

A Genuine Progress Indicator for the Waikato Region

Summary Report

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Environment Waikato**

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Executive Summary

Introduction

The Genuine Progress Indicator (GPI) is a concept that is becoming increasingly popular world-wide as a measure of human welfare. Over the last decade the GPI has been promoted internationally as an alternative to the Gross Domestic Product (GDP) measure. Unlike GDP, the GPI incorporates aspects of the non-market economy, separating welfare-enhancing benefits from welfare-detracting costs, correcting for the unequal distribution of income, and distinguishing between sustainable and unsustainable forms of consumption. This report presents the findings of a study conducted by Ecological Economics Research New Zealand (EERNZ) and Market Economics Ltd (MEL) on the GPI for the Waikato Region and its individual sub-components.

The Waikato Region GPI began with a valuation of total personal consumption expenditure. A total of nineteen additional socio-economic and environmental components of welfare were then included in the GPI, with each component representing either an addition to, or subtraction from, the region's total personal consumption expenditure. The primary benefit of a regional GPI is to monitor regional progress over time and to benchmark the region's progress.

The study for the Waikato Region GPI covers the period from 1990 to 2006. This time frame is relatively short by GPI standards. The New Zealand GPI study, for example, begins in 1970. It is important to recognise that a short time frame tends to emphasise peaks and troughs in the data. Those same short-term variations would appear less significant in a longer time series. Care must therefore be taken in attributing a cause and effect relationship to short-term variations in sub-component trends, especially for socio-economic components. Indeed, a particular weakness of the GPI is that the relationships between cause and effect are not explicitly established. Lag effects, for example, are likely between the cause (i.e., a national level policy change) and the time it takes for the effect (if any) to be evident in national or regional level data such as that utilised for the GPI.

Many of the socio-economic component trends experienced in the Waikato Region are closely related to the national level trends. That is, many of the cause and effect relationships, whatever they may be, will also be at the national level. As such, this report has sought to identify those national level forces likely to correspond to socio-economic data trends. It is not possible to directly compare regional results for the environmental cost components with the national level results as the scarcity of environmental data sets has meant that data used and some of the methods of calculation are inconsistent. Trends experienced in the environmental cost components are more likely to be impacted by regional level forces and these have been identified where possible.

Please note: (1) all dollar figures in this report are NZ\$₂₀₀₆ dollars unless stated otherwise, and (2) all comparisons with the soon-to-be-released EERNZ and MEL national GPI study are based on the latest (at time of publication of this report) draft versions of the national socio-economic and environmental GPI technical reports. These reports are however subject to ongoing review and the final national results may differ from those reported in this study.

Headline results

Over the study period, the Waikato Region GPI grew by 25.3 percent from \$9.1 billion to \$11.4 billion, an annual average rate of 1.42 percent. This can be compared to the region's GDP which grew by 43.5 percent (from \$9.3 billion to \$13.4 billion) at an annual average rate of 2.29 percent. Over the same period, the national GPI rose from \$93 billion in 1990 to \$131 billion in 2006, an annual average rate of 2.2 percent, while national GDP grew at an annual average rate of 3.1 percent.

When the Waikato Region GPI is expressed in per capita terms the results are relatively static over the study period – rising only 7.5 percent (or an annual average growth rate of 0.45 percent). By comparison, the national GPI per capita increased by 15.4 percent or an annual average of 0.9 percent.

The level of socio-economic benefits that are accounted for in the GPI climbed by \$4,760 million, or a rise of 42.8 percent. The socio-economic costs and the environment costs also increased, by \$1,531 million (135.2 percent) and \$932 million (104.2 percent) respectively – a total of \$2,462 million for the two cost components.

Overall, the net increase in the Waikato Region GPI for the study period is estimated to be \$2,297 million.

Component results

Personal consumption is the major contributor, accounting for \$2,921 million or 61.4 percent of the total socio-economic benefits increase over the study period. This was followed by non-defensive public consumption at \$905 million (19.0 percent) and the value of household and community work at \$638 million (13.4 percent). Lastly, the value of services of public capital added \$296 million (6.2 percent) over the study period.

The most significant components of the socio-economic costs were income inequality which accounts for \$1,200 million, or 78.4 percent of the increase in total socio-economic costs over the study period. The cost of commuting makes up \$230 million (15.0 percent), the cost of overwork \$97 million (6.3 percent), and the remaining socio-economic cost components together account for \$4 million (0.3 percent) of the increase.

In terms of the increase in total environmental costs over the study period, the most significant contributions came from: climate change at \$334 million (35.9 percent of total environmental costs); loss of soils at \$215 million (23.1 percent), loss of water quality \$110 million (11.8 percent), loss of wetlands \$110 million (11.8 percent). Small contributions, to the sum of approximately \$162 million (17.4 percent), were made by the loss of loss of terrestrial ecosystems, loss of air quality, loss of non-renewable resources, land degradation and noise pollution components.

Outstanding issues

This study represents a first step in creating a GPI for the Waikato Region.

The study is unique in that it is among the first fully evaluated GPI to be developed within the New Zealand context¹. Moreover, it is among only a few sub-national GPI to be developed globally. It also builds on past efforts aimed at improving measurement of national well-being or genuine progress.

The study represents a first, and preliminary, step in measuring genuine progress in the Waikato Region. There are a number of outstanding theoretical, methodological and empirical issues with the Waikato Region GPI which are beyond the scope of the current study, but which future work may address. These are discussed further in the document entitled *A Genuine Progress Indicator for the Waikato Region: Valuation Methodology Technical Report* (McDonald *et al*, 2010).

¹ A GPI was also completed for Auckland Region for the Auckland Regional Council. Refer “*A Genuine Progress Indicator for the Auckland Region*” (McDonald *et al*, July 2009). See <http://www.arc.govt.nz/auckland/population-and-statistics/genuine-progress-indicator.cfm>

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Introduction

The GPI was first developed in 1995 by the non-profit organisation Redefining Progress. Like its forerunner, the Index of Sustainable Economic Welfare (ISEW), the GPI is promoted on the grounds that it attempts to undertake a more holistic measure of welfare than GDP (Daly and Cobb, 1989; Cobb *et al*, 1995; Daly, 1996; Anielski and Rowe, 1999; Lawn, 2003). It incorporates aspects of the non-market economy, separating welfare-enhancing benefits from welfare-detracting costs, correcting for the unequal distribution of income, and distinguishing between sustainable and unsustainable forms of consumption (Talberth *et al*. 2007). Among the nations for which an ISEW or GPI has been developed are the US (Anielski and Rowe, 1999), UK (Jackon *et al*, 1997), Germany (Diefenbacher, 1994), Australia (Hamilton and Denniss, 2002), China (Wen *et al*, 2008), India (Lawn, 2008) and Canada (Nova Scotia Province) (PannoZZo *et al*, 2009).

In July 2009, Environment Waikato contracted the New Zealand Centre of Ecological Economics (now Ecological Economics Research New Zealand; EERNZ) and Market Economics Ltd (MEL) to develop a GPI for the Waikato Region covering the period 1990 to 2006. This work builds on EERNZ and MEL's national and Auckland Region GPI projects which have been respectively funded by the Foundation of Research, Science and Technology under the 'Sustainable Pathways' programme (contract number MAUX0306) and Auckland Regional Council.

There are two key outputs of the Waikato Region study:

- this summary report outlining the major findings and trends/patterns in the Waikato Region GPI; and
- a technical report that describes in detail the data and methods used to estimate the Waikato Region GPI.

The starting point for the valuation of the Waikato Region GPI is total Personal Consumption expenditure. A total of nineteen additional socio-economic and environmental components of welfare were then taken into consideration, with every component representing either, an addition to, or subtraction from, the total personal consumption expenditure (Figure 1)². Table 1 provides a brief description of each component of the Waikato Region GPI. The table is divided into three sections covering the socio-economic benefits, socio-economic costs and environmental costs. Both component descriptions and brief methodologies are provided. This has been necessary as often components are only partially valued due to data paucity and/or lack of appropriate valuation techniques. For a full account of the valuation methods employed in developing the Waikato Region GPI please refer to the *A Genuine Progress Indicator for the Waikato Region: Valuation Methodology Technical Report* (McDonald *et al*, 2010).

In this summary report, the key findings, patterns/trends and causal mechanisms underpinning the GPI components are briefly discussed. The report is divided into four sections:

- An overview of the Waikato Region;

² The cost of ozone depletion is excluded from the Waikato Region GPI. This is discussed further in the section entitled 'Exclusions – Ozone Depletion'.

- GPI headline results;
- GPI socio-economic component results; and
- GPI environmental component results.

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Figure 1: Components of the Waikato Region GPI

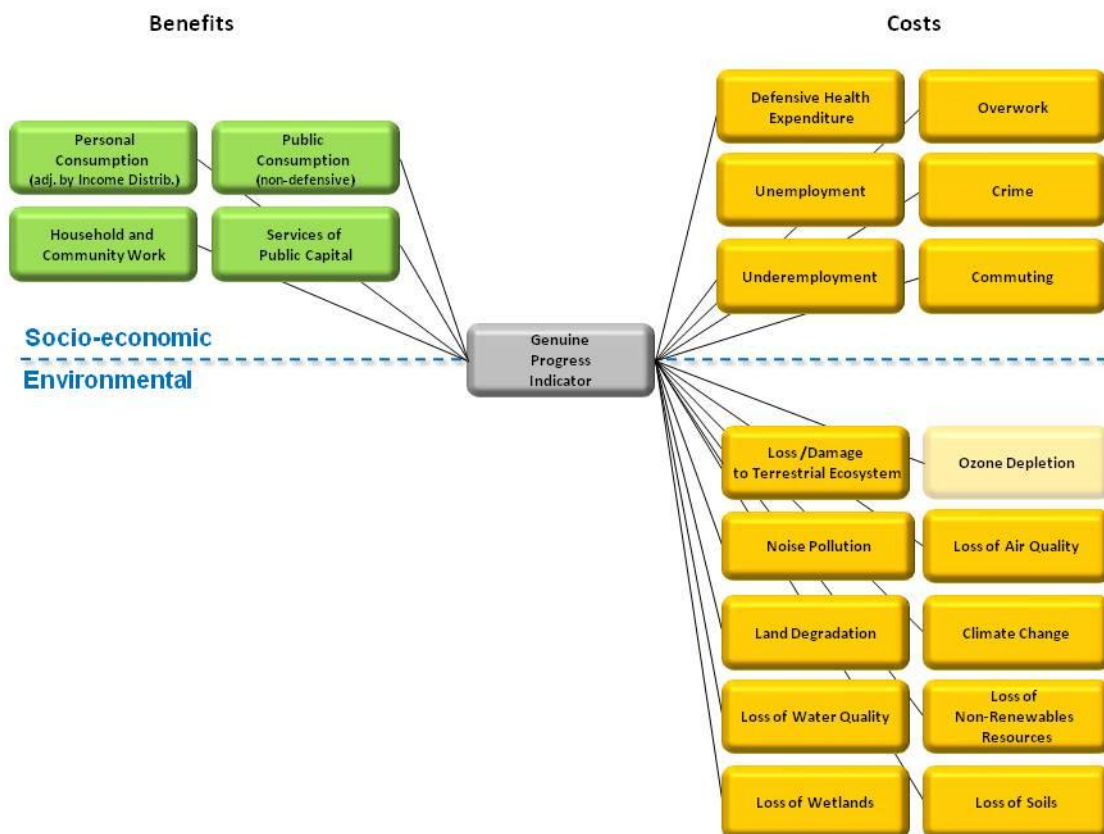


Table 1: Components of the Waikato Region GPI

| Component | What is valued? | Brief description of valuation method applied ¹ |
|---|--|---|
| Personal Consumption | | |
| + Personal consumption | All household outlays on consumer goods and services along with expenditure on non-capital items by private non-profit organisations serving households. | Waikato Region consumption per capita multiplied by resident population. |
| - Income distribution | Income distribution between different income quintile groups. | An Income Distribution Index generated from Gini coefficients. |
| + Weighted personal consumption | Personal consumption adjusted for income inequality. | Derived by dividing Personal Consumption by the Income Distribution Index and then multiplying by 100. |
| Socio-economic Benefits | | |
| + Public consumption non-defensive | The value of goods and services provided by the government for the consumption by the community. | Public sector consumption by category (as derived from regional input-output tables) multiplied by an assumed non-defensive ² proportion. |
| + Value of household and community work | Non-leisure time spent on household and community work. | Time spent on household and community work by age-sex cohort multiplied by the median wage rate for housekeepers. |
| + Services of public capital | Non-market services rendered by government-owned capital stocks. | Estimated as the depreciation of capital stocks (including non-defensive and non-market services) plus the opportunity cost of government investment funds. |
| Socio-economic Costs | | |
| - Cost of unemployment | The involuntary leisure time that unemployment brings. | Total unemployed hours multiplied by a average hourly wage rate. |
| - Cost of underemployment | The involuntary leisure time that underemployment brings. | Total underemployed hours (part-time employees looking for full time work) multiplied by the average hourly wage rate. |
| - Cost of overwork | The loss of leisure time from overwork. | Total hours overworked multiplied by the average wage rate. |
| - Cost of private defensive expenditure on health | Resident household private defensive ² expenditure on health. | Total private expenditure on health multiplied by an assumed defensive ² proportion. |
| - Cost of commuting to work | The direct costs (i.e. vehicle purchases, maintenance, bus and train fares, etc) and time costs of commuting to work. | Direct costs are calculated for both private and public components of commuting to work. Time costs are estimated as total hours spent on commuting by employed people multiplied by a cost per hour. |
| - Cost of crime | Private sector property loss, property damage and preventative expenditure including associated administration costs borne by insurance companies. | Total offences multiplied by a cost per offence. |

Table 1 Cont: Components of the Waikato Region GPI

| Component | What is valued? | Brief description of valuation method applied ¹ |
|---|--|---|
| <i>Environmental Costs</i> | | |
| - Loss and damage to terrestrial ecosystems | Losses resulting from invasive pests and weeds and indigenous forest/scrub change. | Calculated as the loss and damage to terrestrial ecosystems by 1) pest-related annual expenditure as taken from central and local government estimates, 2) biodiversity loss of old growth native forest and scrub valued on the basis of hectares cleared. |
| - Loss of wetlands | Decrease in wetland areas. | Hectares of wetland converted to other uses valued on the basis of ecosystem services loss. |
| - Loss of soils | Loss of fertile soil to the built environment and soil erosion. | Erosion loss is estimated as the tonnes of soil lost annually multiplied by a cost per tonne. Hectares of agricultural land lost to urban expansion is valued on the basis of ecosystem services loss. |
| - Loss of air quality | Increases in mortality rate, and restricted activity days as a result of air pollution. | Calculated by weighing the cost of loss of life years and reduced activity days for 2001 by an air pollution index (PM ₁₀). |
| - Land degradation | Waste to landfill and contaminated sites. | Estimated using the costs for remediation of contaminated sites in the Waikato Region and the tonnes of waste going to landfills. |
| - Climate change | The cost of long-term environmental damage resulting from all greenhouse gas emissions (i.e. agriculture, transport, industry and energy). | Calculated by multiplying annual greenhouse gas emissions by an estimate of the marginal social cost of emitting an additional tonne of carbon dioxide into the atmosphere. |
| - Loss of water quality | Nutrient loading, turbidity, loss of habitat etc. | The value for loss of water quality is based on water quality remediation: riparian planting for rivers and lake restoration costs. |
| - Loss of non-renewable resources | The consumption of non-renewable income-generating assets. | Calculated for gold and silver extracted using the El Serafy method. |
| - Noise pollution | Unwanted or offensive sounds coming from a variety of sources. | Vehicle kilometers travelled has been used as a proxy to estimate the loss of amenity from noise exposure. |

Notes:

1. Only a brief description is provided in this table. Please refer to the A GPI for the Waikato Region Valuation Methodology Technical Report (McDonald *et al*, 2010) for full details.

2. Defensive expenditures are defined by Leipert (1989, p.28) as “expenditure ... made to eliminate, mitigate, neutralize, or anticipate and avoid damages and deterioration that industrial society’s process of growth has caused to living, working, and environmental conditions.” Defensive expenditure relates to both socio-economic and environmental costs.

Waikato Region Overview

At approximately 25,000 square kilometres or 2.5 million hectares, Waikato is the fourth largest region in New Zealand and covers most of the central North Island. The regional boundary defines the natural catchment of the Waikato River and the land area adjoins approximately 1,150 kilometres of diverse coastline on the east and west coast. The land is rich in natural resources. While originally covered in native vegetation, subsequent Maori and European settlement and economic development has seen the land cover converted largely to pastoral farming in the north, plantation forestry in the south and a network of urban settlements and land uses.

Urban Form

The spatial form of early urban development in the Waikato Region was linked to the Waikato River. More dispersed settlement patterns were then influenced by the progression of economic activity including pastoral farming, related manufacturing, mining, forestry and also large power generation projects. Today, the Waikato's urban areas are linked by a substantial transport network with the main trunk rail line and State Highway 1 running through the Region's north-south axis. Approximately 1 percent of the Region's land area is categorised as having an urban use (Forgie *et al.*, 2004).

At the time of the 2006 Census, the Region contained almost 169,000 dwellings, including occupied (84 percent), unoccupied (15 percent) and those dwellings under construction (1 percent). The resident population, occupying private dwellings, is concentrated in the large Hamilton urban area (41 percent of the population or 155,000 people), with the remainder distributed over a number of moderate to small provincial town centres including Taupo (6 percent or 21,300), 4 percent in each of Cambridge (15,180), Te Awamutu (14,460) and Tokoroa (13,520), 2 percent each in Huntly (6,830), Thames (6,760), Morrinsville (6,600) and Matamata (6,310) and a range of smaller rural service towns and coastal urban settlements. A significant 21 percent of the Waikato Region population live in rural (non-urban) areas (Statistics New Zealand, 2010a, 2010b).

The unoccupied dwelling stock is largely comprised of holiday homes. They are concentrated in coastal settlements on the Coromandel Peninsula (42 percent) and surrounding Lake Taupo (21 percent) (Statistics New Zealand, 2010b). The large population base in neighbouring Auckland Region is a key driver of demand for these holiday homes.

Hamilton is the dominant commercial centre serving the Region and is the location of key retail, business, education, health and government infrastructure.

Demographics

According to the 2006 Census, the Waikato Region had a usually resident population of approximately 383,000, accounting for 9.5 percent of the New Zealand population. The region ranks fourth in size of population out of the 16 regions in the country and it has experienced average growth of approximately 5,000 persons per annum since 2001. The

Maori ethnic population is nationally significant at approximately 77,000 (2006). The Waikato Region accounts for 13.5 percent of the total New Zealand Maori population, ranking second out of 16 regions. Ngāruawāhia is home to the Māori Kīngitanga or King Movement. Tūrangawaewae Marae is on the eastern bank of the Waikato River.

Waikato Region has a similar age-sex profile to the national average in terms of median age (35.6 years) and the proportion of the population aged 65 year and over (12.4 percent). It does however have a higher proportion of children (15 years and under) at 22.9 percent compared to 21.5 percent nationally. In 2006, 37.1 percent of the Region's population had a post-graduate qualification, slightly below the national average for those aged 15 and over (39.9 percent), and 29 percent had no formal qualifications compared to 25 percent nationally. The unemployment rate was 5.2 percent compared to the national rate of 5.1 percent in 2006. The personal income profile of the 15 year and over population in the Waikato Region is similar to the national average, although fewer residents (17.1 percent) earn higher incomes (\$50,000 per annum plus) compared to New Zealand wide (18.0 percent) (Statistics New Zealand, 2010a).

Economy

Waikato Region GDP is estimated at \$15,606 million for 2007. The top 10 contributing industry sectors³ account for 57 percent of this (Table 2). The dairy cattle farming sector contributes the most to the Waikato's GDP at \$₂₀₀₇1,412 million or 9 percent, followed by the business services sector at 8 percent and the real estate sector at 6 percent (Market Economics Ltd, 2009).

Table 2: Waikato Region GDP 2007 by 48 Industry Sector – Top 10

| Rank | Sector (48 Sector) | Regional GDP \$ ₂₀₀₇ mil | Share of Region Total |
|-------|---------------------------------------|--|-----------------------------|
| 1 | Dairy cattle farming | \$ 1,412 | 9% |
| 2 | Business services | \$ 1,243 | 8% |
| 3 | Real estate | \$ 931 | 6% |
| 4 | Construction | \$ 836 | 5% |
| 5 | Wholesale trade | \$ 826 | 5% |
| 6 | Retail trade | \$ 815 | 5% |
| 7 | Health and community services | \$ 810 | 5% |
| 8 | Ownership of owner-occupied dwellings | \$ 808 | 5% |
| 9 | Education | \$ 662 | 4% |
| 10 | Dairy product manufacturing | \$ 569 | 4% |
| Total | | \$ 15,606 | |

Source: Market Economics Ltd, 2009

³ A concordance of ANZSIC industry codes to 48 Industry Sectors is contained in Appendix A.

There are almost 51,600 business units in the Waikato Region (2007) of which the top ten sectors (in terms of the count of business units) account for 77 percent of the region total (Table 3). The real estate sector accounts for the largest number of businesses (9,070), although this represents the number of registered real estate agents rather than just the count of agencies in which they operate. There are 6,680 businesses in the dairy cattle farming sector (13 percent of the total) and 5,010 businesses in the construction sector (10 percent). Seven of the top ten sectors in Table 3 also factor in the top 10 sectors contributing to regional GDP. While the livestock and cropping farming sector has the 6th largest count of businesses, it is ranked 15th in GDP contribution terms.

Table 3: Waikato Region Business Activity Units 2007 by 48 Industry Sector – Top 10

| Rank | Sector (48 Sector) | Business Activity Units | Share of Region Total |
|-------|---------------------------------------|-------------------------|-----------------------|
| 1 | Real estate | 9,070 | 18% |
| 2 | Dairy cattle farming | 6,680 | 13% |
| 3 | Construction | 5,010 | 10% |
| 4 | Business services | 4,440 | 9% |
| 5 | Retail trade | 4,430 | 9% |
| 6 | Livestock and cropping farming | 3,950 | 8% |
| 7 | Health and community services | 1,700 | 3% |
| 8 | Wholesale trade | 1,690 | 3% |
| 9 | Personal and other community services | 1,460 | 3% |
| 10 | Finance | 1,390 | 3% |
| Total | | 51,580 | |

Source: Market Economics Ltd, 2009

There are just over 197,000 persons employed in the Waikato Region (2007) according to estimates of the modified employment count (MEC)⁴. The top ten sectors (in terms of total employment) accounts for 69 percent of the region total (Table 4). The retail sector accounts for the largest number of persons employed (24,090 or 12 percent of the region total). There are 20,310 persons employed in the business services sector (10 percent) and 17,870 persons employed in the health and community services sector (9 percent). Seven of the top ten sectors in Table 4 also factor in the top 10 sectors contributing to regional GDP. While the accommodation, restaurants and bars sector has the 7th largest number of persons employed, it is ranked 16th in GDP terms.

The sectors for which the Waikato Region has a comparative advantage compared to the rest of New Zealand (measured in employment (MEC) terms) have been identified using a location quotient (LQ). The top ten sectors are shown in Table 5. The LQ measures the relative strength and weakness of sectors in a region relative to the national situation whereby values greater than 1.0 signify Waikato's strength in that sector and *vice versa*. Waikato's strongest sectors are diary and cattle farming, mining and quarrying, dairy product

⁴ The MEC is calculated by Market Economics Ltd and includes (at the 6 digit ANZSIC level) the Employment Count (EC) and estimates of the business owners (working proprietors) not counted as employees and therefore excluded from the EC.

manufacturing and other farming. Forestry and related manufacturing are also in the top ten sectors.

Table 4: Waikato Region Modified Employment Count 2007 by 48 Industry Sector – Top 10

| Rank | Sector (48 Sector) | Modified Employment Count (MEC) | Share of Region Total |
|-------|---------------------------------------|---------------------------------|-----------------------|
| 1 | Retail trade | 24,090 | 12% |
| 2 | Business services | 20,310 | 10% |
| 3 | Health and community services | 17,870 | 9% |
| 4 | Construction | 17,240 | 9% |
| 5 | Education | 14,510 | 7% |
| 6 | Dairy cattle farming | 11,660 | 6% |
| 7 | Accommodation, restaurants and bars | 11,220 | 6% |
| 8 | Wholesale trade | 8,470 | 4% |
| 9 | Cultural and recreational services | 5,560 | 3% |
| 10 | Personal and other community services | 5,140 | 3% |
| Total | | 197,100 | |

Source: Market Economics Ltd, 2009

Table 5: Sectors with a Comparative Advantage in Waikato Region 2007 by 48 Industry Sector – Top 10

| Rank | | Employment based Location Quotient |
|------|-------------------------------------|------------------------------------|
| 1 | Dairy cattle farming | 3.61 |
| 2 | Mining and quarrying | 3.06 |
| 3 | Dairy product manufacturing | 3.03 |
| 4 | Other farming | 2.25 |
| 5 | Forestry and logging | 1.89 |
| 6 | Wood product manufacturing | 1.75 |
| 7 | Electricity generation and supply | 1.49 |
| 8 | Meat and meat product manufacturing | 1.40 |
| 9 | Water supply | 1.28 |
| 10 | Basic metal manufacturing | 1.27 |

Source: Market Economics Ltd, 2009. Employment according to MEC.

Those sectors for which the Waikato Region has a comparative advantage *and* have a large contribution to regional GDP are those sectors of most significance to the regional economy. Dairy cattle farming and dairy product manufacturing rank in the top ten sectors for both measures (Table 5 and Table 2). The electricity generation and supply sector may also be considered significant (ranking 7th and 11th respectively).

Environment

Before human settlement most of the region was covered in native vegetation. Now, approximately three quarters of the region has been converted to farming and plantation forestry. Natural resources (natural capital) has significantly influenced the type of development that has taken place in the Waikato Region. The suitability of the climate and land contour for settlement and farming was recognised by the early settlers and capitalised on. Regular rain serves both to encourage natural grass growth and renew groundwater aquifers that supply a ready source of water for agricultural, industrial and domestic use. Mineral resources were discovered early and their exploitation also influenced regional settlement, growth and development. For example, the discovery of coal provided a source of cheap energy for industrial development, especially cost-effective milk processing. As a result a dairy industry has been established in the region that is a world-leader in productivity and efficiency. The Waikato River, New Zealand's longest river, runs through the region and provided an easy means of transport so early settlement by both Maori and Europeans was predominantly along its banks. Energy provision has been a mainstay of the region with construction of hydro-electric dams on the Waikato River and harvesting of geothermal activity in the Central Plateau. To the south of the region, the natural environment was unsuitable for livestock farming: animals did not thrive and developed 'bush sickness'. This was later established to be due to deficiencies in the soil of trace elements, particularly cobalt and copper. The unsuitability for agriculture resulted in large tracts of exotic forest being planted, providing the basis for the timber industry, which is now a key regional industry.

While the wealth of natural capital has provided a good platform for economic growth, development has not always been in the most sustainable way. Negative environmental outcomes are a legacy of past actions and continue to occur as an externality of present day economic activity.

The characteristics of the Waikato Region's physical environment, economy and population and the spatial form of these interconnected elements, including how they change over time, have a direct impact on the Region's GPI, particularly for the environmental costs. The interaction of these elements have more of an indirect influence on the socio-economic costs and benefits in the GPI in that they influence the way in which many national level forces are manifest in the Waikato.

Headline Results

The Waikato Region GPI, along with regional GDP, is represented for the 1990-2006 study period in Figure 2. There are two notable findings:

- the Waikato Region GPI is lower than regional GDP; and
- the Waikato GPI tracks closely with regional GDP over the study period.

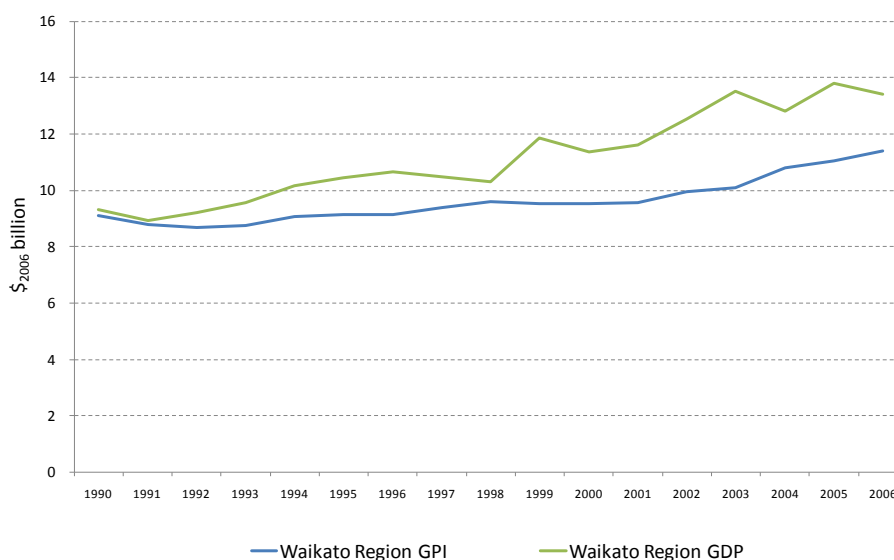
A more in depth analysis of these findings reveals several underlying changes:

- the plateau in both indicators during the early 1990s is a lag effect largely attributable to a period of relatively slow economic growth and recession following the central and local government reforms of 1984 to 1993; and
- while both the Waikato Region GPI and GDP experienced some recovery following the reforms, the two indices have slowly diverged, particularly since the millennium.

Over the study period 1990 to 2006, the Waikato Region GPI grew from \$9.10 billion to \$11.39 billion. Or, put alternatively, the Waikato Region GPI grew at an annual average rate of 1.42 percent. Over the same period the national GPI grew from \$93 billion to \$131 billion or a rise 2.17 percent. By comparison, national GDP grew at an annual average rate of 3.15 percent.

In 1990 the Waikato Region GPI amounted to 97.5 percent of Waikato Region GDP, while in 2006 it amounted to 85.0 percent. By comparison, the national GPI in 1990 amounted to 94.2 percent of national GDP, while in 2006 it amounted to 80.9 percent.

Figure 2: Waikato Region GPI versus Waikato Region GDP, 1990-2006



On the one hand, the Waikato Region's per capita GPI has been relatively static over the past 17 years; rising by only 7.46 percent, or an average annual growth rate of 0.45 percent. By comparison, the national GPI per capita grew by 15.4 percent, or an annual average rate of 0.90 percent. On the other hand, Waikato Region and national per capita GDP rose respectively 23.2 percent (1.31 percent per annum) and 34.5 percent (1.87 percent per annum) over the same period.

Figure 3 provides a summary of the net contributions by socio-economic and environmental component over the study period 1990 to 2006 as measured in \$₂₀₀₆ terms.

The top figure shows the net period changes 1990 to 2006 by major categories, namely socio-economic benefits, socio-economic costs, and environmental costs. The bottom three figures, in turn, provide a breakdown of each major category into its constituent components. On the one hand, the net study period change for socio-economic benefits is \$4,760 million. On the other hand, the socio-economic costs and the environment costs have also increased respectively by \$1,531 million (135.2 percent) and \$932 million (104.2 percent). Or, in total, by \$2,624 million. Overall, the net increase in the Waikato Region GPI for the study period, from 1990 to 2006, is estimated to be \$2,297 million.

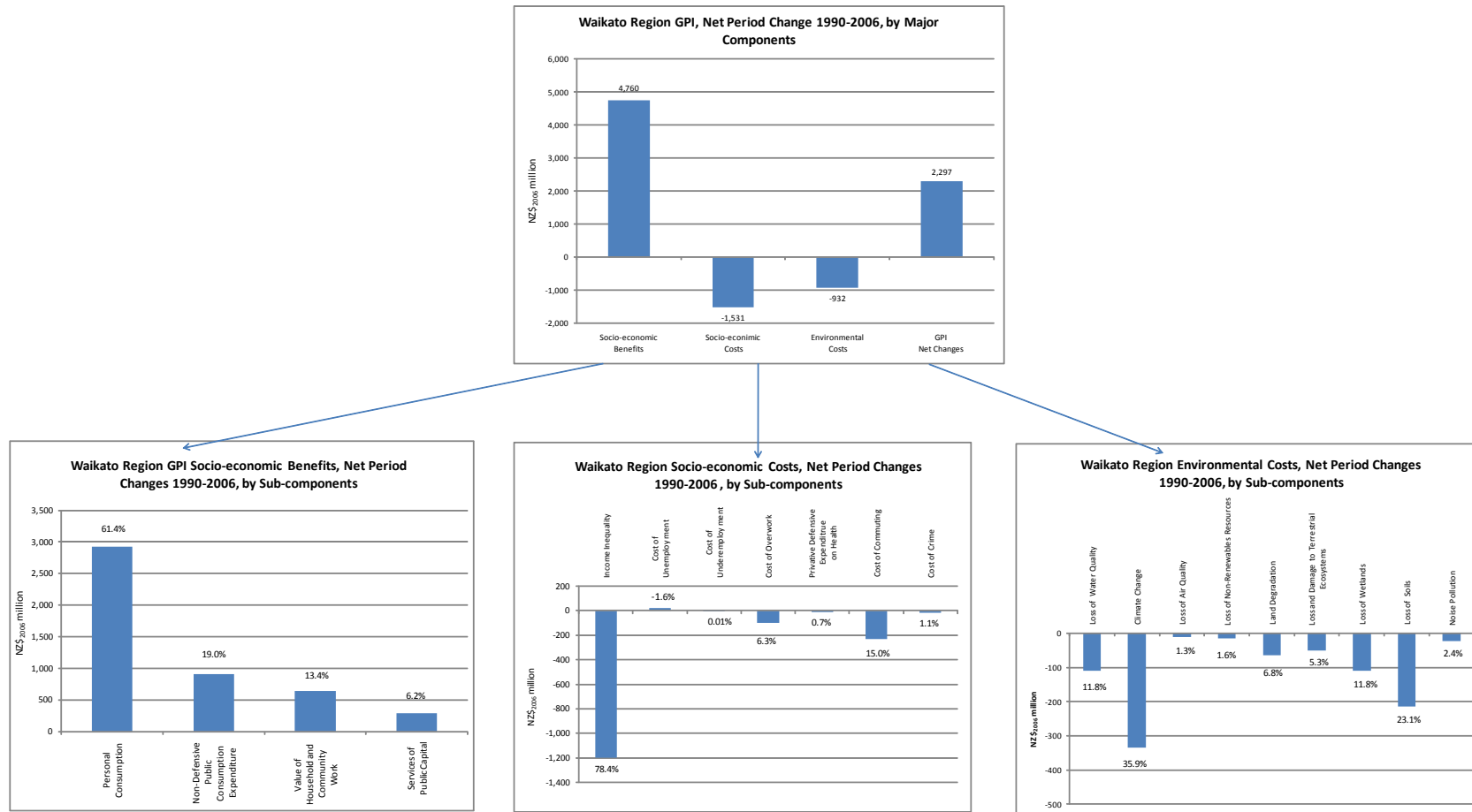
Personal consumption is the major contributor accounting for \$2,921 million or 61.4 percent of the total socio-economic benefits increase over the study period. This was followed by non-defensive public consumption at \$905 million (19.0 percent) and the value of household and community work at \$638 million (13.4 percent). Lastly, the value of services of public capital added \$296 million (6.2 percent).

The most significant components of the socio-economic costs are income inequality; which accounts for \$1,200 million, or 78.4 percent of the total increase in socio-economic costs. The cost of commuting makes up \$230 million (15.0 percent), the cost of overwork \$97 million (6.3 percent), while the remaining socio-economic cost components together account for \$4 million (0.3 percent). It is worth noting that in the case of the cost of unemployment component there was a net benefit of \$24 million over the study period.

In terms of the increase in total environmental costs over the study period, the most significant contributions came from: climate change at \$334 million (35.9 percent of total environmental costs); loss of soils at \$215 million (23.1 percent), loss of water quality \$110 (11.8 percent), loss of wetland (110 million (11.8 percent). Small contributions, to the sum of approximately \$162 million (17.4 percent), were made by the loss of loss of terrestrial ecosystems, loss of air quality, loss of non-renewable resources, land degradation and noise pollution components.

Table 6 provides a comprehensive year-by-year valuation of each component of the Waikato Region GPI including cumulative impacts and net change over the entire study.

Figure 3: Waikato Regional GPI – Net Period Changes 1990-2006 by Major Components



Note: Unadjusted personal consumption (bottom left figure) is taken as the starting point for calculation of the Waikato Region GPI, with the subtraction for income inequality shown separately (bottom middle figure).

Table 6: Waikato Region Genuine Progress Indicator, 1990–2006

| Year | Personal Consumption | | | Socio-Economic Benefits | | | Socio-Economic Costs | | | | | |
|---------|------------------------|---------------------------|---|--|---------------------------------------|-----------------------------|-----------------------------|-----------------------------|-----------------------------|---|-----------------------------|-----------------------------|
| | Personal consumption | Income Distribution Index | Personal Consumption adj by Income Distribution | Public Consumption Expenditure (Non-Defensive) | Value of Household and Community Work | Services of Public Capital | Cost of Unemployment | Cost of Under-employment | Cost of Overwork | Private Defensive Expenditure on Health | Cost of Commuting | Cost of Crime |
| | \$ ₂₀₀₆ mil | 1989=100 | + \$ ₂₀₀₆ mil | + \$ ₂₀₀₆ mil | + \$ ₂₀₀₆ mil | + \$ ₂₀₀₆ mil | - \$ ₂₀₀₆ mil | - \$ ₂₀₀₆ mil | - \$ ₂₀₀₆ mil | - \$ ₂₀₀₆ mil | - \$ ₂₀₀₆ mil | - \$ ₂₀₀₆ mil |
| 1990 | 5,942 | 101 | 5,859 | 1,852 | 2,427 | 901 | 70 | 41 | 329 | 16 | 271 | 322 |
| 1991 | 5,850 | 104 | 5,634 | 1,824 | 2,522 | 861 | 88 | 63 | 322 | 17 | 277 | 351 |
| 1992 | 5,841 | 104 | 5,625 | 1,839 | 2,528 | 841 | 88 | 58 | 314 | 19 | 281 | 365 |
| 1993 | 5,968 | 104 | 5,765 | 1,856 | 2,496 | 818 | 75 | 56 | 335 | 18 | 266 | 364 |
| 1994 | 6,216 | 103 | 6,025 | 1,868 | 2,560 | 826 | 54 | 52 | 334 | 18 | 285 | 352 |
| 1995 | 6,315 | 103 | 6,121 | 1,945 | 2,549 | 822 | 41 | 48 | 352 | 18 | 329 | 366 |
| 1996 | 6,576 | 106 | 6,230 | 1,956 | 2,554 | 809 | 39 | 40 | 398 | 20 | 355 | 375 |
| 1997 | 6,741 | 108 | 6,244 | 2,092 | 2,628 | 824 | 38 | 45 | 350 | 20 | 369 | 372 |
| 1998 | 6,792 | 108 | 6,291 | 2,175 | 2,727 | 848 | 69 | 48 | 326 | 21 | 387 | 413 |
| 1999 | 6,973 | 112 | 6,215 | 2,215 | 2,774 | 884 | 57 | 60 | 420 | 22 | 383 | 385 |
| 2000 | 7,225 | 117 | 6,197 | 2,203 | 2,842 | 903 | 52 | 67 | 474 | 22 | 381 | 343 |
| 2001 | 7,212 | 117 | 6,186 | 2,334 | 2,740 | 928 | 46 | 52 | 420 | 23 | 393 | 321 |
| 2002 | 7,757 | 117 | 6,632 | 2,347 | 2,757 | 970 | 50 | 45 | 433 | 23 | 427 | 338 |
| 2003 | 7,827 | 117 | 6,671 | 2,420 | 2,891 | 1,018 | 39 | 38 | 454 | 24 | 468 | 314 |
| 2004 | 8,514 | 117 | 7,256 | 2,528 | 2,898 | 1,057 | 25 | 37 | 419 | 26 | 498 | 291 |
| 2005 | 8,669 | 117 | 7,401 | 2,635 | 2,947 | 1,129 | 37 | 30 | 381 | 27 | 502 | 311 |
| 2006 | 8,863 | 117 | 7,581 | 2,757 | 3,065 | 1,196 | 46 | 42 | 426 | 27 | 500 | 339 |
| Total | 119,281 | | 107,934 | 36,845 | 45,907 | 15,636 | 917 | 822 | 6,486 | 362 | 6,371 | 5,921 |
| 1990-06 | 2,921 | | 1,722 | 905 | 638 | 296 | -24 | 1 | 97 | 11 | 230 | 16 |

Table 6 Cont: Waikato Region Genuine Progress Indicator, 1990–2006

| Year | Environmental Costs | | | | | | | | | GPI | GDP |
|---------|------------------------|------------------------|------------------------|----------------------------------|------------------------|---|------------------------|------------------------|------------------------|------------------------|------------------------|
| | Loss of Water Quality | Climate Change | Loss of Air Quality | Loss of Non-Renewables Resources | Land Degradation | Loss and Damage to Terrestrial Ecosystems | Loss of Wetlands | Loss of Soils | Noise Pollution | Total | Total |
| | \$ ₂₀₀₆ mil | \$ ₂₀₀₆ mil | \$ ₂₀₀₆ mil | \$ ₂₀₀₆ mil | \$ ₂₀₀₆ mil | \$ ₂₀₀₆ mil | \$ ₂₀₀₆ mil | \$ ₂₀₀₆ mil | \$ ₂₀₀₆ mil | \$ ₂₀₀₆ bil | \$ ₂₀₀₆ bil |
| 1990 | 181 | 204 | 22 | 9 | 41 | 70 | 139 | 194 | 36 | 9.1 | 9.3 |
| 1991 | 189 | 208 | 22 | 8 | 41 | 71 | 147 | 205 | 36 | 8.8 | 8.9 |
| 1992 | 187 | 261 | 23 | 24 | 41 | 64 | 156 | 217 | 37 | 8.7 | 9.2 |
| 1993 | 201 | 291 | 23 | 25 | 41 | 62 | 164 | 230 | 39 | 8.7 | 9.6 |
| 1994 | 212 | 297 | 23 | 20 | 41 | 54 | 173 | 243 | 41 | 9.1 | 10.2 |
| 1995 | 222 | 307 | 24 | 21 | 41 | 51 | 182 | 255 | 43 | 9.1 | 10.5 |
| 1996 | 220 | 312 | 24 | 20 | 41 | 53 | 191 | 268 | 44 | 9.1 | 10.7 |
| 1997 | 218 | 322 | 25 | 16 | 40 | 55 | 200 | 280 | 46 | 9.4 | 10.5 |
| 1998 | 220 | 274 | 26 | 9 | 39 | 54 | 210 | 294 | 47 | 9.6 | 10.3 |
| 1999 | 225 | 289 | 27 | 8 | 39 | 61 | 219 | 307 | 48 | 9.5 | 11.8 |
| 2000 | 239 | 293 | 25 | 13 | 38 | 63 | 229 | 321 | 49 | 9.5 | 11.4 |
| 2001 | 256 | 328 | 27 | 15 | 38 | 65 | 239 | 335 | 50 | 9.6 | 11.6 |
| 2002 | 280 | 340 | 28 | 17 | 37 | 93 | 249 | 349 | 54 | 9.9 | 12.5 |
| 2003 | 291 | 427 | 29 | 14 | 38 | 101 | 249 | 364 | 54 | 10.1 | 13.5 |
| 2004 | 299 | 463 | 33 | 16 | 39 | 109 | 249 | 378 | 55 | 10.8 | 12.8 |
| 2005 | 306 | 520 | 29 | 24 | 100 | 113 | 249 | 393 | 58 | 11.0 | 13.8 |
| 2006 | 291 | 538 | 34 | 23 | 104 | 120 | 249 | 408 | 58 | 11.4 | 13.4 |
| Total | 4,036 | 5,672 | 443 | 281 | 800 | 1,259 | 3,496 | 5,040 | 797 | 163.6 | 190.0 |
| 1990-06 | 110 | 334 | 12 | 15 | 63 | 50 | 110 | 215 | 22 | 2.3 | 4.1 |

Socio-Economic Components

This section is split into four parts:

- personal consumption adjusted for income inequality (or weighted personal consumption);
- public sector benefits resulting from non-defensive public consumption and services of public capital;
- labour market costs relating to unemployment, underemployment and overwork; and
- other socio-economic benefits and costs including the value of household and community work, private defensive expenditure on health, costs of commuting, and costs of crime.

Personal consumption

It is important to note that at any particular point in time, the total level of personal consumption in the Waikato Region (Figure 4) and the degree of income inequality (Figure 5) are the consequences of many interrelated and complex factors. Rather than considering the effects of each individual policy change and other events during the period in isolation, it is more helpful to review the overall context upon which the levels of consumption in each period were determined. This discussion is also of relevance when interpreting the results obtained in other socio-economic categories of the GPI.

Figure 4: Waikato Region Personal Consumption Expenditure, 1990–2006

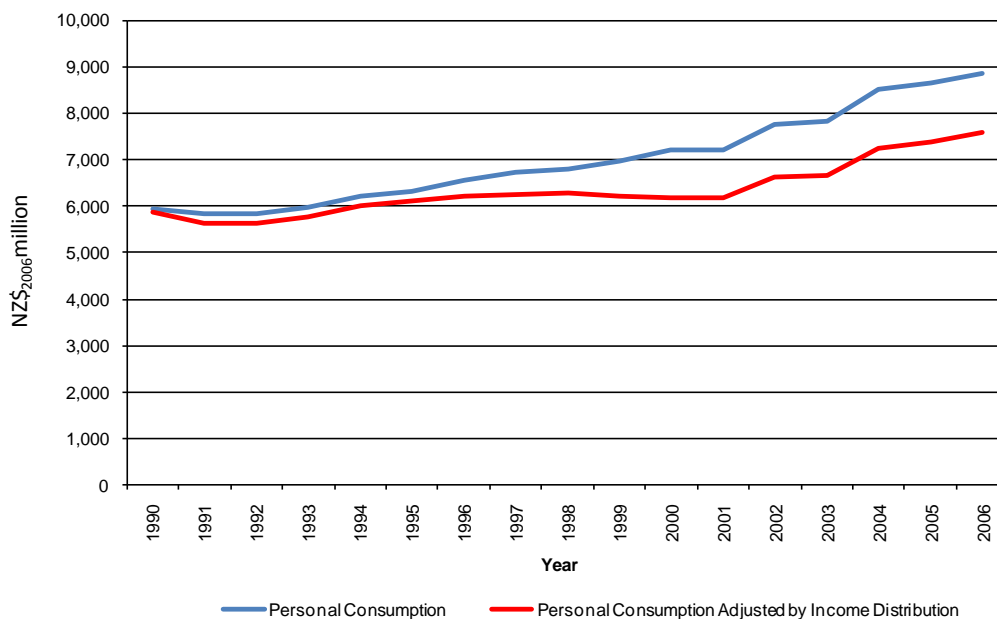
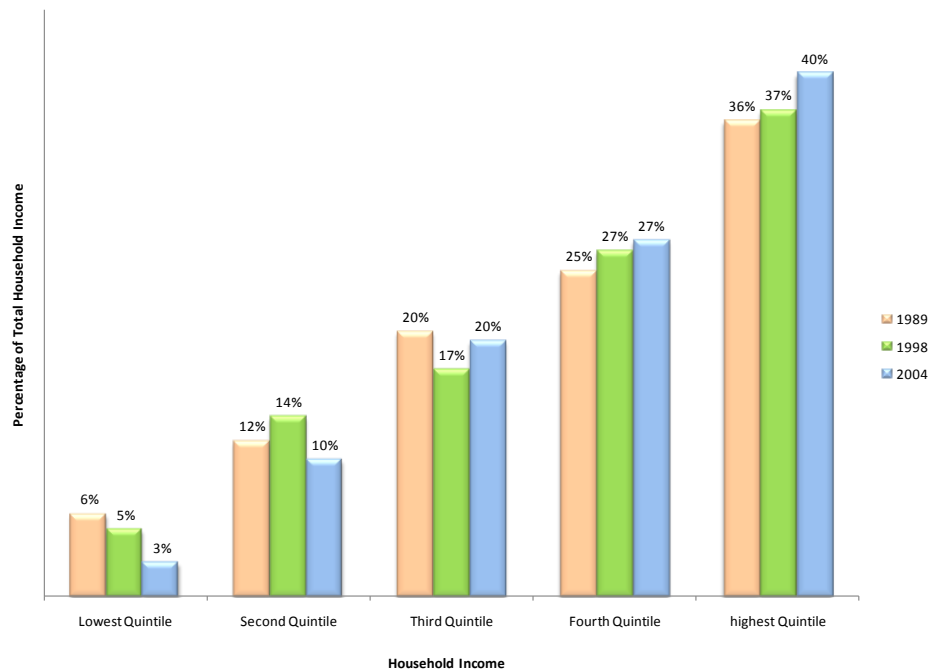


Figure 5: Waikato Region Household Income by Quintile

Total personal consumption expenditure is estimated to have increased from \$5,942 million in 1990 to \$8,863 billion in 2006, a rise of 49.2 percent or 2.5 percent per annum. This growth is 3.0 times more than the total population growth, at 16.6 percent over the same period. On a per capita basis, personal consumption expenditure rose steadily by 28.0 percent over the study period, an average annual growth rate of 1.6 percent.

The relatively static trend in personal consumption expenditure in the early 1990s was largely a result of a lag effect from the period of slow economic growth and recession following the central and local government reforms occurring between 1984 and 1991. The economic atmosphere at the beginning of the 1990s was characterised by further economic deregulation, privatisation of state owned enterprises (e.g. tele-communications, energy provision), public sector reform and removal of barriers to overseas investment (Evans *et al.*, 1996). These reforms included across-the-board benefit cuts, abolition of family benefits in favour of a more targeted family support, cuts in health subsidies and increases in medicine prescription charges, introduction of market rents for public housing, higher levies on petrol, alcohol and tobacco, introduction of ACC levies, and the introduction of tertiary student fees (Bell and Elliott, 1993).

Declining levels of unemployment, with corresponding higher levels of disposable income, were a strong influence on the levels of personal consumption during the rest of the study period, as was a generally strong level of business confidence. Both of these factors were to some degree negatively influenced during a downturn in tourist activity associated with the Asian crisis in 1998.

In the late 1990s other factors influencing personal consumption included international immigration and increased purchasing power associated with low levels of inflation and periods of appreciation in the New Zealand dollar. Globalisation, the process of deepening and changing links throughout the world economy, has also had profound impacts on the

consumption patterns of all New Zealand residents. Among the many dimensions of globalisation impacting on personal consumption during this period were the significant investments undertaken in shopping centres and malls by a mixture of New Zealand and overseas companies, closer economic relations (CER) with Australia, and the large growth in trade with China – particularly in respect to imports of low cost apparel, clothing and footwear.

On the negative side, the degree of income inequality in the Waikato Region also increased substantially over the study period, with a larger proportion of total household income going to the top quintile of households (refer also to OECD (2008) for the national result).

In 1989⁵, the top 20 percent of the households in the Waikato Region accounted for 36 percent of total regional income. By 2004, this situation had changed with the top 20 percent of households accounting for 40 percent of total regional income. By comparison, the bottom 20 percent of households in 2004 accounted for only 3 percent of total regional income.

The widening income gap has emerged partly from the effects of the central government economic reforms, but also from other influences which have not been felt evenly through the population. Importantly, there was a steady loss of jobs in the manufacturing sector nationally, and to a lesser extent the primary sector, and a marked shift towards more of a service economy. Thus, while there was a marked deterioration in the labour market position and employment opportunities for many of the lower skilled ‘working class’ during the period, there was, for example, also some increase in demand and remuneration levels for a relatively small number of jobs in the corporate, financial and producer services. Not surprisingly these shifts, in the composition of employment opportunities, had disparate implications for different social and geographic groups. Overall, the increasing income disparity during the period is evidence of rising social and economic polarisation. During the study period the same structural changes occurred in the Waikato Region economy.

Once personal consumption is adjusted for income inequality (referred to as weighted personal consumption) a much lower growth rate of 29.4 percent over the study period is recorded; from an estimated \$5,859 million in 1990 to \$7,581 million in 2006. This equates to 1.6 percent annual average growth over the study period. By comparison, national personal consumption expenditure adjusted for income inequality grew from \$59.5 billion in 1990 to \$86.4 billion in 2006; or 2.4 percent annual average over the period.

Public consumption (non-defensive) and services of public capital

The governmental fiscal, monetary and exchange rate reforms of the late 1980s and early 1990s not only affected personal consumption expenditure, but also to some degree, non-defensive public consumption (Figure 6) and expenditure on government services of public capital (Figure 7).

In particular, a hiatus in local and central government expenditure followed the 1987 and 1991 share market crashes. This was accentuated in the case of local government consumption expenditure by the local government reform of the late 1980s that resulted in the

⁵ Income by quintile data has been sourced from the Household Economic Survey (HES), Statistics New Zealand. Annualised data for the Waikato Region was unavailable and 1989 was the closest available data year to the beginning of the GPI study period (1990).

amalgamation of numerous borough and county councils within the region into 12 territorial local authorities⁶ and one regional council (Environment Waikato).

Figure 6: Waikato Region Public Consumption (Non-Defensive), 1990-2006

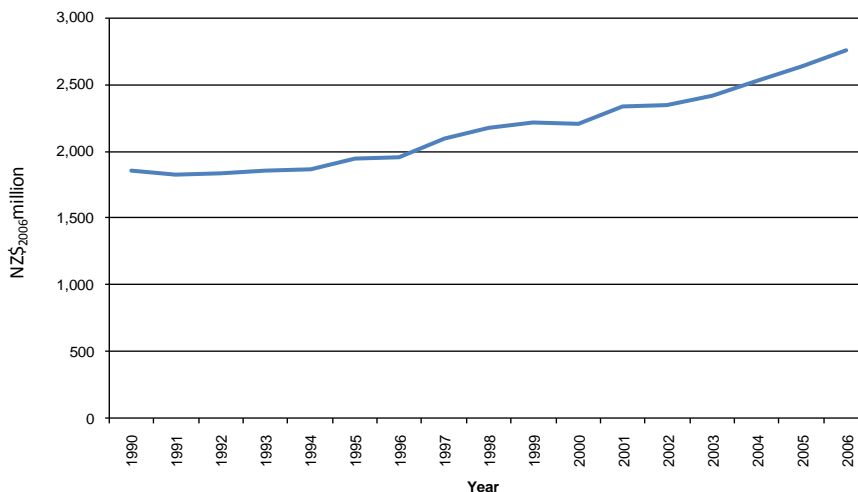
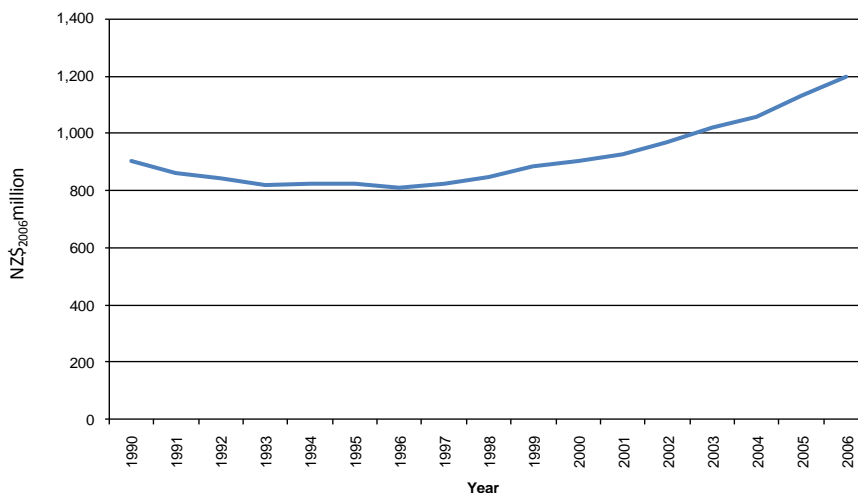


Figure 7: Waikato Region Services of Public Capital, 1990-2006



Prior to 1994, non-defensive public consumption expenditure is estimated to have increased by around only \$16 million, or an annual average rate of 0.2 percent. The economic reforms of 1984 to 1991 were marked by the introduction of numerous measures to curb growth in public consumption. The public sector itself underwent drastic restructuring with the idea of promoting efficiency and productivity. Other reforms affecting public consumption included increases in tertiary student fees, increases in medicine prescription charges and restructuring

⁶ Four of the territorial authorities (Franklin, Rotorua, Waitomo and Taupo) have parts of their area included in the Waikato Region.

of public housing and health funding (Statistics New Zealand, 1993; Bell and Elliott, 1993; Evans *et al.*, 1996).

For the rest of the study period, the level of non-defensive public consumption grew significantly faster (1995-2006), estimated at an annual average rate of 3.2 percent (compared with 3.0 percent nationally). A more buoyant national economy entailing greater public revenues was one of the many influences during this period. It can also be noted that despite the earlier government reforms of the health sector, health spending continued to increase substantially, both in real and per capita terms. Another major contribution to public consumption is expenditure on education. During the study period central government expenditure on education grew both in absolute terms and as a percentage of total government expenses.

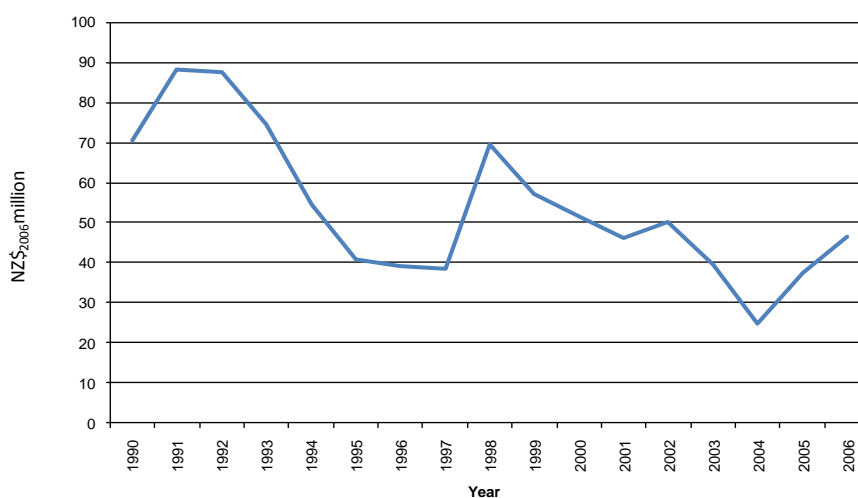
Consistent with the numerous measures put in place to curb growth in government expenditure, the early years of the study period saw a slight drop in the level of services derived from public capital despite population growth. Over time, a number of government owned assets, for example New Zealand Rail, were sold to help meet fiscal deficits (Statistics New Zealand, 1990, 1991, 1995). Partly as a result of these sales, services derived from public capital declined by 2.2 percent per annum in Waikato Region (compared with 1.9 percent per annum nationally), from \$901 million in 1990 to \$826 million in 1994. From the mid 1990s however the services of public capital rose steadily from an estimated value of \$822 million in 1995 to \$1,196 million in 2006, driven by population growth. This represents an annual average increase of 3.5 percent. By comparison, national level expenditure on services of public capital has grown from \$8.5 billion in 1995 to \$12.7 billion in 2006; or an annual average increase of 3.7 percent.

Labour market costs: unemployment, underemployment and overwork

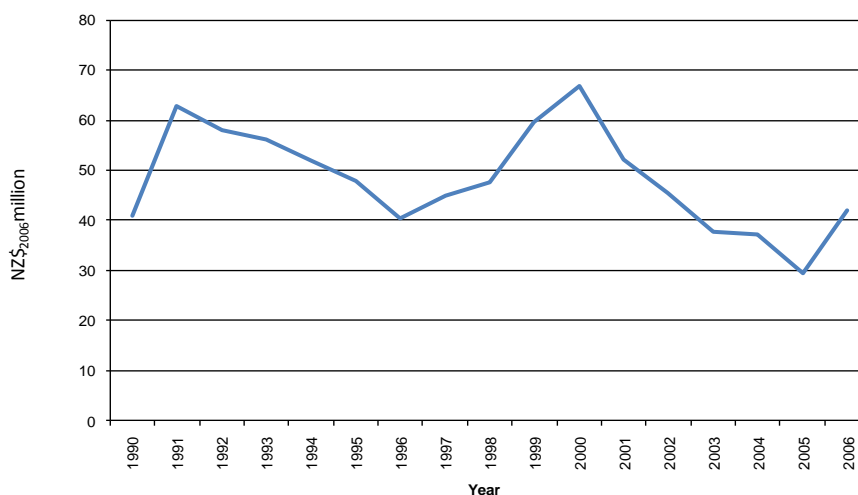
The labour market experienced enormous change throughout the time of this study (Figures 8, 9 and 10). Key reasons for the changes observed in these categories include the period of intense restructuring during the national level economic reforms, followed by a subsequent period of economic recovery.

The major economic reforms of the 1980s and 1990s had some far-reaching consequences for New Zealand's labour market. Numerous policies were implemented in the 1980s which focused upon deregulating the private sector and exposing the domestic economy to market forces. During the 1990s, further reforms were implemented including across-the-board benefit cuts, and the enactment of the Employment Contracts Act 1991. Following the latter measure, New Zealand saw the abolishment of compulsory trade unionism, sharp declines in union memberships, and a strong shift from collective to individual employer-employee agreements (Britton *et al.*, 1992).

The lagged impacts from policies and economic conditions in the reform period saw the number of unemployed in the Waikato Region rise sharply during the early period, reaching a peak in 1991, where the official number of unemployed in the Waikato Region was recorded as 17,700 people (Statistics New Zealand, 2009). This is clearly shown in Figure 8 where the cost of unemployment moved from \$70 million in 1990 to \$88 million in 1991; or an increase of 25.2 percent. By comparison the national cost of unemployment moved from \$643 million in 1990 to \$847 million in 1991 (31.7 percent).

Figure 8: Waikato Region Cost of Unemployment, 1990-2006

Similarly, the cost of underemployment also rose sharply by 53.0 percent from \$41 million in 1990 to \$63 million in 1991 (Figure 9). One of the reasons for the growth in underemployment was the rapid growth in part-time employment, particularly in service sector industries such as retail trade, restaurants and hotels. The number of people in other forms of contingent employment, i.e., casual, contract, temporary and intermittent employment, also increased significantly during the period (Le Heron and Pawson, 1996).

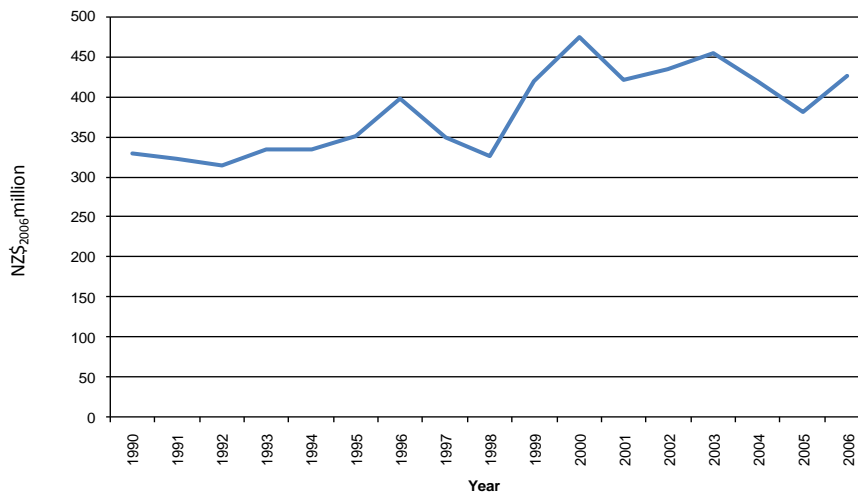
Figure 9: Waikato Region Cost of Underemployment, 1990-2006

The data on costs of unemployment and underemployment indicate a period of recovery in the regional economy between 1992 and 1996, where costs reduced by 55.2 percent and 30.4 percent respectively. The cost of unemployment in Waikato Region is estimated to have fallen from \$88 million in 1992 to \$39 million in 1996. The impacts of the Employment Contract Act and other reforms continued to be observed including a decline in real wages, increased levels of productivity, and a reduction in the cost of hiring.

Following the falls in unemployment and underemployment costs during 1992–1996 in the Waikato Region, there was another period of cost increases in both components, particularly in underemployment which continued until the year 2000. A notable event during this period was the Asian economic crisis of 1998. The 2000 peak in the cost of underemployment in the Waikato Region is estimated at \$67 million. The second key phase of recovery for the study period lasted until 2005, reaching a period low of \$30 million, only to rise again to \$42 million as at December 2006.

The cost of overwork (Figure 10) is estimated to have grown gradually at an annual average rate of 0.2 percent for the first six years of the study period to an intermediate peak, from approximately \$329 million in 1990 to \$398 million in 1996. This trend is set against a backdrop of strong growth in part-time employment, coupled with declining working conditions and rates of pay in depressed sectors, particularly manufacturing (Britton *et al.*, 1992; Le Heron and Pawson, 1996). Such conditions are likely to have encouraged workers to take on additional hours in order to maintain previous take-home levels, as evidenced by the substantial rise in multiple job holders during this period (Statistics New Zealand, 1993). At the same time, strong growth was experienced nationally in service sector employment, with associated skill shortages in areas such as information technology, telecommunications and finance (Le Heron and Pawson, 1996). These trends are reflected in the national GPI study where the cost of overwork grew from \$2.3 billion in 1990 to \$3.3 billion in 1996.

Figure 10: Waikato Region Cost of Overwork, 1990-2006

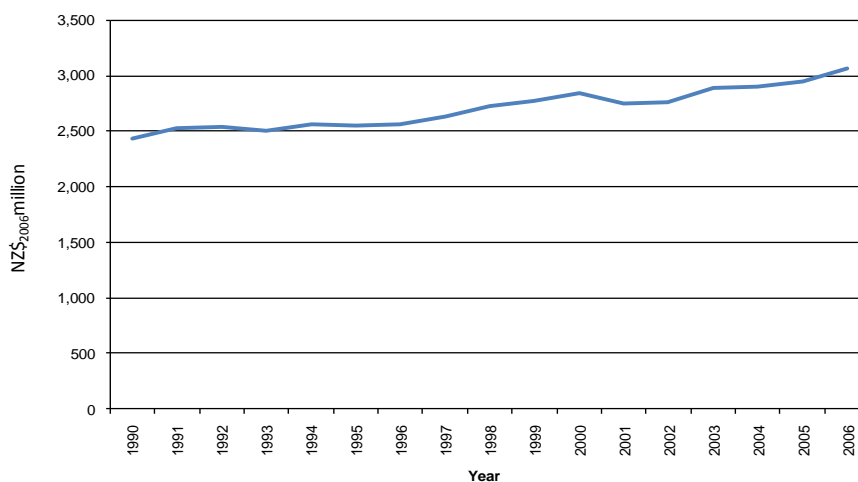


The cost of overwork in the Waikato Region has been relatively volatile over the rest of the study period, although trending upwards compared to a smoother growth profile nationally. The annual average growth rate is estimated to be 1.9 percent from 1996 to 2006 or 1.6 percent per annum for the whole period. There appears to be some negative correlation between the estimated cost of overwork for the post reform period and the estimated costs of unemployment for the same period. Additionally, there seems to have been some shift towards more flexible working conditions during this period (Career Services, 2006).

Other socio-economic components

The trends over time for the remaining socio-economic categories namely, household and community work, private defensive expenditure on health, cost of commuting and cost of crime are presented respectively in Figures 11, 13, 14 and 15. While the matters addressed in these categories vary quite substantially, they are all related to various societal factors and influences on human welfare.

Figure 11: Waikato Region Value of Household and Community Work, 1990-2006

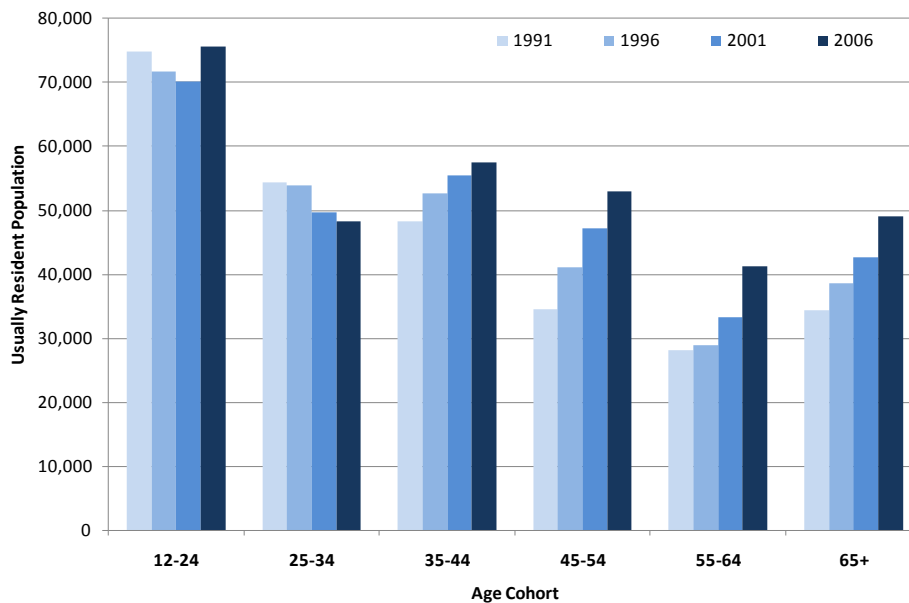


The value of household and community work (Figure 11) generally increased over time, with an annual average growth rate of 1.5 percent. There was however a temporary and minor slump in the total value of these activities around the period 2001–2002. This corresponds with a fall in the real wage rate.

Acceleration in the rate of population growth was an important factor contributing towards growth in the value of household and community work, especially for the latter years of the period. The ageing of the Waikato Regional population, in particular an increase in the number of retired persons who spend time on community and household activities, is also considered to have had a noticeable effect (Figure 12).

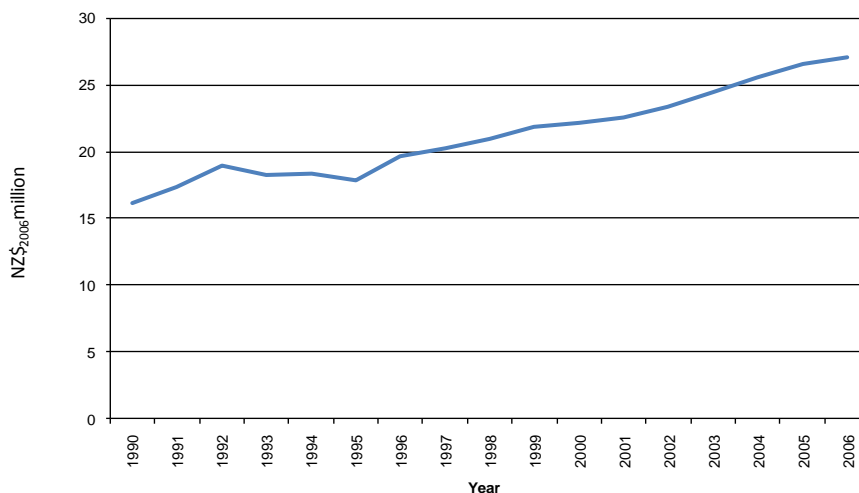
Overall, the value of household and community work in the Waikato Region rose from \$2,427 million in 1990 to \$3,065 million in 2006. This represents 26.3 percent growth over the study period. By comparison, the value of household and community work for the nation rose from \$23.9 billion in 1990 to \$31.7 billion in 2006, a rise of 32.6 percent for the period.

Figure 12: Waikato Region Population by Age Cohort, 1991, 1996, 2001 and 2006



Private defensive expenditure on health (Figure 13) continued to increase during the entire period from an estimated value of \$16 million in 1990 to \$27 billion in 2006, or a rise of 67.4 percent. These trends are also reflective of the national situation where private defensive expenditure on health increased from \$192 million in 1990 to \$322 million in 2006 (also 67.4 percent).

Figure 13: Waikato Region Private Defensive Expenditure on Health, 1990-2006

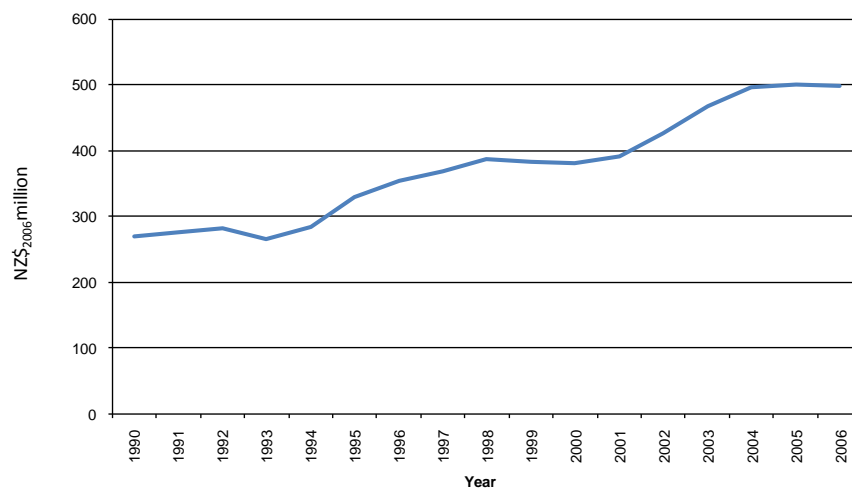


As previously described, the economic reform period was characterised by the introduction of numerous measures to help curb growth in government expenditure. In particular, there were a number of reforms implemented in the early 1990s with respect to the health sector. These

included reductions in health subsidies, increases in prescription charges and doctor fees, and the implementation of separate funding and providers for the public health system (Statistics New Zealand 1993, 1999; Evans *et al.*, 1996). In addition, an ageing population, as well as technology advances and a higher demand for alternative and ancillary clinical health services (e.g. physiotherapy), were important factors leading to additional private health expenditure nationwide.

From 1990 to 1993, the cost of commuting remained relatively static, with upper and lower values of \$271 million and \$266 million, respectively (Figure 14). This represents a reduction of 1.9 percent over that period. By comparison the national equivalents for the same years were \$2.10 billion and \$2.05 billion (-2.5 percent). Both regionally and nationally, this was followed by a period of steady growth in the cost of commuting to a peak of \$502 million in 2005.

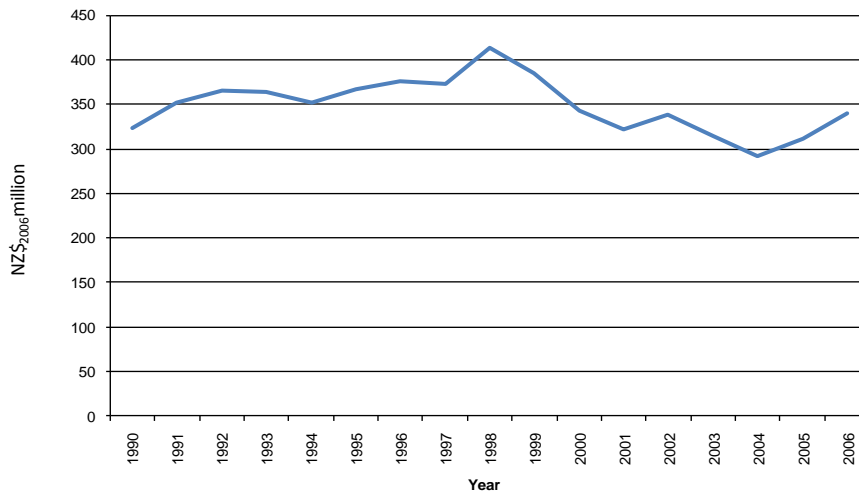
Figure 14: Waikato Region Cost of Commuting, 1990-2006



There are a number of factors influencing the steady increase in commuting costs to 2006. From 1993 and leading up to 1998, the labour market recovery influenced the regional cost of commuting, shown as a steady increase at an average growth rate of 7.8 percent per annum. Longer term, the emergence of increasingly dissimilar urban environments and communities, coupled with a more specialised and pluralistic labour market (Le Heron and Pawson, 1996) have had an effect. As has the privatisation of public transport, and dismantling of the import licensing regime for motor vehicles and tariff reductions (NZIER, 1998). The real price of motor vehicles fell significantly over the period as the number of imported motor vehicles, particularly second-hand motor vehicles, increased dramatically – effectively putting more cars on the roads and increasing traffic congestion.

During the entire study period, the total estimated cost of crime has fluctuated but the start and end points remain similar at \$322 million in 1990 and \$339 million in 1996 (Figure 15). The Region's cost of crime peaked in 1998 at \$413 million and reached a period low in 2004 at \$291 million. There is a strong correlation between the region's cost of unemployment and the cost of crime, particularly in the period 1998 to 2006.

Figure 15: Waikato Region Cost of Crime, 1990-2006



Environmental Components

This section is split into three parts:

- a short discussion on why natural capital adjustments must be incorporated within the GPI;
- a discussion on why ozone depletion, which is often in other GPI studies, has been excluded from the Waikato Region study; and
- an analysis of the key trends and patterns evident each environmental component valued in the Waikato Region GPI, this includes: loss and damage to terrestrial ecosystems, loss of wetlands, loss of soils, loss of air quality, land degradation, climate change, loss of water quality, loss of non-renewable resources, and noise pollution.

Natural capital adjustments

Just as the goods and services that are measured to provide an approximate value for GDP are generated from the store of man-made capital aggregated over time, the environment provides goods and services that we benefit from as a result of the stock of natural capital.

New Zealanders have benefited from the plentiful natural capital in this country, but as has happened elsewhere in the world, a point has been reached where natural capital resources have become increasingly scarce. This scarcity is a combination of reduced natural capital and increased demand for the services provided by that capital. For many of the environmental components valued in this report the losses incurred are a result of past decisions.

At some point in time, the marginal benefit gained from depleting (drawing down on) natural capital became less than the margin cost incurred as a result of the loss of ecosystem services provided by that natural capital. This cross-over has been described by Daly (2005) as a transition from an 'empty' world to a 'full' world. Evidence of this transition can be seen in such situations as:

- the inability of the environment to assimilate the wastes produced by human activity, resulting in water pollution and the build up of greenhouse gases in the atmosphere;
- the lack of native timber available for use as it has been harvested at a rate exceeding natural regeneration; and
- the replacement of ecosystem services such as flood and storm protection, previously provided by wetlands, by built more vulnerable infrastructure.

It is difficult, if not impossible, to determine when these cross-overs occurred. The national GPI used 1970 as this cross-over point, and for consistency 1970 has also been used here. The use of 1970 can be considered to provide conservative estimates of costs.

Exclusions – Ozone Depletion

Most GPIs include the cost of ozone depletion because it represents a long-term environmental impact of economic activity with consequences for biological and human health. Reduced ozone in the atmosphere has been shown to be the main cause of increased UV (McKenzie, 2007). Because of its southern location, New Zealand is vulnerable to increased solar ultraviolet radiation. The hole in the ozone layer currently covers a substantial area over Antarctica, and modelling studies by the National Institute of Water and Atmospheric Research have confirmed that the Antarctic ozone hole is a major contributor to the lower summer ozone levels measured over New Zealand (Ajtić and Connor, 2004). Health risks from ultraviolet radiation in New Zealand are accentuated by the proportion of the population with pale skin, relatively low air pollution levels, plentiful sunlight and an outdoors-oriented lifestyle (Armstrong, 1994 cited in Woodward *et al.*, 2001).

While it is known that ozone depletion has an impact on the well-being of New Zealanders (death from Melanoma cancer alone was estimated at more than \$200m in 2006), the causes are mostly generated off-shore and the GPI *only measures the impact of economic activity within a country*. In 1986, prior to restrictions being introduced under the Montreal Protocol (UNEP, 1987), New Zealand's total emissions of ozone-depleting gases (mostly Chlorofluorocarbons ()) was 2,100 tonnes, or less than 0.002 percent of global emissions (McCulloch *et al.*, 1994). CFC consumption was phased out by 1 January 1996 and Hydrochlorofluorocarbons (HCFC) consumption has reduced from 726.4 metric tonnes in 1995 to 345.8 in 2006 metric tonnes a decrease of 52% (Minister of Commerce and Minister for the Environment, 2009). Increases in methyl bromide imports during this period have reduced the ozone benefits but not negated them. If the total cost of ozone depletion was measured in terms of health effects in New Zealand (\$200m in 2006), emissions generated in New Zealand would be responsible for an environmental cost of just \$0.4m in 2006.

Therefore inclusion of the costs of ozone depletion in the Waikato Region GPI is too small to justify.

Results for the Waikato Region GPI environmental components are presented below.

Loss and damage to terrestrial ecosystems

This category is divided into two parts: loss of indigenous forest ecosystems and cost of pests and weeds.

Loss of indigenous forest/scrub ecosystems

Loss of indigenous forest and native scrubland represents a long-term loss of a range of ecosystem services, including: habitat for native birds, endemic biodiversity,

landscape amenity, passive value (existence, bequeath, option)⁷, climate regulation and recreation value. As the ecosystem services are lost not just in the year of the clearance but for every subsequent year costs in the GPI are aggregated from 1970 onwards.

Indigenous timber milling and conversion of forest/scrub to agriculture was common place in the Waikato Region in the early 1970's. Public pressure in the late 1970s resulted in legislation changes which reduced milling in State forests towards the end of the decade and ultimately halted it altogether. Land Development Encouragement Loans and good prices for native timber continued to encourage milling and clearing on private lands till the early 1980s. Actual data for measuring the loss of indigenous forest and native scrub is not available for the Waikato Region for the time period of the study. Estimates of the number of hectares lost each year (supported by qualitative data where possible) have therefore been made. The per hectare ecosystem services values are as per Patterson and Cole (1999).

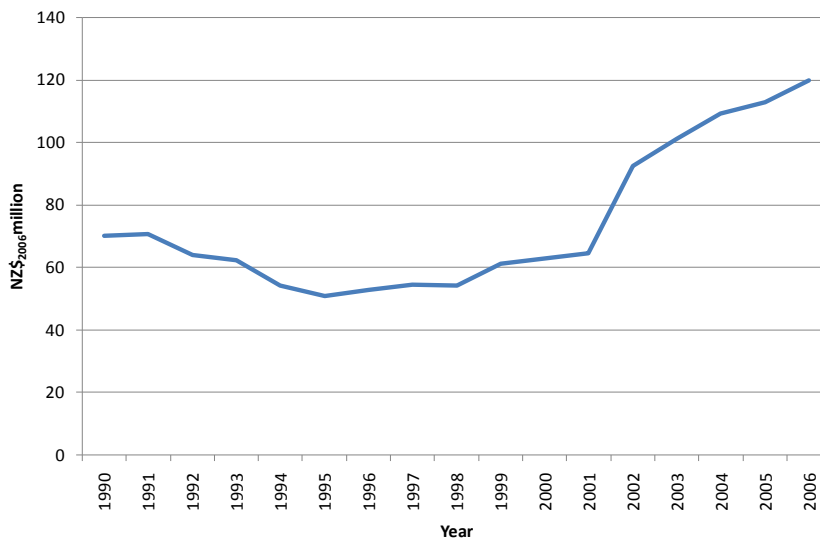
Cost of pests and weeds

Economic activity, including settlement, in New Zealand has resulted in the introduction of a large number of species that are destroying native flora and fauna. Significant defensive costs are paid annually not to eradicate pests and weeds, but to keep them under control. The annual cost of this expense is money that could be spent on providing services to improve the well-being of people in the Waikato Region, if keeping pests and weeds at bay was not necessary. To determine the real cost of progress in the Waikato Region the GPI therefore deducts this expenditure.

The Waikato Region's defensive expenditure has been calculated from private, local and central government efforts to stop the spread of weeds and pests. Costs figures have been derived from Regional Pest Management Strategies and central government expenditure. Data for 1991-1998 came from Hackwell and Bertram (1999). The Waikato Region's estimated expenditure on management of animal and plant pests for the years 1995 and 1996 was very low and the proportion of central government expenditure is also low. For the period 1990–2006 the total cost of loss and damage to terrestrial ecosystems has been estimated at \$1,259 million (Figure 16). The annual average growth rate from 1990–2006 is 3.4 percent.

⁷ Passive value is value not related to the actual use of biodiversity and is usually made up of (i) existence value which is the amount an individual is willing to pay to preserve biodiversity though they may never want to use that biodiversity (ii) bequeath value which is the willingness to pay to ensure future generations have the benefit of the biodiversity (iii) option value which is the willingness to pay to preserve biodiversity for some unforeseen future use.

Figure 16: Waikato Region Loss and Damage to Terrestrial Ecosystem, 1990-2006



Loss of wetlands

The Waikato Region has three of the six wetlands in New Zealand of sufficient international importance to be listed as Ramsar sites. The region once had an extensive wetland cover. It is estimated that there were 356,516 ha of wetlands in the Waikato Region prior to settlement based on soil type (Ausseil *et al.*, 2008). There are now just 28,226 ha or 7.9 percent remaining (Ausseil *et al.*, 2008). The vast majority of wetlands have been drained or modified for coastal land reclamation, farmland, flood control, road construction and the creation of hydro-electricity reservoirs.

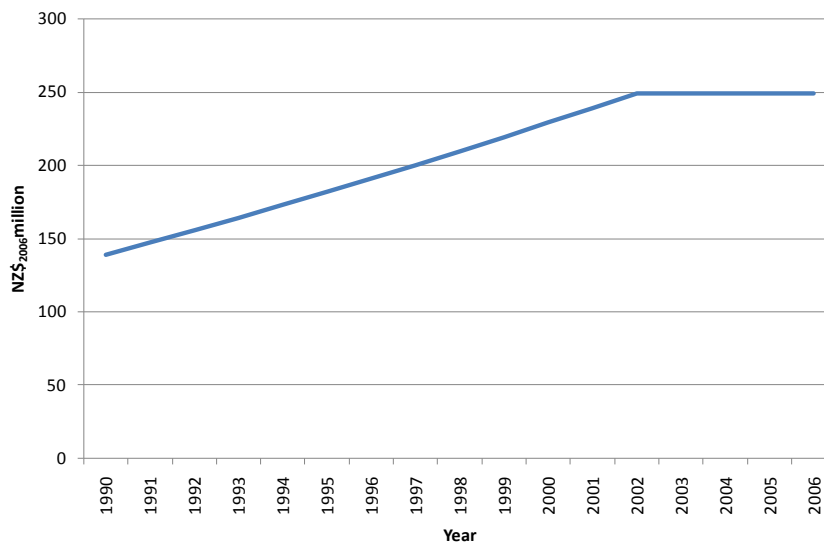
Most of the loss of wetlands occurred between 1920 and 1980, but loss was still occurring up to 1997 (Ministry for the Environment, 1997, p.7.37). The end of government subsidies for flood control and drainage schemes in the mid-1980s stopped wholesale drainage and infilling. However, even during the 1990’s, conversions were taking place associated with dairying and urbanisation.

The wetlands remaining in the region are degraded as a result of sediment and nutrient inputs from the surrounding catchment, invasive weed, livestock and pests such as koi carp and catfish. Pest fish species are prolific and difficult to control (Department of Conservation, n.d.).

In their GPI calculation for the USA, Anielski and Rowe (1999) included all wetlands lost from the colonial period onward. This amounted to \$_{US}349.9 billion, and is justified on the basis that the loss of ecosystem services when wetlands are converted to other uses is permanent, and therefore the value needs to be accounted for in perpetuity. Only the hectares of wetlands lost since 1970 has been valued for the Waikato GPI, therefore the valuation is very conservative. We have assumed that 1970 levels were reasonably sustainable – from the viewpoint that flood protection, habitat, recreation, water retention, etc., services were adequately provided by remaining wetlands. Wetland loss from 1970 onwards is aggregated as the ecosystem services lost from a hectare of wetlands is an ongoing cost each year.

For the period 1990–2006 the total cost of loss and damage to wetlands has been estimated at \$3,496 million (Figure 17). The annual average growth rate from 1990–2006 is 3.7 percent.

Figure 17: Waikato Region Wetland Loss, 1990-2006



Loss of soils

Agricultural soils are built up over hundreds of years, supporting terrestrial biodiversity as well as providing humans and other species with food. As such, they are a valuable natural capital asset that must be maintained. Soils are lost in the Waikato Region as a result of expansion of built-up areas and erosion. As with the loss of indigenous forest ecosystems, the flows of services provided by soils are lost for every subsequent year after the loss – not just in the year of loss. Soil loss has therefore been estimated from 1970 onward.

Loss of soils in the Waikato has been predominantly land suited to arable use (Class I-IV as assessed in the Land Use Capability (LUC) classification in the New Zealand Land Resource Inventory (NZLRI, 1975-1996). Only land change from rural to subdivided land in Classes I-IV has been included as a loss of natural capital as this is the valuable agricultural land. Based on land use change over the 15 years, 1991 to 2006, the rate of loss of arable land is increasing.

Soil loss from expansion of urban areas has been measured using estimates for the annual increase (hectares) in urban area in the Waikato Region. To calculate the per hectare cost of this loss a study to quantify the economic value of ecosystem services associated with highly modified arable landscapes in Canterbury, New Zealand by Sandhu *et al.* (2007) was used. That study estimated the total economic value to be between \$₂₀₀₅1792/ha/yr and \$₂₀₀₅20,254/ha/yr for conventional farmland. We have used the average of these bounds, which is \$₂₀₀₅11,023/ha/yr or \$₂₀₀₆11,290/ha/yr. The ecosystem services valued included: biological control of pests, soil formation, mineralisation of plant nutrients, pollination, services provided by shelter belts and

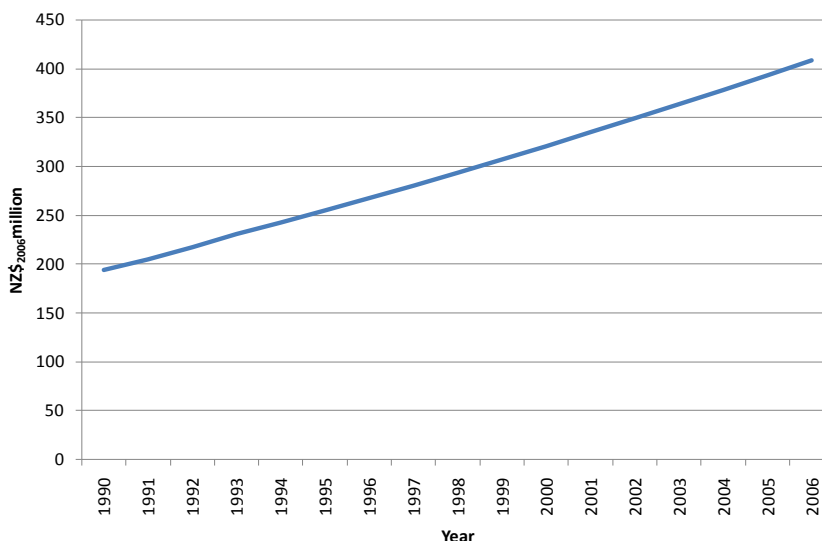
hedges, hydrological flows, aesthetics, carbon accumulation, nitrogen fixation, soil fertility, food, and raw materials (Sandhu *et al.*, 2007).

Erosion causes permanent long-term loss of productive capacity as well as external effects not captured by market values, such as impacts on landscape quality, siltation of dams and rivers, reduced biodiversity, and reduced water quality. Erosion costs have been calculated based on the number of tonnes of sediment lost from land in agricultural use as estimated by the soil erosion model developed by Landcare Research (Dymond and Betts, 2007). The model covers sedimentation of waterways and soil transfer to the marine environment. Soil loss from forestry is included, but no account is taken of the extra soil loss in conversion from forestry to pasture. The model does not take into account wind erosion, but this is small by volume, compared to water erosion (Dymond, Landcare Research, pers. comm., 2007). The per tonne cost of erosion is derived from an economic evaluation of the cost of erosion and sedimentation in New Zealand in 1998 (Krausse *et al.*, 2001).

The total area of farmland in the Waikato Region was obtained from Statistics New Zealand (Infos AGRA.SGAJRC) for 1990–1996 and 2002–2006. Years in between have been estimated. The percentage of farmland in grassland was assumed to be 70 percent based on the average of the 4 years of data from Agricultural Production Censuses and Surveys (Statistics NZ, various years). In the valuation the following impacts of agriculture-induced erosion have been allowed for: (i) permanent loss to future agricultural output, (ii) the downstream costs imposed on other sectors, and (iii) the cost of defensive expenditure undertaken to prevent further erosion.

For the period 1990–2006, the total cost of loss of soils has been estimated at \$5,040 million (Figure 18). The annual average growth rate from 1990–2006 is 4.8 percent.

Figure 18: Waikato Region Loss of Soils, 1990-2006



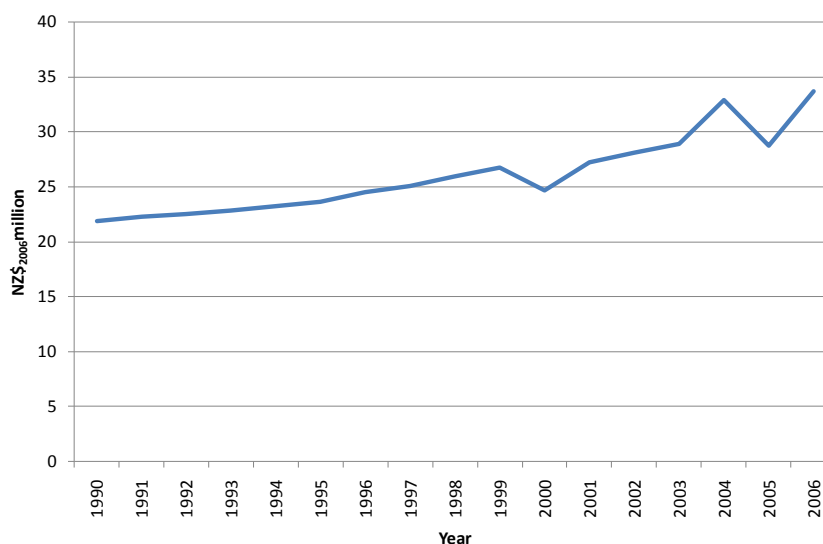
Loss of air quality

Urban air pollution causes both premature deaths and lesser health effects that lead to days of restricted activity. The cost of air pollution for the Waikato Region between 1990 and 2006 has been based on the number of premature deaths and Restricted-Activity-Days (RADs) per year attributable to air pollution in New Zealand, as calculated by the HAPINZ study completed in 2007 for the Health Research Council of New Zealand (Fisher *et al.*, 2007).

Fine Particulate Matter (PM₁₀) measures have been used to calculate the cost of air pollution as is done elsewhere (Künzli *et al.* 2000; Fisher *et al.*, 2007). PM₁₀ data were available for eight urban areas starting in various years – the earliest being 1998 – and running till 2008 (EW, pers. comm., 26 August 2009). The data for each of these towns was extrapolated back to 1990 using a simple linear regression to give a complete time-series for 1990–2008 for each town. The urban area with the longest data series was Hamilton, which – mostly because it has the largest population in the Waikato Region – also had the highest expected number of deaths from air pollution in the region. Mortality and RAD rates per unit of PM₁₀ per capita were back-calculated from the results given by Fisher *et al.* (2007) for each of the five urban areas with more than three years of data (Hamilton, Taupo, Tokoroa, Te Kuiti, Matamata). These rates were applied to time-series of PM₁₀ and population from 1990–2008 to obtain estimated deaths and restricted-activity days for the region.

Using values of \$308,000 per death and \$60 per restricted-activity day, the total cost of air pollution for the Waikato Region for the period 1990–2006 has been estimated as \$443 million (Figure 19). The annual average growth rate from 1990–2006 is 2.7 percent.

Figure 19: Waikato Region Loss of Air Quality, 1990-2006

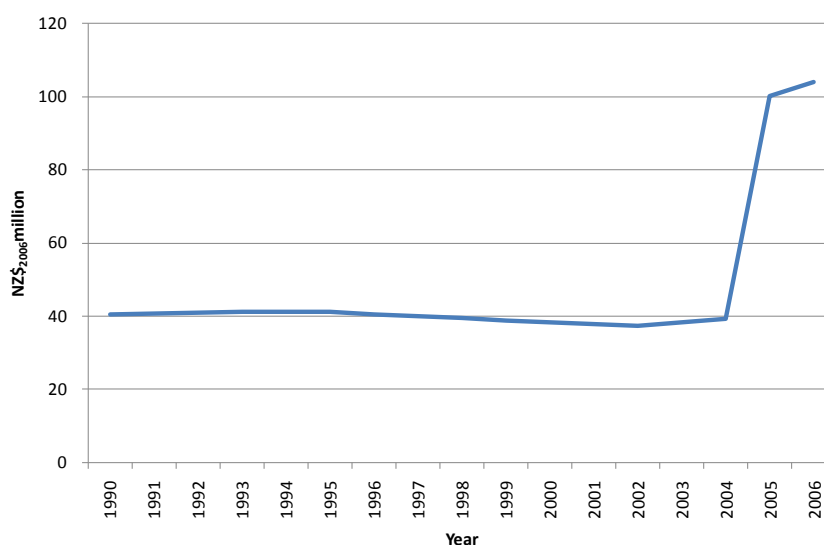


Cost of land degradation

The real costs associated with solid waste and contaminant generation from both households and businesses as a result of economic activity are often not experienced until a later period in time. The GPI allocates solid waste and contamination of land to the period of time the pollution was most likely generated. Waste to landfills and the estimated cost of cleaning up contaminated sites in New Zealand are used as proxies for this cost. Providing pesticides, herbicides and timber treatment to the forestry, farming and horticulture sectors has left large clean-up costs as well as damage to the health of people and the environment. An unwanted legacy has been left behind not only by businesses, such as old gasworks, petrol stations and drycleaners, but also by households. While standards have improved since the implementation of the Resource Management Act (1991) many municipal solid waste sites were not managed to a high standard, and as a result pollution from these sites still remains.

As no annual data is available for the Waikato Region the annual average waste per head of population for New Zealand was used (Ministry for the Environment, 2008) and multiplied by the Waikato Region population statistic to get annual figures. Since 2005/06 the Auckland region has been disposing of solid waste in the Hampton Downs landfill which is in the Waikato Region. This amount is added to the total as the Waikato Region benefits from this economic activity so therefore assumes responsibility for the environmental impact. The Waikato GPI study used the cost of disposing of a tonne of waste at the Kate Valley regional landfill (\$₂₀₀₅125 per tonne or \$₂₀₀₆128 per tonne) because full cost accounting, which covers management, administration and organisational overheads, pollution control, planning and resource consents, land costs, development costs, operational costs, as well as closure and aftercare costs (Parliamentary Commissioner for the Environment, 2006) was used extensively to establish costs when the landfill was proposed (Centre for Advanced Engineering, 2005).

Figure 20: Waikato Region Cost of Land Degradation, 1990-2006



A 1992 study that calculated the cost of cleaning up high- and moderate/ slight-risk sites in the Waikato Region at \$₁₉₉₂119 million (Worley Consultants Limited, 1992) was used to proportion over time the costs associated with contaminated sites.

For the period 1990–2006 the total cost of land degradation (Figure 20) has been estimated at \$800 million. The annual average growth rate from 1990–2006 is 6.1 percent.

Cost of climate change

Increased fossil fuel use, industrial activity, deforestation and farming have led to a global rise in carbon dioxide in the atmosphere. As a result of the greater concentration of greenhouse gases (GHGs) in the atmosphere, the Earth has begun to warm up and its climate is changing.

The greenhouse gas emissions for the Waikato Region have been estimated for each year 1990–2006 based on data in the New Zealand Greenhouse Gas Inventory 1990–2006 (Ministry for the Environment, 2008), MED’s Energy Greenhouse Gas reports (MED, 2008), EECA’s Energy database (EECA, 2004), and other sources.

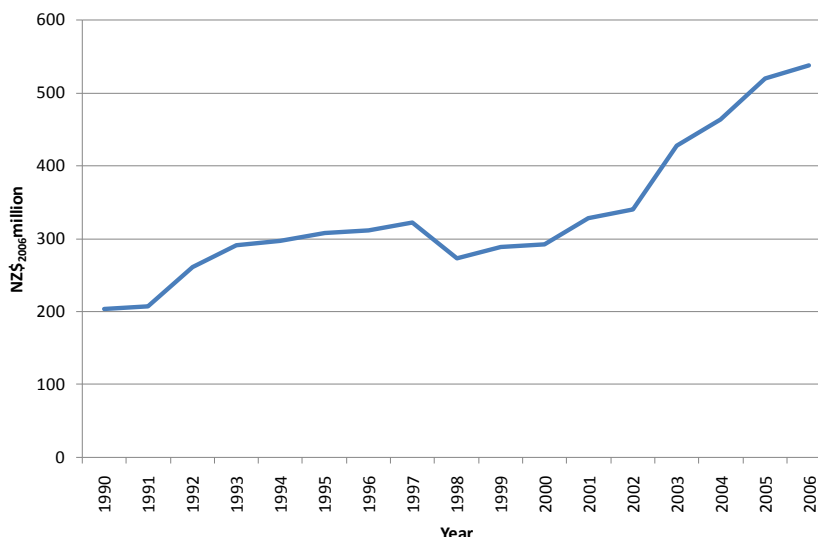
The valuation of environmental damage from CO₂ emissions is calculated using the marginal social cost per tonne of CO₂-e emitted into the atmosphere -referred to as the social cost of carbon (SCC). This is a measure of the full global cost today of an incremental unit of carbon dioxide (or equivalent amount of other greenhouse gases) emitted now, summing the full global cost of the damage it imposes over the whole of its time in the atmosphere (Price *et al.*, 2007). The SCC reflects “the total (discounted) value of all future damage arising from that tonne of emissions” (Neumayer, 2000, p.354). Greenhouse gas emissions are therefore not accumulated over time.

The value of \$_{NZ2006}50 per tonne of carbon dioxide was used based on the Stern Review SCC of \$_{US2000}30 per tonne for a 450ppm CO₂-e stabilisation goal (Stern, 2006, p.304). The average \$_{US}/\$_{NZ} exchange rate from 1990 to 2006 was \$_{NZ}0.58 to \$_{US}1.00, which equates to \$_{NZ}51.72 for 450 ppm CO₂-e. In a recent study using scenario modelling it was estimated technologies already in existence, or at an advanced state of development, could bring global CO₂ emission back to current levels by 2050 at a marginal cost of up to \$_{USD2005}50 per tonne (\$_{NZ2005}71) (International Energy Agency, 2008). There are numerous prices for carbon that could be applied as tradable instruments have different risks and volume volatility and operate in a range of global markets. An international price per tonne of carbon is used as climate change is an externality of global proportions and the marginal damage from an extra tonne of GHG is the same regardless of where it comes from. Exchange rate fluctuations for the New Zealand dollar impact significantly on the New Zealand price per tonne.

For the period 1990–2006 the total cost of GHG emissions has been estimated at \$5,672 million (Figure 21). The annual average growth rate from 1990–2006 is 6.3 percent. Between 1997 and 2001 the cost of climate change grew at a relatively slow rate. From 2001 onwards the CO₂-e emissions generated in the region increased

rapidly mainly from a mix of increased pastoral activity and electricity generation combined with reduced sequestration.

Figure 21: Waikato Region Climate Change, 1990-2006



Loss of water quality

The availability of clean water is fundamental to every aspect of life and its quality is of prime importance to anyone intending to drink water, swim, eat fish, provide water for livestock and food processing, or base their business on tourism. The calculation for change in water quality used in the GPI has been based on remedial action, which reflects the cost of righting or offsetting damage realised at a particular point in time. This does not truly reflect the real cost of loss of water quality, as it makes no allowance for damage to the ecology of the waterways over the period. It also does not reflect the cumulative effects of damage over time, or the fact that thresholds may be breached and recovery may need to take place over extended timeframes, if recovery is possible at all.

The impact of land use on waterways in the region is evident in the Waikato River, the country’s longest river. Power stations on the river have impacted water quality by contributing arsenic and slowing water flow which encourages phytoplankton growth. Water quality which is good leaving Taupo deteriorates to not good enough for swimming from Hamilton city to the coast due to high E Coli levels from farm and stormwater runoff, farm dairies and sewage treatment plants. Any drinking water extracted from the Waikato River requires a high level of treatment (Environment Waikato, 2009). Some water quality measures improved between 1990-2006 with decreases in dissolved colour, biochemical oxygen demand, arsenic, boron and ammonia. Change was attributed to better wastewater management over the past 20 years at known point source discharges (e.g. Hamilton and Taupo wastewater treatment plants, Kinleith mill, Wairakei power station). These improvements were countered by increases in concentrations of nitrate, total phosphorus, E. coli and

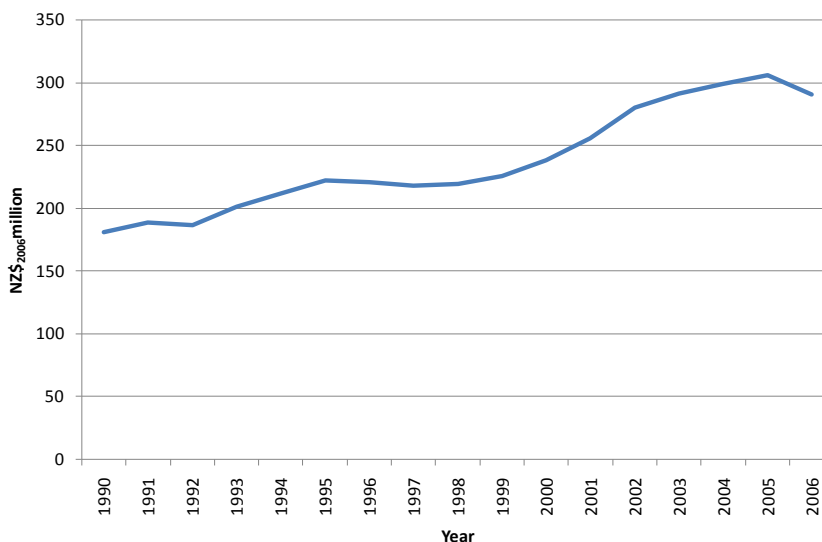
enterococci from more intensive land-use. These represent deteriorations and major contamination problems (Vant, 2008).

For the GPI, separate valuations have been conducted for change in water quality for rivers and lake water. This study did not value change in groundwater quality as there is insufficient data.

It is not possible to calculate precisely the extent that water quality deviated from acceptable standards between 1990 and 2006; nor is it possible to place an exact dollar value on this cost. For these reasons, to calculate the cost of river water degradation, the more holistic approach of estimating the monetary cost of establishing riparian margins to prevent non-point pollution has been used. Riparian planting reduces nutrient flow and provides some shade for waterways which cools water temperatures. Costs have been annualised based on stock numbers and fertiliser application. Point pollution costs have been linked to this cost and annualised based on Biochemical Oxygen Demand (BOD₅) trends.

For loss of lake water quality the estimate for the cost of cleaning up Lake Taupo has been used. Additional costs to clean up the 21 lakes covering a total of 62.51 km² with low water quality in the region (Jenkins and Vant, 2006) have been based on the costs of cleaning up the Rotorua lakes (Environment Bay of Plenty Regional Council, 2006).

Figure 22: Waikato Region Loss of Water Quality, 1990-2006



It has been estimated that the cost of restoring the Rotorua lakes to water quality levels of the 1960s would be \$170 million over 20 years (Environment Bay of Plenty Regional Council, 2006). Strategies to maintain the current water quality in Lake Taupo have been estimated at \$₂₀₀₃72m over a 10 year period, funded by rates in the region, and a further \$₂₀₀₃83m over a 15 year period from central government (Environment Waikato, 2003). Costs have been annualised based on stock numbers and fertiliser application.

For the period 1990–2006 the total cost of loss of water quality has been estimated at \$4,036 million (Figure 22). The annual average growth rate from 1990–2006 is 3.0 percent.

Loss of non-renewable resources

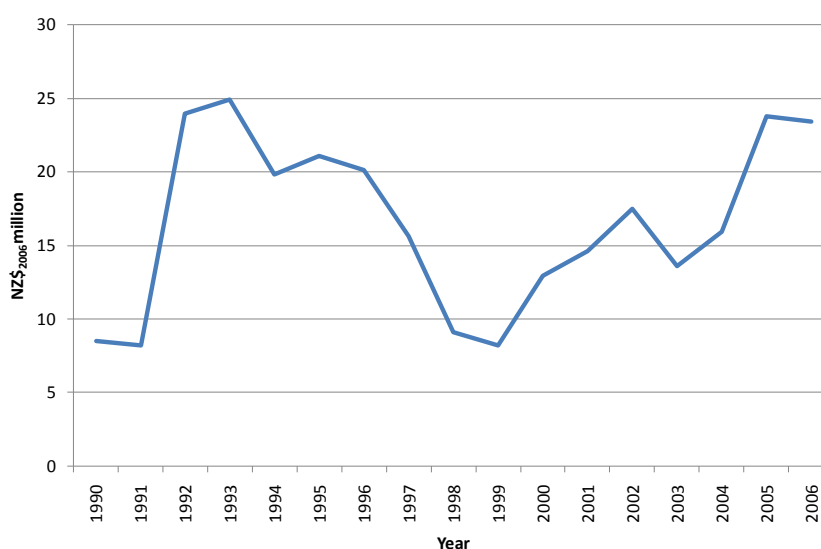
Underpinning the ideology of the GPI is the need to maintain the asset base from which we generate a sustainable economic income. Non-renewable mineral resource depletion represents the consumption of income-generating capital and results in running down natural capital to boost current market-based economic income.

There are large known reserves of metallic and non-metallic minerals located in the Waikato Region. For the majority of minerals, extraction rates are not so great that the opportunity cost to future generations associated with consumption now is significant enough to warrant inclusion in the GPI. Reserves of platinum group metals exist but there is no current mining or exploration. Lead and zinc were mined from the small Tui Mine near Te Aroha but this ceased in 1974 (Crown Minerals, n.d.). Titanomagnetite reserves are substantial and at the current level of extraction estimated to last for approximately 368 years (calculated from Crown Minerals, n.d.). Only two resources – gold and silver – are being extracted at such a rate that known 1998 reserves as identified by Christie and Braithwaite (1999, p.58) of 64 tonnes of gold and 308 tonnes of silver are likely to be exhausted in the near-term future.

For these two resources the revenues generated from extraction contain a large component of depreciation of the natural resource stock, which does not represent genuine income and therefore needs to be accounted for in the GPI. This is calculated as per the El Serafy method as the percentage of total profit that needs to be put aside and reinvested to ensure a similar level of income can be generated after the resource has been depleted (El Serafy, 1989).

For the period 1990–2006 the total cost of non-renewable loss has been estimated at \$281 million (Figure 23). The annual average growth rate from 1990–2006 is 6.5 percent.

Figure 23: Waikato Region Loss of Non-renewable Resources, 1990-2006



Noise pollution

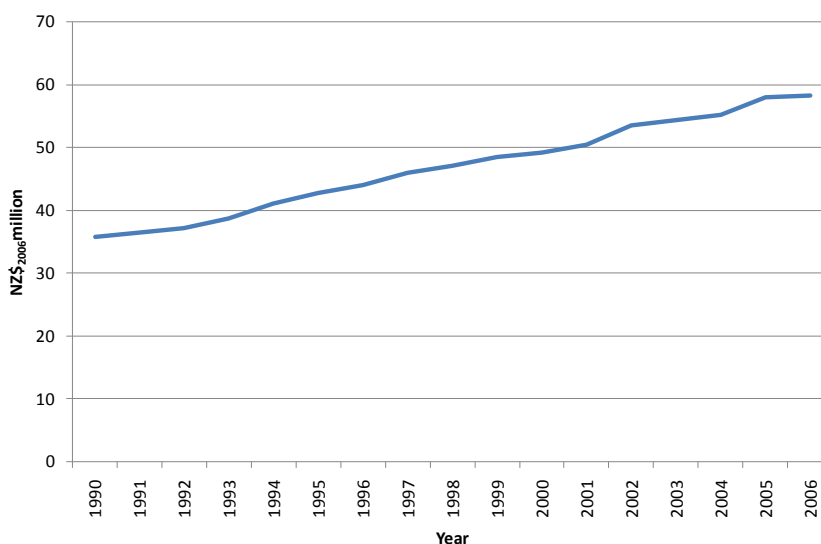
Noise pollution refers to unwanted or offensive sounds from a variety of sources including: industry, activities such as lawn mowing, recreational events, people communicating, animals, etc. It is both a health and an environmental issue. One of the main sources of noise that unreasonably intrudes into our daily activities is traffic, especially from heavy vehicles (Hamilton and Denniss, 2000). Traffic noise, according to an OECD (1995) report, has the following negative impacts:

- productivity losses due to poor concentration, communication difficulties or fatigue due to insufficient rest;
- health care costs to rectify loss of sleep, hearing problems or stress;
- lowered property values; and
- reduction in psychological well-being.

As no data is available to calculate absolute noise levels or change in intensity, the vehicle kilometres travelled (vkt) in the Waikato Region has been used as a proxy. Given that most people live in urban areas and that car ownership levels are high, a significant proportion of the population experience noise associated with traffic. In large urban areas, high density development as well as urban spread (which increases car dependency) means that people live close to traffic noise (Statistics New Zealand, 1999). Vehicles may have become quieter but more densely populated urban areas result in more exposure to noise over longer periods.

For the GPI for the Waikato Region the annual social cost of traffic noise per kilometre travelled for New Zealand was used. This noise cost value was derived from a Ministry of Transport study into environmental externalities associated with motor vehicle use. The Land Transport Pricing Study estimated the total annual social cost of noise pollution from vehicles at between \$₁₉₉₅230 million and \$₁₉₉₅2,650 million with the best estimate being \$₁₉₉₅290 million per year (Ministry of Transport, 1996, p.38). For the Hamilton urban area, costs for noise were given as \$₁₉₉₅11m or \$₂₀₀₆14m (Ministry of Transport, 1996).

Figure 24: Waikato Region Noise Pollution, 1990-2006



The vkt travelled in the region was used as an index to calculate the annual cost of noise pollution for each year based on the cost of noise pollution from vehicles per kilometre travelled of 1.2₂₀₀₆cents/km in 1995.

For the period 1990–2006 the total cost of noise pollution (Figure 24) has been estimated at \$797 million. The annual average growth rate from 1990–2006 is 3.1 percent.

Matters for Further Consideration

This study represents a unique first step in creating a GPI for the Waikato Region. The study is unique in that it is among the first fully evaluated GPIs to be developed within the New Zealand context. Moreover, it is among only a few sub-national GPIs to be developed globally⁸. It is the opinion of the authors that the Waikato Region GPI is also unique in that it represents a more meaningful indicator of well-being or ‘genuine progress’ than regional GDP since it does not arbitrarily place a zero value to the goods/services derived from social and ecological capital – which are essential ingredients in the well-being of any society (Cobb *et al.*, 1995). At this point it is worth noting that the contribution presented in this report is grounded in the detailed, meticulous and comprehensive work undertaken as part of the national GPI study. It also builds on past efforts aimed at improving measurement of national well-being or genuine progress.

Despite the level of detailed analysis that has gone into creating this report, it is hoped that the study will constitute only the first, early step towards the establishment of ongoing work in measuring and monitoring the genuine progress of the Waikato Region. As the work in this area progresses, it is envisaged that the methods used to develop the GPI will be further developed and refined. In these regards, the document entitled *A Genuine Progress Indicator for the Waikato Region: Valuation Methodology Technical Report* (McDonald *et al.*, 2010) provides a short summary of some of the theoretical, methodological and empirical matters associated with the calculation of the GPI which, although beyond the scope of the current study to resolve, might be given further consideration in future work.

⁸ A GPI was also completed for Auckland Region for the Auckland Regional Council. Refer “*A Genuine Progress Indicator for the Auckland Region*” (McDonald *et al.*, July 2009). See <http://www.arc.govt.nz/auckland/population-and-statistics/genuine-progress-indicator.cfm>

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Appendix A: 48 Sector Industry Concordance

| 48IO Code | 48IO Sector Name | 6Digit (1996) ANZSIC Industry Code | |
|-----------|--|------------------------------------|-------------------|
| 1 | Horticulture and fruit growing | A011100 - A011990 | |
| 2 | Livestock and cropping farming | A012100 - A012500 | A015910 |
| 3 | Dairy cattle farming | A013000 | |
| 4 | Other farming | A014100 - A015300 | A015930 - A016990 |
| 5 | Services to agriculture, hunting and trapping | A021200 - A022000 | |
| 6 | Forestry and logging | A030100 - A030300 | |
| 7 | Fishing | A041100 - A042000 | |
| 8 | Mining and quarrying | B110100 - B110200 | B131100 - B142000 |
| 9 | Oil and gas exploration and extraction | B120000 | B151400 - B152000 |
| 10 | Meat and meat product manufacturing | C211100 - C211300 | |
| 11 | Dairy product manufacturing | C212100 - C212900 | |
| 12 | Other food manufacturing | C213000 - C217900 | |
| 13 | Beverage, malt and tobacco manufacturing | C218100 - C219000 | |
| 14 | Textile and apparel manufacturing | C221100 - C226200 | |
| 15 | Wood product manufacturing | C231100 - C232900 | |
| 16 | Paper and paper product manufacturing | C233100 - C233900 | |
| 17 | Printing, publishing and recorded media | C241100 - C243000 | |
| 18 | Petroleum and industrial chemical manufacturing | C251000 - C253500 | |
| 19 | Rubber, plastic and other chemical product manufacturing | C254100 - C256600 | |
| 20 | Non-metallic mineral product manufacturing | C261000 - C264000 | |
| 21 | Basic metal manufacturing | C271100 - C273300 | |
| 22 | Structural, sheet, and fabricated metal product manufacturing | C274100 - C276900 | |
| 23 | Transport equipment manufacturing | C281100 - C282900 | |
| 24 | Machinery and equipment manufacturing | C283100 - C286900 | |
| 25 | Furniture and other manufacturing | C291100 - C294900 | |
| 26 | Electricity generation and supply | D361000 | |
| 27 | Gas supply | D362000 | |
| 28 | Water supply | D370100 | |
| 29 | Construction | E411100 - E425900 | |
| 30 | Wholesale trade | F451100 - F479900 | |
| 31 | Retail trade | G511010 - G532900 | |
| 32 | Accommodation, restaurants and bars | H571010 - H574000 | |
| 33 | Road transport | I611000 - I612300 | I661100 - I661900 |
| 34 | Water and rail transport | I620000 - I630300 | I662100 - I662900 |
| 35 | Air transport, services to transport and storage | I640100 - I650900 | I663000 - I670900 |
| 36 | Communication services | J711100 - J712000 | |
| 37 | Finance | K731000 - K734000 | |
| 38 | Insurance | K741100 - K742200 | |
| 39 | Services to finance and investment | K751100 - K752000 | |
| 40 | Real estate | L771110 - L771190p | L771210 - L772000 |
| 41 | Ownership of owner-occupied dwellings | L771190p | |
| 42 | Business services | L773010 - L786900 | |
| 43 | Central government administration, defence, public order and safety services | M811100 | M812000 - M820000 |
| 44 | Local government administration services and civil defence | M811300 | |
| 45 | Education | N841000 - N844000 | |
| 46 | Health and community services | O861100 - O872900 | |
| 47 | Cultural and recreational services | P911100 - P933000 | |
| 48 | Personal and other community services | D370200 | Q951100 - Q962900 |
| | | | Q963400 - Q970000 |