Supplement to Proof of Evidence submitted by Peter Bonsall

Preamble

This document supplements my Proof (OBJ1719). It does not replace my original Proof. It comprises material which could not have been provided in the original document (because it draws on facts which had not been made clear at that stage and on statements made by Promoters' witnesses during the Inquiry). For convenience, it also includes an extract of my Curriculum Vitae (which was previously referred to as "available via Google") and errata relating to my Proof.

Contents

A Extract of Prof Bonsall's CV

My name is Peter Bonsall, I am Professor Emeritus of Transport Planning at the University of Leeds. I have 40 years of experience in transport analysis and planning including spells in the private sector and on secondment to local government. My particular specialism has been in the analysis and modelling of traveller behaviour and in the assessment of transport policy interventions.

I have worked as a consultant /advisor to:

- The Department of Transport – most recently on the potential use of new technologies to replace or enhance the National Travel Survey
- The Highways Agency – most recently on the evaluation and modelling of their Smart Motorways Program
- The Department of Trade and Industry – on E-commerce and on the market for Electric Cars
- The Cabinet Office on issues of Social Equity in Transport Policy
- Overseas Governments - most recently the Dutch Rikswaterstadt on issues in the interpretation of new evidence on the perceived value of Travellers' Time
- Local Councils including, most recently, an assessment for Liverpool's City Council of their City Centre Traffic management proposals.

I have been called to give evidence on a number of Inquiries and Audits including:

- The Department of Transport's SACTRA (Standing Advisory Committee on Trunk Road Appraisal) on the question of the extent to which new roads generate traffic
- A House of Commons Select Committee to which I gave evidence on Planning Gain
- A House of Lords Select Committee investigation on the effectiveness of a range of methods of influencing behaviour (where my evidence was on the relative effectiveness of pricing and "exhortation" in changing traveller behaviour)
- The US Transportation Research Board's recent investigation of equity issues in Transport Financing

I have worked closely with a number of consultancy companies on a range of projects – my role usually being to advise on the design of surveys, the suitability of models and the interpretation of results. I have led research teams on numerous research projects including, most recently, a European Union funded investigation of transport connectivity and integration.

I have published over 200 papers, books, chapters and reports on wide range of transport topics – the most recent being a book chapter reviewing methods of achieving modal shift. I have specified and programmed a number of Transport Models including models of mode choice and route choice and a strategic planning model which encapsulates the relationship between transport and land use and which is in use as a basic training aid in transport planning courses around the world.

I am a former Fellow of the Chartered Institute of Transport and its successor the Chartered Institute of Logistics and Transport and was, until recently, co-editor of the Journal of Transport Policy.

I had, for many years, a central role in teaching at the Institute for Transport Studies and was its Director of Studies from 1996 to 2000. I led courses on Transport Planning and Modelling, Public Transport Planning and on Transport Planning Forecasting and Analysis. A version of this course was developed for mid-career officials in The Department for Transport and has been delivered to several cohorts of DfT staff.

B Responses to the Promoters' rebuttal of my Proof of Evidence

My original response to the Promoters' rebuttal of my Proof was available before the start of the Inquiry and an un-proof-read version was offered to the Programme Officer on day one. I pointed out that I anticipated updating the document when further information which had been requested became available. She suggested that there was no hurry to put in my response to rebuttal since I would not be giving evidence until June. Nevertheless, having discovered, at 1700 on 10th June 2014, that Mr Hanson intended to refer to his rebuttal of my Proof during his Evidence in Chief, I thought it important to submit my response in advance of any further comment he might make. I therefore submitted it, still not proof-read, to the Programme Officer at 0915 on 11th June (before Mr Hanson had referred to his rebuttal of my original Proof). It was labelled as NWLTF118.

This addendum subsumes the material submitted in NWLTF118 (which is clearly marked in red font) and provides my further responses to the rebuttal in the light of information which has become available, though APP documents or verbally from Promoters' witnesses, since the start of the Inquiry. It is no longer necessary to read NWLTF118.

Paragraphs B1 to B85 relate to the Promoters' rebuttal of my concerns about deficiencies in the analysis. Paragraphs B86 to B110 relate to their rebuttal of my concerns respecting failure to give full, fair and adequate attention to alternative schemes (including the Do Minimum). Paragraphs B111 to B139 relate to their rebuttal of my concerns respecting failure (of the NGT proposal) to meet key tests. The Promoters offered no rebuttal of my conclusion that the problems with the NGT proposals are fundamental rather than cosmetic, and it still stands.

B1 My concern (in my Proofs 5.1 and A1) that bus journey times might have been overestimated relative to NGT times is addressed by Mr Hanson in his paragraphs 2.2, 2.3 & 2.4, and by Mr Chadwick in his paragraphs 2.43 to 2.45. Respecting SDG's Run Time Model, one of the issues raised during cross-examination of Mr Chadwick was the assumed dwell times for NGT vehicles (the equation in para 2.19 of C-1-13 shows it to be 7 secs + 0.7x Boarders + 0.7 x Alighters). Mr Chadwick maintained that it was reasonable to modify the result found in London (reducing the fixed element from 9.4 seconds to 7 seconds) because the trolley vehicle specification would allow for faster boarding and alighting than did the London articulated bus. Having now studied the original report, I note two interesting facts which were not mentioned by Mr Chadwick in his verbal evidence or in C-1-13. Viz:

- The survey found average dwell times per passenger were higher for three-door articulated buses than for single-door double-deck Routemaster buses.
- Two articulated bus routes were surveyed. One gave the results quoted in C-1-13, the other suggested a higher fixed boarding time (10 seconds rather than 9.4) - making the decision to reduce this to 7 seconds all the more notable.

B2 In his paragraph 2.3, Mr Hanson introduces new data which results from the realisation that the previously published data was '*internally inconsistent*' and '*could have been better labelled*' (although the re-labelling is trivial and in no way affects my understanding of the content). I think

it quite worrying that this error had not discovered earlier (particularly given the supposed quality control procedures). Apparently, the error was only discovered ~~it~~ when seeking to rebut my Proof's paragraph A1.i. I note that, because the nature of the error has not been explained, it is difficult to judge whether it has consequences elsewhere in the analysis.

B3 I note that the revised values still show that, contrary to any reasonable explanation, bus times are shown to increase more than highway times. Mr Hanson refers in his paragraph 2.4, to the fact that Mr Turner has noted reductions in bus speeds between 2009 and 2013. This inclines me to think that the inconsistency points to a problem with the forecasts of car journey times rather than bus journey times. But in any event, **my original concern about inconsistency in the data still stands.** Again respecting SDG's Run Time Model, Mr Hanson noted, in cross-examination, that DfT's letter of March 2010 (C-6-8) had specifically required further work on NGT to be done using a new model which Mr Hanson identified as the LTM. I note that the LTM's public transport generalized time equation, reproduced on page 29 of C-1-3, includes a factor, t_h, which captures changes in highway times and is designed to avoid the type of inconsistency between highway and public transport run times which I noted in my Proof. The problems I noted may have arisen as a consequence of the decision to abandon the t_h factor in favour of a free-standing model of public transport run times.

B4 I note that, although Mr Chadwick states that he is confident that the NGT and bus journey times are fit for purpose, he provides no specific response to my Proof's paragraphs A1.iv to A1.vi (dealing with delays to NGT which appear not to have been anticipated and assumed delays to buses which are unexplained). Mr Smith stated, under cross-examination, that he believed that the Run Time Model would reflect the fact that buses and trolleybuses would have to travel more slowly in the shared access area in front of the University of Leeds (where 10mph was mentioned as the recommended maximum) and along the narrow lane which they share with cyclists northbound past the University's Engineering Departments (where it was stated that buses and trolley vehicles would be unable to overtake cyclists). However, it is clear that the "cruise speed" indicated for these sections in C-1-13 (Annex page 7 run 03-01A) is no different from that for the wider stretches of shared lane north of the junction with Victoria Road. Similarly, under cross-examination, Mr Chadwick was unable to point to any allowance in the Run Time model for delays to southbound trolleybuses due to potential delays caused by stationary buses at the stop near Glen Road. Nor could he explain why, in C-1-13 Annexe page33 run 16.01A, southbound buses were assumed to suffer from "junction delay" near St Michael's church in Headingley.

B5 Mr Chadwick responds to my concern about modelling (in my Proof's A1.vii) by stating, in his paragraph 2.45, that the modelling is based on design freeze A-11 (Is this the same as Design Freeze 7?).

B6 My confidence in the fitness for purpose of the bus run time values is in fact further reduced in the light of the fact (which I had not realised until reading their rebuttal of my original Proof) that the bus journey times are assumed to remain constant throughout the life of the NGT scheme. This assumption is untenable because it means that changes in road congestion will not affect public transport (run times on the A660 would be particularly vulnerable to increased delay at approaches to junctions where public transport shares road space with general traffic – e.g. at the southbound approach to the Hyde Park junction and at the northbound approach to the Thornbury Avenue junction – the latter being close to saturation even in 2016). Webtag advice on this issue is very

clear; in paragraph 6.4.5 of Unit 3.11.2 (E-3-16) it states that "*For submodes that run on-street and share road space with other vehicles (mainly bus, but some LRT schemes) it is important that journey times in the PT assignment model are consistent with the level of traffic congestion*". But, even more obviously, the assumption of no change in trolleybus run times runs contrary to the fact, noted by Mr Robertson during cross-examination, that when trolley frequencies increase to more than 10 per hour (the proposal is for 12 per hour in the peak period in 2031), signal priority constraints would inevitably lead to increased run times.

B7 My concern about likely underestimation of delay caused by NGT to traffic on the A660 (my Proof's 5.2 and A2) is addressed in Mr Robertson's paragraphs 2.100– 2.104.

B8 Mr Robertson's description of the junction modelling process (in his paragraph 2.103) confirms my previous understanding of the process. He states that I was wrong to assume that differences between inflow and outflow would cause blocking back. That was not my point. Rather, I was suggesting that, where input to a link was greater than outflow from it, blocking back would occur. Nevertheless, I can accept that blocking back need not occur if the maximum flows allowed for in the junction modelling are lower than the flows predicted by the LTM assignment model. **Unfortunately, despite repeated requests, the data that would satisfy me on this point have not yet been made available.** Flow information annotated on the maps released as an appendix to APP103 was revealing in various respects:

- It confirms my fear that the flows predicted by the LTM are greater than those considered by TRANSYT at the Shaw Lane Junction (see C10 below).
- It shows that the turning movements predicted by LTM indicate that the SATURN network has not been coded with a realistic representation of the junction detail (see C11 below).
- It shows that the predicted flows on local links are far from realistic (see C14 below).

B9 Mr Robertson's paragraph 2.104 seeks to address my particular concern about the Alma Road junction (which is that traffic blocking back from the North Lane Junction will prevent the Alma Road junction from operating as desired). He seeks to explain why he thinks it will perform adequately but does not satisfy me that there is any reason to assume that the current level of blocking back will be reduced (indeed, in his Proof of evidence APP-6-2- in the final bullet of his 5.83 - he states that that the North Lane/Otley Road junction is unchanged and '*will continue to be a capacity restraint*'. **Unfortunately, my concern about Alma Road junction remains.** Information supplied in APP103 confirms my fear that LTM predicts an increased flow into North Lane (pages 18 and 28 of the appendix to APP103 identify an increase of 150 pcus using node 2152 between 2016 and 2031) and, as Mr Robertson repeatedly stated during cross-examination, North Lane is already a key capacity restraint on the performance of this part of the network. Mr Robertson stated under cross examination that any tendency to blocking back from North Lane to Alma Road could be prevented by using queue detectors outside the Arndale Centre to trigger restrictions on the inflow to Shaw Lane junction. I accept that this might be possible but note that it would reduce the capacity of the Shaw Lane junction below that assumed in the LTM (see B10 below).

B10 Mr Robertson's paragraph 2.104 related specifically to the problem which I had anticipated at Alma Road. However, the responses to questions put to Mr Roberson and Mr Hanson during cross-examination suggest that there is a more general problem respecting consistency between the

detailed modelling conducted using TRANSYT and the more strategic, SATURN-based, modelling in LTM. Viz:

- Mr Robertson stated that the relatively large zone sizes and incomplete coding of the local network made it difficult to compare the flows predicted by the LTM with those used as inputs to the TRANSYT modelling (e.g. it prevented any meaningful investigation of the fact that, as noted in NWLTF111 and repeated more clearly in C10 below, the LTM was forecasting greater flow through the critical Shaw Lane junction than had been assumed in the TRANSYT modelling).
- Mr Robertson stated that the turning movement capacities (traffic light green times) supplied to LTM by TRANSYT were not reduced to reflect the use of STM to avoid blocking back (he had earlier stated that, were the NGT scheme to be introduced, STM would need to be used to avoid blocking-back and that this would result in reduced green time at upstream junctions). The green times used in LTM will thus have resulted in over-optimistic forecasts of the A660's ability to accommodate NGT.
- Mr Hanson indicated that consistency between the two models had been assessed by checking the predicted journey times up and down the NGT corridor. Reliance on this check will not have alerted the analysts to problems which were apparent only on the side roads.

These issues are symptomatic of the failure to LTM to meet Webtag guidance in respect of its "area of detailed modelling" (see D1 below).

B11 My concern over errors in the representation of passengers' walking routes which will have inflated predicted shift of passengers from bus to NGT. (My Proof's paragraph 5.3 and A3) is addressed in Mr Hanson's paragraphs 2.6 – 2.9.

B12 I deduce from his paragraphs 2.8 and 2.9 that Mr Hanson assumed that I was challenging the location of the zone centroids. I was not. My challenge relates to deficiencies in the location of the centroid connectors. My point is that the location of these connectors will have caused demand to flow via the Headingley Hill NGT stop rather than the Arndale NGT stop and the St Michael's bus stop – with a net tendency to make NGT more attractive at the expense of bus. I also note (having looked again at the map) that it will divert demand which would, in reality use the number 56 bus, onto Otley Road services. **My concern about the consequence of the errors in the location of centroid connectors remains**. During cross examination, Mr Hanson identified an example of a centroid connector which might have exaggerated the distance to an NGT stop. I do not claim that all the errors will act in favour of NGT, rather than those I have so far identified tend to do so.

B13 Some of my concerns about errors in the estimation and application of quality factors (my Proof's paragraph 5.4 and A4) are addressed in Mr Hanson's paragraphs 2.10-2.12 and Mr Chadwick's paragraphs 2.50 – 2.59.

B14 I should begin by saying that my investigation of these factors has been somewhat hampered by the lack of consistent terminology in the promoters documentation (the term 'boarding penalty' seems sometimes to refer to the bus-stop penalty, sometimes to the vehicle quality factor and sometimes to the sum of the two) and by the lack of a clear statement of the average value of the bus-stop penalty in the various scenarios. The values of the quality factors were eventually clarified in APP103 (answers 1, 2 and 3).

B15 Mr Hanson's paragraph 2.11 introduces a new test to show the effect of assuming that all passengers would have to stand. This is interesting because it gives a first indication of the sensitivity of the BCR and NGT revenues to assumptions about perceptions of NGT seating, but its usefulness is hampered by the fact that the description does not make it clear what quality values were used nor where they came from. (I assume that they were the 3.55, 7.33 and 4.02 values from Table 2 in Doc C-2-4 which indicate, for different journey purposes, willingness to pay – in pence per minute - to avoid standing in crowded conditions but which I maintain are underestimates of the true penalty because they were derived from a survey which omitted concessionary ticket holders). Nor is it made clear whether the results post-date the correction of the various errors in the specification of the PA test. Cross examination of Mr Chadwick revealed that the value used for the test was actually that derived from the Stated Preference work for travelling while "there is sufficient space to stand" (i.e. not when "standing in densely crowded conditions"). Furthermore, as revealed in Section C8 below, the estimate of passengers' aversion to standing derived from the Leeds SP appears to be very much lower than that which has been found in other studies.

Mr Hanson confirmed, during cross-examination, that the description of an important component of the generalised time formulation used in the LTM (see section 4.2.1.1 of C-1-3) was incorrect: component P_C *(inconvenience associated with travel on crowded public transport services)* should, he said, actually be called "*inconvenience associated with travel on crowded trains"* because LTM does not include any representation of crowding on buses or trolleybuses. This is a serious matter (see D2 below).

B16 Mr Chadwick's paragraph 2.51 describes the reasons for using stated preference methods. I do not dissent from it, but point out that the results always need to be treated with great care – particularly if they are out of line with those from other studies.

B17 Mr Chadwick's paragraph 2.52 begins by suggesting that, because the proposed trolley bus system has been designed to share many of the attributes of successful tram systems, and because it is (intended to be) more like a tram than a bus, it follows that it will be preferred to a bus. The logic of this argument obviously leaves something to be desired but appears to be that, since the promoters want the trolley bus to be preferred to a bus, it will be! ~~However, all is not lost because the paragraph 2.52 goes on to say that it is necessary to use stated preference techniques to derive quality factors.~~

It was confirmed during cross-examination of Mr Hanson that the vehicle penalty (5.5 minutes) was applied not only to buses but also to trains – thus implying that journeys by trolleybus would be preferred to journeys by train. This is clearly inconsistent with Mr Chadwick's argument in paragraph 2.52 of REB2/OBJ1917. Mr Chadwick stated under cross-examination that the application of the penalty to trains had not been intended (he described it as a clumsy application of the penalty).

Mr Chadwick's suggestion that the trolleybus would share many of the attributes of a successful tram system invites a comparison between the preference for trolleybus used in the LTM and the preference for tram (relative to bus) found in the recent meta-analysis of stated preference studies conducted by Johnson et al for UKTram (submitted as NWLTF119). According to APP103, the total penalty applied in LTM to journeys by bus (and, it turns out, also to journeys by train) averaged 11.3 minutes (5.5 +7.1-1.3). The mean preference found by Johnson et al for trams relative to conventional buses was 8.8 minutes (Table 5.1 of NWLTF119 – using the value for people without

cars available since that is the subgroup whose preferences have been used in the LTM). Thus the preference used in LTM for trolleybuses is 28% higher than that found for trams – and even the Promoters had not claimed that trolleybuses would be perceived more positively than trams.

B18 Mr Chadwick's paragraph 2.53 mentions two stated preference exercises (described more fully in C-4-24) and explains that the first ~~one~~ is ~~the~~ relevant while the second is not. I have no argument with that.

B19 The first part of his paragraph 2.54 refers to section A4.i of my Proof and argues that I am wrong to suggest that the phrase "*all seats taken but plenty of standing space*" is better than "*plenty of seating spaces*" as a description of conditions to be expected on the NGT vehicles. **I disagree** (although I could be persuaded that the most appropriate description lies somewhere between the two). ~~and indeed~~ I note that, in paragraph 2.17 of his rebuttal when referring to trains entering Leeds station, Mr Hanson clearly states that '….*services operate approximately 10% over capacity entering central Leeds in the am peak hour*' and that '…*conditions using NGT would not be expected to differ materially from those observed*'.

B20 I note that there is no attempt to rebut my suggestion (in the second part of my Proof's A4.iii) that the exclusion of old people from the sample selected for the stated preference work will have tended to reduce the size of the "no seating" penalty. Responding to my observation that the SP sample had excluded concessionary pass holders, Mr Chadwick stated that they would have been included if they had travelled before 0930. This actually makes my point stronger - the sample will have excluded them if they chose to travel at the less crowded times of day - and hence their aversion to travelling in crowded conditions will not have been picked up in the survey. Section C8 below reveals that the estimate of passengers' aversion to standing derived from the Leeds SP work is very much lower than that found in other studies.

B21 The second part of Mr Chadwick's paragraph 2.54 states that '*the quality attributes of the NGT vehicle, when compared to a bus have been specified to be equivalent to the difference between an old bus and a new bus'* and suggests that this aspiration justifies borrowing the value derived in the stated preference for a "very new bus" and applying it to the NGT vehicle. **I do not think it safe to assume that the public will necessarily perceive the NGT vehicle in the manner intended by its promoters and would prefer to take account of evidence from the stated preference work**. Cross examination of Mr Chadwick confirmed that the Stated Preference surveys had included questions designed to reveal the willingness to pay for a journey by trolleybus rather than by bus (one of the graphics for the question appears as figure 4.7 in C-4-24). The result, first revealed in APP155, was that the willingness to pay was statistically insignificant (and actually negative). This result was ignored by SDG. The reason given in paragraph 7.46 of C-4-24 for doing so (*"By explicitly accounting for the various service attributes, it appears that we have succeeded in explaining the choice of a public transport service without the need to capture in such constants other factors which are not modelled")* was described as "dubious" in the review by Johnson et al (NWLTF119). Mr Chadwick made no attempt in APP156 or in response to cross-examination, to refute the opinion expressed by Johnson et al (even though, since he apparently commissioned their study, he must have been aware of their opinion). Indeed, no convincing reason has ever been given for ignoring the results of the Stated Preference questions which had been specifically designed to reveal the extent of any preference for travel by trolleybus rather than by bus and I find it hard to avoid the conclusion that

the original result was ignored because it showed no preference for trolleybus and that it was known that use of such a value would have seriously undermined the Business Case for NGT.

There was no suggestion in C-4-24 that the (large positive) willingness to pay to travel on a very new bus might be used in place of the (small negative) willingness to pay to travel on a trolleybus, and so one can only speculate on what Johnson et al would have made of that idea.

The final part of the final paragraph of APP155 indicates that the substitution of the large positive value for the small negative value obtained from the SP survey was justified because "*it is considered that the uplift in quality that a trolley vehicle would deliver is at least if not greater than the quality uplift that a new bus can deliver compared with an old bus*". Under cross- examination Mr Chadwick could not identify anyone, other than the Promoters, who hold this belief nor could he identify any evidence to support it.

In the penultimate and final paragraphs of APP156 Mr Chadwick indicates that the (assumed) preference for trolleybus would reflect factors such as ride quality, noise and comfort which characterise journeys by tram and would be equally pertinent for journeys by trolleybus, but which were not included in the SP study. He omits to point out that, even if these factors were perceived by users of NGT and valued to the same degree as is reported in some of the tram studies reviewed in Johnson et al, they would need to be offset by a negative value on the chances of getting a seat on NGT (and note that the AECOM report G-4-13 states, in paragraph 3.6 on page 191, that seat availability is given a higher value than any other vehicle characteristic in all the studies which have considered it).

B22 His paragraph 2.55 seeks to suggest that it would be wrong to think that the values derived for a "*new bus with advanced technology like FTR*" (illustrated by a graphical representation of an articulated vehicle looking very like a trolleybus) could be a better guide to perception of the proposed NGT vehicle than would the values for a "*very new bus*" (illustrated by a graphical representation of a modern double decker bus). This is extraordinary! The reason given in paragraph 7.10 of the Stated Preference Report (C-4-24) for rejecting the values derived for the "FTR-like" vehicle is that '*most respondents who did not choose FTR were those who did not use it*' – a reason which loses any significance when one reads, in paragraph 7.47 of the same report that '*most respondents in the survey are not FTR users*'. I therefore restate my opinion that the Stated Preference work justifies use of the value derived for "*a new bus with advanced technology*" rather than that for a "*very new* bus" as the basis of the quality factor for NGT vehicles. The preceding lines (in red font) were written before it was confirmed that the Stated Preference work had included a question on willingness to pay to travel by trolleybus. Clearly, it would have been most appropriate to use the result from that question (although it remains my opinion that the preference for the "FTR-like" vehicle is more relevant than that for the "very new bus").

Respecting the public perception of FTR, Mr Henkel confirmed under cross-examination that, prior to its introduction, Metro had expected bus users to perceive FTR, with its sleek lines and strong branding, as sharing some of the characteristics of a tram and thus as superior to a bus. The fact that the 2008 Stated Preference survey showed that they thought it inferior to a very new double-deck bus offers an interesting commentary on the reliability of the Promoters' assumptions about user preferences.

B23 I note that there is no attempt to argue with my assertion that the value derived for "a *very new bus*" (illustrated by a modern double decker) is a better source of a value for a modern bus than is the "*old bus*" (illustrated by a double decker circa 1980).

B24 Mr Chadwick's paragraph 2.56 reports results of the test of changing the assumption about the availability of seating described in their paragraph 2.11 (see ~~my 2.5.2~~ B15 above) and notes that it is not as devastating as he says that I had implied. But he must have misread my original text; my claim (in my Proof's A4.ii) did not relate to the implications of correcting the seating value alone but to correction of all the dubious values. I remain convinced that correction of these errors would have a devastating impact on the predicted demand for NGT.

B25 His paragraph 2.57 addresses the issue of bus stop penalties. It begins by suggesting that I have assumed that a value of 11.73 was applied to all journeys made from conventional bus stops. I can only assume that he misread my Proof because my statement (in A4.iv) was that the 11.73 penalty is applied to '*….journeys made via a typical bus stop (rather than via a typical NGT stop)'*. I believe that I have fully understood how the penalties are derived and how they are applied. The one thing that I was not sure of (despite having made several requests) is their average value. Information in the Core Documents led me to assume that the average value was 11.73 minutes but evidence from Mr Hanson's proof (on page 3 of APP-5-3) leads me to believe it may be lower. **It would be helpful to everyone if the promoters would allow this number to be published.** The information was released on 9th May (as APP103). The value of the penalty applied to a typical bus journey is 11.3 minutes (made up of an average bus stop penalty of 7.1 minus an average NGT stop penalty of 1.3 plus a bus quality penalty of 5.5).

Under re-examination, Mr Chadwick was taken to paragraph 4.10 of C.2.8 which indicated that an unspecified "intermediate" value was used for the stop penalty for train journeys. The value of this penalty was revealed in APP-172 as 9.4 and C12 below demonstrates that this value is higher than can reasonably be justified for the relevant rail stations.

B26 The middle third of Mr Chadwick's paragraph 2.57 suggests that I have misunderstood the use of the value for "good lighting when it is dark". I can assure him that I have not misunderstood it. My point (at the end of my Proof's paragraph A4.iv) is that the use of the graphics illustrated in my Proof (and taken from the Stated Preference report) will have made people think about conditions when dark and should therefore not be applied to journeys made in daylight**. I stand by this assertion**. The suggestion, in the final sentence of his paragraph 2.57, that any over-estimation will not benefit NGT because the values are applied to stops irrespective of whether they are NGT stops or bus stops, would only be valid if a typical bus stop had the same level of lighting as a typical NGT stop. But, according to information published in the Appraisal Summary Tables (respecting personal security), this is not the case (although, again, it would be helpful if the relevant data were allowed to enter the public domain). Further to my suggestion that the value of good lighting derived from the Stated Preference survey was unusually high and was probably inflated by the particular graphic used. It is clear that Mr Chadwick was aware of the risk that graphics might be misunderstood (viz paragraph 2.33 of C-4-24, discussing the use of graphics in Stated Preference surveys, says "*Graphics are useful in illustrating the presented service attributes and their different levels to respondents. However, experience shows that the way respondents interpret a photo or a drawing presented to them may differ from what was intended by the designer of the survey"*). Further, Mr Chadwick stated that he had commissioned the study by Johnson et al (NWLTF119) which, on page

25, expressed surprise at the size of the value of the good lighting result and suggested that it might have been due to the fact that the survey work was conducted during winter time.

B27 I am happy to learn from Mr Chadwick's paragraph 2.58 that the current version of LTM has no need of the scaling parameters referred to in C-4-24 but I would not want the Inquiry to lose sight of the fact that it is generally accepted that models based on stated preference data tend to over-predict mode shift. At the time of writing the preceding lines (in red font), I took Mr Chadwick's claim that there was no need to apply a scaling correction to the quality factors at face value but information which came to light during my cross-examination of him and of Mr Hanson causes me to change my mind. The "scale parameters" referred to in Section 3.2 of C-1-3 relate to the sensitivity of the models to differences in total generalised cost, they do NOT correct for the general tendency for stated preference surveys to produce an inflated estimate of willingness to pay. The model of choice between trolleybus and other public transport will have been particularly exposed to this tendency because there was, of course, no data on which to validate it.

B28 Mr Chadwick's paragraph 2.59 restates his opinion that his estimation and application of the quality factors is robust and appropriate**. I regret that we have to disagree on that point.** My opinion on the inappropriateness of the quality factors is further strengthened by the fact that, under cross-examination, Mr Chadwick indicated that he had accepted the results of the original Stated Preference surveys because, in his opinion, the survey work had been conducted appropriately. He had, apparently, been unconcerned by the fact that key results from the Leeds Stated Preference study were out of line with previous research and, in a departure from what would be regarded as good practice in such circumstances, had apparently given no consideration to the possibility that the Leeds results were biased due to the sample population (exclusion of concessionary pass holders travelling after 0930 potentially resulting in underestimation of aversion to standing), the weather conditions (cold and wet, potentially leading to an overestimation of the value of bus shelters), or the time of year (dark mornings and evenings) or the recent spate of serious attacks at bus stops (potentially leading to an overestimate of the value of good lighting and of CCTV). The possibility that the results of the Leeds Stated Preference exercise had been affected by darkness and poor weather was mentioned in the review by Johnson et al but is nowhere mentioned in the documentation provided by the Promoters for this Inquiry. Similarly, no mention is made of the fact that the quality factors used in LTM imply a preference for trolleybus over all other modes of public transport which is significantly higher than that found for trams relative to buses in Johnson et al's study for UKTram – see B17 above.

B29 My opinion on the inappropriateness of the quality factors is not diminished by the claim, made by Mr Chadwick under cross-examination, that DfT had not questioned them. I state this because:

a. It is clear from slides presented at an internal DfT meeting on 22/06/12 (Appendix H2 of the NWLTF Statement of Case – OBJ1719) that DfT officials did have concerns about the quality factors – and particularly the assumption that the differential between bus and trolley bus would not diminish over time - but that they had accepted the Promoters' claim (set out on page 8 of Appendix 1 of C-2-4) that the assumed preference was in line with results from the AECOM study (G-4-13). In fact, as is shown in C6 below, the penalties applied were considerably greater than those derived from the AECOM study.

b. No evidence has been produced to suggest that DfT were aware that the Leeds Stated Preference study had revealed that bus passengers had no willingness to pay to travel on a

trolleybus rather than on a conventional bus (or that their willingness to pay to travel on a trolleybus was actually lower than that to travel on a conventional bus)

c. It is clear that DfT were unaware that the vehicle quality penalty had been applied to journeys by rail (even Mr Chadwick was apparently unaware of that fact).

d. There is no evidence to suggest that DfT were aware that the quality factors used in LTM imply a preference for trolleybus which is significantly higher than that found for trams in the study for UKTram.

e. DfT cannot have been aware that the stop penalty applied to rail was higher than can be justified (see C12 below) because its value was not released until September 2014.

B30 My concerns about deficiencies in the specification of bus services (my Proof's 5.5, A5 and A6) are addressed in Mr Chadwick's paragraphs 2.60 to 2.62. My original Proof was written before it became clear that a rail station penalty of 9.4 had been applied to all journeys by rail (its value was not revealed until September 2014). Had I known this at the time that I wrote my original proof, my concern about the value of the bus stop penalty would have been broadened to include the rail station penalty which, as is shown in section C12 below, is larger than can be justified.

B31 Mr Chadwick's paragraph 2.61 says that my assumption (in my Proof's A5.i) that Metro's improvement to bus stops will not extend beyond installation of CCTV is wrong. I am happy to be corrected on this issue but would point out that I based it on text in paragraph 4.2 of Document C.1.8 dated January 2014 (which says *"The NGT stop quality value is 1.27 minutes. This compares with normal bus stops which generally have base year values in the range of 10 minutes to 17 minutes with the average around 11 minutes. It is expected that there will continue to be a general roll out of CCTV across the bus fleet over the next few years therefore the differential between ordinary bus stops and NGT stops has been reduced by over 4 minutes (the value of CCTV per trip) to reflect this*"). Their paragraph 2.61 says that '*the differences between NGT stops and bus stops will remain constant over the sixty year appraisal period'.* I think it was reasonable to assume that the text meant that there is to be no enhancement of bus stops (beyond the installation of CCTV) after the base year**. It really would be helpful to have a clear and definitive statement about the assumptions about bus stop attributes, and hence average penalty factors, for each of the scenarios in 2016 and 2031.** The value of the bus stop penalties used was clarified in APP103 (answers 1 and 2). During re-examination of Mr Chadwick it was established that the reduction in the average bus stop penalty reflected the roll-out of CCTV across the bus fleet (rather than at bus stops) and so my original concern that no allowance had been made for improvement of facilities at bus stops remains. It is in fact strengthened by Mr Henkel's acknowledgement that further improvements in bus stop facilities could be very cost effective and would be implemented if the budget were available.

B32 The first part of Mr Chadwick's paragraph 2.62 addresses my assertions (in my Proof's A5.ii and A5.iii) that the modelling assumes that bus operators will not provide more attractive vehicles and that the fleet of trolleybuses will for ever be regarded as newer than the buses with which they will be competing. I can agree with Mr Chadwick that a trolleybus might age more slowly than a diesel bus and that a maintenance programme has been assumed, but this does not detract from my argument that there will be times during their 12 year life when the NGT vehicles are competing with much younger buses. I note that Mr Chadwick seeks to deflect my argument about the

possibility that bus operators will introduce improved vehicles by repeating his assertion that the NGT vehicles will be always be perceived as newer and better because that is what is intended by the promoters. **I am not convinced by this argument and repeat my original assertions and their corollary - that inappropriate quality factors are being used in the modelling.** The maintenance of a constant differential in favour of Trolleybus was explored during cross-examination of Mr Chadwick. He did not produce any evidence to refute the suggestion that any initial advantage which trolleybuses might have in terms of ride quality (or other aspects of the passenger experience) were "low hanging fruit" which would soon spread to the bus fleet as new stock is introduced.

B33 The second part of Mr Chadwick's paragraph 2.62 addresses my assertions (in my Proof's A6.i and A6.ii) that the demand forecasts are based on inappropriate assumptions about what operators might offer in respect of reduced boarding times and lower fares. In respect of bus boarding times, Mr Chadwick suggests that boarding times could only be improved if fares were simplified and new payment technologies were introduced – but he seems to assume that this will never happen. **I therefore maintain my assertion**. In respect of fares, Mr Chadwick refers to paragraph 6.16 of his Proof APP-7-2 (where he simply states that the issue was carefully considered and that it was concluded that any instability would be of a short term nature – although no evidence is identified to support this conclusion). I do not regard this as a serious attempt to rebut my assertion and **I continue to maintain that the forecasts of demand and revenue are dangerously dependent on the assumption that competing bus operators will not respond by offering lower fares.** In respect of improved boarding times, it is interesting to note that Mr Henkel identified the trend towards improved payment technologies and simplified ticketing as something which Metro was seeking to encourage irrespective of whether NGT was introduced. I would therefore argue that it was perverse to assume that no progress would be made on that front. The need to explore the likely impact of serious and sustained competition from bus operators was raised with several witnesses. None offered any good reason for having ignored Webtag advice on this issue. (Section 3.4 of TAG Unit 3.15.3 [E-3-22] discusses sensitivity analyses to reflect policy uncertainties when modelling public transport schemes. Paragraph 3.4.5. discusses the representation of existing bus operators' response to new services and notes that "*Operators of existing bus services may choose to respond to the opening of the new services by …._actively seeking to undermine the viability of the new services by increasing competition*". It concludes by saying that *"The Department also expects that the impacts on the new scheme of increased competition from the operators of existing bus services will be explored through one or more sensitivity tests").*

B34 My concerns about the modelling of the demand for Park and Ride (my Proof's 5.6 and A7) are addressed in by Mr Hanson in paragraphs 2.13 to 2.18.

B35 The final sentence of Paragraph 2.14 refers to my admission that that I did not know what values had been used for the "penalties" at the Park and Ride sites (actually, since they are negative penalties it might be better to call them "attraction factors"). I still do not know but, following a Freedom of Information request by Mr Kemp, which was responded to on 14th April, I learn that they were based on the values calibrated for Garforth and New Pudsey (ignoring King Lane) with some adjustment *'to reflect differences between the existing and proposed sites'*). I think this means that they are in the order of 70 minutes but I cannot be sure and suggest that **it would clearly be**

useful if these values were released into the public domain. Mr Chadwick draws attention, in paragraph 2.21 of the Stated Preference Report (C-4-24), to the dangers inherent in relying on constants when modelling choice and I note that few modellers would be happy to rely on constants which are as large, relative to the overall generalised cost, as those being used here to predict use of Park and Ride. During cross-examination, Mr Hanson confirmed that:

i. The value of the alternative specific constant (ASC) used for the Stourton and Bodington P&R sites was 70 minutes.

ii. This value was simply based on the ASC's estimated for the Garforth and New Pudsey rail-based P&R sites despite the fact that:

- they had faster onward journeys into the city centre and far fewer stops en-route than would be the case for the NGT P&R site (their onward journey is about 12 minutes compared to Bodington's 19; they have a maximum of one intermediate stop compared to Bodington's 11).
- The ASCs estimated for Garforth and New Pudsey simply reflected errors and data inadequacies in the Park and Ride Model (as is clearly stated at the bottom of page 43 of C-1-3).

iii. Use of a 70 minute ASC for the Bodington and Stourton P&R sites means that, other things being equal, LTM will predict use of a P&R site in preference to parking in the city centre even if the generalised time of the former is 60 minutes greater than the latter.

iv. Putting the 70 minute ASC in context, it is broadly equivalent to the total generalised cost (expressed in generalised minutes) of a trip from Garforth to the City centre.

B36 Paragraph 2.15 explains that the overweighting of car costs combined with an underweighting of public transport costs (which I identified as a questionable practice devoid of theoretical underpinning) is a means of reducing any tendency to drive away from the destination in order to access a park and ride site. I accept that this is a useful consequence of the differential weighting **but my view remains that this differential weighting is what modellers call a "fix" rather than a legitimate application of modelling theory.** I agree that differential weighting between modes is not unique to this model but point out that, consistent with behavioural evidence and theory, it is usual to overweight the public transport mode rather than the drive mode (such evidence as exists on the weighting of time while driving, and time aboard a public transport vehicle, indicates that it is the latter, rather than the former, that tends to be overweighted and this is consistent with behavioural theory which draws attention to perceptions of comfort, privacy, and locus of control).

B37 Mr Hanson's paragraph 2.17 discusses my Proof's A7.iii in which I question the use of P&R sites at Garforth, King Lane and New Pudsey as models for P&R proposed at Bodington and Stourton. The concern I expressed in A7.iiia was that the calibration sites had '*rail or non-stop bus shuttles*' (I now learn that the King Lane site was not used and so my concern should be read as being that the calibration sites have rail shuttles) whereas the NGT vehicles will have to call at intervening stops. Mr Hanson points out that the Garforth and New Pudsey rail links do have intermediate stops – but I note that they each have only one intermediate stop (rather than the ten or more NGT stops between Bodington to Leeds Station) and that each of them have some non-stop services. **My concern that the calibration sites have better shuttle services than Bodington and Stourton will have is, if anything, strengthened.**

B38 Paragraph 2.17 also seeks to address the concern I expressed in my Proof's A7iiib that '*whereas there is no shortage of capacity on the shuttles returning to the calibration sites, people returning to the Bodington and Stourton sites will have to compete for space with other passengers using the NGT services*'. Mr Hanson's response refers to crowding on rail services arriving in Leeds in the am peak and does not refer to the pm peak to which my concern relates.

B39 **Mr Hanson's rebuttal does not reduce my concern that the calibration sites have a much better shuttle service than will be available for the NGT P&R sites and so I remain concerned that the usage of P&R is likely to have been overestimated.** Some of my concerns about the Park and Ride model are perhaps shared by one of its authors; Mr Hanson stated, under cross examination, that he would not claim that its predictions would be accurate to within better than plus or minus 50%. Information revealed in APP147 (which was released only in response to a specific data request from Dr Dickinson) adds to my concerns because it reveals some curious features of the predicted park and ride catchments:

a. the model predicts that some drivers would start by driving out of town before using the P&R and trolleybus to ride back in again. This phenomenon is apparent at the Bodington P&R site (which is predicted to be used by people originating in the zone to the west of Queenswood Drive) and even more dramatically, in the case of the Stourton P&R site (which is predicted to be used by people who originate in Beeston, Holbeck, Cross Green and Hunslet – all of which are closer to the city centre than is Stourton). This phenomenon is probably a consequence of the model's large negative ASCs for P&R users.

b. the model predicts that the Bodington P&R would attract significant numbers of people for whom Horsforth Rail station would be a more natural means of getting quickly in to Leeds City Centre. This prediction is probably due to the quality penalties applied to rail combined with the large negative ASC for users of the P&R and the underweighting of the trolleybus costs.

c. the model predicts that the Stourton P&R would not attract any users from Osset or Wakefield (both of which might have been regarded as prime customers for a P&R site adjacent to the M621). This prediction is probably due to the overweighting of the "drive" costs of trips which use P&R.

B40 My concerns about deficiencies in the estimation of the impact of NGT on accessibility and connectivity (my Proof's 5.7 and A8) are addressed by Mr Chadwick in paragraphs 2.63 and 2.64.

B41 In his paragraph 2.64, Mr Chadwick claims that he followed guidance in Webtag 3.6.3 in respect of journey times. However, I note that paragraph 1.2.2 of Webtag 3.6.3 (now to be found as Paragraph 8.2.2 of TAG Unit 4.1) reads as follows: *'In some cases, accessibility benefits from transport interventions are the same as transport user benefits. However, transport user benefits are usually defined in a narrow way within the appraisal process, and it is important to consider accessibility benefits in a more holistic way*'. Section 8 of TAG Unit 4.1 goes on to describe the need for accessibility audits and refers to more detailed guidance in TAG Unit 4.2. Guidance in TAG Unit 4.2 clearly envisages the need to look and the door to door journey and not simply at the in-vehicle element (see for example paragraph 8.5.8). Mr Chadwick did not do this.

In the context of estimation of development and regeneration benefits, ~~section 5.11.5 of Webtag unit 3.5.6~~ Section C.5 of TAG Unit A2.2 (which is now the main document on regeneration

impacts) envisages the use of total (door-to-door) generalised costs for all modes when seeking to measure accessibility improvements. **My concern therefore still stands**.

My opinion on this point is further strengthened by the fact that, under cross-examination, it became clear that the Urban Dynamic Model's predictions of the effect of NGT on regeneration and growth in employment had been driven simply by changes in the generalised time of trips by public transport (a large part of which was contributed by the assumed reduction in quality penalties) and that the increases in costs of trips on the highway network had been ignored completely despite their obvious impact on business costs. The claim, made during cross-examination and re-examination of Mr Chadwick, that DfT had been satisfied with the UDM predictions is undermined by the fact that, according to slides from an internal meeting at DfT (Appendix H2 to OBJ/1917 Statement of Case) on 22/06/12 – less than a month before they issued their decision letter - DfT had not seen the assumptions underlying the predictions.

B42 My concerns about the failure to give due account to potential threats to the forecast revenue (my Proof's 5.8, A9 and A10) are addressed in by Mr Hanson in paragraphs 2.19 to 2.27 and by Mr Chadwick in paragraphs 2.65 to 2.69.

B43 His paragraph 2.21 accepts my assertion that the number of students in street properties in Headingley has fallen in recent years but draws attention to the new halls of residence which have been built on the Headingley Campus. I do not dispute that (indeed I referred to the new residential accommodation in A9.i of my proof), but note that students who live on campus are, other things being equal, less likely to need to use public transport to reach their lectures (I also note the existence of an inter-campus student bus which will further reduce student demand for NGT).

B44 His paragraph 2.22 points out that sensitivity tests have explored the effect of differences in levels of demand. I do not dispute that but suggest that the 'central' assumption is too high.

B45 His paragraphs 2.23 to 2.26 address my speculation (in my Proof's A9.ii) that levels of travel demand in the A660 corridor may have been more than normally affected by a switch to e-travel. I agree that this is a speculation and accept that the new traffic data presented in their paragraph 2.24 shows growth since the 2008 base year.

B46 Mr Chadwick's paragraph 2.66 refers to my concern (expressed in my Proof's A10.i) that the revenue forecasts were exposed to the risk that bus operators might seek to compete by offering lower fares. Mr Chadwick claims to have addressed this in his paragraph 2.60. The last sentence of his paragraph 2.62 does address it but leaves me completely unconvinced (see ~~2.6.3~~ B33 above). Webtag advice respecting the need to explore the effects of competition (summarised towards the end of B33 above) is clearly of relevance here.

B47 Mr Chadwick's paragraph 2.67 appears to be directed to my Proof's A10.ii, in which I identify the particular risks involved in equipping a system which will be unique to the UK. Mr Chadwick simply states that he has included an allowance for risk and Optimism Bias. I simply note that DfT thought the Proposer's allowance, in the PEBC, of 29% for Optimism Bias was insufficient.

B48 His paragraph 2.68 appears to be directed to my Proof's A10.iii in which I suggest that the costs of upgrading to a new technology might be substantial. Mr Chadwick simply refers to the fact that allowance has been made for a replacement fleet every 12 years – he does not address my particular point about a change in technology.

B49 All in all, **I remain very concerned that insufficient account has been taken of potential threats to the net revenue forecast**.

B50 My concerns about significant bias in the calculation of the BCR (my Proof's 5.9a-h and A11-23) are addressed in Mr Hanson's paragraphs 2.28 to 2.34 (see ~~my 2.13~~ B60 below) and in Mr Chadwick's paragraphs 2.70 to 2.93 (see B51-B56 below).

B51 Mr Chadwick's paragraphs 2.70 and 2.71 contend that my concern (expressed in my Proof's 5.9a) that the deficiencies I had outlined in my sections 5.1 to 5.8 would lead to an over-estimation of the switch to NGT ~~(my 5.9a)~~ has been fully addressed and do not shake his confidence that the BCR is appropriate in respect of the contribution of modal shift. **As will have been clear from paragraphs ~~2.1 to 2.9~~ B1 to B50 above, I remain unconvinced**.

My belief that the extent of switch to NGT has been over-estimated is further strengthened by having learned:

a. (from APP155) that the Stated Preference work had indicated that passengers expressed no willingness to pay to travel on a trolleybus – indeed that they were less willing to pay to travel on a trolleybus than on a bus.
b. (during cross-examination of Mr Hanson) that the vehicle quality penalty was applied to trains as well as to buses.
c. (during cross-examination of Mr Chadwick) that the boarding stop penalties were accepted without consideration of the possibility of bias due to sample characteristics and the timing of the survey.
d. (during cross-examination of Mr Hanson) that none of the quality penalties were scaled to allow for the well-known tendency of Stated Preference surveys to exaggerate willingness to pay.
e. (during September 2014 that a penalty of 9.4 was applied to all journeys starting at a rail station – and the realisation (see Section C12 below) that this is larger than can be justified.
f. (during cross-examination of Mr Hanson) that he, as an author of the Park and Ride model, would not endorse its predictions to within plus or minus 50%, or the overall LTM predictions to within plus or minus 30%.

B52 Paragraphs 2.72 to 2.75 relate to my concern (my Proof's 5.9b, A11 A12 and A13) that the BCR is distorted by the inclusion of the (arguably inflated) perceived benefits of NGT while omitting the widely perceived disbenefits.

B53 Mr Chadwick states, in his paragraph 2.73, that he has followed DfT guidance in the choice of which costs and benefits should be monetised. **I do not accept that he has followed the principles of the DfT guidance** and give the following reasons:

- A central principle of DfT guidance is that, where costs and benefits can be monetised in a consistent and comparable way, they should be included in the Cost Benefit Appraisal. I do not believe that this principle has been adhered to. A particular cause for concern is the fact that assumed increases in journey quality have been added to time savings (without being separately identified) and montetised in the CBA while reductions in other 'qualities' have been entirely ignored in the CBA calculation (note, for example, the Treasury Green Book's

reference to Social Cost Benefit Appraisal and the substantial literature on the use of willingness-to-pay as a method by which to value assets such as landscape and heritage).

Paragraph 2.1.4 of Webtag 3.5.4 (Cost Benefit Analysis - E-3-26) lists the items which were, as of August 2012, included and excluded from monetised cost benefit analysis. *"Journey ambience"* is one of those listed as usually excluded while *"impacts on landscape, townscape, heritage of historic resources"* is listed as excluded on the grounds that the Department had not at that time established money values for them).

The Promoters departed from the then "usual" DfT practice by including journey ambience benefits in the appraisal while adhering to it by excluding any disbenefit on landscape, townscape and heritage – to the obvious advantage of the NGT project. In doing so they ignored the fact that DfT had stated, in paragraph 2.1.2 of Webtag 3.5.4 that they were *moving towards valuing more of the impacts in the AST in money terms*…" and the fact that values for heritage and landscape had already entered the literature. DfT's movement on this issue was confirmed in December 2013 when it produced an updated Advice Note https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/267296/vfm-advice-local-decision-makers.pdf on Value for Money Assessment which includes advice on the valuation of landscape loss and suggests (in Table 1.1) that it be included along with reliability and wider economic benefits as part of an adjusted BCR. Guidance is given (in paragraphs 3.25 to 3.35) on the procedure to be adopted whenever the impacts on landscape are judged to be greater than "slight" (as is the case with the expected impact of NGT). A fair and balanced approach would have reflected this new advice (which could easily have been anticipated) by estimating a value for the landscape /heritage disbenefit to set alongside that of the benefits attributed to improved journey ambience, increased reliability and wider economic impacts. Calculations in C16 below suggest that the value of the landscape impacts might easily more than outweigh the claimed value of improved reliability and wider economic benefits.

Although Table 1 of the December 2013 Advice note indicates that monetised values for disruption during construction and for changes in physical activity should typically be included in the initial BCR, no such values are included in the Revised Business Case. I am unable to estimate a cost for disruption during construction but C17 below suggests that the monetised impact of the reduction in active mode use might amount to £4.2m.

DfT guidance requires transport appraisal to be based on rationally defined equity values of time (Mr Chadwick claims to have followed this guidance). However, I note that the results presented by Mr Chadwick in the TEE table and Appraisal Summary Table do not distinguish between the 'time savings' which are based on equity values of time and those derived from locally-defined quality factors. I further note that the Analysis of Monitored Costs and Benefits (AMCB) Tables submitted by Mr Chadwick are misleading in claiming that journey ambience is '*not valued*' (it has been valued and indeed dominates the calculation of benefits). The desirability of being able to identify the contribution made by quality factors is implicit in its identification as separate elements of the AMCB table and the Appraisal Summary table and in the advice in paragraph 6.2.13 of Webtag A4.1 (excerpt reproduced on page 1 of NWLTF113) that: if the impact of journey quality factors is not otherwise

identifiable *'consideration may need to be given to running TUBA twice: once with other measures only, and then again with the inclusion of soft measure inputs'*.

B54 In his paragraph 2.74, Mr Chadwick draws attention to the fact that the BCR is also sensitive to assumptions about NGT run times and punctuality. I accept that as a matter of fact. Mr Chadwick then points out that the calculation I introduced in my Proof's A12 was based on an employer's business value of time and so overestimates the contribution of quality factors to the NGT appraisal. I accept that as a matter of fact. I cannot claim to be able to make an accurate calculation of the contribution because key values (such as the average bus stop boarding penalty) have not been put in the public domain. Indeed, this difficulty exemplifies an important issue: **I suggest that the Promoters' failure to identify the specific contribution of the quality factors to the overall value for money and their failure to distinguish it from 'real' time savings based on equity values of time prevents the outside observer from appreciating the true nature of their business case.** The information released in APP103 did not provide an estimate of the total value of the reduction in quality penalties but did include information which enabled me to improve my own estimate. My revised estimate (in C1 below) is that it is likely to exceed £280m. APP103 also revealed that, when considering the 2012 Business Case, DfT had wanted to know the split between real time savings and quality benefits and had estimated that the latter constituted between 50% and 60% of the whole.

B55 Mr Chadwick's paragraph 2.75 relates to my Proof's A13 which identifies negative aspects of the public transport offer (in the NGT scenario). Mr Chadwick suggests that these aspects are included in the specification of the generalised cost and are therefore included in the CBA. I agree that this is true in respect of the increased walk and wait times but argue that the generalised cost equation ignores aspects such as the "hassle factor" of having to begin the journey by choosing between two transport services, the frustration if one chooses one service only to then see the first vehicle arrive at the "other" stop, and the potential confusion/ frustration caused by the different fare structures. Other important negative aspects of journeys on NGT which were not included in the modelling or analysis include the risk of not being able to get on the first trolley vehicle to arrive and the likelihood of having to stand while travelling. The full impact of the assumption that passengers would make their decisions in the expectation that there would always be "plenty of sets available" on the trolleybuses did not become clear until this issue was explored with Mr Hanson. Section C7 below demonstrates that:

- some passengers will be unable to board the first trolley to arrive (and thus that their waiting time would be 9 minutes rather than 3 minutes) and that
- on many journeys, being unable to get a seat will be the norm.

Another negative feature of the public transport offer in the NGT scenario, which did not become apparent until the cross-examination of Mr Robertson, is that buses may be less punctual (because it would no longer be possible to give late-running buses additional priority at signals).

B56 Paragraphs 2.76 to 2.79 relate to my concern at the failure to estimate costs to road users and local bus operators during the construction period (my Proof's 5.9c and A14). Mr Chadwick states that it is "conventional" to exclude such costs at this stage in the development of a rapid transit project because they are difficult to estimate (he then points out that construction of the NGT scheme would cause less disruption than has been experienced with some other rapid transit projects –

and I would not dispute that). I repeat my observation that paragraph 10.11 of Webtag A1.3 states that '*costs to existing users due to construction of a project and costs (or benefits) to users arising from future maintenance should be recorded in the TEE tables where they are likely to be significant*' and suggest that it would be extremely useful to have an estimate, even a rough estimate, of these costs – particularly in the light of the considerable disquiet which has been expressed by local traders and by the existing bus operators.

B57 Paragraphs 2.28 to 2.32 and 2.80 to 2.82 are intended to relate to my concern at the overly pessimistic assumptions about conditions in the Do Minimum case (my Proof's 5.9d, A15, A16, A17 and A18).

B58 Paragraph 2.81 claims to be addressing my Proof's paragraph A15 which relates to assumptions about the provision of bus stop facilities, ~~and~~ about bus provision and about boarding times. Their text refers back to their paragraph 2.35 onwards (but, since those paragraphs are dealing with a different issue, I assume the reference is in error). I refer back to ~~my paragraphs 2.61-2.63~~ B31 to B33 above and repeat that, having read their rebuttal, **my concern at the representation of the Do Mimimum bus stops, ~~and~~ services and boarding times remains**. During cross-examination of Mr Hanson it was confirmed that the vehicle quality penalty estimated for 2009, was assumed to apply to all transit modes other than NGT in 2016 and in 2031. This implies that there will be no improvement in the perceived quality of buses or trains post 2009 despite the extensive programme of fleet modernisation which is already underway. During cross-examination, Mr Henkel agreed that bus boarding times would be improved by the introduction of improved payment technologies and simplified ticketing and that Metro was seeking to encourage these developments irrespective of whether NGT was introduced. I therefore argue that it was perverse to exclude any progress on that front from the Do Minimum (or LCA).

B59 Paragraph 2.82 addresses my concern about the degree of signalised bus priority in the Do Minimum case. It simply states that the inputs have been corroborated by experts from the Leeds UTMC team and can therefore be considered robust. I remain concerned that it appears to be being assumed that, not only will the established and ongoing program of signal refinement and optimisation cease if NGT is constructed, but that a number of known problems are apparently not to be addressed (I referred in my Proof's A17 to the specific problem at Blackman Lane). **I therefore remain concerned about the assumptions about signalisation in the Do Minimum scenario**. Under cross-examination, Mr Robertson confirmed that further extension of bus priority at signals on the A660 would give time savings for buses (all be it only a few seconds per junction) but that more substantial savings (in excess of 20 seconds) could be achieved for southbound buses at Blackman Lane if the exit from Lodge Street were restricted to left turn only.

B60 Paragraphs 2.30 to 2.32 relate to my concern that the optimisation of junction design in the DM and LCA has received less attention than it had in the NGT scenario (my Proof's A18). The paragraphs describe a process whereby the need for changes to LCA and DM signal settings is considered if the junctions are highly congested in the DM scenario or if the settings at that junction were changed in the NGT scenario. I contend that a "reactive" approach of this kind is not as thorough as that provided for the NGT scenario. I note that none of the specific points I made in my A18.i, A18.ii or A18.iii have been addressed or denied (though I note that my argument in A18.ii

may have been difficult to follow because of the transposition of "am peak" and "interpeak" on the fifth line). The failure to address my A18.iii (which noted that the run time analysis showed bus run times to be worse in the LCA than in the DM) is particularly remarkable. **My concern remains**.

Under cross-examination, Mr Robertson confirmed that he had not been approached to advise on improved signal settings for the LCA and that, in his opinion, improvements (to general traffic, buses, cyclists and pedestrians) associated with the signalisation of the junction of Otley Old with the A660, the signalisation of Lawnswood Roundabout and the signalisation/redesign of junctions near Hyde Park corner, could be achieved, all be it at some cost, without NGT. He also agreed that, if a stretch of northbound bus lane could be introduced, there was scope for a bus gate to assist traffic flow though Headingley while giving additional priority to buses.

During examination, Mr Chadwick claimed that the reason why LCA bus run times from "Bodington to the City" (shown in Table 4.1 of C-1-13 and repeated in APP-7-3.1) were higher than those shown for the Do Minimum bus was that the former included the time taken to call in at the Park and Ride Site. I accept that this is part of the reason. However, it does not provide a complete explanation. C4 below compares LCA and DM run times between Weetwood and the City and is therefore unaffected by the fact that the LCA vehicle calls in at the P&R site. It shows that the southbound LCA times are higher than those of the DM in the interpeak and pm peak and only marginally lower than them in the am peak.

B61 Paragraphs 2.84 to 2.86 relate to my concern at the apparent failure to consider all capital costs (my Proof's 5.9e, A19 and A20).

B62 Paragraph 2.85 states that DfT guidance has been followed but makes no reference to the findings respecting capital asset values contained in the Arboricultural Report to which I referred in my A19. Revised guidance, issued by DfT in December 2013 but trailed in advance of that date, includes procedures and values by which to monetise adverse impacts on landscape (see C16 below) – although these are not considered as capital costs in the normal sense.

B63 Paragraph 2.86, referring to my (A20) statement that I had found no reference to any allowance for the required relocation of bus stops, states that all elements of implementation costs are included in the Cost Benefit appraisal. **If so, I am reassured**.

The information released on 9th May (as APP103) included a statement (in answer to Q7) that £500,000 had been allowed for like-for-like replacement of 66 stops. This seems to be an extremely modest price tag for 66 stops – many of which require new laybys, and does not seem consistent with the £2.96m which was allowed to upgrade 52 existing stops in the LCA.

B64 Paragraphs 2.87 and 2.88 relate to my concern at the underestimation of mitigation costs (my Proof's 5.9f and A21).

B65 Paragraph 2.88, referring to my concern (in A21.i) about the likely underestimation of the cost of tree maintenance, states that allowances have been made – but does not address the specific point about the evidence that normal allowances are leading to the loss of 25% of newly planted trees. No mention is made of the potential costs of mitigation related to heritage assets. **My general concern remains**. My concerns about the possible mitigation costs in respect of heritage assets would increase if, as has been suggested, the Supplementary Heritage Assessment

Document has identified many more affected assets than had been apparent in the original document.

B66 Paragraphs 2.89 to 2.93 relate to my concern at the exaggeration of the punctuality benefit (my Proof's 5.9g and A22).

B67 Paragraph 2.90 accepts my point that the "known" difference between travel times in and out of term were not allowed for in the calculation of punctuality benefits and paragraph 2.91 accepts that this means that the punctuality benefit may have been overstated. Results of a new test are presented which are described as an upper bound estimate of this overestimation and show the BCR falling from 2.90 to 2.81.

B68 Mr Chadwick states that the scale of the effect is modest compared to the likely underestimation implied by his "conservative" approach to the calculation of punctuality benefits. That is a matter of opinion, I maintain that his calculation is not as conservative as he suggests (see B69, B70 and B71 below).

B69 Paragraph 2.92 relates to my Proof's A22.ii in which I point out that the calculation of variability (the standard deviation) is exaggerated if one ignores an invariant element of the data. I deduce that Mr Chadwick did not understand the point I was seeking to make. I repeat my assertion that, because he has omitted the (relatively invariant) walking time element of total journey time, his estimates of variability are inflated and that this will have resulted in an overestimation of potential punctuality benefit. During examination, Mr Chadwick defended the use of in-vehicle times, rather than door-to-door times as the basis for his calculation of journey time reliability, on the grounds that this is the norm in the rail industry. However, I contend that this is not a relevant argument; the rail industry's interest in late arrivals at stations is related to penalty clauses in the Train Operating Companies' contracts whereas the relevant metric for travellers is the likelihood of arriving late at their destination not at their alighting bus stop.

B70 Paragraph 2.93 relates to my argument that it is inappropriate to value punctuality benefits for people who transfer from active modes to NGT. Mr Chadwick explains Webtag conventions and states that the demand models do not include an assumption that increased punctuality would affect demand but he does not deny that the £84 million of punctuality benefit included in the AMCB, and thence in the BCR, includes an element of punctuality benefit for people who previously used active modes. My concern that the punctuality benefit has been exaggerated remains.

B71 **In view of all the above I suggest that the calculation of punctuality benefits should be corrected and new appraisal results issued**. A further concern about Mr Chadwick's estimation of punctuality benefits in the NGT scenario emerged during the cross-examination of Mr Robertson. Namely that, were NGT to be introduced, the current practise whereby late-running buses are given additional signal priority would have to be abandoned. This would lead to additional bunching of buses and hence impact adversely on their punctuality in the NGT scenario – a fact which has not apparently been allowed for in Mr Chadwick's estimation of punctuality benefits in the NGT scenario.

B72 Paragraphs 2.33 and 2.34 relate to my concern at the exaggeration of annualised scheme benefits (my Proof's 5.9h and A23).

B73 Paragraph 2.34 refers to Section 10.12 of Mr Hanson's Proof of Evidence (APP-5.2) in which he states that, since annualisation factors were based only on data from the NGT corridor, the annualisation will reflect the particular features of that corridor (e.g. the importance of the University term/vacation difference). I could accept this reassurance provided that the data was weighted such that it correctly reflects average conditions in the corridor (and not, for example simply an average of all factors available for the corridor).

B74 My concern at the numerous examples of errors and inconsistencies which, even if not individually crucial to the outcome, taken together, must cast doubt on the care taken over the analysis (my Proof's 5.10, A24 and A25) are addressed by Mr Hanson in paragraphs 2.35 to 240 and by Mr Chadwick in paragraphs 2.94 to 2.97.

B75 Paragraph 2.38 relates to my A24.ii (in which I note an apparent discrepancy in bus flows) and indicates that the discrepancy was due to an unspecified definitional change between 2008 and 2014.

B76 Paragraph 2.39 relates to my A24.iii (in which I identify an apparent discrepancy between two estimates of bus flows) and points out that one (1045 - from the table on page 57 of DOC C-2-8) is for an average hour during the three hour morning peak while the other (1400 from the graph on page 18 of appendix 13 of C-2-3 – unfortunately not submitted as an enquiry document but available on the NGT website) is for the morning peak hour. I agree that that is the case and accept that I had misread the table.

B77 Paragraph 2.40 relates to my A25.i (where I point out that the number of NGT users transferring from bus as quoted in Table 12.4 of C-1 is different from that quoted in Table 51 of C-1-8). Mr Hanson explains that the numbers in C-1 were incorrect (they were interim values which had not been updated to reflect the forecasts reported in C-1-8).

B78 Paragraph 2.95 relates to my A25.ii (in which I identify a clearly erroneous reference to significant benefits to a development site at Kirkstall Forge). Mr Chadwick, while not admitting that there had been an error, confirms that the assessment of benefit to Kirkstall Forge had not been used in the business case. During cross-examination, Mr Chadwick stated that the reference to benefits at Kirkstall Forge had been "complete rubbish" but he was unable to state why such an obvious error had not been noticed before it was drawn to the proposers' attention nor was he prepared to assure me that were no other similar errors as yet undiscovered.

B79 Paragraph 2.96 addresses my A25.iii (in which I expressed concern at the statement that bus bunching is "*caused by traffic congestion*" – because its fundamental cause is long dwell times) Mr Chadwick now revises his original wording to say that the disruptive impact of congestion is one of the key causes of extended dwell times. I of course accept that congestion can result in increased dwell times but do not accept that dwell times extended in that way need cause bunching – because the following bus will also be delayed by congestion. This may begin to sound like a semantic argument but it is important to understand that bunching cannot be eliminated by reducing congestion (and so would remain a problem even if, under the NGT scenario, buses were less subject to congestion) whereas it can be reduced by reducing dwell times (and so could be reduced through improvements in bus boarding times which are not dependent on the NGT scheme and which Mr Henkel, under cross-examination, anticipated as a likely consequence of the trend towards improved ticketing).

B80 Paragraph 2.97 addresses my A25.iv (which noted that, while some documents indicated that public transport run times had been calculated for 2016, others said they were for 2020) and responds by saying that the same run times are assumed to hold for 2016 and 2020 and 2031 – see ~~my paragraph 2.2.6~~ B7 above.

B81 As noted in my original proof, several of the points which I raised in A24 and A25 were individually trivial (and I freely admit that examples A24.i and iii were due to error on my part). My point was that there were several instances of errors or inconsistencies which, taken together, were indicative of a lack of attention to detail. **Subsequent to the preparation of my original proof, a number of other examples of errors and inconsistencies have come to light**. Viz:

- Mr ~~Chadwick's~~ Hanson's revelation (in 7.2 of his Proof APP-5-2) that, due to a late-discovered error in the specification of bus service frequencies, the results for the LCA presented in document C-1.9 have now been superseded.
- Mr Hanson's revelation (in 8.13 of his Proof APP-5-2) that the late discovery of an error in the representation of fares in the LTM results in a 4% decrease in the forecast NGT demand.
- Mr Hanson's introduction, in paragraph 2.3 of his rebuttal of my proof, of a new table of run time data resulting from their realisation that their previously published data was '*internally inconsistent'.*
- Mr Chadwick's late recognition, in paragraph 2.90 of his rebuttal of my Proof, that the known differences between university term time and vacation should have been allowed for in the calculation of punctuality benefits.

This list of errors which had been acknowledged since submission of my original proof should also have included:

- an error in the calculation of GHG emissions which had erroneously shown a benefit rather than as a disbenefit (admitted in APP-7-2 para 3.97).
- Mr Chadwick's revelation (in para 1.50 of his Proof APP7-2) of an unspecified an error in the representation of the LCA in the LTM.

B82 Mr Chadwick's revelation, in paragraph 2.110 of his rebuttal of my Proof, that the description of the Low Cost Alternative vehicle, in the January 2014 Business Case Review, was wrong and had not been updated to reflect a change of mind on which type of bus should be assumed for the LCA. (I note that this change of mind necessitates a re-run of the LCA models to reflect the quality factors derived from the stated preference work, but that this has not yet been done).

B83 Further errors which have come to light since the opening of the Inquiry include:

- Yet another error in the specification of the LCA (a failure to include any benefit from improved bus stops). This error came to light only when the Proposers were seeking to meet one of NWLTF's data requests. Correction of this error (see APP104) means that the revisions to the Revised Business Case included in Mr Chadwick's APP-7-3.6, 7-3.7, 7-3.8 and 7-3.9 had all to be revised again and the LCA's BCR increased yet further.
- Application of the vehicle quality factor to rail (Mr Chadwick described it as a "clumsy assumption" which should not have been made).
- Failure to scale down the quality penalties to allow for the fact that SP tends to produce exaggerated estimates of WTP for innovations admitted by Mr Hanson during cross examination).

- Failure to reflect, in the run time model, the low speeds which would be achieved by buses and trolleybuses passing the University of Leeds (in the space shared with pedestrians and in the narrow lane shared with cyclists).

B84 **In the light of new revelations, my concern about errors and inconsistencies in the analysis is stronger now than it was when I submitted my proof**. The discovery of additional errors during the Inquiry yet further strengthens my concern about lack of care in the analysis and its documentation. It may be relevant to observe that, under cross-examination, Mr Chadwick conceded that he would have liked to have had more time to check the documentation before it was issued in January 2014.

B85 Although I accept the rebuttal of some relatively minor points, **I remain seriously concerned about the serious deficiencies in the analysis. I am most particularly concerned about the reliance of the demand forecasts and business case on inappropriate use of quality factors.**

B86 My concern, that deficiencies discussed in my Proof's paragraphs 5.1 to 5.10 will have tended to exaggerate the performance of NGT relative to all of the options – including the Do Minimum (my 6.1), is addressed by Mr Chadwick in his paragraphs 2.107 and 2.108. His rebuttal is simply a statement that he believes that this issue has been dealt with earlier in their rebuttal and that he therefore considers the analysis to have been robust. **My concerns have not in any way been reduced by his rebuttal.**

B87 My concern that the specification of the Low Cost Alternative is overly pessimistic (my Proof's 6.2a-g and A26-A27) is addressed by Mr Chadwick in paragraphs 2.109 to 2.124.

B88 Under examination, Mr Chadwick repeatedly stated that the LCA described in Document C-1 should not be regarded as the best possible low cost package of measures designed to address the objectives of the NGT project. This admission is not apparent to a reader of Document C-1 but is clearly of crucial importance to the Inquiry. It highlights the fact, which I have consistently claimed, that the LCA described in C-1 is not a serious attempt to show what could be achieved at lower cost. Mr Chadwick also suggested that Matter 3, the question of alternatives to NGT, need not be addressed further since the strategic case for NGT had been accepted by DfT through the PEA process. This is clearly wrong on several grounds (see D5 below).

B89 Paragraph 2.110 relates to my concern that the specification of articulated vehicles (as detailed in C-1) for the LCA was undesirable and failed to capture the quality benefits indicated by the stated preference work (my Proof's 6.2a and A26.i).

B90 Mr Chadwick states that the specification in C-1 was a mistake – it had not been updated to reflect a change of mind on which type of bus should be assumed for the LCA.

B91 Mr Chadwick does not seek to rebut my argument respecting the quality benefits indicated in the Stated Preference work but I note that, having now recognised that the LCA vehicle should be a double-decker bus, the LCA vehicle quality factor should be updated accordingly.

B92 Paragraphs 2.111 and 2.112 relate to my concern that the LCA did not allow for any improvement in bus service quality or routing (my Proof's 6.2b, A26.ii and A26.iii).

B93 In the first sentence of paragraph 2.112, Mr Chadwick refers to his assumptions about the qualities of fully electric vehicles. I simply draw attention to the fact that he chooses to ignore the

results of his own Stated Preference work respecting bus users (un)willingness to pay extra to travel on trolleybuses.

B94 In the remainder of paragraph 2.112, Mr Chadwick misunderstands my comment about inefficient routing at Blackman Lane and ignores my comment that the LCA could provide cross city routes. Under cross-examination, Mr Robertson agreed that some of the current delay to southbound buses turning from Woodhouse Lane into Blackman Lane could be avoided if the exit from Lodge Street were to be left-turn-only. Also, respecting cross city services, Mr Henkel opined under cross-examination that commercial bus operators would implement services for which a significant demand could be expected.

B95 Paragraphs 2.113 to 2.115 relate to my concern that reductions in bus emissions had not been associated with the LCA (my Proof's 6.2c and A26.iv). Paragraph 2.114 seems to be saying that the calculation of emissions for all scenarios has taken into account the legislated changes in emissions but paragraph 2.115 seems to suggest that this is not the case in the LCA. **Some clarity on this point would be welcome**.

B96 Paragraphs 2.116 to 2.11~~5~~8 relate to my concern that the specification of LCA had not allowed for improvements in bus capacity, frequency or punctuality (my Proof's 6.2d, A26.v and A26.vi).

B97 In the first sentence of paragraph 2.11~~5~~7 Mr Chadwick notes that the LTM does not constrain bus demand by the capacity available. I accept that point but note that it applies also to NGT capacity and assume that it is one of the reasons why the modelling work has ignored the issue of overcrowding and lack of seating on the NGT vehicles.

B98 Mr Chadwick goes on to suggest that an increase in frequency would have no material impact on waiting times because the existing frequencies are already high. I think this assertion should have been tested in the modelling work by means of a simple sensitivity test.

B99 Mr Chadwick then asserts that the possibility that frequencies might be increased can safely be ignored because (paraphrasing his argument) a commercial operator would not increase frequencies because the marginal cost of doing so would exceed the marginal revenues. I note the confidence with which he second guesses the decisions of commercial operators but observe that the operators have already increased frequencies beyond the 2008 base line.

B100 In paragraph 2.118, responding to my Proof's A26.vi, Mr Chadwick states his belief that an improvement in the LCA's punctuality could only be of limited impact and would not materially affect the ~~CBR~~ BCR. I think it would be prudent to test the issue in the ~~modelling~~ analysis. Mr Chadwick's paragraph 2.118 makes no reference to my assertion that the LCA bus punctuality could be improved if boarding times were improved. That the improved boarding times were not allowed for in the specification of the LCA is remarkable because, under cross-examination, Mr Henkel agreed that bus boarding times would be improved by the introduction of improved payment technologies and simplified ticketing and that Metro was seeking to encourage these developments irrespective of whether NGT was introduced.

B101 Paragraphs 2.119 to 2.120 relate to my concern that the specification of LCA had not allowed for improvements in bus priority (my Proof's 6.2e, A17 and A18). Mr Chadwick states his strong belief that an allowance for such improvements would not bring the LCA's value for money close to that which has been calculated for the NGT. I accept that, taken in isolation, allowance for

improvements in bus priority would not bring the LCA into contention. I note that, under cross-examination, Mr Robertson agreed that, given a modest budget, there was scope for additional bus priority on the A660.

B102 Paragraphs 2.121 to 2.122 relate to my concern that the specification of LCA had included only very modest improvements in bus stop quality – despite their relative cheapness and evident importance in the benefit calculation (my Proof's 6.2f, A11 and A27). Mr Chadwick refers to Table 5.1 of C-1 and states that the specification of the LCA stops is '*similar*' to that for the NGT and NBA. Noting in passing that this table contains an error in its description of the LCA vehicle type, I draw attention to the fact that the Proposers' documents are inconsistent and evasive on this issue (Compare, for example, The description of impacts on personal security claimed in APP-7-3.3 with that claimed in APP-7-3.9; For the NGT we see that the NGT stops will have "*best practice design including effective lighting, CCTV, help points, landscaping and natural surveillance*" whereas for LCA we have "*modest improvements to facilities which would enhance passenger security*"). **I must admit to some frustration in the continued failure to allow details about key attributes which have been assumed for the alternatives to NGT to enter the public domain**. As noted at B83 above, when seeking to meet one of NWLTF's data requests, the Promoters found an error in their specification of LCA bus stop improvements. Even as corrected (and thereby reducing the average penalty from 7.1 minutes to 5.4 minutes – according to answer #1 in APP103), I maintain that this is well below what could easily be achieved in a Low Cost Alternative. APP103 reveals that £4.35m (£2.96m + £1.39m according to answer# 7) has been allowed for bus stops in the LCA. Given that the first paragraph of answer #7 indicates that 66 bus stops can be relocated on a like-for-like basis for only £500,000 in the NGT scenario, the modest achievement with a £4.35 budget is all the more remarkable. Improvements such as provision of shelters, RTI, CCTV and good lighting are very cost effective and, given the values attached to them in the LTM, it can safely be assumed that, had they been included in the specification of the LCA, they would have had a significant positive impact on its predicted patronage, benefits and BCR.

B103 Paragraphs 2.123 to 2.124 relate to my concern that the specification of LCA had not included dedicated non-stop shuttles for the Bodington P&R (my Proof's 6.2g). Mr Chadwick refers to a new LCA test which included a dedicated express bus between the two P&R sites – although he does not indicate its frequency or quality characteristics (on past form, I imagine that the~~y~~quality was set as "old bus" as defined in the Stated Preference work). The test shows that such a service is unattractive and Mr Chadwick deduces that this is because it has insufficient frequency. Given that the test had been specified such that the existing high frequency bus services would not stop at Bodington, I do not find that conclusion surprising! I do think this can be regarded as having been a serious attempt to explore the potential for express shuttles to and from the Bodington P&R.

B104 The rebuttal has not altered my view that the specification of the Low Cost Alternative was unduly pessimistic but has led me to conclude that there seems to be a great reluctance to explore more attractive specifications. See B88 above and D5 below

B105 My concern at the limited consideration given to other low cost alternatives (my Proof's 6.3) is addressed by Mr Chadwick in his paragraphs 2.125 to 2.132.

B106 Paragraphs 2.125 and 2.126 relate to my identification of *partnerships with bus operators to produce improved services, vehicle specification, ticketing, fares, bus priority at signals, bus stop facilities, improved boarding times and reliability* (my 6.3a). Mr Chadwick refers to the statement that the LCA would be delivered through a quality partnership. That is not at issue. My point is that the LCA, as specified, does not deliver the benefits listed above. The "quality partnership" envisaged in the specification of the LCA is clearly not a very good one.

B107 Paragraphs 2.127 and 2.128 relate to my identification of the potential benefits of *extension/provision of bus lanes where appropriate* (my 6.3b). Mr Chadwick refers to a new test which has assumed that LCA run times could be improved to approach those of the NGT. He notes that its BCR is still far below that calculated for NGT. I note that an increase of 0.33 in the BCR is not insignificant but that the generally poor result is unsurprising given that the LCA quality factors were still set at "old bus". This cannot be said to have been a serious test of what could be achieved by increasing the provision of bus lanes for ~~an~~ attractive buses.

B108 Paragraphs 2.129 and 2.130 relate to my identification of the potential benefits of *substituting the most problematic part of the NGT route (north of the Universities) by a Partnership or Quality Contract together with limited engineering works and phased introduction of P&R at Bodington* (my 6.3c). Mr Chadwick refers to the poor performance of a newly-tested option (LCA on the northern route). This option bears little resemblance to the proposal which I had described and its poor performance is unsurprising given the assumed reliance on "old bus" vehicles.

B109 Paragraphs 2.131 and 1.132 relate to my identification of the possible benefit to be gained by *redirecting any available resources to other transport projects in the City Region* (my 6.3d). Mr Chadwick notes that, if the DfT contribution were lost, the available resource would be limited. He identifies £30.4m of local funding plus the value of land in the NGT corridor (some of which presumably could be sold if no longer required for NGT) plus Prudential Borrowing associated with a projected revenue stream. This does not convince me that it might not be a good idea to redirect any available resources to more useful transport projects in the City Region.

B110 The rebuttal has not persuaded me that full fair and adequate attention has been given to alternative schemes. As noted in B88 above, Mr Chadwick has repeatedly asserted that the LCA described in C-1 should not be regarded as the best possible low cost package of measures designed to address the objectives of the NGT project. This was not stated in Document C-1 but is clearly of crucial importance to the Inquiry. It highlights the fact that the LCA described in C-1 is not a serious attempt to show what could be achieved at lower cost (see D5 below).

B111 The points in Section 7 and A28-A33 of my Proof were made in relation to the failure to meet transport policy aspirations and objectives - some of which were specific to the NGT project.

B112 My concern that *the proposed public transport offer will in many respects be worse than that on offer in the do minimum case* (my paragraphs 7.1a- to 7.1d) is addressed by Mr Hanson in his paragraph 2.134 and by Mr Chadwick in his paragraphs 2.146 to 2.156.

B113 Paragraphs 2.146 to 2.148 relate to my observation (7.1a) *that the public transport system would be less integrated, in that:*

- *Passengers will be faced with two alternative systems, each with their own set of stops, and will have to choose between them before making their journey – rather than being able to access all services from a single stop.*
- *Interchange with other buses at the bus station will necessitate a significant walk from the nearest NGT stop.*
- *According to Para 15.136 of Doc C-1, passengers may be faced with different fare structures on NGT and on bus.*

B114 In his paragraph 2.147, Mr Chadwick simply refers to his paragraph 2.75 (to which I ~~rebut in my paragraph 2.11.3~~ respond in B55 above) relating to components generalised cost. It does not address the question of reduced integration. The question of integration was raised with several of the promoters' witnesses. Two points emerged:

1. They were unable to point to anything positive beyond:
    i. improved access to the rail station (which turns out to refer to the fact that the NGT stop would be a few tens of metres closer to the rail station than is the existing stop for the southbound #1bus and ignores the fact that that stop could be moved closer to the station if there was the will so to do and the fact that the northbound #1 bus on Bishopgate is actually closer to the rail station than the proposed NGT stop).
    ii. strong branding of NGT (which surely serves to differentiate NGT from other services, not integrate it with them) and
    iii. the potential for through-ticketing (which could equally well be applied to bus).
2. In the context of transfer between NGT and bus, witnesses stated that, since the stops were not very distant from one another, interchange would not be difficult. Mr Chadwick was taken through an example (someone who begins their journey in City Square and wishes to transfer to the #28 bus for onward travel to Adel). He agreed that interchange at the Arndale Centre would become more difficult but, during re-examination, stated that the transfer could be effected with ease at the University. However, this suggestion ignores the fact that it would not make sense to transfer at that point because of the greater degree of crowding outside the University and because the Arndale Centre is a layover point for the #28 bus.

B115 Paragraphs 2.134 to 2.136 and 2.149 to 2.151 relate to my observation (in my Proof's 7.1b, A29) that *users of the trolley system would:*

- *on average, have to walk further to and from the stops (due to greater inter-stop spacing)*
- *on average have to wait longer for a service (6 minute rather than 3 minute headway)*
- *have less chance of getting a seat (A28)*
- *have to pay a higher fare for short journeys (see para 15.136 of Doc C-1), and*
- *in many cases, have longer perceived journey times.*

B116 Addressing all of these points, Mr Chadwick refers to his paragraph 2.75 (to which I ~~rebut in my paragraph 2.11.3~~ respond in B55 above) but does not seek to claim that, for some users, the service will not be worse in these respects. C2 below explores the negative impact that introduction of NGT would have on door-to-door journey times by bus. C3 below demonstrates that, for some journeys, the perceived journey time by NGT would be greater than that by Do Minimum bus.

B117 Addressing the third point (on the chance of getting a seat) Mr Chadwick refers to his paragraph 2.54 (to which I ~~rebut in~~ ~~my paragraph 2.5.6~~ respond in B19 above) which did not seek to deny that users of the trolley bus system would have less chance of getting a seat). C7 below explores the likelihood of getting a seat on NGT.

B118 Addressing the fifth point (on journey times), Mr Hanson refers to my Proof's A35 (in which I present a worked example of journey times which shows that perceived door-to-door journey times by NGT are 5 minutes longer than those by DM bus in the interpeak and only 2 minutes shorter than them in the am peak). Mr Hanson argues that I should have added in the quality factor (5.5 minutes) claimed for NGT by the proposers. I do not accept that that would be appropriate to do so (but would agree that a calculation which incorporated the values derived from the Stated Preference work might be interesting). I should clarify that the preceding remark (in red font) referred to the fact that I do not accept that a 5.5 minute penalty on bus journeys is justified but that it would be interesting to apply a bonus to journeys by bus which reflects Leeds bus users' stated willingness to pay to travel on a very new bus. The revelation, in Table 1 of APP155, that Leeds bus users' stated preferences would justify a penalty of 2.76 minutes on NGT journeys reinforces my belief that the application of a 5.5 minute penalty on bus journey times would be unjustified. Note that an updated version of my Proof's A35 is presented as C3 below.

B119 Paragraphs 2.137 and 2.152 to 2.153 relate to my observation (7.1c) that *Users of buses, including those who are effectively captive to bus (A30), would:*

- *in many cases suffer from less conveniently located bus stops*
- *on average have to wait longer for a service (6 minute rather than 3 minute headway)*
- *often have longer journey times (A31).*

B120 Mr Hanson points out, in his 2.137, that his evidence had indicated that, for some journeys, bus will be more attractive and for others NGT will be. We can agree on that. C3 below provides more evidence on some circumstances in which a bus would still offer a better journey than that offered by NGT.

B121 Mr Chadwick refers to his paragraph 2.75 (to which I ~~rebut in~~ ~~my paragraph 2.11.3~~ respond in B55 above drawing attention to the previously unrecognised fact that, due to reduced priority for late-running buses, bus punctuality may be worse in the NGT scenario than in the Do Minimum scenario)

B122 My concern (detailed in the first part of my 7.1d), that financial or commercial considerations might lead to further erosion of the public transport offer envisaged in the TWAO, is addressed by Mr Chadwick in his paragraph 2.155. He argues that the commercial operating case is robust (which I dispute) and that DfT funding is likely to be conditional on delivery of committed outputs - which presumably raises the prospect of Leeds citizens having to pay back part of the £173m! (see paragraph aii of D6 below).

B123 My concern (detailed in the second part of my Proof's 7.1d), that introduction of a Bus Quality Contract or partnership to protect an inefficient NGT service might deprive users of potentially lower fares, is addressed by Mr Chadwick in his paragraph 2.156 which refers to Mr Henkel's Proof and notes that such use of a partnership or quality contract scheme would not be allowed. I hope he is right!

B124 My observation (in my Proof's 7.2 and A32) that, rather than achieve a mode shift in favour of public transport (a WYLTP key indicator), NGT is forecast to result in a *net decrease in public*

transport passenger miles combined with a net increase in car miles and with most of the predicted trolleybus users having transferred from bus or train (A32), is addressed by Mr Chadwick in his paragraphs 2.157 and 2.158 and by Mr Hanson in his paragraphs 2.139 to 2.141.

B125 Mr Chadwick refers to his belief that the net increase in car miles is not a material impact in the context of the cost benefit appraisal and to the fact that transfer from other modes is a common feature of similar schemes. His rebuttal misses the point: a key indicator of WYLTP is to achieve mode shift towards ~~public transport~~ sustainable modes. Mr Chadwick's claim that the increase in car miles is immaterial is interesting in view of the fact that it appears to be about 8 times greater, in percentage terms, than the reduction in the number of car trips (see C15 below) which is frequently mentioned in C-1 as a positive achievement (twice in Table 6.1, three times in Table 7.1, once in Table 7.3 and once in Table 17.12).

Turning to the WLTP target, the target is to increase the use of sustainable modes and the commentary in Table 7.3 of C-1 leaves the reader with the impression that NGT would make a positive contribution towards meeting this target. However, as revealed in C15 below, NGT is predicted to result in a greater increase in kms travelled by car than in kms travelled aboard public transport, walking or cycling (i.e. NGT would result in a lower proportion of total person kms being travelled by sustainable modes). I accept that the proportion of sustainable trips, as opposed to the proportion of sustainable kms, is predicted to increase as a result of introducing NGT, but note that it would amount to small fraction of a one percent increase (the size of the increase depends on whether or not P&R trips are counted as sustainable - they involve a trip by car as well as a trip by public transport).

The broader issue of the extent to which the Revised Business Case is fair and balanced in the way that it reports the predicted impacts of NGT was explored in my cross-examination of Mr Chadwick. My conclusions on this issue are summarised in D3 below.

B126 Mr Hanson refers to paragraph 8.13 of his proof which reveals that, following discovery of an error in the representation of fares in the LTM, the forecasts had been re-run and no longer show a decrease in public transport passenger kms due to NGT (the forecast is now for a 1% increase). This correction is allowed for in the calculations in C15 below.

B127 My observation (in my Proof's 7.3) that *Increases in overall journey times by car (Table 58 of Doc C-1.8), when combined with the increased journey times by bus, seriously detract from any claim to have increased connectivity* is addressed by Mr Chadwick in his paragraphs 2.160 to 2.161.

He refers to paragraph 3.69 of his Proof (APP-7-2) - which maintains that the net time disbenefit to highway users is not a material impact – and to paragraph 6.17 of his proof which sets out his opinion that traffic impacts have not been understated. Neither of which points address my concern. He then refers to paragraph 2.63 of his rebuttal, I assume he meant to say 2.64 (to which I ~~rebut in my paragraph 2.8.1~~ respond in B41 above).

B128 My observation (in 7.4) *that NGT was forecast to result in increases in emissions (Table 4.9 of Doc B-2), accidents (Table 17.12 of Doc C-1), noise (para 2.5.24 of Doc B-8) and fuel consumption (Table 16.1 of Doc C-1)* is addressed by Mr Hanson in his paragraph 2.144. Mr Hanson refers to the conclusion in his Proof that NGT will have little impact on daily traffic conditions within the corridor. He also refers to Mr Chadwick's conclusion, in his Proof, that these increases are not significant. I have never argued that these impacts are very significant (although they might be so

regarded by those who are affected) simply that they indicate a failure to meet key tests for ~~a~~ this transport project.

B129 My observation (in my Proof's 7.5 and A33) that the fourth objective listed for NGT was to improve the efficiency of the transport system and my conclusion that introduction of NGT clearly reduces transport system efficiency (when measured appropriately), are addressed by Mr Chadwick in his paragraph 2.162 to 2.164.

B130 He accepts ('in general terms') that the correct way to measure system efficiency is as a ratio but argues that, in this case, it is appropriate to use the definition which was lodged in Table 3.8 of C-1 alongside the objective. I accept that, in this case, it may be appropriate to use the measure identified by the people who set the objective even though it is emphatically not a measure of efficiency.

Mr Chadwick claims to have adhered to the definition of efficiency used in table 3.8 of C-1, namely: *"the conventional DfT Value for Money case measured as the quantity of user benefits (journey time, quality, but also reliability, option value etc.) and non-user benefits (impact on congestion)".* However, in Table ~~76.2~~ 7.2 of C-1 (which reports on achievement of objectives), NGT's impact on efficiency as is described thus: *"The Preferred Option is forecast to deliver £701m of public transport passenger journey time benefits and generate a revenue surplus of £457m in present values. Approximately 25% of its demand is new to public transport. Public transport punctuality will also improve, generating £84m of additional passenger benefits".* It excludes any mention of impacts on congestion (which Mr Chadwick describes as "not material") and misleadingly labels the £701m as "public transport passenger journey time benefits" when much of it is actually the disputed quality factor. The list of items reported in Table 7.2 does not constitute a measure of efficiency. Nor is it the "conventional DfT Value for Money case" mentioned in Table 3.8. Nor is it, as Mr Chadwick claims, the list of items specifically mentioned in that table. I am concerned that summaries such as that included in Table 7.2 will have misled the lay reader[1]. A further indication of the fact that, contrary to what is claimed in Table 7.2, NGT would lead to a reduction in system efficiency is provided by the fact that data provided for the first time in APP103 indicates that introduction of NGT would result in an overall increase in average trip duration (see C9 below).

B131 My A12 included an attempt to separate out the true journey time savings from the £701m but, due to the continued unavailability of information on some of the key factors, I am not confident that my estimate is accurate and look forward to repeating the calculation when the requisite data are revealed. The information released as APP103 (in answer to Qs 1, 2 and 3) has allowed me to improve my estimate of the contribution of the quality factors to the benefit described as "journey time savings"; I now estimate it (see C1 below) to be in excess of £280m.

[1] My use of the term "lay reader" was picked up by Mr Cameron during his examination of Mr Chadwick. Mr Chadwick responded by saying that the information in C-1 was not intended for the lay reader. I should perhaps have said "people without specialist knowledge of transport analyses" – which definition would include some of those people, politicians and others, who need to understand what the Business Case actually means (and recall that the Treasury Green Book, in its section 2.130, emphasises that "*the presentation of the conclusions and recommendations to decision makers and key stakeholders can be as important as the analysis itself. In all cases transparency is vital*").

B132 My observation that there is a deterioration in many measures of the Quality of Life, (whose improvement is one of Leeds' high level policy objectives) is addressed by Mr Chadwick in his paragraphs 2.165 to 2.172.

B133 My Proof's 7.6 identifies that NGT is forecast (by the Proposers) to lead to: *increased congestion, traffic, accidents, emissions, traffic noise and time spent driving; less convenient public transport for many users; reduced use of active modes; and adverse impacts on the local environment, streetscape, historic heritage and vitality of local businesses.*

B134 In respect of *emissions, accidents, and noise,* Mr Chadwick refers to Mr Hanson's paragraph 2.143 (but doubtless meaning 2.144) as the basis of his conclusion that there would be no consequent deterioration in the Quality of Life. Despite the circularity of the referencing (Mr Hanson's paragraph 2.144 refers to Mr Chadwick as the source of the conclusion that the forecast changes [= increases] in *emissions, accidents, and noise* are not significant), neither of them seek to dispute that emissions, accidents and noise are forecast to increase.

B135 There is no attempt to rebut my observation that there will be increases in congestion or time spent driving.

B136 Respecting *less convenient public transport for many users*, Mr Chadwick refers to his paragraphs 2.146, 2.149 and 2.152 (and others unspecified) as the basis for his conclusion that the introduction of NGT will represent an improvement in public transport provision. I have already ~~rebutted~~ responded to the specified paragraphs but point out that my claim (in my Proof's 7.6) was simply that there will be *less convenient public transport for many users*. I cannot imagine that that claim would be in dispute – indeed it appears to be accepted in Mr Chadwick's 2.137.

B137 Respecting *reduced use of active modes*, Mr Chadwick refers to his proof of evidence which records his assessment that there will be a strong beneficial impact on physical activity. Published results from the LTM have not identified active mode users as a separate group (despite requests, details of predicted mode splits have not been released). The March 2012 forecasts specifically mentioned the transfer of active mode users to NGT but the current tables lump this group in with car drivers. The closest thing to a published forecast of impact on active mode use appears to be Section 5.3 of C-1-8 which indicates that the "sizeable" group classified as "new public transport trips" includes former users of active modes. I look forward to a clear statement of the forecast use of active modes in the NGT and Do Minimum scenarios. The information released as APP103 (answer to Q8) indicated that the number of active mode trips, and the person kms by active modes would be lower in the NGT scenario than in the DM scenario. Calculations in C15 below show that the majority of the trips lumped together in Table 12.4 of C-1 as "car /active" are actually active mode trips. The LTM clearly predicts that NGT will result in less use of active modes.

B138 Respecting *adverse impacts on the local environment, streetscape, historic heritage and vitality of local businesses*, Mr Chadwick refers to paragraph 3.158 of his proof which states that the overall value for money case of NGT is stronger than that for the NBA and LCA. This paragraph does not address my point (which is that these impacts contribute to a reduction in the Quality of Life). Further to my specific point about the negative impact on the viability of local businesses; I understand that the issue of the deleterious impact of the reductions in off-peak parking in the southbound bus/NGT lanes in the vicinity of Far Headingley was raised with Mr Smith who stated

that the parking restriction was necessary for the performance of NGT. Calculations presented in C5 below suggest that this is not so.

B139 **My view (expressed in paragraphs 7.1 to 7.6 of my Proof) that the NGT scheme fails to meet key tests is not diminished by the rebuttals from Mr Hanson and Mr Chadwick.**

C Calculations based on data supplied by Promoters

C1 Rough estimate of the contribution of "quality factors" to the £701m of "time savings"

This is a revised estimate, all be it still only rough, based on information provided in APP103. It replaces an earlier calculation included as Appendix A12 to my Proof of Evidence and suggests that the reduction in quality penalties assumed to occur when people switch to NGT will account for at least £279m of the £701m.

The method I have used to estimate this value is, in outline, to multiply the average penalty avoided by the number of passengers transferring to NGT from other public transport, to multiply this by the value of time and then discount the result over 60 years. This method requires me to make some simplifying assumptions. Namely:

a. That 80% of am and pm peak NGT passengers are commuters and the rest are "other", hence (using values from table 6 in C-1-8) the average value of time for NGT users during peak periods is 0.8X6.46 +0.2x 5.71 = £6.31 per hour- this is probably an under-estimate since some will be in course of business and so have a much higher value of time.
b. That 20% of Interpeak NGT passengers are in course of business and the rest are "other". Hence (using values from tables 5 and 6 in C-1-8) the average value of time for NGT users during the interpeak is 0.2x 21.69 + 0.8x5.71 = £8.91 per hour.
c. That the average demand during scheme life is similar to that in 2031 (15 years after introduction) – probably an underestimate.
d. That discounting over 60 years is approximated by multiplying by 20 (the correct multiplier is between 18 and 26 depending on assumptions about start year with respect to base year (discounting over 60 years at 3.5% for 30 then 3% for another 30 means that year one value is multiplied by 25.65 – or if you start at year 10 because base year is 2010, then multiply year 1 by 18.28), hence use of 20 is probably an underestimate.

The inputs to the estimate are:

e. average penalty relieved by transferring to NGT from other PT = 11.3 minutes = 0.188 hrs (information in APP103, in answer to Qs 1, 2 and 3 therein, indicates an average bus stop penalty = 7.1 minutes, average NGT stop penalty = 1.3 minutes, average bus penalty = 5.5 minutes) 7.1+5.5-1.3 = 11.3 – although this may be inaccurate because I do not yet know the average train stop penalty.
f. Number of NGT passengers transferring from other PT in 2016 (from Table 51 in C-1-8) is 1227 am peak, 1420 interpeak, 1706 pm peak. Note that this excludes Park and Ride trips and so may be an under-estimate
g. Growth in patronage between 2016 and 2031 (from Table 50 in C-1-8) is 23% in am peak, 26% in interpeak, 20% in pm peak.
h. Annualisation factors representative hour to year (from C-1 table 12.10) 772 am peak, 1543 interpeak, 514 pm peak, then a further adjustment (from C-1 Table 12.12 using the same assumptions about purpose split as at a and b above) to move from 12 hour weekday to 24 hour everyday: (peaks = 0.8x2.22 + 0.2x1.92 = 2.16; interpeak = 0.8x1.92 + 0.2x1.26= 1.788).

Calculation for the am peak:

0.188 (average penalty, in hrs, avoided) x 6.31 (average value of time in £ per hr) x 1227 (passengers transferring in 2016) x 1.23 (growth 2016 to 2031) x 772 (12 hour annualisation) x 2.16 (12hr weekday to 24 hour anyday adjustment) x 20 (approx. discounting over 60 years) = £60m

Calculation for the interpeak:

0.188 (average penalty, in hrs, avoided) x 8.91 (average value of time in £ per hr) x 1420 (pass transferring in 2016) x 1.26 (growth 2016 to 2031) x 1543 (12 hour annualisation) x 1.788 (12hr weekday to 24 hour anyday adjustment) x 20 (approx. discounting over 60 years) = £165m

Calculation for the pm peak:

0.188 (average penalty, in hrs, avoided) x 6.31 (average value of time in £ per hr) x 1706 (pass transferring in 2016) x 1.20 (growth 2016 to 2031) x 514 (12 hour annualisation) x 2.16 (12hr weekday to 24 hour anyday adjustment) x 20 (approx. discounting over 60 years) = £54m

Overall = **£279m** (60+165+54)

Note that this estimate does not include any element for the quality factors' influence, through the composite cost function, on benefits attributed to travellers switching from car, or active modes or from other time-periods and destinations. Were these to be included, the estimate would probably be significantly higher.

C2 Calculation of door-to-door journey times by bus

Bus users whose journey does not start and end close to proposed NGT stops (e.g. those whose journey starts along the northern extremities of the #1, #28 or #97 routes or those seeking to access the northern and eastern parts of the City Centre - including the new Victoria Gate Development – which are not served by NGT, and those wishing to connect with other bus services at the Bus Station), and those who are averse to the prospect of having to stand while travelling, would have little reason to use the NGT services and so a comparison of bus times in the Do Minimum and NGT scenarios is of great relevance to them.

Appendix A of C-1-13 details run times output from the Run Time Model. Runs 17-02 and 11-02 show southbound interpeak run times for buses in the Do Minimum and NGT scenarios respectively. The journey routings are different at the north and south ends and so, in order to compare equivalent journeys, I will consider the time taken to travel from the Weetwood bus stop to the Merrion bus stop.

The time taken to make this journey in the Do Minimum Scenario is 21.34 minutes (27.89 minutes minus 1.13 mins prior to arrival at Weetwood and minus 5.42 mins after arrival at Merrion). The time taken in the NGT scenario is 20.10 minutes (26.67 minutes minus 2.08 mins prior to arrival at Weetwood, and minus 4.49 after arrival at Merrion). The in-vehicle part of the journey is thus 1.24 minutes quicker in the NGT scenario.

However, this 1.24 minute advantage is outweighed by the additional 2.5 minutes of average waiting time due to the reduced frequency in the NGT scenario (the Do Minimum scenario has a headway of 5 minutes at the Weetwood bus stop and hence an average wait time of 2.5 minutes, the NGT scenario bus headway

at this bus stop would be 10 minutes giving an average wait time of 5 minutes). Thus the door-to-door bus journey would, on average, take 1.26 minutes longer in the NGT scenario than in the Do Minimum scenario.

Note that the journey used in this calculation has no additional walking time in the NGT scenario but that the proposed relocation of some bus stops away from intersections is likely to increase walk times for many bus journeys and so the additional journey time in the NGT scenario would be even more marked.

C3 Comparison of Bus and Trolleybus journey times

This calculation updates and replaces A35 in my original Proof and Appendix G of the NWLTF Statement of Case (OBJ1719) to deal with Mr Chadwick's comment that the original calculations had not allowed for the fact that stops at the northern end of the route differ between scenarios.

Appendix A of C-1-13 details run times output from the Run Time Model. Runs 17-02 and 5-02 show southbound interpeak run times for buses in the Do Minimum and for NGT vehicles respectively. The summary statistics would suggest that the journey by NGT is 7.25 minutes quicker (20.64 minutes compared to 27.89 minutes). However, that comparison is unfair because the journeys are not truly comparable and the figures exclude time taken waiting and walking to and from stops.

The stops at the north end of the route differ and so, in order to compare equivalent journeys, I will consider journeys boarding at the Churchwood stop (the first location where the existing bus stop and proposed NGT stop are very close together). The City Square stops are inappropriate as the end point because City Square is not a common destination for interpeak travellers. A more relevant interpeak destination is the Merrion Centre (the first major shopping mall encountered when arriving in the City centre from the North West and the point of divergence between the bus and NGT routes). The Merrion Centre is served by the Merrion bus stop and, at slightly greater distance, by the Arena NGT stop.

According to run 1702 in C-1-13, the time taken to travel by bus from the Churchwood stop to the Merrion stop interpeak in the Do Minimum Scenario is 18.15 minutes (27.89 minutes minus 4.32 mins prior to arrival at Churchwood and minus 5.42 mins after arrival at Merrion). According to run 0502 in C-1-13, the time taken to travel by NGT from the Churchwood stop to the Arena stop interpeak is 13.87 minutes (20.64 minutes minus 3.94 mins prior to arrival at Churchwood and minus 2.83 mins after arrival at Arena). The in-vehicle part of the journey is thus 4.28 minutes quicker on NGT than on the Do Minimum bus.

However, this 4.28 minute advantage is reduced by the additional 1.5 minutes of average waiting time due to the reduced frequency in the NGT scenario (the Do Minimum bus headway at Churchwood is 3 minutes resulting in an average wait time of 1.5 minutes while the NGT headway is 6 minutes resulting in an average wait time of 3 minutes) and by the additional 3 minutes of walking time (according to Google Map) from the NGT Arena stop to the Merrion Centre. Thus, compared to the Do Minimum bus, the door-to-door journey from Churchwood to the Merrion Centre takes 0.22 minutes longer by NGT (4.28 -1.5 -3.0).

The comparison would tip further against NGT if account were taken of:

i. The likelihood that bus dwell times, and thus run times, will fall in the Do Minimum due to improvements in ticketing technology and procedures. This alone could result in the door-to-door journey by NGT being longer than the Do Minimum bus equivalent.

ii. The possible reduction in bus run time achievable by modification to the junction of Blackman Lane with Woodhouse Lane (Mr Robertson agreed that time savings in excess of 20 seconds could be achieved for southbound buses if traffic from Lodge Street were obliged to turn Left.

iii. The additional weighting placed on time spent walking and waiting (the behavioural weightings detailed on page 30 of C-1-3 are 1.8 for walking time and 2.0 for waiting time). If these factors were applied, the increase the perceived NGT journey time of NGT would be by 8.4 minutes more than that of the equivalent Do Minimum bus (1.8 x the 3 minutes extra walking plus 2 x the extra 1.5 minutes waiting = 5.5 +3 = 8.4).

iv. The additional weighting placed on time spent travelling without a seat (paragraph 6.41 of Webtag Unit 3.11.2 (E-3.16), discussing the impact of crowding on values of in-vehicle time, suggests that the in vehicle time be factored by 1.5 during crowded conditions). Given that, as discussed in C7 below, the trolley vehicle would have to be the NGT3 specified in APP108, that NGT3 vehicles would provide only 400 seats per interpeak hour, and that Table 53 of C-1-8 indicates that the interpeak passenger load at Churchwood exceeds 400 per hour, there would be no spare seats for people boarding at Churchwood. Application of the DfT factor would increase the perceived NGT journey time by 6.94 minutes (0.5x the 13.87 in vehicle time).

v. The result from the Stated Preference survey (first revealed in APP155) implies a further 2.76 minute penalty on the journey by trolleybus.

Application of the usual and uncontroversial weighting factors (iii and iv above) alone would leave the door to door journey by NGT perceived to be more than 11 minutes longer than the equivalent bus journey in the Do minimum scenario (8.4+6.94 -4.28 = 11.06).

It should be noted that this comparison is for a journey on which NGT benefits from its segregated route behind Headingley Arndale Centre. Door to door journeys which do not include this stretch could even more readily be shown to take longer by NGT than by Do Minimum bus.

C4 The effect of bus priority measures in the LCA

Para 3.147 of APP-7-2 indicates that the LCA option includes '*some on-street priority additional to the Do Minimum, which would improve bus journey times and their punctuality*'. However, Table 1 in APP-7-3 (listed as APP-7-3-1) shows that the LCA bus journey times between "Bodington and the City" are actually longer than those in the Do Minimum case. This finding holds true in all time periods and in both directions of travel.

Under examination, Mr Chadwick indicated that this result was due to the fact that, although all journeys are described in the table as "Bodington to City", the northern end of the LCA journeys was actually within the Park and Ride site while that of buses in the Do Minimum case was on the A660 (at Otley Old Road)

and that the LCA journeys took longer because of this difference. In order to test this explanation, I examined the data in Appendix A of C-1-13 which had been the source of the results quoted in APP-7-3. The results are provided in the table below.

Period	am peak		interpeak		pm peak	
Direction	southbound	northbound	southbound	northbound	southbound	northbound
Do minimum times (mins) for curtailed route						
Run #	1602	1302	1702	1402	1802	1502
	32.51-1.3 - 3.2 = 31.21	28.33-1.25-3.56 = 23.52	27.89-1.13 = 26.76	28.33-1.25 - 3.56 = 23.52	27.89 – 1.13 = 26.76	34.16-3.56-0.17-1.42 = 29.01
LCA times (mins) for curtailed route						
Run #	2202	1902	2302	2002	2402	2102
	33.12-2.1-3.2= 31.02	28.58-2.09-3.26 =23.23	29.01-1.94 = 27.07	28.58-2.09 – 3.26 = 23.23	29.01-1.94 = 27.07	34.42-3.26 - 0.17-2.26 = 28.73
Difference (Do min minus LCA)						
	0.19	0.29	-0.31	0.29	-0.31	0.28

It is clear that, if the Weetwood bus stop is taken as the northern extremity of the timing corridor, then 4 out of the 6 journeys are now quicker in the LCA scenario (the average difference being 0.26 minutes). The two journeys which are slower in the LCA scenario are those in the southbound interpeak and southbound pm peak (each being slower by 0.31 minutes).

While the LCA does seem to be receiving some benefit from the priority measures, it is only minimal. Note in particular that new northbound bus lanes near West Park and from Hyde Park up to Richmond Avenue appear to provide a benefit of less than 30 seconds. In my opinion, this indicates that the design of the priority measures specified for the LCA is poor. It is interesting that Mr Robertson, the local expert on signal priorities, was not asked to assist in designing priorities for the LCA.

C5 Calculation of impact of parking restriction in bus lanes adjacent to Far Headingley

This calculation explores the impact of the 24 hour ban on waiting and parking which is proposed in the southbound bus lanes on the A660 between Glen Road and Burton Crescent. It uses outputs from the Run Time Model described in C-1-13 to explore the effect of the ban by comparing run times achieved without the ban in place (by buses running outside the morning peak in the Do Minimum scenario) with those achieved with it in place (by buses running outside the morning peak in the NGT scenario).
The data in Appendix A of C-1-13 allows comparison of running speeds of southbound buses between the Churchwood and Arndale bus stops. Runs 1702 and 1802 relate to the Do Minimum scenario and show bus run times for the interpeak and pm peak respectively. Runs 1102 and 1202 show the same thing for buses in the NGT scenario.

Running time from Churchwood bus stop to Arndale Centre bus stop (mins)

Do Minimum scenario (no ban)		NGT scenario (ban in place)	
interpeak	pm peak	interpeak	pm peak
Run 1702	Run 1802	Run 1102	Run 1202
0.74 +0.85 +1.37 =2.96	0.74 +0.85 +1.37 =2.96	1.04 +0.53 +1.39 =2.96	1.04 +0.53 +1.39 =2.96

It can be seen that all four run times are the same (at 2.96 minutes). This indicates that, based on evidence from the run time model, the proposed ban on parking and waiting in this stretch of bus lane after 10 am provides no benefit to buses (or, by extension, to NGT vehicles).

C6 Comparison of Penalties

The final paragraph on page 8 of C-2-4 suggests that the combination of the vehicle quality penalty and the capped boarding penalty used in the NGT project is broadly equivalent to (within "20% or so" of) a bus quality package based on research conducted for DfT by AECOM. I dispute that claim because it is based on a spurious comparison of 11.73 with 9.51. Neither 11.73 nor 9.51 are the appropriate figures to use in the comparison.

The AECOM package is based on values recommended to DfT by AECOM (reproduced in Figure 2 on page 8 of Appendix A of C-2-4). The penalty applied in the NGT project is based on a demand weighted average of the capped boarding penalty package based on "commuter" values in Table 1 on page 1 of Appendix A of C-2-4.

The first error is in the specification of the package (both packages included an element for lack of CCTV on buses despite the fact that CCTV is already present on all buses). According to information provided in APP103, the demand weighted average capped boarding penalty was 7.1 and Mr Chadwick stated in re-examination that the reduction from 11.73 to 7.1 reflected the fact that CCTV was present on buses. The AECOM package has to be reduced to reflect this change. It must therefore be reduced by 2.54 (the value ascribed to CCTV on buses) making its value 6.97 rather than 9.51.The comparison now looks like 7.1 compared to 6.97 – a difference of about 2%. In this respect I agree with everything that is said in APP171 – except the final sentence.

The second, more serious, error is in comparing a package comprising all the relevant attributes (as was done to calculate the value of the AECOM package of 9.51 - or 6.97 - minutes) with one which is demand weighted (as was done to give a NGT project penalty of 11.73 or 7.1 - minutes).

Although it would be useful to compare demand-weighted packages I can only compare packages comprising all the features ("maximal" packages) because I do not have access to the data which would allow me to calculate a demand-weighted version of the AECOM package. We already know the value of the maximal AECOM package to be 6.97 minutes. The equivalent penalty based on values used in the NGT project should be the capped value of maximal bus boarding penalty minus the capped value of the maximal NGT boarding penalty.

The uncapped bus boarding penalty is 40.46 minutes [= poor lighting (10.59 mins) + No shelter (13.98 mins) + No real time information (10.18 mins) + No CCTV at bus stops (half the 11.42 shown is 5.71 mins)]. Capping, using the procedure described on page 5 of C-2-4 reduces 40.46 minutes to 20.115 minutes (1x 10 + 0.5 x 10 + 0.25 x 20.46 = 20.115). The capped value of maximal NGT boarding penalty is not known but, based on the NGT stop specification, seems unlikely to exceed 6.36 minutes (standard shelter + half of 10.18 No Real Time Information = 1.27 +5.09). Thus the maximal differential penalty is 13.755 minutes (20.115 – 6.36).

Thus the fairer comparison is between 13.755 and 6.97 – which indicates that the penalty applied in the NGT work was 97% greater than the equivalent penalty based on the AECOM work. This is very much greater than the "20% or so" which was reported to DfT via the final paragraph on page 8 of C-2-4.

This comparison of maximal packages is far from ideal because it ignores the true distribution of penalties. A more valid comparison would be between demand-weighted average values, or perhaps better still, between average bus stop values (a demand-weighted average will be lower because people tend to choose better-equipped stops). This comparison is difficult because I do not have all the necessary data. However, I can make use of the fact that, as shown in C13 below, the average bus stop penalty to be 16.5 minutes. This value suggests that the average stop value is about 0.82 (16.5/20.115) of the maximal value and 2.32 (16.5/7.1) times the demand-weighted value. Answer 2 in APP103 shows the demand weighted NGT stop penalty to be 1.3 and so we may assume its average value to be 3.0 (1.3 x 2.32). The average bus stop, based on AECOM values would be 5.71 (6.97 x 0.82). The comparison would thus be 13.5 (16.5-3.0) with 5.71. On this basis the Leeds SP package is about 136% greater than an equivalent one based on AECOM values. Again this is very much greater than the "20% or so" which was reported to DfT.

It should also be noted that, while the capping procedure described part way down Table1 of C-2-4, is able to avoid use of ridiculously high penalty values at boarding points with very few facilities, it will not have prevented excessive values at boarding points which lacked only one attribute (consider the case of a commuter using a stop which was lacking only in respect of CCTV: using the Leeds SP values the boarding penalty would be 5.71 minutes (half the 11.42 in Table 1) whereas, using the AECOM values, it would be only 2.91) – again showing that the Leeds values are considerably greater than those in the AECOM report.

I therefore refute the final sentence of APP171.

C7 Calculation of required capacities and consequent seat availability

Appendix 13 of Appendix 3 of C-2-3 is not on the Inquiry website but it is on the NGT website. It shows, on its page 18, that the 0800-0900 bus flow on Woodhouse Moor is about 1450 while that for 0700-0800 is about 500 and that for 0900-1000 is about 1200. Thus, to obtain the busiest hour (0800-0900) as a proportion of the average hour in the three hour peak period, we need to divide 1450 by the average of the three peak hours. The divisor is 1050 (500+1450+1200)/3 = 1050). The required factor is thus 1.38 (1450/1050).

Table 53 of C-1-8 shows the southbound usage of NGT predicted by LTM for 2016. The flow passing the stop at Hyde Park Corner - chosen because it is closest to the Woodhouse Moor census point – is 1053

passengers per hour during the am peak period (0700-1000). The peak hour (0800-0900) flow at Hyde Park Corner is thus likely to be 1453 (1.38x 1053 rounded down).

But of course the peak hour actually has a peak within it. I think it is fairly well known in the bus business that the busiest 15 mins in the peak hour is about a third busier than the average 15 minute period in the peak hour (in discussion with First West Yorkshire, I understand that their data shows the factor to be about 1.27 and I am happy to use that figure). So the flow during the busiest 15 minutes would be 461 passengers (1453/4 x 1.27).

The proposal is to run one additional trolley vehicle in the peak hour (making a total of 11 in the peak hour). Deployment of the extra vehicle during the busiest 15 minute period would, in theory, result in an average load of 131 (461 passengers divided by 3.5 trolleys – 3.5 being one quarter of the standard ten plus the extra one) during the busiest 15 minute period. However, this ideal could not be achieved in practice because the extra vehicle would need to be available simultaneously at all the overloaded stops - northbound and southbound - and because it would render the signal priorities unachievable (Mr Robertson indicated that full priority would be unachievable if the flow of priority vehicles exceeded one per six minutes). It would clearly be unsafe to assume that these practical difficulties could be overcome and a more realistic assumption would be that the 11 vehicles would be deployed at equal intervals during the peak. Thus there would be 2.75 vehicles (11/4) per 15 minute period. The average load per vehicle during the busiest 15 minute period would therefore be 167 (461/2.75). Note that this loading is based on predictions for the medium growth scenario and that it would be substantially higher in the high growth scenario.

APP108 outlines three different trolley vehicle configurations; NGT1, NGT2 and NGT3 with progressively higher capacities achieved by progressively reducing the number of seat (NGT3 has the legal maximum capacity of 160 and has 40 seats). The predicted average maximum load of 167 in the medium growth scenario exceeds even that of NGT3. NGT2 would be adequate only if demand did not exceed that in the medium growth scenario AND the theoretically ideal deployment of vehicles could be achieved). Given the undesirability of leaving passengers at the road side because the capacity is inadequate, and of not being able to achieve the desired signal priority, I suggest that it would be unsafe to select any vehicle with a lower capacity than NGT3 (NGT2 offers 50 seats but has a capacity of only 140) .

The “flow” column of Tables 52 and 53 of C-1-8 shows how many people will be on the trolleybuses leaving each stop during the specified period (the number on board when it arrives can be taken from the preceding row). NGT3 offers only 40 seats per vehicle. The proposal for 2016 is to run 10 vehicles during the interpeak and 11 during the peaks. Thus there will be a maximum of 400 seats per hour during the interpeak and a maximum of 440 seats per hour during the peaks. Tables 52 and 53 show interpeak flows in excess of 400, and peak hour flows in excess of 440, along much of the route. It is therefore clear that there would be no spare seats available for passengers boarding at stops along much of the route at most times of day.

If, despite the risks outlined in earlier paragraphs, the lower capacity NGT2 vehicle were selected, there would be 500 seats per hour in the interpeak and 550 per hour in the peak. Examination of the flow column in Tables 52 and 53 of C-1-8 shows that there would still be no spare seats available for passengers boarding at stops along much of the route at most times of day.

Note that, given the flows expected during the peak hours (1.38 times that shown for the peak periods in Tables 52 and 53) and the even higher flows expected during the busiest 15 minute periods (1.35 x 1.27 times that shown for the peak periods in Tables 52 and 53). There would certainly be times when, even if NGT3 is chosen, the NGT capacity would be insufficient to allow all passengers could get on the first vehicle to arrive. Some trolley passengers would therefore have to wait for the next vehicle to arrive - thus raising their typical wait time from the 3 minutes assumed in the LTM to around 9 minutes. Longer wait times would dissuade passengers. This would reduce the degree of overcrowding but would leave the equilibrium patronage, and revenue, lower than that which is assumed in the Business Case.

C8 Estimate of the value of seat availability

Table 2 on page 3 of Appendix A of C-2-4, which is derived from the Stated Preference study conducted in Leeds in January 2008, shows that, for a typical 10 minute commuting journey on NGT, the difference in the value of time with *plenty of seating spaces* and with *sufficient space to stand* is 3.4 pence (2.75 - 2.41 X 10 = 3.4). This compares with values of 24.57 pence and 27.56 pence for RTI and CCTV respectively. The value which bus users are deemed to place on seat availability is thus, according to the Leeds SP results, about an eighth (3.4/[24.57+27.56]/2) of that placed on these other factors. This result is way out of line with that of studies reviewed in the AECOM report for DfT (G-4-13).

The Conclusion to the literature review appended to the AECOM report (Section 3.6 on page 191) notes that availability of seating had a higher value than any other attribute in all the studies which included it. The AECOM study does not itself recommend a value for seating availability (their seating values relate to the nature of the upholstery and the seat configuration), but it does report values found in other studies.

Table 3.2 (on page 160) indicates that, in 2004, bus users in Dublin were found to value an increased probability of getting a seat (from 50% to 90%) at 5.29 €c per km which is equivalent to about 20 €c or 16 pence for a typical 4km journey. Table 3.4 (on Page 168) shows values from an Australian study in 2003 which suggest that being seated for an entire journey might be worth 0.64 to 1.72 AUD per trip (i.e. about 35pence to 95 pence). The Leeds value of 3.4 pence per trip is clearly far below what was found in Dublin or Australia.

Another way of looking at the Leeds value is to look at the relative values put on seat availability and on other journey attributes. The only bus attribute to appear in the Leeds SP and in those studies reviewed by AECOM which examined the value placed on seat availability, is the provision of RTI. Tables 3.1 and 3.2 (on pages 159 and 160 respectively) show bus users' willingness to pay for seat availability (defined as moving from a 50% chance of getting a seat to a 90% chance of getting a seat) and for provision of RTI (moving from absent to present). The tables contain three sets of values which suggest that the average ratio of the value of seat availability to RTI provision is about 3.3 to 1 (actual values are 1.45:1, 5.5:1 and 3.3:1).

Thus, while the Leeds SP suggests that seat availability is valued at 0.277 times the value of on-board RTI (3.4/12.29, using a divisor of 12.29 rather than 24.57 because the value for RTI needs to be halved to allow for the fact that it relates to RTI at the stop as well as on board the bus), the research presented in the AECOM report suggests a value of 3.3 for the same multiplier. This suggests that the value of the Leeds SP result is less than a tenth of that found in the studies reviewed by AECOM (0.277/3.3= 0.08).

A further indication that the Leeds SP value for crowding is out of line may be had from the fact that Paragraph 6.4.1 of Webtag Unit 3.11.2 (E-3.16), discussing the impact of crowding on values of in-vehicle time, suggests that a factor of 1.5 might be applied to represent the scale of impact. Their suggested factor of 1.5 compares with the Leeds SP's 1.14. (2.75/2.41 based on values in Table 2 of Appendix A of C-2-4 for the ratio of values of time when there is *sufficient space to stand* to that when there are *plenty of seats available*).

The value of crowding used in the NGT work was derived from the Stated Preference surveys described in C-4-24 and, although it is possible that Leeds travellers are unusually tolerant of crowding and inability to get a seat, a much more convincing explanation may be found in the fact that, as reported in paragraph 6.9 and Figure 6.4 of that report, the interviewee sample over-represented travellers aged between 20 and 35 and excluded holders of concessionary passes travelling after 0930. The sample was thus skewed towards the most fit and healthy bus users and had no representation at all of elderly people choosing to travel off-peak.

C9 Increases in person hours spent travelling

APP103 page 7 shows that the 2016 am peak hour total person hours is greater in the NGT scenario than in the Do Minimum scenario (the totals are 769,866 and 769,750 respectively). This increase implies an increase in average trip duration (the total number of trips is unchanged – the apparent increase in trip numbers recorded elsewhere in APP103 was put to Mr Hanson during cross-examination and he stated that it was simply the result of each park and ride trip appearing as two trips – one from the origin to the P&R site and one from the P&R site to the destination).

The increase in person hours (116) cannot be expressed as a proportion of total trip time because, as pointed out by the authors of APP103, the person hours in cars and active modes include hours spent travelling in areas distant from Leeds (the absolute numbers therefore have no meaning). However, since no cost changes were introduced outside the NGT area, there is no reason to question the size of the difference in person hours or to doubt the conclusion that introduction of NGT would lead to more time being spent travelling during the morning peak.

The Promoters note that the situation at other times of day may be different. Indeed it might, but they have produced no reason why it should be nor any data to permit exploration of that possibility.

C10 Shaw Lane Flow totals (TRANSYT and LTM)

This section demonstrates points raised during cross-examination of Mr Robertson and Mr Hanson and documented in NWLTF111. (NWLTF111 contained the facts but contained an arithmetic error and had insufficient explanatory text).
The diagram on page 17 of APP-6-3 shows flows through the Shaw Lane junction assumed in the detailed TRANSYT modelling. The total input flow for the 2020 Do Something scenario sums to 3006.
The maps on pages 17 and 37 of the appendix to APP103 show LTM Do Something predictions of flows into the Shaw Lane junction (node 2153) in 2016 and 2031 respectively. They sum to 3050 and 3400 respectively. The growth over 15 years is thus 23.33 per annum (= [3400-3050]/15). The 2020 LTM prediction for 2020 can therefore be interpolated as 3143 (= 3050 + 23.33 x 4).

The 2020 LTM prediction (3143) is 3% higher than the flow assumed in the TRANSYT modelling for the same year.

C11 Shaw Lane Flow Patterns

The map on page 52 of the appendix to APP103 shows am peak hour turning movements at the Shaw Lane junction (node 2153) for the 2016 Do Minimum scenario. The black font numbers on page 17 of APP-6-3 shows the same thing based on data observed in 2012.

The right turn into St Anne's Road from the A660 was measured as 11 cpus but is predicted to be 150 (a discrepancy which strongly indicates that the coding of the SATURN network failed to allow for the fact that this movement is constrained by traffic heading north up the A660).

The right turn from Shaw Lane onto the A660 was measured as 162 but is predicted to be zero (a discrepancy which indicates that the SATURN network has not been coded with a realistic representation of the capacities of local roads and/or turning movements).

C12 The Boarding Penalty applied to rail journeys

A boarding penalty (sometimes called the "stop penalty") is used in the LTM to reflect deficiencies in facilities at boarding points and more specifically the absence of facilities listed in the second half of Table 1 in appendix A of C-2-4. Paragraph 4.10 of C.2.8 indicates that, in the absence of information on facilities at each rail station, an "intermediate value" was applied at all rail stations.

According to information released in APP172, the value used for this penalty was 9.4 minutes. Note that this penalty is in addition to the vehicle penalty of 5.5 minutes and that the total penalty applied to rail journeys (14.9 minutes) is 13.6 minutes greater than that applied to the average journey by trolleybus.

Mr Hanson claims, in APP172, that the 9.4 minute penalty is reasonable because, paraphrasing:

- it has to allow for walking time within stations – i.e. time to get to the platform,
- it has to allow for time spent walking to stations which is not accounted for in the time value of the centroid connectors, and
- it is only 2.3 minutes greater than the demand weighted average boarding penalty applied to bus stops.

I will deal with each of these arguments in turn:

- Inspection of maps suggests that most of the journeys shifting from rail to NGT will probably have started out at Horsforth with fewer from Headingley and fewer still from Burley Park, and that almost all will return homeward from Leeds City Station. The time, measured on 3/09/14, required to walk to and from the platforms at each of the stations is given in the table below.
- There is no reason to suppose that the centroid connectors stopped short of the stations (Mr Hanson does not claim that they stopped short). In fact, since they are station-specific, one might have expected the centroid connectors to include part of the in-station walk.
- The size of the demand weighted average bus stop boarding penalty is irrelevant, the question is what penalty is justified by the facilities (not) provided at the stations. All four have good lighting, shelter with seating, and real time information provided via RTI displays and/or audio announcements. All except Headingley have CCTV. I therefore argue that, with reference to the

penalties in Table 1 of C-2-4, the only facility-related penalties that could be justified are at Headingley and Burley Park where the absence of RTI displays might warrant application of part of the at-stop portion of the "no real time information" penalty (say 2.05 of the 10.18 minutes) and at Headingley where absence of CCTV would warrant a penalty of 5.71 (the at-stop portion of the 11.42). On this assumption the penalties shown below could perhaps be justified.

Origin station	Horsforth	Headingley	Burley Park	Leeds
Share of journeys	35%	10%	5%	50%
Walk from highway/station entrance to platform (mins)	0.88	0.73	0.6	2.5
Penalty for lack of facilities (mins)	0	7.76	2.05	0
Walk from platform at destination station (mins)	2.5	2.5	2.5	0.82*
Total penalty (mins)	3.38	10.99	5.15	3.32
* weighted average for the three suburban stations (in each case returning to the same position on the public highway as was assumed as the starting point for outward journey)				

The values in the table suggest that an average penalty of 4.2 minutes [(35x3.38 + 10x10.99 + 5x5.15 +50x3.32)/100] could be justified at rail stations. This is substantially less than the 9.4 minutes which was applied. Use of an over-large penalty will have exaggerated the shift from rail to NGT.

C13 Calculation of average bus stop penalty

Table 10 of C-2-8 shows the distribution of bus stop penalties and so it is possible to estimate the average value of the capped Leeds package applied in the LTM by dividing the total penalty (penalty values x number of occurrences of that penalty) by the number of bus stops. The answer is 58781 (= 17.28x2836 [49006] + 14.94x501 [7484] + 10.52x211 [2219] + 9.96x6[59] + 1.1x3 [3] + 10.16x1 [10]) divided by 3562 (2836+501+211+4+6+3+1). 58781 divided by 3562 is 16.50. Thus the average bus stop penalty is 16.50 minutes.

The average penalty faced by someone wanting to use their nearest bus stop will be something between the 16.50 minutes quoted above and 7.1 minutes quoted as the demand-weighted average in APP103 (answer #1) (the demand weighted average reflects behaviour and thus will reflect the natural tendency to choose stops with lower penalties).

C14 Local Flow mismatches

The map on page 6 of the appendix to APP103 shows flows predicted by LTM for 0800-0900 in 2016 in the Do Minimum scenario. The flow on Moor Road (the road in the SE corner of the map running from node 6263) is predicted as 50 going SE and 300 going NW. This is clearly unrealistic, the flow recorded on Thursday 1st May 2014 was 299 going SE and 155 going NW, and counts on Tuesday 10th September 2013 - which is perhaps a better reference point since 1st May was between two bank holidays - suggested a SE-bound flow in excess of 350 (Appendix 3 of OBJ728 shows 291 going SE between 0800 and 0845 – equivalent to 388 in the full 0800 to 0900 period) and Mr Robertson, who lives on Moor Road, volunteered during his cross-examination that the morning peak flow is overwhelmingly in the SE direction.

The map also shows a predicted flow on Weetwood Lane (the road heading almost due south to meet Moor Road at node 6263). The LTM forecasts the Do Minimum southbound flow on Weetwood Lane in 2016 as 250 pcus (whereas the flows recorded on 10th September 2013 suggest that the figure is around 750 vehicles (Appendix 3 of OBJ728 shows 574 vehicles in a 45 minute period from 0800). It was noted during re-examination of Mr Hanson that, although the SATURN validation tests reported in Table 1 of C-1-3 showed that the Weetwood Lane site had failed to meet the DfT standard, the standard had been met at the required proportion of sites across the whole network. I am not suggesting that the assignment is insufficiently accurate at the strategic scale – rather that it is insufficiently accurate to indicate impacts at the local level.

The map on page 52 of the appendix to APP103 shows turning movements at Shaw Lane's junction with the A660 (node 2153) as predicted by LTM for the am peak in 2016 in the Do Minimum scenario. The right turn into St Anne's Rd is predicted to be 150 while that out of Shaw Lane is predicted to be Zero. These predictions are clearly wrong (the diagram on page 17 of APP-6-3 shows Do Minimum (and Do Nothing) flows, based on actual counts, as 11 and 162 for these two movements respectively).
The LTM has clearly failed to replicate local flows with any degree of accuracy and therefore cannot be relied on as a means of assessing the impact of NGT on the local road network.

C15 Predicted impact of NGT on mode use

The predicted impact of NGT on mode use is difficult to determine from the C-1 series documents because none of the tables clearly state the mode split (number or % of trips or of pass kms) by each mode in the Do Minimum and NGT scenarios. Also, the main source of information on NGT's impact on mode use, Table 12.4 in C-1, fails to distinguish between trips transferring to NGT from car and from active modes (the aggregation of the two numbers was described by Mr Hanson as a "convenience" despite the fact that the raw data will have identified the two numbers separately). Data released in APP103 and in NWLTF112 gives some insight but is difficult to interpret because some of the data items are provided for the Leeds area while others are provided for GB as a whole. The following text attempts to set out some facts which can be deduced from the data available.

According to data in Table 58 of C-1-8, the introduction of NGT is predicted to result in increased car kms (in the range 0.1% to 0.2% of the Do Minimum total in any given time period).

According to data released in APP103 (in the first table on its penultimate page), the impact of the introduction of NGT on person kms in the am peak in 2016 would be:

- An increase of 4,428 in person kms by car (measured across the whole of GB but presumably almost entirely within the Leeds area)
- An increase of 1,097 in person kms by public transport (comprising 11,749 new person kms by NGT offset by a reduction of 10,652 person kms by bus and train)
- A reduction of 664 in person kms by active modes.

This indicates that car use (measured as person kms) becomes a higher proportion of total mode use while the "sustainable modes" (walking, cycling and public transport) become a lower proportion.

According to data reproduced as the first table in NWLTF112 (originating from AECOM following a request by NWLTF), the introduction of NGT is predicted to cause:

- the daily total number of car trips to fall by 985 from 96,242,323 in the Do Minimum scenario to 96,241,338 in the NGT scenario
- the daily total number of trips by active modes to fall by 1,698 from 52,750,536 in the Do Minimum scenario to 52,748,838 in the NGT scenario.

The predicted reduction in the number of car trips thus makes up only just over 1/3 (985/[985+1698] = 36.7%) of the car+active total.

If a car trip is defined as one which involves use of a car (and thus includes P&R trips), and if the car/active ratio revealed in the first table of NWLTF112 can be used to disaggregate estimate the "*new PT trips from car/active modes*" identified in Table 12.4 of C-1, we can deduce that introduction of NGT is predicted to cause:

- a reduction in car trips of 55 (151x 0.367) in an average am peak hour, of 127 (346 x 0.367) in the average interpeak hour and of 195 (533 x 0.367) in the average pm peak hour
- a reduction in active mode trips of 96 (151x 0.663) in the average am peak hour, of 219 (346 x 0.663) in the average interpeak hour and of 353 (533 x 0.663) in the average pm peak hour.

Note that only about 4% of the predicted demand for NGT is contributed by reduction in car trips.

Note also that the reduction in car trips in the am peak hour appears, at 55, to be about 0.02% of the number of car trips during the am peak hour in the Leeds area (estimated to be about 270,000 based on the fact that Table 58 of C-1-8 shows the Do Minimum peak hour kms as 2,697,000 and that tables in APP103 show the fall in highway distance travelled to be about 10 times that in highway trip numbers – thus indicating an average trip length of 10 kms). This percentage reduction in car trips is about an eighth of the percentage increase in car kms identified in the first calculation above.

If trips by P&R do not qualify as "sustainable modes" (on the grounds that they include a trip by car) then NGT's overall impact on the number of trips by sustainable modes is an increase of 55 in the am peak hour, 127 in the average interpeak hour and 195 in the pm peak hour. The am peak hour figure of 55 is about 0.07% of the number of public transport trips in that period (according to Table 18 in C-1-8).

If each extra trip by P&R is deemed to count as half of one trip by a sustainable mode (on the grounds that half of the trip is by public transport), these figures become 308, 291 and 366 respectively- with the am peak hour increase being 0.39% of the number of public transport trips in that period.

C16 Estimation of money value of adverse landscape impact

Guidance provided by DfT in their December 2013 Advice Note on Value for Money Assessment https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/267296/vfm-advice-local-decision-makers.pdf includes advice on the monetisation of impacts on landscape. Table 1.1 of the Advice Note indicates that the monetised values should be included along with reliability and wider economic benefits as part of an adjusted BCR. Paragraphs 3.25 to 3.35 detail the procedure to be adopted

whenever the impacts are judged to be greater than "slight" and indicative monetised values per affected hectare are provided in Annex A.

The guidance is incomplete (for example on which values to use when impacts are "moderate" rather than "severe") and the "infinite period" values in Table A1 are not unambiguously defined. However, an indicative money value for the impact of NGT on landscape (assessed by the Promoters as "moderate adverse") can be derived fairly easily.

The Advice Note suggests that landscape impact may be assumed to affect a "footprint" stretching 500m on either side of the route (i.e. 100 hectares per linear km) but suggests that, for the purposes of calculation, the affected area should be assumed to be only 50 hectares per linear km to allow for reduced impact towards the edge of the footprint. Table A1 gives annual money values (at 2010 prices) per hectare for landscape in different types of area. The value for landscape in the urban core is £75,153/ha while that for landscape on the urban fringe (greenbelt) is £1,237/ha.

If it is accepted that the landscape impact is significant along the entire 14.5km route and that half of the rote is urban core and half is urban fringe, this suggests an annual value of £27.69m (7.25x50x £75,153 + 7.25x50x£1,237). Discounting this over 60 years (at 3.5% for the first 30 years and 3% for the next 30 years) gives a present value in the range £498m to £720m (depending on whether discounting begins in 2010 or in 2020).

If it is maintained that the "landscape" impact is restricted to Bodington, the new alignment in Headingley and Woodhouse Moor, the linear distance is about 1.44km of urban core and 0.34km of urban fringe and giving an annual value of £5.43m (1.44x50x£75,153 + 0.35x50x£1,237) which discounts over 60 years to give £98m to £141m.

I do not, of course, claim that these are the appropriate values to use in the NGT appraisal but offer them as a preliminary indication of what that value might be. A more accurate estimate would require more detailed calculation of the extent of the affected area, discussion with DfT as to the appropriate scalar for "moderate" impacts and of any uprating to recognise the heritage value of the affected area, and application of the same discounting convention as was used to estimate other whole-life costs and benefits of the scheme.

C17 Estimation of money value of reduced physical activity

According to data reproduced as the first table in NWLTF112 (originating from AECOM following a request by NWLTF), the introduction of NGT is predicted to cause the daily total number of trips by active modes to fall by 1,698 (from 52,750,536 in the Do Minimum scenario to 52,748,838 in the NGT scenario).

Table 1 in DfT's Advice Note on Value for Money Assessment for Local Transport Decision Makers https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/267296/vfm-advice-local-decision-makers.pdf indicates that changes in Physical activity should be monetised in the initial BCR.

Further advice on monetising changes in physical activity is provided in section 3 of TAG Unit A41 https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/275364/webtag-tag-unit-a4-1-social-impact-appraisal.pdf (Social Impact appraisal). It states that appraisals should include a monetised value for changes in physical activity if the impact is expected to be significant. Section 3.2 of the document describes the recommended procedure for calculation of the value (the method is based on calculating the expected impact of physical activity on mortality and the DfT recommended value of a fatality).

The figures provided in Section 3.2.15 give the 2010 value of 190 additional cycle trips as £61,269 (assuming each trip is 4km long and repeated 120 times a year). If we assume that a walking trip has the same value as a cycling trip and that the average length of a replaced active mode trips is 3km (the NGT fare structure is designed not to attract the very shortest trips), we can estimate the monetised cost of the reduction in active mode trips caused by NGT as £161,556 (£61,269 X668/190 x 3/4).Discounting over 60 years we get a value in the range £2.9m to £4.2m (depending on whether discounting begins in 2010 or in 2020).

D Discussion of claims made by Proposers' Witnesses during cross-examination

D1 That the modelling within "the area of detailed modelling" is fit for purpose

As noted in section 3.17 of APP-5-2, the LTM was originally developed in 2008 to assess a wide range of policy options. It was what is generally described as a strategic transport model (its traffic assignment submodel is still described as such in the final paragraph of the conclusions of C-1-3). The 2008 model was adapted to assess the NGT proposal but, in my opinion, that adaptation did not result in a model which was properly fit for that purpose. Having looked at it in some depth, I conclude that it is deficient in terms of its representation of the decision to choose park and ride (see B35 to B39 above), its assumption of unlimited capacity on NGT vehicles (see D2 below) and the lack of detail in its representation of the NGT corridor.

Section 2.2.5 of Webtag Unit 3.19 (E-3-25) refers to the need for an "area of detailed modelling" in order that the local impacts of a scheme can be appropriately represented. Local impacts are particularly important in the context of the NGT scheme because:

- The problem of local congestion and rat-running on local roads was one of the issues which justified consideration of intervention in the A660 corridor. The impact of NGT on traffic flows on the local roads is therefore of great relevance.
- The impact of NGT on bus services running along the A660, crossing it or running parallel to it, is an important issue and it is therefore important that the forecast impacts are sufficiently detailed.
- The accommodation of NGT requires the banning of some highway movements and the signalisation of several priority intersections. There is clearly the possibility that this would have an adverse impact on some local traffic movements, particularly those which need to cross the A660. This issue cannot be explored appropriately unless the modelling is at a sufficient level of detail.
- The cost of the NGT scheme depends to some degree on the specification of the NGT stops. This specification varies according to the amount of use predicted for each stop. A reliable estimate of the usage of individual NGT stops is therefore required.
- The A660 is characterised by an unusually high existing level of use of active modes (walking and cycling) and further increase in use of these modes is an identified objective of the NGT scheme. Prediction of active mode use requires a high level of modelling detail.

Against this background it is particularly important to follow Webtag guidance on the extent and degree of detailed modelling. However, although Figure 1 of C-2-7 identifies an "area of detailed modelling" which is appropriate in extent, the modelling conducted within that area was not sufficiently detailed to provide the required forecasts of local impacts. There are particular issues in respect of the definition of zones, the level of detail at which the local network is represented, the representation of active modes and the requirement for validation of predictions:

a. Respecting zones, Section 4.3 of Webtag Unit 3-11-1 (E-3-15) indicates that, within the area of detailed modelling, zones should be defined such that "*they avoid grouping together areas which are served by different public transport services*", that they "*should be focused on stops or stations",* and that *"generally there should be one zone of this kind for each stop or station*". Section 5.4.4 of Webtag Unit 3-11.2 (doc E-3-16) goes on to say that "*zone centroids should be connected to stops or stations*

in a way that realistically represents how people access the available public transport services". However:

- Mr Robertson volunteered under cross examination that the zone sizes around West Park and around Shaw Lane were too large to allow him to determine whether apparent discrepancies between his detailed modelling of junctions and the LTM flow forecasts (as detailed in C10 above) were serious or not.
- My investigation of the zones and zone centroids in the Headingley area, stimulated by unexpected prediction that the NGT stop at Headingley Hill would be more heavily used than that at the Arndale Centre, revealed that Webtag guidelines had not been followed in respect of zone sizes or centroid connectors (several of the zones shown in the map on NWLTF108 are served by more than one set of public transport services – one on the A660 and one not, and the centroid connectors tend to route demand onto the A660 services rather than those on parallel routes – e.g. to use bus #1 or #6 rather than bus #56 or #19). It is clear that the positioning of the centroid connectors will have distorted the true pattern of use of different stops and services and appears likely to have resulted in an inflated prediction of NGT use).

b. Respecting network detail, Section 2.2.3 of Webtag Unit 3.11.2 (E-3-16), discussing modelling of public transport schemes, states that "*the road traffic assignment model should be sufficiently detailed to model both the road capacity changes required by the public transport scheme and the effects of those changes on road traffic congestion. If the road traffic assignment model is not sufficiently detailed to enable the effects of the scheme to be modelled, it would not be regarded as 'fit for purpose'.* Section 2.2.5 of Webtag Unit 3-19 (E-3-25) refers to "*very detailed networks and junction modelling (including flow metering and blocking back)*". However:
   - A number of locally-important links were omitted altogether (e.g. Glen Road and the southern tip of Weetwood Lane).
   - Although the 2016 Do Minimum forecast flows on important rat-runs were clearly wrong, no attempt was made to ensure that the flows were accurately represented. When I drew Mr Hanson's attention, during cross-examination, to the significant mismatch with observed flows on Weetwood Lane and Moor Road (now summarised in C14 above), he indicated that accurate representation of local flows was beyond the scope of LTM.
   - Although the 2016 Do Minimum forecast turning movements at the intersection of A660 with Shaw Lane (a critical intersection in terms of the A660) were clearly wrong, no attempt was made to correct it. I drew Mr Hanson's attention, during cross-examination, to the infeasibly high am peak right turn into St Anne's Road (now summarised in C11 above) and suggested that this turn's conflict with the northbound traffic on the A660 had not been correctly coded in the SATURN model. He did not disagree.
   - Although detailed modelling of individual junctions in the NGT corridor was conducted using TRANSYT software, the value of this work was undermined by deficiencies in the interaction between the TRANSYT modelling and the SATURN modelling within the LTM (see B10 above)

c. Respecting the choice between active modes and motorised modes, LTM's representation of this choice is hampered by the fact that, as stated in the final paragraph of section 4.2.1.1 of C-1-3, it does not have any validated network. Its representation of the changes in generalised costs of using active modes is synthetic and so cannot be relied on predict use of such modes. (It is not possible to say

whether, in the absence of a detailed network showing the changes in conditions to be experienced by pedestrians and cyclists, it will have under-predicted or over-predicted use of active modes. On the one hand it will not have recognised any impact of the introduction of new pedestrian crossings or greater segregation of cycles from general traffic. On the other hand it will not have reflected the impact of reduced pedestrian priority at existing signalised crossings or any impact that pavement narrowing and removal of cycle-only lanes might have had on perceived of safety and thus on desire to walk/cycle).

d. Respecting the validation of predictions, paragraph 8.3.17 of E-3-25 states that, even though accurate replication of all observed conditions may be unachievable when using a strategic model, it should be achievable *within the area of detailed modelling.* As is demonstrated above, the LTM was not able to reproduce observed traffic flows on many of the local links in the A660 Corridor.

D2 <u>That it is acceptable to assume, in the modelling, that the capacity of trolleybus vehicles is effectively infinite</u>

The decision to ignore the potential impact of crowding on trolleybuses (and effectively to assume that trolleybuses would have infinite capacity) is inconsistent with advice in Webtag Unit 3.11.2 (E-3.16):

- Paragraph 5.6.4, discussing crowding, indicates that "*In principle, if crowding is, or is expected to be, so severe that demand for the mode concerned is, or would be, constrained, some means of representing the costs of the crowding for use in the demand model would be required".*
- Paragraph 6.4.1, discussing the impact of crowding on values of in-vehicle time, indicates that a factor of 1.5 might be applied to represent the scale of impact and notes that such a factor "*represents the additional discomfort and inconvenience to passengers – all passengers and not just boarders. It makes the crowded service less attractive to travellers, and will reduce the general attractiveness of PT in a mode choice model*".
- Paragraph 6.4.4, acknowledging the practical difficulties involved in including a representation of crowding, accepts that it is not necessary to model crowding except "*where it is likely to have a significant effect on traveller behaviour or where an effect on crowding is one of the objectives of the scheme*" (both of which are true for NGT).

LTM's ability to represent crowding on public transport was an attractive feature of the original model - particularly because lack of public transport capacity was one of the original reasons given for intervention in the A660 corridor. LTM is capable of representing crowding on public transport, and indeed does so for rail, but a decision was taken to dispense with any representation of crowding on buses or trolleybuses. The decision to ignore crowding on <u>buses</u> may be justified by the fact that, were crowding to become an issue, bus operators could alleviate the problem by running extra buses at the busiest times. The Promoters argue that it is acceptable to ignore the possibility of crowding on <u>trolleybuses</u> on the grounds that additional trolley vehicles could be provided at the busiest periods. However:

- if frequencies were increased to more than 10 per hour, signal priority constraints would lead to increased run times and thus invalidate a key assumption underlying the demand forecast.

- the possibility of running additional services is anyway constrained by the available fleet (it would be very expensive to lease additional vehicles which would remain unused for much of the time).

The Promoters further assert that, since no decision has yet been taken on the internal configuration of the trolley vehicles, it will be possible to specify a configuration which gives adequate capacity (APP108 indicates a range of potential configurations) and that the assumption that users would perceive there to be plenty of seats available is therefore realistic. However:

- APP108 acknowledges that none of the potential configurations could offer "plenty of seating space" to all passengers at all times.
- Calculations reported in C7 above demonstrate that none of the potential configurations could cope with the predicted demand at the busiest times. If the predicted demand were to materialise it is inevitable that some would-be passengers would be unable to board the first trolley vehicle to arrive and would be faced with a wait of a further 6 minutes or so for the next one (thereby invalidating the waiting time assumption used in the model).
- Further calculations in C7 above show that, since the Promoters would have to choose the maximum (NGT3) capacity vehicle if they are to get anywhere close to accommodating the predicted demand at the busiest times of day, there would be no spare seats available for passengers boarding at stops along much of the route at most times of day.

The Promoters further assert that, even if the trolleybuses were unable to guarantee "plenty of seats available" for all passengers at all times, sensitivity analyses had demonstrated that the impact on demand would be minimal (this is a reference to a test reported in Paragraph 2.11 of REB2-1719 under which the penalties were revised to reflect an assumption that passengers would perceive there to be "no seats available but plenty of room to stand"). However, this test was inadequate in various respects:

- Firstly, it did not reflect the fact that, at the busiest times, some passengers would be unable to board the first trolleybus to arrive and would therefore be faced with an additional 6 minutes of waiting time (and, having experienced this once or twice, might decide not to use NGT at the busiest times of day)
- Secondly, it did not reflect the fact that, at some times of day, even those passengers who managed to board the first trolley vehicle would be faced with limited space to stand.
- Thirdly, the value used in the LTM to reflect people's aversion to standing was almost certainly a gross underestimate of the true level. C8 above shows that the value for aversion to standing derived from the Leeds Stated Preference survey is well below that found in other research and recommended by DfT and offers a suggestion as to why the Leeds values are so out of line.

Under cross-examination, Mr Chadwick claimed that it was acceptable to ignore the issue of limited seating availability because any passengers who were particularly averse to standing could choose to travel at less busy times. However this claim ignores some important facts:

- The analysis suggests that lack of seating on trolleybuses is likely to be a problem at all times of day and so people who are averse to standing would not be able to retime their trips to use less busy trolleybuses – they would have to use an alternative mode.

- The LTM model has no means of representing time-switching in order to make use of less busy trolleybuses (and hence, if such behaviour is expected to occur, one must conclude that the LTM predictions are inaccurate).
- By admitting that behaviour of this kind might occur in response to crowding on the trolleybuses, Mr Chadwick is perhaps inadvertently drawing attention to one of the circumstances identified by Webtag as indicative of the need to model the occurrence of crowding.

The LTM model assumes that the choice between NGT and other modes of public transport is made in the expectation that the trolley vehicles will have plenty of seating space available at all times, that all would-be users of the trolley vehicles will be able to board the first vehicle to arrive and that there is no question of having to travel at a different time of day in order to get a seat. If any of these assumptions does not hold then the predicted demand for NGT will be wrong; it will be an exaggeration.

D3 That the presentation of the Business Case is fair and balanced

Under cross examination, Mr Chadwick claimed that, in line Treasury Green Book guidance stressing the need for transparency in the presentation of appraisal results (see for example para 2.130 of The Green Book), he believed that his presentation of results in the Revised Business Case (C-1) was fair and balanced. I do not believe that he was able to substantiate that claim in respect of several points which were put to him. For example:

a. Table 6.1 of C-1 refers to strategic fit with National Policy Objectives and contains a number of misleading claims:
    i. Respecting the White Paper's preference for low carbon modes and its aspiration to reduce carbon emissions, the commentary is misleading in not making it clear that the LTM predicts that, compared to the Do Minimum scenario, NGT would result in increased GHG emissions (admitted in the AST) and reduced use of active modes (see C15 above)
    ii. The claim that *NGT delivers mode shift from private car* is somewhat misleading given that the LTM predicts that the NGT scenario would actually result in an increase in total car kms and only a very small reduction in the number of trips by car (see C15 above)
    iii. The claim that NGT improves public transport accessibility is presumably based on its reduced in-vehicle journey times, but the claim ignores the fact that many people would experience longer door-to-door journey times (see C2 and C3 above) and reduced journey quality (see giv below).
    iv. Respecting fit with Door-to-Door (A Strategy for Improving Sustainable Transport Integration), it should be recalled that, as stated in Paragraph 6.7 of C-1, the strategy "*looks to address the entirety of door-to-door journeys to help reduce the complexities of travel, encourage the use of public transport and healthier modes and to reduce carbon".* The text in Table 6.1 refers to provision of RTI, improved connectivity, multimodal ticketing and improved interchange with national rail but makes no reference to the respects in which NGT would reduce integration and increase the complexity of travel (see for example B113 and B114 above), to the fact that NGT journeys would, on average, entail longer walks and longer waits, or to the fact that it is predicted to lead to increased emission of GHGs.

b. Table 7.1 in C-1 reports on strategic fit with local policy objectives and includes two references to reduced emissions. In each case claiming that the preferred alternative (NGT) would produce the "lowest net emissions" but failing to make it clear that the emissions in the NGT scenario would be higher than those in the Do Minimum scenario.

c. Table 7.2 in C-1 reports on the achievement of scheme objectives. It refers, inter alia, to objectives respecting the efficiency of the city's public transport and road networks, emissions of CO_2 and other GHGs, promotion of the quality of life through a safe and healthy built and natural environment, and enhancing the quality of life by improving access to all jobs and services.

   i. Respecting network efficiency, Mr Chadwick claimed in his rebuttal of my Proof that efficiency had been measured according to the definition provided in Table 3.8 of C-1, namely; *"the conventional DfT Value for Money case measured as the quantity of user benefits (journey time, quality, but also reliability, option value etc.) and non-user benefits (impact on congestion)".* However, the text in Table 7.2 reports that *"The Preferred Option is forecast to deliver £701m of public transport passenger journey time benefits and generate a revenue surplus of £457m in present values. Approximately 25% of its demand is new to public transport. Public transport punctuality will also improve, generating £84m of additional passenger benefits".* This is misleading because:

      - Even though congestion was specifically identified as a relevant issue in the definition of efficiency provided in Table 3.8, the commentary in Table 7.2 ignores the fact that introduction of NGT is predicted to result in <u>increased congestion</u> (evidenced in the AST which refers to a net £224m disbenefit to Business drivers, "travel time disbenefits to general traffic" affecting commuters, and "additional congestion" that would affect fuel consumption).
      - Even though journey time was specifically identified as a relevant issue in the definition of efficiency provided in Table 3.8, the commentary in Table 7.2 ignores the fact that, summing over all modes, the introduction of NGT would lead to <u>an increase in average trip duration</u> (see C9 above).
      - A substantial part of the £701m described as "public transport passenger journey time benefits" is actually due to the disputed quality factor.
      - The reference to "*revenue surplus*" is entirely gratuitous – it was not in the definition of "efficiency" given in Table 3.8 and indeed has nothing to do with efficiency.

   ii. Respecting emissions of CO_2 and other GHG, the table erroneously claims a carbon reduction benefit of £6.2m over the appraisal period (the correct figure, according to appendix B1 in APP-7-3, is a disbenefit of £3.1m).

   iii. Respecting enhancement in the quality of life through a safe and healthy built and natural environment, the text says that "*electrically powered trolleybuses, will be clean and quiet, however the segregated sections of alignment will introduce a source of noise where currently there is none. Rationalisation of the existing bus network and mode shift will result in a decrease in roadside noise and air quality emissions. There will be improvements to facilities for pedestrians and cyclists*" This description is unbalanced in that it ignores the adverse impact on landscape and townscape (which must surely feature in any

assessment of quality of life), the predicted increase in road casualties (admitted in the AST) and the reduction in use of active modes (see C15).

iv. Respecting enhancement of the quality of life by improving access to all jobs and services, the table lists places which are on or near the NGT route but makes no mention of the fact that, compared to the Do Minimum scenario:

- journeys by road would be slower (which can be deduced from results in Table 7 of C-1-9)
- journey times by bus would increase (see C2 above), and
- journeys by NGT would require longer walks, longer waits, greater likelihood of having to stand and, for some journeys, would take longer than the equivalent journey in the Do Minimum scenario (see C3 above).

d. Table 7.3 in C-1 refers to targets in the WYLTP and seeks to show how NGT would contribute to achieving these targets. However, several of the claims are misleading:

i. Respecting the target to increase the use of sustainable modes, the commentary leaves the reader with the impression that NGT would make a positive contribution towards meeting this target. However, as discussed in C15 above, introduction of NGT is predicted to result in a reduction in the use of sustainable modes (measured in person kms) and to result in a reduction in the number of the most "sustainable" trips (those by active modes).

ii. Respecting the target to reduce CO_2 emissions, the commentary gives the impression that NGT would make a positive contribution towards achievement of this target. However, as noted in para 3.96 of APP-7-2, the increased vehicle mileage brought about by introduction of NGT means that the net effect of introducing NGT would be an <u>increase</u> in GHG emissions.

iii. Respecting the target to reduce KSI road casualties, the commentary claims, without any evidence, that pedestrian and cyclist casualties will fall but fails to mention that, using the accepted calculation methodology, NGT is predicted to result in an <u>increase</u> in road casualties.

e. Paragraphs 13.15 to 13.29 of C-1 claim to summarise the impacts of NGT but contain several misleading statements:

i. Paragraph 13.16 includes the statement that "*Passengers switching to NGT will benefit from a …. more frequent …. service ….than existing bus services".* This is simply wrong; the existing frequency at bus stops averages 20 vehicles per hour while the frequency at NGT stops would be about 10 vehicles per hour (11 during peak periods).

ii. Paragraph 3.18 states that the effects of bus service rationalisation have been allowed for in the appraisal. This is misleading because, even if the effect on average wait time has been allowed for, the reduced availability of seats in the overall public transport fleet has not been represented.

f. Table 17.4, the Analysis of Monetised Costs and Benefits, states that journey ambience benefits are '*not valued*'. This is a very misleading statement because, in fact, they have been quantified and indeed, as shown in C1 above, they contribute a very substantial part of the £293,728k and £325,875k benefits which are included under the heading "economic efficiency" further down the table. They also contribute a substantial proportion of the benefits which are described elsewhere

in C-1 (e.g. in Tables 7.2 and Table 17.12) as "journey time benefits". DfT's wish to see journey quality impacts separately identified may be deduced from:

- The reference in paragraph 6.2.13 of Webtag unit A.4.1 ("Social Impact Appraisal" – excerpt included in NWLTF113) to the procedures that might be necessary if the impact of journey quality factors is not otherwise identifiable. And from
- The fact (apparent from the final paragraph of the answer to question 5 in APP103) that DfT had sought an estimate the contribution made by the quality factors to the estimated benefit as reported in the 2012 Business Case.

g. Table 17.12, the Appraisal Summary Table, contains a number of rather misleading or contentious statements:

i. Respecting impacts on business users and transport providers, the text refers to benefits being "offset" by disbenefits. This is an understatement; "outweighed" would have been a more accurate description.

ii. Respecting impacts on commuting and other users, the text refers to material benefits including reduced journey times but fails to mention that, compared to the Do Minimum scenario, door-to-door journey times would be longer for many bus users and even for some NGT users (see C2 and C3 above). A net benefit of £620m is quoted in the table but, again, it is not made clear that a substantial proportion of this "material benefit" is attributable simply to the assumed quality benefit (see f above).

iii. Respecting physical activity, the text claims a slight beneficial impact (inexplicably inflated to "a strong beneficial impact" in paragraph 3.131 of Mr Chadwick's Proof, APP-7-2) despite the fact that the LTM predicts that NGT would actually result in <u>reduced</u> use of active modes. C17 above indicates that a cost of up to £4.2m should have been included in the "monetary" column for this item.

iv. Respecting journey quality, the text claims a strong beneficial impact and refers to the use of modern high quality vehicles (and, rather oddly, to improved views!), but makes no reference to the increased waiting times (due to reduced frequency at any given stop), the reduced likelihood of getting a seat, or the need to walk further to get to an NGT stop. The text interestingly claims that NGT would bring about reduced stress levels but makes no reference to the frustration likely to be experienced if, having committed oneself to the NGT stop, the first vehicle to arrive is a bus (or vice versa). The text also makes no reference to the various respects in which a journey by bus would be less attractive than in the Do Minimum scenario (see, for example, 7.1c of my Proof).

v. Respecting access to services, the text claims a strong beneficial impact due to faster public transport, links to key facilities and the provision of improved cross-city links. This claim ignores the increased congestion (which can be deduced from results in Table 7 of C-1-9), slower door-to-door journeys by bus (demonstrated in C2 above) and, for some people, NGT journeys which take longer than the DM bus (demonstrated in C3 above). Furthermore, not only would many journeys take longer but they would also be more difficult for people who find it difficult to walk far or to have to stand for long periods (journeys by NGT would, on average, require longer walks because of greater distance between stops and would provide seats for a lower proportion of passengers). This would be a particular issue for elderly and infirm passengers – whose needs are given particular

prominence in Webtag's discussion of accessibility issues – see page 8 of TAG Unit A4.2 (reproduced as page 6 of NWLTF113).

vi. The table entries for landscape, townscape and heritage indicate that quantitative valuation of the adverse impacts are "N/A" although, as noted in B53 above, DfT have, since December 2013, included advice on how to estimate values for landscape loss (see C16 above for indicative calculation).

D4 <u>That DfT's grant of Programme Entry status implies that they are satisfied that the modelling tools and input assumptions are appropriate.</u>

I do not think it is a credible argument and give the following reasons.

a. Firstly, condition i of the PEA letter (C-6-15) makes clear that approval at PE stage was entirely without prejudice to the view that might be taken at any future stage.
b. Secondly, approval at the PE stage was given in the knowledge that, as is set out towards the bottom of the third page of the PEA letter, an updated 5-case business case would be required before full funding could be approved.
c. Thirdly, and much more importantly, it appears that, at the time they granted PEA, DfT were unaware of a number of key issues. Namely:
    i. That the vehicle quality penalty had been applied to journeys by rail as well as to journeys by bus. (The text in para 1.2 of C-2-4 justifying the use of the vehicle quality penalty refers only to a quality differential relative to bus services and there is no evidence that DfT's attention was drawn to the fact that the penalty had also been applied to rail journeys. Quite extraordinarily, even Mr Hanson, a key member of the Promoters' modelling team, appeared unaware of the fact).
    ii. That a boarding penalty of 9.4 had been applied to all rail journeys despite the fact that the facilities at the average boarding point does not warrant a penalty approaching that value (the value of this penalty was unknown to Mr Chadwick and only became known in September 2014 following my specific query).
    iii. That the Stated Preference work had revealed that Leeds bus users' preference for trolleybuses over conventional buses was statistically indistinguishable from zero and actually negative. (This fact was first revealed in APP155. It was not in any of the core documents, not even in C-2-4 which is described as being a combination of the various papers which had been provided to DfT during discussions about the various quality factors).
    iv. That the penalty value (5.55 minutes per journey) had been derived on the assumption that all passengers would be able to get a seat whereas, in actual fact, many would be unable to do so – see C7 above).
    v. That the comparison (provided in the paragraph immediately below Figure 2 on page 8 of Appendix A of C-2-4) of the proposed penalty of 5.55 minutes with the combined value of a package based on research conducted for DfT by AECOM had ignored the fact that the AECOM values had not been deflated to allow for the need to stand. (Nor was DfT's attention drawn to the fact that only one component of the AECOM package - audio announcements - is not already a feature of most buses operating on the A660).

vi. That the comparison provided in the second paragraph below Figure 2 on page 8 of Appendix A of C-2-4 was misleading. The comparison sought to show that the capping procedure described at the top of page 5 of C-2-4 results in a penalty package whose value is in line with that obtained simply by summing values from the AECOM survey. However, the comparison was flawed because it did not allow for the fact that the Leeds package had been demand-weighted while the AECOM package had not. A fairer comparison (see C6 above) indicates that the value used in the NGT work is approximately double that suggested by the AECOM work.

vii. That, despite the intention noted in paragraph 2.10 of C-4-24, no steps were taken to scale down the penalties to allow for the known tendency, referred to in paragraph 2.8 of the same document, of Stated Preference surveys to produce exaggerated estimates of willingness to pay for innovations. (Failure to do this will have had a particularly strong effect in the model of the choice between NGT and other modes of public transport – over-estimating the former and under-estimating the latter).

d. Fourthly, recognising that DfT will have been aware that, if they gave approval at the PE stage, they would have another opportunity to scrutinise the case more carefully, there is evidence to suggest that DfT had a number of concerns about the analysis as presented and circumstantial evidence to suggest that they were under pressure to make a quick decision on the PEA (see Appendix H1 to the NWLTF Statement of Case which is a note to HM Treasury dated 15/5/12 – for references to the perceived need for a quick decision). Evidence of their concern about aspects of the analysis in the PE Business Case includes:

i. Their downrating of the BCR from 3.76 to 2.70

ii. Their insistence that the allowance for optimism bias be increased from 29% to 36.3%.

iii. Their insistence that predicted increase in jobs be excluded from the BCR. (This insistence is not specific to the NGT project, it reflects their general scepticism about the accuracy of any predicted impact on employment. But it is interesting to note that, notwithstanding the fact that the UDM had been used in other work funded by DfT, DfT staff made a point of including a statement on the slide presented to the Permanent Secretary on 22/06/12 [see Appendix H2 of the NWLTF Statement of case - OBJ/1719] to the effect that they had not yet seen the workings or assumptions used in this application of the UDM – and note that this was less than a month before they issued their decision letter).

iv. Their belief that the outbound NGT run times were over-optimistic (see for example para 3.109 of APP-7-2).

v. Their concern about a number of issues, including the less than ideal validation of the SATURN assignments, are evident in the slides presented to the Permanent Secretary at a meeting on 22/06/12 (See appendix H2 of the NWLTF Statement of Case – OBJ1719).

e. Finally, it was suggested by Mr Hanson that, since the MSBC approval letter (C-6-8) had specified that any further work should be conducted using "Metro's new transport model", this could be taken as an endorsement of the LTM. This is not a reasonable deduction because the development of LTM was at that stage (March 2010) incomplete and its specification included a number of features (notably a representation of crowding on all PT services and a mechanism to ensure that changes in congestion would be reflected in public transport run times) which have since been abandoned.

D5 <u>That alternatives to the proposed scheme have been examined to the extent necessary</u>

Mr Chadwick did not seek to argue that the analysis of low cost alternatives in the 2014 Business Case could be regarded as demonstrating that the NGT scheme was superior to any lower cost alternative (he repeatedly stated that the LCA did not represent the best that could be achieved with a lower budget). However, he did suggest that the question of alternatives to the proposed NGT scheme had already been explored to the extent necessary because the strategic case for NGT, set out in the MSBC, had clearly been accepted by DfT. This suggestion is incorrect in a number of respects:

a. The Secretary of State's request to be informed on the main alternatives considered by the Proposers (Matter 3) would not have been necessary if he was prepared to accept MSBC and/or PEBC approval as sufficient evidence that alternatives had been properly considered. The funding approval procedures detailed in Appendix 1 to APP135 indicate, at 5.2.8 on page 23 of 77, that the Programme Entry Approval (PEA) was subject to granting of Statutory Powers. This, together with the fact that, as noted in C-6-15, PEA was granted *without prejudice to any view that the Secretary of State, or other Minister, may take on any subsequent application for statutory powers,* indicates that the TWAO decision is not to be constrained by any view taken at PEA stage.

b. Webtag advice on the generation and testing of alternatives has not been followed. The advice, set out in Webtag's Overview of the Transport Appraisal Process (January 2014), consistent with the principles set out in HMT Green Book, clearly states that proposals should be developed following a review of problems and a systematic consideration of alternatives.

i. At paragraph 1.1.5, it states that "*In summary, the following key principles should be followed through the appraisal process:*

- *There must be a clear rationale for any proposal and it must be based on a clear presentation of problems and challenges that establish the 'need' for a project.*
- *There must be consideration of genuine, discrete options, and not an assessment of a previously selected option against some clearly inferior alternatives. A range of solutions should be considered across networks and modes.*
- *There should be an auditable and documented process which identifies the best performing options to be taken forward for further appraisal.*
- *There should be an appropriate level of public and stakeholder participation and engagement at suitable points in the process. In most cases this should inform the evidence-base which establishes the 'need' for an intervention, guide the option generation, sifting and assessment steps, as well as informing further appraisal in Stage 2."*

ii. At 2.8, discussing option generation, it says:

"2.8.1 The purpose of option generation is to develop a range of alternative measures or interventions that look likely to achieve the objectives identified in Step 4a. <u>Analysts should start with a wide range of possible measures, and then narrow these down (in Steps 6 and 7) in a robust, transparent and auditable manner.</u>

2.8.2 <u>It is important that as wide a range of options as possible should be considered,</u> including all modes, infrastructure, regulation, pricing and other ways of influencing behaviour. Options should include measures that reduce or influence the need to travel, as well as those that involve capital spend. Revenue options are likely to be of particular relevance in bringing about behavioural change and meeting the Government's climate change goal.

2.8.3 "Studies should not start from an assertion about a preferred modal solution, or indeed that infrastructure provision is the only answer. Following the Eddington Transport Study[2], Sponsoring Organisations will be looking to encourage the better use of existing infrastructure and avoiding "solutions in search of problems". In this context, it is recognised that small schemes can represent high value for money.

2.8.4 For public transport schemes, options should include different technologies and lower cost alternatives. For example, where light rail schemes are being considered, alternative bus based options should also be identified."

c. Notwithstanding Webtag advice, the Promoters' choice of trolleybus seems to have been precipitate and their consideration of alternatives rather cursory. The particular, post Eddington, stricture to avoid *"solutions in search of problems"* and to recognise the high value for money achievable by small schemes making best use of existing infrastructure seems to have been ignored. The main driver throughout appears to have been to obtain DfT funding for the closest approximation to the Supertram scheme.

i. The Initial Business Case of March 2007 (C-5-1) indicates, at 2.1.1, that "*the BRT scheme originates from the cancellation of the Leeds Supertram in November 2005*" and, at para 2.1.3, states that "*conventional bus priority scheme has been discounted since it does not fit with the objectives of the Promoters nor the challenge set by the former Secretary of State to deliver a "top of the range bus system for Leeds*". At 2.2.1 it goes on to say that "*The starting point for the option sifting process was the Review of the Bus Rapid Transit scheme as reported in November 2004 Appraisal Document and in Atkins' September 2005 report".*

ii. Subsequent paragraphs of C-5-1 indicate that the consideration of options was focussed on the question of which corridors were most suitable for BRT. Alternatives to trolleybus were rejected following a desk study and, as is made clear in para 2.5.1, the appraisal of alternative corridor options assumed use of "bus-tram" (the phrase "bus-tram" was used in the IBC to denote trolleybus).

iii. Justifying the need for investment in bus-tram, para 2.5.3 of the Initial Business Case (C-5-1) states that "*There is now an expectation in Leeds that a high quality alternative be developed in place of the Supertram scheme. As such the BRT system must ultimately present a significantly more attractive offer than a standard diesel bus in order to satisfy public, political and commercial expectations*." This theme is repeated in Table 4.2.1 where it is stated that use of a Do Minimum enhanced bus (as per the Yorkshire Bus Initiative) would be perceived by the public and stakeholders as a "*low quality option*" providing no perception of a "*significant step change in quality*". This reference to expectations and perceptions is interesting - particularly in the light of the fact that, as stated in paragraph 2.2.4, *"There has been no public consultation to date because of the need, for the promoter's credibility, to have funding identified… before the public involvement process can start*". The expectation and perception seems to have been on the part of the Promoters and other stakeholders. Further evidence on this comes from the July 2007 Gateway Review (C-4-7), which refers to the fact that "*although this is a new project, it has its roots in earlier Rapid Transit proposals going back to the early 1990s and that the scheme has been developed following the cancellation of Supertram and direction from DfT to develop a "top of the range bus system". It is clear, however, that the legacy of Supertram is still very influential, particularly in terms of stakeholder relationships, and therefore those legacy effects need to be carefully manage*d". The

reviewers, perhaps cognisant of the lack of public consultation to date, went on to identify a "*requirement to draw up comprehensive consultation and communications proposals"*.

iv. Although the Initial Business Case (C-5-1) includes a fairly comprehensive assessment of problems and issues in the corridors proposed for BRT, it does not contain any analysis which justifies the adoption of BRT as the only possible solution to those problems. Indeed, although challenged to do so during cross examination, neither Mr Haskins, Mr Henkel nor Mr Chadwick were able to point to any evidence of there having been any serious, model based, analysis of alternative ways to meet the objectives of the NGT scheme nor, more particularly, to address the transport problems affecting the A660 corridor. The January 2006 review (G-4-5) identified two classes of problem in this corridor; firstly for short distance trips within the corridor (which suffered from periodic congestion and unreliable bus services and for which it was suggested that increased bus priority and measures to reduce rat-running on local roads should be considered) and secondly longer distance commuters (for which a park and ride served by express shuttles was advocated). Eight years later, these solutions have still not been seriously investigated (Mr Haskins agreed, under cross-examination, that action on these matters had probably been shelved pending introduction of NGT).

v. The DfT's July 2007 response to the IBC (C-6-2) made it clear that, although they were broadly content with the work so far, any further work should include "*a comprehensive range of options and treatments exemplified for the three corridor network*" and that although they did not object to tram-bus being one of the options, they did not want the technology to be prejudged and that they wanted to see consideration of different degrees of bus priority.

vi. The Promoters' preference for trolleybus was not apparently shaken by this (although the minutes of the NGT project Board of 22/10/07 refer, at item 3.5, to "difficulties" experienced in convincing DfT that trolleybus is a viable option) nor by the comments in the July 2007 Gateway Review (C-4-7) which indicated that the reviewers had major concerns about the Promoters' early preference for trolleybus ("*The Review Team have major concerns that the sponsors' preferred technology option for the BRT, the Trolley Bus, may not yet be based on sufficiently robust evidence and that, as a consequence, there is a risk that this preferred technological choice, rather than a thorough and unbiased option appraisal, may drive the preparation of the OBC. The consequent risk of rejection and/or delay from the DfT would clearly impact negatively on the reputation of the joint sponsors and their subsequent ability to achieve the project's objectives*").

vii. Despite DfT's call for a consideration of a wider range of options, the 2009 Major Scheme Business Case (C-4) restated, at para 1.14, that *"The promoters are committed to delivering a top of the range bus-based system for Leeds and believe that NGT represents the necessary step change in the quality of public transport provision".* The reported consideration of modal alternatives was simply a desk study of alternative technologies (Light rail, Ultra light rail, Light rail on tyres, Trolleybus, High specification buses, Monorail and Personal Rapid Transit) followed by definition of a Next Best Alternative (articulated diesel-electric hybrid bus) and a Low Cost Alternative (articulated diesel bus) which are assessed no more convincingly than are their descendants in C-1. C-4 addresses the question of alternative corridors by referring to work detailed in "Investing in Public Transport: A Framework for Leeds" (C-4-2) having "*confirmed which routes*

should be prioritised for NGT". Para 4.10 indicates that three corridors "*were identified as having the greatest initial potential for NGT*" (although, interestingly, C-4-2's conclusion relates not to NGT – and still less to trolleybuses – but to "rapid transit" which is illustrated by a picture of an FTR-like vehicle with no OHLE). Nowhere in C-4-2 is there any reference to detailed analysis of alternative solutions to problems found in any of the corridors. It appears that, as in 2007, the emphasis was on deciding which corridors were appropriate for NGT rather than on considering what solution was appropriate in each corridor. This approach is clearly at odds with Webtag guidance.

viii. DfT's response to the 2009 MSBC, dated March 2010 (C-6-8) indicated Programme Entry Approval (PEA) for the Southern and Northern Routes (i.e. excluding the Eastern Route and the City Centre box). It made no reference, positive or negative, to the consideration of alternative solutions but did note that the PEA "*was entirely without prejudice to any view that the Secretary of State, or other Minister, may take on any subsequent application for statutory powers or in accordance with any other functions*".

ix. Discussing the "*need for the scheme*", the second bullet of Paragraph 3.41 of Mr Haskins' Proof (APP-2-2) concludes that *'the A660 Otley Road and A61/M621 corridors <u>have the demand characteristics necessary</u>, and <u>fulfil the criteria, to support</u> a rapid transit scheme….as well as <u>present the opportunity to implement one</u>*' – a phrasing which suggests that the Promoters' view is not that these corridors need NGT but that they provide an opportunity to implement NGT.

x. It appears that at least part of the reason for pursuing a trolleybus solution seems to be that it allows the Promoters to use the TWAO route to approval (which is in turn desired because it offers them the prospect of controlling the operations of the system post implementation).

d. Although it may be argued that DfT have accepted the strategic case for an intervention of some kind, such acceptance cannot possibly be taken to imply acceptance that the proposal for which TWAO approval is now sought is superior to any alternative:

i. The Supertram Scheme approved in 1996 was based on a different technology on a different route in a different policy context. Any implied rejection of alternatives to that scheme is of little relevance to the current scheme.

ii. Any consideration of alternatives to NGT - in appraisal or in public consultation - up to and including submission of the 2009 MSBC, was in respect of alternatives to a network of routes including an Eastern route and a City Centre Box but excluding the Holt Park extension. They could not be said to represent alternatives to the scheme now being considered for TWAO approval.

iii. The lower cost alternatives analysed in the 2009 and 2012 Business Cases were no more carefully defined than those in the 2014 Business Case and can therefore be dismissed in the same way as Mr Chadwick dismissed those in the 2014 Business case.

iv. Any appraisal of alternatives up to and including submission of the 2009 MSBC was conducted using models whose replacement was a condition of any further consideration of the NGT Business Case. Slides presented to the Permanent Secretary on 22/06/12 (Appendix H2 of NWLTF Statement of Case – OBJ1719) indicate that DfT still had reservations about aspects of the modelling used in the 2012 Business Case.

v. Approval of the Leeds UDP Review and, in due course, of the Leeds Core Strategy might be taken as evidence of the strategic need for a scheme of some kind but cannot be said

to have been based on a systematic consideration of alternative means of achieving the relevant policy objectives.

e. The funding approval procedures detailed in Appendix 1 to APP135 indicate, at the top of page 34 of 77, that the move from PEA to Conditional Approval may require further consideration of low cost alternatives if the cost of the preferred alternative has increased significantly. In fact, as noted in D6ai below, the cost of the scheme to the public purse has already increased very significantly beyond that indicated in the 2012 PEBC.

D6 <u>That the funding is secure (relating to Matter #12)</u>

Mr Chadwick stated that, with a combination of DfT funding, prudential borrowing and revenue surpluses, the funding of the scheme is secure. I suggest that all three elements are open to question.

a. Firstly, although PEA has been granted on the 2012 Business Case, that approval does not guarantee granting of Conditional or Full Approval and there are a number of grounds for believing that that approval may not be forthcoming:

   i. The 2012 PEA letter (C-6-15) made it clear that the maximum DfT contribution would be £173.5m towards a total scheme cost of £249.981m and that (in bold and underlined) **<u>"No further funding will be provided by the Department for this scheme</u>**". However:

      - The grant/subsidy element of total costs as recorded in the TEE tables has increased significantly since 2012; from £289.9m in 2002 prices (see Table 8.9 of C-2) to £532.5m in 2010 prices (see Table 17.1 in C-1).
      - The net contribution required from Central Government has increased since 2012 due to the increased abstraction of rail revenue (which will be reflected in reduced franchise income to the Treasury). The 2012 Business case (Table 8.9 in C-2) showed this sum as £21m in 2002 prices whereas the 2014 Business Case (Table 17.1 in C-1) shows it as £38.5m.

   ii. Condition #ii of the PEA letter makes it clear that the funding is conditional on there being no significant change in the specification of the scheme and condition #xi clarifies that the specification and delivery of NGT services is an integral element of the scheme. Any attempt to reduce costs by reducing the level of service would thus invalidate condition #ii. (It will be recalled that, under cross examination, Mr Henkel identified reductions in frequency, particularly during the peak and beyond Bodington, as one of the measures which might have to be considered if the expected revenue surplus did not materialise).

   iii. Condition #i of the PEA letter indicated that PEA was entirely without prejudice to any view which might be taken at a subsequent stage. This leaves the Department ample scope to reconsider its approval when it next has the opportunity to examine the Business Case and to scrutinise the modelling and analysis which underlie it. Given the number and seriousness of issues which have come to light for the first time during this Inquiry (see for example Ci to Cvii in D4 above), the Promoters must acknowledge the probability that the DfT or its advisors will find some fault with the Revised Business Case.

b. Secondly, the funds available via prudential borrowing will only be forthcoming if local political support for the scheme is forthcoming at all stages through to acceptance of the terms of the loan. There must be some doubt about this because:

i. There is already evidence of an erosion of local political support. The scheme originally had the support of all the local MPs and of all the main parties on Leeds City Council but:
   - The Lib Dem MP for Leeds North West, Mr Greg Mulholland, originally a prominent supporter of the scheme, has now clearly announced his opposition to it and recently tabled an Early Day Motion in Parliament seeking release of the £173m for alternative schemes.
   - The Labour MP for Leeds East, Mr George Mudie, originally a supporter of the scheme, has since withdrawn his support and has very publicly criticised the proposals.
   - Objections have been lodged by local Councillors for Adel (OBJ/0527 - Conservative), Weetwood (OBJ/1593 - Lib Dem) and Kirkstall (OBJ/1684 - Labour) and by the Adel and Wharfedale Labour Party (OBJ/1605).
   - Although the controlling Labour Group on Leeds City Council still backs the scheme, there is evidence of growing dissent within the party (the full extent of disquiet among the Labour Group is unknown because a whip was applied during the Resolution 239 votes in July and November 2013):
     - the Labour candidate for the Leeds North West Constituency, a member of the Labour Group on Leeds City Council, has openly declared his opposition to the scheme
     - the Labour candidate for Weetwood Ward in the May 2014 local election openly declared her opposition to the scheme
     - one of the Headingley Labour councillors who backed Resolution 239 in July and November 2013 has since said that she did so to ensure that it would be subject to the Public Inquiry process rather than as an explicit expression of her support for the scheme.
     - Resolutions have been passed by the Middleton Branch Labour Party (which includes the Belle Isle Circus area) and by the Leeds Central Constituency Labour Party (covering the route from Belle Isle up to Hyde Park), opposing the scheme (see OBJ/692).

ii. Statements by senior members of the controlling labour group lead one to believe that they may be unaware of the predicted outcomes of the scheme and that they still believe that the scheme will meet its objectives (e.g. to "reduce congestion", "reduce car use", "encourage sustainable travel", "reduce emissions", "create 4,000 new jobs"). There is no evidence to suggest that the local politicians have been fully briefed on the weaknesses in the Revised Business Case, still less on the flaws which have been exposed during the Inquiry (under cross-examination, neither Mr Haskins nor Mr Chadwick were able to confirm that local politicians were aware of these issues). None of the senior local politicians have attended the Inquiry to learn what is happening and the briefing papers provided for them have not been released. Briefing notes intended for all Councillors, e.g. prior to the votes on Resolutions 239 in July and November 2013, did not fully reflect the reality of the business case. (The Briefing for the July meeting http://democracy.leeds.gov.uk/documents/s98581/NGT%20Report%20190613.pdf refers to the expectation that the scheme would "*improve the local environment by helping to address conges*tion" (2.8), to the anticipated generation of 4,000 long term jobs (2.9), to "*extensive consultation* (which) *showed strong support for the proposals*" (4.1.1) and claims that the proposals "*support the objectives of the Local Transport Plan and contribute to the delivery of the Council's Strategic Plan objectives for transport and those*

of the Vision for Leeds. The scheme … is predicted to encourage a switch from private car to public transport, thereby alleviating congestion on the NGT routes." (4.3.1). The November briefing similarly includes these claims despite the fact that many of them appear not to be supported by information in the Business Case). Interestingly, the minutes of the NGT Project Board (G-4-101? Submitted on 2/09/14) refers, at 4g in the minutes for October 2013, to the need to "*manage elected members through the* (section 239 resolution) *process*".

iii. Against this background, it cannot be safe to assume that local political support for the scheme would be unaffected by an eventual recognition that:
- Even based on the existing modelling, the scheme fails to meet some of its key objectives.
- The anticipated revenue stream is dependent on a number of critical assumptions which have not even been subject to sensitivity analyses (see c below) and that, were it to fail to materialise, Leeds City Council would be faced with servicing an ongoing debt.
- The impact of the scheme on the local network is not known (because the modelling has not been sufficiently detailed).
- The forecast increase in jobs was derived without taking into account the increase in road congestion which is predicted to occur as a result of introduction of NGT.
- The conditions attached to the PEA letter could result in Leeds and the Combined Authority having to contribute an even greater share of the required funding (see ai and aii above).

iv. Recent evidence of Ministerial support for the principle of increased funding of transport investment for northern cities, and the "One North" proposition launched in July 2014, may be taken as offering a better route to the achievement of investment in Leeds' transport infrastructure (the desire for which has driven much of the support for NGT).

c. The anticipated revenue stream is dependent on a number of critical assumptions which have not even been subject to sensitivity analyses. For example that:

i. despite evidence from the SP surveys conducted in 2008, bus users would prefer to travel on trolleybuses.

ii. rail passengers would prefer to travel on trolleybuses.

iii. trolleybus vehicles will have sufficient seating capacity to offer all passengers a seat (this assumption, which is demonstrably wrong, has been subject to a sensitivity test but as is explained at B15 above, the result is unconvincing).

iv. trolleybuses will have sufficient capacity to carry the predicted demand and that passengers will be unable to board the first trolley to arrive at their stop (see final paragraph of C7 above).

v. use of the park and ride services at Bodington and Stourton would be boosted by an unexplained preference equivalent to a 60 minute reduction in journey time (and that, as noted at B39 above, this preference would be strong enough to cause drivers whose journeys begin inside the Outer Ring Road to drive out to Bodington P&R site – and drivers from Holbeck to drive out to Stourton - in order to use the trolleybus to travel back in towards the city centre).

vi. bus operators will not seek to compete with the trolleybus by improving their vehicle offer and/or reducing their fares.

vii. There will be no improvement in the perceived quality of buses or trains or of facilities at bus stops or rail stations, during the life of the NGT project.

E Errata in Proof of Evidence

1. Page2, para 5.9f: replace "(A17, A18)" by "(A18 and parenthesised comment in A17)"
2. Page 6, sub para ii, line 5: replace "33 minutes 21 secs" by "33 minutes 3 secs"
3. Page 6, sub para ii, line6: replace "30 minutes and 3 secs" by "30 minutes and 21 secs"
4. Page 8 , sub para d, line 8: replace "is most" by "is likely to be most"
5. Page 9 , line 8: replace "right turn" by "left turn"
6. Page 12 , sub para v, line 1: replace "C-2-4" by "C-4-24"
7. Page 16 , para A12: entire para can be deleted (it is – replaced by C1 above)
8. Page 18, para A18ii line 5: replace "am peak than in the interpeak" by "interpeak than in the am peak"
9. Page 19. para A21i line 3: replace "2008, shows that" by "2008 (http://webarchive.nationalarchives.gov.uk/20120919132719/www.communities.gov.uk/documents/planningandbuilding/pdf/treesintownsii.pdf) in its para 122 shows that"
10. Page 19. para A21i, line 4: replace "at least 25% of new tree planting in towns and cities perished" by "over 23% of new tree planting near highways perished (as did over 24% in public open space".
11. Page 20, para A24i, line 2: replace "4908" by "2535"
12. Page 20, para A24ii, line 1, replace "Table 10" by "Table 11"
13. Page 23, para A33, 5th line from end: replace "£440m" by "£280m" (calculations in C1 above replace those in A12).