Auckland Transport

Auckland light rail peer review - Part B: options and assessment

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Contents

1. INTRODUCTION

This paper has been prepared for Auckland Transport by consultants Ian Wallis Associates (IWA), as part of a peer review of AT's proposals for a light rail network for Auckland.

The paper is one of three papers prepared by IWA for this peer review.

This paper (B) is concerned with **options and their assessment**. Specifically it addresses the following aspect of the peer review task:

> *"…the reliability of the options analysis results against the achievement of the study objectives, including whether there are further viable options that could be considered and appropriateness of the MCA for the purpose used – to identify the broad strategic option for further development."*

For conciseness, our review of this aspect is provided in tabular form, within the following sections:

- A: Project Purpose and Objectives
- B: Problem Definition
- C: Range of Options Considered
- D: Selection of 'Short' List Options
- E: Framework for Option Assessment
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The other two papers in this peer review set cover the following aspects of the AT proposals:

Paper A: Robustness of the deficiency analysis. This paper focuses on demand and capacity analyses regarding the maximum number of buses that can practically and reliably be accommodated on main routes in the isthmus and city centre.

Paper C: Cost estimates. This paper reviews the estimates of LRT infrastructure costs, vehicle capital costs and operating costs for the LRT proposals relative to the costs for the bus-based base case.

2. OPTIONS AND ASSESSMENT - PEER REVIEW

Summary of AT Work Undertaken	Peer Review Comments
A. Project Purpose and Objectives We were advised by AT[1] that the **purpose** for this (CCFAS2) project has been defined as follows: "*Provide an effective transport solution for those parts of inner Auckland and the City Centre that cannot be served by the heavy rail network, with CRL; that supports growth requirements in a way that maintains or enhances the quality and capacity of the City Centre streets; and thereby resolve the outstanding issues identified in CCFAS including the impact of a high number of buses on urban amenity.*" AT also advised that six **objectives** had been set for the project, in summary as follows (full objectives/sub-objectives set out in Annex A): 1. *Significantly contribute to lifting and shaping Auckland's economic growth* 2. *Improve the efficiency and resilience of the transport network of inner Auckland and the City Centre.* 3. *Improved transport access into and around the City Centre to address current problems and for a rapidly growing Auckland.* 4. *Provide a sustainable transport solution that minimises environmental impacts.* 5. *Contribute positively to a liveable, vibrant and safe city.* 6. *Optimise the potential to implement a feasible solution.* In relation to the stated project purpose and objectives, we were further advised by AT[2] as follows: "*You will see the emphasis given (in the project purpose) to urban amenity. In this context I can confirm that achievement of objectives 4 and 5 is given particular weighty in accordance with the guidance of the AT executive. Objective 1 should also be understood to have an amenity dimension – we understand that enhanced economic activity in the City Centre is not seen as likely to occur unless the aesthetical qualities improve.*"	• We note the 'two-pronged' nature of this purpose statement, ie focusing on: (i) providing an effective **transport** solution for inner Auckland that supports growth requirements; and (ii) maintaining the **amenity** of the city centre streets, in particular in the light of the prospect of an increased number of buses on these streets to cater for future public transport demand. • Taken at face value, these objectives/sub-objectives are consistent with the 'two-pronged' ('balanced') statement of project purpose: objective 1 focuses on economic development; objectives 2 and 3 on transport system accessibility and efficiency in/around the city centre; objective 4 on sustainability and environmental impacts of the transport system; objective 5 on city 'liveability', including restraining transport costs and congestion levels; and objective 6 on implementability and 'stageability'. • However, we note that, in interpreting these objectives, the further advice from AT indicates a somewhat different balance between the objectives – focusing primarily on city 'liveability' and amenity of the city central area. • This direction will clearly have implications for the option assessment framework and criteria (as discussed in a later section).
B. Problem Definition The definition of the problem that this project is intended to address is essentially summarised in the	• We note that the 'problem definition' as outlined in the Jacobs' Deficiency Analysis paper is entirely based on a 'do minimum' transport scenario for year 2046: this Do Min case includes CRL and the

[1] Email John Allard to Ian Wallis, 20 July 2015.

[2] Ibid.

CCFAS2 'Deficiency Analysis' paper prepared by the AT Project Team[3]. That paper focuses on the transport issues and problems expected to occur in the southern corridor and the central area over the period to 2046. Its analyses are based primarily on transport modelling using the APT model. Its findings on these issues and problems are summarised as follows: *"In summary, the deficiency analysis for CCFAS2 has highlighted that capacity on public transport bus services is likely to be a real issue, particularly as they near the City Centre and then within the City Centre itself. The problem of delivering sufficient capacity is already evident by 2026 on some services and corridors and by 2046, nearly twice the number of buses currently operating would be required to meet the demand for travel by bus. The central isthmus is the main area where issues are evident as services entering the City Centre at Symonds Street struggle to cope with demand and Symonds Street itself will struggle to cope with the required bus volumes beyond the very early 2020s."* In regard to issues relating to the amenity of the City Centre area as affected by transport, a separate report was prepared, focusing on the 'amenity capacity' of central area streets in terms of bus volumes.[4] Arguably, a more balanced summary of the problems is provided in a recent AT document[5]: • *Increasing congestion in the City Centre is reducing urban amenity and liveability.* • *Constrained access to the City Centre will limit economic growth and reduce the region's productivity.* • *Inefficient use of city centre street space will restrict accessibility, mobility and the city's economic competiveness.*	new bus network, but otherwise minimal changes to the existing PT system. Its estimation of future bus service levels is based on continuing to use 'standard' size buses (c. 50 passenger capacity) in the corridors of interest, despite the use of much larger capacity vehicles elsewhere in AKL. Thus it paints a 'worst case' picture of the number of buses in future – which, prima facie, could be substantially improved upon by use of a smaller number of larger (eg double-decker) buses. Its results need to be interpreted in that light.
C. Range of Options Considered	
The main outcome of the long list review workshop [10 Oct 14, AT34] was the selection of five suburban routes for further assessment (Dominion, Manukau, Sandringham, Mt Eden, Remuera Roads). A variety of city centre streets/ corridors were also nominated as providing potential routes for operation of the suburban services in/through the CBD.	• We have reviewed the paper summarising the findings from the long list workshop and have no issues with selection of these five suburban routes/corridors and options for their extension in/through the CBD. We note that these options are described in various places as 'Long list options', although arguably at that stage they were no more than specifications of potential corridors/roads to be used rather than future network or service options.

[3] CCFAS2 – Deficiency Analysis (ref ZB01598), Jacobs for AT, 9 January 2015.

[4] Built Environment and Amenity Technical Paper (draft), Jasmax for AT, November 2014. [IWA 65]

[5] LRT Technical Advisor RoI (ref 303-15-791-PS), AT, July 2015.

D. Selection of 'Short' List Options	
Following the long list review work (as above), AT prepared a Short List Summary Paper [13 Feb 15, AT 61.1]. This paper *"developed a short list of 10 network options that would enable a range of combinations of modes to be evaluated*". Of these 10 options, five are focused on LRT (involving different combinations of the five suburban corridors identified earlier), two involve bus on-street (using double-decker buses), one involves BRT (predominantly on-street), one involves a combination of heavy rail and bus, and one a combination of heavy rail and LRT. The five LRT options all involve different combinations of the five suburban corridors identified earlier, and all would run into the CBD via Queen and/or Symonds Streets.	• While a multitude of 'short' list options could be defined, consistent with the outcomes from the long list review workshop above [AT 34], we consider that the 10 short list options defined are likely to have covered the range of more promising options (recognising that the options might be further refined in the subsequent stages of the study). • However, we note that we have not identified any written material that explains and justifies the selection of these 10 options from the wide range of possibilities: this short list assessment is a significant step in the overall study and should be appropriately documented. We also note that while five LRT-based options were included in the short list, only one of these options was 'mirrored' by a corresponding BRT-based option - whereas there appears to be no reason why the other four LRT options were not similarly 'mirrored'. • We further note that, in the specification/discussion of the options, the aspect of bus capacity gets only brief mention. Our understanding is that: the Do Min option is based on 'standard' size buses; options 1, 2 and 3 involve double-decker buses; other options (including the BRT option 7) most likely involve standard size buses (although this is unclear). Given the demand forecasts for 2046, we would have expected that the main bus routes in all options would be operated by double-decker buses.
E. Framework for Option Assessment	
A multi-criteria analysis (MCA) approach was taken to the comparative assessment (evaluation) of the 10 'short list' options. This involved [refer AT27, 23 Dec 14]: • Specification of objectives (8). • Specification of criteria relating to each objective (over 50 criteria in total, within the 8 objectives). • For each criterion, specification of an appropriate measure and the data source for this measure. • Specification and then application of a relative rating scale (2, 1, 0, -1, -2) for rating the performance of each option against each criterion. • Selection and application of weightings for each objective and the criterion within the objectives, and hence derivation of the weighted sum score for each option under each set of weights. • Drawing conclusions from these results on the relative performance of the options, and the sensitivity of the performance results to a range of weighting assumptions.	• We support in principle the use of the multi-criteria analysis (MCA) framework for the study's comparative assessment of options against the range of objectives. However, we have considerable concerns relating to some of the details of application of this framework, as noted in the following sections. • We note that the MCA application in this case is more ambitious and complex than most such applications, in terms of having: o A relatively large number of objectives (8) o A relatively large number of criteria (> 50), many of which significantly overlap (hence may result in double-counting) and some of which contradict others. o A relatively large number of options (10) to be compared • We have been unable to identify any statement as to the role of the MCA, potentially as part of a wider assessment of the most promising options – which would be expected to include a business case analysis, including an economic appraisal. By default, the impression is given that the MCA assessment comprises the **total** assessment of

	options, rather than only a component of a wider assessment process.
F. Assessment Objectives and Criteria	
The assessment (evaluation) framework has eight 'objectives'. Six of these relate to 'benefits' - of which three relate directly to transport (city centre access, city centre mobility, regional movement), two to environment and one to economic performance. The seventh objective relates to implementation and the eighth to cost aspects. Within the eight objectives, over 50 assessment criteria are specified. For each objective, a corresponding measure is defined along with the data source to be used in measuring performance.	• The eight objectives used in the assessment differ from the six study objectives defined earlier (refer Annex A). One reason is that an additional objective (cost) has been included for assessment purposes, but was not included in the original objectives. . • Apart from that, there is only a broad correspondence (no more) between the other seven assessment objectives and the six project objectives. Further, there is no clear correspondence between the assessment criteria and the project sub-objectives. We cannot see any good reason for these differences, particularly at the top (objective) level, and have not identified any documentation to explain the reasons. • Further, we note that the eight assessment 'objectives' are not couched in 'objective terms', but are merely topic heading in the spreadsheet analyses. • We note that, of the eight objectives, seven are essentially measuring 'benefits' (to transport users, the community, the environment, etc) while only one is measuring 'costs' (to the public sector). • The > 50 criteria is a relatively large number for such assessments, and tends to give rise to issues of double (or triple) counting and interpretation. For example, criteria 1.02, 1.04 and 1.07 appear in part to double-count similar effects, and in part to point in contradictory directions. We have not attempted to review/critique every individual criterion and its associated measures.
G. Assessment Scoring Methodology	
The assessment scoring is set out in two main spreadsheets [AT27, Evaluation framework v O9, sheets 'Assessment' and 'Scored version']. It involved ranking (rating?) performance against each criterion on a relative scale, comparing every option against the Do Minimum case. The rating scale used was +2, +1, 0, -1, -2, using only integer scores and where the Do Minimum was scored 0 (zero) in all cases.	• The 'Do Minimum' should be defined somewhere (we have not sighted any definition). We are unclear whether the Do Min is a realistic option over the longer-term (eg 2046): if not, we suggest it should be replaced, as the assessment base case, by a minimum cost variant that would be realistic (maybe this is option 1?)[6] • We have seen no statement as to the 'assessment year' adopted but assume it is 2046, representing a medium/long term year for which model estimates are available and by which the full scheme is assumed to have been implemented. • The 5-point assessment scale is relatively crude for a project of this type: a 7-point scale may be worth consideration. • Where quantitative assessments are possible/ available against criteria, it would be helpful to include these in the assessment. Then, as required, they can be also expressed in terms of points

[6] AT advises that option 1 is being used as the 'base case' for economic assessment purposes in work currently in progress.

	(usually assuming a linear relationship between the quantified estimates and the corresponding point scores). This will give more confidence that relative performance figures (e.g. out of the transport model) are being reflected consistently in the rating scores. • The above point is considered especially important in the case of the cost objective. It is not readily apparent to people examining the results that the total cost range between the options is very substantial, probably in the order of $2.0 billion (PV terms) over the economic life of the project. This significant amount (of similar order to the total costs of CRL) tends to get lost in the way that the assessment results are presented.
H. Assessment Scoring Application	
Each option was assessed against each criterion on the 5-point scale (relative to Do Min = 0). The Excel worksheet [AT27, Assessment] sets out the scores awarded with a brief comment as to the basis for them.	• We have not attempted to review the awarded scores in any detail. However, we do have some reservations from the limited checks made (noting that no two parties are ever likely to agree completely on the relative merits of options against all criteria). • To review the assessment findings on the relative merits of BRT v LRT, we specifically compared option 5 (full LRT network) and option 7 (full BRT network). A view quite often expressed is that anything an LRT solution can achieve, an equivalent BRT option can also achieve, but at significantly lower total costs (capital and operating, in PV terms). This review found that, according to the assessment results, option 7 performs substantially worse than option 5 against most objectives (1, 2, 4, 6 and 8). In 'unweighted' terms (all objectives weighted equally, and all criteria within any objective weighted equally) option 7 performs no better than option 1 (double decker buses, on-street operation). We find these relative results somewhat unlikely, which raises more general concerns about the assessment scoring and weightings applied (refer following section). • We also note that, under the base assessment (all objectives given equal weighting), the 10 options fall into two groups: options 1, 2, 3 and 7, with weighted sum scores in the range -0.6 to 0.7; and the other six options, with weighted sum scores considerably higher, in the range 1.7 to 2.8. We observe that all six high-scoring options are focused on LRT mode; whereas the four lower-scoring options are focused on bus mode (with one including a limited heavy rail extension, Mt Roskill Spur). The conclusion that may well be taken from this scoring is that, for the area under study, LRT-based PT **is very considerably** superior to bus-based PT services on the assumption that **all objectives are equally weighted**. This result is somewhat surprising in our view.

I. Approach to Assessment Weightings (and Sensitivity Tests)	
Our understanding is that the 'base' assessment (A) results give equal weight to each objective (ie a one-point score difference between options is given the same weight across all objectives); and also equal weight to all criteria within any objective. Sensitivity tests have also been undertaken on the weighting of objectives and criteria, adopting: (B) Equal objective weighting, unequal criterion weighting (C) Unequal objective weighting, equal criterion weighting (D) Unequal objective weighting, unequal criterion weighting.	• The results we have inspected [AT27, v9: Scored version] appear to be identical for equal and unequal criteria weightings (ie assessment (B) is identical to (A), (D) identical to (C). This suggests that the unequal criteria weightings have not been applied in practice. • The main changes in objective weightings for (C) and (D) compare with (A) and (B) are that two objectives (Environment, Cost) are down-weighted (to 5% each), while three objectives (city centre access, city centre mobility, economic performance) are up-weighted (to 20% each). However, we note that this re-weighting of objectives has resulted in very little change in the relative rankings of the ten options. • It was noted in the first section of this table that AT's intention was to give particular weight to the project objective 4 ('a sustainable transport solution that minimises environmental impacts') and objective 5 ('significantly contribute to lifting and shaping Auckland's economic growth'). In our interpretation, project objective 4 best corresponds to assessment objective 'Environment' and objective 5 to 'Built Environment'. But, in the sensitivity testing for objective weightings, 'Environment' has been sharply down-weighted (from 12.5% to 5.0%) and 'Built environment' has been marginally down-weighted (from 12.5% to 10.0%). Our conclusion is that the current sensitivity tests do not reflect the relative importance of the various project objectives as advised by AT management. • We have a substantial concern about the relative weightings adopted between 'benefit' objectives and criteria and 'cost' objectives and criteria (refer item F above). The current base objective weightings (A) result in a weighting for 'benefit' objectives against cost objectives of 87.5%: 12.5%; while the reweighted objectives result in a ratio of 95%: 5%. • We note that, for a project of this nature, conventional economic evaluation typically shows a broad comparability between the magnitude of benefits and the magnitude of costs (i.e. a BCR ratio in the order of 1.0). This would suggest that, from a socio-economic perspective, the appropriate balance between benefit objectives (in total) and cost objectives would be expected to be in the order of 50%: 50%. It would be of interest to examine the results of sensitivity tests on these lines. • Indicatively, we note that the cost range between the 10 options is likely to be in the order of $2 billion (capital and operating, PV terms, over the project life). This cost range would equate to a difference of two rating points (-2 compared with 0) on the cost

	objective, i.e. around $1.0 billion per one rating point difference. We suggest that some thought be given to the 'value' (in willingness-to-pay terms) that society might reasonably give to a score difference of one rating point on each of the seven 'benefit' objectives. If this value is considered to be significantly lower than $1 billion, then this benefit objective should, logically, be given lower weighting than the cost objective; or vice versa if the value is considered to be higher. It would also be worth considering a similar question for all the 'benefit' objectives combined: the logic of weighting all objectives equally, as has been done at present, is that a one point higher rating across all of the benefit categories would be worth in the order of seven times the $1.0 billion per point cost advantage on the cost objective. • We suggest that the treatment of the cost objective in the MCA evaluation needs re-consideration, with a choice between: (i) re-assessing the weighting to be given to the cost objective, in the light of the above comments; or (ii) not attempting to include the cost objective in the MCA, but addressing the costs v benefits trade-off separately (eg in the economic case assessment). The present approach is a very unsatisfactory solution.
J. Summary of Option Assessment Findings	
The MCA findings indicate (based on the objectives, criteria and scoring system used): (i) a strong superiority for all the LRT-based options over the bus-based options. They also indicate a similarly strong superiority for the LRT-based option 5 over the BRT-based option 7: apart from the mode/technology involved, these two options are very similar in terms of route, network, services, etc. (ii) The ordering of options is very insensitive to the different criterion weightings tested. (iii) The ordering of options is very insensitive to major changes in their relative costs.	• In regard to point (i), while 'real-world' experience indicates some advantages for LRT-based solutions over bus-based solutions in similar situations, it would generally suggest a closer balance between the two types of solutions than is indicated by the MCA results. • In regard to point (ii), we find that the sensitivity tests undertaken are not consistent with the advice provided by AT management on the relative priorities of the various objectives. • In regard to point (iii), we find that the attempt to include the cost objective in a framework otherwise including only 'benefit' objectives has not been successful or helpful. We suggest that further consideration needs to be given to this, with one option being to exclude costs from the MCA assessment and to address cost v benefit trade-offs elsewhere (eg in the economic case).

ANNEX A: Study Objectives

(**Source:** Light Rail for Auckland: Potential Peer Review – Terms of Reference).

Project Objectives	
Significantly contribute to lifting and shaping Auckland's economic growth	• Support economic development opportunities including serving and stimulating the development of areas of potential higher activity in the City Centre and Fringe • Enable a more productive and efficient city • Provide the greatest amount of benefit for cost
Improve the efficiency and resilience of the transport network of inner Auckland and the City Centre	• Improve journey time, frequency and reliability of transport access into and within the City Centre and Fringe • Improve the linkages and service of key destinations, particularly those not served by the CRL • Maximise the benefits of existing and proposed investment in transport - including the CRL • Release the capacity constraints around the City Centre's most important approach routes and nodes
Improve transport access into and around the City Centre to address current problems and for a rapidly growing Auckland:	• Provide a transport system that is best able to satisfy the immediate needs and the long term, rapidly growing customer demand in the City Centre and approaches through moving more people with high reliability • Facilitate opportunities to better serve critical corridors such as the Airport or North Shore
Provide a sustainable transport solution that minimises environmental impacts	• Limit visual, air quality and noise effects associated with the growth in road traffic • Contribute to the country's carbon emission targets • Take account of 'whole of life' sustainability impacts
Contribute positively to a liveable, vibrant and safe city	• Enhance the attractiveness of the City Centre and Fringe as an outstanding place to live, work and visit • Protect the city's cultural and historic heritage for future generations
	• Help safeguard the city and community against rising transport costs • Reduce surface transport congestion
Optimise the potential to implement a feasible solution	• Ensure that a solution is achievable in target timeframes – to allow immediate issues to be addressed and to provide for the longer term • Take account of the ability to stage a solution