The Monorail Alternative

Straddle-Beam Monorails cost about 10% of Rail Subways and can carry 46,000 passengers / hour.

An extensive urban monorail system can be constructed for a fraction of the price of a heavy rail subway

www.MonorailsAustralia.com.au
11th of July 2011

The Monorail Solution

Imagine gliding silently above Melbourne's trees and traffic on a graceful and elegant Monorail – and being able to build it for a fraction of the cost of a rail subway!

Seattle monorail *(Image: Wikipedia)*

The Proposal

To use a straddle-beam monorail system to add a new layer of public transport in Melbourne. These electric monorails use rubber tyres to run along an elevated concrete or steel track so are nearly silent and pollution-free.

East-West Link	Route / Notes	Cost ($Billions)
Highpoint – Ashburton Monorail	Footscray – CBD – Domain – Caulfield – Chadstone – Holmesglen - Ashwood.	**$1.12**
Dockland – Doncaster Monorail	Lonsdale Street, Albert Road, Hoddle Street, Eastern Freeway, Doncaster Road.	**$0.92**
TOTAL		**$2.04**

Why Monorail?

Monorails are the cheapest way of adding grade-separated, high-capacity public transport over the gridlock on the ground. They are also totally independent of existing tram, train and bus systems.

Monorails are proven. Many monorail systems are in use as high-capacity public transport systems carrying thousands of passengers a day – especially in Japan

Monorails are safe. Being totally grade-separated monorails are one of the safest forms of transport.

Monorails are environmentally friendly. Monorails have similar energy-efficiency to other mass-transit systems. They are far less energy-intensive to build than a rail subway while having a far lower footprint than surface rail. Monorails can be installed with a minimum of disruption on the ground and have a lower visual impact than other types of elevated rail systems. Monorails can travel at over 80km/h providing an excellent alternative to cars in crowded cities.

Monorails are cost effective. Retrofitting a subway to a crowded city is usually prohibitively expensive. Great uncertainties usually exist as to the full cost of dealing with the myriad underground services (sewers, storm water, mains water, electricity & gas.) as well as geological challenges such as rock and mud. Often subway systems are below sea-level creating many expensive and time-consuming challenges during construction and maintenance.

Monorails are quick to build. The monorails proposed here could be built in time for the 2014 election.

Monorails Cost Less

Monorail systems cost about **10% per kilometre** of a subway system. Construction risks are less with Monorail system due to the ease of above-ground construction.

Transport System	Cost per kilometre ($Millions)	Notes
Heavy rail subway	**$A 550**	Public Transport Victoria - $4.9 Billion for the 9km Footscray-Domain tunnel.
Shanhai Maglev Monorail (Transrapid)	$US 40	Constructed in 2002, speeds up to 500 km / h. Cost $US 1.2 Billion for 30 km.
Okinawa Monorail * (Hitachi)	$US 27	Constructed in 2003 and now operating. A Medium sized monorail with flat walk-through floors.
Kitakyushu Monorail * (Hitachi)	$US 62	Large monorail system with full-sized carriages. Flat walk-through floors. Constructed 1985.
Tokyo-Haneda Monorail * (Hitachi)	$US 15	Medium sized monorail with walk-through floors. Constructed 1964.
Kuala Lumpur Monorail * (Monorail Malaysia)	$US 36	A recent two-carriage monorail system on high pillars.
Melbourne East-West Monorail	**$A 40**	Projected cost of Hitachi 'Medium Sized' monorail.

* See Monorail Society cost data page.

Proposal	Approximate Distance (kilometres)	Cost per kilometre ($A Millions)	Estimated Total Cost ($Billions)
Highpoint – Ashburton Monorail	28	$40	**$1.12**
Dockland – Doncaster Monorail	23	$40	**$0.92**
Total Cost			**$2.04**

Note that some of this cost should be recouped from a 'Monorail land tax' on commercial land near monorail stations. Highpoint, Crown and Chadstone would be expected to donate space to route the monorail to their properties.

Building rail subways is so expensive it should only be considered as a last resort.

Monorail System Capacity

Monorails capacity varies widely from small tourist systems to the giant Tama commuter trains.

Monorail Type	Example	Passenger Load / train	Carriages	Passengers / hour / direction with 2 minute headway
Very Small 30 km/h **Far Too Small** **Far Too Slow**	 E.g. Sydney	48 (Seated)	7	1,440
Hitachi - Small 60 km/h **Too Small**	 E.g. Singapore	400 ('Full Load')	6	12,000
Hitachi - Medium 80 km/h **Recommended for Melbourne**	 E.g. Tokyo & Okinawa	783 ('Full Load')	6	23,500
Hitachi - Large 80 km/h **Too Large?**	 E.g. Chongqing, Tama & Kitakyushu	897 ('Full Load')	6	26,900

The high capacity of the Hitachi monorails is due to the wheels being below the floor, unlike the low-capacity Sydney monorail which has the wheels between each car. Passengers in all Hitachi monorails can move through the full length of the monorail train.

The passenger loadings for the Hitachi monorails were provided by Hitachi Australia as part of their review of an earlier version of this document. Note that the Hitachi system-capacity page provides higher 'peak load' figures suitable for typical Japanese commuters.

Monorail Cars

***Left**: The flat walk-through floor on a Hitachi's Kitakyushu monorail.(Image: Hitachi)*
***Right**: Tokyo Monorail. Note the front door for emergency evacuation between trains. (Image: Wikipedia)*

Hitachi monorails are characterised with an open layout allowing for loads of about 780 passengers on a Medium-sized six-car train.

The straddle-beam ALWEG designs shown on this page are recommended over the suspended car designs such as SAFEGE to reduce the visual impact of beams and the risk of truck - monorail collisions.

As ALWEG monorails run on rubber tyres and are powered by electric motors they are very quiet. Levels of 75dB are quoted here for Hitachi ALWEG systems. Like other public transport, monorails would require adequate heating and cooling to ensure passenger comfort.

Disabled Access

The Monorail system can be accessed by lift from street level. As lift floor, platform floor and monorail car floors are at the same level there is no impediment to the disabled person using a Monorail system.

Hitachi's vehicles are also able to accept a walkway to evacuate disabled passengers between monorail trains should a monorail become stranded between stations.

Operation

Ideally the Monorail would use the new myki system. It could be operated by Metro, Yarra Trams or some other body.

Hitachi monorail trains can be fully or partially automated. If partially automated an operator would close the doors and then the train's computer would drive the monorail to the next station as is done for London's Dockland Light Rail.

Stations

Stations can be built into existing buildings increasing the value of the building. Minor stations could have a smaller footprint if they use multiple lifts rather than escalators. Stairs should also be provided for the athletic as well as for emergencies.

Ideally stations would be translucent to reduce visual impact. This would entail as much as possible of the structure being constructed of glass or other transparent material. Solar panels could provide power to the station. Station walls would probably need to wrap around the monorail to provide protection for passengers in bad weather.

A station on the small Sydney monorail. Use of transparent materials should reduce the impact of the station while retaining the weather-proofing (Image: Wikipedia)

Aesthetics

Tokyo monorail (Image: Google Street View)

Melbourne's monorail could be a great visual asset to the city and a major tourist draw card if adequate attention is given to the design of the pillars and beamway. (This has not always been the case with other existing monorails.)

A 'Medium sized' monorail such as the Seattle Monorail is recommended for Melbourne. The 'large sized' monorail such as the Kitakyushu Monorail probably has too large a visual impact.

The beam should be placed above street trees to avoid the need for tree removal, as demonstrated with sections of the Tokyo Monorail. Some Japanese monorail pillars are covered in lattice work to encourage creepers to cover the pillar. This would discourage graffiti. See also the Singapore Monorail pillars.

Advertising should not be permitted on pillars, monorail cars or the beamway. Pillar design should be simple and elegant - the objective should be to fit in with Melbourne rather than stand out from it.

Switching

There is a myth that monorails have a problem with switching. However, in reality all serious monorail systems have switches that are used continuously in day-to-day operation.

The proposed system requires switching at the Ashburton end and from the main beamway to storage and maintenance facilities. This can be achieved using one of the methods explained by The Monorail Society on their switch myth page. See also Hitachi Track Switch page. Both sites have video clips of switches in operation.

The Melbourne Monorail would probably use the Segmented Switches shown on the above pages.

Safety

Monorail systems are not immune from problems caused by poor design.

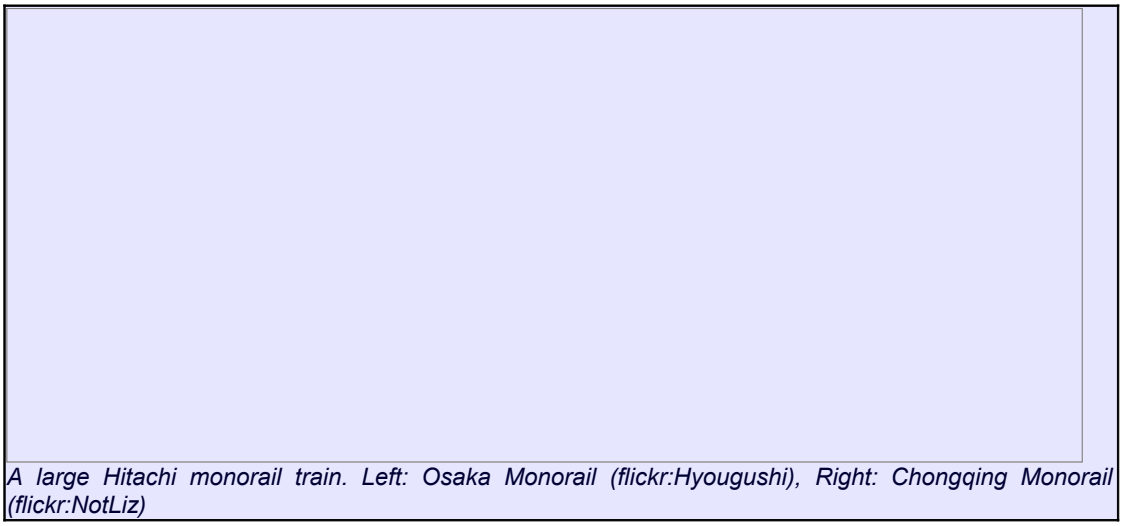
[35][17]The Seattle monorail has suffered a collision between two cars on a section of track where the beams were too close together. The beams should always be far enough a part to allow monorails to pass without signalling.

[35][17]As far as possible Monorail cars should be fire proof and provide some means of escape. Hitachi recommends evacuation from one monorail train to another one on the adjacent beam - although this has never been necessary in practice. Hitachi monorails can also be coupled together and passengers evacuated through the front or rear doors. (See Hitachi web site for diagram.)

[35][17]Where monorail beams cross roads with a height clearance less than other existing infrastructure then a protecting beam should be placed across the road ahead of the monorail beam.

[35][17]The monorail should draw power at multiple points and have multiple back-up generators capable of at least moving the monorail cars to the next station.

[35][17]All monorail stations should be staffed. Staff should be trained in first aid and be ready to assist the disabled as well as providing security and information. Platform Screen Doors should be used.



A large Hitachi monorail train. Left: Osaka Monorail (flickr:Hyougushi), Right: Chongqing Monorail (flickr:NotLiz)

A Case Study: The Tokyo Monorail

The Tokyo Monorail - *a 'Medium Sized' Hitachi monorail. (Image: Wikipedia)*

The Tokyo – Haneda Monorail provides a great example of how well a monorail can perform and is a good model for a Melbourne Monorail.

- 127,000 Passengers / day.[1]
- 1.5 Billion Passengers from 1964 – January 2007.
- 9 Stations.
- 17 km.
- 500 Train / day operating 05:30 – 24:00.
- 80 km / h top speed.
- Cost ~$US 15 Million / km to build. (Includes a tunnel, seismic protection and several long-span bridges that are not required in Melbourne. Many support pillions are on reclaimed land or in canals.)
- Run at a profit by a private operator.
- Dual-beam system with multiple switches.

While technically similar to what I propose for Melbourne, more attention needs to be given to pillar aesthetics than is evident in this and some other Monorails.

1*See Japan Times Article 25 Jan 2007*

Highpoint – Ashburton Monorail Route

Highpoint – Footscray – CBD – Domain - Queens Road – Windsor - Caulfield – Chadstone – Holmesglen – Ashwood - Ashburton

Except for the turning loop at the Highpoint end of the system, the beamway would consist of two beams supported on single pillars. Pillars would generally be located on the median strips of major roads and not result in loss of roadway – except on Queens Road. (Click URL to see relevant Google Map.)

Segment / Monorail Station	Details	Available Transport Interchange
Highpoint Return Loop	140m diameter single-beam loop with maintenance walkway and some stabling. Provision for future extension to Airports	
Highpoint	Station between Highpoint Home Maker and Shopping Centre.	Highpoint bus services.
Highpoint - Flemington	Dual-beam over Pipe Makers Park, Maribyrnong River and Fischer Parade to Flemington Racecourse	
Flemington	Station at West-end of main stadiums.	**Flemington Railway Line**
Flemington – Victoria University	Dual-beam over Fischer Parade and parkland.	
Victoria University	Station over Mills Close	None.
Victoria University - Footscray	Dual beam over Nicholson Street, over low-rise shops to Footscray Railway Station.	
Footscray	The Footscray Monorail Station is above Irving Street and the Footscray Railway Station.	**Geelong, Altona, Williamstown, Melton, Bendigo, St. Albans lines** plus bus and tram services.
Footscray - North Melbourne	Dual-beam over Hopkins Street and Dynon Road. The main maintenance and Monorail storage facility could be located at some point adjacent to Dynon Road.	
North Melbourne	Monorail Station is over railway station.	**Broadmeadows, Upfield** and all North Melbourne lines.
North Melbourne – Southern Cross	Dual-beam over rail tracks leaving space for future rail overpasses that are needed to remove flat rail crossings in this area.	
Southern Cross	Monorail Station is over V/Line platforms near Spencer Street and under existing roof structure.	**All rail services.** Collins, Bourke and Spencer Street Trams.
Southern Cross – Exhibition	Monorail exits through new opening in South wall over Collins Street and in front of the new Age building along Spencer Street. Dual beam crosses over rail viaduct and Yarra River to Exhibition Station. Some loss of parking in Spencer Street.	
Crown	Monorail Station is over or near Crown Casino near Clarendon Street. Footbridge to Exhibition Centre.	St. Kilda, Port Melbourne, Albert Park Trams.
Exhibition – South Melbourne	Dual-beam over Clarendon Street, Whitman Street, Kings Way Street OR another route over the M1 Toll way.	

Segment / Monorail Station	Details	Available Transport Interchange
South Melbourne	Station near the intersection of Sturt Street and Kings Way.	Sturt Street and Kings Way trams
South Melbourne - Domain	Power Street, Sturt Street, Kings Way, Park Street	
Domain	Monorail Station is over Domain tram interchange	All St. Kilda Road Trams
Domain - Leopold	Dual-beam over St. Kilda Road (north service lane over trees) and Bowen Crescent to Queens Road. Beam over street trees. Some loss of car parking spaces.	
Leopold	Station over Queens Road & Leopold Streets. Connecting walkway from Albert Park to Armadale Street over Queen and St. Kilda Roads.	St. Kilda Road Trams
Leopold – Lorne	Dual beam continues over centre of Queens Road.	
Lorne	Station over Queens Road & Lorne Streets. Connecting walkway from Albert Park to High Street over Queen and St. Kilda Roads.	St. Kilda Road Trams
Lorne – Windsor	Dual-beam along Queens Road to Princes Hwy.	
Windsor	Over Princes Hwy.	**Sandringham Line.** Chapel Street Trams
Windsor – Malvern	Dual-beam along Princes Hwy. Pylons on North side of central median strip with beam over street trees.	
Malvern	Over or near Malvern Railway Station.	Glenferrie Road and Hawthorne Road Trams. **Cranbourne, Pakenham and Frankston Line**
Malvern – Caulfield	Dual-beam along Princes Hwy and then along Sir John Monash Drive.	
Caulfield	Over Sir John Monash Drive adjacent to Caulfield Railway Station. (Possible monorail stabling over current rail work yards)	**Cranbourne, Pakenham and Frankston Line.** No 3 Tram.
Caulfield - Carnegie	Dual-beam along Sir John Monash Drive and Dandenong Road / Princes Hwy	
Carnegie	Station over Kornang Road.	
Carnegie - Chadstone	Dual-beam along Dandenong Road / Princes Hwy, entering shopping centre near David Jones.	
Chadstone	Station in, over or next to Chadstone Shopping Centre.	Chadstone bus services
Chadstone – Holmesglen	Dual beam along Middle Road and Warrigal Hwy over(?) Monash Freeway.	
Holmesglen	Monorail Station at East-end of Holmesglen TAFE near railway station.	**Glen Waverley Railway Line.**
Holmesglen – Ashwood	Dual beam along Warrigal Hwy median strip.	
Ashwood	Station near High Street – Warrigal Hwy intersection	
Ashwood-Ashburton	Dual beam above High Street median strip.	
Ashburton	Monorail station over Ashburton Railway Station car park. Beam switch to allow trains to return to Highpoint.	**Alamein Railway Line**
Ashburton Terminus	Stabling for several monorails over rail easement North of station between red tennis courts and rail line.	

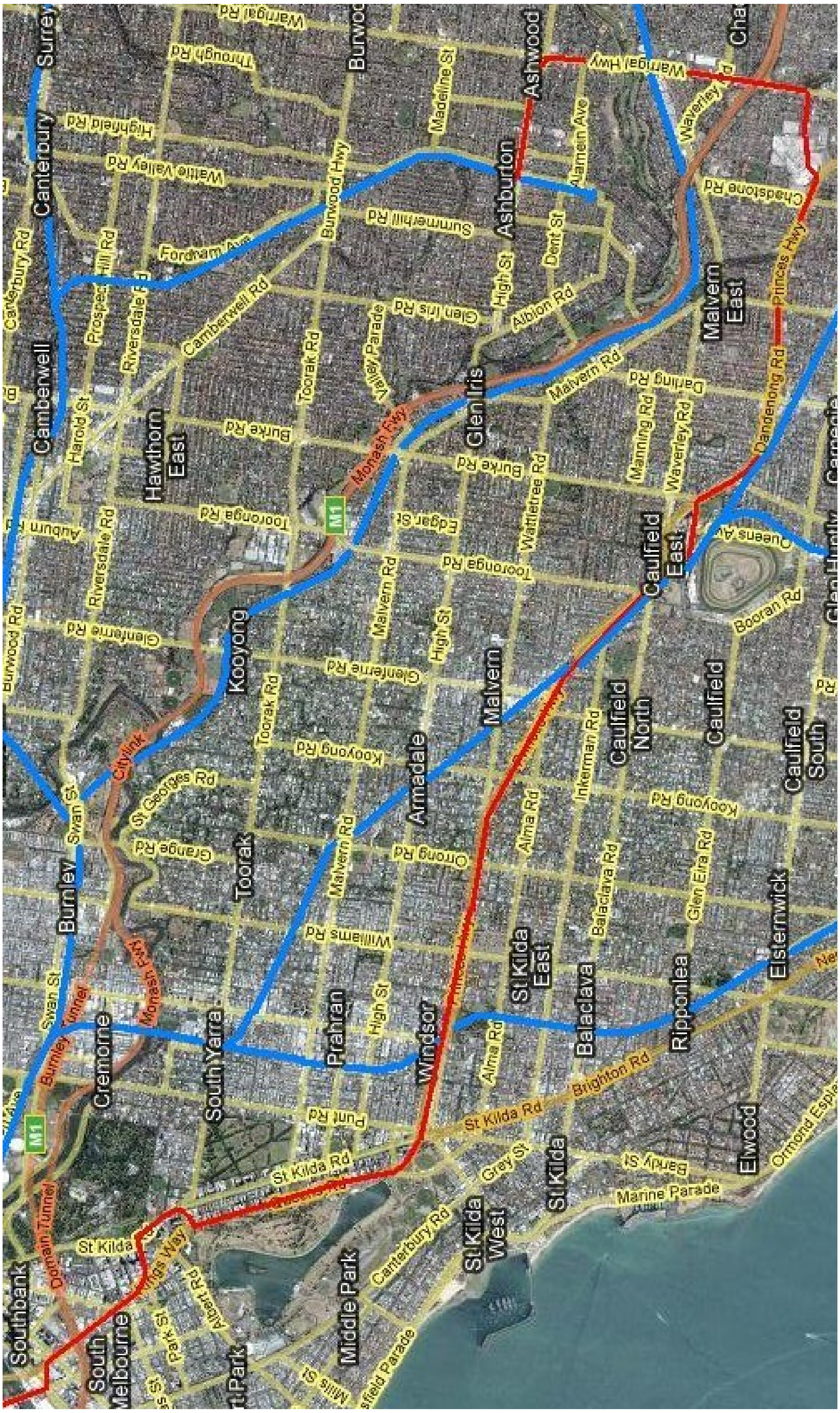
Highpoint – Southern Cross Station Segment

Monorail path shown in red.
Existing heavy rail MET lines shown in blue.

(Maps courtesy of Google Maps)

Southern Cross – Alamein Railway Line Segment

This segment connects the Sandringham, Dandenong, Frankston, Glen Waverley and Alamein heavy rail lines.



Docklands - Doncaster Monorail Route

Docklands – Lonsdale Street – Albert Road – Hoddle Street – Eastern Freeway – Doncaster Road – Springvale Road - Nunawading

Except for the turning loop at the Docklands end of the system, the beamway would consist of two beams supported on single pillars. Pillars would generally be located on the median strips of major roads and not result in loss of roadway. (Click URL to see relevant Google Map.)

Segment / Monorail Station	Details	Available Transport Interchange
Docklands **Return Loop**	A single-beam loop around the docklands area with a station.	
Southern Cross	Station over the DFO near Southern Cross	Highpoint – Ashburton Monorail All other rail lines.
Lonsdale Street	Dual-beam over trees	
Melbourne Central	Station over Myer-end of Melbourne Central (above walkway)	All loop services
Lonsdale Street	Dual-beam over trees	
Parliament	Station near Parliament Rail Station	All loop services. Trams.
Albert Road & Hoddle Street	Dual beam over trees.	
North Richmond	Link to North Richmond Rail Station	Clifton Hill Lines, Trams
Hoddle Street	Dual-beam over trees	
Victoria Park	Monorail Station is near railway station.	Clifton Hill Lines
Eastern Freeway	Dual-beam on median strip with protective barriers.	
Chandler	Monorail Station near Chandler Highway.	Buses
Eastern Freeway	Dual-beam on median strip with protective barriers.	
Burke	Monorail Station is near Burke Road	Buses
Eastern Freeway	Dual-beam on median strip with protective barriers.	
Bulleen Road	Station near intersection.	Buses
Eastern Freeway	Dual-beam on median strip with protective barriers.	
Doncaster Road	Station near intersection.	Buses. No 48 Tram Terminus??
Doncaster Road	Dual-beam over median strip	
Doncaster Shopping Centre	Station over or in Shopping Centre	Buses
Doncaster Road – Springvale Road	Dual beam continues over centre of road. Several stations in this segment.	
Nunawading	Station near Nunawading rail station. Beam switch to allow trains to return to Docklands. Line could be extended down Springvale Road.	Ringwood Line Trains

Increasing Heavy Rail Capacity

One of the key justifications for proposing an East-West rail subway is to increase the capacity of the suburban train system. The proposition is that the existing four tracks between Footscray and Caulfield are at capacity and two new tracks are needed.

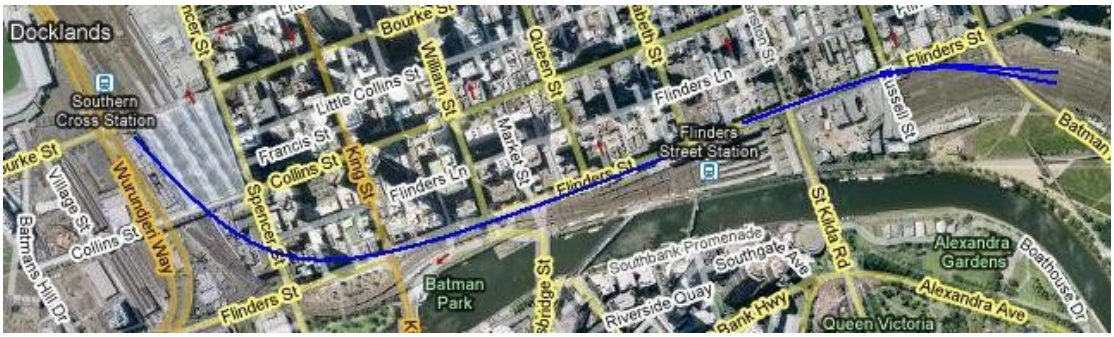
However, if signalling across the network is enhanced to allow trains to run with 2-minute headway most of these problems can be solved. (2-minute headway is already attained in the evening peak in the city loop. Headway of 2-minutes or less is common on the Moscow, Paris and London metros.)

A short rail subway between Southern Cross and Richmond could also solve this problem.

The Southern Cross – Richmond Rail Subway

The key bottleneck is between Flinders Street and Southern Cross Stations where there are only six tracks to carry all East-West traffic. A short rail subway can solve the problem while keeping the enormous costs involved with subway construction to a minimum.

This two-track ~2 km subway could run under the CBD with Eastern portals near Exhibition Street and a Western Portal near Southern Cross Station. A single underground station would be provided under Flinders Street with escalators up to Flinders Street station.



The proposed rail subway route is shown in blue on the above map. The platform at Southern Cross would be just north of the Bourke Street pedestrian walkway. This subway could connect Altona, Williamstown & Werribee services to one or more eastern lines.

Better Timetabling

To fully utilise existing tracks trains should be run in “bursts”. On the Dandenong line this would involve running the following services in the following sequence in twenty-minute bursts from the city on the Dandenong track:

1. FSS[2] - Gippsland Express Pakenham Service (Passenger or Freight)
2. Loop - Pakenham Express Dandenong Service 1
3. Loop - Pakenham Express Dandenong Service 2 (peak hours)
4. Loop - Cranbourne Express Oakleigh Service 1
5. Loop - Cranbourne Express Oakleigh Service 2 (peak hours)
6. Loop - Rowville Express Caulfield Service 1
7. Loop - Rowville Express Caulfield Service 2 (peak hours)

Similarly on the Frankston track:

1. FSS - Stony Point Express Frankston service (Passenger or Freight)
2. Loop - Frankston Express Cheltenham Service 1
3. Loop - Frankston Express Cheltenham Service 2 (peak hours)
4. Loop - Cheltenham Stopping All Station service 1
5. Loop - Cheltenham Stopping All Station service 2 (peak hours)

2*Flinders Street Station*

Since the Gippsland services originate from Flinders Street Station only ten of the above services travel via the single Caulfield Underground Loop track. Assuming trains run with a 2-minute headway these ten services could run every 20 minutes. This then provides the following level of service:

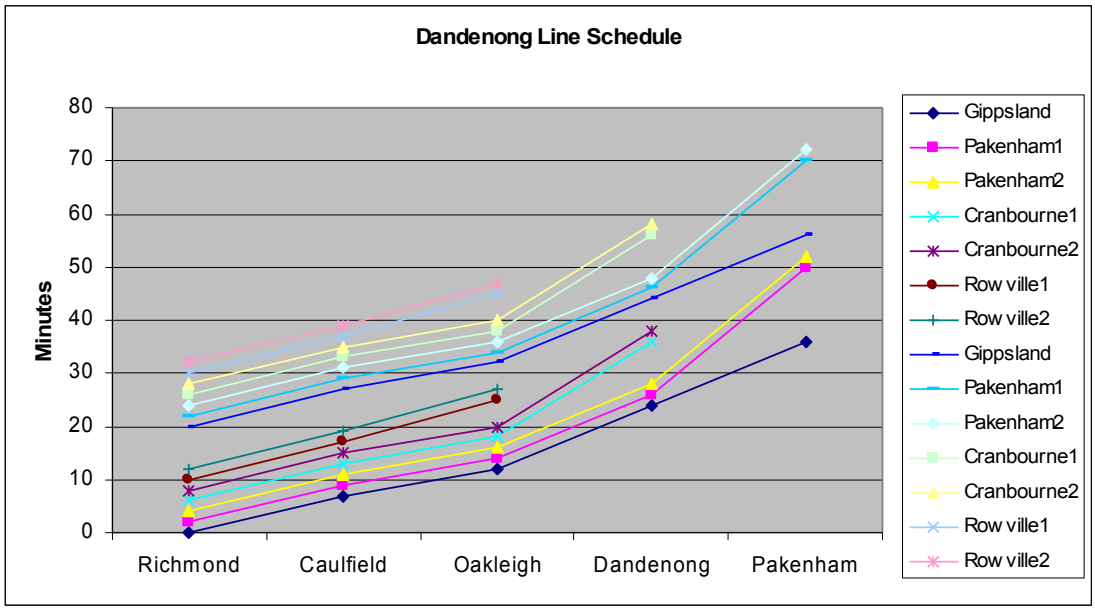
Destination	Current evening peak services per hour	Proposed evening peak services per hour
Gippsland	Two	Three
Pakenham	Four	Six
Cranbourne	Three	Six
Rowville	**None!** (Line not built yet)	Six
Stony Point	One every other hour	One[3] every hour
Frankston	Five	Six from loop, two from FSS[4]
Cheltenham	Five	Six

Here is a sample 20-minute segment for the Dandenong Line. For simplicity it starts at 17:00 at Richmond. The second service to each destination would only run in peak hours.

	Gippsland Service1	Pakenham Service1	Pakenham Service2	Cranbourne Service1	Cranbourne Service2	Rowville Service1	Rowville Service2	Gippsland Service2
Richmond	17:00	17:02	17:04	17:06	17:08	17:10	17:12	17:20
Caulfield	17:07	17:09	17:11	17:13	17:15	17:17	17:19	17:27
Oakleigh	17:12	17:14	17:16	17:18	17:20	17:25	17:27	17:32
Dandenong	17:24	17:26	17:28	17:36	17:38			17:44
Pakenham	17:36	17:50	17:52					17:56

The area shaded yellow shows the portion of each service that is express. (Stations from Richmond to Caulfield are serviced by Cheltenham stopping-all-stations trains on the Frankston tracks.)

Graphically this can be presented as follows. (Rowville trains split off after Oakleigh station, Cranbourne trains split off after Dandenong Station.)



Sample Dandenong Line train schedule showing two 'bursts' of trains over 40 minutes.

Note that the second Gippsland service is able to run at express speed to Dandenong without running into the back of the previous Pakenham, Cranbourne or Rowville services. Similarly the Pakenham services do not run into the Cranbourne services, and so on.

3*Due to single track to Stony Point only one service / hour is practical at this stage.*

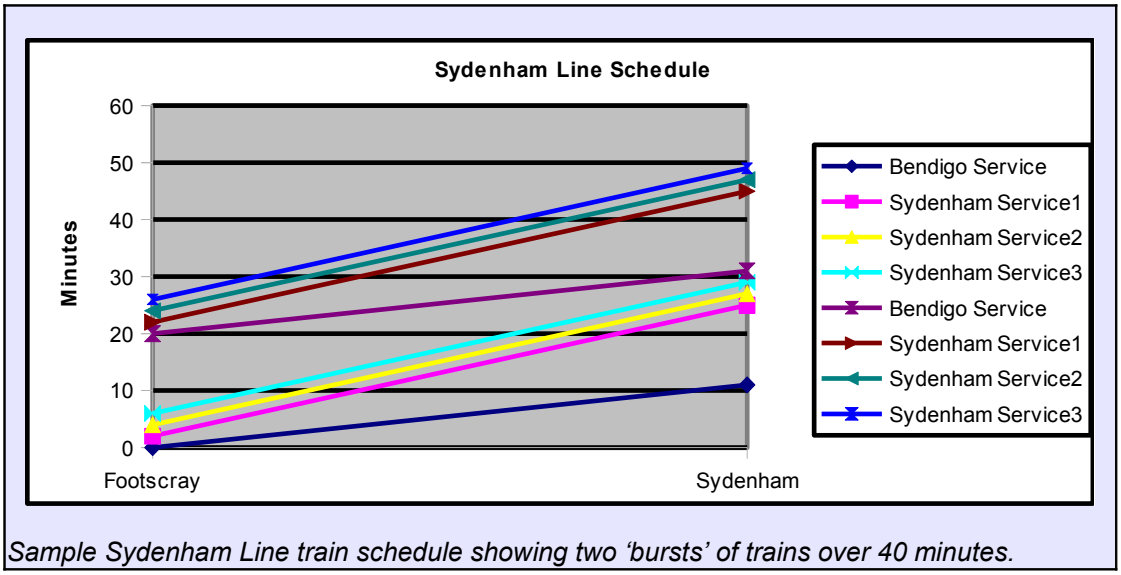
4*Estimate does NOT consider use of third track so more services should be feasible.*

Note also that the timetable is “clock face”. The Caulfield to Pakenham passenger need only remember that there is a train at 9 past, 29 past and 49 past each hour on every day morning and night. In peak hours there is an extra train in case she can’t get on the first one.

The only question mark over this is the assumption that the network is capable of safely running with 2-minute headway. If not, clearly work is needed to bring the signalling system up to international standards. This is likely to be far cheaper than building extra track in a subway.

A similar result can be achieved on the Sydenham line. In the following example 3 Bendigo-line trains are scheduled (and can run at ~100kmh) with 9 Sydenham trains in peak hour. At best 6 Sydenham trains are scheduled currently with Bendigo-line trains often forced to travel at below 60kmh.

Note that Sydenham Service3 would need to operate out of Southern Cross and not via the Loop.



Sample Sydenham Line train schedule showing two ‘bursts’ of trains over 40 minutes.

Rail Overpasses between Southern Cross and North Melbourne

Currently there are major delays near Southern Cross Station due to MET trains from North Melbourne crossing V/Line trains attempting to reach the V/Line platforms at Southern Cross.
Building one or two rail overpasses for MET trains would eliminate this problem.

Consistent City Loop Operation

The current practice of altering the direction of the city loop at lunch time should be abandoned. All MET trains should run to Southern Cross or Flinders Street stations first as these are best able to cope with large crowds. Caulfield, Burnley and Jolimont loop trains should then travel clockwise around the loop at all times. North Melbourne loop trains should operate counter-clockwise at all times. This should optimise signalling in the loop to facilitate maintaining 2-minute headway and reduce passenger confusion.

In peak hour many more services can be scheduled by not running trains through the loop but terminating them at Southern Cross (North or West trains) or Flinders Street (North, South & East trains).

No Waiting in the CBD

All loop services should run to the CBD, around the loop and back to the edge of the network without waiting at Flinders Street station. Trains terminating at Flinders Street or Southern Cross should 'bounce' back out again after the driver has walked from one cab to the other.

Cleaning, maintenance, fuelling, driver change-over and safety checks should all happen at the outer edge of the network, not in the congested centre.

Seven Car Train Sets

Many new train sets would be needed to operate an improved timetable. All new train sets should be four-car sets. These can be matched with existing three-car sets to form seven-car sets – which are the most that can be accommodated at the loop stations.

Recommendations

- Proceed with a feasibility study of the monorail options.
- Proceed with the design of a 2 km Southern Cross – Richmond rail subway.
- Proceed with other public transport projects made possible by not building a 17 kilometre rail subway or a road tunnel.
- Improve train scheduling to obtain immediate capacity improvements.

Acknowledgements

Earlier versions of this document were reviewed by:

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***NOTE**: (1) Hitachi's comment is limited to technical aspects where Hitachi finds it applicable to comment as a supplier. (2) Hitachi is not in the position to comment on any commercial values indicated in this paper. (3) By giving comments to this paper, it does not mean Hitachi's approval of the document or does not make Hitachi responsible for the contents of this document, or any damage or loss arising from or in relation to this document.*

Key References

The Monorail Society	www.monorails.org
Hitachi Rail Systems - Monorails	www.hitachi-rail.com/products/monorail_system
East West Link Needs Assessment (DOI)	http://www.doi.vic.gov.au/doi/internet/planningprojects.nsf
Wikipedia	Information about and images of various monorail systems.
Google Maps	Satellite maps of Melbourne – see hyperlinks in **Proposed Route** section.

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