Ministry of **Transport**
TE MANATŪ WAKA

(1)

THE OPTION VALUE OF NEW ZEALAND'S RAILWAY LINES

Executive Summary

1. Option value refers to the value attributed to preserving the option of providing rail services at a future point when they become economically viable (provide net economic benefits).

2. NPV analysis captures the future benefits and the option value under the forecast assumptions.

3. The option value should also include analysis of potential alternative futures which may affect the economic benefits of rail though NPV analysis of high and low scenarios recognising the probability of those scenarios.

4. KiwiRail's analysis provides NPVs for its base case, and high and low scenarios (although without probabilities). This analysis concludes that, depending on whether of not it is already adequately captured in KiwiRail's upside scenario, NPV analysis of an additional 'favourable conditions' scenario, could appropriately capture the option value for the wider rail network.

5. While an NPV (including external economic benefits) would capture the option value, alternatively the option value can be measured by:
   - estimating the economic surplus that could result (in best case or favourable circumstances)
   - and multiplying it by an estimate of the probability of that occurring.

6. Using KiwiRail's base case and high scenarios, the option value of New Zealand's rail network as a whole is estimated to have a present value of between $23 million and $37 million dollars.

7. Ultimately there are a range of mothballing and maintenance options that would preserve to varying degrees, and at varying costs, railway lines for potential future use and its option value.

8. Any decisions to close or maintain individual railway lines should be supported by more detailed and specific analysis of the option value for that railway line. The impact of shifts in supply chains for some railway lines is analysed in this paper, as a potential starting point for such analysis.

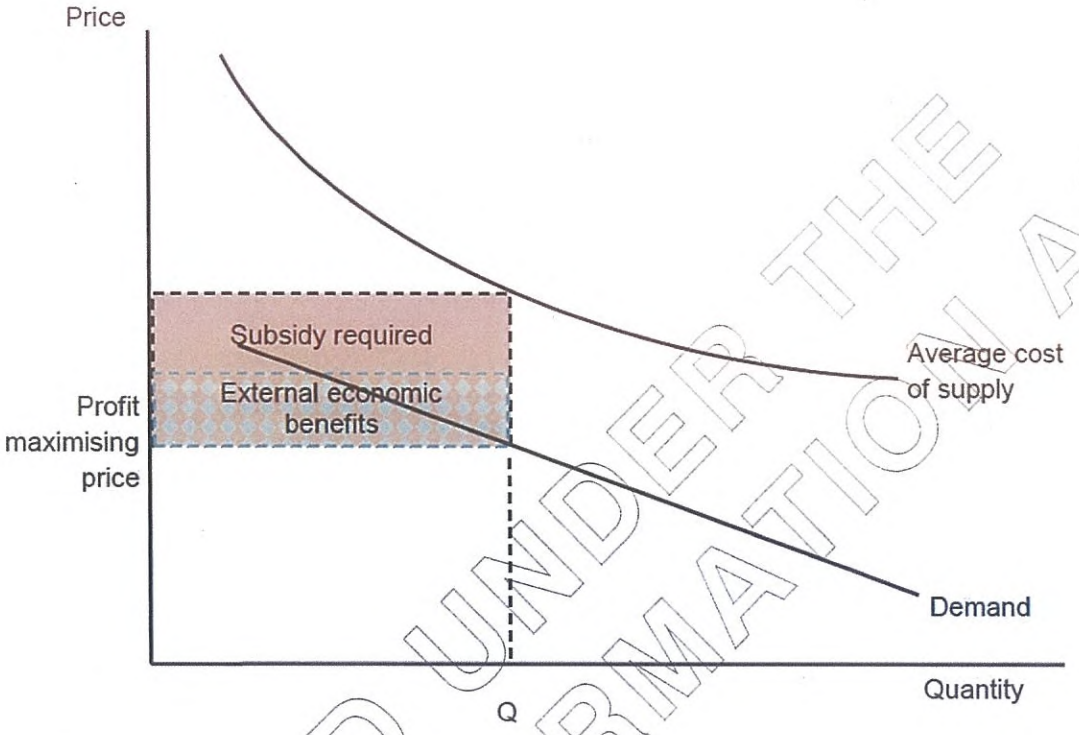
Background and purpose

9. This paper analyses the potential "option value" of key rail freight lines in New Zealand. It is intended to inform advice to government ministers on the merits of investment in the rail freight network in New Zealand.

10. Analysis suggests that rail is not an economically positive prospect at the current time, because:
    - the costs of supply are greater than the demand for rail, and
    - the subsidy required is greater the external economic benefits (from improved road service levels, reduced road accidents, and reduced environmental impacts).

11. This uneconomic scenario is demonstrated in Figure 1.

Figure 1 – An uneconomic scenario

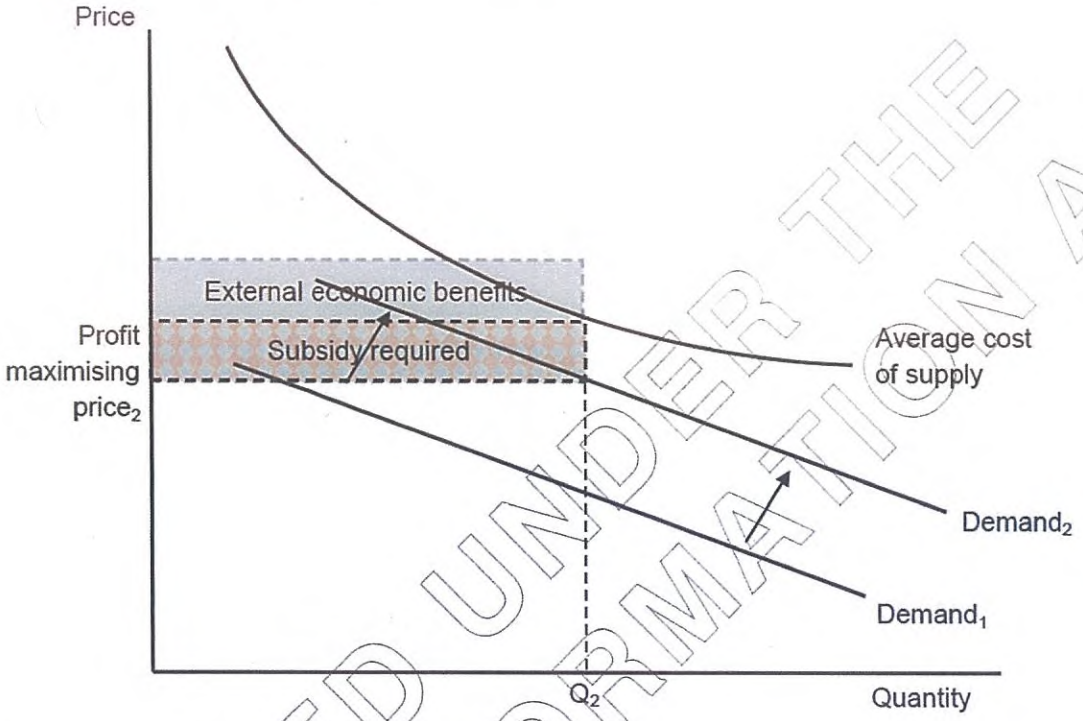


12. This paper considers the potential for rail to be economically viable in the future as a result of one, or a combination, of the following:

- growth in freight demand over time
- changes in fuel or labour prices
- an increase in demand for eco-friendly transportation
- shifts in supply chains (including port choices)

13. These changes all have the potential to shift the demand curve away from the origin (so that at any given price more quantity would be demanded). This paper assesses whether or not these changes would be sufficient to reduce the subsidy required to a point the external economic benefits are greater than the subsidy required. Such a scenario is demonstrated in Figure 2.

Figure 2 – A future scenario where increased demand results in the external economic benefits being greater than the subsidy required



14. 'Option value' is the value attributed to preserving the option of providing rail services for such a future. It can be valued as:

- the value of the external economic benefits over and above the subsidy required at some future point (the light blue box in Figure 2).

multiplied by

- the probability of that future occurring.

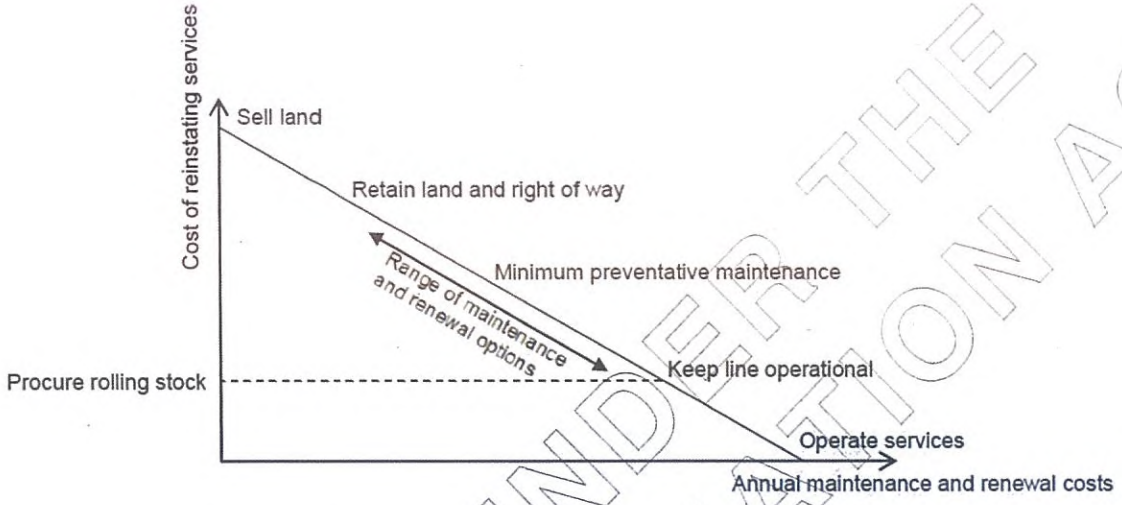
15. The option value must then be weighed against the costs of preserving the option.

Disclaimer

16. This paper provides an analysis framework for considering the "option value" of rail. It then uses currently available information and indicative scenarios to explore the potential scope and magnitude of the option value of New Zealand rail, and in some instances, key rail freight lines.

17. It is expected that there will be a continuum of maintenance and renewal choices that will preserve to varying degrees, and at varying costs, railway lines for potential future use (as shown in Figure 3).

Figure 3 – Tradeoffs between maintenance costs and the level of preservation of the railway line for potential future use.



18. Complete analysis and evaluation of the option value of particular railway lines requires information on:

- The freight demand (volume and price) that would be required for the railway line to be economically viable (cover its costs).
- The likelihood of such demand occurring at future points.
- The maintenance and renewal options, including:
  - The costs of preserving ("mothballing") the line, including the value of the land (if any) in alternative use
  - the likely cost of reinstating the line at future points
- The cost of replacement if the asset has been lost.
- The likelihood that suspending rail services would permanently damage the demand for rail.

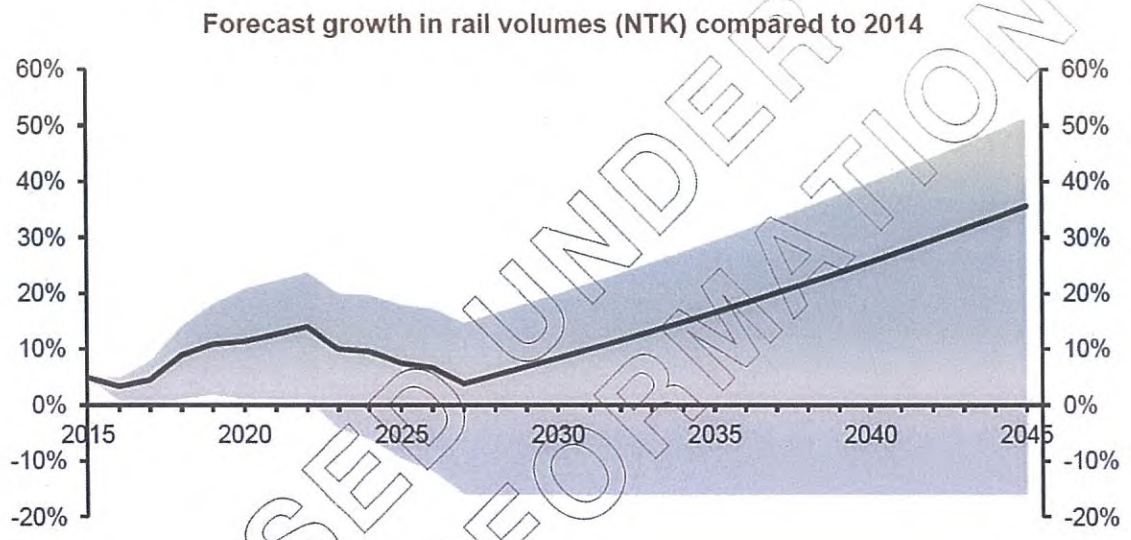
19. This information is not currently available from KiwiRail, but may become available as KiwiRail reaches the conclusion of its *Project 2045.*

Growth in freight demand over time

20. KiwiRail have formed a realistic commercial view of what rail freight demand is likely and achievable. KiwiRail has also developed downside (zero growth), and upside (optimal growth) scenarios.

21. Figure 4 shows the growth in NTK that KiwiRail is forecasting, as well upside and downside ranges.

Figure 4 – KiwiRail's forecast rail volume growth



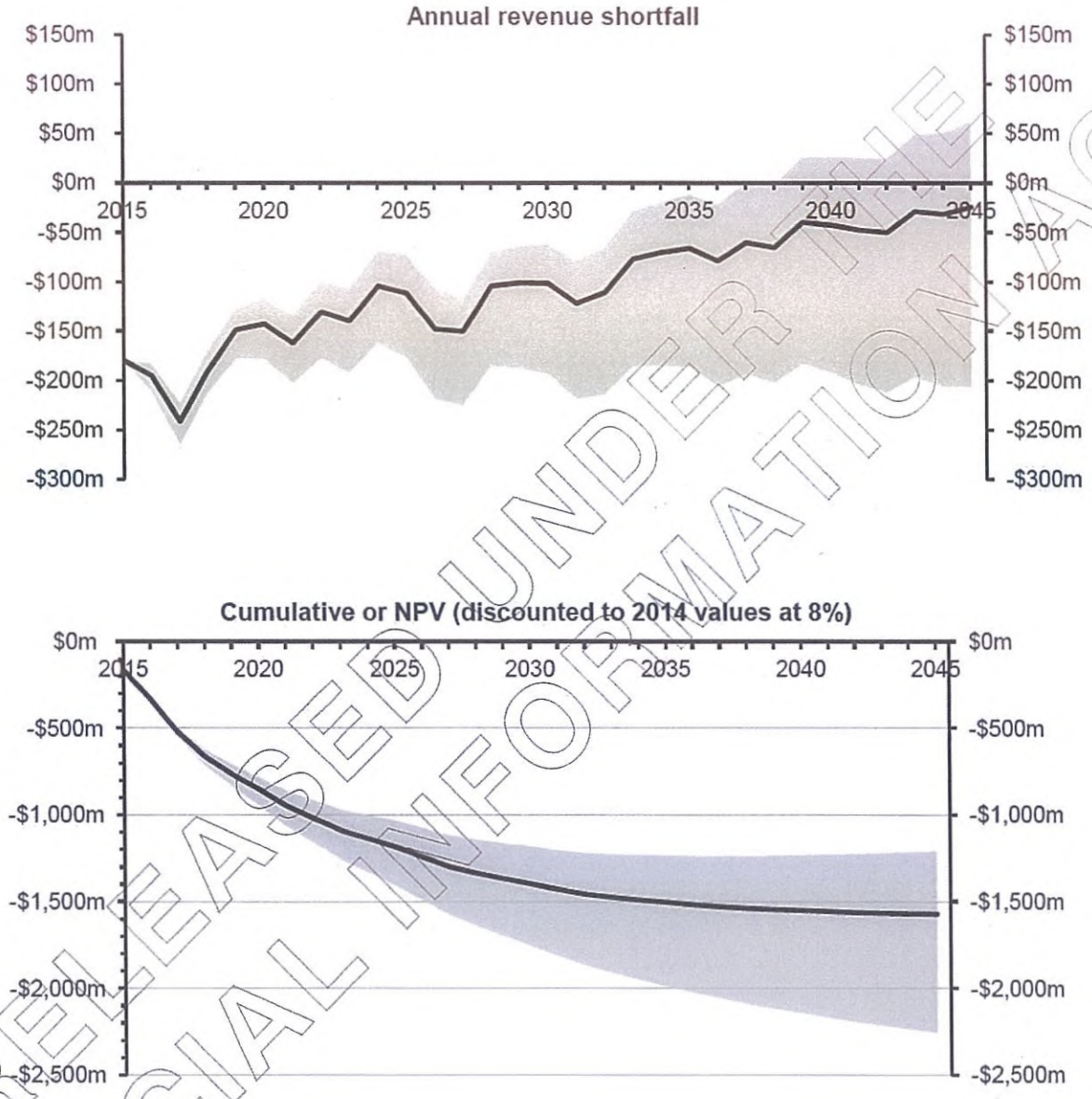
22. KiwiRail's forecasts and range provides the most informed view of how growth in New Zealand's freight task over time will benefit rail. Figure 5 shows that under its base case, KiwiRail would not become financially self sufficient within the 30 year forecast period.[1] In the upside scenario, KiwiRail would become financially self sufficient in around 2037–39.

23. These forecasts and ranges provide a useful base case which includes any option value associated with growth in freight demand over time.

24. The remaining three potential demand shifts identified in paragraph 4 can also be tested against this base case.

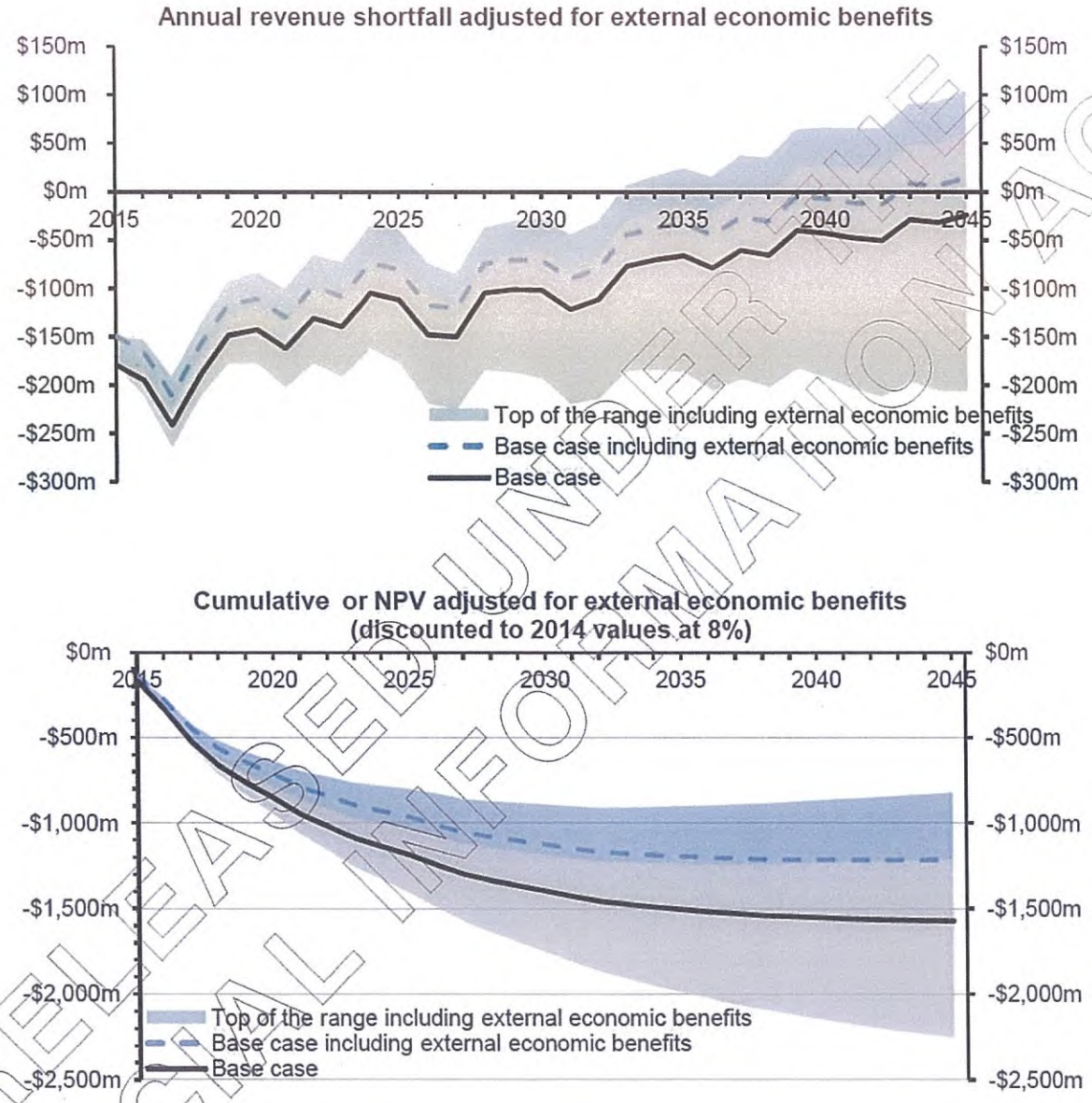
[1] KiwiRail, Project 2045 RGG Update, 13 October 2014

Figure 5 – KiwiRail's forecasts of the annual subsidy required



25. Figure 6 shows KiwiRail's forecasts taking into account the external economic benefits (current estimate of $20 m in safety benefits, and $10 m in environmental benefits projected to increase with NTK). Figure 6 shows the point at which rail would become economically viable (where the external economic benefits are greater than the subsidy required) under the base case and the upside scenario – the point where the blue enters into positive.

Figure 6 – KiwiRail's forecasts of the annual subsidy required adjusted for external economic benefits



26. KiwiRail's forecasts provide the base case for this analysis (one that takes into account forecast growth in freight demand). However, there is a wider range of uncertainties regarding supply chain patterns, economic opportunities, environmental concerns, and fuel price, all of which could affect freight demand for rail and the future value of rail services. Alternative futures can be considered against KiwiRail's base case and range.

Increase in fuel price increases and/or labour costs

27. Rail is generally uses less fuel and labour (on a fuel or driver per tonne-km basis) than road. So road freight is more exposed to cost increases in fuel and labour than rail (and coastal shipping). Increases in the cost of fuel or labour could provide rail a cost advantage, compared to present, or allow rail to increase its margin while maintaining its market competitiveness.

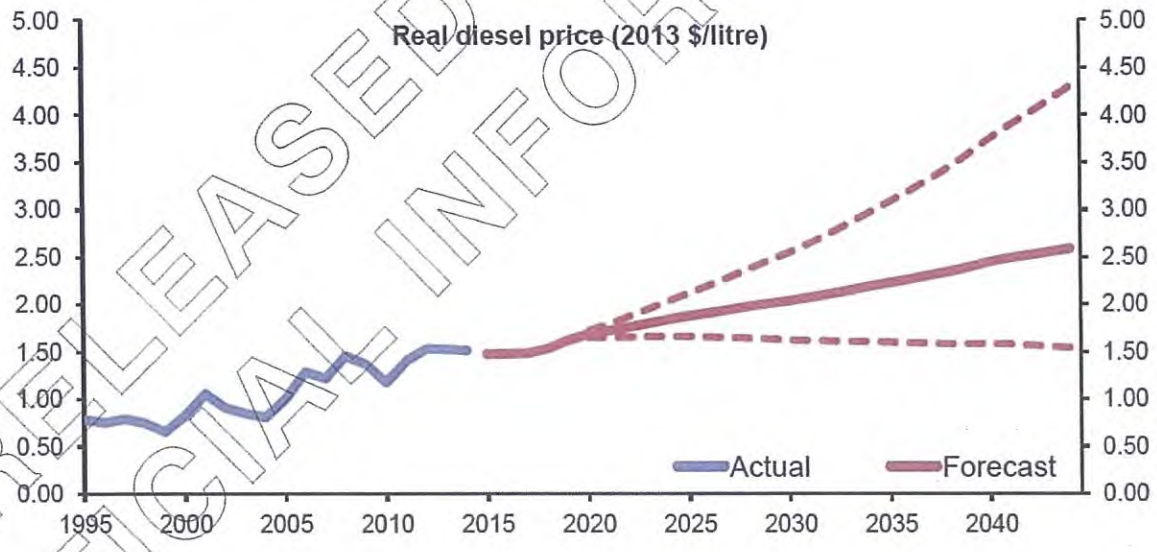
28. The potential impact on the demand for road freight and rail freight depends on the cross price elasticity of demand for road and rail freight, and the volume of freight that is actually contestable between the two. There could also be offsetting substitution from rail to coastal shipping (which is even less affected by fuel and labour cost increase).

29. Rail's pricing is on average 40-50% below the next best alternative for road.[2] Analysis of the potential substitution of changes in relative prices of road, rail and shipping has not been undertaken for this paper.

30. An alternative, for KiwiRail, would be to capture the benefits in its price margin.

31. Figure 8 shows current fuel forecasts for the next 30 years.[3] Figure 8 shows that real diesel price is forecasts to increase by 78% over the next 30 years (a CAGR of 1.9%). The high scenario (at 67% confidence) allows for an increase in the real price of diesel of 201% over the next 30 years (a CAGR of 3.7%).

Figure 8 – Forecast diesel prices[4]



32. Fuel costs represent approximately 15–20% of road freight rates[5], and approximately 8–15% of rail freight rates. This suggests that KiwiRail could potentially capture up to 12% of any increases in fuel prices in its margin and maintain cost relativity.

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[2] IBID, and also New Zealand Transport Agency research report 497, *Freight transport efficiency: a comparative study of coastal shipping, rail and road modes*, October 2012

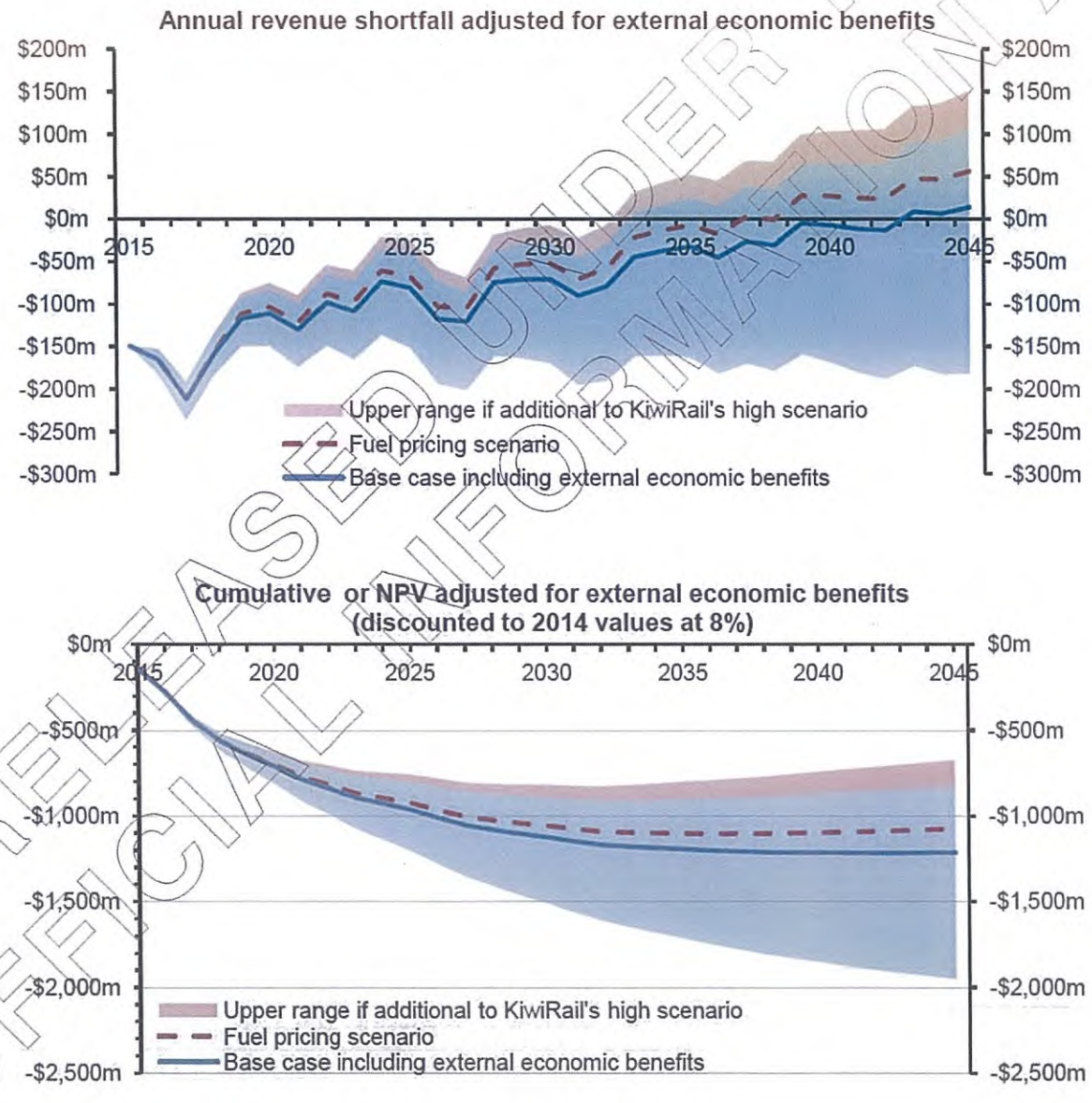
[3] MoT, NLTF Revenue forecasting model, OBU 2014 – based on international oil price forecasts from the US Energy Information Administration's 2014 Annual energy outlook, and converted into $NZ per litre of diesel.

[4] MoT, NLTF Revenue forecasting model, OBU 2014 – based on international oil price forecasts from the US Energy Information Administration's 2014 Annual energy outlook, and converted into $NZ per litre of diesel.

33. But with a fuel cost CAGR of up to 3.7% (at the upper range), this represents an annual increase in rates of just 0.4% a year. On current external freight revenues of around $420 – 490 million, this represents additional annual revenue of just $1.9 – 2.2 million, but such increase can add up over time.

34. Figure 9 shows the impact of strategy in a high fuel price scenario (at the upper range), over and above whatever impact is assumed in KiwiRail's base case forecasts and high and low scenario.

Figure 9 – Impact of increasing prices to capture comparative advantage from fuel price increases



[5] Pearsons Transport Resource Centre Pty Ltd, *Review of Road Freight Costs in New Zealand and Comparable Australian states*, October 2007, and "2006 Operator Comparison Report", prepared by the University of Waikato, as reported in the Ministry of Transport, Understanding Transport Costs and Charges – Phase two – Transport costs in freight logistics, November 2010.

35. A high diesel price scenario might support the revenue growth needed by KiwiRail's upper scenario. It would make little difference in the near term, but could bring forward the point at which rail becomes economically viable and impact on the long term NPV.

36. Depending on whether of not it is already adequately captured in KiwiRail's upside scenario, NPV analysis of an additional 'favourable conditions' scenario, as shown in Figure 9, and considering its probability, could appropriately capture the option value for the wider rail network. If additional to KiwiRail's upside scenario it could have greater impact on the long term NPV.

37. Over time, or incentivised by an increase in prices, improvements in productivity and the fuel efficiency of trucks may reduce the impact of increases in fuel prices, and the cost advantage to rail.

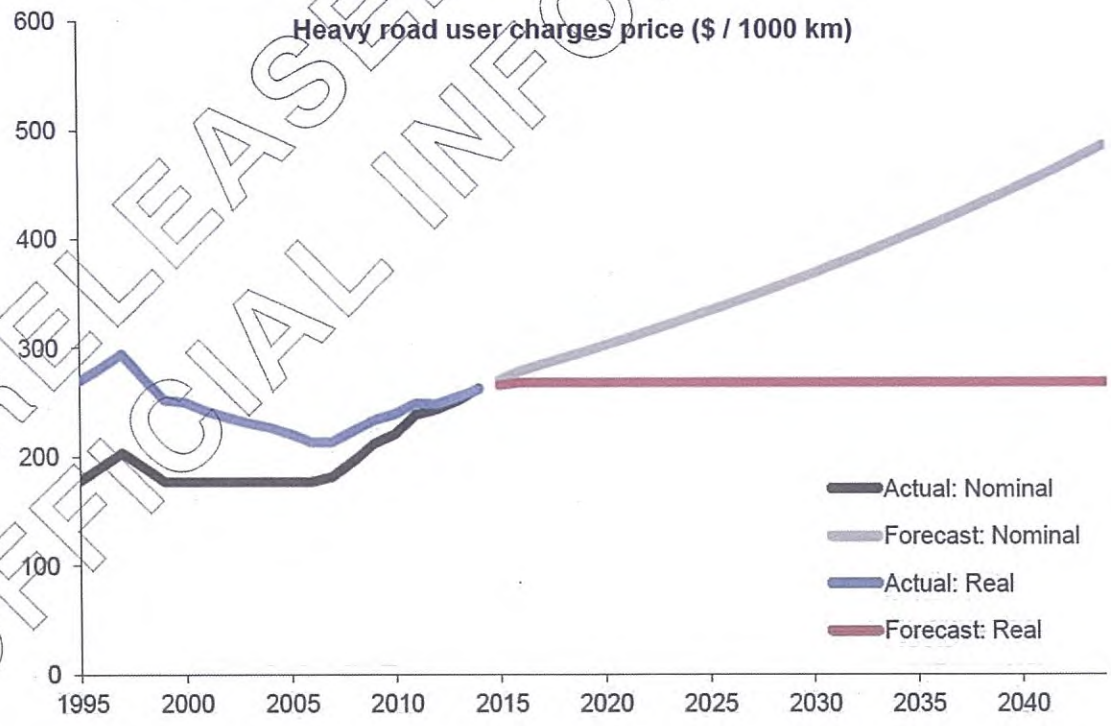
Labour Prices

38. A similar exercise could be completed for increases in labour price. However, labour prices are less volatile and uncertain than fuel prices – subject to economic cycles they generally increase in line with price inflation – so should be adequately captured in KiwiRail's analysis.

Road user charges increase

39. As shown in Figure 9, there are currently no plans or policies in place to increase the real road user charges rates for heavy vehicles after 1 July 2015.

Figure 10 – Future heavy road user charges price increases[6]



[6] MoT, NLTF Revenue forecasting model, OBU 2014

An increase in demand for eco-friendly transportation

40. The result of such a change would be a price driven and customer driven increase in rail use.

41. As carbon emissions are directly linked to fuel burn, the impact of price changes to carbon, or demand shifts to low carbon options would be the same as increases in the price of fuel.

42. Again, if incentivised by an increase in prices, improvements in productivity and the fuel efficiency of trucks and trains may reduce the impact (and comparative advantage to rail) of such a change.

Estimating the option value

43. While an NPV (including external economic benefits) would capture the option value, alternatively the option value can be measured by:

- estimating the economic surplus that could result
- and multiplying it by an estimate of the probability of that occurring.

44. Figure 11 shows this calculation using the KiwiRail's scenarios, and the further 'favourable conditions scenario' (based on the fuel price analysis outlined above).

44.1. The base case, with a future economic surplus of effectively zero[7] (including economic benefits), is assumed to have a probability of 50% (i.e. it could be equally above or below).

44.2. A normal distribution is assumed[8] to work out to work out a weighed average (by probability) for the future economic surplus.

44.3. The value of the positive economic surplus under KiwiRail's high scenario, occurring from 2033 –2045 (the area shown in blue in Figure 11) has a present value of $88 million (discounted at 8%).

44.4. The value of the positive economic surplus under the 'favourable conditions scenario', occurring from 2032 –2045 (the blue and pink areas in Figure 11) has a present value of $153 million.

44.5. Two estimates of probability distribution were used to provide an estimated range for the option value. The two distributions reflect the degree to which KiwiRail's upper scenario might already reflect (or be supported by) the possibility of more favourable conditions, such as increases in fuel price.

44.6. For the lower estimate, KiwiRail's high scenario is assumed to represent the upper bound of a 90% confidence interval.

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[7] Actual figure is $3 million, but this has been assumed zero in the distribution calculations. This assumption does not have a material impact on the estimate of the option value.

[8] Sensitivity testing using of alternate distribution patterns resulted in immaterial differences relative to the final estimate range.

44.7. For the upper estimate, KiwiRail's high scenario is assumed to represent the upper bounds of a 67% confidence interval, which corresponds to the 'favourable conditions scenario' representing the upper bound of a 90% confidence interval.

45. The option value is estimated to have a present value of between $23 million and $37 million dollars.

46. This estimate only considers the potential value within the 30 year forecast period. There is potentially additional value if rail were able to provide economic benefits beyond this period. The potential value and likelihood and of this have not been estimated.

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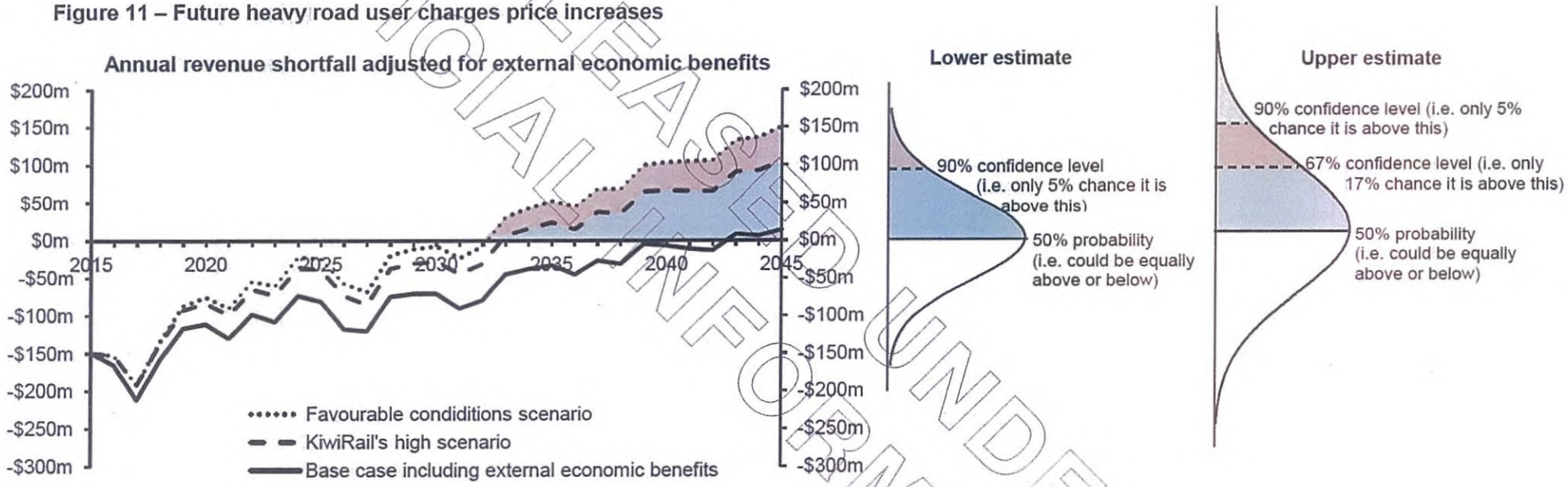
Figure 11 – Future heavy road user charges price increases



Present value of economic surplus under the scenarios	
Base case	$3 million
KiwiRail's high scenario (blue shading)	$88 million
Favourable conditions scenario (blue and pink shading)	$153 million

Option value	
Lower Estimate	Upper Estimate
$23 million	$37 million
(weighted average of the present value of economic surplus according its probability using the above probability distribution)	

Shifts in supply chains (including port choices)

47. The following sections examine the potential impacts on particular railway lines from potential shifts in supply chains, or changes in port choice.

The Northland line

withheld under section 9(2)(b)(ii) and section 9(2)(i) of the Official Information Act 1982

[redacted]

The potential impact of shifts in supply chains - Northport container scenario

50. The only supply chain shift that we have identified that may substantially impact the freight demand for the Northland to Auckland corridor would be the development of Northport into a significant container port as a replacement to the Ports of Auckland.

51. Analysis into the potential for Northport identified[10]:

51.1. It would involve considerable capital investment, including upgrading the North Auckland rail Line would require upgrading, probably including additional passing loops and reducing the number of tunnels and increasing the height of those that remain. A new link would be required between Northport and the main trunk line.

51.2. If POA can achieve substantial operational efficiencies in container berth usage and productivity, and upgrade its container stacking technology, the current container infrastructure should be sufficient to cater to future growth out to 2041 (though only just). The port will still require additional berth and storage space before 2041 if it is to cater to our projected bulk cargo trade task. If POA is unable to gain consent for an expanded footprint, then some of the projected growth at POA will need to be accommodated at other ports.

51.3. The report also notes that Northport has significant constraints around the turning area for larger ships, that would require significant development with potentially large environmental costs. It would result in additional costs for cargo owners through the increased distance to port

51.4. The report concludes that it seems doubtful that the benefits are large enough to justify the development of Northport.

withheld under section 9(2)(b)(ii) and section 9(2)(i) of the Official Information Act 1982

[redacted]

[10] PWC, Upper North Island Port Study, November 2012

52. Based on the above analysis, the option of Northport developing into a significant container terminals seems:

- highly unlikely
- a long way off
- would require significant capital investment including into the rail link, regardless of whether or not it remains operational or has been mothballed.

Conclusion

53. The development of Northport into a significant container port as a replacement to the Ports of Auckland is the only foreseeable future in which the Northland line might become economically viable. However, the likelihood of this occurring is remote. It would not occur for a significant period, and significant capital investment would be required anyway, lessening the impact of significant reinstatement costs. Mothballing at minimal cost is likely to sufficiently maintain the option value for the Northland line.

South Island West Coast line

54. For the South Island West Coast line, uncertainties surrounding the future of coal are the only relevant consideration. Excluding coal, just 600,000 tonnes of freight leaves the West Coast Region, with 1,000,000 tonnes moved into the region, a third of which comes from the neighbouring Tasman, Nelson Marlborough region, where there are no direct railway lines. This leaves little other freight potential for rail.

55. Should this rail line not be economic at this point it may make sense to undertake mothballing at minimal cost in the event that the transportation of coal by rail becomes economic in future due to changes in world coal demand and price.

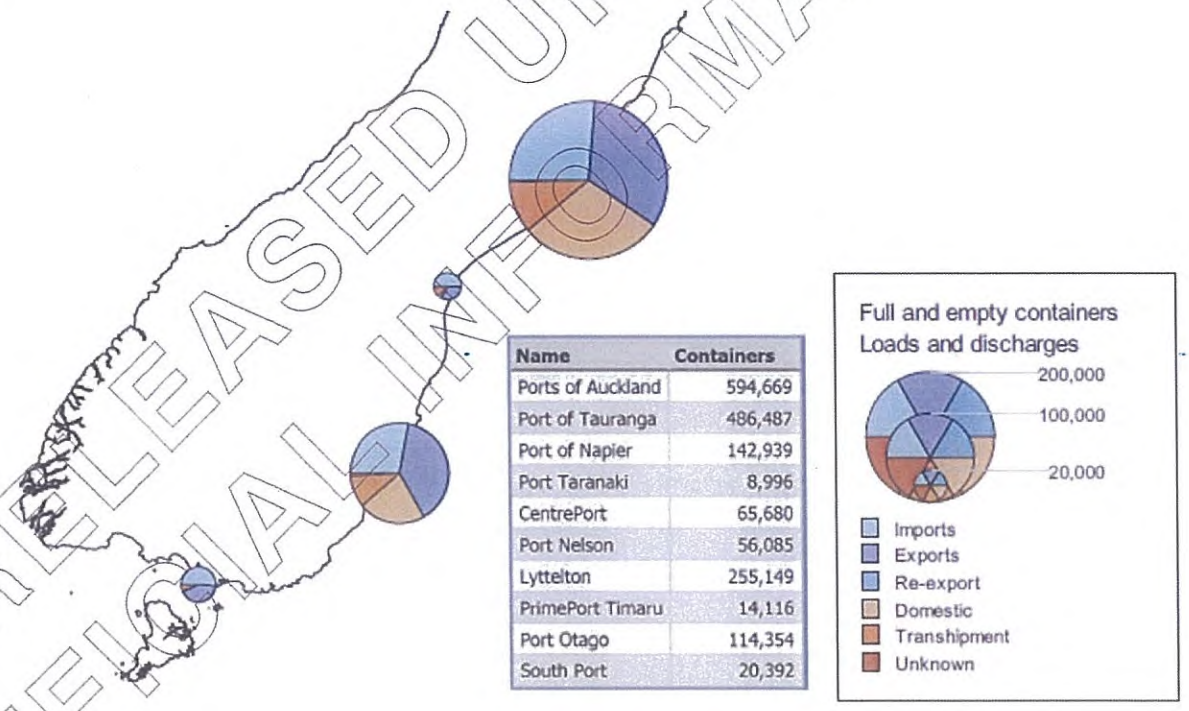
56. Detailed analysis of the potential future for coal has not been undertaken for this paper.

[redacted]

The potential impact of shifts in supply chains

58. For the South of Christchurch lines, there is some uncertainty around export flows depending on the choice of port. Currently there are four container ports in operation in the mid-lower South Island (shown in Figure 12). Consolidation of these ports has the potential to impact on the freight demand for rail on particular sections of the line.

Figure 12 – Current lower South Island ports and container import and export volumes



Name	Containers
Ports of Auckland	594,669
Port of Tauranga	486,487
Port of Napier	142,939
Port Taranaki	8,996
CentrePort	65,680
Port Nelson	56,085
Lyttelton	255,149
PrimePort Timaru	14,116
Port Otago	114,354
South Port	20,392

59. Figure 13 shows the modelled impact on South of Christchurch rail lines from a consolidation of South Island container ports to either two (Lyttelton and Otago), or just one port. It demonstrates that port consolidation has the potential to increase overall rail volumes in the order of 100,000–200,000 tonnes (6-33%), or more if Port Otago were to become the sole South Island container port.

Figure 13 – Modelled impact on South of Christchurch rail lines from a consolidation of container ports

Rail container movements	BAU		Lyttelton and Otago		Lyttelton		Otago	
Tonnes	2012	2042	2012	2042	2012	2042	2012	2042
Port Chalmers - Balclutha	108,392	170,178	135,412	202,306	-	-	136,561	204,016
Port Chalmers - Christchurch	-	-	-	-	-	-	391,008	655,186
Port Chalmers - Dunedin	-	-	-	-	-	-	-	-
Port Chalmers - Invercargill	375,174	553,723	472,889	706,492	-	-	477,025	712,646
Port Chalmers - Oamaru	13,018	16,676	24,329	34,407	-	-	27,141	38,044
Port Chalmers - Timaru	52,870	95,775	80,707	148,025	-	-	179,756	310,288
Port of Lyttelton - Balclutha	1,149	1,710	1,149	1,710	136,561	204,016	-	-
Port of Lyttelton - Christchurch	95,010	159,178	98,176	164,280	97,752	163,796	-	-
Port of Lyttelton - Dunedin	8,891	13,275	8,891	13,275	71,562	114,019	-	-
Port of Lyttelton - Invercargill	2,955	4,395	2,955	4,395	340,732	509,033	-	-
Port of Lyttelton - Oamaru	4,687	6,062	4,687	6,062	45,234	63,407	-	-
Port of Lyttelton - Timaru	123,812	202,829	123,812	202,829	224,695	387,860	-	-
Port Southport - Balclutha	10,808	12,851	-	-				
Port Southport - Dunedin	-	-	-	-				
Port Timaru - Christchurch	13,710	23,090	-	-				
Port Timaru - Dunedin	-	-	-	-				
Port Timaru - Oamaru	18,851	29,550	-	-				
Total	**829,326**	**1,289,294**	**953,005**	**1,483,782**	**916,536**	**1,442,130**	**1,211,491**	**1,920,180**
Difference from BAU			123,679	194,488	87,210	152,837	382,164	630,886

Conclusion

60. Consolidation of container ports in the South Island has the potential to materially increase rail volumes on some parts of the South of Christchurch line.

Central North Island lines

withheld under section 9(2)(b)(ii) and section 9(2)(i) of the Official Information Act 1982

[redacted]

61. Although the Central North Island and Hamilton to Palmerston North railway lines come close to covering their capital costs and contributing to overheads:

61.1. the Central North Island line is reliant on the Hamilton – Palmerston North line

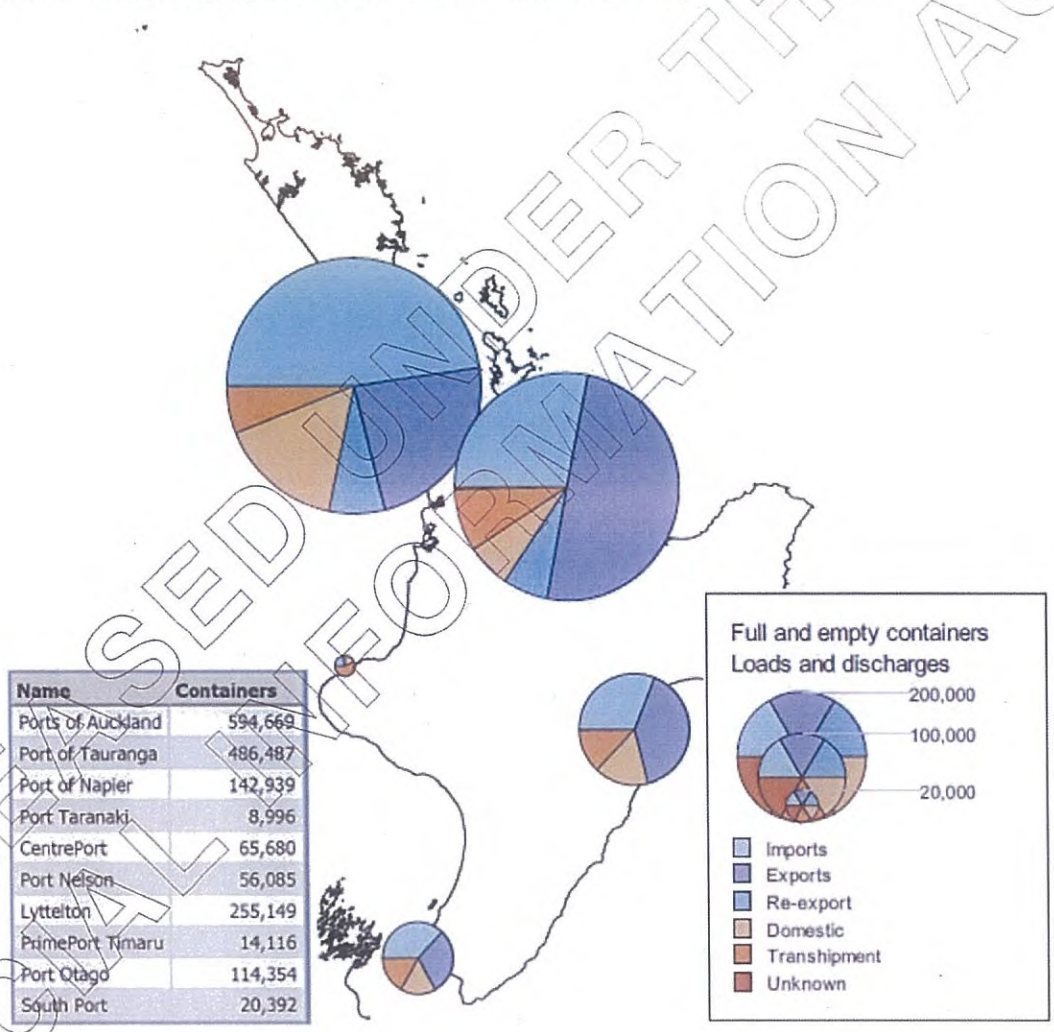
61.2. the Hamilton – Palmerston North is reliant on the connection to Christchurch (much of its revenues come from freight moving from Auckland to Wellington and Christchurch).

[redacted]

The potential impact of shifts in supply chains

64. The central North Island railway lines connect central North Island exports to a range of ports: Auckland/Tauranga, Napier, Taranaki, Wellington. Figure 14 shows the North Island container ports and their current volumes of import and export. Like the South of Christchurch lines, consolidation of container ports, or significant shifts in exporters' choice of port could impact particular lines.

Figure 14 – Current North Island ports and container import and export volumes



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PrimePort Timaru	14,116
Port Otago	114,354
South Port	20,392

65. Figure 15 shows the modelled impact on central North Island rail from a consolidation of North Island container ports to either three (Auckland, Tauranga, Napier), or two (Auckland and Tauranga). It demonstrates that port consolidation has the potential to increase overall rail volumes in the order of 150,000–250,000 tonnes (10–25% of current volumes).

Figure 15 – Modelled impact on Central North Island rail lines from a consolidation of container ports

Rail container movements	BAU		Auckland, Tauranga, Napier		Auckland, Tauranga	
Tonnes	2012	2042	2012	2042	2012	2042
Ports of Auckland - Hastings	-	-	-	-	-	-
Ports of Auckland - Hawera	25,125	30,483	25,125	30,483	25,125	30,483
Ports of Auckland - Kawerau	18,365	22,014	18,365	22,014	18,365	22,014
Ports of Auckland - Masterton	-	-	-	-	-	-
Ports of Auckland - Napier	11,116	16,949	11,116	16,949	11,116	16,949
Ports of Auckland - Nelson	-	-	-	-	-	-
Ports of Auckland - New Plymouth	-	-	-	-	-	-
Ports of Auckland - Palmerston North	6,573	7,051	6,573	7,051	6,573	7,051
Ports of Auckland - Taupo	-	-	-	-	-	-
Ports of Auckland - Wellington	-	-	-	-	-	-
Ports of Auckland - Whanganui	187	289	212	326	187	289
Port Napier - Auckland	121	180	121	180	-	-
Port Napier - Christchurch	428	475	428	475	-	-
Port Napier - Hamilton	453	673	453	673	-	-
Port Napier - Hastings	95,790	143,013	95,790	143,013	-	-
Port Napier - Hawera	105,493	123,585	110,936	130,150	-	-
Port Napier - Masterton	151	224	2,402	3,574	-	-
Port Napier - Palmerston North	81,646	110,978	118,328	164,630	-	-
Port Napier - Whanganui	905	1,347	905	1,347	-	-
Port Napier - New Plymouth	-	-	-	-	-	-
Port Napier - Wellington	-	-	129,660	192,518	-	-
Port Tauranga - Gisborne	-	-	-	-	-	-
Port Tauranga - Hastings	55,383	82,384	55,383	82,384	246,962	368,410
Port Tauranga - Hawera	31,304	39,027	52,846	68,146	132,086	161,111
Port Tauranga - Kawerau	477,302	717,487	477,302	717,487	477,302	717,487
Port Tauranga - Napier	33,360	60,645	33,360	60,645	33,360	60,645
Port Tauranga - Nelson	-	-	-	-	-	-
Port Tauranga - New Plymouth	1,525	2,352	23,720	32,354	23,720	32,354
Port Tauranga - Masterton	-	-	-	-	12,012	17,868
Port Tauranga - Palmerston North	12,812	14,795	12,812	14,795	131,140	179,425
Port Tauranga - Tauranga	-	-	-	-	-	-
Port Tauranga - Wellington	26,647	36,294	26,647	36,294	188,722	276,942
Port Tauranga - Whanganui	-	-	38,651	70,731	39,582	72,115
Port Wellington - Hawera	6,221	7,504	-	-	-	-
Port Wellington - Palmerston North	36,682	53,652	-	-	-	-
Port Wellington - Wellington	-	-	-	-	-	-
Port Wellington - Whanganui	25	37	-	-	-	-
Port Wellington - Picton	1,119	1,812	-	-	-	-
Port Taranaki - Hastings	-	-	-	-	-	-
Port Taranaki - Hawera	12,925	17,471	-	-	-	-
Port Taranaki - Masterton	-	-	-	-	-	-
Port Taranaki - New Plymouth	22,195	30,001	-	-	-	-
Port Taranaki - Palmerston North	-	-	-	-	-	-
Port Taranaki - Whanganui	7,730	14,146	-	-	-	-
Total	**1,071,581**	**1,534,869**	**1,241,134**	**1,796,219**	**1,346,252**	**1,963,142**
Difference from BAU			169,553	261,350	274,670	428,273

Conclusion

66. Consolidation of container ports in the North Island has the potential to materially increase rail volumes on some North Island lines.