Department for Transport

TAG Unit A2.2

Appraisal of Induced Investment Impacts

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Department for Transport

Transport Analysis Guidance (TAG)

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This TAG Unit is guidance for the **Appraisal Practitioner**

This TAG Unit is part of the family **A2 - Economic Impacts**

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1. Overview

1.1 Introduction

1.1.1 This unit provides guidance on how to quantify and value induced investments impacts – changes in the level or location of private sector investment as a result of a transport investment – for their inclusion within transport appraisal as part of the value for money assessment; and as non-welfare metrics such as number of jobs and GDP. The particular induced investments captured in this unit include dependent development and output change in imperfectly competitive markets.

1.1.2 Transport investments can have a broad spectrum of impacts and it is by no means certain that private sector investment will increase at either the local or national level; any induced investments will be context specific. For this reason, prior to analysing induced investment impacts, scheme promoters should develop an Economic Narrative, which articulates and justifies the scope of the analysis; this will inform the Appraisal Specification Report (ASR). The Economic Narrative should contain information on the following: (1) a summary of the expected induced investment impacts and justification for their occurrence on the basis of economic theory and context specific evidence; (2) the associated welfare change (including the identification of any relevant market failures); and (3) the methods to quantify and value the impacts.

1.1.3 In line with the principles of HM Treasury Green Book guidance, the Department's appraisal process uses welfare analysis to determine value for money.[1] Under a well-defined set of circumstances, user benefits will capture the entire welfare effects of a transport investment, including investment impacts. However, if there are (a) significant feedback effects into the transport market as a result of land use change or (b) 'distortions' or market failures that mean the economy is not functioning efficiently, additional benefits (or disbenefits) will arise as the impact of transport investment is transmitted into the wider economy.

1.1.4 The value for money assessment is based on national welfare impacts. Key to any assessment of induced investment is **displacement** – the extent to which induced investment impacts at the local level represent a relocation of investment from other locations. Changes in investment at a local level may not represent benefits at a national level.

1.1.5 In specific circumstances induced investment impacts may also be valued in terms of changes in non-welfare metrics, for example Gross Domestic Product (GDP). Both welfare and non-welfare measures of induced investment impacts are reported in the Economic Case. Non-welfare measures may be referenced

[1] https://www.gov.uk/government/publications/dft-value-for-money-framework

in the Strategic Case, if they help inform the extent to which a transport scheme will achieve an economic objective, such as to rebalance the economy or regenerate a specific area.

1.1.6 The analysis which informs the non-welfare estimates referenced in the Strategic Case should use the same: scenarios in terms of the magnitude, nature and location of economic impacts; core assumptions such as population, employment and workforce skills; discount year; modelling of shocks; appraisal period and price base as welfare estimates.

1.1.7 This unit is structured as follows:

- Section 2 “Understanding Induced Investments” explains the mechanisms by which transport schemes can impact on private sector investments and the circumstances in which these impacts may increase welfare over and above user benefits;
- Section 3: “Quantifying and Valuing Dependent Developments” provides guidance to value the welfare and GDP effects associated with dependent developments;
- Section 4: “Quantifying and Valuing Output Change in Imperfectly Competitive Markets” provides guidance to value the welfare and GDP effects associated with imperfect competition; and
- Section 5 “Reporting Induced Investment Impacts” provides guidance for reporting the welfare and GDP effects associated with induced investments in the Strategic and Economic Cases, as well as the information to be included in the Economic Impacts Report.

2. Understanding Induced Investments

2.1 Introduction

2.1.1 Induced investments refer to changes in investment as a direct response to a transport investment. Changes in investment will affect the level and location of economic activity, and as a result output, employment and productivity. This section outlines the transmission mechanisms through which transport investment can affect investment and how the impacts can be included in a Transport Business Case.

2.1.2 The section is structured as follows:

- Section 2.2 explains the transmission mechanisms through which transport investments can induce investment and the concept of displacement;
- Section 2.3 provides guidance for measuring the impact of induced investments in the Transport Business Case;
- Section 2.4 provides guidance on producing an Economic Narrative; and

- Section 2.5 discusses how private-sector investments should be appraised where they are dependent on a number of complementary interventions (not just local transport improvements).

2.2 Transmission Mechanisms and Displacement

2.2.1 Through improving accessibility, as measured by reductions in generalised travel costs, transport investment may induce behavioural changes in terms of firms' investment decisions. As mentioned in A2.1 - Wider Impacts Overview, accessibility improvements are equivalent to productivity increases, as output can be produced with reduced resources (time and financial). Productivity increases can also be considered as increases in the effective returns to capital and labour: employees can allocate less time to work purposes due to reductions in commuting travel time, which means the opportunity cost of working is reduced (a similar argument holds for businesses).

2.2.2 Increases in the effective returns to labour and capital, the corollary of GTC reductions, will be transmitted to secondary markets, as households and businesses change their behaviour in response to the new opportunities. With respect to increases in the effective returns to capital, businesses may change their decisions about the desirable level or location of investment and hence economic activity, as a result impacting output, employment and productivity.

2.2.3 Induced investments are associated with land use change (changes in the purpose or intensity of usage). For example, if a transport investment were to induce a housing developer to replace terraced housing with an apartment block (induced investment), this would be equivalent to an increase in the intensity of usage. Similarly, if a manufacturing business were to relocate from an urban to a rural area, it may involve a change in the purpose of land use in the latter from agricultural to manufacturing.

2.2.4 The impacts of induced investments will be context specific; the type and magnitude of economic impacts which occur will depend on the scheme type and more importantly the local attributes, such as workforce skills and developable plots. Given the importance of local attributes, complementary interventions, such as investment in skills and land zoning, may be required for the full potential of the transport investment to be realised.

2.2.5 Understanding these impacts is important – not least – because any changes in the level and location of economic activity will change the demand for travel. These feedback effects have the potential to change accessibility, as measured by generalised travel costs, and lead to further changes in behaviour and economic activity. An important role of the Economic Narrative is to understand the potential significance of these feedback effects and to consider how these can be represented in the modelling approach – see A2.1 - Wider Impacts Overview for more details.

Displacement effects

2.2.6 Key to any assessment of the impact of induced investment in secondary markets is additionality. In accordance with HM Treasury Green Book guidance, only government expenditure which affects the supply-side of the economy is considered additional.

2.2.7 Value for Money (VfM) assessments are made at a national level irrespective of scheme size, scope and funding arrangements.[2] Welfare changes at a national level alone are considered additional. An analysis of the impacts of alternative schemes can still be done at a local level; the results should be reported in the Economic Case and may be referenced in the Strategic Case to inform the extent to which the scheme achieves local economic objectives.

2.2.8 The extent to which an induced investment is additional will be dependent on the level of deadweight and displacement.

- Deadweight – this describes the situation in which a rise in investment is expected to occur in both the do-something (with-scheme) and the do-minimum (without-scheme) scenarios and
- Displacement – the extent to which investment is relocated from one industry or location to another.

2.2.9 Displacement can occur in many markets, for example:

- Capital market – the decision to undertake a given investment may be at the expense of other potential investments. For example, a transport scheme may affect where a developer decides to build new offices rather than affecting the total number offices built or the type of investment (e.g. retail or residential development).
- Product market – increased production by one business may lower the demand for goods of their competitors. For example, a new supermarket may draw customers away from existing retailers.
- Labour market – an investment may draw inputs such as labour away from alternative uses. As a consequence, transport schemes may influence the location (but not necessarily the level) of total employment - see TAG unit A2.3 for details.

2.2.10 If induced investment leads to displacement of economic activity, the areas or industries losing economic activity will experience a loss of investment. For example, if households were to move to a new residential development and abandon existing houses, the net national impact would equal the value of the new houses less the value of abandoned properties. Likewise, if consumers were to shop at a new retail development and abandon an existing shopping area, the net national impact would equal the value of the new retail development less the value of the abandoned retail units.

[2] https://www.gov.uk/government/publications/dft-value-for-money-framework

2.2.11 In line with HM Treasury Green Book guidance, the default position when undertaking an economic appraisal is to assume the economy is operating at full employment and that there is 100% displacement at the national level from any interventions. To move away from this default assumption, scheme promoters should provide credible evidence of additionality. Ideally, they should provide evaluation evidence, but the Department acknowledges that this is currently limited. Alternatively, scheme promoters should provide practical, qualitative evidence to justify the additionality of impacts, such as comparing the amount of the land available for development to the proposed number of dwellings/employment space required to meet the underlying population and labour market pressures. In order to estimate the complete extent of additionality, scheme promoters should consider a large enough geographical area to fully capture the behavioural responses of households and firms at the national level - refer to Section 3.6 in TAG Unit A.2.1 for more detail on the Size of Geographical Study Area and Displacement.

2.3 Measuring Induced Investments

2.3.1 The Department's appraisal process is based on the principles of the HM Treasury Green Book guidance, which advocates the use of cost-benefit (welfare) analysis to determine the value for money of investment spend. Welfare analysis captures a broad range of impacts, such as economic, environmental and social. The results of welfare analysis are reported in the Economic Case and inform the value for money assessment.

2.3.2 GDP and other non-welfare metrics may be used to inform the extent to which economic objectives, which are included in the Strategic Case, are achieved. These non-welfare metrics must be reported in the Economic Case but **not** included in the Value for Money assessment – see TAG Unit A2.1, Section 2 for information on the links between GDP and Welfare analysis.

Welfare Analysis

2.3.3 Within Welfare analysis, economic impacts are primarily captured by the estimation of user benefits – see TAG Unit A1.3 - User and Provider Impacts. Under a well-defined set of circumstances, user benefits will capture the entire welfare impact of a transport investment. These conditions are that the feedback effects into travel demand, as a result of land use change, are insignificant and that the rest of the economy is operating perfectly efficiently. Whilst improvements in transport may be transmitted into the wider economy (e.g. increased productivity being passed through as reduced demand for labour) under these assumptions, such changes are simply transfers - they net out in aggregate and can be ignored.[3]

2.3.4 These conditions fail if there are (a) significant feedback effects into the transport market as a result of land use change or (b) 'distortions' or market failures that mean the economy is not functioning efficiently. In these situations,

[3] See TIEP (2014).

additional benefits (or disbenefits) may arise when the impact of transport improvements is transmitted into the wider economy.

2.3.5 Table 1 defines and describes market failures and distortions associated with induced investments. This unit provides guidance to appraise induced investment impacts associated with two particular types of market distortions: dependent developments, which are associated with land rationing, and investments, to expand output in imperfectly competitive markets. Sections 3 and 4 provide guidance as to how these wider economic impacts can be quantified and valued.

Table 1 – Market failures and distortions associated with induced investments

Market failures and distortions	Explanation	Potential context-specific evidence to identify market failures and distortions
Product markets		
Imperfect competition	Where markets are dominated by a small number of businesses, there is a risk that supply is restricted in order to raise prices above marginal production costs. This may result in an inefficiently low levels of production and investment in this sector.	• Small number of businesses in a given sector. • Evidence for 'barriers to entry' of a given market. • Evidence that businesses in this sector have 'market power' (i.e. can set prices above marginal production costs).
Tax distortions	Firms make investment decisions on the basis of private costs and benefits. Nevertheless, the requirement to pay tax on profits may distort businesses incentives, potentially resulting in an inefficiently low levels of production and investment.	• Evidence that tax distortions are influencing businesses' investment decisions.
Positive externalities from product variety	There may be positive externalities to consumers and businesses as a result of an increase in the variety of goods and services available.	• Evidence that proposed investments will significantly increase the variety of goods and services available
Land markets		
Imperfect competition	If land is owned by a small number of individuals or institutions, there is a risk that supply is restricted in order to raise the value of developed land. This may result in an inefficiently low level of investment in new developments.	• Land held by a small number of land-owners. • Large areas of under-utilised land in city centres (e.g. warehouses, poor quality developments etc).

Co-ordination failure	Developers may under-invest in local transport improvements due to co-ordination failure, resulting in an inefficiently low level of investment in new developments.	• Evidence that there are a number of developers who might benefit from local transport improvements.
Land rationing	Planning policies may be inefficiently restrictive, resulting in an inefficiently low level of investment in new developments.	• Significant differential between the price of developed and un-developed land in the local area.

2.3.6 In addition, there are further ways in which private-sector investments may result in wider economic impacts. For example:

- **Dynamic clustering**– Increases in economic activity near existing economic clusters may result productivity benefits due to 'dynamic clustering' – see TAG Unit A2.4.
- **Employment impacts** - New non-residential developments may be associated with a move to more/less productive jobs – see TAG Unit A2.3.
- **'Attractiveness' benefits** – new commercial, industrial or retail developments may benefit existing businesses and consumers by increasing the variety of goods and services available. These benefits are only likely to be significant for large-scale developments such as station-area regeneration schemes. Currently TAG does not include methods for estimating these impacts; however, Venables (2015) includes a discussion regarding how these impacts may be quantified.

2.3.7 There are a number of other potential market failures and distortions, which may occur in specific local contexts. If other types of market failures are considered relevant to a particular scheme, these should be justified in the Economic Narrative. See TAG Unit M5.3 on Supplementary Economy Modelling for guidance on the analytical principles for assessing these market failures.

Gross Domestic Product

2.3.8 In certain circumstances GDP analysis may be used to supplement the cost benefit analysis, such as scheme prioritisation or understanding market failures not captured in the wider economic impacts guidance. For full details on assessing the costs and benefits of economic impacts and the circumstances in which GDP analysis may be warranted, see TAG Unit A2.1.

2.3.9 Gross Domestic Product measures the value of marketable output produced by the factors of production and not the change in welfare. For this reason, it should **not** be included in the Value for Money assessment. GDP estimates should be reported in the Economic Case. If they inform specific economic objectives, such as to rebalance the economy or regenerate a local area, the Strategic Case may refer to these.

2.3.10 In many instances the economic objectives of the Strategic Case will be locally focussed, such as to increase investment and GDP in a regeneration area. In such circumstances, displacement may not be a primary concern of the scheme objectives. However, the national GDP impact should also be presented alongside these local impacts. This sets the local impacts in the broader national context.

2.4 Economic Narrative

2.4.1 Any analysis of induced investment impacts should be justified in an Economic Narrative, as set out in A2.1 - Wider Impacts Overview. Within the Economic Narrative, the scheme promoter should describe what, if any, induced investment impacts are expected to occur and justify these. In addition, the scheme promoter should identify the welfare impacts associated with any investment impacts, whether these impacts are captured fully by user benefits or whether there are market failures, which provide additional sources of benefits and disbenefits. Finally, the Economic Narrative should outline the methodologies which will be utilised to quantify and value the induced investment impacts. Box 1 provides a checklist of the types of information, which should be provided in the Economic Narrative when assessing induced investment impacts.

2.4.2 The next sections of this unit provides guidance to estimate two potential induced investment impacts: dependent developments – new residential or non-residential developments which require a complementary transport investment to receive planning approval; and the output change in imperfectly competitive markets – an increase in the production of goods or services where businesses benefiting from the transport improvement compete in imperfectly competitive markets.

2.4.3 If alternative transmission mechanisms or market failures have been identified, or it is decided to utilise more context specific parameters in the analysis than those presented in this unit, the economic impacts can be assessed – see TAG Unit M5.3 for guidance on the use of Supplementary Economic Modelling. Note the results of Supplementary Economic Modelling should be reported as indicative monetised impacts or non-monetised impacts in the Value for Money assessment. Subject to certain criteria being met, indicative monetised impacts can be included in the indicative benefit cost ratio (BCR) metric – see value for money guidance for more information.

2.5 Complementary Interventions

2.5.1 The outcome of a transport scheme may depend on a range of complementary public- and private-sector interventions. For example, proposed new developments may be ‘dependent’ on a number of other public-sector or private interventions in order to proceed, such as the provision of utilities or policies to develop the skills of the local workforce.

2.5.2 All relevant complementary interventions should be identified and justified in the Economic Narrative. In addition, the assumptions about the likelihood they will proceed and how they will be represented in the analysis should be explained.

2.5.3 The core scenario from transport appraisals should include only those complementary interventions which are near certain or more than likely to occur. Alternative scenarios should also be presented alongside under a range of plausible assumptions for these complementary interventions (e.g. alternative assumptions for developable land). For further information on scenario testing see TAG Unit M4 - Forecasting and Uncertainty.

Box 1: Example Information required in Economic Narrative for Induced Investment Impacts and Output Change in Imperfectly Competitive Markets

Below is a checklist of the types of information that should be presented in the Economic Narrative, if induced investment impacts are to be analysed. **This list is not exhaustive,** and additional information may be required to set the context of the transport investment, justify the impacts and explain the appraisal approach.

1. Expected induced investment effects

- Is the transport investment expected to have induced investment impacts?
  - If so, what effects are expected to occur?
- Is the Transport scheme expected to have any other wider economic impacts such as agglomeration/disagglomeration effects?
- Are the induced investment impacts and any other wider economic impacts expected to be additional at the national level?
- Are the impacts dependent on any non-transport complementary interventions?
  - If so, what complementary interventions are required and what is their relative importance in the realisation of the expected impact? Are the impacts expected to be additional at the national level?

2. Justify induced investment impacts

- What is the transmission mechanism through which transport investment is expected to have induced investment effects?
- What evidence is there that transport acts as a barrier to investment?
- What evidence is there that firms will make additional investment as a result of the transport investment?

3. Dependent developments

- Has context-specific evidence been presented that the private-sector investment decision is 'dependent' on the transport improvement (i.e. will not occur without the scheme)?
- If the private-sector investment will proceed even without the scheme, then associated welfare impacts cannot be attributed to the scheme.
- Has planning permission been granted? If so, is it conditional on local improvements to the transport network?
- Is the transport improvement expected to 'unlock' land for development which couldn't previously be accessed?
- Have all complementary interventions together with their relative importance in the realisation of the development been identified?

- To what extent will the development displace economic activity?
  - Is there relevant evaluation evidence?
  - Have underlying population/labour market pressures been considered?
  - Have alternative development sites been identified at both a local and national level?
  - Have details on the planned number and type of dwellings/employment space at different development sites been accounted for?
- In the case of 100% displacement, are there broader strategic objectives for the investment (for instance supporting sustainable travel, potential for future expansion, or other wider economic impacts)?

4. Output change in imperfectly competitive markets

- Do businesses benefiting from the transport improvement compete in imperfectly competitive markets?
- Is the expansion of production of goods and services 'dependent' on the transport improvement?

5. Quantifying and valuing induced investment impacts

- How are the induced investment effects to be quantified and valued?

3. Quantifying and Valuing Dependent Development

3.1 Introduction

Defining dependent development

3.1.1 A dependent development is a very particular case of induced investment. It is a special type of development where a transport improvement “unlocks land” and there is a clear intention to develop it. It is distinct from other types of development and land use change captured in appraisal.

3.1.2 The National Trip End Model (NTEM) contains forecasts of population, households and employment and allocates this across Great Britain. The accommodation of these households and employees will necessitate new residential and non-residential developments. However, these developments

may be dependent upon complementary investments, such as transport investment, utility connections or the provision of school places. Dependent development is the name given to those residential and non-residential developments which require a complementary transport investment.

3.1.3 Dependent development typically has one of these characteristics set out below:[4]

- **Development that is 'directly enabled' by the transport improvement.** The transport improvement directly alleviates land constraints, such that the land would not have been developed at all in the absence of the intervention (i.e. the 'without-scheme' scenario).[5] This is usually within the site boundary of the transport improvement – without the transport improvement, the developable land does not exist or is inaccessible.

- **Development that is 'partially enabled' by the transport improvement.** This is where the transport improvement alleviates transport capacity constraints, which in turn alleviates land constraints allowing the full development to go ahead (i.e. the 'with-scheme' scenario). However, some of the land could have been developed in the without-scheme scenario. A dependency is likely to occur where a development will breach 'a reasonable level of service' on the transport network. This is a tipping point where the existing transport network cannot reasonably accommodate the additional traffic associated with the full development, hence the need to provide complementary transport investment. In this 'partially enabled' scenario, some of the development could take place without the transport improvement until the tipping point is reached.

3.1.4 In both cases, land constraints are being alleviated but in slightly different ways, and there must be a clear link to a market failure (usually 'land rationing'). In addition, a dependency test is usually required to establish whether the development is 100% dependent (therefore "directly enabled") or only partially dependent (e.g. a portion of the development can go ahead without overwhelming the transport network). However, there may be some specific cases of 'directly enabled' development where a dependency test is not required. Section 3.2 provides illustrative examples of how this may work in practice.

3.1.5 The development may have planning permission conditional on a transport investment. However, this is not a prerequisite for it to be considered dependent development. For example, a housing development could be dependent on a road scheme to gain planning permission. But it could fail the dependency test, which means the housing development does not overwhelm the existing transport system. In other words, dependent development has a special meaning for appraisal purposes.

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[4] The definition has been reworded and clarified compared to previous versions of this guidance. However, it is not a fundamental change in definition nor does it affect the methodology.

[5] This goes beyond what is set out in the National Planning Policy Framework where "b) safe and suitable access to the site can be achieved for all users" – in other words, point(s) of entry for the development onto the existing transport network.

3.1.6 The methodology in A2.2 is concerned with quantifying and monetising the dependent development impacts – the welfare impacts that are directly attributable to the transport scheme. This creates challenges where attribution of costs and benefits is not straightforward, for example where transport interventions are part of a wider policy programme (e.g. regeneration).

Dependent development and overall land use change

3.1.7 Dependent development is distinguished from other types of land use change, such as:

- where it is an unintended consequence of a transport intervention;
- where a transport intervention is used to improve the attractiveness of an area as a place to live or work, thereby encouraging development, rather than to accommodate the additional traffic.

3.1.8 An assessment of these other types of induced investment requires Supplementary Economic Modelling – see TAG Unit M5.3.

3.1.9 This also highlights the need to categorise land use change depending on the scenario (do minimum (DM) or do something (DS)),[6] and on dependency and additionality. For example, dependent development is not additional if it simply displaces development that would have happened in the DM but in a different location. And transport interventions can also increase site viability that triggers development to come forward in the DS.

3.1.10 **Table 2** summarises the four types of land use change based on these definitions. The categories are complete and mutually exclusive. The typology can be used to disaggregate land use change and identify what element is dependent. This can also support the quantification and valuation of other impacts where double counting may arise.[7]

Table 2: land use change typology

Name	**Description** *(including housing development example)*	*Is it dependent?*	*Is it additional? Does it add to UK housing stock relative to BAUD?*	*Is it part of the DM or DS, or both DM and DS?*	*Are the residents assumed to live elsewhere in DM?*
Business as usual development (BAUD)*	The development that failed the dependency test** but is commercially viable in DM. *e.g. house building that happens anyway.*	No	n/a	Both DM and DS	n/a

[6] DM and DS are equivalent to 'without-scheme' and 'with-scheme' scenarios respectively.
[7] For example, land use uplift benefits from dependent development may also capture other wider economic impacts such as agglomeration.

Attracted development (AD)	Not dependent, but only viable or happens in DS. *e.g. transport intervention means housing development is viable and goes ahead.*	No	Yes	DS	Yes
Dependent displaced development (DDD)	Dependent development but it's displaced from elsewhere. *e.g. transport intervention unlocks land enabling housing development to go ahead. Without the transport intervention the houses would have been built in a different location.*	Yes	No	Both DM and DS	Yes
Dependent additional development (DAD)	Dependent development and is additional *e.g. transport intervention unlocks land which means housing development can go ahead. Without the transport intervention the houses would not have been built.*	Yes	Yes	DS	Yes

** As in NTEM which contains forecasts of population, households and employment and allocates this across Great Britain.*
*** see subsequent sections for more information on the dependency test.*

3.1.11 Table 2 shows that transport interventions are not sufficient alone to demonstrate dependency. For example, AD is an example of where transport investment is used to improve the attractiveness of an area as a place to live or work, thereby encouraging development. This is distinct from dependency represented by DDD and DAD.

Dependent development and reasonable level of service

3.1.12 A 'dependency test' is used to determine dependency – it is a measure of the extent to which a development is dependent upon a complementary transport investment.

3.1.13 There is no precise definition of reasonable level of service, such that decisions about dependency are judgement based. However, if additional traffic can be accommodated by the network without significant increases in the costs of travel for existing users, then the network can be assumed to provide a reasonable level of service.

3.1.14 For example, if traffic flows on a road network remain within the 'flat' part of the speed/flow curve, the network should be assumed to provide a reasonable level of service. Similarly, if there is no crowding on a public transport network, it should be assumed to be providing a reasonable level of service.

3.1.15 This approach is consistent with the proposition that what is of concern to the transport authority is the transport external costs resulting from the new development. "Transport external cost attributable to the new development" refers to the change in costs (including time, vehicle operating costs and charges) caused to all other transport users on the network by the traffic generated by the new development. Transport external costs are discussed in more depth in Appendix B. In addition, the dependent development may be associated with environmental and social impacts, such as local air quality and noise – see section 3.3.

3.1.16 As outlined in TAG Unit A2.1, the methodology to estimate user benefits is less accurate under land use change and this could potentially have significant implications for Transport Business Cases predicated on land use change. In the case of dependent developments, the user benefits, estimated under the fixed land use assumption can be supplemented with an estimate of the change in land value; the land value uplift approach may only be adopted in cases of dependent development due to methodological short-comings – see section 3.3 for details on estimating land value uplift.

Dependent development and economic narrative

3.1.17 Prior to analysing dependent developments, an Economic Narrative should be produced. It should include information on the following:

- identification of a development and any other complementary interventions;
- justification of the development's dependence on a transport investment and any identified complementary interventions;
- identification of the associated welfare effect, including any distortions in the land market; and
- outline how the dependent development guidance will be applied.

3.1.18 The quantification and valuation of dependent developments is associated with distortions and market failures in the land market. Land rationing, where the regulation of land for housing and other activities leads to planning restraints on residential and commercial uses, can restrict supply. Estimation of dependent development impacts values the welfare benefits resulting from a transport investment's impact on land rationing; easing the constraints on the use and development of land.

3.1.19 Changes in land value associated with dependent development can potentially include the welfare associated with wider economic impacts arising at that site. Therefore, they should be presented as an indicative monetised impact and the

risk of double counting considered in the Economic Narrative and presentation of results. Subject to certain criteria being met, indicative monetised impacts can be included in the indicative BCR metric – see value for money guidance for more information.

3.1.20 See section 2 for example information for inclusion in the Economic Narrative. For further guidance for producing an Economic Narrative see TAG Unit A2.1.

3.1.21 A detailed method for demonstrating that a development is dependent on a transport investment is given by Appendix A. Alternative sources of evidence may be used to demonstrate dependency and will be judged on their own merit.

3.1.22 Transport modelling will be required to quantify and value the welfare impacts of the scheme. Supplementary Economic Modelling may also be used to estimate the GDP and jobs impacts of these schemes but these will not inform the Value for Money assessment – see TAG Unit M5.3 for more details.

3.1.23 There is a high degree of uncertainty around estimates of dependent development benefits. This is because the scale or speed of dependent development delivery can be impacted by a range of factors. To account for the potential impact of these factors, the uncertainty should be captured in the economic narrative by considering the following three questions:

1. Is dependent development a key part of the expected benefits arising from the transport investment scheme?

2. What proportion of total development is dependent? The lower the proportion of total development that is dependent the higher the risk that dependent development benefits could be overestimated.

3. Is there any expectation or evidence that local planning constraints (such as regulatory or land scarcity constraints) may limit or slow down the delivery of dependent development units?

3.2 What is and isn't dependent development

3.2.1 Dependent developments are likely to have a wide range of characteristics such as the:

- rationale for intervention (e.g. specific market failure);
- capacity of the existing transport system;
- type of transport improvement proposed;
- scale and nature of development (e.g. housing, commercial); and
- geographic spread (e.g. concentrated versus dispersed).

3.2.2 This means whether there is dependency is not usually clear cut. However, there are cases where some dependency is anticipated. **Table 3** sets out illustrative examples which are based on real schemes. This is designed to help identify more quickly whether dependency is likely or not. It can also be used be used to sense check whether a scheme fits a particular archetype.

3.2.3 However, **it is not prescriptive**. The scheme promoter must follow the methodology to demonstrate dependency. **Solely matching to an illustrative scheme in Table 3 is not sufficient to prove dependency in of itself**.

Table 3: illustrative examples

Illustrative scheme	Market failure(s) present (linked to Table 1)	Is there dependent development? And is there a method to quantify and monetise this in A2.2?
Office and retail development above a new railway station	Land rationing	**Yes** – this is an example where land is unlocked directly by the transport improvement. Without the railway station, there is no development because the land is not unlocked.
A new bridge which unlocks industrial land near a port	Land rationing	**Yes** – this is an example where land is unlocked directly by the transport improvement. Without the bridge, the land is inaccessible and is not developed on.
A large geographically concentrated housing scheme which is accompanied by public investment to improve the capacity of local roads and public transport.	Land rationing, co-ordination failure	**Potentially yes (subject to a dependency test)** – this is an example whereby a portion of the new development could come forward without the need to improve the transport capacity, but government investment in transport is required to enable the full housing development to go ahead. Without it the existing transport system would be overwhelmed.
Mass transit scheme in a city increases attractiveness of an area, raising land values near the stations and encouraging developers to build houses in those areas rather than elsewhere.	n/a or land rationing	**No** - this is not a dependent development, although land rationing could mean there is a lower level of housing developing in those areas than expected.
Regeneration programme that includes transport intervention(s) as well as other complimentary investments to achieve local/regional regeneration goals	Land rationing, co-ordination failure	**Yes and no** - depends on the nature of the scheme and market failures. It may be that some of the transport interventions may include elements of illustrative schemes (1), (2) or (3) in which case these can be quantified and monetised. But where there is no clear dependency issue based on unlocking sites or capacity, there is no method to value this. In general, it is not appropriate to use the dependent development method for very large individual and programmatic schemes that aim to have significant structural impacts on

	multiple, geographically dispersed, unidentified sites. An assessment of induced investment impacts for these schemes would require Supplementary Economic Modelling (see TAG Unit M5.3).

3.2.4 Another way to consider dependency is through the presence of transport or non-transport complementary intervention. For example, whether it is linked to a wider policy programme such as regeneration, which includes a range of non-transport interventions such as housing and commercial development. Table 4 below provides a summary of the interaction between this and dependency. In summary, A2.2 methodology can be used so long as there is dependency. Similar to Table 3, Table 4 should not be used prescriptively (see paragraph 3.2.3).

Table 4: dependency and complementary interventions

	Transport led intervention	**Development or non-transport led intervention**
Dependency	A transport improvement that directly unlocks sites (i.e. land that could not come forward for development without the transport improvement). There is a method to quantify and monetise these benefits in this Unit.	Large scale interventions which are linked to regeneration or other spatial strategies. This may be where transport unlocks a proportion of the development, whereby the existing transport system would be overwhelmed if the new development went ahead. There is a method to quantify and monetise these impacts in this Unit.
No dependency	All other transport schemes which influence location choices of houses and businesses, and therefore investment choices and locations of new developments in the usual way. In this way such schemes are guiding and supporting development but without directly enabling it. Because there is no dependency there is no method to value these impacts in this Unit, although any land use should ideally be captured as part of the appraisal.	Large scale regeneration where there is some other issue such as low viability or coordination failure, but there is no obvious dependency issues based on directly unlocking land or where improvements in transport capacity are required. Because there is no dependency there is no methodology to value these impacts in this Unit, although any land use should ideally be captured as part of the appraisal.

3.2.5 Subsequent sections provide guidance for quantifying and valuing the welfare changes associated with dependent developments.

- Section 3.2 provides guidance to quantify potential site-specific dependent developments;
- Section 3.3 provides guidance to value dependent developments; and
- Section 3.4 provides a checklist for valuing the welfare impacts of site-specific dependent developments.

3.3 Quantifying Dependent Developments

3.3.1 The quantification of dependent developments requires several transport model scenarios, summarised in Table 2. These are required to estimate the following:

- Dependency – could the development occur in the absence of a new transport scheme?
- Extent of dependency- what proportion of the development is dependent on a new transport scheme?
- Identification of an appropriate scheme - which is the least cost scheme that will resolve the dependency issue and meet the wider transport objectives?
- Quantifying and valuing the impacts of the scheme on the transport network

Table 5 – Combinations of Scenarios – with/without dependent development and the transport scheme

	Without Dependent Development	With Dependent Development
Without transport scheme	P	Q
With transport scheme	S	R

** This table appears similar to Table 3 in TAG Unit A2.1, however, there are subtle differences. Scenario A in TAG Unit A2.1 is a baseline scenario i.e. without transport scheme and without land use change. In contrast to this scenario P is a hypothetical scenario, which includes those parts of residential and commercial developments which can be accommodated without imposing excessive costs on existing transport users. In reality, a developer may choose not to construct the non-dependent residential or commercial development in the absence of the transport scheme. The hypothetical scenario is required in order to identify an appropriate transport scheme and the associated costs and benefits.*

Transport Dependency Test

3.3.2 The dependency test demonstrates the extent to which a development is dependent upon a complementary transport investment. A dependency is likely to occur where a development will breach 'a reasonable level of service' on the transport network.

The following should be noted with respect to the dependency test:

- There is no precise definition of ‘reasonable level of service’, such that decisions regarding dependency are ultimately judgment based;
- If a development is not dependent on a transport scheme, then the need for a transport scheme should be considered solely on transport grounds.

3.3.3 Appendix A sets out in detail how these tests can be undertaken. The underlying principle is to compare the transport flows and costs on the existing transport network, with and without the proposed development. With additional development, traffic flows will usually increase. To demonstrate dependency, this increase must be exceptional to show that the network has reached a critical point.

3.3.4 These tests should consider the extent to which some, but not all, of the potential developments could be accommodated in the existing transport network. It may be the case that only a fraction of the development is dependent on a transport investment. In such instances the non-dependent traffic should be assumed to occur in both the with- and without-transport scenarios.

Identification of an Appropriate Transport Scheme

3.3.5 The selection of an appropriate scheme should take account of the need to resolve the dependency as well as the wider aims for the transport scheme.

3.3.6 A key element of the assessment should be to explore whether each transport scheme considered resolves the dependency issue under consideration. To carry out this assessment, a third scenario must be considered for each potential transport scheme: Scenario R - with the new development and with the transport scheme

3.3.7 This scenario should be subject to the same tests and analyses as were used in the dependency testing (Appendix A). Attention should focus on those parts of the network where the new development is expected to have greatest impact.

3.3.8 For some transport schemes, this analysis may suggest that dependency has not been fully resolved. There may be good reasons for retaining a scheme that does not fully resolve dependency. For example, if a transport scheme is being developed to address transport related goals, it may not be sufficient to address the needs of a new development as well. In these circumstances, further analysis should be carried out to determine the extent to which the transport scheme does ‘unlock’ the development. Only that part of the development which would be unlocked by the transport scheme should be used in the assessment of the benefits of the dependent development.

3.3.9 If a low-cost transport scheme can be shown to resolve the dependency, any more costly transport schemes should be tested as increments to the low-cost transport scheme. The incremental analysis should assume that the low-cost transport scheme and the development are part of the 'without scheme’ transport scenario. A conventional transport appraisal should be used to assess the incremental transport benefits of the more costly transport scheme.

Other Non-Transport Complementary Interventions

3.3.10 A development may be also dependent on other non-transport complementary interventions, such as the provision of school places or utilities. These other non-transport complementary interventions should be identified, such as through discussions with developers and local authorities, and appropriately represented in the appraisal.

3.3.11 Currently, there is no guidance for the inclusion of non-transport complementary interventions in appraisal or attribution of impacts. However, if these are near certain or highly likely to be relevant for a scheme appraisal, the following steps should be followed:

1. The non-transport complementary interventions should be identified in the Economic Narrative (see sub-section 2.4 for advice on developing an Economic Narrative);

2. Report assumptions and forecasts regarding the extent to which complementary interventions, such as utility upgrades, are expected to occur;

3. Model and report scenario analysis to demonstrate the core scenario results are significant given uncertainty surrounding complementary interventions; and

4. The associated costs should be accounted for in the value for money assessment as disbenefits – see section 3.3 for more details. In certain circumstances, these costs may not be publicly available. If this is the case, scheme promoters should report why the costs of these non-transport interventions have not been included in the assessment.

3.3.12 Alternative scenarios should be presented alongside assumptions that complementary investment will go ahead. For further information on scenario testing see TAG Unit M4 - Forecasting and Uncertainty.

3.4 Valuing the Welfare Effects of the Transport scheme and Dependent Developments

3.4.1 The valuation of the welfare effects associated with the transport scheme and dependent development are addressed separately. Welfare from transport schemes is valued under fixed land use, whereas welfare from dependent developments includes land-use change.

Valuing the Transport Scheme

3.4.2 As outlined in TAG Unit A2.1 – Overview of Wider Economic Impacts, the basis of all transport scheme appraisals is Level 1 analysis, the estimation of user-benefits under fixed land use. Land use should be the same in the do-something and do-minimum transport model scenarios. Thus user-benefits

should be estimated excluding the impact of the dependent development on travel demand.

3.4.3 The estimation of conventional transport user-benefit assessment requires two transport model runs:

- Scenario P - without the dependent development and without any form of transport scheme; and
- Scenario S- without the dependent development but with the transport scheme.

3.4.4 See TAG Unit A1.3 - User and Provider Impacts, for guidance on how to estimate user-benefits.

Valuing Dependent Developments

3.4.5 This section sets out methods to estimate the incremental impact on scheme benefits arising from a transport scheme unlocking a development which would not have been possible in the absence of that investment. In estimating the incremental impact of dependent development on the benefits and costs of a scheme, four elements need to be considered:

- Transport External Costs
- Environmental and Social Impacts
- Land Amenity Value
- Land Value Uplift adjusted for Displacement

3.4.6 Note that the user benefits of the transport scheme could be low (relative to the scheme cost) or negative for existing users as these are estimated on the basis of fixed land-use. Under the do-minimum scenario the transport network already provides a reasonable level of service so there is no need for a transport investment. When a dependent development takes place, the objective of a new transport scheme is to minimise congestion for new users, and it is not targeted at existing users of the network. User Benefits could be negative for existing users if the intervention acts to increase general travel costs. For example, introducing a new junction to allow access to a development could reduce the free-flow of traffic. Thus the value for money assessment may be dependent upon the inclusion of the welfare effects of the dependent development – the value for money guidance provides advice on how to include the welfare effects of the dependent development in the VfM conclusion.

3.4.7 If the development is also dependent on other non-transport complementary interventions (NTCI), such as the provision of local schools or utilities, and the costs are known, these should also be included in the valuation of the dependent development. Note: if the developer has contributed to the cost of any complementary interventions, these may be accounted for in the estimate of land value uplift – this will depend on the valuation methodology. In cases where the land value uplift has been estimated using the residual land valuation methodology (Appendix E), developer contributions will already be included

within the estimation of land value uplift, such that NTCI should only include those costs borne by third parties.

Table 6 – Valuing the Benefits of the Dependent Development

$$\boldsymbol{Total\ Benefits = LVU_D + Other - TEC - LAV - NTCI}$$

LVU_D	Land Value Uplift adjusted for displacement
$Other$	This includes Environmental Impacts, and Social and Distributional Impacts – TAG units A3 and A4 respectively
TEC	Transport External Costs
LAV	Land Amenity Value
$NTCI$	This refers to the costs associated with Non-Transport Complementary Interventions – the benefits are assumed to be captured by the land value uplift.

3.4.8 This is a rapidly developing area and the method detailed above deals with one form of dependent development. Therefore, it is critical that the Economic Narrative sets out the basis on which dependent developments may occur in response to investment in transport. In more complex cases it is advisable to contact the Department at an early stage to discuss potential approaches. This is particularly recommended (though not limited to) situations where:

- a significant number of dependent trips are made on public transport;
- it is considered that the scheme will unlock development across a wide area rather than at a specific site; and,
- the dependent development is considered likely to generate significant dynamic clustering impacts.

Transport External Costs

3.4.9 Transport external costs refer to the costs imposed by dependent transport users on all other users, such as increased levels of congestion or over-crowding. These costs arise as a result of those trips which are dependent on the transport scheme. Where a transport model is available and it is proportionate to do so, transport external costs should be estimated using the approach in Appendix B. If a transport model is not available, an alternative approach is to estimate this impact using the Marginal External Cost guidance in TAG Unit A5.4.

3.4.10 The assessment of transport external costs of the dependent development requires two transport model runs:

Scenario S - without the new housing but with the transport scheme; and
Scenario R - with the new housing and with the transport scheme.

3.4.11 Both runs should employ the same transport network, which should include the transport scheme. Both of these model runs should be straightforward to carry out, since both scenarios would result in realistic forecasts of level of service.

3.4.12 An important point to note is that the transport scheme should reduce the transport external costs, compared to the without-scheme scenario, and the transport external costs estimated at this stage in the baseline scenario.

Environmental and Social Impacts

3.4.13 The transport scheme may be associated with environmental and social impacts, such as local air pollution and road safety impacts. These impacts will arise as a result of dependent users and any changes to the travel behaviour of other users. Environmental and social impacts should be estimated using the approaches described in TAG Units A3 and A4. The assessment of environmental and social impacts requires two transport model runs:

Scenario P - without the new housing and without the transport scheme; and
Scenario R - with the new housing and with the transport scheme.

Land Amenity Value

3.4.14 The 'amenity value' of a plot of land refers to the level of pleasantness of the area. For example, where new developments are built on greenfield land there may be a loss in the land amenity value if the area becomes less desirable for recreational activity.

3.4.15 Default assumptions for the amenity value of different types of land can be found in the TAG Data Book 'Valuing Dependent Development Workbook', based on estimates obtained by Department of Communities and Local Government (2001). The welfare impact from the change in land amenity value can be estimated as the difference between the present value benefits for different land types: it is assumed that developed land has no amenity value, such that land use change is associated with a loss of amenity value.

$$LAV = Amenity\ Value_{Developed\ Land} - Amenity\ Value_{Existing\ Land\ Use}$$
$$LAV = -Amenity\ Value_{Existing\ Land\ Use}$$

3.4.16 Where a scheme is expected to have major landscape impacts, it may be desirable to undertake context-specific analysis for the change in land amenity value.

Land Value Uplift and Displacement

3.4.17 Land value uplift measures the difference between the price of land in its new and former uses and represents the private gain to landowners. It provides a convenient way of estimating the economic value of a development which is dependent on a transport intervention. It should only ever be used in the appraisals of dependent developments.

3.4.18 Land value uplift will capture any impacts which are capitalised into land values. It could potentially capture any of the following impacts: user benefits, land

market distortions and other wider economic impacts, such as agglomeration economies.

3.4.19 In the case of the dependent development, the associated land value uplift will capture user benefits to new residents, which are missing from user benefits estimated under fixed land use. These can be considered additional to the fixed land use user benefits estimated via the rule of a half methodology. Note that land value uplift should only be estimated for those parts of the development which are dependent on the transport investment. Nevertheless, there are challenges associated with the use of land value uplift in transport appraisal:

1. Theory suggests the relationship between land rents and GTCs is ambiguous; land rents need not necessarily increase in response to GTC reductions, the response will depend upon the elasticity of substitution between land and other consumption goods;[8]

2. Land value uplift will capture any impacts capitalised into land, such that causal factors are ambiguous: it could potentially include the welfare associated with wider economic impacts and complementary interventions, which could potentially lead to double-counting or the false attribution of benefits respectively. For this reason, consideration should be given in the Economic Narrative on the degree to which there is an overlap between land value uplift, direct transport benefits and other wider economic impacts; and

3. Land value uplift is a local site-specific measure, as such it will not account for the loss of land value on other sites, which will occur if there is a relocation of economic activity. In other words, it fails to account for displacement. Furthermore, there is a lack of robust evidence on displacement factors – the extent to which land value uplift at one specific plot is at the expense of another area – which could lead to inaccurate estimates of the net land value change.

3.4.20 For these reasons, the scheme promoter should attempt to identify the causal factors driving the land value uplift, such as user benefit capitalisation, land market distortions or other wider economic impacts. The robustness of land value uplift as a measure of welfare will depend on the extent to which these factors have been identified and evidenced. It is included as an indicative monetised impact within the value for money assessment – see section 5 for details on reporting the land value uplift associated with dependent developments.

3.4.21 The preferred method to estimate land value uplift is the residual valuation methodology – see Appendix E. The application of this methodology will require a valuation surveyor. Where this is not possible, land prices can be estimated by comparison to similar developments or using benchmark estimates from land

[8] Arnott, R. J. & Stiglitz, J. E. (1981), "Aggregate Land Rents and Aggregate Transport Costs," Economic Journal, Royal Economic Society, vo. 91 (362), pages 331-347, June

[4] https://www.gov.uk/government/publications/department-for-communities-and-local-government-appraisal-guide

[5] https://www.gov.uk/government/organisations/valuation-office-agency/about/statistics

value surveys. Potential sources of benchmark land price data include the following:

- DCLG (2016)[4] provides estimates for the average prices of residential, greenfield and brownfield land in England (with residential land split by Local Authority).
- VOA (2011)[5] provides estimates for average land prices for greenfield land, residential developments, retail developers, offices and industrial developments split by region.
- DCLG's appraisal guidance[4] includes data for average land-value uplifts for new business parks and city centre developments on brownfield and greenfield land split by region.

3.4.22 Note benchmark results will not be context specific and could provide estimates significantly different from the outturn.

3.4.23 All land prices should be converted to the same base year as the rest of the transport appraisal and reported in market prices (i.e. including indirect tax).

As mentioned above, land value uplift is a local site-specific measure and does not account for the relocation (displacement) of economic activity or households from other locations. As a result, land value uplift is likely to over-estimate the national welfare effect of a dependent development. For example, new offices or houses in one location may reduce the level of economic activity or number of households elsewhere, if businesses or households were to relocate. Thus land value uplift should be adjusted to account for displacement.

3.4.24 In keeping with the wider economic impacts framework, the starting position is that local impacts represent the displacement of activity from other locations. For this assumption to be relaxed, evidence should be presented which demonstrates that the economic impacts are at least in part additional at the national level; note only welfare effects at the national level can be included in the value for money assessment.

3.4.25 There is currently limited evaluation evidence on additionality. It is recommended that scheme promoters use the approach set out in the DCLG guidance.[9]

3.4.26 Even in cases where the land value uplift is 100% displaced there could be other market failures present, such as agglomeration impacts, which make the identified site more attractive than the alternatives. If such a case were made, the market failures and an appropriate valuation methodology would need to be identified and justified in the Economic Narrative. Note if the market failure cannot be valued, the impact should be reported as a non-monetised impact in the value for money assessment.

9 https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/576427/161129_Appraisal_Guidance.pdf

Other Non-Transport Complementary Interventions

3.4.27 Development may be also dependent on non-transport complementary interventions, such as the provision of local schools or utilities. For this reason, the land value uplift associated with a scheme may not be entirely attributable to the transport investment. If the costs are known, these should be included in the valuation of the dependent development as disbenefits, to ensure that the analysis reflects all known and quantifiable costs and benefits.

3.4.28 Note it may be the case that the costs of non-transport complementary interventions are unknown. In such instances, non-transport complementary interventions should be reported in the Economic Case together with an explicit acknowledgement that it has not been possible to cost these, and care should be taken when interpreting the benefits of the transport scheme.

Estimating Jobs and GDP Impacts

3.4.29 The local or national jobs and GDP impacts associated with a dependent development cannot be inferred from the land value uplift approach. If an estimate of jobs and GDP is considered relevant to the Transport Business Case, such as to inform an economic objective in the Strategic Case, these may be estimated by way of 'additionality modelling' – see TAG Unit M5.3 on Supplementary Economy Modelling.

3.4.30 Note estimates of jobs and GDP should **not** be reported in the Value for Money assessment, as these are non-welfare measures. Land value uplift is the appropriate measure of welfare associated with a dependent development, as it values distortions in the land market.

3.5 Sensitivity Testing

3.5.1 Research into evaluation evidence, set out in Appendix C, has shown that there is a strong tendency to overestimate dependent development benefits in transport appraisals. This shows that there is a high degree of uncertainty around estimates of dependent development benefits.

3.5.2 A sensitivity test should be used to explicitly show how a scheme's value for money category is impacted if dependent development delivery is less than forecasted.

3.5.3 The sensitivity test should be a switching value that calculates the percentage decrease in dependent development benefits required to move the indicative BCR into the lower value for money category.

3.5.4 The switching value should then be compared to the average overestimate of dependent development benefits, which has been calculated from evaluation evidence. The average overestimate is given by the range 30%-50%.

3.5.5 Schemes where the switching value is less than 50% should be considered higher risk, as an average or below average overestimation of dependent

development benefits will lead to a lower value for money category. On the other hand, schemes with a switching value greater than 50% should be considered lower risk, as an above average overestimate of dependent development benefits is required to put the scheme in the lower value for money category.

3.5.6 If the indicative BCR is less than 1, then a switching value can't be applied. In this case the indicative BCR should be compared with the adjusted BCR. The average overestimate of dependent development benefits (30%-50%) should then be used to contextualise the difference between the two.

3.5.7 Please see Appendix C for further details of how this is derived and the evidence base.

Box 2: Examples of the sensitivity test being applied in different scenarios

Example 1 – indicative BCR and equivalent VfM category greater than 1

- Assume in this example that the indicative BCR is greater than 1 and the VfM category is medium (meaning a BCR greater than or equal to 1.5 and less than 2.0).
- Let's also assume that for the BCR to fall below 1.5, and therefore the scheme to fall into the low VfM category, the estimated dependent development benefits need to fall by 25%.
- The 25% fall can then be compared to the average under delivery of dependent development benefits calculated above. Since we know that the average under delivery is up to 50%, we also know that a fall of 25% means there is a high risk that dependent development will under deliver sufficiently to affect the VfM of the scheme.
- Therefore, the uncertainty around the delivery of dependent development benefits, and the risk this poses to the VfM category, is made explicit.

Example 2 – indicative BCR and equivalent VFM category is less than 1

- If the indicative BCR is less than 1 then the switching value outlined in example 1 cannot be used, as the scheme is likely to be categorised as 'poor' VfM. In this scenario the indicative BCR can be compared to the adjusted BCR to illustrate the sensitivity of the analysis to the estimates of dependent development delivery.
- Let's assume that a scheme has an adjusted BCR of 0.5 but an indicative BCR of 0.9, so the level 3 benefits are pushing the scheme close to the next VfM category.
- The indicative BCR can then be compared to the adjusted BCR, using the average under delivery of dependent development to judge how likely it is the indicative BCR will be an accurate reflection of a scheme's costs and benefits.
- For example, if reducing the dependent development benefits by 50%, the average under delivery calculated above, only leads to an indicative BCR of 0.6, the indicative BCR of 0.9 might be considered to be highly sensitive to dependent development benefits being overestimated. This would need to be factored into the final VfM decision which considers other non-monetised benefits and uncertainty.

3.6 Checklist for Appraising Site-Specific Dependent Developments

3.6.1 Table 7 provides a checklist of the key evidence requirements when quantifying and valuing site-specific dependent developments.

Table 7 – Site-Specific Dependent Development Checklist

Issues	Check
Identify and quantify potential site-specific developments;	
Demonstrate that these developments are 'dependent' on the transport improvement	
Identify market or government failures associated with these developments	
Demonstrate that welfare gains from site-specific dependent developments are 'additional' at the national level (i.e. increase the productive capacity of the country)	
Identify and value other public-sector costs associated with enabling dependent developments	
Estimate the welfare impacts associated with these site-specific dependent developments	
(If required) estimate the jobs and GDP impacts associated with site-specific dependent developments	
Undertake uncertainty and scenario testing	

4. Quantifying and Valuing Output Change in Imperfectly Competitive Markets

4.1 Introduction

4.1.1 Output change in imperfectly competitive markets refers to changes in the level of economic activity as a result of a transport investment. Changes in the level of output as a result of a transport investment are not unique to imperfectly competitive markets. However, the presence of a market failure – the market structure affecting the level of competition – means that there are additional sources of welfare which should be captured.

4.1.2 In a perfectly competitive market, the value of the output is equal to the cost of production. A reduction in generalised travel costs lowers the costs of production, which as noted in section 2 acts to raise the effective return to capital and induce investment. The value of the resulting increased output will

equal the magnitude of the change in generalised travel costs. Therefore, the welfare effects, associated with increased output, resulting from a transport investment will be fully captured by business user benefits.

4.1.3 In the case of imperfectly competitive markets, the value of the output is greater than the costs of production. As in the case of perfect competition, a reduction in generalised travel cost will induce investment and hence output. However, the value of the resulting increased output will not be fully captured by the magnitude of the change in generalised travel costs. Business user benefits will therefore fail to capture the total value of the output change. The methodology described below estimates the additional welfare effects associated with increased output in imperfectly competitive markets, resulting from a transport investment.

4.1.4 Prior to analysing output changes in imperfectly competitive markets an Economic Narrative should be produced. It should include information on the following: (1) identify potential changes in output as a result of a transport investment and justify these; (2) identify the sources of welfare, including any market failures and distortions; and (3) outline how the output change will be quantified and valued. See A2.1 - Wider Impacts Overview for guidance on producing an Economic Narrative.

This section provides guidance for quantifying and valuing the benefits associated with output change in imperfectly competitive markets. The methodology contained within the section implicitly assumes induced investment and land use, but these are not quantified. The structure of this section is as follows:

- Section 4.2 provides guidance to quantify output change in imperfectly competitive markets;
- Section 4.3 provides guidance to value dependent developments; and
- Section 4.4 provides a checklist for valuing the welfare, jobs and GDP impacts of site-specific dependent developments.

4.2 Quantifying Output Change in Imperfectly Competitive Markets

4.2.1 The methodology to estimate output change in imperfectly competitive markets does not seek to explicitly quantify the change to net investment or the associated land use. Instead, the methodology uses the conventional transport user benefits and applies an uplift factor.

4.2.2 The estimation of conventional transport user-benefits requires two transport scenarios, in which the only difference is the presence of the transport scheme in the do-something.

4.2.3 Note that because of potential double-counting, output change in imperfectly competitive markets should **not** be estimated in cases of dependent development. If output change in imperfectly competitive markets is to be estimated with variable land use, scenarios A and C in Table 3 of TAG Unit

A2.1 should be used. See A1.3 User and Provider Impacts for guidance on how to estimate user benefits.

4.3 Valuing Output Change in Imperfectly Competitive Markets

Welfare Effects

4.3.1 The welfare effects which arise due to the presence of imperfect competition (the market structure distorts the efficient operation of the market), is estimated by applying a 13.4% uplift factor to the business and freight user benefits (including reliability impacts) – see Hyman (2024) for an explanation of how this has been estimated.

4.3.2 The methodology outlined here is a simplified approach. Supplementary Economy Modelling may be used to ascertain more context specific estimates of the welfare effects arising from imperfect competition – see TAG Unit M5.3. Note the results of Supplementary Economy Modelling should be reported alongside those derived from the methodology in this section, and will only be included as an indicative monetised impact in the value for money assessment. Subject to certain criteria being met, indicative monetised impacts can be included in the indicative BCR metric – see value for money guidance for more information.

4.3.3 Output change in imperfectly competitive markets does not need to be interpolated between modelled years or extrapolated after the final modelled year. This is because it is a proportion of business user benefits which should have already been interpolated and extrapolated – see TAG Unit A1.3.

Estimating Jobs and GDP Impacts

4.3.4 The increase in GDP associated with output change in imperfectly competitive markets is equal to the additional welfare, as estimated by the 13.4% uplift (described above). It is not possible to infer the change in jobs associated with increased output. As a consequence, where there is a desire to estimate the change in employment associated with increased production, this should be done following principles laid out in TAG Unit M5.3 on Supplementary Economy Modelling.

4.4 Checklist for Appraising Output Change in Imperfectly Competitive Markets

4.4.1 Table 8 provides a checklist of the key evidence requirements when quantifying and valuing wider economic impacts from output change in imperfectly competitive markets.

Table 8 – Output Change in Imperfectly Competitive Markets Checklist

Issues	Check
Provide evidence that businesses will increase output in response to the transport improvement	
Valuing transport user benefits	
Value the wider economic impact from output change in imperfectly competitive markets	

5. Reporting Induced Investment Impacts

5.1.1 The purpose of the Transport Business Case is to aid the decision-making process by presenting evidence of the potential impacts of a transport scheme in a transparent and consistent manner. Thus, where the expectation of induced investment impacts can be justified and credible analysis produced, these should be reported.

5.1.2 Welfare and non-welfare measures of induced investment impacts are reported in the Economic Case. Welfare measures inform a scheme's Value for Money assessment. However, in certain circumstances, non-welfare measures may also be referenced in the Strategic Case, if they can usefully inform the extent to which an economic objective will be met. For example, an economic objective to boost local housing levels may be best informed by expectations of the number of new houses that will be created by a scheme. See TAG Unit A2.1, Section 2 for details on the relationship between welfare and non-welfare measures; and TAG Unit A2.1, Section 7 for details on the reporting of welfare and non-welfare measures of economic impacts.

5.1.3 An Economic Impacts Report (EIR) should be included as an annex to the Economic Case that details all the technical analysis underlying the measures reported in the Economic Case - see TAG Unit A2.1, Section 6 for details on producing an EIR.

6. References

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Appendix A: Use of transport models to test and account for dependent development

A.1 Introduction

A.1.1 Section 3 outlines the purpose of testing for dependency of a transport scheme that unlocks land use development. This appendix discusses how the analyst should go about this, using modelling tools to determine the dependency of identified site-specific developments on transport investment. For larger-scale, non-specific developments derived from land use or economic models, the analyst should refer to TAG Unit M5.3 on Supplementary Economic Modelling.

A.1.2 This annex describes two important processes:

- Calculating the volume of dependent developments that cannot be accommodated without a transport intervention ("dependency testing");
- Creation of a new baseline scenario that accommodates non-dependent development, to allow for the calculation of the benefits and externalities arising from the volume of development identified as dependent.

A.1.3 To facilitate understanding, the reader may wish to assume the case that one large development site has been identified, that is more than likely to reduce the surrounding transport network to an insufficient level of service. In reality, there may be a number of different sites contributing to this outcome, which may require more care and judgment from the analyst in assessing dependency. This is explained later.

A.2 Testing for dependency

A.2.1 The purpose of dependency testing is to determine at what point proposed site-specific developments will breach a 'reasonable level of service' on the transport network. In practice, transport networks often operate beyond the limits of a 'reasonable level of service', so it is not practical to define specific thresholds for a dependency test. However, it should be possible to form an opinion of whether or not a "reasonable level" is being met, based on readily available network characteristics. Therefore, this guidance is not prescriptive, but relies on the application of judgement supported by evidence.

A.2.2 This is a key step in the process. If development is not dependent on a transport scheme, then the need for a transport scheme should be considered solely on transport grounds, as one would for a standard appraisal. In order to accept evidence of dependent development impacts, DfT would require the methodology set out in this Unit to be followed.

A.2.3 The definition of dependency focuses on the impact of land use development on the existing transport network. Land use development may be dependent on a wide variety of other factors, but for a transport authority, the key issue in determining whether a transport scheme is required is the impact of new development on the current transport network.

A.2.4 This step in the process must achieve two objectives. First, it must determine whether new development is dependent on the provision of some form of publicly funded transport scheme. Then, if dependency exists, the analyst must estimate how many planned new developments are dependent.

A.2.5 To test for dependency, two initial scenarios are required:

Baseline Scenario - without the development and without any form of transport scheme;

Scenario Q - with the whole development but without any form of transport scheme.

A.2.6 Scenario Q will be controlled to total trip end growth from the NTEM data set across the study area. The baseline scenario will not include the trips ends associated with the development that are being tested for dependency. For clarity:

Total trips in baseline scenario = Total Trips in Scenario Q (controlled to NTEM) – Development trips.

A.2.7 The analyst needs to control the total trip ends in the matrix of Scenario Q to NTEM growth between the base year and forecast year. For the baseline scenario, the productions and attractions associated with the development will need to be removed. This includes the productions and attractions associated within the zones that host the specific development site, but also the associated trip ends from elsewhere in the matrix. A simple approach may be to factor the trip ends across zones in the study area downwards to reflect this decrease. It should be recognised that ‘study area’ in this context is more likely to concern trips in the locale of the development, and will have a lower influence on more distant zones in the model in question.This should be reflected in the matrix adjustment. TAG Unit M4 – Forecasting and Uncertainty gives details in matrix adjustment, taking into account different patterns of development in forecast matrices.

A.2.8 The analyst needs to judge, for the zones that host the development site(s), the appropriate level of growth between the base and forecast years and the associated trips where the development is included for Scenario Q. The simplest approach will be to add to the core NTEM growth in these zones and remove trips from other zones in the matrix to compensate. However, the analyst should take care not to overstate the amount of possible development in individual zones as this could affect the fidelity of the dependency test.

A.2.9 For the baseline scenario, this could result in growth in these zones being higher or lower than the growth from NTEM for these zones. The rationale is

that presumably in many cases part of the NTEM growth is likely to be associated with the dependent development being examined. If that is the case, and trips in these zones are subtracted from the growth provided by NTEM for the baseline scenario, the level of development (and hence trips in the matrix) should not be lower in the forecast matrix than the base year (i.e. lower than zero growth).

A.2.10 In the following, it is assumed that in the baseline scenario, the network provides a reasonable level of service. Clearly if that is not the case then the new development is likely to be wholly dependent on some form of transport scheme. However, it must be demonstrated that the baseline scenario does not provide a reasonable level of service before this conclusion can be reached.

A.2.11 Attention should focus on those parts of the network where the new development is expected to have greatest impact. If, in Scenario Q, the network no longer provides a reasonable level of service in those locations, then at least some of the new development can be assumed to be dependent on some form of transport scheme.

A.2.12 The simplest approach to determining whether the network provides a reasonable level of service is to compare forecast transport demand at key locations with available capacity. This approach is likely to be appropriate where new development is restricted to a single site. It may be possible to adopt this approach without using a transport model.

A.2.13 However, where new development is large, and/or new development is located in a number of different places, and/or the impact on the transport network is complex, this approach may be difficult to apply and interpret. In these circumstances, a transport model and a more detailed assessment of the impact of the development on the network will be needed.

A.2.14 Model runs for the baseline scenario and scenario Q will usually be required. In some cases, it may be impossible to carry out the model run for Scenario Q - the model may not converge, for example. Provided the model is properly specified, this may be taken as evidence that the new housing is at least partially dependent on a transport scheme.

A.2.15 Comparison of the model outputs for the baseline scenario and scenario Q will reveal where the new development has had the greatest impact on the level of service on the network. Dependency testing should focus on those key locations where there are significant increases in traffic flows or passenger loadings.

A.2.16 Increases in traffic flows on highway networks will usually result in increased travel costs. To demonstrate dependency, increased travel costs in key locations affected by new development must be exceptional, demonstrating that the network has reached a critical point. The analysis should examine link transit times and junction delays in those key locations. If link transit times have increased sharply, or if significant junction delays have emerged, this may be taken as evidence of dependency.

A.2.17 It may be helpful to calculate the transport external costs for links at key locations in the network – for details of how to do this, see Appendix B. Transport external costs (or transport external costs per existing transport user) will reflect the size of the development and its impact on existing users.

A.2.18 Essentially, the volume versus the capacity of links and junctions will have a fundamental influence on transport external costs (i.e. transit times and congestion), and the local network needs to be examined to identify instances where flows become unacceptably large.

A.2.19 Where development is expected in a number of locations, it cannot be assumed that all of the new development is dependent. Further analysis is required to determine which developments are dependent and which are not. Developments that contribute only a small number of trips to the flows at key locations may be assumed to be not dependent on a transport scheme. To understand why this is so, consider the impact of a development in isolation, rather than as part of a package of developments. If its impact at the key location is small, it should be assumed that it is not dependent on a transport scheme at that location.

Creating a do minimum scenario – Scenario P

A.2.20 After dependency has been tested and the scope of how new developments create unacceptable externalities on the transport network has been understood, the next step is to explore whether a reduced level of new development could be accommodated on the network without some kind of transport scheme. This will allow for an estimate to be made of the volume of new development that may be assumed to be dependent on some form of transport scheme.

A.2.21 This analysis may be carried out using a trial and error process, reducing the number of dwellings or employment floorspace from Scenario Q (and hence the number of trips generated) and repeating the dependency analysis discussed above, until a level of new development is found that does not lead to an unacceptable level of service on the transport network. Where new developments are expected in a number of locations, those developments that have been demonstrated to be not dependent on a transport scheme should not be included in this analysis. It should, however, be included in the background pattern of housing development (i.e. assumed to be present in both scenarios).

A.2.22 This analysis should have resulted in an estimate of the number (and, where multiple development locations are being considered, the location) of new homes or amount of new employment floorspace in the development site(s) that are dependent on the provision of a transport scheme.

A.2.23 This process produces a new do minimum scenario (Scenario P) that includes all development that is judged to be ‘non-dependent’ to the point at which the transport network can accommodate them without exceeding an acceptable level of service. This scenario will then be used in the subsequent steps in the process, to identify the welfare impacts of the volume of new development that is judged to be dependent on transport intervention.

A.3 Modelling Considerations

A.3.1 The Department recommends that all scenarios be modelled using standard modelling methods. This will be an appropriately calibrated assignment model with sufficient detail in the area of interest (see TAG Unit M3.1 – Highway Assignment Modelling; and where public transport is a particular consideration TAG Unit M3.2 – Public Transport Assignment Modelling). If in scope of the transport problem, a variable demand model should also be used in principle (see TAG Unit M2 – Variable Demand Modelling for the prerequisites). Where non-standard approaches are proposed, analysts should discuss this with the Department.

Modelling the Four Scenarios

A.3.2 **Baseline Scenario** requires selected developments to be omitted. This involves identifying the number of dwellings/ amount of employment floorspace comprising a potentially dependent development, and removing the associated number of trip ends from those zones in the trip matrix (or, indeed, not including the growth in trip ends that would occur should these developments go ahead). The TEMPRO software may be used for this purpose[10].

A.3.3 For **Scenario Q**, the first step is to explicitly model each development that is expected to have a significant impact on level of service on the transport network and thus is likely to be dependent on a transport scheme. This essentially involves including all of the development trips at each identified site that is potentially dependent. The total trip end growth in this scenario should be controlled to NTEM growth.

A.3.4 **Scenario P** is constructed via the process described in the previous Section – it is characterised by a matrix of trips that include all trips at the identified development sites that may be accommodated before breaching an acceptable level of service on the transport network. At this stage, the dependency testing analysis has been completed, and the baseline scenario is no longer used.

Modelling for **Scenarios R** and **S** should follow standard modelling procedures. In each case, the analysis must add a transport scheme to the appropriate 'without scheme' network. Scenario R should build upon scenario Q, with scenario S building on scenario P.

Use of Variable Demand Modelling

A.3.5 A key issue to consider when modelling scenario Q is whether variable demand modelling is needed. The Department recommends that the usual standards should be applied: if a fixed matrix analysis suggests that the housing development significantly increases network congestion, variable demand modelling of some sort should be applied. The application of variable demand modelling may suggest that the trips generated by the development can be

[10] See guidance at https://www.gov.uk/government/collections/tempro and also TAG Unit M4 – Forecasting and Uncertainty.

accommodated on the network.For example, bus services may accommodate much of the travel demand related to the site so traffic congestion may remain acceptable. In that case, the housing development is not dependent, and the appraisal of any transport scheme may follow standard guidelines, taking scenario Q as the 'without scheme' scenario.

A.3.6 It may be argued that the application of variable demand modelling means that dependent trips from the development are imposing costs on all other trips. This may be true but is irrelevant. Growth in the number of developments over time and their impact on user costs in the 'without scheme' scenario is an integral part of forecasting for standard scheme appraisal. Provided the overall level of service remains satisfactory, some increase in costs to existing users is acceptable. This guidance is intended to address circumstances, where specific, localised developments result in an unacceptable – and therefore unrealistic – level of service on the network.

Appendix B: Transport External Costs Arising as a Result of Land Use Development: Technical Theory and Detail

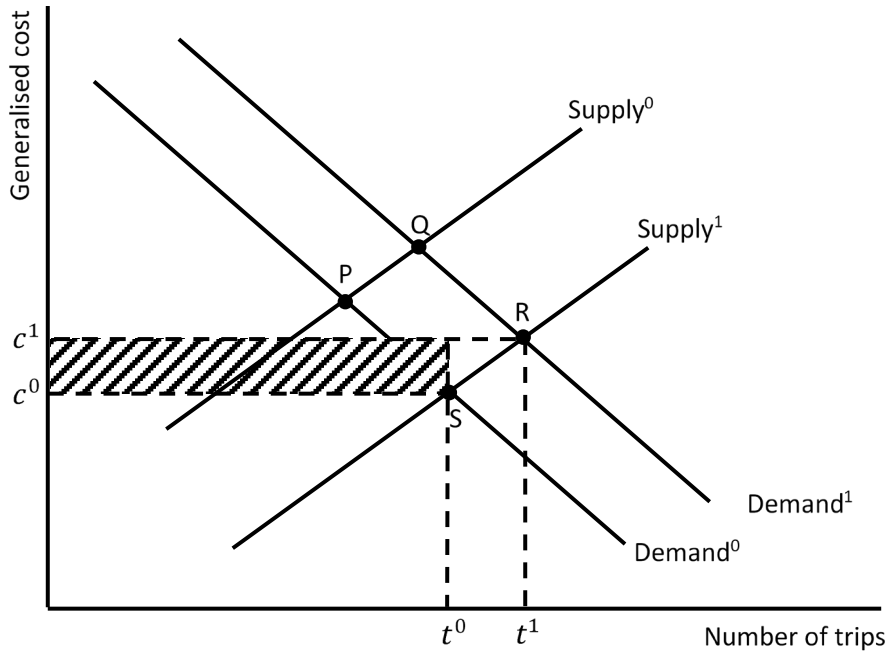
B.1 Principles

B.1.1 Most land use developments give rise to trips on transport networks. These trips are usually regarded as 'new' trips (though, in reality, many will have been diverted from other locations). These trips take place on transport networks already being used by other, 'existing' users. Thus, they exacerbate current congestion, crowding and so on, leading to increases in costs (including journey times, the money costs of journeys, unreliability, crowding and so on) for existing users not associated with dependent developments. These increases in costs are termed the transport external costs of land use development. Transport external costs are an important consideration in the analysis of land use developments that are dependent on (i.e. cannot proceed without) transport schemes, particularly since in most circumstances they concentrate trip generations at particular points on the network.

B.1.2 These costs can be estimated using the principles of marginal external costs. In that context, marginal external congestion cost is the change in costs (including time, vehicle operating costs and charges) to users of a given link in the transport network, as a result of one additional - or 'marginal' - vehicle on the link.

B.1.3 In the context of land use development, we can consider the marginal change in costs imposed on existing users of the transport network as a result of one additional trip generated by the development.

Figure 1 Figure B.1: The calculation of Transport External Costs



B.1.4 Figure B.1 depicts the supply and demand curves for a given O-D pair ij. The points P-S have been labelled consistently with the naming of the four scenarios in Appendix A. The shaded area indicates the transport external costs of the dependent development on the base traffic.

Demand^0 represents the trip matrix with no dependent trips;

Demand^1 represents the trip matrix with all trips, including dependent ones;

Supply^0 represents the without-scheme scenario;

Supply^1 represents the with-scheme case (i.e. the transport scheme is present).

B.1.5 The transport external costs of a land use development can be estimated using the following equation:

$$TEC = \sum_{IJ}\left(c_{ij}^1 t_{ij}^1 - c_{ij}^0 t_{ij}^0\right) - \sum_{ij} c_{ij}^1 t_{ij}^D = \sum_{ij}\left(c_{ij}^1 t_{ij}^1 - c_{ij}^0 t_{ij}^0\right) - \sum_{ij} c_{ij}^1\left(t_{ij}^1 - t_{ij}^0\right) = \sum_{ij} t_{ij}^0\left(c_{ij}^1 - c_{ij}^0\right)$$

where c_{ij} and t_{ij} are, respectively, the cost per trip and the numbers of trips between zones i and j. The superscripts 1 and 0 denote the with and without land use development scenarios and the superscript D denote the matrix of trips generated by the development (i.e. $t_{ij}^1 - t_{ij}^0$).

B.1.6 In basic terms, this is calculating the difference in costs between the matrix without the dependent trips included compared with the matrix with the dependent trips included. Then, this is multiplied by the total trips in the matrix without the dependent trips, in order to determine the impact on those non-dependent users (i.e. their "external costs").

B.1.7 The transport external costs of a land use development can also be estimated on a link basis. This formulation may be useful in establishing dependency. The following equation should be used:

$$TEC_L = c_L^1 * (f_L^1 - f_L^D) - c_L^0 * f_L^0$$

where TEC_L, c_L and f_L are, respectively, the transport external costs, the link transit costs and the link flow for link L. Of course, $f_L^D = f_L^1 - f_L^0$, so this simplifies to $TEC_L = f_L^0 (c_L^1 - c_L^0)$, put simply the change in costs to the existing trips where development trips are also present.

TEC_L may be summed over all links in the network to give:

$$TEC = \sum_L TEC_L$$

B.2 Theoretical considerations

B.2.1 The transport external costs of a development can readily be calculated using results from a conventional transport model. Model runs for two scenarios are required: Scenarios R and S from Appendix A, which are:

Scenario S: the scenario without the dependent development/trips, providing the matrices c_{ij}^0 and t_{ij}^0; and

Scenario R: the scenario including the trips generated by the land use development, providing the matrices c_{ij}^1 and t_{ij}^1.

B.2.2 The costs c_{ij}^0 and c_{ij}^1 for each scenario should be based on the same values of time, vehicle operating cost models and so on as are used in the application of any associated transport appraisal.

B.2.3 It is important to note that TEC may be positive (implying that the land use development imposes costs on existing users) or negative. Negative values may arise where routing throughout the network occurs in less congested areas. This may particularly be the case where the dependent development is attracting more trips to a less congested route (since the scheme proposal may be ameliorating congestion significantly), through the trip distribution mechanism in the variable demand model.

Appendix C: Sensitivity test assumptions and derivation

C.1 Background

C.1.1 Empirical research shows that the construction duration, defined as the time between shovels hitting the ground and dwellings being completed, can vary significantly depending on which area of the UK the development occurs in. For example, Ball et al[11] find that:

"*a 1 percentage point increase in housing demand reduces the construction duration in the 'average' location by 2.7%, all else equal. However, the reduction in the construction duration weakens to 0.8%, 1.7%, and 2.1%, respectively, if regulatory constraints, land-scarcity related constraints, or market concentration are one standard deviation higher."*

C.1.2 This suggests that the construction duration can vary over region depending on the strictness of the planning system, degree of land scarcity and market concentration of developers. This means that dependent development benefits could be overestimated if the construction duration is underestimated when appraising transport schemes. This is because if development takes longer than expected many of the mechanisms and feedback loops that generate the delivery of dependent development units might not occur, therefore reducing the overall scale of dependent development benefits.

C.1.3 Ex-post evaluation also finds that there is a strong tendency for dependent development delivery to be significantly overestimated. For example, in the case of the Ebbsfleet development it was found that:

"*the volume of development at Ebbsfleet has significantly disappointed compared to the original plans, leading to further government initiatives to speed up delivery, including establishing the Development Corporation in 2015*"[12]

C.1.4 An evaluation carried out by the What Works Centre for Local Economic Growth[13] looked at completed road schemes where dependent development guidance or a clear housing objective was key to justify their business case. They found that all cases had failed to meet their dependent development

[11] Ball et.al (2024), Why delay? Understanding the construction lag, aka the build out rate - https://cep.lse.ac.uk/pubs/download/dp1990.pdf

[12] Transformative impacts of transport investment, DFT Report, 2023 - https://assets.publishing.service.gov.uk/media/6437f3098b86bb000cf1b191/transformative-impacts-of-transport-investment-final-case-study.pdf

[13] Evaluating the Performance of Dependent Development - What Works Centre for Local Economic Growth, Lynne Miles & Patrick Andison, April 2018, ARUP. A summary of the research is published here: https://whatworksgrowth.org/wp-content/uploads/19-10-21_Dependent_Development.pdf

target, measured as number of dwellings completed by a specified date – which at the time of the research was 2017.

C.1.5 What Works Centre for Local Economic Growth carried out updated research in 2022[14] and assessed the same schemes. Table 9 shows the percentage progress towards the original expected dependent development in 2017 and 2022. The number of dwellings completed in 2017 as a proportion of the target range from 0% for the worst performing scheme up to 43% for the best performing scheme, with an average of 23% over all schemes. By 2022, all schemes had delivered additional dwellings, but only one scheme had met the original dependent development target. In addition, the evaluation noted that:

"*For five of the six schemes, the dependent development targets are unlikely to be met by the target date (or within 20 years of the scheme completion, where a target date is not given). The Abbey Bridge Maintenance Scheme in Evesham is the exception."*[16]

Table 9 – Dependent development delivery over time for each scheme

Scheme Name	Scheme completion date	Original Timetable for dependent development	Original expected no. of dependent development dwellings	Total completed dwellings up to 2017	Total completed dwellings up to 2022	% progress towards original expected development	
						2017	2022
Turnstall Northern Bypass	2008	No timetable data available	395	168	292	43%	74%
East of Exeter M5 Junction 29	2013	2026	20,000	3,561	11,709	18%	59%
Doncaster Network Woodfield Link Rd	2013	No timetable data available	1,600	268	364	17%	23%
Evesham Abbey Bridge Maintenance Scheme	2014	2030	550	0	815	0%	148%
Newark to Widmerpool A46 Improvement	2012	2026	5,000	358	1,070	7%	21%
Taunton Third Way (Major Scheme Bid)	2011	No timetable data available	1,100	321	427	29%	39%

[14] Dependent development research update for Department for Transport, What Works Centre for Local Economic Growth (What Works Growth), June 2022

Table 9: Dependent development delivery over time for each scheme included in Dependent development research update for Department for Transport, What Works Centre for Local Economic Growth (What Works Growth), June 2022

C.1.6 In conclusion, the evaluation evidence suggests there is a strong tendency to overestimate the scale of dependent development (though it should be noted that the What Works Centre for Local Economic Growth reports only looked at road schemes and delivery of housing), and geographic variation in the build out rate of housing schemes more generally. This means that dependent development benefits are likely to be overestimated which could impact VfM analysis and decision making.

C.2 Derivation of dependent development overestimate

C.2.1 To derive the dependent development overestimate, we utilised two methods to ensure the robustness of the final estimate. The two methods are as follows:

1. Used the What Works Centre for Local Growth evaluation data to extrapolate how many units of dependent development would be delivered after 15 years as a percentage of the original target.

2. Used data on the average build out rate of development to construct a counterfactual. The linear extrapolation from method 1 was then taken as a percentage of the average build out rate counterfactual to give an annual estimate of dependent development overestimation. The annual estimate was then averaged across year to give the average overestimation over the first 15 years after scheme completion.

C.2.2 The below sections outline the assumptions and caveats of the derivation of the overestimate, and then provides details of both methods.

Key assumptions and caveats

C.2.3 There are three key assumptions and caveats to this approach that need to be highlighted:

1. The sensitivity is only applied to the overall dependent development benefit, it does not affect the land use change assumed in the rest of the economic case.

2. It assumes all components of total dependent development benefits (i.e. land value uplift, transport external costs, land amenity value and non-transport complementary interventions) scale down linearly. So, if fewer developments are completed the components would change proportionately. This means that the sensitivity can be applied to total benefits without having to account for non-linearities in how individual components may change. It also means the evaluation data on the delivery of dependent development units can be used as a proxy for the overestimation of benefits.

3. Because the sensitivity is applied to the total dependent development benefits, no specific assumption is made about the cause of the decreased benefits. It could be caused by a slow construction rate, housing not being delivered in full or some combination of both.

Derivation of linear extrapolation

C.2.4 To calculate the average overestimate of dependent development benefits, the Dependent Development Build Out Data from the What Works Centre for Local Economic Growth's 2022 report[16] is used.

C.2.5 It is assumed that there is a constant rate of change in each year between 2017 and 2022 to derive an estimate of the annual number of dependent development units delivered each year between 2017 and 2022. Using that derived annual number of units delivered, it is extrapolated out until the schemes exceed their original dependent development target.

C.2.6 Table 10 presents the linear extrapolation as a percentage of the original dependent development target. Fifteen years after schemes' completion date, the average delivery as a percentage of the original target was 75% over all schemes. If it is only averaged across schemes that under delivered dependent development units relative to the original target, then the average delivery falls to 48%. This suggests that across all schemes the average under delivery was 25%, while of the schemes that underdelivered, the average under delivery was 52%. This provides evidence supporting a contextualising range of approximately 30 to 50%, to capture the variable scale at which schemes tend to underdeliver dependent development benefits.

Table 10: a linear extrapolation of cumulative dependent development delivery

Scheme Name	3rd year after scheme completion	5th year after scheme completion	10th year after scheme completion	15th year after scheme completion
Turnstall northern bypass	14%	24%	49%	80%
East of Exeter M5 junction 29	13%	26%	67%	107%
Doncaster network Woodfield link rd	13%	18%	24%	30%
Evesham Abbey Bridge maintenance scheme	0%	59%	100%	148%
Newark to Widmerpool	4%	7%	21%	36%

A46 improvement				
Taunton Third Way (major scheme bid)	15%	24%	37%	47%

Table 10: A linear extrapolation of cumulative dependent development delivery, assuming the annual rate of dependent development delivery continues at the rate it showed between 2017 and 2022 for each scheme, as a percentage of the original dependent development target. Based on data from 'Dependent development research update for Department for Transport', What Works Centre for Local Economic Growth (What Works Growth), June 2022.

Derivation of counterfactual

C.2.7 A counterfactual is then constructed which is used to compare the extrapolation derived using the above approach outlined in C.2.5. To construct this counterfactual, we utilise the data presented in Table 11, which is from a 2024 Lichfields report[15] which includes the mean and median build out rates in dwellings per annum for differing sizes of development. Using this data, we calculated how many dependent development dwellings would be delivered by the time the above extrapolation exceeded the original target, if the delivery for each scheme followed the mean build out rate.

Table 11 - Mean and median build out rates by site size

Site size (dwellings)	Mean build-out rate (dwellings per annum, third edition)	Median build-out rate (dwellings per annum, third edition)
50-99	20	18
100-499	49	44
500-999	67	68
1,000-1,499	90	87
1,00-1,999	110	104
2,000+	150	138

Table 11: Mean and median build out rates by site size. Third edition refers to the fact that the latest publication is the third edition published in 2024. Data from Lichfield[15]

Final derivation of average overestimate

C.2.8 The extrapolation for each scheme, which is presented in Table 10, is then taken as a percentage of the counterfactual. This gives the delivery relative to what we would expect if delivery had followed the mean build out rate, and is presented in Table 12.

[15] Lichfields (2024) Start to Finish How quickly do large-scale housing sites deliver? - https://lichfields.uk/media/w3wjmws0/start-to-finish-3_how-quickly-do-large-scale-housing-sites-deliver.pdf (The full data in the publication includes build out rate data over time which shows that the build out rate has been falling)

C.2.9 The figures in Table 12 are then averaged across scheme to create an all-scheme average for each year. Table 13 then presents the all-scheme average averaged over the first 15 years after scheme completion. These figures indicate that the under delivery is approximately 30% to 40% (100 minus 63 or 66). This supports the contextualising range of 30% to 50% suggested above.

C.2.10 The delivery was calculated including and excluding the Exeter scheme which was a large scheme with a dependent development target of 20,000. This is because the Lichfields paper only gives the mean build out rate for sites in select categories, with the highest site size category being in 2,000+ as shown in Table 11, and it's unclear if site sizes above this size all have similar build out rates.

Table 12: delivery of schemes compared to mean build out rate counterfactual

	Year 1	Year 5	Year 15
Turnstall northern bypass	38%	38%	80%
East of Exeter M5 junction 29	59%	69%	107%
Doncaster network Woodfield link rd	61%	52%	30%
Evesham Abbey Bridge maintenance scheme	0%	97%	152%
Newark to Widmerpool A46 improvement	48%	48%	79%
Taunton Third Way (major scheme bid)	59%	59%	47%

Table 12: Average delivery of each scheme compared to a counterfactual constructed using the mean build out rates shown in Table 10. Year 1, 5 and 15 refer to the number of years since scheme completion.

Table 13: fifteen-year average of delivery (averaging across all schemes) compared to mean build out rate counterfactual

	Delivery relative to a counterfactual – 15-year average
Average delivery of all schemes	66%
Average delivery of all schemes (excluding Exeter)	63%

Table 13: 15-year average of delivery compared to a counterfactual constructed using the mean build out rates shown in Table 10. The average presented is the average of all schemes (which are shown for year 1, 5 and 15 in Table 11) averaged over each year of the first 15 years after scheme completion, rather than the average for each scheme in only year 15 shown in Table 11.

Appendix D: Principles Underlying Appraisal of Combined Land Use and Transport

D.1 Appraisal of combined land use and transport

D.1.1 This section provides an explanation of the principle of breaking down benefits into transport benefits (given an assumed land use) plus additional land use / development related benefits.

D.1.2 The objective is to estimate the combined benefits[16] S[T&L] of a transport scheme, T, and a land use development, L, where the land use development cannot proceed without the transport scheme.

D.1.3 In principle, the combined benefits would be estimated by comparing a scenario that includes both land use development and transport scheme with an alternative that includes neither. However, we do not have the tools to allow us to make that comparison. In particular, we know that conventional transport appraisal methods *cannot* be used if land use differs between with and without transport scheme scenarios.

D.1.4 An alternative approach would be to assess the benefits of the two components separately, then combine them. But we cannot simply assess the benefits of the two components in isolation, then add them:

S[T&L] is **not** equal to S[T] + S[L]

where S[T] is the benefit of the transport scheme **without the land use development**, and S[L] is the benefit of the land use development **without the transport scheme**.

D.1.5 Because the land use development is dependent on the transport scheme, the land use development cannot proceed in isolation and hence S[L] does not reflect the true benefits of the development.

D.1.6 However, we can assess the benefits of the transport scheme in isolation, then assess the benefits of the land use development incrementally, adding the two to give:

S[T&L] = S[T] + S[L/T]

where S[L/T] is the benefit of the land use development, assuming that the transport scheme already exists.

[16] We use the term 'benefits' here to refer to the net present value (NPV) of benefits less costs.

D.1.7 S[T] can always be estimated, though the result may suggest that the transport scheme **in isolation** is not good value for money. There is no change in land use between the without- and with-scheme scenarios, so conventional transport appraisal techniques may be applied. In both scenarios the only determinants of demand will be growth and the limitations of the transport network, so there should be no extraordinary inconsistency between network capacity and demand.

D.1.8 S[L/T] - the incremental benefits of the land use development, assuming the transport scheme is already present - can also be estimated satisfactorily. Because the transport scheme is assumed to be present, the problem reduces to that of estimating the benefits of the land use development alone.

D.1.9 Note that the alternative form - S[T&L] = S[L] + S[T/L] - is not acceptable. As discussed above, the land use development cannot be built without the transport scheme, so the benefits of the land use development in isolation are not relevant.

D.2 Benefits of land use development

D.2.1 MHCLG has developed a methodology for estimating the benefits of land use development based on 'land value uplift' arising from the development, LVU, less transport and other externalities, TE and OE:

S[L/T] = LVU - TE – OE

D.2.2 The land value uplift - LVU - arising from the land use development may be estimated by subtracting the value of the land in its 'without development' use from its value in new (residential/non-residential) use. Note that, because the transport scheme is assumed to have been implemented, the value of the land in its new use will reflect the improved accessibility provided by the transport scheme. However, the benefits S[T] of the transport scheme will not have captured these benefits because it is based on a land use scenario that excludes the land use development L. Thus, there is no double counting across S[T] and S[L/T].

D.2.3 For information on the methodology to estimate land value uplift, see Appendix E.

D.2.4 The transport externality, TEC, is the additional cost imposed on users of the transport system as a result of the construction of the land use development. The cost can be estimated using a transport model.

Appendix E: Derivation of Land Value Uplift

E.1 Origin of Land Value Uplift

E.1.1 Land value uplift refers to the change in land prices as a result of land use change. Households' and businesses' willingness to pay for land depends on the purpose and intensity with which they will use it. Thus, if either of these change (land use change), so too will households' and businesses' willingness to pay and hence the land value.

E.2 Residual Land Valuation Methodology

E.2.1 One commonly used method to determine the maximum value households and business will place on land is the residual methodology. This method involves estimating the final value of the development (Gross Development Value) and subtracting from this an estimate of the development costs. Note developers will have their individual views on both the Gross Development value and development costs, and hence the maximum value they are willing to pay for the land. The residual method is equal to:

$$Maximum\ Land\ Value = Gross\ Development\ Value - Development\ Costs$$

E.2.2 The Gross Development Value is equal to the expected total revenue which the developer will receive from the sale of the completed development. For example, in the case of a housing development the GDV would equal the expected price per house multiplied by the number of houses. Similarly, for non-residential developments the GDV would equal the expected price per square foot multiplied by the total floor space.

E.2.3 The Development Costs include the costs of construction, fees charged for professional services and Government, and profit – but not cost of land before development. If a developer makes contributions to a non-transport complementary intervention, such as utility connections or the provision of a school, these will be included in the development costs.

E.2.4 To determine the land value uplift, the price of the land in its existing state must be subtracted from the expected value of the land after development has taken place.

$$Land\ Value\ Uplift = Land\ Value\ after\ Development - Land\ Value\ before\ Development$$

E.2.5 In the case of a redevelopment, in which there is an existing development on the plot, it is unlikely the land price can be directly observed. However, this can be estimated using the residual land valuation methodology. This would involve subtracting an estimate of the costs to build the existing development from the current value of the property.