Norfolk County Council

# NORWICH WESTERN LINK

Technical Report

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OCTOBER 2017

PUBLIC

Norfolk County **Council**

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Technical Report

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# 1

# INTRODUCTION

# 1 INTRODUCTION

This document summarises recent work undertaken to identify the potential case for, and viability of, a Norwich Western Link to enhance connectivity between the A47 and A1067.

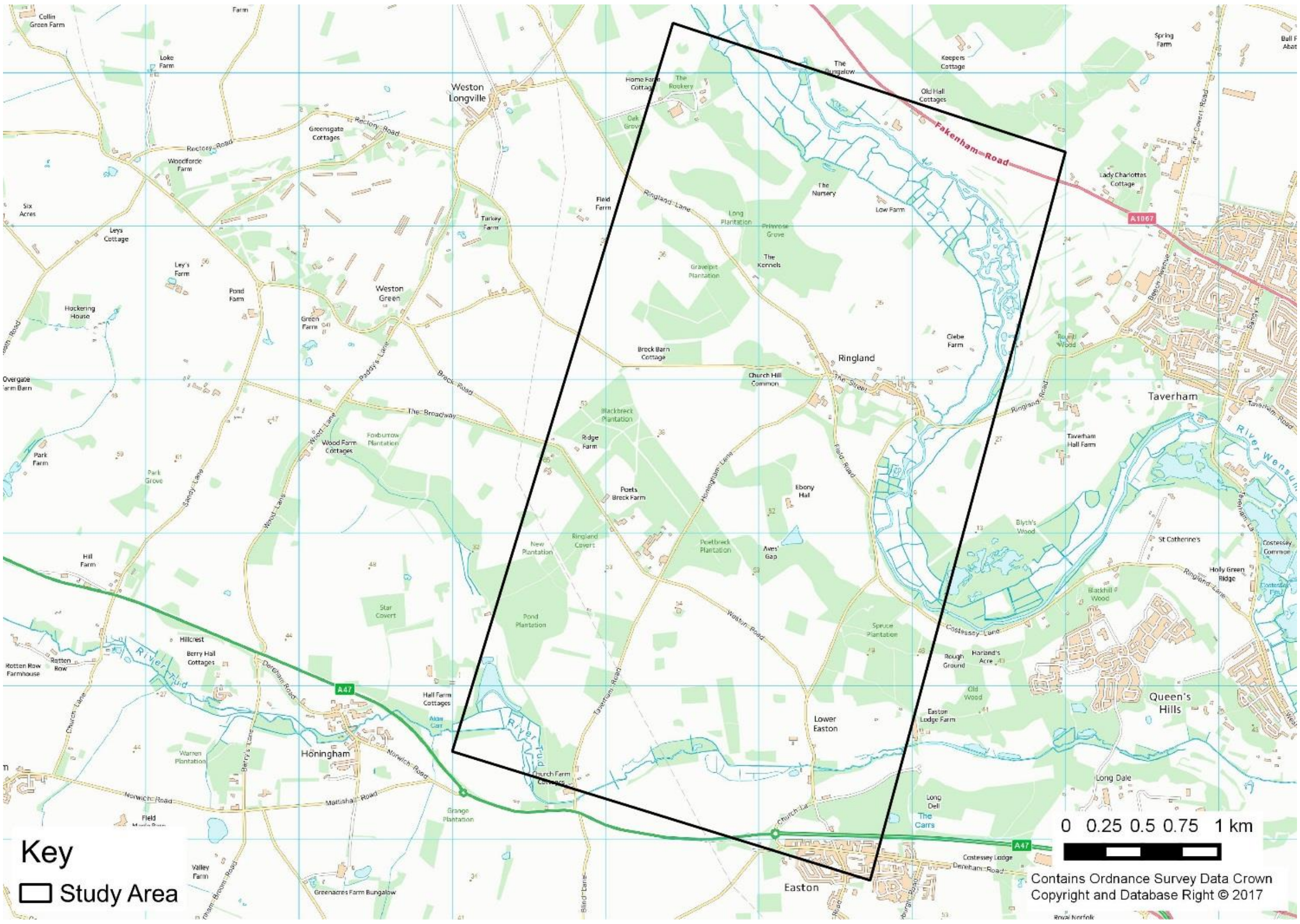
The work has focussed on the wider strategic context, identification of transport problems, possible engineering options, environmental considerations and economic benefits to set out a series of recommended next steps.

## 1.1 STUDY AREA

A Norwich Western Link (NWL) scheme, if progressed, would be located to the north-west of Norwich, in an area known as the Norwich Western Quadrant (NWQ). The NWQ Strategy area includes the key radial routes of A1074 (Dereham Road), A47 trunk road, and A1067 (Drayton High Road/ Fakenham Road) and encompasses the western fringe of Norwich and a number of local settlements.

For the purpose of this report, the wider challenges for the NWQ are considered; however, when considering potential options for a NWL the work has focussed on a central corridor as illustrated in Figure 1 below.

**Figure 1: NWL Indicative Study Area**



## 1.2 PROJECT BACKGROUND

Since the adoption of the Norwich Northern Distributor Road (NNDR) preferred route in 2005 providing a connection between the A1067 (Fakenham Road at Attlebridge) and the A47 (at Postwick), there has been sustained local pressure for provision of a Norwich Western Link (NWL) to connect the A47 (west) to the A1067 (Fakenham Road) to ease perceived traffic problems in the local area and enhance strategic connectivity.

Early plans to link the A47 (west) to the A47 (east) via the A1067 were not progressed due to environmental concerns regarding the Wensum Valley. However, following full approval of the NNDR (in 2015) and an announcement from Highways England (in 2014) of their intention to investigate options to dual the A47 between Easton and North Tuddenham, the County Council committed to revisit the feasibility and need for a NWL.

A pre-feasibility study was completed in June 2016 which reviewed previous work, including a scoping study from 2014 which investigated potential route options. The output of the 2016 study (presented in the Norwich Western Link Technical Report) included amongst other aspects a series of actions to support the next stage of development for the NWL, and these were presented at Norfolk County Council's Environmental, Development and Transport (EDT) Committee in July 2016. The report concluded that further work needs to be undertaken to help develop a business case and set out a compelling case for the scheme.

## 1.3 PURPOSE & CONTENT OF THIS DOCUMENT

This report builds on the previous work; the key technical issues regarding the viability of a NWL have been identified and analysed to provide an updated evidence base and provide early insight on the potential case to pursue the scheme.

This report focusses on the need for the scheme as part of a wider strategy, describes the outputs from initial traffic modelling to present the challenges and likely economic benefits associated with a NWL, and explores the potential engineering solutions to identify a number of possible options and wider considerations.

Following this Introduction the remainder of the document is structured as follows:

- Section 2: Strategic Context
- Section 3: Evidence Base
- Section 4: Potential Options
- Section 5: Initial Economic Appraisal
- Section 6: Summary
- Section 7: Recommendations
- Section 8: Suggested Next Steps

# 2

# STRATEGIC CONTEXT

# 2 STRATEGIC CONTEXT

## 2.1 INTRODUCTION

This section considers the strategic context of a NWL: it notes the council's commitment to progress a solution; includes a summary of the previous work undertaken; an overview of the emerging transport strategy being developed for the Norwich Western Quadrant; and includes consideration of major transport and growth proposals in the area.

## 2.2 NORFOLK'S TRANSPORT INFRASTRUCTURE PRIORITIES

The County Council, at its full council committee meeting in December 2016, agreed a motion setting out that the 'Council recognises the vital importance of improving our transport infrastructure and that this will help to deliver the new jobs and economic growth that is needed in the years ahead.' In addition the motion set out that the 'Council also recognises the importance of giving a clear message of its infrastructure priorities to the government and its agencies, and so ensure that there is universal recognition of their importance to the people of Norfolk.'

Three projects were identified as priorities for the coming years and the Norwich Western Link is identified as one of these demonstrating strategic level commitment to investigate the case for and seek to deliver a potential NWL.

## 2.3 PREVIOUS STUDIES

The 2016 Norwich Western Link Technical Report included a review of earlier studies and considered the strategic background to the NWL proposal, the evidence supporting it, the gaps in appraisal, and the possible difficulties to identify a series of actions to support the next stage of development.

The 2016 report examined the need for intervention, and outlined the existing problems, future challenges, opportunities, constraints and uncertainties with the following conclusions:

- There is considerable circumstantial and anecdotal evidence that an intervention to link the A47 and the NNDR is needed;
- There is support for a link, and potential for this to accommodate, or otherwise benefit, pedestrians, cycle users and public transport;
- There is a lack of robust evidence of the severity of existing problems (e.g. congestion, delay). This does not mean that problems do not exist, but there is a need to test assertions with better evidence from surveys (existing problems) and modelling analysis (future problems);
- There would be significant environmental challenges in designing an acceptable road link, and more work is needed to see how these might be overcome; and
- There is clearly an opportunity to generate benefits for road users, local residents and businesses by providing a NWL, but there is a need for further work to test whether these would outweigh the financial and environmental costs involved, and, if so, to determine when the scheme should be provided and on what alignment.

The report ultimately concludes that there are good reasons for believing that a NWL would help to address the traffic problems identified by local people and stakeholders, and improve connectivity for all modes, however, significant further work is required to set out a compelling case to include:

- Evidence of the problem(s) to be solved;
- Understanding the implications of the NNDR post-opening, A47 dualling and potential growth
- The role of a NWL as part of a wider coherent strategy;
- Consideration of a wide range of potential options;
- Environmental considerations;
- Engineering solutions; and
- Understanding of the likely costs and benefits.

## 2.4 A TRANSPORT STRATEGY FOR THE NWQ

### 2.4.1 OVERVIEW

WSP, in collaboration with NCC and other key stakeholders, are currently progressing the development of a potential transport strategy for the NWQ, which includes the study area for the NWL. This emerging strategy will capture evidence of the issues and challenges facing the local area, set out high level and specific objectives for the NWQ, and will present a number of potential measures and interventions for the study area.

While still in development, the work undertaken thus far in progressing the NWQ Transport Strategy is of direct relevance to the NWL, and is considered in the following subsections.

### 2.4.2 PRIORITIES AND KEY CHALLENGES

As part of developing the emerging NWQ Transport Strategy a wide ranging review of national and sub-national policy and strategy documents has been undertaken; the key priorities that have emerged from this review include:

- Transport investment to facilitate sustainable development
- Enabling significant growth in jobs, businesses and housing
- Reducing the traffic impacts of growth, in particular environmental impacts, to negate a detrimental effect on the road network and communities
- Enhancing strategic connections and improving accessibility
- Responding to local needs and developing locally-led solutions
- Delivering value for money
- Supporting significant growth in the Norwich Policy Area
- Reducing carbon emissions and improving air quality
- Encouraging more walking, cycling and public transport trips
- Improving safety, user satisfaction, and efficiency

Furthermore, a review of available information and data has identified a number of challenges across the western quadrant; these include:

- Significant increase of population, particularly increase of older residents is likely to generate additional pressures on transport and community infrastructure.
- The overall study area has areas with high and low levels of deprivation which suggests different areas will have different local challenges, and the area cannot be considered as one.
- Levels of employment and economic activity vary across the study area meaning that local communities will have different challenges and may require different measures to support access to employment.
- High proportion of economically active people and rapidly growing population in NWQ will increase demand for journeys to work and put additional pressure on the road network.
- There is a high volume of traffic movement through the study area.
- There is high car dependence and ownership in NWQ which puts pressure on local transport networks.
- Relatively low levels of walking and cycling as mode of travel to work despite high number of journeys being under 10km suggests high number of short car journeys being undertaken.
- Existing pressure exists on the rural single carriageway roads, especially due to HGV movements.
- Cycle facilities are located to the east of the western quadrant.
- There are inadequate pedestrian facilities between villages and to services outside build-up areas.
- Walking infrastructure perceived as unsafe due to high volumes of traffic.
- Bus services connecting residents with Norwich city centre do not provide late evening / night services.
- Speeding along certain routes, particularly along Heath Road.
- Evidence that some routes are used as ‘rat-runs’ in peak times.
- There has been eight fatal collisions within a recent five year period and nearly a fifth of all casualties involved non-motorised users.
- Mixture of land uses will require a wide ranging approach to engagement.
- The existing character, rural environment and designations need consideration in the identification of any potential measures to improve accessibility and connectivity.
- The valley and natural topography act as a barrier to transport and a constraint to access.

- Development of new houses and jobs will result in an increased demand for travel and could put significant pressure on the existing transport network.
- Important to consider access to/from new housing and jobs for all modes to help encourage greater use of more sustainable travel modes
- Timing of other schemes and growth plans will be crucial.
- Need to build on and incorporate successful delivery of improvements and measures for more active and sustainable modes of travel

### 2.4.3 ENGAGEMENT WITH STAKEHOLDERS

The emerging NWQ Transport Strategy builds on the outputs from ongoing local engagement which to date has highlighted local support for improvement within the study area, with a particular focus on addressing the problems associated with 'rat running', HGV routing, connectivity for all modes, and network resilience.

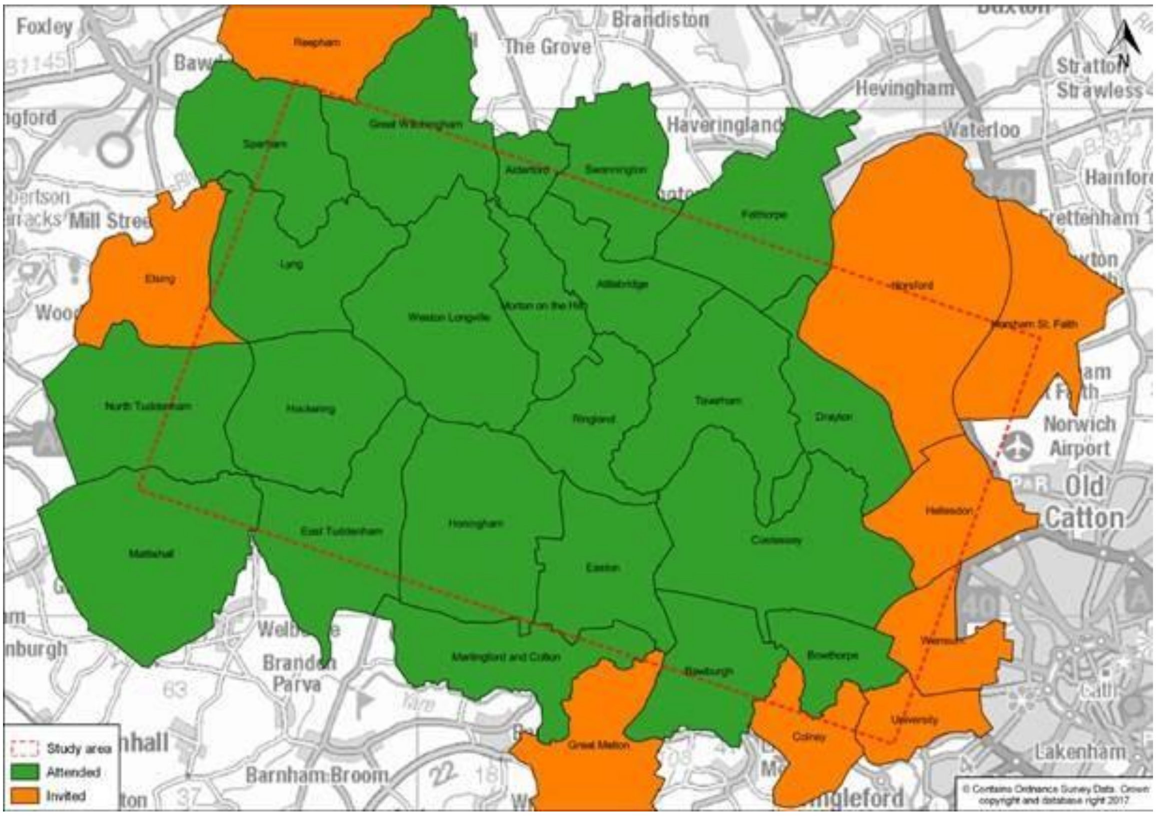
In March 2016, two 'drop-in' sessions were held, one at Costessey Hall and one at Hall for All in Weston Longville. These sessions were well attended with representatives from: Morton; Weston Longville; Hockering; Taverham; Easton; Ringland; Costessey; Wensum Valley Alliance; CPRE and Friends of the Earth.

These 'drop-in' sessions gave local representatives the chance to provide views on the main transportation issues adversely impacting the area. A summary of these discussions is included within the 2016 Norwich Western Link Technical Report.

To build on this initial engagement and to support the development of an emerging transport strategy a series of 1-2-1 meetings were held with local parish council representatives and key stakeholders during October and November 2016 to discuss problems and challenges, opportunities, objectives and potential measures.

Figure 2 shows the geographical boundaries of each Parish that is within the study area or crosses the study area boundary. The Parish Councils that attended a 1-2-1 session are highlighted green, a meeting also took place with representatives of the Wensum Valley Alliance

**Figure 2: Boundaries of each Parish**



From these meetings the following key concerns were identified:

- Rat running
- HGV routing and volumes
- Longwater Interchange delays and safety
- Increasing traffic on local road network post NNDR
- Network resilience
- Limited Public transport provision
- Limited Cycling & walking infrastructure
- Future housing developments need advance infrastructure
- Impact of commercial development

A number of opportunities were also discussed, and these include:

- Give direct access to A47 from north and west
- Improve access to employment e.g., Food Enterprise Zone
- Enhanced east & west connections
- Support growth
- Faster journeys to work
- Improved access to tourism, business
- Create jobs and attract new businesses
- Find archelogy and gives opportunity to learn
- Connecting Businesses

As a result of these 1-2-1 sessions a local steering group was set up to facilitate a two-way flow of information and ideas. To date, there have been two meetings held on Tuesday 21st February 2017 and Wednesday 20th September 2017 – both meetings were well attended and have included discussion of the following topics:

- Highways England proposals for A47 dualling between Easton and North Tuddenham, and the potential implications on a Norwich Western Link scheme.
- Discussion of the Food Enterprise Zone proposals.
- Discussion of the high-level and specific objectives for the Norwich Western Quadrant.
- Review of potential measures identified through the emerging transport strategy work.

### 2.4.4 DRAFT OBJECTIVES

The emerging NWQ Transport Strategy identifies a number of objectives for the NWQ; these have been developed by considering the key themes from the analysis of national and sub-national policy and strategy documents, the challenges identified from the review of evidence, and comments from local engagement.

In developing the objectives it has been anticipated that the NNDR will be open and that the A47 will be dualled between Easton and North Tuddenham, as despite these significant improvements a number of local and strategic challenges are anticipated to remain in the Norwich Western Quadrant.

The objectives remain draft for the current time, and the high-level objectives for the Norwich Western Quadrant are currently as follows:

- Support sustainable growth in the western quadrant
- Improve the quality of life for local communities
- Support economic growth
- Protect and enhance the natural environment
- Improve strategic connectivity with the national road network

A number of draft specific objectives for the Norwich Western Quadrant have also been developed and are currently as follows:

- Reduce congestion and delay, and improve journey time reliability, on routes through the study area (SP01)
- Improve network resilience and efficiency of the strategic and local road network (SP02)
- Reduce the number of HGVs using minor roads (SP03)
- Reduce the number of road user casualties (SP04)
- Improve the safety of Non-Motorised Users (pedestrians, cyclists and equestrians) (SP05)

- Increase modal shift to more sustainable modes of transport (SP06)
- Provide traffic relief to residential areas (SP07)
- Improve access to Queen's Hills and Longwater Business Park (SP08)
- Encourage public transport (SP09)
- Improve access to green space (SP10)
- Reduce noise and vibration in residential areas (SP11)
- Reduce the impact of traffic on the local environment / unique characteristics of valley (SP12)
- Contribute to the improved health of local residents (SP13)
- Maximise access to new development sites (SP14)
- Improve connectivity and accessibility to Norwich airport (SP15)

### 2.4.5 POSSIBLE INTERVENTIONS

In response to the identified challenges and objectives an initial list of potential measures has been identified and a high-level appraisal is in progress to consider how well each measure may support the identified objectives and by considering the likely deliverability challenges and risks.

This initial list of potential intervention was formulated to enable discussion with the parish councils and other stakeholders. Further work is required to develop these, however, an overview is provided here to illustrate the relevance of a NWL as part of the wider strategy.

The options identified include a range of capital, revenue and policy interventions and can be grouped into six categories:

- Information
- Demand Management
- Infrastructure
- Public Transport
- Walking and Cycling
- Public Realm / Local Environment

The emerging appraisal has generated a number of potential measures which can be considered as either shorter-term local measures or longer-term strategic measures.

Within the longer-term strategic measures the following options appear to closely align with the objectives:

- Enhance connection between A47 and A1067 by upgrading an existing route; and
- Enhance connection between A47 and A1067 with new route.

Clearly further work, including further engagement, is required to assess and compare these potential measures but the ongoing work on the strategy does demonstrate that an enhanced link between the A47 and A1067 (whether by way of an upgrade or new link) is likely to form an important element of the emerging transport strategy for the NWQ.

## 2.5 TRANSPORT AND GROWTH CONSIDERATIONS

The NWQ is an area experiencing significant change in terms of the transport network and level of growth, including:

- the Norwich Northern Distributor Road (NNDR) to open in late 2017 / early 2018;
- the announcement of the preferred route to dual the A47 between Easton and North Tuddenham progressing;
- the Food Enterprise Zone (FEZ); and
- the Greater Norwich Local Plan which is currently under development.

An overview of these is provided below. It is considered that each of these schemes is likely to have a significant effect on travel demand and behaviours in the NWQ, and the impacts and implications of each will need to be understood and accounted for when appraising the current and future problems, and assessing the benefits associated with a NWL.

## 2.5.1 AN AREA OF GROWTH

Within the study area, Easton / Costessey has been identified as a major growth location, with plans to accommodate 1,000 new dwellings and enhanced local services. The Easton / Costessey area is also a prime location to accommodate some of the 1,800 units in the Norwich Policy Area that the Joint Core Strategy does not attribute to a particular settlement.

There are proposals to develop a FEZ at Easton. When complete the hub is expected to provide 3,000-5,000 jobs and host multiple businesses with a range of complimentary uses connected to the agri-food sector.

Further development of the Greater Norwich Local Plan (GNLP) is ongoing and will eventually lead to formal allocation of sites for housing and employment for the period up to 2036.

The impact of this growth on the network needs to be fully understood and considered within any appraisal of a NWL.

## 2.5.2 NNDR & ASSOCIATED MITIGATION WORK

The Norwich Northern Distributor Road (NNDR) is a 20km dual carriageway road currently under construction, which will provide a link from the strategic road network to Norwich International Airport and beyond, serving a large area of Broadland and North Norfolk, including existing and planned business and housing areas.

There are a number of mitigation measures to be discharged as part of the Development Consent Order (DCO) for the NNDR to help minimise adverse impacts on the villages and communities, including:

- Requirement 26 refers to the need for a signed route between A47 west of Norwich and the NNDR/Norwich airport.
- Requirement 27 provides for a scheme of traffic management measures to ensure rat-running through Weston Longville and Hockering is minimised, including speed limits, flashing signs, road humps, pinch-points and other physical barriers or impediments.
- Requirement 28 refers to rat-running measures for Ringland, Costessey, Taverham and Drayton, including enhancement of existing traffic calming measures, enforcement of weight restrictions on roads over the River Wensum and speed reductions.
- Requirement 29 requires monitoring of traffic levels through Lyng, with traffic measures to be implemented should such monitoring identify an increase in traffic that could be associated with the NNDR.

These measures are currently being finalised and will be implemented in advance of the NNDR opening with the aim to deter existing and additional drivers from using local routes through villages in the western quadrant after the opening of the NNDR.

A review of these mitigation measures was undertaken by WSP to identify opportunities for enhancement; this review identified a number of key themes, problems and wider opportunities which have helped to inform the identification of potential options as part of the emerging transport strategy. It is worth noting that one of the key themes emerging from this review was '*Movement – vehicular circulation and traffic control'* and the work identified a number of problems including HGV behaviour, 'rat running' and a need for more direct and faster connections for vehicles.

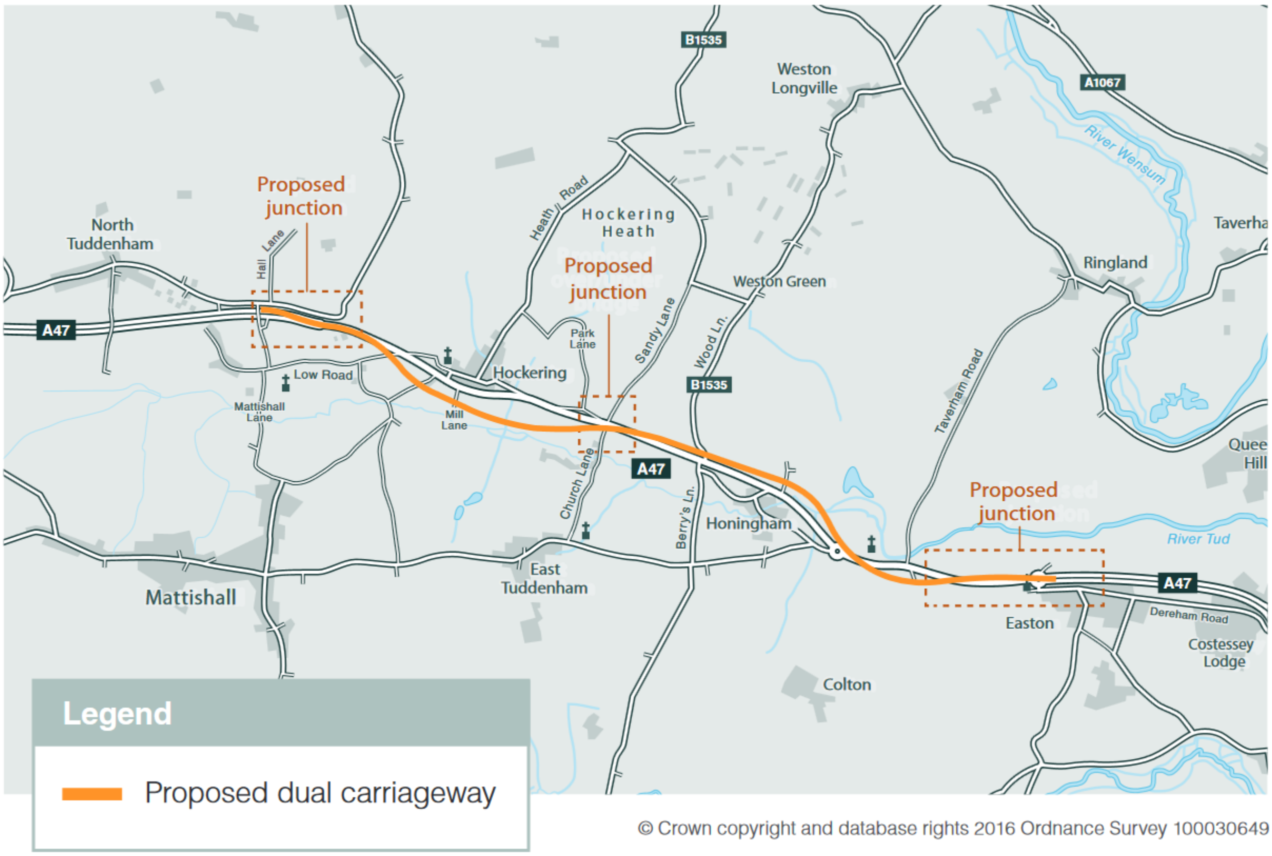
Once the NNDR and associated mitigation measures are complete an assessment of traffic behaviour will need to be undertaken. The impact of the NNDR will need to be based on actual monitored data, which will not be available until after a period of traffic redistribution after the new road has opened.

## 2.5.3 A47 IMPROVEMENTS

In August 2017 Highways England announced the preferred route for the A47 North Tuddenham to Easton scheme. The proposed scheme is expected to relieve the currently congested single carriageway section of the A47, reduce journey times, encourage economic growth and improve user experience.

Figure 3 below illustrates the preferred route. At the time of publishing this report Highways England and their consultants were undertaking a number of local engagement sessions with council representatives and so the full details of the proposal are still to emerge, however, it is understood that Highways England expect to start works on site in 2020 subject to securing the appropriate approvals.

**Figure 3: A47 Preferred Route**






The dualling of the A47 will influence traffic behaviour across the NWQ and beyond, and whilst the impact of the dualling will need to be considered alongside the potential for a NWL the improvement does present a possible opportunity to ensure that a NWL could effectively tie in the dualled A47 at an existing or upgraded junction.

# 3

# EVIDENCE BASE

# 3 EVIDENCE BASE

## 3.1 INTRODUCTION

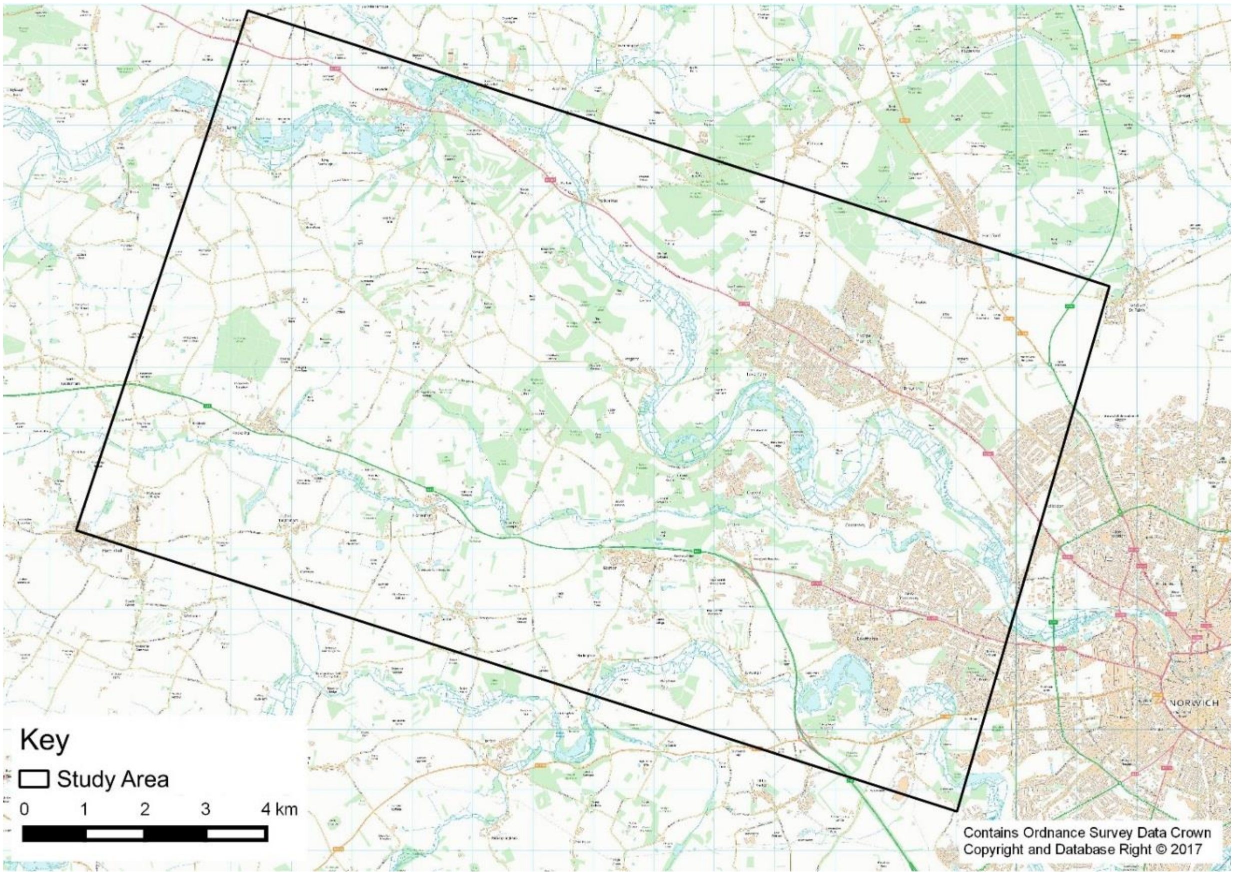
This section of the report summarises the traffic modelling and analysis undertaken in the assessment of a potential NWL and the resulting outputs associated with the various future scenarios, considering the impacts of growth and specific major development sites both on the surrounding highway network.

## 3.2 MODELLING APPROACH

### 3.2.1 STUDY AREA

The broad study area used in the modelling is shown in Figure 4 below, and incorporates the areas between the key radial routes—the A1074 Dereham Road / A47 and A1067 Drayton High Road.

**Figure 4: NWL Modelling Study Area**




### 3.2.2 MODELLING SOFTWARE

The NWL modelling study has been undertaken using SATURN v11.3.12W software. SATURN is an industry standard software tool and was used previously to develop the Norwich Area Transport Strategy (NATS) model. A fixed demand model was used at this stage as the most appropriate and proportional approach.

### 3.2.3 SIMULATION NETWORK EXPANSION

The existing NATS model has some limitations in the western area that make the model less suitable for appraisal of a NWL. The majority of the secondary (local) road junctions have not been specifically coded into the model; this means that demand flows are considered unrestricted in these areas, and that any results for these areas will be less realistic. This includes all the junctions within the study area for the NWL, as well as any junctions along the A47 to the west of the A47/Dereham Rd junction, and any junctions along the A1067 to the west of the old Fakenham Rd.

Given the limitations of the existing model, the existing zoning system and simulation network has been updated in order to better represent the existing local road network, as well as to take future growth and potential highway schemes into account.

## 3.3 FORECASTING

Forecasting the usage and performance of transport networks is a critical component of any transport appraisal. The principal purpose of the future year traffic forecasts is to develop a robust, appropriate, and proportionate methodology in order to examine and report on the technical issues and indicative viability of a NWL scheme.

The forecasting model has been developed in accordance with guidance provided by the DfT in the WebTAG series of documents, with particular attention paid to WebTAG Unit M4 “Forecasting and Uncertainty”, and the approach to forecasting was agreed through scoping discussions with NCC.

The following subsections summarise the various requirements of the forecasting and appraisal process for a NWL scheme. These include the prediction of the future year travel demands, and the assumptions relating to changes in the future year highway network.

### 3.3.1 FUTURE YEAR TRAVEL DEMAND SCENARIOS

The principal requirement of the traffic model was to provide traffic forecasts for use in the economic appraisal of the NWL scheme for the following specific years:

- The Opening Year (2021);
- Design Year (2036); and
- Horizon Year (2050).

Future travel demand forecasts for these years take into account the existing base year traffic demand together with the effects of future traffic growth and the additional traffic due to new development activity. It is acknowledged that an opening year of 2021 for a NWL is unrealistic; however, 2021 was chosen in agreement with NCC in order to align with the modelling and appraisal expected to be undertaken as part of the Highways England A47 improvement scheme.

### 3.3.2 NETWORKS

A number of scenarios were developed in order to test the initial ‘Do Minimum’ (or Without-Intervention case) networks and subsequent ‘Do Something’ (or With-Intervention case) networks for the Opening (2021), Design (2036) and Horizon Year (2050).

**‘Do Minimum’ Network**

The 2017 ‘Do Something’ NATS model scenario has been used as the basis for the ‘Do Minimum’ (DM) Network in the assessment of a NWL, and consists of the following elements:

- The Norwich Northern Distributor Road (NNDR);
- Offline improvement measures; and
- City Centre network improvements.

Highways England's A47 Corridor Improvements scheme is currently anticipated to begin construction by 2020 and while not currently fully 'committed', it was determined through scoping that this scheme should be considered as part of the baseline highway network within the study area, along with the NNDR, enabling a comparison to be made between the expected future network (NNDR and A47 dualling) both with and without a NWL.

The DM Network therefore also includes:

- Dualling of the A47 between Easton and North Tuddenham.

**'Do Something' Networks**

Two different 'Do Something' (DS) networks have developed in order to test a possible range of highways interventions, which are described below.

- **DS1**
  - Dual carriageway standard NWL;
  - Dual carriageway on the A47 between Easton and North Tuddenham (HE Scheme);
  - Proposed A47 NWL south roundabout;
  - Dual carriageway on A1067 between NNDR junction and NWL north junction; and
  - The closure of two local roads where NWL intersects (Honnigham Lane and Unnamed Road)
- **DS2**
  - As DS1, but with a single carriageway NWL

### 3.3.3 FUTURE GROWTH

The model development process considers three forecast year scenarios (2021, 2036, and 2050) for the AM, Inter, and PM peak hour assessments. The forecast traffic levels were estimated by applying growth factors to the 2017 NATS 'Do Something' model matrices. These growth factors were derived from the Department for Transport's TEMPRO program (Trip End Model Presentation Program) Version 7.

The total traffic growth (i.e. including development related traffic) between the 2017 base year and forecast years in the AM, IP and PM peak hour models has been factored to align with the overall TEMPRO growth, avoiding any double counting.

The anticipated development traffic trip generation has also included the following levels of future growth in each assessment year:

The 2021 reference forecast scenario includes the following developments:

- 25% of the Food Enterprise Zone.

The 2036 reference forecast scenario includes the following developments:

- 1,000 houses at Costessey;
- 2,000 houses at Honingham;
- 1,600 houses north of Thorpe Marriot; and
- 100% of the Food Enterprise Zone.

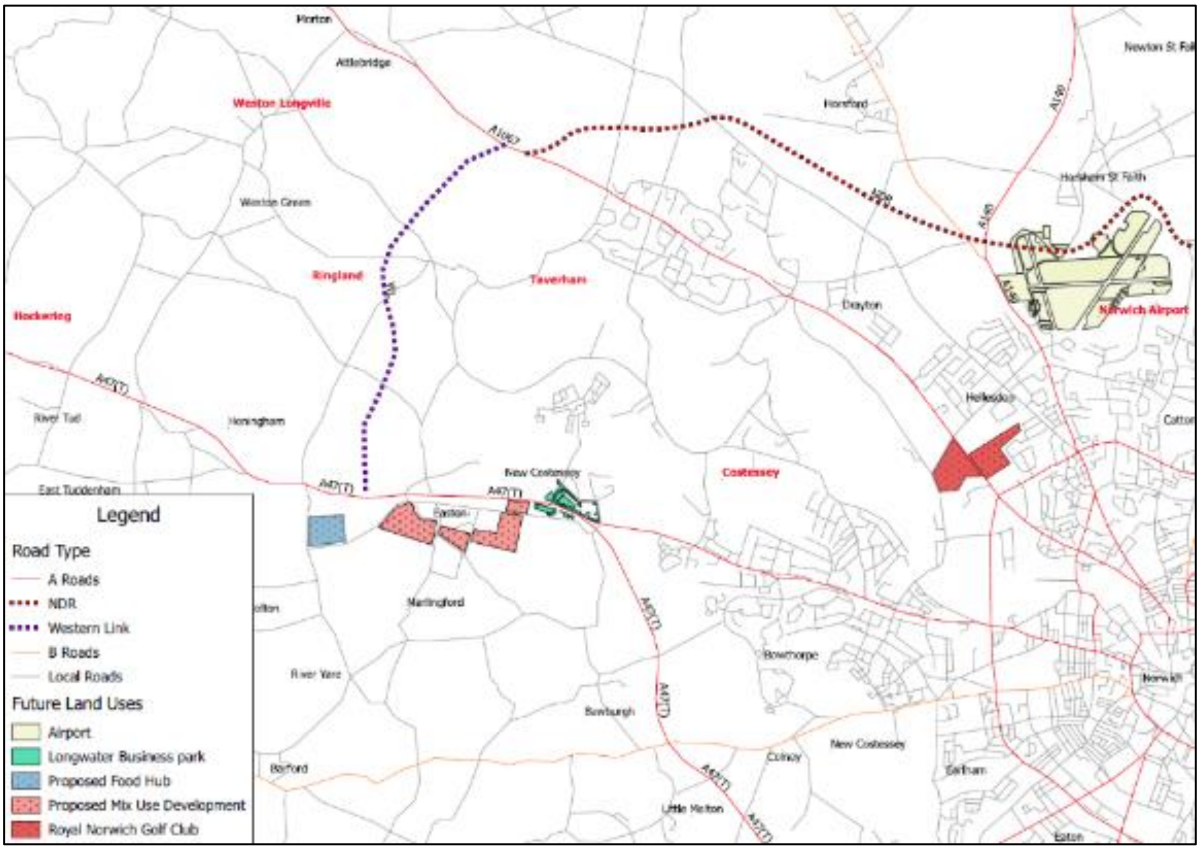
The 2050 reference forecast scenario includes the following developments:

- 4,000 additional houses at Honingham.

Where available, information from Transport Assessments provided data on the AM and PM peak hour trips/ trip rates; where this was not available the TRICS database was used to generate likely trip rates.

Figure 5 overleaf illustrates a notional alignment for a NWL used in the modelling assessment, and includes some of the anticipated development sites. Note that this alignment is representative of the route and no decision on the alignment has yet been made.

Figure 5: NWL Notional Alignment and Anticipated Developments




## 3.4 MODELLING RESULTS

The following sections provide a summary of the outputs for the modelled network, providing an overview of the difference in network performance between the DM, DS1, and DS2 networks, as well as highlighting the benefits and disbenefits along specific corridors of interest within the modelled network.

Queues, travel times, and speeds are used as indicators of overall network performances, and it is important to correctly understand these values when interpreting the modelling results; these are defined as:

- **Total Travel Time** – Total journey time of all vehicles within the model during the modelled time period;
- **Transient Queueing** – Queues that occur at junctions operating within their designed capacity; for example, vehicles stopping momentarily at a give-way line, or during one traffic signal cycle;
- **Over-Capacity Queueing** – Queues that occur due to there being more traffic than there is network capacity to deal with; for example traffic held for more than one cycle at a traffic signal junction;
- **Total Trips on Network** – The total number of vehicles travelling on the network in the modelled time period.

## 3.5 'DO MINIMUM' (DM) MODELLING RESULTS

It is considered that the existing strategic movement based network in the study area carries a high level of vehicular demand, and that this is predicted to increase in future years due to the high level of anticipated growth in the study area and beyond. The results of the DM network modelling for future years (2021, 2036, and 2050) allows an estimation of likely conditions in the future on the entire modelled network and selected specific corridors.

### 3.5.1 THE IMPACT ON THE OVERALL NETWORK

Table 1 summarises the overall network performance statistics for the DM scenario in each future year (AM and PM peak periods) for comparative purposes. Note that the data is presented as passenger car units (PCUs), as per the industry standard methodology, and is only relevant to the simulated time periods. They also show the percentage change in the overall network performance statistics for the DM network in 2036 and 2050 in comparison with the DM 2021 base year.

**Table 1: DM Network Performance Statistics**

| Network Performance Statistics DM AM Peak Period | | | |
|---|---|---|---|
| | **DM 2021** | **DM 2036** | **DM 2050** |
| **Total Travel Time (pcu hr)** | 13,940 | 18,343.7 **(+32%)** | 23,269.7 **(+67%)** |
| **Transient Queueing (pcu hr)** | 2,358.6 | 3,032.7 **(+29%)** | 3,653.8 **(+55%)** |
| **Over-Capacity Queueing (pcu hr)** | 863.6 | 2,384.1 (+**176%**) | 4,660.8 (+**440%**) |
| **Total Trips on Network (pcu)** | 90,469.76 | 105,005.79 **(+16%)** | 117,801.65 **(+30%)** |
| **Network Performance Statistics DM PM Peak Period** | | | |
| **Total Travel Time (pcu hr)** | 13,958.9 | 18,551.4 **(+33%)** | 23,473.2 **(+68%)** |
| **Transient Queueing (pcu hr)** | 2,399 | 3,118.2 **(+30%)** | 3,694.3 **(+54%)** |
| **Over-Capacity Queueing (pcu hr)** | 785 | 2,351.4 (+**200%**) | 4,738.8 (+**504%**) |
| **Total Trips on Network (pcu)** | 90,868.6 | 104,910.95 **(+15%)** | 116,753.41 **(+28%)** |

The DM network modelling shows that demand on the network increases by approximately 15% in 2036, and 30% in 2050 in comparison with 2021; this increase in demand is shown to significantly decrease network performance, with proportionally greater increases in queueing and travel time.

The results show transient queueing increases by 29% in the AM peak period and by 30% in the PM peak period between the 2021 and 2036 DM scenarios. Transient queuing across the network is predicted to rise by more than half by 2050, with an approximate 55% increase recorded in both AM and PM peak periods. Furthermore, overcapacity queueing increases significantly in future years, more than doubling in both the AM and PM peak periods in 2036, and increasing approximately five fold by 2050.

### 3.5.2 THE IMPACT ON KEY ROUTE CORRIDORS

While an analysis of network performance statistics provides an overview of the performance of the entire modelled network, further analysis has been undertaken on selected key route corridors in order to understand the impacts of growth, and evaluate the potential implications of a NWL.

Two-way flows have therefore been examined on the following key route corridors:

- The A47;
- The A1067;
- The NNDR; and
- The B1535.

For the purposes of this modelling exercise and data reporting, the extent of the B1535 is as defined in Figure 6 below.

**Figure 6: Extent of B1535**

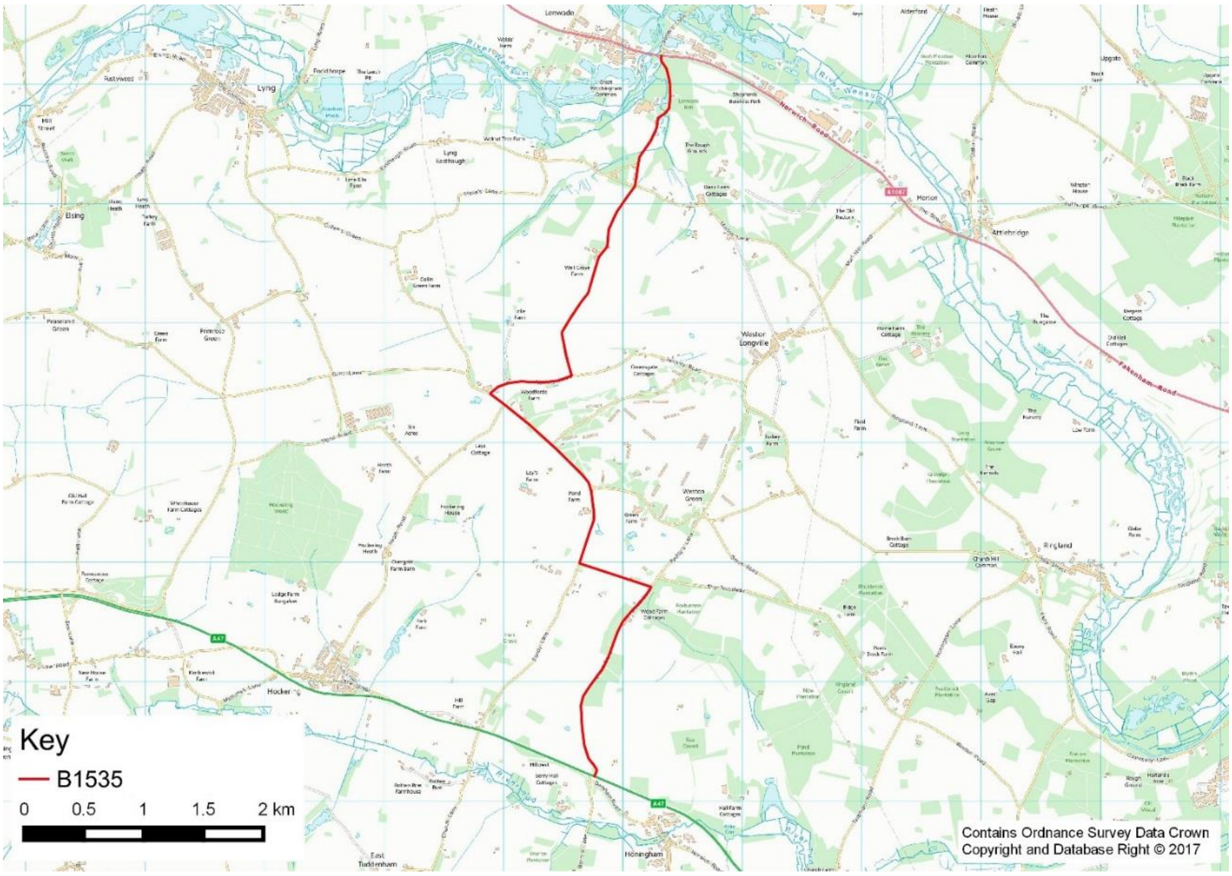



Table 2 presents the two-way vehicular flows for these selected key corridors in the DM network in each future year for the AM and PM peak periods. The table also shows the percentage change in comparison to the DM2021 scenario.

**Table 2: DM Key Corridor Two-way Flows**

| Road | DM 2021 | DM 2036 | DM 2050 |
|---|---|---|---|
| **Two-Way AM Peak Flows (PCUs/hr)** | | | |
| **A47** | 3,497 | 3,603 **(+3%)** | 3,724 **(+6%)** |
| **A1067** | 1,371 | 1,864 **(+36%)** | 2,104 **(+53%)** |
| **NNDR** | 1,093 | 1,495 **(+37%)** | 1,874 **(+71%)** |
| **B1535** | 502 | 568 **(+13%)** | 537 **(+7%)** |
| **Total** | 6,463 | 7,530 **(+17%)** | 8,239 **(+27%)** |
| **Two-Way PM Peak Flows (PCUs/hr)** | | | |
| **A47** | 3,370 | 3,721 **(+10%)** | 3,650 **(+8%)** |
| **A1067** | 1,269 | 1,765 **(+39%)** | 2,029 **(+60%)** |
| **NNDR** | 1,023 | 1,491 **(+46%)** | 1,936 **(+89%)** |
| **B1535** | 471 | 521 **(+11%)** | 525 **(+11%)** |
| **Total** | 6,133 | 7,498 **(+22%)** | 8,139 **(+33%)** |

The results show a significant increase in vehicular demand on the key routes, particularly on the A1067 and NNDR. It is noted that flows on the B1535 are relatively unchanged in the DM future scenarios; this could indicate a number of different scenarios: that congestion and high journey times on the B1353 limit the potential for additional traffic growth; that congestion on the A47 and A1067 limit access to this route; or that other routes are absorbing the growth.

Table 3 overleaf shows the one-way (eastbound and westbound) average delay per vehicle (in seconds) and the ratio of Flow Volume to Capacity (V/C) as a percentage for selected key links in the DM network in each future year for the AM and PM peak periods.

**Table 3: DM Key Corridor One-way Delay and V/C**

| | Year | 2021 | | 2036 | | 2050 | |
|---|---|---|---|---|---|---|---|
| | **Direction** | **Delay (Sec)** | **V/C (%)** | **Delay (Sec)** | **V/C (%)** | **Delay (Sec)** | **V/C (%)** |
| **AM Peak Period** | | | | | | | |
| **A47** | EB | 0 | 47% | 0 | 50% | 0 | 56% |
| | WB | 0 | 28% | 0 | 32% | 0 | 38% |
| **A1067** | EB | 10 | 52% | 18 | 70% | 22 | 77% |
| | WB | 6 | 39% | 11 | 55% | 15 | 63% |
| **NNDR** | EB | - | 14% | 0 | 20% | 0 | 21% |
| | WB | - | 13% | - | 17% | 0 | 25% |
| **B1535** | NB | 1 | 17% | 1 | 18% | 0 | 11% |
| | SB | 1 | 23% | 1 | 26% | 1 | 31% |

| PM Peak | | | | | | | |
|---|---|---|---|---|---|---|---|
| **A47** | EB | 0 | 35% | 0 | 45% | 0 | 54% |
| | WB | 0 | 38% | 0 | 41% | 0 | 44% |
| **A1067** | EB | 7 | 44% | 13 | 60% | 18 | 71% |
| | WB | 6 | 40% | 13 | 58% | 16 | 64% |
| **NNDR** | EB | - | 12% | 0 | 18% | 0 | 20% |
| | WB | - | 13% | 0 | 19% | 0 | 27% |
| **B1535** | NB | 1 | 15% | 1 | 13% | 0 | 7% |
| | SB | 1 | 23% | 1 | 28% | 1 | 34% |

The results show a decrease in capacity associated with the additional growth in and around Norwich in future years. The significant increase in flows identified on the A1067 also increases the average delay per vehicle in either direction, while this route also records the highest V/C results in each scenario.

The B1535 and other local roads are currently used as links between the A47 and the A1067, passing through small villages in the western quadrant. The majority of these local roads are considered inappropriate for the demand currently experienced, and are unlikely to be suitable for additional growth, particularly when considering strategic through-traffic. Given the current conditions experienced, any increase in traffic flows is likely to adversely affect residential amenity and restrict walking and cycling on and adjacent to these roads. A reduction in vehicular demand is ideally required to align demand for these routes in line with the traditional route hierarchy and facilitating the efficient allocation of resources for the maintenance of the transport network.

Further analysis on the impact on local roads was undertaken by setting up a cordon in the model to determine the amount of traffic originating, passing by, or attracted to the western quadrant. Figure 7 below illustrates the extent of the cordon in the modelling; data on the different trip types was collected from all the local roads highlighted in red where these meet the strategic routes of the A1067 to the north and A47 to the south.

Table 4 overleaf presents these trip types for the DM network for each scenario in the AM and PM peak period. Note that ‘through trips’ are of particular interest; these are trips that do not have an origin or destination with the cordoned zone, and could therefore be considered as ‘rat-running’.

Figure 7: Local Road Cordon Boundary

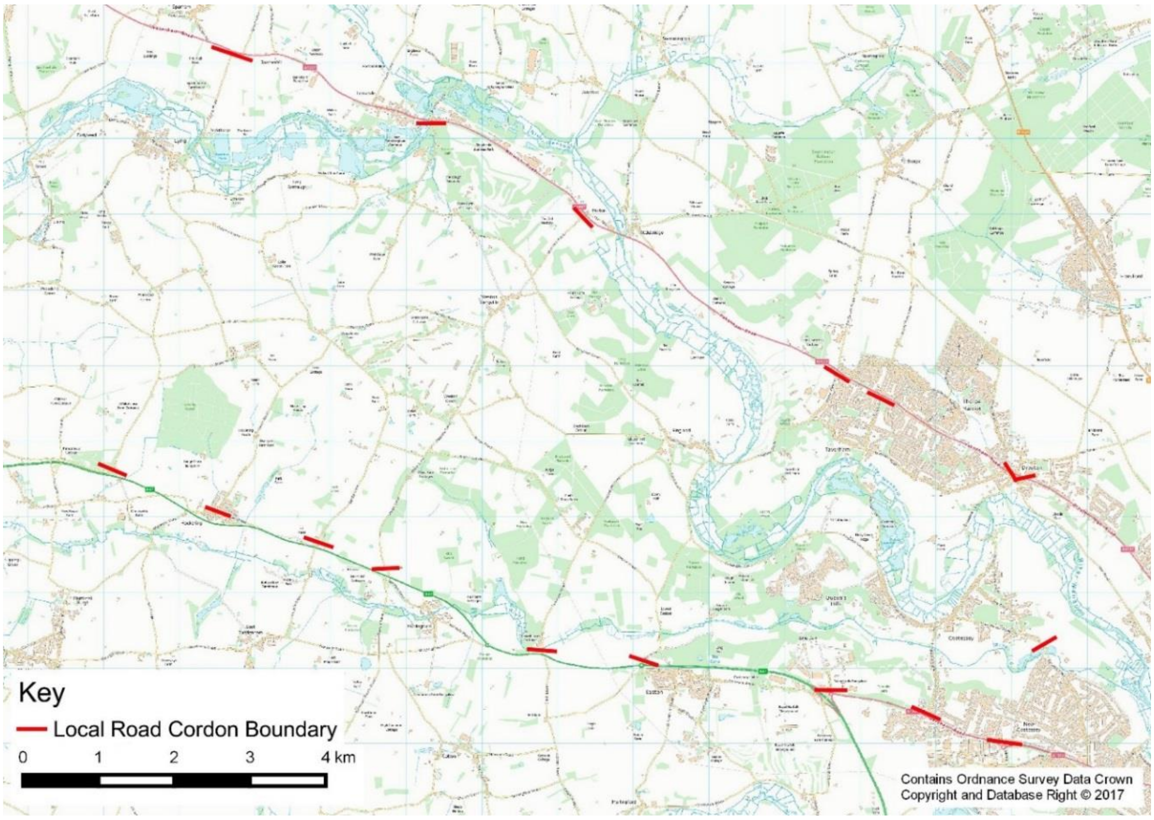



Table 4: DM Local Road Cordon Flows

| Local Road Trips: AM Peak Period | | | |
|---|---|---|---|
| **Scenario** | **DM 2021** | **DM 2036** | **DM 2050** |
| **Through Trips** | 1276 | 2259 | 2843 |
| **Internal** | 195 | 198 | 206 |
| **Inbound** | 1646 | 1774 | 1960 |
| **External** | 2123 | 2322 | 2520 |
| **Local Road Trips: PM Peak Period** | | | |
| **Through Trips** | 1286 | 2175 | 2883 |
| **Internal** | 208 | 207 | 207 |
| **Inbound** | 2114 | 2256 | 2420 |
| **External** | 1701 | 1810 | 1993 |

While the results show some increase in internal, external, and inbound trips, which is to be expected as a result of growth in housing and employment, there is a greater increase in through trips, or those 'rat-running' through the area.

### 3.5.3 DM SUMMARY

The DM results indicate that the network is likely to approach capacity in a number of locations in future years without intervention, increasing queueing and delays—particularly on the A1067—and on the minor roads served by both the A47 and A1067. Of particular note is the significant increase in through traffic on local roads considered inappropriate for strategic movements; this increase is likely to have significant detrimental impacts on amenity and quality of life for those living and working along these routes.

The modelling undertaken concludes that the DM network is likely to provide insufficient capacity to accommodate the expected level of traffic generated by the high levels of employment and residential growth planned for greater Norwich, and would lead to a substantial deterioration in operational performance of the highway network and in transport journey times and reliability, thus reducing the economic competitiveness of the area. The limitations of the existing road network could potentially lead to increasing congestion on the strategic and urban network in future years, resulting in strategic traffic displacing onto local link roads and rural routes, whilst traffic levels would remain high on existing urban routes.

## 3.6 'DO SOMETHING' (DS) MODELLING RESULTS

This subsection presents the results of the DS modelling, and provides a comparison between the DM and DS modelling, highlighting the changes in network performance associated with each option.

### 3.6.1 THE IMPACT ON THE NETWORK

Table 5 summarises the overall network performance statistics for the DS1 / DS2 scenarios in each future year (AM and PM peak periods) for comparative purposes. Note that the data is presented as passenger car units (PCUs), as per the industry standard methodology, and is only relevant to the simulated time periods.

**Table 5: DS1 / DS2 Network Performance Statistics**

| Network Performance Statistics DS1 / DS2 AM Peak Period | | | | | | |
|---|---|---|---|---|---|---|
| | DS1 2021 | DS2 2021 | DS1 2036 | DS2 2036 | DS1 2050 | DS2 2050 |
| Total Travel Time (pcu hr) | 13,680.9 | 13,826.8 | 17,903.8 | 18,191.5 | 22,873.1 | 23,101.8 |
| Transient Queueing (pcu hr) | 2,297.6 | 2,320.6 | 2,993.7 | 2,995.5 | 3,595.8 | 3,601.6 |
| Over-Capacity Queueing (pcu hr) | 755.5 | 858.7 | 2,153.6 | 2,394.3 | 4,627.2 | 4,724.8 |
| Total Trips on Network (pcu) | 90,469.76 | 90,469.76 | 105,005.8 | 105,005.8 | 117,801.7 | 117,801.7 |

| Network Performance Statistics DS1 / DS2 PM Peak Period | | | | | | |
|---|---|---|---|---|---|---|
| **Total Travel Time (pcu hr)** | 13,768.9 | 13,887.4 | 18,174.9 | 18,394.5 | 23,074.1 | 23,179.7 |
| **Transient Queueing (pcu hr)** | 2,362.9 | 2,374.3 | 3,049.5 | 3,058.1 | 3,639 | 3,612 |
| **Over-Capacity Queueing (pcu hr)** | 715.2 | 839.7 | 2,254.7 | 2,421.3 | 4,748.7 | 4,792 |
| **Total Trips on Network (pcu)** | 90,868.6 | 90,868.6 | 104,911 | 104,911 | 116,753.4 | 116,753.4 |

Table 6 below shows the percentage change between the DM Network and the DS1 / DS2 networks, across all future scenarios in both the AM and PM peak periods, allowing a comparison of the overall network benefits between DM and DS1 / DS2. Decreases are highlighted in green, indicating a potential benefit.

**Table 6: Comparison of Network Performance Statistics**

| Comparison of Network Performance Statistics—DM with DS1 / DS2 AM Peak Period | | | | | | |
|---|---|---|---|---|---|---|
| | **DS1 2021** | **DS2 2021** | **DS1 2036** | **DS2 2036** | **DS1 2050** | **DS2 2050** |
| **Total Travel Time (pcu hr)** | -1.86% | -0.81% | -2.40% | -0.83% | -1.70% | -0.72% |
| **Transient Queueing (pcu hr)** | -2.59% | -1.61% | -1.29% | -1.23% | -1.59% | -1.43% |
| **Over-Capacity Queueing (pcu hr)** | -12.52% | -0.57% | -9.67% | 0.43% | -0.72% | 1.37% |
| **Total Trips on Network (pcu)** | 0% | 0% | 0% | 0% | 0% | 0% |
| **Comparison of Network Performance Statistics—DM with DS1 / DS2 PM Peak Period** | | | | | | |
| **Total Travel Time (pcu hr)** | -1.36% | -0.51% | -2.03% | -0.85% | -1.70% | -1.25% |
| **Transient Queueing (pcu hr)** | -1.50% | -1.03% | -2.20% | -1.93% | -1.50% | -2.23% |
| **Over-Capacity Queueing (pcu hr)** | -8.89% | 6.97% | -4.11% | 2.97% | 0.21% | 1.12% |
| **Total Trips on Network (pcu)** | 0% | 0% | 0% | 0% | 0% | 0% |

While both options show a reduction in total travel time and transient queueing in comparison with the DM scenario, there are better results in the DS1 network in almost every instance and the DS1 network records considerably better results in regards to overcapacity queueing. DS2 actually records an increase in overcapacity queueing in comparison with DM in every scenario bar the 2021 AM peak period.

It is noted that the impacts of either option lessen in the 2050 scenario, which includes significant additional traffic growth, as a result of both background growth and the development aspirations for Norwich; it is considered that this is attributable to the significant additional growth in 2050 limiting the overall available network capacity.

## 3.6.2 THE IMPACT ON KEY ROUTE CORRIDORS

Table 7 below compares the two way peak flows in the AM and PM peak periods in the DM, DS1, and DS2 scenarios.

**Table 7: DS Key Corridor Two-way Flows**

| Two-Way AM Peak Flows (PCUs/hr) | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | 2021 | | | 2036 | | | 2050 | | |
| **Road** | **DM** | **DS1** | **DS2** | **DM** | **DS1** | **DS2** | **DM** | **DS1** | **DS2** |
| **A47** | 3,497 | 3,599 | 3,614 | 3,603 | 4,406 | 4,145 | 3,724 | 4,805 | 4,969 |
| **A1067** | 1,371 | 2,304 | 1,648 | 1,864 | 2,660 | 1,781 | 2,104 | 2,829 | 1,791 |
| **NNDR** | 1,093 | 2,480 | 1,813 | 1,495 | 3,295 | 1,911 | 1,874 | 3,266 | 1,915 |
| **B1535** | 502 | 277 | 308 | 568 | 259 | 283 | 537 | 301 | 376 |
| **NWL** | - | 1,984 | 1,270 | - | 2,561 | 1,312 | - | 2,539 | 1,531 |
| **Total** | 6,463 | 10,304 | 8,304 | 7,530 | 12,345 | 8,919 | 8,239 | 12,484 | 9,354 |
| **Two-Way PM Peak Flows (PCUs/hr)** | | | | | | | | | |
| **A47** | 3,370 | 3,517 | 3,500 | 3,721 | 4,564 | 4,236 | 3,650 | 4,805 | 5,207 |
| **A1067** | 1,269 | 2,002 | 1,618 | 1,765 | 2,593 | 1,641 | 2,029 | 2,829 | 1,805 |
| **NNDR** | 1,023 | 2,391 | 1,845 | 1,491 | 3,377 | 1,951 | 1,936 | 3,266 | 2,043 |
| **B1535** | 471 | 279 | 269 | 521 | 279 | 356 | 525 | 301 | 404 |
| **NWL** | - | 1,828 | 1,340 | - | 2,731 | 1,294 | - | 2,539 | 1,421 |
| **Total** | 6,133 | 9,671 | 8,254 | 7,498 | 12,461 | 8,752 | 8,139 | 12,484 | 9,258 |

The flows show a significant increase in vehicle movements in the DS1 and DS2 scenarios on the strategic movement based routes in comparison with the DM flows. Both DS1 and DS2 show a further reduction in vehicles utilising the B1535, although the lesser capacity provided by a single carriageway option (DS2) reduces the impacts of the NWL on the B1535.

The impacts of the A47 scheme in conjunction with the NWL on traffic in the western quadrant can be further analysed through a comparison of the results obtained through the modelled cordon around the area of interest. Table 8 below presents a comparison of the results in the AM and PM peak periods for the DS1 and DS2 scenarios.

**Table 8: DS Local Road Cordon Flows**

| Local Road Trips: AM Peak Period | | | | | | |
|---|---|---|---|---|---|---|
| **Scenario** | **DS1 2021** | **DS2 2021** | **DS1 2036** | **DS2 2036** | **DS1 2050** | **DS2 2050** |
| **Through Trips** | 344 | 392 | 506 | 1,428 | 867 | 1,665 |
| **Internal** | 193 | 190 | 198 | 195 | 205 | 202 |
| **Inbound** | 1,598 | 1,610 | 1,724 | 1,752 | 1,907 | 1,931 |
| **External** | 2,059 | 2,068 | 2,246 | 2,314 | 2,472 | 2,489 |
| **Local Road Trips: PM Peak Period** | | | | | | |
| **Through Trips** | 333 | 339 | 475 | 1,230 | 669 | 1,686 |
| **Internal** | 206 | 204 | 205 | 202 | 205 | 206 |
| **Inbound** | 2,060 | 2,087 | 2,206 | 2,247 | 2,381 | 2,427 |
| **External** | 1,651 | 1,658 | 1,760 | 1,786 | 1,894 | 1,912 |

The cordon results show the significant impact of the NWL in removing through trips from the local road network through the western quadrant; of particular note is the benefit of DS1 over DS2, with through trips reduced by approximately half in either peak period in the 2050 scenario.

## 3.7 COMPARISON OF RESULTS

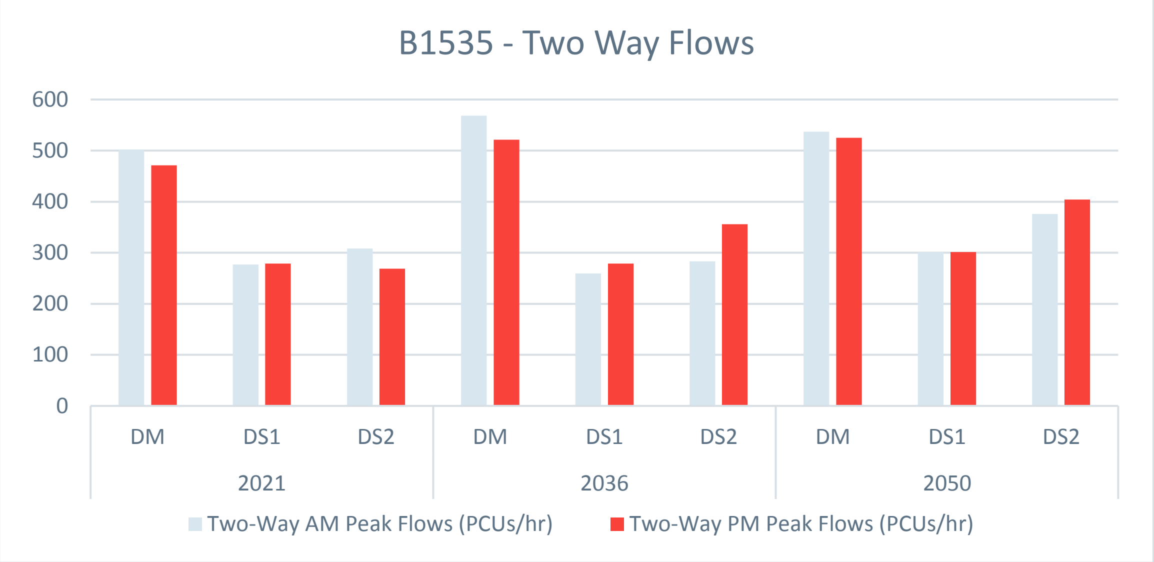
The results of the DM modelling show that without intervention the network within the study area may be unable to accommodate Norwich’s development aspirations.

The comparison of network performance statistics shown in Table 6 above clearly demonstrates the benefits of the NWL to the overall network performance, in particular when considering the dual carriageway option presented in DS1. However, the NWL has a number of strategic and local objectives to achieve, with a focus on the impact on local roads, including the transference of through trips onto more appropriate routes and a reduction in HGVs.

Further comparisons are therefore focused on the impact of the NWL on the local road network, highlighting the change in flows and through traffic on the B1535 as a proxy for the local highway network within the western quadrant.

Figure 8 overleaf compares the two-way peak flows in the AM and PM peak periods in every scenario for each network scenario, allowing a direct comparison between each potential option.

**Figure 8: Comparison of Two-way Flows**




The comparison of the results shows the clear benefits of DS1 over DS2 in regards to decreasing traffic flows on the B1535.

A further comparison between the schemes and their impact on the local road network in the western quadrant can be made through the cordon data available for each network / scenario. Figure 9 below and Figure 10 overleaf present the number of 'through' trips recorded in the cordon area in the AM and PM peak.

**Figure 9: Comparison of Local Road Through Trips – AM Peak Period**

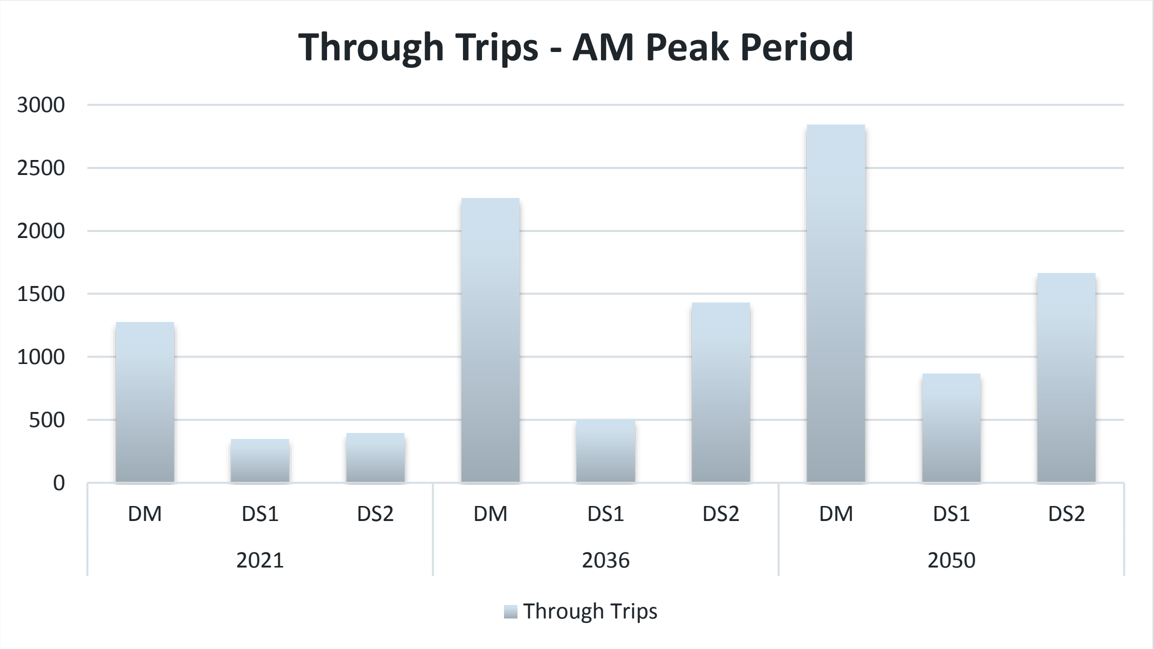
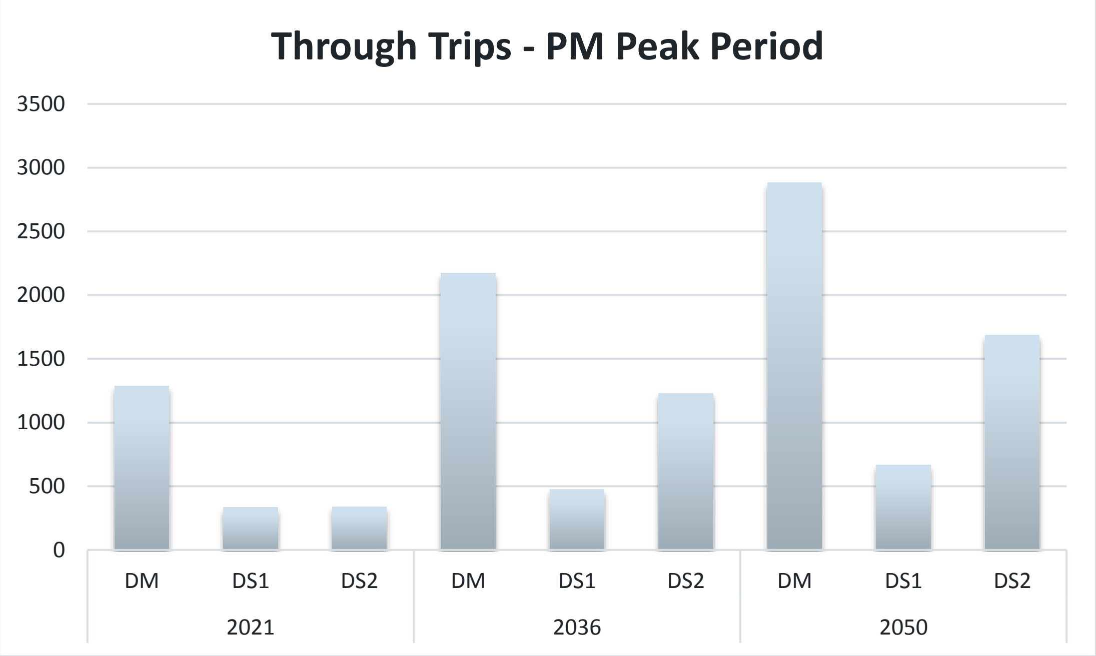


**Figure 10: Comparison of Local Road Through Trips – PM Peak Period**




The cordon results indicate that through traffic is likely to increase in each future scenario as a result of the additional growth on the network. In contrast, both DS options have a significant impact on the amount of through traffic recorded by the cordon in 2021. However, the results show that DS1 has a much greater impact than DS2 in the future scenarios of 2036 and 2050; the reduced capacity offered by the single carriageway in DS2 appears to result in more vehicles looking for alternative routes, and consequently through traffic rises sharply in each future scenario.

### 3.7.1 COMPARISON OF DELAY

One of the draft NWQ specific objectives is to:

*"Reduce congestion and delay, and improve journey time reliability, on routes through the study area." (SP01)*

It is therefore considered appropriate to analyse the impact of the scheme on delay through the network. Figure 11 and 12 overleaf illustrate the comparison between the DM, DS1 and DS2 scenarios, highlighting the difference between the 'with' and 'without' scheme networks.

Note that while delay was recorded in relation to the NNDR, A47, and B1535, the results were minor in every scenario, and therefore these have been omitted from this comparison.

**Figure 11: Comparison of Average Delay – AM Peak Period**

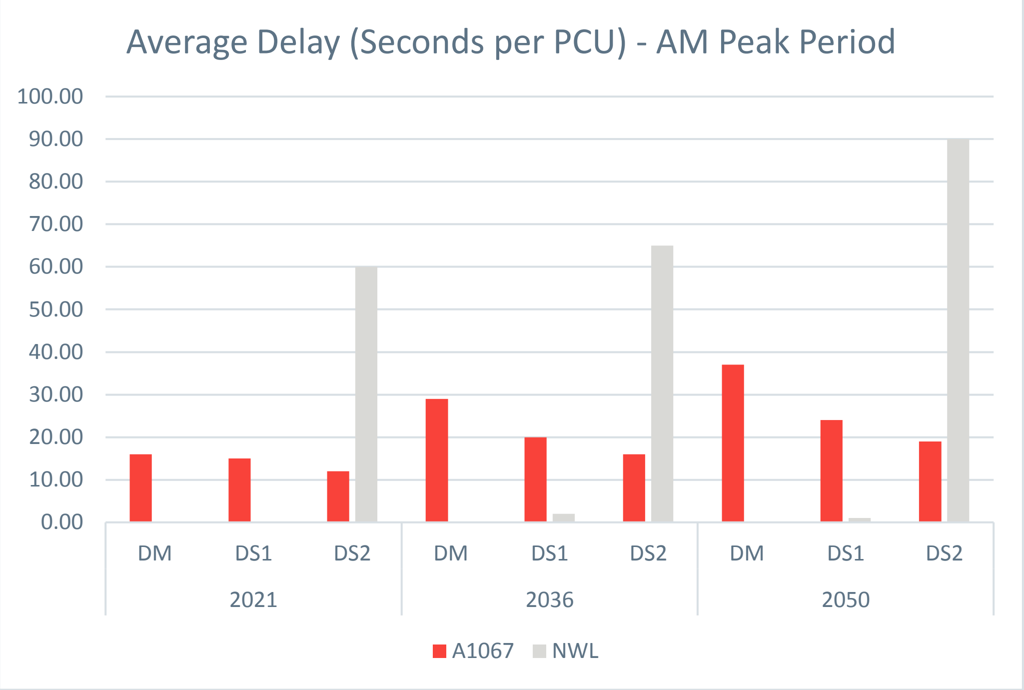
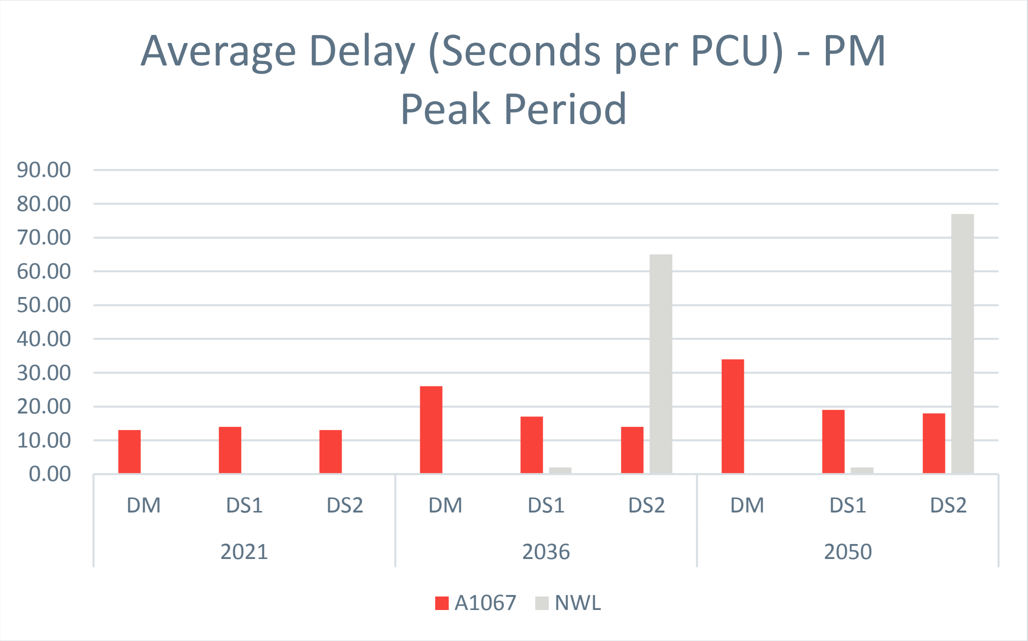



**Figure 12: Comparison of Average Delay – PM Peak Period**




The results across the different networks and scenarios show the clear benefit of the NWL in minimising delay on the key corridors of the A1067. DS1 records a slightly higher average delay per PCU result than DS2 in each scenario; however, in comparison, DS2 records significant delays on the NWL in future growth scenarios, at over a minute per PCU in the 2036 and 2050 PM peak periods. This delay induces the route choice seen in other results, diverting vehicles back onto the local road network in the western quadrant.

### 3.7.2 HGV MOVEMENTS

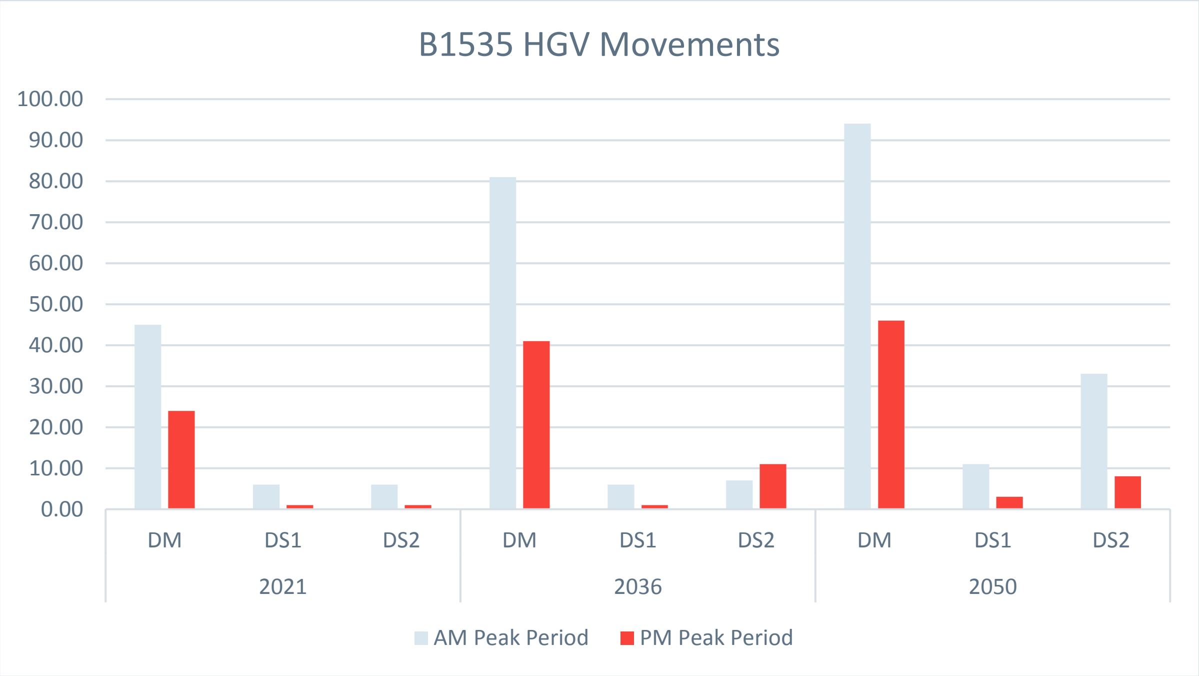
One of the draft NWQ specific objectives is to:

*"Reduce the number of HGVs using minor roads" (SP03)*

The promoted HGV route between the A47 and A1067 is the B1535, which is considered the most appropriate available option; despite some improvements, the route remains a relatively narrow rural road, and a NWL would represent a considerably more attractive option for HGV movements. The modelling undertaken has therefore considered whether HGV movements are affected in each network configuration, looking to transfer HGVs from the local road network in the western quadrant and displace these onto a route more appropriate for their size and weight.

Figure 13 below compares the HGV movements recorded on the B1535 in both the AM and PM peak periods in each network configuration.

**Figure 13: Comparison of HGV Movements**




The results show that the DM network is likely to increase the number of HGVs using the B1535 through the western quadrant in each successive scenario, as the A47 Corridor Improvements scheme provides additional capacity on the SRN without facilitating west – north movements. Each 'Do Something' option creates a considerable reduction in the numbers of HGVs using the B1535, with fewer than 10 HGVs using the B1535 in either peak period in 2021. The impact of further growth in the network in the 2050 scenario shows the benefits of DS1 in minimising HGV movements away from the strategic movement based network in comparison with DS2.

## 3.8 SUMMARY

The DM network modelling shows that the development aspirations for Norwich are likely to significantly increase demand on the network. This high level of development, without intervention, is expected to have a negative impact on network performance, with greater increases in queueing and travel time—showing the network provides insufficient capacity to accommodate the potential level of growth without other intervention.

Of particular note is the increase in through traffic and HGVs on local roads that are unsuited to such movements, which may impact on quality of life for those living and working adjacent to these local corridors.

While the modelling results indicate significant overall network performance increases associated with a NWL, it is clear a dual carriageway option provides additional benefit over a single carriageway, decreasing over capacity queuing in every scenario.

The full benefits of the NWL are shown when considering the impacts on the local highway network; the cordon results show a significant reduction in both through trips and HGVs, providing additional reserve capacity for further local growth and transferring strategic movements onto more suitable routes.

# 4

# POTENTIAL OPTIONS

# 4 POTENTIAL OPTIONS

## 4.1 INTRODUCTION

This section focusses on potential options for a NWL. The section initially presents a summary of options previously considered, including initial engagement with statutory bodies. A number of options are then considered and appraised, based on a notional alignment and crucially the feedback received from the Environment Agency and Natural England.

A total of four shortlisted options are presented including feedback received from recent discussions with the Environment Agency and Natural England, and a number of further considerations with regards to design and environmental assessment are outlined.

Lastly, an overview of land ownership is provided, initial cost estimates are presented and possible funding sources are discussed.

## 4.2 PREVIOUS OPTIONS AND ENVIRONMENTAL ENGAGEMENT

The 2016 Norwich Western Link Technical Report provides further detail on previously considered options for a NWL and summarises the work undertaken as part of the 2014 Scoping Study which identified 13 possible route options and one public transport option.

The 13 route options can be considered to fall within three broad corridors, defined as: eastern; central; and western – the 2016 Technical Report suggested that a central option is likely to offer the preferred corridor. However, significant additional work would be required to robustly test and identify the benefits of different options and, notwithstanding the potential benefits, it is important to remember that any scheme must pass the three environmental sequential 'tests', which are:

- There must be no feasible alternative.
- There must be an "Imperative reason of overriding public interest".
- All necessary compensatory measures must be secured.

Using the Scoping Study as a basis for discussion, meetings were held with both the Environment Agency and Natural England during summer 2016. The impact of the crossing of the Wensum River was the primary concern for both the EA and NE; the key points from these meetings are summarised as:

- A minimal number of piers in the floodplain;
- No piers within the water and no impact upon the bank;
- Loss of flood storage in the flood zone would require compensation;
- Surface water treatment will need to be to a high standard; and
- The development is not unacceptable in principle, but the right balance with sustainable development is required.

Both the EA and NE welcomed the suggestion to involve a scheme engineer in future meetings where the river crossing could be discussed in more detail.

## 4.3 CONSIDERATION OF OPTIONS

### 4.3.1 CORRIDOR

For the purposes of considering potential engineering options for a NWL this technical report has primarily considered the provision of a new link road from the A1067 to the A47 west of Norwich within a 'central corridor' as suggested in the 2016 Technical Report.

A notional route alignment, as shown in Figure 14, has been used to provide an indication of possible route length, type and junction locations for the purposes of appraisal. It should be noted that further work to define the corridor and alignment would need to be undertaken should development work be progressed.

**Figure 14: NWL Notional Route Alignment**


## 4.3.2 ENGINEERING

In response to the feedback from the EA and NE the consideration of engineering solutions has focussed on the crossing of the River Wensum and the key points raised at the meetings were used to develop and appraise potential options.

Following the 'central corridor' route as described in the section above, preliminary engineering solutions to carry a NWL across the valley have been defined. Initially, 13 options, as listed below, were examined and all the solutions assumed a NWL would operate like a suburban dual carriageway with a speed limit of 60mph.

**Table 9: Preliminary engineering solutions**

| PRELIMINARY OPTION | BRIDGE TYPE / OTHER |
|---|---|
| 1 | Steel Composite Box Girder |
| 2 | Composite Steel / Concrete Twin Plate Girder |
| 3 | Constant Depth Trapezoidal Concrete Box Girder - Constructed by Launching or Gantry |
| 4 | Green / Living Bridge |
| 5 | Tunnel |
| 6 | In situ Concrete Balanced Cantilever |
| 7 | Embankments with Bridge over river |
| 8 | Composite Steel / Concrete  Multiple Girder |
| 9 | Half through Steel Plate Girder |

| | |
|---|---|
| 10 | Cable Stay |
| 11 | Tied Arch / truss bridge / bow string |
| 12 | Composite Pre-cast Concrete |
| 13 | Constant Depth Concrete Box Girder |

These preliminary engineering solutions were then evaluated regarding the aesthetic and environmental impact that these structures may have on the area and were scored on constructability, aesthetics and environmental considerations within an option design matrix.

This review identified four potential options that could deliver the most appropriate solution; these options are listed below and then discussed further in subsequent sections:

- Steel Composite Box Girder Bridge
- Composite Steel / Concrete Twin Plate Ladder Girder Bridge
- Constant Depth Trapezoidal Concrete Box Girder Bridge
- Tunnel

**Steel Composite Box Girder Bridge**

The option proposed a steel composite box girder bridge over the Wensum Valley of 660m consisting of nine spans of approximately 73m each. This bridge form comprises rectangular or trapezoidal steel box girders acting compositely with a concrete deck slab cast above. Each dual carriageway would be supported by two box girders.

**Figure 15: Western Elevation of Steel Composite Box Girder Option**

**Composite Steel / Concrete Twin Plate Ladder GIRDER Bridge**

The second option suggested a composite steel / concrete twin plate girder “ladder deck” bridge over the Wensum Valley of 660m consisting of nine spans of approximately 73m each. This bridge form comprises one section steel plate girders and cross girders with a concrete slab cast above the main girder top flange level. Each dual carriageway would be supported by a deck comprising two main plate girders.

**Figure 16: Soffit of Steel/Concrete Composite Twin Plate Ladder Girder Option.**

**Constant Depth Trapezoidal Concrete Box Girder Bridge**

This option recommended a constant depth trapezoidal concrete box girder bridge over the Wensum Valley of 660m consisting of nine spans of approximately 73m each. This bridge form comprises a pre-stressed concrete box girder formed from precast sections or cast in-situ. Each dual carriageway would be supported by a deck consisting of one box girder.

**Figure 17: Soffit of Concrete Box Girder Option.**

**Tunnel**

The fourth option proposed a tunnel to convey the Norwich Western Link beneath the Wensum Valley. The tunnel would be approximately 1.1 km in length. The tunnel structure could be constructed via cut and cover technique using reinforced concrete segmental box sections. Alternatively, top down construction could be used in the form of a pre-deck tunnel comprising contiguous piled edge walls with top spanning slab. Once the top slab has been constructed the ground beneath would be excavated to form the tunnel.

**Figure 18: Indicative Junction Arrangement at the Northern end of Tunnel.**

## 4.4 ENVIRONMENTAL CONSIDERATIONS

### 4.4.1 FURTHER ENGAGEMENT WITH THE ENVIRONMENT AGENCY AND NATURAL ENGLAND

The four options described above were presented to Natural England and the Environment Agency in July 2017 and a summary of the key points is provided below.

The following were specifically noted by both the EA and NE as positive contributions to the design:

- It was acknowledged that there was no construction upon the river banks which was a key concern from previous consultation;
- It was welcomed that the embankments and bankseats are not within the floodplain; and
- A significant soffit height of the bridge above the watercourse would reduce the degree of shading that is encountered.

However the following concerns remain:

- Concerns about the potential effects of the tunnel option upon groundwater flow which could compromise the Water Framework Directive objective for the groundwater body. This could become a 'showstopper' for this option;
- Highway runoff is likely to require a high degree of treatment to both remove common highway pollutants, but also to provide adequate emergency provision;
- It was queried whether salt spray could result in an impact upon the Wensum and this will require additional assessment:
- Smaller, thinner piers are preferable from the perspective of flood water attenuation and this should be considered as the design progresses:
- Greater information on the construction process should be included in any future optioneering;
- A significant number of species surveys are likely to be required in order to provide sufficient information to inform the assessments; and
- Opportunities for environmental enhancement should be sought.

In summary, both the EA and NE were supportive of the progress that had been made with the potential options since consultation in 2016, and continued liaison during the adoption of a preferred alignment was recommended.

## 4.4.2 DESIGN CONSIDERATIONS

This section provides further detail on the environmental mitigation and enhancement measures that could be embedded into the design of any proposed scheme or proposed as mitigation measures to address significant environmental impacts.

**Bridge Options**

The bridge options presented in the engineering solutions section above were selected to allow relatively long span lengths which will reduce the number of piers within the flood plain of the River Wensum. All bridge options incorporate a clear span over the river and its banks, although construction activity will be required within the flood plain. At this stage the proximity of works to the River are not known. We advise that the EA and Natural England are likely to require a greater degree of detail on the method of construction than is usually required at the planning application stage. It would therefore be advisable for the Council to seek advice on the buildability of the scheme in relation to the constraints of the River Wensum.

The three bridges materials can achieve a 120 year design life without the requirement for reapplication of a protective treatment. As painting of the bridge structure will not be required the potential environmental issues associated with this are avoided. Bridge decks of full concrete construction do not require the application of protective treatment following installation.

In order to improve accessibility a footpath and cycleway could be incorporated onto the bridge structure. This could be achieved with a cantilevered solution beneath the bridge deck that would provide views across the valley and be segregated from the new highway.

**Figure 19: Example Visualisation showing Cantilever Walk/Cycle-way for Bridge Options.**

**Tunnel Option**

The tunnel option, once operational and all mitigation has established, would be likely to have a minimal impact on the Wensum Valley environment above ground level as there would be no structure present. However, the EA and Natural England have raised concerns about a tunnel structure interrupting the flow of groundwater to the River Wensum and this is potentially a 'show stopper' for the tunnel option.

To reduce the visual impact of the tunnel portals and approaches, vegetated battered slopes or vertical retaining walls clad with planted baskets to create a living wall could be incorporated. As part of the ground reinstatement works the river diversion excavations could be adapted to provide a wetland habitat, if deemed to be of benefit.

### 4.4.3 SCOPING FOR APPROPRIATE ASSESSMENT & NEED FOR SEA

**Appropriate Assessment**

The Conservation of Habitats and Species Regulations 2010 (as amended) are commonly referred to as the "Habitats Regulations". The Habitats Regulations (Regulation 8) define "European sites" as candidate Special Areas of Conservation (cSACs), Special Areas of Conservation (SACs), Special Protection Areas (SPAs), and Sites of Community Importance (SCIs)

Regulation 102 of the Conservation of Habitats and Species Regulations 2010 (as amended) states that 'A competent authority, before deciding to undertake, or give any consent, permission or other authorisation for, a plan or project which,

- is likely to have a significant effect on a European site or a European offshore marine site (either alone or in combination with other plans or projects), and
- is not directly connected with or necessary to the management of that site,
- must make an appropriate assessment of the implications for that site in view of that site's conservation objectives'.

Regulation 102 further states that 'In the light of the conclusions of the assessment, and subject to considerations of overriding public interest, the competent authority may agree to the plan or project only after having ascertained that it will not adversely affect the integrity of the European site or the European offshore marine site (as the case may be)'.

The application of the Habitats Regulations involves the precautionary principle; that is that plans and projects can only be permitted having ascertained no adverse effect on the integrity of the site. Plans and projects may still, however, be permitted if there are no alternatives, and there are imperative reasons of overriding public interest as to why they should go ahead. In such cases compensatory measures will be necessary to ensure the overall integrity of network of sites.

**Conservation Objectives**

The Habitats Directive requires that Member States maintain or where appropriate restore habitats and species populations of European importance to favourable conservation status. The conservation objectives for the SPA and SAC sites form the basis against which to assess the likely impacts of the proposed scheme alone and in-combination.

Conservation objectives are closely linked to the qualifying features for which each of the European sites was given its designation. The overarching conservation objectives defined by Natural England for SPA, Ramsar and SAC are as follows: With regard to the natural habitats and/or species for which each of the SPAs/SACs has been designated (i.e. the Qualifying Features) the broad conservation objectives as defined by Natural England (2012a) are to: "Avoid the deterioration of the qualifying natural habitats and the habitats of qualifying species, and the significant disturbance of those qualifying species, ensuring the integrity of the site is maintained and the site makes a full contribution to achieving Favourable Conservation Status of each of the qualifying features." Subject to natural change, to maintain or restore:

- The extent and distribution of qualifying natural habitats and habitats of qualifying species;
- The structure and function (including typical species) of qualifying natural habitats and habitats of qualifying species;
- The supporting processes on which qualifying natural habitats and habitats of qualifying species rely;
- The populations of qualifying species;
- The distribution of qualifying species within the site.''

For the SPA species (i.e. populations of birds) favourable condition status can be defined by reference to Article 1(i), and for the habitats within the SACs by reference to Article 1(e).

Regulation 102 of the Habitats Regulations describe a procedure that provides for a systematic set of stages for the transparent consideration of the likely effects a plan or project could have on a European site.

Guidance states that there are four tasks in producing an assessment of a plan:

- **Stage One: Screening** - the process which identifies whether the plan is required for the management of European site(s) and if not whether there are likely to be any effects upon a European site as a result of the plan, either alone or in combination with other projects or plans, and considers whether these effects are likely to be significant;

- **Stage Two: Appropriate Assessment -** the consideration of the impact on the integrity of the European site of the plan, either alone or in combination with other projects or plans, with respect to the site's structure and function and its conservation objectives. Additionally, where adverse effects on site integrity exist, an assessment of the effectiveness of potential mitigation of those impacts will be made;
- **Stage Three: Assessment of alternative solutions -** the process which examines alternative ways of achieving the objectives of the plan that avoid significant effects on the integrity of the European site identified at Stage Two;
- **Stage Four: Assessment** where no alternative solutions exist and where adverse impacts remain — an assessment of compensatory measures where, in the light of an assessment of imperative reasons of overriding public interest (IROPI), it is deemed that the plan should proceed.

Each stage determines whether a further stage in the process is required. If, for example, the conclusions at the end of Stage One are that there are no likely significant effects on the European sites, there is no requirement to proceed further.

### Strategic Environmental Appraisal

A Strategic Environmental Appraisal (SEA) is a requirement for "plans and programmes" that are being proposed.

The SEA Directive defines "plans and programmes" as follows:

*Article 2*

*(a) 'plans and programmes' shall mean plans and programmes, including those co-financed by the European Community, as well as any modifications to them:*

- *(i) which are subject to preparation and/or adoption by an authority at national, regional, or local level or which are prepared by an authority for adoption, through a legislative procedure by Parliament or Government, and*
- *(ii) which are required by legislative, regulatory or administrative provisions.*

European Commission guidance[1] on the implementation of the SEA Directive details that the first requirement in order for plans and programmes to be subject to the Directive, is that they must meet the conditions of both indents in Article 2(a) – see Table 1 below for a NWL against these conditions.

In other words, they must be both 'subject to preparation and/or adoption by the prescribed authorities' and 'required by legislative, regulatory or administrative provisions'.

Whether such a situation is in place for a NWL should be subject to further legal advice.

**Table 10**

| Directive Article | Does this apply to a NWL? |
|---|---|
| 2(a)(i) | This element stresses that plans and programmes need to fulfil certain formal conditions in order to be covered by the Directive.<br>Yes – the NWL will be prepared by the local planning authority - Norfolk County Council, are the 'authority'. |
| 2(a)(ii) | Directive states that it must be required by legislative, regulatory or administrative provisions. If these conditions are not met, the Directive does not apply.<br>A NWL is not required by a legislative or regulatory provision i.e. primary or delegated legislation.<br>'Administrative provisions' is unclear. A possible wider interpretation would include guidance which exhorts an authority to adopt a plan or programme or which stipulates the preparation/adoption of a plan or programme as a matter of good practice or policy. |

[1] Commission's Guidance on the implementation of Directive 2001/42/EC on the assessment of the effects of certain plans and programmes on the environment – available at http://ec.europa.eu/environment/eia/sea-support.htm

## 4.5 OVERVIEW OF COMPARABLE SCHEMES

A review of similar schemes in which significant environmental concerns were addressed has been performed as part of this analysis, highlighting the approach adopted to mitigate the issues / impacts. The reviewed schemes include, in nearly all cases, requirement to cross valley(s) in the United Kingdom.

The list of the reviewed schemes is:

- Western rail Link to Heathrow
- Cross Valley Link Road, Northampton
- Preston Western Distributor Road
- Penwortham Bypass
- A582 South Ribble Western Distributor
- Ely Southern Bypass

The key findings arising from the review indicate that:

- Early stage environmental assessments are crucial in order to identify and minimise the adverse impacts that most projects have associated.
- These impacts must demonstrate a compelling need for intervention.
- The benefits from the schemes need to be considered from a holistic perspective and not only considering economic benefits.
- Local residents and users will experience relief from the noise, pollution and severance effects of the removal of traffic from congested areas.
- Mitigation measures end up generally assisting in the regeneration of misused areas improving the accessibility for non-motorised users.
- The final scheme solution needs to represent an appropriate balance between the needs of the community and the natural and historic environment in order to deliver sustainable infrastructure.
- Many of the potential impacts are mitigated by the design stage, however projects require good construction management plans.

This review demonstrates that schemes with similar environmental challenges can be effectively mitigated through detailed assessment, robust engagement and appropriate design.

## 4.6 CONSIDERATION OF LAND

The NWL area incorporates a mixture of land uses, including: rural farmland; parkland; the River Wensum; River Tud; residential areas; and business / retail uses. The study area also includes the Wensum Valley and a number of environmental designations, including a Special Area of Conservation (SAC), designated due to its international importance in biodiversity conservation. The River Wensum, running through the study area, is designated as both an SAC and as a Site of Special Scientific Interest (SSSI).

An assessment of all the land ownership parcels within initial study area, according with the principles of the 'central corridor' previously identified within this chapter to understand the scale / number of land owners. Further work would explore land ownership based on an identified / preferred corridor alignment to demonstrate a more accurate scale of land parcels affected by the final proposed Norwich Western Link scheme.

The total number of individual contacts (i.e. landowners) are summarised in the table below to give a more representative overview of the number of people within the referencing limits. The number of Freeholders is high as this accounts for people with an interest in multiple HMLR titles (i.e. multiple land interests).

**Table 11: Land ownership individual contacts**

| Total No. | |
|---|---|
| Landownership Parcels | 307 |
| HMLR Titles | 177 |
| Individual Contacts (landowners)* | 235 |
| Freeholders (includes landowners with multiple title interests) | 482 |
| Leaseholders | 35 |
| Occupiers** | 168 |
| Freeholder Mortgagees | 79 |
| Leaseholder Mortgagees | 1 |
| Rights*** | 5 |
| Beneficiaries | 11 |
| Caution | 1 |

**Total number of individual contacts (excluding Mortgagees and Unknown Freeholders)*

***Landowners who occupy the property i.e. the address of the landowner in the HMLR title is the same as the property address*

****A full review of all Rights within HMLR titles has not been undertaken. This information would be obtained at a later stage if the scheme were to progress to the Book of Reference production*

## 4.7 INITIAL COST ESTIMATES

### 4.7.1 OVERVIEW

This section summarises the high-level cost estimates that have been produced. The costing exercise has used the notional alignment within the central corridor as described earlier and has considered dual and single carriageway options; the different bridge options; and the tunnel option.

It should be noted these are high-level cost estimates for the purposes of comparison and for use in the initial economic analysis.

### 4.7.2 BRIDGE BASE COST ESTIMATE

For the purposes of this exercise the average cost of the three different bridge options has been used, and the costs are presented below:

**Table 12: Bridge Base Cost Estimate**

| Scheme element | Dual carriageway Estimate cost 2017 Q2 | Single carriageway Estimate cost 2017 Q2 |
|---|---|---|
| Roadworks | 34,236,727 | 17,885,290 |
| Bridge works | 49,903,081 | 31,316,729 |
| **Sub-total: Construction costs** | **84,139,808** | **49,202,020** |
| Utilities | 1,711,836 | 1,699,103 |
| Land | 6,533,713 | 3,414,167 |
| Fees | 12,019,230 | 7,126,157 |
| **Base cost at 2017 q2 prices** | **104,404,587** | **61,441,447** |

### 4.7.3 TUNNEL BASE COST ESTIMATE

The costs for the tunnel option are presented below:

**Table 13: Tunnel Base Cost Estimate**

| Scheme element | Dual carriageway Estimate cost 2017 Q2 | Single carriageway Estimate cost 2017 Q2 |
|---|---|---|
| Roadworks | 32,151,929 | 16,842,891 |
| Tunnel works | 110,825,000 | 66,264,115 |
| **Sub-total: Construction costs** | **142,976,929** | **83,107,006** |
| Utilities | 1,607,596 | 1,600,075 |
| Land | 6,137,637 | 3,203,616.78 |
| Fees | 20,241,834 | 11,858,991 |
| **Base cost at 2017 q2 prices** | **170,963,996** | **99,769,689** |

### 4.7.4 ACCOUNTING FOR RISK

DfT guidance (TAG Unit A1.2) requires that all project related risks that may impact on the scheme costs should be identified and quantified in a Quantified Risk Assessment (QRA), in order to produce a risk-adjusted cost estimate.

The range of possible costs associated with each risk was estimated, and each risk was assigned a high, medium or low value. The likelihood of each risk occurring was then estimated, and assigned a high, medium, or low value, both before and, where appropriate, after mitigation. For each risk, the cost multiplied by its likelihood gives an expected value.

Commercial software programme, @RISK 6.3 was used to undertake a Monte Carlo simulation with 1,000 iterations per run, each representing a different risk occurrence scenario, in order to determine the probability distribution of the total risk cost for the scheme. From this distribution, the 85th percentile value was used as an overall estimate of the quantified risk for the scheme. Using this methodology, the 85th percentile value (at 2017 Q2 prices) of quantified risk was calculated and is presented below.

**Table 14: Accounting for risk - Bridge**

| Scheme element | Dual carriageway Estimate cost 2017 Q2 | Single carriageway Estimate cost 2017 Q2 |
|---|---|---|
| Bridge option base cost at 2017 q2 prices | 104,404,587 | 61,441,447 |
| Quantified Risk | 27,781,759 | 16,432,218 |
| **Risk adjusted base cost at 2017 q2 prices** | **132,186,346** | **77,873,665** |

**Table 15: Accounting for risk - Tunnel**

| Scheme element | Dual carriageway Estimate cost 2017 Q2 | Single carriageway Estimate cost 2017 Q2 |
|---|---|---|
| Tunnel option base cost at 2017 q2 prices | 170,963,996 | 99,769,689 |
| Quantified Risk | 46,629,528 | 27,275,131 |
| **Risk adjusted base cost at 2017 q2 prices** | **217,593,525** | **127,044,820** |

## 4.7.5 SPEND PROFILE

As stated earlier it is acknowledged that an opening year of 2021 for a NWL is unrealistic; however, an opening year of 2021 was chosen in agreement with NCC in order to align the modelling and appraisal work with the expected timescales for the Highways England A47 improvement scheme. As such, for the purposes of this assessment an assumed spend profile to opening in the 2021/22 financial year has been used and is shown below.

**Table 16: Spend Profile**

| Scheme element | 2017/18 | 2018/19 | 2019/20 | 2020/21 | 2021/22 |
|---|---|---|---|---|---|
| Construction | | | 22.5% | 45.0% | 32.5% |
| Statutory undertakers | | 60.0% | 30.0% | 10.0% | |
| Land | | 75% | 25% | | |
| Prep | 10.0% | 60.0% | 10.0% | 20.0% | |
| Supervision | | 10.0% | 25.0% | 50.0% | 15.0% |

## 4.7.6 ADJUSTMENT FOR INFLATION

Inflation will mean that the actual amount of money to be spent on the scheme will differ from the 2017 Q2 estimates. An allowance for inflation has therefore been calculated for each future year. The 2017 prices have been inflated through the delivery and construction period based on Bank of England CPI forecasts of general inflation as set out in the table below.

**Table 17: Inflation**

| Factors applied | 2017/18 | 2018/19 | 2019/20 | 2020/21 | 2021/22 |
|---|---|---|---|---|---|
| General inflation | 0.0% | 2.7% | 2.5% | 2.4% | 2.4% |
| Inflation factor | 1.000 | 1.027 | 1.052 | 1.077 | 1.103 |

## 4.7.7 SCHEME COSTS

The initial estimated scheme costs including risk and inflation are presented below, however, it must be noted that these costs are based on a notional alignment and high-level information to help provide a basis for comparison and initial appraisal. Further work to provide detailed cost estimates will be required.

**Table 18: Scheme Cost - Bridge**

| Scheme element | Dual carriageway Estimated cost | Single carriageway Estimated cost |
|---|---|---|
| Bridge option - Base cost | 104,404,587 | 61,441,447 |
| Quantified Risk | 27,781,759 | 16,432,218 |
| Inflation | 9,040,846 | 5,315,361 |
| **Total** | **141,227,192** | **83,189,025** |

**Table 19: Scheme Cost -Tunnel**

| Scheme element | Dual carriageway Estimated cost | Single carriageway Estimated cost |
|---|---|---|
| Tunnel option – Base cost | 170,963,996 | 99,769,689 |
| Quantified Risk | 46,629,528 | 27,275,131 |
| Inflation | 15,107,353 | 8,809,029 |
| **Total** | **232,700,877** | **135,853,849** |

## 4.7.8 WHOLE LIFE COSTS

An initial calculation of the potential costs to maintain the bridge and the highway, and the longer term costs of infrastructure renewal have been considered for each option.

The annual average cost over a 60 year period at current (2017) prices has been estimated for each option as follows:

- Bridge with dual carriageway - £489,354 annual average
- Bridge with single carriageway - £290,136 annual average
- Tunnel with dual carriageway - £824,132 annual average
- Tunnel with single carriageway - £482,830 annual average

# 4.8 POTENTIAL FUNDING SOURCES

The funding strategy for a NWL is yet to be defined and work to develop this will need to form part of any future stages of work, however, initial consideration of potential funding sources has been undertaken and this is summarised below.

## 4.8.1 DFT FUNDING

The DfT has previously offered Local Authorities the opportunity to bid for funding from a Local Majors fund, which aims to provide funding for large, transformative, local schemes that are too big to be taken forward within Local Growth Deal allocations and might not otherwise be funded. Access to the funding is becoming increasingly competitive and schemes must demonstrate there is a compelling need for intervention through the preparation and submission of a business case following the DfT five case model.

It is unknown whether the DfT will offer another round of applications for Local Majors funding, however, the need for a robust business case is considered necessary to ensure the council is well positioned to respond to any future opportunities.

Notwithstanding the above, in summer 2017 the transport secretary, Chris Grayling announced that new funding may be made available to allow English councils to apply for funding paid for out of vehicle exercise duty to help councils enhance or replace important roads to support the economy, increase productivity and tackle congestion.

In addition to these potential funding sources which may provide the opportunity to apply for large contributions towards a NWL there may be other, smaller funding opportunities such as the National Productivity Investment Fund which may provide the opportunity to support the delivery of complementary measures and other schemes within the NWQ.

## 4.8.2 LOCAL AUTHORITY FUNDING

It is likely that any NWL scheme would require a contribution from the Local Authority and their partners, this could include:

- Integrated transport block funding through the Norwich Area Transport Strategy (NATS)
- Pooled Business Rates funding
- Growth Deal funding through the New Anglia LEP
- Credit arrangements under the prudential borrowing powers from the Local Government Act 2003

The details of local funding mechanisms would need to be clarified if the scheme is progressed further.

## 4.8.3 THIRD PARTY CONTRIBUTIONS

Given the scale of growth that could come forward across the Norwich western quadrant it may be possible to seek third party contributions from the private sector through the Community Infrastructure Levy (CIL) and Section 106 contributions from developers.

# 5

# INITIAL ECONOMIC APPRAISAL

# 5 INITIAL ECONOMIC APPRAISAL

## 5.1 INTRODUCTION

This section presents the initial economic appraisal that has been undertaken to quantify the possible value for money of a NWL. The costs and benefits are both presented in 2010 values, in line with DfT guidance.

## 5.2 COSTS

Costs have been estimated under two broad headings:

- Investment costs (scheme preparation and construction)
- Maintenance and renewal costs

### 5.2.1 SCHEME PREPARATION AND CONSTRUCTION

The estimated risk-adjusted cost for scheme preparation and construction at 2017 Q2 prices (excluding inflation) for the four different options are as follows:

- Bridge with dual carriageway - £132,186,346
- Bridge with single carriageway - £77,873,665
- Tunnel with dual carriageway - £217,593,525
- Tunnel with single carriageway - £127,044,820

### 5.2.2 MAINTENANCE AND RENEWAL COSTS

The estimated costs of maintenance and renewal, expressed as an average annual cost at 2017 Q2 prices for the four options are:

- Bridge with dual carriageway - £489,354 annual average
- Bridge with single carriageway - £290,136 annual average
- Tunnel with dual carriageway - £824,132 annual average
- Tunnel with single carriageway - £482,830 annual average

### 5.2.3 OPTIMISM BIAS

In line with DfT guidance in TAG Unit A1.2, an adjustment for optimism bias has been applied to all costs in this initial economic assessment. The allowance is designed to compensate for the systematic tendency for appraisers to be overly optimistic about key parameters.

The relevant project types identified in guidance are:

- Fixed link (bridges and tunnels)
- Roads (motorways, trunk and local roads, cycle and pedestrian facilities etc.)

As a project develops, the scheme cost estimate will be refined. As project-specific risks become better understood, quantified and valued, the factors that contribute to optimism bias are better captured within the risk management process. Therefore, as risk analysis improves it is expected that the risk-adjusted scheme cost estimate will become more certain, whilst the applicable level of optimism bias will decrease.

At Stage 1 ‘Programme entry’ the recommended optimism bias uplifts are as follows:

- 66% for Fixed links
- 44% for Roads

Whilst a robust approach has been adopted to quantify risk it is considered appropriate to apply optimism bias at 55% (average of the recommended levels for Stage 1) to account for the early stage of scheme development.

The present value costs for each of the four options are presented in the tables below.

**Table 20: Present Value of Cost – Bridge & dual carriageway**

| Element | Scheme cost | Maintenance cost | Total |
|---|---|---|---|
| Cost at current prices | 132,186,346 | 29,361,262 | 161,547,608 |
| Cost at 2010 prices | 103,949,519 | 10,251,141.03 | 114,200,660 |
| Optimism Bias (55%) | 57,172,236 | - | 57,172,236 |
| **Present Value of Cost** | **161,121,755** | **10,251,141.03** | **171,372,896** |

**Table 21: Present Value of Cost – Bridge & single carriageway**

| Element | Scheme cost | Maintenance cost | Total |
|---|---|---|---|
| Cost at current prices | 77,873,664 | 17,408,184 | 95,281,848 |
| Cost at 2010 prices | 61,249,844 | 6,077,864 | 67,327,708 |
| Optimism Bias (55%) | 33,687,414 | - | 33,687,414 |
| Present Value of Cost | **94,937,258** | **6,077,864** | **101,015,122** |

**Table 22: Present Value of Cost – Tunnel & dual carriageway**

| Element | Scheme cost | Maintenance cost | Total |
|---|---|---|---|
| Cost at current prices | 217,593,525 | 49,447,908 | 267,041,433 |
| Cost at 2010 prices | 170,921,841 | 17,264,158 | 188,185,999 |
| Optimism Bias (55%) | 94,007,012 | - | 94,007,012 |
| Present Value of Cost | **264,928,853** | **17,264,158** | **282,193,011** |

**Table 23: Present Value of Cost – Tunnel & single carriageway**

| Element | Scheme cost | Maintenance cost | Total |
|---|---|---|---|
| Cost at current prices | 127,044,820 | 28,969,822 | 156,014,642 |
| Cost at 2010 prices | 99,806,629 | 10,114,474.06 | 109,921,103 |
| Optimism Bias (55%) | 54,893,646 | - | 54,893,646 |
| Present Value of Cost | **154,700,274** | **10,114,474** | **164,814,748** |

## 5.3 BENEFITS

An initial appraisal of economic benefits has been undertaken – user benefits including time savings, fuel-related vehicle operating costs (VOC), non-fuel VOC, and operator and Government revenues typically form the major element of benefit attributable to highway schemes. The assessment reported here uses the Department for Transport's (DfT) Transport Users Benefit Appraisal tool (TUBA) Version 1.9.7. The software provides the DfT standard approach to appraising changes in demand, travel time and operating costs.

The forecast models consist of three distinct peak hours: AM peak hour (08:00-09:00), average inter-peak hour (10:00-16:00), and PM peak hour (17:00-18:00). TUBA analysis is, however, required to be carried out for all the hours for the whole year. For non-modelled hours (i.e. AM Peak shoulders (07:00-08:00 and 09:00-10:00), PM peak shoulders (16:00-17:00 and 18:00-19:00), off-peak and weekend and Bank Holidays), it is only appropriate to calculate benefits for hours in which traffic levels are similar to the modelled hours.

Due to lack of recent traffic data, it has been deemed appropriate not to include the off-peak and weekend/Bank Holidays user benefits in our calculations. As such, the total user benefits outputs should be considered as conservative. The annualisation factors for AM, IP and PM peak periods have been derived from the economic appraisal study undertaken in 2014 as part of the NNDR proposal.

The benefits are presented for a dual carriageway and single carriageway option – at this stage no economic appraisal has been undertaken to compare the bridge or tunnel option, however, at this stage it is considered appropriate to use the same level of economic benefit to appraise both.

### 5.3.1 TRANSPORT ECONOMIC EFFICIENCY

The Transport Economic Efficiency (TEE) benefits are derived from travel time and vehicle operating cost benefits as a result of the scheme, the likely benefits associated with changes in greenhouse gases and indirect taxation have also been calculated, and these are summarised in the table below:

**Table 24: User benefits**

| Benefits | £,000s 2010 prices, discounted to 2010 | |
|---|---|---|
| | Dual | Single |
| Consumer – commuting user benefits | 28,477 | 9,464 |
| Consumer – other user benefits | 133,517 | 37,736 |
| Business benefits | 151,086 | 34,116 |
| Greenhouse gases | -1,630 | -782 |
| Wider public finances (indirect taxation) | 3,516 | 2,161 |
| **Total** | **314,966** | **82,695** |

### 5.3.2 ADDITIONAL BENEFITS

At this early stage of economic appraisal the benefits associated with changes in travel time and vehicle operating cost have been quantified (as described above), however, a number of other additional benefits can be expected based on DfT guidance and economic appraisals undertaken on similar schemes, these benefits include:

- Accident reduction
- Increased physical activity
- Reliability
- Maintenance
- Wider economic benefits

A reduction in the number of accidents and casualties can be expected as a result of the proposed scheme and the benefit has been estimated to be equivalent to 5% of the user benefits. Based on similar highway schemes this is considered a conservative estimate.

Increased physical activity and the associated health benefits, improved quality and reduced journey times for people walking and cycling are expected as a result of the scheme and the benefit has been estimated to be equivalent to 3% of the user benefits.

Journey time reliability is defined as variation in journey times that drivers are unable to predict, and is assessed as part of the DfT's Appraisal Reliability Sub-impact. It is expected that a NWL would help to improve journey time reliability and therefore, based on experience from similar highway projects the journey time reliability benefits have been estimated at 10% of the overall user benefits.

A NWL is expected to help reduce the current level of maintenance and renewal on the local roads and based on experience from similar highway projects the maintenance benefits have been estimated at 5% of the user benefits.

A NWL would also help support the current and future growth aspirations of the western quadrant and wider Norwich area. The wider economic benefits have been conservatively estimated at 10% of the business user benefits to account for the welfare impact and change in GDP as referenced in WebTag unit A2.1.

### 5.3.3 BENEFIT COST RATIO

The Benefit-Cost Ratio (BCR) is defined by dividing the Present Value of Benefits (PVB) by the Present Value of Costs (PVC).

According to WebTAG, Value for Money categories are defined as follows:

- Poor VfM if BCR is below 1.0;
- Low VfM if the BCR is between 1.0 and 1.5;
- Medium VfM if the BCR is between 1.5 and 2;
- High VfM if the BCR is between 2.0 and 4.0; and
- Very High VfM if the BCR is greater than 4.0.

The summary of benefits and costs are presented below, and this shows that the dual carriageway bridge option would deliver high value for money, whilst the single carriageway would deliver low value for money.

**Table 25: NWL BCR Calculation - Bridge**

| Benefits | £,000s 2010 prices, discounted to 2010 | |
|---|---|---|
| | Dual | Single |
| Consumer – commuting user benefits | 28,477 | 9,464 |
| Consumer – other user benefits | 133,517 | 37,736 |
| Business benefits | 151,086 | 34,116 |
| Greenhouse gases | -1,630 | -782 |
| Wider public finances (indirect taxation) | 3,516 | 2,161 |
| Safety | 15,654 | 4,066 |
| Physical activity | 9,392 | 2,439 |
| Reliability | 31,308 | 8,132 |
| Maintenance | 15,654 | 4,066 |
| Wider economic impacts | 15,109 | 3,412 |
| **Present Value of Benefits** | **402,083** | **104,809** |
| Investment Cost (Bridge option) | 161,122 | 94,937 |
| Operating Cost (Bridge option) | 10,251 | 6,078 |
| **Present Value of Costs (Bridge option)** | **171,373** | **101,015** |
| **Net Present Value (Bridge option)** | **230,710** | **3,794** |
| **BCR (Bridge option)** | **2.3** | **1.0** |

If the Present Value of Benefits are compared to the Present Value Costs for a tunnel option the dual carriageway option would deliver low value for money, and the single carriageway option would deliver poor value for money.

**Table 26: NWL BCR Calculation - Tunnel**

| Benefits | £,000s 2010 prices, discounted to 2010 | |
|---|---|---|
| | Dual | Single |
| **Present Value of Benefits** | **402,083** | **104,809** |
| Investment Cost (Tunnel option) | 264,929 | 154,700 |
| Operating Cost (Tunnel option) | 17,264 | 10,114 |
| **Present Value of Costs (Tunnel option)** | **282,193** | **164,815** |
| **Net Present Value (Tunnel option)** | **119,890** | **-60,006** |
| **BCR (Tunnel option)** | **1.4** | **0.6** |

## 5.3.4 NON-MONETISED BENEFITS

At this stage the appraisal has focussed on the potential economic benefit and value for money as described above, however, there are a number of other benefits that would need to be considered and appraised should the scheme progress. This would include wider consideration of the Environmental impacts including air quality, noise, landscape, historic environment, biodiversity and water environment; and the Social impacts including journey quality, accessibility to services and severance.

## 5.3.5 SENSITIVITY TESTING

At this stage it has not been necessary to prepare sensitivity tests, however, any future appraisal would need to consider how sensitive the benefits described are to a range of alternative parameters which could include alternative growth scenarios, or alternative levels of Optimism Bias.

# 6

# SUMMARY

# 6 SUMMARY

This report summarises the work undertaken to identify the potential need for, and viability of, a Norwich Western Link (NWL) to enhance connectivity between the A47 and A1067. The work has focussed on the wider strategic context, identification of transport problems, possible engineering options, environmental considerations and economic benefits to set out a series of recommended next steps.

Early plans to link the A47 (west) to the A47 (east) via the A1067 were not progressed due to environmental concerns regarding the Wensum Valley. However, following full approval of the Norwich Northern Distributor Road (NNDR) (in 2015) and an announcement from Highways England (in 2014) of their intention to investigate options to dual the A47 between Easton and North Tuddenham, Norfolk County Council (NCC) committed to revisit the feasibility and need for a NWL. The NWL is now recognised as a priority scheme for the Council.

Work has been carried out to start to develop an emerging Norwich Western Quadrant (NWQ) Transport Strategy. Local engagement, comprising a series of 1-2-1 meetings with local parish council representatives and key stakeholders to discuss problems and challenges, opportunities, objectives and potential measures, has highlighted local support for improvement within the study area, with a particular focus on addressing the problems associated with 'rat running', HGV routing, connectivity for all modes, and network resilience.

As a result of these 1-2-1 sessions a local steering group was set up to facilitate a two-way flow of information and ideas. To date, there have been two meetings held which have sought to identify objectives for a NWL scheme. Whilst these remain draft for the current time, the high-level objectives for the NWQ are currently as follows:

- Support sustainable growth in the western quadrant
- Improve the quality of life for local communities
- Support economic growth
- Protect and enhance the natural environment
- Improve strategic connectivity with the national road network

The work undertaken to develop the emerging strategy including the engagement sessions and steering group meetings has helped to develop a draft set of specific objectives for the NWQ and generate an initial long list of potential interventions. Whilst further development of the objectives is needed and assessment of the potential interventions is required the work to date does suggest an improved connection between the A47 and A1067, whether as a new link or upgraded route, will be an important element of the emerging transport strategy.

In considering future transport requirements, it is important to capture the expected changes and growth within the area. The NWQ is an area experiencing significant change in terms of the transport network and level of growth, including:

- the NNDR which is to open in late 2017 / early 2018;
- the announcement of the preferred route to dual the A47 between Easton and North Tuddenham;
- the Food Enterprise Zone near Easton; and
- the Greater Norwich Local Plan which is currently under development.

Traffic modelling and analysis, to help understand the challenges and for use in a preliminary economic appraisal, has been undertaken for various future scenarios, considering the impacts of growth and specific major development sites on the surrounding road network.

The chosen assessment years are an Opening Year of 2021; a Design Year of 2036; and a Horizon Year of 2050. It is acknowledged that an opening year of 2021 for a NWL is unrealistic; however, 2021 was chosen in agreement with NCC in order to align with the modelling and appraisal expected to be undertaken as part of the Highways England A47 improvement scheme. For each future year, travel demand forecasts take into account the existing base year traffic demand together with the effects of future traffic growth including the additional traffic due to new development activity.

A 'Do Minimum' (DM) network has been used which includes an open NNDR; offline improvement measures; City Centre network improvements; and dualling of the A47 between Easton and North Tuddenham. This has been compared with two 'Do Something' schemes which include a new NWL road, making an assumption about alignment that is roughly central within the study area. This notional alignment has been used to provide an indication of possible route length, type and junction locations for the purposes of appraisal. It should be noted that further work to define the corridor and alignment would need to be undertaken should development work be progressed.

The model also assumes that the NWL is connected to the dualled A47 to the south and with a new section of dual carriageway on A1067 between NNDR junction and NWL north junction; and includes the closure of two local roads where they would intersect the NWL.

The first of the 'Do Something' (DS) scenarios assumes that the NWL is constructed as a two-lane dual carriageway, whilst the second scenario assumes the road to be of single lane construction.

The DM results show that the network is likely to approach capacity in a number of locations in future years without intervention, increasing queueing and delays—particularly on the A1067—and on the minor roads served by both the A47 and A1067. Of particular note is the apparent increase in through traffic on local roads.

While the modelling results of the DS scenarios indicate that a NWL could result in a significant overall network performance increase, it is also clear that a dual carriageway option provides additional benefit over a single carriageway, decreasing over-capacity queuing in every scenario. The model suggests that further benefits of a NWL could include: the redistribution of through trips and HGVs from more local roads on to a NWL; as well as providing additional reserve capacity for further local growth.

To consider whether this performance benefit is likely to deliver economic benefits, it is necessary to ascertain likely costs for the scheme. To this end, and to assess the likely feasibility of developing a scheme which crosses the Wensum Valley, consideration has been given to a range of engineering solutions crossing the River Wensum.

The bridge options selected for further consideration would allow relatively long span lengths, whilst reducing the number of piers within the flood plain of the River Wensum. All bridge options incorporate a clear span over the river and its banks, although construction activity will be required within the flood plain. The EA and Natural England were supportive of the progress that had been made with the potential options, having regard to previously registered concerns and are willing to continue to consider proposals and advise on impacts and mitigation should further work be undertaken.

In addition to bridge solutions, consideration has also given to a tunnel option which, once operational and all mitigation has established, would be likely to have a minimal impact on the Wensum Valley environment above ground level as there would be no structure present. However, the EA and Natural England have raised concerns about a tunnel structure interrupting the flow of groundwater to the River Wensum and this is potentially a 'show stopper' for the tunnel option.

With these schemes in mind, high-level cost estimates have been produced, using the notional alignment within the central corridor as described earlier and considering both dual and single carriageway options; the different bridge options; and the tunnel option. It should be noted these are high-level cost estimates for the purposes of comparison and for use in the initial economic analysis. They consider construction costs, utilities, land, fees, risk, inflation (where required), and whole life costs (maintenance and renewal) to present initial scheme costs. For use in the initial economic appraisal optimism bias has been applied and the costs have then been deflated and discounted to 2010 prices and values in accordance with Department for Transport (DfT) guidance, this results in a Present Value of Costs (PVC)

At this early stage of economic appraisal the benefits associated with changes in travel time and vehicle operating cost have been quantified and assumptions made relating to additional benefits that can be expected (such as accident reduction, increased physical activity, reliability, maintenance and wider economic benefits), based on DfT guidance and economic appraisals undertaken on similar schemes. This results in a Present Value of Benefits (PVB).

When the benefits are compared to the costs, for a bridge-based scheme, the work to date suggests that the dual carriageway bridge option would deliver high value for money, whilst the single carriageway would deliver low value for money. For a tunnel option, the dual carriageway option would deliver low value for money, and the single carriageway option would deliver poor value for money.

# 7

# RECOMMENDATIONS

# 7 RECOMMENDATIONS

## 7.1 HIGH-LEVEL RECOMMENDATIONS

The work undertaken and discussed within this report suggests that:

- There is a problem to address, even with the NNDR and dualling of A47 and especially if the expected levels of growth occur.
- A NWL improvement is likely to form an important intervention within the emerging transport strategy for the NWQ.
- A NWL would deliver economic benefit reducing travel times and reducing levels of traffic including HGVs on the more local roads.
- A NWL could deliver high value for money.
- There appear to be feasible and viable engineering solutions to cross the valley.

Considering the results of the economic appraisal it is recommended that future work focus on a dual carriageway scheme with a bridge to cross the Wensum valley. The single carriageway scheme does not appear to address the problems or offer a good level of value for money; and the tunnel option has very high costs, offers low or poor value for money and presents significant environmental concerns.

It is considered there is a strong case to progress and it is recommended that further work be undertaken to develop a DfT compliant business case for a NWL. This would need to consider and appraise a wide range of potential options and packages of improvement.

It is recommended that the next stage of development work is focussed on the following elements:

- **Communication and engagement** with a wider range of stakeholders. This should build on the local parish steering group sessions, meetings with Highways England, and early discussions with the Environment Agency and Natural England and start to engage with local businesses, community services and groups, and residents.
- Progress the **emerging transport strategy** for the NWQ and co-ordinate its development with the work being undertaken to develop the Greater Norwich Local Plan, and work to review and update the Norwich Area Transport Strategy.
- **Option development** to identify the potential options and potential packages of improvement for the NWQ including identification of a preferred corridor and possible alignments for a NWL.
- **Prepare appraisal specification** (including consideration of the appraisal being undertaken by Highways England on the A47 as well as details and timescales for the NNDR, FEZ and Local Plan) to scope the work required to update the existing traffic model and enable a robust appraisal.
- **Develop the business case** by collecting necessary data and progressing the scheme including design, environmental assessment, traffic modelling, economic appraisal and costs.

The development of a good business case will be crucial to the future development of a NWL and the section below provides a summary of what will be required.

## 7.2 DEVELOPING A GOOD BUSINESS CASE

As part of this work a guidance document setting out the requirements for producing a Strategic Outline Business Case (SOBC) and an Outline Business Case (OBC) has been produced. Extracts from this document are summarised below.

### 7.2.1 INTRODUCING BUSINESS CASES

The business case is the key to major scheme funding. It will also be a public document and source of information for anyone interested in the scheme. It may be used as evidence in a Public Inquiry. It therefore needs to be clear, accurate, complete and convincing.

It therefore needs to be prepared in line with the guidance and expectations of the funding body. In this instance, the main funding body is expected to be the Department for Transport (DfT) on behalf of the government, and the business case should comply with DfT guidance, specifically that set out in WebTAG.

As well as complying with guidance, the business needs to set out a compelling case for the scheme. It must provide evidence that:

- There is a real problem to be solved
- The scheme is part of a coherent wider strategy
- A full range of options has been considered, and the best scheme has been selected
- The scheme represents high or very high value for money
- The scheme is feasible and affordable, and can be delivered within the planned timescale

### 7.2.2 THREE PHASES

DfT guidance envisages that a business case will be developed over three phases:

- **Strategic Outline Business Case** (SOBC) – sets out the need for the scheme and its strategic fit. Identifies possible solutions and describes an initial sift of options. Carried out at Stage 1 (Option Identification)
- **Outline Business Case** (OBC) – Identifies a preferred option and sets out the case for change in much more detail. Describes the overall balance of benefits and costs against objectives. It is carried out as part of Stage 2 (Option Selection) of the project
- **Full Business Case** (FBC) – the final updating of the business case to secure full funding approval. The OBC is reviewed in Stages 3 and 4. It is then refined in Stage 5 prior to start of construction.

### 7.2.3 THE FIVE CASES

Each phase builds upon the previous phase. The level of detail required at each phase is different, but the basic structure is the same. At each phase, DfT guidance requires submission of five separate, but related cases:

- Strategic Case
- Economic Case
- Financial Case
- Commercial Case
- Management Case

The level of detail needs to be agreed in advance. This is done by preparing and submitting an Appraisal Specification Report (ASR) in advance of the Strategic Outline Business Case. The ASR will then be refined as the project progresses.

### 7.2.4 TECHNICAL WORK

The SOBC should outline a minimum of five short-listed options for further examination at the OBC stage. These should include:

- The 'do nothing' - which provides the benchmark for adding public value throughout the appraisal process
- The 'do minimum' option - which provides a benchmark to identify where an option loads on costs for little real gain in functional benefit
- Reference option - which gives a base comparison for completion of the proposal
- Two other realistic options

In order to provide the necessary supporting evidence that an appropriate level of analysis has been carried out to support the SOBC, the following Stage 1 documents may be required:

- ASR – Appraisal Specification Report refined
- OAR - Options Assessment Report
- EAR – Economic Assessment Report
- Traffic Data Collection Report
- TFR - Traffic Forecasting Report
- LMVR - Local Model Validation Report
- AST – Appraisal Summary Tables refined for each option still under consideration
- TAR – Technical Appraisal Report

- Options Cost Estimate & Statutory Undertakers Estimate
- Public Consultation Strategy

Many of these documents would need to be refined as the business case progresses through subsequent phases.

### 7.2.5 ROBUST DATA COLLECTION

The collection of robust data and evidence are crucial to the development of a good business case. As a business case for a NWL is progressed data collection will need to focus on two areas:

- Transport and traffic data / surveys; and
- Environmental data / surveys

As part of the NNDR the County Council intend to undertake monitoring and evaluation of the scheme over the construction and aftercare period. To report the findings from the monitoring and evaluation process and confirm the scheme is following the intended trajectory, three reports have been proposed:

- Baseline report
- 1 Year After report
- 5 Years After report

Crucially any transport and traffic data collected to assist the development of the traffic model for a NWL will need to be undertaken after a period of traffic redistribution following the opening of the NNDR.

**Transport and traffic data / surveys**

Improved journey times and reliability will form a key measure of the success of a NWL scheme in relieving existing routes and improving access between the A47 and the north / north-west area of Norwich. Therefore data should be collected to enable journey times and journey time reliability on key routes to be analysed. Options to collect journey patterns and origin-destination data using ANPR, road side interviews and mobile phone data should be explored.

Data on public transport journey times, journey reliability and usage should also be gathered, and count data for cycle users and pedestrians should also be included.

**Environmental data / surveys**

A comprehensive Phase 1 ecological survey of the likely route corridor should be undertaken to identify, in greater detail than a desk study can provide, what additional ecological constraints are present.  This survey should feed into the appraisal and will be integral to the HRA process (see section 4.4.3).

Two years of survey data are likely to be required in support of any planning application.  It is recommended that the county ecologist and Natural England are jointly consulted on a proposed ecological monitoring programme once a preferred route has been identified

# 8

# SUGGESTED NEXT STEPS

# 8 SUGGESTED NEXT STEPS

## 8.1 NEXT STEPS

The work undertaken indicates that there is need for intervention in the Norwich Western Quadrant and a NWL could provide a solution that delivers high value for money. There will be a need to update the evidence base once the impacts of the NNDR and associated mitigation measures are known and further details regarding the A47 dualling, the FEZ and the GNLP are confirmed. However, there is sufficient evidence to suggest that a case for a NWL should be progressed and that the work undertaken should focus on the development of a business case.

Given this context it is recommended that a staged approach is taken forward over the next 12 -14 month period.

- Phase A: Communications, Engagement and Governance (November 2017 to December 2018)
- Phase B: Option development and initial appraisal (December 2017 to July 2018)
- Phase C: Development of NWL business case (February 2018 to December 2018)

Each of these Phases are described in more detail below.

### 8.1.1 PHASE A: COMMUNICATIONS, ENGAGEMENT AND GOVERNANCE

This phase would establish a clear governance structure and enable effective consultation and engagement with key stakeholders.

| Reference | Activity | Timescale | Cost | Scope |
|---|---|---|---|---|
| A1 | Project Management & Governance | November 17 to December 18 | £30k | ▪ Establish NWL Project Board<br>▪ Ensure effective management and governance of project |
| A2 | Communication & Engagement | November 17 to December 18 | £120k | ▪ Develop engagement strategy<br>▪ Continue to provide regular updates to Member Working Group and Local Steering Group<br>▪ Undertake meetings with key stakeholders<br>▪ Initial public engagement<br>▪ Produce stakeholder engagement report |

### 8.1.2 PHASE B: OPTION DEVELOPMENT AND INITIAL APPRAISAL

This phase would review previously identified options and then develop and appraise a range of potential options and packages, and would set out future the proposed approach to appraise the options.

| Reference | Activity | Timescale | Cost | Scope |
|---|---|---|---|---|
| B1 | Corridor appraisal | November 17 to January 18 | £20k | ▪ EAST approach to appraise the corridor<br>▪ High-level review of economics, environment, geotech, land, planning and engineering<br>▪ Identify preferred corridor |
| B2 | Option generation | January 18 to March 18 | £30k | ▪ Detailed review of previously identified alignments within preferred corridor<br>▪ Generate options and alignments within identified corridor |

| | | | | |
|---|---|---|---|---|
| B3 | Transport Strategy | November 17 to July 18 | £30k | ▪ Engage with stakeholders to progress<br>▪ Develop strategy document |
| B4 | Option development and initial appraisal | February 18 to July 18 | £70k | ▪ Develop options reflecting likely range of routes, scheme types, alternatives, junctions etc<br>▪ Undertake viability and feasibility considerations against agreed criteria<br>▪ Identify best performing options using available information<br>▪ Prepare options assessment report |
| B5 | Appraisal specification | January 18 to July 18 | £50k | ▪ Prepare appraisal specification report |

### 8.1.3 PHASE C: DEVELOPMENT OF NWL BUSINESS CASE

This phase would develop the business case for a NWL.

| Reference | Activity | Timescale | Cost | Scope |
|---|---|---|---|---|
| C1 | High-level SOBC | March 18 to August 18 | £100k | ▪ Produce high-level SOBC document |
| C2 | Design progress | February 18 to November 18 | £100k | ▪ Progress initial design options<br>▪ Develop design strategy for NMU, Drainage, Landscape, Highways and Structures, Geotechnical<br>▪ Review land ownership for options<br>▪ Initial architectural involvement<br>▪ Explore innovative options<br>▪ Urban design review<br>▪ Prepare visuals |
| C3 | Environmental assessment | February 18 to November 18 | £150k | ▪ Desk-top assessments<br>▪ Scoping of surveys<br>▪ Collation of available information |
| C4 | Traffic modelling and economic appraisal | April 18 to December 18 | £150k | ▪ Confirm traffic survey requirements<br>▪ Commission data collection<br>▪ Update and review modelling<br>▪ Update economic appraisal |
| C5 | Costs and Risk | April 18 to October 18 | £25k | ▪ Update costs based on options<br>▪ Update risk register and QRA |
| C6 | Enhanced SOBC / OBC light | August 18 to December 18 | £25k | ▪ Update the SOBC with revised information<br>▪ Produce enhanced SOBC |

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