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The Worst Groundwater Contamination Incident in the Southern Hemisphere - A Case Study of Orica's Botany Industrial Park

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Abstract:
Sydney appears to be a clean city. However, not many people know that she also suffers from environmental impacts of contaminated land. The ignorance in the past allowed a lot of industrial sites to be contaminated. In recent years, the impacts of the contaminated sites begin to surface like the explosion of time bombs. The most prominent one is Orica's Botany Industrial Park.

This site was formerly owned by the British chemical company ICI. As a result of decades of manufacturing activities and poor environmental practices on the site, chlorinated hydrocarbons leaked into the ground for a period from as early as 1940s to late 1980s. The carcinogenic chemicals mix with groundwater and eventually form a toxic plume that has spread 2 square kilometres covering the area under the houses of about 1000 residents. The plume is now gradually moving towards Botany Bay and is only a few hundred metres from the bay. In unchecked, the toxic plume will bring disaster to marine life and cause health problems to human and animals in contact with the contaminated water in the bay.

Orica, an Australian chemical company, acquired the site from ICI in 1997 and immediately inherited the liability to fix the contamination problems. It is estimated that the remediation program will cost A$167 million (about US$125 million) and take 30 years to complete. This paper aims at examining the challenges facing the company and the impact on the value of the site.

Keyword:
Land contamination, liabilities, remediation, land value

Introduction

Sydney, the biggest city in Australia, is generally regarded as a beautiful city with clean environment. While Sydney is not a heavy industrial centre, she has various kinds of industry ever since the early settlement. The ignorance in the past has led to different degrees of contamination to the industrial sites.

As a result of changes in economy, industrial activities have ceased on a number industrial sites. Some of these sites have been left idle for a number of years. Owing to the shortage of land supply in urban areas, former industrial sites are being sought after for alternative uses (Simons, 1998, Chan, 1999, Adams & Watkins, 2002). Very often land contamination problem is discovered during the due diligence process of the redevelopments.

For industrial sites with continual operation, land contamination issue is often revealed by the media, or green groups such Greenpeace. The Orica's Botany Industrial Park is one of those contaminated sites brought in the limelight by the media and green groups. The Orica site has the largest stockpile of HCB (hexachlorobenzene) in the world (Greenpeace, 2004). The site has also a stockpile of EDC (Ethylene Dichloride) that leaked for 40 years and contaminated the groundwater below the site. The contaminated groundwater spreads into a toxic plume covering an area of about 2km^2 under the houses of about 1000 residents (Skelsey, 2004c). The plume is moving at a speed of 120m/year towards the Botany Bay (Huxley, 2005a).

This paper aims to examine the challenges facing Orica and the impact on the value of the site. A conclusion is provided at the end of the paper.

The site

The site is known as Botany Industrial Park (BIP). It is located in the Sydney suburb of Banksmeadow, 11km south of the Sydney CBD. The land area is about 74ha. The site is surrounded by residential and industrial suburbs of Banksmeadow and Botany on the west side, Port Botany and Sydney international airport on the south side, residential suburbs of East Botany, Maroubra, Kingsford and Pagewood on the north side, and residential suburbs of Hillsdale, Matraville, Malabar, Chifley and shopping area of Maroubra Junction on the east side.

The site has been used for manufacturing of chemicals and related products since 1942 under different ownerships. From 1942 to 1997, the site was owned by ICI Australia , a subsidiary of the British ICI chemical company. It was the largest chemical site in NSW. In July 1997 the British parent company sold the controlling shares and the company became an independent Australian company and was renamed Orica Australia Pty Ltd in February 1998 (Orica Botany HCB, 2004).

Under the ownership of ICI Australia, the site was used to manufacture different types of chemicals and products as shown in Table 1.

Table 1 Chemicals and products manufactured between 1942 to 1996

Acetylene	Ammonia	Ammonium nitrate	Carbon bisulphide	Carbon tetrachloride
Chlorine	Diphenylamine	Ethylene	Ethylene dichloride	Ferric chloride
Formaldehyde	Herbicides 2, 4D/2,4,5T	Hydrogen	Hydrochloric acid	Hydrocarbons
Hexachlorobenzene HCB	Nitric acid	Penothiazine	Perchloroethylene	Polythene
Linear low density polythene	Propylene	Polypropylene	Rubber	Soda ash
Sodium hydroxide	Sodium sulphide	Sodium silicate	Surfactants	Trichloroethylene perchlorethylene
Vinyl chloride PVC	Urea			

Source: HCB CIS, 2002b

In December 1998, the site was subdivided into 9 new lots sharing common facilities and access. A special purpose company, the Botany Industrial Park Pty Ltd (BIP), was established to provide common site services. In addition, it is also responsible for the maintenance of safety and environmental standards. Orica retains the majority share of the site and is responsible for site management and legacy issues (Oricia Botany HCB, 2004)

At present, the chemicals and products in Table 2 are produced on the site.

Table 2 Chemicals and products currently manufactured on site

Chlorine	Ethylene glycol	Ethylene
Polyethylene	Low density polyethylene	Demineralised water

Source: HCB CIS, 2002c

Land and groundwater contamination problems

In the early years of production, the importance of proper disposal of trade waste and prevention of land contamination was not recognised. Environmental awareness and standards at that time were far lower than those of today. From the 1960s to 1991, hexachlorobenzene (HCB) was produced on the site as a by-product from the manufacture of chemical solvents and plastics. HCB is a powder (crystals) form chemical and is used as a wood preservative and as a fungicide. In regard to environmental impacts, it is a persistent organic pollutant (POP) that is chemically stable and resistance to biodegradation. It may attack the skin, nerve, liver and kidneys. It may cause reproductive problems and cancer (US EPA, 2005b).

About 10,000 tonnes of HCB is now stored on the site. There are other contaminated wastes from the decontamination and demolition of the Solvents and Vinyls Plants. These contaminated wastes are separately stored in containers on the site. In addition, about 45,000m^3 of sand, coal ash and HCB contaminated soil is encapsulated in a Hypalon liner (a rubber sheet) under the car park on the northern side of the site (HCB CIS, 2002a).

Land contamination on the site is not the biggest the problem. The biggest problem is groundwater contamination. The improper waste disposal practice in the past together with leakage and accidental spills of chemicals and liquid trade wastes over a long period of time have contaminated the groundwater which forms a toxic plume that spreads beyond the site boundaries. In regard to liquid trade wastes, it was an acceptable practice in the early days to dispose them into unlined stormwater channels and pits. In 1958, ICI installed an effluent treatment plant on site and Sydney Water began to accept trade wastewater from the site since then (HCB CIS, 2002b).

In 1989 the State Pollution Control Commission (now the NSW EPA) ordered ICI Australia to carry out an investigation of groundwater contamination in the vicinity of the BIP site. The survey focused on chlorinated hydrocarbons, chromium and mercury. The outcomes confirmed that there was contamination of groundwater over a period of up to 50 years (Orica Botany Groundwater, 2004) and a 2 km^2 toxic groundwater plume was developed under Banksmeadow (Skelsey 2004a). Based on this initial investigation, a second survey was carried out in 1993. This survey identified 6 major sources of contamination:

1. the former solvent plant
2. EDC [dichloroethane] storage tanks
3. former CTC [carbon tetrachloride] storage tank
4. filled areas adjacent to the railway line
5. old 'heavy ends' drum storage area
6. old surface drain

(HCB CIS, 2004)

In September 2003, the New South Wales Environmental Protection Authority (NSW EPA) issued Orica a cleanup notice under section 91 of the Protection of the Environment Operations Act 1997 (HCB CIS, 2004). The notice requires Orica to use the 'best practice' to clean up the groundwater contaminated by the chemicals in Table 3 originally emanating from the BIP site.

Table 3 Chemicals in groundwater listed in the cleanup notice

Volatile Chlorinated Hydrocarbons	Semi-volatile Chlorinated Hydrocarbons
Chlorinated Methanes:	
Carbon Tetrachloride (CTC)	1,2-Dichlorobenzene
Methylene Chloride	1,3-Dichlorobenzene
Chloroform	1,4-Dichlorobenzene
Chloromethane	1,2,4-Trichlorobenzene
Chlorinated Ethenes:	1,3,5-Trichlorobenzene
1,1,1,2-Tetrachloroethane	1,2,4,5-Tetrachlorobenzene
1,1,1-Trichloroethane	Pentachlorobenzene
1,1,2-Trichloroethane	Hexachlorobenzene
1,1,2,2-Tetrachloroethane (PCA)	Hexachlorobutadiene
1,2-Dichloroethane (EDC)	Hexachlorocyclopentadiene
Chloromethane	Hexachloroethane
Chlorinated Ethenes:	Hexachloropropylene
cis-1,2-Dichloroethene	
Tetrachloroethene (PCE)	
trans-1,2-Dichloroethene	
Trichloroethene (TCE)	
Vinyl Chloride (VC)	

Source: NSW EPA, 2003

Amongst the various chemicals that contaminated the groundwater, 1, 2-Dichloroethane (EDC) has caused major concern. EDC is a colourless, oily, organic liquid with a sweet, chloroform-like odour. It is mainly used for manufacturing plastics, rubber and synthetic textile fibres. It will cause central nervous system disorders, and adverse lung, kidney, liver circulatory and gastrointestinal effects. It may also cause the development of cancer (US EPA, 2005a).

The toxic groundwater plume has spread 2 km^2 covering the area under the homes of about 1000 residents (Skelsey, 2004c). The amount of groundwater contaminated is enormous. It is estimated that based on a cleanup treatment of 15 million litres a day, it will take at least 30 years to complete (Peatling, 2005). In July 2005, the Department of Infrastructure, Planning and Natural Resources (now the Department of Planning) declared the vicinity of the contaminated groundwater plume at the BIP a Groundwater Extraction Exclusion Area and requested residents not to use the bore water in any capacity.

Jerzy Jankowski, a hydrogeologist at University of New South Wales, claims that this is "*the biggest toxic groundwater plume in the southern hemisphere*" (Skelsey, 2004b). The plume is moving at a speed of 120m/year towards the Botany Bay (Huxley, 2005a). The most concentrated part of the plume is only 300m from the edge of the Penrhyn Estuary and Botany Bay. When the plume enters the bay, it will be a disaster for marine life and dangerous to human and animals in contact with the contaminated seawater. The City of Botany Bay Council has already installed warning signs to warm people not to swim in the area or eat any form of marine life from the bay (Skelsey, 2004b).

Major challenges facing Orica

1. Legal and bureaucratic challenges
   Contaminated land in NSW is subject to regulatory controls under various laws. Remediation works have to be approved by various government authorities accordingly the legal requirements. These laws and statutory authorities are summarised in Table 4.

Table 4 Summary of approvals required for the remediation project

Authority	Relevant Legislation	Approval
NSW Department of Environment and Conservation	*Protection of the Environment Operations Act* 1997	Variation to the existing Environment Protection Licence (ref. 2148) issued to Orica under the POEO Act 1997.
WorkCover Authority and NSW Environment Protection Authority	*Dangerous Goods Act, 1975*	Variation to the existing Dangerous Goods License for the storage of dangerous goods on GTP site
NSW Department of Infrastructure Planning and Natural Resources (Former DLWC)	*Water Act* 1912	License to undertake groundwater extraction from installed extraction wells on the PCA and SCA containment lines and the DNAPL containment area
NSW Maritime Authority	*Rivers and Foreshores Improvement Act* 1948 *Maritime Services Act 1935* *Management of Waters and Waterside Lands Regulation*	Part 3A Permit to undertake the construction works within 40 m of the mean high water mark of Botany Bay (for the works on the discharge point into Bunnerong Canal) Approvals to construct discharge point into waters vested in the NSW Maritime Authority.
Sydney Ports Corporation	-	Approval to discharge treated water into Bunnerong Canal
Sydney Water Corporation	*Sydney Water Act* 1994	Variation to the existing Industrial Trade Waste Consent (No. 489) issued to the BIP under the Sydney Water Act 1994
NSW Fisheries	*Fisheries Management Act* 1994	Permit from the Minister of Primary Industries to address the potential for impact on seagrasses and mangroves

Source: URS, 2004, Table 6.1.

The groundwater remediation project is potentially hazardous as defined by the State Environmental Planning Policy (SEPP) No. 33 - Hazardous and Offensive Development. Orica is required to carry out a Preliminary Hazard Analysis. Clause 21(a) of the State Environmental Planning Policy (SEPP) No. 55 – Remediation of Land provides that "*any development or activity carried out for the purpose of complying with a clean-up notice may be carried out without development consent*". Orica is therefore not required to get development consent for the remediation works. However, it is required to prepare an environmental impact statement (EIS) under section 111, Part 5, of the Environmental Planning and Assessment Act 1979 (URS, 2004). The EIS was submitted in November 2004.

In view of the number of authorities involved in the approval process, the NSW EPA's assured Orica that a "whole of government' approach would be used to speed up the approval process. Nevertheless, the remediation project was still held up by various

government 'red tapes'. Being under the pressure to urgently stop the toxic groundwater from reaching Botany Bay, Orica desperately lodged an appeal to the Carr government in August 2004 for "*urgent intervention to gain the statutory approvals which now are critical if Orica is to have any chance of undertaking the works necessary to deal with the plumes in time to avoid reaching Botany Bay*." (Skelsey, 2004a). Eventually, the Department of Environment and Conservation in February 2005 approved the groundwater treatment project to proceed with strict conditions (Orica Botany Groundwater, 2004).

2. Financial challenge

   Orica accepts the groundwater remediation responsibility. In October 2004, it announced that the total cleanup cost is A$154 million (about US$115 million), 3 times higher than the original estimated of $51 million (about US$38 million) announced in August 2003. A$116 million (about US$87 million) of which is used to remove the toxic groundwater and A$38 million (about US$28 million) is used to process the groundwater to drinking water standard. The announcement saw its share price drop by 18 cents to A$17 (about US$13) (Skelsey, 2004e).

   The above cleanup budget is not final. In March 2005, it was reported that the amount was revised to A$167 million (about US$125 million) (Huxley, 2005a). There is no guarantee that this amount will not be raised again in the future. The financial commitment is an enormous amount by any scale. There is concern about whether Orica can afford to complete the cleanup project. There is also suggestion that the NSW government should secure a bond from Orica to cover the remediation works (HCB CIS, 2004)

3. Public image

   The groundwater contamination incident has been widely published by the media. It has been referred to as "*one of the state's worst chemical spills*", "*the biggest [groundwater toxic plume] in the southern hemisphere*", "*southern hemisphere's worst groundwater contamination*", "*southern hemisphere's worst groundwater spill*" (Skeley, 2004a, b, c & e), "*worst toxic threat that Sydney has ever faced*" (Peatling, 2004) and "*the most serious ground contamination issue in Australia*" (Huxley, 2005b), etc.

   In response to the negative media exposure, Orica adopts an open and sincere attitude on the issue. It does not deny responsibility. It regrets the groundwater contamination caused in the past and commits to clean it up to prevent long-term environmental damage. It has entered into a Voluntary Investigation and Remediation Agreement with the NSW EPA and responded quickly to the cleanup notice by promptly submitting a draft cleanup plan to the NSW EPA.

   Orica keeps the remediation process open. It actively maintains community consultation and keeps residents informed on the progress via a regular column in the local Southern Courier newspaper and through a web page 'Orica Botany Groundwater' (http://www.oricabotanygroundwater.com/index.htm). It also invites from time to time news reporters to report on the remediation plan, facilities and progress of the remediation project (Huxley, 2005a, Peatling, 2004, Skelsey, 2004d)

4. Time constraint

   The toxic groundwater plume is moving at 120m/year towards Botany Bay. The closest front of the plume is only 300m from Penrhyn Estuary and Botany Bay. If the toxic groundwater reaches the bay, it will be a disaster to marine life and dangerous to human and animals in contact with the water. A market research commissioned by Orica revealed that the residents nearby were "more concerned about what would happy to

Botany Bay if the untreated toxic plume reached it than they were about the effects of the proposed treatment plant on local air quality" (Peatling, 2004).

It unchecked, high concentrations of contaminants could reach the upper extent of Penrhyn Estuary in the first half of 2006 (URS, 2004). Orica is now racing against time to contain the movement of the toxic plume.

5. Cleanup methods

Orica has a legal duty to contain the contaminated groundwater plume that is migrating towards Penrhyn Estuary and Botany Bay. In choosing the appropriate method for the job, the following criteria have to be satisfied:

- use of best practice technology;
- the technology chosen must use proven, safe and commercially viable, and able to be designed, purchased, installed and started up within the critical timeline; and
- the technologies must achieve a critical start-up timeline that stops the plumes in time to prevent high concentration contamination reaching Penrhyn Estuary and Botany Bay.

(URS, 2004)

Orica has tried to remediate the contaminated groundwater by biological approach. In early 2004, it carried a 'bioremediation trial' by dropping vegetable oil plus other chemicals into the plume to neutralise the toxins in the groundwater flow. In August 2004, the 'bioremediation trail' was declared unsuccessful (Skelsey, 2004b).

The cleanup notice requires Orica to carry out hydraulic containment and treatment of contaminated groundwater. Regarding hydraulic containment, Orica has begun work on the construction of a 750m containment barrier along Foreshore Road. The barrier has 30 sets of hydraulic pumps that will extract the toxic groundwater to a nearby treatment plant. Orica is confident that there is sufficient time for the completion of the containment barrier and the treatment plant construction works as the toxic groundwater plumes are expected to reach the containment barrier in 1 year (Huxley, 2005a).

For the treatment of the contaminated groundwater, Orica faces the challenge of choosing the appropriate technologies. There are different technologies available. In order to pick the appropriate technologies for the treatment works, Orica adopted the US Government's Federal Remediation Technologies Roundtable (FRTR) matrix for the screening process. Eventually it recommended and was accepted to use air stripping plus recuperative thermal oxidiser as the groundwater treatment technologies. Air stripping is a proven efficient technology for removing contaminants from water. Recuperative thermal oxidiser is a technology for destroying the EDC waste from the air stripping process. This technology operates at 1000^{o}C and is claimed to have a destruction efficiency of greater than 99.99% (URS, 2004).

The groundwater treatment plant is to be built on the BIP site and has a capacity to treat 15 million litres per day. At this rate of treatment, Orica has to work non-stop for 30 years to clean up the toxic groundwater (Peatling, 2004). The treated groundwater is aimed at meeting the standards in the Australian and New Zealand Environment and Conservation Council (ANZECC) Marine Guidelines and the Australian Drinking Water Guidelines. The treated groundwater will be mainly reused for other industrial processes on the site. The rest will be discharged into Botany Bay (URS, 2004). Construction works for the groundwater treatment plant were approved in February 2005 (Orica Botany Groundwater, 2004). At the time of writing this paper, the construction works are still in progress.

Land value issues

It is well documented that land contamination has negative impacts on land value (Patchin, 1988, Mundy, 1992a & b, Roddewig, 1996, Dotzour, 1997, Chan, 1999, etc.). Unlike clean land, contaminated land will cause legal and financial liabilities to the owner or occupier. Depending on the degree and type of contamination, it may cost a fortune to remediate the land. Even after remediation, there is no guarantee that the land value will revert to clean land value due to the impacts of stigma. Stigma is "*an intangible factor that may not be measurable in terms of cost to cure but may have real impact on Market Value. It arises from the effect of present or past contamination upon the market's perception of the property and represents a discount, beyond the direct and indirect costs likely to be incurred, required to compensate for the risks associated with contaminated or previously contaminated property including the risk of achieving the planned remediation.*" (API & NZPI, 2004).

As far as the BIP site is concerned, it is regarded as one of the biggest contaminated sites in Australia. It has the largest stockpile of HCB wastes in the world and caused the worst groundwater contamination in Australia. Even after the completion of the remediation project, the stigma impacts on the land value are still significant. The impact of land contamination on the value of the BIP site is analysed below.

In Australia, valuers use the following model to value contaminated land:

$$V_c = V_u - L - C_r - S$$

where V_c = contaminated value
V_u = uncontaminated value
L = loss due to reduced income/productivity and/or legal liabilities
C_r = investigation, remediation, and monitoring costs
S = stigma impacts

(Chan, 2001)

This model is used to provide a rough estimate of the BIP site value for the purpose of this study.

BIP is a big site of about 74ha. It is more suitable for subdivision than single use. If fact it has already been subdivided in 9 lots sharing common roads and facilities. It has the potential for further subdivision into smaller lots to match other industrial sites in the neighbourhood. A hypothetical subdivision of the site is assumed for this analysis. It is assumed that 20% of the land area is needed to meet infrastructure and amenity requirements for the subdivision.

Annex 1 shows the value of large industrial sites in Sydney, Newcastle and Wollongong in recent years recorded by the Department of Lands of the NSW government (DoL, 2005). The value of a typical 2.18 ha industrial site in Botany in 2004 was $5,900,000 (about US$4.4 million), i.e. $2,706,422/ha (about US$2 million/ha). Assuming the 9% annual growth rate in 2003 – 2004 remains unchanged in 2004 - 2005, industrial land value in Botany in 2005 is about $2,950,000/ha (about US$2.2 million/ha).

Since the BIP site is still being used for manufacturing chemicals, assume there is no loss due to reduced income/productivity. Orica has announced that the total remediation cost is A$167 million. Regarding stigma value reduction, a survey of Australian valuers revealed that the range of percentage value reduction for industrial land used for chemical manufacture and formulation is 6% - 13% of clean land value (Chan, 2002). Since the contamination on this site is extremely serious, it is reasonable to apply a 13% value reduction for the stigma factor.

Substituting the data into the valuation model, the value of BIP is:

V_u = \$2,950,000/ha x 74ha x 0.80	174,640,000
Less	
L =	0
C_r =	167,000,000
S = \$174,640,000 x 13%	22,703,200
Contaminated land value (V_c)	-15,063,200

The estimated contaminated land value of BIP is a negative figure. In other words, it has no market value. It should be noted that this estimate is based on the remediation cost for treating the contaminated groundwater only. The clean up cost for land contamination has not been considered. If the land remediation cost is considered or there is a budget blow out of the groundwater remediation cost, the land value may enter further into the negative value territory.

Conclusion

The land and groundwater contamination at BIP is one of the worst environmental incidents in Australia. Orica inherited the legal and financial liabilities after acquiring the site from the British ICI chemical company. After accepting cleanup responsibility, Orica faces major challenges including legal and bureaucratic issues, financial liabilities, adverse public image, time constraint, and choice of remediation methods.

As far as financial challenge is concerned, Orica is facing a groundwater cleanup bill of A\$167 million (about US\$125 million). In addition, it also suffers from a zero market value of the BIP site. It is unlikely that financial institutions will accept the land as security for lending. There are not many enterprises in the world that can bear this huge financial burden. The groundwater remediation project will take at least 30 years to complete. Orica will have to live with this nightmare of many years to come.

The Orica saga is a good example to show the cost of land contamination to landowners. Apart from the cost issue, it highlights the challenges and hassles that landowners may have to face. It warns landowners that they have to be more environmentally alerted and appropriate actions have to be taken to prevent land contamination. Orica's commitment to cleanup the site is also a good example for other owners of contaminated land on the right attitude to deal with remediation of contaminated land.

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Table 5 Metropolitan Property Market – Large Industrial Sites, Sydney, Newcastle, Wollongong

SUBURB	AREA HECTARES	1996 ($)	2000 ($)	2001 ($)	2002 ($)	2003 ($)	2004 ($)	% CHANGE 03-04
ALEXANDRIA	2	3,570,000	6,500,000	6,500,000	7,150,000	8,000,000	9,000,000	13%
BANKSMEADOW	3.9	4,770,000	6,800,000	7,100,000	7,800,000	8,900,000	9,400,000	6%
BLACKTOWN	3.4	1,625,000	3,460,000	3,800,000	3,800,000	4,950,000	5,900,000	19%
BOTANY	2.18	3,050,000	3,850,000	4,200,000	4,750,000	5,400,000	5,900,000	9%
CAMPBELLTOWN	2.9	785,000	1,560,000	2,550,000	2,550,000	3,690,000	4,240,000	15%
CARRINGTON	3.27	642,000	750,000	825,000	825,000	1,075,000	1,225,000	14%
MOOREBANK	3.85	1,890,000	3,760,000	3,900,000	4,900,000	7,350,000	8,820,000	20%
MARRICKVILLE	2.4	3,500,000	4,860,000	5,430,000	5,870,000	6,750,000	7,200,000	7%
NORTH RYDE	3	9,500,000	12,500,000	13,200,000	13,200,000	13,200,000	13,600,000	3%
PORT KEMBLA	0.76	425,000	446,000	463,000	601,000	721,000	937,000	30%
RIVERWOOD	2.1	2,200,000	2,790,000	3,060,000	3,360,000	4,700,000	5,070,000	8%
RYDALMERE	2.42	2,550,000	4,760,000	5,000,000	5,300,000	5,800,000	6,100,000	5%
TAREN POINT	2	2,140,000	3,520,000	3,850,000	4,400,000	5,700,000	6,450,000	13%
UNANDERRA	1.26	370,000	438,000	438,000	547,000	629,000	817,000	30%
WETHERILL PARK	2.04	1,270,000	2,090,000	2,290,000	2,750,000	3,050,000	4,050,000	11%
Average		2,552,467	3,872,267	4,173,733	4,520,200	5,327,667	5,913,933	
% Variation From Previous Year			15%	8%	8%	18%	11%	
Index (1996=100)		100	152	164	177	209	232	

Source: DoL, 2005, Table 8.