

The economic environment of Waihi - a review

Report to Hauraki District Council

March 2005



Preface

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Executive Summary

This report is designed to establish the economic indicators in terms of which the economy of Waihi is to be evaluated now and in future. We believe it is optimal to maintain a small number of higher level measures, given the size of the economy and the precise nature of the impacts Hauraki District Council are interested in monitoring. We have used indicators based on employment and GDP (value added) as the basis upon which future comparisons could be made. Employment is important for obvious reasons (which extend beyond inanimate concepts often used as indicators of economic activity), while GDP is a well known concept that has widespread use.

In addition, the report establishes the economic role of the Martha Mine activities within the wider Waihi economy. This is particularly important given the eventual closure of mining activity associated with Martha. The report is motivated by condition 3.6 of the land use consent granted by Hauraki District Council requiring that the consent holder pay for monitoring and reporting on the social environment up to the cessation of mining. Two social assessments have taken place, and rather than complete a further one, the Council decided to complete an economic review, largely to assess the degree of preparedness of local businesses in terms of the eventual mine closure.

There is little doubt that Newmont contributes significantly to Waihi both in economic and social terms. Gold Ore Mining is second only to Supermarkets in terms of the share of total Waihi employment in 2004, representing around 7.5% of total headcount employment. We estimate that for the year ending March 2004, Waihi GDP (value added) was around \$105 million. The mining sector is the largest sector in value added terms in the Waihi economy, generating nearly 27% of the local economy's value added. While only a fraction of the amount of GDP apportioned to mining would actually be represented by spending in the economy, this is still substantial in the context of a relatively small economy.

Mining's employment multipliers are very close to the average for Waihi, suggesting that Martha Mine operations provide an average level of indirect support for employment throughout the economy. Our input-output analysis of the flow-on impacts of the Martha Mine suggests that if it were to cease all operations, value added of the Waihi economy would fall by \$35.8m, including \$21.6m of the mine itself and \$14.2m across the remainder of the economy. Similarly, the number of economy-wide jobs would decrease by 135, including the loss of 92 jobs at the mine.

However, the analysis also indicates that the flow-on impacts from the Favona extension will generate a total of \$18.6m of value added (including \$11.2m of the mine) and 70 jobs (including 48 at the mine).

The interview process undertaken indicated that there will be a noticeable impact on local businesses of the closure, but it was by no means catastrophic. In fact, the process of adjustment required to account for the finite nature of mining has already begun. There is an acceptance of the need to identify alternate sources of revenue, and most of the businesses spoken to have already started the process to put in place alternatives where required. Not all businesses considered this necessary.

From the perspective of the overall economy, some possible indicators for future prosperity were identified in terms of current industry sector “stars” and also those that have some potential for the future. In broad terms, manufacturing and retail trade seem to be the sectors in which Waihi enjoys a comparative advantage and these sectors may be instrumental in the future prosperity of Waihi post-mining. Changes in the comparative advantage over time will provide a useful measure of structural changes in the Waihi economy in the future. These measures are based on employment data, which together with estimates of GDP (or value added) are the high level measures that will provide useful comparisons going forward. Employment data is released annually by Statistics New Zealand, while the other measures are indirectly estimable from this official data.

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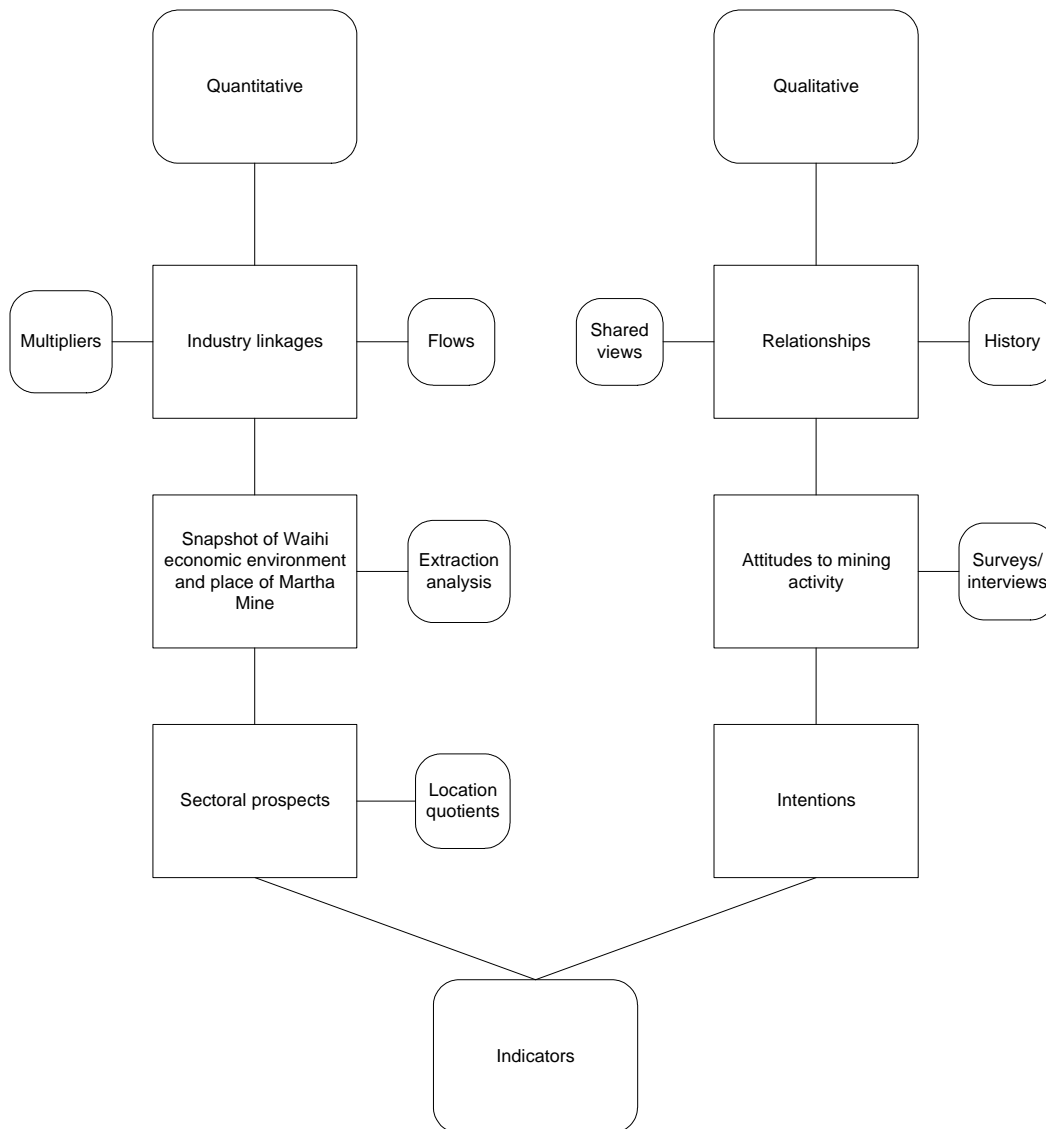
1. Introduction

In February 2005, the Hauraki District Council commissioned NZIER to undertake a review of the Waihi Town economic environment. The review was designed to establish the economic indicators in terms of which the economy of Waihi is to be evaluated, that apply in 2004. In particular, the review will establish the economic role of the Martha Mine activities within the wider Waihi economy.¹

This report sets out the findings of research undertaken using the broad organising framework shown in Figure 1. In addition to using strictly quantitative methods, a series of interviews were conducted within Waihi to inform the qualitative aspects of the study. As is evident in Figure 1, the qualitative and quantitative elements are distinct from each other. This is appropriate given the nature of the assessment undertaken in this project. Notwithstanding this, there are good reasons for using qualitative and quantitative methods in parallel. The use solely of quantitative methods may omit some of the contextual influences and changes that may not be adequately captured in available historical data, while qualitative methods alone risk being biased by subjective views that may not be substantiated by the data.

¹ Taken from Maunsell Invitation for Proposal on behalf of Hauraki District Council, dated 14 November 2004.

Figure 1 Components of study



Source: NZIER

The remainder of the report is structured as follows. Section 2 presents an overview of the Waihi economy, highlighting key structural features. Section 3 concentrates on the activities of Newmont, first presenting some brief details on current operations and then placing that activity within the wider Waihi context. Section 4 details the impressions gained from interviews undertaken to determine, *inter alia*, the actions and degree of preparation of businesses in response to any winding down of mining activities. The section also includes discussion of where efforts should possibly be directed, given the structure of the Waihi economy.

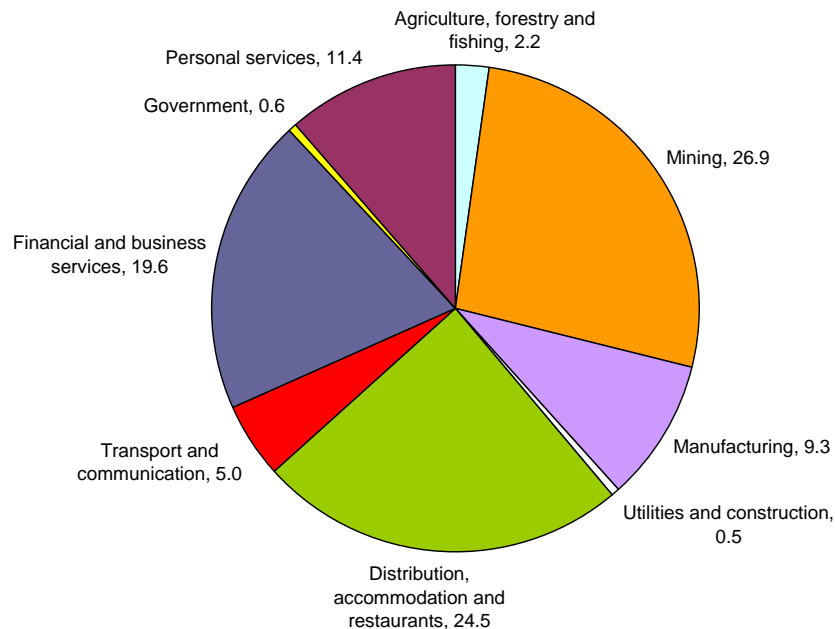
2. An overview of the Waihi economy

For the majority of this report, we refer to the Waihi Census area unit in terms of the geographical boundaries of the Waihi economy.² However, when conducting the input-output/multiplier analysis further below, we combined the Waihi and Waihi Beach Census area units in order to adequately capture the overall economic benefits, which tend not to be retained within geographical borders.

We estimate that for the year ending March 2004, Waihi GDP was around \$105 million. The broad structure of Waihi's economy is shown in Figure 2.

Figure 2 Waihi economic structure

Percentage contribution to Waihi GDP



Source: NZIER

With the exception of mining, all of the sectors shown in Figure 2 are aggregations of the sectors used in the input-output analysis outlined below. Despite this, the mining sector is the largest sector in value added terms in the Waihi economy, generating nearly 27% of the local economy's value added. Other significant contributors are Distribution (including retail and wholesale trade), accommodation and restaurants (24.5%), and Financial and business services (19.6%).

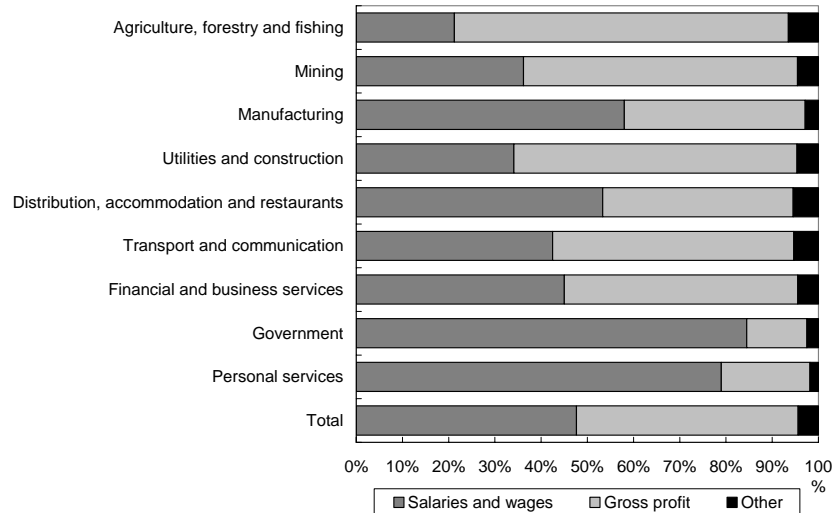
It should be noted, however, that the composition of value added varies across industries. The two biggest components of value added for all

² Value added estimates presented in this section are derived using SNZ's employee count data, and estimates of sectoral labour productivity produced by NZIER as part of the production of *Quarterly Predictions*.

industries are invariably salaries and wage payments to employees, and gross surplus (which includes depreciation and is akin to business profit); but the mix of these in different sectors can vary considerably. Figure 3 shows the value added breakdowns of sectors in the Waihi economy.³

Figure 3 Sectoral composition of value added

Percent of total value added



Source: NZIER

The split of value added can be important because it potentially influences both the size and the nature of the impact of each sector on the remainder of the economy. Salaries and wages clearly represent a form of household income, and thus support spending in the local community. It is not clear that the same could be said of gross profit, however. While profits may represent a form of income to the owner of the business, it could be argued that they are more likely to be saved than wages via reinvestment in the business. Further, one could argue that additional business investment in the form of an expansion of premises or purchase of new equipment will rely more heavily on purchases made outside of the economy. The extension of this argument is that sectors with relatively low wage and salary payments (i.e. those sectors that are relatively less labour intensive) may be less interwoven into the local economy than those with high wage and salary payments.

The relative labour intensities of Waihi's industries are also indicated by comparison of sectoral employment numbers with contribution to Waihi GDP. While the mining sector makes the largest sectoral contribution to Waihi's GDP, Figure 4 shows that it employs around 100 staff, or 7.5% of Waihi's total employment.⁴ This suggests that mining is a relatively capital

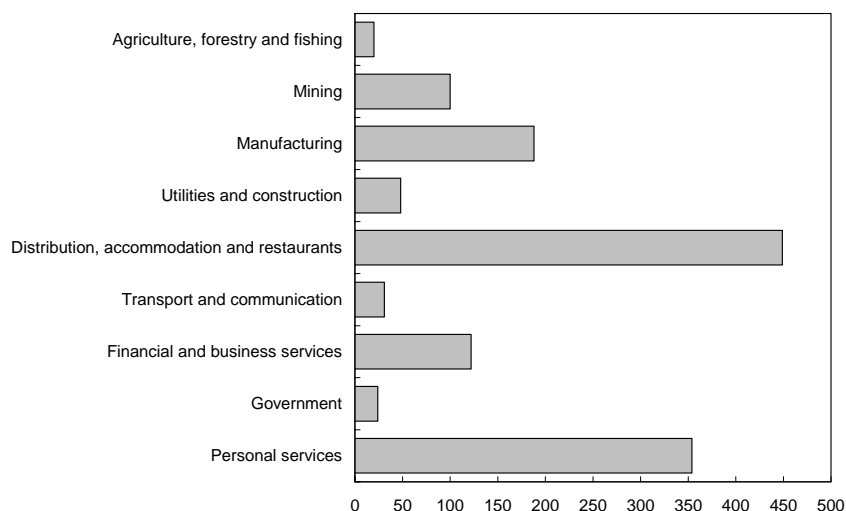
³ Data is drawn from our Waihi input-output table.

⁴ Note that Newmont Waihi Gold also make extensive use of contracted staff who potentially spend their incomes in the local economy. For the multiplier analysis that follows, these have been treated as if they were salaried employees (as indicated in Table 6).

intensive operation, which fits with what we know about mining as a heavy user of equipment used for drilling, tunnelling, excavation, etc.

Figure 4 Waihi sectoral employment

Employee count



Source: NZIER

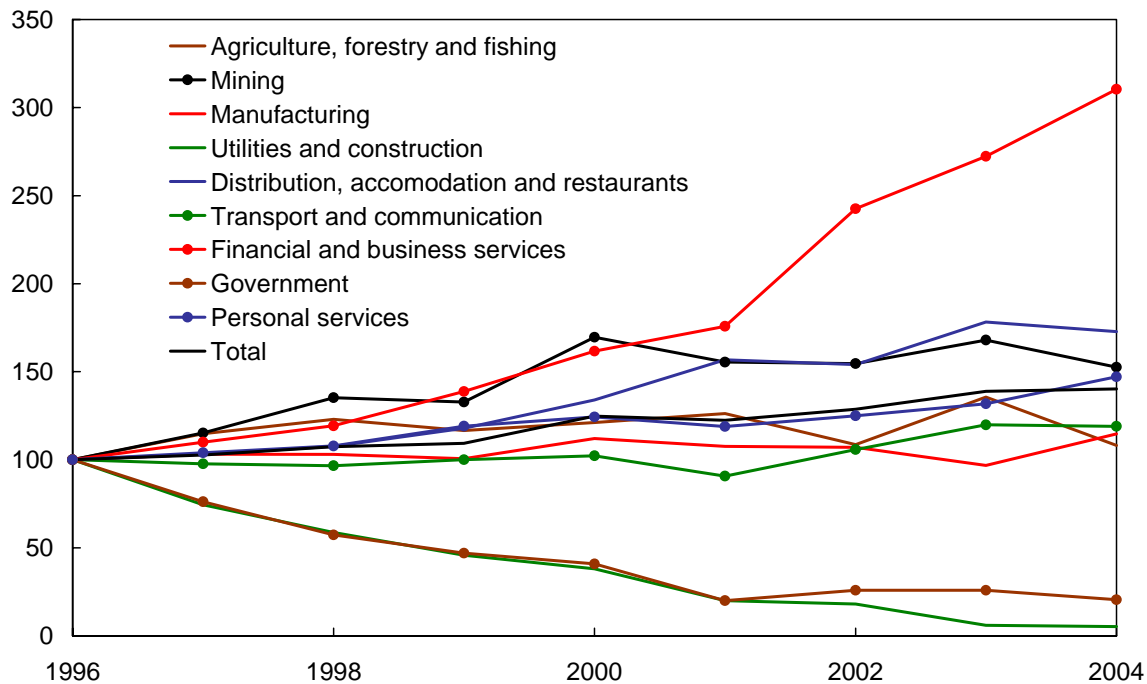
In a small economy such as Waihi, there is also the likelihood that the owners of a particular business live outside the local economy. This is certainly the case for Martha Mine. Therefore, profits are effectively repatriated beyond Waihi, and thus have little chance to impact on the local economy. These two factors - the relatively low capital intensity and the external ownership of the mine – indicate that the link between Martha Mine and the Waihi economy may not be as strong as share of Waihi GDP suggests. The strength of this link is explored further in the input-output analysis that follows.

Returning to the structure of the Waihi economy, rates of sectoral growth have varied considerably, both across sectors and over time. The variation in sectoral growth since 1996 is illustrated in Figure 5, which shows the change in each sector's value added relevant to its level in 1996.⁵ Financial and business services has been the stand-out performer, more than trebling in size since 1996. The weakest growing sectors have been Utilities (i.e. electricity, gas and water) and construction, and Government. However, as shown in Figure 2, these are relatively small sectors in the context of the Waihi economy.

⁵ Note that given the relatively small size of the Waihi economy, sectoral growth shown in Figure 5 can be sensitive to business start-ups and closures.

Figure 5 Real value added in Waihi

Index, 1996 = 100



Source: NZIER

3. Economic role of Martha Mine

Martha Mine has a long and distinguished history, dating back to mid-late 1800's. Mining activity has not been constant, however, with 1952 marking the closing of the Martha Mine. During its life up until then, Martha Mine produced 174,160kg (5.6 million oz) of gold and 1,193,180 kg (38.4 million oz) of silver, from 11,932,000 tonnes of ore. For seventy years up to its closure Martha Mine had a workforce averaging 600 people. With the advent of modern technology, there is less need for such large numbers of employees, and following its re-opening in 1987 (following prospecting in the late 1970s) activity continues.

In 1998, resource consents were granted to extend mine life to 2007. Waihi is synonymous with mining and therefore the role of Martha Mine in the local economy is an important issue to consider. We have also considered the mitigating effects of the opening of the Favona underground mine, however, the focus is largely on Martha Mine for two reasons. First, there is some uncertainty around the exact timing of Favona operations commencing. Second, it falls somewhere outside the brief for this project, in that economic baselines need to be established as at 2004 (the latest data available) and the inclusion of any impacts associated with Favona would tend to introduce bias and potentially compromise the integrity of such estimates. In saying this, we have provided some analysis of the net effect of Martha Mine's closure (i.e. estimating the full impact of closure of Martha less any offsetting impacts from the opening of Favona), though this is more indicative in nature.

3.1 Analytical framework

The economic analysis that follows uses the input-output framework to identify Waihi's key sectors in terms of their connectedness with the local economy.⁶ The analysis contained in this section utilises different forms of *input-output analysis*. At the core of the analysis is an input-output (IO) table (see Appendix B), which is a snapshot of the production-related transactions of industries, households and government in a particular region and at a particular point in time. The analysis in this report employs a 30-sector input-output (IO) table for the Waihi economy, which in turn has its origins in Statistics New Zealand's national IO table for 1996.⁷ Derivation of the Waihi IO table, and updating of the analysis from 1996, was done using a combination of data from SNZ and Newmont.

⁶ For the purposes of this section, Waihi refers to the area comprising the townships of Waihi and Waihi Beach.

⁷ SNZ's 1996 IO table is the most recent available. For a list of the sectors used in our analysis, see Appendix A .

Local businesses contribute to the Waihi economy via direct, indirect and (income) induced impacts. These impacts can be illustrated via reference to the consequent effects from an increase in the level of production at Newmont's Waihi operation.

1. *Direct impacts*: the immediate, or direct, consequence of an increase in Newmont's operations will be that it will require of the inputs needed to conduct its daily business. This in turn creates additional demand for local suppliers of those inputs, including demand for new employment.
2. *Indirect impacts*: indirect impacts are the second and subsequent round effects on supplying sectors. Suppliers to Newmont, who lift their level of production to service the mine expansion, in turn generate greater demand for their inputs. This leads to other increases in local production, which generates further demand, and so on.
3. *Income-induced impacts*: these record the additional change in activity in the Waihi economy that is induced by a change in the income accruing to households. The direct and indirect changes resulting from an expansion of activity at the Newmont mine will include increases in the value of wage and salary income paid to employees (both of Newmont and upstream sectors). This additional income provides the basis for new household spending in the local economy, which creates further demand for locally supplied goods and services.

Sectoral multipliers and linkage measures capture these effects, and are reported and discussed below.

3.2 Waihi's sectoral linkages

The extent to which a sector has the potential to affect its local economy depends on the strength of the linkages between it and other businesses in the area. A sectoral multiplier, as discussed below, is a measure of the strength of the *backward linkage* between that sector and the rest of the local economy. Backward linkages refer to the links between a sector and its suppliers; these are also commonly known as upstream linkages. A relatively large measure of backward linkage for a particular sector suggests that an increase in activity in that sector will tend to have a relatively large impact on the remainder of the economy via the additional demand it places on its suppliers, who in turn demand more from their suppliers, and so on.

Table 1 Waihi economy sectoral linkages

	Direct backward linkage	Total backward linkage	Direct forward linkage	Total forward linkage
Agriculture	0.173	1.221	0.110	1.132
Forestry and Logging	0.314	1.424	0.179	1.239
Fishing	0.160	1.195	0.113	1.134
Mining	0.068	1.076	0.071	1.080
Food, Beverage and Tobacco Manufacturing	0.000	1.000	0.000	1.000
Textiles and Apparel Manufacturing	0.088	1.114	0.101	1.118
Wood and Paper Product Manufacturing	0.114	1.156	0.352	1.431
Printing, Publishing and Recorded Media	0.116	1.147	0.435	1.577
Petroleum, Chemical, Plastic and Rubber	0.167	1.226	0.292	1.371
Non-metallic Mineral Product Manufacturing	0.315	1.422	0.762	2.036
Metal Product Manufacturing	0.201	1.260	0.299	1.386
Machinery and Equipment Manufacturing	0.204	1.262	0.120	1.147
Furniture and Other Manufacturing	0.218	1.275	0.103	1.123
Electricity, Gas and Water Supply	0.440	1.748	0.497	1.858
Construction	0.364	1.494	0.174	1.212
Wholesale Trade	0.267	1.345	0.301	1.384
Retail Trade	0.126	1.163	0.122	1.156
Accommodation, Restaurants and Bars	0.110	1.143	0.037	1.040
Transport and Storage	0.303	1.404	0.350	1.495
Communication Services	0.217	1.274	0.502	1.710
Finance and Insurance	0.171	1.212	0.373	1.497
Property Services	0.398	1.599	0.390	1.594
Ownership of Owner-occupied Dwellings	0.000	1.000	0.000	1.000
Business Services	0.182	1.231	0.444	1.598
Central Government Administration and Defence	0.186	1.241	0.044	1.056
Local Government Administration	0.381	1.545	0.048	1.050
Education	0.089	1.112	0.048	1.058
Health and Community Services	0.142	1.179	0.051	1.054
Cultural and Recreational Services	0.238	1.310	0.095	1.104
Personal and Other Community Services	0.220	1.280	0.113	1.141
Waihi Economy Average	0.199	1.269	0.218	1.293

Source: NZIER

In a similar manner to that used to generate multipliers as measures of the strength of backward linkages, IO tables can also be used to derive measures of the strength of the *forward linkages* of a particular sector. Forward (or downstream) linkages refer to the links between a sector and its customers. A relatively large measure of forward linkage for a sector suggests that an increase in the value of output in that sector will tend to have a relatively large impact on the remainder of the economy via the additional output that it makes available to potential customers, who in turn are able to supply more to their customers, and so on.⁸

Table 1 shows the backward and forward linkage measures (direct and total) for each of the sectors in the 30-sector IO Waihi table used in this analysis. The final row of Table 1 shows the average value of each of the measures for the Waihi economy; sectors which have linkage measures greater than the average are highlighted. Forward linkage measures indicate how much the local economy relies on each sector, while backward linkage measures indicate how much each sector relies on the local economy.

This analysis effectively highlights those sectors that have the potential to have the greatest impact on the local economy should they alter their production levels. Relatively low linkage measures reflect the relative size of the sector in the context of the whole economy, the strength of the link (backward or forward) between that sector and the rest of the economy, or a combination of both. Linkage measures can thus indicate sectors, which although may be large, rely relatively heavily on suppliers from outside the region, or sell most of their output to external customers.

Notable from Table 1 are the relatively low measures of linkage between mining and the Waihi economy. While this may seem a surprising result, two points are worth noting with respect to these measures. First, linkage measures do not reflect the link between a sector and the local economy via the employment by that sector of local workers. The linkages shown in Table 1 refer only to the links between producing sectors. Thus a business or sector that is a heavy employer in the area, such as Martha Mine, but tends to trade outside the local economy for its raw materials and sales, will tend to have a low linkage measure despite being a significant payer of salaries and wages in the area. To examine employment related linkages, we must turn to multiplier analysis, which is reported below.

Second, it must be remembered that the economy of interest in this analysis is that of the combined Waihi and Waihi Beach townships. By any measure this represents a small collection of businesses. It is hardly surprising, therefore, that many businesses source significant proportions of their inputs

⁸ Strictly speaking, forward linkages are better interpreted as representing the influence of sectoral *price* changes on the remainder of the economy, rather than being treated as measures of quantity impact. For the purposes of illustrating the flow-on nature of downstream sectoral impacts, however, the explanation provided here is sufficient.

from outside the local economy (or make significant sales outside Waihi). To a certain extent, the ranking of linkage measures simply reflects the degree to which each business can source its inputs, or sell its production, locally.⁹ Analysis of Newmont financial information and the Waihi input-output table suggests that around 87% of Martha Mine purchases are from outside the Waihi economy, providing the basis for mining's relatively low linkage measure.

It will be apparent from Table 1 that it is possible for a sector to be relatively closely-linked in one direction but not the other. In other words, a sector may rely heavily on the local economy for the supply of the goods and services it uses in production, but may sell the bulk of its output further afield. The converse is also clearly true.

As noted earlier, backward linkage measures and multipliers are closely related; in fact, the total backward linkage measure is equivalent to the Type I output multiplier. However, multipliers extend the notion of sectoral linkage, denominating sectoral impact in terms of real measures such as jobs, and accounting for induced impacts arising from changes in income flows. Waihi sectoral multipliers are discussed in the next section.

3.3 Multiplier effects

The resultant change in the total activity of the local economy arising from a change in the level of activity in one sector is measured via multipliers. The various types of multipliers and their values for the Waihi economy are discussed and presented below.

3.3.1 Direct and indirect (Type I)

As noted earlier, direct and indirect impacts are the flow-on (upstream or backward) impacts arising from a change in activity in a single sector. Combined direct and indirect impacts are measured by Type I multipliers.

Multipliers can be calculated for a range of economic variables: output, employment, income, value added, imports, etc. Here we present value added, employment and output multipliers. We believe that these provide sufficient basis on which to comment on the economy-wide impacts resulting from a sectoral change in activity.

The Type I multipliers for the Waihi economy are presented in Table 3, together with Waihi economy average multiplier for each variable. Again, multipliers higher than the average are highlighted. The multipliers represent the economy-wide change in that variable, relative to the change in that variable in the sector in which the initial change occurred.

⁹ To put it another way, the greater the size of the economy of which a sector is a part, the greater the linkage between that sector and the economy is likely to be.

Using the mining sector to illustrate, the interpretation of the multipliers shown in Table 3 is as follows:

Value added: for each \$1 increase in value added generated by Martha Mine, a total increase of \$1.075 of value added will be generated throughout the Waihi economy. This comprises the original increase of \$1 in Newmont value added, and a further 7.5c across the remainder of the Waihi economy.

Employment: for each new full-time equivalent position created at Martha Mine, a total (i.e. including the mine) of 1.085 jobs will be created in the economy; that is, 0.085 additional jobs will be created in the remainder of the economy.

Output: for each \$1 increase in the quantity of Martha Mine's output, an additional 7.6c of output is supplied by the remainder of the economy.

Bringing these multiplier effects together, we can decompose the direct and indirect impacts of a \$1million increase in Newmont Waihi Gold's mining activity as follows.

Table 2 Decomposition of mining economic impacts

Direct and indirect impacts

	Mining (\$m)	Multiplier (Type I)	Total Waihi economy (\$m)
Output	1.00	1.076	1.076
Value added/output (%) ¹	26.63		
Value added	0.266	1.075	0.286
Employment/output (Employees per \$m output) ²	1.23		
Employment	1.23	1.085	1.338

Notes: (1) See Table 6.

(2) Based on 100 employees

Source: NZIER, Newmont Waihi Gold

Thus, if Newmont Waihi Gold were to expand its operations by \$1 million (in terms of output), it would (on the basis of the current operating structure of the company) increase its value added by \$0.266 million and create 1.23 new jobs. These increases would give rise, via the multiplier effects, to the direct and indirect impacts on the Waihi economy shown in the final column of Table 2. That is, total Waihi output and value added would rise \$1.076m and 0.286m, respectively, and 1.338 new jobs would be created across all sectors.

Table 3 Waihi sectoral Type I multipliers

	Value added	Employment	Output
Agriculture	1.2233	1.1631	1.2206
Forestry and Logging	1.4367	1.9157	1.4243
Fishing	1.2362	1.2527	1.1954
Mining	1.0750	1.0849	1.0759
Food, Beverage and Tobacco Manufacturing	0.0000	0.0000	1.0000
Textiles and Apparel Manufacturing	1.1397	1.0943	1.1136
Wood and Paper Product Manufacturing	1.2181	1.1632	1.1557
Printing, Publishing and Recorded Media	1.1475	1.1951	1.1470
Petroleum, Chemical, Plastic and Rubber	1.2588	1.2275	1.2256
Non-metallic Mineral Product Manufacturing	1.4365	1.4918	1.4221
Metal Product Manufacturing	1.2839	1.2536	1.2596
Machinery and Equipment Manufacturing	1.3194	1.3096	1.2620
Furniture and Other Manufacturing	1.3171	1.2061	1.2751
Electricity, Gas and Water Supply	1.7664	2.2460	1.7481
Construction	1.6300	1.4929	1.4944
Wholesale Trade	1.3873	1.4383	1.3452
Retail Trade	1.1502	1.0904	1.1629
Accommodation, Restaurants and Bars	1.1677	1.0677	1.1427
Transport and Storage	1.4238	1.4863	1.4044
Communication Services	1.2422	1.3824	1.2744
Finance and Insurance	1.1879	1.3154	1.2120
Property Services	1.6294	1.6256	1.5989
Ownership of Owner-occupied Dwellings	0.0000	0.0000	1.0000
Business Services	1.2185	1.1751	1.2309
Central Government Administration and Defence	1.2273	1.2649	1.2409
Local Government Administration	1.5105	1.9823	1.5447
Education	1.0778	1.0548	1.1121
Health and Community Services	1.1440	1.1122	1.1787
Cultural and Recreational Services	1.3812	1.2087	1.3102
Personal and Other Community Services	1.2775	1.1589	1.2797
Waihi average	1.2171	1.2487	1.2686

Source: NZIER

3.3.2 Income-induced (Type II)

Type II multipliers have a broader coverage than Type I in that they also include the induced impact associated with the change in household income that arises from a change in production activity. The interpretation of Type II multipliers, however, is exactly the same as for Type I. The Type II employment multiplier for Waihi's agriculture sector, for instance, counts the number of jobs created across all the sectors of the Waihi economy as a ratio of the number of jobs created within agriculture; the only difference now is that changes in activity induced by household income changes are also taken into consideration.

Again focussing on Martha Mine, the interpretation of the multipliers in Table 5 is as follows:

Value added: for each \$1 increase in value added generated by Newmont, economy-wide value added (including that of Martha Mine) will increase by \$1.38. In other words, 38c will be generated in the remainder of the economy.

Employment: for each new position created at the mine, 1.66 jobs will be created across the entire economy (including the initial new position in at the mine).

Output: for each \$1 increase in the quantity of output produced by Martha Mine, the value of economy-wide output (i.e. including that of Newmont) will increase by \$1.46.

With the exception of the Type II employment multiplier, Martha Mine's multipliers are lower than the average for all sectors in the Waihi economy. This is consistent with the linkage measures presented earlier, and again reflects the fact that much of Martha's inputs are sourced from outside the local economy. Thus, with the exception of a relatively strong link via its employment of local staff, this analysis indicates that Martha Mine's links with the local economy are relatively weak.

As was the case for the Type I multipliers (see Table 2), we can decompose the direct, indirect and induced impacts of a \$1million increase in Newmont Waihi Gold's mining activity as follows.

Table 4 Decomposition of mining economic impacts

Direct, indirect and induced impacts

	Mining (\$m)	Multiplier (Type I)	Total Waihi economy (\$m)
Output	1.00	1.465	1.465
Value added/output (%) ¹	26.63		
Value added	0.266	1.378	0.367
Employment/output (Employees per \$m output) ²	1.23		
Employment	1.23	1.658	2.044

Notes: (1) See Table 6.

(2) Based on 100 employees

Source: NZIER, Newmont Waihi Gold

As before, if Newmont Waihi Gold were to expand its operations by \$1 million (in terms of output), it would (on the basis of the current operating structure of the company) increase its value added by \$0.266 million and create 1.23 new jobs. These increases would give rise, via the multiplier effects, to the direct, indirect and induced impacts on the Waihi economy shown in the final column of Table 4. That is, total Waihi output and value added would rise \$1.465m and 0.367m, respectively, and 2.044 new jobs would be created across all sectors.

Table 5 Waihi sectoral Type II multipliers

	Value added	Employment	Output
Agriculture	1.4878	1.3322	1.6675
Forestry and Logging	1.7972	2.6407	1.9612
Fishing	1.4898	1.5360	1.5042
Mining	1.3777	1.6576	1.4649
Food, Beverage and Tobacco Manufacturing	0.0000	0.0000	1.0000
Textiles and Apparel Manufacturing	1.9593	1.3448	1.6597
Wood and Paper Product Manufacturing	1.7673	1.4642	1.5640
Printing, Publishing and Recorded Media	1.6734	1.6716	1.7453
Petroleum, Chemical, Plastic and Rubber	1.8916	1.6585	1.7443
Non-metallic Mineral Product Manufacturing	1.9789	2.0876	1.9925
Metal Product Manufacturing	1.9600	1.6222	1.7785
Machinery and Equipment Manufacturing	2.0387	1.7032	1.7591
Furniture and Other Manufacturing	2.0603	1.4695	1.7999
Electricity, Gas and Water Supply	2.1583	3.9347	2.2852
Construction	2.2698	1.8193	1.9825
Wholesale Trade	1.9820	1.8878	1.9566
Retail Trade	1.7056	1.2943	1.7912
Accommodation, Restaurants and Bars	1.6537	1.1898	1.6115
Transport and Storage	1.8896	1.8689	2.0019
Communication Services	1.5985	1.9789	1.9095
Finance and Insurance	1.6230	2.0076	1.9437
Property Services	2.0762	1.9753	2.1962
Ownership of Owner-occupied Dwellings	0.0000	0.0000	1.0000
Business Services	1.8085	1.4584	1.9555
Central Government Administration and Defence	2.3046	1.7180	2.0923
Local Government Administration	2.1928	2.7447	2.2437
Education	2.0613	1.3113	2.2521
Health and Community Services	2.0019	1.3742	2.1520
Cultural and Recreational Services	2.0266	1.4117	1.8686
Personal and Other Community Services	2.0715	1.3805	2.0751
Waihi average	1.7635	1.6515	1.8320

Source: NZIER

3.3.3 Multiplier analysis: caveats

For a host of reasons multiplier analysis should be interpreted with caution. In particular, three key points should be noted:

- (i) Multipliers assume that sectors combine inputs, and produce outputs, in fixed proportions.
- (ii) Multipliers take no account of induced changes in relative prices.
- (iii) Multipliers assume that labour and capital are available in unlimited quantities.

These assumptions are, to some degree, abstractions from reality. Businesses will, to an extent, be able to substitute between purchased goods, and thus alter their input mix. Changes in the supply and demand of goods and services will affect the price of those products. And the factors of production, particularly labour in the current New Zealand context, are only available in limited quantities, certainly in the short run.

Further, these assumptions become increasingly unrealistic the greater the size of the economic change being modelled. Clearly then, multipliers are at their best when being used to examine relatively small economic shocks. It is with these provisos in mind that the multiplier analysis contained in this report is presented.

3.4 The value of Martha Mine to Waihi

Data provided by Newmont provided the values of the key transactions of Martha Mine. These are presented in Table 6.

Table 6 Martha Mine economic variables

\$NZ million, 2004

Gross output (operating revenue)	81.1
Goods and services purchases	59.4
Value added	21.6
Of which:	
Gross operating surplus	15.9
Salaries and wages (including contractor payments)	5.7

Source: Newmont Mining

Together with the multipliers for the mining industry presented above, these figures provide the basis for estimating the impact on the local economy of

the closure of the open pit mine in Waihi.¹⁰ We also estimate the value of the Favona underground extension.

As noted in Section 3.3.3, multipliers rely on a number of assumptions in their construction, and implicitly, in their application. The outcome of these assumptions is that Type I multipliers tend to understate economy-wide impacts (because they ignore induced income effects), while Type II multipliers tend to overstate economy-wide impacts (because factors are assumed to be available in unlimited supply). One approach to correcting for these tendencies, and the one that is adopted here, is to take a simple average of the Type I and Type II multipliers. These are presented in Table 7.

Table 7 Waihi mining sector multipliers

	Type I multiplier	Type II multiplier
Value added	1.075	1.377
Employment	1.085	1.658
Output	1.076	1.465

Source: NZIER

The application of these multipliers to the Martha Mine data is shown in Table 8.

Table 8 Local impact of the closure of Martha Mine

	Output (\$m)	Value added (\$m)	Employment (FTEs)
Current level	81.1	21.6	92
Type II multiplier	1.377	1.658	1.465
Total local impact	111.7	35.8	134.8

Source: NZIER

Similarly, Table 9 shows the impact of the Favona underground extension on the Waihi economy. Wheeler’s analysis of Favona’s impact (including both construction and mining) shows an average annual direct impact of around \$42 million.¹¹

¹⁰ Note that in the analysis that follows, we apply *mining industry* multipliers to the economic data of Newmont. We consider it appropriate to use industry-wide multipliers given the significance of Newmont in the mining industry in Waihi.

¹¹ Refer Wheeler (2003), Appendix I. This data is also replicated in Appendix D .

Table 9 Local impact of the Favona underground extension

	Output (\$m)	Value added (\$m)	Employment (FTEs)
Direct impact	42.1	11.2	48
Type II multiplier	1.377	1.658	1.465
Total local impact	58.0	18.6	70.0

Source: NZIER

The analysis therefore suggests that if the Martha Mine were to cease all operations, value added of the Waihi economy would fall by \$26.5m, including \$21.6m of the mine itself and \$4.6m across the remainder of the economy. Similarly, the number of economy-wide jobs would decrease by 126, including the loss of 92 jobs at the mine.

However, the analysis also indicates that the flow-on impacts from the Favona extension will generate (locally) a total of \$18.6m of value added (including \$11.2m of the mine) and 70 jobs (including 48 at the mine).

The net impact of the closure of the existing Martha Mine and the Favona underground extension is shown in Table 10.

Table 10 Net impact

	Output (\$m)	Value added (\$m)	Employment (FTEs)
Martha Mine closure impact	-111.7	-35.8	-134.8
Favona extension impact	58.0	18.6	70.0
Net impact	-53.7	-17.2	-64.8

Source: NZIER

4. Putting it together

Previous sections of this report have built a high level picture of the Waihi economy and established the importance of mining activity within this economy. In this section we augment that quantitative analysis with a mix of qualitative information and some further, more detailed quantitative elements. The qualitative material presented here is based on community consultation undertaken in Waihi directly as part of the project, but also draws on surveys and studies undertaken previously. Following this, we analyse employment data from 2004 to identify industry sectors that have performed well in the past and those that might provide future performance.

4.1 Structure and goals of consultation

Interviews were conducted with various stakeholders and interested parties to determine, *inter alia*, business responsiveness to the presence of mining activity in Waihi. While the sample size was relatively small (i.e. a total of 12 businesses) this was sufficient to glean insights into the operation of the Waihi economy as well as the role of Newmont in the economy. The interviews were fairly broad ranging and included discussion on issues such as

- the nature of the business and the industry in which it operates
- any changes in the business environment over time
- the relationship between the business and Newmont
- the degree of thought given, and preparation for, the possibility of mine closure
- views on the efficacy of proposed alternatives when the mine does wind down
- general impressions of community and economic needs, particularly in relation to any perceived dependence on mining activity
- perceptions of Newmont as a corporate citizen, including social involvement in Waihi

Given the scope of the project, a detailed survey-based approach was not feasible and thus we rely on the interviews to augment our understanding of the economy and the impacts of Martha Mine within it. In saying this, the two streams of analysis (qualitative and quantitative) were conducted separately, rather than jointly. While input was sought from Newmont representatives in terms of prospective candidates to interview, we did not conduct any interviews with Newmont representatives as input into the qualitative aspects of this work.

The quantitative aspects of the business relationships between Newmont and the businesspeople (i.e. as supplier and/or demander of goods and services) is estimated through the input-output (multiplier) analysis above. This

section looks to establish the context around which these relationships are formed as well as shed light on the non-business related facets to Newmont that provide a valuable input into economic life in Waihi, without necessarily being amenable to quantitative modelling as such. In a sense what we are talking about is the social infrastructure underpinning the Waihi economy Newmont, and indeed any other major employment provider, is instrumental in the provision (both directly and instrumentally) of such “infrastructure” and to that end, this is an important component in the overall assessment.

A useful analytical framework is to consider what would happen if Martha Mine were not there.¹² Couching the discussion in these terms is useful for gaining insights into current business activity, but also brings into stark reality the actions needed (and possibly underway) to mitigate the effects of the eventual closure of Martha. There is a well established literature on the effects of major company closures in New Zealand over the past 20 years. This literature shows a common pattern in the types of impact experienced by the towns and districts in which these closures took place. These impacts could include:

- A drop in house prices as relatively large numbers of houses are put on the market over a short period
- A drop in rent levels as a surplus of rental housing becomes available
- Loss of key skills from the wider community (e.g. health workers and teachers) as spouses leave town with former company workers
- Loss of volunteers from community organisations
- Closure of businesses that had been reliant on sales to the company and its employees (leading to further redundancies)
- Increased household debt, defaults on mortgages and rents, and increased incidence of service disconnections
- Disruption to community structures resulting from the influx of newcomers, loss of friends and family members, as well as workers losing the sense of camaraderie gained through being part of the organisation’s workforce. This could lead to a reduction in the level of social connectedness.
- Symptoms of stress among school pupils due to anxiety and uncertainty in the homes of those affected by the closure and the loss of friends when families move away

¹² Much of the material presented in this section is based on previous work NZIER completed with Corydon Consultants Ltd, who specialise in social impact assessment.

- A high turnover in school rolls, with associated disruption to school programmes as those affected by the closure leave and new people move in

This literature confirms that impacts are felt more acutely in provincial areas, as bigger cities are generally characterised by relatively high demand for housing, higher relative house prices and more abundant employment opportunities. However, while a useful framework, some of the impacts observed above may not necessarily hold true in the case of Waihi, and Newmont. The most obvious of these is the reduction in house prices. In normal circumstances, this is a standard supply and demand situation, where the evacuation of a large employer and its employees results in a relative over-supply of houses, placing downward pressure on prices for a given demand.

In the case of cessation of mining activity and a resultant loss of employment, it is conceivable that house prices might rise on the back of a reduction in the anxiety associated with mining activity contributing to instability. This is certainly a view that was put forward in discussions with a Real Estate agent in Waihi, who thought that mining activity in Waihi was having a dampening effect on demand, resulting in lower prices and volumes of sales. It is difficult to assess whether this view was widely held in Waihi, or is particular to one person's experience or perception. There is data that suggests quite clearly that prices have not been held down by the recommencement of mining activity. Indeed, there was a marked turnaround in relative average prices of houses and vacant land in Waihi and Paeroa, that coincided with the recommencement of mining activity.¹³

It is beyond the scope of this report to quantify the effect on house prices of mining activity. We do however, report the view expressed by one interviewee, despite there being data that would tend to contradict that view.

4.2 Impressions

The most striking feature of the site visit to Waihi was the degree of relaxed acceptance of mining in the town. There was a distinct feeling in the business community (at least those members that we spoke to) that mining was instrumental to the community life of Waihi and that if it weren't present the loss to the community would be significant. In terms of the views on Newmont, there was again a casual, but cautious acceptance that they were in an invidious position, but had made good efforts to ameliorate any negative effects (perceived or actual) on the community associated with the mine. While not being amenable to estimation in a quantitative sense,

¹³ See "Favona Underground Mine- Assessment of Effects on Waihi Residential Values." TelferYoung (Auckland) Limited, March 2003. In addition, there is a further confidential report that provides data contradicting the view that downward pressure is being exerted on Waihi house prices by mining activity.

there was a definite sense that Newmont was an integral part of not only economic life, but the overall community in Waihi. That is not to say that there were no negative comments or issues raised, only that on balance, the overall impression was positive.

The other major feature of the consultation process was the degree of action already undertaken in some businesses to prepare for the eventual closing down of Martha Mine. This was more than just an exercise in 'holding one's breath' and hoping for the best. There were clear cases of looking to capitalise on new and existing opportunities that are not related to mining activity. In saying this, the organisations undertaking this course of action were both relatively reliant on Newmont, with around forty percent of revenue being derived from mining in one case and around fifty percent in another. Thus, it was clear that not only had thought been given to life after Martha Mine, but specific activity in terms of looking to maximise non-mine related revenue was already underway.

However, it was not the case that such undertakings took place completely independent from current relationships with Newmont. Mining-based revenue, by virtue of its size and its relative certainty, provide a degree of 'insurance' against the risks of diversification. That is, Newmont relationships provided businesses with the steady platform on which to undertake such expansions. According to the businesses we spoke to, in the absence of the 'backbone' of mining revenue, the type of exploratory market testing which is now starting to deliver alternate revenue sources would not have taken place when it did. In this sense, Newmont is tacitly providing at least some of the means by which businesses previously reliant on the mine can reduce that reliance in the future.

4.2.1 Transition appears underway

Given the nature of the mineral extraction industry, there is something of a natural transition as mine output and activity scales down through scarcity. Many of the businesses spoken to commented that decreasing levels of activity associated with Martha mine has provided the catalyst for looking at alternative sources of revenue. Of course, this is more relevant for those businesses who are direct suppliers to Newmont, as opposed to those who provide goods or services indirectly. In terms of the latter, the most obvious business operation we spoke to was the Goldmine Motel. In their case, while acknowledging that they derived a good proportion of revenue from mining-related customers (not all of whom were affiliated with Newmont), the proprietors expressed a view that the accommodation business is very dynamic in nature and that adjusting to customer demand is a necessary part of the business. Thus, while there will be an obvious impact from the eventual closure of Martha Mine, it is not estimated to be major and there was no real plan to alter the business strategy as a result of mine closure.

The “business as usual” reaction to the eventual closing down of mining operations was largely mirrored by other businesses spoken to, though to a lesser extent than in relation to the motel. As mentioned above, the real estate agent spoken to considered mine closure would be a boon to his industry, however, this was definitely the exception rather than the rule. No other mention was made of potentially positive business impacts from mine closure. Therefore, in answer to the implicit question concerning any business or commercial opportunities being hampered or held back by Martha it appears these are relatively concentrated and in one case at least, may be more of a perception. Waihi was seen by business operators as having undergone a change over the last 10 years or so in terms of becoming more of a destination, rather than a stopping-off point. Therefore, with suitable assistance and promotion, it will continue to attract sufficient visitors to maintain occupancy rates at profitable levels, and may also be sufficiently attractive to entice some to stay.

4.2.2 Degree of reliance not large

With the exception of a major transport operator, none of the businesses we spoke with expressed the view that without Newmont, they would likely cease trading.¹⁴ One particular business operator, with interests in both the Art Market and provision of contract labour to Martha mine was confident that while mine closure would drastically affect the labour hire side of his interests, it would not greatly affect the art side. The confidence and entrepreneurial spirit associated with this proprietor were such that mine closure would be seen as more of a challenge than an obstacle, and his view was that Waihi was more than resilient enough to continue to prosper in the mine’s absence. In saying this, he acknowledged that the mine were “a good payer” in terms of regularity and quantum so this loss would be felt keenly. He also felt that available labour in Waihi was becoming scarcer, which indicted that there was an element of Waihi sharing in the economic good times as opposed to being totally reliant on mine activity.

In addition to the moteliers we spoke to, we also sought the views of the Manager of a large supermarket chain in Waihi, employing around 100 people, 60 of whom on a full-time equivalent basis. The supermarket had recently expanded operations and moved to a new site, and this was thought useful to test further the indirect contribution of Newmont to the Waihi economy. He confirmed that he has limited direct business with Newmont. The primary connection between his supermarket and Newmont is in terms of servicing family grocery and other needs, though it is difficult to be precise about proportions of revenue generated from mining workers and their families. What was well understood was that revenue impacts were

¹⁴ In response to the possibility of re-configuring the business, the Transport manager indicated that Newmont was the major reason for locating a depot in Waihi (as opposed to servicing demand from the head office in Kopu) and that without that work, operations servicing Waihi would be through relocation to Kopu. This was despite the firm having other contracts that were not mining-related.

strongly related to the phase that extraction and development of the mine was in. It is the operational phase where most of the impact is felt, as contractors who do the development and operational aspects often do not spend as much in Waihi, due to the ephemeral nature of their work.

He also confirmed that having mining activity in town has a beneficial impact on his business outside of store sales. The families (spouses, children, etc) often provided a good source of labour. In addition, having heavy earthmoving machinery handy in town also assisted in the expansion undertaking, where the levelling of the new site was completed in a fraction of the time it would normally have taken.

In terms of the composition of customers, the supermarket was increasingly seen as a tourist-driven business, with a much broader client base than just the Waihi town and district. Visitors are now a much larger proportion of customers than previously, reflecting again that nature of Waihi as a destination. Interestingly, when asked whether the expansion of the store on a new site would have taken place had Newmont not been in town, he responded that the closing of the mine was the catalyst for such a move. It was realised that to service the wider clientele that something bigger and better was needed and that it needed to be in place before any closure of the mine.

A further point of interest is the proposed expansion of Mitre 10 in Waihi. The Mitre 10 store is already a fairly large undertaking, employing in the order of 41 full-time equivalent persons. Newmont are a large element in terms of revenue generation, but it would not be accurate to say that Mitre 10 is reliant on this revenue for survival. There are other “strings to their bow” but the revenue sourced from mining has tended to provide a solid base from which the fluctuations of the rural economy and housing market can be offset. When asked whether the expansion would take place were Newmont not present, the answer was yes, but that the risks associated with such a move would have been far greater. In this sense, having Newmont business served as a confidence builder. The store also derives income from the personal purchases of mine employees. This is estimated to be slightly above the average purchasing share in Waihi as mine employees were paid more generously than average.

4.2.3 Impressions confirm previous studies

A full-scale interview and surveying process was not within the scope of this project and as a result the observations made are based on a necessarily small sample of business operators as well as some less formal interactions with community members. However, the general findings are consistent with two previously conducted attitudinal surveys with much larger sample sizes. The 2004 Residents’ Survey commissioned by Hauraki District Council indicated a large majority of respondents (92%) believe that gold

mining provides economic benefits for Waihi. This is broadly in line with the consultation undertaken as part of this project.

Similarly, the 2002 Report on the Social Environment prepared for the Hauraki District Council by Meritec Limited (now Maunsell) found "...that the community is now actively engaged in the development of alternative initiatives and measures to assist in the wellbeing of the town and its inhabitants" (Maunsell, 2002, p.42). Our impression is that the process of transformation from a with-mine to a without-mine economy has largely evolved naturally. Information provision appears to have played a big part. While there is still some uncertainty around exactly when Martha will close down, businesses have been able to take preliminary steps to mitigate its effects and continue operating due to the level of information available. That is, the finite nature of extraction-based activity means that the speed of the required transition is lowered and the adjustment path smoothed.

Finally, while not the major subject of our interviews, all those interviewed considered Newmont to be community-minded and had done a reasonable job of satisfying the myriad requests they receive for funding and other support from the community. While acknowledged as somewhat hard-nosed on engagement terms and conditions, the overall view espoused by the respondents was of a fair organisation, which does not look to exploit its dominant position. This had largely been personality-driven in the past, so was identified as an area of potential risk, given the relatively new management structure in place.

4.3 Possible future directions

A useful guide to assist in Waihi in preparing for the eventual scaling down or cessation of mining activity in Waihi is to consider particular areas where Waihi might enjoy some advantage. We can use a measure of "comparative advantage" on an industry basis to identify relative specialisation within such an industry when compared to the rest of New Zealand. Location quotients are utilised for this purpose. Location quotients are commonly used for all manner of economic and geographic purposes, and have been used as an input into previous studies on the impact of Martha and Favona mines. A location quotient (LQ) gives the industry's share of employment in a particular region (in this case Waihi, as defined by territorial authority boundaries) as a fraction of the same industry's share of employment in all industries in the wider economy. In compact notation, an LQ for industry i is given by:

$$LQ_i = \left[\frac{E_{ik}}{E_k} \bigg/ \frac{E_i}{E_w} \right]$$

where E = employment¹⁵
 i = industry sector
 k = region
 w = wider economy

In the material contained in this section.; , w = New Zealand and k = Waihi. The value of LQ_i can range from zero to infinity. We say an area is relatively specialised in an industry if LQ_i is greater than 1. This means that the proportion of employment in a particular region accounted for by a particular industry is greater than the proportion of total industry employment accounted for by that industry in the wider economy.

The logic assumed in using LQ 's is that relative specialisation is based on some kind of comparative advantage. Economic theory and intuition suggests that if the proportion of employment in an industry in a region is above the nationwide proportion of employment in that industry it is due to that region having some "comparative advantage" in that industry. In the absence of such an advantage, it is thought that normal competitive and market activity would see industry relocation to the region with advantageous features. That is, it should not be the case that a region employs a disproportionate share of FTEs in a particular industry relative to the wider economy if they do not have a comparative advantage in that industry.

We use the results from these procedures to identify those industry sectors that might be considered "stars" in terms of employment growth and/or comparative advantage. Identification of these "stars" allows organisations such as HDC and Go Waihi to consider their reported activities and priorities relative to the "star" sectoral performers, and others that may become future "stars." This is useful in terms of establishing the structure of the Waihi economy now, as well as identifying potential measures by which progress can be monitored in the future. While data are presented at a fairly detailed level below, it is largely based on employment data which can be aggregated to suit.

4.3.1 Snapshots of Waihi economy in 2004

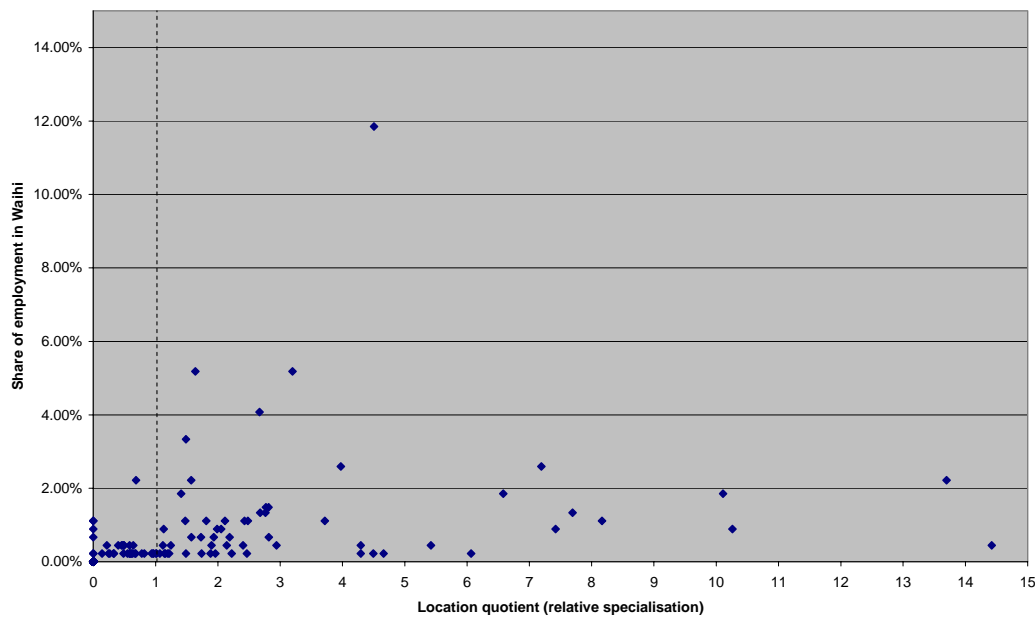
First, we consider some snapshots of employment in Waihi. Figure 6 below plots the industry sector share of total employment against the LQ for that industry sector in 2004. There are 476 such sectors, with a total of 65 having an LQ of one or greater. As mentioned above, an LQ of one or greater

¹⁵ Employment is classified as head count, which includes full-time and part-time wage and salary workers as well as working proprietors who pay themselves a wage or salary. This is the measure that Statistics New Zealand now uses in place of FTEs.

indicates that Waihi has a “comparative advantage” in that sector, relative to the rest of New Zealand. In the interests of presentation, three “outliers” have been omitted from the figure. These industry sectors all have high LQ’s. The sectors are Electric Light and Sign Manufacturing, Automotive Electrical and Instrument Manufacturing, and Gold Ore Mining. The last sector is particularly important to this study, and further mention is made in more detailed analysis to follow.

Figure 6 Relative specialisation and employment in Waihi 2004

Employee headcount



Source: Statistics NZ, NZIER

Ideally, there would be some kind of upward sloping pattern to the plot, indicating that the share of Waihi employment in a particular industry sector is positively related to the degree of relative specialisation that Waihi enjoys in the sector. That is, Waihi is fully capitalising on its revealed comparative advantages. While relatively encouraging, the shape of the plot in Figure 6 suggests that, in general, most of the sectors where Waihi does have a comparative advantage are responsible for only a relatively modest share of employment. The major exceptions are supermarket employees (with an LQ of 4.5 and an employment share of almost 12%); Gold ore mining (with an LQ of 327 and an employment share of 7.4%) and Automotive Electrical and Instrument Manufacturing (with an LQ of 194 and an employment share of 2.6%).

Table 11 Top 20 industry sectors where Waihi has a comparative advantage

Employee headcount

Sector code and name	LQ 2004
B131400 Gold Ore Mining	327
C281300 Automotive Electrical and Instrument Manufacturing	194
C285400 Electric Light and Sign Manufacturing	22
G524200 Toy and Game Retailing	14
L782900 Technical Services nec (not elsewhere classified)	14
C276400 Metal Coating and Finishing	10
C274200 Architectural Aluminium Product Manufacturing	10
C284900 Electronic Equipment Manufacturing nec	8
G512520 Chicken Takeaway Stores	8
Q951100 Video Hire Outlets	7
C232900 Wood Product Manufacturing nec	7
G523300 Domestic Hardware and Houseware Retailing	7
C276900 Fabricated Metal Product Manufacturing nec	7
D370200 Sewerage and Drainage Services	6
C286400 Machine Tool and Part Manufacturing	5
C294100 Jewellery and Silverware Manufacturing	5
G511010 Supermarkets	5
G526900 Household Equipment Repair Services nec	4
G523200 Floor Covering Retailing	4
D370100 Water Supply	4

Source: NZIER, Statistics New Zealand

The major question arising out of Figure 6 is what exactly the sectors are that Waihi appears to have a comparative advantage in. Table 11 shows the top 20 from the 65 sectors with an LQ greater than or equal to one. Interestingly, for the purposes of this study, Gold Ore Mining is the industry classification with the greatest relative specialisation for Waihi. The proportion of total Waihi employment in Gold Ore Mining is some 327 times greater than the proportion of total New Zealand employment in the sector. In terms of the broad industry divisions, Manufacturing (division C)

and Retail Trade (division G) provide the vast majority of the top 20. Outside of these, only division D, Electricity, Gas and Water Supply, division B, Mining, division L Property and Business Services and division Q Personal and Other Services feature.

Table 12 Twenty industry sectors with largest employment shares in Waihi

Employee headcount

Sector code and name	Share of employment in Waihi 2004
G511010 Supermarkets	11.85%
B131400 Gold Ore Mining	7.41%
N842200 Secondary Education	5.19%
O861100 Hospitals (except Psychiatric Hospitals)	5.19%
O872100 Accommodation for the Aged	4.07%
N842100 Primary Education	3.33%
C281300 Automotive Electrical and Instrument Manufacturing	2.59%
G523300 Domestic Hardware and Houseware Retailing	2.59%
G532100 Automotive Fuel Retailing	2.59%
L782900 Technical Services nec	2.22%
K732100 Banks	2.22%
H573000 Cafes and Restaurants	2.22%
C274200 Architectural Aluminium Product Manufacturing	1.85%
C276900 Fabricated Metal Product Manufacturing nec	1.85%
I611000 Road Freight Transport	1.85%
L786200 Contract Staff Services	1.48%
G525900 Retailing nec	1.48%
G512520 Chicken Takeaway Stores	1.33%
E412200 Non-Building Construction nec	1.33%
G525100 Pharmaceutical, Cosmetic and Toiletry Retailing	1.33%

Source: Statistics NZ, NZIER

While this information is interesting, we also need to consider the size of the industry sectors. Table 12 shows that while there are more sectors represented, division G, Retail Trade features six times (accounting for 21.17% of total employment) with division C, Manufacturing again

prominent, featuring three times (accounting for 6.66% of total employment). Clearly, supermarkets stand out as the major employers in Waihi and this may be a reflection of the broad sales base of Waihi-resident supermarkets, who often serve large geographical areas outside Waihi. Gold Ore Mining features again, with the second largest share of employment in Waihi.

4.3.2 Employment growth 2000-2004

A further factor of interest is the rate of growth of industry sectors. This is especially important in identifying possible “stars” of the future. Table 13 shows the top 20 industry sectors in Waihi in terms of growth from 2000-2004. The relatively short time period is because Statistics New Zealand has altered how it measures and presents employment data (it is now employee headcount as opposed to full-time equivalents) and comparable series’ only extend as far back as 2000.

While there appear to be some sectors that exhibit relatively prodigious growth, all but two of the industry sectors, being E412200 Non-building construction and G525900 Retailing (not elsewhere classified), had zero employment in 2000. This does not necessarily mean that they were not in existence, merely that there were no wage and salary earners in that sector in 2000. For instance, there may have working proprietors who never paid themselves a wage or salary. In order to calculate growth rates for those with zero employment registered in 2000, it was assumed that there was one employee in 2000, and average annual percentage growth was calculated from there. While this is a somewhat arbitrary assumption, it is necessary to give a picture of growth (i.e. a fraction with zero in the numerator is undefined).

A slightly different picture emerges when we consider only those sectors classed as significant employers. Table 14 shows the 20 significant industry sectors that grew fastest between 2000 and 2004. In this context, significant is taken to mean employing six people or more. Again, this cut-off was somewhat arbitrary, but seemed to adequately satisfy the goals of tractability and insight. While there is some similarity in the sense that 11 industry sectors appear in both tables (as highlighted by an asterisk in Table 14) there are also nine industry sectors that have grown fastest, but do not employ more than five people in 2004. This may not necessarily be an issue in absolute terms, as 20% growth in a sector employing six people is roughly equivalent to 33% growth in a sector with three people. However, it is useful in determining which sectors have the potential to grow further, and where energies should possibly be directed.

Table 13 Twenty industry sectors with largest growth rates in Waihi

Employee headcount

Sector code and name	Growth rate 2000- 2004 (average annual % change)
C281300 Automotive Electrical and Instrument Manufacturing	143%
L786200 Contract Staff Services	111%
H571020 Motels and Motor Inns	97%
Q951100 Video Hire Outlets	97%
F479900 Wholesaling nec	86%
G512510 Fish and Chips, Hamburger and Ethnic Food, Takeaway Stores	73%
F453100 Timber Wholesaling	57%
O864000 Veterinary Services	57%
C264000 Non-Metallic Mineral Product Manufacturing nec	32%
D370100 Water Supply	32%
E412200 Non-Building Construction nec	32%
E422200 Bricklaying Services	32%
G523100 Furniture Retailing	32%
G525900 Retailing nec	32%
G526900 Household Equipment Repair Services nec	32%
L771290 Commercial Property Operators and Developers nec	32%
L782100 Architectural Services	32%
L785500 Business Management Services	32%
O863100 Pathology Services	32%
P931900 Sports and Services to Sports nec	32%

Source: Statistics NZ, NZIER

Table 14 Top twenty 'significant' sectors in Waihi with fastest growth rates

Employee headcount for those industry sectors employing 6 or more in 2004

Sector code and name	Growth rate 2000-2004 (average annual % change)
C281300 Automotive Electrical and Instrument Manufacturing*	143%
L786200 Contract Staff Services*	111%
H571020 Motels and Motor Inns*	97%
Q951100 Video Hire Outlets*	97%
F479900 Wholesaling nec*	86%
G512510 Fish and Chips, Hamburger and Ethnic Food, Takeaway Store*s	73%
E422200 Bricklaying Services*	57%
F453100 Timber Wholesaling*	57%
O864000 Veterinary Services*	57%
E412200 Non-Building Construction nec*	32%
G525900 Retailing nec*	32%
L782900 Technical Services nec	19%
Q952600 Hairdressing and Beauty Salons	19%
G524200 Toy and Game Retailing	19%
G532400 Tyre Retailing	19%
L784100 Legal Services	19%
L786900 Business Services nec	19%
K732100 Banks	11%
G532300 Smash Repairing	11%
G511010 Supermarkets	10%

*= sectors that appear in both Table 13 and Table 14

Notes: (1) Excludes A011500 Apple and Pear Growing and A013000 Dairy Cattle farming, with 12 and 6 employees respectively in 2004, as no time series information was available.

(2) Some inconsistencies may be present due to the rounding process used by Statistics New Zealand.

Source: Statistics NZ, NZIER

4.3.3 Identifying the “stars”

In this section we put together some aspects of the preceding sections to explicitly place them in the context of how the New Zealand economy is moving. First, we consider average annual percentage employment growth in Waihi for the 56 “significant” industry sectors, relative to the equivalent figure for New Zealand employment growth in those sectors. Two points to note are:

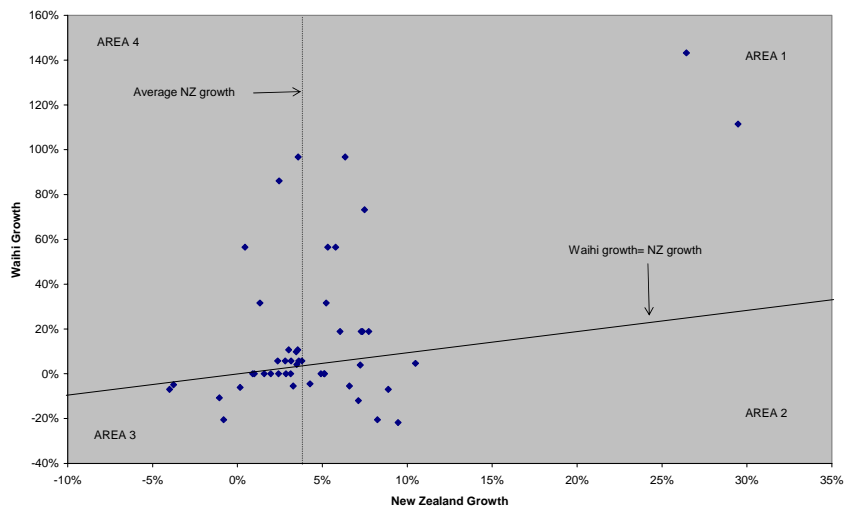
- Any point to the right of the vertical dashed average New Zealand (NZ) growth line means that NZ employment in that sector has grown faster than average NZ growth.
- Any point above the “Waihi growth=NZ growth” 45° line means that Waihi’s employment in that sector has grown faster than the rate of growth for NZ.

Therefore any point in Area 1 indicates a sector in which:

- Waihi employment growth is greater than NZ employment growth; *and*
- Sector growth is above average NZ growth.

Figure 7 Waihi employment growth versus NZ employment growth in “significant” sectors

Average annual percentage change, 2000-2004



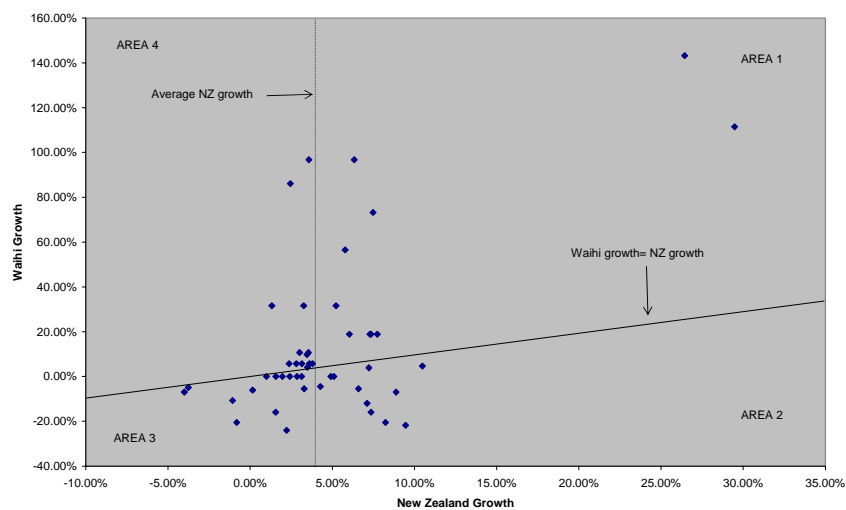
Source: NZIER

Figure 8 re-plots Figure 7, but only for the 47 significant sectors in which Waihi has a comparative advantage. Appendix A contains a full list of these sectors as well as the area each lies in. This process enables us to identify those sectors that might be considered as “star performers” in the Waihi economy. The “star performers” (in Area 1) are those sectors which:

- Are significant (employment of six or more workers);
- Waihi employment growth is greater than NZ employment growth;
- NZ growth in that sector is above average NZ sector growth (of 3.67%); and
- Waihi enjoys a “comparative advantage” in the sector.

Figure 8 Waihi employment growth versus NZ employment growth in “significant” sectors

Average annual percentage change in sectors with comparative advantage 2000-2004



Source: NZIER

There are 11 such “stars” which combined account for 13.24% of total employment in Waihi. Table 15 shows that these stars cover a range of broad divisions, with division G Retail Trade being the most prominent, while division C Manufacturing also features. Services are also well represented, with divisions Q Personal and Other Services, O Health and Community Services, and L Property and Business Services present. While there are a few sectors in there that are directly or indirectly associated with mining (e.g. Contract Staff Services, Technical Services nec and Non-Building Construction) there are also some sectors represented that are not necessarily related to, or reliant on, mining activity.

Table 15 Star performers in Waihi

Those sectors in area 1 of Figure 8

Sector code and name	Share of employment in Waihi	Average annual % growth in Waihi, 2000-2004	Average annual % growth in NZ, 2000-2004	Location quotient
C281300 Automotive Electrical and Instrument Manufacturing	2.59%	143.23%	26.44%	194
L782900 Technical Services nec	2.22%	18.92%	7.36%	14
C276900 Fabricated Metal Product Manufacturing nec	1.85%	5.74%	3.80%	7
L786200 Contract Staff Services	1.48%	111.47%	29.48%	3
E412200 Non-Building Construction nec	1.33%	31.61%	5.23%	3
Q951100 Video Hire Outlets	1.11%	96.80%	6.34%	7
G512510 Fish and Chips, Hamburger and Ethnic Food, Takeaway Stores	0.67%	73.21%	7.48%	3
Q952600 Hairdressing and Beauty Salons	0.67%	18.92%	6.04%	1
G524200 Toy and Game Retailing	0.44%	18.92%	7.29%	14
G532400 Tyre Retailing	0.44%	18.92%	7.73%	3
O864000 Veterinary Services	0.44%	56.51%	5.78%	2

Notes: (1) Excludes Agriculture, as time series data not available.
2) Some inconsistencies may be present due to the rounding process used by Statistics New Zealand

Source: NZIER

There are also 11 sectors in area 2, which are those sectors where Waihi has a comparative advantage, employs more than 5 people, growth in that sector is faster than average annual percentage New Zealand sectoral growth from 2000-2004, but Waihi growth in that sector is slower than New Zealand growth. These sectors would be of interest in terms of looking for potential future “stars.” Again, Retail Trade features prominently with almost half the representation in the area. Manufacturing also features.

Table 14 Potential “stars”

Those sectors in area 2 of Figure 8

Sector code and name	Share of employment in Waihi	Average annual % growth in Waihi, 2000-2004	Average annual % growth in NZ, 2000-2004	Location quotient
G523300 Domestic Hardware and Houseware Retailing	2.59%	3.93%	7.23%	7
C274200 Architectural Aluminium Product Manufacturing	1.85%	-5.43%	6.59%	10
G512520 Chicken Takeaway Stores	1.33%	4.66%	10.48%	8
C284900 Electronic Equipment Manufacturing nec	1.11%	-21.75%	9.46%	8
O871000 Child Care Services	1.11%	0.00%	5.10%	2
Q963100 Police Services	1.11%	-4.46%	4.27%	2
H572000 Pubs, Taverns and Bars	1.11%	0.00%	4.92%	1
C285400 Electric Light and Sign Manufacturing	0.67%	-6.94%	8.88%	22
G512400 Bread and Cake Retailing	0.67%	-11.99%	7.12%	2
G523400 Domestic Appliance Retailing	0.67%	-20.47%	8.24%	2
G523200 Floor Covering Retailing	0.44%	-15.91%	7.36%	4

Notes: (1) Excludes Agriculture, as time series data not available.
 (2) Some inconsistencies may be present due to the rounding process used by Statistics New Zealand

Source: NZIER

4.3.4 Limitations

Despite providing some insights into the nature of economic activity in Waihi, there are some limitations to the above analysis that are useful to spell out. The first is that there may be reasons other than comparative advantage for a region having an employment share greater than that of the country as a whole. For instance, in the case of mining, or other “natural” endowments, it is simply not possible for other regions or the country as a whole to enter that industry even if they wanted to. The geographical immobility of the resource leads almost by definition to a high concentration of employment around the site. This is particularly so for relatively labour

intensive industries. Also, some sectors that are related to “publicly provided” services such as policing or teaching have relatively high “fixed” components that mean in a small region they may represent a significant proportion of employment relative to a larger region, but that is not necessarily synonymous with any comparative advantage.

A further limitation is on the degree to which employment is actually a useful indicator of comparative advantage, particularly when productivity is not included in the analysis. It may be the case that high employment levels in a particular sector in a particular region may be due to “overstaffing.” While we would expect that well-functioning, competitive markets would effectively weed out such inefficiency, it may be that historical legacies outweigh efficient markets. Also, in the case of a reasonably small region, by themselves, the measures used might understate the interaction between a dominant industry (in this case Mining) and other activity and fail to diagnose substantial changes or potential harm to those industries that are reliant on the major one. This is not such an issue in this case, as the input-output analysis allows for such interdependencies to be made explicit.

Finally, the small size of the area under study, and the highly disaggregated data used in the analysis suggests that scale factors may be important. In terms of growth rates, increasing employment from one person to three entails growth of 200%. If we start from the position of employment of 100 persons, then we would need employment of three hundred for the growth rates to be the same. That is, growth rates are generally more impressive the lower the base. While the LQ measures are relative, one should also be mindful of the absolute implications.

Appendix A : Sector list

The table below lists the 30 sectors used in the input-output analysis undertaken in this study.

Table 16 Input-output sectors

- 1 Agriculture
- 2 Forestry and Logging
- 3 Fishing
- 4 Mining
- 5 Food, Beverage and Tobacco Manufacturing
- 6 Textiles and Apparel Manufacturing
- 7 Wood and Paper Product Manufacturing
- 8 Printing, Publishing and Recorded Media
- 9 Petroleum, Chemical, Plastic and Rubber
- 10 Non-metallic Mineral Product Manufacturing
- 11 Metal Product Manufacturing
- 12 Machinery and Equipment Manufacturing
- 13 Furniture and Other Manufacturing
- 14 Electricity, Gas and Water Supply
- 15 Construction
- 16 Wholesale Trade
- 17 Retail Trade
- 18 Accommodation, Restaurants and Bars
- 19 Transport and Storage
- 20 Communication Services
- 21 Finance and Insurance
- 22 Property Services
- 23 Ownership of Owner-occupied Dwellings
- 24 Business Services
- 25 Central Government Administration and Defence
- 26 Local Government Administration
- 27 Education
- 28 Health and Community Services
- 29 Cultural and Recreational Services
- 30 Personal and Other Community Services

Source: NZIER

Appendix B : Input-output analysis

B.1 Introduction

This appendix aims to provide detail regarding the techniques employed in this report. The appendix covers the input-output table, derivation of multipliers, and extraction and linkage techniques.

B.2 The input-output model

An input-output (IO) table is a matrix representation of the flows related to the production and consumption of goods and services for a particular economy. A stylised picture of an input-output table is presented in Figure 9.

Figure 9 The input-output table

	Industry inputs				Final demands (f)				Total sales (x)
Industry sales	z_{11}	z_{12}	...	z_{1n}	c_1	i_1	g_1	e_1	x_1
	z_{21}	z_{22}	I	z_{2n}	c_2	i_2	II	e_2	x_2
	\vdots	\vdots		\vdots	\vdots	\vdots		\vdots	\vdots
	z_{n1}	z_{n2}	...	z_{nn}	c_n	i_n	g_n	e_n	x_n
Value added	l_1	l_2	III	l_n	IV				l
	k_1	k_2	...	k_n					k
Imports	m_1	m_2	...	m_n	m_f				m
Total outlays (x)	x_1	x_2	...	x_n	c	i	g	e	

The first n rows of Figure 9 record the distribution of a sector's output; the first n columns record the distribution of a sector's inputs. The cells in the intersection of the first n rows and columns represent the interindustry transactions; this square array of transactions is known as the transactions matrix, or quadrant I of the input-output table, and is denoted Z .

Purchases by final consumers from each sector i are recorded in the array to the right of the transactions matrix (i.e. quadrant II). These purchases can be broken down into:

c_i = personal consumption expenditure on goods from sector i

i_i = purchases of fixed assets for investment on goods from sector i

g_i = government purchases on goods from sector i , and

e_i = exports of goods from sector i .

Sector j 's payments to the factors of production are recorded in quadrant III (i.e. the array below the transactions matrix). In Figure 9 these are:

L_j = payments made to labour

K_j = payment made to owners of capital, including the depreciation allowance.

Also included within quadrant III are imports of intermediate inputs by sector j , m_j . Imports purchased by final consumers, m_f , are recorded in quadrant IV.

Using the observed inter-relationships portrayed in an IO table, we can measure the impact of a change in one industry on the remainder of the economy, and these measures are known as multipliers.

B.2.1 Type I and Type II multipliers

Type I and Type II multipliers differ in the extent to which they fully capture economy-wide impacts of a sectoral change. Type II multipliers provide a more comprehensive measure of economic change. The derivation of Type II multipliers is essentially an extension of the Type I algebra; hence both Type I and Type II derivations are presented here.

The distinction between Type I and Type II multipliers is as follows:

- *Type I multipliers* measure the direct and indirect effects of a change. In the instance of an output multiplier, the direct effect is the initial rise in output in the industry which is experiencing higher demand. The indirect effects result from the need to produce more inputs for that industry.
- *Type II multipliers* include the direct and indirect effects, as well as the income-induced effect of a change. The initial direct and indirect effects result in higher employment, which in turn boosts household income, which increases demand, which lifts output, which then lifts employment further, and so on.

B.2.2 Derivation of Type I multipliers

Given an n -sector economy, the transactions matrix and the vectors of final demands and outputs can be represented as:¹⁶

$$\mathbf{Z} = \begin{pmatrix} z_{11} & z_{12} & \cdots & z_{1n} & z_{1c} \\ z_{21} & z_{22} & \cdots & z_{2n} & z_{2c} \\ \vdots & \vdots & & \vdots & \vdots \\ z_{n1} & z_{n2} & \cdots & z_{nn} & z_{nc} \\ \hline z_{c1} & z_{c2} & \cdots & z_{cn} & \end{pmatrix} \quad \mathbf{f} = \begin{pmatrix} f_1 \\ f_2 \\ \vdots \\ f_n \end{pmatrix} \quad \mathbf{x} = \begin{pmatrix} x_1 \\ x_2 \\ \vdots \\ x_n \end{pmatrix}$$

where:

z_{ij} = sector i sales to sector j

f_j = sector j sales to final demand

x_j = total sector j sales

The c -th row represents compensation of employees (i.e. payments for labour), and the c -th column is household consumption.

The relationship between the elements of these matrices is:

$$x_i = z_{i1} + z_{i2} + \dots + z_{in} + f_i \quad (1)$$

The technical coefficients (or direct input coefficients) of sector j are written:

$$a_{ij} = z_{ij} / x_j \quad (2)$$

which in matrix form is:

$$\mathbf{A} = \begin{pmatrix} a_{11} & a_{12} & \cdots & a_{1n} \\ a_{21} & a_{22} & \cdots & a_{2n} \\ \vdots & \vdots & & \vdots \\ a_{n1} & a_{n2} & \cdots & a_{nn} \end{pmatrix}$$

Thus a_{ij} is the proportion of sector j 's total output (the value of which is equivalent to the value of sector j 's total input) and is made up of inputs from other sectors.

Given equation (1), sector i 's sales can be rewritten and expressed in terms of technical coefficients as:

¹⁶ In the Inter-industry Study 1996, which forms the basis of the multiplier analysis contained in this report, $n = 126$.

$$x_i = a_{i1}x_1 + a_{i2}x_2 + \dots + a_{in}x_n + f_i \quad (3)$$

Equations (1) and (3) respectively can be written in matrix form as:

$$\mathbf{x} = \mathbf{Z}\mathbf{i} + \mathbf{f} \quad (4)$$

$$\mathbf{x} = \mathbf{A}\mathbf{x} + \mathbf{f} \quad (5)$$

where \mathbf{i} is an n -element column vector of 1s.

Recall that equations (1) and (3), and hence (4) and (5), are equivalent.

Using an $n \times n$ identity matrix, \mathbf{I} , and rearranging equation (5) yields:

$$\mathbf{I}\mathbf{x} - \mathbf{A}\mathbf{x} = \mathbf{f}$$

$$\Rightarrow (\mathbf{I} - \mathbf{A})\mathbf{x} = \mathbf{f} \quad (6)$$

From this we can derive the change in output, \mathbf{x}^* , arising from a change in final demand, \mathbf{f}^* :

$$\mathbf{x}^* = (\mathbf{I} - \mathbf{A})^{-1}\mathbf{f}^* \quad (7)$$

$(\mathbf{I} - \mathbf{A})^{-1}$ is the Leontief Inverse, or the total (initial, direct and indirect) requirements matrix. This can be represented by \mathbf{B} so that:

$$\mathbf{x}^* = \mathbf{B}\mathbf{f}^* \quad (8)$$

B.2.2.1 Output multipliers

Re-expressing equation (8) in expanded format gives:

$$\mathbf{x}^* = \begin{pmatrix} b_{11} & b_{12} & \dots & b_{1n} \\ b_{21} & b_{22} & \dots & b_{2n} \\ \vdots & \vdots & & \vdots \\ b_{n1} & b_{n2} & \dots & b_{nn} \end{pmatrix} \begin{pmatrix} f_1^* \\ f_2^* \\ \vdots \\ f_n^* \end{pmatrix}$$

From this it can be seen that the economy-wide impact of f_j^* is:

$$x_j^* = \sum_{i=1}^n b_{ij} f_j^* \quad (9)$$

For $f_j^* = 1$, x_j^* reduces to:

$$x_j^* = \sum_{i=1}^n b_{ij} \quad (10)$$

x_j^* is the (Type I) *output multiplier*: that is, how much does economy-wide output have to increase to meet a \$1 increase in final demand for the output of sector j .

B.2.2.2 Value added multipliers

In principle these are calculated in the same way as for output multipliers; the distinction is that changes in sectoral output arising from a change in final demand are scaled by each sector's value added input coefficient (i.e. the ratio of value added to total inputs).

The value added input coefficients are calculated using the sum of the compensation of employees, the operating surplus and net indirect tax rows of the input-output table. We shall denote this sum as z_{vaj} . In a manner similar to that used to derive the direct input coefficients in equation (2), the value added input coefficients are:

$$a_{vaj} = z_{vaj} / x_j \quad (11)$$

By using this to scale the impact of changes in output we have:

$$v_j^* = \sum_{i=1}^n a_{vai} b_{ij} / a_{vaj} \quad (12)$$

This is the (Type I) *value added multiplier*. Its interpretation is: how much will economy-wide value added increase, above the initial increase in sector j 's value added payments, given an increase in final demand of sector j 's output of \$1.

B.2.2.3 Income multipliers

These are calculated as for the value added multipliers, with scaling of sectoral output done by compensation of employees (i.e. household income). Recalling that compensation of employees is recorded in c -th row of the input-output table, the compensation of employees coefficient is:

$$a_{cj} = z_{cj} / x_j \quad (13)$$

By using this to scale the impact of changes in output we have:

$$h_j^* = \sum_{i=1}^n a_{ci} b_{ij} / a_{cj} \quad (14)$$

This is the (Type I) *income multiplier*. Its interpretation is: how much will economy-wide income increase, above the initial increase in sector j 's

income (i.e. compensation of employees) payments, given an increase in final demand of sector j 's output of \$1.

B.2.2.4 Employment multipliers

These are calculated as for the income multipliers, but rather than use compensation of employees to scale the output effects we have used the ratio of full-time equivalent (FTE) jobs to output by sector. This employment ratio is:

$$e_j = FTE_j / x_j \quad (15)$$

Using this in our multiplier calculation gives:

$$e_j^* = \sum_{i=1}^n e_i b_{ij} / e_j \quad (16)$$

B.2.3 Derivation of Type II multipliers

In the calculations above, the matrix elements are restricted to those within the $n \times n$ confines of the transactions matrix of the inter-industry table. However, this effectively excludes the impact of changes in household income arising from additional final demand, since household income and consumption is outside of the $n \times n$ matrix. Type II multipliers address this issue by expanding the $n \times n$ matrix to include household consumption and compensation of employees. Households are effectively treated as another production sector in Type II multiplier analysis, producing labour services and demanding consumption goods and services.

The technical coefficients for the household row and column are:

$$a_{cj} = z_{cj} / x_j \quad (17)$$

$$a_{ic} = z_{ic} / x_c \quad (18)$$

where:

a_{cj} = the labour coefficient for sector j

a_{ic} = the 'household consumption' coefficient.

In equation (18), x_c represents household disposable income. For the analysis contained in this report we calculated household disposable income as the sum of:

- compensation of employees (from the input-output tables)

- self-employed earnings (derived from SNZ's *Institutional Sector Accounts*)
- dividend earnings (derived from SNZ's *Institutional Sector Accounts*)

and then subtracted tax from that sum using an average personal income tax rate derived from the *Institutional Sector Accounts*. Note that both self-employed earnings and dividend earnings are reflected in the operating surplus row of the input-output table.

B.3 Linkage measures

In the same way that the matrix, \mathbf{A} , of direct input coefficients is calculated for the *Leontief quantity* model, we can construct a matrix, \mathbf{G} , of direct output coefficients for the *Ghosh price* model, where

$$g_{ij} = z_{ij} / x_i \quad (19)$$

In other words, g_{ij} indicates the proportion of output from sector i that goes to sector j . In a similar fashion to the Leontief inverse, the Ghosh inverse

$$(\mathbf{I} - \mathbf{G})^{-1} \quad (20)$$

can be computed.

As noted earlier, the various linkage measures can be computed directly from these matrices, namely:

- The *direct backward linkage* for sector j is the j -th column sum of \mathbf{A} .
- The *total backward linkage* for sector j is the j -th column sum of $(\mathbf{I} - \mathbf{A})^{-1}$.
- The *direct forward linkage* for sector i is the i -th row sum of \mathbf{G} .
- The *total forward linkage* for sector i is the i -th row sum of $(\mathbf{I} - \mathbf{G})^{-1}$.

Appendix C : Comparison with earlier work

This section compares the methodology employed in this report with those adopted in the earlier studies by Brent Wheeler (2003) and Market Economics (2004). Comparison of the significant elements of the analyses is provided below.

Input-output model: NZIER uses a region-specific input-output table which forms the basis of its multiplier analysis. This table, representing the combined Waihi-Waihi Beach economy, is derived from the national table published by SNZ using regional shares of employment and population. This is known as the GRIT method and is similar to that employed by Market Economics (*Economic Impact of the Favona Mine Underground Project*, Market Economics, Appendix 2). The GRIT method is an internationally accepted method of regionalising national input-output tables (see *Regional Input-Output Study*, Statistics New Zealand, 2003). In contrast, Wheeler (*Favona Project – Waihi: Updated Estimates of Likely Economic Impacts*, Brent Wheeler Limited, 2003) adopts multipliers derived for other studies, including “the Butcher MAF Forestry impact study” (*Estimate of Employment and Household Income Changes in Wairoa District Arising from a Land Use Change from Farming to Forestry*, G Butcher, Butcher Partners, March 1997), raising questions about the suitability of the analysis to mining. NZIER shares the concerns outlined by Market Economics regarding the Wheeler multiplier analysis (Market Economics, p.15).

Multipliers: The Type II multipliers used in each of the NZIER, Market Economics and Wheeler studies is shown below.

Table 17 Comparison of Type II mining multipliers

	NZIER	Market Economics	Wheeler
Output	1.46	1.42	2.15
Value added	1.38	1.38	Not used
Note:	NZIER multipliers relate to the Waihi-Waihi Beach area; Market Economics and Wheeler multipliers relate to the Hauraki District Council area.		
Source:	NZIER		

NZIER multipliers are very similar to those derived by Market Economics. The differences between these and the Wheeler multipliers arise from the differing methods used in their derivation (as noted above). Regarding the Wheeler multipliers, Market Economics states that they have “concerns about the extent of the multipliers employed...We consider that the

multipliers used are too high” (Market Economics, p.21). NZIER agrees with this assessment.

Definition of economic impact: NZIER presents the impact of Newmont Waihi Gold’s activity in terms of local economic output, value added and employment. It is NZIER’s view that value added is the most appropriate measure of the economic activity generated within an economic area, and consequently that value added multipliers are the most appropriate when considering the economic impact of Newmont Waihi Gold’s operations on the local economy. This view is similar to that held by Market Economics (p.15). Alternatively, Wheeler equates gross output with economic impact. Gross output includes purchases of goods and services that originate from outside the local economy; thus, the use of output multipliers applied to Newmont Waihi Gold’s expenditure (as in Wheeler) overstates the local impact of that expenditure.

In conclusion, NZIER has adopted what it believes to be best practice in terms of regional input-output analysis. NZIER’s method is supported by SNZ (*Regional Input-Output Study*, Statistics New Zealand, 2003) and Market Economics. Wheeler adopts a different approach, however, which embodies a number of serious flaws that undermine the quality of the analysis. This view has already been expressed by Market Economics (pp.9-16).

Appendix D : Favona direct impacts

Table 18 Annual Favona direct impacts

\$ million

	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
Capital	5.6	18.4	17.5	15.4	10.8	11.2							
Mining		0.9	10.1	28.9	44.6	52.0	51.5	51.0	50.5	50.0	49.5	49.0	30.6
Total	5.6	19.3	27.5	44.3	55.3	63.1	51.5	51.0	50.5	50.0	49.5	49.0	30.6

Total annual average impact: 42.1

Source: Wheeler, *Favona Project – Waihi: Updated Estimates of Likely Economic Impacts*, 2003, Appendix I Base Case