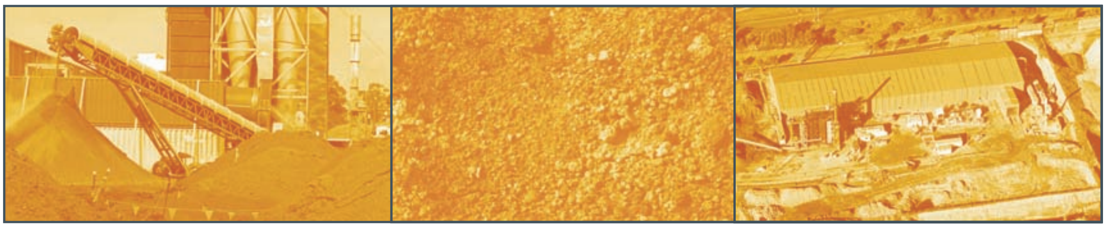

a p p e n d i x d

remedial action plan

Remedial Action Plan – Car Park Waste Encapsulation
Botany Industrial Park
Matraville, NSW

10 July 2007

Prepared for:
Orica Australia Pty Ltd
16-20 Beauchamp Road
MATRAVILLE NSW 2036

Report by:
HLA-Envirosciences Pty Limited
ABN: 34 060 204 702
Level 5, 828 Pacific Highway Gordon NSW 2072
PO Box 726 Pymble NSW 2073
Ph: +61 2 8484 8999
Fax: +61 2 8484 8989

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Orica CPWE Remedial Action Plan
Botany Industrial Park
Matraville, NSW

10 July 2007

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This document was prepared for the purpose described in our proposal (5 July 2006) and as agreed to by Orica. From a technical perspective, the subsurface environment at any site may present substantial uncertainty. It is a heterogeneous, complex environment, in which small subsurface features or changes in geologic conditions can have substantial impacts on water and chemical movement. Uncertainties may also affect source characterisation assessment of chemical fate and transport in the environment, assessment of exposure risks and health effects, and remedial action performance.

HLA's professional opinions are based upon its professional judgement, experience, and training. These opinions are also based upon data derived from the testing and analysis described in this document. It is possible that additional testing and analysis might produce different results and/or different opinions. HLA has limited its investigation to the scope agreed upon with its client. HLA believes that its opinions are reasonably supported by the testing and analysis that have been done, and that those opinions have been developed according to the professional standard of care for the environmental consulting profession in this area at this time. That standard of care may change and new methods and practices of exploration, testing, analysis and remediation may develop in the future, which might produce different results. HLA's professional opinions contained in this document are subject to modification if additional information is obtained, through further investigation, observations, or validation testing and analysis during remedial activities.

By

HLA-Envirosciences Pty Limited
ABN: 34 060 204 702
Level 5, 828 Pacific Highway Gordon NSW 2072
PO Box 726 Pymble NSW 2073

Andrew Rolfe
Associate Environmental Scientist

Peer Review: **Date:**

	10 July 07
Rui Henriques **Principal, Remediation**	

for.

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APPENDICES

Appendix A : Environmental Protection Licence 2148
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Appendix C : Regulatory Compliance Discussion Report

GLOSSARY OF TERMS

ANZECC	Australian and New Zealand Environment Conservation Council
ARMCANZ	Agriculture and Resource Management Council of Australia and New Zealand
AQMP	Air Quality Monitoring Plan
AS	Australian Standards
ASFSO	Automatic soil feed shut off
BCD	Base Catalysed Decomposition
BIP	Botany Industrial Park
CH_4	Methane
CCO	Chemical Control Order
CHC	Chlorinated Hydrocarbons
CO	Carbon Monoxide
CO_2	Carbon dioxide
CoBB	City of Botany Bay Council
COC	Chemicals of Concern
COPC	Chemicals of Potential Concern
COD	Chemical Oxygen Demand
CEM	continuous monitoring equipment
CPRC	Community Participation and Review Committee
CPWE	Car Park Waste Encapsulation
CTC	Carbon tetrachloride
DEC	NSW Department of Environment and Conservation
DoP	NSW Department of Planning
DM	Data Manager
DQI	Data Quality Indicators
DQO	Data Quality Objective
DTD	Directly-heated Thermal Desorption
EBCRC	Environmental Biotechnology Cooperative Research Centre
ECS	Emission Control System
EDC	1,2-dichloroethane
EA	Environmental Assessment
EMP	Environmental Management Plan
EPA	Environmental Protection Authority
EPL	Environmental Protection Licence
ERP	Emergency Response Plan
ESB	Excavation Soil Building
FSB	Feed Soil Building
ESTD	*Ex situ* Thermal Desorption
GAC	Granular activated carbon
GHD	GHD Pty Ltd
GTP	Groundwater Treatment Plant
ha	Hectare
HAZOP	Hazardous On-site Operations and Processes
HCB	Hexachlorobenzene
HCBD	Hexachlorobutadiene
HDPE	High Density Polyethylene
HLA	HLA-Envirosciences Pty Limited
ISTD	*In situ* Thermal Desorption
ITD	Indirectly-heated Thermal Desorption
LGA	Local Government Area
bgl	below ground level
MCB	Chlorobenzene

MHSPE	Netherlands Ministry of Housing, Spatial Planning and the Environment
MSDS	Material Safety Data Sheet
NATA	National Association of Testing Authorities
NEPC	National Environment Protection Council
NEPM	National Environment Protection (Assessment of Site Contamination) Measure
OCP	Organochlorine Pesticide
OCS	Octachlorostyrene
OH&S	Occupational Health and Safety
OHSP	Occupational Health and Safety Plan
PAE	Pacific Air & Environment Pty Ltd
PACT	Plasma Arc Centrifugal Treatment
PC	Principal Contractor
PCE	Tetrachloroethene
PoP	Proof of Performance
PPE	Personal Protective Equipment
PQL	Practical Quantitation Limit
QA/QC	Quality Assurance/Quality Control
RAP	Remedial Action Plan
RPD	Relative Percent Difference
RBRC	Risk Based Remediation Concentrations
RBSC	Risk-based Soil Concentrations
SCW	Scheduled Chemical Waste
SIL	Soil Investigation Level
SPCC	State Pollution Control Commission
SPM	Site Project Manager
SSO	Site Safety Officer
SSA	Soil Stockpile Area
SSSA	Surplus Soil Stockpile Area
STA	Soil Treatment Area
TCE	Trichloroethene
TDS	Total Dissolved Solid
TEQ	Toxic Equivalent
Thiess	Thiess Services Pty Ltd
TOC	Total Organic Carbon
TSP	Total Suspended Solids
UNSW	University of New South Wales
USCS	Unified Soil Classification System
USEPA	United States Environmental Protection Authority
VCH	Volatile chlorinated hydrocarbon
VOC	Volatile organic compound
WHO	World Health Organisation
WTP	Water Treatment Plant

1 INTRODUCTION

HLA-Envirosciences Pty Limited (HLA) was commissioned by Orica Australia Pty Limited (Orica) to develop a Remedial Action Plan (RAP) for the Car Park Waste Encapsulation (CPWE) at the Botany Industrial Park (BIP), Matraville, New South Wales (NSW) (refer to **Figure 1**). This RAP is to be included in the Environmental Assessment (EA) for the remediation of the CPWE, which is currently being prepared to meet the requirements of Condition E3 of Orica's Environmental Protection Licence (EPL) No. 2148 (refer to **Appendix A**).

For the purposes of this report, the CPWE area and associated remediation areas are referred to as 'the Site'.

The land comprising the BIP has been used for industrial purposes since the early 1940s and was operated by ICI Australia Operations Pty Ltd (ICI, now Orica) until 1996 when Orica established the BIP.

Commencing in the 1960s, chlorinated solvents such as tetrachloroethene (PCE - commonly used as dry cleaning fluid) and carbon tetrachloride (CTC – an industrial solvent and formerly used for manufacturing refrigerants) were produced at the BIP in the 'Solvents Plant'. During this manufacturing process, a number of waste by-products were produced, including hexachlorobutadiene (HCBD), PCE, hexachlorobenzene (HCB) and octachlorostyrene (OCS). The waste by-product was commonly known as 'Heavy Ends'.

Prior to 1979, the Heavy Ends from the Solvents Plant were drummed and stored on a bed of boiler ash. Drum corrosion led to contamination of the ash bed and underlying sandy soil. Orica (then ICI) undertook investigations into the treatment and storage of the contaminated ash and soil. At the time there was no suitable technology available to treat this material, therefore, it was managed by encapsulation – that is, containing the soil within a synthetic liner (Hypalon) and burying it awaiting the development of a suitable remediation technology. In 1980, the contaminated material was excavated and transferred to the subject site located in the north east of the BIP. Approximately 45,000 m^3 of excavated material was encapsulated and the surface capped with bitumen. The area has subsequently been referred to as the CPWE.

The project involves the remediation of the CPWE using Directly-heated Thermal Desorption (DTD) technology. The primary objective of the project is to clean up this site in line with the requirements of Orica's Licence.

This RAP has been prepared with reference to the following key documents:

- NSW EPA (1997). *Guidelines for Consultants Reporting on Contaminated Sites*;
- USEPA (1997). *Best Management Practices for Soils Treatment Technologies – Suggested Operational Guidelines to prevent Cross-Media Transfer of Contaminants During Cleanup Activities*, Ref: EPA530-R-97-007;
- NSW EPA (2004). *Chemical Control Order in Relation to Scheduled Chemical Wastes*;
- NSW EPA (1997). *Polychlorinated Biphenyl (PCB) Chemical Control Order*; and
- ANZECC (1996). *Hexachlorobenzene Waste Management Plan*.

1.1 Proposed Future Land Use

At the time of writing this document, the specific future use of the CPWE area has not been determined. However, the RAP anticipates that the proposed remediation works will allow the land to be returned to productive commercial/industrial use in line with the zoning and surrounding land uses.

1.2 Project Objectives

The key objectives for the proposed remediation works are:

- to protect the environment by ensuring that the CPWE area is remediated such that it does not constitute a contamination source for the BIP site, surrounding properties and Botany Bay;
- compliance with legislative requirements and the appropriate requirements from City of Botany Bay (CoBB) Council, the NSW Department of Planning (DoP) and the NSW Department of Environment and Conservation (DEC, formerly the Environment Protection Authority, EPA);
- to ensure that the CPWE land is suitable for the anticipated ongoing commercial/industrial use.

1.3 Scope

The CPWE, is defined in the EPL as the encapsulation cell that lies beneath the car park on the north east boundary of the BIP. This RAP describes the remediation works proposed for the CPWE area and details the remediation methodologies specific to the CPWE area. The RAP outlines the proposed methods of excavation of contaminated soil contained within the CPWE, and the on-site *ex situ* treatment of this soil for reuse on the BIP. The remediation works do not include remediation of groundwater, contaminated material which may exist outside the boundary of the CPWE area or contaminated material where the source of contamination is not within the BIP site and not related to industrial activities undertaken by Orica.

It should be noted that this document provides as much detail as possible in relation to the remediation strategy to be adopted. At this stage, the detailed design of the proposed DTD Plant and associated plant/equipment has not been finalised and therefore, the detailed remediation methodology can not been completed. It is possible that the RAP may need to be updated prior to the project commencing and also during the project.

2 ASSESSMENT AND APPROVAL PROCESSES

The proposed remediation project has been declared by the Minister for Planning as a 'major project' under the provisions of the *Environmental Planning and Assessment Act 1979* (EP&A) and *State Environmental Planning Policy (Major Projects) 2005* (SEPP 2005). The project approval is therefore being sought under Part 3A of the EP&A Act.

2.1 Legislation Relevant to Remediation Works

The DEC administers a number of Acts and legislative instruments relevant to these remediation works. These include:

- the *Contaminated Land Management Act 1997* (CLM);
- the *Protection of the Environment Operations Act 1997* (POEO), in particular, licensing obligations under that Act; and
- the *Environmentally Hazardous Chemicals Act 1985* (EHC), in particular the Chemical Control Order (CCO) for Scheduled Chemical Waste (SCW) and PCBs under that Act.

2.1.1 Contaminated Land Management Act

The CLM Act is the primary Act under which contaminated land is regulated by the DEC.

This section addresses the following aspects of the Act:

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

The *Guidelines for the NSW Site Auditor's Scheme* (DEC 2006) describe a decision process for assessing urban redevelopment sites that should be followed by contaminated land consultants. The Guidelines prescribe soil investigation levels (SILs) which are the concentration levels of particular contaminants above which further investigation and evaluation are required. SILs are arrived at using appropriate sampling, analytical and data interpretation techniques.

However, the substances for which SILs have been prescribed do not include many of the Chemicals of Potential Concern (COPC) identified within the CPWE. The Guidelines make the following provision for such circumstances:

> *"…where SILs are not available for particular contaminants, or assessment of contaminants against SILs at a particular site is inconclusive… The auditor must check whether the risk assessment is in accordance with the NEPM* [National Environmental Protection (Assessment of Site Contamination) Measures] *and any relevant guidelines made or approved by DEC. The auditor must also check that any human health risk assessment satisfies all the requirements in the checklist in Appendix VII. The auditor must check that all site-specific risk assessments are scientifically valid and that the site-specific criteria recommended by the consultant are appropriate to protect public health and the environment."*

Since SILs are not available for all COPC in the CPWE, it is necessary and appropriate to adopt a health-based risk assessment approach in determining suitable criteria for these chemicals and the level of remediation required for the proposed future use of the CPWE land, which is commercial/industrial. The risk assessment process, by which the risk based remediation concentrations were derived, is summarised in **Section 6.1**.

The CLM Act also sets out requirements for site audits. The Act requires a site audit to be undertaken under certain circumstances such as where a voluntary investigation proposal or voluntary remediation proposal has been agreed with the DEC or where required under *State Environmental Planning Policy 55– Remediation of Land* (SEPP 55).

Currently, SEPP 55 does not require a mandatory site audit at any stage of the planning process for remediation work, and the CPWE site is not subject to a voluntary investigation and voluntary remediation proposal, therefore a site audit under the CLM Act is not required at this time. Although a site audit is not required at this time, Orica has made a commitment to engage an independent, DEC accredited site auditor (Contaminated Land Auditor) in respect of the proposed works. Given this, the Contaminated Land Auditor will be required to review and endorse this RAP and any remediation goals, including any modifications or revisions.

2.1.2 Protection of the Environment Operations Act

Section 48 of the POEO Act requires a person to obtain a licence from the DEC before carrying out any of the premises-based activities described in Schedule 1 of that Act.

Schedule 1 includes the following activity:

> *"Contaminated soil treatment works for on-site or off-site treatment (including, in either case, incineration or storage of contaminated soil but excluding excavation for treatment at another site) that:*
> *(1) handle more than 1,000 cubic metres per year of contaminated soil not originating from the site on which the works are located; or*
> *(2) handle contaminated soil originating exclusively from the site on which the works are located; and*
> *(a) incinerate more than 1,000 cubic metres per year of contaminated soil, or*
> *(b) treat otherwise than by incineration and store more than 30,000 cubic metres of contaminated soil, or*
> *(c) disturb more than an aggregate area of 3 hectares of contaminated soil."*

The remediation works will involve the treatment of more than 30,000 m^3 of contaminated soil. Accordingly, the remediation works will require a licence under the POEO Act. Subject to the outcome of discussions with DEC, this licence may be in the form of a variation to Orica's existing EPL, which applies to the CPWE area.

2.1.3 Environmentally Hazardous Chemicals Act

The CPWE is regulated by the DEC under the provisions of the national *HCB Waste Management Plan* (ANZECC 1996) and the DEC (2004) CCO in relation to SCW.

Under Division 5, Part 3 of the EHC Act the DEC can make a CCO in relation to an environmentally hazardous chemical or a declared chemical waste.

The *Guidelines for the NSW Site Auditor's Scheme* published by the DEC (2006) state that:

> *"CCOs set out requirements for manufacturing, keeping, using, processing, storing, selling, transporting or disposing of chemicals and declared chemical wastes. A site auditor must not endorse a management strategy proposed for a site which involves chemicals or chemical wastes subject to a CCO, unless they are satisfied it complies with the requirements set down in the CCO. For example, certain chemicals occurring above the prescribed concentrations are prohibited from being disposed of at any landfill.*
>
> *There is a program of national management plans for Schedule X wastes (ANZECC 1994b). The program includes wastes associated with HCB (hexachlorobenzene) (ANZECC 1996b), PCBs (polychlorinated biphenyls) (ANZECC 1996c), and OCPs (organochlorine pesticides) (management plan proposed). The national management plans set timelines for the destruction and disposal of Schedule X wastes. The relevant authorities implement regulatory aspects of the plans. Site auditors should be aware that CCOs either have been or will be revised by the EPA* (now DEC) *as part of implementing the national management plans."*

CCOs are a primary regulatory tool under the EHC Act and are used by the DEC to control particular compounds, and their potential or actual impact on the environment. For the remediation works proposed at the CPWE, a CCO applies for HCB, pentachlorobenzene, 1,2,4-trichlorobenzene and 1,2,4,5-tetrachlorobenzene, which are considered SCW.

The CCO in relation to SCW dated 11 June 2004 prohibits the manufacturing, processing, keeping, distributing, conveying, using, selling or disposing of SCW, or any act related to any such act, unless it is otherwise permitted by, and carried out in accordance with the conditions of, the SCW CCO. The SCW CCO requires a licence for various activities, including treatment (processing).

The CCO for PCBs (NSW EPA 1997) also needs to be considered given that the (average) concentration at which PCBs have been identified in the CPWE material is greater than the 2 mg/kg threshold for PCB wastes. However, PCB concentrations are below the threshold for scheduled PCB waste. Therefore the CPWE material is classified to be non-scheduled PCB waste.

The material contained in the CPWE is also considered HCB waste under the *HCB Waste Management Plan* (ANZECC 1996).

The proposed thermal treatment technology would be reviewed and licensed by the DEC under the appropriate provisions of the EHC Act based on a future Technology Assessment to be completed by Orica in accordance with the *National Protocol for Schedule X Wastes* (ANZECC 1994). The Technology Assessment will include treatability trials on the CPWE material to assist with the optimisation of the DTD Plant design.

2.1.4 Existing Orders and Regulatory Instruments

Prior to the enactment of the CLM Act, the DEC regulated sites by orders under sections 35 and 36 of the EHC Act. The transitional arrangements for the commencement of the CLM Act repealed these sections of EHC Act, but preserved the operation of orders made under the EHC Act.

The CPWE forms part of the land that is affected by Notice No. 450 issued under Section 35 of the EHC Act. This notice states the following:

"*The occupier must obtain the written approval of the EPA if works are to be carried out at the Premises for the purpose of:*

a) covering, dispersing or reducing the contamination of the premises; or
b) restoring or rehabilitating the Premises; or
c) removing or disposing of any soil, sand, rock, water, or any other solid or liquid material of any kind from the premises."

CCOs are a primary regulatory tool under the EHC Act and are used by the DEC to selectively and specifically control particular chemicals of concern, and their potential or actual impact on the environment. The nature of the contaminated materials within the CPWE is such that the contents of the CPWE are considered to be SCW under the SCW CCO (NSW EPA 2004), HCB waste under the *HCB Waste Management Plan* (ANZECC 1996) and PCB waste under the PCB CCO (NSW EPA 1997).

The proposed thermal treatment technology would be reviewed and licensed by the DEC under the appropriate provisions of the EHC Act.

3 SITE IDENTIFICATION AND HISTORY

3.1 Site Location

It is proposed to remediate the CPWE, which is located in the north eastern corner of the BIP on Corish Circle and occupies an L-shaped area of approximately 1.4 ha (refer to **Figure 1** and **2**). The area proposed for the treatment of the contaminated material, termed the “Soil Treatment Area” (STA), is also located within the north eastern portion of the BIP, and will occupy an area of approximately 3.2 ha (refer to **Figure 2**).

The BIP covers an area of approximately 74 ha and occupies the north eastern sector of a larger industrial area that extends south to Port Botany on Botany Bay. The BIP is located in an area of mixed industrial, commercial and residential land uses and lies within the Local Government Area (LGA) administered by CoBB Council. The BIP is located immediately south of central Sydney, with the Mascot international and domestic airports located to the west, and Port Botany and Botany Bay to the south.

3.2 Surrounding Land Use

The CPWE area is on the perimeter of the BIP, bounded by Corish Circle to the east and neighbouring industrial land to the north and west. Access is via internal roads on the BIP or via a gate (Gate 8) off Corish Circle.

To the south of the CPWE is the BIP. Hensley Athletics Field is to the east across Corish Circle and is used for various recreational and sporting activities.

3.2.1 External Neighbours

The nearest residential areas are in Denison Street around 160 m to the east / southeast of the CPWE and in Eastlakes / Pagewood around 400 m away to the north-west of the CPWE.

The Hensley Athletics Field is located on the eastern side of Corish Circle (refer to **Figure 2**).

Banksmeadow Primary School is located approximately 1,000 m south west, Matraville Primary School is located approximately 800 m south east and Pagewood Primary school is located approximately 600 m north west of the Site.

Kellogg (Aust.) Pty Ltd (Kellogg’s) - snack foods, cereals etc - is a food manufacturing facility located approximately 800 m west of the proposed remediation facility (DTD Plant) and 1 km west of the CPWE.

A juice factory (Nudie Juice) has reopened on Corish Circle, approximately 300 m north of the proposed remediation facility and approximately 150 m north of the CPWE.

There was also a food distribution company (Gazelle Foods Pty Ltd) in Denison Street, near the corner of Smith Street which is opposite Hensley Athletics Field. The facility no longer exists and the Site has been cleared awaiting development.

A food manufacturing facility (soy products are produced and distributed) exists within 19A Baker Street, located approximately 400 m to the west of the CPWE and approximately 400 m north west of the proposed remediation facility. A bakery/patisserie is also located approximately 500 m north west of the CPWE and approximately 600 m north west of the remediation facility.

Eastgardens shopping centre across Wentworth Avenue also has typical food outlets. None of these are food manufacturing or repackaging facilities. However, a childcare centre is located at the shopping centre.

Immediately north of the CPWE is an industrial building leased out to various industrial users, including a bakery and food repackaging company. The remaining businesses are of a general industrial non-hazardous nature.

3.2.2 Internal BIP Neighbours

Currently there are three different operators on the BIP site – Orica, Qenos Pty Ltd (Qenos) and Hunstman Corporation Australia (Huntsman). Orica operates the Chlorine Plant and Groundwater Treatment Plant (GTP) at the southern end of the BIP, whilst Qenos (formerly a joint venture between Orica and Exxon-Mobil and now owned by China National Chemical Corporation) operates the Olefines, Alkathene, Alkatuff and Site Utilities Plants which are typically in the northern portion of BIP. Huntsman is independent of Orica and operates the Surfactants Plant which is in the southern portion of BIP. Air Liquide and BOC gases also operate on the BIP site, on land leased from Orica.

The nearest internal BIP neighbour to the CPWE is the Qenos Olefines facility Administration Building immediately to the south and the Olefines car park is located adjacent to the western boundary of the CPWE. The Gate 4 security gatehouse, the Olefines canteen and former Propathene Plant Administration Building (currently unoccupied) are also relatively close to the southern boundary of the CPWE.

The closest process operations to the former Propathene Plant area are the Qenos Olefines propane (C3/C4) storage bullets immediately south of 9th Street. ABB Ltd (ABB) maintenance sheds and workshops are located on the north eastern corner of the former Propathene Plant area.

The location of the BIP and the surrounding area is shown in **Figures 1** and **2**.

3.3 General Description

Topographically the BIP rises from about 5 m above sea level at the western boundary, to approximately 20 m above sea level at the eastern boundary. The CPWE is located on an elevated area that was formed from coastal sand dunes, and is further elevated above the surrounding ground level as a result of the waste encapsulation.

The CPWE comprises an L-shaped Hypalon[1] lined waste cell, overlain by engineered fill and a bitumen cap to protect the integrity of the liner and on the sides by landscaping soil. It contains some 45,000 m³ of contaminated waste.

A bitumen-sealed access ramp, rises about 1.5 m from an entry gate (Gate 8) on Corish Circle - this forms the southern boundary of the CPWE. The eastern boundary consists of a landscaped bank which rises some 4 m above Corish Circle, running along the eastern boundary, about 1.5 m above the bitumen surface of the car park. The northern boundary consists of a landscaped bank which falls about 2 m to the level of the industrial building on the northern boundary. The western boundary of the CPWE comprises a bitumen-sealed access ramp over

[1] Hypalon® is a chlorosulfonated polyethylene rubber manufactured by Du Pont.

the CPWE batter in the north western corner which falls about 6 m to the adjacent Qenos (Olefines facility) car park.

The CPWE site is currently vacant and is not used for car parking.

The STA is proposed to be located at the former Propathene Plant area (owned by Orica), located to the south west of the CPWE area. The soil pre-treatment, remediation (DTD) process and treated soil stockpiles will be located in this area. The Propathene Plant has been previously demolished and the area is effectively clear.

On the BIP itself (including surface runoff from the CPWE), uncontaminated stormwater discharges into Springvale Drain. Treated trade waste effluent is discharged into the Sydney Water sewer system.

3.4 Site History and Ownership

3.4.1 The CPWE

From 1963 to 1991 chlorinated solvents such as PCE (commonly used as dry cleaning fluid) and CTC (an industrial solvent and formerly used for manufacturing refrigerants) were produced on the BIP in the plant known as the Solvents Plant. The Solvents Plant was decommissioned in 1991.

During this manufacturing process, a number of waste by-products, such as HCBD were produced – the waste was commonly known as Heavy Ends. Typically, Heavy Ends were a mixture of solid and liquid phases, containing HCBD, hexachloroethane (HCE), HCB and PCE, which were formed from the bottom split of PCE refining. HCE and HCB are usually solids at normal atmospheric conditions; they were dissolved in the liquid HCBD and PCE. OCS was another solid by-product dissolved in the Heavy Ends, but it was present at low concentrations (<3%) until the start-up of the Heavy Ends Treatment Plant (HETP, see below) when this waste reprocessing plant caused the concentrations to build up to around 30%.

The Heavy Ends generated by the Plant was drummed and typically stored on site; adjacent to the plant, in an area where the Heavy Ends Store (where the 'HCB Waste' is currently stored) currently exists and in an ash-filled area in the northern portion of the BIP (Northern Drum Area) – where the Olefines 2 Plant is located today.

In 1978, a HETP was commissioned at the southern end of the Solvents Plant. This plant was built to reprocess the Heavy Ends waste that had been stored on site and treat the ongoing waste generated by the Solvents Plant. However, the HETP was ultimately not used to reprocess the Heavy Ends waste that was stored on site prior to 1978 for technical reasons. The HETP continued to treat ongoing waste generated by the Solvents Plant until the Solvents Plant was closed and decommissioned in 1991. The Heavy Ends waste that could not be treated was continually re-drummed and initially stored in the Northern Drum Area.

In the late 1970s an inspection of the Northern Drum Area identified that a number of leaks and spills had impacted the soil beneath the drums. The Heavy Ends waste remaining was re-drummed and the new drums were moved to the Heavy Ends Store.

In 1979, steps were taken to identify and resolve the contamination issues in readiness for construction of the Olefines 2 facility, which was scheduled to commence in 1980. The investigation identified a large area of contamination, extending across the waste storage area and at depth. This contamination was required to be removed prior to construction commencing.

As remediation commenced, excavated material was classified as either 'low level' or 'high level' impacted material. High-level impacted material was transferred to a Hypalon lined cell – the area now known as the CPWE. The CPWE land was previously occupied by the Nightingale Chemicals Company sodium silicates factory, which was purchased in 1977 to expand Orica's (then ICI) silicates market opportunities.

Low-level impacted material was reused on the BIP for landscaping purposes and also disposed to the Merrylands Regional Waste Disposal (approximately 11,600 m^3). The Metropolitan Waste Disposal Authority (MWDA) approved off-site disposal of this material. Material impacted by salinity and alkalinity, but not chlorinated hydrocarbons (CHCs), was also approved for off-site disposal at the Botany Municipal Council Tip at Matraville (18,500 m^3).

This remediation work was conducted in agreement with the environmental authority at the time, the State Pollution Control Commission (SPCC), the Health Commission and MWDA.

Approximately 45,000 m^3 of ash, sand and peat material contaminated with CHCs was relocated to a Hypalon lined cell. The primary contaminants include HCBD, HCB, PCE and OCS. Small quantities of foreign materials such as steel, timber, crushed drums and polythene granules were also reported to be present in the waste.

The L-shaped waste cell was overlain by engineered fill (sand) and a bitumen cap to protect the integrity of the liner and on the sides by landscaping soil.

3.4.2 The BIP

The land comprising the BIP has been used for industrial purposes since the early 1940s and was operated by ICI until 1996 when Orica established the BIP. Further information regarding the BIP is provided in **Section 3.2.2**.

3.5 Site Conditions

The CPWE has been managed in accordance with the Australian and New Zealand Environment and Conservation Council (ANZECC) HCB Waste Management Plan (November 1996). The CPWE is also regulated by the DEC under Orica's EPL (No. 2148) and EHC Act Licence (No. 26) conditions. As part of the management process, Orica conducts routine visual inspections of the CPWE and its surrounds, and regularly monitors the groundwater and soil vapour emissions in the vicinity of the CPWE.

A summary of the previous investigations and conditions at the CPWE is provided as follows.

3.5.1 Previous Investigations

To prepare this RAP, the following sources of previous investigation data from the CPWE were collected and reviewed:

- Orica Pty Ltd (1999). *Encapsulation Manual for Orica Pty Ltd Olefines Car Park Area, Botany Site, NSW. ENV-95-01, Section 4, Encapsulation Design Features*. Outlined a summary of previously collected design information for the encapsulation area.

- AGC Woodward-Clyde Pty Ltd (February 1998). *HCB Waste Management Plan, Waste Material Characterisation (Car Park Waste)*. Works involved the collection of 41 samples from three boreholes drilled into the encapsulation.
- URS Australia Pty Ltd (22 April 2004a). *HCB Encapsulation – Response to EPA. Report to Orica Australia Pty Limited.* Provided a summary of all groundwater and soil sampling data relating to HCBD and associated compounds in the vicinity of the encapsulation cell.
- URS Australia Pty Ltd (8 October 2004b). *Visual Inspection, Repairs and Testing of the HCB Encapsulation Liner.*
- URS Australia Pty Ltd (23 July 2004c). *HCB Encapsulation – Further Soil Sampling of Landscaped Areas Surrounding the HCB Encapsulation.*
- URS Australia Pty Ltd (22 December 2004d). *Off-site Sampling Investigation Along Corish Circle, HCB Encapsulation, Orica Botany Environmental Survey Stage 4 - Remediation.* Letter report to Orica Australia Pty Limited. Work involved the collection of five leachate samples from six leachate lines and sumps draining the encapsulation cell.
- URS Australia Pty Ltd (2004e). *HCB Waste Management Plan – Human Health Risk Assessment (Car Park Waste)*.
- Thiess Services Pty Ltd (March 2005). *Feasibility Assessment of Remedial options, Car Park Waste Encapsulation, Botany Industrial Park, Matraville*. Report to Orica Australia Pty Limited – Summary of data from previous investigations, review and presentation of remediation options.
- URS Australia Pty Ltd (6 May 2005a). *Embankment Capping Options Assessment – Car Park Waste Encapsulation, Botany NSW*. Report to Orica Australia Pty Ltd. Presented options for the installation of a capping system for the encapsulation batter slopes to minimise rainfall infiltration into the cell and reduce the potential for vapour emission from the embankment.
- URS Australia Pty Ltd (13 July 2005b). *Car Park Waste Encapsulation Groundwater Monitoring Report Round 10*. Report to Orica Australia Pty Limited. Provides groundwater monitoring results for the March 2005 groundwater monitoring programme. The report found that elevated CHC concentrations were identified beyond the vicinity of the waste encapsulation. The report recommended further investigation to determine and delineate the extent of contamination associated with the encapsulation cell.
- URS Australia Pty Ltd (1 August 2005c). *Car Park Waste Encapsulation Groundwater Monitoring Report Round 11*. Report to Orica Australia Pty Limited. Provides groundwater monitoring results of the June 2005 monitoring programme. The report found that CHC concentrations extended beyond the vicinity of the waste encapsulation. The report stated that the results are consistent with those observed in the July 2005 report.
- URS Australia Pty Ltd (14 December 2005d). *Car Park Waste Encapsulation Groundwater Monitoring Report Round 12*. Significantly higher volatile CHCs (in particular TCE) were reported in wells located along the northern, up-gradient CPWE boundary. This was attributed to possible pumping from Orica production bores which ‘may be drawing impacted groundwater from an alternative source area’ or ‘alternatively a localised source of impacts exists’. Additional monitoring was recommended.
- URS Australia Pty Ltd (29 May 2006a). *Car Park Waste Encapsulation Groundwater Monitoring Report Round 13.* The reported findings were

similar to the previous sampling round. Additional monitoring was recommended.

- URS Australia Pty Ltd (7 December 2006b). *Car Park Waste Encapsulation Groundwater Monitoring Report Round 14*. The reported findings were similar to the previous sampling round. Additional monitoring was recommended.
- URS Australia Pty Ltd (2 March 2007). *Car Park Waste Encapsulation and Denison Street Stockpile - Further Characterisation*.

3.5.2 Summary of CPWE Conditions

Previous investigations undertaken within the CPWE are summarised in the following sections. The relevant data is separated into firstly the encapsulated material, followed by the capping material and the material surrounding the CPWE.

CPWE
Based on previous investigations, the materials contained in the CPWE comprise a mixture of ash, sand and some peaty material (Thiess 2005), some of which originated from the vinyls manufacturing area. The waste contains some foreign material including polythene granules, crushed drums, drum liners, steel reinforcement, scrap steel sections, scrap pipework, timber, Raschig rings, crystalline material, thought to be sodium carbonate and amorphous material, thought to be catalyst pellets.

The waste materials were initially placed in the north eastern corner of the CPWE and the excavation area was brought up to level. The lateral extent of the encapsulation was then increased, by extending it to the west, when the storage of additional waste was required. Likewise, the height of the encapsulation was also increased to provide additional storage. Based on the observations in the AGC Woodward-Clyde Pty Ltd (Woodward-Clyde) investigation in 1998, the ash, peat and sand components within the CPWE appear to be well mixed.

The base of the CPWE was graded to the west to assist drainage through six collection points, which were constructed on the western side of the CPWE and comprise a pipeline and pit for each point. It is understood that water had been used for dust suppression and rainwater had collected in the liner during the construction of the CPWE and these collection lines were to assist with the drainage of this water. However, it is understood that little leachate was generated following the completion of construction of the CPWE and the collection lines were eventually sealed in 1989. Further information is detailed in the ‘Collection Points’ section below.

The completed encapsulation was covered with engineered fill and a bitumen-sealed cap on the top with access roadways to the south and west and a landscaping layer on the remaining batters. Further information is detailed in the ‘CPWE Capping Material’ section below.

The L-shaped CPWE is approximately 134 m by 90 m on its longest dimensions and has a projected maximum plan area of 7,900 m^2 for the bitumen-sealed cap (Woodward-Clyde 1998). The encapsulation was constructed by excavating to between 2.5 m and 3.5 m below ground level (bgl). The excavation was then filled to approximately 2.5 m above ground level. The volume of material in the CPWE is estimated to be approximately 45,000 m^3 or 70,000 tonnes, comprising ash from the coal fired boilers (approximately 17,000 m^3), sand (approximately 26,000 m^3) and peaty material (approximately 2,500 m^3). The matrix material consists mainly of fine to medium size sand particles, and has a strong solvent odour. The amount of oversize material in the CPWE has not been quantified in any of the previous investigations. A figure of less than 5% volume equating to less than 2,227 m^3 was assumed in the Thiess Feasibility

Assessment (Thiess 2005). Average moisture content of the materials in the CPWE is reported at approximately 13% and increases to approximately 22% in the base.

Characterisation of the CPWE was undertaken by Woodward-Clyde in 1998. This assessment indicated that the CPWE material comprised elevated levels of HCBD, OCS, PCE and HCB. Minor quantities of other SVOCs, including the hexachloro-1,2-butadiene isomer, pentachlorobutadiene and pentachlorobenzene were also identified in selected samples. Strong solvent odours were noted in all samples collected during this investigation. Based on the observed concentrations, the waste within the CPWE was defined as 'HCB Waste' under the *HCB Waste Management Plan* (ANZECC 1996) and SCW under the DEC (2004) CCO.

Soil gas levels measured during the Woodward-Clyde (1998) investigation were observed to have low oxygen content and elevated levels of carbon dioxide (CO_2) and methane (CH_4). Volatile CHCs present in the soil gas included HCBD, vinyl chloride (VC), 1,2-dichloroethane (EDC), ethene and ethane. Sections of sandy soil surrounding the CPWE were observed to contain low concentrations of HCBD.

Further characterisation of the CPWE material was undertaken by URS, reported in March 2007, as part of the Treatability Trials and included the following key tasks within the CPWE area:

- Non-intrusive geophysical survey of the encapsulation for the presence of drums and/or other bulky objects;
- Hollow flight auger drilling at 10 locations (SB01 to SB10) within the CPWE area on an approximate 30 m grid;
- Drilling of six of the ten locations using a push tube rig to retrieve undisturbed samples following completion of the hollow flight auger sampling; and
- Sampling of the soil/fill beneath the base of the encapsulation using inclined (45 degrees) hollow flight augers to a depth of approximately 4 to 5 m below ground level (3.0-3.5 m vertical) at two locations along the western edge of the CPWE.

The results of these works are summarised below.

Subsurface Geophysical Survey
The URS investigation (March 2007) included a subsurface geophysical survey of the CPWE. The report includes maps of the total magnetic field and horizontal magnetic gradient. Some anomalies in the CPWE, which were considered to be buried metallic items (such as drums), were identified. URS used the survey information to assist in placing drilling locations away from drums and other metallic objects.

CPWE Material
A sampling density of approximately 1 sample per 1000 m^3 was attained during the investigation.

The material contained within the CPWE was reported to largely comprise sand, ranging in colour from yellow to black depending on the amount of staining. Soil/fill samples collected from all 10 locations generally contained concentrations of chromium, copper, lead, nickel, zinc, mercury, total PCBs, PCE, HCBD, HCB and OCS above the respective laboratory limit of reporting (LOR).

Concentrations of arsenic, cadmium, TCE, HCE, 1,1,2-trichloroethane (1,1,2-TCA), 1,1,2,2-tetrachloroethane (1,1,2,2-TeCA) and cis-1,2-dichloroethene were detected at only a few locations across the CPWE.

Mercury, TCE, PCE, HCBD, HCE and HCB results from samples collected within the CPWE fill material were grouped by URS according to sample depth below the Hypalon liner (0 to 1 m, 1 to 3 m and 3 to 5.3 m) and their minimum, maximum and average results tabulated (refer to Table 1 below). These results indicate that the minimum, maximum and average concentrations generally increased with increasing depth for all of the selected analytes.

Table 1: Concentrations of Selected Analytes Grouped According to Depth Below Hypalon Liner

Depth Range	Selected Analytes	Number of Samples	Minimum	Maximum	Average
0 to 1 metre	Mercury	10	0.1	4.6	1.3
	TCE	10	2.2	4.3	3.2
	PCE	10	0.5	79.0	40.8
	HCBD	10	18.7	347	159.2
	HCE	10	0.7	5.7	3.7
	HCB	10	2.4	96.1	23.8
1 to 3 metres	Mercury	20	0.2	10.4	1.6
	TCE	20	0.8	4.0	2.4
	PCE	20	5.1	266.0	58.1
	HCBD	20	31	3,880	782.7
	HCE	20	1.6	71.1	16.8
	HCB	20	7.1	161.0	40.5
3 to 5.3 metres	Mercury	19	0.1	14.7	2.5
	TCE	19	0.9	176.0	51.3
	PCE	19	4.5	1,010.0	195.1
	HCBD	19	17.1	11,700	1,919
	HCE	19	12.4	131.0	55.3
	HCB	19	2.3	641.0	149.5

Notes: Table taken from Table 6-1, URS (March 2007).
All contaminant concentrations in mg/kg.

URS reported no obvious correlation between mercury, TCE, HCBD, HCE and HCB concentrations in the soil/fill and the lateral distribution of the sampling locations. The concentration of PCE was, however, higher in the eastern portion of the CPWE, when compared with concentrations found in the western portion of the CPWE. At sampling locations in the eastern portion of the CPWE (SB01 to SB06), PCE concentrations ranged from 5.5 to 1,010 mg/kg, while at the western locations (SBO7-SB10) the PCE concentrations were reported to range from 0.5 to 28.1 mg/kg.

URS reported that sample SB02_3.0-3.6 appeared to be a ‘hotspot’, with elevated concentrations of HCB, HCBD, OCS, PCE and TCE and detections of polycyclic aromatic hydrocarbons (PAHs), CHCs (1,2- dichlorobenzene, 1,3-dichlorobenzene and 1,4-dichlorobenzene) and other organic compounds (Bis(2-chloroethyl) ether, Acetophenone, I,2,4-

Trichlorobenzene and 1,1,2,2-Tetrachloroethane), which were not detected at other CPWE sampling locations. Inorganic concentrations were not noted to be significantly higher at SB02.

The maximum PCB concentration reported within the CPWE during this investigation was 20 mg/kg at SB03_3.5-4.1.

A composite undisturbed soil sample (TS1-FS) collected from sampling locations SB02 and SB03 on the south east portion of the CPWE was also analysed for dioxin and furans. This soil sample was a feed sample collected for use in the thermal treatability trials. The reported World Health Organization (WHO) Toxic Equivalents (TEQs) for the analysed sample were as follows:

- WHO TEQ (zero) - 82.22 ng/kg; and
- WHO TEQ (LOR) – 85.22 ng/kg.

Toxicity equivalence is measured with reference to 2,3,7,8 TCDD for all dioxin and furan congeners and PCBs.

The total and speciated PCB analysis of the TS1-FS sample reported the following results:

- Total PCBs - 4.48 mg/kg;
- WHO TEQ (zero) – 10.87 ng/kg; and
- WHO TEQ (LOR) – 10.87 ng/kg.

It was concluded that the reported dioxin concentrations in soil/fill samples from the CPWE were within the background ranges included in the *National Dioxins Program* published by the Department of Environment and Heritage (2004).

CPWE Capping Material

URS (2007) reported that the CPWE capping materials comprised bitumen, crushed rock, sand and then the Hypalon liner. The bitumen pavement has a typical thickness of 25 mm, the thickness of the crushed rock sub-base is estimated at 100 mm and the sand is estimated at 100 mm. The mass of the Hypalon contained at the CPWE was estimated to be approximately 6 tonnes (Thiess 2005).

The Hypalon liner was reported to have high concentrations of HCBD (35,100 mg/kg). No other volatile organic compounds (VOCs) were detected at concentrations above the raised LOR. High concentrations of semi volatile organic compounds (SVOCs) were detected in the Hypalon liner sample, including HCB (896 mg/kg), HCE (59.3 mg/kg) and OCS (580 mg/kg). Low levels of other SVOCs were also detected.

Recent inspections of the CPWE liner indicate that the liner is becoming more brittle and therefore more susceptible to tears (URS 2004b). Further information relating to this is provided in sections ‘Collection Points’ and ‘Air Emissions and Groundwater Monitoring’ below.

The sand sample contained low levels of inorganic analytes (nickel 4 mg/kg and zinc 9 mg/kg), a HCBD concentration of 87.9 mg/kg (VOC analysis) and OCS concentration of 3.2 mg/kg. The bitumen sample had a higher concentration of HCBD (392 mg/kg – VOC analysis), which is likely to be attributable to its higher absorbing ability. Other organic (HCE, 2.9 mg/kg) and some inorganic analytes (chromium 6 mg/kg, copper 71 mg/kg, nickel 50 mg/kg and zinc 47 mg/kg) were also detected in the bitumen sample.

Material Surrounding the CPWE

Outside the bitumen pavement the encapsulation batters are overlain by fill sand derived from the BIP site.

Anecdotal evidence exists that low level contaminated soil (from the remediation of the area where the Olefines 2 Plant is currently situated) was placed on the encapsulation batters. During the liner investigation reported by URS (October, 2004), drum liners and crushed drums were excavated from fill sand overlying the liner on the eastern batter of the encapsulation. Dark staining of the fill was also observed in one location. Thus it appears that a proportion of contaminated material may be present in the fill overlying the encapsulation. The quantity of the overlying material is estimated at approximately 19,500m^3 (Thiess 2005).

Elevated levels of HCBD were detected outside the CPWE during borehole investigations of the embankments surrounding the CPWE (URS 2004c). Other organic analytes, such as HCE, were also detected in samples collected from shallow boreholes (less than 2 m bgl) along the northern, eastern and southern embankments of the CPWE, and in samples collected from several boreholes outside the western embankment of the CPWE.

Additionally, the analysis of soil samples from BH04 located at the northern end of the eastern embankment of the CPWE area (adjacent to Corish Circle) identified HCBD concentrations of a similar order of magnitude to the lower range of HCBD levels within the encapsulation. PCE concentrations at this sampling location were also reported to be similar to the mean concentrations reported within the encapsulation.

Elevated concentrations of total petroleum hydrocarbons (TPH) and monocyclic aromatic hydrocarbons (MAHs) were also detected in boreholes in the embankments outside the north eastern corner of the CPWE (URS 2004c). These compounds were detected at depths of approximately 11 m bgl, in the vicinity of a disused fuel pipeline identified running along the north and east boundaries of the CPWE.

Soil samples were collected from only two sampling locations (AH01 and AH02) on the western embankment of the CPWE during the URS (2007) investigation. URS reported that the sand sampled during the sub-encapsulation soil investigation was largely medium grained sand, ranging in colour from white to yellow to grey. One HCBD concentration of 0.6 mg/kg (VOC analysis) was detected at AH01 (the northern sampling location on the embankment) at a depth of 3.3 to 3.65 m (2.3 to 2.58 m vertically). No other organic compounds were detected above the LOR.

Metals detected at concentrations above the respective LORs included chromium, copper, lead, zinc and mercury.

Based on a review of the available data obtained from the landscaped material, the sampling density undertaken is less than that for the material in the CPWE and significant impact is present in the northern portion of the eastern embankment (in the BH03 and BH04 area). This material was potentially sourced from other BIP areas and therefore, the COPC may be different to those identified for the CPWE material. Consequently, screening of this material for an expanded suite of analytes will be necessary.

Collection Points

As part of an assessment conducted by URS (2004), the scope of works included an inspection of the six collection lines to confirm the absence/presence of moisture. Moisture was confirmed to be present in the collection lines. The water was analysed and was confirmed to contain organic analytes, including HCBD and HCE.

Further investigation of the collection points was undertaken in 2005 and indicated that rainwater (this is assumed as there are no underground (water) services at the CPWE and irrigation of the embankments is not being undertaken) appears to be seeping in the encapsulation. Consequently, Orica commenced a draining program to minimise the accumulation of water in the CPWE.

The water is continually drained from the six collection lines and treated on the BIP. The water has been treated at the Steam Stripping Unit (a treatment plant on the BIP) and is soon to be treated at the GTP on the BIP.

Air Emissions and Groundwater Monitoring
Air emissions and groundwater monitoring has been undertaken at the CPWE since 1997 by URS (and Woodward-Clyde, which is now URS).

The HCB Waste Management Plan Human Health Risk Assessment (Car Park Waste) (URS 2002) concluded that the risks to off-site residential, recreational, on and off-site industrial workers associated with emissions to air from the existing CPWE do not represent an unacceptable risk to human health. Results from subsequent air emission monitoring have confirmed the conclusions presented in this report.

Fourteen rounds of groundwater monitoring have also been undertaken since 1997 in accordance with *HCB Waste Management Plan* (ANZECC 1996) and DEC requirements. The monitoring has confirmed that low levels of organic analytes (volatile and semi volatile CHCs) are present in the groundwater within the vicinity of the CPWE. These levels are not considered to pose a risk to human health or the environment.

During an investigation conducted by URS (2004c) fill material was identified in the eastern embankment of the CPWE. It was considered that this fill material may be contributing to local groundwater impacts. Further detail is provided in the 'Material Surrounding the CPWE' section above.

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4 REMEDIATION/TREATMENT TECHNOLOGY OPTIONS ASSESSMENT

4.1 Overview

The project involves the remediation of the CPWE area as a requirement of Orica's EPL (No. 2148). Due to the environmental risk associated with not remediating the CPWE and the obligation imposed upon Orica by its EPL, the option of not undertaking the remediation works was not considered viable.

A range of remediation methods and technologies was available to Orica, therefore this section focuses on the alternatives considered in this respect. Orica considered two main remediation methods for the CPWE – thermal technology and bioremediation.

Orica has been investigating the use of bioremediation for the treatment of the CPWE since the late 1990s. Initial research was undertaken by the University of NSW (UNSW), however, the results were inconclusive. With advances in the bioremediation industry, bioremediation as a treatment option was revisited in 2004 when Orica engaged the Environmental Biotechnology Cooperative Research Centre (EBCRC) to commence a research project to develop technologies for the remediation of the CPWE. The project commenced late 2004.

In addition to the bioremediation research, Orica engaged Thiess Services Pty Ltd (Thiess) in conjunction with GHD Pty Ltd (GHD) and Focus Environmental Inc. (Focus) to undertake an assessment of alternative remediation technologies for the CPWE in early 2005. The work undertaken by Thiess included an initial review of the feasibility of possible remedial options (by GHD) and recommendation of a number of options for more detailed evaluation.

The Thiess (2005) report recommended three options - DTD, *In situ* Thermal Desorption (ISTD) and Indirectly-heated Thermal Desorption (ITD), which were subsequently assessed and considered in greater detail. Orica's intention was to identify one of these technologies as its preferred alternative in the event that bioremediation was determined as being unsuitable for remediating the CPWE. Following extensive review and community consultation DTD was selected as the preferred alternative option.

Research by the EBCRC continued through 2005 and into 2006. Over this period many potentially limiting technical issues were identified, including lack of clear evidence of HCB or OCS degradation, poor availability of cyanocobalamin (Vitamin B12, which is an essential supplement to the biodegradation process), and uncertainty with regard to the likely duration of bioremediation activities.

In the face of these uncertainties and technical issues, and due to concerns about the integrity of the CPWE liner and resultant potential emissions to the environment from the CPWE, Orica determined to focus its resources on developing the DTD remediation option.

The technology options assessment work conducted is discussed in more detail in the sections below.

4.2 Bioremediations

As noted earlier, the EBCRC commenced a bioremediation research project in late 2004. The objectives of this research were:

- To develop novel *in situ* and *ex situ* bioremediation technologies that can be applied generically to soil and aquatic environments polluted with CHCs;
- To develop and demonstrate an efficient and cost-effective strategy for remediation of the CPWE at the BIP; and
- To generate a firm understanding of the ecological phenomena underlying successful bioremediation processes.

The project is being undertaken in a collaborative arrangement, including UNSW, University of Queensland (UQ), Macquarie University (Mac) and Murdoch University (MU). It should be noted that Mac and UQ are no longer part of the project team.

The initial research work conducted by the EBCRC comprised identification of the environmental and biological factors that were limiting natural attenuation. The research concluded that:

- The CPWE soil is low in moisture and essential nutrients – this could be overcome by adding water and nutrients to facilitate bioremediation; and
- The CPWE soil has the right bacteria but they are low in abundance – this could be overcome by adding more bacteria or waiting for them to grow to facilitate bioremediation.

A search of journals and articles was undertaken to identify whether the contaminants present in the car park waste (HCBD, HCB, PCE and OCS) could be broken down biologically. The information found was positive for HCB and PCE, but not for OCS and HCBD.

It was concluded that conditions at the CPWE are appropriate for biological reductive dechlorination and that organisms capable of dechlorination are present at the site (the CPWE). However, in order for this process to be effective at the CPWE, the soil environment must be supplemented with biologically available nitrogen and phosphorus sources which would increase microbial biomass in the soil. On this basis, the EBCRC commenced development of a treatment solution.

With limited information available for HCBD, the EBCRC focused resources on identifying a process that could facilitate degradation of that compound biologically. Subsequently, a treatment solution was developed that resulted in complete dechlorination of HCBD to butadiene. This was seen as a very positive first step to the successful implementation of the technology.

Given that the laboratory investigations with the treatment solution had been positive (in relation to HCBD) Orica applied to the DEC to conduct an *in situ* bioremediation pilot scale field trial. The trial commenced during October 2005 and was completed in April 2006.

4.2.1 *In situ* Bioremediation Pilot Scale Field Trial

The objectives of the pilot field trial were to:

- Demonstrate the efficacy of an *in situ* biostimulation treatment to facilitate reductive dechlorination of HCBD, HCB, OCS and PCE in the CPWE;
- Establish a zone of influence and rates of reductive dechlorination *in situ* for each compound;
- Characterise the impact of the treatment on the microbial community indigenous to the CPWE; and

- Identify metabolic dead ends, toxic breakdown intermediates or adverse affects on soil quality that may occur during the course of treatment.

The trial involved application of a 1,000 L solution made of sodium lactate, diammonium hydrogen phosphate, nanoscale zero valent iron and other constituents to the CPWE soil, in the nominated trial area. Over the next six months, extensive soil sampling and analysis was undertaken within the trial area.

The results from the initial rounds of sampling highlighted issues with moisture retention, indicating that biodegradation may not be occurring. In response, the EBCRC advanced its research on polymers that could be used to hold the treatment solution or moisture in the CPWE soil, and also began assessing the feasibility of treating the CPWE using *ex situ* bioremediation.

The results of the *in situ* trial were not surprising and confirmed that there were no signs of biodegradation. The trial also revealed the following information:

- Pollutant distribution in the CPWE is not consistent (heterogeneous);
- Solution was not evenly distributed (i.e. bell shaped distribution);
- Soil moisture was increased after treatment;
- Soil moisture decreased over time;
- Nutrient limitations within the CPWE soil were resolved by adding nitrogen and phosphorus sources; and
- A depth dependent concentration gradient formed.

Based on these results the following conclusions were drawn:

- Comprehensive distribution of a treatment solution in the CPWE requires a fine scale network of injection points, i.e. a large number of injection wells would need to be installed across the CPWE;
- The treatment solution mobilises the contaminants attached to the ash component of the sand;
- The soil has high hydraulic conductivity, so any treatment solution would need to be immobilised;
- If uncertainties in treatment delivery can be overcome, the biological activity would still need to be tested in the field; and
- *Ex situ* Bioremediation options should be explored.

The results of the pilot trial were presented in a report titled, Commercial-in-Confidence: Report for a Pilot Test of *In situ* Bioremediation of the Car Park Waste Encapsulation (EBCRC 2006), and submitted to the DEC in June 2006. The report is Commercial-in-Confidence as it contains certain Intellectual Property.

4.2.2 Status of *In situ* Bioremediation

Concurrent with the polymer research, Orica commenced the conceptual design for the second *in situ* bioremediation pilot trial including the addition of the treatment solution with polymer to the CPWE soil.

The conceptual design for the treatment technology included placement of a series of injection wells across a nominated area of the CPWE, injection of the treatment solution and monitoring (soil and gas) for the duration of the second pilot trial.

During the development of the conceptual design for the second pilot trial and proposed full scale design a hazard study of the technology was undertaken for the trial application (by Orica).

The hazard study highlighted a number of issues, which Orica considered to be high risk or impossible to overcome including:

- Limitations on the ability to add and adequately distribute liquid and solid treatment solutions and supplements throughout the CPWE contents;
- Potential for negative impact of the treatment solution on the integrity of the liner resulting from biogas generation, elevated temperature and chemical effects;
- Potential for the presence of large solid masses in CPWE to adversely affect placement of injection wells and soil coring for verification/validation; and
- Inability to alter the treatment process once commenced.

For these reasons, Orica decided in mid 2006 that *in situ* bioremediation would no longer be considered a feasible remediation technology for the CPWE and resources would be focused on developing *ex situ* bioremediation. At that point in time it was decided that the EBCRC would continue development of the treatment solution and Orica's engineering resources would continue with the design of the *ex situ* treatment system.

This information was presented to the DEC on 20 June 2006 and to the community at a public workshop on 27 June 2006.

4.2.3 *Ex situ* Bioremediation

The proposal for *ex situ* bioremediation comprised excavation of the CPWE material, placement in large tanks and then addition of the treatment solution (still under development).

Conceptually, the proposal included excavation of the CPWE material and placement in large tanks, which would have required a large staging area somewhere in the order of 20,000 m^2. The former Propathene Plant area (located within the BIP) was identified as the potential staging area for the tanks.

At the time of the proposal development, the treatment solution included several ingredients including zinc powder and activated sludge. Therefore, some form of mixing (the CPWE material with these ingredients) would have been required prior to placement in the tanks. It is likely that an enclosure with an ECS would have been required over the tank staging area initially, to limit impacts on air quality during mixing.

A shed or building, with an ECS, would have been required over the CPWE, for the duration of the remediation project, to control fugitive emissions. The design would have been similar to that proposed for other *ex situ* treatment technologies, including DTD.

The proposal also included a heating system. The research identified that heating the solution (50° C) increases the rate of biodegradation. Also, at the time of proposal development, the EBCRC indicated that gases such as ethene, methane and 1,3-butadiene and small amounts of hydrogen sulphide, were likely to be generated during the initial period of the process. Therefore, a gas collection and treatment system would have been required. However, design of this system had not been considered as details on the full composition of potential gases emitted were not known.

It was determined that a multi-stage remediation (three was the minimum number of stages estimated) would be required to implement *ex situ* bioremediation. Based on information from the EBCRC (it had been stated that bioremediation could take three to five years or longer), it was estimated that remediation of the CPWE using *ex situ* bioremediation could have taken between nine to 15 years.

4.2.4 Status of Bioremediation Research

Table 2 provides a summary of the status of the bioremediation research as at August 2006 and the development required to enable application of the technology to the remediation of the CPWE.

Table 2: Status of Bioremediation Research and Development

Challenges	Status	What next?
HCBD	The laboratory research has confirmed that the treatment solution degrades HCBD.	The EBCRC needs to address the production of 1,3-butadiene in HCBD breakdown.
PCE	The laboratory research has confirmed that the treatment solution degrades PCE.	Acquire mass balance – see below.
HCB	The treatment solution has not been proven to degrade HCB.	The degradation of HCB is a two step process (anaerobic then aerobic). Therefore, the EBCRC needs to: demonstrate and optimise HCB dechlorination in the CPWE soil in the laboratory; and demonstrate and optimise aerobic degradation of HCB breakdown intermediates.
OCS	The treatment solution has not been proven to degrade OCS.	Assess the environmental and health effects of this compound and whether treatment is required.
Cyanocobalamin (Vitamin B12)	Very effective compound required for the dechlorination process but there is limited supply available in the world.	The EBCRC needs to identify a replacement for cyanocobalamin in dechlorination reactions.
Bioremediation timeframe	Estimates for bioremediation are three to five years or longer.	The EBCRC needs to determine the duration of anaerobic and aerobic incubations for biodegradation.
Biogases	Gases such as ethene, methane and 1,3-butadiene and small amounts of hydrogen sulphide initially would be generated. Full composition of gases has not been defined as all compounds have not been broken down.	The EBCRC needs to define the composition of gases generated in successful degradation of all contaminants.
Mass Balance	This is required to prove that treatment solution has been effective at degrading all contaminants to harmless gases. This has not been completed as degradation of all contaminants has not been demonstrated in the laboratory.	The EBCRC needs to acquire mass balances for the degradation of HCBD, PCE and HCB in the laboratory.

Challenges	Status	What next?
Polymer	Alginate has been selected as the polymer to assist moisture retention.	Although the polymer is not required for *ex situ* bioremediation, the EBCRC will continue work to characterise the longevity of alginate in the CPWE soil.

Considering the above, it was estimated that a treatment solution may be ready for field evaluation within two to three years. Based on this timing, it was estimated that it would be three to four years before the technical capability of bioremediation was demonstrated (i.e., degradation of contaminants, no harmful by-products produced, composition of gases emitted known and characterisation of the remediated product for disposal/re-use) and full scale design could commence.

4.3 Assessment of Alternative Remediation Technologies

In 2005 Thiess undertook the assessment of alternative remediation technologies in two stages. The first stage involved an initial screening of remediation technologies, further screening of a shorter list of technologies and then selection of three technologies. The second stage of the assessment included a more detailed engineering evaluation of these selected technologies. The assessment was focused on feasible remediation technologies for the contaminated sand, ash and peat material stored in the CPWE and the adjacent landscaped embankments (if necessary).

4.3.1 Stage 1 Assessment

The first stage of assessment is summarised below, with further details provided in the Thiess (2005) report, *'Feasibility Study: Technology Review for Remediation of Car Park Waste Encapsulation, Botany Industrial Park, Matraville'*, March 2005.

First Phase of Assessment
The first phase of assessment characterised the wastes, establishing a list of possible treatment and disposal technologies for consideration, then initial screening of these technologies was undertaken. The first phase of assessment was undertaken with reference to:

- Commercial Status – the commercialisation and proven status of each remediation technique;
- Suitability – the ability to treat the CPWE material to an acceptable level; and
- Environmental Risk – the potential for environmental impact.

Based on these factors, the highest ranking or 'most preferred' technologies were then selected for further consideration in the second phase of assessment.

Second Phase of Assessment
The most preferred remediation technologies selected for further consideration in the second phase of assessment were as follows:

- Export of the CPWE materials to an overseas treatment facility;
- *Ex situ* mobile high-temperature incineration;
- *Ex situ* cement kilns;
- *Ex situ* DTD;
- ISTD (or i*n situ* electrical conductive heating);

- *In situ* and *ex situ* vitrification;
- *Ex situ* Startech (plasma-electric waste converter)/Plasma Arc Centrifugal Treatment; and
- *Ex situ* ITD with treatment of the condensate by Base Catalysed Decomposition (BCD) or Plascon (In-flight Plasma Arc System).

The second phase of assessment involving a more detailed screening of the above listed technologies. Each technology was assessed in terms of the following parameters:

- Probable cost for establishing the technology and carrying out the treatment operation;
- Likelihood of the technology being successfully approved and implemented; and
- Technical suitability of the technology.

As per the first phase of assessment, a ranking approach was adopted to identify cost effectiveness, technical suitability and the likelihood of gaining regulatory and peak environmental body support. The report concluded that of the selected remediation technologies, DTD, ISTD and ITD coupled with separate treatment of the recovered condensate (by Plascon or BCD) were the three most suitable technologies to treat the CPWE material. The review also recommended that the three options be assessed in greater detail.

Alternative Remediation Technologies – DTD, ITD and ISTD
DTD, ITD and ISTD are thermal technologies involving the application of heat to the contaminated soil to cause the contaminants to separate or vaporise from the soil. The result is 'clean' soil and a gas stream containing the vaporised contaminants. This process of separation is called thermal desorption.

The main differences between the technologies relate to how the heat is applied to the soil, and the type of gas stream treatment system used to treat the resultant contaminated gas stream (off-gas). There are two main types of gas stream treatment systems: a recovery type system and destructive type system. The recovery type system involves cooling the gases and condensing the contaminants into a liquid which is collected and stored for further treatment. The destructive type system involves destroying the contaminants in the gas stream in a thermal oxidiser. ISTD can be fitted with either a recovery type or a destruction type emission control system. A brief review of each of the technologies is provided below:

DTD
DTD is an *ex situ* treatment method requiring the excavation of the waste from the CPWE. To control emissions of dust and odour, the material handling process would be undertaken within an enclosed building, also fitted with an emission control system (ECS). The excavated soil would be stockpiled and screened, to remove any debris, breakdown any large soil particles and homogenise the soil, and then transported via a conveyor system to the DTD Plant for treatment.

There are two main types of DTD plants currently used to treat contaminated material, including chlorinated compounds. They differ principally in terms of the direction of gas and soil flow in the rotary dryer (co-current and counter current), with consequent differences in gas temperatures and the sequence of unit operations used to treat the off-gas. Both types of plants produce similar outcomes in terms of soil treatment levels and air emissions, the latter providing the ECS is Stockholm Convention on Persistent Organic Pollutants (December, 2004) compliant (i.e. includes a thermal oxidiser with appropriate residence time, temperature and turbulence, fast cooling and acid gas scrubbing). For convenience the co-current type of plant is described herein – this consists of a rotary dryer where the feed soil enters at the end where the gas burner is located, so that the soil and combustion gas move in the same direction where they exit at the opposite end. More detail is provided below.

In a DTD Plant, heat is applied directly to the soil in a rotary dryer by intimate mixing of the soil and combustion gases from a gas fired burner that fires inside the dryer. The treated soil passes along the dryer, and then drops into a soil cooler (or pugmill) where the soil is cooled. The cooled soil is then stockpiled, and tested to confirm that contaminants have been removed to an appropriate level.

DTD technology utilises a destructive type gas stream treatment system. The off-gas that arises from the rotary dryer typically passes through a cyclone to remove large dust particles prior to being routed to a thermal oxidiser, where contaminants are destroyed by combustion at a temperature of around 1,000^{o}C. The hot gas stream is then transferred to a quench where water mist is injected to rapidly cool the treated gas. The gas stream then passes through a baghouse, where fine dust particles are removed. An acid gas scrubber is the final step in the gas treatment system where products from the combustion of chlorinated contaminants are neutralised.

ITD

As for DTD, ITD is an *ex situ* treatment process requiring the excavation of the waste from the CPWE. The excavation and material handling processes described above for DTD are also applicable for ITD.

In an ITD plant, heat is applied to the soil indirectly by radiating through the shell of the rotary dryer. To achieve this, a number of gas fired burners are positioned external to the dryer shell.

ITD plants typically use a recovery type gas treatment system. The off-gas from the rotary dryer is first directed to a particle removal device such as a baghouse, and then to a gas scrubbing and condensing unit. Within this unit, the gases are cooled by water and condensed. The emissions from this process are uncondensable gases. The residues are condensate containing the contaminants and water.

The uncondensable gases then pass through activated carbon to remove any remaining condensable contaminants. The contaminated carbon is recycled through the process. The off-gas is then routed back to the furnace of the plant to combust any carbon monoxide and non-condensable hydrocarbons present. The condensate, which contains the contaminants would be collected and stored (in 200 L drums or equivalent containers) whilst awaiting further treatment. Recovered water is transported to an onsite wastewater treatment facility, where it is treated and then discharged. Treated water may also be used for cooling and rehydrating the treated soil.

The hot treated soil is transported to a soil cooler, where it is re-moisturised and discharged. The cooled soil is transported to a storage area and sampled to confirm that contaminants have been removed to an appropriate level.

The stored condensate, containing concentrated contaminants, would then require a second stage treatment for destruction. This was likely to have involved transport to another off-site facility for treatment.

ISTD

Unlike ITD and DTD, desorption of contaminants in the ISTD process occurs *in situ*. Therefore, excavation of the soil and control of associated emissions from materials handling would not have been required.

The ISTD process involves the installation of a series of heater and vacuum wells in the soil to be treated. The heater wells are installed in a hexagonal pattern arrangement and used to transfer heat into the soil. The vacuum wells are installed in the centre of each hexagon and used to extract the vaporised contaminants (off-gas).

To ensure worker safety and minimise heat loss at the surface, an insulation layer would be placed over the area undergoing treatment. To enable access to the wells and other equipment, concrete is typically placed over the insulation layer.

The heater wells use electrical energy to conductively heat the soil surrounding each well. In the heating process, some contaminants are destroyed *in situ* and some are vaporised.

Like the ITD and DTD processes, the off-gas also has to be treated. ISTD processes have been developed with either a recovery system, like ITD, or a destructive system, like DTD. For the CPWE, a destructive system was considered most suitable because of the high levels of carbon monoxide that would likely be present in the off-gas. A description of this is provided in the DTD section above.

4.3.2 Stage 2 - Detailed Assessment

The second stage of the Thiess (2005) assessment included a more detailed engineering evaluation of the preferred technologies – DTD, ITD and ISTD. A comparison of these technologies is summarised in **Table 3.** More detailed information is contained in the following Thiess (2006) reports:

- Stage 3 Feasibility Assessment of DTD;
- Stage 4 Feasibility Assessment of ITD; and
- Stage 5 Feasibility Assessment of ISTD.

Table 3: Comparison of Remediation Treatment Solutions

Parameter	DTD	ITD	ISTD
Applicability	Applicable to treat the CPWE materials and the Hypalon liner. Treatability trials may be necessary to optimise plant configuration.	Applicable to treat the CPWE materials and the Hypalon liner. Treatability trials may be necessary to optimise plant configuration.	Applicable to treat the CPWE materials.
Cost Effectiveness	Most cost effective of the three solutions.	Moderate cost solution.	Moderate cost solution.
Approvals	Previously approved and undertaken on Allied Feeds site on the Rhodes Peninsula for the treatment of soil impacted with similar contaminants. Received opposition from some peak environmental groups.	Previously approved on Lednez site on the Rhodes Peninsula. Generally supported by peak environmental groups.	Not previously undertaken in Australia, but approval considered possible. Opposition by environmental groups considered likely.

Parameter	DTD	ITD	ISTD
Technical Suitability	Commercialised and proven in previous projects under similar conditions. Suitability considered high.	Commercialised and proven in previous projects under similar conditions. Suitability considered high.	Commercialised and proven in a limited number of mostly small previous projects. Suitability somewhat uncertain, given the potential for perched water in the encapsulation and limited number of projects.
Project Duration	Shortest project duration of the three options.	Moderate project duration.	Longest project duration of the three options.

1.1 Selection of the Alternative Remediation Option

A review of the three preferred alternative remediation options was conducted by Orica and in consultation with the DEC, the Community Participation and Review Committee (CPRC) and the community. Formal discussions on the options commenced with the CPRC at its meeting of 14 April 2005. Community workshops were held on 11 October and 22 November 2005 and 7 February 2006.

At the second workshop (22 November 2005) Orica outlined its concerns for ISTD. Consensus was reached that this technology would not be further pursued for the following reasons:

- the risk of adverse impact on the groundwater was unacceptable (due to the installation of heater and vacuum extraction wells through the base of the CPWE liner); and
- there is less experience with the application of this process on a project scale similar to the CPWE and therefore greater risk.

Based on the detailed review of the technologies and feedback from these workshops, Orica selected DTD as its preferred alternative remediation option. As indicated previously, this was Orica's contingency option for the CPWE should bioremediation prove to be unsuccessful. Orica's decision was communicated to community members at a workshop held on 7 February 2006 and the DEC was informed of this selection on 28 February 2006. Further details on the community consultation undertaken for the technology selection process are provided in the EA.

DTD was selected as the alternative remediation technology for the following reasons:

- Degree proven
  Orica considers DTD to be a proven technology as it has been in use since the mid-1980s. The technology has been applied to around 120 remediation projects, treating approximately 3.5 million tonnes of contaminated material.
- Simplicity of design and operation
  DTD is a relatively 'simple' technology when compared to ITD. Put simply, it is considered that DTD is more robust and easier to operate and maintain as compared to ITD - meaning that the likelihood of operational success for DTD is greater than for ITD.
- Stack Emissions

Emissions to air for the ITD and DTD technologies are anticipated to be comparable, but ITD has marginally lower emissions than DTD. If designed and operated properly in accordance with the best practice guidance of the Stockholm Convention, emissions from the technologies are not anticipated to cause appreciable health or environmental risks.

- Residues
  As DTD utilises a destructive emission control system to treat the off-gases, there are no residues generated. Consequently, secondary treatment systems are not required. ITD is, by contrast, a technology that requires extensive secondary treatment processes such as BCD or plasma arc to destroy the concentrated residues that are produced. For DTD there is no requirement for treatment, storage and transport of residues, as there is for ITD.
- Project Timeframe
  The anticipated duration of the treatment activity (at the time of the Thiess detailed evaluation) is five months for DTD and eight months for ITD. The reduced timeframe of the DTD operations as compared to the other alternatives would directly translate into a shorter overall project duration with corresponding reduction in associated impacts for the local community.
- Other
  A DTD treatment process is currently in operation at the former Allied Feeds site and has been approved at the Lednez site at the Rhodes Peninsula. Successful, local demonstration of the technology at full scale would provide confidence in this technology and assist in achieving planning approvals and community acceptance.

4.4 Preferred Option for Remediation of the CPWE

On the basis of all the available information, it appeared unlikely that bioremediation (*ex situ* and *in situ*) was a feasible option for remediating the CPWE.

The condition of the CPWE is the main driver for remediation. The CPWE has been on BIP for 27 years and recent inspections indicate that the liner is likely to be leaking – water is seeping in – and also appears more brittle and therefore more susceptible to tears. Monitoring of air emissions and groundwater indicate that conditions have not declined such that there is a risk to human health or environment, but they do indicate that conditions are not improving.

These conditions indicate that remediation is required sooner rather than later. With bioremediation, it was considered likely that it would be five years before remediation could be undertaken (i.e. full scale, three stage program) and then it would be another nine to 15 years (based on current estimates) before remediation would be completed. Therefore, in total, it could take 14 to 20 years to remediate the CPWE.

Orica also considered there was a high degree of novelty, and therefore risk, associated with bioremediation due to the scale (volume of material) and type of contaminants and concentrations being remediated. The limited availability of one of the constituents of the treatment solution – cyanocobalamin (Vitamin B_{12}) - is currently a significant limitation for this technology as a remediation option for the CPWE. Essentially an alternative for this compound needs to be identified for this technology to be viable.

Based on the above, although the progress the EBCRC had made in terms of the research was substantial, Orica considered there was a high degree of technical risk associated with bioremediation as an option for the CPWE, given the current degraded condition of the liner and resultant potential ongoing emissions. Even if bioremediation was proved to be a viable solution, the timing for development and for full scale remediation would have been unacceptable. However, Orica is committed to further research in this area which may result in the use of bioremediation for future remediation projects.

Orica therefore determined to adopt the selected alternative remediation technology – DTD - as the preferred option for remediating the CPWE.

4.5 Conclusion

As described above, Orica undertook an extensive process of reviewing feasible alternatives for the remediation of the CPWE. Whilst bioremediation was originally the preferred option, the field trial and research information indicated that further work was required before this technology could be used to adequately remediate the CPWE. The time required for the development of this technology did not meet Orica's EPL requirements for the CPWE, therefore it was discounted for this particular project.

As bioremediation was not considered viable for this project, Orica reverted to its alternative remediation technology, DTD, as the remediation technology for the CPWE. It is considered that remediation of the CPWE using DTD technology presents the most efficient and appropriate method of remediating the CPWE in accordance with the requirements imposed by Orica's EPL.

5 REMEDIATION WORKS OVERVIEW

5.1 Extent of Remediation

It is proposed to remediate only the material contained within the liner of the CPWE, including the liner material itself where required. The material surrounding and beneath the liner within the CPWE boundary will be tested and assessed against risk-based soil criteria. If the material does not meet the criteria, then it will be treated in the DTD Plant. If it does meet the criteria, it will remain on-site. The project does not include remediation of groundwater and contaminated material at the CPWE that may exist outside the boundary of the CPWE.

From investigations conducted at the CPWE, Orica is aware of a source of petroleum hydrocarbons likely to be related to the fuel pipelines located outside and adjacent to the BIP boundary. Given the compounds detected, Orica considers that the source is outside the CPWE boundary and is unlikely to be from industrial activities conducted within the BIP. It is not proposed to remediate the petroleum hydrocarbon contamination, but the presence of these compounds will be one of the Occupational Health and Safety (OH&S) issues addressed during the remediation works. Orica acknowledge that further management procedures may need to be developed and agreed with the Contaminated Land Auditor during the life of the project.

5.2 Proposed Remediation Methodology

The DTD process is an *ex situ* remedial treatment method, and as such, excavation of the CPWE will be required prior to treatment. The proposed works would involve the staged excavation (refer to **Figure 3**) of the CPWE materials within an Excavation Soil Building (ESB). The excavated materials will be assessed upon excavation and sampled for classification. Excavated materials requiring treatment will be transported from the ESB to a Feed Soil Building (FSB), where they will be readied for treatment in the adjoining DTD Plant. The ESB and FSB will be equipped with an ECS to control and regulate emissions from the excavation of the CPWE area and material handling processes. After treatment, the material will be validated and temporarily stockpiled adjacent to the FSB (refer to **Figure 4**) and the surplus soil stockpile area (refer to **Figure 2**). Once treatment of the CPWE area has been completed, the treated material will be transported to the CPWE excavation for reuse as backfill material. Surplus treated material will be retained for future reuse on other Orica land within the BIP.

At this stage of planning, the excavation of the encapsulated materials for treatment will be undertaken in up to five stages depending on the outcome of detailed design studies. It is anticipated that the maximum impact to the surrounding environment in terms of construction noise and contaminant emissions would occur in the five stage scenario in the areas illustrated in **Figure 3**. Consequently, to incorporate a conservative level of assessment into the EA, the five stage scenario was adopted as a point of reference.

At this stage, excavation works are proposed to commence at the southern end of the CPWE, progressing to the north and then to the west. A road will be constructed to the north west of the CPWE to move contaminated materials to the STA as shown in **Figure 2**.

Specific information on the individual plant, site facilities and treatment processes are outlined in the appropriate sections of this RAP. The proposed remedial works will involve the following general operations:

- Preliminary activities including project planning and licensing;
- Site establishment, including:

  - Set-up of site offices, fencing, decontamination stations, environmental control measures, Water Treatment Plant (WTP) and other associated facilities;
  - Staged construction of the ESB over the CPWE to house excavation works;
  - Construction of the ECS servicing the ESB;
  - Installation of DTD Plant and equipment;
  - Construction of the surplus soil stockpile area, FSB and associated ECS and the sealed hardstand adjacent to the FSB; and
  - Construction of internal haul roads.
- Commissioning and trial period for the DTD Plant and associated ECS for the ESB and FSB;
- Progressive excavation of contaminated soils from the CPWE within the ESB enclosure;
- Screening of oversize excavated materials within the ESB enclosure;
- Transport of the excavated materials from the ESB to:
  - The FSB if the initial testing finds that the excavated materials require remedial treatment; or
  - The treated soil stockpile if initial testing indicates that the excavated materials are suitable for reuse without remedial treatment; or
  - An off-site licensed waste facility where excavated materials are considered unsuitable for remedial treatment, but are suitable for disposal/recycling at such a facility.
- Treatment of soils within the DTD Plant;
- Progressive validation of the treated soils and placement in temporary stockpile areas;
- Progressive validation of the CPWE (against the risk based concentrations) after the excavation and removal of the CPWE materials;
- Dismantling and reconstruction of the ESB for each stage of the CPWE excavation works;
- Backfilling of the validated CPWE excavation after completion of the excavation and remedial treatment works;
- Final reinstatement and finishing of the CPWE; and
- All necessary OH&S, environmental protection works and monitoring.

These project tasks and other remediation requirements are detailed in the following sections of this report, refer to **Table 4**.

Table 4: Overview of Remediation Tasks Detailed in this Report

KEY REMEDIATION TASK	RELEVANT REPORT SECTION
Remediation Goals	Section 6
Public Consultation Strategy	Section 7
Preliminaries	Section 8

KEY REMEDIATION TASK	RELEVANT REPORT SECTION
Excavation Works	Section 9
Materials Handling	Section 10
Treatment Operations	Section 11
Management of Water	Section 12
Removal and Disposal of Materials from the Site	Section 13
Validation Plan	Section 14
Placement of Reinstatement Materials	Section 15
Environmental Management Plan	Section 16
Occupational Health and Safety	Section 17
Contingency and Emergency Response Plan	Section 18

5.3 Project Schedule

The remediation process is expected to take approximately 18 months to complete including site establishment, pre-treatment, treatment, validation, decommissioning and reinstatement.

The breakdown of this program is generally as follows:

- Site establishment and construction (including DTD Plant commissioning - Proof of Performance (PoP) testing) – approximately 26 weeks;
- Excavation and treatment – approximately 30 weeks;
- Decommissioning and demobilisation – approximately 14 weeks; and
- Reinstatement of excavated areas – approximately 14 weeks (NB Concurrent with demobilisation).

A more detailed project schedule will be prepared once the DTD Plant has been selected.

Construction and demobilisation hours would be between the hours of 7am and 6pm Monday to Friday, and 7am to 1pm Saturdays. No construction work would occur on Sundays and Public Holidays.

Operation hours for the ESB would be between 7am to 7pm, six days per week. Operation hours for the FSB and the DTD Plant would be 24 hours per day, seven days a week, with the seventh day scheduled for maintenance.

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6 REMEDIATION GOALS

6.1 Soil Remediation Goals

The current generic assessment criteria used in NSW to evaluate soil analytical results are based on the NSW DEC (2006) *Guidelines for the NSW Site Auditor Scheme*, NSW EPA (1994) *Guidelines for Assessing Service Station Sites* and the *National Environment Protection (Assessment of Site Contamination) Measure* (NEPC 1999). These guidelines present a range of Health-Based Soil Investigation Levels (HILs), sensitive land use thresholds and expected background concentration ranges for urban redevelopment sites in NSW.

As discussed in **Section 2.1.1**, since HILs are not available for all contaminants in the CPWE, it is necessary and appropriate to adopt a health-based risk assessment approach in determining safe Remediation Goals for these chemicals and the level of remediation required for the proposed future use of the CPWE land. Accordingly, Remediation Goals have developed using this approach that will be referred to a Contaminated Land Auditor for approval.

The discussed Remediation Goals will apply to all remedial activities at the CPWE site that involve reuse or retention of materials, including the DTD treatment process. This approach is contemplated in Section 28 of the SCW CCO (June 2004) and is espoused by the provisions of clause 9 and 28:

> *"9. The manufacture of scheduled chemical wastes is permitted by:*
> *9.3 works associated with the remediation of contaminated Sites; and…"*
>
> *"28. The use of scheduled chemical waste manufactured in accordance with clause 9.3 and not covered by clauses 26 and 27 is permitted where the use is:*
> *28.1 onsite and is not in an environmentally sensitive area (see Schedule B); or*
> *28.2 onsite in an environmentally sensitive area (see Schedule B) and:*
> *28.2.1 the EPA forms the opinion that the basis for the Site being an environmentally sensitive area has been satisfactorily addressed in determining the proposed use;*
> *or*
> *28.2.2 the appropriate consent authority provides specific approval for the use having had regard to the requirements of this order.*
>
> *Note: Use includes use of soil containing scheduled chemical waste in a manner which does not necessitate the employment of barriers or other engineering structures which may be associated with the keeping or disposal of waste".*

6.2 Risk Based Soil Concentration

Risk-based Soil Concentrations (RBSCs) have been presented by URS in report, *Risk-Based Remediation Concentrations* [RBRCs], *Car Park Waste Encapsulation* (2007b) to provide human health risk-based concentrations that can be used for the purpose of validation of treated materials and/or the validation of the excavation. A copy of the URS (2007b) report is provided in **Appendix B**.

The approach taken to develop the RBSCs was generally in accordance with the health risk assessment protocols/ guidelines recommended by enHealth (*Environmental Health Risk Assessment, Guidelines for Assessing Human Health Risks from Environmental Hazards*, June 2002). These guidelines draw on and are supplemented by those provided by ANZECC and NHMRC and detailed in the documents:

- Contaminated Soil Monograph Series (CSMS, 1991, 1993, 1996 and 1998) and enHealth (2002). *The Health Risk Assessment and Management of Contaminated Sites;*
- ANZECC/NHMRC (1992) *Australian and New Zealand Guidelines for the Assessment and Management of Contaminated Sites*; and
- National Environment Protection (Assessment of Site Contamination) Measure (1999). Schedule B(4), Guideline on Health Risk Assessment Methodology.

ANZECC and NHMRC currently provide only general guidance and, as such, the more detailed protocols and guidelines developed by the United States Environmental Protection Agency (USEPA 1989 and 2001) are referred to for supplementary guidance. The derivation of remediation concentrations for the site-related chemicals at the CPWE site has been based on assumptions relevant to potential for human exposure to the chemicals using guidance recommended and endorsed by Australian regulators in particular the DEC and NSW Health.

The aim and objective of the RBRCs report (URS 2007b) were to develop RBSCs for the treated material to enable validation of the CPWE site after treatment has been completed. The RBSCs are developed for use within the BIP and as such are relevant to the existing industrial land use of the BIP.

The RBSCs have been derived on the basis of contaminants identified within the CPWE and potential use of these materials on the site (at the CPWE and/or BIP) within commercial/industrial use outdoors and in all areas, including beneath a building. As such the RBSCs are project-specific values that cannot be used for other purposes. The RBSCs presented are not relevant to waste materials that may be removed from the Site.

The RBSCs have been derived using the following approach:

- COPC have been identified following review of data collected from the CPWE. This included soil gas data and data from a number of waste characterisation assessments. The 95% Upper Confidence Limits (UCLs) for contaminants previously identified to be present in the CPWE material were assessed against existing screening guidelines. Those contaminants with 95% UCLs which exceeded the screening guidelines were considered to be Contaminants of Concern (COCs, refer to Table 3.2 in the URS (2007b) RBRC report, **Appendix B**). This included some contaminants which were not analysed in some stages of CPWE characterisation works;
- Human health RBSCs for indoor areas have considered potential exposures associated with COCs in soils that may be present (or placed) in an area where a building will be constructed over the top of the soils (refer to **Table 5**). The RBSCs have been derived to be protective of the inhalation of vapours that may migrate into the building only. Direct contact with the soil is not relevant; and
- Human health RBSCs for outdoor areas have considered potential exposures associated with COCs in soils that may be present (or placed) in an open area where no buildings are to be located in the future. The RBSCs have been derived to be protective of direct contact (including dermal and ingestion) with the soils and the inhalation of vapour and particulates in the outdoor air (refer to **Table 6**). The RBSCs have also been derived taking into consideration the depth to the remediated material. Clean top fill may be placed above the remediated material therefore values have been determined for three different depths of 1, 2 and 3 m bgl, and for when the validated material is present at the surface; and

- For these scenarios, the human health RBSCs for each individual COC has been derived by adjusting the concentration in soil such that the total risk from all exposure pathways is equal to the individual risk target adopted for individual chemicals and the total risk (from all chemicals present at the adopted RBSC) is equal to the adopted target.

In following this process it is noted that the derived RBSCs are specific to the validation of treated materials from the CPWE and are not generic concentrations that could be applied to other sites. Furthermore, the RBSCs for outdoor areas are not applicable to areas under buildings and vice versa. It should be noted that during the CPWE remediation project, the proposed RBSCs can be adjusted to account for additional COPC should they be identified as well as a different distribution of individual risk targets (such as a higher RBSC for a chemical found to be more persistent in the remediation process and a lower value for another chemical found to be more successfully treated or not present at the concentrations expected on the basis of the existing data).

The RBSCs will be adopted as Remediation Goals during the remediation works and can be used for the following purposes:

- Reviewing soil data from the areas adjacent to the encapsulation within the Site boundary. If all COCs in samples are below the RBSCs, then further assessment of the health risks would not be warranted; and
- As conservative validation criteria. The RBSCs may be used for identifying on-site reuse options for the treated material.

The use of the RBSCs for either of the above purposes requires the correct RBSC to be selected. The RBSCs have been developed according to the proposed end us of the material such beneath a building or in areas where no building is to be constructed. The derivation of the RBSCs also considers the amount of clean top fill (likely to be virgin excavated natural material, VENM) that may be placed above the validated materials. These RBSC will need to be endorsed by the Contaminated Land Auditor prior to the commencement of the remediation works.

6.2.1 How the RBSCs and Other Guidelines are to be Applied

A hierarchy of guidelines and a decision making process has been presented in the URS report (2007b) to assist in the application of the RBSCs and other guidelines. The guidelines should be utilised in the following order:

- The Director-General's Environmental Assessment Requirements (EARs) which require that:

  "The Environmental Assessment must clearly indicate the proposed remediation criteria to be applied to the site, including details of how these criteria have been derived. The Environmental Assessment must demonstrate how the treatment will achieve:

  > *A statistical average dioxin, furan and dioxin-like PCB WHO-TWQ of less than 1 µg/kg (1000 ppt) determined with a methodology acceptable to the DEC;*
  >
  > *An aggregate concentration of scheduled chemical waste constituents of less than 2 mg/kg;*
  >
  > *A polychlorinated biphenyl concentration of less than 2 mg/kg; The relevant requirements of the HCB Waste Management Plan 1996; and*

Best practice limits as demonstrated with the technology assessment application to the DEC for other principal contaminants of concern".

- The derived RBSCs relevant for the end use and depth;
- Flux emission testing has been recommended by URS (2007b) at the excavation surfaces and backfilled soil to confirm that the CPWE site is suitable for ongoing commercial/industrial landuse with or without additional management measures (i.e. an Environmental Management Plan); and
- Testing of soils (and flux emissions) will also include contaminants in addition to the identified COC. The specific requirements of this testing is detailed in Appendix E of the RBRC report (refer to **Appendix B**).

The Remediation Goals for indoor and outdoor areas, as derived in the RBRC report for the COC, are provided in **Table 5** and **Table 6** respectively. Detailed information relating to how the RBSC were calculated is provided in the URS (2007b) report.

Use of either the indoor or outdoor Remediation Goals will be dependant on Orica's development plans for the CPWE area. These plans are yet to be determined.

Table 5: Remediation Goals – Indoors

Constituent	RBSC Surface (mg/kg)	RBSC 1 m (mg/kg)	RBSC 2 m (mg/kg)	RBSC 3 m (mg/kg)
EDC	3.2	3.3	3.4	3.5
cis-1,2-dichloroethene	6.5	6.8	6.8	6.8
HCB	55	5000	5000	5000
hexachlorobuta-1,2-diene	4.5	5	5	5
HCBD	4.5	5	5	5
methylene chloride (DCM)	130	135	135	135
OCS	110	5000	5000	5000
pentachlorobutadiene	4.2	4.5	4.5	4.5
tetrachlorobutadiene	4.2	4.5	4.5	4.5
PCE	16	16	16	16
1,1,2-trichloroethane	15	16	16	16
TCE	1	1	1	1.1
1,2-dibromo-3-chloropropane	9.5	9.5	10	10

Table 6: Remediation Goals – Outdoors

Constituent	RBC Surface (mg/kg)	RBC 1 m (mg/kg)	RBC 2 m (mg/kg)	RBC 3 m (mg/kg)
EDC	52	110	230	330
cis-1,2-dichloroethene	110	230	450	660
HCB	55	5000	5000	5000
hexachlorobuta-1,2-diene1	38	5000	5000	5000
HCBD	38	5000	5000	5000
methylene chloride (DCM)	280	5000	5000	5000
OCS	110	5000	5000	5000
pentachlorobutadiene	35	5000	5000	5000
tetrachlorobutadiene	35	5000	5000	5000
PCE	1500	5000	5000	5000
1,1,2-trichloroethane	210	500	1000	5000
TCE	17	36	70	100
1,2-dibromo-3-chloropropane	21	300	600	5000

In addition to the above risk-based Remediation Goals, the Director-General's EARs noted that the following should apply to treatment materials:

- A statistical average dioxin, furan and dioxin-like PCB WHO-TWQ of less than 1 µg/kg determined with a methodology acceptable to the DEC;
- An aggregate concentration of SCW constituents of less than 2 mg/kg; and
- A PCB concentration of less than 2 mg/kg.

As noted in **Section 11.4.3,** these treatment standards may not be achievable due to operational or practicability constraints. Accordingly, treatment standards to address the compounds highlighted in the above Director-General's EARs, will be ultimately determined following optimisation trials in the context of practicability (technically and economically) as is allowed (with the DEC's approval) in the applicable CCOs (refer to Section 2.1.3).

6.3 Water Quality Criteria

In terms of groundwater criteria, groundwater in the BIP area is managed under a separate regional groundwater management plan that relies on pumping and treatment to prevent migration of contaminated groundwater to Botany Bay. Consequently, groundwater in the CPWE area is managed as part of this system and requires no further consideration here.

It is unlikely that significant volumes of seepage water will accumulate within the excavation during the course of the proposed remedial works as these works will be undertaken within the ESB. Furthermore, ongoing monitoring undertaken by URS, since the initiation of a groundwater monitoring program in 1997, has indicated that groundwater levels have been approximately 4.0 m below the base of the Hypalon liner during the last three monitoring events (URS 2005d, 2006a and 2006b). It can be assumed that significant rainfall events during the proposed excavation works are unlikely to raise groundwater levels to a level that may impact the remediation works.

All water collected on the Site will be treated on-site (in the WTP) to a standard suitable for discharge to sewer as per **Section 12** or reused during the excavation, remediation and reinstatement works, where possible.

6.3.1 Surface Water Quality Criteria

Surface waters captured on building roofs at the Site will be considered to be free from contamination and will be discharged directly to the stormwater system during the remediation works. Surface water collected from the STA will be recovered and managed as if it is contaminated, and directed to the WTP.

No other discharges to surface waters are proposed to be recovered during the works.

6.3.2 Liquid Trade Waste

A trade waste licence will be obtained (or an existing one will be modified) from Sydney Water for the disposal of treated waters into the sewerage system. This licence will nominate the appropriate types and concentrations of any contaminants that are permitted for discharge. Site water will not be discharged from the Site unless tested and in full compliance with the licence water quality criteria. All discharges will be documented in terms of quantity and quality, and compliance with the licence criteria will be recorded.

7 PUBLIC CONSULTATION STRATEGY

7.1 Background

Given the sensitive nature of the project and the issues involved, it is in the best interests of all stakeholders that an open communication and consultation system be continued for the duration of the project. This section outlines the various methods of communication proposed between the contractors undertaking the remediation works, the BIP site operators, and members of the community.

In preparing the proposed consultation process, the following factors have been considered:

- the consultation work undertaken for the BIP and for the CPWE area to date;
- the location of the Site and the surrounding communities; and
- the need for the general public to be informed of the progress of the remediation works.

7.2 Consultation Objectives, Scope and Duration

It is essential to the overall success of the project (and the ability to gain workable statutory approvals) that consultation does not cease once the EA is lodged. Open communication, allowing all stakeholders access to information is necessary during the course of the remediation works, and it is essential that all stakeholders have a means of providing feedback and airing any concerns.

The key goal of the consultation process is to disseminate clear and factual information in order to minimise the generation of false information and to reduce the potential for uninformed objections to the works. The following objectives have been identified:

- To advise the community of the project objectives, benefits and works proposed in order to remediate the CPWE;
- To provide up-to-date information on the progress of the project on a regular basis;
- To provide opportunities for all stakeholders to comment and air concerns during the course of the project;
- To respond to comments and requests for information in a timely manner; and
- To pass on information relating to stakeholder issues and concerns to the remediation project team.

The scope of information released in the consultation process will include the following:

- Any changes in key components of the Site works proposed during the course of the remediation works;
- Any changes in the timetable and timeframes proposed over the course of the remediation works;
- Expected effects of the proposed works on the surrounding community;
- Measures to be taken to manage and mitigate these effects;
- Potential risks to the community; and

- Realistic project outcomes.

7.3 Consultation Methods and Tools

Over the course of the project, continued and ongoing consultation will be undertaken to inform stakeholders of the progression of the project and to provide an avenue to receive and respond to feedback and concerns. This will largely be done through dedicated open community meetings to specifically manage issues related to the remediation of the CPWE, and by holding additional meetings with specific interest groups. The frequency of meetings will be determined in consultation with interested parties.

To ensure effective and efficient consultation with stakeholders for the duration of the remediation project, a Community Liaison Plan will be prepared, specific to the project and will include, but not limited to, the following key components.

7.3.1 Community Participation and Review Committee

Since its inception in 1997, the CPRC has been provided with information on the investigations for remediating the CPWE and has provided feedback on issues of interest and concern. The CPRC will continue to be a key stakeholder during the project and project information will be provided to and discussed with the Committee.

7.3.2 Consultation Database

A database will be prepared to identify all stakeholders in the proposed remediation works. The key parties identified to date are the DEC (as regulator responsible for licensing of the proposed remediation), CoBB Council, other government agencies, local residents, local businesses, users of Hensley Athletics Field, the CPRC, and other interested community groups.

Over the course of the project, the database will be updated regularly and will be used to document communications between stakeholders.

7.3.3 Initial Contact

Appropriate communications tools will be used to distribute information to all identified stakeholders prior to establishment of works at the CPWE. The tools will contain information relating to the proposed CPWE remediation works, a project program showing the anticipated duration of works, the opportunities available for stakeholder participation and means for providing feedback or seeking information.

7.3.4 Newsletters

At key stages throughout the project, newsletters will be prepared and distributed to stakeholders to communicate project information. The newsletters will provide an avenue for communicating specific information on the progress of the remediation works where appropriate and for reinforcing how interested or concentred stakeholders can seek additional information.

7.3.5 Feedback

Feedback on the information will be collected via the consultation methods described above and also through the dedicated telephone number, refer to **Section 7.3.6**, and e-mail, refer to **Section 7.3.8**.

7.3.6 Dedicated Telephone Number

A dedicated 1800 telephone number/service will be used to receive and respond to queries on the project and comments and complaints. It is likely that this will be the existing Orica Community Hotline number: 1800 025 138.

7.3.7 Information Board

A notice board will be established at the main entrance to the Site. The notice board will present recent newsletters, contact information and inform interested parties on the available methods of communication with the remediation team.

7.3.8 Website

Information about the project, including progress updates and relevant contact details will be posted on Orica's website and updated regularly. The website will be advertised to key stakeholders. E-mail inquiries will be available through this web site.

7.3.9 Newspaper Columns

Information about the project and consultation opportunities will also be shared through Orica's regular columns in local newspapers.

7.3.10 Open Days

Open days or site bus tours will be arranged to enable interested stakeholders to view the Site. Visitors to the Site would be supervised and appropriate precautions taken to ensure safety.

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8 PRELIMINARIES

8.1 Background

Prior to establishment of the Site, all plans, programs, licences, certificates and other documents necessary for the commencement of work will be completed. These documents will include the following:

- Management Plan and Work Procedures for :
  - OH&S;
  - Environmental management;
  - Project management;
  - Quality management; and
  - Emergency response and contingency management.
- Studies relating to potentially hazardous on-site operations and processes (HAZOP);
- Community Liaison Plan;
- Detailed work program and logic diagram;
- All necessary licences and approvals from regulatory authorities;
- Insurance certificates;
- Submission of all WorkCover NSW (WorkCover) notifications; and
- Any additional documentation required.

All assessment and design work for the excavation and remediation works, including the design of site buildings, processes and equipment used, will be completed by appropriately qualified and experienced engineers. All assessment and design will be documented in the form of plans and drawings that are properly certified for use on the Site.

8.2 Licences and Approvals

8.2.1 Occupational Health and Safety

Prior to site establishment, all appropriate OH&S planning activities will be completed, i.e. an OH&S Plan (OHSP) will be prepared, documented and approved, where necessary. An overview of OH&S activities is provided in **Section 17**.

8.2.2 Environmental Management

Prior to site establishment, all appropriate environmental management activities will be completed, i.e. an Environmental Management Plan (EMP) will be prepared, documented and approved, where necessary. An overview of environmental management activities is provided in **Section 16**.

8.2.3 WorkCover NSW Notification

Prior to site establishment, WorkCover will be notified of the proposed commencement date for site works.

8.2.4 Commissioning and Mobilisation of Plant and Equipment

All equipment and plant used on-site during the remediation works must:

- Be suited to the work intended and meet all operational requirements;
- Be in good condition, in sound working order and have a current documented maintenance logbook;
- Be reliable and have low-maintenance requirements;
- Comply with all regulatory requirements;
- Comply with the design and manufacturer's standards; and
- Be operated by a suitably trained and licensed operator.

Plant and equipment that does not comply with these requirements will not be permitted on-site. In the event of a break down on-site or inactivity due to routine maintenance requirements, additional equipment and plant complying with these standards may be brought to Site in the interim.

8.2.5 Utilities and Resources

Utilities and resources required for the proposed remediation works include:

- Natural gas - required for the rotary dryer and thermal oxidiser of the DTD Plant. Gas will be supplied to the DTD Plant via underground pipe from AGL's network or via the existing reticulation system on the BIP. No alternative or back-up fuels are proposed and a loss of gas supply would automatically initiate a controlled shutdown of the DTD Plant.
- Electricity - during normal operation all power for the plant will be supplied from the existing grid. The DTD Plant will be fitted with a back-up power supply to enable controlled shutdown and restart in the event of a power outage.
- Diesel - Diesel is required for the back-up generator fitted to the DTD Plant as well as for the operation of equipment to be used on site such as excavators, loaders and trucks. All re-fuelling will be by mini-tanker in a dedicated bunded area. No diesel storage will be provided on site.
- Potable Water - required for the cooling process within the quench and the acid gas scrubber within the DTD Plant. This water will be sourced from the Orica GTP should surplus water be available. The water will be supplied to a break tank at the DTD Plant and then pumped from the break tank to the quench and acid gas scrubber. A back-up water tank will be provided for the quench, pressurised by air cylinders to cater for loss of mains water flow.
- Mains sewer and telecommunications – required for site facilities, etc.

The installation and commissioning of temporary site services (gas, electricity, water, sewer and telecommunications) required for the duration of the remediation works will be undertaken by qualified and experienced personnel in accordance with the specifications and requirements of the appropriate regulatory authorities. All approvals in respect to the installation, operation and eventual removal of temporary services will be obtained.

There may be services located within the vicinity of the proposed CPWE excavation works. In order to confirm this, a cable/pipe location survey will be conducted of the CPWE and its immediate surrounds to identify and locate any underground services that may be affected by the excavation and reinstatement works.

Any existing utilities located within materials requiring excavation would be temporarily bypassed and removed so as not to hinder excavation activities. These services and utilities would be re-established as required as part of the Site reinstatement works.

8.3 Site Facilities and Procedures

8.3.1 Contractor’s Facilities

Site accommodation and facilities required for the remediation works will be established in compliance with relevant regulations. These facilities will be connected to appropriate utilities as required.

The following facilities will be established at the Site:

- ESB, FSB and the DTD Plant;
- Site Offices located adjacent to the ESB and FSB;
- Air lock and wheel wash zones at the entrance and exit points to the ESB and FSB;
- ECS for the ESB and FSB respectively (refer to **Figures 3** to **5**);
- Stores, work sheds, lunchrooms and changing areas for the use of subcontractors and consultants;
- Temporary site sheds, first aid and emergency facilities, bathroom facilities and decontamination units; and
- Any additional site facilities to facilitate work in other areas of the Site, or in areas requiring additional safety measures.

8.3.2 Exclusion Zones

Exclusion Zones are areas of the Site outlined in the OHSP that either require additional protective measures or may require the adoption of additional OH&S requirements and work practices. Exclusion Zones may also include other areas affected by emissions from the works being undertaken at any point in time. All Exclusion Zones will incorporate a buffer area along the boundary of the zone.

The boundaries of all Exclusion Zones will be defined by fencing (or other solid barriers) and safety signs erected at regular intervals around each exclusion zone warning of the boundary of the exclusion zone, the nature of the hazard associated with it and access restrictions that apply for entry into the zone. Access of personnel into and out of Exclusion Zones, will be controlled at Decontamination Stations, and will depend on the personnel classification. The location and extent of Exclusion Zones will be detailed in the OHSP and addressed in the Site-Specific Safety Induction. The following Exclusion Zones have been nominated at the Site:

- The ESB and its immediate surrounds;

- The FSB and its immediate surrounds; and
- The DTD Plant area and its immediate surrounds.

8.4 Site Access and Security

8.4.1 General

Only authorised personnel and equipment will be allowed on to the Site. Entry to the Site will be strictly controlled throughout the course of the remediation works.

8.4.2 Site Haul Roads & Parking Areas

Existing access roads entering and leaving the CPWE area (internal to the BIP site) will be utilised as haul roads to the extent practicable. However, several extensions and diversions of existing roads will need to be established in BIP to serve as haul roads for the transport of materials between the ESB and the FSB. **Figure 2** illustrates the proposed haul roads for transport of materials between the ESB and FSB.

All newly constructed haul roads will be built to a suitable industrial standard, and finished with a bitumen-sealed surface. Sediment and erosion control measures, drains or barriers will be erected adjacent to all haulage roads to control drainage and run-off during rainfall events, where necessary.

8.4.3 Site Access

The primary access route to the Site would be via the main entry gate to BIP on Denison Street (Gate 3) and the secondary access route would be via the Wight Street gate located at the northern end of the BIP. As the main access point for the Site would be via Denison Street, the Wight Street access would only be used where necessary.

Vehicles travelling to and from the Site will be limited to employees, delivery of plant and equipment and deliveries of consumables.

The likely primary routes to the Site would be:

- Inbound - along General Holmes Drive, then Foreshore Road, Beauchamp Road, and then Denison Street accessing the BIP through Gate 3; and
- Outbound – exit via Gate 3, along Denison Street, Wentworth Avenue, and then Southern Cross Drive.

Access routes to the secondary access point at Wight Street are as follows:

- Along Southern Cross Drive, then Foreshore Road, Beauchamp Road, Denison Street, Wentworth Avenue, Baker Street, Moore Street and then Wight Street accessing the CPWE; or
- Along Southern Cross Drive, then Wentworth Avenue, Page Street, Holloway Street, Baker Street Moore Street and then Wight Street accessing the CPWE.

The primary traffic routes to and from the Site utilise arterial roads to access to the Sydney metropolitan area, therefore minimising the impact on the local road network.

8.4.4 Signage

Signage will be installed at the Site entrance off Denison and Wight Streets, detailing directions to key areas (including to the various site areas, offices, decontamination units, haul roads, first aid facilities and parking). Traffic restrictions will be installed to limit access further into the Site and ensure the safety of site visitors and to restrict off-site vehicles from disrupting site operations. Signage at the main access points will include after hours contact details.

As detailed in **Section 8.3.2**, additional signage will be erected along Exclusion Zone boundaries to restrict access to these areas to authorised personnel only.

8.4.5 Fencing

Security fencing will be established around the STA. Additional fencing will be erected where necessary to secure portions of the Site, in particular areas such as the Exclusion Zones.

8.4.6 Control of Site Entry and Exit

Entry and exit to and from the Site will be controlled through the use of a sign-on/sign-off log system at the entry to the Site. The following site entry controls will be implemented:

- Only authorised personnel will be allowed on-site;
- Personnel will gain access to the Site only after they have:
  - Undertaken the required medical examination;
  - Signed on in the sign-on/sign-off logbook;
  - Attended and completed a site safety induction briefing (applicable to all site workers and visitors);
  - Are wearing all applicable personal protective equipment (PPE) as detailed in the OHSP; and
  - Signed the OHSP acceptance form (applicable to all site workers and visitors).
- All construction vehicles and delivery vehicles will enter the Site through the nominated gates. When a vehicle enters the Site, it will proceed along the designated vehicle route to the pre-arranged rendezvous area where an authorised person will meet the vehicle and provide the driver with further instructions.

In the event of an emergency on-site and the need for emergency services personnel to access the site works, the site access process may be expedited. In these situations, which require the need to minimise delays in accessing injured site personnel or critical areas of the Site, prior arrangement will be made for special site access procedures. However, given the nature of the remediation works, all PPE and decontamination protocols will remain in effect at all times. An Emergency Response Plan (ERP) will be developed prior to site establishment detailing the specific procedures relating to site emergencies. The local emergency services will be notified of the ERP, Site procedures and protocols prior to site establishment.

8.4.7 Parking

Sufficient parking for private vehicles will be provided on the BIP at all times.

8.5 Site Preparation and Maintenance

All surplus materials, off-cuts, construction plant, other clean waste items and personnel-generated rubbish will be disposed off-site. Bins for the disposal of low level contaminated PPE will be placed within the decontamination station. Additional rubbish bins for personnel-generated rubbish will be provided adjacent to Site buildings and facilities. The bins will be regularly emptied by licensed waste disposal contractors.

9 EXCAVATION WORKS

9.1 Background

This section addresses works associated with the excavation of the CPWE. This includes the following activities:

- All stages of the construction and deconstruction of the ESB;
- Control and minimisation of emissions from the excavation area;
- Control and treatment of water from the CPWE excavations;
- Excavation of the CPWE; and
- Loading of excavated materials for transport to the treatment area.

The excavation works will be undertaken in up to five stages as described in **Section 5.1**. This RAP describes the five stage scenario in detail. Where fewer stages are implemented, the same methodologies and protocols described herein will apply to the extent required.

Each stage of the excavation works will include the following steps:

- Erection of purpose-constructed and enclosed building, known as the ESB;
- Connection of the ESB to the ECS;
- Excavation of the overlying and encapsulated CPWE materials within the ESB; and
- Disassembly and reconstruction of the ESB in the next stage of the CPWE works.

9.2 Excavation Soil Building and Emission Control System

Excavation of the material overlying the liner and CPWE material will take place within the ESB via the use of an excavator. Excavated material requiring treatment will be stockpiled within the building before being fed to a coarse vibrating screen (“Grizzly”) by a front end loader to remove oversized materials, such as bricks, concrete, crushed drums, etc. Oversized material will be stockpiled and tested for contamination before being disposed to an appropriate waste facility, recycled where possible or transported to the FSB for treatment. The remaining material will be temporarily stockpiled within the ESB before being loaded into trucks for transportation to the FSB.

The purpose of the ESB will be to mitigate uncontrolled emissions from the excavation of the CPWE material and ensure these emissions are vented to atmosphere through an ECS. Operation of the ESB and associated ECS will be in accordance with operation and maintenance management systems developed on completion of the final design. An overview of the controls to be designed into the system is provided below.

Subject to structural considerations, the ESB will be constructed of either a steel frame with metal sheeting, or from a tensioned truss arrangement with impermeable membrane covering and fitted with louvres for ventilation as required to facilitate management of air flow. It will include doors, lights, electrical and other ancillary facilities that are required for safe and efficient operation.

The building will be equipped with personnel entrances and truck entrances. The truck entrances will include an air-lock consisting of a small structure internal to the building. The air-lock will be equipped with two doors. When a truck enters the air-lock, the inner door will be closed and the outer door will open. The outer door will then close, the inner door will open and the truck will enter the building. The procedure will be reversed when a truck exits the building.

An ECS will be constructed and operated to preserve air quality within the building and minimise emissions (dust and organic vapours) to the atmosphere. The ECS will be operated to ensure the flow of air into the building. Conceptually, the ECS will comprise an induced draft fan, duct work system, particulate control device (dust filters), two stage carbon beds and a stack. It is anticipated that the ECS used will be sized at 90,000 m³/hr. However, the actual capacity will be determined through detailed design studies, to satisfy OH&S considerations. The ECS will be located directly to the west of the CPWE on the existing Qenos Olefines facility car park.

The air exhausted from the building will first pass through a particulate control device to remove fugitive dust. Dust removed will be collected in enclosed drums or hoppers. When the dust collection container is taken off-line, the dust will be taken to the STA for treatment.

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

Air will be exhausted to the atmosphere via a stack. Periodic stack testing will be undertaken in accordance with licence requirements.

1.3 Excavation Staging

Once excavation works are under way within the ESB in Stage 1, the construction of a second excavation building will commence enclosing the Stage 2 excavation area directly to the north of the Stage 1 area. Once the Stage 1 excavation works are completed, the excavation equipment will be transported to the adjoining Stage 2 excavation area, and the process repeated as the ESB is moved across the CPWE. This sequence will be undertaken for all stages of the excavation works. When a new ESB is constructed, it will be connected to the existing ECS via appropriate ductwork.

The advantages of this methodology are:

- It minimises the downtime of excavation equipment between successive stages, and will assist in the progression of the excavation program; and
- It allows for each stage to be progressively validated and revisited if necessary prior to the commencement of the scheduled reinstatement works. This should assist in minimising the length of the reinstatement works, reducing the duration and limiting the extent of exposure of the validated areas and minimising erosion, surface water infiltration and dust generation.

The potential for release of emissions to the atmosphere from the exposed excavation face of the CPWE during the proposed sequential excavation process is anticipated to be mitigated by covering the excavation face with the CPWE liner (Hypalon) and sealed as best as practicable prior to any stage of the ESB being disassembled. If the liner cannot be reused, then alternatives such as covering the face with High Density Polyethylene (HDPE) or by some other appropriate means would be used to control fugitive emissions. This will be addressed during the detailed design.

9.3 Excavation Planning

All excavation works will be undertaken in accordance with the following procedures (in sequence):

- Prior to commencement of excavations on each work shift, all necessary environmental and OH&S measures and equipment including the ECS, truck access air-lock and vehicle decontamination processes, vapour monitoring equipment, truck haul roads (both inside the ESB and on haulage routes), and all worker PPE and respiratory controls are in place and are in full working order in accordance with the OHSP;
- All excavation plant operators, haulage operators and supervisors will be made familiar with the excavation strategy and their responsibilities prior to the commencement of each shift;
- Stockpile areas within the FSB have been prepared with adequate capacity to receive the contaminated materials after excavation;
- Designated signage is placed around the boundary of the CPWE area and along haulage roads specifying that the area is an exclusion zone.
- All truck haulage roads are suitable for transportation and haulage of the excavated materials;
- All haulage trucks are covered, followed by decontamination prior to exiting the ESB or FSB in accordance with the EMP; and
- All personnel, vehicles and equipment leaving the excavation building are properly decontaminated in accordance with the OHSP and EMP.

9.4 Excavation Operations

The materials to be excavated comprise ash, sand, peat and solid waste materials as outlined in **Section 3.5.2**. The ESB will operate 12 hours per day, six days per week. As noted above, the plant operating within the building will include a tracked excavator, front end loader and grizzly screen (refer to **Figure 6**).

Prior to excavation works within the CPWE, any seepage water (free water) present, will be removed (by pump) for treatment at the WTP. Exploratory trenches will be advanced to the base of the remediation area to ensure that any seepage water has been suitably removed. Should uncontrolled seepage water leak into the material beneath the base of the liner, the impacted material will be tested and if required excavated and treated in the DTD Plant. The residual soil will be validated as per **Section 14**.

It should be noted that ongoing groundwater monitoring has indicated that the groundwater table is located greater than approximately 4.0 m below the base of the Hypalon liner (URS 2006b). Accordingly, it can be assumed that significant rainfall events during the proposed excavation works are unlikely to raise groundwater levels to a level that may impact the remediation works.

Excavation operations will commence within any stage by the removal and stockpiling of the overlying materials (bitumen cap and sand). Once in stockpile, this material will be classified to determine if treatment is required, or if off-site disposal is possible in the case of the surface bitumen-sealed layer. The bitumen will be sampled and analysed to assess its suitability for disposal to landfill or a recycling facility in accordance with the *Environmental Guidelines: Assessment, Classification & Management of Liquid & Non-Liquid Wastes* (DEC 2004).

The excavated encapsulation material requiring treatment will be stockpiled within the building before being fed to a coarse vibrating screen (Grizzly) by a front end loader to remove oversized materials (greater than 100 mm in size). Oversized material will be sampled and analysed to assess its suitability for treatment in the DTD Plant, disposal to an appropriate waste facility in accordance with *Environmental Guidelines: Assessment, Classification & Management of Liquid & Non-Liquid Wastes* (DEC 2004) or transfer to a recycling facility.

The remaining material will be temporarily stockpiled within the ESB before being loaded into trucks for transportation to the FSB. Materials considered suitable for off-site disposal will be labelled and temporarily stockpiled within the ESB for transport and disposal at an appropriately licensed waste or recycling facility.

The CPWE will be excavated to below the level of the encapsulation liner, where the soil will be sampled and tested for compliance against the Remediation Goals. The Hypalon liner will be excavated and transported to the FSB. Excavation will continue until the base and walls of the excavation have been validated to comply with the Remediation Goals (refer to **Section 14**).

Bogie drive tip trucks will operate on a daily basis to haul materials from the ESB (via the air-lock) to the FSB in the case of materials destined for treatment, and for haulage of materials suitable for reuse without treatment directly to the soil stockpile areas. Once inside the excavation building, the trucks will be loaded, covered with a steel lid (with seals) and driven into the air-lock for decontamination by high pressure washing in a fully automated spray system or wheel wash (refer to **Figure 6**). Once decontamination is completed the trucks will pass out of the air-lock and will transport the excavated materials directly to the required destination along the designated haul roads.

Water that may be present in the encapsulation (seepage water) and wash water from the decontamination area will be recovered and treated in a WTP (refer **Section 12.2.4** for discussion). The water will be treated to a standard to enable reuse in the wheel wash system, reuse as grey water on-site, or alternatively for disposal to sewer subject to compliance with licence criteria.

9.5 Excavation Support

At all times, the sides of excavations will be maintained in a stable and safe condition. Soil will generally be excavated with batters set at an angle of repose of no greater that 1 in 1. Steeper batter angles may be used in instances where the safe angle of repose of the soil is greater than 45° or where additional reinforcement such as woven geotextile can be utilised to stabilise and support the slope.

Subject to the results of further detailed investigations, shoring works may be required along the Corish Circle boundary of the CPWE if contaminated soils are identified at depth in close proximity to the boundary. Such shoring would likely comprise driven sheet piles or bored concrete piers. Detailed design of any shoring system will be undertaken by a suitably qualified structural engineer.

10 MATERIALS HANDLING

10.1 Background

This section specifies the proposed materials handling procedures. The materials handling procedures have been designed to provide "cradle-to-grave" control and management of excavated materials at all times and are necessary to ensure that the remediated CPWE area is suitable for the proposed land use with a high level of confidence.

10.2 Classification of Excavated Materials

Materials excavated from the CPWE will be initially screened within the ESB to separate oversize material (greater than 100 mm) from materials suitable for remediation treatment. All screened material will be loaded into trucks for transportation to the FSB for further processing and treatment (in the DTD Plant).

Oversize material and the bitumen capping will be temporarily stockpiled within the ESB, and subsequently sampled and analysed to assess their suitability for disposal to landfill or recycling facilities in accordance with *Environmental Guidelines: Assessment, Classification & Management of Liquid & Non-Liquid Wastes* (DEC 2004). Materials considered unsuitable for off-site disposal will be transported to the FSB for further processing.

Overlying materials from the CPWE will be sampled and analysed, and the results compared against the Remediation Goals. Where the results indicate that the material may be reused on site, it will be transported directly from the ESB to soil stockpiling areas. Alternatively, where the results indicate that the material is unsuitable for reuse and treatment is required, it will be hauled to the FSB for processing and treatment (in the DTD Plant).

10.3 Materials Tracking System

Due to the scale and nature of the earthworks program to be undertaken, a Materials Tracking System will be developed to monitor and control excavation of all materials and their movements at the Site. The main objective of the system will be to ensure traceability of the remediation process and to track materials through the duration of the project from excavation through to treatment and stockpiling, for subsequent use as backfill during the reinstatement process.

The Materials Tracking System will monitor and control each of the different phases of material handling that will occur during the project including:

- Excavation;
- Screening;
- Transport of the excavated materials from the ESB;
- Classification of overlying materials suitable for reuse without treatment;
- Classification of oversize materials and bitumen in accordance with the *Environmental Guidelines: Assessment, Classification & Management of Liquid & Non-Liquid Wastes* (DEC 2004) ;
- Transport of oversize materials and bitumen for licensed off-site disposal or recycling;
- Transport of oversize material to the FSB;

- DTD treatment of suitable materials;
- Stockpiling of the treated materials in preparation for reuse;
- Transport of the stockpiled materials from the stockpile to the CPWE excavation for reuse;
- Placement and compaction of the material as backfill within the CPWE excavation;
- The surveyed final depth of backfilled material within the CPWE excavation; and
- Stockpiling of the surplus treated materials for future reuse at the BIP.

The system will provide detailed information about the treatment, location and quantity of all materials on the Site from the time of excavation until their reuse or long-term stockpiling on the Site.

10.4 On-site Transportation of Materials

Materials at the CPWE will be excavated, handled, moved, treated and stockpiled in a manner designed to minimise exposure to the environment. The following materials handling requirements have been developed for trucks transporting materials within the Site:

- Trucks carrying excavated materials will be covered with steel lids and decontaminated in the air-lock and wheel wash facility within the ESB before exiting the building;
- Trucks will proceed directly to the FSB or soil stockpile areas as appropriate along the predetermined haul roads as shown in **Figure 2**;
- Trucks carrying contaminated materials will not be permitted to drive over areas of the CPWE site which have previously been excavated, validated or reinstated;
- Trucks carrying contaminated materials from the ESB will remain covered until authorised to unload within the FSB. The trucks will be decontaminated inside the air-lock and wheel wash facility of the FSB, and the truck body recovered before exiting the building;
- Empty trucks will return directly to the ESB along predetermined haul roads, as shown in **Figure 2**; and
- Validated areas of the CPWE excavation will be effectively isolated from contaminated areas of the site by the use of physical means such as the placement of clean material bunds, temporary fences and by use of signage.

10.5 Stockpiling of Materials

10.5.1 Stockpile Locations

Treated and validated soil materials will be stockpiled within the STA as shown in **Figure 4**. Once the stockpile capacity of the STA has been reached, surplus material will be hauled directly to the surplus soil stockpile area located to the east of the STA, as shown in **Figure 2**.

It is anticipated that the reinstatement of the CPWE, will not commence until the conclusion of the CPWE excavation and validation operations. The stockpiled soil will then be transported directly from the STA and surplus soil stockpile area (as appropriate) to the validated CPWE excavation for placement and compaction as backfill. Treated materials surplus to reinstatement of the CPWE area, will be stockpiled in the surplus soil stockpile area for future use by Orica elsewhere within the BIP.

10.5.2 Stockpile Area Preparation

During site establishment, stockpile areas will be prepared using the following methods:

- Works will be undertaken initially to clear the area of rubbish, rubble, structures and vegetation. The area will then be graded, to remove local depressions and to create a smooth and even surface;
- The STA will be constructed with hardstand surfaces;
- Diversion drains and bunds will be constructed around the perimeter of the stockpile areas. Additional sediment and erosion control measures including silt fencing and hay bales will be installed where necessary;
- Signs will be erected at the entrance to the stockpile area and at locations around the stockpile specifying individual stockpile numbers and the type of materials stored; and
- Buffer zones will be established around each stockpile area to enable access to the stockpiles and minimise impacts of the stockpile area on the surrounding facilities.

10.5.3 Stockpile Construction and Maintenance

The drainage, sediment and erosion control measures installed within stockpiling areas at the commencement of the project will be maintained, repaired and replaced where necessary for the duration of the stockpiling activities. All long term soil stockpiles on Site will be covered or treated as required, to reduce dust generation and erosion by spray grass seeding or coating materials such as PVA spray.

All stockpiles will be maintained in a tidy and safe condition with stable batter slopes.

10.6 Screening of Materials

Excavated encapsulation material and contaminated overlying material may be screened within the ESB. In addition to primary screening conducted in the ESB, additional screening may be required within the FSB to prepare the soil for treatment (in the DTD Plant). Subject to the characteristics of the feed system of the DTD Plant, a maximum particle size of 50 mm may be required in the feed material. Oversize materials (greater than 50 mm diameter) will be crushed in the FSB prior to treatment.

A coarse, active Grizzly screen will be used in the ESB for primary screening of excavated materials. A “powerscreen” with a nominal capacity of 100 tonnes per hour will be used in the FSB for secondary screening prior to DTD treatment. Both screens will be equipped with appropriate control measures to reduce noise emissions.

10.7 Crushing/Shredding of Materials

The crushing of oversize excavated materials and shredding of the encapsulation liner and other contaminated non-earthen materials may be necessary to ensure that the excavated materials can be treated in the DTD Plant. If required, it is anticipated that conventional mobile crushing and shredding equipment will be used within the FSB, minimising the potential for dust generation.

10.8 Reinstatement of Materials

Once the CPWE excavation works are completed and the base and batter slopes of the excavation have been validated, it is anticipated that approximately 20,000 m^3 of the treated and validated materials will be used to backfill the excavation. Backfill materials will be placed and compacted in 300 mm layers. The final reinstatement levels will be several metres below the current levels of the CPWE area. Therefore, it is anticipated that approximately 30,000 m^3 of treated and validated material will be surplus to requirements. All surplus stockpiled material will be kept in the surplus soil stockpile area, at the location shown in **Figure 2**, for appropriate reuse within the BIP.

11 TREATMENT OPERATIONS

11.1 Background

The sand, ash and peat materials excavated from within the CPWE area will have different treatment requirements in terms of their workability, management and contaminant concentrations. This section describes the methodologies to be employed for preparing and treating the excavated materials for reuse on-site, and stockpiling of surplus materials.

11.2 Pre-Treatment of Materials

The pre-treatment of excavated materials will be undertaken in two stages. Initially, excavated encapsulation material and overlying material may be screened within the ESB, as described previously. Material required to be treated (in the DTD Plant) will be transported to the FSB, where further handling and testing of this material will take place.

The material will be stockpiled in the FSB using a front end loader before undergoing further screening and testing for contaminant levels and other characteristics. The material will then be blended to achieve a relatively homogenous feed material prior to being loaded into the feed hopper of the DTD Plant. Activities within the FSB, including screening and testing will take place 24 hours per day, seven days.

11.3 Feed Soil Building and Emission Control System

The purpose of the FSB is to control emissions during pre-treatment activities and ensure these emissions are vented to atmosphere through an ECS. Operation of the FSB and associated ECS will be in accordance with operation and maintenance management systems developed on completion of the final design. An overview of the controls to be designed into the system is provided below.

The FSB will be constructed of a steel frame with metal sheeting. It will include doors, lights, electrical, adjustable louvres and other ancillary facilities that are required for safe and efficient operation. The building will contain approximately a seven day working inventory of feed soil plus a sufficient buffer for soil drying and other pre-treatment activities. This inventory volume is designed to provide adequate storage capacity to feed the thermal treatment plant during periods when unforeseen conditions interfere with normal excavation activities.

Similar to the ESB, the FSB will be fitted with an air-lock and automated wheel wash, louvres and an ECS for air quality control. The ECS for the FSB will operate in the same way as the system for the ESB, as described in **Section 9.2**.

11.4 Directly-heated Thermal Desorption

11.4.1 DTD Plant Commissioning and Testing

Upon establishment at the Site, the DTD Plant will undergo a commissioning and testing program to:

- Ensure the satisfactory mechanical operation of each individual plant unit operation;
- Ensure the integrated operation of the process;

- Check the operation of the instrumentation and controls;
- Process an amount of soil and to sample process streams to ensure the safe operation of the plant and ability to meet the Remediation Goals;
- Provide the monitoring data required to control the plant operations and demonstrate protection of human health on-site and off-site during the process; and
- Demonstrate the extent that regulations are complied with under conditions that are required during ongoing operations, by undertaking a full stack test.

The DTD Plant test program will be implemented in the following three phases:

- Mechanical/electrical shakedown/clean soil startup – after all DTD Plant equipment, auxiliary equipment, monitors, instruments, data acquisition systems and utilities are determined to be operational, the clean soil startup will commence. Clean soil testing would typically be conducted for 8 hours, and does not involve processing of contaminated material or monitoring of air emissions and treated materials, except to show that on line continuous monitoring equipment (CEM) is functioning normally. The automatic soil feed shut off (ASFSO) interlocks will be checked followed by a normal shutdown sequence. This sequence will be repeated to the extent necessary to determine that the DTD Plant controls are operating properly. Clean soil shakedown would continue until the DTD Plant is determined to be fully operational;
- Optimisation trials/contaminated soil shakedown testing – optimisation trials will be undertaken for at least one week to enable steady state conditions to be reached and maintained, and to allow for collection of the appropriate samples and analyses. Monitoring during this stage will be undertaken using the CEM system, to demonstrate that combustion efficiency in the after burner is within control limits. During this stage stack gas monitoring will also be undertaken under a range of possible operating conditions. The performance of the afterburner would be monitored using the automated CEM system to record levels of carbon monoxide (CO), CO_2 and oxygen (O_2) in the stack gas emissions. These parameters are routinely monitored to provide evidence of efficient combustion in the afterburner. During the stack tests an independent, mobile CEM system will be used to monitor CO, CO_2, O_2, nitrogen dioxide (NO_2) and sulfur dioxide (SO_2) in the stack gas emissions. Further sampling will be undertaken for analysis of particulates, hydrogen chloride and chlorine (Cl_2), dioxins and furans and other selected volatile and semi-volatile compounds in stack gas emissions to confirm compliance with DEC criteria. The contaminated soil shakedown test would determine treated soil contaminant concentrations for a range of operating parameters, as a basis for selecting a treated soil standard that optimises regulatory compliance for stack emission concentrations and waste treatment criteria; and
- Compliance testing – the duration of the compliance test for soil and stack emission criteria and operating parameters may take up to 5 days, allowing 1 day for setup, up to 3 days for testing and 1 day for demobilisation of the sampling crew and equipment. The compliance test will be undertaken under operating conditions required for subsequent routine processing, based on the results of the optimisation trials. Subsequent compliance testing would be undertaken on an annual basis, during routine processing.

11.4.2 DTD Plant

The DTD Plant will be located within the STA to the west of the FSB as shown in **Figures 4** and **5**. After pre-treatment in the FSB, the excavated materials will be fed into the feed hopper located inside the FSB. The materials will be transported via a conveyor to the DTD Plant for treatment.

The DTD Plant will operate 24 hours a day, seven days a week with the seventh day typically scheduled as down-time for maintenance. The nominal maximum rate of treatment through the DTD Plant is anticipated to be up to 35 tonnes per hour.

The DTD Plant will have a footprint of approximately 50 m square. It will be established within a concrete paved and bunded area having its own internal surface water drainage control measures. Electrical power to the DTD Plant will be provided by mains power, with a diesel powered generator used as a back-up. Natural gas sourced from the mains supply, will be used to fire the heating burners of the plant. A typical thermal process area layout is shown in **Figure 5**.

There are two main types of DTD plants currently used to treat contaminated material including chlorinated compounds. They differ principally in terms of the direction of gas and soil flow in the rotary dryer (co-current and counter current), with consequent differences in gas temperatures and the sequence of unit operations used to treat the off-gas. Both types of plants produce similar outcomes in terms of soil treatment levels and air emissions when treating material that contains chlorinated chemicals. As indicated, the detailed design for the DTD Plant and associated equipment/plant would be completed following any project approval. For convenience the co-current type of DTD plant is once again described herein. Further detail on the compliance to the Stockholm Convention and NSW legislation and regulations in regard to the DTD Plant is provided in Appendix K of the EA.

A typical process flow diagram for the DTD Plant is shown in **Figure 8**. Brief descriptions of typical key unit operations in the process are presented below.

Rotary dryer
The first step in the DTD treatment process involves the volatilisation or separation of contaminants from the material in the rotary dryer.

The rotary dryer utilises natural gas as fuel to heat the contaminated material to a temperature of approximately 300ºC to 450ºC.

In a co-current system, the contaminated material enters the rotary dryer at the end where the burner is located and the combustion gas and treated soil move in the same direction to where they exit at the opposite end of the dryer.

Contaminants desorb and volatilise as they pass through the dryer. Soil is heated in the first third of the dryer with most desorption and volatilisation occurring in the next third as contaminants reach their boiling points.

Once it has passed through the rotary dryer, the heated soil material passes to a pugmill where it is sprayed with water for cooling and rewetting. The treated material is then transferred to temporary treated soil stockpiles awaiting validation.

Cyclone
The off-gases flow from the rotary dryer through a cyclone, where large dust particles are removed, to the thermal oxidiser. The dust from the cyclone is directed to the pugmill where it is mixed with the treated soil for rewetting and validation.

Thermal Oxidiser
The thermal oxidiser is used to treat the gases produced through the heating of the soil material in the rotary dryer and would be designed to be Stockholm compliant, i.e. with appropriate residence time, temperature and turbulence.

The thermal oxidiser typically operates at a temperature of between 900 and 1,000 º C using natural gas fuel. At this temperature, the contaminants present in the gas (from the feed material) oxidise or decompose forming carbon dioxide (CO_2), water vapour and hydrogen chloride (HCl) with small amounts of other byproducts such as chlorine (Cl_2) and sulphur compounds.

In order to maintain the correct temperature to maximise destruction efficiency and minimise the formation of by-products, the thermal oxidiser would be fitted with a sophisticated temperature control system which would be consistently monitored.

Quench
Once gases have passed through the thermal oxidiser they must be rapidly cooled to minimise the potential for dioxin formation and allow further treatment before release to the atmosphere – as required by the Stockholm Convention.

To achieve this, the hot gases are drawn into the quench by an induced draught (ID) fan. In the quench, water is injected to rapidly cool the gases to a temperature which is suitable for further treatment.

Baghouse
The cooled gas from the quench is combined with steam from the pugmill and drawn into the baghouse by an ID fan. The baghouse contains a series of fabric filters which remove particulates. If required, activated carbon may also be blown into the baghouse to coat the fabric filters and assist with removal of mercury which is present in the feed soil. The need for this additional control technology would not be known with certainty until commissioning trials have been completed, but provision would be made for the necessary hardware**.**

The design of the baghouse would also take into account other factors such as the high moisture and acidity of the gas stream and suitable materials of construction and insulation would be used as required. These are matters of detail that will be addressed in the plant design, HAZOP study and Technology Assessment.

Acid Gas Scrubber
The final step in the treatment process involves the removal of acid gases from the exhaust gas. The acid gas scrubber consists of a packed tower with a re-circulating caustic solution that reacts with any HCl and Cl_2 in the exhaust gas to form a salt solution.

Following this, the 'clean' treated gas is vented to the atmosphere via the scrubber stack which is some 30 m in height.

Treated Soil
Treated soil would be stockpiled in the south and west of the STA with drains and bunds provided to manage runoff. An additional, overflow stockpile area has been identified on Orica land to the east of the STA (see **Figure 2**). Stockpiles would be stabilised with spray grass or other such treatment and would be wetted when necessary to control dust. Stockpile management is illustrated in **Figure 10**.

The treated, stockpiled soil would be retained until completion of remediation works on the CPWE when it would be transported (by truck) to the CPWE site for reinstatement of the area. Surplus treated soil would be retained for future reuse on other Orica land within the BIP.

11.4.3 Soil Treatment Standards

The soil treatment standard achieved by the DTD Plant will depend on:

- the starting concentration of the contaminants of concern in the feed soil; and
- the soil treatment temperature in the rotary dryer.

A best practice soil treatment temperature (and resulting removal efficiency) will be established during the optimisation trials by running a matrix of tests with different starting concentrations and soil treatment temperatures. The results will be analysed to identify the point of diminishing returns in terms of contaminant removal and energy use and mercury concentrations in stack gas. The potential for accelerated plant wear and tear and possibility of catastrophic failure (e.g. due to metal fatigue in the dryer) will also be considered particularly in terms of operating at the high end of the soil treatment temperature scale (around 500^{o}C).

The treatment standard will be below the least conservative reuse criteria. Whether it meets or can be demonstrated to meet the criteria in national standard for HCB and the NSW CCOs for SCW will depend on the factors above as well as the number of SCW compounds present and the achievable laboratory detection limits.

11.4.4 DTD Plant Air Emissions Standards

Air emission standards proposed for the DTD Plant are based on the POEO (Clean Air) Regulation 2002 concentration standards for Group 6 plant operating at scheduled premises. These are outlined in the *Air Quality Impact Assessment for Remediation of the Car Park Waste Encapsulation at the Botany Industrial Park* (PAE, 2006). It is anticipated that the DTD Plant will meet the applicable stack concentration limits and ambient air standards for most pollutants. However, some uncertainty was identified for mercury, nitrogen oxides (NO_x), sulphur trioxide (SO_3) and hydrogen fluoride (HF).

The level of mercury in the CPWE material is low, but if all the mercury volatilises and is emitted in the stack gas, the concentration would exceed the maximum allowable stack concentration limit, although being well within the maximum allowable ambient level. The chemistry of mercury in the off-gas and effectiveness of mercury control technology is poorly understood. Therefore prediction of the concentration of mercury in the stack is uncertain and would be quantified during commissioning and testing.

Concentrations of NO_x and SO_3 in the stack gas are estimated to be within their maximum allowable stack concentrations. However, the associated ambient concentrations are close to or at their respective limits for the estimated concentrations, based on most likely scenarios or over their respective limits based on worst case scenarios. These would also be further evaluated during commissioning and testing. There are no data on levels of fluoride in the CPWE material to enable estimation of stack gas concentrations. However, there is no reason to believe that fluoride is present or that stack concentration limits would not be met.

The POEO (Clean Air) Regulation also sets out additional performance provisions for afterburners that are in Group 6, and treating Principal Toxic Air Pollutants. They are:

- a residence time of more than 2 seconds;
- a combustion temperature of more than 980 ^{o}C; and

- a destruction efficiency of more than 99.9999% based on a one hour rolling average for the mass in the air emission as a percentage of the mass in the feed soil.

Application of these performance provisions for the CPWE DTD Plant is discussed in detail in **Section 11.4.2**.

11.4.5 Reclassification and Post Treatment Storage

Treated material outputs from the DTD Plant will be transferred to the temporary treated soil storage area via a radial conveyor (refer to Item 8 and 9, **Figure 5**). Treated materials stored in this area will undergo validation testing and reclassification. This is to determine whether the process has been effective and whether or not the materials are ready for reuse at the CPWE area.

Materials that have been treated to the Remediation Goals will then be moved to the validated treated soil stockpiles shown as Item 5, **Figure 4**. Materials that have not been treated to an acceptable level will be transported back to the FSB and subjected to further treatment via the DTD Plant. Stockpiled material will be kept moist using a sprinkler system or similar to prevent the generation of dust.

11.5 Hazard and Operability Operation Studies

HAZOP studies of the DTD Plant will be conducted prior to establishment to the Site.

12 MANAGEMENT OF WATER

12.1 Background

Over the course of the remediation works, contaminated water will be encountered in the forms of potential free water (seepage water) within the CPWE, water used for truck and plant decontamination and rainfall on the STA. A Water Management Program will be implemented at the Site to minimise the volume of contaminated water generated, and to manage the water in the most efficient manner possible in compliance with regulatory requirements.

The types of water encountered during the remediation works are likely to comprise:

- Clean water - water that is not contaminated. Clean water is likely to collect in areas of the Site that remain undisturbed by site works, such as in areas upgradient of site works and water collected from the roofs of the ESB and the FSB;
- Contaminated water - water that does not meet the water reuse criteria as presented in **Section 6.3** and which requires recovery, treatment and recycling or disposal. Contaminated water will likely be encountered from seepage associated within the materials at the base of the CPWE, within the treatment area bunds, and the truck washes;
- Grey water – water on-site which has been untreated or has been treated and which is acceptable for being recycled on-site in truck wheel wash facilities or for dust suppression. Grey water must be sufficiently non-odorous, and comply with the reuse criteria outlined in **Section 6.3**; and
- Sewer quality water – is defined as water that has been either treated or untreated and which meets the Trade Waste Criteria, as detailed in the Sydney Water Trade Waste Licence.

Water recycling will be undertaken on-site where possible but it may be necessary to discharge site water into the sewer system. A Trade Waste Licence will be modified or obtained for the Site in consultation with Sydney Water prior to the commencement of Site works. Detailed records of the quantity and quality of all water recycled and discharged from the Site will be kept and made available to the regulatory authorities as required.

12.2 Water Management Methods

This section outlines a hierarchy of four methods, from most preferred to least preferred, to be implemented for the management, treatment or disposal of water encountered during the remediation works. A schematic water management diagram is provided as **Figure 9**.

12.2.1 Water Management Method 1 – Minimise Contaminated Water

The preferred approach to managing contaminated water at the Site is to minimise the volume of contaminated water during the works wherever possible. To achieve this goal, clean surface water will be directed away from excavations, depressions, pits and stockpiles, where possible, by the construction of the ESB and FSB and other drainage works such as bunds and diversion drains. These measures will minimise the flow of clean water into other areas of the Site that contain contaminated materials.

12.2.2 Water Management Method 2 – Recycle Water

Wherever possible, measures will be implemented to maximise the volume of water that can be recycled on-site. All recovered and/or treated water that complies with the established reuse criteria is to be recycled on-site. Where possible, water will be recycled using the following methods:

- Use of recycled water for dust control during earthworks activities; and
- Use of recycled water for other site operations including wheel washing, truck washing (refer to **Figure 11**) and soil re-moisturisation in excavation areas.

To ensure that the use of recycled water does not impact on surrounding areas, the following data will be obtained prior to undertaking these activities:

- Chemical data which demonstrates that the water to be recycled complies with the reuse criteria, including consideration of potential for odour generation;
- Definition of the area where the water is to be discharged;
- Details of environmental protection measures installed to ensure that the use of recycled water will have no adverse environmental impact; and
- Appropriate tracking of recycled water reused at the Site.

12.2.3 Water Management Method 3 – Discharge to Sewer

The next preferred method involves discharge to sewer, with or without treatment, as per the guidelines specified in the Sydney Water Trade Waste Licence.

An appropriate sewer water discharge point will be determined in consultation with Sydney Water. Any water that is to be discharged to sewer will be pumped to a designated sewer water storage tank, for testing prior to discharge.

12.2.4 Water Management Method 4 – Water Treatment

The least preferred management method involves treatment of water in the on-site WTP. The following sources of contaminated water potentially require on-site treatment:

- Surface water falling on areas such as the external bunded areas of the STA;
- Water purged during the acid gas scrubbing phase of the DTD treatment process;
- Small volumes of free water (seepage) accumulating in active excavations within the CPWE; and
- Water from personnel and plant decontamination processes.

A WTP will be established adjacent the STA. The conceptual design of the WTP comprises coagulation, flocculation, sedimentation, multimedia/sand filtration and granular activated carbon (GAC) adsorption stages, as discussed below:

- Chemical coagulant addition will consist of aluminium sulphate (or similar) dosing with sodium hydroxide (or similar) dosing for alkalinity and pH control. Coagulated suspended solids and oils will be flocculated for particle growth in a flocculator. The agglomerated particles will then be settled out in a clarifier. Clarified supernatant will be transferred through multimedia/sand filters to remove floc carry over from the clarifier. Multimedia/sand filtered water will be transferred to an intermediate storage tank;

- Settled suspended solids and oils in the clarifier will be withdrawn from the bottom of the clarifier as a dilute sludge. The sludge is transferred into a storage vessel from where, if required it is processed through a plate and frame filter press. Filtrate is returned to the contaminated water storage tank for reprocessing and the dewatered cake is disposed to the FSB for thermal treatment;
- Multimedia/Sand filtered water will be passed through granular activated carbon filters to remove residual dissolved organics. Treated water will be routed to a treated water storage tank. Spent GAC will be transferred to the FSB for thermal treatment; and
- Water from the treated water storage tank will be discharged to sewer or to watercarts for reuse on site and will be used as backwash water for the multimedia/sand and GAC filters. Backwash water will be returned to the contaminated water storage tank for treatment.

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13 REMOVAL AND DISPOSAL OF MATERIALS FROM THE SITE

It is anticipated that the off-site disposal of materials will be necessary during the course of the remediation works. Based on information from previous investigations at the CPWE site (Thiess 2005), the CPWE contains unknown quantities of foreign material in the form of crushed drums, drum liners, steel reinforcement, scrap steel and pipework and timber. These materials (if they do not require treatment in the DTD Plant) and additional waste such as the bitumen cap and other landscaping materials, and low level contaminated clothing and PPE from Site workers, will be transported off-site for disposal at an appropriately licensed landfill or recycling facility. This section of the RAP details the procedures to be adopted for the disposal of materials from the Site.

The procedure for off-site waste disposal will be as follows:

- Notification of the waste facility organised to receive the waste to confirm that the facility is licensed to accept the material;
- If the waste facility is licensed to accept the class of waste, the material will be transported under the appropriate licence to the designated receiving facility. Every load of waste removed from the Site will be recorded and reported; and
- A copy of the waste depot weighbridge docket will be collected and retained for each load of waste delivered.

Waste material from the CPWE remediation works will be disposed only at appropriately licensed landfill and recycling facilities. Waste destined for off-site disposal will be hauled from the Site in semi-trailers or truck-trailer combinations. All loads will be secured prior to leaving the Site with appropriate covers. Trucks wheels and bodies will be washed to ensure that site materials are not tracked onto local roads.

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14 VALIDATION PLAN

14.1 Validation Team

A suitably qualified consultant will undertake the validation of the remedial works under the direction of a Validation Project Director (VPD). The VPD is responsible for ensuring that all required validation systems are fully functional, and that staff are trained in the requirements of the Validation Plan (VP).

Daily validation management will be from an on-site project office. A site-based administrative system will be established to ensure that the project is fully documented. A daily fieldwork summary will be prepared and filed. All job-related incoming and outgoing communications will be logged in a register.

Decisions related to validation will be made in accordance with relevant guidelines endorsed by the DEC. Copies of relevant guidelines will be kept in the site office. All fieldwork will be undertaken by qualified environmental engineer(s)/scientist(s) with experience working on contaminated sites.

A member of the Consultant's field team will be the Site Validation Manager (SVM) responsible for making all validation decisions and directing all routine site fieldwork. Prior to commencement of the project, the SVM will prepare a project manual containing all required procedures and forms. The manual will be updated, in conformance with the VP, on an as needed basis. It is the responsibility of the SVM to ensure that the VP is followed.

Site meetings will be convened as required to discuss fieldwork procedures. At least one meeting per week will be held with Orica and the Remediation Contractor to plan work for the following week and to resolve outstanding issues.

Where, because of an unforseen circumstance, the SVM considers that a departure from the VP is required, this must be discussed with the VPD before any other related action is taken. If the departure is approved it will be documented on site files. If urgent action is required, the VPD will be responsible for deciding the particular issue. The Contaminated Land Auditor will be sent written confirmation as soon as practicable, but in any case within 10 working days of the reasons for making the changes to the VP procedures and feedback and endorsement of the changes will be requested in writing from the Contaminated Land Auditor.

14.2 Validation Principles

All soil materials to be retained on-site must satisfy the Remediation Goals detailed in **Section 6**. The sampling and analysis program is described below.

The requirements of the *Guidelines for the NSW Site Auditor Scheme* (DEC 2006) will be implemented for continued commercial/industrial land use. Given that the CPWE site and any surplus materials will be used for commercial/industrial land use, aesthetic considerations are not anticipated to be significant. However, where the field team considers that material appears, because of aesthetic issues (including odours and discolouration), to be incompatible with the requirements of the nominated land use, guidance will be sought from Orica and the Contaminated Land Auditor on an appropriate location for the ongoing management of the offensive material.

Validation data will be assessed in accordance with the *National Environment Protection* (Assessment *of Site Contamination) Measure*, *National Environment Protection Council, 1999*. This will involve checking that:

- each individual sample concentration does not exceed the adopted criteria by more than 2.5 times; and
- the standard deviation of the sample set, is not more than 50% of the adopted criteria.

For the validation data to satisfy the relevant criterion, the 95% UCL on the arithmetic average concentration ("95% UCL_{AVG}") for each COPC must be less than the criterion. A site or sampling area cannot be considered suitable for a specified land use or successfully remediated if the 95% UCL_{AVG} concentration exceeds the adopted criterion. Further remediation is required where validation fails to meet the adopted criterion for each COPC.

14.3 Material Sampling Frequencies

Materials that will require validation sampling during the remediation works will be as follows:

- Residual, unexcavated material within the CPWE area. This will comprise the base and walls of the final excavated surface;
- Excavated untreated material overlying the CPWE;
- Excavated untreated material present in landscaped areas outside the CPWE; and
- Excavated material which has been treated in the DTD Plant.

The sampling regime for the above validation scenarios is detailed in the following sections.

14.4 Suite 1 - Excavated Surface

In all cases, before collecting any surface samples, the SVM, or an appropriately trained team member, will inspect the entire validation surface area to ensure that there are no visible, or other, indications of contamination. Therefore, all validation surfaces will at least appear suitable before any validation samples are collected.

As discussed previously, the remediation works will involve the excavation of the material contained within the CPWE liner and potentially material present beneath and surrounding the liner (**Section 5.1**). Therefore, the excavation works will provide a significant level of confidence that all contaminated material will be removed. Further, where visible or other evidence of contamination is present, the impacted material will be removed and managed as required under this RAP, leaving a suitable surface for validation. The design of sampling frequencies nominated in this section incorporates the above remediation approach.

Where there is a justifiable reason for reducing the proposed sampling grid size, the SVM may do so but must seek approval for this action from the VPD. The sampling grid size, as defined below, cannot be increased unless authorised in writing by the Contaminated Land Auditor.

It is proposed to collect validation samples from the base of the excavation using a 20 m square grid. Samples will be collected from a depth interval of 20 to 100 mm after scraping the overlying 20 mm of material away. The walls of the excavation will be validated at 20 m lineal intervals around the wall of the excavation areas at depths of 20 to 100 mm into the walls. The validation approach is based on the characterisation works undertaken on the material which indicated that contaminant concentrations are relatively homogenous throughout the material.

However, should field observations during the remedial excavations indicate that localised areas of the CPWE material are more impacted or the lower surface of the Hypalon liner is ruptured, it may be required that a smaller validation sampling grid (i.e. 10 m square grid) be adopted. Such an approach will require authorisation in writing by the Contaminated Land Auditor.

14.5 Suite 2 - Capping Material

Capping material overlying the CPWE will be temporarily stockpiled within the ESB upon excavation. These materials will be sampled and analysed in accordance with the Remediation Goals detailed in **Section 6.1**. Samples of the overlying materials will be collected from the temporary stockpile at a rate of 1 sample per 100 m^3 of stockpiled material. Should the sample results indicate that the materials are within the Remediation Goals, the materials will be placed in a designated “overlying material” stockpile within the STA for reuse in the validated CPWE excavation. If the results indicate that the materials exceed the Remediation Goals, the overlying materials will be transported to the FSB for treatment in the DTD Plant.

14.6 Suite 3 - Landscaping Material

Due to the identified impacts present in the northern portion of the eastern embankment (refer to **Section 3.5.2**), the material in this area will be stockpiled separately and additional testing undertaken to confirm the COCs. Samples of the overlying materials will be collected from the temporary stockpile at a rate of 1 sample per 100 m^3 of stockpiled material. Should the sample results indicate that the materials are within the Remediation Goals, the materials will be placed in a designated “overlying material” stockpile within the STA for reuse in the validated CPWE excavation. If the results indicate that the materials exceed the Remediation Goals, the overlying materials will be transported to the FSB for treatment in the DTD Plant.

14.7 Suite 4 – Treated Material

Treated material validation samples will be collected from the exit conveyor at the rate of one sample per eight hours of DTD Plant operation. This will result in approximately one sample being collected per 160 m^3 of treated material. This treated soil will be combined individually into tracked 500 m^3 stockpiles. Three sub-samples (1 per 160 m^3) will be collected from each of the 500 m^3 stockpiles and composited for analysis using National Association of Testing Authorities (NATA) accredited (or equivalent) methods. Consequently, one composite sample will be analysed per 24 hours of DTD Plant operation.

The 95% UCL for the COC will be calculated for each of the 500 m^3 stockpiles to assess whether contaminant concentrations are less than the Remediation Goals. This approach will follow Method 2 of Section 6 of the *Sampling Design Guidelines* (NSW EPA 1995).

Materials that are to be disposed off-site will be sampled and analysed in accordance with *Environmental Guidelines: Assessment, Classification & Management of Liquid & Non-Liquid Wastes* (DEC 2004) and if relevant the CCOs for SCW (2004) and PCBs (1997).

14.8 Summary of Validation Sampling Frequencies and Specific Laboratory Analysis

Dioxins, furans and dioxin-like PCBs are not considered to be COC for unexcavated or untreated material, based on the results of previous investigations. Therefore, no testing of the unexcavated or untreated material for dioxins, furans and dioxin-like PCBs is proposed. This is also likely to be the case for the treated soil which would be confirmed during PoP testing. On confirmation and subject to Contaminated Land Auditor agreement, no further testing for dioxins, furans and dioxin-like PCBs is proposed.

Based on the results of previous investigations, PCBs are not considered to be COC for unexcavated or untreated material, as they are not present above health based criteria in the CPWE. Unexcavated material would not be classified as PCB waste. Excavated treated and untreated material would be tested for PCBs, because it may be classified as PCB waste (if the material contains *'PCB at concentration levels above 2 mg/kg'*), based on data obtained from previous investigations.

HCB was the only SCW compound considered to be a COC in the CPWE and therefore a RBSC was derived. Consequently, HCB would be a validation compound for the unexcavated soil, but not other SCW compounds because the unexcavated soil is not SCW. Other excavated treated and untreated soil would be validated for SCW compounds that have been detected above 2 mg/kg in the CPWE. This will include HCB, pentachlorobenzene, 1,2,4,5-tetrachlorobenzene and 1,2,4-trichlorobenzene.

Table 7: Summary of Validation Sampling Frequencies and Specific Laboratory Analysis

Validation works	Sample Density/Sampling Grid	Required Analysis
Suite 1 – Validation of final excavated surface within the CPWE (base and walls)	Samples collected on a 20m sampling grid	Suite 1 analysis[1]. This will include: OCS; HCB; HCBD; Pentachlorobutadiene (and related isomers); Methylene chloride (commonly known as dichloromethane); Tetrachlorobutadiene (and related isomers) EDC; cis-1,2-Dichloroethene; Tetrachloroethene; 1,1,2-Trichloroethane; Trichloroethene (TCE); and 1,2-Dibromo-3-chloropropane.
Suite 2 – Validation of capping materials above the CPWE	1 sample collected per 100 m^3	Suite 1 analysis plus pentachlorobenzene, 1,2,4,5-tetrachlorobenzene and 1,2,4-trichlorobenzene and PCBs.
Suite 3a – Validation of landscaped materials (north east corner)	1 sample collected per 100 m^3	VOC/SVOC screens and metals.
Suite 3b – Validation of landscaped materials (remainder of the landscaped areas)	1 sample collected per 500 m^3	Suite of analysis to be based on findings of 'Suite 3a' analysis and following discussions with the Contaminated Land Auditor.
Suite 4 – Validation of material treated in the DTD Plant	1 composite sample collected per 500 m^3	Suite 1 analysis plus pentachlorobenzene, 1,2,4,5-tetrachlorobenzene and 1,2,4-trichlorobenzene and PCBs[2].

Notes: [1] The laboratory will also be requested to undertake a check of all analytical chromatograms to assess if other chemicals are present at elevated concentrations (and subsequent reanalysis if required).

[2] Dioxins and furans and dioxin-like PCBs analysis will be undertaken during the POP testing to confirm requirements for this analysis during the validation works. The frequency of this analysis will be determined in consultation with the Contaminated Land Auditor

The sampling regime described above will require Contaminated Land Auditor endorsement prior to the commencement of any remediation works.

14.9 Sample Location Surveying

A registered surveyor will survey all validation sample points located in the remedial excavations. Proposed validation sampling will be based on square grid patterns. An initial grid cell will be selected (randomly on the validation area boundary) to mark the start of the relevant square grid that covers the entire validation area. The initial grid cell will be aligned and coincident with the validation area boundary, and the samples will be obtained from the centre of the grid cell.

14.10 Additional Recommendations (Air Emissions Testing)

In addition to the validation sampling discussed above, the URS RBRC (2007b) report also recommends that flux emission sampling be undertaken to confirm that the CPWE site is suitable for ongoing commercial/industrial landuse with or without management measures, e.g. an Environmental Management Plan. Flux emissions sampling using Summa Canisters and sorbent (carbon) tubes is proposed in the following locations:

- the excavation bases in the CPWE prior to reinstatement to confirm that volatile COPC (which includes all volatile and semi volatile compounds identified as COPC) have been adequately removed (and are not of significance from the underlying groundwater) such that the land is suitable for ongoing commercial/industrial landuse (with or without management measures); and
- on the treated material after reinstatement in the CPWE area to confirm that volatile COPC have been adequately removed (and are not of significance from the underlying groundwater) and are acceptable for ongoing commercial/industrial landuse (with or without management measures).

The methodology for flux emission sampling is provided in Appendix E of the URS RBRC report (**Appendix B**). This appendix includes a proposed sampling frequency and analytical list. However, these will need to be agreed with the Contaminated Land Auditor prior to the commencement of sampling.

There is the potential for workers involved in intrusive activities (such as during construction works) on the Site to be exposed to COCs in soils. As the soils are to remain within the BIP, intrusive works will be managed under existing site management plans that include health and specific safety requirements and works permits. Hence the potential for exposure by intrusive workers within the BIP were not considered as part of the URS RBRC (2007b) report.

14.11 Treatment Area and Stockpiling Areas

Activities within the treatment area, including treated soil storage and WTP, will be undertaken on appropriately sealed hardstand areas, with diversion drains and bunding constructed around the perimeter of the area (refer to **Section 10.5.2**). Consequently, the soil beneath the concrete slabs is unlikely to be impacted by the stockpiling activities and subsequently, validation testing of these areas, once the concrete slabs are removed, is not proposed.

As a precautionary measure, before removal of concrete slabs is commenced, a careful inspection of these will be undertaken to identify the presence of contamination. If this inspection indicates the visual presence of any contamination relating to treatment operations, validation of the soil beneath the concrete slabs will be undertaken as outlined in **Section 14.4**.

14.12 Analytical Methods

Two laboratories will analyse original and duplicate soil samples using NATA registered methods. Both laboratories must undertake the required analytical testing in accordance with the requirements of the *National Environment Protection (Assessment of Site Contamination) Measure (NEPC, 1999)*. Details regarding the analytical methods to be used will be discussed with the Contaminated Land Auditor and the appropriate analytical laboratory engaged to undertake the works.

14.13 Sampling Methodology

Fieldwork will be conducted in accordance with written standard operating procedures, copies of which will be maintained in a register on Site during the remedial works. This will ensure that representative samples of materials are collected and the sampling methodology remains consistent throughout the duration of the remedial works.

Sample collection will be by:

- push tube or directly from the centre of an excavator bucket from the centre of stockpiles for validation of excavated material;
- grab samples from the exit conveyor for treatment plant materials;
- push tube or trowel from excavation bases; or
- trowel from excavation walls.

Materials will be described in accordance with the Unified Soil Classification System (USCS), with soil type, descriptive properties (colour, particle size, moisture content, sorting), as well as discolouration, staining, odours and other indications (if any) being noted. The information will be recorded on field logs completed for each location.

Soil samples will be placed into laboratory supplied glass jars as soon as practicable after collection. The jar size will be sufficient to meet the laboratories requirements for the requested analysis. All sample containers will be filled completely using a method such that volatile components are not lost from the sample. Sample containers will be filled in the order of VOCs and SVOCs (including OCPs). Water samples will be placed into laboratory-supplied bottles and/or VOC vials depending on the requested suite of analysis. All sample containers will be clearly labelled with information such as sample number, sample location, depth, date collected and sampler’s identification. After filling, sample containers will then be transferred to a chilled esky for sample preservation prior to and during shipment to the testing laboratory.

A sample register will be updated daily to manage and track the validation process.

Equipment decontamination will be undertaken as described below. The following equipment will be needed for the detergent wash and water rinse decontamination process:

- laboratory (phosphate-free) detergent or Decon 90;

- tap water and deionised water;
- buckets or tubs (sufficient for size of equipment to be cleaned); and
- stiff brushes for cleaning.

The following procedures will be followed for decontamination of sampling equipment, by detergent wash and water rinse methods:

- buckets or tubs used for decontamination will be cleaned with tap water and detergent and rinsed with tap water before sampling commences;
- fill first bucket or tub with tap water, and phosphate-free detergent;
- fill second bucket or tub with tap water;
- clean equipment thoroughly in detergent water, using brushes;
- rinse equipment in tap water;
- dry equipment with disposable towels;
- rinse equipment by thoroughly spraying with tap water and/or deionised water (as appropriate);
- allow equipment to thoroughly air dry; and
- change water and detergent solution after each sampling site.

Used wash water will be taken to the WTP. Equipment that cannot be thoroughly decontaminated using the detergent wash and water rinse should be steam cleaned, or if a steam cleaner is not available, not used for further sampling (and marked clearly "not decontaminated") or discarded. Equipment decontaminated using the high pressure steam cleaner will be further decontaminated as described above.

Any equipment that cannot be decontaminated to the satisfaction of the sampling team will be discarded (to an appropriate facility) and replaced. Such sampling equipment will be collected and stored on-site in appropriately marked drums. When a sufficient number of items have been collected these will be disposed of in an approved manner, in accordance with this RAP and DEC requirements. The sample preservation requirements are listed in **Table 8** and **Table 9**.

Table 8: Soil Sample Preservation and Storage

Analyte	Preservation	Storage
VOCs	Unpreserved, glass jar with Teflon lined lid	Store at <4°C, nil headspace, extraction within 14 days, analysis within 40 days
SVOCs (including OCPs)	Unpreserved, glass jar with Teflon lined lid	Store at <4°C, extraction within 14 days, analysis within 40 days
Metals	Unpreserved glass jar with Teflon lined lid	Store at <4°C, analysis within 7-28 days

Table 9: Water Sample Preservation and Storage

Analyte	Quantity (ml)	Preservation	Storage
VOCs	2 x 40	Glass vials, Teflon lined lid, preserved with pH<2 HCl	Store at <4^0C, nil headspace, analysis within 7 days

Analyte	Quantity (ml)	Preservation	Storage
SVOCs (including OCPs)	1000	Glass container, Teflon lined lid, unpreserved	Store at <4^0C, extraction within 7 days, analysis within 40 days
Metals	1000	Plastic bottle, preserved with pH<2 HNO_3	Store at <4^0C, extraction within 7 days, analysis within 40 days

14.14 Quality Control samples

The following quality control (QC) samples will be collected as part of the field QC procedures:

- Intra-Laboratory Duplicates – are identical to field samples, but both samples are sent anonymously to the primary laboratory. Blind duplicates provide an indication of the analytical precision of the main testing laboratory, but may also be affected by sampling techniques and inherent heterogeneity in the sample medium;
- Inter-Laboratory Duplicates – are identical to blind duplicates, but the duplicate sample is sent to the second (check) laboratory. Split duplicates provide an indication of the accuracy of the main testing laboratory;
- Equipment Blanks – are prepared in the field (at the sampling site) using empty bottles and the distilled water used during the final rinse of sampling equipment. After completion of the decontamination process fresh distilled water is poured over the sampling equipment and collected. The distilled water is exposed to the air for approximately the same time the sample would be exposed. The collected water is then transferred to an appropriate sample bottle and the proper preservative added, if required. Equipment blanks are a check on equipment decontamination procedures;
- Trip Blanks/Spikes – are samples of soil or water prepared by the laboratory with either zero or known analyte concentration. Trip blanks/spikes are a check on the sample contamination originating or lost from sample transport and handling, and shipping; and
- Field Blanks – are similar to trip blanks except the water is transferred to sample containers on Site. Field blanks are a check on sample contamination originating from sample transport, handling, shipping, site conditions or sample containers.

Procedures for duplicate sampling will be identical to those used for routine sampling and duplicate samples will be despatched for analysis for the same parameters using the same methods as the routine sample. Duplicate soil samples will be collected from directly adjacent to original samples (i.e. from the adjacent area of the excavation base or wall). No homogenisation of samples will occur to reduce the loss of volatile compounds (such as HCBD).

Duplicates and equipment blank samples will be collected as follows:

- Intra-Laboratory duplicate samples will be collected at a rate of approximately 1 in 10 soil samples and analysed for the full analyte suite. At least one blind duplicate sample will be included in each batch of samples;
- Inter-Laboratory duplicates samples will be collected at a rate of approximately 1 in 20 soil samples and analysed for the full analyte suite. At least one split duplicate sample will be included in each batch of samples; and

- One equipment blank of soil sampling equipment will be collected for every day of sampling and analysed for the full analyte suite. At least one equipment blank will be included in each batch of samples.

14.14.1 Laboratory QA/QC

The laboratories will undertake the analyses utilising their internal procedures and their test methods (for which they are NATA, or equivalent, registered) and in accordance with their quality assurance (QA) system which forms part of their registration.

Laboratory QC procedures, which will be used during the project, will comprise the following:

- Laboratory Duplicate Samples – these are sub-samples taken from one sample submitted for analytical testing in a batch. A laboratory duplicate provides data on analytical precision. The rate of duplicate analysis will be according to the requirements of the laboratory's accreditation but will be at least one per batch;
- Matrix Spiked Samples – the purpose of the matrix spike is to monitor the performance of the analytical methods used, and to determine whether matrix interferences exist. A sample is spiked by adding an aliquot of known concentration of the target analyte(s) to the sample matrix prior to sample extraction and analysis. A spike documents the effect of the sample matrix on the extraction and analytical techniques. These will be analysed at a rate of approximately 5% of all analyses. At least one per batch will be reported;
- Laboratory Blank – this is usually an organic or aqueous solution that is as free of analyte as possible and contains all the reagents in the same volume as used in the processing of the samples. The reagent blank must be carried through the complete sample preparation procedure and contains the same reagent concentrations in the final solution as in the sample solution used for analysis. The reagent blank is used to correct for possible contamination resulting from the preparation or processing of the sample. Blanks will be analysed at a rate of once per process batch, and typically at a rate of 5% of all analyses;
- Laboratory Control Samples – these comprise either a standard reference material or a control matrix fortified with analytes representative of the analyte class. Recovery check portions should be fortified at concentrations that are easily quantified but within the range of concentrations expected for real samples. These will be analysed at a rate of one per process batch, and typically at a rate of 5% of analyses; and
- Surrogates – surrogate spikes are known additions to each sample, blank and matrix spike or reference sample analysis, of compounds which are similar to the analytes of interest in terms of:
  - extraction;
  - recovery through clean-up procedures; and
  - response to chromatography or other determination;

but which:

  - are not expected to be found in real samples;
  - will not interfere with quantification of any analyte of interest; and

- may be separately and independently quantified by virtue of, for example, chromatographic separation or production of ions of different mass in a GC/MS analyser.

Surrogate spikes are added to the analysis before extraction. The purpose of surrogates is to provide a means of checking, for every analysis that no gross errors have occurred at any stage of the procedure leading to significant analyte losses. Other internal laboratory quality control procedures, as required for NATA, or equivalent, registration, will also be performed.

Results of the QC analyses for both laboratories will be reported with each batch.

14.15 Data Quality Objectives

The primary Data Quality Objectives (DQOs) for sampling techniques and laboratory analysis of collected soil and groundwater samples defines the acceptable level of error required for this project, as outlined in *Guidelines for the NSW Site Auditor Scheme* (DEC, 2006). The DQOs will be assessed by reference to Data Quality Indicators (DQIs) as detailed below.

14.15.1 Precision

Precision measures the reproducibility of measurements under a given set of conditions. The precision of the laboratory data and sampling techniques will be assessed by calculating the Relative Percent Difference (RPD) of duplicate (laboratory and field) samples. The criteria to be used for the assessment of RPD will be based on guidelines given in AS4482.1 (1997). These criteria listed in **Table 10**.

Table 10: RPD Assessment Criteria

Sample Type	Typical Acceptable RPD [a]
Intra-Laboratory Duplicate	30-50% [b]
Inter-Laboratory Duplicate	30-50% [b]

Notes: a) The significance of RPDs of results should be evaluated on the basis of sampling technique, sample variability, absolute concentration relative to criteria and laboratory performance.
b) This variation can be expected to be higher for organic analysis than for inorganics and for low concentrations of analytes.

If duplicate results are not within the acceptable RPD range, investigation into the cause will be initiated. The results of the investigations will be written up and filed, and followed up with the laboratories to achieve resolution. Thus the precision of the laboratory will be assessed by the acceptability of the RPD of laboratory duplicate samples, which should be within the acceptable RPD limits as established for intra-laboratory and inter-laboratory duplicates.

14.15.2 Accuracy

Accuracy measures the bias in measurement. Accuracy can be impacted by factors such as field contamination of samples, poor preservation of samples, poor sample preparation techniques and poor selection of analysis techniques by the analysing laboratory and improper analyses.

The accuracy of the laboratory data that will be generated during the project is a measure of the closeness of the analytical results obtained by a method to the ‘true’ value. For reference laboratory methods (e.g. USEPA methods), the following levels of accuracy should generally be achievable within ± 15 % of:

- the expected value of a certified reference material of similar matrix; or
- the value obtained by a separately validated and recognised quantitative method for the sample matrix.

Accuracy will be assessed by:

- reference to the analytical results of laboratory control samples;
- use of trip, equipment and field blanks to check the accuracy of sampling techniques; and
- evaluating the results of laboratory spikes and analyses against reference standards.

Analytical results of these should be sufficient to establish that accuracy has been achieved in the work of the sampling team.

14.15.3 Representativeness

Representativeness expresses the degree to which sample data accurately and precisely represents a characteristic of a population or an environmental condition. Representativeness will be achieved by collecting samples on a grid basis across validation areas from an adequate number of sample locations, to characterise the area to the required accuracy and ensuring that an appropriate number of reliable analyses have been reported for each population or environmental condition, and that the COPC concentrations have been maintained in the samples during and after their collection. Regular collection and analysis of treated soil samples at the specified sampling density will also ensure the analytical data is representative of the treated material for the duration of DTD treatment operations.

Consistent sampling techniques and methods, with reference to written procedures, will be utilised throughout the sampling program to ensure consistency.

14.15.4 Completeness

Completeness is defined as the percentage of measurements made which are judged to be valid measurements. The completeness goal is set at there being a sufficient amount of valid data generated during the study. If there are insufficient valid data, as determined by the other DQIs, then additional data will be required to be collected.

14.15.5 Comparability

Comparability is a qualitative parameter expressing the confidence with which one data set can be compared with another. This will be achieved through maintaining a level of consistency in techniques used to collect samples, and ensuring the selected laboratories use consistent analytical techniques and reporting methods. Reporting of results will be done in consistent units and nomenclatures, and comparability will be achieved by ensuring that precision and accuracy objectives are met.

Table 11 below summarises the required QA/QC acceptance criteria for the laboratory analytical testing.

Table 11: Laboratory QA/QC Testing DQOs

Laboratory QA/QC Testing	Laboratory QA/QC Acceptance Criteria
Method Blanks	Results not detected at Practical Quantitation Limit (PQL)
Surrogate Spikes	Recoveries within 70 – 130%. The exception being for phenols (50 – 130%) & SVOC (60 – 130%).
Matrix Spikes	Recoveries within 70 – 130% for Organics & 80 – 120% for inorganics. The exception being for phenols (50 – 130%) & SVOC (60 – 130%).
Laboratory Control Samples	Recoveries within 70 – 130%. The exception being for phenols (50 – 130%) & SVOC (60 – 130%).
Laboratory Duplicate Samples	Results < 4xPQL : duplicate results to be within +/- 2 PQL Results 4 -10xPQL : duplicate RPD within 25 - 50% Results > 10xPQL : duplicate RPD within 10 – 30%
Calibration of Chromatography Equipment	Retention Time Window : +/- 2 % Reference Standard : +/- 10 % Recalibration Standard :+/- 15 percent Internal Standard Recoveries: acceptable recoveries required

15 PLACEMENT OF REINSTATEMENT MATERIALS

At the conclusion of the CPWE excavation and validation works, treated and validated soil material stockpiled within the STA and surplus soil stockpile area will be used to reinstate the CPWE excavation to the level of Corish Circle. This section of the RAP outlines the processes and methodologies involved in the reinstatement of the CPWE excavation.

The remediated materials will be transported from their respective stockpile areas to the CPWE excavation area. The materials will be placed and compacted in successive layers for the full width and length of the excavation. The compacted layer thickness will not exceed 300 mm. Where necessary, water will be sprayed on the material by watercart in sufficient quantity to ensure that the appropriate moisture content is achieved for each layer. The distribution and compaction of backfill materials will be undertaken by appropriately sized rollers for the main excavation areas, and by mini-rollers or mechanical hand tampers for perimeter areas that cannot be accessed by the larger plant.

As RBSCs have been derived for final placement of validated material at varying depths during the backfilling of the CPWE area, surveying during backfilling operations, in conjunction with the Material Tracking System (refer to **Section 10.3**) will be undertaken by a registered surveyor to confirm appropriate placement of materials.

The excavation will be reinstated to approximately 75 mm below the final level of the surrounding area. A 75 mm layer of clean topsoil sourced from a commercial supplier will be placed over the finished backfill, and the former excavation will be turfed to stabilise the surface. A landscaped mound will be reinstated along the eastern boundary with Corish Circle to preserve the existing outlook across the CPWE area and provide screening for future development.

Compaction testing will be conducted for each layer to confirm that the desired compaction standard is achieved. Testing will be conducted using density index and field density tests. Should the testing results indicate that the specified degree of compaction is not being achieved, the necessary modifications will be made to the compaction methodology or equipment to obtain the specified results. All testing will be undertaken by a qualified geotechnical engineer using NATA certified methods.

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16 ENVIRONMENTAL MANAGEMENT PLAN

16.1 General

An EMP will be developed to provide a management strategy to effectively manage the environment and the remediation activities considered to potentially have an adverse impact on the environment.

This section outlines the environmental management measures proposed to minimise and mitigate the potential impacts of the remediation operations on the environment and surrounding Site areas. These measures address the following:

- Surface water management;
- Management of water in excavations;
- Air quality management including dust, gaseous emissions and odours;
- Noise management;
- Vibration;
- Equipment operation; and
- Traffic control.

The remediation works will comply with relevant legislative requirements, licences and approvals and notices. At all times work will be undertaken to minimise impact on the environment and the surrounding areas. Regular monitoring will be conducted to monitor environmental performance and to identify areas of improvement in both work methods and scope.

16.2 Environmental Control Measures

The installation, operation and regular maintenance of a wide range of environmental protection measures will be undertaken to minimise impacts on the environment and surrounding areas. These works will include the installation and operation of the following:

- Stormwater control measures including retention basins, bunding, silt fences, oil absorbent materials, dewatering systems, and water treatment systems for the management of site water;
- Works enclosures for waste excavation and handling as described in **Sections 8** and **10**;
- Vehicle emission controls, stockpile covering and treatment designed to control air and dust emissions from equipment, plant and stockpiles;
- Equipment decontamination control measures, comprising washing facilities, to manage the potential for cross-contamination during excavation and soil treatment; and
- Protective fencing and restricted site access, including delineation of Exclusion Zones to limit unauthorised access to designated areas.

16.3 Environmental Inspections

Regular inspections of all implemented measures will be undertaken as follows:

- Within the CPWE area and in the vicinity of the STA area – prior to the commencement of work on each day;
- Along haul roads and in perimeter areas outside Exclusion Zones – prior to the commencement of work on the first working day of each week; and
- At all Site locations – at hourly intervals throughout major storm events.

An inspection report will be recorded and maintained on file after each inspection.

16.4 Water Management

16.4.1 General

The work methodology has been developed to manage surface water at the Site and to minimise the impact of surface water on the remediation works. By conducting all CPWE excavation works within the ESB, the impact of direct rainfall on the excavation works will be eliminated. Drainage and sediment control measures will be constructed to prevent surface water originating in surrounding areas from entering works areas and becoming contaminated. These measures will be progressively installed and maintained as works proceed across the CPWE.

This section of the RAP outlines the water management control measures proposed for use during the remediation works.

16.4.2 Controlling Surface Run-off from Outside Work Areas

Perimeter drainage control measures will be installed upgradient of all operational site areas prior to the commencement of works to prevent clean surface water from entering work areas and becoming potentially contaminated. Drainage control measures such as diversion drains, ditches, straw bales and silt fences will be constructed. The diverted water will be directed away from works areas, through a series of sediment and erosion control devices into existing on-site stormwater drains.

16.4.3 Controls on the Existing Stormwater System

Existing stormwater discharge points in the CPWE and STA will be blocked-off to prevent any unauthorised discharge of site water. Clean water will be directed away from works areas, through a series of sediment and erosion control devices and into existing on-site stormwater drains.

16.4.4 Controlling Surface Run-off within Work Areas

The construction of the ESB will eliminate the impact of direct rainfall in active CPWE excavations. Additional bunding and diversion drains will be constructed within finished excavations where necessary to minimise the impact of surface water on reinstatement activities.

16.4.5 Controlling Surface Run-off within Stockpile Areas

As shown in **Figure 10**, perimeter drainage control measures, bunding and erosion control measures will be installed around the perimeter of all stockpile areas. Additional drainage measures will be constructed upgradient of all stockpile areas prior to the commencement of stockpiling activities to minimise the volume of clean surface water entering stockpile areas.

16.4.6 Spill Response Plan

A spill response plan will be developed and implemented as part of the Emergency Management Plan. The procedures outlined in the plan will be aimed at minimising the impact of any contaminant releases that may occur.

The plan will detail the following actions to be taken in the event of a spill:

- Training of site personnel in appropriate spill response techniques;
- Allocation of spill response materials and equipment on-site (such as oil absorbent pads, booms and biodispersants);
- Containment of all storage tanks or drums inside bunded areas with a capacity of 110% of the largest tank contained, or 25% of the total volume of all drums, whichever is greater.
- Initial assessment of the spill;
- Notification of the appropriate authorities if necessary;
- Action in spill containment and cleanup;
- Investigation of the spill or leak to determine the root cause of the incident; and
- Identification of corrective and preventative actions to prevent future incidents.

16.4.7 Groundwater Management Strategy

Based on the results of previous investigations, groundwater should not be encountered during excavation of the CPWE area. It should be noted that ongoing groundwater monitoring has indicated that the groundwater table is located greater than approximately 4.0 m below the base of the Hypalon liner (URS 2006b). However, free water (seepage) water in the encapsulation and infiltrated water from adjacent areas may be encountered during the excavation works. Should water accumulate in active excavations, it will be regarded as contaminated and transferred directly to the WTP for treatment.

16.5 Air Quality Management

16.5.1 General

The objective of the Air Quality Management Plan is to conduct site works in a manner that ensures that ambient air quality on-site and in adjacent areas complies with statutory requirements.

16.5.2 Odour Control for Site Works

Emissions from the CPWE excavation and from the STA will be addressed by the construction of the ESB and FSB, and operation of an ECS for each of these buildings.

The following additional odour control measures may also be implemented:

- Use of appropriate excavation rates – where particularly odorous materials are encountered, the rate of excavation may be slowed to reduce odour generation, and assist in the management of emissions; and
- Installation and operation of a boundary misting system – consisting of a polyethylene pipework system for the discharge of deodorising agents in water sprayed into the atmosphere around the perimeter of the Site.

16.5.3 Dust Suppression

Water carts will be used to assist in dust suppression across unsealed areas of the Site, such as excavated and validated areas, and during reinstatement works. The water cart will be on-site and available for use at all times.

16.5.4 Ambient Air Quality Monitoring Program

An Air Quality Monitoring Plan will be developed prior to Site establishment. Air quality monitoring will be conducted by an appropriately a qualified and experienced air monitoring consultant, in accordance with Licence requirements. The selection of appropriate sampling locations would be determined by the prevailing winds at the time of monitoring, and it is anticipated that the monitoring locations will generally be on the down-wind boundaries of the Site. Should concerns regarding air quality arise either through monitoring results or the receipt of complaints, additional targeted monitoring will be conducted, as required.

The Air Quality Monitoring Plan will detail specific information regarding the monitoring techniques and equipment, frequency of monitoring, monitoring locations, and outline the specific air quality standards applicable to conditions and emissions from the remediation works.

16.5.5 Personal Air Monitoring Program

A program of personal air monitoring will be undertaken during all stages of the works. This program will be aimed at monitoring worker exposure to airborne hazardous substances to determine the appropriateness of work methods and levels of personal protective equipment (respirators in particular) for specific site works. The personal air monitoring program will conducted by a qualified and experienced OH&S consultant, and will be documented in the OHSP.

16.5.6 Stack Emission Monitoring Program

A stack emission monitoring program will be undertaken to document the performance of the DTD Plant, and ESB and FSB ECSs. This program will be undertaken by a qualified and experienced stack emission consultant in accordance with Licence requirements.

16.6 Noise Management

16.6.1 General

The proposed works program and strategy have been developed to minimise the noise impact of the works on nearby receptors. This section of the RAP outlines the noise control strategies and measures proposed.

16.6.2 Control Measures

DTD and associated plant will be sourced/designed with the objective of achieving the noise goals set out in Orica's EPL. The following general mitigation measures will be considered in the detailed design of the plant in order to achieve the required noise reductions.

- Plant layout and orientation shall be designed to minimise noise impacts.
- ECS and DTD Plant fans to incorporate silencers and enclosures to achieve appropriate noise reductions.
- Solid barriers shall be incorporated, wherever reasonably practicable at noise sources at a height.
- Plant items shall be located at lower heights where reasonably practicable such that noise shielding from the FSB is maximised. Plant shall be located to the west of the DTD Plant.
- A flexible connection may be used between the fan and ductwork in the DTD Plant stack. The connection may be encased to control break out noise.
- Ductwork, including the stacks shall be acoustically lagged if required. This shall be confirmed with measurement once operational and lagging retrofitted if needed.

Details of the above measures and noise reductions achieved will be provided to the DoP during the detailed design stage of the project.

Orica will prepare a Noise and Vibration Management Plan which will include the following:

- Appropriate noise monitoring program for the project including details of periodic noise and vibration testing to be undertaken during activities deemed likely to generate high noise and vibration levels;
- Management of vibration during any use of piling rig and roller;
- Scheduling of works/respite periods from activities likely to generate high levels of noise during major sporting events at Hensley Athletics Field; and
- Provision of a 24 hour community hotline to allow the local community to register complaints regarding noise at the Site.

Orica will ensure that works on the Site are carried out in accordance with the following:

- All CPWE excavation operations shall be undertaken within the enclosed ESB in between the hours of 7.00am and 7.00pm from Monday to Saturday;
- All operations undertaken within the enclosed FSB (screening, crushing, blending of stockpiled materials and feeding material to the DTD Plant) and the operation of the DTD Plant may be undertaken 24 hours per day, seven days per week;
- All other works including stockpile management, maintenance of drainage and environmental control measures, and the maintenance of haul roads will be undertaken between the hours of 7.00am and 7.00pm from Monday to Saturday;
- All equipment and plant used on-site will be maintained in good order in accordance with manufacturers recommendations; and
- All construction vehicles will enter and exit the Site in accordance with the Site entry controls specified in the EA and RAP prepared for the project.

16.6.3 Noise Emission Standards

The noise levels arising from operations are to comply with the requirements of the EPL.

16.6.4 Noise Monitoring Program

An ambient Noise Monitoring Plan will be developed prior to Site establishment. It is anticipated that a noise monitoring program will be conducted for the duration of the remediation works. The objective of the monitoring program will be to measure performance of the Site works at the nearest sensitive receptors, and to monitor compliance with the noise limits detailed in the EPL..

The monitoring program will be conducted by a qualified and experienced noise monitoring specialist. The program will commence prior to Site establishment in order to determine background noise levels.

Noise level monitoring will be conducted at off-site locations to monitor the impacts of Site works on the surrounding community. These locations will be determined prior to Site establishment and will be detailed in the Noise Monitoring Plan. Additional monitoring will be conducted for all plant and equipment to be used on-site.

Additional monitoring will be conducted as appropriate in response to noise complaints and during site works identified as a potential noise hazard.

16.6.5 Definition of Non-Compliance

Noise levels measured from the Site works will be considered to be unacceptable if:

- The noise level of any item of plant or equipment working on the Site exceeds its maximum recommended noise level; or
- The noise levels exceed the limit detailed by the EPL.

Where unacceptable noise levels are identified at the Site boundary, measures will be instigated to reduce the noise levels to below the acceptable limits. Where a sustained exceedance of the EPL criteria is recorded, either as a result of regular monitoring or monitoring in response to a complaint, the exceedance will be investigated and prompt action taken to identify the source of the noise, determine the appropriate mitigation measures, and to implement corrective measures. Additional monitoring of noise levels at these locations will be conducted following the implementation of these measures.

16.7 Equipment Control Measures

16.7.1 General Operational Requirements

Plant and equipment used on the Site has the potential to create a hazard to workers, other items of plant and to the surrounding environment. The following measures will be implemented to minimise these risks:

- Each item of plant and equipment will be operated in a proper manner by a trained, licensed and competent person;
- All items of plant and equipment will be maintained in a clean and safe condition;

- All noise, odour and dust attenuation measures provided for each item of plant and equipment will be maintained in good working order; and
- Site works will be conducted by all site personnel in a safe and responsible manner.

16.7.2 Controls on the Movement of Vehicles

Due to the presence of contaminated materials, the following controls will be placed on the movement of vehicles in and around work areas:

- All vehicles and equipment inside the ESB and FSB will be decontaminated within the air-lock before leaving these areas;
- All trucks and equipment will travel along designated haul roads;
- No vehicles or equipment carrying contaminated materials will travel across validated or clean areas except on designated haul roads;
- All vehicles transporting materials on-site will be operated in a safe and responsible manner to prevent the loss of materials during loading, soil transport and unloading activities; and
- All vehicles leaving the Site will be cleaned to prevent the trafficking of soil to local roads.

16.7.3 Equipment Cleaning

Plant and equipment that come in contact with contaminated material will be washed and cleaned before it is removed from the Site. The primary locations of contamination will be within the ESB and the FSB. Cleaning will be conducted by high pressure water sprays in the truck wash facilities located in the exit air-locks of these structures (refer to **Figure 11**).

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17 OCCUPATIONAL HEALTH AND SAFETY

17.1 General

This section of the RAP describes the minimum standards to be adopted to protect the health and safety of all persons involved in the Site works. A suitable Health and Safety Management System will be developed and implemented in compliance with legislative and regulatory requirements. A Site-specific OHSP will also be developed prior to commencement of the works. The OHSP will detail the appropriate health and safety information necessary to conduct the remediation works in a safe manner.

17.1.1 Occupational Health & Safety Plan

The purpose of the site-specific OHSP is to present all relevant health and safety information for the works. The information presented in the OHSP will include:

- Assignment of responsibilities for all Site personnel;
- An outline of the existing Site conditions;
- Details of all work to be conducted;
- An evaluation of hazards and risks;
- Details of the proposed measures to be implemented to manage the identified hazards and risks;
- Establishment of personnel protection standards and mandatory safe work procedures;
- Establishment of OH&S monitoring protocols;
- Training requirements for emergency team members;
- Communication protocols and training procedures;
- Evacuation procedures, emergency contacts and emergency drills to be implemented; and
- Provision for contingencies and changes in work practices.

17.1.2 Responsibilities

The responsibilities and duties of the principal contractor in relation to OH&S will include:

- Ensuring all work undertaken is performed in accordance with relevant legislation and regulations, and directions issued by regulatory authorities;
- Developing and documenting safe working practices for all employees and subcontractors;
- Ensuring workers are adequately trained to undertake their work tasks using the adopted work practices;
- Ensuring that work is performed in strict adherence to the adopted work practices;
- Appointing a suitably qualified and experienced Site Safety Officer (SSO) to supervise and control safety matters;
- Supplying and maintaining first aid kits, first aid facilities and ensuring first aid attendants are present in accordance with statutory requirements;

- Ensuring that workers are inducted prior to their commencement of work. This will include site-specific training in regard to the Site conditions, works procedures, emergency and evacuation procedures, first aid procedures, decontamination procedures and other relevant matters detailed in the OHSP;
- Ensuring that copies of the OHSP are readily available;
- Establishment and maintenance of a record of all hazardous substances on the Site including provision of Material Safety Data Sheets (MSDSs);
- Ensuring that all personnel who work with contaminated materials undergo a medical examination prior to and at the completion of their work on-site;
- Reporting all site incidents and accidents to WorkCover;
- Ensuring that the SSO is on-site during all site works to monitor compliance with the OHSP;
- Ensuring that regular documented OH&S inspections are conducted, including the use of a documented follow-up system to monitor improvements and measures introduced to rectify any observations made;
- Supplying and maintaining the required PPE;
- Ensuring all workers are trained in the use of the PPE and correctly use PPE; and
- Ensuring that all electrical equipment, plant and tools comply with appropriate statutory requirements and are maintained in a good, serviceable and safe condition.

17.1.3 OH&S Legislation, Regulations and Standards

The remediation works will be conducted in compliance with applicable OH&S legislation, regulations and standards. In addition, the remediation works will comply with relevant industry codes of practice, guidelines and other publications that have been developed by WorkCover. These may include:

- The *Occupational Health and Safety Act 2000* and *Regulation 2001*;
- *The Dangerous Good Act 1975* and *General Regulation 1999*;
- *Guide for Riggers* (November 1995);
- *Electrical Practices for Construction Work* (February 1992);
- *Exposure Standards for Atmospheric Contaminants in the Occupational Environment* (National Occupational Health and Safety Commission (NOHSC), 1995);

A number of Australian Standards (AS) have been identified relating to OH&S issues for the works proposed at the Site. These standards include:

- AS 1319 -1994 *Safety Signs for the Occupational Environment*;
- AS 1336 -1997 *Recommended Practices for Occupational Eye Protection*;
- AS 1470 -1986 *Health and Safety at Work - Principles and Practices*;
- AS 1715 -1994 *Selection, Use and Maintenance of Respiratory Protective Devices*;
- AS 1716 -2003 *Respiratory Protective Devices*;

- AS 1801 -1997 *Occupational Protective Helmets*;
- AS 1885.1 -1990 *Measurements of Occupational Health and Safety Performance - Describing and Reporting Occupational Injuries and Disease* (known as the National Standard for Workplace Injury and Disease Recording);
- AS 2161 - 2000 *Occupational Protective Gloves*;
- AS 2210 - 2000 *Occupational Protective Footwear*;
- AS/NZS 2865-2001 *Safe Working in a Confined Space*;
- AS 2986 -1987 *Workplace Atmospheres - Organic vapours - Sampling by Solid Adsorption Techniques*;
- AS/NZS 3012 -1995 *Electrical Installations – Construction and Demolition Sites*;
- AS 3640 -1989 *Workplace Atmospheres - Method for Sampling and Gravimetric Determination of Inspirable Dust*;
- AS/NZS 4576 -1995 *Guidelines for Scaffolding*; and
- Any other recognised Standard applicable to works conducted at the Site.

17.2 Risk Assessment

A hazard analysis will be conducted prior to site establishment to identify the OH&S hazards expected during the course of the project. A Risk Management Plan will be developed to identify hazards associated with the proposed site works, evaluate the associated risks and determine the necessary measures to reduce or mitigate those risks. This section of the RAP outlines some of the hazards expected over the course of the project. Hazard identification and risk assessment will be conducted and documented on an ongoing basis as the project works proceed.

17.2.1 Chemical Hazards

Based on the information provided in previous investigations of the CPWE, the presence of SVOCs and VOCs has been confirmed within the CPWE. The hazard posed by these materials will be evaluated and the associated risks assessed in the Risk Management Plan.

The Risk Management Plan and OHSP will also consider the petroleum hydrocarbon impact, identified in the north eastern corner of the CPWE area, as discussed in **Section 5.1**.

17.2.2 Atmospheric Exposure Limits and Recognition Qualities

The exposure limits and recognition qualities of the chemicals likely to be encountered in the remediation works will be taken from the following guidelines (listed in order of precedence) and detailed in the OHSP:

- NOHSC, *Exposure Standards For Atmospheric Contaminants in the Occupational Environment*, 1995;
- American Conference of Governmental Industrial Hygienists – Threshold Limit Values and Biological Exposure Indices for 1991 – 1992; and
- National Institute for Occupational Safety and Health (NIOSH) 1985, *Pocket Guide to Chemical Hazards*.

17.2.3 Additional Hazards and Risks

The OHSP will identify and describe a range of other hazards anticipated during the remediation works. These hazards will include:

- Heat stress;
- Explosive atmospheres in areas dealing with contaminated materials;
- Oxygen deficient atmospheres and confined spaces (as defined under AS/NZS 2865 - 2001 *Safe Working in a Confined Space)*;
- Underground utilities;
- Underground pipelines, pits, and other obstructions;
- Above ground electrical and utility hazards;
- Traffic hazards;
- Instability of excavation batters and stockpiled material;
- Hazards associated with the construction and decontamination of the ESB and FSB;
- Hazards associated with operation of the DTD Plant;
- Hazards associated with the airlock and decontamination operations in the ESB and FSB; and
- Physical hazards such as trip hazards and mobile plant.

Specific minimum standards for these hazards will be outlined within the Risk Management Plan.

17.3 Work Practices

17.3.1 Levels of Personal Protective Equipment

For all works outside Exclusion Zones (ESB, FSB and DTD operation) standard PPE comprising long sleave shirt, long pants, hard hat, eye protection, hearing protection, steel capped boots and high visibility vest will be required for site personnel. This level of protection will be referred to as the Base Level. When working within the Exclusion Zones, personnel will require additional protective equipment, with the amount of the protection dependent upon the type of hazards present in the specific work area.

The necessary levels of PPE will be detailed in the OHSP.

17.3.2 Personnel Decontamination

Site workers will be decontaminated to limit the transport of contaminants from one zone to another. All personnel leaving the ESB and the STA will be decontaminated upon exit. The OHSP will detail the decontamination methods proposed.

Clean and dirty zones will be located adjacent to the decontamination stations at the southern boundary of the CPWE excavation and to the north of the STA. The decontamination stations will be located such that all workers will pass through these zones when entering and exiting these parts of the Site. All site workers will be decontaminated upon exiting the Site through these facilities, and all staff will be trained in the purpose and use of these zones during the site-specific induction.

17.3.3 Medical Checks

Site workers who are exposed to contaminated materials for a period longer than one month, will complete a medical examination before commencement and following cessation of their employment on the project. The medical examination will comprise a full blood test including analyses for chemicals specific to the Site, urine test, physical examination and chest x-ray. The medical examination will be carried out by an Occupational Physician.

“Fitness for Duty” reports will be prepared by the Occupational Physician and made available to the Remediation Contractor prior to each employee commencing work on the Site. The exit medical examination will be undertaken within six months of completion of work at the Site.

17.3.4 Work Zones

The Site will be divided into a number of work zones, as follows:

- Exclusion Zones – the ESB and the immediate surrounding areas and the STA, comprising the FSB and the DTD Plant areas;
- Decontamination Zones – decontamination stations including the air-locks within the FSB and ESB, and the personnel decontamination facilities; and
- Support Zones – the site office and site facilities areas located adjacent to the ESB and STA as shown in **Figure 4**.

Movement of personnel and equipment between these zones will be minimised and restricted to specific access control points and decontamination stations to prevent cross contamination to clean areas.

Exclusion Zone
Exclusion Zones are areas of the Site that require the adoption of specific OH&S requirements and work practices. These zones will primarily correspond to areas of the Site where there is a potential for exposure to contaminated materials, potentially hazardous vapours or physical hazards. Exclusion Zones may also include other areas of the Site that are affected by emissions from the works being undertaken or are in close proximity to the works area, such as haul roads.

Access of personnel in and out of Exclusion Zones will be limited by the inclusion of designated Decontamination Stations. The Exclusion Zones will be defined by fencing, with safety signage placed at regular intervals around the perimeter warning on-site personnel of the boundary of the zone, the nature of the hazards associated with it and any access restrictions that apply.

Decontamination Stations
The decontamination stations will be the only entry and exit points to Exclusion Zones. The stations will be located to minimise the transportation of contaminants between the various areas of the Site, and to ensure that the Support Zone does not become contaminated or affected by other site hazards. Decontamination stations will be constructed at the following locations:

- The exit air-lock of the ESB;
- The exit air-lock of the FSB; and
- The Site entry and exit located adjacent to the site office.

As discussed in **Section 17.3.2**, clean and dirty zones will be established at all decontamination stations. All workers will be required to pass through the Decontamination Stations when entering and exiting the Exclusion Zones.

These stations will also house the PPE stock rooms and change rooms, so that when entering the Exclusion Zones workers are able to apply the necessary PPE.

Support Zone
The Support Zone refers to the site office and other support facilities involved in administering the remediation works. Site personnel may wear normal work clothes within this zone, leaving any potentially contaminated clothing, equipment and materials in the decontamination station until decontaminated or appropriately disposed of.

In the event of an emergency, support zone personnel are responsible for alerting the correct authorities. All emergency telephone numbers, evacuation route maps, vehicle keys and site safety information would be held within the Support Zone.

17.3.5 Buddy System

Work activities conducted in the Exclusion Zones should be conducted with a "buddy" who is able to:

- Provide their partner with assistance;
- Observe their partner for signs of chemical or heat exposure;
- Periodically check the integrity of their partner's protective clothing; and
- Notify others in the Support Zone if emergency help is needed.

17.3.6 Site Induction Procedure

The workplace safety induction will be undertaken prior to all workers starting on-site. The induction should provide each worker with the following information:

- Plan of the Site layout showing:
- Site Office locations;
  - First aid facilities;
  - Fire extinguisher;
  - Spill kit equipment;
  - Extent and location of the Work Zones;
  - Exclusion Zones and decontamination stations;
  - Site access; and
  - Amenities location.
- History of the Site;
- Description of the anticipated site contaminants;
- Procedure for reporting hazards identified on-site;
- Procedure for reporting incident/accidents occurring during site works;
- Emergency Evacuation Plan;
- First Aid Procedures;

- Health & Safety Committee Meetings and Tool Box Meetings;
- Applicable Specific Work Procedures;
- Personal Protective Equipment requirements;
- Hazardous Substances Handling Procedures;
- Plant Safety requirements;
- Drugs and Alcohol Policy and Procedures; and
- Site Safety Rules.

The induction program will be presented by the SSO at the beginning of the project and at any time when new workers are due to commence work on-site. Inductions may also be presented when conditions vary from those anticipated prior to commencement. All safety inductions will be documented and the names of all participants will be recorded.

17.4 Occupational Air Monitoring Program

The Occupational Air Monitoring Program will be undertaken to monitor gas and particulate levels within the breathing zone of site workers to indicate the need for respiratory protection. Over the course of the project, the air quality will be monitored periodically in all work areas by qualified and experienced personnel. These results will be recorded and compared with the exposure levels and limits detailed in the OHSP.

An Occupational Health Risk Assessment will be completed prior to site establishment. The assessment will detail all monitoring techniques, the frequency of monitoring and the appropriate exposure limits and action levels.

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18 CONTINGENCY AND EMERGENCY RESPONSE PLAN

18.1 Contingency Plan

18.1.1 Approach

The purpose of the contingency plan is to outline procedures for the identification and management of unexpected issues or events that may occur during the works. The contingency plan will detail the following information:

- The assignment of responsibilities to nominated key personnel;
- The assessment of hazards associated with such situations, and the potential off-site impacts;
- Contingency responses; and
- Procedures for reporting relevant issues to regulatory authorities.

The following events have been identified as having the potential to occur during the remediation works:

- Identification of greater amounts of contaminated material than presently anticipated;
- Variation of contaminant characteristics or identification of unanticipated contaminants and materials;
- Generation of unacceptable levels of dust during excavation and reinstatement works;
- Release of unacceptable levels of volatile gases during the CPWE excavation, from the FSB or DTD processes;
- Generation of unacceptable odours from the CPWE excavation, from the FSB or DTD processes;
- Generation of unacceptable noise levels during site works;
- Generation of unacceptable vibration levels during CPWE excavation and reinstatement works; and
- Spills and leaks of hazardous materials.

18.1.2 Increased Volumes of Contaminated Material

Excavated, treated and reused materials will be managed on site using the Materials Tracking System outlined in **Section 10.3** of this RAP. The quantities of materials excavated, screened and treated will be regularly compared to the estimated quantities.

Increased volumes of foreign materials in the form of crushed drums, drum liners, steel reinforcement, scrap steel and pipework, and timber believed to be present in the CPWE may adversely impact on the project. Depending on the magnitude of the changes of anticipated volumes of excavated materials, and the extent of contamination beneath the CPWE, changes to the depth of excavation and to the final reinstatement levels may be made during the project.

18.1.3 Variation of Contaminant Characteristics

The range of contaminants analysed in previous site investigations is considered to be appropriate for the characterisation of the CPWE area, and for development of risk-based Remediation Goals. However, there is the potential for occurrence of as-yet unidentified contaminants, and for variation to the concentration or distribution of known contaminants.

Should any significant changes to the nature or types of contaminants be identified during the works a variation to the RAP and Remediation Goals may be required. Variations will be issued to the Contaminated Land Auditor for review and approval.

18.1.4 Flooding of the Site

The EMP for the remediation works was developed to control the impact of site works in order to minimise and mitigate against any impacts to off-site waters. The implementation and maintenance of a variety of environmental control measures will be undertaken during the project to manage water encountered during the works. Measures such as the installation of drains to divert clean water from upgradient areas to on-site stormwater drains, recycling of water, and the use of an on-site WTP will be implemented to manage and control water.

In extreme situations such as flooding or heavy rainfall, the discharge of untreated water may be permitted to the sewer system in accordance with the conditions of the EPL. Records of all discharges will be kept describing the estimated volume of water discharged, the time period over which the discharge occurred, and the water quality results of water samples collected during discharge.

18.1.5 Control of Dust

Should unacceptable levels of dust be detected during the project, an investigation will be conducted to determine the source of the dust, and evaluate the appropriate measures to be implemented.

These measures may include the following:

- Increased use of a water cart to suppress dust in open areas;
- Installation of temporary sheeting to cover localised exposed areas and stockpiles;
- Alteration of the works program to minimise the extent of disturbed open areas;
- Consolidation of material stockpiles;
- Use of chemical dust-suppressants provided the chemicals do not pose a contamination or OH&S hazard;
- Use of alternative coverings such as hydromulch to stabilise the surface of open disturbed areas;
- Use of additional dust suppression features on items of dust generating plant and equipment; and
- Use of alternate work practices such as modified equipment to minimise dust generation.

18.1.6 Volatile Gases and Odours

Should unacceptable levels of volatile gases be detected at the Site boundaries or in the surrounding area during the project, an investigation will be conducted to determine the source of the emissions, and to evaluate the appropriate measures to be implemented. This includes the petroleum hydrocarbon impact, located in the north eastern corner of the CPWE area, as discussed in **Section 5.1**.

These measures may include the following:

- Alteration in the works program to minimise in the extent of disturbed open areas;
- Prompt removal and treatment of heavily contaminated materials that have been exposed and are identified to have caused the emissions;
- Conducting the work in more favourable weather conditions;
- Use of alternate work practices to minimise the period of impact of the emissions;
- Use of additional features to control emissions from plant and equipment;
- Use of alternate work practices such as using modified equipment;
- Relocation of offending plant and equipment to less sensitive on-site areas;
- Reducing the number of plant and equipment items on-site; and
- Use of a deodorant within water sprays at locations on-site and at Site boundaries provided the chemicals do not pose a contamination or OH&S hazard.

18.1.7 Noise and Vibration

Should unacceptable noise levels be detected during the project the following measures may be implemented:

- Modify the works program to minimise the impact of noisy or vibratory operations, including:
  - Modify the timing of the works to appropriate times of the day; and
  - Accelerate the works program to complete the works quickly and minimise the period of disturbance;
- Install additional noise suppression features on plant and equipment;
- Construct additional noise attenuation measures such as stockpile barriers, works area enclosures; and
- Use of different items of plant and equipment that generate less noise or vibration.

18.1.8 Spills and Leaks

A spill response plan will be developed and implemented as part of the ERP detailing the procedures for responding to spills and leaks. The procedures outlined in the plan will be aimed at minimising the impact of any contaminant releases that may occur during the works.

The following actions will be taken in preparation for spills or leaks:

- Training of site personnel in appropriate spill response techniques;

- Allocation of spill response materials and equipment on-site (such as oil absorbent pads, booms and biodispersants);
- Containment of all storage tanks and drums inside bunded areas with a capacity of 110% of the largest container, or 25% of the total volume of all containers, whichever is greater.
- Initial assessment of the spill;
- Notification of the appropriate authorities if necessary;
- Following a spill or leak, an investigation to determine the root cause of the incident will be undertaken; and
- Corrective and preventative actions implemented to prevent future incidents.

18.2 Emergency Response Plan

An ERP will be prepared prior to the commencement of the Site remediation works. The plan will outline the process for identifying possible emergency situations and detailing the procedures necessary to ensure the safety of both on-site and off-site personnel in the event of an emergency.

The plan should include the following general information:

- Assignment of responsibilities to nominated key personnel;
- Assessment of the potential on and off-site impacts of hazards;
- Emergency reporting procedures including on-site reporting and reporting to the appropriate authorities;
- Emergency response procedures including, but not limited to, the following:
  - On-site fires or explosions;
  - Chemical spills;
  - Rupture of buried services;
  - Hazardous gas releases and emissions;
  - Confined spaces situations;
  - Traffic accidents both involving the transportation of "Dangerous Goods";
  - First aid for injured personnel;
  - Evacuation of on-site personnel; and
  - Managing unknown/uncertain situations.
- Incident investigation procedures to determine the root cause of the incident, and to identify the appropriate corrective and preventative actions to prevent future incidents.

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Figures

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Figure 1

Site Location
Orica Australia Pty Ltd
Orica Car Park Waste Encapsulation -
Remedial Action Plan
Botany Industrial Park, Matraville NSW

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