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Appendix F

Leeds New Generation Transport

Wider Economic Impacts

Report

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Executive Summary

This report describes the assessment of the *wider* effects on the economy that can result from major transport projects such as NGT. This is as opposed to the *conventional* economic welfare benefits such as monetised time savings of public transport users. These wider welfare effects are referred to as Wider Economic Impacts (WEI).

DfT's WebTAG provides guidance on assessing WEI and explains their significance. WEIs tend to be particularly important for projects that improve connectivity in and to urban areas and have been found to typically add between 10% and 30% to conventional user benefits calculated for the economic appraisal. Including WEIs in the Business Case for Leeds NGT is therefore important to ensure that the full range of economic welfare benefits of the project is captured and considered.

The WEIs of a transport project include changes to agglomeration, labour supply, competition and productivity, and are driven by changes in generalised transport costs that result from the project. For instance, a project such as NGT may be expected to reduce travel times to a highly productive area such as Leeds city centre, and thereby attract more businesses and workers to the area to increase productivity further.

These interactions between transport and the economy have been modelled using the West Yorkshire Urban Dynamic Model (UDM), using input data on transport demand and costs from the Leeds Transport Model (used in calculating the conventional benefits).

The UDM is a simulation of how transport, land-use, population and employment all interact over time. It looks at processes such as how developers provide new floorspace and residences, households migrate, and businesses open and close. It includes internal models of the transport networks that connect locations, enabling employers to recruit and do business with their customers and suppliers and helping people to travel to work. In this way, it is able to model the wider economic processes in play and provide the necessary inputs to subsequent WEI and tax revenue calculations in line with WebTAG.

The effect that the introduction of NGT has is modelled in the UDM as a change in generalised cost between the origins and destinations between which NGT can be used for all or part of the journey. As NGT journeys are designed to be faster, more punctual and of higher quality than other modes of public transport, the generalised cost of the journey is lower, making it more likely that people will choose NGT over other modes of transport.

So that the impact of NGT can be understood, a base case and a test scenario are created in the UDM. The test scenario includes the generalised cost reductions of NGT and the base case does not. Running both scenarios and then comparing the outputs provides information on the impacts of NGT. Various outputs from the UDM for these scenarios - such as travel times and fares for different modes of transport, and the numbers of jobs filled by business type - are then used in assessing the WEI.

Introducing NGT reduces the cost in terms of both time and money to travel between certain locations. This increases the attractiveness of these locations as both places to live and work. The With NGT Scenario has a forecast increase of **3,687 jobs** in Leeds District by 2031. (This could be up to 5,036 jobs depending upon car parking policy in Leeds City Centre.)

The value of WEI attributable to agglomeration, labour supply, imperfect competition and moves to more productive jobs as a result of NGT have been estimated to provide a potential **29%** increase in economic benefits when WEI are taken into account. The WEIs are towards the upper end of the 10% to 30% range mainly because NGT successfully achieves relocation of jobs towards locations where they are more productive.

WEIs account for £115m PV (in 2010 prices) and increase the User Benefits from £396m PV to £511m PV. Therefore, including WEIs in the BCR of the project increases the ratio from 2.96:1 to 3.71:1.

Impact on GVA (although not additional to the WEI) is another useful way to report the economic effects of NGT. GVA is forecast to increase in Leeds, and although there will be some reduction in surrounding areas, there is a net positive national effect:

- The With NGT Scenario has a forecast increase of **£235.6million** in GVA in Leeds District in 2031
- The With NGT Scenario has a forecast increase of **£18.7million** in net national GVA in 2031

A proportion of the forecast GVA impact will increase net national taxation revenues (the With NGT Scenario has a forecast increase of **£5.8million** in net national taxation revenues by 2031) indicating the potential for an EarnBack arrangement between the Leeds City Region and Treasury.

1 Introduction

1.1 Metro commissioned Steer Davies Gleave to assess the economic impacts that would result from improvements to the transport system from the proposed Leeds New Generation Transport Project (NGT Project).

1.2 The *conventional* economic welfare benefits – such as monetised time savings of public transport users - of the NGT Project are appraised following the DfT WebTAG appraisal methodology and documented in the Business Case[1]. This report describes the assessment of the *wider* effects on the economy that can result from major transport projects such as NGT. Guidance is provided in WebTAG for the assessment of these wider welfare effects, referred to as Wider Economic Impacts (WEI).

1.3 WEIs of a transport project include changes to agglomeration, labour supply, competition and productivity, and are driven by the change in generalised transport costs[2] that result from the project. For instance, a project such as NGT may be expected to reduce travel times to a highly productive area such as Leeds city centre, and thereby attract more businesses and workers to the area to increase productivity further.

1.4 One measure of the overall WEI is the increase in net national Gross Value Added (GVA)[3], which in turn raises additional tax revenue to central Government. Recently, Transport for Greater Manchester (TfGM) negotiated an arrangement whereby increases in tax revenue that result from their transport investment are shared with TfGM in what is termed an *EarnBack* deal. The NGT Promoters are investigating whether a similar arrangement could work in the Leeds City Region and the potential increase to national tax revenues has therefore also been investigated and reported here.

1.5 The conventional approach to transport demand and benefit forecasting as set out in WebTAG modelling guidance is to look at the impacts of a transport intervention assuming that other than at the margin, there is no change to the geographic distribution of population and employment. This simplifying assumption means that transport supply (the road and public transport network) can be modelled in some detail. Land-use transport interaction (LUTI) models relax this assumption and allow population and employment location to change in response to transport interventions. The corollary for this added complexity is that transport supply is treated in a simpler manner. This is why transport models and LUTI models are often used in conjunction.

[1] Leeds New Generation Transport Major Scheme Business Case, 2014, Steer Davies Gleave

[2] i.e. the sum of monetary and non-monetary costs of a journey, including elements such as time, distance and fare

[3] GVA, or Gross Value Added, is the contribution to the economy of each individual producer, industry or sector in the United Kingdom. Its relationship to Gross Domestic product, or GDP, is: GVA + taxes on products - subsidies on products = GDP

1.6 Conventional benefits have been assessed using outputs from the Leeds Transport Model[4]. The interactions between transport and the economy were simulated with the West Yorkshire Urban Dynamic Model (UDM), using input data on transport demand and costs from the Leeds Transport Model. The WEIs of the NGT Project have then been assessed following WebTAG guidance.

1.7 The UDM is a simulation of how transport, land-use, population and employment all interact over time. It looks at processes such as how developers provide new floorspace and residences, households migrate, and businesses open and close. It includes internal models of the transport networks that connect locations, enabling employers to recruit and do business with their customers and suppliers and helping people to travel to work. In this way, it is able to model the wider economic processes in play and provide the necessary inputs to the WEI and tax revenue calculations.

1.8 The remainder of this report is structured as follows:

- Section 2 describes the UDM inputs, processes and outputs in more detail, and also the application of the UDM as a decision-supporting tool in West Yorkshire
- Section 3 explains how the NGT Project has been assessed using the UDM
- Section 4 presents the results of the WEI analysis and tax revenue calculations

[4] Leeds Transport Model Forecasting Report, 2014, Aecom

2 The Urban Dynamic Model

Introduction

2.1 The UDM is a simulation of how transport, land-use, population and employment all interact over long periods of time. It was developed to demonstrate how transport investment, particularly when coupled with land-use planning, can help stimulate economic growth by making places more attractive for employers to locate in, and for people to live in.

2.2 It looks at how house builders and property developers provide new infrastructure, the inward and outward migration of households, and the start-up and closure of businesses. It includes internal models of highways, bus and rail services, walking and cycling, all connecting places together and enabling employers to recruit and do business with their customers and suppliers and allowing people to travel to work.

2.3 The UDM was developed by Steer Davies Gleave and first used in the year 2000; it has undergone continuous development since then. It has been used in the North East of England, Merseyside (at regular intervals since 2006), Scotland (for which it won an award for innovation), South Yorkshire, The Yorkshire and Humber Region, Leeds City Region and West Yorkshire.

Structure of the UDM

2.4 In each application of the UDM, the modelled area is divided into zones. In each zone, the model tracks the number of households living there, the people and workforce they bring and the houses they live in. It also tracks the numbers of employers, categorised by industrial sector, the number of jobs they bring and the premises they occupy.

Input Data

2.5 Each application is carefully initialised using data from the Office for National Statistics (ONS), including the Census, the Labour Force Survey and employer surveys. Information about actual traffic flows and speeds is used to ensure the network models are behaving realistically, and survey data, including the travel-to-work (TTW) Census, is used to ensure that the modelled choice of travel mode is robust.

Baseline Scenario

2.6 The model is first set up so that it generates a baseline case, that simulates a time period up to an agreed forecast horizon year. This incorporates agreed assumptions about background trends in the economy and population, committed new transport investment and expected new land releases for housing or commercial development.

2.7 The baseline case depicts how population, employment, travel and land-use will all change, year by year, out to the horizon year. This is the reference scenario against which specific tests are compared to assess their impact.

Test Scenarios

2.8 The UDM is set up so that it can read, from a spreadsheet database, descriptions of proposed new schemes and policies to be tested. It can read in future changes in any of the transport networks that will result from the proposed new schemes, with their opening year. It can also read in tables of new land releases, in hectares, for housing or commercial development in each zone, with the year in which the land will become available.

Simulation of Transport / Economic Interactions

2.9 Given this information, the UDM will then simulate the consequences. Reduced transport times and costs will, in general, have the following effects:

- increase the recruitment reach of employers, making it easier to fill new posts;
- increase the range of employment opportunities available to the workforce, enabling more of them to get into employment;
- increase the range of customers and suppliers accessible to businesses, increasing the attractiveness of such locations and encouraging further growth.

2.10 These effects will tend to increase economic activity. There are then some counter-effects:

- traffic congestion may rise, increasing travel times;
- new employers need premises, and that requires land; if land is not available growth may be constrained;
- less well located employers may lose out as competition for the labour force increases;
- significant increases in employment may require a net increase in the workforce. This requires new housing, which in turn requires new land.

2.11 The UDM will simulate how these changes progress and interact year-by-year. The test scenario can then be compared to the baseline case to assess the net effect of the investment project or policy tested.

Output Data

2.12 The UDM generates a wide range of outputs that can be shown in tables, graphs or GIS plots. They include:

- travel patterns, volumes and mode shares;
- changes in land-use in each zone (i.e. the number of housing units and employment premises);
- changes in households, population and the workforce;
- changes in employment (jobs filled) and the unemployment rates;
- changes in CO_2 emissions from transport activity;
- time savings benefits for appraisal, and the wider economic impacts on productivity and agglomeration.

DfT Review

2.13 In 2013 the Department for Transport (DfT) commissioned a review of models of transport and the economy. Their report, "Assessment of Methods for Modelling and Appraisal of the Sub-national, Regional and Local Economy Impacts of Transport"[5], was published in October 2013 on the DfT website. It stated that the UDM:

> *"… seems well suited to analysing the interaction between overall local strategies, transport schemes, and land use planning constraints. It uses empirical evidence to simulate how individuals, businesses and developers behave in response to changes in attractiveness in conditions. The model tends to be calibrated against observed data for the particular target area (time series and cross sectional) with many of the parameters used in the business and employer model estimated as part of an earlier study for DfT. The metrics generated by the approach can be calculated annually over a number of years and can therefore be discounted to a present value to compare impacts across a range of interventions. The model also provides impacts on other areas to allow estimation of the net as well as gross results across the various metrics and can therefore be used to estimate the gross and net impacts of an intervention and therefore who are the winners and losers."*

2.14 Whilst generally positive about the UDM, the DfT also note that a possible weakness is "the UDM is a wide-area strategic model and has been used primarily to estimate the impacts of relatively large schemes. There could be difficulties in adapting it to apply to small local schemes".

Use of the UDM in West Yorkshire

2.15 In 2012, an application of the UDM was developed covering the five Districts of West Yorkshire (Leeds, Bradford, Wakefield, Calderdale and Kirklees) plus a large buffer area beyond in order to capture recruitment and other business-to-business activity between West Yorkshire and elsewhere. The model contained 202 zones, and is a development of an earlier application of the UDM for West Yorkshire.

2.16 The West Yorkshire UDM was set up and calibrated using information from the Census, the Labour Force Survey, the Annual Business Inquiry and the Business Register and Employment Survey (BRES), Local Transport Plan monitoring cordon counts, TrafficMaster journey times, plus other data supplied by Metro. It includes a strategic highways model to represent the motorways, trunk roads, A-roads and other important local roads. It also has models of the rail network, buses, walk and cycle.

2.17 A baseline scenario was set up using information from the Regional Economic Model (REM), built and maintained by Experian. This provided projections of employment and population for each district. In consultation with the districts, zones where this growth was expected to occur were identified and the future land requirements also identified. The baseline scenario was constructed to

[5] https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/252114/sub-national-impacts-dft-017.pdf

reproduce the REM forecasts *assuming no changes in transport costs*. This was an implicit assumption of the REM.

2.18 A 'constrained' baseline scenario was then constructed showing what would happen if transport costs were allowed to rise due to road congestion, crowding on the railways, rising fares and fuel costs. This showed that in the absence of new investment in transport, some 22,000 jobs would be lost, worth about £1.4 billion per annum in lost GVA[6] compared with the unconstrained baseline.

2.19 Analysis of this constrained baseline was used to identify where jobs were lost and why. A long-list of 60 candidate transport schemes and policies was developed to address the problem in a series of workshops with Metro and the districts. Each scheme was carefully defined and estimates made of the scale of individual scheme impacts on the transport networks or on land availability. The transport impacts were defined in terms of changes in point-to-point travel times and costs.

2.20 Each of the 60 schemes were then tested in the UDM and assessed in terms of a set of strategic objectives that had been agreed at the start of the study:

- to maximise GVA;
- to improve social equity (defined in terms of minimum thresholds for improved access to employment opportunities for residents of areas with high indices of deprivation);
- to minimise transport related CO_2 emissions.

2.21 Schemes were ranked on the basis of the ratio of their generated GVA to their capital cost, and the top ranking schemes selected, up to a total capital cost of just over £1 billion.

2.22 A schedule was drawn up of when these schemes could be expected to open. The resulting package of schemes, with defined opening years for each scheme, was then tested in the UDM. The test showed that:

- the majority of the 22,000 lost jobs were recovered;
- the thresholds for improved social equity were met;
- CO_2 emissions did not rise, despite the increased amount of employment and other activity;
- using user benefits from the UDM with whole life costs, the benefit to cost ratio (BCR) was around 5 to 1 (likely to be a conservative estimate because it does not take into account effects such as carbon savings and accident reductions);
- the combined effect of the package of schemes was greater than the cumulative individual impact of each scheme if assessed separately, due to synergy between the individual measures.

[6] GVA, or Gross Value Added, is the contribution to the economy of each individual producer, industry or sector in the United Kingdom. Its relationship to Gross Domestic product, or GDP, is: GVA + taxes on products - subsidies on products = GDP

2.23 It was concluded that the proposed package was capable of countering the projected rises in transport costs, would generate increased employment, improve social equity, would be carbon-neutral and provide good value for money.

2.24 The package of schemes identified by the UDM has been taken forward as the initial scheme prioritisation for the West Yorkshire Transport Fund, a £1billion investment in transport in West Yorkshire over the next 10 years, funded as part of the Leeds City Deal[7].

NGT in the West Yorkshire UDM

2.25 As a committed scheme, NGT is included in the baseline case of the West Yorkshire UDM. The transport schemes tested as part of the proposed investment package include, amongst other things, extensions to NGT.

2.26 To assess the impact of NGT on the economy, a new baseline case for the West Yorkshire UDM was therefore developed without NGT, and a new test scenario developed with NGT. The next section sets out the forecasting assumptions used.

[7]Report of the PTE to the West Yorkshire ITA, 27/09/13: http://www.wyita.gov.uk/NR/rdonlyres/A6C6E68C-3872-428E-B5B6-108B1B7C1C3A/0/Item15WestYorkshirePlusTransportFund.pdf

3 Forecasting Approach

Introduction

3.1 This section describes how a test scenario was developed for the West Yorkshire UDM to assess the WEIs of the NGT Project. The key inputs, processes and outputs of the UDM critical to this analysis are detailed.

Overall Approach

3.2 The UDM models the trips that people make from origins to destinations by all modes of transport. The decisions on what route and mode of transport these (simulated) people use are based upon factors such as how much it costs, how long it takes, how punctual it is and how it is perceived by the potential users (for example, research has shown that people generally have a preference for driving their own car than taking the bus). All of these elements are captured in what is referred to as the *generalised cost* of the journey, with trip-makers always seeking to minimise the generalised cost of their trip.

3.3 The effect that the introduction of NGT has is modelled in the UDM as a change in generalised cost between the origins and destinations between which NGT can be used for all or part of the journey. As NGT journeys are designed to be faster, more punctual and of higher quality than other modes of public transport, the generalised cost of the journey is lower, making it more likely that people will choose NGT over other modes of transport.

3.4 So that the impact of NGT can be understood, a base case and a test scenario are created. The test scenario includes the generalised cost reductions of NGT and the base case does not. Running both scenarios and then comparing the outputs provides information on the impacts of NGT.

3.5 Assessing WEI requires various outputs from the UDM, such as travel times and fares by different modes of transport, and the numbers of jobs filled by business type (see Appendix A for a full list).

Input Assumptions

Public Transport Generalised Cost

3.6 The representation in the UDM of the reduction of generalised public transport costs associated with the NGT Project is an output of the Leeds Transport Model (LTM). Similarly to the UDM, the LTM also models trips between origins and destinations, but with a focus on the detailed simulation of the cost, demand and mode choice for trips on the Leeds transport network for a given land-use (population and employment) scenario. The development and use of the LTM in forecasting the transport effects of the NGT Project are documented elsewhere[8].

[8] http://www.ngtmetro.com/uploadedFiles/Content/Documents/Archive/Appendix8LTMPublicTransportModelValidationReport.pdf

Park and Ride Generalised Cost

3.7 The NGT Project has two Park & Ride sites, one at Bodington and one at Stourton, so in addition to the public transport generalised cost changes, a second set of inputs to the UDM is needed to represent the change in travel costs associated with the Park & Ride (P&R) travel options.

3.8 Park & Ride is only suitable for people with a car available. For such people living in the catchment[9] of a P&R site, the model compares the generalised cost of using the existing bus services to travel from home to the city centre against the generalised cost of driving to the P&R site and taking the NGT to the centre. If the P&R option has a lower cost the model substitutes that for the bus service, and calculates how many car users driving to the centre would switch to the new P&R.

City Centre Parking

3.9 The future availability of car parking spaces within Leeds city centre will depend on the rate and amount of development that occurs, whether that development has available parking, and whether there is a reduction in the existing car parking stock. There is a degree of uncertainty associated with each of these.

3.10 Car parking availability is important because the level of parking availability affects the generalised cost of trips by car. With less parking available, finding a parking space takes longer and increases the generalised cost of car trips. This can be a factor in encouraging people to use public transport for all or part of their journey to avoid the inconvenience of searching for and incurring the costs of car parking. Clearly, if the demand for parking exceeds the capacity available, travel by car is constrained.

3.11 The number and mix of public, private and informal spaces in central Leeds is difficult to estimate with precision. However, it is known that there are around 100,000 jobs in the central area and the car mode share is approximately 50%. Allowing for shared vehicle use, and that average trip frequencies are a little less than five days per week, this implies a daily *capacity* for around 40,000 car trips. This is consistent with the number of physical spaces from Leeds City Council surveys, allowing for daily churn (due to shift and part time workers, for example). The **With NGT Scenario** was modelled with this level of provision in the Reference and Test Scenarios, and a further test was undertaken in which provision was reduced by 5,000 spaces (referred to in Chapter 4 as the '**With NGT, Reduced Parking Capacity Test**'). Depending upon parking policy for new developments and those developments that come forward, such a reduction is a plausible future scenario. The effect of this reduction would be to increase the attractiveness and effectiveness of NGT, as it provides access capacity that substitutes for car.

[9] The catchments are largely self-defining, because the P&R sites will be less and less attractive as the distance to them increases relative to a direct drive and/or the quality of the alternative bus services improves.

4 Assessment of Wider Economic Impacts

Introduction

4.1 This section sets out the economic impacts of NGT forecast using the West Yorkshire UDM. These include the forecast impacts on employment, locations of residents in employment, the formal assessment of WEIs following WebTAG guidance, and the potential increase in national tax revenue.

Employment

4.2 A key indicator of the economic impact of the NGT Project is the change in the level of employment compared to the base case. Introducing NGT reduces the cost in terms of both time and money to travel between certain locations and thereby increases these locations' attractiveness as both places to live and work, which in turn attracts workforce and businesses, increasing the level of employment. The changes in level of employment by 2031 for the **With NGT Scenario** and the **With NGT, Reduced Parking Capacity Test** are presented in Table 4.1 at three levels of spatial aggregation.

TABLE 4.1 ADDITIONAL JOBS FACILITATED BY NGT BY 2031

	With NGT Scenario	With NGT, Reduced Parking Capacity Test)
Leeds District	3,687	5,036
West Yorkshire	2,959	4,121
Leeds City Region	2,811	3,948

4.3 The increase in the number of jobs in the Leeds District facilitated by the introduction of NGT is **3,687** in the **With NGT Scenario**, and **5,036** in the **With NGT, Reduced Parking Capacity Test**[10]. From this it can be seen that the actual effect of the NGT Project on job numbers will be somewhat dependent on the future level of parking availability in the city centre.

4.4 In the absence of any compensating measures - such as improved public transport provision - reduced parking availability could reduce the total number of people employed in the city centre if accessibility is constrained. However, with NGT, public transport options for travel to the city centre are improved, and policies such as reductions in city centre parking and provision of out-of-centre Park & Ride, can be implemented for overall net economic benefit.

[10] These figures are consistent with earlier analyses using similar methodologies which suggested approximately 4,000 jobs would be facilitated by the introduction of NGT.

4.5 The number of jobs facilitated by the introduction of NGT is lower in the Leeds City Region - at **2,811** in the **With NGT Scenario** and **3,948** in the **With NGT, Reduced Parking Capacity Test** – than in Leeds District. This is because the employment increases in Leeds District are counter-balanced to a degree by employment decreases in the wider area, caused by jobs relocating to more productive central areas.

4.6 Figure 4.1 shows the change in residents in employment (increases and decreases) per UDM model zone in Leeds District following the introduction of NGT in the **With NGT Scenario**. This illustrates that most of the areas from where many of the workers filling the additional jobs travel from are situated along the NGT route; indicating that the increase in accessibility provided by NGT is facilitating trips to areas of employment from these residential areas. In addition to areas directly on the NGT route, workers filling the additional jobs are also coming from zones in southeast and north west Leeds, who are accessing city-centre jobs by using the Park & Ride at Stourton and Bodington respectively.

Wider Economic Impacts

4.7 DfT's WebTAG Unit 2.8 provides guidance on assessing WEI and explains their significance. WEIs are a set of economic welfare changes that are additional to those normally quantified as part of conventional transport cost benefit analysis. WEIs tend to be particularly important for projects that improve accessibility in and to urban areas and have been found to typically add between 10% and 30% to user benefits calculated for the economic appraisal. Including WEIs in the Business Case for Leeds NGT is therefore important to ensure that the full range of economic welfare benefits of the project is captured.

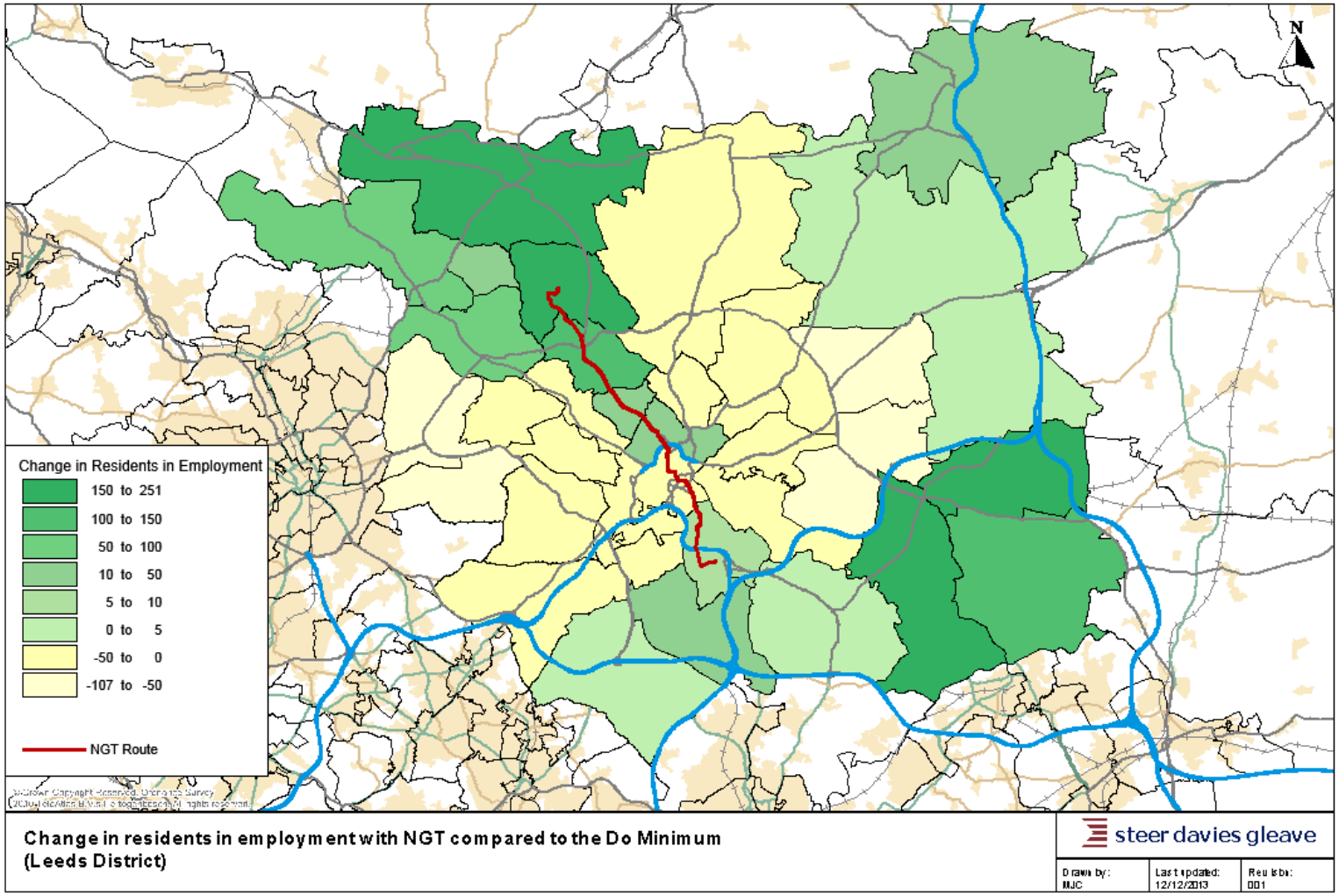
4.8 The following text, adapted from WebTAG Unit 2.8, provides further information on how WEIs manifest themselves.

Under conditions of 'perfect competition' (a set of assumptions often employed by economists to facilitate analysis) a Cost Benefit Analysis (CBA) of a transport scheme can capture all the economic costs and benefits of a transport scheme at the national level.

However, markets are often not perfect, resulting in WEIs via direct user impacts being amplified through the economy. Such impacts would include productivity and welfare changes associated with the impact of transport on agglomeration and labour supply. Appraising only the direct user impacts means that some economic impacts would be missing from the appraisal, so the WEI appraisal aims to capture these effects, both positive and negative.

Benefits may not be evenly distributed across the population, and some people might gain whilst others lose. Even if there were no overall effect at the national level, benefits such as increased employment might be gained in some areas, while an equivalent reduction might occur elsewhere across the country.

FIGURE 4.1 CHANGE IN RESIDENTS IN EMPLOYMENT



4.9 The categories of WEI are described in WebTAG as:

- ***Agglomeration**: The term agglomeration refers to the concentration of economic activity over an area. Transport can act to increase the accessibility of an area to a greater number of firms and workers, thereby having an impact on the level of agglomeration. The level of agglomeration in a location is related to the proximity of businesses to one another and to workers, and so the relevant measure is the generalised costs for business and commuting trips and freight travel. Agglomeration has an impact on UK welfare through its effect on productivity and UK Gross Domestic Product (GDP)*
- ***Labour Supply**: Transport costs can have an impact on labour supply, as they affect the overall costs and benefits to an individual from working. In deciding whether or not to work, an individual will weigh travel costs against the wage rate of the job travelled to. A change in transport costs is therefore likely to affect the incentives of individuals to work and hence the overall level of labour supplied in the economy. The extent to which potential workers are employed in the economy affects the level of UK GDP*
- ***Imperfect Competition**: In most cases, markets are not "perfectly competitive" and this can lead to lower production and higher prices than would exist in the case of a "perfectly competitive market", normally to the detriment of consumers and the economy as a whole. A reduction in transport costs (to business and/or freight) allows for an increase in production or output in the goods or services that use transport. For example, better transport provision may result in less congestion and hence enable a firm to carry out more deliveries in a day*
- ***Move to More Productive Jobs**: Transport costs can affect decisions for firms and workers on where they locate. This can affect the extent to which workers are employed in their most productive uses in high productivity jobs, and hence have an impact the level of UK GDP*

4.10 WEIs for the NGT Project have been quantified in line with DfT's method, which is described in WebTAG Unit 3.5.14. Below is an outline of the calculations used:

- **Agglomeration:** Demand and transport generalised costs, together with data on employment by sector are used to calculate the change in effective density of economic activity by location from the base case to the test scenario. The change in effective density drives productivity benefits through elasticities provided in the guidance
- **Imperfect Competition:** As per WebTAG methodology, this is simply 10% of the business user benefits
- **Labour Supply:** Increased labour supply is calculated by estimating the average value of commuter time and cost savings as a proportion of commuters' wages. This drives increased labour supply through the elasticities provided in the guidance. The tax take of the additional GVA generated by the increased labour supply is a Wider Economic Impact
- **Move to More Productive Jobs**: Jobs by location from the UDM are used to calculate the increased average productivity caused by relocation of jobs to where they are more or less productive using the estimates of differences in

productivity for equivalent jobs. The tax take of 30% on the additional productivity is considered the WEI.

4.11 For the agglomeration, labour supply and imperfect competition benefits, data on demand, journey times and costs for bus, rail, car, walking and cycling have been provided from the UDM. Economic data on GVA and employment have been sourced from ONS. Other parameters required for the calculations - such as agglomeration elasticities, labour supply elasticities and tax revenues - have been sourced from WebTAG. In addition, the predicted impacts on jobs from the UDM have also been used to calculate the impacts of a move to more productive jobs. The WEI guidance requires for this analysis that the total number of jobs at a national level is kept constant. Since the UDM forecasts an increase in the total number of jobs within the modelled area, it has been assumed for the WEI calculation that the additional forecast jobs are relocated from other parts of the UK. While consistent with guidance, this is arguably a conservative assumption. The size of the UK economy and the number of jobs it supports is a complex function of many things, a number of which are outside the control and influence of domestic policy. Nonetheless, it is recognised that transport connectivity at all spatial levels is one thing that influences the UK's competiveness and so overall size of the economy[11].

4.12 The WEIs assessment has been set up to model the year 2031. The first column in Table 4.2 shows the results for both the conventional cost benefit analysis and the additional WEIs. The former is the results for the year 2031 underlying the Present Value calculations reported in the 2014 Business Case.

4.13 The rightmost column in the table shows the impacts of NGT on national GDP. These are different from the Wider Economic Impacts for two reasons:

- Time savings and cost savings to travel in the course of work translate into productivity gains and, hence, increased GDP, while savings to other purposes do not
- The increased output from increased labour supply and move to more productive jobs do not translate directly into economic welfare gains. The latter only arise because of the tax wedge[12] between the value of the output produced by the worker (GDP) and workers' take home wage

4.14 Although GDP impacts are not in themselves additional to the economic welfare benefits captured as part of CBA, they are still of interest to policy makers.

4.15 Total annual conventional user benefits of NGT in 2031 amount to **£32.7m**. The WEI analysis finds that in addition to this, the project will deliver £5.6m worth of agglomeration benefits, £0.6m of labour supply gains and £3.5m from a move to more productive jobs. In total, WEIs add **£9.6m** (29% of the conventional user benefit), giving a total benefit including WEI in 2031 of **£42.3m**. This magnitude of WEIs in relation to conventional user benefits is within the range of 10% to 30% noted above. They are towards the upper end of the range mainly because NGT

[11] See Eddington Transport Study, 2006

[12] 'tax wedge' is a measure of market inefficiency caused by taxes changing the equilibrium between supply and demand

successfully achieves relocation of jobs towards locations where they are more productive.

4.16 Table 4.2 also shows that NGT will raise UK productivity by £17.8m in 2031, which is mainly driven by agglomeration benefits and move to more productive jobs.

4.17 These findings suggest that WEIs will add 29% to conventionally measured user benefits in 2031. These benefits arise because NGT makes Leeds a more productive location for existing employment and because additional jobs are attracted to the city that are more productive than if located elsewhere. It is a valid assumption that this uplift does not differ materially across the appraisal horizon and so can be applied to other years in the modelled period too. This is because the factors driving changes in the value of user benefits over time - namely growth in values of time, demand and changes in time and cost savings - broadly affect the WEIs in the same way.

4.18 The NGT economic appraisal calculates the present value of user benefits as £396m. The WEI will add a further £115m to this (29% of £396m). Therefore, including WEIs in the BCR of the project increases the ratio from 2.96:1 to 3.71:1.

TABLE 4.2 CONVENTIONAL AND WIDER IMPACTS IN 2031 (£M, 2031 VALUES, 2010 PRICES)

Conventional User Benefits	**Welfare**	**GDP**
Business User Benefits	-0.8	-0.8
Commuter User Benefits	14.8	
Leisure User Benefits	18.6	
Total Conventional	*32.7*	*-0.8*
Wider Economic Impacts		
Agglomeration Benefits	5.6	5.6
Imperfect Competition Benefits	-0.1	-0.1
Labour Supply Benefits	0.6	1.6
Move to More Productive Jobs Benefits	3.5	11.5
Total Wider	*9.6*	*18.6*
Total Benefits	**42.3**	**17.8**
Wider Impacts as proportion of Conventional User Benefits	*29%*	

Next Best Alternative

4.19 Wider Impacts have been calculated based on generalised cost and demand data from the Leeds Transport Model. The generalised cost for travel includes in-vehicle time, wait time, walk time, boarding time and transfer time. The Next Best Alternative has the same run time and uses the same route as the Preferred Option but is a lower quality service and therefore has a higher generalised cost (passengers perceive time spent on a lower quality service as longer than on a higher quality service). The Next Best Alternative also attracts less demand than the Preferred Option. As a result, Wider Impacts for the Next Best Alternative are expected to be less than the Preferred Option.

4.20 If we assume that Wider Impacts have the same proportionate impact in the Next Best Alternative as the Preferred Option, these impacts account for £41m PV (in 2010 prices) and increase the User Benefits from £143m PV to £184m PV. Therefore, including WEIs in the BCR of the project increases the ratio from 1.03:1 to 1.26:1.

GVA and Taxation Impacts

4.21 The GVA impacts on Leeds District, the rest of West Yorkshire, the rest of the UDM modelled area and on the rest of UK have been disaggregated and reported in Table 4.3.

4.22 The proportion of the WEI retained by central Government as taxation receipts has also been calculated following the WEI guidance and shown in Table 4.3. The proportions assumed are: 30% of agglomeration and job relocation gains as taxation due to increased productivity, and 40% of labour supply gains (30% due to taxation gains plus 10% as a reduction in benefits payments and tax rebates).

TABLE 4.3 PRODUCTIVITY GAINS AND TAXATION IMPACTS OF LEEDS NGT IN 2031 (£M, 2031 VALUES, 2010 PRICES)

	Agglomeration	Labour Supply	Job Relocation	Total GVA	Taxation*
Leeds District	3.2	1.2	231.3	235.6	70.8
Rest of West Yorkshire	0.1	0.3	-47.6	-47.2	-14.1
Rest of Modelled Area	2.3	0.1	-19.9	-17.5	-5.2
Rest of UK	0.0	0.0	-152.2	-152.2	-45.7
Net National	**5.6**	**1.6**	**11.5**	**18.7**	**5.8**

*** Taxation refers to total taxation to HMT, so both direct and indirect taxation. Direct taxation includes business rates, income tax, stamp duty. Indirect taxation includes VAT.**

4.23 Nationally, the agglomeration benefits amount to £5.6m in 2031, most of which fall to Leeds and to the rest of the modelled area. Increased labour supply further raises GVA, mainly in West Yorkshire, by £1.6m per year.

4.24 The job relocation impacts are by far the most significant, at least on a local level. With NGT, Leeds is able to attract additional jobs, generating a GVA of more than £230m per year. Although much of this is at the expense of the rest of West Yorkshire and of the rest of UK, there is still a net national GVA gain of £11.5m per year. Since the analysis keeps constant the total number of jobs at a national level, this net gain is the result of jobs being attracted to locations where they are more productive.

4.25 Overall we find that NGT raises UK GVA by **£18.7m p.a.** in 2031 and as a result there is a **£5.8m p.a.** increase in total tax revenues to the Treasury. The GVA gain for the Leeds District is **£235m p.a**. in 2031.

4.26 It should be noted that the geographical distribution shown in Table 4.3 attributes all productivity gains where the jobs are located. It does not take account of leakage and spatial spillovers. In response to productivity gains, firms are likely to reduce prices, which would mean passing on some benefits to customers – who may be located in different parts of the country. Neither does it recognise that a significant proportion of the additional GVA generated in Leeds will be earned by workers and owners residing in other parts of the country. Therefore, the results do not suggest that residents in these locations will face such gains and losses.

EarnBack

4.27 Potentially, as a result of the City Deal and putative Leeds City Region Strategic Economic Plan (LCR SEP), an EarnBack mechanism could be negotiated with Treasury. The proposition would be for a proportion of the additional £5.8m tax revenue that the Treasury would receive as a result of NGT to be returned to the City Region. Such an EarnBack proposition could be based on the premise that the Treasury support the Promoters borrowing additional funding and that the Promoters repay this, at least in part, using a proportion of the future taxation uplift resulting from NGT which is returned to the City Region. The Promoters could therefore potentially use this mechanism as a means to finance their share of the capital funding for the construction of the NGT Project, without the annual repayment cost of the borrowing being paid for fully from NGT revenue surpluses or other sources.

4.28 While similar mechanisms have been implemented in Manchester, the proposition for EarnBack is at an extremely early stage. Substantial further development work, including dialogue with Treasury, would need to be undertaken to understand better the potential opportunity for EarnBack with the NGT scheme. .

Summary of Wider Economic Impacts

4.29 Introducing NGT reduces the cost in terms of both time and money to travel between certain locations. This increases the attractiveness of these locations as both places to live and work.

- The With NGT Scenario has a forecast increase of **3,687 jobs** in Leeds District by 2031. This could be up to 5,036 jobs depending on car parking policy in Leeds City Centre.

4.30 Conventional cost-benefit analysis does not include the value of WEI attributable to agglomeration, labour supply, imperfect competition and moves to more productive jobs as a result of NGT. These benefits have been estimated using the outputs of the UDM, indicating a potential **29%** increase in economic benefits when WEI are taken into account.

- The With NGT Scenario has a forecast increase of **£9.6million** in welfare benefits due to WEIs in 2031 (a 29% uplift to the £32.7million conventional benefits in 2031, for a total benefit of £42.3million in 2031)
- Wider impacts account for £115m PV (in 2010 prices) and increase the User Benefits from £396m PV to £511m PV. Therefore, including WEIs in the BCR of the project increases the ratio from 2.96:1 to 3.71:1.

4.31 Impact on GVA (although not additional to the WEI) is another useful way to report the economic effects of NGT. GVA is forecast to increase in Leeds, and although there will be some reduction in surrounding areas, there is a net positive national effect.

- The With NGT Scenario has a forecast increase of **£235.6million** in GVA in Leeds District in 2031
- The With NGT Scenario has a forecast increase of **£18.7million** in net national GVA in 2031

4.32 A proportion of the forecast GVA impact will increase net national taxation revenues, indicating the potential for an EarnBack arrangement between the Leeds City Region and Treasury.

- The With NGT Scenario has a forecast increase of **£5.8million** in net national taxation revenues by 2031

APPENDIX

A

UDM VARIABLES USED IN WEI ANALYSIS

UDM VARIABLES USED IN WEI ANALYSIS

- Actual rail zone to zone fares with intervention[livezone,workzone, PT Route number]
- Bus travel to work trips CNA[livezone, workzone, Manual]
- Bus travel to work trips CNA[livezone, workzone, NonManual]
- Bus travel to work trips for CA[livezone, workzone, Manual]
- Bus travel to work trips for CA[livezone, workzone, NonManual]
- Bus value of time[Manual]
- Bus value of time[NonManual]
- Bus zone to zone off peak generalised times CA[livezone,workzone,Household type]
- Bus zone to zone off peak generalised times CNA[livezone,workzone,Household type]
- Bus zone to zone peak generalised times CA with intervention[livezone,workzone,Manual]
- Bus zone to zone peak generalised times CA with intervention[livezone,workzone,NonManual]
- Bus zone to zone peak generalised times CNA with intervention[livezone,workzone,Manual]
- Bus zone to zone peak generalised times CNA with intervention[livezone,workzone,NonManual]
- Car route generalised times with costs[livezone,workzone,Manual,route number]
- Car route generalised times with costs[livezone,workzone,NonManual,route number]
- Car travel to work trips[livezone, workzone,Manual]
- Car travel to work trips[livezone, workzone,NonManual]
- Convert HH to person[Household type,Manual]
- Convert HH to person[Household type,NonManual]
- Convert person to HH[Household type,Manual]
- Convert person to HH[Household type,NonManual]
- Current bus zone to zone fares with intervention[livezone,workzone]
- Current zone to zone generalised walk times CA[livezone, workzone, Manual]
- Current zone to zone generalised walk times CA[livezone, workzone, NonManual]
- Current zone to zone generalised walk times CNA[livezone, workzone, Manual]
- Current zone to zone generalised walk times CNA[livezone, workzone, NonManual]
- Fraction of bus to bus trips in peak
- Fraction of TTW trips in AM peak
- Jobs filled by business type and zone[workzone,bustype,Manual]
- Jobs filled by business type and zone[workzone,bustype,NonManual]
- Off peak business zone to zone times[Buszone,CustomerZone,bustype,route number]

- Off peak Car route generalised times[livezone,workzone,Household type,route number]
- Peak business zone to zone times[Buszone,CustomerZone,bustype,route number]
- rail travel to work for CNA[livezone,workzone,Manual]
- rail travel to work for CNA[livezone,workzone,NonManual]
- rail travel to work trips for CA[livezone, workzone, Manual]
- rail travel to work trips for CA[livezone, workzone, NonManual]
- Rail value of time[Manual]
- Rail value of time[NonManual]
- Rail zone to zone generalised time with intervention[livezone, workzone, Manual, PT Route number]
- Rail zone to zone generalised time with intervention[livezone, workzone, NonManual, PT Route number]
- total business to business trips[Buszone,CustomerZone,bustype]
- Walk to work for CNA[livezone,workzone,Manual]
- Walk to work for CNA[livezone,workzone,NonManual]
- Walk travel to work trips for car available[livezone,workzone,Manual]
- Walk travel to work trips for car available[livezone,workzone,NonManual]

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