1 Terms of Reference

This report has been produced at the request of Auckland Transport and assesses the feasibility of the alternative underpass design submitted to Auckland Transport by the Cowie Street Residents' Association in May 2014.

The documents reviewed in this assessment were those included in the submission to Councillor Mike Lee under cover letter of 12 May 2014.

The scope of the review has included an assessment of the structural design of the underpass, the geometric design of the approach roads and the road through the underpass, and an outline comparison of the cost estimates provided for the alternative against the cost estimates prepared by Cuesko for Auckland Transport of the concept underpass options produced by Opus for Auckland Transport in late 2013.

2 Geometric Design

The alternative underpass alignment is very similar to the Opus Option 2 underpass layout except that the Opus design had the bridge perpendicular to the rail rather than a 45 degree skew. In general we would expect the skew to be better for sight distance and geometry but we would expect this would put the bridge costs up considerably. We note the traffic engineer's report suggestion that some splaying of the eastern end of the bridge would be required to permit left turns from the underpass onto Laxon Terrace.

In geometric terms the Opus Option 2 vertical grade was approx. 8% whereas the alternative appears to be approx. 12% (as a result of shorter length to drop to level due to the skew). This is less desirable for pedestrians on the footpath – refer the safety audit comments on Opus design.

In addition they are showing a low point in the middle of the underpass which would have ponding/flooding issues.

3 Structural Design

Vertical Clearance – The critical section is at HFC's cross sections 35 and 20 where rail level at the northeast corner of the underpass railway bridge structure is about RL 46 and the road level is about RL 42, which does not allow for the 4.5m vertical clearance, let alone the structural depth for railway ballast, bridge deck and bridge edge beam.

Structural depth required based on the BBD estimate is 300mm ballast + 200mm concrete slab + 1,000mm beam = 1.5m which implies a road level on the inside of the corner turning under the bridge of RL 40 or another 20m road length parallel to the railway at the 10% grade from cross section 35, which probably puts the underpass railway bridge structure in the location shown on the Opus drawings. This would in turn, require additional retaining walls along the cut to the north.

Geotechnical Design – The HFC cross sections indicate cut slopes, the BBD estimate calls up reinforced concrete pile walls. There is no geotechnical information presented in the CSRA reports

and the contingency for "exclusion of unknown ground conditions" is not sufficient to cover our identification of the underpass railway bridge site as being a steep sided valley filled with uncontrolled tipping of the cuttings from the Parnell Railway tunnels. This geotechnical assessment was the basis for proposing a three span bridge with spill through abutments.

It is not clear what width is provided on the northern side of the underpass railway bridge structure and retaining wall. The bridge structure must support the ballast and the electrification posts and some form of side protection for the railway and our assessment was that a full height retaining wall with a side protection barrier was required from the underpass railway bridge to Sarawia Street.

The batters shown are at 1H:2V. These are actually sloping walls (they need to be to support the rail and also the adjacent flats) which change to a 1.5H:1V batter at the top. The Opus walls were vertical with a batter at the top of 2H:1V to negate the need for land take. There is mention in the cost estimate of piling inferring they have been priced but no details are provided. It appears to indicate raked/angled piles which would be harder to construct and incur a cost premium.

4 Cost Estimates

We have compared the BBD cost estimate of the alternative option to the Cuesko estimate of the Opus Option 2.

We note an error in the subtotalling of the BBD estimate for retaining walls on Page 8 of their calculation sheet where the sub total is shown as $121,590 but should read $1,042,120 however this does not affect their total estimate of $5,025,000 as the error has not been carried through.

The high level cost comparison is shown overleaf. The main area of difference is the estimated cost of the bridge structure, where the Cuesko estimate was $1.65m and the bbd estimate is $0.4m. The bbd estimate has no allowance for piling, while the Cuesko estimate has $615k. The other major element is for bridge beams where the bbd estimate has 36m of 1000 deep beam compared to Cuesko's 434m of 800 deep beam, with a subsequent cost difference of nearly $400k. In addition there are no abutments allowed for in the bbd estimate.

We would expect that the alternative design's bridge, being at 45 degree skew compared to 90 degree for the Opus Option 2 bridge, could cost up to 50% more. This would mean a bridge cost of about $2.4m which would lead to an overall project cost of about $8.6m. However, this is balanced by a shorter structure (single span vs. three span), which should have been reflected in greater earthworks volumes.

We are concerned about the volume of earthworks allowed for and the design details of the retaining wall on the Sarawia Street approach. We would need more details to assess this and would need geotechnical engineering input.

Construction		bbd estimate		Cuesko Estimate
	Preliminary & General	$ 357,750.00		$ 609,185.92
	Bulk Earthworks	$ 481,892.50		$ 553,980.00
	Retaining Walls	$ 1,042,120.00		$ 1,567,984.00
	Overbridge Structure	$ 395,850.00		$ 1,645,016.00
	Road	$ 250,821.00		$ 417,060.00
	Site works	$ 119,600.00		$ 167,288.00
	Main Contractor's Margin	$ 161,966.50		-
	Subtotal	**$ 2,810,000.00**		**$ 4,960,513.92**
Professional Fees				
	Consultant Fees	$ 565,000.00		$ 1,052,201.50
	Consent Fees	$ 60,000.00		
AT MANAGEMENT COSTS		$ -		$ 49,605.14
KIWI RAIL CONSTRUCTION COSTS		$ 100,000.00		$ 99,980.00
KIWI RAIL PROTECTION & BOL COSTS		$ 650,000.00		$ 650,000.00
CONTINGENCIES		$ 840,000.00		$ 1,352,539.08
Total Estimate (excl. GST) =		**$ 5,025,000.00**		**$ 8,164,839.64**

5 Constructability

One of the key aspects around this location is the constructability of the chosen option. Given the location on the rail network, and the fact that individual block of lines need to be paid for from the project budget this can add significant costs to the project. The Opus underpass option noted these challenges, with this being part of the reason to provide a three span option. This would have allowed construction of at least some portion of the foundations off-line.

The alternate option does not discuss this sequence in any detail, but it is assumed that the tracks would be cut, the unknown abutments created and then backfilled. Any backfilling of up to 5m in height, allowing for compaction would have to occur during a block of line. It is understood the aim is to construct this bridge over the Easter block of line period, and this would present a challenging construction programme to achieve this. A detailed methodology would need to be reviewed to confirm its feasibility. If possible to extend, the cost of additional block of lines would need to be included in the estimate.

6 Conclusion & Recommendations

The proposed underbridge option "The Solution for the Newmarket Level Crossing Closure", April 2014 was reviewed at a high level. Overall the option does not differ substantially from the two underpass options developed by Opus in 2013. The major difference lies within the assumptions on geotechnical conditions, piling, retaining requirements and constructability issues.

The substantial cost savings noted could be realised, but queries remain regarding headroom issues, geometrics and the apparently missing abutment costing. We also have concerns regarding the constructability of the proposed option, and a proposed construction sequence could be provided.

Additionally, there is limited structural or geotechnical information provided within the alternative option material. We have drawn conclusions and assumptions based primarily on items in the costing schedule, which limits our ability to be prescriptive about the feasibility of the proposal. If further detail is required, the information provide to BBD to cost would enable us to have a more informed response.

Overall, our assessment indicates that the cost estimate appears to be considerably less than we would expect for a structure of this nature in this location.

Andrew Cutts
Structures Work Group Manager