

REPORT No: EN.1591.61.PR031	Rev: 0
GROUNDWATER CLEANUP PLAN PROGRESS REPORT NO. 22	

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REVISION 0

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REVISION HISTORY

REV	STATUS	DATE	PREPARED	CHECKED	AUTHORISED
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20. Matraville Branch Library, Anzac Parade, Matraville (hard copy)
21. Ross Anthony, Randwick City Council for Randwick Branch Library, Royal Randwick Shopping Centre (CD version)
22. Bowen Library, Anzac Parade, Maroubra (hard copy)

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LIST OF ACRONYMS

ACRONYM	DEFINITION
ADWG	Australian Drinking Water Guidelines
AHD	Australian Height Datum
ANZECC	Australia and New Zealand Environment and Conservation Council
BAF	Biological Aerated Filter
BEW	Botany Environment Watch
BEREPA	Botany and Eastern Region Environment Protection Agency
BGC Project	Botany Groundwater Cleanup Project (hydraulic containment and treatment project as described in the EIS)
BGL	Below ground level
BGP	Botany Groundwater Project (entire set of activities pertaining to Orica's contamination of the BIP and environs)
BIP	Botany Industrial Park
BP	Bundle piezometer
CFM	Chloroform (trichloromethane)
CHC	Chlorinated hydrocarbon
cis-1,2-DCE	cis-1,2-dichloroethene
CoBB	City of Botany Bay
COPC	Chemical of potential concern
CPRC	Community Participation and Review Committee
CTC	Carbon tetrachloride (tetrachloromethane)
CLC	Community Liaison Committee
DEAC	Diethyl aluminium chloride
DEC	Department of Environment and Conservation, incorporates the EPA and is now DECC
DECC	Department of Environment and Climate Change, formerly DEC
DIPNR	Department of Infrastructure, Planning and Natural Resources (former NSW Government department, separated into DoP and DNR)
DNAPL	Dense non-aqueous phase liquid
DNR	Department of Natural Resources (formerly part of DIPNR, now part of DWE)
DWE	Department of Water and Energy
DoD	Department of Defence
DoP	Department of Planning (formerly part of DIPNR)
EDC	Ethylene dichloride (1,2-dichloroethane)
EDO	Environmental Defender's Office
EIAD	Environmental Impact Assessment Document
EIS	Environmental Impact Statement
EPA	Environment Protection Authority
EPL	Environmental Protection Licence
EP&A Act	Environment Planning and Assessment Act
GAC	Granular activated carbon
GCP	Groundwater Cleanup Plan
GEEA	Groundwater Extraction Exclusion Area
GIR	Groundwater Injection and Recovery
GTA	General Terms of Approval
GTP	Groundwater Treatment Plant

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ACRONYM	DEFINITION
HCB	Hexachlorobenzene
HCBD	Hexachlorobutadiene
HHRA	Human Health Risk Assessment
IMC	Independent Monitoring Committee
ISCO	In Situ Chemical Oxidation
JBS	JBS Environmental Pty Ltd, an environmental consultancy
KBR	Kellogg, Brown and Root Pty Ltd, Engineering Contractor for many sub-projects of the BGP
KMH	KMH Consulting Pty Ltd, independent compliance auditor for the BGP
MoU	Memorandum of Understanding
NCUA	Notice of Clean Up Action
NHMRC	National Health and Medical Research Council
NSW	New South Wales
OEMP	Operational Environmental Management Plan
PCA	Primary Containment Area
PCE	Perchloroethylene (tetrachloroethene)
PFM	Planning Focus Meeting
PHA	Preliminary Hazard Analysis
PRP	Pollution Reduction Program
PVDF	Poly vinylidene fluoride
QRA	Qualitative Risk Assessment
RAP	Remedial Action Plan
REF	Review of Environmental Factors
RO	Reverse osmosis
RTA	Roads and Traffic Authority
RWG	Regulatory Working Group
SCA	Secondary Containment Area
SCW	Scheduled Chemical Waste
SEPP	State Environmental Planning Policy
SESPHU	South East Sydney Public Health Unit
SPC	Sydney Ports Corporation
SSU	Steam Stripping Unit
SWC	Sydney Water Corporation
TBA	To be advised
1,1,2,2-TeCA	1,1,2,2-Tetrachloroethane
1,1,2-TCA	1,1,2-Trichloroethane
1,2,4-TCB	1,2,4-Trichlorobenzene
1,2,4,5-TeCB	1,2,4,5-Tetrachlorobenzene
TCE	Trichloroethene
TO	Thermal Oxidiser
TWA TLV	Time Weighted Average Threshold Limit Value
TWSA	Trade Waste Service Agreement
URS	URS Australia Pty Ltd, Orica's principal environmental consultant on BGP
VC	Vinyl chloride (chloroethene)
VOC	Volatile organic compound
VSD	Variable speed drive

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EXECUTIVE SUMMARY

The NSW Environment Protection Authority (EPA), now part of the Department of Environment and Climate Change (DECC), issued Orica Australia Pty Ltd (Orica) with Notice of Clean Up Action (NCUA) No. 1030236 on 26 September 2003, under the Protection of the Environment Operations (POEO) Act 1997.

This document is the twenty-second report submitted in accordance to NCUA Condition 4G. The reporting interval for this report is 1 January to 31 March 2009, however if more recent and relevant information is available it is also included.

Orica engaged URS to complete a quarterly monitoring event in March 2009 in accordance with the agreed monitoring plan. Results and discussions were provided in the URS report *Groundwater Treatment Plant (GTP) Quarterly Groundwater and Surface Water Monitoring Report, May 2008*.

Hydraulic Containment

Botany Industrial Park Containment Area

- The primary purpose of the Botany Industrial Park (BIP) containment area is to contain contaminated groundwater migrating from source areas located on BIP. If groundwater extraction is temporarily reduced due to periodic GTP capacity limitations, this reduction occurs at sections of the BIP containment line based on a predetermined order of priorities; and
- The inferred contours and patterns of the shallow and deep groundwater flow infer that hydraulic containment during the monitoring period was limited to the central portion of the containment line. Containment may not have been achieved at the northern and southern portions of the BIP containment line during the monitoring period. However, water elevation contours show that flow from the northern and southern ends of the containment line was towards the central portion of the containment line, suggesting that in those areas some containment may have been taking place. As discussed in previous monitoring reports, the PCA will effectively capture a large portion of the flow that has migrated past the BIP containment line.

Primary Containment Area

- The primary purposes of the Primary Containment Area (PCA) are mass removal of the central 1,2-dichloroethane (EDC) plume in the deep aquifer, and hydraulic containment on Block 2, Southlands;
- Interpreted deep groundwater flow at the PCA shows deep groundwater was successfully contained at the PCA;
- The interpreted contours and groundwater flow lines infer that although some drawdown was recorded, shallow groundwater may have been migrating from the PCA for the period of measurement. However, it is important to note that the rate of migration of shallow containment has been significantly reduced and the majority of contaminant mass lies within the deep aquifer that is being successfully contained. It is recommended that the trial of increased extraction

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rates at the PCA be continued and, where possible, extended to allow additional assessment during the next monitoring round; and

- Further assessment of shallow groundwater containment at PCA will be provided in the June 2009 quarterly monitoring report (provided in August 2009) when data from the newly installed shallow monitoring wells is available.

SCA Containment Line

- The primary purpose of the SCA is to minimise migration of groundwater contamination to Botany Bay (recognising that there was already contamination in areas downgradient and to the east of the containment line before groundwater extraction commenced);
- Hydraulic containment was achieved in both the shallow and deep aquifers as water levels and hydraulic heads in monitoring wells remained consistently at or below the nominated target levels; and
- Results of salinity monitoring downgradient of the SCA indicate similar levels to those observed during previous monitoring rounds at most locations, although the results for BP115I and BP115D are higher than previously reported.

Chemical Monitoring Results

General

- Concentrations reported for offsite monitoring wells were similar to those previously reported with the exception of wells located at the leading edge of the Central Plume, which is continuing to slowly migrate towards the SCA, and at sampling locations in the dune areas in Penrhyn Estuary.
- The increases and reported maximum concentrations observed at BP60 and BP77 are considered consistent with short- and long-term historical trends. It is noted that contamination from this location will be captured at the SCA and will not discharge into Penrhyn Estuary;
- The increased concentration of VC at BP95 (3 m port) is also considered significant and while the reported concentration does not change the assessed human health risk in the adjacent area ongoing monitoring at this location is required to ensure that the concentrations adopted in the risk assessment remain relevant; and
- Increases were observed for VC and PCE at BP115 (5.25 m port) and MWF15I. The increases are consistent with historical trends and are considered to be representative of groundwater that migrated downgradient of Foreshore Road prior to the commencement of hydraulic containment at the SCA.

Penrhyn Estuary

- In general, volatile CHC concentrations in pore water within Penrhyn Estuary are similar to or lower than historical concentrations; and

- Vinyl Chloride (VC) concentrations above the ANZECC (2000) Trigger Value were observed at BP43 at both high and low tides. These concentrations are similar to those reported in September 2007 suggesting fluctuations at this location are seasonal in nature and not due to significant changes in contaminant distribution in Penrhyn Estuary.

Surface Water

- The concentrations of volatile CHCs in surface water sampling locations were generally less than the respective ANZECC (2000) Trigger Values. This is consistent with the monitoring rounds performed since the GTP commenced steady operation indicating the remediation is having a significant effect on the surface water quality in the estuary; and
- Increases in VC concentrations were noted at the Springvale Drain outlet at SW031 at high tide and downstream of the aforementioned outlet at SW030. The VC concentration at SW031 is a historical maximum and both recorded concentrations are equal or greater than the ANZECC Trigger Value for VC.

Implications for Human Health Risk Assessment

- There are no additional data presented in the March 2009 round of sampling with respect to the Western Margin of the Northern Plumes that affect the conclusions of the Consolidated Human Health Risk Assessment (HHRA) (URS, 2005c) and Addendum (URS, 2006). That is, the groundwater contamination within the Northern Plumes near the western margin is not considered to pose an unacceptable risk to human health, assuming that groundwater is not extracted and used;
- There are no additional data presented in the March 2009 Quarterly Monitoring Report that alter the conclusions of the HHRA (URS, 2005c) with respect to existing commercial/industrial workers in areas above the main plumes. That is, the groundwater contamination within the main plumes is not considered to pose an unacceptable risk to human health, assuming that groundwater is not extracted and used untreated; and
- Based on the data collected to March 2009, the conclusions presented within the HHRA associated with exposures within the inner and outer estuary remain unchanged. That is, given the conservative nature of the range of assumptions and the safety factors applied to toxicity values, the risks to human health for all exposure scenarios are considered to be low. However, the assessment has identified worst-case exposure scenarios (particularly within the inner estuary) where the calculated risks exceed the target values. It is noted that the potential for exposure within the inner estuary is effectively eliminated by access restrictions associated with the Port Botany expansion works.

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1 INTRODUCTION

The NSW Environment Protection Authority (EPA), now part of the Department of Environment and Climate Change (DECC), issued Orica Australia Pty Ltd (Orica) with Notice of Clean Up Action (NCUA) No. 1030236 on 26 September 2003, under the Protection of the Environment Operations (POEO) Act 1997. Since then the DECC has issued three variation notices as follows:

Notice under Protection of the Environment Act 1997	Date Issued
Notice of Cleanup Action (NCUA) No. 1030236	26 September 2003
<i>Variation NCUA No. 1033107</i>	17 February 2004
<i>Variation NCUA No. 1042957</i>	7 December 2004
<i>Variation NCUA No. 1052882</i>	2 February 2006

Condition 3 of the NCUA requires Orica to submit a Groundwater Cleanup Plan (GCP) by 31 October 2004 for consideration by the EPA. Condition 3 defines the issues to be addressed in the GCP within timeframes defined in Condition 4. Condition 3(e) defines requirements for a comprehensive monitoring plan, the results of which were to be reported to the EPA (under Condition 4G) on a quarterly basis.

This document is the twenty second report submitted in accordance to NCUA Condition 4G. The reporting interval for this report is 1 January to 31 March 2009, however if more recent and relevant information is available it is also included.

Progress Report No	Date	Comment
1	Wednesday 25 February 2004	Submitted on schedule
2	Monday 17 May 2004	Submitted on schedule
3	Friday 20 August, 2004	Submitted on schedule
4	Thursday 18 November 2004	Submitted on schedule
5	Wednesday 16 February 2005	Submitted on schedule
6	Tuesday 17 May 2005	Submitted on schedule
7	Monday 15 August 2005	Submitted on schedule
8	Wednesday 30 November 2005	Submitted on schedule
9	Tuesday 28 February 2006	Submitted on schedule
10	Wednesday 31 May 2006	Submitted on schedule
11	Thursday 31 August 2006	Submitted on schedule
12	Thursday 30 November 2006	Submitted on schedule
13	Wednesday 28 February 2007	Submitted on schedule
14	Thursday 31 May 2007	Submitted on schedule
15	Friday 31 August 2007	Submitted on schedule
16	Friday 30 November 2007	Submitted on schedule
17	Friday 29 February 2008	Submitted on schedule
18	Friday 30 May 2008	Submitted on schedule
19	Friday 29 August 2008	Submitted on schedule
20	Friday 28 November 2008	Submitted on schedule
21	Friday 27 February 2009	Submitted on schedule
22	Friday 29 May 2009	Current Report

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Previous reports are available at the relevant section of the website [www,oricabotanytransformation.com](http://www.orcabotanytransformation.com) and a distribution list is provided at the beginning of this document.

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2 COMPLIANCE SUMMARY

2.1 Notice of Clean Up Action (NCUA)

A summary of the compliance status against current NCUA (including variation notices) condition requirements is provided below. DECC has advised that the regulation of the Botany Groundwater Cleanup (BGC) Project is currently being reviewed to take into account cleanup progress and recent developments. Orica has made a submission to DECC to outline a proposed way forward.

Cond.	Summary of Requirement	Status	Reference Documents / Comments
3A	Commence preparation of GCP by 30/09/2003	Achieved	Commenced on 26/09/2003
3B	Prepare and submit GCP by 31/10/2003 covering matters listed	Achieved	GCP submitted 31/10/2003. EPA authorisation of GCP on 17/02/2004 by Variation Notice No.1033107.
4A	Commence implementation of GCP by 16/03/2004	Achieved	Work commenced immediately after submission of GCP, in anticipation of its approval.
4B	Commence containment works within primary containment area within 14 days of receipt of all approvals and complete such work within 90 days.	Achieved	Extraction commenced 28/10/2004. Orica letter of 29/10/2004, DECC letter 10/11/2004.
4BA	At least once every 3 months during GCP implementation report on effectiveness of hydraulic containment works.	Ongoing compliance	Most recent data provided in Section 3.1 of this report.
4C	Complete identification of the locations of the DNAPL sources by 31 May 2004.	Ongoing compliance	Significant DNAPL investigations completed to date and discussed in previous GCP Progress reports. No further work in this reporting period.
4D	Complete containment of DNAPL sources by 30/11/2004.	Achieved	Orica submission regarding compliance submitted 30/11/2004. DEC letter of 06/01/2005 has stated in-principle acceptance and requested further information. Orica submitted requested information on 27/01/2005. DEC provided letter of compliance on 07/09/2005.
4D	Remove DNAPL sources to the maximum extent practicable by 31 October 2005.	Achieved	Progress included in Section 4.3 of this report.
4E	Reduce the concentrations within the primary containment area to the maximum extent practicable by 31/10/2005, with an 80% target on July 2002 levels.	Achieved	Letter of compliance (to maximum extent practicable requirements of the Condition) received on 1 February 2006.
4F	Establish a secondary containment area by 31/10/2004.	Achieved	Commenced extraction 29/10/2004. Orica letter of 29/10/2004, DEC letter of 10/11/2004 (confirmed in DEC letter of 06/01/2005).
4G	Implement monitoring program and report at the end of February, May, August and November of each year.	Ongoing compliance	Summary of monitoring program results for this reporting period provided in Section 3 of this report. Details are provided in Attachment A.

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Cond.	Summary of Requirement	Status	Reference Documents / Comments
5	Remedial measures to ensure groundwater and surface water flows into Botany Bay and Penrhyn Estuary achieve ANZECC Guidelines for slightly to moderately disturbed ecosystems.	Work in progress	Discussion on latest findings provided in Section 3 and Attachment A of this report.
6	Emission controls from works and measures required by the NCUA strictly controlled through adoption of best practice. Works and operations to be carried out in a controlled and competent manner.	Ongoing monitoring being performed	A discussion on GTP emission compliance provided in Section 5 of this report.
7	Orica to make all reasonable attempts to obtain consent for work on premises not occupied by Orica and related companies. Notify EPA within 7 days if refusal to grant access.	Ongoing compliance	Ongoing access to third party premises sought as required.
7A	Updating of GCP to take account of developments.	Ongoing compliance	The GCP remains relevant in terms of the overall groundwater containment and remedial strategy. The strategy is currently under review (see comments on 7E). The Groundwater and Surface Water Monitoring Plan was agreed for 2006 and a revised Plan was submitted and agreed with former DEC (now DECC) for 2007. In June 2008 Orica, in conjunction with its consultants, submitted a proposal for monitoring from late 2008 to 2010 (URS, 2008). DECC has agreed to the revised program.
7B	Orica to monitor groundwater in any other area likely to have been, or to be, impacted by the contaminants.	Ongoing compliance	The most recent residential bore monitoring round took place in May 2009, the results will be reported in GCP Progress Report No. 23.
7C	7B monitoring is to: a) Determine the spatial distribution of the contaminants; and b) Monitor changes in the spatial contamination and distribution of the contaminants.	Ongoing compliance	Refer to comments on 7B.
7D	Monitoring results to be provided to the EPA as soon as possible after results become available to Orica.	Ongoing compliance	Important results are provided to DECC as soon as possible. The quarterly progress reports are the primary mode of reporting monitoring data.
7E	Orica must consider best practice technology in the remediation of DNAPL and groundwater containing dissolved phase contamination.	Ongoing compliance	DNAPL overseas mission completed in April 2005: Orica representatives have attended Battelle conference on "Remediation of Chlorinated and Recalcitrant Compounds" in Monterey, California in May 2008. Orica held a workshop at Botany in

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Cond.	Summary of Requirement	Status	Reference Documents / Comments
			December 2007 to discuss remediation strategy with a range of respected overseas and local experts. A submission and presentation was made to the DECC and the Botany Groundwater Community Liaison Committee (CLC) in September 2008. A community workshop was held on 31 March 2009. Revised remediation strategy will be included in the documents arising from the review of the regulatory framework for the project.
7F	Orica must provide an annual written report to DECC on actions required by 7E. First report to be provided no later than 28 February 2006.	Ongoing compliance	Annual detailed update provided in the February Progress Report each year.
7G	Orica must review the need to revise the HHRA in light of relevant monitoring data.	Ongoing compliance	See 7H
7H	All reports submitted to DECC must include an assessment of the potential risk to human health.	Ongoing compliance	All reports now submitted to DECC include relevant appraisal of potential risk to human health and hence identify any requirement to update the Consolidated HHRA.
7I	By 30 April 2006, Orica must prepare and submit to DEC, a monitoring plan for all necessary input parameters to the HHRA.	Achieved	Plan submitted on 30 April 2006.
7J	Orica must provide copies of reports issued under 7F and 7H to DWE, SESPHU, NSW Health, and City of Botany Bay (CoBB) Council within 7 days of submission to DECC.	Ongoing compliance	Ongoing compliance
7K	Orica must inform the community of developments by: <ul style="list-style-type: none"> a) A community forum agreed to by the DECC. b) Provision of a quarterly newsletter to people residing within a 1 km radius of BIP. c) Maintenance of a website in which copies of relevant reports are posted. 	Ongoing compliance	<ul style="list-style-type: none"> a) The CLC meets quarterly b) See Section 6.1. c) www.oricabotanytransformation.com
8	Works and measures under voluntary agreement must not compromise the efficacy of measures under the notice.	Ongoing compliance	Orica has since discontinued bioremediation trials because sufficient data had been obtained to assess the efficacy of bioremediation, and the PCA interim hydraulic containment was interfering with the flow of groundwater through the trials area. Orica proposed and DECC agreed to defer installation of a zero valent iron permeable reactive barrier wall.
8A	Provide additional information as detailed to DEC by 16/03/2004.	Achieved	Issued by Orica 16/03/2004, received by DEC 17/03/2004 due to courier

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Cond.	Summary of Requirement	Status	Reference Documents / Comments
			error. Additional information on PCA extraction design progressively provided in accordance with Orica's response of 16/03/2004.

2.2 Environmental Protection Licence No. 2148 (EPL2148)

Orica reports compliance against EPL2148 requirements via the submission of the annual return in September each year. The following matters in this reporting period are noted in relation to the licence conditions and the Groundwater Treatment Plant (GTP):

- EPL2148 was varied in April 2009 with the following key changes noted:
 - Updates to technical matters in relation to monitoring at the GTP stack (i.e., the frequency of and method for Volatile Organic Compound (VOC) monitoring and the method for hydrogen chloride monitoring);
 - Inclusion of a Pollution Reduction Program (PRP) for the temperature of treated water discharged to Bunnerong Canal, with the first report due by 1 September 2009;
 - Removal of most references to the Steam Stripping Unit (SSU);
 - Inclusion of permission to proceed with the Groundwater Injection and Recovery (GIR) trial;
 - Confirmation of the next reporting date for the ammonia PRP as 1 July 2009;
 - Clarification that three independent audit reports have been submitted for the GTP to date and that the need for any future audits is to be determined in consultation with the Independent Monitoring Committee (IMC) and in light of the plant's performance; and
 - Clarification of the parts of the environmental review that are to be prepared by Orica and submitted with the annual return.
- Results from an analytical scan of the GTP feedwater, discharge to Bunnerong Canal and discharge to sewer for semi-volatile compounds were reported to the DECC. This scan was undertaken in response to a request from DECC following advice to the Community Liaison Committee (CLC) from IMC member John McCracken. The results confirm that water discharged from the GTP at Point 14 does not present a risk to human health or the environment with respect to the presence of semi-volatile compounds.
- DECC is progressing a draft licence variation to ensure consistency following the review of waste classifications under the *Protection of the Environment Operations Act, 1997*. This is not expected to have any significant impacts on Orica's operations.
- As noted in Progress Report No. 21, Orica has identified an opportunity to treat contaminated stormwater, liquids and activated carbon from Stores G & H of the HCB Waste Repackaging operation at the GTP. These proposals were presented to the February 2009 Community Participation and Review Committee (CPRC)

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meeting and the March 2009 CLC meeting. Orica has since met with the Department of Planning (DoP) and DECC to discuss the possible means for seeking approval for this proposal. Further discussion is required to determine the appropriate approvals and assessment approach.

2.3 Other Licences and Statutory Approvals

A summary of recent compliance activity regarding other approvals relevant to the project is provided in the table below.

Licence / Statutory Approval	Comments
Conditions under Part V of the Water Act	<ul style="list-style-type: none"> Groundwater and surface water monitoring conducted during this reporting period was undertaken in accordance with the program developed in response to condition E5.1.3 of EPL2148. A summary of the results is provided in Section 3 of this report. Orica submitted production bore applications to DWE in mid 2008 and awaits a response. Orica is currently working with DWE to secure bore licences for the injection of contaminated groundwater for the GIR trial.
Conditions from Department of Planning	<ul style="list-style-type: none"> These conditions require that Orica maintain a register of accidents, incidents and potential incidents with actual or potential significant off-site impacts on people, property, or the biophysical environment. Orica maintains an incident register for the GTP in the internal Safety Health and Environment Incident Management database. The DoP conditions require preparation of Hazard Audits. The first GTP hazard audit was conducted in November 2008 and the report submitted in December 2008. The results of this audit will be presented to the CLC in July 2009.
Network Operator and Retail Supplier licence under the Water Industry Competition Act, 2006.	<ul style="list-style-type: none"> Orica is currently preparing an application for a combined Network Operator and Retail Supplier licence under the Water Industry Competition Act, 2006. Applications are due to be submitted to the Independent Pricing and Regulatory Tribunal of NSW by 8 August 2009.

3 QUARTERLY MONITORING EVENT

NCUA Condition 3B(e) requires Orica to implement a comprehensive monitoring program within the defined area (formerly named as the Groundwater Protection Zone 1 by the then DIPNR (subsequently DNR and now part of DWE), and now referred to as the Groundwater Exclusion Extraction Area [GEEA]) to:

- monitor changes in concentrations of the substances in the contaminant plumes;
- monitor changes in the spatial distribution of contaminant plumes in the sub-surface;
- gauge groundwater levels to assess effectiveness of hydraulic containment; and
- monitor concentrations in groundwater and surface water discharges to Botany Bay and Penrhyn Estuary for comparison against the Australian and New Zealand Guidelines for Marine and Fresh Water (ANZECC, 2000) trigger values for protection of slightly to moderately disturbed ecosystems.

Orica and DEC (now DECC) subsequently agreed the content and scope of the *GTP Groundwater and Surface Water Monitoring Plan* (URS, 2005c). On an annual basis DECC and Orica meet to discuss the effectiveness of the monitoring program and revise monitoring requirements as appropriate. In June 2008 Orica, in conjunction with its consultants, submitted a proposal for monitoring from late 2008 to 2010 (URS, 2008).

Orica engaged URS to complete a quarterly monitoring event in March 2009 in accordance with the agreed monitoring plan. Results and discussions were provided in the URS report *Groundwater Treatment Plant (GTP) Quarterly Groundwater and Surface Water Monitoring Report, May 2009*. This report is bound separately as Attachment A. The remainder of this section has effectively been transcribed from the URS report to summarise the monitoring event.

3.1 Hydraulic Containment

General

- The slow migration of groundwater and the potential for increased pumping to recapture groundwater mean that hydraulic containment can still be maintained through extended periods of no, or low, groundwater extraction. An assessment of the maximum time periods that the Secondary Containment Area (SCA) and Primary Containment Area (PCA) containment lines can be off-line before groundwater at the containment line cannot be recaptured was presented in previous GTP monitoring reports (URS, 2007);
- Implementation of hydraulic containment has altered the natural groundwater flow regime with flow now characterised by flow drawn towards the three containment lines;
- Large areas of very low hydraulic gradients have developed due to hydraulic containment. These areas represent zones of very slow groundwater flow and as a result contaminant concentrations in these areas are likely to remain relatively constant for the medium to long term;

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- While the observed pattern of groundwater flow in March 2009 is clearly different to that observed during the baseline monitoring in October 2004 (URS, 2005a) it is very similar to that presented in recent monitoring reports; and
- Water levels at regional monitoring wells show no discernible water level impact due to hydraulic containment thus indicating a limited potential to affect infrastructure and licensed groundwater users.

BIP Containment Line

- The primary purpose of the Botany Industrial Park (BIP) containment line is to contain contaminated groundwater migrating from source areas located on BIP. If groundwater extraction is temporarily reduced due to periodic GTP capacity limitations, this reduction occurs at sections of the BIP containment line based on a predetermined order of priorities; and
- The inferred contours and patterns of the shallow and deep groundwater flow infer that hydraulic containment during the monitoring period was limited to the central portion of the containment line. Containment may not have been achieved at the northern and southern portions of the BIP containment line during the monitoring period. However, water elevation contours show that flow from the northern and southern ends of the containment line was towards the central portion of the containment line, suggesting that in those areas some containment may have been taking place. As discussed in previous monitoring reports, the PCA will effectively capture a large portion of the flow that has migrated past the BIP containment line.

PCA Containment Line

- The primary purposes of the PCA are mass removal of the central 1,2-dichloroethane (EDC) plume in the deep aquifer, and hydraulic containment on Block 2, Southlands;
- Interpreted deep groundwater flow at the PCA shows deep groundwater was successfully contained at the PCA;
- The interpreted contours and groundwater flow lines infer that although some drawdown was recorded, shallow groundwater may have been migrating from the PCA for the period of measurement. However, it is important to note that the rate of migration of shallow containment has been significantly reduced and the majority of contaminant mass lies within the deep aquifer that is being successfully contained. It is recommended that the trial of increased extraction rates at the PCA be continued and, where possible, extended to allow additional assessment during the next monitoring round; and
- Further assessment of shallow groundwater containment at PCA will be provided in the June 2009 quarterly monitoring report (provided in August 2009) when data from the newly installed shallow monitoring wells is available.

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SCA Containment Line

- The primary purpose of the SCA is to minimise migration of groundwater contamination to Botany Bay (recognising that there was already contamination in areas downgradient and to the east of the containment line before groundwater extraction commenced);
- Hydraulic containment was achieved in both the shallow and deep aquifers as water levels and hydraulic heads in monitoring wells remained consistently at or below the nominated target levels; and
- Results of salinity monitoring downgradient of the SCA indicate similar levels to those observed during previous monitoring rounds at most locations, although the results for BP115I and BP115D are higher than previously reported.

3.2 Chemical Monitoring Results

Chemical Abbreviations

The following chemical abbreviations are used in this Section:

TCE	trichloroethene
VC	vinyl chloride
EDC	1,2-dichloroethane
PCE	tetrachloroethene
CFM	chloroform

Onsite Monitoring Wells

- The March 2009 sampling period represents a quarterly monitoring event. As such, it is focussed on collecting data from offsite locations that are critical to environmental and human health receptors. No samples have been collected from onsite sampling locations (i.e. on BIP or Southlands).

Offsite Monitoring Wells

- It was noted during the December 2008 monitoring event that the concentrations recorded for the 5.25 m and 6.5 m ports at BP115 deviated significantly from historical data. It was suspected that the samples were interchanged during the sample handling process, either in the field or laboratory. The results from BP115 in the current (March 2009) monitoring event are consistent with historical data confirming that the December 2008 data for the 5.25 m and 6.5 m ports is suspect and is considered anomalous. Hence, the December 2008 data for the 5.25 m and 6.5 m ports at BP115 have not been included in the parametric tests;
- Concentrations reported for offsite monitoring wells were similar to those previously reported with the exception of wells located at the leading edge of the Central Plume, which is continuing to slowly migrate towards the SCA, and at sampling locations in the dune areas in Penrhyn Estuary. Concentration fluctuations in the dune areas are due to contaminants that had migrated downgradient of Foreshore Road prior to the commencement of hydraulic

containment at the SCA being moved back and forth as the extraction rates in the containment line are varied;

- The increases and reported maximums observed at BP60 (TCE and VC) and BP77 (EDC, PCE, TCE, VC and CFM) are considered to be significant and are considered consistent with short- and long-term historical trends. It is noted that contamination from this location will be captured at the SCA and will not discharge into Penrhyn Estuary;
- The increased concentration of VC at BP95 (3 m port) is also considered significant and while the reported concentration does not change the assessed human health risk in the adjacent area ongoing monitoring at this location is required to ensure that the concentrations adopted in the risk assessment remain relevant; and
- Increases were observed for VC and PCE at BP115 (5.25 m port) and MWF15I. The increases are consistent with historical trends and are considered to be representative of groundwater that migrated downgradient of Foreshore Road prior to the commencement of hydraulic containment at the SCA.

Penrhyn Estuary

- In general, volatile CHC concentrations in pore water within Penrhyn Estuary are similar to or lower than historical concentrations; and
- VC concentrations above the ANZECC (2000) Trigger Value for VC (0.1 mg/L) were observed at BP43 (0.1 m port) at both high (0.16 mg/L) and low (0.36 mg/L) tides. These concentrations are similar to those reported in September 2007 suggesting fluctuations at this location are seasonal in nature and not due to significant changes in contaminant distribution in Penrhyn Estuary

Surface Water

- The concentrations of volatile CHCs in surface water sampling locations were generally less than the respective ANZECC (2000) Trigger Values. This is consistent with the monitoring rounds performed since the GTP commenced steady operation indicating the remediation is having a significant effect on the surface water quality in the estuary; and
- Increases in VC concentrations were noted at the Springvale Drain outlet at SW031 at high tide (0.5 mg/L) and downstream of the aforementioned outlet at SW030 (0.1 mg/L). The VC concentration at SW031 is a historical maximum and both recorded concentrations are equal or greater than the ANZECC Trigger Value for VC (0.1 mg/L).

Implications for Human Health Risk Assessment

- There are no additional data presented in the March 2009 round of sampling with respect to the Western Margin of the Northern Plumes that affect the conclusions of the Consolidated Human Health Risk Assessment (HHRA) (URS, 2005c) and Addendum (URS, 2006). That is, the groundwater contamination within the Northern Plumes near the western margin is not considered to pose an

unacceptable risk to human health, assuming that groundwater is not extracted and used;

- There are no additional data presented in the March 2009 Quarterly Monitoring Report that alter the conclusions of the HHRA (URS, 2005c) with respect to existing commercial/industrial workers in areas above the main plumes. That is, the groundwater contamination within the main plumes is not considered to pose an unacceptable risk to human health, assuming that groundwater is not extracted and used untreated; and
- Based on the data collected to March 2009, the conclusions presented within the HHRA associated with exposures within the inner and outer estuary remain unchanged. That is, given the conservative nature of the range of assumptions and the safety factors applied to toxicity values, the risks to human health for all exposure scenarios are considered to be low. However, the assessment has identified worst-case exposure scenarios (particularly within the inner estuary) where the calculated risks exceed the target values. It is noted that the potential for exposure within the inner estuary is effectively eliminated by access restrictions associated with the Port Botany expansion works.

3.3 Recommendations

On the basis of the results of the March 2009 program, the following recommendations are made:

- A number of loggers and transducers require repair and/or replacement; and
- Optimisation of the network of automated water level loggers and transducers is recommended.

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4 OTHER ENVIRONMENTAL ACTIVITIES

Other groundwater and surface water monitoring and data acquisition activities that have been undertaken in this reporting period pursuant to, or that have relevance to, the agreed monitoring plan and conditions of the NCUA are detailed below.

4.1 Air Monitoring and Human Health Risk Assessment

It was reported in Progress Report No. 6 that the draft *Consolidated Human Health Risk Assessment 2005* (URS, 2005c) was prepared by URS and submitted to the DEC on 31 March 2005 with copies provided also to NSW Health and Prof. Brian Priestly (Monash University) from the Australian Centre for Human Health Risk Assessment for independent review. Following a request from the DEC, the draft report was released publicly.

Prof. Priestly completed the independent review and provided comments in a letter to the DEC on 11 May 2005. Generally the comments were overwhelmingly positive and strongly supported the findings of the risk assessment.

Since 1995 air emission monitoring has conducted on a nominally 15-month cycle (targeting different seasons every year). Sampling locations are on and off the BIP and are usually adjacent to shallow groundwater-monitoring points. Some air monitoring locations – such as the Car Park Waste Encapsulation – are not directly relevant to the Botany Groundwater Project. Sampling was last performed in March 2008 and the next round is scheduled for June 2009.

4.2 Residential Monitoring

The first residential bore sampling event for 2009 was completed on 8 May. The results will be provided to the residents and DECC in early June. A summary will be provided in GCP Progress Report No. 23 in August.

4.3 DNAPL Source Area Depletion Projects

In accordance with Condition 7E of the NCUA, Orica is required to stay abreast of relevant DNAPL remedial technologies and apply them as practicable. Orica is required to submit an annual report pursuant to this condition at the end of February every year. The 2009 report was provided in GCP Progress Report No. 21.

Orica held a workshop at Botany in December 2007 to discuss the remediation strategy – particularly with regard to removal of DNAPL source areas – with a range of respected overseas and local experts. A submission and presentation was made to the DECC and the CLC in September 2008. A community workshop was held on 31 March 2009. The revised remediation strategy will be included in the regulatory instruments arising from the review of the regulatory framework for the project that is underway.

4.4 Groundwater Injection and Recovery

In January 2009, DECC provided feedback on the proposed Groundwater Injection and Recovery (GIR) project. GIR proposes to reinject extracted groundwater into the aquifer upgradient of the containment lines on BIP if the GTP is unable to treat groundwater for an extended period of time.

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Orica has received a variation to EPL2148 allowing for the completion of a trial injection of groundwater. Orica has also applied for test bore licences from the Department of Water and Energy (DWE) to allow for drilling of the injection and monitoring wells required for the trial. At the time of writing, DWE had advised that the licences were to be issued shortly. Work will commence shortly thereafter.

4.5 Springvale Drain Infilling

Previous GTP reports have detailed the monitoring of chlorinated solvent vapours in air close to Springvale Drain caused by the influx on contaminated groundwater into the drain. Accordingly it was observed that reducing the groundwater level at Southlands (through pumping at the BIP and PCA containment lines) has decreased groundwater levels and hence decreased CHC concentrations in the surface water in Springvale Drain.

The monitoring also determined that the realignment channel located in Southlands contains concentrations of contaminants far greater than the main channel. Consequently, as a precautionary measure to protect against possible elevated concentrations of CHCs in air close to the realignment channel, it was determined to be prudent to infill this channel. The channel is not a natural feature, but was created by the sediment remediation works performed by Orica in the late 1990s.

Orica applied to DWE for a permit under Part 3 Chapter 3 of the *Water Management Act, 2000*. DWE has advised Orica that the works may proceed.

At the time of writing, preparations for the works were underway.

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5 GROUNDWATER TREATMENT PLANT OPERATION

5.1 GTP Performance

A summary of the GTP operational performance for 1 January to 31 March 2009 is provided below:

Average volumetric rate of groundwater treated 1 January 2009 to 31 March 2009	4.25 ML/day
Total volume of groundwater treated since pump and treat activities commenced in 2005 (at 31 March 2009).	5.2 GL
Total mass of CHCs destroyed in the thermal oxidiser	671 tonnes

5.2 Stripped Water Treatment Plant (SWTP)

It has been reported previously that co-current Biological Aerated Filters (BAFs) were installed in the first half of 2008. Since installation, these have generally increased the run times and treatment capacity of the GTP.

In this reporting period, a batch of sub-standard graded zeolite substrate (used to encourage biological growth in the BAFs) resulted in a temporary reduction in treatment capacity for the latter half of the reporting period.

At the time of writing, a staged zeolite replacement program was in progress and capacity was again approaching more than 5 ML/day on average.

5.3 Thermal Oxidiser and Dioxin Air Emissions

A routine quarterly stack emissions sampling event took place in March 2009. All parameters, including dioxins, were within specification.

5.4 Beneficial Reuse of Treated Water

The GTP began supplying the Orica ChlorAlkali Plant with treated water in December 2006. Qenos is regularly receiving treated water for use in cooling towers. Solvay Interlox continues to receive and utilise treated water.

GCP Progress Report No. 21 reported that Orica had commenced an investigation to determine the maximum sustainable volumetric rate of groundwater the aquifer could provide to the GTP from the existing groundwater extraction network and to assess the impacts that this extraction would have on the built and natural environments (e.g., subsidence).

At the time of writing, Pells Sullivan Meynink (PSM) was completing the subsidence assessment and A D Laase Hydrologic had commenced the model recalibration. Work is expected to be completed in July 2009.

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6 COMMUNITY CONSULTATION

Orica supports a two-way communication process with the local community and this section incorporates feedback received from the community during the reporting period.

6.1 Community Liaison Committee

A quarterly CLC meeting was held on 17 March 2009. Presentations were made by the DECC and Orica on progress of the BGC Project. The following table summarises key matters raised by members of the CLC at the meeting, and actions taken or planned as a result (please note that this information has been summarised from draft minutes not yet endorsed by the CLC).

Matter Raised by CLC	Action Taken or Planned
Concerns with non-groundwater related Orica legacy issues/projects being raised at CLC meetings	Orica has commenced liaison with the Chair and key community members to discuss how information related to other Botany Transformation Projects could be more appropriately shared with the community
Reporting style by Orica in its progress reports to the DECC/CLC on contaminant mass and groundwater cleanup status	Orica has taken these comments on board for future reporting.
Notification protocols	Protocols finalised at the CLC meeting. Copy circulated with draft CLC minutes.
Attendance of DoP at CLC meetings	Orica has discussed the request with the DoP. DoP has advised an intention to attend CLC meetings, but noted that circumstances could sometimes prevent a representative being available for every meeting.
Prof Acworth to be asked to provide feedback to the CLC on the results of the assessment of maximising hydraulic containment.	Prof Acworth has been asked to provide feedback to the CLC. This will occur following completion of the modelling and geotechnical work. The September CLC meeting would be the first opportunity.
DECC review of regulatory tools to manage BGC Project: consultation with the CLC and the Environmental Defender's Office (EDO)	Feedback from the EDO has been shared with the CLC – no further meeting with EDO is proposed. DECC to circulate its proposed regulatory plan to the CLC two weeks prior to the June CLC meeting.
Future independent compliance audits for the GTP	Orica has sought a modification to the EPL to remove the need for a compliance audit in 2009. Orica will present the BGC results from the 2009 EPL Annual Return to the CLC when available (either September or December CLC meeting).
Community members of the CLC wish to consider how it can distribute information on the BGC Project to the community independently from Orica	Further discussions to be held at the June CLC meeting
Effective means to obtain updates on non-Orica related groundwater contamination in the Collins Street area in Pagewood	DECC to make information on the regulation or the source site available on its website and to liaise directly with concerned residents of Collins Street to provide an update on the investigation and remediation plans for the site

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CLC Newsletter

CLC Newsletter No. 32 was distributed in March 2008 after being reviewed by the CLC. It included updates on groundwater treatment and containment, the December 2008 CLC meeting, residential bore monitoring results from November 2008 sampling, and the community ambient air monitoring results.

6.2 Independent Monitoring Committee

The IMC contracts with Orica will be extended for a year in accordance with the contract wording. The CLC agreed to extend Dr Hibberd's contract for twelve months to bring it in line with all other IMC members. The table below lists recently completed and current IMC tasks.

Task #	IMC Task Description	Status
21	Orica to share the requirements of its Environment Protection Licence, Trade Waste Service Agreement and Ammonia Pollution Reduction Program for the GTP, along with recent results for each, with Dr John McCracken in order to better describe the inputs and outputs from the GTP treatment process. Dr John McCracken to provide feedback to the CLC following review of this information.	DECC sent a letter to Orica on 12/09/08 requesting sampling of feed and product water and scanning for semi-volatile compounds. Results were reported to the DECC and will be shared with CLC at June quarterly meeting. DECC wrote to Orica on 28/04/09 thanking Orica for conducting the work as requested.
23	Prof Acworth to be invited to attend a community workshop on Orica's Strategy Review and DNAPL technology investigations.	Prof Acworth attended the workshop on 31 March 2009.

6.3 Communication Tools

Community Workshops

A workshop on BGC Project Remediation Strategy Review/DNAPL technology investigations was held on 31 March 2009. The majority of the presentations given at the session have been uploaded on the Orica project's website. A workshop report is being drafted and will be made available on the website when ready.

Orica plans to hold further community workshops on Water Recycling initiatives as those plans develop further over time.

Newspaper Columns

Two newspaper columns were published in the *Southern Courier* since the last quarterly Progress Report. A column was also published in the *St George and Sutherland Shire Leader* in March 2009. The columns incorporate information on a range of Orica projects. Reporting on the BGC Project was as follows:

- *Column 88: 31 March 2009:* An invitation to the BGC Remediation Strategy Review Community Workshop.
- *Column 89: 28 April 2009:* Information on GIR system.

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- *Column 90: 26 May 2009:* Groundwater levels investigations near Hensley Athletics Field and an invitation to the June CLC meeting.

Website

The website is an important tool which provides immediate access to information about the BGC Project and supports Orica's commitment to open and transparent communication.

The following material has been posted on the website during the reporting period:

- Groundwater Cleanup Plan Progress Report No. 21;
- Recent newspaper columns;
- The March 2009 CLC newsletter;
- The Briefing Paper, and all presentations from the CLC March 2009 meeting; and
- Final report (No. 3) on the Orica Community Ambient Air Monitoring Program.

There were 3,210 visits to the Botany Transformation Projects website from 23 February to 19 May 2009, of which 1,805 visits were to BGC Project pages and 159 visits to Treated Water Recycling Program pages.

1800 Number

Calls during this reporting period related to requests for residential bore testing, requests to tour the BIP site and queries about the BGC project from new purchasers of property in the local area.

E-mail Feedback

Several e-mails were received in this reporting period from browsers of the Botany Transformation Projects website and from readers of the CLC newsletters included requests regarding the availability of previous CLC newsletters.

There were no emails received via the CLC feedback facility in this reporting period.

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7 REFERENCES

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Orica Australia Pty Ltd (Orica, 2003). *Groundwater Cleanup Plan*. EN1591-00-10-001, Rev 0. October 2003.

URS (2005a) Orica Botany Environmental Survey, Stage 4 – *Remediation. Groundwater Cleanup Plan (GCP) Quarterly Groundwater and Surface Water Monitoring Report - December 2004*. Doc. No. R021_A, 15 February 2005.

URS (2005b) Orica Botany Environmental Survey, Stage 4 – Remediation. *Groundwater Treatment Plant – Groundwater and Surface Water Monitoring Plan*. Document Number R013_A. 17 May 2005.

URS (2005c) Orica Botany Environmental Projects. *Consolidated Human Health Risk Assessment 2005*. Document Number R022_D. August 2005.

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URS (2008) *Proposed Amendment to the GTP Groundwater and Surface Water Monitoring Program, 2008-2010*. WCIE 4396. 6 June 2008.

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ATTACHMENT A – QUARTERLY MONITORING REPORT – MARCH 2009.

Groundwater Treatment Plant (GTP) Quarterly Groundwater and Surface Water Monitoring Report, May (published) 2009, URS Australia Pty Ltd. *Separately bound report.*