Briefing Document for an independent analyst seeking to assess the case for Trolleybus as presented at Public Inquiry

This document sets out some questions on which an independent analyst would wish to form a view. Under each question, attention is drawn to important evidence drawn from documents produced at the Inquiry – most of them by applicants' own consultants. The questions are:

A. Does the proposed scheme fit with Leeds City Council's objectives?
B. Are the revenue forecasts reliable?
C. What implications would local control of buses (via a Quality Bus Contract or as part of a devolution agreement) have for the Trolleybus project?
D. Were the performance and impacts of the trolleybus scheme accurately modelled?
E. Is the result of the Cost Benefit Analysis credible? and
F. Were alternative solutions properly investigated?

Further observations, directly addressing the issues on which the Secretaries of State wished to be informed by the Inquiry, are provided in the Closing Statement by North West Leeds Transport Forum (NWLTF). It, along with the documents referred to in the footnotes, is an Inquiry Document which can be found on the PA website http://www.persona.uk.com/LTVS/index.htm .

A. **Does the proposed scheme fit with LCC's objectives** (i.e. improved quality of life, reduced emissions, increased economic activity, etc.; as set out in the LDP and elsewhere)?

1. According to predictions set out in the Business Case and other documents prepared by the Applicants' consultants, introduction of the trolleybus would result in:
   i. increased car mileage[1], emissions[2] and casualties[3] (these predictions are due, not to the stimulation of extra trips, but to the fact that existing trips would become more circuitous),
   ii. reduced use of active modes[4],
   iii. increased average journey times during the morning peak (summed across all modes)[5],
   iv. increased congestion (measured as lower average journey speeds for cars)[6],
   v. reduced connectivity (measured as increased average generalised cost of travelling – summed across all modes and time periods)[7],
   vi. increased noise nuisance[8],
   vii. adverse impact on landscape and townscape[9] and on heritage assets[10],

[1] Section C15 of NWLTF122 – original evidence from Table 58 of C-1-8 supplemented by data in first table of the penultimate page of APP103.
[2] Table B1 of APP-7-3
[3] Para 15.85 of C-1 also in Table 17.12 of C-1
[4] Section C15 of NWLTF122 – original evidence in Table 12.4 of C-1 supplemented by data in first table on penultimate page of APP103
[5] Section C9 of NWLTF122 – original evidence from APP103 page 7
[6] See Table 7 of C-1-9
[7] Against a background of no increase in overall trip numbers, answer 8 in APP-105 shows increased person miles and answer 9 shows increased journey time (in each case summed over all modes for the morning peak). This implies increased trip cost. Note that these results relate only to the morning peak but that mileage data in APP-122 suggests that the effect is present in all time periods.
[8] Para 17.28 and Table 17.11 of C-1
[9] Para 17.28 and Table 17.11 of C-1
[10] Paras 14.209-211 of C-1 indicate negative impact on heritage assets although Para 14.213 apparently suggests that, over time, this would cease to matter because people would get used to the new situation!

viii. no significant shift from car to public transport (the majority of trolleybus users would otherwise have travelled by bus or train[11] and the reduction in car trips is only half that in active mode trips[12]).

2. According to the predictions made by the Applicants' consultants, introduction of the trolleybus would worsen the public transport offer in several respects:
   i. the public transport frequency from any given stop would be lower (current headway at stops on the A660 is 3 minutes, proposed headway at trolleybus stops, and at bus stops, is 6 minutes)[13],
   ii. the overall public transport seating capacity (measured as number of seats provided per hour) would be reduced[14],
   iii. almost all bus journeys would take longer door-to-door than they currently do[15],
   iv. door-to-door journey times by trolleybus would be longer than they currently are by bus for many journeys in the A660 corridor[16],
   v. passengers would, on average, have further to walk (a simple consequence that the average distance between trolley stops would be greater than that between existing bus stops) .
   vi. origins and destinations on bus routes #1 and #6 which are not directly served by the trolleybus would have a reduced service (notably #1 beyond Bodington Fields and between Hunslet and Beeston, #6 in Cookridge/Tinshill and between the Merrion Centre and the Bus station)[17],
   vii. interchange between trolleybus and bus would be less easy than it currently is between bus and bus (due to separation of stops – consider for example the journey from Leeds City station to Adel which is currently effected by transferring from #1 to #28 at Headingley Arndale Centre)[18].
3. The impact on economic activity is likely to be negative because, as noted at A.1.v above, introduction of the trolleybus would result in reduced connectivity. The prediction by the Urban Dynamic Model (UDM) that there would be a *positive* impact on employment does not fit this expectation. Closer examination reveals that this is because the UDM treated an assumed willingness to pay to ride on trolleybuses as if it were a real time saving, and because it ignored:
   i. the increased time and cost suffered by cars and commercial vehicles[19],
   ii. the costs and disruption to business during construction[20].

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[11] Table 12.4 in C-1

[12] Section C15 of NWLTF122 - original data from letter from AECOM to NWLTF (reproduced as NWLTF112).

[13] Para 11.22 of C-1

[14] The Promoters envisage 8 fewer buses per hour. FWY144 indicates that each bus has 72 seats so this implies a loss of 576 bus seats per hour. This would be offset by an increase of up to 440 seats on trolleybuses – assuming the stated peak frequency of 11 vehicles per hour and assuming 40 seats per trolleybus (a value which, according to evidence in section C7 of NWLTF122, cannot be exceeded if space is to be preserved for the anticipated peak loading). The net effect would therefore be a loss of 136 seats during the peak hour.

[15] Section C2 of NWLTF122 – original data from Appendix A of C-1-13

[16] Section C3 of NWLTF122, using data from Appendix A of C-1-13, demonstrates this for journeys from West Park to Merrion Centre. It is also true for journeys to the St John's Centre, The Victoria Quarter, the Grand Theatre, West Yorkshire Playhouse, Leeds bus station, the new Victoria Gate development and indeed to much of the city centre. The effect is even more marked for journeys which do not need to pass through Headingley

[17] Compare NGT route map with routes of buses #1 and #6. E.g. on Metro's website - http://www.wymetro.com/uploadedFiles/WYMetro/Content/BusTravel/maps_and_guides/Leeds_Route_Map.pdf

[18] See B114.2 in NWLTF122

[19] Table 7 of C-1-9 indicates increased time and distance for road based traffic. Paragraphs 3.6 to 3.11 of C-1-18 describe the travel costs which were input to the UDM but contain no reference to the increased car costs. Mr Chadwick confirmed, under cross-examination, that the UDM forecasts ignored the increases in the generalised costs of road-based traffic.

B. Are the revenue forecasts reliable?

1. The revenue forecast relies on some very controversial assumptions all of which will tend to have exaggerated the trolleybus revenues. Namely:
   i. That people would choose to travel on a trolleybus rather than on a bus or a train even if, ceteris paribus, the trolleybus took 5.5 minutes longer (or cost about 15 pence more) than the bus or train[21]. This assumption, which is in addition to assumptions about the superiority of boarding point facilities discussed at B.1.iii below, was said to be justified by the results of Stated Preference (SP) work conducted in Leeds. However the SP surveys had actually shown a marginal reluctance to travel on trolleybuses[22] and the 5.5 minute value was actually derived from people's willingness to pay to travel on a "very new bus" rather than on an "old bus"[23]!
   ii. That people's assumed preference to travel on trolleybuses would exist in perpetuity[24]. This was assumed despite the fact that, as noted above, the Leeds SP work had shown a strong preference for new vehicles and that, during the life of the project, it is reasonable to assume that there would be times when the bus fleet is newer than the trolleybus fleet.
   iii. That, over and above the 5.5 minute preference discussed above, the superior quality of facilities at the trolleybus boarding points would mean that people would be prepared to use trolleybuses even if a bus or train was cheaper and quicker. The average value of this assumed preference was 5.8 minutes for buses[25] and 8.1 minutes for train[26]. The average values of the total assumed preference for trolleybus over bus and rail are thus 11.3 (5.5 +5.8) and 13.6 (5.5+8.1) minutes respectively. It should be noted that:
      a. The boarding point quality factors were derived from the Leeds SP work and are significantly higher than values typically found in research elsewhere[27].
      b. A possible reason for the unusually high values placed on the provision of CCTV and lighting at boarding points may be that the Leeds SP survey was conducted in winter shortly after national media coverage of a series of serious assaults, including a murder, at bus stops.
      c. The penalty used to represent paucity of facilities at rail stations was chosen without any study of the facilities actually available (it was apparently thought safe to assume that an

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[20] Mr Chadwick confirmed, under cross examination that the effects of disruption during construction on generalised costs of travel had not been estimated (and so cannot have been included in the inputs to the UDM).

[21] Value confirmed for bus in answer 3 in APP103, the fact that it was also applied to trains was confirmed by Mr Hanson under cross-examination. A similar preference was effectively assumed for travelling on trolleybuses rather than by car or active mode but the precise magnitude is difficult to quantify (it is a function of the composite cost passed through the nests in the hierarchical model of mode choice).

[22] This fact was not revealed in any of the documentation sent to DfT. Nor was it revealed to the Inquiry until it was documented in APP155 (Table 1 indicates that the willingness to pay to travel on a trolleybus rather than on a bus is minus 2.76 pence).

[23] Under cross examination, Mr Chadwick justified the use of the preference for new buses over old buses to represent an assumed preference for trolleybuses on the grounds that it was the promoters' aspiration that trolleybuses would be perceived as being that much better than buses. He was unable to quote any other support for the assumption. See further discussion in B21 of NWLTF122.

[24] Answer 3 in APP103 confirmed that the same penalty was applied in 2031 as in 2016

[25] Combining answers 1 and 2 in APP103, we have 7.1 minus 1.3 = 5.8

[26] Combining the answer given in APP172 with answer 2 from APP103, we have 9.4 minus 1.3= 8.1.

[27] A comparison of the values derived from the Leeds SP work with those derived from work elsewhere was provided for DfT (and is reproduced in C-2-4) but it was misleading in that it compared an average of the Leeds values with a maximum of the other values. Section C6 of NWLTF122 indicates that the Leeds values are about double those found elsewhere.

"intermediate" value would be appropriate[28]). Subsequent investigation of facilities at stations close to the NGT route indicates that, even assuming the Leeds SP values to be correct, the penalty is much higher than can be justified[29].

iv. That people would have no aversion to having to stand on the trolleybus (SP studies generally indicate that passengers have a strong aversion to standing and, although the Leeds SP work showed this effect[30] and although a significant proportion of trolleybus passengers would have to stand[31], this was not allowed for in the mode choice model). If passengers' aversion to standing had been allowed for it would have more than offset the assumed the "benefit" from improved facilities at bus stops[32].

v. That all trolleybus passengers would be able to board the first trolley to arrive at a given stop (a goal which would not be achievable in practice)[33].

vi. That car drivers would choose to use the trolleybus park and ride sites (and thus contribute revenue to the trolleybuses) rather than drive into the city centre even if, ceteris paribus, use of the park and ride sites increased their door to door travel time by an hour[34].

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[28] Stated in para 4.10 of C-2-8 and confirmed by Mr Chadwick under cross-examination.

[29] See section C12 in NWLTF122

[30] The Leeds SP revealed a disinclination to stand but it was somewhat lower than that generally found – probably because the survey sample had excluded concessionary travellers who choose to travel outside the morning peak period – see C8 of NWLTF122.

[31] No decision has yet been taken on the internal configuration of the trolleybus vehicles but APP108 indicates some possibilities ranging from "NGT1" (capacity 120 of whom 60 could be seated) to "NGT3" (capacity 160, of whom 40 could be seated). The promoters indicate that, if NGT1 were selected, then 10% of passenger minutes would be spent without a seat. However, as is demonstrated in section C7 of NWLTF122, an analysis of predicted demand profiles shows that, to ensure that capacity is available to meet average demand during the busiest 15 minute periods at the busiest stops, NGT3 would have to be selected. This implies fewer seats and would result in passengers having to stand at most times of day and a majority would have to stand at the busiest times.

[32] DfT's AECOM review of soft factors indicated, on page 191, that having a seat was the most important public transport attribute in all the studies which examined it. As noted above, section C8 of NWLTF122 indicates that the Leeds SP values for crowding are out of line with research elsewhere. Values quoted by the DfT review from studies in Dublin and in Australia suggest that not having a seat would reduce the journey utility by about 65 pence (see Section C8 of NWLTF122). An analysis of predicted demand and available seating (see section C7 of NWLTF122) shows that there would be no spare seats available for passengers boarding at stops along much of the route at most times of day. The passengers' perception is therefore likely to be that crowding is to be expected on most journeys. If we assume that they expect not to get a seat on half of their journeys we should divide the 65p by two. This gives an average penalty of 32 pence which, when translated in to minutes using the value of time used in the original work, gives a penalty of 13.3 minutes – which is significantly greater than the 5.8 minute advantage associated with superior facilities at boarding points. The consultants suggest a different way of looking at the perception of seat availability – namely the percentage of passenger hours which would be travelled without a seat. Figures for NGT3, provided in Table 1 of APP108, indicate that about 22.5% of trolleybus passenger hours would be without a seat in 2016 – rising to 26.5% in 2031. Dividing the 65 pence by an average of these two gives a penalty of about 16 pence which equates to 6.6 minutes. Even this lower figure more than outweighs the 5.8 minute average benefit which was assumed to come from trolleybus stops having better facilities than those at bus stops.

[33] Calculations in Section C7 of NWLTF122 show that the predicted demand would, at some points, exceed the legal maximum capacity of trolleybuses (160) and that it is unrealistic to imagine that this can be overcome by running extra vehicles at these times. It is thus inevitable that some would-be passengers would be denied access to the first trolleybus to arrive (thereby increasing waiting times and reducing the attractiveness of the trolleybus relative to other modes).

[34] This is because the car parking model has large negative Alternative-Specific Constants (ASCs). The carpark-specific penalty for city centre parks is around zero (see para 4.5.1.3 and Figure 11 in C-1-3) while that for the park and ride sites is minus 70 minutes (Mr Hanson confirmed, under cross-examination, that the Bodington and Stourton Park and Ride sites were assumed to be as attractive as the rail based park and ride sites at Garforth and Pudsey and that they were therefore given an ASC of minus 70 minutes based on the average ASC for those two sites - see para 4.5.1.1 and table 15 in C-1-3). In fact, as argued in the first bullet of section B3.2 in

vii. That the bus operator would not make a serious and sustained attempt to compete with the trolleybus[35]. For example by:
   a. maintaining frequencies (a sensitivity test of the consequences of bus frequencies simply being maintained suggested that this would reduce trolleybus revenues by 4%[36] but the main appraisal assumes that this would not happen)
   b. cutting fares (this assumption was not even subject to a sensitivity test – despite the fact that bus operators' willingness to cut fares in order to gain market share is already evident from the £1 fares from the Arndale Centre to the University)[37]
   c. introducing the newest, most comfortable, buses on the #1 and #6 routes (again, this assumption was not even subject to a sensitivity test)[38]
   d. taking steps to reduce dwell times - for example through greater use of cashless fares (again, this assumption this assumption was not even subject to a sensitivity test)

2. It appears that no tests of the sensitivity of the revenue forecasts to these dubious assumptions have been conducted but it is clear that their replacement by more reasonable/evidence-based assumptions would seriously reduce the predicted revenue for the trolleybus[39] .
3. A precise estimate of the implications for revenue is impossible without access to the models but, given the impact of the above factors on generalised costs, it would be unsafe to assume that patronage would be more than half that forecast in the Business Case[40]. If patronage were halved but trolleybus service levels were maintained at planned levels[41], the annual revenue would fall from £16.02m[42] to around £8m while annual costs would remain around £7.41[43]. An annual revenue surplus of less than £0.59 would not even cover the interest on the £35m of the "prudential borrowing" which is required to help finance the trolleybus project.
4. Given the importance of the revenue issue, the consultants should, as a matter of urgency, be asked to produce a run of the model in which the assumptions listed in section B.1 are replaced by more realistic ones. Namely, a run with:
   i. the trolleybus's 5.5 minute quality advantage set to zero,

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NWLTF122, there is good reason to suggest that a trolleybus-based P&R service would be perceived as less attractive than ones based on rail.

[35] Para 3.45 of Webtag Unit 3.15.3 (Inquiry doc E-3-22) notes the need to allow for the effects of competition from existing operators. It recommends including likely effects in the main forecast and using sensitivity testing to explore other effects. Sensitivity tests are detailed in C-1-9, in APP-5-3 and in APP-7-3 but no test of the effect of a reduction in bus fares, of introducing new buses, or of reducing dwell times, is mentioned there or anywhere else in the evidence.

[36] See result for "High Competition" in Table 9 in C-1-9.

[37] The modelling has assumed that trolleybus fares would be similar to those on buses – see C-1-6.

[38] The modelling has assumed that, in the trolleybus scenario, the bus service would be provided by buses of a type which was "current" in 2009. The Leeds SP work indicated that passengers would have perceived a significant benefit if the bus service were provided by "new buses" rather than by the then "current" buses.

[39] If the aspiration-based 5.5 minute preference for trolleybuses were replaced by a more reasonable figure, if passengers' aversion to standing were allowed for, and if a more accurate indication of rail qualities were allowed for, the trolleybus would have little or no "quality advantage" over other modes and it would have to compete solely on the basis of the journey time differential, hampered by the fact that people would know that they would often have no seat if they used the trolleybus.

[40] If trolleybus patronage were halved (but if its services remain as planned), people could be fairly sure of getting a seat on the trolleybus and so the advantage of the superior boarding point facilities would no longer be negated by the aversion to crowding and so a reduction to less than half is unlikely.

[41] If services were cut to reduce costs, the problem of seat shortage would re-emerge and the equilibrium demand level would fall further.

[42] Table 12.14 in C-1 shows annual revenues of £16.02m.

[43] Table 11.3 in C-1 identifies £5.41m annual operating cost while para 11.35 in C-1 identifies £2m annual infrastructure maintenance costs.

ii. the bus and trolleybus boarding point penalties reduced to 3.5 and 0.6 respectively[44],
iii. the rail boarding point penalty reduced from 9.4 minutes to 2.1 minutes[45],
iv. a penalty added to trolleybus trips to represent the likelihood of crowding (an accurate representation of crowding would not be possible without further model development but a proxy could be applied via an average penalty based on average loadings at a given time of day. An average figure of 6.6 minutes would seem fair[46]),
v. bus dwell times reduced by (say) 33% (to reflect faster the boarding times achievable through greater use of cashless fares),
vi. the frequency of the #1 and #6 buses kept at their current levels (to compete with trolleybus), and
vii. a reduction of (say) 25% in bus fares in the NGT corridor offset by bus fare increases in the rest of the network (to compete with trolleybus while maintaining overall bus revenues).

C. <u>What implications would local control of buses (via a Quality Bus Contract or as part of a devolution agreement) have for the Trolleybus project?</u>

1. Part of the rationale for selecting trolleybus as the NGT vehicle was that it enabled the promoters to apply for a Transport Works Act Order (TWAO). This was thought desirable because it would give the promoter control of the services and allow them to keep the revenues. The revenues on the A660 are particularly attractive and explain why that corridor was selected for the trolleybus. A Quality Bus Contract (QBC), or the powers for devolved authorities trailed in the 2015 Queen's Speech, would give the Combined Authority (WYCA) control of bus services and would allow them to keep any surplus revenues.
2. Given control of bus services, WYCA could rationalise bus services to make sure that the buses did not compete with it. However, if the Combined Authority had control of revenues, any financial case for introducing a trolleybus would disappear because the increased costs of providing public transport would exceed the expected increase in total public transport revenues. Introduction of NGT would thus result in an ongoing drain in the resources available for public transport. The scale of this annual drain on resources can be calculated in various ways[47,48,49] but is likely to be around £3m per annum.

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[44] Reflecting the fact that the analysis presented in section C6 of NWLTF122 suggested that the penalties derived from the Leeds SP work were about double those found elsewhere.

[45] A figure of 4.2 minutes is justified in section C12 of NWLTF122 but this should be halved in order to reflect the recommended halving of the equivalent penalties for bus and trolleybus.

[46] Based on calculations in footnote 32 above

[47] Table 21.1 of C-1 indicates a net NGT surplus of £3m p.a. while Table 21.3 indicates a net loss to bus operators of £6.3m. This indicates a net loss for the <u>combined</u> (bus + NGT) service of around £3.3m p.a. If rail services are included in the equation then the net loss is greater because, while there would be little opportunity to reduce rail costs, rail revenues are likely to fall by around £1.3m p.a. (Table 12.14 of C-1 shows that about 8.5% of NGT trips would have been abstracted from rail, 8.5% of the £16.02m NGT revenue is £1.35m). This suggests an annual loss for all public transport services of £4.6m.

[48] The annual cost of providing bus and NGT services would be about £7.5m greater than that of providing bus services alone. This figure comprises £4.15m net increase in operating costs (see Table 11.3 of C-1), around £2m for NGT infrastructure maintenance (see para 11.35 of C-1) and around £1.4m to service the £35m debt. This £7.5m is of course offset by increased revenues but, even accepting the (arguably inflated) revenues presented in Table 12.14 of C-1, this is likely to be less than £4m p.a. (Table 12.14 shows that around 75% of NGT trips would have been abstracted from other modes of public transport. If the 25% that are genuinely new are assumed to contribute 25% of the predicted £16.02m annual revenue, then the extra revenue is only £4m p.a.). This indicates a net loss of around £3.5m p.a. (£7.5m minus £4m).

D. <u>Were the performance and impacts of the trolleybus scheme accurately modelled?</u>

1. There are serious concerns about the use, within the mode choice model, of quality factors whose values are not supported by evidence. Specifically:
    i. The assumption, despite contrary evidence from the Leeds SP study, that people would prefer to travel on a trolleybus than on any other public transport vehicle (see B.1.i above),
    ii. The use of boarding-point quality factors which are considerably higher than those found elsewhere (see footnote 27 above),
    iii. The use of unjustifiably high penalty factors for use of rail (see B.1.i and B.1.iii.c above).
2. There are serious concerns about the failure to consider the limits on the capacity of trolleybus vehicles[50]. The models represent traffic congestion and of crowding on rail services but have no representation of crowding or seat availability on buses or trolleybuses. The failure to consider crowding on buses may be justified by the fact that, in an incremental demand model, it is unnecessary to represent a continuation of a pre-existing condition. Also, although it may be assumed that extra buses would be deployed if demand were to exceed supply, this assumption is not realistic for trolleybuses (see section C7 of NWLTF122). Given passengers' well-known aversion to standing, the failure to consider the practical limits on trolleybus capacity limits on the carrying is a serious flaw.
3. There are concerns about the accuracy of the traffic assignment model. For example:
    i. The representation of the A660/Shaw Lane junction appears to be seriously deficient (the flows predicted for the base year are very different from reality[51]). Given that the performance of this junction is critical for the corridor as a whole, it is clearly important that it is correctly represented. Indeed, given that it needs to be coordinated with the junctions at Alma road and North Lane, it would seem appropriate to consider some form of detailed simulation modelling of this part of the network.
    ii. The inaccurate representation of turning movements at the A660/Shaw Lane junction and of the flows on rat-runs such as Moor Road and Weetwood Lane[52], indicates that the model cannot be relied on to show the effects of the scheme on local traffic.[53]
4. There are concerns about the accuracy of the representation of local access links. For example, zone centroid connectors in Headingley are linked into the walk network at locations which will have distorted the predicted usage of individual boarding points and will have tended to exaggerate the accessibility of the trolleybus relative to other public transport modes (most particularly relative to rail and buses #19 and 56)[54].
5. There are serious concerns about the Park and Ride model:
    i. The fact that attempts to calibrate the parking model resulted in extraordinarily large car-park-specific constants and in the need to employ an unusual "fix" whereby car costs are factored up and public transport costs are factored down[55].

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[49] Table 21.3 in C-1 shows that non-NGT public transport revenues would fall by £8.3m. The forecast revenue for trolleybus is shown, in table 12.14, as £16.02m. £16.02 minus £8.3 is £7.72 which is similar to the £7.5m of additional cost calculated in footnote 48 above but, as argued in B.3 above, there is good reason to believe that trolleybus revenues would be substantially less than £16.02m p.a.

[50] See section D2 of NWLTF122.

[51] See C11 of NWLTF122 and original data from APP103

[52] See C14 of NWLTF122 and original data from APP103

[53] It is accepted that the assignment passed the normal DfT tests but these relate to the network as a whole – the assignment may be acceptable at the strategic level but its inability to represent local traffic must limit its usefulness for detailed analysis of the type required to model impacts of capacity-critical systems such as NGT.

[54] See Section D1of NWLTF122 (particularly the bulleted points at the end of section D1.a)

[55] Mr Hanson conceded, under cross-examination, that the parking model was not as good as he would wish and that its predictions could not be regarded as accurate to within plus or minus 50%. Paragraph 4.5.1.3 of C-1-3,

ii. The fact that the predicted demand includes a significant element of reverse-flow traffic (drivers driving out to a P&R site in order to ride back in again) and that the Stourton P&R site apparently fails to attract any users from the Wakefield area[56].

6. There are serious concerns about the Urban Dynamic Model:
   i. The fact that it has ignored the predicted increases the cost and duration of journeys by car (see footnote 19 above)
   ii. The fact that its prediction of increased employment is largely[57] due to the quality benefits which, despite evidence from the Leeds SP work, were attributed to travel on trolleybuses.
   iii. The fact that, because the model looked only at public transport users, it was unable to reflect the fact that overall transport costs (summed over all modes and time periods) are predicted to increase if the trolleybus scheme goes ahead[58].

E. <u>Is the result of the Cost Benefit Analysis credible?</u>

1. There can be little doubt that the "benefit" which produces a positive Benefit Cost Ratio (BCR) has been exaggerated:
   i. About a quarter[59], of the "time saving benefit" is derived from the quality factors which were assumed to be associated with use of trolleybus but which, as noted in B.1.i above, are contrary to the results of the Leeds SP study.
   ii. A further quarter of the "time saving benefit" is derived from the value placed on the superior facilities to be provided at trolleybus boarding points but there is good reason to believe that too high a value has been placed on these aspects[60].
   iii. No allowance has been made for passengers' well-known aversion to standing. Discussion at B.1.iv above indicates that correct allowance for this aversion would more than outweigh all the benefit assumed to result from the fact that facilities at trolleybus boarding points would be better than those at bus stops.
   iv. No allowance has been made for the value of the health disbenefits associated with the reduced use of active modes[61].
   v. The benefit has not been reduced to allow for a number of other factors which, although difficult to quantify without access to the models, would certainly result in reduced "benefit" in the BCR. For example:
      a. delays to trolleybus passengers unable to board the first vehicle to arrive (likely to occur sometimes even with "NGT3" and inevitable if, in an attempt to provide more than the minimum number of seats, trolleybus capacities are lower than 160),

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discussing the parking model's ASCs, concludes that they reflect weakness and inconsistencies in the input data. The use of the "fix" is discussed in paragraph B36 of NWLTF122.

[56] Data in APP147, discussion in B39 of NWLTF122.

[57] Mr Chadwick accepted, under cross-examination, that about half of the supposed "travel time savings" for public transport users were actually attributable to the quality factors. Calculations in C1 of NWLTF suggest that the contribution may be higher than that.

[58] See A.1.v above

[59] Mr Chadwick accepted, under cross-examination, that about half of the supposed "travel time savings" for public transport users were actually attributable to the quality factors. The total average quality factor is 11.3 minutes (see B.1.iii above). The disputed 5.5 minutes is about half (5.5/11.3) of this total. Thus the disputed figure is about a quarter of the total benefit.

[60] As noted at B.1.iiia above.

[61] Recent DfT guidance indicates that this effect should be allowed for and section C17 of NWLTF122 estimates that it could be a disbenefit of up to £4.2m).

b. loss of passenger utility caused by any reduction in the provision of bus services other than the #1 and #6 due to loss of revenues to trolleybus (services #28, #92 and #97 are perhaps most obviously at risk).

vi. Correction of these deficiencies would reduce the contribution of "quality" benefits to about zero and thus reduce the estimate of overall benefit by about 50%. This would result in a BCR of about 1.5[62].

2. The calculation of wider benefits which, although not included in the calculation of the Benefit Cost Ratio, are relied on in the Business Case. They are exaggerated in that:
   i. They exclude the loss in value of the heritage/landscape assets which would be adversely affected by the scheme (despite recent DfT guidance indicating that this impact should be included)[63].
   ii. They include a benefit attributed to reduced journey time variability which is exaggerated because it was calculated for the in-vehicle part of the journey rather than for the full door-to door journey[64].
   iii. They include the assumed increase in employment predicted by the UDM (see D6 above).
3. The baseline used to calculate the benefits (the Do Minimum Scenario) is unduly pessimistic in that:
   i. it does not allow for the value which, according to the Leeds SP study, people put on travelling on new buses (it was, in effect, assumed that, if NGT does not proceed, the route would for ever be served by buses which were the norm in 2009[65]).
   ii. it assumes:
      a. very modest improvement in the quality of rail travel (despite on-going initiatives)
      b. no significant improvement in bus stop facilities (despite there being a Metro policy of continued improvements)
      c. no saving in bus boarding time associated with roll-out of smart ticketing (which is already underway)
4. The deficiencies in the Leeds Transport Model (see D above) will, on balance, have resulted in forecasts which were unduly favourable to the scheme.
5. The net effect of the above will have been to exaggerate the net benefits of the "Preferred Alternative" (PA) scheme. It seems reasonable to assume that correction of all the above would leave the estimated BCR well below 1.5 (note that the 2012 DfT approval letter [66] indicates that approval of the Final Business Case is contingent on the BCR not falling substantially below 2.7).

[62] APP-7-3.2 shows benefits of £438m and costs of £151m. Removing the contribution from "quality" would reduce benefit to about £220m giving a BCR of 1.45. However, a more accurate estimate would require a re-run of the models – use of the run recommended at B.4 above would be an obvious first step.

[63] See section C16 of NWLTF122.

[64] See discussion in para B69 of NWLTF122.

[65] 2009 was the date of the SP survey.

[66] See condition iii of the July 2012 Programme Entry Approval letter – C-6-15.

F. Were alternative solutions properly investigated?

1. Neither the "Next Best Alternative" (NBA) nor the "Low Cost Alternative" (LCA) are serious attempts to show what could be achieved by other means if there were a will to do so[67]. As such they are constructs of little value.
   i. Given that the NBA has no identified source of funding, it has no more relevance than any other unfunded scheme. It would have been much more useful to have shown what could be achieved by, for example, significant investment in rail-based Park and Ride and/or tram-train investment, combined with enhanced bus priority and minor traffic management measures in the NGT corridor.
   ii. Notwithstanding the above, it is clearly useful to be aware of the likely performance of alternatively-powered vehicles using the trolleybus alignment. Unsurprisingly, because it requires similar infrastructure and has its own set of stops separate from bus stops, the NBA produces almost all the same disbenefits as the trolleybus[68]. It is predicted to attract fewer passengers than trolleybus because it has been assumed that it would be less attractive to potential passengers. However, this assumption is highly questionable (there is nothing in the results of the Leeds SP work to warrant it) and a sensitivity test[69] shows that, if it were perceived as the trolleybus is assumed to be, it would achieve a BCR of 3.49 (which is greater than the 2.90 predicted for the PA).
   iii. The LCA was very poorly specified:
      a. The bus priority measures which were specified give no significant reduction in bus run times. No attempt appears to have been made to consider additional bus priority measures (and those measures which were included give, inexplicably, less benefit in the LCA than they do in the PA[70]).
      b. Given that the Leeds SP showed that improvements to bus stops would be very cost effective, the LCA should have included very significant investment in such improvements. However the assumed improvement is limited[71] (and, inexplicably, the unit costs of improvements appear to be assumed to be higher in the LCA than in the PA[72]).
      c. Give that the Leeds SP showed that passengers would perceive significant benefit from the introduction of new buses, the LCA should have allowed for the introduction of new buses rather than the continued use of old diesel engine stock.
      d. The traffic signal settings devised for the PA were assumed to be employed in the LCA – they were not optimised for the LCA and so under-estimate what could be achieved in terms of network performance in a LCA scenario[73].
      e. The possibility of improvements in traffic management in the centre of Headingley (around North Lane) has been ignored[74].

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[67] This was clearly stated by Mr Chadwick several times during his evidence and cross examination. See Section D5 of NWLTF122 for a fuller discussion of the consideration that was given to alternatives.

[68] The main difference would be that the particular costs and aesthetic disbenefits associated with the use of trolleybus technology would be avoided.

[69] The "full quality" NBA test reported in APP-7-3.5

[70] See Section C4 in NWLTF122

[71] Answer 1 in APP103 shows that the bus stop penalty in the LCA is, at 5.4, only slightly lower than that in the Do Minimum case – whereas, as reported in answer 2, the penalty for trolleybus stops is reduced to 1.3.

[72] Answer 7 in APP103 reveals that £2.96m was assumed to be required to improve 52 bus stops in the LCA while £0.5m was thought sufficient to cover replacement of 66 bus stops in the PA.

[73] See para B60 in NWLTF122 – referring back to para 2.31 of REB-OBJ1719.3

[74] A discussion document outlining such improvements, and public opinions regarding them, has been produced by NWLTF and appears on their website: http://www.nwltf.org.uk/docs/ngt/Alternative%20Transport%20Strategy%20discussion%20doc.pdf

f. No improvement in bus boarding times has been allowed for (despite the clear potential for this via improved ticketing, use of smart cards and, potentially, of buses with multiple doors and two staircases).
g. The rail stock has been assumed to remain unimproved.

NWLTF 27/02/15 (revised to include reference to Devolution powers in August 2015)