New Zealand Transport Outlook: Future State

Rail Freight Tonne-KM Model

December 2018

Short name

Rail Freight Tonne-KM Model

Purpose of the model

The Rail Freight Tonne-KM Model projects New Zealand rail freight flows over the rail lines of each region in billions of tonne-kilometres for the years 2012/13, 2022/23, 2032/33, and 2042/43.

Software used

Excel

For questions and comments:

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New Zealand Transport Outlook: Future State

Rail Freight Tonne-KM Model Documentation

1. At a high level, what does this model do?

The Transport Outlook Rail Freight Tonne-KM Model projects New Zealand rail freight flows over the rail lines of each region in billions of tonne-kilometres for the years 2012/13, 2022/23, 2032/33, and 2042/43. Each rail freight tonne handled may incur tonne-kilometres in several regions. For example, a tonne from Auckland to Wellington would incur tonne-kilometres on the rail lines of the Auckland, Waikato, Manawatu-Wanganui, and Wellington regions. This model aggregates projected rail tonne-kilometres in each region across all tonnes handled.

The model is heavily based on projections from the separately documented New Zealand Transport Outlook Freight Model, which provides projections of region-to-region freight flows in millions of tonnes for 19 commodity groups, by various transport modes, including road, rail, and coastal shipping.

There are 14 regions in the model, with the Tasman, Nelson, and Marlborough regions treated as a single region, labelled 'TNM'.

2. Where do I find the model results?

The model consists of a single Excel workbook for each scenario to be modelled. The table in the upper left corner (C6:G21) of the second sheet in the workbook, labelled 'Results', summarises total projected tonne-kilometres by region of the rail line where the tonne-kilometres are incurred. Results for each of four modelled years are provided under coloured headings: 2012/13 is shown in red in column D; 2022/23 is shown in yellow in column E; 2032/33 is shown in green in column F; and 2042/43 is shown in blue in column G. These heading colours are used consistently with the given years throughout the model.

There are also projection sheets for individual regions, with tabs identified by the name of each region. The tables on rows 29-44 of these tabs show total tonne-kilometres on the rail lines of that region broken out by the region-to-region lane incurring the tonne-kilometres. For example, in the 'Manawatu' sheet, cell I36 shows the 2012/13 tonne-kilometres on the railways of the Manawatu region incurred by freight moving from Taranaki to Hawke's Bay.

3. What are the inputs to this model and where do they come from?

As noted above, the most important inputs are from the Freight Model, which provides projections of region-to-region freight flows in millions of tonnes, by road, rail, and coastal shipping for 2012/13, 2022/23, 2032/33 and 2042/43. These results for rail are reproduced in rows 52-67 of the 'Results' sheet.

For each region, there is also a table showing the assumed tonne-kilometres incurred on the rail lines of the region by one tonne moving on the indicated region-to-region lane or, equivalently, the distance a tonne moving on the indicated region-to-region lane would move within the region. These tables appear in cells C6:Q20 of each of the sheet for each region. For example, cell I15 of the

‘Manawatu’ sheet shows that a tonne moving from Wellington to Hawke’s Bay would incur 134 tonne-kilometres in the Manawatu region; that is, a tonne moving from Wellington to Hawke’s Bay would move 134 kilometres over railways in the Manawatu region.

For freight that does not originate or terminate in the region, the distances are calculated by first selecting the most likely available routing for rail movements between the two regions, then measuring the distance between the nearest town to where that route would enter the region and the nearest town to where that route would leave the region. The assumed routings are shown in the ‘Routings’ sheet, which shows the assumed origin of the freight, the assumed towns nearest to each regional border crossed, and the assumed destination of the freight. For example, cell I15 of the ‘Routings’ sheet shows that the assumed routing from Wellington to Hawke’s Bay would be Napier-Kopua-Manakau-Wellington (it is actually shown in the reverse order, but this does not affect the distances) where Manakau is the nearest town to where the route enters the Manawatu region from the Wellington region and Kopua is the nearest town to where the route enters the Hawke’s Bay region from the Manawatu region. The assumed distance moved by this freight in the Manawatu region is, therefore, the distance from Kopua to Manakau. These distances are found in the ‘Distances’ sheet. Cell R16 of this sheet shows that this distance from Kopua to Manakau is 134 kilometres.

For freight that originates or terminates in a region, the distance within the region is based on the distance from an assumed hub town in the region to/from the town on the assumed route nearest the regional border. In most cases, the hub town is the largest city in the region. For example, the distance incurred in the Waikato region by freight moving from Waikato to Bay of Plenty is the distance from the Hamilton to Hemopo, which cell H9 of the ‘Distances’ sheet shows to be 63 kilometres. This distance is repeated in cell G9 of the ‘Wakato’ sheet.

There are four exceptions where the hub town is not the largest city in the region:

1) For Hawkes Bay, the hub town is Napier, although Hastings has a larger population. This is because Napier is the location of the Port of Napier, a major rail freight origin and destination.
2) For TNM (Tasman-Nelson-Marlborough), the hub town is Blenheim. Although Nelson has a larger population, it is not served by a rail line.
3) For the West Coast, the hub town is Ngakawau. Although Ngakawau is a small town, it is adjacent to the Stockton Mine, a major origin point for freight on the West Coast.
4) For Bay of Plenty, Tauranga is the hub city for inbound freight, as it is the largest city and the location of the Port of Tauranga. However, for outbound freight, the hub city is Kawerau, in the heart of the Bay of Plenty’s logging region, which is the source of much of the Bay of Plenty’s outbound freight.

The nearest towns to regional boundaries were identified primarily from the maps on the website of Local Government New Zealand: www.lgnz.co.nz/home/nzs-local-government/new-zealands-councils/. Rail distances were taken from Section 10 of Kiwirail’s “Rail Operating Procedures”, which we used with the kind permission of Kiwirail.

For freight that originates and terminates in the same region, distances were obtained by dividing the intra-regional tonne-kilometres from the National Freight Demand Study by the intra-regional tonnes from the National Freight Demand Study to obtain an average distance for each intra-regional tonne. For example, cell K14 of the 'Manawatu' sheet shows that the assumed distance incurred on the railways of Manawatu for a Manawatu to Manawatu tonne would be 40 kilometres.

4. How does this model derive its results?

The calculation proceeds in two stages. First, the tonne-kilometres incurred in each region by freight on each 'lane' (an origin region-destination region combination) are calculated by multiplying the tonnes on the lane by the distance incurred on the rail lines of each region. These results are shown in the tables in rows 29-44 of each regional sheet. For example, cell I36 of the 'Manawatu' sheet shows that freight from Taranaki to Hawke's Bay incurred a total of 0.021 billion tonne-kilometres in the Manawatu region, which is obtained by multiplying 0.109 million tonnes moving from Taranaki to Hawke's Bay by 194 kilometres and dividing by 1000.

Second, these tonne-kilometres incurred in each region are then summed across all region-to-region lanes to obtain the total tonne-kilometres incurred in each region. These totals are shown in the Manawatu sheet for 2012/13 in cell R44, for 2022/23 in cell AJ44, for 2032/33 in cell BB44, and for 2042/43 in cell BT44. These same results are then summarised in the 'Results' sheet, cells C6:G21.

The 'Results' sheet also shows the total tonne-kilometres incurred by freight moving on each region-to-region lane in all regions. These are shown in rows 29-44 of the 'Results' sheet. For example, cell I36 of the 'Results' sheet shows that freight from Taranaki to Hawke's Bay incurred a total of 0.047 billion tonne-kilometres. By evaluating the formula in this cell, we can see that this consists of roughly 0.011 billion tonne-kilometres on the railways of the Hawke's Bay region, 0.014 billion tonne-kilometres on the railways of the Taranaki region, and 0.021 billion tonne-kilometres on the rail lines of the Manawatu region, which rounds to 0.047 billion tonne-kilometres. \

The model estimates total rail freight in 2012/13 as 4.056 billion tonne-kilometres. This compares to the National Freight Demand Study (NFDS) estimate of 4.2 billion tonne-kilometres[1] for calendar year 2012. Kiwirail's Annual Report for 2012/13 reported 4.585 net tonne-kilometres[2], while the Ministry of Transport's Freight Information Gathering System (FIGS) reports 4.675 billion tonne-kilometres.[3] However, the NFDS report notes that their figures (and thus our figures, which are based on the NFDS) "exclude the weights of any containers used and so are different to the figures which include the weights of containers as published by FIGS and by KiwiRail".[4]

[1] See https://www.transport.govt.nz/assets/Uploads/Research/Documents/e8dbdbc206/National-Freight-Demand-Study-Mar-2014.pdf, Table 1.
[2] See https://www.kiwirail.co.nz/uploads/Publications/2013%20Annual%20Report%20(Web%20Version).pdf, p. 15.
[3] See https://www.transport.govt.nz/mot-resources/freight-resources/figs/rail/rail-trends/.
[4] https://www.transport.govt.nz/assets/Uploads/Research/Documents/e8dbdbc206/National-Freight-Demand-Study-Mar-2014.pdf, p. 184.