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LEEDS BRADFORD INTERNATIONAL AIRPORT

Appraisal Specification Report

Final

19/11/2014

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1 Introduction

1.1 Purpose of the ASR

The purpose of this Appraisal Specification Report (ASR) is to document the methodology for taking forward the schemes and package options shortlisted as part of the study into the connectivity and accessibility of Leeds Bradford International Airport (LBIA) as described in an Option Assessment Report (OAR). The OAR acts as a precursor to this report. Commentary is provided terms of how the economic, environmental, social and operational impacts will be addressed should the schemes be progressed to more detailed stages of assessment.

Transport Analysis Guidance (TAG): The Transport Appraisal Process sets out the following which should be detailed within an ASR:

- Proposed approach to modelling and forecasting;
- The proposed methodology for assessing each of the sub-impacts presented within the AST;
- Proposed level of design or specification which will inform the cost estimation, and how better cost information will be obtained; and
- Evidence that views on the appraisal methodology have been sought from the statutory environmental bodies and others.

The report reflects the current stage of scheme development where it has been recommended that there are two schemes considered as potential options that could be taken forward.

1.2 The current stage of scheme development

WSP and Parsons Brinckerhoff (WSPPB) were jointly commissioned in March 2014 to undertake a study into the connectivity and accessibility of Leeds Bradford International Airport (LBIA). This study is one of six 'notorious and longstanding road hot spot' studies being undertaken, as identified in the governments strategic document "Investing in Britain's Future" (2013).

The objective of the study was to identify and appraise potential improvements that would substantially improve the connectivity of LBIA to its catchment area. The study takes account of the aspiration of the airport to grow and the surface access improvements that would be required to facilitate and serve this growth, including both road and public transport options. The study drew on the knowledge and expertise of local stakeholders, all previous work and proposals, and included a full examination of all pre-existing assumptions and conclusions.

The final study output has been the OAR appraising a wide range of options to ameliorate existing connectivity issues and facilitate the growth of the airport. The OAR presented a recommendation on a way forward with this ASR produced for the option identified as necessary for improving connectivity in the near term. In addition, as two schemes have been identified, one with a longer term timescale for delivery, the second scheme is also discussed.

1.3 Report structure

The remaining section of the report is structured with the following chapters:

- Challenges and issues;
- Options;
- Transport modelling;
- Economic appraisal;
- Scheme costs;

- Environmental appraisal;
- Operational assessment; and
- Summary.

2 Challenges and issues

2.1 Strategic case

The Evidence Review, undertaken as an early stage in the study, defined a number of problems that currently exist, or are expected to become more acute over time. This defines the strategic case for intervention.

LBIA attracts only 12% of its passengers from outside the Yorkshire and Humber Region. 58% of all passengers are from within the West Yorkshire area giving it a much smaller catchment than other regional airports. Conversely, more passengers in the Yorkshire and the Humber Region travel to Manchester Airport, (3.5 million) than LBIA (2.3 million). Collectively, the number of passengers not using LBIA in the Region is high; the total 'leakage' from the Yorkshire and the Humber region is 5.47 million passengers.

Currently 93.2% of passengers arriving at LBIA are by private vehicle giving a very poor mode share by sustainable modes. International travellers are more dependent on public and other transport modes as they do not have access to a private car. There are currently no direct rail services to LBIA, and poor interchange facilities exist at local rail stations. LBIA is served by direct and non-direct bus services from Leeds, Bradford, Harrogate and Otley, but private car (and Taxi) provide superior journey times compared to bus. Public transport accessibility to the airport from outside the Leeds City Region is limited.

When compared to other regional airports in this part of the UK, LBIA is the worst performing in terms of public transport accessibility.

Figure 1 – Existing highway signage at A65/A658 junction

In terms of the highway network, high traffic flows are located on a number of the surround highways, with congestion and queuing at peak periods around the following junctions:

- A658 / A660 (Signals);
- A657 / A658 Green gates Junction (Signals);
- A65 / A658 (Roundabout);
- A65 / A6120 (Roundabout); and
- A657 / A6210 (Roundabout).

Through meetings with stakeholders, it has been identified that interchange information (Leeds and Bradford Rail Stations and other transport hubs) and highway signage to LBIA is not clear and requires improving along the key corridors. This could be further enhanced by VMS to define likely travel times and improve perceptions.

3 Options

3.1 Options considered

During the study, a long list of schemes was identified to improve connectivity to LBIA. The long list was collated through consultation with representatives from the Stakeholder Reference Group and also by the project team, following analysis of issues identified through the Evidence Base gathered in the earlier stages of the project.

Information about the individual schemes was recorded in EAST (DfT Early Assessment and Sifting Tool) consisting of appraisal forms which allow summary information to be presented about schemes in a clear and consistent format. However, EAST is not designed to make recommendations, and TAG recommends that specific criteria or thresholds are set to determine which options pass or fail the sifting process and ensure that this is clearly explained in reporting.

Following this recommendation, the project study team developed a project focused LBIA Appraisal Framework, which assesses each of the long-list schemes against criteria, weighted specifically to the core objectives of the study.

The following schemes / packages were selected for further appraisal following the outline appraisal set out above.

Table 1 – Shortlist of Schemes and Packages prioritised for further appraisal (Short/ medium and Long term)

Short / Medium Term (5-10 years)

Scheme Type	Scheme Details	
Highway	A65 to LBIA Link Road	
	Package 1 – Bradford / Harrogate Corridor Junction Improvements	New Rd / Harrogate Rd
		New Line / Harrogate Rd
		A65 / A658 Roundabout
		A660 / A658 (Poole Bank Road)
Bus	Package 2 - Express Bus Services	Express Bus Service Leeds Train Station to LBIA
		Express Bus Service Bradford Interchange to LBIA to Harrogate
		Express Bus Service York to LBIA
Rail / Light Rail	Heavy Rail - Horsforth to LBIA – interchange at Horsforth New branch from Leeds to Harrogate rail line, extending out from Horsforth to LBIA. Interchange required at Horsforth. Following initial sensitivity testing, the appraisal identified that through services performed better than those requiring interchange,	
	LBIA Parkway Station (Harrogate Line) New station on Harrogate Line close to Bramhope Tunnel (between Horsforth & Weeton). Would require linking to airport via shuttle bus.	
Traffic Management	Improved signage and UTMC measures to improve routing	
Smarter Travel	Improved travel planning, information and ticketing issues	

Long Term (beyond 10 years)

Scheme Type	Scheme Details
Rail / Light Rail	Heavy Rail - Guiseley-LBIA-Horsforth A new rail line providing a connection between the Leeds-Ilkley line at Guiseley and the Leeds-Harrogate line at Horsforth with an intermediate stop at LBIA. Following sensitivity testing, the appraisal identified that through services performed better than those requiring interchange, and this is the recommended scheme.

3.2 The preferred option

At this stage the following two schemes are recommended as preferred options that could be progressed:

- Short/Medium Term - A65 to Leeds Bradford International Airport Link Road (Single Carriageway 40mph) with improved bus services to Leeds and Bradford delivered as a result of time savings from the highway changes (the primary focus of this ASR); and
- Long Term - Heavy Rail (Guiseley – LBIA – Horsforth) (also discussed).

It is also recommended that whichever option is progressed a combination of Traffic Management and Smarter Travel supporting measures are included as part of scheme implementation and operation. This would need to be more clearly defined once the detail of the infrastructure scheme itself was clarified.

Further assessment of the approach to model cordoning and the wider impacts of the link road are recommended, due to the observed increase in delays on the approaches to the link road, and at the Dyneley Arms junction (particularly to/from Harrogate). Whilst journey times are forecast to improve for the majority of movements, trips to and from Harrogate do experience some detriment as a result of the increased junction delays. Further optimisation of these junctions may be possible during more detailed analysis and scheme design.

Discussions with the Combined Authority and Bus Operators would be required in order to define more clearly how the bus services would be implemented. Similar discussions would be required with Network Rail and Train Operating Companies regarding rail operating patterns.

4 Transport modelling

4.1 Introduction

The modelling undertaken so far, as described in the OAR, was undertaken based on the existing Leeds Transport Model (LTM) which was made available for the study. For highway scheme modelling, the Saturn highway model (LTM_H) was used as a standalone model. For the public transport scheme modelling, the Cube Voyager public transport model (LTM_PT) was used but only to inform elements of a bespoke public transport spreadsheet model which was developed specifically for the study. The demand model (LTM_D) was only used in the sense that it informed the mode choice logit parameters and mechanism in the public transport spreadsheet model.

This section sets out the transport modelling requirements for taking the schemes and packages forward. The following topics are covered:

- Model availability and scope;
- Data age, availability, and survey programme;
- Supply model structure, calibration and validation;
- Demand model structure, realism and sensitivity testing; and
- Forecasting.

Future transport modelling will need to adhere to the appropriate TAG.

4.2 Model availability and scope

The LTM is considered the most appropriate modelling tool for further progressing the schemes and packages. It was developed by Aecom in association with the Denvil Coombe Practice (DCP) starting in 2008. It is a suite of models as follows:

- LTM_H (Highway model in the Saturn software);
- LTM_PT (Public Transport model in the Cube Voyager software); and
- LTM_D (Demand model primarily in the Emme software).

The LTM_D provides the demand responses to changes in costs in the two assignment models; it also includes a parking model. The model currently has a 2008 base year.

The LTM was originally commissioned with the purpose of using it to support a Transport Innovation Fund (TIF) bid as well as a number of related major schemes. However during the life of the model development this funding was removed by central government but Leeds City Council and Metro (now the West Yorkshire Combined Authority) still required the model to advise them on the development of transport strategies as part of their Transport for Leeds (TfL) initiative as well as the New Generation Transport (NGT) major scheme funding bid.

Other multi-modal models exist that provide some coverage of the airport and surrounding network, for example SYSTEM+. However the level of detail in the vicinity of the airport and scheme areas is less than that offered by LTM and therefore they are not considered as appropriate.

4.3 Data age, availability, and survey programme

4.3.1 Data age

The LTM highway model was developed using the following data sets (data age is shown in brackets):

- RSI (2008 – 2009);
- Household survey (2008);
- MCC – (2005 – 2009;
- ATC (2002 – 2009); and
- Journey time data (2007 – 2008).

The LTM public transport model (LTM_PT) was developed using the following data sets:

- Rail
  - Leeds station questionnaire survey (2008);
  - Leeds station footfall count (2008);
  - Northern rail ticket sales data (2008 – 2009); and
  - Northern rail loading counts (2008).
- Bus
  - On-bus surveys (2007 – 2008);
  - Ticket sales (ETM) Data (2008); and
  - Cordon counts (2008).

Design Manual for Roads and Bridges (DMRB), volume 12, section 1, part 1 (The Application of Traffic Appraisal to Trunk Road Schemes) recommends that models built primarily on data 6 years or greater are considered too old for assessment purposes and require some form of present year validation as a minimum.

Based on this it is suggested that more up to date data will need to be integrated into the model.

4.3.2 Movement coverage

For highway, the demand satisfactorily covers the movements of traffic arriving and departing at the airport and all highway schemes except for the New Line / Harrogate Road (Green gates) junction (part of Package 1 – Bradford Corridor Junction Improvements) which falls outside of the RSI cordons and the model area. For public transport the demand provides some coverage of the movements between the airport and Leeds city centre, but not for movements intercepting the other schemes.

Therefore it is recommended that the missing movements are captured as part of a new survey programme.

One of the areas of uncertainty identified in the modelling and appraisal for the study was the representation of demand in terms of capturing the benefits of both airport users, and non-users who would intercept the scheme and gain some advantage of it being in operation.

4.3.3 Survey Programme

It is recommended that a new survey programme is undertaken to collect primary and more recent data for the study, focussed in the vicinity of the airport and scheme areas. The surveys will need to cover both highway and public transport modes and incorporate schemes delivered recently, or in the process of being delivered (such as Horsforth Cross Roads). This will ensure the model is as up to date as possible, reflecting any changes to traffic assignment and flow.

TAG Unit M1-2 (Data sources and surveys), provides the relevant guidance on data collection.

4.4 Supply model structure, calibration and validation

4.4.1 Structure

4.4.1.1Spatial Detail

The highway supply model zone systems and networks are of sufficient detail within the vicinity of the airport and the wider Leeds district. However there is less detail outside of this area and beyond the Leeds district. This is a particular concern for modelling the New Line / Harrogate Road (Green Gates) junction. Therefore it is recommended that some further spatial detail is included in the model to better reflect the transport system at this location.

The public transport supply model network is also considered to be of sufficient detail within the vicinity of the airport and wider Leeds district. However it is recommended that the services are reviewed to ensure they provide a reasonable representation of the current public transport supply in the area of interest. Similarly to the highway model, it is recommended that further spatial detail is included in the model in the area of interest.

The initial tests run through the model produced no benefits, suggesting high levels of model 'noise' in the areas outside the scheme and study area. Further analysis of the impact of cordoning, and the detailed reasons for the disbenefits outside the scheme area were not undertaken during this stage of assessment. This remains an uncertainty and would need further investigation, in line with updates to the model for future scheme testing, as the scheme becomes more defined

4.4.1.2Time periods

The time periods represented in the existing LTM are average weekday as follows:

- Highway:
  - AM peak hours 7-8, 8-9 & 9-10;
  - Inter-peak average hour 10-16; and
  - PM peak hours 16-17, 17-18 & 18-19.
- Public Transport:
  - AM Peak period average hour 7-10;
  - Inter-peak average hour 10-16; and
  - PM peak hours average hour 16-18.

It is recommended that consideration is given to representing the weekend and time periods before and after the peaks which could be significant in terms of airport demand.

4.4.1.3User classes

The user classes represented in the existing LTM area as follows:

- Highway:
  - Car Personal Low Income (<15k);
  - Car Personal Medium Income (£15k to £30k);
  - Car Personal High Income (>£30k);
  - Car Employers Business;
  - LGV; and

- OGV.

- Public Transport:
  - Non concessionary fare payers; and
  - Concessionary fare payers.

The highway user classes provide segmentation between business and non-business users. The public transport user classes do not provide this segmentation. Appraisal requires scheme impacts to be segmented to business, commute and other.

It is recommended that the user classes are better aligned to demand at the airport, for example disaggregating between passenger and employees, business and leisure passengers.

4.4.1.4Vehicle types

The vehicle types represented in the existing LTM area as follows:

- Highway:
  - Car;
  - LGV; and
  - OGV;
- Public Transport:
  - Bus; and
  - Rail.

It is recommended that there is also consideration of representing taxi journeys in the model, because of the nature of travel to/from the airport where these may form a larger proportion than is typically observed.

4.4.1.5 Wait Time

An area of uncertainty in the study modelling and appraisal was the wait time assumptions. It is recommended that the core and alternative (sensitivity test) approaches are reviewed in terms of their appropriateness for representing wait time in the context of the LTM_PT.

4.4.1.6 Fares

Fares will need updating to a more recent price base and to reflect the changes recently implemented by the current operator, Yorkshire Tiger. Fares specific to the LBIA in terms of service operators and ticket types will need to be considered as there has been recent change in ticketing products.

4.4.1.7 Service Quality and In-vehicle time factors

The LTM included stop quality factors to represent stop and service quality. It is recommended that these are reviewed across the model to ensure the service quality in the vicinity of the LBIA is satisfactorily in place.

4.4.2 Calibration and validation

The existing LTM highway and public transport models were calibration and validated in line with TAG and agreed fit for purpose in the modelling and appraisal of the Leeds New Generation Transport (NGT) scheme.

Closer examination of the existing model in the vicinity of the airport identified the following in terms of model performance:

For highway:

- The model network coverage becomes too simplified outside of the Leeds district area, for example Bradford;
- Comparison of the model against observed flows demonstrates that the model performs well at a screen line level but less so in terms of individual count sites. There are some potentially significant locations with highway GEH values in excess of acceptable levels;
- Comparison of the model against observed journey times demonstrates that the model representation of journey times is mixed; and
- Demand at the airport is under-represented.

For public transport:

- Comparison of model flows against observed data shows that about half the sites comply with the 15% TAG threshold, and the majority within 25%; and
- Travel times covering key radials connecting peripheral areas in the model with Leeds city centre are all within 5% of AVL data.

It is recommended that the model is re-calibrated and validated as part of incorporating fresh data into the model and focussing validation in the vanity of the airport and scheme locations to ensure fitness for purpose in the scheme modelling.

4.5 Demand model structure, realism and sensitivity testing

4.5.1 The need for variable demand modelling

TAG Unit M2 Variable Demand Modelling sets out the criteria for determining the need for variable demand modelling. If these criteria are satisfied, it may be acceptable to limit the assessment of a scheme to a fixed demand assessment.

The test for variable demand modelling for the highway schemes undertaken for the study and described in the OAR identified that variable demand would be expected to have a significant impact on scheme appraisal.

The existing LTM demand model is described in the following sections below. It is suggested the set up could be retained, but with the following considerations:

- There will be a need to recalibrate and validate as part of the incorporation of fresh data into the highway and public transport models;
- Review the need for retaining the parking model;
- Representation of the weekend demand;
- Time period, user class and time period changes as described in section 4.4; and
- Re-defined model zone system in the scheme areas where there is insufficient spatial definition.

4.5.2 Demand Model Structure

The existing LTM_D model was developed at the same time as the highway and public transport supply models. It is a pivot-point incremental model that estimates changes in trip patterns relative to reference case matrix demand.

It includes the following component parts:

- A trip end model;
- A set of Emme data banks to hold demand and cost matrices;
- A parking model;

- A simplified Emme highway model, converted from Saturn;
- A user-interface; and
- A collection of DOS batch files, executables and Emme format macros that control the demand model operation.

The 2008 base demand matrices were created as part of the process of developing the highway and public transport models.

4.5.2.1Segmentation

Demand is segmented into the following time periods

- Early off-peak: Midnight – 7am;
- 7am to 8am;
- 8am to 9am;
- 9am 10am;
- Interpeak Period (IP): 10am to 4pm;
- 4pm to 5pm;
- 5pm to 6pm;
- 6pm to 7pm; and
- Late off-peak: 7pm to midnight.

These are linked to form tours within the demand model.

For the off-peak demand there has been no calibration or validation.

Demand is segmented by the following purposes and income types:

- Commuting Low Income;
- Commuting Medium Income;
- Commuting High Income;
- Home Based Other Low Income;
- Home Based Other Medium Income;
- Home Based Other High Income;
- Education Medium Income;
- Non Home Based Other Low Income;
- Non Home Based Other Medium Income;
- Non Home Based Other High Income;
- Heavy Goods Vehicles (HGV); and
- Light Goods Vehicles (LGV).

In addition to this segmentation, the mode choice model operates with demand segmented by car-availability as follows:

- No-car available (traveller belongs to a household owning no cars); and
- Car-available (traveller belongs to a household owning at least one car).

4.5.2.2Zone system

The zone system is the same as the highway and public transport supply models.

4.5.2.3Traveller Choice

The traveller choices are implemented as a series of logit modules in increasing order of sensitivity as follows:

- Trip frequency;
- Active mode choice;
- Motorised mode choice;
- Time period choice;
- Trip Distribution; and
- Parking choice.

Note that a trip frequency module exists at the top of the hierarchy but is not used in practice (i.e. the sensitivity is zero) because active mode choice is represented.

4.5.2.4Economic Data

The demand model estimates of generalised costs require the following economic data:

- Fuel prices for car and freight travel;
- Fuel usage for each vehicle type;
- Non-fuel vehicle operating costs; and
- Values of time.

All these data have been taken directly from TAG Unit 3.5.6

4.5.2.5Sensitivity Parameters

The sensitivity parameters are based on the illustrative values in TAG with small adjustments, but not in excess of 25%.

A cost dampening function has been used to reduce the sensitivity for long distance trips.

4.5.2.6Parking Model

The parking model estimates the choice of parking sites for trips in central Leeds. Search times are estimated based on a function of site capacity and occupancy. Car park charges are represented by parking duration between the arrival and departure time for a tour. The parking model has been calibrated based on demand entries and exits from parking survey data.

4.5.3 Sensitivity and Realism Testing

The existing demand model underwent sensitivity and realism tests as part of the base model development, calibration and validation.

It is important that these tests are reproduced as part of the recommended demand model update in accordance with TAG.

4.6 Forecasting

4.6.1 NTEM / TEMPRO

TAG unit M4 Forecasting and Uncertainty describes using NTEM growth at a suitable spatial area to define a core forecast scenario. NTEM was used in the existing LTM forecasts to provide a control to the quantity of growth in each district as well as providing information on how the demographics of the area will change and how car ownership is expected to rise over time.

It is recommended that this approach is suitable for generating new forecasts, whilst ensuring that the latest NTEM growth projections are applied.

4.6.2 Use of uncertainty logs

The purpose of the uncertainty log is to record the central forecasting assumptions that underpin the core scenario and record the uncertainty around these central assumptions. TAG unit M4 sets out the different categories of forecasting uncertainty which should be considered.

The existing LTM was developed based on a comprehensive uncertainty log reflecting scheme and development land use assumptions across the model area. This was sourced from the local planning authority, Leeds City Council. The data has been recently updated along the New Generation Transport (NGT) trolleybus scheme corridor and in Leeds City Centre as part of the NGT major scheme funding bid.

It is recommended that the existing model uncertainty log is reviewed and updated with more recent land use assumptions to support new forecasts as the Local Plan is finalised and land allocations become more defined.

4.6.3 Scenarios

TAG unit M4 Forecasting and Uncertainty describes the following scenarios which it is recommended are considered:

- Core;
- Low;
- High; and
- Alternative Scenarios – to test significant sources of local uncertainty

4.6.4 Sensitivity Tests

It is recommended that there is consideration of model parameter sensitivity tests to inform scheme modelling and appraisal uncertainty.

5 Economic appraisal

5.1 Introduction

This section sets out the economic appraisal requirements for taking the schemes and packages forward. The following impacts are covered:

- Transport Economic Efficiency (TEE);
- Accidents;
- Reliability;
- Regeneration / Wider Impacts;
- Social and distributional impacts;
- Impacts during construction and maintenance; and
- Annualisation.

The appropriate TAG units will need to be adhered to.

The economic appraisal results presented in the OAR were produced primarily using the DfTs Transport User Benefit (TUBA) software programme.

5.2 Transport Economic Efficiency

Transport Economic Efficiency (TEE) captures the monetised benefits for transport users and private sector providers. TAG Unit A1.3 User and Provides Impacts sets out the guidance for deriving transport economic efficiency.

It is recommended that TEE will be assessed using the DfT's Transport User Benefit (TUBA) software programme. The output results will need to be checked based on the TUBA Guidance for Checking Outputs.

For each scheme it is suggested that a highway and public transport model TUBA will need to be run to capture the associated benefits or disbenefits.

5.3 Accidents

TAG Unit A4.1 Social Impact Appraisal sets out the guidance for deriving accident benefits.

It is anticipated that assessment of accidents will be required for the highway schemes only. It is recommended that an accident assessment using the Cost Benefit Analysis Light Touch (COBALT) software is expected to be the most appropriate approach.

5.4 Reliability

TAG unit A1.3 User and provider impacts sets out the guidance for assessing reliability.

For the highway schemes, it is recommended that the assessment for urban roads is used which is based on a model to forecast changes in the standard deviation of travel time from changes in journey time and distance. This is used to estimate the monetised benefits in journey time variability.

For the public transport schemes, it is recommended that the reliability ratio for public transport is calculated to determine reliability benefits. Reliability data for services to and from the airport can be calculated using data from the West Yorkshire Real Time Information system, administered by the West Yorkshire Combined Authority, as this provides a consistent sample and far higher sample size than could be collected through roadside surveys.

5.5 Regeneration / Wider Impacts

5.5.1 Regeneration

It is recommended that the need for an assessment on regeneration impacts will be based on the approach set out in TAG Unit A2.2 Regeneration Impact. It is suggested that a regeneration report only needs to be considered for schemes that affect travel to, from, or within one or more regeneration areas. It is understood the airport does not represent a regeneration area based on current land designations and therefore a regeneration report is unlikely to be required. Any subsequent changes in the Local Plan designations would need to be considered in this respect.

5.5.2 Wider Impacts

TAG Unit A2.1 Wider Impacts sets out the relevant guidance.

It is recommended that the scope for wider impacts is undertaken to determine the need for assessment, based on the scheme area being within a Functional Urban Region (FUR). As an example, wards within the Leeds authority area comprise a mixture of hinterland and core functional urban regions. Therefore, for a scheme in Leeds, it is recommended that a wider impact assessment is required including the full compliments of items, as listed below.

Wider impacts that will be relevant to most schemes:

- Output change in imperfectly competitive markets; and
- Tax revenues arising from changes in labour supply;

Additional wider impacts based on scheme proximity to functional urban regions:

- Agglomeration; and
- Tax revenues arising from move to more or less productive jobs

5.6 Social and distributional impacts

TAG unit A4.1 Social impact appraisal sets out the relevant guidance.

For each scheme it is recommended that the guidance is followed to determine the appropriate method for assessment bearing in proportionality, for each of the following impacts:

- Physical Activity;
- Journey quality;
- Security impacts;
- Accessibility impacts;
- Personal affordability;
- Severance impacts; and
- Option values and non-use values.

5.7 Impacts during construction and maintenance

As part of the Transport Economic Efficiency assessment, costs to existing transport users due to the construction of a project and costs (or benefits) to users arising during future maintenance, where they are likely to be significant, should be assessed.

TAG unit A1.3 User and Provider Impacts provides guidance on the appropriate approach.

It is recommended that impacts during construction and maintenance are considered across all schemes and for different modes.

5.8 Annualisation

Annualisation factors for the modelling and appraisal described in the OAR were derived separately for highway and public transport as follows:

- Highway factors were based on traffic count data provide by Leeds City Council for a selection of sites located in the vicinity of the airport; and
- Public transport factors were based on passenger demand data provided by Yorkshire Tiger representing existing demand on services to and from the LBIA.

Annualisation factors will need to be derived to expand the benefits estimated from model outputs to cover the whole day and then a full year. TAG unit A1.3 User and Provider Impacts provides guidance on the appropriate approach.

It is anticipated that annualisation factors will need to be derived separately for highway and public transport as follows:

- For highway, it is recommended the annualisation factors are derived based on traffic count data in the vicinity of the airport and scheme areas; and
- For public transport it is recommended that passenger demand on services operating across the scheme areas and in the vicinity of the airport is used.

It is recommended that the representing non-modelled hours and seasonal variation is considered.

6 Scheme costs

Scheme costs for the scheme appraisal described in the OAR were outline only, derived based on a combination of consultants estimates (based on previous project experience) and cost estimates from schemes included in the West Yorkshire (Plus) Transport Fund.

TAG unit A1.2 Scheme costs provides guidance on the appropriate approach. Based on this consideration of the following cost elements is recommended:

- Base costs;
  - Investment (or capital);
  - Maintenance; and
  - Operating;
- Real costs changes over time;
- Forecast operating, maintenance and renewal costs;
- Treatment of cost risk and uncertainty;
  - Quantified risk assessment; and
  - Optimism bias.

The detail and certainty of the scheme costs will depend on the proposed level of scheme design, the time of implementation and any decisions over phasing. Further detailed assessment of the cost of the recommended schemes should be undertaken, considering the current levels of uncertainty resulting from only having a very indicative scheme description.

7 Environmental appraisal

7.1 Introduction

This section sets out the environmental appraisal requirements for taking the schemes and packages forward. The following impacts are covered:

- Noise
- Air quality;
- Greenhouse gases;
- Landscape;
- Townscape;
- Heritage or historic resources;
- Biodiversity; and
- Water environment.

The appropriate TAG units will need to be adhered to.

It is recommended that there is consideration in seeking the views of relevant statutory environmental bodies to inform the environmental appraisal methodology.

7.2 Noise

TAG unit A3 Environmental Impact Appraisal provides guidance on the appropriate approach.

It is recommended that the following five step approach method is followed:

- Scoping;
- Quantification of impacts;
- Estimation of the change in noise annoyance resulting from:
    - Increase or decrease in traffic flow on key links;
    - Increase in percentage heavy goods (this change is not expected to be significant);
    - Increase in speed;
    - Change in incline used by re-assigned traffic
    - Change in distance from source to receiver, and
    - Change in pavement surfacing.
- Monetary valuation of changes in noise impact; and
- Consideration of the distributional impacts of changes in noise.

We would expect the noise study area to broadly consist of the area between the start and end points of the physical works associated with the road project and an agreed distance boundary from the carriageway edge of the route, taking into account the elevated position of the highway in relation to some aspects of the surrounding area.

Particular reference to night time flows may be required in order to correctly assess the impacts of traffic in the early hours of the day to and from the airport.

Figure 2 – View towards Aire Valley from Link Road junction location on A65 showing elevated position

7.3 Air quality

TAG unit A3 Environmental Impact Appraisal provides guidance on the appropriate approach

It is recommended that the following six step approach method is followed:

- Scoping;
- Quantification of air quality impacts;
- The appraisal of local air quality impacts;
- The appraisal of regional air quality impacts;
- Monetary valuation of air quality impacts; and
- Consideration of the distributional impacts of changes in air quality.

In compliance with guidance contained in the Design Manual for Roads and Bridges (DMRB) (Volume 11, Section3), for air quality, each appraisal level has two components:

- The first is for local air quality, that is, estimation of pollutant concentrations that could change as a result of the proposals (nitrogen dioxide, oxides of nitrogen, fine particles (PM10)), carbon monoxide benzene and 1,3-butadiene) at specific locations. These concentrations are compared with the air quality criteria set to protect human health or vegetation, as appropriate. Both construction and operational effects should be considered for local air quality; and
- The second component is for the regional impact assessment and examines the change in emissions of a range of pollutants (oxides of nitrogen, particles, carbon monoxide, hydrocarbons and carbon) as a result of operation of the scheme as these can have impacts on the regional, national or international scale.

Throughout the assessment process, consideration should be given to the minimisation of any negative impacts of the project on air quality, and any resulting benefits from traffic reduction, delay reduction or traffic re-assignment.

For rail it is anticipated that regional air pollution emission impacts can be scoped out, however it is recommended that there is consideration of emissions savings from modal transfer.

Leeds has been at the forefront of Air Quality monitoring, with detailed monitoring being carried out since 1993. Much work on assessment has been carried out jointly with the University of Leeds. No current permanent air quality monitoring stations are situated in the area around the airport.

A number of diffusion tube sites have been monitored since 2008 in a number of relevant locations including Kirkstall, along Kirkstall Road and Rawdon.

Following Screening and Assessment processes undertaken by LCC in 2001, a number of Air Quality Management Areas (AQMAs) were identified following identified exceedances of annual mean Nitrogen Dioxide, covering relatively small areas around residential properties but none in the area of interest around the airport. In general terms, Air Quality objectives are likely to be exceeded where residential properties are located on busy roads with façades adjoining the road or at the back of a 2 metre pavement or at heavily trafficked road junctions.

The impact of the proposed schemes is intended to be traffic re-assignment away from such areas along existing highway sections and junctions. The proposal for the A65 – LBIA Link Road is not expected to generate any such conditions, but pre and post monitoring along the proposed route of the link road, and along highways expected to be positively affected, is recommended.

Further detailed assessment of the impact of traffic reassignment using outputs from the SATURN highway model and LCC AIRVIRO air quality model are recommended during the detailed design and assessment process, as highway link specifications and junction arrangements are clarified.

DMRB advises that the assessment should be carried out using traffic data for the “Do-Minimum” (without the scheme) and “Do-Something” (with the scheme) scenarios, for the opening year and a further future year (to be determined). The worst year in the first 15 years from opening needs to be assessed along with the base case.

A report presenting the assessment results will be required setting out a network diagram indicating roads affected by the proposals, together with information, either on the diagram on in tabular form, for existing year, and future year Do-Minimum and Do-Something traffic flows and speeds. Supporting this should be:

i. a constraints map for local air quality showing:
    a. which roads will be affected by the proposals;
    b. the 200 m boundary of roads affected by the proposals with properties and Designated Sites shown;
    c. boundaries of Air Quality Management Areas (AQMAs) and Designated Sites;
    d. Air Quality Strategy objectives and limit value exceedance areas without the proposals and a comment on whether these are likely to deteriorate or improve with the scheme and if known, the exceedance areas with the proposals;
ii. assessment of any existing air quality monitoring data or monitoring data collected as part of the scheme design;
iii. a description of the methodology used for any modelling and the verification of the approach used;
iv. results of any future year modelling and a description of that work;
v. results of the TAG appraisal for local air quality;
vi. an outline of further work, either modelling or monitoring, to be carried out at the next stage;
vii. identification of potential mitigation for any exceedances and what effect it is likely to have; and
viii. for the regional assessment, the total and change in emissions expected.

Detailed environmental assessment requires impacts to be located precisely. Geographically accurate link and node coordinates would be made available to the environment teams in order to support any assessments being undertaken.

7.4 Greenhouse gases

TAG unit A3 Environmental Impact Appraisal provides guidance on the appropriate approach.

For highway schemes, it is recommended that greenhouse gases are assessed using quantified outputs from TUBA. For public transport schemes it is not expected that TUBA will be appropriate.

7.5 Landscape

A description of the current landscape surrounding the airport and scheme areas is given in this section.

Pattern - The topography of the land places the airport at the top of a number of valleys, being the highest airport in England at 208m above sea level. As a result of this position, all approaches to the airport are hills, and therefore present particular engineering considerations when assessing schemes. Assessment of the A65 – LBIA Link Road will require particular consideration of the impact on land once the alignment is more defined. The area is largely undeveloped, consisting of green space, partial green belt and is close to an existing golf course.

Figure 3 – Approximate location of A65 Link Road junction (looking in direction of road alignment)

As the aspects (views) are not continuous, due to the varied nature of the topography (often described as 'rolling hills'), development is often well hidden and not visually intrusive. Rail lines are situated in the valley bottoms, away from the airport and water courses fall away to these valley bottoms at Horsforth and the along the Aire Valley.

Tranquillity – There are a number of existing highways in the area surrounding the airport, many of which carry significant volumes of traffic. Much of the highway traffic is non-airport based, travelling through the area from adjoining towns and villages such as Otley, Ilkley and Harrogate towards Leeds and Bradford. The area does have a relatively tranquil feel however, with small local centres, parks and greens providing a less dense development pattern.

Cultural – This area of West Yorkshire is characterised by stone built properties, villas and farm buildings, many of which are dated back to the 1600's. Increased levels of development appear to have occurred around the period from 1850 – 1900 and beyond, when a number of commercial property developments are noted[1].

Land Cover - The environment around the airport is largely rural (as illustrated in Figure 2) and consists largely of arable farm land and dispersed areas of housing. Concentrations of development exist at Rawdon, Yeadon and Horsforth and there are pockets of light industrial and hotel development closer to the airport and along the A65.

Summary of Character – Generally the area would be considered to be semi-rural with a distinct attractiveness that makes the need to treat scheme design with care in order to ensure that environmental aspects are considered and that designs mitigate the impact of noise and landscape detriment.

It is recommended that further guidance included in TAG unit A3 Environmental Impact Appraisal is followed as this provides detail of the appropriate approach for more detailed assessment as scheme designs become more detailed, including the staged assessment of landscape impacts and production of a Landscape Appraisal Worksheet.

[1] A History of Rawdon – D.C. Willcock

The impact on landscape could be significant, because of the characteristics set out above, and it is expected that careful consideration of scheme designs will be required in order to minimise the impact on landscape, townscape and ecology.

7.6 Townscape

Layout – As set out above, the area around the airport consists of dispersed development, generally residential in nature with supporting facilities including light/medium scale retail development and a small number of employment sites, generally consisting of light industrial and offices.

Figure 4 – General illustration of housing density at Rodley (A658/B6152 junction)

Density & Mix – Development is low density, with concentrations at Rawdon and Yeadon with Horsforth providing a wider range of facilities, and effectively representing the edge of the Leeds built up area. There are a number of active farms in the area, with associated farm buildings. Housing tends to be larger detached properties or smaller semi-detached housing on estates developed more recently.

The development of either rail or road options would not be expected to impact directly on the overall townscape, as each would be within an undeveloped area, although some sections of the scheme may overlook the route. The townscape assessment will need to consider whether certain design aspects can be influenced in order to minimise the impact on existing and future proposed development. There is an indication, through existing traffic modelling, that significant benefits to the existing townscape will be experienced, in terms of reduced levels of traffic flow, noise and intrusion.

TAG unit A3 Environmental Impact Appraisal provides further guidance on the appropriate approach for detailed assessment at later design stages.

7.7 Heritage or historic resources

As the proposed line of route for the A65 – LBIA Link Road and proposed Rail Link are indicative at this stage, and the majority of the route is inaccessible, being on private land, outline assessment of the impact on historic environment has not been undertaken, and would need to be completed at later stages including an assessment of how historic development may have been impacted during subsequent development.

It is known however, from outline assessment of the townscape character, and observation of the existing built environment, that the area includes a number of properties and developments dating back to the 1600's. There is also evidence of historic quarrying around Rawdon Billing and Yeadon tarn, along with Rawden Hill Manor, which receives mention in the Doomsday Survey, linked to land deals with William the Conqueror.

TAG unit A3 Environmental Impact Appraisal provides guidance on the appropriate approach including initial scoping and preparation at Stage 2 of the Historic Environment Impacts Worksheet which will need to be followed.

7.8 Biodiversity

No detailed assessment of biodiversity has been completed at this stage. An ecology assessment to provide a high level understanding of the scheme route will help identify potential ecological constraints and inform the requirement for further ecological surveys. The findings from the report should act as a sifting stage and pre-cursor to more comprehensive habitat and protected species surveys to support any works undertaken on the site as part of the construction process.

Details from West Yorkshire Ecology should be sourced to identify internationally, nationally and locally protected sites within 2km of the route of either scheme.

It should be noted that in addition to species protected under European and UK legislation, those listed under ODPM Circular 06/2005 Biodiversity and Geological Conservation and within Biodiversity Action Plans are capable of being material considerations in planning decisions.

In addition, Section 40 of the Natural Environment and Rural Communities (NERC) Act 2006 places a duty upon all local authorities and public bodies in England to have regard to the conservation of Habitats and Species of Principle Importance listed under Section 41 of the Act.

As the route of both the proposed highway and rail link passes through land which is largely rural in nature, it is expected that significant biodiversity impacts could be experienced and mitigation during construction and operation will be required.

7.9 Road Drainage and Water environment

The required assessment for the water environment includes a requirement to identify the size of the study area, and the key water environmental resources in this area that may be affected by the scheme construction and operation. There are a number of observed watercourses in the vicinity of the likely scheme area including:

- Gill Beck towards the River Aire; and
- Scotland Beck and Moseley Beck towards the valley carrying the Harrogate Rail Line close to Horsforth

Either a road or rail scheme has the potential to impact on water flow and the pattern of drainage and run off. Highway pavement surfaces in particular, with associated pollutants need careful management, with attenuation and interception before entering natural watercourses. The topography results in little risk of flooding, and the Environment Agency flood mapping indicates the rea around the River Aire in the foot of the valley being within Flood Zone 3, with similar risk being observed around Scotland Beck towards Horsforth, which could be immediately impacted upon by any diversion of natural or drained water flow from the road or rail schemes.

The primary risk from either scheme is therefore expected to be upon water run-off, rather than flood risk. The Stage 2 assessment required will describe the features of each key water environment resource, identify and characterise those key water environmental resources that may be affected by the proposal. The design of the scheme will inform this assessment by describing the surface water discharge points, expected flows and the potential resulting impact.

8 Long Term Scheme-Heavy Rail (Guiseley - LBIA - Horsforth)

There are a number of potential options that emerged from this study. Considering the overarching strategic objective of the study to identify and appraise measures to improve the existing connectivity between LBIA and its catchment area, in addition to the standard economic calculations resulting in the Benefit to Cost Ratio (BCR), we have considered the measures identified in the study to assess the impact of a particular scheme, these being:

- Travel time indicators: the average travel time from origins to destinations; and
- Accessibility indicator: providing a measure of the number/percentage of people able to access the airport.

Taking these all into account, and considering in particular the complexities that would be experienced in delivering rail based schemes, a longer term scheme to deliver rail connectivity to the airport has been identified and prioritised. This is the through service linking from Bradford via Guiseley and the Airport to Horsforth and Leeds.

Although currently presenting a relatively low (but positive) BCR, the limitations of the modelling approach highlighted during the study indicate that although the cost side of the equation appears relatively sound at this stage, the demand for a potential rail scheme is likely to be understated, particularly when considering intermediate journeys and the ability to provide longer distance through trips on the rail network. More detailed railhead and MOIRA demand modelling would help to understand the likely market for such a service, along with a consideration of other external influences that may impact upon demand for a rail service (such as land use changes away from the airport).

Further engineering analysis would be required to demonstrate the work needed in order to deliver a rail link considering local topography, along with analysis of rail timetable requirements and more detailed revenue forecasting. This scheme can only be delivered if other infrastructure investment allowing through services from Leeds and Bradford is forthcoming. It is likely that the scheme would need to be delivered in stages as these constraints can be tackled, possibly with the Leeds section being delivered first, because of the higher levels of demand and shorter distance.

Longer distance through services may be a step even further as this would involve a more complicated recast of the rail timetable and may have to be linked to changes delivered as part of the major investment for High Speed Rail.

This therefore has to be recognised as a longer term aspiration, linked to the shorter term highway and bus strategy set out in the earlier sections of this ASR, but could present an opportunity to implement improvements cumulatively, in line with expected performance, with staged construction to Leeds and then Bradford as network constraints can be released.

The Highway and Rail options should not be seen as mutually exclusive as they deliver a different set of benefits. New, emerging technology such as Tram Train may present additional opportunities and provide lower capital and operating costs, with better traction performance. The delivery of schemes should also be viewed in the context of significant changes to the transport network resulting from the delivery of High Speed Rail to the City Region (both HS2 and now potentially HS3). It is seen as essential that all areas of LCR can gain the benefits of High Speed connectivity, and new infrastructure will no doubt be part of emerging plans in this respect.

9 Summary

The following Appraisal Specification Summary Tables (ASST's) summarise the appraisal approach for further developing each of the short listed schemes.

Figure 1 Appraisal Specification Summary Table – Short/Medium Term - A65 to Leeds Bradford International Airport Link Road (40mph) with improved bus services to Leeds and Bradford

Impacts	Sub-impacts	Estimated impact in OAR	Level of uncertainty in OAR	Proposed proportionate appraisal methodology	Reference to evidence and rationale in support of proposed methodology	Type of Assessment Output (Quantitative / Qualitative / Monetary /Distributional)
Economy	Business & transport providers	£69,421	Some uncertainty	TUBA (TAG Unit A1.3)	Section 5.2	Monetary
	Reliability impact on Business users	Moderate Beneficial	Some uncertainty	Assessment for urban roads (TAG Unit A1.3)	Section 5.4	Monetary
	Regeneration	Moderate Beneficial	Some uncertainty	Scope need for regeneration (TAG Unit A2.2)	Section 5.5	Qualitative
	Wider Impacts	Neutral	Some uncertainty	Scope wider impact requirements (TAG Unit A2.1)	Section 5.5	Monetary
Environmental	Noise	Slight Negative	Some uncertainty	Five step approach (TAG Unit A3)	Section 7.2	Qualitative
	Air Quality	Moderate Beneficial	Some uncertainty	Six step approach (TAG Unit A3)	Section 7.3	Qualitative
	Greenhouse gases	Moderate Beneficial	Some uncertainty	TUBA (TAG Unit A1.3)	Section 7.4	Monetary
	Landscape	Moderate Adverse	Some uncertainty	TAG Unit A3	Section 7.5	Qualitative
	Townscape	Slight Beneficial	Some uncertainty	TAG Unit A3	Section 7.6	Qualitative
	Heritage of Historic resources	Neutral	Some uncertainty	TAG Unit A3	Section 7.7	Qualitative
	Biodiversity	Slight Adverse	Some uncertainty	TAG Unit A3	Section 7.8	Qualitative

Impacts	Sub-impacts	Estimated impact in OAR	Level of uncertainty in OAR	Proposed proportionate appraisal methodology	Reference to evidence and rationale in support of proposed methodology	Type of Assessment Output (Quantitative / Qualitative / Monetary /Distributional)
	Water Environment	Slight Adverse	Some uncertainty	TAG Unit A3	Section 7.9	Qualitative
Social	Commuting and Other users	£71,552	Some uncertainty	TUBA (TAG Unit A1.3)	Section 5.2	Monetary
	Reliability impact on Commuting and Other users	Moderate Beneficial	Some uncertainty	Public Transport Reliability Ratio (TAG Unit A1.3)	Section 5.4	Monetary
	Physical activity	Neutral	Some uncertainty	TAG Unit A4.1	Section 5.6	Qualitative
	Journey quality	Large Beneficial	Some uncertainty	TAG Unit A4.1	Section 5.6	Qualitative
	Accidents	Moderate Beneficial	Some uncertainty	COBALT (TAG Unit 5.3)	Section 5.3	Monetary
	Security	Neutral	Some uncertainty	TAG Unit A4.1	Section 5.6	Qualitative
	Access to services	Slight Beneficial	Some uncertainty	TAG Unit A4.1	Section 5.6	Qualitative
	Affordability	Neutral	Some uncertainty	TAG Unit A4.1	Section 5.6	Qualitative
	Severance	Moderate Beneficial	Some uncertainty	TAG Unit A4.1	Section 5.6	Qualitative
	Option values	Neutral	Some uncertainty	TAG Unit A4.1	Section 5.6	Qualitative
Public Accounts	Cost to Broad Transport Budget	£37,249	Some uncertainty	TUBA (TAG Unit A1.3)	Section 6	Monetary
	Indirect Tax Revenues	-£2,642	Some uncertainty	TUBA (TAG Unit A1.3)	Section 6	Monetary

Figure 2 Appraisal Specification Summary Table – Long Term - Heavy Rail (Guiseley – LBIA – Horsforth).

Impacts	Sub-impacts	Estimated impact in OAR	Level of uncertainty in OAR	Proposed proportionate appraisal methodology	Reference to evidence and rationale in support of proposed methodology	Type of Assessment Output (Quantitative / Qualitative / Monetary /Distributional)
Economy	Business & transport providers	£23,983	Some uncertainty	TUBA (TAG Unit A1.3)	Section 5.2	Monetary
	Reliability impact on Business users	Moderate Beneficial	Some uncertainty	Public Transport Reliability Ratio (TAG Unit A1.3)	Section 5.4	Monetary
	Regeneration	Moderate Beneficial	Some uncertainty	Scope need for regeneration (TAG Unit A2.2)	Section 5.5	Qualitative
	Wider Impacts	Neutral	Some uncertainty	Scope wider impact requirements (TAG Unit A2.1)	Section 5.5	Monetary
Environmental	Noise	Slight Negative	Some uncertainty	Five step approach (TAG Unit A3)	Section 7.2	Qualitative
	Air Quality	Moderate Beneficial	Some uncertainty	Six step approach (TAG Unit A3)	Section 7.3	Qualitative
	Greenhouse gases	Moderate Beneficial	Some uncertainty	TUBA (TAG Unit A1.3)	Section 7.4	Monetary
	Landscape	Moderate Adverse	Some uncertainty	TAG Unit A3	Section 7.5	Qualitative
	Townscape	Slight Beneficial	Some uncertainty	TAG Unit A3	Section 7.6	Qualitative
	Heritage of Historic resources	Neutral	Some uncertainty	TAG Unit A3	Section 7.7	Qualitative
	Biodiversity	Slight Adverse	Some uncertainty	TAG Unit A3	Section 7.8	Qualitative
	Water Environment	Neutral	Some uncertainty	TAG Unit A3	Section 7.9	Qualitative

Impacts	Sub-impacts	Estimated impact in OAR	Level of uncertainty in OAR	Proposed proportionate appraisal methodology	Reference to evidence and rationale in support of proposed methodology	Type of Assessment Output (Quantitative / Qualitative / Monetary /Distributional)
Social	Commuting and Other users	£41,939	Some uncertainty	TUBA (TAG Unit A1.3)	Section 5.2	Monetary
	Reliability impact on Commuting and Other users	Moderate Beneficial	Some uncertainty	Public Transport Reliability Ratio (TAG Unit A1.3)	Section 5.4	Monetary
	Physical activity	Neutral	Some uncertainty	TAG Unit A4.1	Section 5.6	Qualitative
	Journey quality	Large Beneficial	Some uncertainty	TAG Unit A4.1	Section 5.6	Qualitative
	Accidents	Moderate Beneficial	Some uncertainty	TAG Unit 5.3	Section 5.3	Monetary
	Security	Neutral	Some uncertainty	TAG Unit A4.1	Section 5.6	Qualitative
	Access to services	Slight Beneficial	Some uncertainty	TAG Unit A4.1	Section 5.6	Qualitative
	Affordability	Neutral	Some uncertainty	TAG Unit A4.1	Section 5.6	Qualitative
	Severance	Moderate Beneficial	Some uncertainty	TAG Unit A4.1	Section 5.6	Qualitative
	Option values	Neutral	Some uncertainty	TAG Unit A4.1	Section 5.6	Qualitative
Public Accounts	Cost to Broad Transport Budget	£143,932	Some uncertainty	TUBA (TAG Unit A1.3)	Section 6	Monetary
	Indirect Tax Revenues	£2,583	Some uncertainty	TUBA (TAG Unit A1.3)	Section 6	Monetary

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