RAYLINK CONSULTING

REGIONAL RAIL EAST & HASTINGS RAIL LINK
Concept of Operations Report

PRELIMINARY RAIL INFRASTRUCTURE CAPACITY REPORT

FEBRUARY 2017

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1. Purpose of Report

The purpose of this report is to provide strategic rail planning support to the planning requirements for port development in the future, in particular a possible future container port at Hastings. The report provides a high-level assessment regarding how the rail system would operate along the Dandenong and Cranbourne lines to Lyndhurst where a future new rail link could provide a connection to Hastings.

2. Background and RRE Context

The existing rail connection to the Port of Hastings is via the Frankston/Stony Point rail line. This line is a broad gauge line and the line is electrified between Melbourne and Frankston. The location of the Frankston/Stony Point line is shown in figure 1 below.

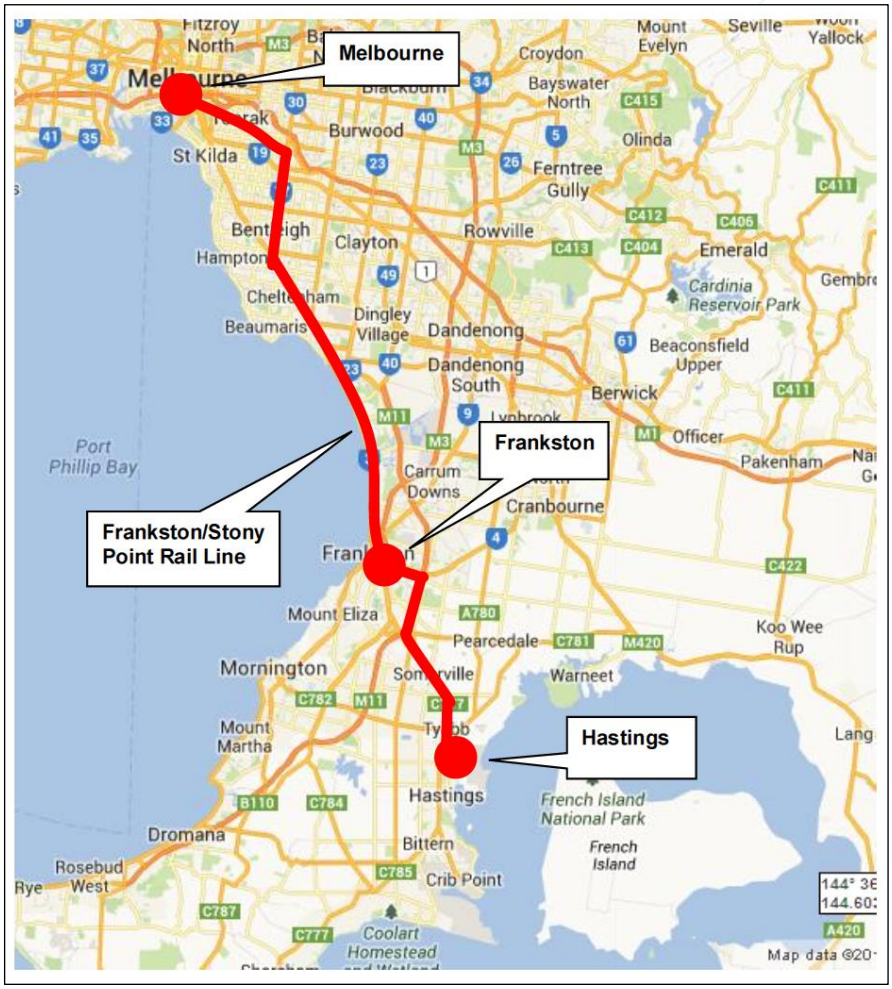

Figure 1. The Frankston/Stony Point Rail Line

Between Melbourne and Frankston the Stony Point line accommodates an intensive suburban electric rail passenger service with limited opportunities for freight trains. Beyond Frankston, the line is a diesel train only line with diesel passenger trains operating to Stony Point and diesel freight trains operating to the BlueScope steel mill near the existing Port of Hastings.

Between Melbourne and Frankston, the line is one of Melbourne's most heavily trafficked railways, experiencing very high passenger demand and is constrained by various issues that limit the ability to run more services. If a large container port were to be built at Hastings the demand for rail freight services to the Port would increase enormously, however as the demand for passenger services grows in line with population growth, these capacity issues will limit the available pathways for rail freight services to the port.

Although it would be physically possible to connect to a possible future Hastings container port, via the Frankston/Stony Point line, there would be insufficient capacity on that line between Melbourne and Frankston to accommodate the additional rail traffic. In addition, the existing rail corridor width along a significant portion of the Stony Point line between Melbourne and Frankston is not wide enough to accommodate the line or lines that would be required for an upgraded rail link to Hastings. A significant amount of addition land would be required for the rail link along this corridor and the resultant residential property impacts would be very significant. In addition, construction of any additional tracks would necessitate removal of all remaining level crossings on the line that are not already part of the Government's current level crossing removal program.

There are a number of advantages in providing a possible new rail link to Hastings by constructing a separate dual gauge line to Dandenong and Lyndhurst as well as a new independent rail link to Hastings via the Western Port Highway corridor. As well as providing a pathway for Port of Hastings container trains if the container port proceeds, the new line would also provide a pathway for Gippsland passenger and freight trains between Dandenong and the City where they currently face significant delays due to growing congestion problems. The new line would also provide a pathway for container shuttle trains between the proposed Lyndhurst Intermodal terminal and the city. The alternative of providing a new independent rail link to Hastings via the Frankston/Stony Point line does not provide these three important additional benefits.

3. Current Dandenong/Cranbourne Line

The Dandenong line is a double track rail line that continues as an electrified line to Pakenham and to Gippsland as a "diesel train" line. At Dandenong, there is a rail junction where the single-track Cranbourne line commences. The layout and operation of the Dandenong and the Cranbourne lines are discussed in more detail below.

3.1 Current Dandenong/Lyndhurst configuration

The rail line to Dandenong is a double track line. The layout of the line is shown in the figure below.

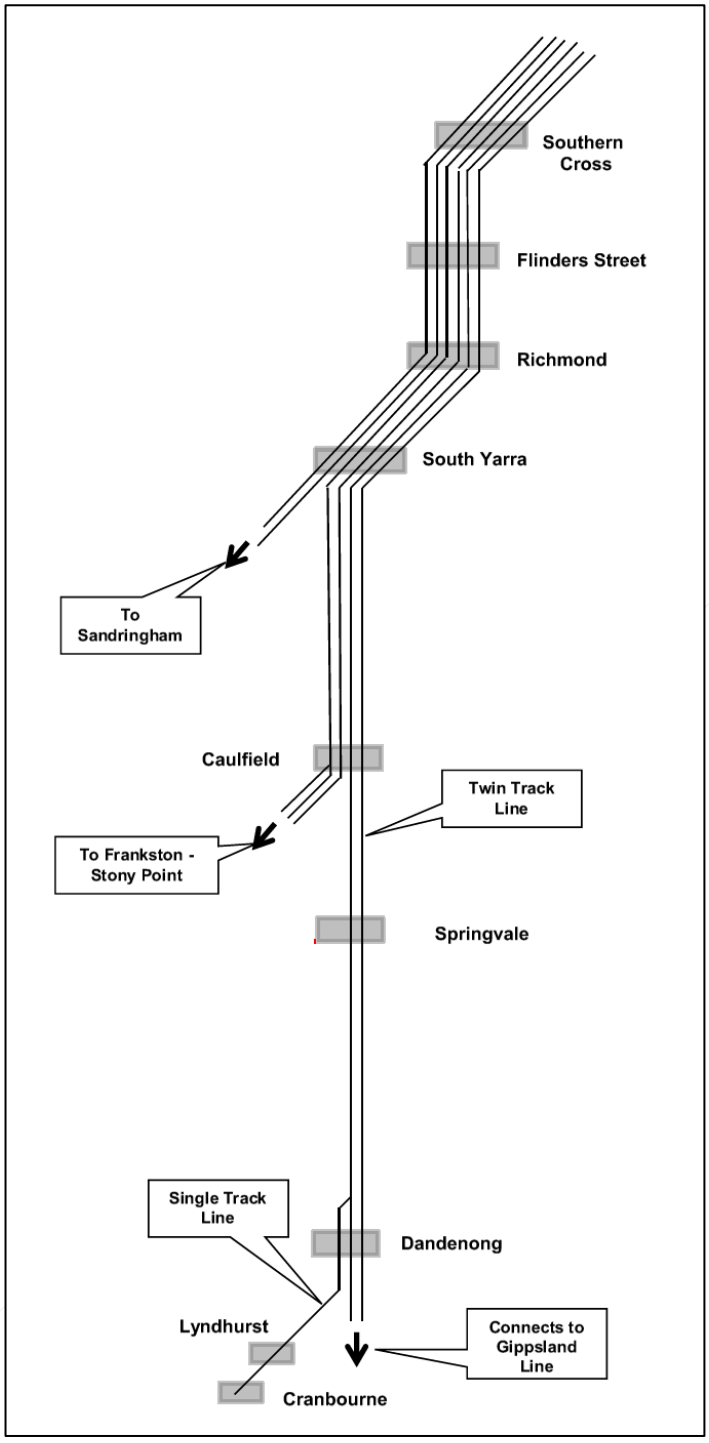

Figure 2. The Dandenong/Cranbourne Rail Line

At Dandenong, there is a rail junction where two lines continue on to Pakenham and Gippsland and a single line continues on to Cranbourne. Part of this single line will be duplicated over the short distance between Dandenong and the Greens Road level crossing as part of the current Cranbourne/Pakenham Rail Upgrade Project.

3.2 Rail operation and capacity of Dandenong/Cranbourne Line

Between the CBD and Dandenong, the current line carries some 18 trains per hour in both directions during peak periods, the balance occurring because all metropolitan trains enter the CBD via the Caulfield Underground Loop and thereby return towards Dandenong in comparable numbers. Two V//line Gippsland trains per hour are also included in the overall peak period train numbers. The line also now operates at 10 minutes frequency during inter-peak and shoulder peak periods, as well as during most of Saturdays and Sundays. Services revert to a 20 minute frequency after 1900 hours until after midnight with a gap of around 4 hours until morning services resume. This does not apply on early Saturday and Sunday mornings when all-night services run at hourly intervals.

For V/Line Gippsland trains and freight trains operating between Dandenong and the CBD and continuing through Southern Cross station to the Port of Melbourne or destinations to the west or north of Melbourne, a cross-move has to occur in the vicinity of Flinders Street station from the Dandenong corridor lines to the Cross-City lines. These presently link Frankston and Werribee. This corridor presently carries 14 trains per hour in peak periods, 9 trains per hour during weekday inter-peak periods and 6 trains per hour at other times, including weekends, excluding any V/Line or freight train movements. The cross-move involves complex scheduling and effectively restricts these movements to two per hour for V/Line and one per hour for freight trains in each direction, peak periods excepted.

The practical outcome is that one freight train path per hour in each direction is currently available between the CBD and Dandenong for 18 hours per day on weekdays and for 24 hours per day on weekends or public holidays. Victorian broad gauge freight trains are permitted to be up to 1200 metres in length and trains of this length could theoretically operate to Hastings, although sidings in the Port of Melbourne precinct have generally been designed to accommodate much shorter trains. In addition, proposed signalling changes in the vicinity of Flinders Street that have been designed to facilitate the cross-movement described above have been configured around a maximum train length of 600 metres. Practical capacity assessments on the current infrastructure should therefore be based on trains of this length.

Further underlying assumptions for calculating present corridor capacity measured in twenty-foot equivalent units (TEUs) for the carriage of containers are:

- Each 600 metre long train can convey a maximum of 84 TEU
- Given normal demand and logistical variability, the average train operates at 80% capacity, i.e. with an average of 68 TEU in each direction or 136 TEU per round trip
- Trains operate 365 days per year comprising 250 weekdays and 115 weekend and public holiday days

Therefore current theoretical freight train capacity of the Dandenong rail corridor if every available train path is utilised is:

(250 days x 18 trips) + (115 days x 24 trips) = 4500 + 2760 = 7260 trips x 136 TEU = 987,360 TEU pa.

This capacity will reduce in coming years and specifically when the Melbourne Metro (MM) tunnels become operational. A new set of potentially conflicting movements will occur for eastbound trains

at the proposed South Yarra Junction due to the need to merge trains from the MM tunnels with V/Line and freight trains coming from Southern Cross and Flinders Street on the existing surface lines. When MM opens, the Sunshine-Dandenong corridor will be carrying 21 trains per hour during peak periods and 7 trains per hour at all other times. At that time, the Cross-City lines change to become Sandringham to Werribee carrying 20 trains per hour at peak periods and 9 trains per hour at other times excluding V/Line and freight services. At that time, Frankston line trains all revert to operating via the Caulfield lines Underground Loop[1].

By 2031, PTV estimates that the Sunshine-Dandenong corridor will be carrying 24 trains per hour during peak periods and 7.5 trains per hour at all other times[2]. At that time, the Cross-City lines will be carrying 22 trains per hour at peak periods, 12 trains per hour during inter-peak periods and at weekends and 6 trains per hour during early mornings and evenings, excluding V/Line and freight services[3].

In addition, there has been a long term trend for the morning and afternoon peak periods to spread beyond their traditional 2 hours in terms of AM train arrivals in Melbourne and PM departures from Melbourne. This equates to 3 hours practical operational time. By 2031, it is expected that this time will have expanded to 4 hours, thus increasing the effective time when freight trains cannot operate on metropolitan lines on weekdays from 6 hours to 8 hours.

The practical implication of these changes is that it will become exceedingly difficult to path freight trains through the various cross movements and particularly on the Cross-City lines between Flinders Street and Southern Cross within the constraints of the existing infrastructure, other than for around 8 hours during evenings and early mornings on all days. However, two freight train paths are likely to be available per hour during this period.

The practical effect of these changes by the early 2030s will be to limit theoretical freight train capacity of the Dandenong rail corridor if every available train path is utilised to:

(365 days x 16 trips) = 5840 trips x 136 TEU = 794,240 TEU pa.

In practice, most terminals would be challenged to accept two trains per hour when this would be constrained within an 8-hour period.

To date, there are no known further quantified assessments of metropolitan train operating requirements expected to emerge beyond the early to mid-2030s that have been prepared by PTV or DEDJTR. However, it is reasonable to assume that a range of factors will continue to diminish the capacity to operate freight trains on the existing infrastructure in the absence of alternative additional infrastructure becoming available on which to redeploy a substantial proportion of Dandenong line metropolitan train operations. Unless this occurs, and given the present state of knowledge in this regard, it would be wise to assume that, for practical purposes, little or no freight train capacity will remain on the existing infrastructure by around 2040.

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[1] Refer Melbourne Metro Program Proposed Service Plans –Business Case Baseline, page 10, PTV, February 2016, accessible on the Melbourne Metro Rail Authority (MMRA) website.

[2] Ibid, page 15.

[3] Network Development Plan – Metropolitan Rail, page97, PTV, December 2012.

4. Single Track RRE & Hastings Rail Link

In the single track Regional Rail East option a new bidirectional single track would be constructed along the Dandenong line and also along the Cranbourne line to Lyndhurst. In this option, a new single-track line would also be built along the Western Port Highway alignment to a possible future container port at Hastings.

4.1 Rail Infrastructure configuration single track RRE & Hastings link

Single Track RRE

The configuration of a single track RRE is shown in figure 3 below.

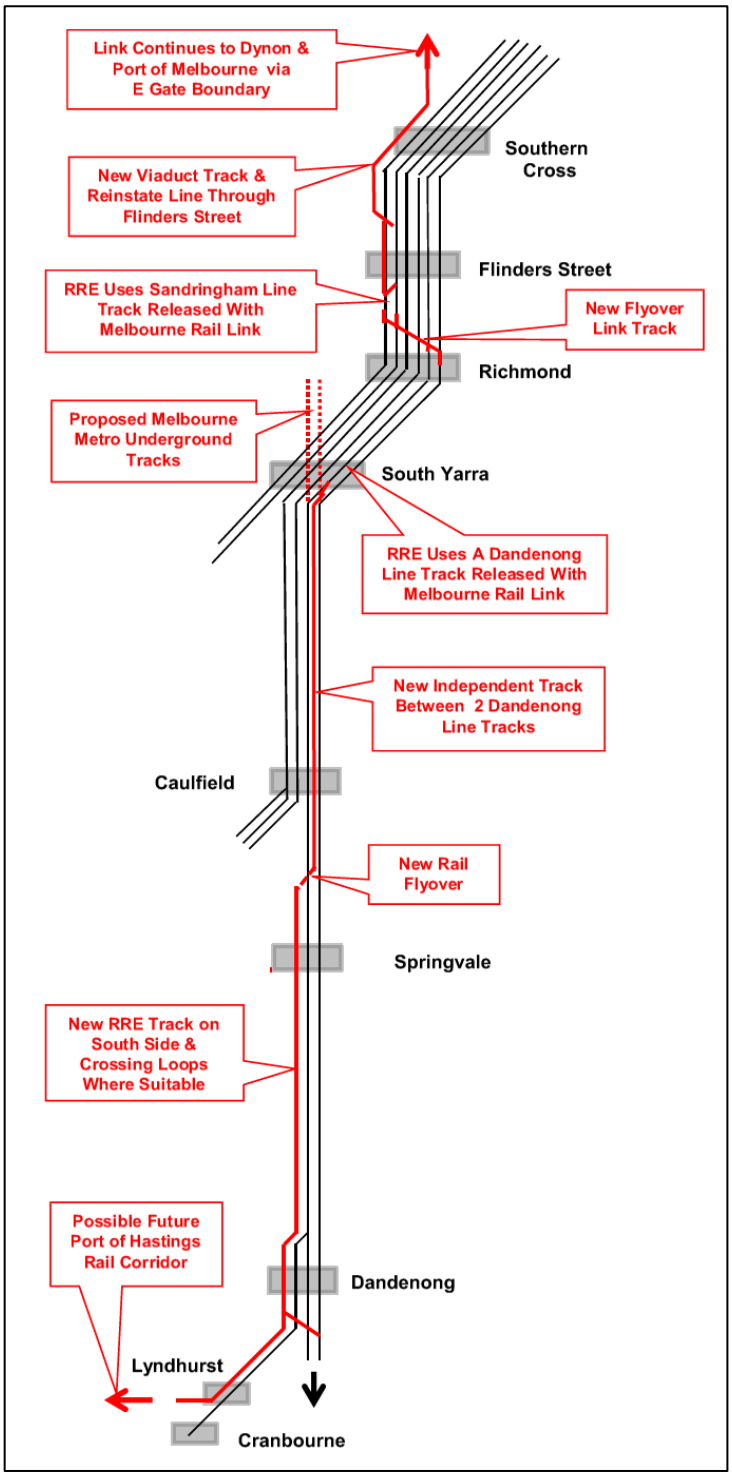

Figure 3. – Single track RRE

In this option, the existing freight rail line from West Melbourne to Southern Cross station would be used.

Between Southern Cross station and Flinders Street station, a new single-track viaduct bridge would be built in the single-track RRE option.

From Flinders Street to a point near the MCG, RRE would use the Sandringham line tracks that will be released when the Melbourne Metro (MM) project is built.

Near the MCG, a new single-track rail flyover would be built to take the RRE track over the top of other tracks. A typical rail flyover is shown in figure 4 below.

Figure 4. Typical rail flyover

From Richmond to South Yarra, the single track RRE uses one of the two tracks released when the MM project is built, although the second released track could also be used to provide a crossing loop in that area.

Between South Yarra and Caulfield, a new single line track would be built between the two existing northern tracks. This would require the cut back of two platforms at a number of stations between South Yarra and Caulfield. These cutbacks would become possible provided that, when MM is built. The two northern lines between South Yarra and Caulfield operate as express tracks and will not require platforms.

The diagram below shows an example of how this could occur.

Recent advice is that Dandenong line trains may now be required to stop at Malvern. If this is confirmed, more substantial modifications will become necessary to accommodate the additional track through Malvern station.

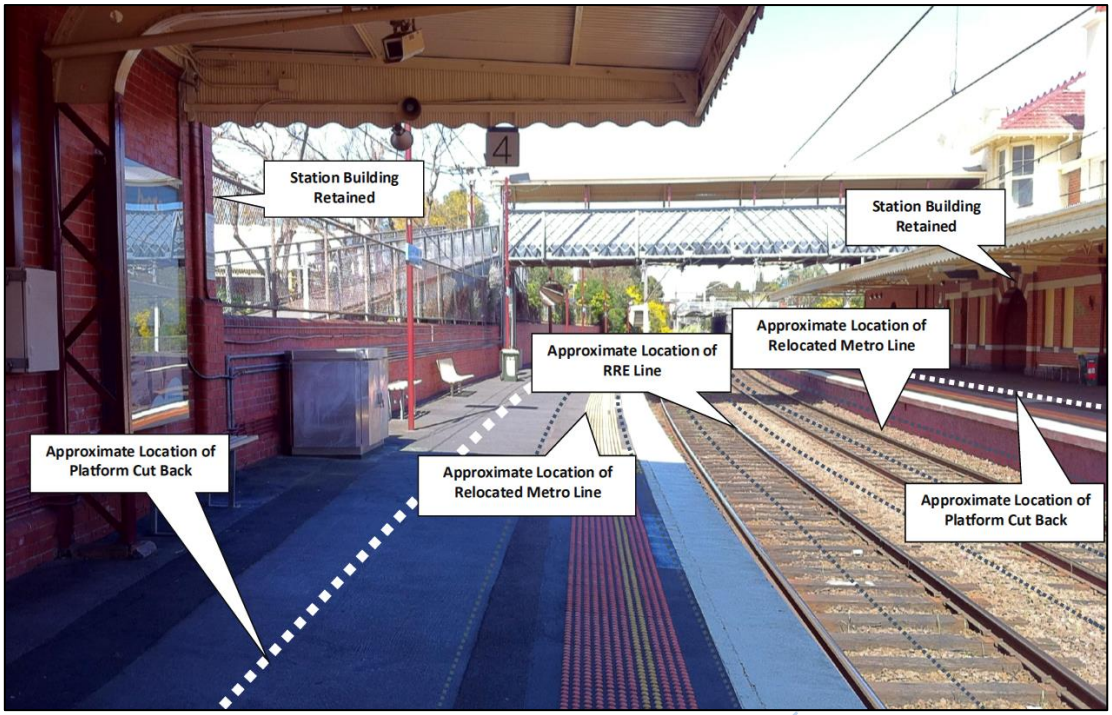

Figure 5. Single RRE – South Yarra to Caulfield

Between Caulfield and Oakleigh, a new single elevated track would be built between the two rail lines that will soon be elevated as part of the level crossing removal works in this area. There would also be a requirement to relocate platforms under this option.

Between Oakleigh and Dandenong and on to Lyndhurst a new RRE track would be built on the south side of the rail corridor in this option.

New Single track Rail Link to Hastings

The possible future Port of Hastings Rail Link would involve construction and operation of a rail line in the median strip of a possible new freeway along Western Port Highway. This alignment is shown in figure 6 below

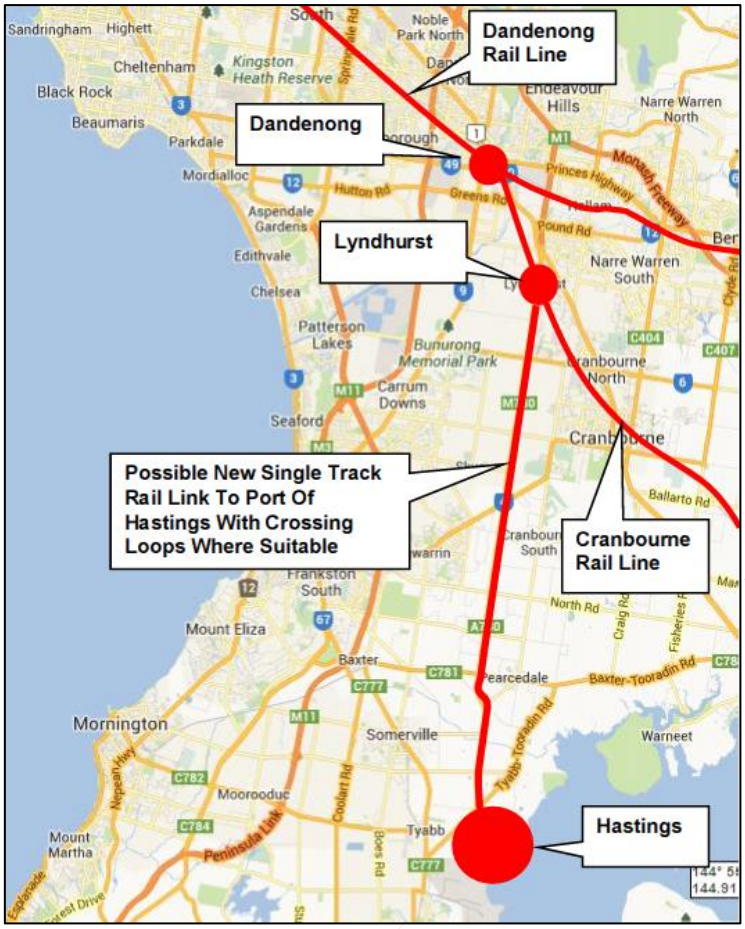

Figure 6. Single Track Rail Link to Hastings

Although this would be new to Victoria, there are examples of this type of transport integration in Australia and overseas. Perth has two rail lines located within freeways. The line to Mandurah and the line to Joondalup are both generally located within freeways. Figure 7 below shows the Mandurah rail line in Perth.

Figure 7. Mandurah Rail Line in Perth

The experience in Perth has been that locating a new rail line within a freeway reservation reduces the social, environmental and economic impacts of transport land use by having only one transport corridor rather than two separate ones.

Indicative Cost of Single Track RRE and New Rail Link to Hastings

The order of cost for construction of a single track RRE between West Melbourne and Lyndhurst with strategically located crossing loops is approximately $3 billion. The order of cost for construction of a new single track rail link from Lyndhurst to Hastings with crossing loops is approximately $1.3 billion. The estimates includes the cost of rail tracks, signalling, overhead structures/wiring, substation modifications as well as allowance for rail and road bridgework, drainage etc. In addition, allowance is made for construction of a number of crossing loops to allow opposing trains to pass each other. Allowance is made for platform modifications where necessary provide room for the new tracks and also for such things as retaining walls and heavy-duty barriers between the rail tracks and the adjacent roadway where the new rail line is to be built within Western Port Freeway.

4.2 Rail operation & capacity of single track RRE & Hastings link

The capacity of a single track railway is a reasonably complex function of several variables including train speed, train length, train braking distances, train power/weight ratio, gradients, distance between crossing loops, length and configuration of crossing loops and the detail of the signalling system configuration and its related operating rules and procedures. At the next more detailed stage of assessment, it is suggested that an appropriate train path modelling package be applied by a skilled consultant that can be accurately assess and test the effect of changing some or all of these variables.

A simplistic representation of the capacity of a typical single track railway with crossing loops in a regional context is shown in figure 8 below.

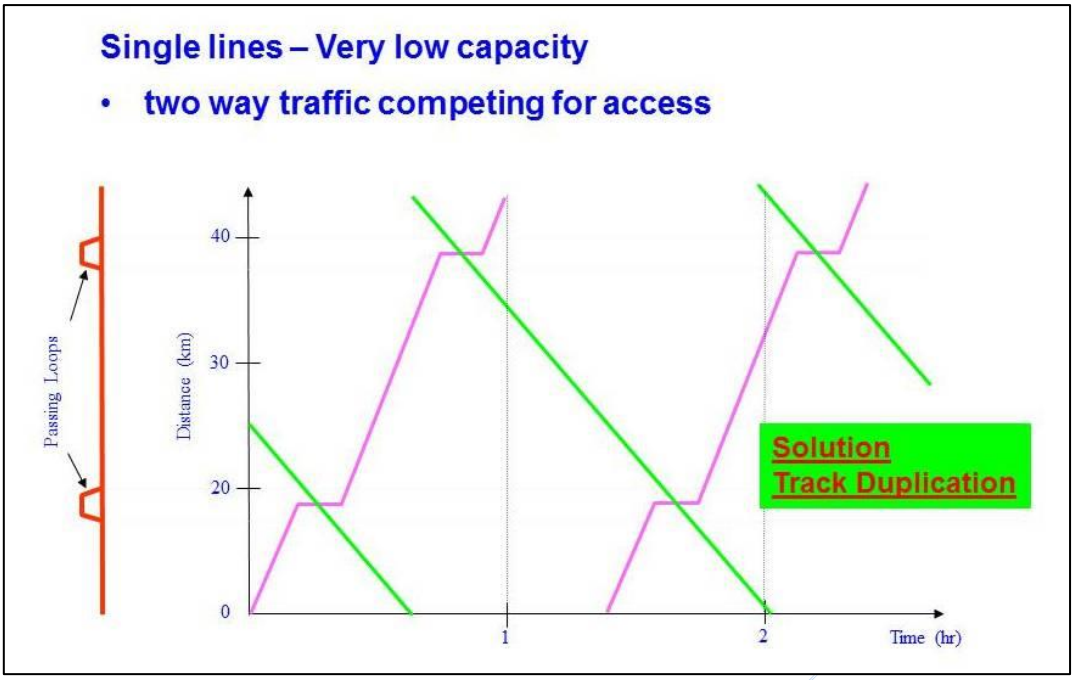

Figure 8. Sample single line train graph

Rail capacity assessments undertaken manually provide very limited opportunity to test a range of the above variables in order to optimise the rail corridor configuration. For this preliminary high level assessment, the following main variables have been assumed:

- Maximum freight train speed – 80 km/h
- Train length – 600 metres
- Minimum train power/weight ratio – 2.3hp/gross tonne
- Length of crossing loops – 2000 metres (1400 metres clear standing room)
- Configuration of crossing loops – 1:15 angle turnouts, 300 metres overlap both ends
- Loop entry speed – 40km/h, maximum exit speed 65 km/h
- Typical loop dwell time (including braking/acceleration) 5 minutes (one direction only)
- Signalling system and configuration – standard Victorian 3-position signal arrangement with TPWS overlay[4].

A simplistic assessment has been made on the basis that either one, two or three such crossing loops can be provided in the 31km between the CBD and Dandenong such that the resultant inter-loop single line sections are of roughly equal length. Very importantly, unlike the previous example which relates to current capacity on a railway predominantly used by passenger trains, the following examples assume that the single line concerned has been provided for the exclusive use of freight trains. They also assume the line is available for use 24 hours per day, and that line and terminal capacity on either side of the CBD to Dandenong line section can handle an equivalent throughput.

[4] TPWS – Train Protection and Warning System – an automated safety supervisory system used extensively in Victoria and the UK, which, in certain high-risk circumstances, will override a train driver's actions and bring a train to a halt before its safe operation could be seriously compromised.

Because of normal perturbations in the day-to-day operational environment, practical line capacity assessments typically work on around 70% of theoretical line capacity being achievable.

The crude calculations are as shown in the following table:

No. of loops	Average distance apart	Section non-stop running time	Average dwell time (opposing trains)	Total section running time	Best train frequency	No. of two-way trips/day @ 100% capacity	No of two way trips/day @ 70% capacity
1	15km	18 min	2.5 min	20.5 min	41 min	35	25
2	10km	12 min	5 min	17 min	34 min	42	29
3	7.5km	9 min	7.5 min	16.5 min	33 min	44	31

In this case, provision of three instead of two loops over a relatively short distance adds very little capacity because the shorter running time between loops is largely offset by the additional dwell time at the third loop.

Therefore, for each case annual approximate capacity is:

- One crossing loop (365 days x 25 trips) = 9125 trips x 136 TEU = 1,241,000 TEU pa.
- Two crossing loops (365 days x 29 trips) = 10585 trips x 136 TEU = 1,439,560 TEU pa.
- Three crossing loops (365 days x 31 trips) = 11315 trips x 136 TEU = 1,538,840 TEU pa.

The question has also been asked in relation to the potential to share the additional infrastructure with public transport. The limited capacity created by a single line solution with crossing loops would, prima facie, be unsuitable for any significant volume of metropolitan electrified service, noting that single line operation is inherently less reliable than double line due to the chain reaction nature of any delays. Therefore as a matter of policy, it is understood that all further additions to the metropolitan network infrastructure must comprise two or more tracks.

Notwithstanding, there would be some potential for use of the single line by peak direction Gippsland passenger services. Rail line utilisation tends to be optimised when used by services with homogenous characteristics, however passenger trains being faster should utilise suitable infrastructure more efficiently (in terms of numbers of train movements) than freight trains. As a rule of thumb, a ratio of 1.2 passenger trains to each freight train can reasonably be applied. Alternatively, for each passenger train path that is substituted for a freight train path, approximately 0.83 fewer freight trains could be accommodated on that type of network. This would also be a suitable subject for more sophisticated train path modelling, as previously suggested.

5. Double Track RRE & Hastings Rail Link

In the double track Regional Rail East, option two new tracks would be constructed along the Dandenong line and also along the Cranbourne line to Lyndhurst. In this option, a new double track line would also be built along the Western Port Highway alignment to a possible future container port at Hastings.

5.1 Rail Infrastructure configuration double track RRE & Hastings link

Double Track RRE

The configuration of a single track RRE is shown in figure 9 below. For simplicity, the new RRE line is shown as a single red line.

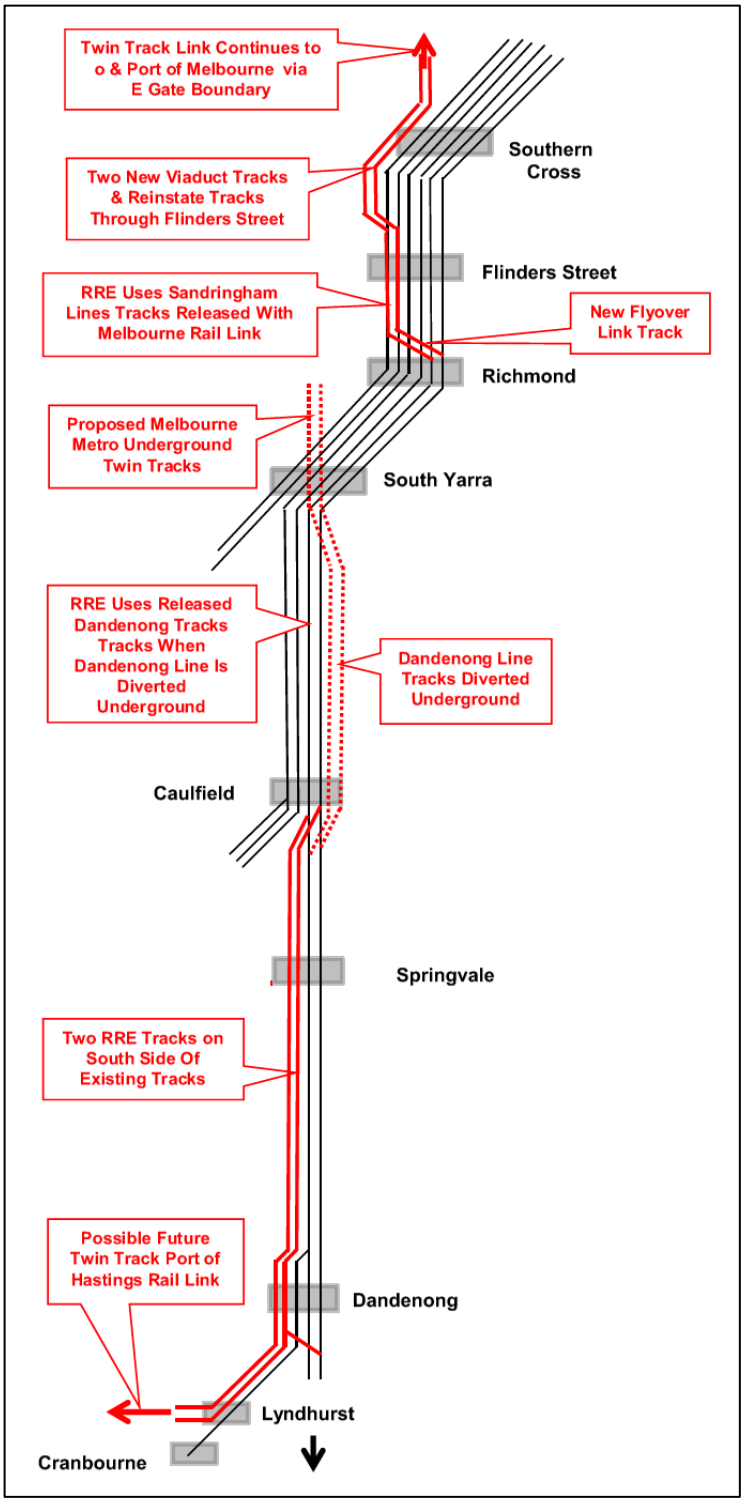

Figure 9. – Double Track RRE Configuration

In this option the existing freight rail line from West Melbourne to Southern Cross station would need to be duplicated. This will be complex and costly due to limited rail reservation width in this area.

Between Southern Cross station and Flinders Street station, a new double track viaduct would be built under this option.

From Flinders Street to a point near the MCG RRE would use the Sandringham line tracks that are released when the MM project is built.

Near the MCG, a new double track rail flyover is built to take the RRE track over the top of other tracks.

Between Richmond to South Yarra, the twin track RRE uses both of the tracks released when the MM project is built.

Between South Yarra and Caulfield there is not enough width in the rail reservation to build two extra tracks. In this option, it would be necessary to construct two new underground tracks. The new underground tracks would be used by Dandenong line suburban trains and the two existing northern tracks would be available for container trains as well as Gippsland passenger and freight trains.

Between Caulfield and Oakleigh, two new elevated tracks would be built between the two rail lines that will soon be elevated as part of the level crossing removal works in this area. There would also be a requirement to relocate platforms in this option.

Between Oakleigh and Dandenong and on to Lyndhurst two new RRE tracks would be built on the south side of the rail corridor under this option.

New Double Track Rail Link to Hastings

The possible future Port of Hastings Rail Link would involve construction and operation of a rail line in the median strip of a possible new freeway along Western Port Highway. This alignment is shown in figure 10 below.

Figure 10. - Double Track Rail Link to Hastings

Indicative Cost of Double Track RRE and New Rail Link to Hastings

The order of cost for construction of a double track RRE between West Melbourne and Lyndhurst is approximately $5 billion and the order of cost for construction of a new double track rail link from Lyndhurst to Hastings is approximately $1.5 billion. The estimate for the West Melbourne to Lyndhurst section includes the cost of a new twin bore rail tunnel from South Yarra to Caulfield. Both estimates include the cost of rail tracks, signalling, overhead structures/wiring, substation modifications as well as allowance for rail and road bridgework, drainage etc. Allowance is made for platform modifications where necessary provide room for the new tracks and also for such things as retaining walls and heavy-duty barriers between the rail tracks and the adjacent roadway where the new rail line is to be built within Western Port Freeway.

5.2 Rail operation & capacity of double track RRE & Hastings link

The capacity of a double track railway is a less complex formulation than that of a single track railway, provided that each line operates in a uni-directional manner only. However, it is still a function of several variables including train speed, train length, train braking distances, train power/weight ratio, gradients and the detail of the signalling system configuration and its related operating rules and procedures. A critical parameter of a conventional signalling system is its

designed headway for successive train movements. This is usually configured around the safe stopping distance of the worst braking trains using that line under adverse braking conditions.

At the next more detailed stage of assessment, it is again suggested that an appropriate train path modelling package be applied by a skilled consultant that can be accurately assess and test the effect of changing some or all of these variables.

By comparison with the above simplistic representation of the capacity of a single track railway, an equivalent simplistic representation of a typical double track railway is shown below:

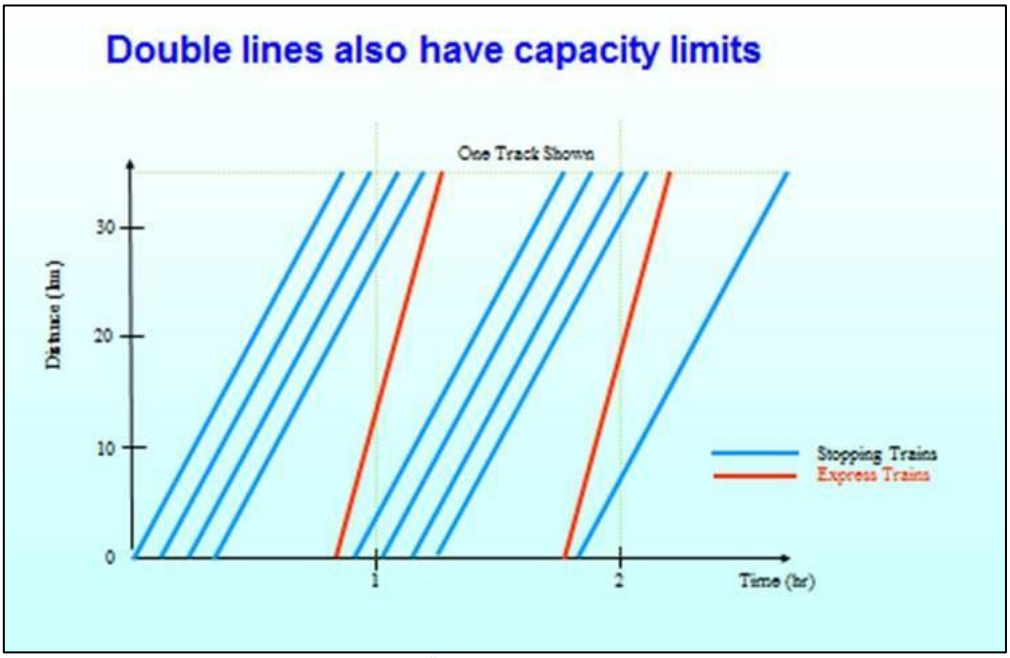

Figure 11. - Sample train graph showing one track on a double track system

A simplistic assessment has been made on the basis described above, i.e. continuous double track can be provided over the 31km between the CBD and Dandenong. Again, very importantly, the following examples assume that the double line concerned has been provided for the exclusive use of freight trains. They also assume the line is available for use 24 hours per day (thus not taking into account any requirements for maintenance windows), and that line and terminal capacity on either side of the CBD to Dandenong line section can handle an equivalent throughput. Train parameters are also assumed to be as previously described.

Because of normal perturbations in the day-to-day operational environment, practical line capacity assessments typically work on around 70% of theoretical line capacity being achievable. However, should the line be not dedicated to freight traffic but is to be shared with, for example, V/Line Gippsland trains, the situation shown in the above simplistic diagram would almost certainly arise where there is a marked disparity between the running speeds of passenger and freight trains. That possibility has not been considered in the following discussion.

It is unlikely that headways on a freight-only line would be less than 5 minutes. This is because of the much longer braking distance of freight trains compared with passenger trains and the need to apply a conservative approach that takes account of worst case conditions (e.g. due to slightly wet,

greasy or otherwise contaminated rail head conditions). That would imply that up to 12 freight train movements per hour could theoretically operate in each direction on a conventional double track railway.

As discussed above, around 70% of theoretical line capacity is normally regarded as being achievable. However, there would be few, if any, freight terminals worldwide that could accommodate eight train movements per hour (70% of 12 rounded) or the 192 freight train movements per day in each direction that such a railway could handle.

Therefore, by way of example, with say, an average of 4 train movements per hour in each direction readily possible in the context of the other assumptions and qualifications discussed above, annual line throughput (as distinct from capacity) would be:

(365 days x 94 trips) = 35040 trips x 136 TEU = 4,765,440 TEU pa.

This would be equivalent to some 53% of the total throughput of a port handling 9 million TEU per annum.

Various options could be applied that would demonstrate that the actual capacity of a suitably engineered continuous double line is substantially greater than the above figure, all other things being equal. It should therefore be seen that conventional double track rail infrastructure would not, of itself, be a constraint in achieving large throughput volumes, even with relatively small 600 metre long trains, loaded on average to 80% of their slot capacity. The real constraints on capacity will be at terminals, at rail network and other interfaces beyond the conventional double track railway and the extent to which other non-homogenous services are using the same rail corridor.

Essentially this devolves into a major strategic issue that suggests the need for deeper analysis and a long term strategic approach to the development of rail infrastructure with a likely economic life of100 years or longer. Full scale development of an international container port at Hastings would, of itself, almost certainly require the provision of four tracks on the Dandenong Rail corridor. In a combined freight and passenger utilisation scenario, ultimately this may not be sufficient. However, the required extent and depth of such analysis is considered beyond the scope of this high level assessment.

6. Alternative Hastings Rail Link via Eastlink/Peninsula Link

An alternative corridor is available for a new rail link to Hastings. The location of this potential rail link is shown in figure 12 below.

Figure 12. - Alternative Rail Link

This optional corridor has a number of disadvantages that are discussed below.

The Eastlink section of this alterative corridor option would commence at a new rail junction near Yarraman station on the Dandenong rail line. The new junction would most likely have a “double connection” to allow container trains from Hastings to travel towards Melbourne or towards Dandenong and Lyndhurst proposed intermodal terminal. It is likely that the double connection to the Dandenong line will have a significant impact on Greaves Reserve and potentially on the Dandenong Showgrounds buildings. Heading south, the median strip within Eastlink in this section is generally wide enough to allow for a double track rail line.

The Peninsula Link section of this optional link would commence at a very complex and expensive new connection within the existing Eastlink - Peninsula Link interchange reservation at Carrum Downs. The Peninsula Link freeway is generally constructed with sufficient median strip width to accommodate a double track rail line. Where Peninsula Link crosses the Stony Point rail line at Langwarrin there would need to be a complex and costly link to join up with the Stony Point line.

From the possible new junction described above, the existing Stony Point line would, in this option, be used for container trains travelling to and from Hastings. To cope with container train traffic if there were to be a large container port at Hastings, in this option, the Stony Point line would require duplication. This would substantially increase closure time at the existing level crossings. Other potential issues on this section would be noise and general amenity issues.

As this alternative route is technically inferior to the Western Port Highway route it has not been costed.

7. Eastern Suburbs Route Alternative

The location of the eastern suburbs alternative corridor is shown in figure 13 below.

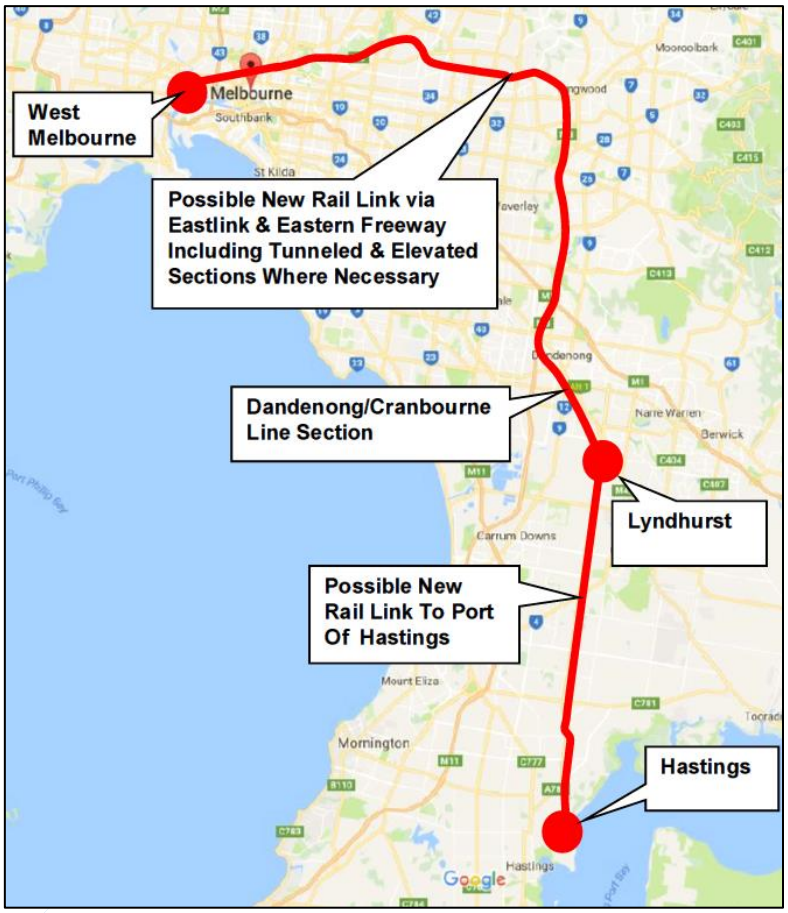

Figure 13. - Eastern Suburbs Alternative Corridor

The eastern suburbs alternative commences in the south at Yarraman station. Heading north from Yarraman station the line would follow Eastlink and then the Eastern Freeway. The rail line would be at grade where possible and generally elevated where the "at grade" solution would not be possible. In some difficult areas, the line would need to be in a tunnel.

The only section where the freeway/tollway median is wide enough to accommodate a rail line is the section between Clifton Hill and Bulleen Road, Bulleen.
It appears that tunnelling will be required in at least four sections. The first section is in the Dandenong area where there is a deep cutting in a short section of elevated land. The second tunnelled section would be at the Eastlink/Monash freeway interchange. The third section is in

Ringwood paralleling the Mullum Mullum tunnel. The fourth tunnelled section would be from Clifton Hill to West Melbourne.

The order of cost for this option is likely to be at least $23 billion to provide an independent rail freight link between the Yarraman Station area and West Melbourne. The main reason for the anticipated high order of cost for this alternative route is that, for a large portion of the route, the rail line would have to be in a tunnel or on an elevated structure. Rail tunnels are very expensive to build and rail viaducts are also quite costly.

8. Relationship with demand forecasts and rail market share

Total container trade forecasts have recently been prepared for Infrastructure Victoria by Deloitte[5]. The key numbers are in the following table:

Table 5: Forecasts of total container trade, volumes (TEU): central, low and high cases

FY	Central	Low	High
2006^	1,930,172	1,930,172	1,930,172
2010^	2,236,552	2,236,552	2,236,552
2016	2,700,580	2,700,580	2,700,580
2020	3,057,040	3,040,633	3,312,745
2025	3,616,080	3,557,482	4,263,291
2030	4,194,106	4,062,702	5,278,987
2035	4,862,804	4,505,063	6,191,559
2040	5,568,872	4,993,432	7,060,221
2045	6,337,338	5,528,578	7,852,741
2050	7,197,297	6,114,665	8,685,215
2055	8,167,833	6,757,441	9,598,208
2060	9,278,132	7,461,081	10,597,652
2065	10,531,514	8,208,516	11,659,301

Source: Deloitte
Notes: ^ Actual container volumes

For the purposes of this report, the Central forecasts have been used for 2065, being one year prior to the expiry of the current Port of Melbourne lease.

We have been asked to consider two scenarios:

- All trade at Hastings – 10.5m TEU
- 50/50 split between Hastings and Melbourne – 5.3m TEU

In terms of rail market share of total container throughput at Hastings, we have been asked to consider two scenarios (numbers rounded to nearest 100,000):

- Scenario 1A -10% rail mode share for all trade at Hastings – 1.1m TEU

[5] IV Port Strategy - Container Trade Forecasts for Victoria, Deloitte, December 2016

- Scenario 1B - 10% rail mode share with 50% trade at Hastings – 0.5m TEU
- Scenario 2A - 30% rail mode share for all trade at Hastings - 3.2m TEU
- Scenario 2B - 30% rail mode share with 50% trade at Hastings - 1.6m TEU

It seems pointless to relate these scenarios to the current rail corridor capacity between Melbourne and Dandenong because, as pointed out earlier in this report, little or no freight train capacity is likely to remain on the existing infrastructure by around 2040.

When considered in the context of potential new infrastructure, two generalised new infrastructure solutions between the CBD and Dandenong were considered earlier in this report:

- Single line with crossing loops – approximate capacity between 1.2m and 1.5m TEU pa
- Continuous double line –nominal capacity (very conservative) - 4.8m TEU pa.

Taking Hastings generated demand alone, Scenarios 1A and 1B could be readily accommodated on a single line, Scenario 2B would be a marginal issue while Scenario 2A would certainly require a double line solution at whatever time these demand numbers were expected to become a reality.

In a situation where port throughput is shared 50:50 between Hastings and Melbourne, the Melbourne component could be expected to generate additional freight demand on the Dandenong corridor, but only to the extent of Gippsland traffic and potential port/rail shuttle traffic to Melbourne's south-eastern suburbs.

In the Port of Melbourne's 2009 Container Logistics Chain Study[6] which contains the latest origin-destination data currently available, combined imports and exports to/from the south-eastern suburbs represented 15% of total port container throughput after including Tasmanian trade and imports and exports of empty containers. In the 50:50 split Melbourne/Hastings scenario, if the same ratio applied, approximately 0.8m TEU handled in Melbourne would move from and to the south-eastern suburbs in 2065.

On the basis of either a 10% or 30% rail market share, that would bring rail demand under Scenario 1B to approximately 0.6m TEU and increase demand under Scenario 2B to around 1.8m TEU. This would not alter the single line requirement for Scenario 1B but could approach justification for a double line solution under Scenario 2B.

A prospective addition to these demand levels would be the emergence of any significant import/export container flows to and from Gippsland. While presently, the overall volume of port related traffic emanating from Gippsland is limited to export paper products from the Australian Paper mill at Maryvale near Morwell, there are various other prospects from rail freight from Gippsland. These include logs, other value-added timber products, copper ore and other minerals, dairy and horticulture products and possibly, brown coal derivative products. All of these possibilities are real but are sufficiently speculative at present as to make any quantified demand assessment rather meaningless.

The question has also been asked as to likely rail demand in the Bay West scenario and the Dandenong rail corridor's capacity to handle that traffic. In that case, it could be expected that demand for container movement along the Dandenong rail corridor would be similar to that

[6] Container Logistics Chain Study on CD, Port of Melbourne 2009.

indicated above for Melbourne, being driven primarily by import/export flows to and from the south-eastern suburbs and potentially also Gippsland, as discussed above. These flows would be relatively small compared with those that would emanate from a major development at Hastings.

9. Standard and dual gauge issues

The question has also been raised regarding the likely need or otherwise for standard gauge access to a Hastings Port development and the associated question of whether dual gauge track would be appropriate on all or part of the Dandenong rail corridor.

This issue will always be driven by market needs together with the nature of supply chain logistics that are practiced at the time of such a development. As a general statement, it should be noted that some 90% of containerised freight carried by rail on the ARTC interstate network is for the domestic market and has little or no relationship with import/export trades. While domestic manufacturing has been steadily falling over recent years and a substantial amount of import substitution has been occurring, the relative economics of rail and shipping mean that there is little land bridging activity by rail between the major capital cities. For many years, much of Adelaide's trade was directed through Melbourne and railed to and from Adelaide; however this practice has been largely superseded by direct port calls in Adelaide.

A more likely driver for standard gauge access to Hastings will be the progressive conversion of the State's regional network to standard gauge. Export containers from regional Victoria and southern NSW currently comprise over 40% of Melbourne export container throughput and around half of this traffic is handled on rail. More than half of these movements already take place from locations served by standard gauge lines. Standard gauge conversion has been a slow but inexorable movement, particularly since 1995 when the western parts of the Victorian network were converted to standard gauge as part of the of the Melbourne-Adelaide standardisation project. In 2012, the Seymour-Albury and Benalla-Oaklands lines were converted to standard gauge. Over the next three years, it is proposed to covert a further 1,000 route kilometres of broad gage line in northern and north-western Victoria to standard gauge under the $440 million Murray Basin Rail Project. Other lines will inevitably follow.

Assuming the continuing need for direct access to Victoria's principal container port by standard gauge, it seems almost inevitable that any new rail infrastructure created specifically for the purpose of linking a Hastings port development with the Melbourne CBD and beyond, will require standard gauge capability. The likelihood is that broad gauge access will also be required for the foreseeable future, hence dual gauge track infrastructure will be needed for this purpose. This is likely to constrain passenger train operation on such infrastructure due to its traditional speed restriction of around 80km/hour for safety reasons, although this is now being challenged in some quarters.

In the bigger picture, the issue of track gauge and the likely need for dual gauge infrastructure should not be overstated. This is essentially a technical and operational issue that will ultimately be driven by market requirements as discussed at the commencement of this section. It is unlikely to have a major bearing on the ultimate nature of major infrastructure investment decisions.