4. Economic Benefits of Heavy Industry at Kwinana

4.1 Introduction

4.1.1 Economic Perspective

Australia, and more specifically Western Australia, have resource-rich and moderately high income economies. Since the early 1980s Australian Real Gross Domestic Product (GDP) has increased at approximately the same rate as the OECD (Organisation for Economic Co-operation and Development) as a whole, and it has been higher than the OECD average in recent years.

Due to its relative strength in industries that are growing strongly nationally, Western Australia has been one of the faster-growing State economies within Australia, along with Queensland and the Northern Territory. However, the Western Australian economy is particularly dependent on the minerals and energy sector.

The minerals, energy and agricultural sectors, which are responsible for the greater part of Western Australia's exports, employ relatively few people. Given the State's small manufacturing base, employment is therefore largely concentrated in service activities, particularly in the Perth metropolitan area.

Despite their overall economic strength, the economies of Australia and Western Australia have experienced adjustment problems, including the following:

- For over two decades, Australia has been opening its economy to international competition: this has put pressure on activities that formerly relied on some form of protection, particularly the manufacturing sector.
- Until recently there was a succession of international balance of payments current account deficits that forced changes in short-term macro-economic management, in particular monetary and fiscal policy.
- The floating of the Australian dollar in the 1980s was a fundamental reform that accompanied liberalisation of the trading regime. The Australian dollar has declined in value from around 75U.S.c in the mid 1990s to its current level of just over 50 U.S.c. This has been of great benefit to exporters and has helped to maintain Australia's and Western Australia's record of economic growth despite adverse trading conditions, due firstly to the Asian economic collapse of 1997-98 and more recently (2001) a weakening world economy.
- Technological changes have reduced labour demand in most sectors of the economy and therefore contributed to historically high rates of unemployment in the late 1980s and early 1990s. This was accentuated by higher labour force participation rates, particularly amongst women. In recent years unemployment nationally has fallen from around 10% to around 7%.

As an open economy, Western Australia must base its economic development strategies on the principle of comparative advantage. Heavy industry linked to the State's natural resource base does have a comparative advantage for (i) processing of Western Australian mineral and agricultural products and (ii) providing bulk supplies of inputs to the mining and agricultural industries. It has been on this basis that there has been a steady increase in large industrial processing projects. However, the continuation of a comparative advantage for an industry does depend on a complex set of macro-economic and local factors, including:

- International and domestic markets;
- Competition internationally from other state-of-the-art plants;
- Exchange and interest rates;
- Wages and skilled labour pool;
- Applied technology;

- The availability of established and cost-competitive infrastructure;
- Political stability; and
- Government regulation, including environmental regulation.

4.1.2 Methodology

The methodology adopted for the economic study was based on a detailed questionnaire addressed to 35 industries in the KIA. The questionnaire included questions on strategic, financial and employment aspects.

From the 35 organisations that were approached, 28 returned the questionnaire. Results are given for 25 of the responding organisations. The remaining three establishments were excluded from the multiplier calculations for the following reasons:

- The Port of Fremantle and the Water Corporation of Western Australia were excluded as they are not currently major drivers of output and investment, and the Kwinana component of their respective operations in 1999-00 was very small; and
- The third plant was not operational, being held on a "Care and Maintenance" basis.

Of the 25 organisations included in the analysis, 20 provided complete data for sales, operating costs and capital investment in 1999-00. Another five firms provided sufficient data for estimates to be made of these items.

The data obtained through the questionnaire were used to perform the following tasks:

- Economic accounts were developed for each respondent, showing sales, operational expenses, wages and salaries and capital expenditure against 119 sales and expenditure categories based on the Australia and New Zealand Standard Industrial Classification (ANZSIC). This data provided a detailed picture of the input and output characteristics of each industry in dollar terms, and enabled aggregation into nine key Kwinana industry groups, used for this report.
- The nine industry groups are:
  - Petroleum and Petroleum Products;
  - Fertilizers;
  - Basic Chemicals;
  - Other Chemicals;
  - Ceramics and Cement;
  - Basic Non-Ferrous Metals;
  - Metal Products (fabricators);
  - Electricity Generation; and
  - Transport and Storage.
- The 111 x 111 industries Input-Output Table for Western Australia for 1992-93 (Islam and Johnson, 1997) was reduced in size and updated to provide a 41 x 41 Input-Output Table and employment estimates for Western Australia in 1999-00, which included nine rows and columns for the key Kwinana activities.
- Western Australian economic multipliers for output, incomes and employment in the Kwinana industries were calculated.
- The above were combined with data from the Ministry for Planning Industrial Land Use Survey 1997 Perth Metropolitan Region (Ministry for Planning, 2000), and identified development opportunities, as a basis for generating estimates of the potential economic impact of future development scenarios for the Kwinana area.
- An appreciation of the national significance of the Kwinana industries was developed by calculating ratios of inputs obtained from the rest of Australia relative to inputs from Western Australia.

4.2 Kwinana's Direct Economic Impact

4.2.1 Kwinana as a Supplier of Goods and Services

An overview of the role of Kwinana's heavy industries in the Western Australian economy can be seen in the pattern of their sales. The Kwinana industries, taken as a group, accounted for sales of $4,342M in 1999-00. Kwinana industries have a significant impact on the Australian, Western Australian and Perth economies. This is illustrated by the composition of their sales, shown in **Table 4.1.**

■ **Table 4.1 Where Kwinana Industries Sold their Output in 1999-00.**

	Sales ($M)	Percent
Cockburn-Rockingham-Kwinana Local Government Areas	249	5.7
Rest of Perth	1,329	30.6
Rest of W.A.	857	19.7
Rest of Australia	326	7.5
Exports	1,581	36.4
Total	**4,342**	**100**

If the Kwinana industries did not exist, most of these sales would have to be replaced by product importation (international or from the rest of Australia) which would have a negative impact on the State and Australian economies. The additional costs associated with such purchases may also cause some downstream industries to be uneconomic with further negative impacts on the economy.

4.2.1.1 The Cockburn- Rockingham- Kwinana- Local Area

The Kwinana industries deliver some $249M worth of goods and services to other industries within the CRKLA areas. Most of these sales occur between the Kwinana heavy industries themselves.

4.2.1.2 Perth and the Rest of Western Australia

The majority of sales from the Kwinana industries are directed to the rest of the Perth metropolitan area or elsewhere in Western Australia. This largely reflects the dominant influence of (i) sales of petroleum, fabricated products, energy and transport services to the Perth and Western Australian markets, (ii) sales of industrial chemicals to the mining sector and (iii) sales of fertilizers and agricultural chemicals to the wholesale sector and through it to Western Australian farmers. These sales illustrate the importance of Kwinana as the supplier of a number of key requirements for consumers and industries throughout the State.

4.2.1.3 Sales to the Rest of Australia and Exports

The Kwinana industries "exported" $326M worth of goods to the rest of Australia and contributed $1,581M to Australian exports overseas. The contribution of Kwinana industries to the Australian Balance of Trade is considered further below.

4.2.2 Incomes generated at Kwinana

A commonly-used measure of incomes produced from an industry is "Total Factor Income". This is the sum of Wages, Salaries and Gross Margin before-tax, debt and interest repayments, shareholder distributions or depreciation. The Total Factor Income earned from the Kwinana industries in 1999-00 was $1,275M. The Total Factor Income generated by all economic activities in Western Australia in 1999-00 was $62,412M (Australian Bureau of Statistics, State Accounts 1999-00). Thus, the Kwinana industries directly account for 2.0% of Western Australian Total Factor Income. The manufacturing sector as a whole accounted for 9.2% of Total Factor Income. Thus, Kwinana accounts for 22.2% of Total Factor Income generated in the Western Australian manufacturing industries, and remains the

largest industrial site in the State. By comparison, the agricultural industries in Western Australia account for 3.7% of Total Factor Income, and the mining and natural gas industries 20.0% in 1999-00. **Table 4.2** provides a summary of the sales, purchases and factor incomes of the Kwinana industries.

■ **Table 4.2 Sales, Purchases and Factor Incomes Generated by Kwinana Industry in 1999-00**

	$M
Sales	4,342
Goods and Services Purchased	3,066
Factor incomes:	
Wages and Salaries	207
Gross Margin before depreciation, taxes, dividends, debt repayment	1,068
Total Factor Income	**1,275**

Note: Excludes Water Corporation and CBI Constructors; includes the Kwinana part of Fremantle Port Authority.

Compared with their total sales, the wages and salaries generated directly by the Kwinana industries ($207M) are relatively small. This reflects the capital-intensive nature of heavy industry, and the relatively small amount of employment in the surveyed Kwinana industries. However, the levels of wages and salaries earned by individual Kwinana workers across all occupational groupings are relatively high, with average earnings per employee of approximately $57,000.

Company earnings, and related tax payments and dividend disbursements from Kwinana activities are a very important contribution to incomes in Western Australia. The Gross Margin before taxes or depreciation ($1,068M) substantially exceeds wages and salaries paid. This is to be expected in capital-intensive industry. The Gross Margin is distributed in a number of ways. These include payments by corporate owners to Australian and overseas shareholders, taxes paid to the State and Commonwealth Government, interest on borrowings, and re-investment for asset renewal (the depreciation element).

In addition to wages paid at each Kwinana establishment, the questionnaire also requested details of wages and salaries paid by other establishments in Western Australia that had the same ownership as the Kwinana company, and which were directly linked by inputs or outputs to the Kwinana establishments. A total wages and salaries bill of $206M was reported for these related establishments, almost equal to the wages and salaries at the Kwinana operations ($207M). These establishments do undertake work that is not related to Kwinana as well as work that is. Nevertheless, the data serve to illustrate the spread of employee benefits over a wider area than Kwinana itself. These benefits are assessed more accurately using input-output analysis below.

4.2.3 Employment

Kwinana industries engaged a total of 3,636 full time and part time employees as at 30 June 2000 (see **Table 4.3**). No distinction has been made between full and part time employment. This is consistent with the definition of employees used by the Australian Bureau of Statistics for determining employment multipliers. This approach reflects the underlying employment pattern of the upstream industries when calculating the employment impacts of changes in industrial output.

The Chemicals industry (including petroleum refining, fertilizers, basic chemicals, industrial gases and agricultural chemical production) accounted for 40% of the total, and the Basic Non-Ferrous Metals industry (including alumina, nickel, and other basic non-ferrous metals) accounted for a further 35.3%.

Metal fabricators, transport and storage providers and electricity suppliers accounted for most of the remaining activities.

■ **Table 4.3 Full Time and Part Time Employment by Industry Groups, June 2000**

Group	Industry	Employment	Percent
I	Petroleum Products	482	13.3
II	Fertilizers	444	12.2
III	Basic Chemicals	413	11.4
IV	Other Chemicals (including Agricultural Chemicals)	28	0.8
V	Ceramics and Cement	367	10.1
VI	Basic Non-Ferrous Metals	1,286	35.3
VII	Metal Products	57	1.6
VIII	Electricity	186	5.1
IX	Water Services	42	1.2
X	Transport and Storage	331	9.1
	Total	3,636	100

Note: Excludes employees of Fremantle Port Authority who are located in Fremantle.

The questionnaire also asked for details of employment in establishments owned by each Kwinana respondent that were located elsewhere in Western Australia, that either received inputs from their Kwinana site, or delivered outputs to it. The results are shown in **Table 4.4**. It is seen that, in addition to the 3,636 employees in the KIA, there were a further 4,205 employees in linked establishments. Of these 1,163 were in establishments within the Perth metropolitan area and a further 3,042 were located elsewhere in the State. It is stressed that these related establishments did not necessarily sell all of their output or obtain all of their inputs from Kwinana. Nevertheless, the responses to this question in the survey may be compared with calculations of employment multipliers presented in later sections.

■ **Table 4.4 Employment in Directly Related Establishments Owned by the Kwinana Companies and Located Elsewhere in Western Australia**

	Employment Elsewhere in Perth metropolitan area (outside the CRKLA)	Employment Elsewhere in WA
Managers and Administrators	224	169
Professionals	329	335
Trades-people	253	593
Clerical and Administrative	172	420
Production and Transport Workers	12	1,444
Labourers	173	81
Total	**1,163**	**3,042**

4.2.4 Capital Investment

Industry has invested heavily in Kwinana since 1995-96. From **Table 4.5** it is seen that around $1,779M has been invested (summing the actual amounts without adjustment for inflation) over the six years for which data were sought. This has been spread across most of the industries represented at Kwinana, and includes upgrades and replacements to existing plant as well as investment in new plant.

■ **Table 4.5 Capital Investment Undertaken in Kwinana 1995-96 to 2000-01**

Year	$M
1995-96	406
1996-97	139
1997-98	163
1998-99	253
1999-00	459
2000-01	359
Total	**1,779**

Note: the estimates are at "current" prices and are not adjusted for inflation.

The average expenditure of around $300M per year in capital investment is a significant direct stimulus to the Western Australian economy, which is additional to that which occurs from operations each year. This is estimated to directly generate some 3,100 ongoing jobs in the capital goods and construction industries, in addition to the direct employment within the Kwinana industries. Just as importantly, this investment is essential to maintain the international competitive standing of the Kwinana industries.

Table 4.6 shows the composition of capital investment by Kwinana industries in the survey year, 1999-00. It is seen that, out of a total investment of $459M, $366M was spent in Western Australia. The areas of highest capital expenditure were Electrical and Electronic goods (including computers and control systems) and Heavy Plant and Equipment (particularly chemical process plant). Imports of capital goods from the rest of Australia were around $50M, and $43M worth of capital goods were imported from overseas. The multiplier effects of this capital investment are considered in the next section.

■ **Table 4.6 Capital Expenditure in 1999-00 by Type of Capital Goods Purchased and Regional Source of Supply ($M).**

Product Description	From Western Australia	Rest of Australia	Direct Imports	TOTAL
Vehicles	1.6	0.4	0	2.0
Electrical, Electronic and Scientific Equipment	162.6	5.1	1.1	168.8
Industrial Machinery and Equipment	8.6	2.4	0.1	11.2
Construction-type Heavy Plant (cranes, dozers, loaders etc)	2.3	0	0	2.4
Industrial Machinery/Machine Tools	3.2	0.1	0	3.3
Lifting and Materials handling Equipment	2.1	0.1	0	2.1
Pumps and Compressors	8.9	0.1	0.2	9.2
Space Heating and Cooling Equipment	0.3	0	0	0.3
Chemical/process Industry Plant (incl. boilers, heat exchangers, vats, pipe work, valves, cooling towers)	140.9	30.7	36.9	208.6
Other Industrial Plant	9.4	9.1	4.5	23.0
Pre-fabricated Buildings, Furniture	0.2	0.8	0	1.0
Construction	24.8	0.9	0.2	25.8
Wholesale Trade Supplies	1.0	0	0	1.0
Retail Supplies for Capital Purposes	0.3	0	0	0.3
TOTAL CAPITAL EXPENDITURE	**366.2**	**49.7**	**43.0**	**459.0**

4.3 Kwinana's Total Economic Impact

4.3.1 Impact Assessment Method

The total impact of Kwinana industries on the Western Australian economy may be estimated using Economic Impact methodology, which utilises economic Input-Output Tables. The consequences of an increase in the output of any industry are firstly, an increase in employment and incomes earned *directly* by that industry. This is, generally speaking, accompanied by an increase in inputs to that industry, giving rise to additional output, incomes and employment in the first industry's suppliers. This is often termed the "first round" effect. The supplying industries will also generate additional demands and in turn increase output, employment and incomes. This cycle of inter-industry interaction is termed the "production effect". Finally, the increases in wages and salaries earned through all these inter-industry effects will give rise to additional consumption, that will further stimulate industrial output, employment and incomes - termed the "consumption effect".

Economic multipliers are defined as the ratio of total (***direct and indirect***) output, employee incomes or employment generated in the economy by the existence of a certain activity divided by the amount of ***direct*** output, employee incomes or employment in the activity. Two types of multiplier are distinguished, as was done in the earlier *Kwinana Heavy Industry Economic Impact Study (*Dames & Moore, 1990b):

- ***Type I multiplier***: this is the output, employee income or employment that is generated directly in the activity ***plus*** the output, income or employment generated through industries and services that supply inputs to the activity, ***divided*** by the amount of income or employment generated directly in the activity.
- ***Type II multiplier***: this multiplier takes account not only of the output, employee income or employment in supplying activities, but also includes the output, employee income and employment generated when employees' incomes from both the activity itself and its suppliers' are spent, thus increasing activity throughout the economy (e.g. in household goods and services manufacturing or importing, retail outlets, theatres and sporting venues).

Multipliers expressing the effect of Kwinana industries on total output, wages and salaries and employment in Western Australia were calculated for nine Kwinana industry groups. The multipliers were obtained by: (i) updating the Input-Output table for Western Australia from 1992-93 to 1999-00; (ii) inserting additional rows and columns for each of the nine industry groups represented within Kwinana, using questionnaire results for the intermediate transactions; and (iii) performing the necessary matrix manipulations to infer the impacts on total output, earnings and employment arising from a 10% increase in the final demand for output from each group.

4.3.2 Results for Income, Earnings and Employment

To illustrate the application of multipliers, a $238M expansion of Kwinana output from the 1999-00 levels (corresponding to a 10% increase in Final Demand for Kwinana products) would be expected to produce the effects shown in **Table 4.7**: this shows Direct, Type I and Type II impacts for total output (sales), employee earnings (wages and salaries) and employment (jobs).

■ **Table 4.7 Illustration of the Multiplier Effects for a 10% Increase in Final Demand for Kwinana Industry Production Across all Industries in Western Australia**

	1999-00 Level	Direct Effect of a 10% increase in Final Demand	Type I Effect of a 10% increase in Kwinana Output	Type II Effect of a 10% increase in Kwinana Output
Kwinana Sales to Final Demand ($M)	2,381	238	360	417
Output Multiplier			1.51	1.75
Employee Earnings ($M)	207	16	27	33
Earnings multiplier			1.66	2.04
Employment (jobs)	3,636	237	794	1081
Employment multiplier			3.35	4.56

The detailed results for Kwinana industry groups are given in **Table 4.8**.

■ **Table 4.8 Output, Earnings and Employment Multipliers for Kwinana Industries in 1999-00**

Group (Number of Companies are shown in brackets)		TYPE I			TYPE II		
		Total Output	Wages and Salaries	Employment	Total Output	Wages and Salaries	Employment
I	Petroleum products (2)	1.48	2.38	4.06	1.55	2.92	5.47
II	Fertilizers (2)	1.33	1.65	3.13	1.52	2.03	4.11
III	Basic Chemicals (5)	1.33	1.31	2.59	1.67	1.61	4.42
IV	Other Chemicals (2)	1.40	4.71	2.99	1.57	5.79	3.63
V	Ceramics and Cement (2)	2.17	2.72	3.45	2.61	3.34	4.36
VI	Non-Ferrous Metals (4)	1.45	1.48	3.26	1.81	1.82	4.45
VII	Metal products (2)	1.50	1.57	4.65	1.97	1.93	6.45
VIII	Electricity (2)	1.70	1.57	3.71	2.03	1.93	5.07
IX	Transport and Storage (3)	1.97	2.04	3.48	2.53	2.51	4.33
	All Kwinana Industries	**1.51**	**1.66**	**3.35**	**1.75**	**2.04**	**4.56**

Type I output multipliers range from 1.33 for Basic Chemicals and the Fertilizers industry to 2.17 for Ceramics and Cement. The relatively high multiplier for wages and salaries earned in Other Chemicals reflects the relatively low total employee earnings per $M of output. Many of the Kwinana industries have high employment multipliers, reflecting the large amount of purchases that they make from the Western Australian economy, including their purchase of contracting services.

A new 111 x 111 industry Input-Output Table was published for Western Australia for the year 1992-93 (Islam and Johnson, 1997). Selected industry multipliers for output, income and employment from that study are compared with the results of the current study in **Table 4.9**. In comparing the two sets of multiplier estimates, differences should be expected, due to the fact that the results for Kwinana are based on data specifically for Kwinana firms, while those for Western Australia include firms from both Kwinana and the rest of Western Australia. This study has produced slightly lower multipliers for the Chemical industries at Kwinana than have been estimated for the corresponding Western Australian industries, but higher multipliers for wages and employment in the Non-Ferrous Metals industries. However, the multipliers obtained in this study are broadly consistent with those found in the Western Australian study.

■ **Table 4.9: Comparison of Type I Industry Multipliers Obtained from this and Previous Studies**

Industry	Islam and Johnson (WA Industries)	This Study (Kwinana Industries)
Petroleum and Coal Products		
Output	1.66	1.48
Household Income	3.58	2.38
Employment	3.78	4.06
Fertilizers		
Output	1.66	1.33
Household Income	2.32	1.65
Employment	2.92	3.13
Basic Chemicals (excluding fertilizers)		
Output	1.76	1.33
Household Income	2.14	1.31
Employment	2.59	2.59
Non-Ferrous Metal Products:		
Output	1.61	1.45
Household Income	1.94	1.48
Employment	2.21	3.26

An economic impact study was conducted for the Port of Fremantle (Starr, Liu and Casey, 2000), utilising the input-output table produced by Islam and Johnson, with appropriate adaptations. Starr et al's multipliers for the Port of Fremantle are shown **Table 4.10**. It is seen that the multipliers fall in the intermediate range.

■ **Table 4.10: Multipliers for the Port of Fremantle**

	Multiplier (TYPE II)
Output	2.13
Value Added	2.05
Household Income	1.8
Employment	2.52

Source: Starr et al (2000)

4.3.3 Results for Capital Investment

In addition to the output, employee incomes and jobs that are generated through the operation of Kwinana's industries, account also has to be taken of the impacts of the capital investments that are made. Indeed, as has been pointed out, the capital investment of about $300M undertaken every year since 1995-96 in Kwinana has generated around 3,100 ongoing jobs: about the same number as are directly employed within the Kwinana industries themselves.

The estimated multiplier effects of an annual average capital investment of $300M (the actual annual average between 1995-96 and 1999-00) are given in **Table 4.11**. These multipliers were estimated using the breakdown of capital expenditure shown in **Table 4.6**.

■ **Table 4.11 Direct and Indirect Effects of Capital Investment Undertaken by Kwinana Industries Annually (Based on Annual Average Investment for 1995-96 to 1999-00).**

	Output ($M)	Wages and Salaries ($M)	Employment (jobs)
Direct Effect	300	78	3,092
Total Production Effect (Type I)	474	117	4,669
Total Effect (Type II)	627	144	5,875
Type I Multiplier	1.58	1.50	1.51
Type II Multiplier	2.09	1.85	1.90

4.3.4 Summary of the Economic Impacts of Existing Kwinana Industries

Table 4.12 combines the estimates of direct impact from operations and capital investment, with estimated multipliers, to obtain an estimate of the total impact of Kwinana industries.

The "bottom line", shown in **Table 4.12**, is that annual output worth $8,714M, employee earnings of $599M and 24,397 jobs are estimated to be directly or indirectly dependent on Kwinana operations and investment. This is an economic assessment of output, employee earnings and jobs that could be lost if the Kwinana industries were to disappear altogether, and not be replaced.

■ **Table 4.12 Summary of the Direct and Indirect Impact of Existing Kwinana Industries**

	Output ($M)	Wages and Salaries ($M)	Employment (jobs)
Operating Impacts:			
Direct (On-site at Kwinana)	4,342	207	3,636
Incremental (Type II) effect in WA	3,257	215	12,944
Incremental (Type II effect) in the Rest of Australia	488	32	1,942
Capital Expenditure Impacts (Type II effect)	627	144	5,875
Total Impact	**8,714**	**599**	**24,397**

The biggest source of indirect effects is the multiplier on the $3,066M worth of goods and services purchased annually by Kwinana industries, of which $1,668M is purchased from Australia, mainly Western Australia.

4.4 Comparison with the 1990 Economic Impact of Heavy Industries in Kwinana

This study up-dates an earlier study of heavy industries at Kwinana (Dames & Moore, 1990b), and allows a comparison to be made showing changes over the last 11 years for industry groups reported in the earlier study. These were (i) Basic Metal Products, (ii) Chemical and Petroleum Products, and (iii) Non-metallic Mineral Products. These groups account for $4,037M in total output in 1999-00, representing 93% of the total output of Kwinana industries. The comparison with 1989-90 data excludes Metal Products, Electricity, Transport and Storage, and Water Services, which together account for the remaining 7% of the value of output in 1999-00.

A comparison of output, wages and salaries, and employment in the two study years is shown in **Table 4.13**. In **Table 4.13** the monetary data for 1988-89 have been inflated to 1999-00 values using the Implicit Price Inflator for Australian GDP (Expenditure Series) for this period. The index is 1988-89 = 124.6, when 1999-00 = 100.

In interpreting **Table 4.13** it should be noted that some activities that were present in 1988-89 have since disappeared, so the table does not solely reflect the performance of the existing industry set. Industries included in the 1988-89 survey that were not present in 1999-00 include the BHP rolling mill (Basic Metals group), and the Hoechst agricultural chemicals plant (Chemical and Petroleum Products group). Also, companies that were not included in the 1989-90 survey account for $305M in output, $20M in wages and salaries and 617 jobs in 1999-00.

■ **Table 4.13 Comparison of Results with the 1990 Kwinana Heavy Industry Study**

	1990 Study (At 1988-89 Prices)	1990 Study (At 1999-00 Prices)	Present Study (At 1999-00 Prices)	Present Study as a percent of 1990 Study
Annual Industry Output ($M):				
Basic Metal Products	942	1,174	895	76%
Chemical and Petroleum Products	1,353	1,585	2,981	188%
Other Non-Metallic Mineral products	77	96	161	168%
Total Output above	2,371	2,855	4,037	141%
Other categories of industry not included in the 1988-89 survey			305	
Total Output 1999-2000			4,342	
Wages and Salaries ($M):				
Basic Metal Products	84	105	68	64%
Chemical and Petroleum Products	79	98	98	100%
Other Non-Metallic Mineral products	16	20	21	104%
Total Wages and Salaries above	179	224	187	83%
Other categories of industry not included in the 1988-89 survey			20	
Total Wages and Salaries 1999-2000			207	
Employment (Jobs):				
Basic Metal Products	1,524		1,266	83%
Chemical and Petroleum Products	1,234		1,386	112%
Non-Metallic Mineral products	366		367	100%
Total Employment above	3,124		3,019	97%
Other categories of industry not included in the 1988-89 survey			617	
Total Employment 1999-2000			3,636	

It is notable that, while total output increased by 41% since the 1988-89 survey, there was a decline of 24% in output from the Basic Metal Products group, due to the de-commissioning of BHP's steel rolling mill. Despite the overall increasing levels of output, employment declined by 3% and total household income generated fell by 27% in these industries in real terms. These trends illustrate the pressure on Kwinana's industries to increase the productivity of their plants, which has necessitated cut-backs in employment and costs generally. It is significant that, while total output of the Chemicals and Petroleum Products group almost doubled, employment in the group increased by just 12%, while direct wages and salaries from the Kwinana plants in this industry were static. However, it should be noted that there was increased sub-contracting over the period.

Table 4.14 gives a comparison of the multipliers obtained in both Kwinana industry studies. It is noted that the multipliers for total output are now generally lower than previously found (the Non-Metallic Mineral products industries were an exception to this trend). This is consistent with the higher productivity in today's plants, which means that they tend to employ fewer people per dollar of output and use less intermediate inputs per dollar of total output.

The multipliers for household income are also generally lower than those found in the 1990 study. The calculation of this multiplier starts with the wages and salaries effect, and traces it throughout the economy, thus showing the effect per dollar of direct earnings. Thus, the fact that employee earnings per dollar of output have fallen does not affect this multiplier.

The employment multipliers obtained in this study are similar for the Chemicals group, slightly higher for Non-Metallic Minerals and significantly lower for Non-Ferrous Metals, as compared with those estimated by the 1990 study. It would require a detailed comparison with the source data for the earlier study to explain this difference.

■ **Table 4.14 Comparison of Multipliers with the 1990 Study**

Impact Type and Industry Group	Type I Multipliers		Type II Multipliers	
	1990 Study	Present Study	1990 Study	Present Study
Annual Industry Output:				
Basic Non-Ferrous Metal Products	n.a.	1.45	2.64	1.81
Chemical and Petroleum Products	n.a.	1.44	2.34	1.58
Non-Metallic Mineral products	n.a.	2.17	2.28	2.61
Annual Household Income:				
Basic Non-Ferrous Metal Products	2.79	1.48	4.15	1.82
Chemical and Petroleum Products	2.04	1.62	3.03	1.98
Non-Metallic Mineral products	1.70	2.72	2.54	3.34
Employment (Jobs)				
Basic Non-Ferrous Metal Products	4.37	1.81	8.91	4.45
Chemical and Petroleum Products	2.43	3.12	4.50	4.58
Non-Metallic Mineral products	1.77	3.45	3.12	4.36

4.5 Impacts on the National Economy

4.5.1 Output and Household Income

The estimates of total impact given in **Section 4.3** above relate to Western Australia, because all multiplier calculations were performed using the Western Australian Input-Output table for 1999-00 estimated by REU. Thus, it is only the production inputs that are obtained from Western Australia that are taken into account in calculating the multipliers. This is the same procedure as was adopted in the 1990 study.

Further impacts will be experienced in the rest of Australia. For the purposes of this report a general indication is offered about the magnitude of output and household income impacts in the rest of Australia. This is based on the ratio of inputs purchased by Kwinana industries from the whole of Australia to the inputs obtained from Western Australia. In 1999-00 this ratio was 1.155 for industries included in the survey. Thus, a good overall indication is that the economy-wide impacts on Australia's (i) total output, (ii) wages *and* salaries and (iii) employment are about 15% higher than the amounts for Western Australia indicated in **Table 4.7. Table 4.15** adjusts the results of **Table 4.7** for this additional effect.

■ **Table 4.15 Indicative Effects of a 10% Increase in Final Demands for Kwinana Industries Output on the Australian Economy as a Whole.**

	1999-00 Level	Direct Effect of a 10% increase in Final Demand for Kwinana output	Type I Effect of a 10% increase in Kwinana Output	Type II Effect of a 10% increase in Kwinana Output
Kwinana Sales to Final Demand ($M)	2,381	238	413	479
National Output Multiplier			1.74	2.01
Employee Earnings ($M)	207	16	31	38
National Wages *and* Salaries multiplier			1.91	2.35
Employment (jobs)	3,636	237	913	1,243
National Employment multiplier			3.85	5.24

4.5.2 International Balance of Payments

A major contribution of Kwinana industries at the national level is via their influence on the balance of international trade, both through direct exports from Kwinana, and through the import substitution afforded by some Kwinana firms. The exports and import substitutes are shown in **Table 4.16**. Firms that deliver a large part of their Kwinana output to international markets in the USA, EEC and Asia-

Pacific regions include Alcoa World Alumina, BP Refinery, WMC Kwinana Nickel Refinery and the Tiwest Joint Venture. A similar impact on the balance of trade is realised through the import substitution effected by firms such as BP Refinery (net import substitution of petroleum and petroleum derivatives, which would probably come from an Asian refinery in the absence of the Kwinana facility), Nufarm Australia Limited (agricultural chemicals used mainly by the WA agricultural industries, which would probably come from either overseas or elsewhere in Australia in the absence of the Kwinana facility), and Wesfarmers CSBP Limited (fertilisers and chemicals used in the WA agriculture, mining and processing industries).

The overall contribution of Kwinana industries to the Australian Balance of Trade, combining both exports and import substitutes, is estimated to be worth $3,287M. This may be compared with total international exports of goods from Western Australia of $24,674M in 1999-00, or 13%. Exports from Kwinana include petroleum products, fuel oils and greases, industrial chemicals and gases, pigments, alumina, nickel and zircon. Import substitutes produced at Kwinana include refined petrol and derivatives, agricultural chemicals, fertilizers and industrial chemicals. Kwinana industries imported $1,322M of inputs.

Table 4.16 Contribution of Kwinana Industry to the Australian Balance of Trade

Contribution to the Trade Balance	Value ($M)
Exports	1,581
Import substitutes	1,706
Gross Contribution	3,287
Direct imports of production inputs	1,322
Net Contribution	1,965

4.6 Future Prospects for Existing Kwinana Industries

In this section we analyse responses of managers in Kwinana to questions about their strategic plans over the next 5-year and 10-year periods, and convert their responses into effects on output, wages and employment using the economic model.

In the introduction to this Section we referred to the critical importance of "national and international comparative advantage" for the survival and prosperity of Kwinana industries. Comparative advantage is what keeps an industry in existence, and anything that reduces comparative advantage is a step in the direction of changed plans for output, technology, incomes and employment. Therefore, in looking to the future of Kwinana we begin by reviewing threats and opportunities, and key uncertainties for the industries.

4.6.1 Positives and Negatives for Kwinana's Comparative Advantage

Managers of the Kwinana industries view locational factors, including the availability of suitable infrastructure, port facilities and market access as prime factors in their comparative advantage. The full set of factors mentioned is given in **Table 4.17**.

■ **Table 4.17 Factors Mentioned as Working for Lower Production Costs at Kwinana**

Factor	Count
Infrastructure	11
Proximity to Port or Cockburn Sound	8
Market Proximity	7
Raw Materials	6
Labour Skills	6
Power	5
Services	5
Heavy Transport Routes	3
Transport Cost	3
No Factor Mentioned	2
Labour Costs	2
Process Costs	1
Buffer	1
Land Availability	1
No Comment	1
Total	**62**

Note: The count represents the frequency of this factor being reported by the industries. It may not reflect the relative importance of the factor to those industries. Industries often provided more than one factor so the total is greater than the number of respondent industries.

The principal risk factors for higher production cost, and potentially reduced comparative advantage, as seen by Kwinana's managers, are freight costs, followed by navigation constraints in Cockburn Sound and raw material costs. The full list of these factors is given in **Table 4.18**.

■ **Table 4.18 Risk Factors for Higher Production Costs at Kwinana**

Factor	Count
Freight Costs	12
Navigation Constraints	4
Raw Materials	4
Environmental Constraints	2
Power	2
Wages Rates	3
Land Availability	1
No Factor Mentioned	2
No Comment	7
Total	**37**

Note: The count represents the frequency of this factor being reported by the industries. It may not reflect the relative importance of the factor to those industries. Industries often provided more than one factor so the total is greater than the number of respondent industries.

4.6.2 Key Factors Influencing Future Plans

Despite the concerns that were expressed by Kwinana managers about local risk factors for comparative advantage, discussed above, they see market demand for their products and in some cases capital availability for expansion, as by far the greatest influence on the likely future levels of their production in Kwinana (see **Table 4.19**). Thus, while the specific local environmental and input cost issues are of concern, it appears that Kwinana managers are optimistic that these issues can be satisfactorily resolved.

■ **Table 4.19 Average Ratings of the Significance of Factors Influencing the Future Level of Output**

Factor	Rating
Market Demand	2.52
Capital Availability	1.54
Environmental	1.25
Cost of Services and Infrastructure	1.21
Services and Infrastructure	1.00
Community	0.96
Technology	0.89

Note: Respondents were asked to rate the factors as "High"(Score = 3) "Medium" (Score = 2), "Low" (Score = 1) or "Not Significant" (Score = zero). If these four ratings have equal probability the expected overall average is 1.5. An average rating across all respondents of greater than 2.0 indicates a high level of significance, and an average rating of less than 1.0 indicates that the factor was of low significance.

Macro-economic factors were also viewed as having considerable importance. Results are summarised in **Table 4.20**.

■ **Table 4.20 Key Australian Macro-Economic Factors Affecting Kwinana Industries**

Macro-Economic Factor	Count
Exchange Rate	14
Level of Investment in the Economy	7
WA Mining Industry Growth	6
GDP Growth Rate	5
Wage Rates	5
Other Price Levels	5
Interest Rate	4
Labour Skills	4
WA Building and Construction Industry	3
WA Agricultural Industry	3
Government Policy	2
Total	**58**

Note: The count represents the frequency of this factor being reported by the industries. It may not reflect the relative importance of the factor to those industries. Industries often provided more than one factor so the total is greater than the number of respondent industries.

The value of the Australian dollar is seen as crucial by many exporting firms, whose contracts for exports are written in terms of U.S. dollars. For these producers a lower Australian dollar increases their international competitiveness and/or their rate of return. Other firms are engaged in import-competing activities, for example in competition with the petrochemical supply chain from the Middle East to south-east Asia, and for these a lower Australian dollar makes overseas products relatively more expensive than locally-produced commodities and works to preserve a comparative advantage for local production. Conversely, the low value of the Australian dollar makes it difficult for importers, and many Kwinana industries rely on imported raw materials as well as Western Australian commodity inputs. For these producers the low value of the Australian dollar increases their relative costs in Australian dollar terms.

In addition to the exchange rate, several managers referred to overall economic growth, the level of investment, and the prospects for the Western Australian mining and construction sectors as key factors for the future level of their production in Kwinana. The factors influencing these macro-economic variables are complex, inter-related, and beyond the scope of this analysis.

International factors were considered to be very important by many industries (refer to **Table 4.21**), with firms variously mentioning: (i) international developments as a "major factor"; (ii) the threat of competing imports or commodity dumping; (iii) the international price of commodities; and (iv) "world demand". A further group mentioned international factors as influencing them indirectly via effects on the Western Australian resources industries. As the exports of Kwinana industries are world-wide, all major trading blocks were mentioned and are important, but prospects for economic recovery in the Asia-pacific region were mentioned more frequently.

■ Table 4.21 Influence of International Factors

International Factor	Count
Unspecified International Factors were a Major Influence	9
Import Competition	9
Price of commodities	9
Unspecified International Factors were a Minor Consideration	8
Unspecified International Factors were an Indirect Influence	8
World Demand	8
Exchange Rates	6
Asia Pacific	6
Competition Dumping	4
Market Position Strong	2
Energy Prices	2
EEC	2
Environmental/Regulation	2
No Comment	1
USA	1
Corporate Competition	1
Total	**78**

Note: The count represents the frequency of this factor being reported by the industries. It may not reflect the relative importance of the factor to those industries. Industries often provided more than one factor so the total is greater than the number of respondent industries.

There is a significant list of issues where resolution of uncertainties would help to strengthen the comparative advantage of the Kwinana industrial complex as perceived corporately; these uncertainties are given in **Table 4.22**.

Environmental issues, along with market strength, were a commonly-mentioned uncertainty for managers of Kwinana industry. From discussions with the managers it appears that the main concern has not been so much with the *level* of environmental standards and provisions, so much as their interpretation on the ground, and the need for greater flexibility in their application, taking account of the objectives of the particular environmental standard, and actual environmental conditions found in different parts of the industrial complex.

■ **Table 4.22 Key Uncertainties Facing Kwinana Industries**

Key Uncertainties	Count
Environmental Issues	11
Market Demand	6
Regulation/Community Expectation	5
WA Economy	4
Waste Product Disposal	3
Global Economy	3
Cost Competitiveness	3
Water Availability	2
Power Costs	2
Exchange Rates	2
Commodity Prices	2
Additional Local Industry	2
Transport Corridors	1
Port Charges	1
Occupational Health and Safety Requirements	1
Navigation Capacity	1
No Comment	5
Total	**54**

Note: The count represents the frequency of this factor being reported by the industries. It may not reflect the relative importance of the factor to those industries. Industries often provided more than one factor so the total is greater than the number of respondent industries.

4.6.3 Expected Impact from Growth of Existing Kwinana Industries

Almost one half of the firms are planning for at least some increased output on their existing sites, and a few have significant expansion plans. The feasibility of future growth in output can be seen in the fact that many of the firms have some spare capacity at present, as reflected by the responses shown in **Table 4.23**.

■ **Table 4.23 Capacity Utilisation in 2001**

Current Spare Capacity	Count
<5%	8
5-10%	1
10-20%	7
20-50%	3
50-100%	4
>100%	6
Total	**29**

Note: The total count exceeds the number of responses due to some firms having more than one plant on site.

Despite the uncertainties elicited by the questionnaire (**Table 4.22**) Kwinana industries are planning for expanded production in future. **Table 4.24** shows the level of capacity growth proposed by respondents for the next ten years. **Table 4.25** indicates the types of capacity upgrades and productivity improvements planned by the respondents to achieve the proposed growth plans. The use of spare capacity will be supplemented by de-bottlenecking and plant optimisation, plant renewal, and technical upgrades.

■ **Table 4.24 Growth Plans for the Next 10 Years**

Extent of growth in output	Next 5 years		5-10 Year Horizon	
	Number of Industries	Percentage	Count	Percentage
None	5	55.6	7	87.5
0-1%	0	0.0	0	0.0
1%-2%	0	0.0	1	12.5
2%-3%	1	11.1	0	0.0
>3%	0	0.0	0	0.0
>5%	0	0.0	0	0.0
>10%	2	22.2	0	0.0
>20%	0	0.0	0	0.0
>50%	1	11.1	0	0.0
>100%	0	0.0	0	0.0
Total	**9**	**100**	**8**	**100**

Note: the total count exceeds the number of responses due to some firms having more than one plant on site.

■ **Table 4.25 Types of Capacity Upgrades and Plant Productivity Improvements Planned**

Type of Improvement	Next 5 Years		5-10 Year Horizon	
	Number of Industries	Percentage	Number of Industries	Percentage
Increase Capacity in Some Form	13	22.4	11	34.4
Technical Upgrades	10	17.2	5	15.6
Plant/Equipment Renewal/Upgrades	7	12.1	4	12.5
Increase Production	6	10.3	4	12.5
Business Re-basing	3	5.2	1	3.1
Environmental/ OHS Issues	3	5.2	1	3.1
Optimise Plant/ Process	3	5.2	1	3.1
Increase Waste Disposal Storage	2	3.4	0	0.0
Uncertain	1	1.7	2	6.3
Increase Water Storage	1	1.7	0	0.0
Automation	1	1.7	0	0.0
On-line Certification/Blending	1	1.7	0	0.0
De-manning	1	1.7	0	0.0
Unit Turnarounds	1	1.7	0	0.0
Acquisition of Related Businesses	1	1.7	1	3.1
Integration with Suppliers	1	1.7	0	0.0
No Comment	3	5.2	2	6.3
Total	**58**	**100**	**32**	**100**

The outcome of these growth intentions is for substantial capital investment to continue at Kwinana. During the next five years a total of $812M is earmarked for developments of existing plants, that already have corporate approval, and expectations are for an increase over the following five years as planned investments come on stream. A summary of this capital investment is given in **Table 4.26.** Thus, the broad picture is that the level of capital investment at Kwinana that has been experienced over recent years will continue and possibly increase in the medium term.

■ **Table 4.26 Planned Capital Investment in the Next 5 and 10 Years**

Expected Amount ($M)	2000-05			2006-10		
	Number of Industries	(%)	Expected Amount ($M)[1]	Number of Industries	(%)	Expected Amount ($M)[1]
<$5	9	45		11	55	
$5-10	1	5		0	0	
$10-20	1	5		2	10	
$20-50	4	20		1	5	
$50-100	3	15		3	15	
>$100	2	10		3	15	
Total			**812**			**1,212**

[1] Actual total expenditure indicated by respondents.

A few significant players expect to see substantial increases in the volume of their production through Kwinana, with the volume and value of production on their existing site increasing by up to 50% to 100% over a ten-year period. However, the majority see production volumes as static or increasing fairly slowly through improvements in plant efficiency, and some others see very real competitive risks to be overcome in future.

All companies were asked to indicate the likely growth in production over the next five and next ten years. Companies that were unable to give an answer to this question were assumed to have unchanged output over the next 5-year and 10-year periods. The volume indices were then converted to individual company growth rates and used to calculate a growth in output for the nine industry groups. The expected additions to output were then treated as increases in final demand and the potential multiplier effects on output, wages and employment were calculated by matrix multiplication in the usual way. Results are shown in **Table 4.27**.

■ **Table 4.27 Estimated Total Economic Impacts of the Expected Expansions of Output within Existing Kwinana Industries, for the Next 5 and 10 Years**

	Output ($M)	Wages ($M)	Employment
Kwinana Base	4,342	207	3,636
Increase			
Direct Effect:			
2000-05	498	38	423
2006-10	1,434	162	1,359
Direct and Indirect Effect (TYPE II)			
2000-05	817	83	1,809
2006-10	2,370	307	5,458
Changes on Base (%/Yr Cumulative)	**%**	**%**	**%**
Direct Effect:			
2000-05	2.2	3.4	2.2
2006-10	2.9	6.0	3.2
Direct and Indirect Effect			
2000-05	3.5	7.0	8.4
2006-10	4.5	9.5	9.6

It is seen that, according to approved plans within the Kwinana industries, there could be a 11.5% overall growth in output over the next five years (an increase of $498M on the base of $4,342M) and up to 33% growth over a 10-year period (an increase of $1,434M on the base of $4,342M. This

assumes that, in addition to reported expansion plans from some plants, all existing plants survive competitive pressures and that productivity gains of around 0.7% per year compound will be achieved in all existing plants.

In addition, there will be multiplier effects of the capital investment planned by existing industries for the coming decade. These are provisionally estimated using the same multipliers as were obtained for capital investment in 1999-00. The results are given in **Table 4.28**.

- **Table 4.28 Indicative Economic Impact of Planned Capital Investment by Existing Kwinana Industries for the Period 2000/01-2005/6. The Impacts are Expressed as Annual Averages**

	Output ($M)	Wages and Salaries ($M)	Employment (jobs)
Direct Effect	162	47	1,830
Total Production Effect (Type I)	256	71	2,763
Total Effect (Type II)	339	87	3,477
Type I Multiplier	1.58	1.50	1.51
Type II Multiplier	2.09	1.85	1.90

4.7 Potential Economic Impacts of New Industrial Development in the Kwinana Industrial Area

4.7.1 Projects with Known Proponents

Since its first development as a heavy industry area there has always been a number of proposed new industrial developments at Kwinana. The mooted projects have long gestations in terms of rounds of negotiations with government, suppliers and service providers; and corporate decision-making procedures, which depend on assessments of market movements, comparisons with nationally or internationally competitive supply projects, and project financing options. Even at a very late stage in these processes the final decision may be negative if everything does not go as initially expected, and conversely some "sleepers" may awake. Thus it is difficult to assign probabilities to particular projects proceeding. Nevertheless, it is possible to indicate the general nature and values of potential economic impacts if known projects, or others with similar characteristics, do in fact proceed.

At the time of this report nine projects with known proponents (either past or current) were identified, in seven broad industry groups. **Table 4.29** shows the industry sector, and potential capital expenditure, output and employment in this group of industries. Total potential capital expenditure, if all such projects were to proceed, amounts to $3,611M producing an estimated direct annual output value of $1,991M and direct employment of 1,618 jobs by 2009-10.

- **Table 4.29 Estimated Potential Capital Expenditure, Total Output and Employment in Developments with Known Proponents: Direct Impact by 2009-10**

Industry	Product	Capital Expenditure	Total Output by 2005-06	Employees in Operational Phase
Basic Petrochemicals	Chlorine, Caustic Soda, Vinyl Chloride, Ethylene dichloride	770	340	420
Other Chemicals	Commercial in Confidence	20	33	50
Iron and Steel	Pig Iron, Iron and Steel (2 projects)	1,890	1,172	825
Non-Ferrous Metals	Aluminium Fluoride, Zirconia (3 projects)	163	128	80
Electricity	Electricity	250	166	185
Waste Management	Waste Conversion Plant	500	150	50
Sewage	Sewage Treatment Plant	18	2	8
TOTAL		**3,611**	**1,991**	**1,618**

The estimated potential impacts if all projects with known proponents were to proceed by 2009-10 are shown in **Table 4.30**. The effects would be to increase total output at Kwinana by 44%. Multipliers calculated for employee earnings and jobs are relatively high, and this is due principally to differences in the input structures of these projects as compared with the existing industry set in Kwinana, particularly the potential projects in the Iron and Steel industry. It should be noted, however, that this estimate assumes that all supplying industries require additional employees to produce the required additional input to Kwinana.

- **Table 4.30 Estimated Potential Impacts on Annual Output, Wages and Salaries, and Employment, if all Projects with Known Proponents were to Proceed by 2009-10**

	Total Output ($M)	Wages and Salaries ($M)	Employment (jobs)
Direct Impact	1,991	87	1,618
After Type I Impact	3,524	311	7,216
After Type II Impact	3,962	380	9,142
Type I Multiplier	1.77	3.57	4.46
Type II Multiplier	1.99	4.37	5.65

The investment required for the identified projects amounts to $3,611M. As already stated, several of the larger projects have relatively low probability of being developed at this point in time. However, if all projects proceeded over a 10-year period the average annual capital investment would be approximately $360M, of which approximately 77% or $278M would be expenditure in WA. This figure has been used to provide an indicative estimate of the potential impacts of investment in the listed projects as viewed in **Table 4.31.**

- **Table 4.31 Potential Impact of Capital Investment in Known Potential Projects (Impacts are Expressed as Annual Average Impacts over a Ten Year Period)**

	Output ($M)	Wages and Salaries ($M)	Employment (jobs)
Direct Effect	278	80	1,677
Total Production Effect (Type I)	439	120	2,532
Total Effect (Type II)	581	148	3,186
Type I Multiplier	1.58	1.50	1.51
Type II Multiplier	2.09	1.85	1.90

4.7.2 Potential Economic Impact of Technical Development Options for Industrial Development of the Kwinana Region

The current study has examined in detail the opportunities for synergistic technical evolution of the existing industries at Kwinana. This was done by identifying the gap between local demand and local supply tonnages in the KIA, and developing indicative estimates of potential sales value for new products. Clearly, this procedure makes many untested assumptions. Nevertheless, it is useful as a guide to product lines that should be further investigated.

Additional commodities that could be produced at Kwinana are indicated in **Table 4.32**, with an indication of potential tonnages and the assumed potential value of output. For each commodity, the assumed input structure for the Input-Output economic model was based on the closest approximation that could be identified within the current Kwinana industry set. Direct and total potential impacts were then calculated in the usual way. It should be noted that when a source or destination was classed as "unspecified" in the survey questionnaire, it was assumed that the source or destination location was outside the KIA, hence possibly providing an opportunity within the KIA. This assumption is reflected in **Table 4.32** and the subsequent analysis.

The results are shown in **Table 4.33**. It is seen that opportunities identified through the technical analysis could add $120M to the direct value of annual total output, or approximately 3% of the current value of output. This is a very conservative estimate of the ultimate potential, with assumptions being for the development of projects at the lower end of the estimated range of potential capacity.

- **Table 4.32 Summary of Potential New Plants Based on Future Technical Evolution of the Kwinana Industrial Complex (No Current Proponents)**

Product	Tonnages (kt/yr)[1]	Assumed Sales ($M/yr)[2]	Notes
Acrylonitrile etc	1-20	10	Two plants have the basic raw materials for an acrylonitrile plant. Acrylonitrile is a fundamental building block for the production of synthetic materials. As acrylonitrile is produced from catalytic air oxidation of propylene and ammonia, there may be a potential synergy with existing ammonia production capacity.
Activated Alumina	10-100	5	Import substitution.
Caustic Soda	100-1,000	30	(a) Mutually exclusive with the development of a new petrochemical plant. (b) The production of caustic soda through chlor-alkali plants could open up a range of new products and opportunities, such as from chlorine production. While chlorine supply approximately meets current demand, at least one industry has considered extending their use of downstream products from chlorine production, if those products were available. Australian transport regulations regarding bulk transport of chlorine was a concern raised in the survey, adding to the desirability for further chlorine production within the Kwinana area if demand increases.
Gypsum	10-100	5	Could be from sulphuric acid gas scrubbing using lime in Kwinana. However, there appear to be other gypsum projects in WA such as Lake MacLeod.
Ferrous Sulphate	10-100	10	
Petroleum Coke	10-100	10	Import substitution
Phosphates and potash	100-1,000	50	Assumes some pre-processing at mine site.
Total		**120**	

[1] Tonnages are provided as orders of magnitude to protect the commercial confidentiality of the industry.
[2] Assumed sales are the best estimates of SKM/REU.

- **Table 4.33 Value of Output, Employee Earnings and Employment that could be Generated by Exploiting Opportunities Identified by SKM for Further Technical Evolution of the Kwinana Industrial Complex**

	Total Output ($M)	Wages and Salaries ($M)	Employment (jobs)
Direct Impact	117	8	135
After Type I Impact	158	15	306
After Type II Impact	178	18	401
Type I Multiplier	1.35	1.82	2.27
Type II Multiplier	1.52	2.23	2.97

For estimating capital investment requirements, an overall factor of five times annual output was used, giving a total investment requirement of $585M. By spreading this over a ten-year period an indicative annual average investment of $59M is obtained. The anticipated total impact of this expenditure is shown in **Table 4.34**.

- **Table 4.34 Indicative Annual Average Economic Impact of Capital Investment Required for Exploiting New Technical Opportunities (the Estimates Assume that the Investment would be Spread over a Ten Year Period)**

	Output ($M)	Wages and Salaries ($M)	Employment (jobs)
Direct Effect	59	17	296
Total Production Effect (Type I)	93	26	447
Total Effect (Type II)	123	31	562
Type I Multiplier	1.58	1.50	1.51
Type II Multiplier	2.09	1.85	1.90

4.8 Summary of Economic Impacts

As can be seen from **Table 4.35**, the Kwinana industries are a significant and growing source of revenue collectively accounting for sales of $4,342M, compared to $2,955M (1999-00 prices) determined in the 1990 study.

The capital intensive nature of many of the Kwinana industries results in lower employment than might be expected at 3,636 full time and part time jobs with a salary and wages bill of $207M. This represents an increase in total employment. The total wages and salaries have reduced in real terms since the 1990 study. However, the comparison with 1990 data ignores the influence of increased sub-contracting as a substitute for direct employment.

The Kwinana industries contributed $1,581M to Australian exports with a further $326M of "exports" from Western Australia to other Australian States. This totals $1,907M in "exports" from Western Australia in 1999-00.

Kwinana industries account for a total factor income (the sum of wages, salaries and gross margin before tax or depreciation) of $1,275M compared to a total factor income of $62,412M for Western Australia: approximately 2.0%. However, when considering the manufacturing sector only, Kwinana industries account for 22.2% of the total factor income for the sector, and remains the largest industrial site in the State in terms of income generation.

■ **Table 4.35 Summary of Existing and Potential Economic Impacts**

	Output ($M)	Wages and Salaries ($M)	Employment (jobs)
A. Impacts of Existing Industries at 1999-00 Output Levels			
Operating Impacts:			
Direct (On-site at Kwinana)	4,342	207	3,636
Total (Type II) effect in WA	3,257	215	12,944
Total (Type II effect) in the Rest of Australia	488	32	1,942
Capital Expenditure Impacts (Type II effect)	627	144	5,875
Total Impact of Existing Industries	8,714	599	24,397
B. Potential Growth of Existing Industries to 2009-10			
10 Years	1,434	162	1,359
C. Potential in 2009-10 from Known Additional Projects			
After Type II Impact	3,962	380	9,142
D. Potential from Exploiting Technical Possibilities:			
After Type II Impact	178	18	401
E. Capital Investment Required for C and D (Annual Average, to 2009-10)			
After Type II Impact	704	179	3,749
Total Impact of Potential Activity	6,278	739	14,651
Total Impact of Existing Industries and Potential Activity for 2009-10	**14,992**	**1,338**	**39,048**

Once multiplier and capital investment effects are considered, the "bottom line" is that annual output worth $8.7B, employee earnings of $600M and 24,400 jobs are directly or indirectly dependent on the operations and ongoing investment programs of existing Kwinana industries. This is an economic assessment of the amount of output, employee earnings and jobs that could be lost if the Kwinana industries were to disappear altogether, and not be replaced.

Prospects for the future development of heavy industry in Kwinana, over and above the operational and planned investment impacts of existing organisations, were considered in terms of (a) potential projects with known proponents, and (b) enhancement of technical linkages between members of the industrial complex.

If all projects with known proponents were to proceed this would have the effect of increasing total output and its Type II impact by around 70%. The employment effects would depend on the industrial mix of new projects. However, expansion at this scale is unlikely, given that several of these projects have "stalled".

Continued exploitation of the technical synergies that are possible at Kwinana could increase output and employment by 2% to 5%. Data provided in this report conservatively estimate the potential at the lower end of this range.

5. Environmental Performance

The surveyed industries were asked to describe any step improvements made under the following categories in the last five years, or improvements they would realise in the coming year:

- Cleaner production;
- Waste minimisation;
- Energy efficiency;
- Water conservation; and
- Noise abatement.

Surveyed industries were also asked to provide details on any recognition they have received for this work (e.g. community or industry awards).

The response to this section of the survey highlights the high and improving standard of work being performed by many of the industries within the Kwinana region, both large and small, to improve their production processes and interaction with the local community environmental program.

Most of these initiatives required significant investments by the industries concerned. These investments have in most cases returned significant benefits to the community and the individual companies. Broad benefits of this work include:

- Reduced noise and other environmental impacts on the surrounding community;
- Better community understanding of environmental aspects of the industrial operations;
- Significant financial benefits;
- Improved sustainability of the industries (individually and co-operatively); and
- Addressed long-standing disposal and operational issues have been addressed for certain industries.

Some of these benefits can only be achieved through co-location of facilities in an industrial area such as Kwinana. This is because of the ability to readily integrate the industries to reduce costs associated with the transport of materials between sites (such as gaseous raw materials), or utilise the efficiencies gained through activities such as the cogeneration of electricity and steam (which can be used for process heating requirements).

Many of the Kwinana industries have implemented environmental management systems and are working towards accreditation against the international standard ISO14001. Several industries have already achieved accreditation against ISO14001. This accreditation reflects the growing awareness of industry of the need to manage their environmental performance not only to meet community expectations, but also as a strategic imperative for maintaining the sustainability of their business in the international marketplace.

5.1 Cleaner Production

Many of the respondents have implemented cleaner production activities over the past five years. These activities ranged from specific activities, such as Coogee Chemicals' improved plant design and operating procedures that reduced their air emissions, through to the integrated Cleaner Production and Solid Waste Management Program of the BP Kwinana Refinery.

Two of the industries have indicated programs as part of the Commonwealth Government's Greenhouse Gas program. Of these, BP Refinery Kwinana has received recognition through several award programs, such as winning the 2000 Downstream Innovation Award and being a Finalist for the 1999 Golden Gecko Awards.

The Tiwest Joint Venture received recognition for it's cleaner production process, being a Finalist for the 2000 State 3R Awards in the Cleaner Production Category for their new synthetic rutile recovery plant.

Wesfarmers CSBP won the 2001 Business and Industry Sector State 3R award which acknowledged their efforts to reduce, reuse and recycle waste through the development of a number of waste management initiatives. These include recycling of domestic waste, near elimination of non recyclable products such as plastic cups and reuse of wastewater and other industrial wastes.

Some of the benefits being achieved through the various cleaner production programs are:
- Reduced emissions to the atmosphere;
- Reduced water treatment chemical usage; and
- Reduced landfilling of various process wastes.

5.2 Waste Minimisation

Waste minimisation activities are being actively implemented by most respondents. Recycling of waste materials is one of the initiatives being pursued by most industries. Some of the larger and better resourced industries have implemented comprehensive waste management programs.

Examples of the waste minimisation activities undertaken by the Kwinana industries include:
- A 90% reduction in emissions of volatile organic compounds by CIBA Specialty Chemicals;
- Sale of waste sodium oxalate as feedstock in vanadium extraction by Alcoa World Alumina Australia;
- Nufarm Australia Limited promotes the use of recyclable and refillable containers, displacing an estimated equivalent of 470,000 (752 tonnes) of 20L containers from landfill between 1998 and 2001;
- Cooperative efforts of several industries to reduce, collect and recycle spillages at the Bulk Cargo Jetty, preventing products (especially fertilizers) entering Cockburn Sound;
- Recycling of paper, oil and other products have been initiated by most industries; and
- Reductions in various gaseous emissions through process improvements or sale to other industries as process feedstock.

As can be seen from the examples above, the range of waste minimisation activities implemented demonstrate a strong focus on improved environmental performance by Kwinana industries.

5.3 Energy Efficiency

Energy efficiency projects are being actively employed by several industries. These projects include:
- Undertaking energy audits and continual energy reviews;
- Incremental process improvements;
- Specific energy reduction projects;
- Installing cogeneration plant; and
- Complete replacement of existing plant to gain a range of benefits.

Many companies are targeting modest improvements in energy efficiency over a period of three to five years as part of their business plans. A few have indicated much more substantial reductions. For example, Wesfarmers CSBP's new ammonia plant uses only 60% of the gas per tonne of ammonia produced compared with the older plant that it replaced.

Benefits realised from improved energy efficiency for the community and the industries include:
- Reduction in greenhouse gas emissions;
- Reduction in other gaseous emissions;
- Lower costs of production, improving the industry's competitive position;
- Reduced demand for new energy infrastructure such as power stations; and
- Improved utilisation of natural resources.

5.4 Water Conservation

Water conservation through reuse and recycling programs is an area of significant effort for the Kwinana industries. Nearly all of the programs are internal to any given company, however it was noted that some co-operative ventures were being undertaken between Kwinana industries.

Most industries in the study have implemented water reuse or recycling activities over the last five years. Initiatives include:
- Reuse and recycling of process and cooling waters;
- Use of wastewater and storm water for irrigation purposes;
- Recovery of steam condensate;
- Redirection of rainwater into process applications;
- Reduced water (and treatment chemical) usage by changing to better quality water;
- Recovery and processing of contaminated groundwater; and
- Substitution of scheme water with softened bore water in various process applications.

Three of the Kwinana industries indicated that they have received significant recognition of their water conservation activities through award programs:
- Alcoa World Alumina Australia received a Water Awareness Award (1996), and a Water Wise Award (1996) for their water conservation activities, which included the installation of a water softening plant to replace potable water with softened bore water in process applications.
- BP Refinery Kwinana won both the Award for Water Treatment/Reuse and overall Minister's Award for Excellence in the WA Water Industry Awards (2000) for their Water Reuse and Minimisation Program.
- The Tiwest Joint Venture received a Water Wise Certificate (1996) for their program to reuse and recycle most of their process and cooling water.

These water conservation projects have benefited the wider community through reducing industrial demand for scheme and ground waters and reducing the volume of wastewater for treatment and disposal.

The Waterlink Project
Whilst the Water Corporation is not a core process industry in the KIA, it is involved in a co-operative venture with the Kwinana industries, through the Waterlink project. This project brings together the Water Corporation, the KIC, individual Kwinana industries and government agencies to develop a "partnership for improved water efficiency and better environmental management" (Water Corporation, 1998). This project has five taskforces to consider and make recommendations on:
- Scheme water supply and demand;
- Groundwater supply, demand and efficient usage;
- Wastewater reuse opportunities;
- Common wastewater treatment opportunities; and
- An integrated strategic plan for management and development of the water resources.

The long-term benefits of the Waterlink project include:

- Reduced demand for scheme water;
- Reduced pressure on the groundwater resource within the Kwinana region;
- Rationalisation of ocean outfalls; and
- Water availability for future development of industry in the Kwinana region.

The Water Corporation is proceeding with the Kwinana Water Recycling Project (KWRP), which has resulted from Waterlink. The KWRP is proceeding subject to agreements from major customers in Kwinana to purchase high-grade industrial water provided by the Water Corporation from treated municipal effluent. With significant environmental and community benefits, this project is strongly supported by the relevant regulators, being the Environmental Protection Authority and the Water and Rivers Commission.

5.5 Noise Abatement

Noise emissions are a significant issue for many of the industries within the study. Much of the noise abatement work undertaken by the industries has involved two main objectives. The first objective is to reduce noise within the workplace, to meet or exceed occupational health and "duty of care" obligations to the workforce. The second objective is to reduce the impacts of noise on the surrounding community. The community impacts of industrial noise is a significant issue for several of the Kwinana industries, because of the proximity of these industries to the local community.

Noise abatement projects have generally centred on:

- Installation of silencers and enclosures for noisy equipment;
- Redesign of noisy equipment;
- Relocation of equipment to reduce noise transmission to the community;
- Policies to purchase lower noise equipment where practicable; and
- Rescheduling and eliminating of noisy activities to minimise noise impacts.

The WMC Kwinana Nickel Refinery implemented a Noise Remediation Program that reduced noise impacts on their North Rockingham community boundary by 7 dB(A). This represented a major reduction in their contribution to noise impacts in the local community.

Through noise surveys and monitoring campaigns undertaken by Kwinana industries, it has become clear that, at a number of points on the periphery of the KIA, there is considerable overlap between the noise emitted from several different sources. To understand this issue and develop management options to address it, the KIC commissioned a study into the cumulative impacts of noise emitted from various sources in the KIA. This has resulted in the *Cumulative Noise Model of the Kwinana Industrial Area for the Kwinana Industries Council Baseline Study Report* (SVT Engineering Consultants, 2001) being completed in November 2001. The baseline study provides guidance on how the Kwinana industries collectively can best address noise levels in the area.

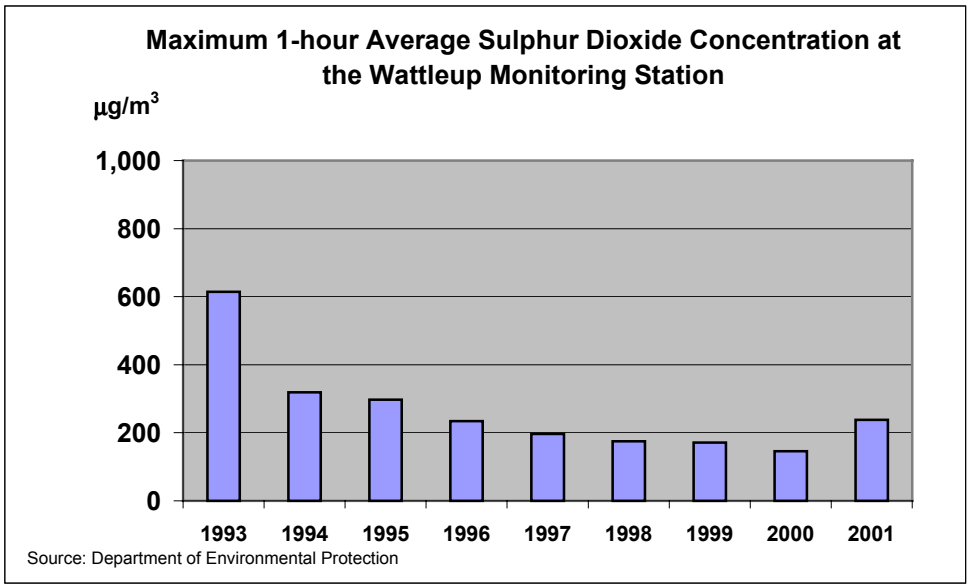
5.6 Sulphur Dioxide Emissions Management

Emissions of sulphur dioxide from the Kwinana industries have been a significant issue for residents in communities located close to the KIA. The *Environmental Protection (Kwinana) (Atmospheric Wastes) Policy* (EPA, 1992) was developed as a management tool for ambient concentrations of sulphur dioxide (and dust emissions) in the Kwinana area. The aim of the Environmental Protection Policy was to provide a framework for the Kwinana industries to manage their collective sulphur dioxide emissions. The KIC contributed to the development of the DISPMOD atmospheric dispersion

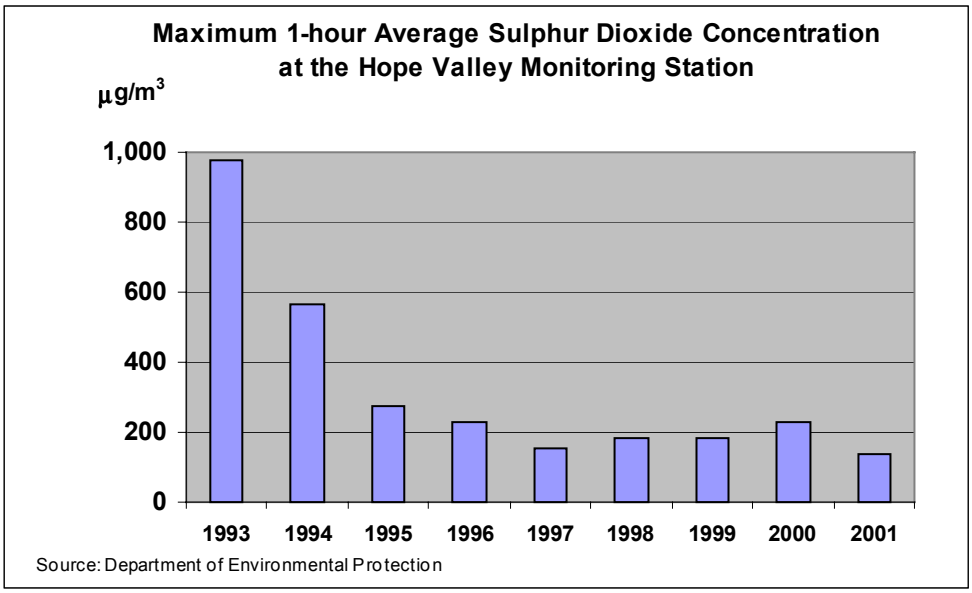
model, which is used in assessing and licensing air emissions to achieve compliance with the Environmental Protection Policy.

The Kwinana industries have collectively adopted the framework of the Environmental Protection Policy. The industries have implemented a range of activities such as cleaner production initiatives and emission reduction strategies that have reduced the ground level sulphur dioxide concentrations measured within the Kwinana region. **Figure 5.1** to **Figure 5.3** illustrate the effect of these improvements, showing a general trend of reduced ground level concentrations of sulphur dioxide at communities near the KIA. The sulphur dioxide concentrations plotted in the figures are the maximum 1-hour average ground level concentrations recorded for the year at the designated monitoring station (sourced from the Department of Environmental Protection). Being the maximum 1-hour average recorded for the year, the sulphur dioxide concentrations would be subject to variation in meteorological conditions from year to year.

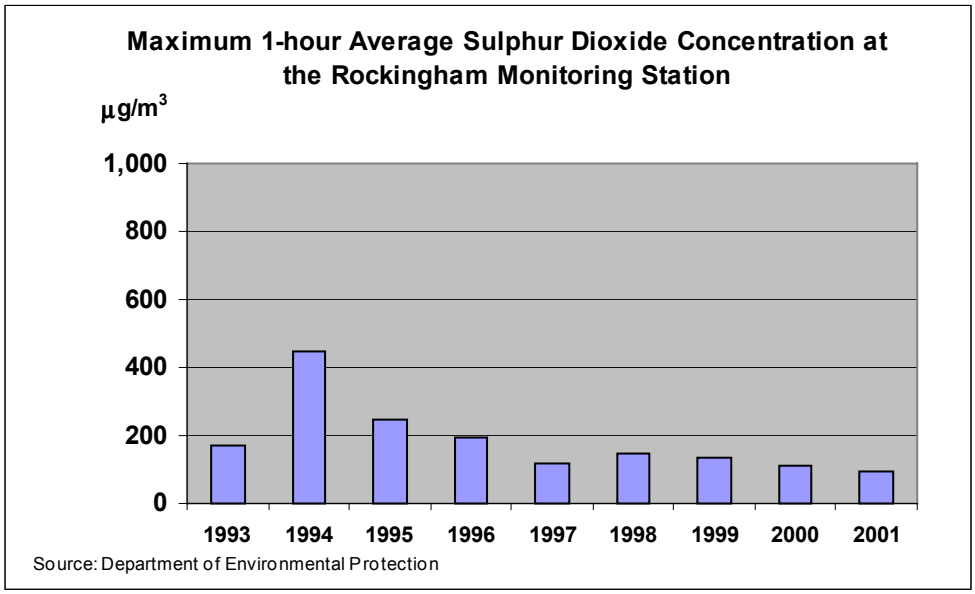
During the nine year period included in the figures, two emission inventories have been undertaken and reported by the Department of Environmental Protection: for the 1992/93 and 1998/99 base years. From the *Perth Airshed Inventory Update 1998-1999* (Department of Environmental Protection, 2002) it is estimated that the annual emissions of sulphur dioxide from industrial and commercial sources located in the Kwinana region have decreased by approximately 14%, or 2,300 tonnes between 1992/93 and 1998/99. This would significantly contribute to the trend observed in **Figure 5.1** to **Figure 5.3** . It should be noted that during the time period included in the figures several industries have expanded production, or added new product facilities at their Kwinana operations.



- **Figure 5 .1 Annual Maximum Measured 1 Hour Average Ground Level Concentration of Sulphur Dioxide Recorded at the Department of Environmental Protection's Wattleup Monitoring Station**



- **Figure 5.2 Annual Maximum Measured 1-hour Average Ground Level Concentration of Sulphur Dioxide Recorded at the Department of Environmental Protection's Hope Valley Monitoring Station**



- **Figure 5.3 Annual Maximum Measured 1 Hour Average Ground Level Concentration of Sulphur Dioxide Recorded at the Department of Environmental Protection's Rockingham Monitoring Station**

5.7 Environmental Initiatives Coordinated and/or Contributed to by KIC

KIC has worked proactively with government regulatory agencies to improve the understanding of potential environmental issues and to define appropriate environmental management tools specifically for the Kwinana area, often with positive benefits to the wider metropolitan area. On behalf of their member industries KIC has coordinated and/or contributed to a range of environmental initiatives that include:

- The Cockburn Sound summer water quality monitoring program conducted each year to measure the levels of chlorophyll a and light attenuation;
- The Cockburn Sound water sediment monitoring program. This monitoring program is undertaken by KIC to collect information on sediment quality in Cockburn Sound to provide supporting data for the Cockburn Sound Environmental Protection Policy which is under development;
- In conjunction the Mineral Council of Australia, funded major submissions to ANZECC's draft water quality guidelines;
- Monitoring of PM10 particulates in the Kwinana airshed in relation to the Kwinana Atmospheric Wastes Environmental Protection Policy;
- Contribution to the development of the DISPMOD atmospheric dispersion model developed by the CSIRO. DISPMOD is the main regulatory dispersion model used in assessing and licensing air emissions in the Kwinana area;
- The operation of an air quality monitoring network and a centralised data collection system to provide continuous monitoring of air quality in the community;
- Development of a model to study the cumulative impact of industrial noise in the community;
- Groundwater monitoring for the CIK plume. The CIK plume relates to a groundwater contamination plume which resulted from the disposal of effluent from CIK agricultural chemicals operations into an unlined pond for approximately twenty years up to the early 1980s. This monitoring is being undertaken in conjunction with the Western Australian Government;

- Contribution of funding to the development of the Cockburn Sound Environmental Protection Policy, that aims to establish a management framework to declare and protect the environmental values of Cockburn Sound;
- Facilitating communication with the community by supporting the Communities and Industries Forum and the Kwinana Industries Emergency Management Liaison Group.

KIC will continue to contribute to, and coordinate, these and future environmental initiatives on behalf of member industries.