embargo Area This embargo area was gazetted to proactively manage sites with potential contamination by restricting new access to groundwater.

The area incorporates parts of the western half of the Botany Sand Beds Northern Zone, where it is known that historic industrial activity has occurred. The area is bounded by Anzac Parade, Bunnerong Road, Gardeners Road, Southern Cross Drive, South Dowling Street, Cleveland Street, Princes Highway and M5 tunnel alignment. The restriction placed on this area precludes any new bore licences for the extraction of groundwater from being issued with the exception of temporary dewatering, groundwater monitoring and remediation bores. The intent of the embargo is to not issue new licences until further assessment of the groundwater system occurs through the Botany Groundwater Strategy.