20121030 Northern Sydney Corridor

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Introduction

A recent document[1] realised the simplicity of creating an almost straight rial corridor from Campbelltown through to Hornsby. This proposed rail corridor travelling north from Campbelltown would branch off the eastern side of the Main Southern line just north of Guildford station, enter an almost straight tunnel that would surface at Rosehill station.

This proposed corridor would then continue up the Carlingford line where it would again enter a new tunnel at Carlingford that would end just north if Beecroft road, where this corridor would join the Epping line, north of its tight bends just south of Pennant Hills station. This rail corridor would allow freight to be transported across the Sydney Basin in about 22 minutes from Casula to Hornsby.

Reader feedback on this document raised an ongoing problem of a very steep gradient north of Cowan and south of the Hawkesbury River. This document looks laterally at Sydney's Northern rail Corridor and proposes a structural change, so that the very steep gradient is minimised, that the sharp bends are minimised, so that freight trains can traverse from Sydney's northern corridor, fast train technology can be utilised and this section of rail track can be made far safer than it is now.

Because of this rather steep gradient south of Brooklyn, it is common to use three (3) diesel locomotives to haul trains up this steep incline. Considering that this line was put in circa 1895, it is amazing that no alternative route has been implemented that would have a much lower gradient, no tight bends, and no need for the double-handling of extra engines just for this section of rail.

The obvious alternative is that road freight trucks are used instead of fixing this single section of rail track. The consequential road rebuild / repair bill for the Pacific Highway, F2, M7, M5, Hume highway etc is in the billions of dollars every year. This short-sighted over-use of road freight is an extremely expensive option that could be almost totally minimised if and when the gradient south of Brooklyn were corrected.

There are some aspects of changing the route of this rail line so that a fast and safe rail connection can be in place and through this infrastructure development, and this short document works through such a process.

The Existing Cowan Brooklyn Corridor

The rail connection north of Cowan to Brooklyn is apparently one of the steepest rail gradients in Australia. By rail, Cowan station[2] is 48.81 km from Central and is about 200 m above sea level. Brooklyn (Hawkesbury River[3]) station[4] is 57.40 km from Central and about 8.7 m above sea level.

The distance between these two stations by rail is 8.59 km and the altitude difference is about 192 m. For the total distance of about 8600 m the average gradient is about

[1] http://www.moore.org.au/senh/2012/20120809%20Sydney%20Basin%20Freight%20Rail%20Link.pdf
[2] http://en.wikipedia.org/wiki/Cowan_railway_station
[3] http://en.wikipedia.org/wiki/Hawkesbury_River_railway_station
[4] http://www.nswrail.net/locations/show.php?name=NSW:Hawkesbury+River&line=NSW:main_north:0

1 in 44.8, which is steep but within limits for a freight train if this gradient were consistent.

An incident report of a Cowan Rail Accident[5] in May 1990 states that the track gradient is 1:40 in the Cowan Bank region and that the wheels of the 3801 locomotive started to slip with this gradient (after some idiot passenger pulled on the emergency brake). The signalling was damaged by the sand used for adhesion. Another train was sent on the single section, resulting in 6 fatalities and many injured.

The rail track is basically in two parts. The first part is where the rail track runs about 300 m south of the Brooklyn shoreline for about 2500 m, where it gradually rises to about 50 m altitude near the first tunnel before the track heads into the Cowan George this track is. In this nominal 2500 m east-west strip, the gradient is about 1:61, and for the remainder 6000 m the altitude difference is about 150 m and the average gradient is about 1:40, which is very steep for rail traffic.

The picture above (thanks to Google) shows the original rail path in red, from the south end of the Hawkesbury River bridge, along the Brooklyn lower escarpment then generally SSW towards Cowan through the Cowan Gorge, under the F3 then crossing under the pacific highway a couple of times before reaching Cowan at about 200 m altitude.

[5] http://en.wikipedia.org/wiki/Cowan_rail_accident

This steeper gradient is too step for simple freight trains and fast trains, and the bend at the base level into the Brooklyn plain is too tight; so an alternative solution needs to be recognised and implemented for efficient NSW transport infrastructure needs.

What has to be recognised is that when the original railway path was put in, this was literally done by hand, and the natural strategy was to run along the contours as much as possible. Even then, there are short tunnels that could not be avoided.

Since mechanisation came into play after about 1965, the road and rail construction game has changed considerably. Big machinery can make create rail paths in a few months where before about 1960, creating an equivalent rail path would have taken many thousands of man-years to create.

Crossing the Hawkesbury

The Rail corridor crosses over the Hawkesbury River clear the water by about 5 to 12 metres, which is fine for small yachts and power boats to pass under, but nothing else that needs a substantial height clearance above the water.

If this clearance were raised to say 30 or 40 m altitude, then the gradient on the southern side could be substantially reduced to about 160 m in 8500 m, which is about 1 in 53. This change would mean that the gradient would have to fall from the south to the north to match with the existing rail line.

For a drop in altitude of 40 m with a gradient of 1 in 53, the track would reach the existing track about 2200 m north of the south pylon located at Brooklyn. This would be just north of the existing bridge, which is in two parts and takes about 2000 m to cross. So the rail would join east of Cogra Bay.

With this type of construction strategy, the rail would pass over the south side of the Brooklyn plain and onto the north side of the Brooklyn hill at about 50 m high, much as it already is, except that the rail track would not run along the south of Brooklyn.

Building a new high bridge is of little value if the existing bridge is in very good condition. So, if the existing bridge is in poor condition than it must be replaced, but there is no need to build a high level overpass because the proposed rail track will simply cut through the existing hill to minimise damage to the existing terrain.

Simple Gradient Maths

From Cowan, with a more direct route that does not involve a hard turn at the base of the Cowan Gorge, the nominal distance from Cowan station to Hawkesbury River Station would be about 5.7 km, not 8.7 km as before. Assuming there is a nominal 190 m altitude difference between these two stations, the average gradient would be 1:30 or about 3.3%.

This gradient is far too step for rail tracks, so, laterally thinking, the gradient down to the Hawkesbury River Station needs to start far further away than Cowan station.

If the Gradient were to start from the northern side of Berowra station, then the nominal “almost straight line” distance would be about 10.8 km to Hawkesbury station. Considering an average gradient from the north of Berowra station, then for a nominal 190 m altitude difference, the average gradient would be 1:57 or about 1.75%. This gradient is highly realisable and highly practical for fast and safe trains.

Using this strategy, Cowan station would become unused and the yards associated there could / would be for storing commuter trains in non-peak times.

Crossing Over the F3

When the main northern line railway was made in the late 1890s, the technology was all manual labour, so the dominant strategy was to run the rail tracks along the top of the plateaus and where possible, fill in the gullies with sandstone boulders to keep the track as level as possible.

This strategy was really good until it was necessary to cross over the Hawkesbury river because the slopes on the hill sides of the river are steep, and retracted from the river itself, making a nominally 200 m high bridge all but impossible.

When the F3 was engineered, this was all done with heavy machinery that literally cut its way through the tops of the plateaus, and put the waste rock between the plateau tops to make an almost level road surface.

The F3 is typically about 20 to 40 m below the plateau altitude, and east of the railway for all of the distance between Hornsby and Cowan, but then the rail path comes in under the F3 north of Cowan before it heads down into the Cowan Gorge.

Heading towards Newcastle, about 600 m to 800 m north of Berowra station (shown below), the current rail line veers from nominally NE to NNE in alignment with the F3, which is about 20 m to the east (right) and about 35 m below the rail elevation.

It would be very opportune to construct an overhead rail bridge at this location so that the rail path can then cross over the F3, and start an almost straight-line descent towards the Hawkesbury River station in Brooklyn.

The picture above shows the F3, looking north just east of the current rail line. Note the freight trucks heading north and the freight rail also heading north. The altitude difference is very significant, showing that a rail overpass at this location would in not impede vehicles using the F3. So, the descent towards the Hawkesbury River bridge could start here as the rail bridge crosses over the F3.

Descending to Brooklyn

Consider that the newly proposed descent to be virtually linear with distance and the rail track would be almost straight between Berowra and Hawkesbury River stations, now a nominal distance of about 10.8 km instead of about 12.8 km.

With Cowan being nominally 4.15 km beyond Berowra station (and with an altitude of nominally 200 m), as the proposed rail track would pass to the east of Cowan station by about 800 m with a nominal altitude of about 124 m.

So, the proposed rail track would already be about 76 m lower than at Cowan station and in the remaining 6.65 km of nearly straight track the altitude would drop another 114 m, at a continuing gradient of about 1:58.

South of the rail line in Brooklyn there is really nothing apart from the national park. The intent of this proposed rail track is to make as little damage to the parklands reserve as possible, but to cut it through the sides of some valleys and west of Porto Bay, include three pairs of short tunnels so that the natural habitat is not location restricted by the pairs of railway lines.

The map below (with thanks to Google) has a blue line, which would effectively be the proposed notional corridor for the descent from Berowra to the Hawkesbury River bridge.

Note that this alignment is almost straight and is without any tight radius bends.

With the earlier rail track no longer being used, the intent would be to remove the tracks and sleepers from this and use this as the preferred fire trail and walk way.

The width of the proposed dual rail track should not be any wider than about 9 m and this is far narrower than the F3. As such, the amount of stone cut-out to make way for the cars should be minimised, and where the track bridges over culverts, those should have suitable drainage in them such that water will not dam on the high side to weaken the rock fill-ins for the proposed rail track.

Cutting through Brooklyn

Currently the rail path runs off the existing rail bridge and then starts to run along the Brooklyn foreshore about 5 to 8 m above the water level.

This bridge is assumed to clear about 5 to 9 m above sea level at the Brooklyn (south side of the bridge) and that a nominal 1:57 climb is being worked in. This means that in the picture below of the existing rail track passing from the Hawkesbury river bridge and station under the Brooklyn Road overpass bridge (thanks to Google), the proposed rail path should head SSW and continue into the valley south of Brooklyn.

This valley is like a box canyon and the intent is that a series of three tunnels be built into the sandstone to get through the spurs west of Porto Bay. After then the rail track should run almost in a straight line towards the proposed Berowra rail overpass of the F3 just north of Berowra station.

Conclusion

The Main Northern Line rail from Sydney as part of the Northern Corridor has a fundamental problem because of the steep gradient and relatively tight radius in the rail section between Cowan and Hawkesbury River stations. This gradient and tight radius situation makes freight rail all but virtually impossible, and causes the commuter rail connection to operate slowly.

In the near future (within five years) the need for fast train technology will become an imperative, but fast trains will not be able to negotiate this gradient or curves without considerable danger, so these trains will have to travel very slowly unless significant improvements are made to this section of the Main Northern Line.

There is about 190 m altitude difference Between Cowan and Hawkesbury stations, but because of the hand technology used in the late 1890s to make this section of rail track, the optimum path was along the Brooklyn foothills and up the Cowan Gorge, resulting in a rather steep gradient of about 1:40 and a rather tight radius bend near the bottom of the Cowan Gorge

The realisation came that the gradient has to be significantly reduced to at least 1:55 or greater if possible, and the tight radius bends have to be removed so that fast trains can used this section safely. Removing tight radius bends means the gradient has to travel further.

By having the Main Northern rail lines cross over to the east of the F3 just north of Berowra station and starting the decline there, an almost straight rail track can be cut

through the sides of the valleys towards the existing Brooklyn Rail Bridge with very little damage to the local reserve.

With this proposed path for the Main Northern line, the distance between Berowra and Hawkesbury River stations would decrease from about 12.28 km to about 10.8 km and the average gradient would be about 1:57 with no tight radius bends.

Currently from Berowra to Cowan the speed limit would be about 80 km/h and the Cowan to Hawkesbury River section would be generally limited to about 40 km/h so that total journey would take about 16 minutes. With the proposed track between Berowra and Hawkesbury River the commuter speed limit would be about 100 km/h and this would take about 7 minutes.

For rail freight if the speed limit was 80 km/h, then the transit time would be about 8 minutes, and there should be no requirement for extra engines to pull these trains through this section, freeing these engines up for extra rail freight capacity.

This proposed virtually straight rail path between Berowra and Hawkesbury stations together with the proposed Sydney Basin Bypass[6] between Casula and Hornsby will provide the necessary infrastructure to substantially replace a large proportion of long distance road freight from the Hume Highway, F3 / Pacific Highway, the M2 and M7.

With this corridor in place, long distance rail freight and commuter services will be substantially faster, making the roads far safer than now. The then highly viable rail freight and commuter option has a far less carbon / pollution footprint, and comparatively is far more fuel-efficient[7] than long distance road freight.

The ongoing very expensive road freight caused damage to the NSW roads will be considerably reduced, making a better economy for businesses and people in NSW.

[6] http://www.moore.org.au/senh/2012/20120809%20Sydney%20Basin%20Freight%20Rail%20Link.pdf
[7] http://www.moore.org.au/senh/2010/National%20Freight%20Network%20Plan.pdf