# Appendix B: Industry by region

## **2002 Industry Geographic Units by Region** (Statistics New Zealand, 2004)

| | Agriculture, Forestry and Fishing | Mining | Manufacturing | Electricity, Gas and Water Supply | Construction | Wholesale Trade | Retail Trade | Accommodation, Cafes and Restaurants | Transport and Storage | Communication Services | Finance and Insurance | Property and Business Services | Government Administration and Defence | Education | Health and Community Services | Cultural and Recreational Services | Personal and Other Services | TOTAL |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Northland Region** | 974 | 39 | 750 | 18 | 1316 | 398 | 1406 | 524 | 428 | 124 | 239 | 2696 | 91 | 390 | 501 | 355 | 470 | 10719 |
| **Auckland Region** | 962 | 84 | 8106 | 60 | 12911 | 8603 | 12642 | 2670 | 4141 | 1285 | 5339 | 37090 | 274 | 1929 | 4687 | 3726 | 4280 | 108789 |
| **Waikato Region** | 1540 | 81 | 2024 | 65 | 3314 | 1424 | 3658 | 1052 | 966 | 303 | 696 | 7897 | 201 | 801 | 1329 | 957 | 1147 | 27455 |
| **Bay of Plenty Region** | 1100 | 20 | 1379 | 29 | 2458 | 989 | 2493 | 713 | 771 | 174 | 525 | 5418 | 119 | 488 | 958 | 533 | 817 | 18984 |
| **Gisborne Region** | 347 | 6 | 159 | 6 | 293 | 127 | 363 | 114 | 112 | 27 | 57 | 610 | 35 | 146 | 146 | 86 | 146 | 2780 |
| **Hawke's Bay Region** | 731 | 12 | 707 | 13 | 1043 | 528 | 1354 | 382 | 386 | 120 | 309 | 2981 | 100 | 363 | 529 | 287 | 450 | 10295 |
| **Taranaki Region** | 377 | 42 | 537 | 25 | 718 | 375 | 1003 | 245 | 233 | 101 | 197 | 2131 | 56 | 249 | 406 | 246 | 331 | 7272 |
| **Manawatu-Wanganui Region** | 953 | 24 | 1116 | 36 | 1581 | 794 | 2121 | 643 | 522 | 204 | 386 | 4043 | 146 | 535 | 744 | 519 | 794 | 15161 |
| **Wellington Region** | 723 | 50 | 1884 | 49 | 4203 | 1782 | 4002 | 1082 | 1298 | 433 | 2269 | 12570 | 345 | 914 | 1730 | 1723 | 1937 | 36994 |
| **West Coast Region** | 305 | 55 | 161 | 10 | 227 | 93 | 316 | 266 | 132 | 20 | 56 | 338 | 32 | 86 | 104 | 82 | 110 | 2393 |
| **Canterbury Region** | 1418 | 45 | 3123 | 36 | 3915 | 2652 | 4919 | 1463 | 1436 | 431 | 1242 | 10530 | 208 | 866 | 1924 | 1200 | 1715 | 37123 |
| **Otago Region** | 768 | 34 | 843 | 22 | 1495 | 650 | 1870 | 891 | 615 | 165 | 444 | 3824 | 131 | 384 | 764 | 650 | 678 | 14228 |
| **Southland Region** | 672 | 16 | 433 | 14 | 602 | 332 | 858 | 277 | 252 | 77 | 204 | 1876 | 63 | 210 | 331 | 240 | 318 | 6775 |
| **Tasman Region** | 460 | 16 | 240 | 5 | 439 | 131 | 366 | 163 | 123 | 24 | 45 | 692 | 9 | 75 | 106 | 97 | 117 | 3108 |
| **Nelson Region** | 250 | 2 | 321 | 5 | 403 | 214 | 477 | 186 | 156 | 46 | 136 | 1145 | 31 | 83 | 221 | 119 | 175 | 3970 |
| **Marlborough Region** | 584 | 4 | 300 | 11 | 396 | 132 | 378 | 217 | 158 | 35 | 76 | 803 | 18 | 75 | 125 | 107 | 136 | 3555 |
| **Area Outside Region** | 65 | - | 11 | 1 | 5 | 1 | 10 | 5 | 5 | - | 3 | 17 | 3 | 6 | 2 | 4 | 10 | 148 |
| **TOTAL** | 12229 | 530 | 22094 | 405 | 35319 | 19225 | 38236 | 10893 | 11734 | 3569 | 12223 | 94661 | 1862 | 7600 | 14607 | 10931 | 13631 | 309749 |

Note: A Geographic Unit is defined as separate operating unit engaged in one, or predominantly one, kind of economic activity from a single physical location or base.

**2002 Industry Employee Count by Region** (Statistics New Zealand, 2004)

| | Agriculture, Forestry and Fishing | Mining | Manufacturing | Electricity, Gas and Water Supply | Construction | Wholesale Trade | Retail Trade | Accommodation, Cafes and Restaurants | Transport and Storage | Communication Services | Finance and Insurance | Property and Business Services | Government Administration and Defence | Education | Health and Community Services | Cultural and Recreational Services | Personal and Other Services | TOTAL |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Northland Region** | 1520 | 200 | 5660 | 360 | 2290 | 1760 | 6240 | 3100 | 1490 | 340 | 640 | 2790 | 1160 | 3880 | 6020 | 960 | 1390 | 39800 |
| **Auckland Region** | 1360 | 340 | 82250 | 1730 | 22200 | 50380 | 62850 | 25210 | 24850 | 11480 | 19380 | 77530 | 14040 | 36520 | 43400 | 14440 | 15690 | 503650 |
| **Waikato Region** | 4450 | 920 | 20710 | 780 | 7740 | 5910 | 17930 | 8270 | 4290 | 2020 | 2120 | 11940 | 3660 | 11830 | 13250 | 3410 | 4620 | 123830 |
| **Bay of Plenty Region** | 4270 | 120 | 13320 | 510 | 4840 | 3930 | 12510 | 5900 | 4000 | 1490 | 1440 | 6940 | 2270 | 6510 | 10680 | 2430 | 2670 | 83820 |
| **Gisborne Region** | 1430 | 18 | 1770 | 45 | 1000 | 670 | 2000 | 750 | 630 | 160 | 180 | 1170 | 420 | 1480 | 1940 | 310 | 520 | 14500 |
| **Hawke's Bay Region** | 3740 | 85 | 11050 | 170 | 2810 | 2860 | 7330 | 2740 | 2170 | 390 | 770 | 4400 | 1450 | 4650 | 5970 | 1030 | 1810 | 53420 |
| **Taranaki Region** | 480 | 660 | 8450 | 290 | 2080 | 1600 | 5020 | 2110 | 1200 | 360 | 570 | 4230 | 940 | 2740 | 4630 | 730 | 1040 | 37110 |
| **Manawatu-Wanganui Region** | 2340 | 80 | 12490 | 450 | 4400 | 3920 | 11420 | 4460 | 2050 | 690 | 1280 | 6680 | 6050 | 8800 | 9930 | 2070 | 2820 | 79940 |
| **Wellington Region** | 1010 | 150 | 17480 | 970 | 8850 | 10400 | 22640 | 11580 | 6800 | 5900 | 12320 | 32420 | 18970 | 14900 | 19890 | 7170 | 8550 | 200030 |
| **West Coast Region** | 350 | 370 | 1450 | 35 | 690 | 310 | 1360 | 1490 | 700 | 75 | 150 | 570 | 360 | 760 | 1450 | 340 | 280 | 10760 |
| **Canterbury Region** | 2760 | 290 | 37330 | 800 | 9910 | 11900 | 27080 | 14200 | 9140 | 4190 | 4330 | 21390 | 6190 | 15850 | 23970 | 6080 | 6350 | 201750 |
| **Otago Region** | 2230 | 310 | 12150 | 270 | 4240 | 2790 | 10260 | 7310 | 2890 | 770 | 1240 | 6170 | 2090 | 7640 | 9410 | 2700 | 2470 | 74940 |
| **Southland Region** | 1600 | 170 | 9170 | 95 | 2040 | 1550 | 4930 | 2530 | 2040 | 320 | 610 | 2110 | 1050 | 2290 | 3860 | 760 | 1200 | 36300 |
| **Tasman Region** | 880 | 50 | 2640 | 30 | 710 | 470 | 2000 | 860 | 470 | 50 | 140 | 670 | 160 | 910 | 670 | 400 | 220 | 11350 |
| **Nelson Region** | 1160 | 0 | 3430 | 15 | 950 | 1050 | 2630 | 1470 | 1330 | 210 | 290 | 1780 | 520 | 1540 | 3350 | 420 | 770 | 20930 |
| **Marlborough Region** | 1320 | 35 | 3770 | 110 | 910 | 400 | 2110 | 1390 | 640 | 80 | 190 | 970 | 810 | 790 | 1420 | 330 | 330 | 15610 |
| **Area Outside Region** | 30 | - | 60 | 3 | 3 | 0 | 12 | 25 | 20 | - | 3 | 30 | 6 | 18 | 9 | 20 | 18 | 260 |
| **TOTAL** | 30930 | 3798 | 243180 | 6663 | 75663 | 99900 | 198322 | 93395 | 64710 | 28525 | 45653 | 181790 | 60146 | 121108 | 159849 | 43600 | 50748 | 1508000 |

Note: Employee Count is defined as a head-count of all salary and wage earners for the February reference month.

# Appendix C: Review of key industries and key firms

| Preliminary Commodity Group | Estimated 2002 Road tonne-km (million)[1] | Industry Production (million tonnes) | Preliminary Industry Information and Profile | Suggested Key Firms and Organisations in Industry (not intended to be comprehensive) |
|---|---|---|---|---|
| Logs | 1466 | 20.940[2] | Forests are spread nationally, with each of the forestry regions having the following share of area planted as at 1 April 2003: Northland – 11%, Auckland (inc Waikato & Coromandel) – 3%, Central North Island – 32%, East Coast – 9%, Hawkes Bay – 7%, Southern North Island (inc Taranaki & Manawatu) – 9%, Nelson & Marlborough – 10%, West Coast – 2%, Canterbury – 7%, and Otago & Southland – 12% *(Source: Ministry of Agriculture & Forestry, 2004b).*<br><br>Note that after rapid growth in the forestry sector in recent decades, harvests have slowed in the last few years, largely as a result of lower commodity prices. | • Carter Holt Harvey<br>• Fletcher Challenge Forests<br>• Rayonier<br>• Weyerhaeuser<br>• NZ Forest Owners Association |
| Milk | 827 | 14.365[3] | The dominant player in milk and milk products is Fonterra. Fonterra handles approximately 98% of all milk production. Two other dairy companies, Westland Co-op Dairy and Tatua Foods, elected not to join the new Fonterra organisation *[www.nzte.govt.nz].*<br><br>Milk is not necessarily distributed to the nearest factory site. Milk is distributed to sites based on factory's ability to produce certain product mix options, and decisions about product mix depend on the market. | • Fonterra<br>• Tatua Cooperative Dairy<br>• Westland Co-op Dairy<br>• New Zealand Dairy Foods |

[1] *Extrapolated from Cavana et al (1997) and Transit New Zealand (2001).*
[2] *Calculated from MAF Forestry Statistics at http://www.maf.govt.nz/statistics/primaryindustries/forestry/production - Ministry of Agriculture & Forestry (2004a).*
[3] *Calculated from information sourced from Livestock Improvement Corporation (2003).*

| Preliminary Commodity Group | Estimated 2002 Road tonne-km (million)[1] | Industry Production (million tonnes) | Preliminary Industry Information and Profile | Suggested Key Firms and Organisations in Industry (not intended to be comprehensive) |
|---|---|---|---|---|
| Livestock | 804<br>(it is not clear which animals and journeys have been included in this estimate) | Not available<br>(this is dependent on the definition of 'livestock' - not easily quantifiable) | Livestock is transported between farms, to and from saleyards and to processing facilities. Movements are highly complex and difficult to quantify.<br>Suggested sources – Wrightson (one of a number of firms involved in the trading of livestock) and transport operators (about 22-27 transport firms, listed in the yellow pages, specialise in the transport of livestock). | • Wrightson<br>• Stock Haulage Firms |
| Sand, rock, gravel, etc. | 705 | 31.007[4] | The largest aggregate producers are Winston Aggregates and Fulton Hogan. Fulton Hogan operates mainly in the South Island. Other significant aggregate operators include J Swap Contractors, W Stevenson and Sons Ltd and Holcim NZ which has an aggregates division. *(Source: Volume 30, New Zealand Mining, Crown Minerals, MED, p14.)*<br>Aggregates are not generally transported long-distance. Aggregate has a low price so it is usually more cost-effective to create quarries close to the markets *(personal communication with Neil Jarrett, Winstone Aggregates).*<br>Until Recently, ACI dredged 40,000 tonnes pa from Parengarenga Harbour for processing into glass at its Auckland factory (*Source: MED Explore New Zealand Minerals, p71).* | • Winston Aggregates Ltd<br>• Fulton Hogan<br>• Holcim NZ (Holcim Aggregates)<br>• J Swap Contractors of Matamata<br>• W Stevenson and Sons Ltd<br>• ACI NZ Glass Manufacturers |

[4] *Ministry of Economic Development (2004) - http://www.med.govt.nz/crown_minerals/minerals/facts/index.html*

| Preliminary Commodity Group | Estimated 2002 Road tonne-km (million)[1] | Industry Production (million tonnes) | Preliminary Industry Information and Profile | Suggested Key Firms and Organisations in Industry (not intended to be comprehensive) |
|---|---|---|---|---|
| Bulk wood products | 545 | 7.100[5] | Includes sawn timber, wood panel products, wood pulp and paper. Processing is spread nationally, in close proximity to forests. There is a concentration of plants around the traditional forestry areas of the central North Island. | *Wood & Wood Products*:<br>• Carter Holt Harvey<br>• Fletcher Wood Panels<br>• Juken Nissho<br>• Nelson Pine Industries<br>*Pulp & Paper:*<br>• Norske Skog Tasman<br>• Carter Holt Harvey<br>• Pan Pacific<br>• Winstone Pulp |
| Wholesale & Retail | 539 | Not available | Two companies, Foodstuffs and Progressive Enterprises, dominate the food retail sector: Foodstuffs (55% of the market) operates New World, Pak 'N Save and other brands. Progressive Enterprises (40% of the market) operates Woolworths, Foodtown, Countdown and other brands. *(Source: www.careers.co.nz/industry)* | • Foodstuffs<br>• Progressive Enterprises<br>• The Warehouse |
| Construction / Building Materials | 456 | Not available | Includes building construction, construction of other structures, roading and support industries. | • Fletcher Construction<br>• Mainzeal Construction<br>• Downer<br>• Fulton Hogan<br>• Winstone Wallboards<br>• Fletcher Building |

5 *Calculated from MAF Forestry Statistics at http://www.maf.govt.nz/statistics/primaryindustries/forestry/production, Ministry of Agriculture & Forestry (2004a).*

| **Preliminary Commodity Group** | **Estimated 2002 Road tonne-km (million)**[1] | **Industry Production (million tonnes)** | **Preliminary Industry Information and Profile** | **Suggested Key Firms and Organisations in Industry** (not intended to be comprehensive) |
|---|---|---|---|---|
| Lime & marble | 322<br>(includes fertiliser below) | 5.294[6] | The largest producer of lime is McDonalds Lime Ltd, which is owned by Holcim NZ. Holcim also partly owns Taylors Lime Company Ltd. Only McDonalds Lime Ltd transports lime across longer distances.<br>Most lime only travels short distances. Taylors Lime Company Ltd only has short-distance travel. Awarua Browns Lime Ltd and Hatuma Lime Company Ltd allow farmers to arrange freight from their quarries.<br>Omya is a producer of lime, marble and related materials. They have relatively significant long-distance freight. | • McDonalds Lime Ltd<br>• Taylors Lime Company Ltd<br>• Awarua Browns Lime Ltd<br>• Hatuma Lime Company Ltd<br>• Omya (NZ) Ltd |
| Fertiliser | 322<br>(includes lime above) | 2.531[7] | Ballance and Ravensdown are co-operatives, which dominate the market for fertiliser (excluding lime).<br>Key imports for fertiliser are urea, DAP (diammonium phosphate), phosphate rock and sulphur. These imports are usually unloaded at ports close to the fertiliser works. Balance does not import much urea because it has its own urea works. | • Ballance Agri-Nutrients Limited<br>• Ravensdown |
| Liquid fuels | 322<br>(bulk petroleum products) | Not available | New Zealand Refining is owned by the major fuel companies (excluding Gull). It operates a refinery at Marsden Point and distributes product from there. | • New Zealand Refining<br>• Shell<br>• BP<br>• Mobil<br>• Caltex<br>• Gull |

6 *Ministry of Economic Development (2004) - http://www.med.govt.nz/crown_minerals/minerals/facts/index.html based on figures of: limestone and marl for cement – 1,696,550; limestone for agriculture – 2,731,850;and limestone for industry – 865,500.*

7 *Calculated from MAF Statistics at http://www.maf.govt.nz/statistics/primaryindustries/land-treatments/fertiliser/index.htm, Ministry of Agriculture & Forestry (2004a).*

| Preliminary Commodity Group | Estimated 2002 Road tonne-km (million)[1] | Industry Production (million tonnes) | Preliminary Industry Information and Profile | Suggested Key Firms and Organisations in Industry (not intended to be comprehensive) |
|---|---|---|---|---|
| Coal | 240 | 4.459[8] | Solid Energy is the largest coal producer in NZ and producers about 3 Mt each year, over three quarters of total coal production. Glencoal Energy Ltd is owned by the New Zealand Dairy and is the second largest coal-mining company. Greymouth Coal is developing the Spring Creek Mine at Rapahoe, near Greymouth, to produce 1.7 Mt per annum for export markets *(Source: Crown Minerals, Explore New Zealand Minerals, p75).*<br><br>Most coal comes from the South Island West Coast (2.4 Mt) and Waikato (1.7 Mt). The West Coast comprises 13 coalfields: Buller is the country's largest producer of bituminous coal (1.1 Mt pa); Greymouth also seems to be significant *(ibid p9).* Over 90% of Waikato Coal comes from Maramarua, Huntly and Rotowaro. The Glenbrook steel mill consumes about 0.8 Mt of Waitako coal pa. *(Source: Crown Minerals Mineral Commodity Report 18 - Coal, p5.).* | • Solid Energy<br>• Glencoal Energy Ltd<br>• Greymouth Coal Ltd |
| Horticulture | 141 | Not available | A wide range of products, which move to export ports, processing and local consumers. | • Zespri Group Ltd<br>• Turners & Growers<br>• Pipfruit New Zealand |
| Grain | 59 | Not available | Concentrated in (but not confined to) the Canterbury region. | |
| Wool | 44 | 0.195[9]<br>(shorn wool - greasy) | The sheep flock is spread over the entire country, with slightly greater numbers in the South Island. There were approximately 40 million sheep in 2002 (Statistics NZ, 2003b), a decline from much larger numbers in the 1970s and 1980s.<br><br>The wool industry has recently seen major changes to its marketing and research areas, with the disbanding of the Wool Board. | • The New Zealand Wool Board (now disbanded)<br>• Meat & Wool New Zealand |

8 *Ministry of Economic Development (2004) - http://www.med.govt.nz/crown_minerals/coal/facts/index.html*
9 *Meat & Wool Innovation – Economic Service (2003).*

| Preliminary Commodity Group | Estimated 2002 Road tonne-km (million)[1] | Industry Production (million tonnes) | Preliminary Industry Information and Profile | Suggested Key Firms and Organisations in Industry (not intended to be comprehensive) |
|---|---|---|---|---|
| Dairy products | 29 | 1.714[10] (non-milk products) | See Milk. | • Fonterra<br>• Tatua Cooperative Dairy<br>• Westland Co-op Dairy<br>• New Zealand Dairy Foods |
| Meat | 16 | 1.045[11] | More than 150 NZ meat companies are licensed to operate, with most exporting. The largest companies are AFFCO, Richmond, The Primary Producers Co-operative Society (PPCS), ANZCO and the Alliance Group. Meat NZ assists their marketing. It is a statutory board which is funded by farmer levies and provides support with market access issues, promotion, research and development and the administration of quotas *(www.nzte.govt.nz).*<br>In contrast, the Meat Industry Association (MIA) represents the meat manufacturers. It is funded by voluntary levies.<br>In the Meat Industry, stock is transported from the farm to the processing plant, for slaughter, then to cold stores and then to port. | • Meat Industry Association<br>• Meat & Wool New Zealand<br>• Richmond<br>• AFFCO<br>• Alliance Group<br>• PPCS<br>• ANZCO |
| Methanol | Not available | 2.400[12] | Methanex produces significant quantities of Methanol at its New Plymouth plant. But most of the Methanol is piped to the New Plymouth port and most of it is exported from there. Only about 6,000 tonnes are distributed domestically to various locations. | • Methanex NZ Ltd |
| Cement | Not available | 1.050[13] | Dominated by two major producers that produce domestically and also import some product. Plants are located at Westport (Holcim) and Portland (Golden bay). | • Holcim<br>• Golden Bay Cement |

[10] *Statistics New Zealand via TERNZ (2003).*
[11] *NZ Meat Board Annual Report 2002 provisional figures, via TERNZ (2003).*
[12] *Sourced from www.ngc.co.nz.*
[13] *Based on NZ Mining vol 29 June 2001, Crown Minerals: Golden Bay Cement produces about 550,000 tpa, Milburn New Zealand Ltd produces about 500,000 t pa.*

| Preliminary Commodity Group | Estimated 2002 Road tonne-km (million)[1] | Industry Production (million tonnes) | Preliminary Industry Information and Profile | Suggested Key Firms and Organisations in Industry (not intended to be comprehensive) |
|---|---|---|---|---|
| Gas fuels | Not available | 0.216[14] (LPG) | The bulk of these are transported by pipeline; however some gas is transported by road and rail. | • BOC Gases<br>• Rockgas<br>• NGC<br>• Liquigas |
| Steel | Not available | 0.200[15] | New Zealand Steel was previously known as BHP Steel and operates a mill at Glenbrook near Auckland. This fully integrated steel mill can produce approximately 700,000 tonnes of steel per annum, of which approximately 60% is exported *(www.nzsteel.co.nz).*<br>Pacific Steel produces about 230,000 tonnes of steel largely from recycled scrap *(TERNZ, 2003).*<br>Pacific Steel is owned by Fletcher Building, so much of the steel will be used in building construction. | • New Zealand Steel<br>• Pacific Steel<br>• Steel and Tube<br>• Kiwi Steel NZ Limited |
| Aluminium | Not available | 0.045[16] | Comalco NZ owns the NZ Aluminium Smelter which is located at Tiwai Point near Invercargill. Tiwai point produces 304,000 tonnes in 2002. Most of the product is exported with only 45000 tonnes sold domestically *(TERNZ, 2003).* | • Comalco |
| Other Chemicals | Not available | Not available | Chemnet NZ manufactures and distributes products throughout New Zealand. It claims to be the country's largest importer of chemicals and plastics. It is associated with the FERNZ brand-name *(www.fernz.co.nz).*<br>Industry association: New Zealand Chemical Industry Council (NZCIC) *(www.nzcic.org.nz)*. | • Chemnet<br>• Members of the NZCIC |

[14] *Ministry of Economic Development (2004) - http://www.med.govt.nz/crown_minerals/petroleum/markets/gas.html. Exports of LPG were 80,000 tonnes. Of the 132,000 tonnes of LPG consumed within New Zealand, most is now used for domestic and commercial heating and cooking though there has been revived interest in the use of LPG as a vehicle fuel. Unlike other gas products, LPG is distributed in the South Island.*

[15] *NZ uses about 200,000 tonnes of steel per year for domestic manufacturing (TERNZ, 2003, p16).*

[16] *Production distributed domestically in 2002 (TERNZ, 2003).*

| **Preliminary Commodity Group** | **Estimated 2002 Road tonne-km (million)**[1] | **Industry Production (million tonnes)** | **Preliminary Industry Information and Profile** | **Suggested Key Firms and Organisations in Industry** (not intended to be comprehensive) |
|---|---|---|---|---|
| Tyres | Not available | Not available | Bridgestone/Firestone is the major manufacturer. Dunlop manufactures and exports tyres from its Upper Hutt facility. | • Bridgestone<br>• Dunlop |
| Food Processing | Not available | Not available | Processing facilities are usually located close to their inputs. | • Heinz Wattie<br>• Inghams<br>• McCains<br>• Talleys<br>• Weston Milling<br>• Goodman Fielder<br>• Allied Domecq Wines |
| Brewing | Not available | Not available | The two dominant beer manufacturers in NZ are Lion Nathan and DB Breweries. | • Lion Nathan<br>• DB Breweries |

# Appendix D: Details of supplementary analysis

# Details of supplementary analysis

The following data and processing procedures were used to generate origins and destinations for the commodity groups that required additional analysis. Known rail and sea tonnages were deducted from these totals to create road origins and destinations for input to the estimation process. Data sources are listed in brackets.

**Milk:**

Origin tonnages were generated using:

- The total number of herds per TLA (Livestock Improvement Corporation, 2003).
- Average litres of raw milk produced per farm (Livestock Improvement Corporation, 2003).
- The volumes generated were converted to a weight using a specific gravity of 1.033 (Source: http://hypertextbook.com /facts/2002/AliciaNoelleJones.shtml).

Destination tonnages were generated using:

- The total milk production calculated above.
- The number of full-time equivalent workers employed in milk processing industries within each TLA (Statistics New Zealand, 2004), as a proportion of the national total, to allocate the input to production by TLA.

**Livestock:**

All livestock data was sourced from the Annual Review of the Sheep and Beef Industry 2002-03 (Meat & Wool Innovation – Economic Service, 2003), unless noted otherwise.

Origin tonnages were generated using:

- The total number of sheep, lambs and cattle processed or exported in New Zealand in 2002.
- A weight per animal based on each average export carcass weight - used on the assumption that this would be roughly similar to (although less than) the corresponding live animal weight.
- The number of sheep and cattle in each TLA as a proportion of the national total (based on the TLA statistics from the Agriculture Statistics 2002 (Statistics New Zealand, 2003b), to allocate the total estimated tonnage. These were used on the broad assumption that the number of animals sent from each TLA would be in proportion to the total number of animals farmed there.

Destination tonnages were generated using:

- The number of animals sent for processing at the above weights.
- The number of full-time equivalent workers employed in meat processing within each TLA (Statistics New Zealand, 2004), as a proportion of the national total, to allocate the input to processing plants by TLA.

- The number of animals sent for export at the above weights – on the assumption that animals would move direct to the export port TLA from the farm.
- It was assumed that all live sheep and cattle exports were from Napier only based on Statistics New Zealand export data.

Note: Livestock movements were very difficult to assess, due to the wide variety of animals moved and the diverse types of movements undertaken - including inter-farm transfers, movements from farms to saleyards, and movements from farms to processing plants. Therefore, for the purposes of this report, the livestock commodity group was defined very specifically as comprising only of sheep, lambs and cattle, moving from farms to processing plants and to ports for live export. These animals made up 97% of livestock slaughterings in the 2002 year (Meat & Wool Innovation – Economic Service, 2003). Rail movements of animals ceased in the 1970's, with the exception of some recent trial shipments - it was therefore assumed that all movements of live animals would move by road.

**Produce:**
Origin tonnages were generated using:

- The harvest tonnage of the main crops within the country - grains & seeds, fruit & nuts, and vegetables – added to give a total tonnage for all crops in each TLA (Statistics New Zealand, 2003b). This source gave some crops in terms of tonnes harvested by TLA, and others in terms of area (in hectares) planted by TLA.
- Where the above crop data was given by area planted, a yield factor (sourced from Hort Research (2004) and a number of additional internet-based sources) was used to calculate the approximate tonnage harvested in each TLA.

Note: It was not possible to generate destination tonnages from the available data, and so this group was treated in a slightly different fashion from the others in the matrix estimation stage (refer to Section 6.6).

**Wool:**
Unprocessed origin tonnages were generated using:

- The total numbers of sheep each TLA in 2002 (Statistics New Zealand, 2003b).
- Total wool production per head (Meat & Wool Innovation – Economic Service, 2003), to generate a wool production in tonnes by TLA.

Unprocessed destination tonnages were generated using:

- The total wool production generated by the origins.
- The number of full-time equivalent workers employed in wool scouring within each TLA (Statistics New Zealand, 2004), as a proportion of the national total, to allocate the input to wool scourers by TLA.

Processed origin tonnages were generated using:

- Processed output from wool scourers was assumed to be equivalent to unprocessed input.

Processed destination tonnages were generated using:

- Exports by port (Statistics New Zealand, 2004).

- The balance not exported was assumed to have been used for domestic manufacture, and was allocated to each TLA on the basis of the number of full-time equivalent workers employed in wool related manufacturing industries within each TLA (Statistics New Zealand, 2004), as a proportion of the national total.

Note: It was assumed that product would not be stored from year to year, and that there would be no weight loss as a result of the manufacturing process. No allowance was made for the processing of sheepskins.

**Meat:**
Origin tonnages were generated using:

- The total tonnage of beef , veal, lamb, mutton, pig and poultry processed during the year ended 2002 (Meat & Wool Innovation – Economic Service, 2003).
- The number of full-time equivalent workers employed in meat processing within each TLA (Statistics New Zealand, 2004), as a proportion of the national total, to allocate the tonnage as an output of processing plants by TLA (Statistics New Zealand, 2004).
- Imports by port (Statistics New Zealand, 2004).

Destination tonnages were generated using:

- Exports by port (Statistics New Zealand, 2004).
- The balance not exported was assumed to have been consumed locally, and was allocated to each TLA on the basis of resident population (Statistics New Zealand, 2004).

Note: It was assumed that product would not be stored from year to year and that both exports and domestic consumption would be sourced from the nearest processing plants.

**Logs:**
Origin tonnages were generated using:

- Estimated roundwood removals by region (YE 2002) from MAF Forestry Statistics (Ministry of Agriculture and Forestry, 2004a).
- Allocated to each TLA according to projected harvest figures sourced from TERNZ and MAF.

Destination tonnages were generated using:

- Exports by port (Statistics New Zealand, 2004).
- The balance not exported was assumed to have been used as inputs into domestic wood related manufacturing (including sawn timber, panel products, wood pulp or paper). It was allocated to each TLA on the basis of the number of full-time equivalent workers employed in these industries within each TLA (Statistics New Zealand, 2004), as a proportion of the national total.

Note: Log totals include woodchips. Estimates were converted from source units of cubic metres (roundwood equivalent), equating to around 1 tonne in weight.

**Sawn Timber:**

Origin tonnages were generated using:

- The output from sawmills was assumed to be equivalent to the proportion estimated as sawmill log inputs. It was assumed that weight loss due to processing would be negligible.

Destination tonnages were generated using:

- Exports by port (Statistics New Zealand, 2004).
- The balance not exported was assumed to have been used largely as inputs to the building industry. Timber was allocated to each TLA on the basis of the number of full-time equivalent workers employed in building construction within each TLA (Statistics New Zealand, 2004), as a proportion of the national total. Building construction was also taken as a proxy for timber consumption related to economic activity in general.

Note: Timber imports were relatively minor and more difficult to quantify, so these were allocated to the 'Other' category where they were identified.

**Wood Products:**

Origin tonnages were generated using:

- The output from wood processing plants (other than from sawmills) was assumed to be equivalent to the proportion estimated as log inputs to these plants. It was assumed that weight loss due to processing would be negligible.

Destination tonnages were generated using:

- Exports by port (Statistics New Zealand, 2004).
- Wood products not exported were allocated on the basis of the number of full-time equivalent workers employed in paper-related industries (for pulp and paper) and building construction (for panel products) with these taken as a proportion of the national total for each TLA (Statistics New Zealand, 2004). As with sawn timber, building construction was taken as a proxy for panel product consumption in relation to economic activity in general.

Note: The Wood Products group included panel products, pulp and paper. Imports were difficult to quantify and were allocated to the 'Other' category where they were identified.

## Appendix E: Modelling technical notes

# Modelling technical notes

**Emme/2 Overview**

Emme/2 is a transport modelling package developed by INRO. It has the ability to model road and public transport services, as well as the interaction between them. As such it is well placed as a transport modelling tool at a strategic level. Currently Emme/2-based models are used in Auckland (through ART and APT) and Wellington (through WTSM).

Information is stored in two key data-types; namely link-based and matrix-based. Link-based information represents individual roads, rail-lines, and access modes. This information can be either as an input to (such as road capacities and lengths) or output from the model (such as numbers of vehicles or passengers). Emme/2 does not limit the type of link-based data it uses, so if a car trip matrix is assigned, the resulting volumes will be numbers of cars; but if a freight matrix is assigned, the volumes will be the freight tonnes. This allows Emme/2 to be particularly flexible in its application to a variety of situations.

Matrix-based information can be stored as either a scalar (single number), a vector (a 1xN or Nx1 matrix), or a full matrix (NxN). Generally matrix-based information is an input to Emme/2, such as initial trip matrices, but as with link-based information it can also be an output (such as distance matrices from an assignment routine, or the result of matrix calculations).

Emme/2 comes equipped with various matrix and assignment-based routines. Matrices can have all the basic operations performed on them, as well as more complex routines such as convolutions. These matrices can then be assigned onto the network (link-based information) either as highway or public transport-based data to give link and matrix-based outputs. The process primarily uses matrix addition, matrix balancing, network calculation, and assignment routines of Emme/2.

**Base Network**

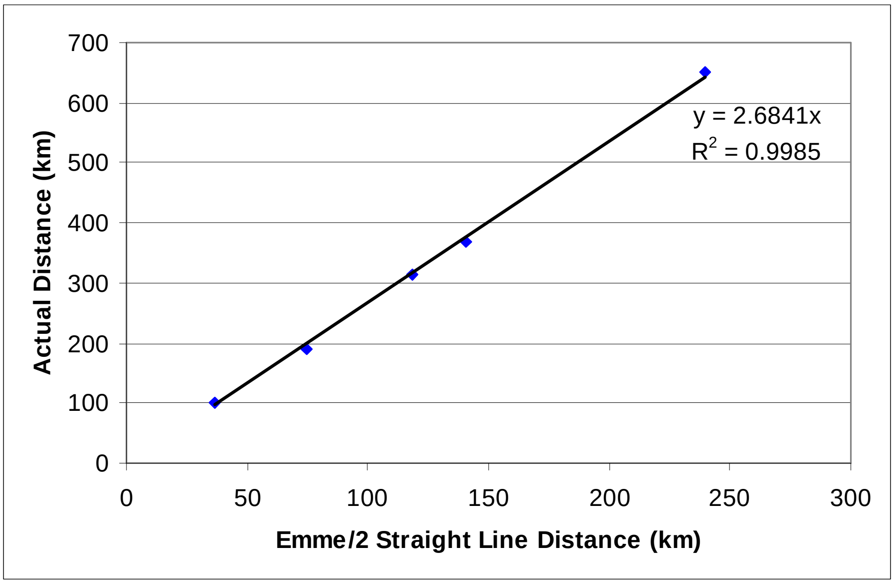
The base network utilised for this project was developed in the Emme/2 transport modelling package, and was previously used for a number of aspects of the Surface Transport Costs & Charges Study for the Ministry of Transport. The network itself consisted of approximately 275 zones, 800 nodes, and 2650 directional links, and incorporated all of the rail and major highway networks within the country. It included 12 modes (10 rail/bus based, 1 transfer, and 1 auto), however only the highway (auto) mode was used in this case as the matrix estimation process was employed only for the estimation of road freight movements.

There was no supporting documentation with the existing network, and so a series of checks were undertaken to ensure that it was valid and had a reasonable representation of routes and corresponding distances. Such checks are vital to any matrix estimation process and summary statistics. It was found that the highway link lengths did not appear to correspond to actual distances and so link lengths were re-estimated. A straight line distance was calculated based on the node co-ordinates (although the distance does not relate to actual but rather to the co-ordinate system) and series of 'shortest-path' trees were built with the corresponding distance regressed against actual distances. It was found that the straight-line link length needed to be factored by 2.68 to match observed distances. Note that the highway network does not include volume delay functions, and as such congestion was not modelled. This was not seen as a significant issue as most long-distance freight movements would be either outside the hours of congestion, or on highways where congestion was not an issue. Table E1 and Figure E1 demonstrate this process.

**Table E1 Straight line, actual, and revised model distances.**

| Flow | Emme/2 Straight Line Distance | Actual Distance (km) | Revised Distance using 2.68 factor (km) |
|---|---|---|---|
| Wellington – Auckland | 239 | 652 | 642 |
| Wellington – Napier | 118 | 313 | 317 |
| Wellington – Wanganui | 75 | 190 | 200 |
| Wellington – Taupo | 140 | 370 | 376 |
| Wellington – Masterton | 37 | 100 | 98 |

**Figure E1 Scatterplot of Actual vs. Straight-Line Distance for Selection of Zones**




A number of paths were also checked to make sure that the routes chosen were feasible, and subset of these is shown in Figure E2. Some may not be considered as optimal, as speed, gradient, and road curvature could not be integrated into the network. A highway assignment was also undertaken to ensure that all zones were connected, with an undefined distance indicating a non-existent path between two zones; none were found.

Some links within the network allowed both rail and highway modes to coexist. The reason for this was unclear, but the allowance for highway flows on the competing rail network would hinder the matrix estimation process, as modelled highway flows would be distributed across two links against observed flows on one link. To eliminate this problem, the highway mode was removed from the rail network.

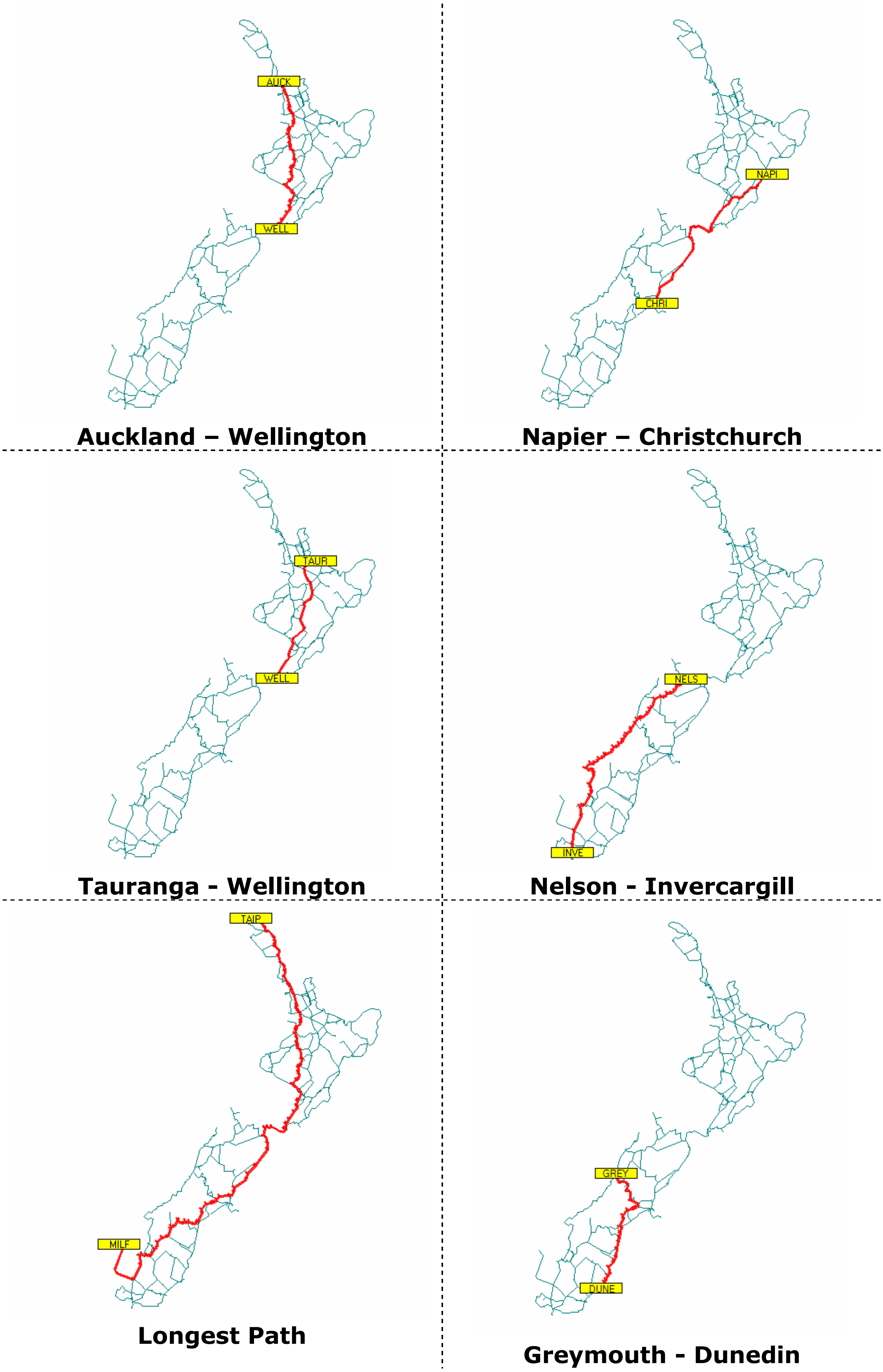
Freight movements were supplied at a TLA level as described in Section 3.3. The zone system in the Emme/2 network was available at a more detailed level; however there was no basis with which to disaggregate the TLA data further. A representative zone was selected within each TLA, with all the data assumed as going from (or to) this zone. It was found that one zone had to be added to the network to represent North Shore City, as there was no suitable zone in the existing network. The representative zones were coded into an Emme/2 ensemble 'GA', and were further aggregated into ensemble 'GB' to give a grouping of TLAs into regions (which were used for reporting purposes).

A network attribute was created to represent the region that a particular highway link fell within (UL1). This attribute was used to add region-specific average loads for link-based heavy-vehicle flow data (see Table E2). Other network attributes such as UL2 and UL3 were also used, with UL3 containing observed vehicle flows and UL2 containing a calculated value of annual freight tonnes on the corresponding link.

**Table E2 Emme/2 data attributes.**

| Attribute | Type | Use |
|---|---|---|
| UL1 | Link-based | Region-specific indicator |
| UL2 | Link-based | Calculated annual tonnes on link |
| UL3 | Link-based | Observed Heavy-Vehicle flows |
| GA | Matrix Ensemble | TLA Zones |
| GB | Matrix Ensemble | Regional Aggregation of TLA Zones |

**Figure E2 Shortest path checks on highway network.**



**Matrix Distribution and the Entropy Function**

The first part of the estimation process was to convert vector-based information into matrix-based flows (with specific origin to destination flows). Generally this is achieved by taking the row and column totals (origin and destination vectors) and distributing trips between them based on a distance function (to represent utility) so as to ensure an average trip length. In this project, an entropy model was used (based on distance rather than time) of the form:

$$C_{p,q,c} = \exp^{\left(\frac{-dist_{p,q}}{\gamma_c}\right)}$$

where:

| | |
|---|---|
| $C_{p,q,r}$ | Utility between zones *p* and *q* for commodity *c* |
| $Dist_{p,q}$ | Distance between zones *p* and *q* (km) |
| $\gamma_c$ | Scaling parameter for commodity *c* |

The following graph (Figure E3) illustrates the impact of the scaling parameter. It shows that the higher the value of $\gamma$, the larger the proportion of trips of long length.

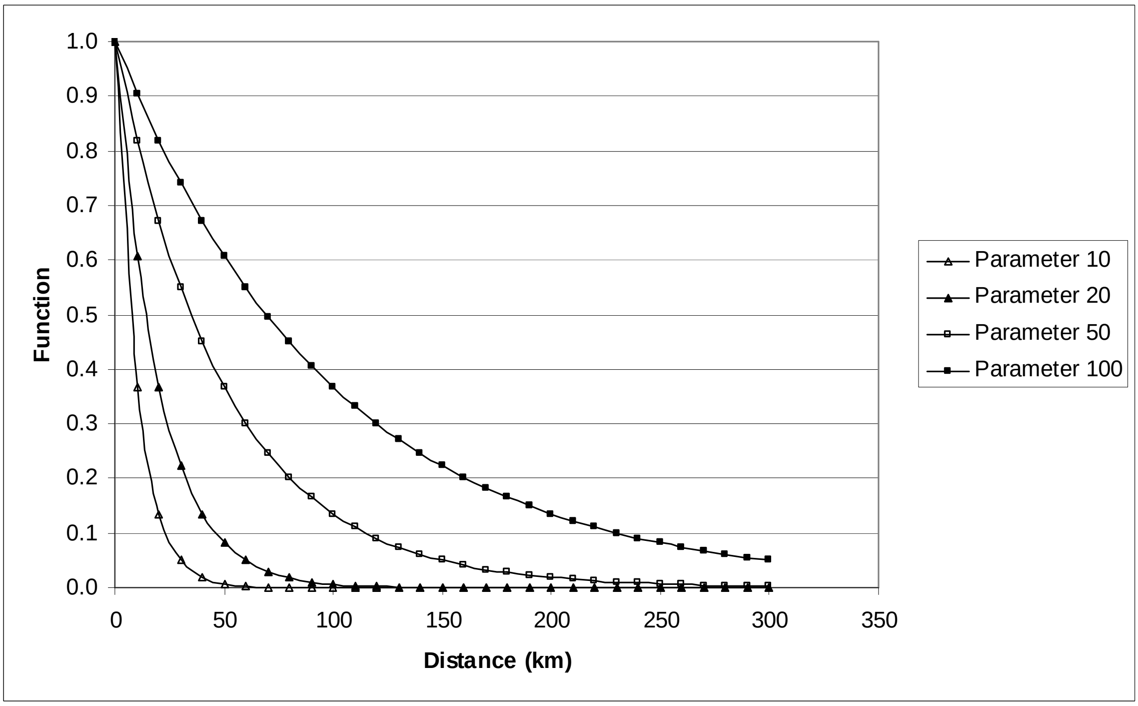



**Figure E3 Plot of entropy function with differing scaling parameters.**

The usual modelling approach is to change the scaling parameter so that the average trip length of the resulting matrix matches an observed or known total, however research into average trip lengths for freight movements did not yield any reliable numbers that could be used for this project (in total, let alone by commodity). The only average trip length data available was based on the matrices that had been supplied through the surveys, and these ranged from 62 km to 228 km depending upon the particular commodity.

This data was such a small component of total tonnage (17% on average) that it was not deemed appropriate to use these commodity-specific trip lengths, particularly when in many cases such information was only available for one consignor in one region (which may not have been representative of industry as a whole). It was decided to use the average trip length of all the commodities combined – 137.3 km – since the final matrix estimation could not be undertaken at a commodity level because equivalent commodity link-based/traffic count information was not available. It should be noted that using the commodity-specific trip lengths made little difference to the resulting matrix in totality, but did change the allocation of tonne-km within commodities. Table E3 gives the scaling parameter required for each commodity to reach the average trip length of 137.3 km.

There was evidence to suggest that trip lengths for the 'Produce' group were significantly shorter than the 137.3 km average and so a much lower trip length of 69 km was assumed (based on existing matrix information) for that commodity. Produce data was also only available at an origin level and so a singly constrained balancing approach (where there are no destination numbers to match to) was adopted.

**Table E3 Matrix balancing scaling parameter.**

| Commodity | Scaling Parameter ($\gamma$) |
|---|---|
| Livestock | 98.8 |
| Meat | 44.0 |
| Wool | 65.9 |
| Milk | 121.4 |
| Produce | 60.0 |
| Logs | 124.6 |
| Sawn Timber | 64.8 |
| Wood Products | 73.1 |

Emme/2 has a matrix balancing function within the modelling suite. It is an iterative approach, which stops when the maximum percentage change in balancing coefficients is within a certain tolerance. A series of balancing factors are determined for each origin and destination zone, such that multiplied with the entropy matrix the row and column totals match the origin and destination vectors.

$$G_{p,q} = \alpha_p \cdot \beta_q \cdot C_{p,q}$$
$$\sum_q G_{p,q} = O_p$$
$$\sum_p G_{p,q} = D_q$$

where:

$G_{p,q}$ Balanced matrix
$C_{p,q}$ Entropy between zones $p$ and $q$
$O_p$ Origin vector summed over destinations
$D_q$ Destination vector summed over origins
$\alpha,\beta$ Balancing factors

The sum of the balanced matrices and the full matrices supplied forms the 'seed' or starting matrix to be used in the assignment-based matrix re-estimation.

**Trip End Model Estimation**

The trip-end models are linear multi-variate, and relate freight productions (or attractions) by origin TLA (or destination), with TLA specific employment by sector and/or population. One of the difficulties when using employment by sector is that there is a high level of correlation between most of the variables. Correlation is a measure of how the behaviour of one variable mirrors the behaviour of another, and if the correlation is high (close to +/- 1) then either variable could be used as a substitute for the other. Including both variables in the equation does not add anything to the model, and may affect the significance or sign of the coefficient of the other.

Table E4 is a correlation matrix of all variables considered for the trip end equations. The variables are listed across the top and along the side (POP is total population, HLD is total households, and the rest correspond to 7.1), with the value of the cell representing the correlation of one variable against another. The diagonal of the matrix has a value of '1' due to each variable having a perfect correlation with itself. A negative value shows a negative relationship; so as one variable increases the other decreases.

The correlation matrix shows that only AFF and MIN are distinctly different from the other variables, with low correlation values. GAD is only marginally correlated, while the rest are extremely similar, and could be substitutes for each other in the equation. As such, it is difficult to develop a robust set of equations, as removing a highly correlated variable from the analysis is likely to change other variables it is correlated with; particularly in terms of sign and significance.

To derive an appropriate trip-end model, all variables have been included in the initial model. One by one, variables are excluded and the model re-estimated. Exclusion of variables are based on whether the parameter value is significantly different from zero, whether it is highly correlated with another variable that has been included, or whether the expected sign of the coefficient is correct (positive or negative). A constant has also been included to allow for any freight not included in the variables.

After initial model estimations, it was found that there were significant outliers (where modelled was vastly different from observed). Further examination identified some of these as TLAs with ports. The employment categories were not disaggregated enough to give an indication of port-based activity. Clearly, overseas freight being loaded and unloaded at ports is going to have a positive impact on freight movements to/from port TLAs and two further variables were created to represent port existence and relative size. Statistics NZ data for overseas freight unloaded in 2002 was used to derive a 'port origin' variable, which took a value of '1' for the largest, and a relative value for the other ports. Another variable 'port destination' had the same form but was based on loaded overseas freight. Three ports (Whangarei, Bluff, and Taharoa) were excluded from the variable as a majority of the incoming/outgoing freight would be internal to the TLA (for example oil at Whangarei).

The form of the linear model is:

$$Trip_O = \sum_i \alpha_i X_{i,o}$$

where:

$Trip_o$ = Trips produced from (or attracted to) TLA '*o*'

$\alpha_I$ = Estimated coefficient for variable '*i*'

$X_{i,o}$ = Variable '*i*' value for TLA '*o*'

**Table E4 Correlation matrix of variables.**

| | POP | HLD | AFF | MIN | MAN | EGW | CON | WST | RLT | ACR | TAS | COM | FIN | PRO | GAD | EDU | HCS | CRS | PER |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| POP | 1.0 | | | | | | | | | | | | | | | | | | |
| HLD | 1.0 | 1.0 | | | | | | | | | | | | | | | | | |
| AFF | -0.1 | -0.1 | 1.0 | | | | | | | | | | | | | | | | |
| MIN | 0.0 | 0.0 | 0.3 | 1.0 | | | | | | | | | | | | | | | |
| MAN | 1.0 | 1.0 | -0.1 | 0.0 | 1.0 | | | | | | | | | | | | | | |
| EGW | 0.8 | 0.9 | -0.1 | 0.1 | 0.8 | 1.0 | | | | | | | | | | | | | |
| CON | 1.0 | 1.0 | -0.2 | 0.0 | 1.0 | 0.9 | 1.0 | | | | | | | | | | | | |
| WST | 0.9 | 0.9 | -0.2 | 0.0 | 0.9 | 0.9 | 0.9 | 1.0 | | | | | | | | | | | |
| RLT | 1.0 | 1.0 | -0.2 | 0.0 | 1.0 | 0.9 | 1.0 | 0.9 | 1.0 | | | | | | | | | | |
| ACR | 0.9 | 0.9 | -0.2 | 0.0 | 0.9 | 0.9 | 0.9 | 0.9 | 0.9 | 1.0 | | | | | | | | | |
| TAS | 0.9 | 0.9 | -0.1 | 0.0 | 0.9 | 0.8 | 0.9 | 0.9 | 0.9 | 0.9 | 1.0 | | | | | | | | |
| COM | 0.9 | 0.9 | -0.2 | 0.0 | 0.9 | 0.9 | 0.9 | 1.0 | 0.9 | 0.9 | 0.9 | 1.0 | | | | | | | |
| FIN | 0.8 | 0.8 | -0.2 | 0.0 | 0.8 | 0.9 | 0.9 | 0.9 | 0.8 | 0.9 | 0.8 | 1.0 | 1.0 | | | | | | |
| PRO | 0.8 | 0.8 | -0.2 | 0.0 | 0.8 | 0.9 | 0.9 | 1.0 | 0.9 | 0.9 | 0.9 | 1.0 | 1.0 | 1.0 | | | | | |
| GAD | 0.6 | 0.7 | -0.2 | 0.0 | 0.5 | 0.7 | 0.6 | 0.6 | 0.6 | 0.7 | 0.6 | 0.7 | 0.8 | 0.7 | 1.0 | | | | |
| EDU | 1.0 | 1.0 | -0.2 | 0.0 | 1.0 | 0.9 | 1.0 | 0.9 | 1.0 | 0.9 | 0.9 | 0.9 | 0.9 | 0.9 | 0.7 | 1.0 | | | |
| HCS | 0.9 | 1.0 | -0.2 | 0.0 | 0.9 | 0.9 | 1.0 | 0.9 | 1.0 | 0.9 | 0.9 | 0.9 | 0.9 | 0.9 | 0.7 | 1.0 | 1.0 | | |
| CRS | 0.8 | 0.8 | -0.2 | 0.0 | 0.8 | 0.9 | 0.9 | 0.9 | 0.9 | 1.0 | 0.8 | 1.0 | 1.0 | 1.0 | 0.7 | 0.9 | 0.9 | 1.0 | |
| PER | 0.9 | 0.9 | -0.2 | 0.0 | 0.9 | 0.9 | 1.0 | 0.9 | 1.0 | 1.0 | 0.9 | 1.0 | 0.9 | 1.0 | 0.8 | 1.0 | 1.0 | 1.0 | 1.0 |