Technical Note 1_Final

Project:	**Ipswich Transport Model Assessment**	Job No:	**60095679**
Subject:	**Ipswich Area Development and Infrastructure Tests – Non-Technical Summary**		
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1 Introduction

1.1 Traffic modelling work has been undertaken recently on behalf of both Ipswich Borough Council (IBC) and Suffolk County Council (SCC), which was aimed at assessing the strategic traffic implications of provision of 5,000 households in Northern Ipswich, 1,000 of which are currently specified in the Proposed Submission Core Strategy and Policies development plan document for Ipswich. The aim of this document is to provide an overview of these analyses and to add some context to the findings.

1.2 Two previous Technical Notes prepared by AECOM, entitled 'Ipswich Area Development and Infrastructure Tests' and 'Ipswich Area Development and Infrastructure Tests - Supplementary', provide a technical review of the modelling results; these have been referenced when preparing this report and are provided in Annex III and IV. These documents represent results of ongoing testing of strategic growth options at Ipswich.

1.3 The aim of this exercise was to gain an understanding of the most appropriate transport solutions to cater for the overall scale of growth in Ipswich.

2 Background

2.1 Ipswich Borough Council is currently consulting on the Proposed Submission Core Strategy and Policies development plan document. The plan document includes policies of relevance to this testing in the identification of northern Ipswich as a likely location for further large scale housing provision beyond 2021. It also includes the proposed provision of the Wet Dock Crossing and the Northern Bypass as long term prospects, if justifiable, and highlights that funding would be required, beyond developer funds, to implement either measure.

2.2 The need to provide alternative capacity for east-west movements to relieve congestion and air quality issues in the Gyratory, which in turn will support the town's economy and health, has been identified within the plan document.

2.3 A key challenge for the future is managing the additional travel demands that growth will generate and guiding as many as possible to sustainable modes for the good of the environment, economy and health. The objectives of the Regional Spatial Strategy to manage *travel behaviour and the demand for transport*, and *to encourage the efficient use of existing transport infrastructure* are highly relevant to this consideration of future growth of Ipswich.

2.4 In addition the Ipswich Borough Council Proposed Submission Core Strategy and Policies development plan document includes the following objective:

To improve accessibility to and the convenience of all forms of transport, and achieve significant modal shift from the car to more sustainable modes through the Ipswich Major Scheme and other local initiatives. This will: (a) promote choice and better health; (b) facilitate sustainable growth, development and regeneration; and, (c) improve integration, accessibility and connectivity. Specifically:

- *Significant improvements should take place to the accessibility to and between the three key nodes of: the railway station (including the wider Ipswich Village environment), the Waterfront (and particularly the education quarter) and the Central Shopping Area;*

- *Additional east-west highway capacity should be provided within the plan period in the Ipswich area to meet the needs of the wider population and to provide the potential to reallocate some central road space; and*

- *Ipswich Borough Council aspires to an enhanced public transport system, such as guided bus, urban light railway, trams or monorail.*

2.5 Travel at, to and from Ipswich is largely dependent on the A14 Trunk Road, and its junctions, which circumnavigates Ipswich to the east and south. The A14 corridor is reaching capacity and Highways Agency focus is on adopting demand management measures to optimise the use of this strategic route.

2.6 Suffolk County Council are awaiting the outcome of a bid for funding from the government for 'Ipswich: Transport Fit for the 21st Century' scheme. This scheme is aimed at improving bus station provision, passenger information, a state of the art computerised traffic management and information system, shuttle bus provision and pedestrian links between the Central Shopping Area, the railway station and Waterfront, with an estimated cost of £25 million.Suffolk County Council have made a successful CIF 2 bid for the provision of Ipswich central area transport improvements focussing on the Fore Street area, aimed at improving the environment for all users. The cost of this work is expected to be in the region of £3.5million.

2.7 Assumed traffic growth as a result of an additional 2,000 jobs and 1,050 dwellings at Martlesham has been included in 2021 base traffic flows. It should be noted that this may be an underestimation of future dwelling numbers as an outline planning application for 2,000 additional jobs and 2,000 dwellings, with ancillary facilities, is currently being considered by Suffolk Coastal District Council.

2.8 Whilst no specific development has been highlighted in the Babergh area within the model the background growth assumptions within the model account for an element of growth in this area.

3 Modelling Results - Non Technical Summary

3.1 The strategic modelling exercise provides a broad understanding of the likely relative implications on the capacity of the Ipswich road network, of the proposed provision of large scale residential development in Ipswich northern fringe, and subsequent iterations testing potential infrastructure solutions. The exercise highlights key problem areas, and potential relative benefits in traffic capacity terms of potential infrastructure measures.

3.2 It is important to note that the model does not dynamically analyse the implications of policies and measures adopted by the Council which may impact upon single occupancy car travel. For example, the impact that congestion and demand management will have on future mode choice, and conversely the impact that providing further traffic capacity is likely to have on mode choice is not fully accounted for. Improving the attractiveness of car travel by providing inappropriate additional road capacity, is most likely to attract further trips onto the network and detract from the potential benefits of any investment in promoting sustainable travel.

3.3 Although an assumption of a shift from car of 20% has been assumed from the development, following a Sustainable Travel Investment, further general measures to encourage sustainable travel are under consideration by the County. The potential behavioural change that could be achieved through combinations of measures to promote sustainable transport modes in the future is outside the scope of these tests.

3.4 The transport modelling will not take into account traffic likely to be induced by the presence of new highway capacity provided. This is particularly relevant to the assessment of the northern bypass.

3.5 Five scenarios with large scale development in place on the northern fringe have been assessed using the highways element of the ITAMS modelling suite, and the findings have been compared to 2008 and 2021 base conditions. The assessment scenarios are outlined below:

Scenario 1: 2008 Base Year 2008 is the year of the interim validation base model; both morning (08:00-09:00) and evening (17:00-18:00) peak hours have been modelled. Future year assessment scenario results have been compared against the 2008 results in order to gain an understanding of the predicted implications of traffic growth on the network.

Scenario 2: 2021 'Do Minimum' Traffic has been factored to 2021 levels using assumptions in line with the Regional Spatial Strategy (RSS) for the East of England. A number of 'Do Minimum' highway infrastructure schemes have also been included which are likely to be constructed between 2008 and 2021; these are:

- Proposed changes in the Duke Street area, emerging from the successful CIF 2 bid.
- Improvements to the A14/A12 Copdock Interchange to mitigate the impacts of development traffic generated by the proposed Felixstowe and Bathside Bay Port expansions and SnOasis development schemes.
- A successful major-scheme business case of 'Ipswich – Transport Fit for the 21st Century', involving full UTMC signalisation, RTPI, an altered bus loop, additional shuttle bus services and an improved active mode network.
- A successful TravelSmart scheme will be implemented by 2021. The TravelSmart policies represent an approach to reducing car travel by providing tailored information packs by

encouraging further journeys by, and providing information on, walking, cycling and public transport modes. For the purposes of these tests, car trips have been reduced by 15% to and from the town centre and at Adastral Park in the eastern fringe.

Scenario 3: 2021 'Do Minimum' with Development Additional traffic resulting from the north Ipswich housing allocation has been added to the 2021 'Do Minimum' traffic levels; the approximate location of this allocation is illustrated in Figure 1. Early model testing was carried out with an allocation of 5,000 dwellings in this location, 1,000 of which are assumed under RSS growth, however it has since been concluded that the 2021 'Do Minimum' demand matrices allowed for 450 dwellings in the northern fringe as part of the RSS proposals. As a result the model was re-run with an allocation of 4,550 dwellings over and above the 'Do Minimum' scenario. The net housing provision tested on the northern fringe remains at 5,000.

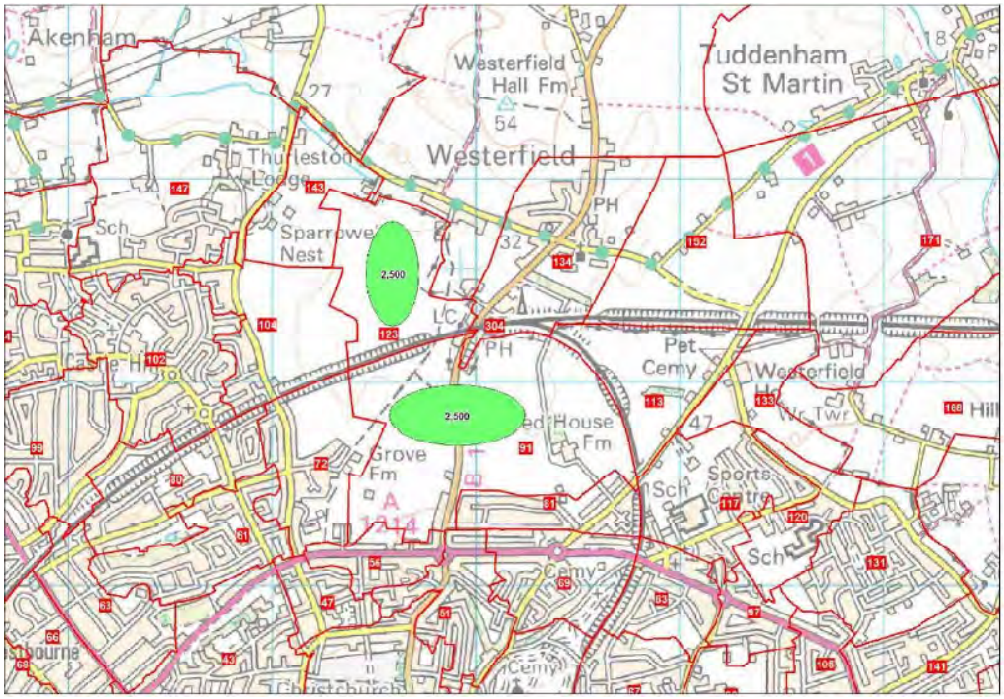

Figure 1: Northern Fringe Housing Allocation Approximate Location

Scenario 4: 2021 With Development, with Sustainable Travel Investment This scenario applies a 20% reduction to vehicular trips from the potential development on the northern fringe. The reduction has been applied based on the assumption that comprehensive investment in public transport and active modes to and from the development site will be made and will achieve a 20% modal shift away from private car use.

Scenario 5: 2021 With Development, with Sustainable Travel Investment, with Northern Bypass The network was modelled using Scenario 4 flows with the addition of an Ipswich Northern Bypass. Figure 2 presents an indicative alignment of the Northern Bypass which has been assumed for modelling purposes only; it has been assumed to be a single carriageway road that connects the A14 at Bury Road and the A12 at Martlesham. Intermediate junctions have been assumed.

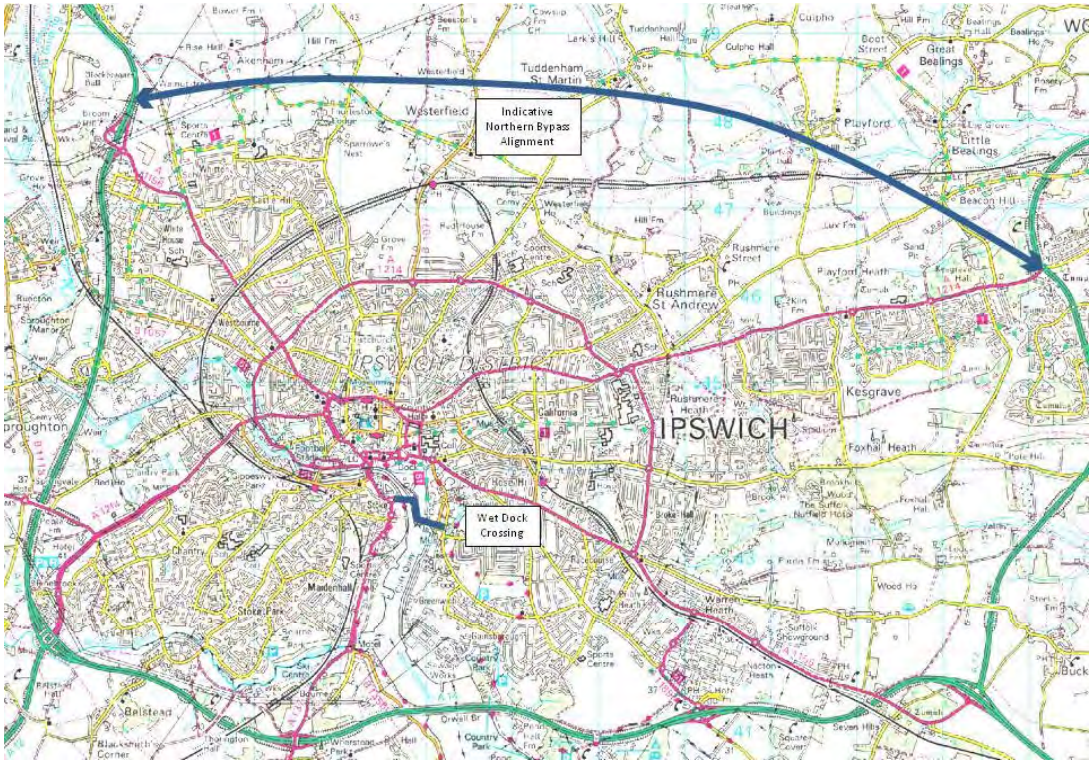

Figure 2: Potential Highway Infrastructure Schemes

Scenario 6A & 6B: 2021 With Development, with Sustainable Travel Investment, with Wet Dock Crossing It should be noted that this scenario has not been re-run using the revised housing allocation of dwellings; therefore all results for this scenario relate to an allocation of 4,550 dwellings above RSS allocations rather than the 4,000 above RSS which testing for the other scenarios assume. This will not alter the overall conclusions, for the purposes of this assessment. The network was modelled using the base Scenario 4 flows (i.e. with the 20% reduction applied for sustainable transport initiatives) with the addition of 4,550 dwellings on the northern fringe and a new bridge linking Landseer Road with Mather Way, the location of which is presented in blue on Figure 2. Capacity reductions at Star Lane and College Street gyratory system as a result of the Wet Dock Crossing being introduced have been incorporated into both assessments. Two permutations of this test have been described in this report:

A. Dual Bridge – Provides for overhead signs allowing for the switching of traffic to either bridge dependent upon water-modes accessing/exiting the port. It has been assumed there would be 30 seconds of no traffic flow every 10 minutes in the morning and evening peak hour as the lane switchover takes place.
B. Swing Bridge – Would physically swing in order to let water-traffic access/exit the port. It has been assumed there would be 2 minutes of no traffic flow every 10 minutes in the peak hours.

Assessment Methodology

3.6 For each of the scenarios, journey times, junction delay and network statistics have been compared in order to assess the implications of each modelling scenario. Key corridors, radials and central Ipswich area have been assessed to provide an overview of the changing journey times in each scenario. 25 junctions which appeared to have high and consistent delays across both time periods (AM/PM) in 2021 were selected for comparison. The journey times assessed and the critical junctions considered are illustrated in Figures 3 and 4 below. They are described in further detail in Annex I.

3.7 In addition the overall network statistics for each Scenario have been examined in order to compare the overall level of change in delay and in levels of route diversion arising from each scenario.

Figure 3: Journey Time Routes

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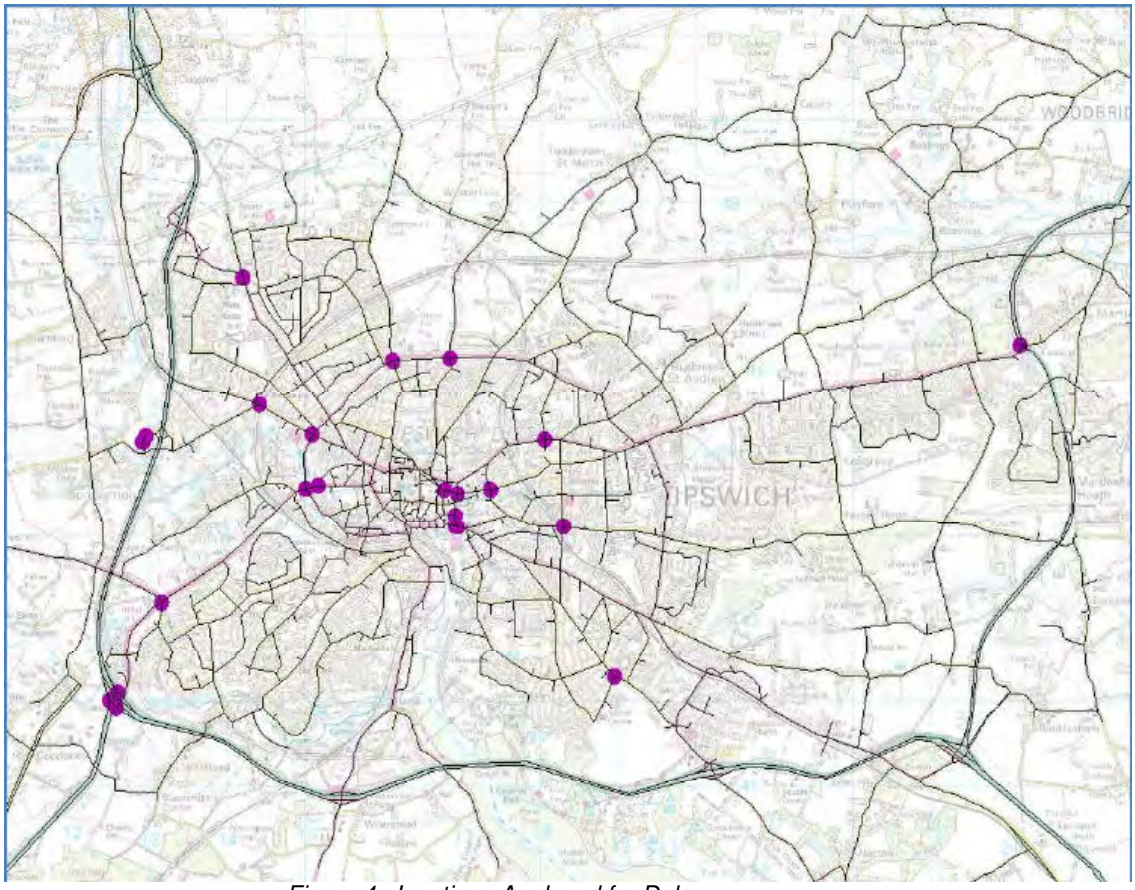

Figure 4: Junctions Analysed for Delay

3.8 Furthermore an analysis on impacts on link capacity on the A14 has been undertaken along with an assessment of the local traffic using the Orwell Bridge on the A14 under each Scenario.

Results and Analysis

3.9 In order to have an understanding of the relative performance of each of the Scenarios it is important to understand the backdrop against which they can be measured, that is the 2008 and 2021 Do Minimum conditions. These are outlined first.

3.10 The key findings from the modelling for each scenario are presented in this section.

3.11 Scenario 1: 2008 Base Year- Model

- The majority of routes displayed an average speed of 20km/hr or above which is considered a reasonable average speed for vehicles travelling around a town centre.
- Average traffic signal cycle times (i.e. the amount of time taken for all approaches to be given their allocated green time) vary between 60 seconds and 120 seconds. The

maximum delays per vehicle at each junction recorded in the model is within this range, it can therefore be assumed that the majority of vehicles only have to wait a maximum of one cycle at each junction, which is reasonable on a town centre road network. The strategic model assumes theoretical optimised signal times which could vary from those currently experienced in reality. As such current experiences may vary in reality, however this information provides a base against which to appreciate the relative change predicted in the future year modelling.

- The largest delays in the network are experienced close to the town centre, as would be expected.

3.12 Scenario 2: 2021 'Do Minimum'

- Significant increased pressure is expected at the A14 Copdock Interchange, highlighting the need for improvement to cater for current predicted growth levels.
- The A14 junctions of Junction 57 at Nacton Road, and Junction 58, Seven Hills are both predicted to be suffering delays in 2021, highlighting the need for junction improvements, none of which are currently allowed for in the modelling.
- Overall increased delays can be expected as a result of general traffic growth; the impact will be greatest around the town centre, highlighting the predicted increase in demand for local trips to, from and through Ipswich Town Centre.
- The majority of junctions still operate with an average delay per vehicle of less than 100 seconds and as such the majority of vehicles will pass each junction in one cycle of the traffic signals, which is considered reasonable for an urban area.
- Average speeds for most routes are still predicted to be 20 km/hr or greater. The Inner Ring Road and the Norwich Road (southbound only) are the exceptions. In general there is no major variance recorded between AM and PM conditions within the model.

3.13 Scenario 2, 2021 Do Minimum, is the Scenario against all of the options tested are examined.

3.14 Scenario 3: 2021 'Do Minimum' with 5,000 dwellings on the Northern Fringe (With Development):

- No significant impact is caused by the development in the AM peak with the exception of along Westerfield Road southbound. This is due to the localised impact of commuting traffic leaving the development and it can be assumed that local road improvements could alleviate this delay.
- During the PM peak the impact of the development is much more elevated. Significant delay increases within the town centre and north of the town centre are caused. The PM peak issues are likely to lead to some peak hour spreading, with individuals altering travel patterns to avoid congestion.
- The strategic road network is not badly affected by the proposed addition of the 4,550 dwellings on the northern fringe, with the exception of at Copdock Interchange where there are only slight increases in delay predicted beyond 2021 'Do Minimum'.
- With the exception of Westerfield Road all routes experience decreases in average speeds of less than 3 km/hr, as such minor localised improvements could have a significant impact in reducing junction delays in the vicinity of the development.
- The Town Centre road network is predicted to suffer increases in congestion, as traffic is predicted to continue to use Ipswich town centre as a through route, and/ or a large proportion of the new trips are bound for the town centre. This demand for local movement highlights the potential to promote sustainable transport for the new development trips by providing strong sustainable links to the Town Centre. In addition this highlights the need

to strengthen links to the strategic network from the development area, to remove unnecessary car trips through the town centre.

- Whilst this could be alleviated through junction improvements local to the developments and along the east west corridor, the increase in congestion in the network is significant and highlights the need to do more to mitigate the effects of the proposed northern fringe development.

3.15 Scenario 4: 2021 With Development, with Sustainable Transport Investment at the Development
The following conclusions regarding the future addition of 4,550 dwellings on the northern fringe, with a target 20% reduction in car trips from the developments, can be established:

- Adopting measures at the proposed developments to achieve a 20% reduction in car trips results in improvements to network delay and to route diversion, although values are still predicted to be in excess of Do Minimum 2021 conditions. As such the impacts of the proposed developments cannot be mitigated solely through on-site investment in sustainable transport.
- The most marked delays remain in the town centre and in the vicinity of the development during the PM peak. It is considered that the potential to cater for trips to the town centre from the development by sustainable means is not fully represented by the modelling results.
- Cumulative delays of 100 sec/veh or greater are shown on seven junctions, as was the situation without the 20% reduction in car trips, from the northern fringe development. Whilst these delays are reduced below Scenario 3 levels, this highlights the need for further measures to reduce delays on the road network to mitigate both future growth and the possible provision of 4,550 new dwellings on the northern fringe.
- Overall the impacts of the development on the strategic road network are alleviated through a reduction in development car trips by 20%.
- If the Travel Smart initiative managed to achieve a 15% reduction in trips across the whole, network, rather than just on trips focussed on the town centre and Adastral Park, obviously much wider benefits would be realised. This would require wider implementation of the Travel Smart project and substantial improvement to non-car alternatives such as Bus Rapid Transit investment and demand management measures in the town centre.
- In addition, assuming a 20% reduction in car mode share at the proposed site, beyond that currently in place in adjacent areas, is a broad assumption. Essentially, this target could be set at a more ambitious level of 25% or even 35%, and the development designed accordingly. This would further reduce the development impacts on the road network. Limiting the development access capacity would reduce car attractiveness and promoting car clubs, car sharing and subsidising public transport services would all help to promote a reduced car mode share. Designing to these targets alone would require consideration of capacity requirements for other modes.

3.16 Scenario 5: 2021 With Development, With Sustainable transport investment, with Northern Bypass.

The following conclusions regarding the potential future addition of the Northern Bypass to the road network can be established:

- The Bypass is predicted to improve capacity on the majority of routes, in many cases bringing them in the region of 2008 results.
- Capacity issues at the Copdock Interchange are not resolved with the addition of the Bypass.

- The impacts on the strategic road network are generally predicted to be reduced with the provision of the northern bypass, with the exception of Copdock Interchange where AM delays are predicted to increase.
- Delays across the network are predicted to be below 2021 Do Minimum conditions.
- Additional capacity in and around the town centre could encourage further car use and work against the Travel Smart policies which promote sustainable modes of transport, and against the target reduction of car travel from the proposed development. Reductions to reflect investment policies in these areas have been included for in the modelling assumptions.
- The potential for the bypass to induce traffic from the surrounding area has not been represented by the modelling and would be likely to lead to further strategic network pressures.
- The provision of further east west capacity clearly helps mitigate against the development impacts. The level of capacity provided could however be detrimental to the effectiveness of policy objectives to reduce car reliance at Ipswich. Provision of additional capacity along existing routes would represent a more metered and cost effective approach.

3.17 Scenarios 6A & 6B: 2021 With Development, With Sustainable transport investment, with Wet Dock Crossing**.**

There are two permutations of the Wet Dock Crossing however results for both have been included in this section as they are broadly similar in pattern. The following conclusions regarding the future addition of a Wet Dock Crossing to the road network can be established:

- The proposed Wet Dock Crossing is predicted to relieve network delays, particularly in the PM period when generally conditions are predicted to be at their worst.
- Regardless of bridge form, strategic network conditions are predicted to be similar to Scenario 3, with sustainable transport investment alone. The proposed Wet Dock Crossing is however predicted to add further delays to the Copdock Interchange. There is also an increase in delays and traffic on the radial routes into Ipswich arising from the release of additional town centre capacity.
- When compared to a Northern Bypass it will have a more positive impact on the town centre in traffic capacity terms and a less positive impact outside the town centre.
- The relief of capacity issues within the town centre would support the provision high quality sustainable transport solutions using the road space released, which would help counteract the level of additional traffic attracted into the town centre.

A14 Assessment

3.18 The assessment of the relative impacts of each scenario on the A14 took two forms. Firstly, the impact on link capacity was assessed. The conclusion of this analysis is that the link capacity does not show significant variance for any of the tests. The results show that the A14 is at capacity at 2021 for the majority of links, regardless of the option being tested. The options alter factors between 95% and 100% slightly, but this does not change the overall picture. Desirable link capacity is 85%, highlighting that the A14 is predicted to be exceeding desirable link capacity limits in 2021.

3.19 The second element of the assessment examined the composition of traffic predicted to be using the Orwell Bridge on the A14. The aim was to understand the potential implications of the proposed scenarios on the use of the A14 for local trips in Ipswich. The results show that none of the tests have a large impact on the total trips using Orwell Bridge. As we would expect, the biggest impact is with the introduction of the Northern Bypass. This is predicted to reduce trips across the Orwell Bridge by around 5% in the AM peak, and by 2% in the PM peak. The

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reductions are from external to external trips, rather than local trips and the marginal change illustrates a low return likely from this very expensive piece of infrastructure. External to external trips are those passing through the Ipswich area.

3.20 For the purposes of this work, we can conclude that the impact of the development itself on the A14 is minor. The northern fringe development is predicted to increase two-way traffic flow across the Orwell Bridge by 90-100 trips in each of the peak hours. Additionally, the development appears to have little impact on the origin and destination of trips using the A14, with only minimal changes on sector-sector trip proportions. Whilst there is some impact on sector-to-sector proportions using the bridge as a result of additional network capacity through a Wet Dock crossing, this too is shown to be minimal.

4 Regional context

4.1 In interpreting the modelling findings, it is necessary to understand the scale of household development required in Ipswich, as specified by the Government Office for the East of England in the 'East of England Plan', in a regional context. Table 1 provides a comparison of the minimum dwelling provision as required by the Regional Spatial Strategy (RSS) between 2001 and 2021 for Ipswich and other comparable urban centres across the region.

Table 1 – Comparison of minimum dwelling provision (RSS) to 2021 for regional settlements

District	Population (2001)	Households (2001)	RSS Minimum Dwelling Provision ('01 – '21)	Minimum Households (2021)
Chelmsford	157,072	64,564	16,000	80,564
Colchester	155,142	63,451	17,100	80,551
Ipswich	**117,069**	**51,684**	**15,400**	**65,423**
Norwich	117,875	54,707	14,100	68,807

4.2 As shown in Table 1, the urban centres of Norwich, Chelmsford and Colchester all have relatively similar and comparable levels of development in terms of household and population numbers in 2001 to Ipswich, although Ipswich is currently the smallest of these four urban centres. All of these areas have further housing targets to meet by 2021, which are likely to be increased beyond the 2021 horizon.

4.3 It is important to understand the changing demands that will occur in Ipswich in the context of conditions experienced by similar size urban centres. For example, in delivering the current RSS targets by 2021 Ipswich will have a greater number of households to that held by Chelmsford in 2001. The levels of congestion which are deemed to be acceptable and the level of attractiveness which public transport could offer must be understood in this context, rather than in the context of existing conditions in Ipswich. As a tangible example, in a congested network, not all vehicles will get through a junction in one signal cycle and queuing between junctions is a regular peak occurrence. The change in conditions is a downside of urban growth and highlights the need to manage travel demand efficiently.

4.4 The potential provision of a further 4,000 homes beyond 2021 RSS growth, would bring Ipswich beyond the size Norwich is currently predicted to reach in 2021. As urban centres grow there is further potential to provide quality public transport solutions as patronage demands justify higher levels of service. In addition, reducing the emphasis on car traffic and placing it instead on improving the attractiveness for pedestrians, cyclists and public transport users creates a more attractive environment to be in and achieves a more efficient use of urban road space.

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4.5 Furthermore, it is shown that, whilst Ipswich Borough may have a challenging target to meet in terms of its dwelling provision to 2021, other regional centres are affected to a similar degree. In order to ensure the impacts of development are minimised and mitigated, there will be a greater pressure to deliver and invest in sustainable policies across the region which will only be supported by demand management measures at source.

5 Summary & Recommendations

5.1 Average journey times within Ipswich are predicted to increase in the coming years however increases are not considered great when compared to existing levels in similar settlements in the region. This demonstrates that there are opportunities to further develop sustainable transport measures to mitigate and further reduce car mode share, and that the need for expensive highway infrastructure is not necessary at this stage.

5.2 The possible provision of large scale residential development in northern Ipswich would place further pressure on the transport network and it is clear that solutions to cater for this growth would need to be identified.

5.3 In policy terms, a focus on modal shift would be a more favourable approach in comparison with increasing road capacity. This would represent the most efficient use of the network and, with the population intensification expected in coming years within the urban area, it is considered that there is real potential to implement meaningful public transport improvements.

5.4 It could be argued that increasing road capacity could alleviate congestion and air quality concerns in the town centre. However providing additional road capacity, if managed inappropriately, has the potential to counteract investment in promoting mode shift and to induce further traffic onto the network, off-setting any potential congestion or air quality benefits, and placing further pressure on the Strategic Road Network.

5.5 It has been found that investment in sustainable transport to ensure that optimal mode share is achieved at the development helps to mitigate against the development impacts. This investment would need to include reliable high frequency public transport service to the town centre and attractive, direct green infrastructure linking with the town centre. Development should be located and designed to minimise the need to travel and to enable access safely and conveniently on foot, by bicycle and by public transport. Strong policies to promote sustainable access would be required to optimise the use of the new infrastructure. It is expected that these are issues which would be addressed through developer funding.

5.6 Providing strong sustainable connections to the town centre would not be sufficient to mitigate the transport impacts of the possible provision of up to 5,000 houses on the northern fringe of Ipswich. Residual impacts are predicted to exist in the town centre and strategic road network, which need to be addressed by other means.

5.7 Two highway solutions tested to cater for the residual impacts are the northern bypass and the proposed Wet Dock crossing. The theoretical highway capacity benefits of either solution are clear, with the Wet Dock Crossing in particular alleviating town centre pressures, whilst the northern bypass is predicted to relieve strategic network issues.

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5.8 The potential northern bypass, which is likely to cost in the region of £100 million to implement, is predicted to improve capacity on the majority of routes, in many cases bringing them to 2008 levels. The level of capacity provided would compromise the effectiveness of policy objectives to reduce car reliance at Ipswich and at the proposed Northern Fringe development. The Northern Fringe development would be encouraged to be car reliant and the potential for sustainable growth in Ipswich would be greatly challenged. Investment in roads infrastructure of this scale is inappropriate without first considering if investment in more sustainable alternatives would be of benefit. Whilst generally strategic impacts are predicted to be reduced by the provision of the bypass, it is expected that induced traffic would have significant detrimental effect on the strategic road network, potentially hindering the provision of other regional growth. In addition some capacity issues at Copdock Interchange are exacerbated by the provision of the bypass. A key conclusion of the testing was that provision of further east west capacity clearly helps mitigate the development impacts and the impacts of growth to 2021.

5.9 The proposed Wet Dock Crossing, predicted to cost well in excess of £55 million, is predicted to relieve delays in general, particularly in the PM period. Compared to a northern bypass it will have a more positive impact on the town centre in traffic capacity terms and a less positive impact on the town centre approaches. In terms of strategic impacts, the proposed Wet Dock Crossing is predicted to add further delays to the Copdock Interchange. Whilst the potential for the Wet Dock crossing to induce strategic traffic from the wider area is limited, it will encourage further use of the town centre for through traffic by releasing additional capacity. This is evident in the increase in delays on the approaches to the town centre. In terms of providing for the east-west transport need, this is not the most appropriate solution as it draws further traffic into Ipswich Town Centre.

5.10 The relief of capacity within the town centre, arising from provision of the Wet Dock Crossing, would however support the provision of high quality sustainable transport solutions using the road space released, which would help counteract the level of additional traffic attracted into the town centre. In this way the Wet Dock crossing would be used to provide an alternative route through town, rather than providing further traffic capacity. The cost of this solution is very high and without assistance could not be implemented, as the roof tax required to fund it solely through development is unlikely to be justified, particularly in the current climate. Reliance on this measure to deliver future development at Ipswich is risky, due to the disproportionate funding requirements. Without committed funding, this measure is best viewed as an attractive option to release capacity to deliver enhanced environment and sustainable access through the Gyratory with less difficulty.

5.11 A14 analysis has shown that overall traffic levels on the A14 are not expected to be altered dramatically through provision of the proposed development. The provision of a northern bypass is predicted to lead to marginal reductions in A14 traffic levels. The level of use of the A14 for local trips at Ipswich is not predicted to vary significantly under any scenario.

5.12 The residual impacts on the network of both future growth and the development in north Ipswich would be mitigated through investment in east west capacity. Provision of an alternative route for east-west movements would relieve congestion and air quality issues in the Gyratory and in the town centre in general. There are a number of ways in which this capacity could be provided. Firstly an enhanced level of service on existing east-west traffic routes could offer a metered and cost effective approach. Secondly, the additional east-west capacity does not have to be highway capacity.

5.13 Stronger alternatives to car travel are required at Ipswich to promote mode shift. The need to provide east west capacity could potentially be met through provision of a high performance public

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transport service such as Bus Rapid Transit which would be segregated from general traffic and hence offer reduced journey times. A substantial Bus Rapid Transit network for Ipswich could be implemented for a fraction of the cost of a northern bypass and would be more in keeping with policy objectives and an efficient use of the limited space available on the town centre road network.

5.14 There is a need to make the town centre area more attractive for non-car users but improving the town centre environment for all users is going to be a challenge without further initiatives to reduce the car dominance of the area.

5.15 The fact that the town centre network is reaching capacity will offer demand management benefits, encouraging the use of more efficient transport solutions. A coordinated approach to parking provision within the town where free long stay parking becomes a thing of the past would also support a reduction of unnecessary car trips to and through the town centre.

5.16 Another issue worth considering is the potential enhanced use of Westerfield station which would provide access to the regional rail network and fast connection to the Town Centre and Town bus network. This would offer a sustainable use of an existing facility and could be promoted through aiming to improve frequency and strengthen sustainable links to the station from the development area.

Conclusion

5.17 A good transport network is generally available throughout Ipswich which should be capable of dealing with future demand. Although growth is forecast, it should be possible to manage and mitigate the growth with appropriate measures, without the need for major new road investment. A number of potential measures to manage and mitigate this growth are outlined below:

- Implementing sustainable solutions and policies at the possible development to provide strong sustainable transport links to Ipswich Town Centre and to generally promote sustainable travel;
- Implementing demand management measures in Ipswich in general, restricting free and long stay parking in the town centre, and limiting the provision of further traffic capacity within the town centre;
- Strongly promoting Travel Smart initiatives throughout the Ipswich area and outlying areas;
- Promoting access to and services from Westerfield Train Station;
- Undertaking capacity improvements to the existing east west route along Valley Road and in the immediate vicinity of the site;
- Providing a high performance public transport service at Ipswich such as Bus Rapid Transit, with a focus on east-west movement through the Town Centre, and potentially leading to provision of a substantial Bus Rapid Transit network for Ipswich.
- If the Wet Dock crossing is found to be deliverable, replace the existing road capacity through the gyratory area with bus priority and enhanced pedestrian and cycle facilities to ensure that no further traffic capacity through Ipswich Town centre is provided.

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5.18 It should be noted that, although AECOM do not consider the provision of either major road scheme tested necessary to accommodate the potential future growth in northern Ipswich, of the Wet Dock Crossing and Northern Bypass, the Wet Dock crossing appears to offer the best outcome for the town centre congestion.

5.19 A key issue in relation to both schemes is the major question over financial and physical deliverability. The high cost of either scheme would require major public funding and with the projected reductions in public sector funding over coming years securing funding is highly unlikely. Furthermore the provision of either scheme would reduce the availability of private or public funds for investment in sustainable travel, which offers a more sustainable solution to growth in Ipswich.

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Annex I
Modelling Results Summary

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Project:	**Ipswich Transport Model Assessment**	Job No:	**60095679**
Subject:	**Ipswich Area Development and Infrastructure Tests –Technical Summary**		
Prepared by:	**Ronan Brophy**	Date:	**30/09/2009**
Checked by:	**Bevin Carey**	Date:	**04/03/2010**
Approved by:	**Jane Cornthwaite**	Date:	**04/03/2010**

1 Introduction

1.1 The aim of this document is to provide a summary of the findings of traffic modelling work undertaken on behalf of both Ipswich Borough Council (IBC) and Suffolk County Council (SCC), which was aimed at assessing the strategic traffic implications of provision of 5,000 households in northern Ipswich, 1,000 of which are specified in the Proposed Submission Core Strategy and Policies development plan document for Ipswich.

1.2 Two previous Technical Notes prepared by AECOM, entitled 'Ipswich Area Development and Infrastructure Tests' and 'Ipswich Area Development and Infrastructure Tests - Supplementary', provide a detailed technical description of the modelling results; these have been referenced when preparing this report and are provided in Annex III and IV.

2 Methodology

2.1 Five scenarios with large scale development in place on the northern fringe have been assessed and compared to 2008 and 2021 base conditions. The assessment scenarios are outlined below:

Scenario 1: 2008 Base Year 2008 is the year of the interim validation base model; both morning (08:00-09:00) and evening (17:00-18:00) peak hours have been modelled. Future year assessment scenario results have been compared against the 2008 results in order to gain an understanding of the predicted implications of traffic growth on the network.

Scenario 2: 2021 'Do Minimum' Traffic has been factored to 2021 levels using assumptions in line with the Regional Spatial Strategy (RSS) for the East of England. A number of 'Do Minimum' highway infrastructure schemes have also been included which are likely to be constructed between 2008 and 2021; these are:

- Proposed changes in the Duke Street area, emerging from the successful CIF 2 bid.
- Improvements to the A14/A12 Copdock Interchange to mitigate the impacts of development traffic generated by the proposed Felixstowe and Bathside Bay Port expansions and SnOasis development schemes.
- A successful major-scheme business case of 'Ipswich – Transport Fit for the 21st Century', involving full UTMC signalisation, RTPI, an altered bus loop, additional shuttle bus services and an improved active mode network.
- A successful TravelSmart scheme will be implemented by 2021. The TravelSmart policies represent an approach to reducing car travel by providing tailored information packs by encouraging further journeys by, and providing information on, walking, cycling and public

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transport modes. For the purposes of these tests, car trips have been reduced by 15% to and from the town centre and at Adastral Park in the eastern fringe.

Scenario 3: 2021 'Do Minimum' with Development Additional traffic resulting from the north Ipswich housing allocation has been added to the 2021 'Do Minimum' traffic levels; the approximate location of this allocation is illustrated in Figure 1. Early model testing was carried out with an allocation of 5,000 dwellings in this location however it has since been concluded that the 2021 'Do Minimum' demand matrices allowed for 450 dwellings in the northern fringe as part of the RSS proposals. As a result the model was re-run with an allocation of 4,550 dwellings over and above the 'Do Minimum' scenario.

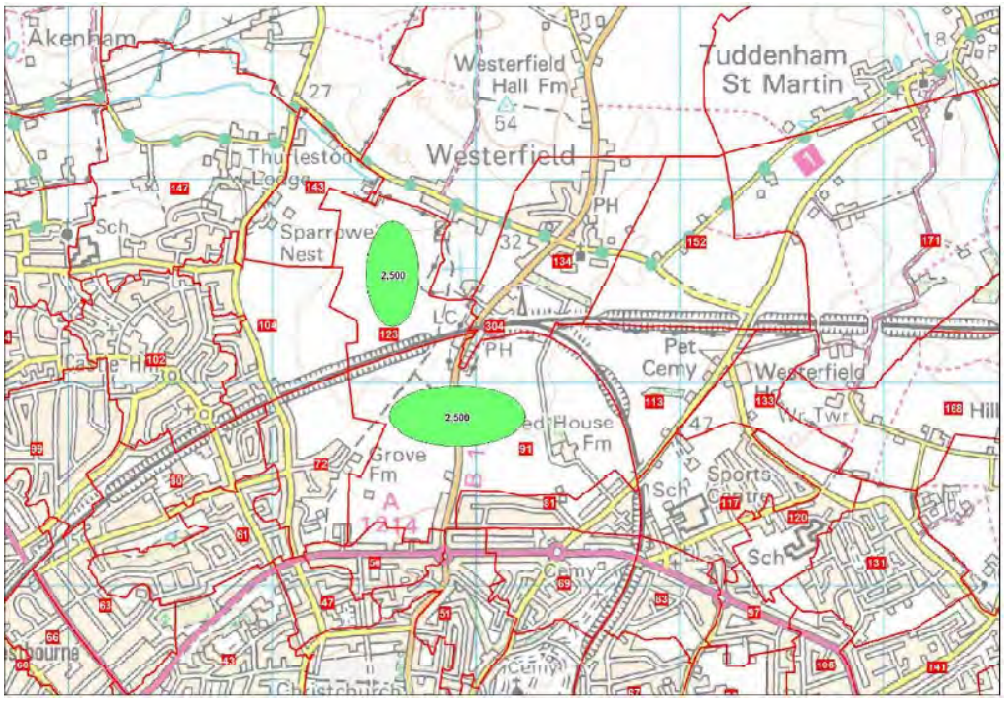

Figure 1: Northern Fringe Housing Allocation Approximate Location

Scenario 4: 2021 With Development, with Sustainable Travel Investment This scenario applies a 20% reduction to vehicular trips from the potential development on the northern fringe. The reduction has been applied based on the assumption that comprehensive investment in public transport and active modes to and from the development site will be made and will achieve a 20% modal shift away from private car use.

Scenario 5: 2021 With Development, with Sustainable Travel Investment, with Northern Bypass

The network was modelled using Scenario 4 flows with the addition of an Ipswich Northern Bypass. Figure 2 presents an indicative alignment of the Northern Bypass which has been assumed for modelling purposes only; it has been assumed to be a single carriageway road that connects the A14 at Bury Road and the A12 at Martlesham. Intermediate junctions have been assumed.

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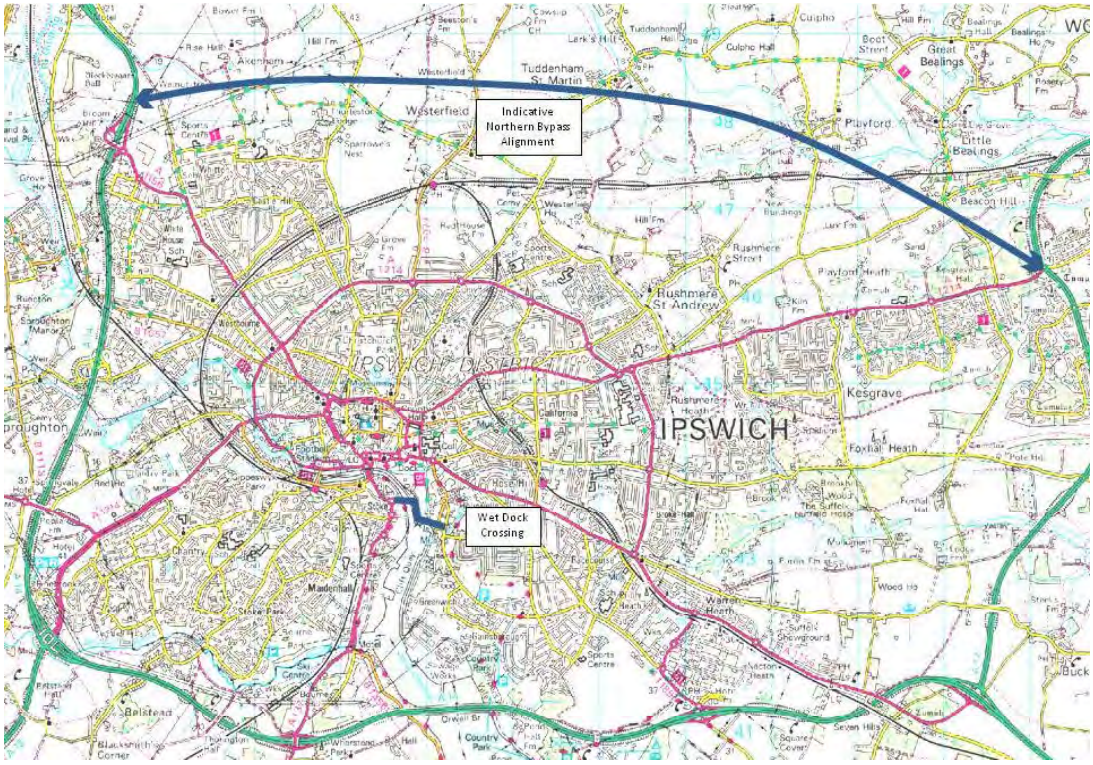

Figure 2: Potential Highway Infrastructure Schemes

Scenario 6A & 6B: 2021 With Development, with Sustainable Travel Investment, with Wet Dock Crossing It should be noted that this scenario has not been re-run using the revised housing allocation of dwellings; therefore all results for this scenario relate to an allocation of 4,550 dwellings, above RSS allocations rather than the 4,000 above RSS which testing for other scenarios assume. This will not alter the overall conclusions, for the purposes of this assessment. The network was modelled using the Scenario 4 flows (i.e. with the 20% reduction applied for sustainable transport initiatives) with the addition of a new bridge linking Landseer Road with Mather Way, the location of which is presented in blue on Figure 2. Capacity reductions at Star Lane and College Street gyratory system as a result of the Wet Dock Crossing being introduced have been incorporated into both assessments. Two permutations of this test have been described in this report:

A. Dual Bridge – Provides for overhead signs allowing for the switching of traffic to either bridge dependent upon water-modes accessing/exiting the port. It has been assumed there would be 30 seconds of no traffic flow every 10 minutes in the morning and evening peak hour as the lane switchover takes place.
B. Swing Bridge – Would physically swing in order to let water-traffic access/exit the port. It has been assumed there would be 2 minutes of no traffic flow every 10 minutes in the peak hours.

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Assessment Methodology

2.2 For each of the scenarios, journey times, junction delay and network statistics have been compared in order to assess the implications of each modelling scenario. A consistent set of 9 routes and 25 junctions have been examined.

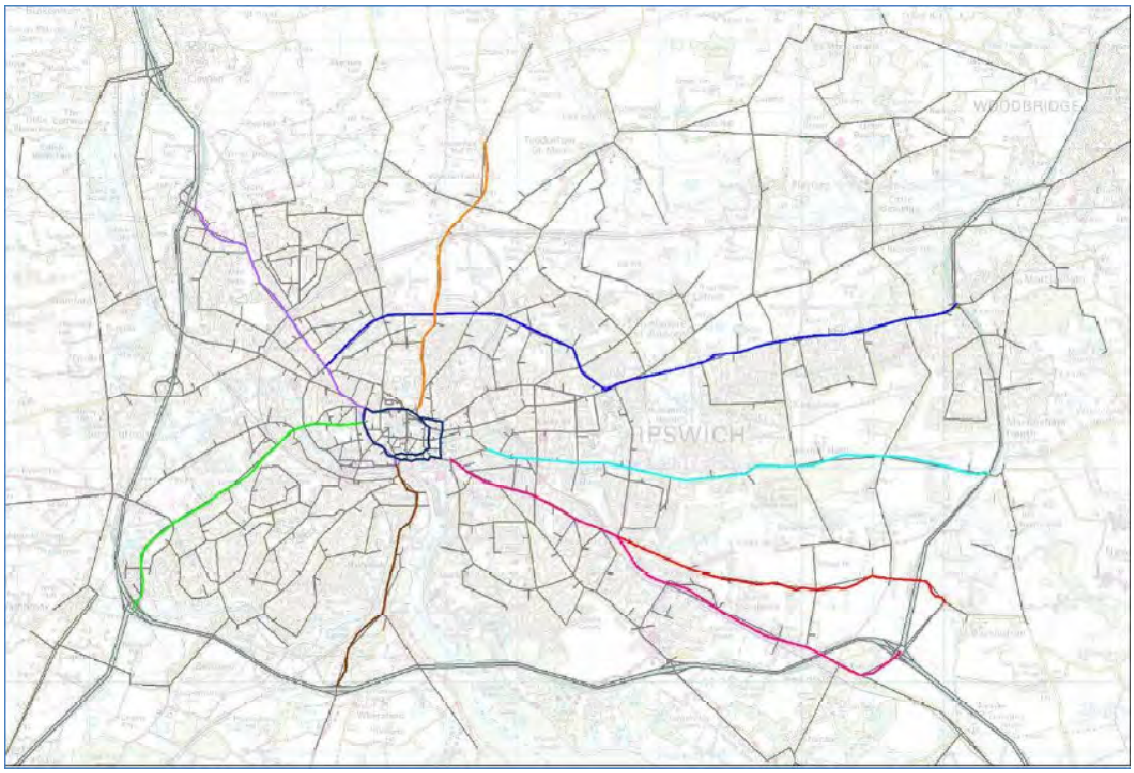

Figure 3: Journey Time Routes

2.3 Key corridors, radials and central Ipswich area have been assessed to provide an overview of the changing journey times in each scenario. The journey time routes are described below and depicted graphically on Figure 3.

- A1214 London Road (Green) – Following the A1214 London Road from A14 Junction 55, then continuing along the route of the A1071 between Yarmouth Road and Civic Drive.
- A1214 Valley Road (Blue) – Routeing across northern Ipswich from the junction of the A1214 and the A1156 at Valley Road/Bury Road and then routeing along the A1214 to the roundabout with the A12 at Martlesham.
- Bucklesham Road (Red) – The route of Bucklesham Road between the A1156 Felixstowe Road and Main Road, Bucklesham.
- Felixstowe Road (Pink) – Along the A1156 between the roundabout of Fore Street and Duke Street in the west to Junction 58 of the A14 in the east.
- Foxhall Road (Cyan) – Along the route of Foxhall Road, between Back Hamlet in the west and the roundabout with the A12 in the east.

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- Inner Ring Road (Teal) – Following the inner ring road both clockwise and anti-clockwise, including Crown Street, Grimwade Street, College Street and Civic Drive amongst others.
- Norwich Road (Purple) – Following the A1156 from Junction 53 of the A14 (Bury Road) to the roundabout of the A1156 and the A1022 Civic Drive.
- Westerfield Road (Orange) – Along the B1077 between St. Margaret's Street (south) and Hall Lane (north).
- Wherstead Road (Brown) – Along the A137 Wherstead Road between Grafton Way (north) and Junction 56 of the A14 (south).

2.4 25 junctions which appeared to have high and consistent delays across both time periods (AM/PM) in 2021 were selected for comparison. Figure 4 presents the junctions that have been included in our analysis.

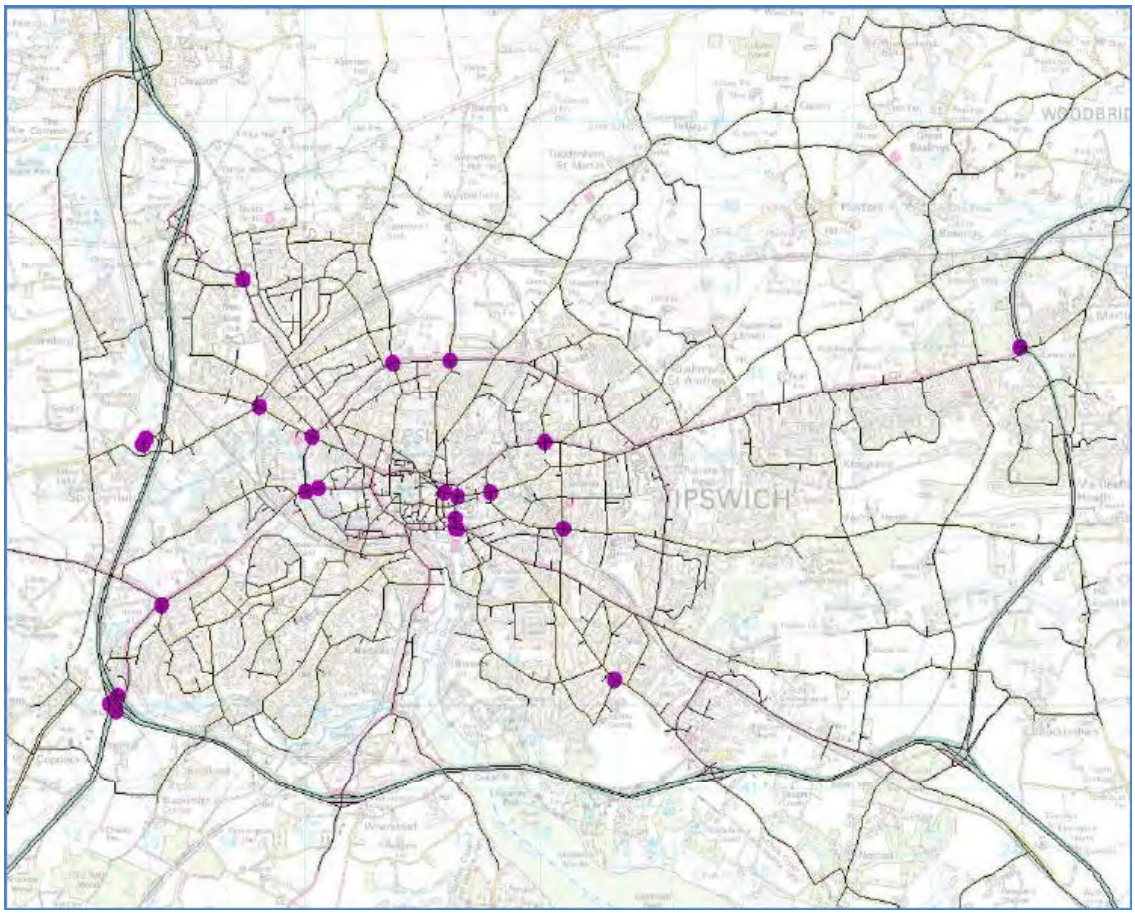

Figure 4: Junctions Analysed for Delay

2.5 In addition the overall network statistics for each Scenario have been examined in terms of PCU hours and PCU kilometres in order to compare the overall level of change in delay and in levels of route diversion arising from each scenario.

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Results and Analysis

2.6 The key results for each scenario are presented in this section along with a discussion on the interpretation of each set of results. In order to have an understanding of the relative performance of each of the Scenarios it is important to understand the backdrop against which they can be measured, that is the 2008 and 2021 Do Minimum conditions.

Scenario 1: 2008 Base Year- Model

2.7 Table 1 below outlines the model generated journey times for each of the routes analysed for the 2008 base year. Due to the varying lengths of each of the routes, average journey times have also been added to the table in order to help identify those routes which experience the biggest delays proportional to their length.

Table 1: 2008 Base Journey Times

Route No.	Route		Journey Length (km)	AM		PM	
				Journey Time (min.)	Average Speed (km/hr)	Journey Time (min.)	Average Speed (km/hr)
1	A1214 Valley Road (Blue)	Eastbound	9.7	19.34	30	20.16	29
		Westbound		21.54	27	20.46	28
2	A1214 London Road (Green)	Eastbound	4.5	11.15	24	10.84	25
		Westbound		10.47	26	11.96	23
3	Bucklesham Road (Red)	Eastbound	7.5	7.47	60	7.48	60
		Westbound		7.47	60	7.47	60
4	Felixstowe Road (Pink)	Eastbound	7.1	10.57	40	10.66	40
		Westbound		10.65	40	10.83	39
5	Foxhall Road (Cyan)	Eastbound	7.1	11.63	37	11.9	36
		Westbound		11.82	36	11.28	38
6	Inner Ring Road (Teal)	Clockwise	3.5	10.37	20	10.89	19
		Anti-Clockwise		9.01	23	8.5	25
7	Norwich Road (Purple)	Northbound	4	12.79	19	11.93	20
		Southbound		14.67	16	13.92	17
8	Westerfield Road (Orange)	Northbound	4.1	8.09	30	8.12	30
		Southbound		7.03	35	7.01	35
9	Wherstead Road (Brown)	Northbound	3.6	6.35	34	6.39	34
		Southbound		6.13	35	6.16	35

2.8 The junction delays results were also examined and the results are laid out in Annex II.

2.9 The key findings which can be taken from both the journey time results and the junction delay results are:

- Norwich Road southbound has the lowest average speed recorded of the routes assessed within the model, in both peak periods. The northbound journey for this route has the second lowest average speed.
- Average speeds on the Inner Ring Road varied from approximately 20k/hr to 25km/hr.

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- The A1214 to the south west of the town centre (Route 2) and to the east of the town centre (Route 1) were the only other routes to experience average speeds of less than 30km/hr.
- Bucklesham Road provides average speeds of 60km/hr in both directions during both peak periods and as such is considered to have minimal delay.
- The maximum junction delays recorded in the model are 83 and 81 seconds/vehicle during the PM peak at the Grimwade Street/Star Lane and London Road/Yarmouth Road junctions respectively. Both of these junctions are within the town centre where delays would be expected.
- The maximum peak hour delay recorded at any junction in the model during the AM peak is an average 71 seconds delay per vehicle at the London Road/Sprites Lane Junction, to the west.
- Overall junction delays and journey travel times are similar during the AM and PM peaks.

2.10 The following conclusions on the 2008 base year modelling results can be established:

- The majority of routes displayed an average speed of 20km/hr or above which is considered a reasonable average speed for vehicles travelling around a town centre.
- Average traffic signal cycle times (i.e. the amount of time taken for all approaches to be given their allocated green time) vary between 60 seconds and 120 seconds. The maximum delays per vehicle at each junction recorded in the model is within this range, it can therefore be assumed that the majority of vehicles only have to wait a maximum of one cycle at each junction, which is reasonable on a town centre road network. The model assumes theoretical optimised signal times and could vary from current experiences on the ground. It does however provide a base against which to appreciate the relative change predicted in the future year modelling.
- The largest delays in the network are experienced close to the town centre, as would be expected.

Scenario 2: 2021 'Do Minimum'

2.11 Table 2 below outlines the model generated journey times for each of the routes analysed for the 2021 'Do Minimum' scenario and also compares them to the 2008 base year results, to give an indication of how traffic conditions are predicted to change under Do Minimum conditions, based on the journey times and junction delays analysed in Annex II.

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Table 2: 2021 'DoMinimum' Route Journey Times								
Route No.	Route		AM Journey Time (min.)			PM Journey Time (min.)		
			2021 'DoMin'	2008 Base	Increase from 2008 to 2021	2021 'DoMin'	2008 Base	Increase from 2008 to 2021
1	A1214 Valley Road (Blue)	Eastbound	21	19.34	1.66	22.43	20.16	2.27
		Westbound	23.03	21.54	1.49	21.36	20.46	0.90
2	A1214 London Road (Green)	Eastbound	11.52	11.15	0.37	12.13	10.84	1.29
		Westbound	9.3	10.47	-1.17	10.81	11.96	-1.15
3	Bucklesham Road (Red)	Eastbound	7.48	7.47	0.01	7.48	7.48	0.00
		Westbound	7.47	7.47	0.00	7.47	7.47	0.00
4	Felixstowe Road (Pink)	Eastbound	11.52	10.57	0.95	10.79	10.66	0.13
		Westbound	11.53	10.65	0.88	13.89	10.83	3.06
5	Foxhall Road (Cyan)	Eastbound	12.12	11.63	0.49	12.57	11.9	0.67
		Westbound	12.31	11.82	0.49	11.37	11.28	0.09
6	Inner Ring Road (Teal)	Clockwise	13.94	10.37	3.57	14.03	10.89	3.14
		Anti-Clockwise	10.7	9.01	1.69	9.37	8.5	0.87
7	Norwich Road (Purple)	Northbound	11.26	12.79	-1.53	11.77	11.93	-0.16
		Southbound	16.1	14.67	1.43	16.83	13.92	2.91
8	Westerfield Road (Orange)	Northbound	8.12	8.09	0.03	8.22	8.12	0.10
		Southbound	7.06	7.03	0.03	7.03	7.01	0.02
9	Wherstead Road (Brown)	Northbound	6.95	6.35	0.60	6.37	6.39	-0.02
		Southbound	6.15	6.13	0.02	6.1	6.16	-0.06

2.12 The key points which can be taken from both the journey time results and the junction delay results are:

- Journey times on Bucklesham Road (both directions), A1214 London Road (westbound), Norwich Road (northbound), Westerfield Road (both directions) and Wherstead Road (southbound) all remain largely unchanged between the base year and 2021.
- The biggest predicted reductions in average journey speed are on the Inner Ring Road clockwise (AM) and on Felixstowe Road westbound (PM).
- The minimum average speed during the AM peak is on the Inner Ring Road clockwise (15 km/hr); on the same route anti-clockwise during the PM peak it is 15 km/hr. Norwich Road southbound has the lowest average speed of 14 km/hr during the PM peak.
- The Star Lane/Grimwade Street Junction experiences increased average delays of 104 sec/veh during the AM peak, increased from 66 sec/veh in 2008, (second highest for AM peak period) and from 168 sec/veh during the PM peak, increased from 83 sec/veh in 2008, (highest of the PM peak period).
- Junctions 22 and 23 which are located at the Copdock Interchange experience the highest increased delays, when compared to 2008 with increases in delay of between 46-115 seconds per vehicle predicted, which is high for a strategic junction such as this.
- Delays are predicted to start to occur at the A14 Junction 57 and the A14 Sevenhills junction with maximum delays of 97 secs/ veh and 55 secs/ veh predicted respectively.
- Two other junctions experience delays of 100 sec/veh or higher during either peak period, these junctions are between London Road/Yarmouth Road and A1156 Bury Road/1156 Norwich Road, delays of this magnitude are only experienced during the PM peak. Of the

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two, the A1156 Bury Road/A1156 Norwich Road Junction shows the highest increase from 2008 values, 53 seconds to 119 sec/veh.

2.13 The following conclusions on the 2021 'DoMinimum' modelling results can be established:

- Significant increased pressure is expected at the A14 Copdock Interchange, highlighting the need for improvement to cater for current predicted growth levels.
- Junction 57 on the A14 and Sevenhills Junction are both predicted to be suffering delays in 2021, highlighting the need for junction improvements, none of which are currently allowed for in the modelling.
- Overall increased delays can be expected as a result of general traffic growth; the impact will be greatest around the town centre, highlighting the predicted increase in demand for local trips to, from and through Ipswich Town Centre.
- The majority of junctions still operate with an average delay per vehicle of less than 100 seconds and as such the majority of vehicles will pass each junction in one cycle of the traffic signals, which is considered reasonable for an urban area. As before, the model assumes theoretical optimised signal times and could vary from current experiences on the ground. However it allows comparison with the base case results and allows a comparison to be made of the relative impact of the additional housing.
- Average speeds for most routes are still predicted to be 20 km/hr or greater. The Inner Ring Road and the Norwich Road (southbound only) are the exceptions.

2.14 Scenario 2, 2021 Do Minimum, is the Scenario against all of the options tested are examined.

Scenario 3: 2021 'Do Minimum' with 4550 additional dwellings on the Northern Fringe (With Development)

2.15 Table 3 below outlines the model generated journey times for each of the routes analysed for the 2021 'DoMinimum' scenario 'with development' and compares them to the 2021 'DoMinimum' results. Annex II presents a more detailed analysis of the journey times as well as the junction delays for each of the 25 junctions assessed for all scenarios.

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Table 3: 2021 'DoMinimum' with P1 Development Route Journey Times								
Route No.	Route		AM Journey Time (min.)			PM Journey Time (min.)		
			2021 'DoMin' with P1	2021 'DoMin'	Increase due to P1 Development	2021 'DoMin' with P1	2021 'DoMin'	Increase due to P1 Development
1	A1214 Valley Road (Blue)	Eastbound	21.71	21	0.71	23.72	22.43	1.29
		Westbound	24.03	23.03	1	23.81	21.36	2.45
2	A1214 London Road (Green)	Eastbound	11.55	11.52	0.03	13.53	12.13	1.4
		Westbound	9.52	9.3	0.22	11.3	10.81	0.49
3	Bucklesham Road (Red)	Eastbound	7.49	7.48	0.01	7.48	7.48	0
		Westbound	7.48	7.47	0.01	7.47	7.47	0
4	Felixstowe Road (Pink)	Eastbound	12.09	11.52	0.57	10.88	10.79	0.09
		Westbound	11.52	11.53	-0.01	12.56	13.89	-1.33
5	Foxhall Road (Cyan)	Eastbound	12.47	12.12	0.35	12.83	12.57	0.26
		Westbound	12.39	12.31	0.08	11.41	11.37	0.04
6	Inner Ring Road (Teal)	Clockwise	13.5	13.94	-0.44	16.03	14.03	2
		Anti-Clockwise	11.06	10.7	0.36	10.3	9.37	0.93
7	Norwich Road (Purple)	Northbound	11.29	11.26	0.03	12.09	11.77	0.32
		Southbound	17.19	16.1	1.09	19.4	16.83	2.57
8	Westerfield Road (Orange)	Northbound	8.19	8.12	0.07	9.1	8.22	0.88
		Southbound	8.29	7.06	1.23	7.08	7.03	0.05
9	Wherstead Road (Brown)	Northbound	7.18	6.95	0.23	6.39	6.37	0.02
		Southbound	6.16	6.15	0.01	6.11	6.1	0.01

2.16 The key points which can be taken from both the journey time and the junction delay AM and PM peak results are:

- The development of the northern fringe is predicted to have minimal impact on journey times in the AM peak with the exception of travelling southbound on Westerfield Road, which experiences a reduction in average speed of 5.2 km/hr; this is not surprising given that the development would have direct access onto Westerfield Road. Average speeds are expected to remain in excess of 24km/hr along this route.
- Valley Road westbound, London Road westbound, Inner Ring Road anti-clockwise and Westerfield Road northbound are predicted to experience decreased average speeds of between 2km/hr and 3km/hr in the PM peak. All other changes in average speeds are predicted to be minimal.
- Junction delays are not predicted to worsen greatly during the AM peak period with only 3 of the junctions examined: Argyle Street/Grimwade Street, Henley Road/Valley Road and Valley Road/Westerfield Road, experiencing increases in delays of greater than 20 seconds per vehicle, when compared to 2021 'Do Minimum' values. The latter two junctions are in the vicinity of the proposed development site. The former junction is in the town centre.
- Argyle Street/Grimwade Street Junction is predicted to experience the greatest delays during the AM peak of all junctions with the addition of the development. Delays of 129 seconds per vehicle are recorded.

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- The development has a much more noticeable effect during the PM peak with all town centre junctions predicted to experience increases in delays of more than 20 seconds, with the exception of Argyle Street/Grimwade Street.
- The second biggest increase in delay during the PM peak is predicted at the Star Lane/Grimwade Street Junction, which already experiences the greatest delays in the 2021 'Do Minimum' scenario. An average of 235 second delay per vehicle is recorded at the junction.
- During both peak periods the Valley Road/Westerfield Road Junction is predicted to experience the maximum delay increases with the addition of the development. The average predicted increase in the delay per vehicle is 89 seconds in the PM peak giving a total delay of 110 seconds per vehicle.
- The development has a further impact on the Copdock Interchange, beyond 2021 'Do Minimum' with only the A14 WB approach showing increases in delay greater than 20 seconds due to the development (38 seconds during the PM peak).
- Bury Road/Norwich Road Junction experiences an increase in delay of 62 seconds due to the development.
- The network statistics highlight that the road network is predicted to experience cumulative increases in delay of 6% in the AM and 13% in the PM over 2021 Do Minimum levels. In addition the distance travelled within the model road network (PCU kilometres) is predicted to increase by 3-4%, over 2021 Do Minimum levels, highlighting the degree of rat running and diversion of trips which would be likely to occur under this scenario.

2.17 The following conclusions regarding the future addition of the northern fringe development flows to the 2021 Do Minimum road network can be established:

- No significant impact is caused by the development in the AM peak with the exception of along Westerfield Road southbound. This is due to the localised impact of commuting traffic leaving the development and it can be assumed that local road improvements could alleviate this delay.
- During the PM peak the impact of the development is much more elevated. Significant delay increases within the town centre and north of the town centre are caused. With increases in junction delays of greater than 100 sec/veh predicted at seven junctions, of most significance is the Star Lane/Grimwade Street Junction.
- The PM peak issues are likely to lead to some peak hour spreading, with individuals altering the travel patterns to avoid congestion, which would not be fully accounted for in the modelling exercise.
- The strategic road network is not badly affected by the possible addition of the 5,000 dwellings on the northern fringe, with the exception of at Copdock Interchange where there are slight increases in delay predicted beyond 2021 'Do Minimum'.
- With the exception of Westerfield Road all routes experience decreases in average speeds of less than 3 km/hr, as such minor localised improvements could have a significant impact in reducing junction delays in the vicinity of the development.
- The Town Centre road network is predicted to suffer increases in congestion, as traffic is predicted to continue to use Ipswich town centre as a through route, and/ or a large proportion of the new trips are bound for the town centre. This demand for local movement highlights the potential to promote sustainable transport for the new development trips by providing strong sustainable links to the Town Centre. In addition this highlights the need to strengthen links to the strategic network from the development area, to remove unnecessary car trips through the town centre.
- Whilst this could be alleviated through junction improvements local to the developments and along the east west corridor, the increase in congestion in the network is significant

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and highlights the need to do more to mitigate the effects of the proposed northern fringe development.

Scenario 4: 2021 With Development, with Sustainable Transport Investment at the Development

2.18 Table 4 below outlines the model generated journey times for each of the routes analysed for the 2021 'DoMinimum' scenario with development (including a 20% reduction in car trips following investment in sustainable transport) and compares them to the 2021 'DoMinimum' base results. Annex III presents a more detailed analysis of the journey times as well as the junction delays for each of the 25 junctions assessed for all scenarios.

Table 4: 2021 'DoMinimum' with Development (-20%) Route Journey Times

Route No.	Route		AM Journey Time (min.)			PM Journey Time (min.)		
			2021 'DoMin' with P1 (-20%)	2021 'DoMin'	Increase due to P1 Development (-20%)	2021 'DoMin' with P1 (-20%)	2021 'DoMin'	Increase due to P1 Development (-20%)
1	A1214 Valley Road (Blue)	Eastbound	21.56	21	0.56	23.03	22.43	0.6
		Westbound	23.91	23.03	0.88	23.07	21.36	1.71
2	A1214 London Road (Green)	Eastbound	11.59	11.52	0.07	13.4	12.13	1.27
		Westbound	9.52	9.3	0.22	11.25	10.81	0.44
3	Bucklesham Road (Red)	Eastbound	7.48	7.48	0	7.48	7.48	0
		Westbound	7.48	7.47	0.01	7.47	7.47	0
4	Felixstowe Road (Pink)	Eastbound	12.19	11.52	0.67	11	10.79	0.21
		Westbound	12.79	11.53	1.26	12.39	13.89	-1.5
5	Foxhall Road (Cyan)	Eastbound	12.41	12.12	0.29	12.69	12.57	0.12
		Westbound	12.35	12.31	0.04	11.34	11.37	-0.03
6	Inner Ring Road (Teal)	Clockwise	14.49	13.94	0.55	16.1	14.03	2.07
		Anti-Clockwise	10.94	10.7	0.24	10.7	9.37	1.33
7	Norwich Road (Purple)	Northbound	11.27	11.26	0.01	12.05	11.77	0.28
		Southbound	16.89	16.1	0.79	19.3	16.83	2.47
8	Westerfield Road (Orange)	Northbound	8.17	8.12	0.05	8.65	8.22	0.43
		Southbound	7.57	7.06	0.51	7.08	7.03	0.05
9	Wherstead Road (Brown)	Northbound	7.16	6.95	0.21	6.4	6.37	0.03
		Southbound	6.17	6.15	0.02	6.1	6.1	0

2.19 The key points which can be taken from both the journey time and junction delay AM and PM peak results are:

- In general the AM peak average journey speeds are predicted to reduce beyond the 2021 Do Minimum scenario with the exception of the Felixstowe Road westbound and the Inner Ring Road clockwise which are predicted to experience reductions to average speeds of 3.7 km/hr and 1.1 km/hr respectively.
- Westerfield Road, which is adjacent to the site, experiences the greatest improvements to average AM Peak speeds. The tidal effect of commuting traffic is evident here as the southbound movement is improved in the AM peak while the northbound movement is improved in the PM peak.

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- Most junctions experience a reduction in delays, maximum reduction of 53 seconds at the Grimwade Street/Fore Street Junction, during the AM peak, due to the 20% reduction in development trips.
- Grimwade Street/Fore Street experiences an increase in delay of 59 seconds per vehicle.
- As with the previous scenario, the largest impact is during the PM peak. Significant increases in junction delays in the town centre, remain although they are predicted to be between 4 and 27 seconds less than Scenario 3 levels.
- The network statistics indicate that the kilometres travelled within the network is predicted to decrease by 1% below Scenario 3 levels as a result of initiating a 20% reduction in development car trips, arising from investment in sustainable travel. This indicates that rat-running and trip diversion will be reduced.
- The cumulative delay to vehicles in the network is predicted to decrease by 4% during the PM peak as a result of the proposed sustainable transport investment at the developments.
- Overall the impacts of the development on the strategic road network are alleviated through a reduction in development car trips by 20%.

2.20 The following conclusions regarding the future addition of 5,000 dwellings on the northern fringe, with a target 20% reduction in car trips from the developments, can be established:

- Adopting measures at the possible developments to achieve a 20% reduction in car trips results in improvements to network delay and to route diversion, although values are still predicted to be in excess of Do Minimum 2021 conditions. As such the impacts of the possible developments cannot be mitigated solely through on-site investment in sustainable transport.
- The most marked delays remain in the town centre and in the vicinity of the development during the PM peak.
- Cumulative delays of 100 sec/veh or greater are still shown on seven junctions, as was the situation without the 20% reduction in car trips, from the northern fringe development. Whilst these delays are reduced beyond Scenario 4 levels, this highlights the need for further measures to reduce delays on the road network to mitigate both future growth and the possible provision of 5,000 new dwellings on the northern fringe.
- Overall the impacts of the development on the strategic road network are alleviated through a reduction in development car trips by 20%.

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Scenario 5: 2021 With Development, With Sustainable transport investment, with Northern Bypass

2.21 Table 5 below outlines the model generated journey times for each of the routes analysed for the 2021 'With Development, with sustainable transport scenario with a Northern Bypass in place and compares them to the Scenario 4 results. Annex II provides the detailed results upon which these findings are based.

Table 5: Scenario 5 Route Journey Times

Route No.	Route		AM Journey Time (min.)			PM Journey Time (min.)		
			2021 with Northern Bypass	2021 'DoMin' with P1 (-20%)	Impact of Northern Bypass	2021 with Northern Bypass	2021 'DoMin' with P1 (-20%)	Impact of Northern Bypass
1	A1214 Valley Road (Blue)	Eastbound	20.35	21.56	-1.21	21.31	23.03	-1.72
		Westbound	20.19	23.91	-3.72	19.79	23.07	-3.28
2	A1214 London Road (Green)	Eastbound	10.9	11.59	-0.69	11.28	13.4	-2.12
		Westbound	9.23	9.52	-0.29	10.47	11.25	-0.78
3	Bucklesham Road (Red)	Eastbound	7.48	7.48	0	7.48	7.48	0
		Westbound	7.47	7.48	-0.01	7.47	7.47	0
4	Felixstowe Road (Pink)	Eastbound	10.29	12.19	-1.9	10.54	11	-0.46
		Westbound	11.34	12.79	-1.45	11.93	12.39	-0.46
5	Foxhall Road (Cyan)	Eastbound	12.12	12.41	-0.29	12.2	12.69	-0.49
		Westbound	12.1	12.35	-0.25	11.26	11.34	-0.08
6	Inner Ring Road (Teal)	Clockwise	11.84	14.49	-2.65	12.73	16.1	-3.37
		Anti-Clockwise	10.36	10.94	-0.58	9.59	10.7	-1.11
7	Norwich Road (Purple)	Northbound	11.04	11.27	-0.23	11.57	12.05	-0.48
		Southbound	15.07	16.89	-1.82	14.18	19.3	-5.12
8	Westerfield Road (Orange)	Northbound	8.34	8.17	0.17	8.62	8.65	-0.03
		Southbound	7.58	7.57	0.01	7.59	7.08	0.51
9	Wherstead Road (Brown)	Northbound	6.81	7.16	-0.35	6.56	6.4	0.16
		Southbound	6.14	6.17	-0.03	6.12	6.1	0.02

2.22 The key points which can be taken from both the journey time and the junction delay AM and PM peak results are:

- The addition of the Northern Bypass is predicted to have a positive impact on all traffic routes with the exception of Westerfield Road (Route 8) during both peak periods, and Wherstead Road (Route 9) during the PM peak.
- Furthermore the bypass is predicted to mitigate the impact of the development traffic on all routes, with the exception of Westerfield Road and Wherstead Road, bringing journey times to approximately the same level or better than the 2021 'Do Minimum' levels.
- In the cases of Valley Road, westbound, London Road, both directions, Felixstowe Road, eastbound, Foxhall Road, both directions, and Norwich Road, both directions, the addition of the Northern Bypass is predicted to bring journey times in line with 2008 levels.
- With the exception of Junction 21 at the Copdock Interchange the bypass brings junction delays lower than or approximately equal to 2021 'Do Min' levels.

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- The impacts on the strategic road network are generally predicted to be reduced with the provision of the northern bypass, with the exception of Copdock Interchange where AM delays are predicted to increase.
- The junctions in the east, west and in the vicinity of the development illustrate reduced delays similar to 2008 levels.
- The Star Lane/Grimwade Street and London Road/Yarmouth Road junctions in the town centre are the two junctions which still have significantly higher delays than those recorded for 2008 during the PM peak.
- During the AM peak the potential bypass has the largest positive impact on the Argyle Street/Grimwade Street junction while during the PM peak the bypass has the largest positive impact on the Star Lane/Grimwade Street and Bury Road/Old Norwich Road junctions.
- The network statistics highlight that the potential Northern Bypass is predicted to reduce overall delays in the network below 2021 Do Minimum conditions, although distance travelled within the network remains 2% above 2021 Do Minimum levels, most likely due to the diversion involved by taking the new route.

2.23 The following conclusions regarding the potential future addition of the Northern Bypass to the road network can be established:

- The bypass is predicted to improve capacity on the majority of routes, in many cases bringing them in the region of 2008 results.
- Capacity issues at the Copdock Interchange are not resolved with the addition of the Bypass.
- Additional capacity in and around the town centre could encourage further car use and work against the TravelSmart policies which promote sustainable modes of transport, and against the target reduction of car travel from the possible development area by 2021 through local investment in sustainable travel.
- The potential for the bypass to induce traffic from the surrounding area has not been represented by the modelling and would be likely to lead to further strategic network pressures.
- The provision of further east west capacity clearly helps mitigate the development impacts. The level of capacity provided could however be detrimental to the effectiveness of policy objectives to reduce car reliance at Ipswich. Provision of additional capacity along existing routes would represent a more metered and cost effective approach.

<u>Scenario 5: 2021 With Development, With Sustainable transport investment, with Northern Bypass</u>

2.24 Table 5 below outlines the model generated journey times for each of the routes analysed for the 2021 'With Development, with sustainable transport scenario with a Northern Bypass in place and compares them to the Scenario 4 results. Annex II provides the detailed results upon which these findings are based.

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Table 5: Scenario 5 Route Journey Times								
Route No.	Route		AM Journey Time (min.)			PM Journey Time (min.)		
			2021 with Northern Bypass	2021 'DoMin' with P1 (-20%)	Impact of Northern Bypass	2021 with Northern Bypass	2021 'DoMin' with P1 (-20%)	Impact of Northern Bypass
1	A1214 Valley Road (Blue)	Eastbound	20.35	21.56	-1.21	21.31	23.03	-1.72
		Westbound	20.19	23.91	-3.72	19.79	23.07	-3.28
2	A1214 London Road (Green)	Eastbound	10.9	11.59	-0.69	11.28	13.4	-2.12
		Westbound	9.23	9.52	-0.29	10.47	11.25	-0.78
3	Bucklesham Road (Red)	Eastbound	7.48	7.48	0	7.48	7.48	0
		Westbound	7.47	7.48	-0.01	7.47	7.47	0
4	Felixstowe Road (Pink)	Eastbound	10.29	12.19	-1.9	10.54	11	-0.46
		Westbound	11.34	12.79	-1.45	11.93	12.39	-0.46
5	Foxhall Road (Cyan)	Eastbound	12.12	12.41	-0.29	12.2	12.69	-0.49
		Westbound	12.1	12.35	-0.25	11.26	11.34	-0.08
6	Inner Ring Road (Teal)	Clockwise	11.84	14.49	-2.65	12.73	16.1	-3.37
		Anti-Clockwise	10.36	10.94	-0.58	9.59	10.7	-1.11
7	Norwich Road (Purple)	Northbound	11.04	11.27	-0.23	11.57	12.05	-0.48
		Southbound	15.07	16.89	-1.82	14.18	19.3	-5.12
8	Westerfield Road (Orange)	Northbound	8.34	8.17	0.17	8.62	8.65	-0.03
		Southbound	7.58	7.57	0.01	7.59	7.08	0.51
9	Wherstead Road (Brown)	Northbound	6.81	7.16	-0.35	6.56	6.4	0.16
		Southbound	6.14	6.17	-0.03	6.12	6.1	0.02

2.25 The key points which can be taken from both the journey time and the junction delay AM and PM peak results are:

- The addition of the Northern Bypass is predicted to have a positive impact on all traffic routes with the exception of Westerfield Road (Route 8) during both peak periods, and Wherstead Road (Route 9) during the PM peak.
- Furthermore the bypass is predicted to mitigate the impact of the development traffic on all routes, with the exception of Westerfield Road and Wherstead Road, bringing journey times to approximately the same level or better than the 2021 'Do Minimum' levels.
- In the cases of Valley Road, westbound, London Road, both directions, Felixstowe Road, eastbound, Foxhall Road, both directions, and Norwich Road, both directions, the addition of the Northern Bypass is predicted to bring journey times in line with 2008 levels.
- With the exception of Junction 21 at the Copdock Interchange the bypass brings junction delays lower than or approximately equal to 2021 'Do Min' levels.
- The impacts on the strategic road network are generally predicted to be reduced with the provision of the northern bypass, with the exception of Copdock Interchange where AM delays are predicted to increase.
- The junctions in the east, west and in the vicinity of the development illustrate reduced delays similar to 2008 levels.

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- The Star Lane/Grimwade Street and London Road/Yarmouth Road junctions in the town centre are the two junctions which still have significantly higher delays than those recorded for 2008 during the PM peak.
- During the AM peak the potential bypass has the largest positive impact on the Argyle Street/Grimwade Street junction while during the PM peak the Bypass has the largest positive impact on the Star Lane/Grimwade Street and Bury Road/Old Norwich Road junctions.
- The network statistics highlight that the potential Northern Bypass is predicted to reduce overall delays in the network below 2021 Do Minimum conditions, although distance travelled within the network remains 2% above 2021 Do Minimum levels, most likely due to the diversion involved by taking the new route.

2.26 The following conclusions regarding the potential future addition of the Northern Bypass to the road network can be established:

- The Bypass is predicted to improve capacity on the majority of routes, in many cases bringing them in the region of 2008 results.
- Capacity issues at the Copdock Interchange are not resolved with the addition of the Bypass.
- The impacts on the strategic road network are generally predicted to be reduced with the provision of the northern bypass, with the exception of Copdock Interchange where AM delays are predicted to increase.
- Delays across the network are predicted to be below 2021 Do Minimum conditions.
- Additional capacity in and around the town centre could encourage further car use and work against the TravelSmart policies which promote sustainable modes of transport, and against the target reduction of car travel from the proposed development. Reductions to reflect investment policies in these areas have been included for in the modelling assumptions.
- The potential for the bypass to induce traffic from the surrounding area has not been represented by the modelling and would be likely to lead to further strategic network pressures.
- The provision of further east west capacity clearly helps mitigate the development impacts. The level of capacity provided could however be detrimental to the effectiveness of policy objectives to reduce car reliance at Ipswich. Provision of additional capacity along existing routes would represent a more metered and cost effective approach.

Scenarios 6A & 6B: 2021 With Development, With Sustainable transport investment, with Wet Dock Crossing

2.27 It should be noted that testing for a Wet Dock Crossing has been carried out using an assumed allocation of 4,550 dwellings on the northern fringe, above RSS allocations. The model was not re-run using the revised housing allocation as on the two major infrastructure proposals the Bypass was deemed the critical one. The re-runs are essentially a sensitivity test on those reported in the original Technical Notes and as such a re-run of the Wet Dock Crossing scenario was not deemed necessary.

2.28 Furthermore, there are two permutations of the Wet Dock Crossing however results for both have been included in this section as they are broadly similar in pattern. Without considering costs or other external factors, a dual bridge is the optimum solution as the lost time as a result of marine craft accessing the port is assumed to be 30 seconds every 10 minutes in peak times. A swing bridge has been assumed to lose 2 minutes every 10 minutes due to marine craft.

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2.29 Table 6 below outlines the model generated journey times for each of the routes analysed for the 2021 'DoMinimum' scenario with the Wet Dock Crossing in place and compares them to the Scenario 4 results.

Table 6: Scenario 6A and 6B Route Journey Times

No.	Route		AM Journey Time (min.)					PM Journey Time (min.)				
			2021 with Wet Dock Crossing		2021 'DoMin' with P1 (-20%)	Impact of Wet Dock Crossing		2021 with Wet Dock Crossing		2021 'DoMin' with P1 (-20%)	Impact of Wet Dock Crossing	
			Swing	Dual		Swing	Dual	Swing	Dual		Swing	Dual
1	A1214 Valley Road (Blue)	Eastbound	21.0	20.9	21.56	-0.6	-0.6	22.1	22.1	23.03	-0.9	-1.0
		Westbound	22.7	22.7	23.91	-1.2	-1.2	21.8	21.8	23.07	-1.2	-1.3
2	A1214 London Road (Green)	Eastbound	11.8	11.8	11.59	0.2	0.2	12.8	13.0	13.4	-0.6	-0.4
		Westbound	9.5	9.5	9.52	0.0	-0.1	11.0	10.9	11.25	-0.3	-0.3
3	Bucklesham Road (Red)	Eastbound	7.5	7.5	7.48	0.0	0.0	7.5	7.5	7.48	0.0	0.0
		Westbound	7.5	7.5	7.48	0.0	0.0	7.5	7.5	7.47	0.0	0.0
4	Felixstowe Road (Pink)	Eastbound	12.1	12.0	12.19	-0.1	-0.2	11.7	11.8	11	0.7	0.8
		Westbound	13.2	13.2	12.79	0.4	0.4	12.6	12.5	12.39	0.2	0.1
5	Foxhall Road (Cyan)	Eastbound	12.4	12.4	12.41	0.0	0.0	13.2	13.3	12.69	0.5	0.6
		Westbound	13.8	13.9	12.35	1.5	1.5	11.6	11.6	11.34	0.2	0.2
6	Inner Ring Road (Teal)	Clockwise	12.3	12.8	14.49	-2.2	-1.7	12.6	12.5	16.1	-3.5	-3.6
		Anti-Clockwise	10.1	10.1	10.94	-0.8	-0.9	10.2	10.0	10.7	-0.5	-0.7
7	Norwich Road (Purple)	Northbound	11.4	11.4	11.27	0.1	0.1	12.5	12.5	12.05	0.4	0.4
		Southbound	15.6	15.6	16.89	-1.3	-1.3	17.6	17.7	19.3	-1.8	-1.7
8	Westerfield Road (Orange)	Northbound	8.1	8.1	8.17	0.0	0.0	8.5	8.5	8.65	-0.1	-0.1
		Southbound	7.4	7.4	7.57	-0.1	-0.2	7.1	7.1	7.08	0.0	0.0
9	Wherstead Road (Brown)	Northbound	7.9	8.2	7.16	0.7	1.0	7.7	7.9	6.4	1.3	1.5
		Southbound	6.5	6.5	6.17	0.3	0.4	6.3	6.4	6.1	0.2	0.3

2.30 The key points which can be taken from both the journey time results and the junction delay results are:

- Both the Dual and Swing bridges have similar results, their biggest positive impact being on the Inner Ring Road (Route 6). Valley Road, London Road, Norwich Road and Westerfield Road also experience positive results but to a lesser extent.
- The largest negative impact of either bridge option is on Wherstead Road.
- For junction delays the crossing has a positive impact on all junctions in the town centre, the most dramatic of which being on Grimwade Street/Star Lane Junction.
- In general the network statistics indicate a substantial improvement in network performance, particularly in the PM peak, although residual delays arising from the possible development remain.
- The addition of either bridge causes delays to reduce to approximate 2008 delays or less for 9 junctions in the vicinity.
- When compared to the Northern Bypass it can be seen that the crossing largely has a better impact on junctions within the town centre but has a worse impact, for the most part on junctions on the approach to the town centre.

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2.31 The following conclusions regarding the future addition of a Wet Dock Crossing to the road network can be established:

- The proposed Wet Dock Crossing is predicted to relieve network delays, particularly in the PM period when generally conditions are predicted to be at their worst.
- Regardless of bridge form, strategic network conditions are predicted to be similar to Scenario 4, with sustainable transport investment alone. The proposed Wet Dock Crossing is however predicted to add further delays to the Copdock Interchange. There is also an increase in delays and traffic on the radial routes into Ipswich arising from the release of additional town centre capacity.
- When compared to a Northern Bypass it will have a more positive impact on the town centre in traffic capacity terms and a less positive impact outside the town centre.
- The relief of capacity issues within the town centre would support the provision high quality sustainable transport solutions using the road space released, which would help counteract the level of additional traffic attracted into the town centre.

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Annex II
Modelling Results Analysis Tables

Junction Delays
Journey Time Analysis
Network Statistics

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Comparison of Junction Delays

Junction Location	Junction No.	Location	Node No.	Route No.	2008		2021 'Do Minimum'						2021 'Do Minimum' with P1 Development								
								2008			2008			2008		2021			2008		2021	
					AM (Seconds)	PM (Seconds)	AM (Seconds)	AM Difference	% Increase	PM (Seconds)	PM Difference	% Increase	AM (Seconds)	AM Difference	% Increase	AM Difference	% Increase	PM (Seconds)	PM Difference	% Increase	PM Difference	% Increase
Town Centre	1	Signals of Star Lane/Grimwade Street	10018	6	66	83	104	38	58%	168	85	102%	104	38	58%	0	0%	235	152	183%	67	40%
	2	Signals of Argyle Street/Grimwade Street/St Helens Street	10020	6	36	44	90	54	150%	69	25	57%	129	93	258%	39	43%	84	40	91%	15	22%
	3	Signals of Bond Street/St Helens Street	10049	6	60	38	58	-2	-3%	51	13	34%	65	5	8%	7	12%	90	52	137%	39	76%
	4	Priority Junction of Fore Street EB/Grimwade Street	10061	6	23	8	78	55	239%	39	31	388%	77	54	235%	-1	-1%	67	59	738%	28	72%
	5	Priority Junction of Grimwade Street/Fore Street EB	10062	6	39	4	76	37	95%	53	49	1225%	3	-36	-92%	-73	-96%	75	71	1775%	22	42%
	6	Signals of London Road/Yarmouth Road/Handford Road/West End Road	20014	2	53	81	68	15	28%	112	31	38%	78	25	47%	10	15%	141	60	74%	29	26%
	7	Signals of A1071 Handford Road/London Road	20015	2	67	51	64	-3	-4%	79	28	55%	67	0	0%	3	5%	109	58	114%	30	38%
	8	Signals of St Helens Street/Warwick Road/Spring Road/Grove Lane	20069	NA	42	37	76	34	81%	72	35	95%	77	35	83%	1	1%	94	57	154%	22	31%
East	9	Signals of Derby Road/Foxhall Road	20077	5	62	59	67	5	8%	76	17	29%	76	14	23%	9	13%	85	26	44%	9	12%
	10	Signals of A12 NB/Main Road/Park and ride exit	30407	1	50	18	78	28	56%	35	17	94%	87	37	74%	9	12%	34	16	89%	-1	-3%
	11	Signals of Sidegate Lane/Nelson Road/Woodbridge Road	20057	NA	31	42	38	7	23%	68	26	62%	39	8	26%	1	3%	84	42	100%	16	24%
	12	Signals of Maryon Road/Nacton Road	30240	NA	28	63	32	4	14%	95	32	51%	40	12	43%	8	25%	98	35	56%	3	3%
West	13	Signals of B1067 Bramford Road/Sproughton Road	30142	NA	43	60	75	32	74%	70	10	17%	66	23	53%	-9	-12%	77	17	28%	7	10%
	14	Signals of London Road/Sprites Lane/A1071	30155	2	71	67	59	-12	-17%	64	-3	-4%	58	-13	-18%	-1	-2%	68	1	1%	4	6%
	15	Priority Junction at A14 Interchange 54	30024		1	1	2	1	100%	1	0	0%	2	1	100%	0	0%	2	1	100%	1	100%
	16	Priority Junction at A14 Interchange 54	30025		1	1	2	1	100%	1	0	0%	2	1	100%	0	0%	2	1	100%	1	100%
	17	Signals of Bramford Road/A1214 Yarmouth Road/A1214 Chevallier Street	30025	NA	34	43	50	16	47%	70	27	63%	57	23	68%	7	14%	93	50	116%	23	33%
	18	Signals of A1156 Bury Road/Old Norwich Road/A1156 Norwich Road	30124	7	60	53	48	-12	-20%	119	66	125%	52	-8	-13%	4	8%	181	128	242%	62	52%
P1 Vicinity	19	Signals of Hanley Road/A1214 Valley Road	20044	1	63	70	67	4	6%	76	6	9%	91	28	44%	24	36%	68	-2	-3%	-8	-11%
	20	Roundabout of A1214 Valley Road/B1077 Westerfield Road	20047	1	8	9	24	16	200%	21	12	133%	66	58	725%	42	175%	110	101	1122%	89	424%
Copdock	21	Signals of A1214/A14 EB off slip	30044	2	61	49	55	-6	-10%	53	4	8%	62	1	2%	7	13%	64	15	31%	11	21%
	22	Priority Junction of A12 NB/Copdock Gyratory	30045	2	6	4	70	64	1067%	50	46	1150%	79	73	1217%	9	13%	61	57	1425%	11	22%
	23	Priority Junction of Copdock A14 WB/Gyratory	30046	2	7	12	112	105	1500%	127	115	958%	125	118	1686%	13	12%	165	153	1275%	38	30%
Junction 57	24	A14 Eastbound On-slip Merge	30081	NA	2	2	4	2	100%	6	4	200%	6	4	200%	2	50%	3	1	50%	-3	-50%
	25	Westbound On-slip merge	30076	NA	3	5	84	81	2700%	102	97	1940%	98	95	3167%	14	17%	90	85	1700%	-12	-12%
Seven Hills	26	A14 Westbound Off-slip/gyratory	30099	NA	4	3	44	40	1000%	50	47	1567%	51	47	1175%	7	16%	7	4	133%	-43	-86%
	27	A1156/gyratory	30098	NA	5	4	54	49	980%	59	55	1375%	59	54	1080%	5	9%	10	6	150%	-49	-83%
	28	A14 Westbound On-slip merge	30092	NA	3	3	7	4	133%	9	6	200%	10	7	233%	3	43%	5	2	67%	-4	-44%

AM/PM Difference

0	Equal or less delay
39	Increase in delay greater than 20 seconds
7	Increase in delay between 1 and 20 seconds

Junction Location	Junction No.	Location	Node No.	Route No.	2021 P1 Development with 20% Reduction in Car Trips due to Sustainable Transport Investment										2021 P1 Development (Including Sustainable Transport Investment) with Northern Bypass								
						2008		2021			2008		2021			2008		2021			2008		2021	
					AM (Seconds)	AM Difference	% Increase	AM Difference	% Increase	PM (Seconds)	PM Difference	% Increase	PM Difference	% Increase	AM (Seconds)	AM Difference	% Increase	AM Difference	% Increase	PM (Seconds)	PM Difference	% Increase	PM Difference	% Increase
Town Centre	1	Signals of Star Lane/Grimwade Street	10018	6	106	40	61%	2	2%	224	141	170%	56	33%	120	54	82%	16	15%	141	58	70%	-27	-16%
	2	Signals of Argyle Street/Grimwade Street/St Helens Street	10020	6	124	88	244%	34	38%	75	31	70%	6	9%	48	12	33%	-42	-47%	56	12	27%	-13	-19%
	3	Signals of Bond Street/St Helens Street	10049	6	64	4	7%	6	10%	75	37	97%	24	47%	65	5	8%	7	12%	48	10	26%	-3	-6%
	4	Priority Junction of Fore Street EB/Grimwade Street	10061	6	24	1	4%	-54	-69%	40	32	400%	1	3%	24	1	4%	-54	-69%	8	0	0%	-31	-79%
	5	Priority Junction of Grimwade Street/Fore Street EB	10062	6	62	23	59%	-14	-18%	66	62	1550%	13	25%	62	23	59%	-14	-18%	53	49	1225%	0	0%
	6	Signals of London Road/Yarmouth Road/Handford Road/West End Road	20014	2	77	24	45%	9	13%	134	53	65%	22	20%	72	19	36%	4	6%	95	14	17%	-17	-15%
	7	Signals of A1071 Handford Road/London Road	20015	2	67	0	0%	3	5%	105	54	106%	26	33%	63	-4	-6%	-1	-2%	65	14	27%	-14	-18%
	8	Signals of St Helens Street/Warwick Road/Spring Road/Grove Lane	20069	NA	83	41	98%	7	9%	79	42	114%	7	10%	82	40	95%	6	8%	55	18	49%	-17	-24%
East	9	Signals of Derby Road/Foxhall Road	20077	5	75	13	21%	8	12%	86	27	46%	10	13%	69	7	11%	2	3%	67	8	14%	-9	-12%
	10	Signals of A12 NB/Main Road/Park and ride exit	30407	1	89	39	78%	11	14%	35	17	94%	0	0%	39	-11	-22%	-39	-50%	30	12	67%	-5	-14%
	11	Signals of Sidegate Lane/Nelson Road/Woodbridge Road	20057	NA	39	8	26%	1	3%	79	37	88%	11	16%	27	-4	-13%	-11	-29%	52	10	24%	-16	-24%
	12	Signals of Maryon Road/Nacton Road	30240	NA	39	11	39%	7	22%	94	31	49%	-1	-1%	28	0	0%	-4	-13%	87	24	38%	-8	-8%
West	13	Signals of B1067 Bramford Road/Sproughton Road	30142	NA	65	22	51%	-10	-13%	74	14	23%	4	6%	40	-3	-7%	-35	-47%	59	-1	-2%	-11	-16%
	14	Signals of London Road/Sprites Lane/A1071	30155	2	58	-13	-18%	-1	-2%	67	0	0%	3	5%	56	-15	-21%	-3	-5%	62	-5	-7%	-2	-3%
	15	Priority Junction at A14 Interchange 54	30024		2	1	100%	0	0%	2	1	100%	1	100%	2	1	100%	0	0%	1	0	0%	0	0%
	16	Priority Junction at A14 Interchange 54	30025		2	1	100%	0	0%	2	1	100%	1	100%	2	1	100%	0	0%	1	0	0%	0	0%
	17	Signals of Bramford Road/A1214 Yarmouth Road/A1214 Chevallier Street	30025	NA	56	22	65%	6	12%	94	51	119%	24	34%	38	4	12%	-12	-24%	49	6	14%	-21	-30%
	18	Signals of A1156 Bury Road/Old Norwich Road/A1156 Norwich Road	30124	7	51	-9	-15%	3	6%	163	110	208%	44	37%	35	-25	-42%	-13	-27%	31	-22	-42%	-88	-74%
P1 Vicinity	19	Signals of Hanley Road/A1214 Valley Road	20044	1	85	22	35%	18	27%	65	-5	-7%	-11	-14%	61	-2	-3%	-6	-9%	57	-13	-19%	-19	-25%
	20	Roundabout of A1214 Valley Road/B1077 Westerfield Road	20047	1	50	42	525%	26	108%	84	75	833%	63	300%	24	16	200%	0	0%	34	25	278%	13	62%
Copdock	21	Signals of A1214/A14 EB off slip	30044	2	62	1	2%	7	13%	49	0	0%	-4	-8%	105	44	72%	50	91%	61	12	24%	8	15%
	22	Priority Junction of A12 NB/Copdock Gyratory	30045	2	79	73	1217%	9	13%	60	56	1400%	10	20%	64	58	967%	-6	-9%	43	39	975%	-7	-14%
	23	Priority Junction of Copdock A14 WB/Gyratory	30046	2	123	116	1657%	11	10%	141	129	1075%	14	11%	113	106	1514%	1	1%	112	100	833%	-15	-12%
Junction 57	24	A14 Eastbound On-slip Merge	30081	NA	6	4	200%	2	50%	3	1	50%	-3	-50%	2	0	0%	-2	-50%	3	1	50%	-3	-50%
	25	Westbound On-slip merge	30076	NA	102	99	3300%	18	21%	97	92	1840%	-5	-5%	51	48	1600%	-33	-39%	35	30	600%	-67	-66%
Seven Hills	26	A14 Westbound Off-slip/gyratory	30099	NA	49	45	1125%	5	11%	8	5	167%	-42	-84%	26	22	550%	-18	-41%	5	2	67%	-45	-90%
	27	A1156/gyratory	30098	NA	59	54	1080%	5	9%	12	8	200%	-47	-80%	21	16	320%	-33	-61%	6	2	50%	-53	-90%
	28	A14 Westbound On-slip merge	30092	NA	9	6	200%	2	29%	5	2	67%	-4	-44%	4	1	33%	-3	-43%	4	1	33%	-5	-56%

Junction Location	Junction No.	Location	Node No.	Route No.	P1 Development (Including Sustainable Transport Investment) with Wet Dock Dual Bridge with Star Lane Capacity Reduction (Based on 5,000 dwellings)										P1 Development (Including Sustainable Transport Investment) with Wet Dock Swing Bridge with Star Lane Capacity Reduction (Based on 5,000 dwellings)								
						2008		2021			2008		2021			2008		2021			2008		2021	
					AM (Seconds)	AM Difference	% Increase	AM Difference	% Increase	PM (Seconds)	PM Difference	% Increase	PM Difference	% Increase	AM (Seconds)	AM Difference	% Increase	AM Difference	% Increase	PM (Seconds)	PM Difference	% Increase	PM Difference	% Increase
Town Centre	1	Signals of Star Lane/Grimwade Street	10018	6	26	-40	-61%	-78	-75%	34	-49	-59%	-134	-80%	26	-40	-61%	-78	-75%	39	-44	-53%	-129	-77%
	2	Signals of Argyle Street/Grimwade Street/St Helens Street	10020	6	46	10	28%	-44	-49%	49	5	11%	-20	-29%	46	10	28%	-44	-49%	51	7	16%	-18	-26%
	3	Signals of Bond Street/St Helens Street	10049	6	63	3	5%	5	9%	52	14	37%	1	2%	62	2	3%	4	7%	53	15	39%	2	4%
	4	Priority Junction of Fore Street EB/Grimwade Street	10061	6	24	1	4%	-54	-69%	6	-2	-25%	-33	-85%	24	1	4%	-54	-69%	7	-1	-13%	-32	-82%
	5	Priority Junction of Grimwade Street/Fore Street EB	10062	6	3	-36	-92%	-73	-96%	3	-1	-25%	-50	-94%	10	-29	-74%	-66	-87%	3	-1	-25%	-50	-94%
	6	Signals of London Road/Yarmouth Road/Handford Road/West End Road	20014	2	77	24	45%	9	13%	118	37	46%	6	5%	77	24	45%	9	13%	118	37	46%	6	5%
	7	Signals of A1071 Handford Road/London Road	20015	2	67	0	0%	3	5%	98	47	92%	19	24%	67	0	0%	3	5%	95	44	86%	16	20%
	8	Signals of St Helens Street/Warwick Road/Spring Road/Grove Lane	20069	NA	45	3	7%	-31	-41%	41	4	11%	-31	-43%	47	5	12%	-29	-38%	43	6	16%	-29	-40%
East	9	Signals of Derby Road/Foxhall Road	20077	5	91	29	47%	24	36%	101	42	71%	25	33%	89	27	44%	22	33%	98	39	66%	22	29%
	10	Signals of A12 NB/Main Road/Park and ride exit	30407	1	79	29	58%	1	1%	49	31	172%	14	40%	79	29	58%	1	1%	50	32	178%	15	43%
	11	Signals of Sidegate Lane/Nelson Road/Woodbridge Road	20057	NA	28	-3	-10%	-10	-26%	51	9	21%	-17	-25%	28	-3	-10%	-10	-26%	53	11	26%	-15	-22%
	12	Signals of Maryon Road/Nacton Road	30240	NA	45	17	61%	13	41%	77	14	22%	-18	-19%	41	13	46%	9	28%	74	11	17%	-21	-22%
West	13	Signals of B1067 Bramford Road/Sproughton Road	30142	NA	56	13	30%	-19	-25%	57	-3	-5%	-13	-19%	56	13	30%	-19	-25%	50 57	-3	-5%	-13	-19%
	14	Signals of London Road/Sprites Lane/A1071	30155	2	58	-13	-18%	-1	-2%	68	1	1%	4	6%	58	-13	-18%	-1	-2%	67	0	0%	3	5%
	15	Priority Junction at A14 Interchange 54	30024		124	123	12300%	122	6100%	1	0	0%	0	0%	123	122	12200%	121	6050%	1	0	0%	0	0%
	16	Priority Junction at A14 Interchange 54	30025		60	59	5900%	58	2900%	1	0	0%	0	0%	61	60	6000%	59	2950%	1	0	0%	0	0%
	17	Signals of Bramford Road/A1214 Yarmouth Road/A1214 Chevallier Street	30025	NA	53	19	56%	3	6%	84	41	95%	14	20%	52	18	53%	2	4%	82	39	91%	12	17%
	18	Signals of A1156 Bury Road/Old Norwich Road/A1156 Norwich Road	30124	7	52	-8	-13%	4	8%	152	99	187%	33	28%	51	-9	-15%	3	6%	150	97	183%	31	26%
P1 Vicinity	19	Signals of Hanley Road/A1214 Valley Road	20044	1	80	17	27%	13	19%	76	6	9%	0	0%	80	17	27%	13	19%	76	6	9%	0	0%
	20	Roundabout of A1214 Valley Road/B1077 Westerfield Road	20047	1	31	23	288%	7	29%	54	45	500%	33	157%	32	24	300%	8	33%	56	47	522%	35	167%
Copdock	21	Signals of A1214/A14 EB off slip	30044	2	62	1	2%	7	13%	48	-1	-2%	-5	-9%	63	2	3%	8	15%	48	-1	-2%	-5	-9%
	22	Priority Junction of A12 NB/Copdock Gyratory	30045	2	96	90	1500%	26	37%	49	45	1125%	-1	-2%	96	90	1500%	26	37%	49	45	1125%	-1	-2%
	23	Priority Junction of Copdock A14 WB/Gyratory	30046	2	177	170	2429%	65	58%	122	110	917%	-5	-4%	172	165	2357%	60	54%	122	110	917%	-5	-4%
Junction 57	24	A14 Eastbound On-slip Merge	30081	NA	4	2	100%	0	0%	3	1	50%	-3	-50%	4	2	100%	0	0%	3	1	50%	-3	-50%
	25	Westbound On-slip merge	30076	NA	12	9	300%	-72	-86%	29	24	480%	-73	-72%	15	12	400%	-69	-82%	36	31	620%	-66	-65%
Seven Hills	26	A14 Westbound Off-slip/gyratory	30099	NA	42	38	950%	-2	-5%	9	6	200%	-41	-82%	39	35	875%	-5	-11%	9	6	200%	-41	-82%
	27	A1156/gyratory	30098	NA	5	0	0%	-49	-91%	13	9	225%	-46	-78%	49	44	880%	-5	-9%	13	9	225%	-46	-78%
	28	A14 Westbound On-slip merge	30092	NA	5	2	67%	-2	-29%	5	2	67%	-4	-44%	5	2	67%	-2	-29%	5	2	67%	-4	-44%

Comparison of Route Journey Times

Route No.	Route		Journey Length (km)	2008 AM Journey Time (minutes)	2008 AM Average Speed (km per hour)	2008 PM Journey Time (minutes)	2008 PM Average Speed (km per minute)	2021 'Do Minimum' AM Journey Time (minutes)	2021 'Do Minimum' AM Average Speed (km per hour)	AM Difference 2008 Journey Time (minutes)	AM Difference 2008 Average Speed (km per hour)	2021 'Do Minimum' PM Journey Time (minutes)	2021 'Do Minimum' PM Average Speed (km per hour)	PM Difference 2008 Journey Time (minutes)	PM Difference 2008 Average Speed (km per hour)	2021 'Do Minimum' with P1 Development AM Journey Time (minutes)	2021 'Do Minimum' with P1 Development AM Average Speed (km per hour)	AM Difference 2008 Journey Time (minutes)	AM Difference 2008 Average Speed (km per hour)	AM Difference 2021 Journey Time (minutes)	AM Difference 2021 Average Speed (km per hour)	2021 'Do Minimum' with P1 Development PM Journey Time (minutes)	2021 'Do Minimum' with P1 Development PM Average Speed (km per hour)	PM Difference 2008 Journey Time (minutes)	PM Difference 2008 Average Speed (km per hour)	PM Difference 2021 Journey Time (minutes)	PM Difference 2021 Average Speed (km per hour)
1	A1214 Valley Road (Blue)	Eastbound	9,7	19,24	30	20,16	29	21	28	1,66	-2,4	22,43	26	2,27	-2,9	21,71	27	2,37	-3,3	0,71	-0,9	23,72	25	3,56	-4,5	1,29	-1,4
		Westbound		21,54	27	20,46	28	23,03	25	1,49	-1,7	21,36	27	0,90	-1,2	24,03	24	2,49	-2,8	1	-1,1	23,81	24	3,35	-4,0	2,45	-2,8
2	A1214 London Road (Green)	Eastbound	4,5	11,15	24	10,84	25	11,52	23	0,37	-0,8	12,13	22	1,29	-2,6	11,55	23	0,4	-0,8	0,03	-0,1	13,53	20	2,69	-5,0	1,4	-2,3
		Westbound		10,47	26	11,96	23	9,3	29	-1,17	3,2	10,81	25	-1,15	2,4	9,52	28	-0,95	2,6	0,22	-0,7	11,3	24	-0,66	1,3	0,49	-1,1
3	Bucklesham Road (Red)	Eastbound	7,5	7,47	60	7,48	60	7,48	60	0,01	-0,1	7,48	60	0,00	0,0	7,49	60	0,02	-0,2	0,01	-0,1	7,48	60	0	0,0	0	0,0
		Westbound		7,47	60	7,47	60	7,47	60	0,00	0,0	7,47	60	0,00	0,0	7,48	60	0,01	-0,1	0,01	-0,1	7,47	60	0	0,0	0	0,0
4	Felixstowe Road (Pink)	Eastbound	7,1	10,57	40	10,66	40	11,52	37	0,95	-3,3	10,79	39	0,13	-0,5	12,09	35	1,52	-5,1	0,57	-1,7	10,88	39	0,22	-0,8	0,09	-0,3
		Westbound		10,65	40	10,83	39	11,53	37	0,88	-3,1	13,89	31	3,06	-8,7	11,52	37	0,87	-3,0	-0,01	0,0	12,56	34	1,73	-5,4	-1,33	3,2
5	Foxhall Road (Cyan)	Eastbound	7,1	11,83	37	11,9	36	12,12	35	0,49	-1,5	12,57	34	0,67	-1,9	12,47	34	0,84	-2,5	0,35	-1,0	12,83	33	0,93	-2,6	0,26	-0,7
		Westbound		11,82	36	11,28	38	12,31	35	0,49	-1,4	11,37	37	0,09	-0,3	12,39	34	0,57	-1,7	0,08	-0,2	11,41	37	0,13	-0,4	0,04	-0,1
6	Inner Ring Road (Teal)	Clockwise	3,5	10,37	20	10,89	19	13,94	15	3,57	-5,2	14,03	15	3,14	-4,3	13,5	16	3,13	-4,7	-0,44	0,5	16,03	13	5,14	-6,2	2	-1,9
		Anti-Clockwise		9,01	23	8,5	25	10,7	20	1,69	-3,7	9,37	22	0,87	-2,3	11,06	19	2,05	-4,3	0,36	-0,6	10,3	20	1,8	-4,3	0,93	-2,0
7	Norwich Road (Purple)	Northbound	4	12,79	19	11,93	20	11,26	21	-1,53	2,5	11,77	20	-0,16	0,3	11,29	21	-1,5	2,5	0,03	-0,1	12,09	20	0,16	-0,3	0,32	-0,5
		Southbound		14,67	16	13,92	17	15,1	15	1,43	-1,5	16,83	14	2,91	-3,0	17,19	14	2,52	-3,4	1,09	-0,9	19,4	12	5,48	-4,9	3,57	-1,9
8	Westerfield Road (Orange)	Northbound	4,1	8,09	30	8,12	30	8,12	30	0,03	-0,1	8,22	30	0,10	-0,4	8,19	30	0,1	-0,4	0,07	-0,3	9,1	27	0,98	-3,3	0,88	-2,9
		Southbound		7,03	35	7,01	35	7,06	35	0,03	-0,1	7,03	35	0,02	-0,1	8,29	30	1,26	-5,3	1,23	-5,2	7,08	35	0,07	-0,3	0,05	-0,2
9	Wherstead Road (Brown)	Northbound	3,6	6,35	34	6,39	34	6,95	31	0,60	-2,9	6,37	34	-0,02	0,1	7,18	30	0,83	-3,9	0,23	-1,0	6,39	34	0	0,0	0,02	-0,1
		Southbound		6,13	35	6,16	35	6,15	35	0,02	-0,1	6,1	35	-0,06	0,3	6,16	35	0,03	-0,2	0,01	-0,1	6,11	35	-0,05	0,3	0,01	-0,1

0,51	Delay of 0.5 minutes or greater
0,5	Increased delay up to 0.5 minutes
0	Equal or less delay
-3	Average speed reduced but more than 2km/hr
-1	Average speed reduced by less than 2km/hr
1	Average speed unchanged or improved

Route No.	Route		Journey Length (km)	2021 P1 Development with 20% Reduction in Car Trips due to Sustainable Transport Investment AM Journey Time (minutes)	AM Average Speed (km per hour)	AM Difference 2008 Journey Time (minutes)	AM Difference 2008 Average Speed (km per hour)	AM Difference 2021 Journey Time (minutes)	AM Difference 2021 Average Speed (km per hour)	PM Journey Time (minutes)	PM Average Speed (km per hour)	PM Difference 2008 Journey Time (minutes)	PM Difference 2008 Average Speed (km per hour)	PM Difference 2021 Journey Time (minutes)	PM Difference 2021 Average Speed (km per hour)	2021 P1 Development (Including Sustainable Transport Investment) with Northern Bypass AM Journey Time (minutes)	AM Average Speed (km per hour)	AM Difference 2008 Journey Time (minutes)	AM Difference 2008 Average Speed (km per hour)	AM Difference 2021 Journey Time (minutes)	AM Difference 2021 Average Speed (km per hour)	PM Journey Time (minutes)	PM Average Speed (km per hour)	PM Difference 2008 Journey Time (minutes)	PM Difference 2008 Average Speed (km per hour)	PM Difference 2021 Journey Time (minutes)	PM Difference 2021 Average Speed (km per hour)
1	A1214 Valley Road (Blue)	Eastbound	9,7	21,56	27	2,22	-3,1	0,56	0,2	23,03	25	2,87	-3,8	0,6	-0,7	20,35	29	1,01	-1,5	-0,65	0,9	21,31	27	1,15	-1,8	-1,12	1,4
		Westbound		23,91	24	2,37	-2,7	0,88	0,1	23,07	25	2,61	-3,2	1,71	-2,0	20,19	29	-1,35	1,8	-2,84	3,6	19,79	29	-0,67	1,0	-1,57	2,2
2	A1214 London Road (Green)	Eastbound	4,5	11,59	23	0,44	-0,9	0,07	-0,1	13,4	20	2,56	-4,8	1,27	-2,1	10,9	25	-0,25	0,6	-0,62	1,3	11,28	24	0,44	-1,0	-0,85	1,7
		Westbound		9,52	28	-0,95	2,6	0,22	0,0	11,25	24	-0,71	1,4	0,44	-1,0	9,23	29	-1,24	3,5	-0,07	0,2	10,47	26	-1,49	3,2	-0,34	0,8
3	Bucklesham Road (Red)	Eastbound	7,5	7,48	60	0,01	-0,1	0	0,1	7,48	60	0	0,0	0	0,0	7,48	60	0,01	-0,1	0	0,0	7,48	60	0	0,0	0	0,0
		Westbound		7,48	60	0,01	-0,1	0,01	0,0	7,47	60	0	0,0	0	0,0	7,47	60	0	0,0	0	0,0	7,47	60	0	0,0	0	0,0
4	Felixstowe Road (Pink)	Eastbound	7,1	12,19	35	1,62	-5,4	0,67	-0,3	11	39	0,34	-1,2	0,21	-0,8	10,29	41	-0,28	1,1	-1,23	4,4	10,54	40	-0,12	0,5	-0,25	0,9
		Westbound		12,79	33	2,14	-5,7	1,26	-3,7	12,39	34	1,56	-5,0	-1,5	3,7	11,34	38	0,69	-2,4	-0,19	0,6	11,93	36	1,1	-3,6	-1,96	5,0
5	Foxhall Road (Cyan)	Eastbound	7,1	12,41	34	0,76	-2,3	0,29	0,2	12,69	34	0,79	-2,2	0,12	-0,3	12,12	35	0,49	-1,5	0	0,0	12,2	35	0,3	-0,9	-0,37	1,0
		Westbound		12,35	34	0,53	-1,5	0,04	0,1	11,34	38	0,06	-0,2	-0,03	0,1	12,1	35	0,28	-0,8	-0,21	0,6	11,26	38	-0,02	0,1	-0,11	0,4
6	Inner Ring Road (Teal)	Clockwise	3,5	14,49	14	4,12	-5,8	0,55	-1,1	16,1	13	5,21	-6,2	2,07	-1,9	11,84	18	1,47	-2,5	-2,1	2,7	12,73	16	1,84	-2,8	-1,3	1,5
		Anti-Clockwise		10,94	19	1,93	-4,1	0,24	0,2	10,7	20	2,2	-5,1	1,33	-2,8	10,36	20	1,35	-3,0	-0,34	0,6	9,59	22	1,09	-2,8	0,22	-0,2
7	Norwich Road (Purple)	Northbound	4	11,27	21	-1,52	2,5	0,01	0,0	12,05	20	0,12	-0,2	0,28	-0,5	11,04	22	-1,75	3,0	-0,22	0,4	11,57	21	-0,36	0,6	-0,2	0,4
		Southbound		16,89	14	2,22	-2,2	0,79	0,2	19,3	12	5,38	-4,8	2,47	-1,8	15,07	16	0,4	-0,4	-1,03	1,0	14,18	17	0,26	-0,3	-2,65	2,7
8	Westerfield Road (Orange)	Northbound	4,1	8,17	30	0,08	-0,3	0,05	0,1	8,65	28	0,53	-1,9	0,43	-1,5	8,34	29	0,25	-0,9	0,22	-0,8	8,62	29	0,5	-1,8	0,4	-1,4
		Southbound		7,57	32	0,54	-2,5	0,51	2,8	7,08	35	0,07	-0,3	0,05	-0,2	7,56	32	0,55	-2,5	0,52	-2,4	7,59	32	0,58	-2,7	0,56	-2,6
9	Wherstead Road (Brown)	Northbound	3,6	7,16	30	0,81	-3,8	0,21	0,1	6,4	34	0,01	-0,1	0,03	-0,2	6,81	32	0,46	-2,3	-0,14	0,8	6,56	33	0,17	-0,9	0,19	-1,0
		Southbound		6,17	35	0,04	-0,2	0,02	-0,1	6,1	35	-0,06	0,3	0	0,0	6,14	35	0,01	-0,1	-0,01	0,1	6,12	35	-0,04	0,2	0,02	-0,1
				213,94						219,5																	

Route No.	Route		Journey Length (km)	P1 Development (Including Sustainable Transport Investment) with Wet Dock Dual Bridge with Star Lane Capacity Reduction (Based on 5,000 dwellings) AM Journey Time (minutes)	AM Average Speed (km per hour)	AM Difference 2008 Journey Time (minutes)	AM Difference 2008 Average Speed (km per hour)	AM Difference 2021 Journey Time (minutes)	AM Difference 2021 Average Speed (km per hour)	PM Journey Time (minutes)	PM Average Speed (km per hour)	PM Difference 2008 Journey Time (minutes)	PM Difference 2008 Average Speed (km per hour)	PM Difference 2021 Journey Time (minutes)	PM Difference 2021 Average Speed (km per hour)	P1 Development (Including Sustainable Transport Investment) with Wet Dock Swing Bridge with Star Lane Capacity Reduction (Based on 5,000 dwellings) AM Journey Time (minutes)	AM Average Speed (km per hour)	AM Difference 2008 Journey Time (minutes)	AM Difference 2008 Average Speed (km per hour)	AM Difference 2021 Journey Time (minutes)	AM Difference 2021 Average Speed (km per hour)	PM Journey Time (minutes)	PM Average Speed (km per hour)	PM Difference 2008 Journey Time (minutes)	PM Difference 2008 Average Speed (km per hour)	PM Difference 2021 Journey Time (minutes)	PM Difference 2021 Average Speed (km per hour)
1	A1214 Valley Road (Blue)	Eastbound	9,7	20,9	28	1,59	-2,3	-0,07	0,1	22,1	26	1,9	-2,5	-0,37	0,4	21,0	28	1,61	-2,3	-0,05	0,1	22,1	26	1,98	-2,8	-0,29	0,3
		Westbound		22,7	26	1,13	-1,3	-0,36	0,4	21,8	27	1,36	-1,8	0,46	-0,6	22,7	26	1,2	-1,4	-0,29	0,3	21,8	27	1,37	-1,8	0,47	-0,6
2	A1214 London Road (Green)	Eastbound	4,5	11,8	23	0,66	-1,4	0,29	-0,6	13,0	21	2,13	-4,1	0,84	-1,4	11,8	23	0,65	-1,3	0,28	-0,6	12,8	21	2	-3,9	0,71	-1,2
		Westbound		9,5	29	-1,01	2,8	0,16	-0,5	10,9	25	-1,03	2,1	0,12	-0,3	9,5	29	-1	2,7	0,17	-0,5	11,0	25	-0,969	2,0	0,181	-0,4
3	Bucklesham Road (Red)	Eastbound	7,5	7,5	60	0,01	-0,1	0	0,0	7,5	60	0	0,0	0	0,0	7,5	60	0,01	-0,1	0	0,0	7,5	60	0	0,0	0	0,0
		Westbound		7,5	60	0,01	-0,1	0,01	-0,1	7,5	60	0,01	-0,1	0,01	-0,1	7,5	60	0,01	-0,1	0,01	-0,1	7,5	60	0,01	-0,1	0,01	-0,1
4	Felixstowe Road (Pink)	Eastbound	7,1	12,0	35	1,47	-4,9	0,52	-1,6	11,8	36	1,12	-3,8	0,99	-3,3	12,1	35	1,48	-5,0	0,53	-1,8	11,7	36	1,07	-3,6	0,94	-3,2
		Westbound		13,2	32	2,51	-7,6	1,83	-4,6	12,5	34	1,65	-5,2	-1,41	3,5	13,2	32	2,55	-7,7	1,67	-4,7	12,6	34	1,8	-5,6	-1,26	3,1
5	Foxhall Road (Cyan)	Eastbound	7,1	12,4	34	0,76	-2,2	0,27	-0,8	13,3	32	1,37	-3,7	0,7	-1,8	12,4	34	0,74	-2,2	0,25	-0,7	13,2	32	1,29	-3,5	0,62	-1,6
		Westbound		13,9	31	2,04	-5,3	1,55	-3,9	11,6	37	0,3	-1,0	0,21	-0,7	13,8	31	1,98	-5,2	1,49	-3,7	11,6	37	0,27	-0,9	0,18	-0,6
6	Inner Ring Road (Teal)	Clockwise	3,5	12,8	16	2,15	-3,9	-1,12	1,3	12,5	17	1,58	-2,4	-1,56	1,9	12,3	17	1,89	-3,1	-1,68	2,1	12,6	17	1,72	-2,8	-1,42	1,7
		Anti-Clockwise		10,1	21	1,04	-2,4	-0,65	1,3	10,0	21	1,47	-3,6	0,6	-1,3	10,1	21	1,12	-2,6	-0,57	1,1	10,2	21	1,68	-4,1	0,81	-1,8
7	Norwich Road (Purple)	Northbound	4	11,4	21	-1,42	2,3	0,11	-0,2	12,5	19	0,54	-0,9	0,7	-1,1	11,4	21	-1,43	2,4	0,1	-0,2	12,5	19	0,57	-0,9	0,73	-1,2
		Southbound		15,6	15	0,94	-1,0	-0,49	0,5	17,7	14	3,73	-3,6	0,82	-0,7	15,6	15	0,93	-1,0	-0,5	0,5	17,6	14	3,69	-3,6	0,72	-0,7
8	Westerfield Road (Orange)	Northbound	4,1	8,1	30	0,05	-0,2	0,02	-0,1	8,5	29	0,41	-1,5	0,31	-1,1	8,1	30	0,05	-0,2	0,02	-0,1	8,5	29	0,42	-1,5	0,32	-1,1
		Southbound		7,4	33	0,39	-1,8	0,36	-1,7	7,1	35	0,08	-0,4	0,06	-0,3	7,4	33	0,41	-1,9	0,38	-1,8	7,1	35	0,08	-0,4	0,06	-0,3
9	Wherstead Road (Brown)	Northbound	3,6	8,2	26	1,83	-7,6	1,23	-4,7	7,9	27	1,53	-6,5	1,55	-6,6	7,9	27	1,51	-6,5	0,91	-3,6	7,7	28	1,27	-5,6	1,29	-5,7
		Southbound		6,5	33	0,39	-2,1	0,37	-2,0	6,4	34	0,25	-1,4	0,31	-1,7	6,5	33	0,33	-1,8	0,31	-1,7	6,3	34	0,18	-1,0	0,24	-1,2

Comparison of Simulation Network Statistics

Time Period	Scenario 1 2008	Scenario 2 2021 Do Minimum	Scenario 3 2021 P1 Development		Scenario 4 2021 P1 -20%		Scenario 5 2021 Northern Bypass		Scenario 6A Wet Dock Dual Bridge		Scenario 6B Wet Dock Swing Bridge	
	PCU-hours	PCU-hours	PCU-hours	Percentage Difference*	PCU-hours	Percentage Difference*	PCU-hours	Percentage Difference*	PCU-hours	Percentage Difference*	PCU-hours	Percentage Difference*
AM Peak hour	8,078	11,949	12,716	6%	12,696	6%	11,852	-1%	12,326	103%	12,596	5%
PM Peak hour	8,209	12,191	13,734	13%	13,248	11%	11,876	-1%	12,339	101%	12,364	3%
Time Period	PCU - kilometres	PCU - kilometres	PCU - kilometres	Percentage Difference*	PCU - kilometres	Percentage Difference*	PCU - kilometres	Percentage Difference*	PCU - kilometres	Percentage Difference*	PCU - kilometres	Percentage Difference*
AM Peak hour	364,579	475,370	488,845	3%	487,012	2%	483,868	2%	487,225	2%	486,829	2%
PM Peak hour	370,843	477,972	494,904	4%	491,524	3%	487,577	3%	490,820	3%	490,635	3%

* Percentage Difference for Scenarios 3, 4, 5, 6A and 6B are measured against Scenario 2 '2021 Do Minimum'

Annex III
'Ipswich Area Development and Infrastructure Tests'

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Technical Note

AECOM

Project:	**Ipswich Transport Model**	Job No:	**60044295**
Subject:	**Ipswich Area Development and Infrastructure Tests**		
Prepared by:	**Sarah Briffett / Nik Bowyer**	Date:	**20/08/2009**
Checked by:	**Ian Burrows**	Date:	**20/08/2009**
Approved by:	**Ian Burrows**	Date:	**20/08/2009**

1. Introduction

This Technical Note is intended to provide a brief outline of the results of recent modelling work using the Ipswich Transport Analysis Modelling Suite (ITAMS). The various tests reported herein have been undertaken by AECOM on behalf of Ipswich Borough Council and Suffolk County Council, in order to assess the implications of the provision of 5,000 households in northern Ipswich. In particular, this scenario assesses the implications of the 5,000 additional households in 2021 over-and-above the minimum dwelling provision presented in the East of England Plan. A number of highway infrastructure schemes have also been tested.

2. The Tests

The tests reported refer to a 2021 horizon, for which demand has been produced using simple growth factors from 2008 to 2021. 2008 is the year of the interim validation base model. Both morning (08:00-09:00) and evening (17:00-18:00) peak hours have been modelled.

Unlike previous tests, the demand assumptions used for these tests have been revised to be in-line with the Regional Spatial Strategy (RSS) for the East of England, whereas previous tests have used TEMPRO v5.4 data from which to infer growth. The RSS forecasts lower housing growth than TEMPRO but higher employment between 2008 and 2021 for the district of Ipswich.

A number of 'Do-Minimum' highway infrastructure schemes have also been included which are likely to be constructed between 2008 and 2021. These are the proposed changes in the Fore Street area emerging from the successful CIF 2 bid, and improvements proposed by the Highways Agency to the A12/A14 Copdock Interchange to the south-west of Ipswich. Additionally, the assumptions reflect a successful major-scheme business case of 'Ipswich – Transport fit for the 21st century', involving full UTMC signalisation, RTPI, an altered bus loop, additional shuttle bus services and an improved active mode network.

2.1. Specification of the tests

The following tests (all 2021) are briefly examined within this Technical Note and are split according to the demand and supply changes:

<u>Demand Changes</u>

- Growth in-line with the RSS;
- Growth as per the RSS, but assuming the successful implementation of SMART travel policies;
- As per SMART travel policies, with 5,000 additional households in the northern fringe (P1);
- Assuming strong sustainable transport policy investment at the P1 development;

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Supply Changes

- P1 with strong sustainable transport, Dual-Bridge alignment of a Wet Dock crossing;
- P1 with strong sustainable transport, Dual-Bridge alignment of a Wet Dock crossing and capacity reduction on the Star Lane/College Street gyratory system
- P1 with strong sustainable transport, Swing-Bridge alignment of a Wet Dock crossing;
- P1 with strong sustainable transport, Swing-Bridge alignment of a Wet Dock crossing and capacity reduction on the Star Lane/College Street gyratory system
- P1 with strong sustainable transport, provision of a northern bypass/relief road.

It should be noted that, with the exception of the initial test, all other tests have been restricted to highway only and are fixed demand assignments. Demand interventions have generally been undertaken manually, as opposed to using the full features of the ITAMS. Given this fact and that the tests represent early applications of the model, further refinement and testing may be required in order to confirm the findings presented in this Technical Note.

2.2. Planning Data assumptions and investment policies

The first two tests presented represent growth in-line with the Regional Spatial Strategy for the East of England, of which the latest version was released in May 2008. This provides dwelling and employment growth targets to 2021 which have been used in the construction of the forecast matrices for these tests.

The TravelSmart policies represent an approach to reducing car travel by providing tailored information packs by encouraging further journeys by, and providing information on, walking, cycling and public transport modes. Such policies have been shown to consistently reduce car travel by 10% or more wherever they have operated. For the purposes of these tests, car trips have been reduced by 15% to and from the town centre (an area which corresponds to the interventions of the MSBC) and at Adastral Park in the eastern fringe, in-line with major employment and leisure centres.

A high-level allocation of the northern fringe development of 5,000 houses is illustrated in Figure 1. These households are within the boundaries of Ipswich Borough and, as previously specified, represent growth over-and-above that of the RSS. These households have been assumed to have the same underlying trip-distribution as their surrounding zones, whilst trip-rates developed from the TRICS package have been applied to convert from households to highway trips. For the purposes of the rest of the report, the development will be referred to as Planning scenario 1, or P1.

An investment in strong sustainable transport policies has been assumed for the P1 development for a number of the tests undertaken. These represent comprehensive investment in public transport and active modes in order to achieve a 20% reduction in car trips to and from the specific development site compared to if no programme of investment occurred. The base percentage level assumed for car trips from the P1 development is around 93% of all highway traffic both to and from the development in both the AM and PM peak hours. Given the high proportion of car trips from the development, a 20% reduction could potentially have a large impact in mitigating highway impacts – this will require further investigation should such findings be borne out of the highway modelling. In the case of the P1 development this 20% reduction equates to a reduction of 492 trips (to 1,934 car trips) and 581 trips (to 2,149 car trips) in the morning and evening peaks respectively.

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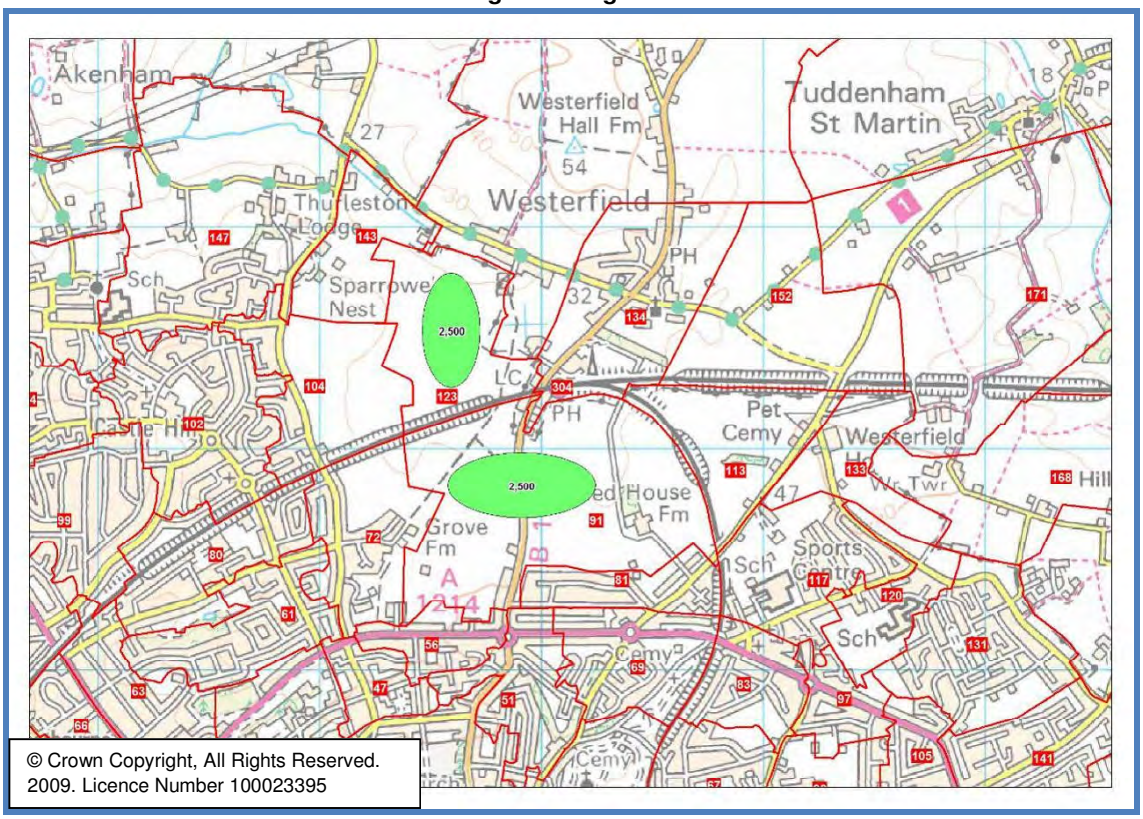
Figure 1 – Location of additional northern fringe housing



2.3. Highway Infrastructure schemes

Two highway infrastructure schemes have been tested as possible mitigation scenarios in addition to the 'Do-Minimum' network improvements assumed between 2008 and 2021. These are a Northern-Relief Road and a number of permutations of a Wet-Dock Crossing. Broad-alignments of these are shown in Figure 2.

The Northern Relief Road has been assumed to be a single carriageway road that connects the A14 at Bury Road (location 1 on Figure 2) and the A12 at Martlesham (7). Intermediate junctions (roundabouts) have been coded at:

- Henley Road (location 2 on Figure 2)
- Westerfield Road (3)
- Tuddenham Road (4) and;
- a link road (5) to Main Road at the Ropes Drive West junction (6)

Wet Dock crossing has been assumed to be a single carriageway road linking Landseer Road and Mather Way. Four permutations of such a crossing have been tested. The first is coded as a dual-bridge set-up, which will provide overhead signs allowing for the switching of traffic to either bridge dependent upon water-modes accessing/exiting the port – this has been coded to have 30 seconds of no traffic flow every 10 minutes in the morning and evening peak hour as the lane switchover

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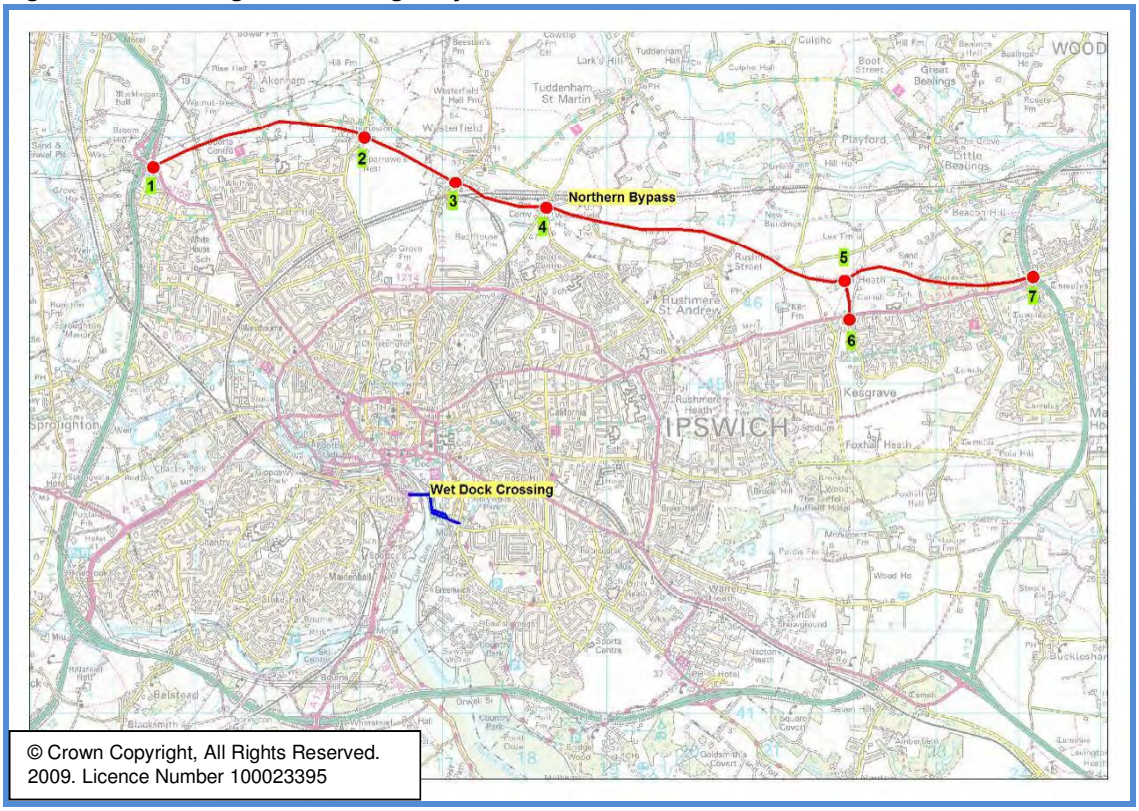
takes place. The second option of Wet Dock is coded as a swing bridge, which would physically swing in order to let water-traffic access/exit the port – this has been coded to have 2 minutes of no traffic flow every 10 minutes in the peak hours. Permutations three and four are identical to one and two, but also incorporate capacity reductions on the Star Lane and College Street gyratory system as a result of the Wet Dock crossing being introduced.

It should be noted that whilst these infrastructure tests have been undertaken in the model as possible mitigation measures, there has been no consideration of scheme feasibility, cost or land take. Furthermore, associated development with the Wet Dock Island has been included for the purposes of these tests, although the scale of development and linked development infrastructure may not be in line with latest proposals.

Figure 2 – Broad alignments of highway infrastructure schemes



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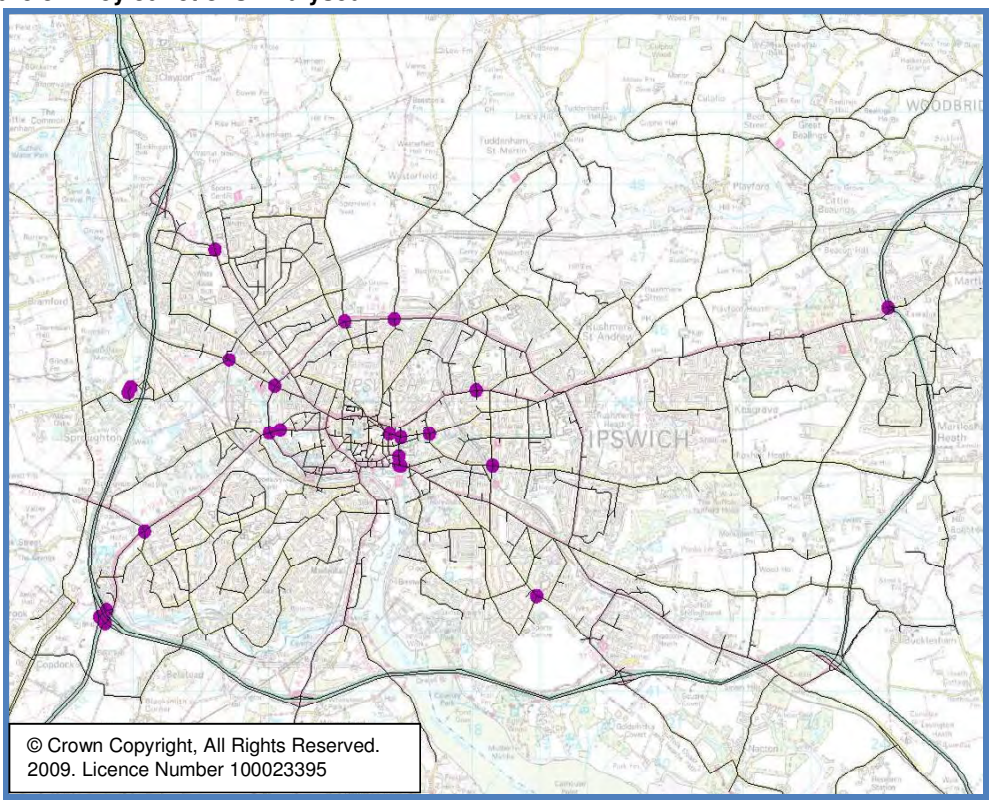
3. Results and analysis

The results of the tests specified in section 2.1 are shown in the following sections.

For each of the tests, a consistent set of delays for 25 junctions across the highway network are presented in table format in addition to a graphic showing all junction delays at a proportional scale. The delays presented in these plots and tables are the average delay in seconds encountered by each vehicle arriving at a junction in the peak hour. This is not necessarily reflective of delays on each arm of the junction, but is useful as a diagnostic tool for assessing and for sifting problem junctions. Figure 3 shows the location of the standard junction outputs.

Figure 3 – Key Junctions Analysed



Additionally, journey time comparisons are displayed for highway links within the model. These are presented for a variety of routes (see Figure 4) in tabular format. The extent of journey times cover the key corridors, radials and central Ipswich area and are designed to provide an overview of changing journey times in each scenario.

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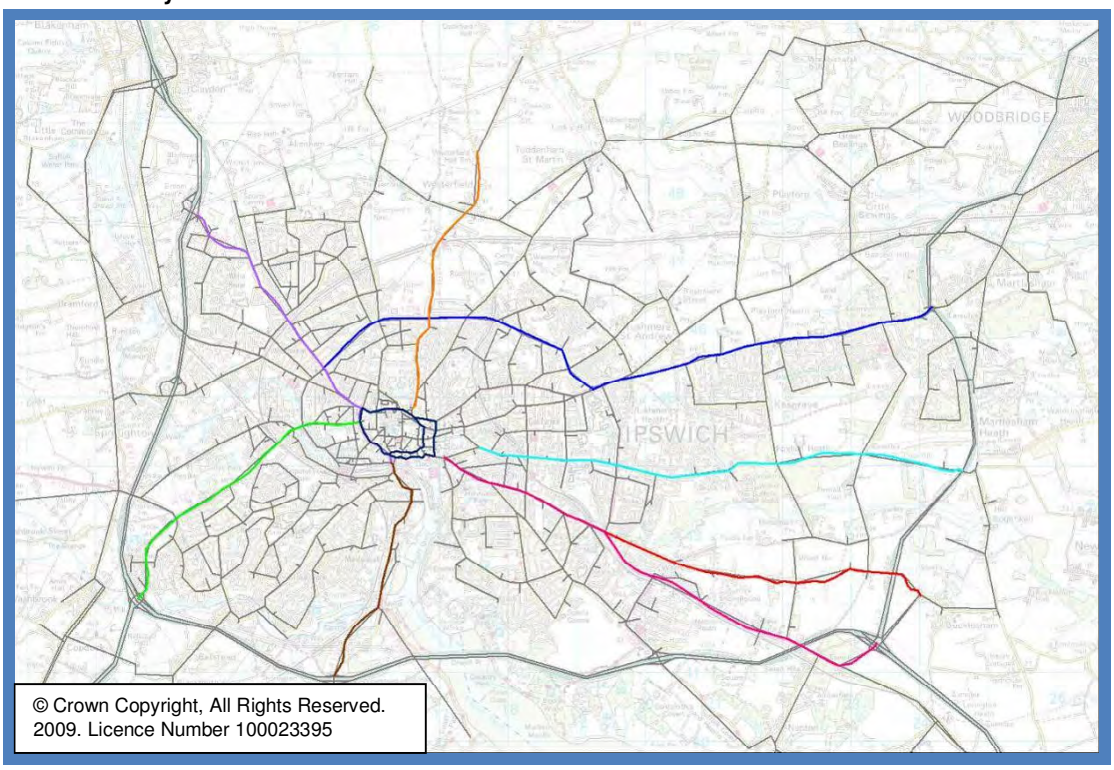
Figure 4 – Journey Time routes assessed



The journey time routes can be described as follows:

- A1214 London Road (Green) – Following the A1214 London Road from A14 junction 55, then continuing along the route of the A1071 between Yarmouth Road and Civic Drive
- A1214 Valley Road (Blue) – Routeing across northern Ipswich from the junction of the A1214 and A1156 at Valley Road/Bury Road and then routeing along the A1214 to the roundabout with the A12 at Martlesham Heath.
- Bucklesham Road (Red) – The route of Bucklesham Road between the A1156 Felixstowe Road and Main Road, Bucklesham.
- Felixstowe Road (Pink) – Along the A1156 between the roundabout of Fore Street and Duke Street in the west to junction 58 of the A14 in the east.
- Foxhall Road (Cyan) – Along the route of Foxhall Road, between Back Hamlet in the west and the roundabout with the A12 in the east.
- Inner Ring Road (Teal) – Following the inner ring road both clockwise and anti-clockwise, including Crown Street, Grimwade Street, College Street and Civic Drive amongst others.
- Norwich Road (Purple) – Following the A1156 from junction 53 of the A14 (Bury Road) to the roundabout of the A1156 and the A1022 Civic Drive.

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- Westerfield Road (Orange) – Along the B1077 between St. Margaret's Green (south) and Hall Lane (north)

- Wherstead Road (Brown) – Along the A137 Wherstead Road between Grafton Way (north) and junction 56 of the A14 (south).

Further journey time analysis is possible for each route. By presenting the cumulative journey time and distance travelled graphically for each route, it is feasible to provide a comparison at a section level between scenarios. These have been presented for a number of the competing routes of the infrastructure tests where relevant.

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3.1. 2021 'Do Minimum' – growth aligned with the RSS

Table 1 shows the average junction delay per vehicle for the 20 largest junction delays in the AM peak hour; these are also represented by bandwidth circles with radii proportional to delays in Figure 5. These are repeated for the PM peak hour in Table 2 and Figure 6.

Table 1 – Average junction delay (seconds), AM peak, 2021 'Do Minimum'

Node	2008	2021 DM	Location
Town Centre			
10018	66	108	Signals of Star Lane / Grimwade Street
10020	36	113	Signals of Argyle Street / Grimwade Street / St Helens Street
10049	60	66	Signals of Bond Street / St Helens Street
10061	23	77	Priority Junction of Fore Street EB / Grimwade Street
10062	39	3	Priority Junction of Grimwade Street / Fore Street EB
20014	53	73	Signals of London Road / Yarmouth Road / Handford Road / West End Road
20015	67	69	Signals of A1071 Handford Road / London Road
20069	42	80	Signals of St Helens Street / Warwick Road / Spring Road / Grove Lane
East			
20077	62	72	Signals of Derby Road / Foxhall Road
30407	50	83	Signals of A12 NB / Main Road / Park and ride exit
20057	31	41	Signals of Sidegate Lane / Nelson Road / Woodbridge Road
30240	28	37	Signals of Maryon Road / Nacton Road
30407	50	83	Signals of A12 NB / Main Road / Park and ride exit
West			
30142	43	79	Signals of B1067 Bramford Road / Sproughton Road
30155	71	61	Signals of London Road / Sprites Lane / A1071
30024	1	2	Priority Junction of
30025	1	2	Priority Junction of
20025	34	53	Signals of Bramford Road / A1214 Yarmouth Road / A1214 Chevallier Street
30124	60	52	Signals of A1156 Bury Road / Old Norwich Road / A1156 Norwich Road
P1 Development vicinity			
20044	63	72	Signals of Hanley Road / A1214 Valley Road
20047	8	34	Roundabout of A1214 Valley Road / B1077 Westerfield Road
Copdock			
30044	61	61	Signals of A1214 / A14 EB off slip
30045	6	73	Priority Junction of A12 NB / Copdock Gyratory
30046	7	118	Priority Junction of Copdock A14 WB / Gyratory

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Figure 5 – Average junction delay, AM peak, 2021 'Do Minimum'

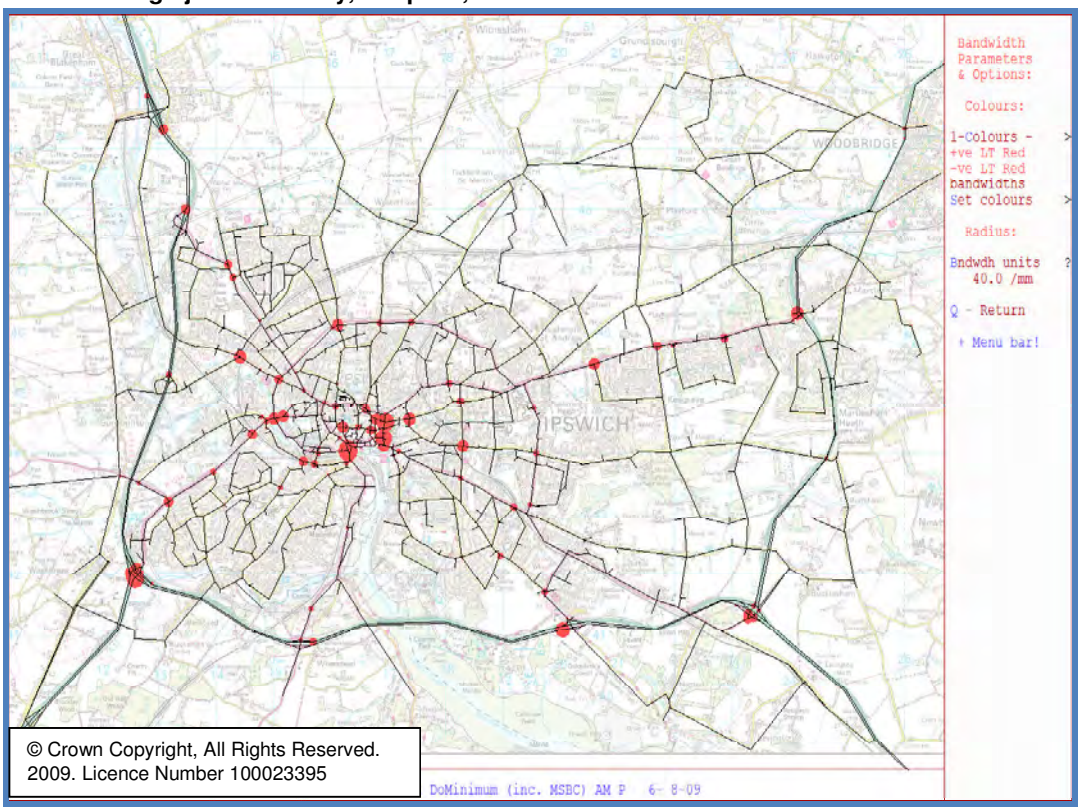

Table 2 – Average junction delay (seconds), PM peak, 2021 'Do Minimum'

Node	2008	2021 DM	Location
Town Centre			
10018	83	221	Signals of Star Lane / Grimwade Street
10020	44	82	Signals of Argyle Street / Grimwade Street / St Helens Street
10049	38	68	Signals of Bond Street / St Helens Street
10061	8	8	Priority Junction of Fore Street EB / Grimwade Street
10062	4	65	Priority Junction of Grimwade Street / Fore Street EB
20014	81	135	Signals of London Road / Yarmouth Road / Handford Road / West End Road
20015	51	81	Signals of A1071 Handford Road / London Road
20069	37	89	Signals of St Helens Street / Warwick Road / Spring Road / Grove Lane
East			
20077	59	98	Signals of Derby Road / Foxhall Road
30407	18	32	Signals of A12 NB / Main Road / Park and ride exit
20057	42	91	Signals of Sidegate Lane / Nelson Road / Woodbridge Road
30240	63	95	Signals of Maryon Road / Nacton Road
30407	18	32	Signals of A12 NB / Main Road / Park and ride exit

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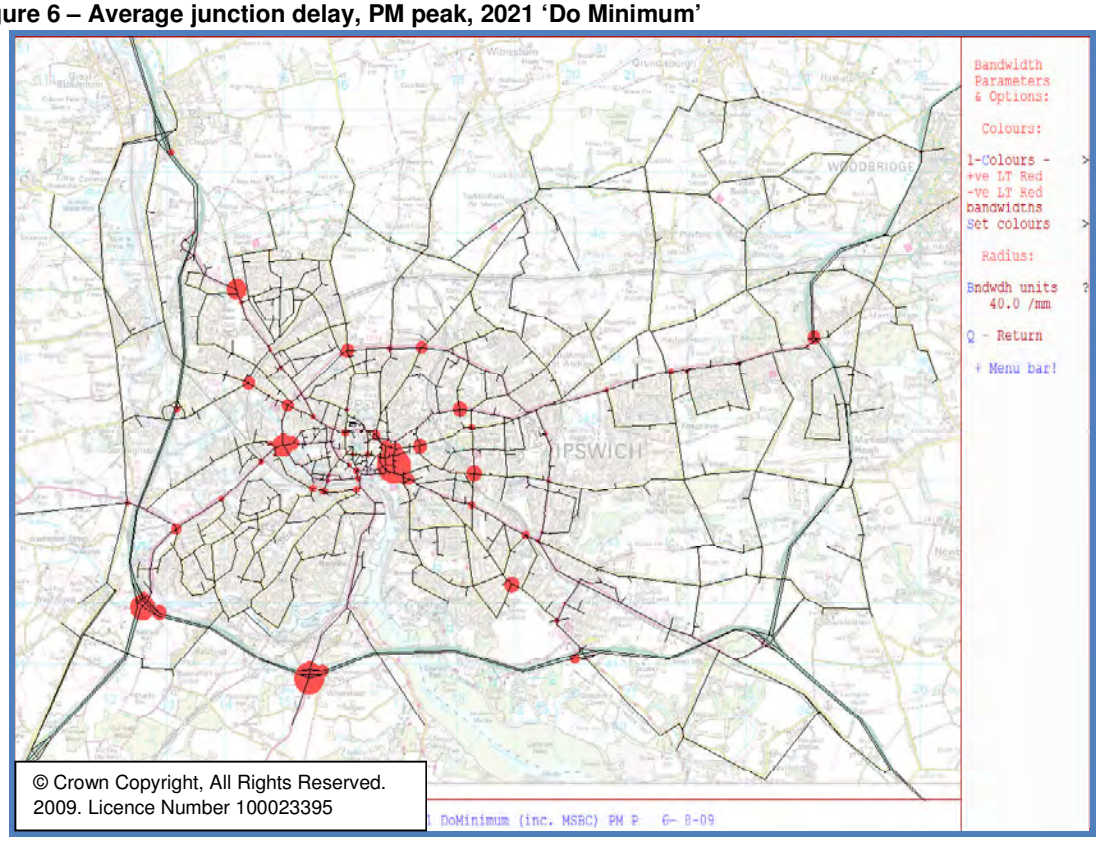
Node	2008	2021 DM	Location
West			
30142	60	80	Signals of B1067 Bramford Road / Sproughton Road
30155	67	65	Signals of London Road / Sprites Lane / A1071
30024	1	2	Priority Junction of
30025	1	2	Priority Junction of
20025	43	76	Signals of Bramford Road / A1214 Yarmouth Road / A1214 Chevallier Street
30124	53	129	Signals of A1156 Bury Road / Old Norwich Road / A1156 Norwich Road
P1 Development vicinity			
20044	70	82	Signals of Hanley Road / A1214 Valley Road
20047	9	32	Roundabout of A1214 Valley Road / B1077 Westerfield Road
Copdock			
30044	49	54	Signals of A1214 / A14 EB off slip
30045	4	59	Priority Junction of A12 NB / Copdock Gyratory
30046	12	165	Priority Junction of Copdock A14 WB / Gyratory

Figure 6 – Average junction delay, PM peak, 2021 'Do Minimum'



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Journey times have also been compared with 2008 for the routes previously specified. These are presented in tabular form in Table 3 for the AM and PM peak hours. Table 4 also notes the change in passenger car unit pcu-hours and pcu-kilometres across the entirety of the simulation network area (broadly that area shown in the delay plots).

Table 3 – Comparison of journey times (minutes), 2008, 2021 'Do Minimum'

Route	Direction	2008		2021 Do Min		Difference	
		AM	PM	AM	PM	AM	PM
A1214 Valley Road/ Woodbridge Road	Eastbound	19.34	20.16	21.28	23.40	1.95	3.24
	Westbound	21.54	20.46	23.95	21.87	2.42	1.41
A1214 London Road	Eastbound	11.15	10.84	12.02	12.30	0.88	1.46
	Westbound	10.47	11.96	9.33	11.18	-1.14	-0.78
Bucklesham Road	Eastbound	7.47	7.48	7.48	7.48	0.01	0.00
	Westbound	7.47	7.47	7.48	7.47	0.00	-0.00
Felixstowe Road	Eastbound	10.57	10.66	11.58	11.11	1.01	0.45
	Westbound	10.65	10.83	11.43	15.14	0.78	4.32
Foxhall Road	Eastbound	11.63	11.90	12.30	12.05	0.67	0.16
	Westbound	11.82	11.28	12.42	11.37	0.61	0.09
Inner Ring Road	Clockwise	10.37	10.89	13.26	14.89	2.89	3.99
	Anti-Clockwise	9.01	8.50	10.95	10.36	1.94	1.87
Norwich Road	Northbound	12.79	11.93	11.57	11.85	-1.21	-0.08
	Southbound	14.67	13.92	16.74	18.13	2.07	4.22
Westerfield Road	Northbound	8.09	8.12	8.13	8.24	0.05	0.12
	Southbound	7.03	7.01	7.10	7.04	0.07	0.03
Wherstead Road	Northbound	6.35	6.39	7.35	6.36	1.00	-0.04
	Southbound	6.13	6.16	6.13	6.11	0.01	-0.05

Table 4 – Comparison of simulation network statistics, 2008, 2021 'Do Minimum'

Time Period	2008	2021 'Do Minimum'	Absolute Difference	Percentage Difference
PCU-hours				
AM Peak hour	8,078	12,432	4,354	35%
PM Peak hour	8,209	13,014	4,806	37%
PCU-kilometres				
AM Peak hour	364,579	483,545	118,967	25%
PM Peak hour	370,843	486,619	115,776	24%

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3.2. 2021 'Do Minimum', with TravelSmart initiatives

Table 5 shows the average junction delay per vehicle for the 20 largest junction delays in the AM peak hour; these are also represented by bandwidth circles with radii proportional to delays in Figure 7. These are repeated for the PM peak hour in Table 6 and Figure 8.

Table 5 – Average junction delay (seconds), AM peak, 2021 TravelSmart

Node	2008	2021 TravelSmart	Location
Town Centre			
10018	66	104	Signals of Star Lane / Grimwade Street
10020	36	90	Signals of Argyle Street / Grimwade Street / St Helens Street
10049	60	58	Signals of Bond Street / St Helens Street
10061	23	78	Priority Junction of Fore Street EB / Grimwade Street
10062	39	76	Priority Junction of Grimwade Street / Fore Street EB
20014	53	68	Signals of London Road / Yarmouth Road / Handford Road / West End Road
20015	67	64	Signals of A1071 Handford Road / London Road
20069	42	76	Signals of St Helens Street / Warwick Road / Spring Road / Grove Lane
East			
20077	62	67	Signals of Derby Road / Foxhall Road
30407	50	78	Signals of A12 NB / Main Road / Park and ride exit
20057	31	38	Signals of Sidegate Lane / Nelson Road / Woodbridge Road
30240	28	32	Signals of Maryon Road / Nacton Road
30407	50	78	Signals of A12 NB / Main Road / Park and ride exit
West			
30142	43	75	Signals of B1067 Bramford Road / Sproughton Road
30155	71	59	Signals of London Road / Sprites Lane / A1071
30024	1	2	Priority Junction of
30025	1	2	Priority Junction of
20025	34	50	Signals of Bramford Road / A1214 Yarmouth Road / A1214 Chevallier Street
30124	60	48	Signals of A1156 Bury Road / Old Norwich Road / A1156 Norwich Road
P1 Development vicinity			
20044	63	67	Signals of Hanley Road / A1214 Valley Road
20047	8	24	Roundabout of A1214 Valley Road / B1077 Westerfield Road
Copdock			
30044	61	55	Signals of A1214 / A14 EB off slip
30045	6	70	Priority Junction of A12 NB / Copdock Gyratory
30046	7	112	Priority Junction of Copdock A14 WB / Gyratory

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Figure 7 - Average Junction Delay, AM 2021 Travel Smart

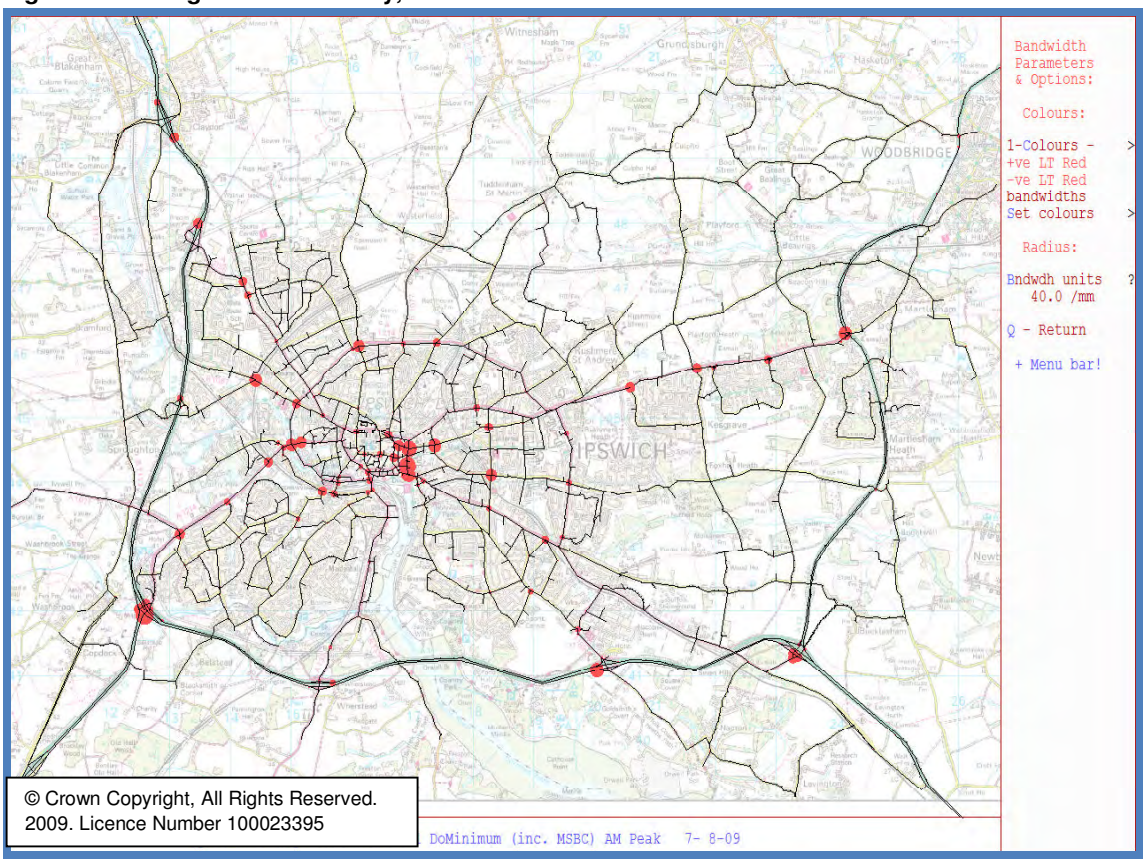

Table 6 - Average junction delay (seconds), PM peak, 2021 TravelSmart

Node	2008	2021 TravelSmart	Location
Town Centre			
10018	83	168	Signals of Star Lane / Grimwade Street
10020	44	69	Signals of Argyle Street / Grimwade Street / St Helens Street
10049	38	51	Signals of Bond Street / St Helens Street
10061	8	39	Priority Junction of Fore Street EB / Grimwade Street
10062	4	53	Priority Junction of Grimwade Street / Fore Street EB
20014	81	112	Signals of London Road / Yarmouth Road / Handford Road / West End Road
20015	51	79	Signals of A1071 Handford Road / London Road
20069	37	72	Signals of St Helens Street / Warwick Road / Spring Road / Grove Lane
East			
20077	59	76	Signals of Derby Road / Foxhall Road
30407	18	35	Signals of A12 NB / Main Road / Park and ride exit
20057	42	68	Signals of Sidegate Lane / Nelson Road / Woodbridge

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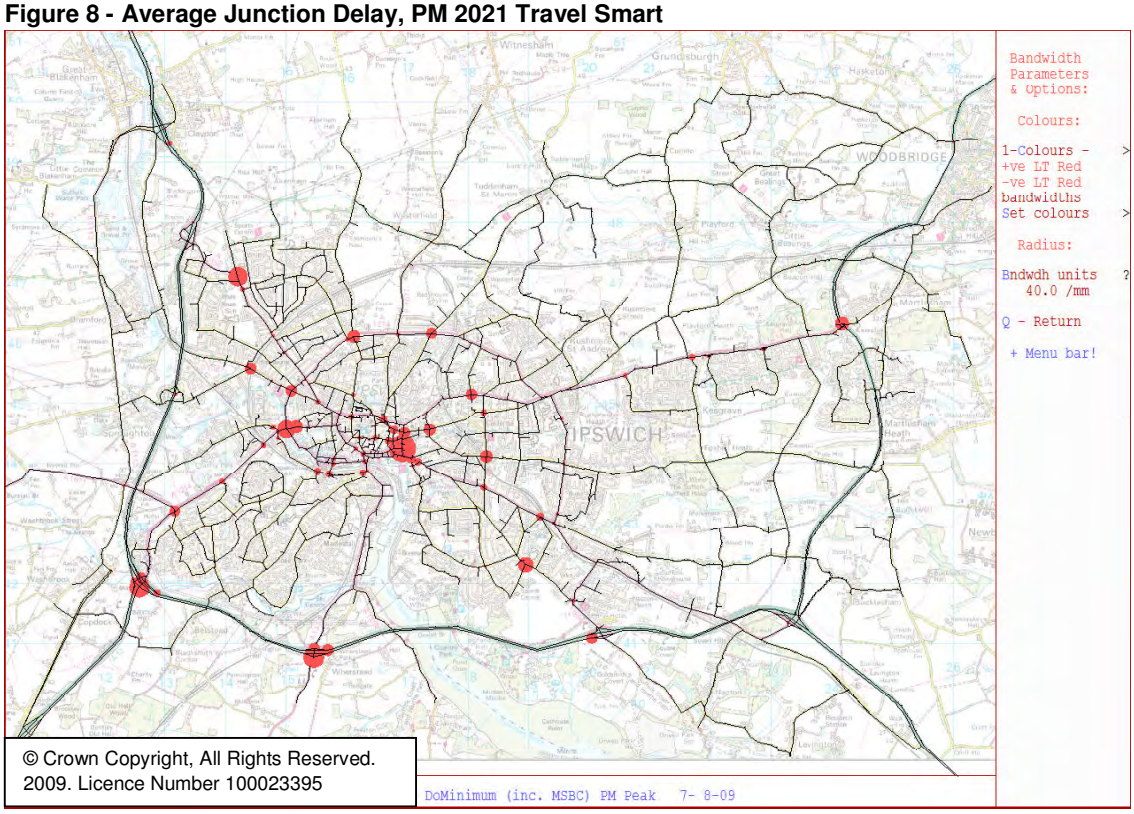
Node	2008	2021 TravelSmart	Location
			Road
30240	63	95	Signals of Maryon Road / Nacton Road
30407	18	35	Signals of A12 NB / Main Road / Park and ride exit
West			
30142	60	70	Signals of B1067 Bramford Road / Sproughton Road
30155	67	64	Signals of London Road / Sprites Lane / A1071
30024	1	1	Priority Junction of
30025	1	1	Priority Junction of
20025	43	70	Signals of Bramford Road / A1214 Yarmouth Road / A1214 Chevallier Street
30124	53	119	Signals of A1156 Bury Road / Old Norwich Road / A1156 Norwich Road
P1 Development vicinity			
20044	70	76	Signals of Hanley Road / A1214 Valley Road
20047	9	21	Roundabout of A1214 Valley Road / B1077 Westerfield Road
Copdock			
30044	49	53	Signals of A1214 / A14 EB off slip
30045	4	50	Priority Junction of A12 NB / Copdock Gyratory
30046	12	127	Priority Junction of Copdock A14 WB / Gyratory

Figure 8 - Average Junction Delay, PM 2021 Travel Smart



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Journey times have also been compared with 2021 Travel Smart for the routes previously specified. These are presented in tabular form in Table 7 for the AM and PM peak hours. Table 8 also notes the change in passenger car unit pcu -hours and pcu-kilometres across the entirety of the simulation network area (broadly that area shown in the delay plots).

Table 7 - Comparison of journey times (minutes), 2021 TravelSmart and 2021 'Do Minimum'

Route	Direction	2021 TravelSmart		2021, 'Do Minimum'		Difference	
		AM	PM	AM	PM	AM	PM
A1214 Valley Road/ Woodbridge Road	Eastbound	21.00	22.43	21.28	23.40	0.29	0.97
	Westbound	23.03	21.36	23.95	21.87	0.92	0.51
A1214 London Road	Eastbound	11.52	12.13	12.02	12.30	0.50	0.17
	Westbound	9.30	10.81	9.33	11.18	0.03	0.37
Bucklesham Road	Eastbound	7.48	7.48	7.48	7.48	0.00	0.00
	Westbound	7.47	7.47	7.48	7.47	0.00	0.00
Felixstowe Road	Eastbound	11.52	10.79	11.58	11.11	0.06	0.32
	Westbound	11.53	13.89	11.43	15.14	-0.10	1.25
Foxhall Road	Eastbound	12.12	12.57	12.30	12.05	0.19	-0.52
	Westbound	12.31	11.37	12.42	11.37	0.11	0.00
Inner Ring Road	Clockwise	13.94	14.03	13.26	14.89	-0.68	0.86
	Anti-Clockwise	10.70	9.37	10.95	10.36	0.24	1.00
Norwich Road	Northbound	11.26	11.77	11.57	11.85	0.31	0.09
	Southbound	16.10	16.83	16.74	18.13	0.64	1.31
Westerfield Road	Northbound	8.12	8.22	8.13	8.24	0.01	0.02
	Southbound	7.06	7.03	7.10	7.04	0.03	0.01
Wherstead Road	Northbound	6.95	6.37	7.35	6.36	0.39	-0.01
	Southbound	6.15	6.10	6.13	6.11	-0.02	0.01

Table 8 - Comparison of simulation network statistics, 2021 'Do Minimum' and 2021 Travel Smart

Time Period	2021 TravelSmart	2021 'Do Minimum'	Absolute Difference	Percentage Difference
PCU-hours				
AM Peak hour	11,949	12,432	484	4%
PM Peak hour	12,191	13,014	824	6%
PCU-kilometres				
AM Peak hour	475,370	483,545	8,175	2%
PM Peak hour	477,972	486,619	8,646	2%

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3.3. 2021 TravelSmart base, with northern fringe (P1) development

Table 9 shows the average junction delay per vehicle for the 20 largest junction delays in the AM peak hour; these are also represented by bandwidth circles with radii proportional to delays in Figure 9. These are repeated for the PM peak hour in Table 10 and Figure 10.

Table 9 – Average junction delay (seconds), AM peak, 2021 with P1 development

Node	2008	2021 P1 Development	Location
Town Centre			
10018	66	106	Signals of Star Lane / Grimwade Street
10020	36	144	Signals of Argyle Street / Grimwade Street / St Helens Street
10049	60	68	Signals of Bond Street / St Helens Street
10061	23	85	Priority Junction of Fore Street EB / Grimwade Street
10062	39	95	Priority Junction of Grimwade Street / Fore Street EB
20014	53	80	Signals of London Road / Yarmouth Road / Handford Road / West End Road
20015	67	65	Signals of A1071 Handford Road / London Road
20069	42	84	Signals of St Helens Street / Warwick Road / Spring Road / Grove Lane
East			
20077	62	79	Signals of Derby Road / Foxhall Road
30407	50	86	Signals of A12 NB / Main Road / Park and ride exit
20057	31	40	Signals of Sidegate Lane / Nelson Road / Woodbridge Road
30240	28	38	Signals of Maryon Road / Nacton Road
30407	50	86	Signals of A12 NB / Main Road / Park and ride exit
West			
30142	43	64	Signals of B1067 Bramford Road / Sproughton Road
30155	71	58	Signals of London Road / Sprites Lane / A1071
30024	1	2	Priority Junction of
30025	1	2	Priority Junction of
20025	34	59	Signals of Bramford Road / A1214 Yarmouth Road / A1214 Chevallier Street
30124	60	52	Signals of A1156 Bury Road / Old Norwich Road / A1156 Norwich Road
P1 Development vicinity			
20044	63	93	Signals of Hanley Road / A1214 Valley Road
20047	8	74	Roundabout of A1214 Valley Road / B1077 Westerfield Road
Copdock			
30044	61	63	Signals of A1214 / A14 EB off slip
30045	6	80	Priority Junction of A12 NB / Copdock Gyratory
30046	7	125	Priority Junction of Copdock A14 WB / Gyratory

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Figure 9 - Average Junction Delay, AM Peak, 2021 with P1 development

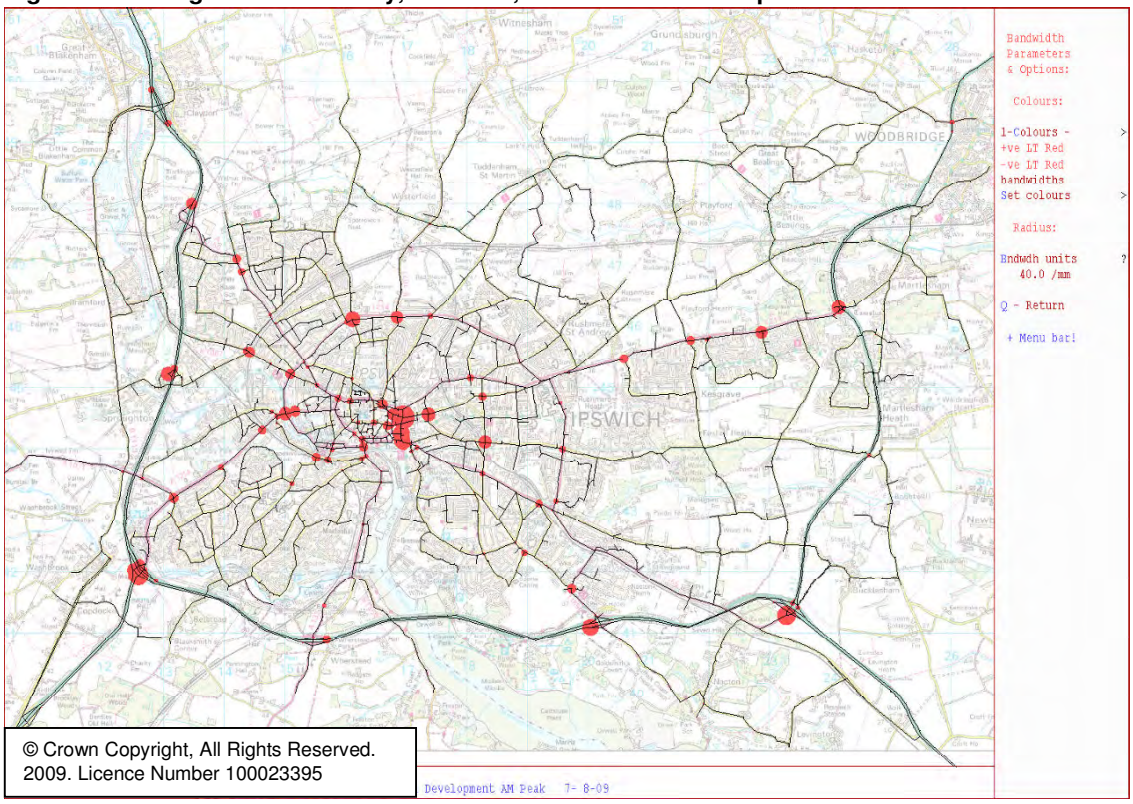

Table 10 - Average junction delay (seconds), PM peak, 2021 with P1 development

Node	2008	2021 P1 Development	Location
Town Centre			
10018	83	224	Signals of Star Lane / Grimwade Street
10020	44	80	Signals of Argyle Street / Grimwade Street / St Helens Street
10049	38	87	Signals of Bond Street / St Helens Street
10061	8	63	Priority Junction of Fore Street EB / Grimwade Street
10062	4	6	Priority Junction of Grimwade Street / Fore Street EB
20014	81	144	Signals of London Road / Yarmouth Road / Handford Road / West End Road
20015	51	111	Signals of A1071 Handford Road / London Road
20069	37	63	Signals of St Helens Street / Warwick Road / Spring Road / Grove Lane
East			
20077	59	87	Signals of Derby Road / Foxhall Road
30407	18	35	Signals of A12 NB / Main Road / Park and ride exit
20057	42	82	Signals of Sidegate Lane / Nelson Road / Woodbridge Road

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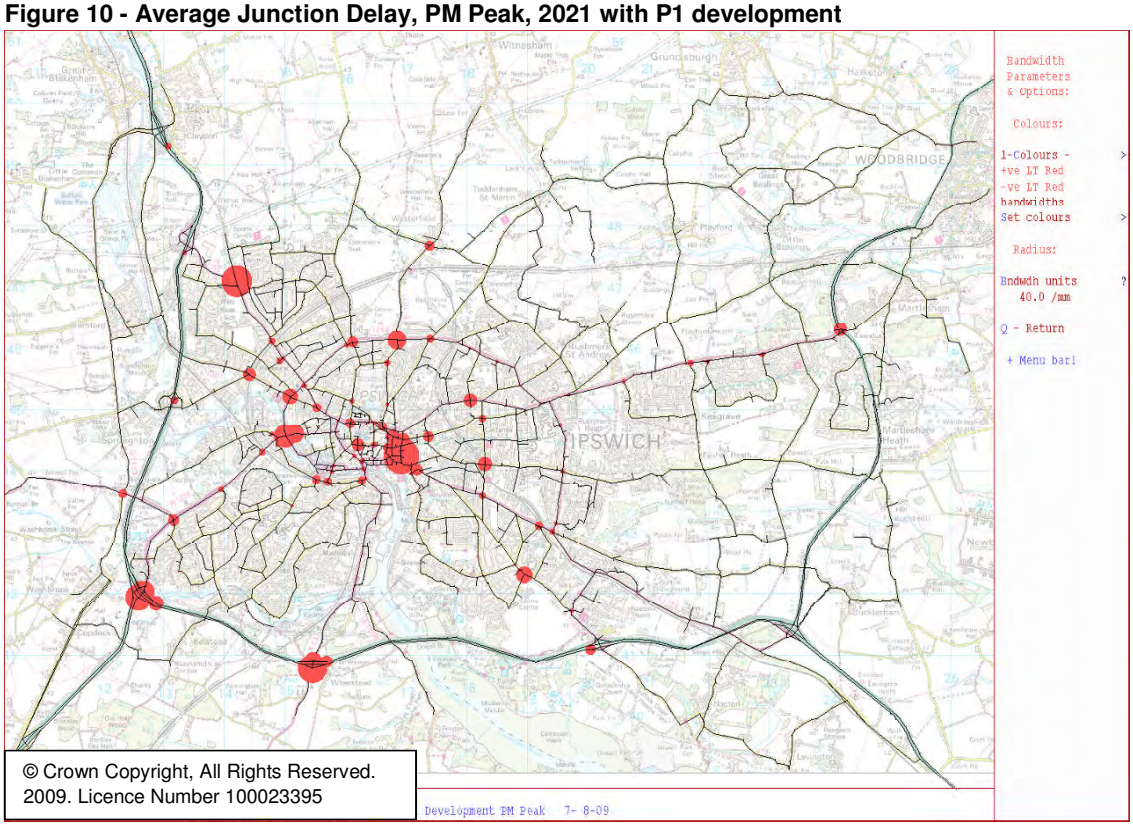
Node	2008	2021 P1 Development	Location
30240	63	101	Signals of Maryon Road / Nacton Road
30407	18	35	Signals of A12 NB / Main Road / Park and ride exit
West			
30142	60	79	Signals of B1067 Bramford Road / Sproughton Road
30155	67	68	Signals of London Road / Sprites Lane / A1071
30024	1	2	Priority Junction of
30025	1	2	Priority Junction of
20025	43	97	Signals of Bramford Road / A1214 Yarmouth Road / A1214 Chevallier Street
30124	53	194	Signals of A1156 Bury Road / Old Norwich Road / A1156 Norwich Road
P1 Development vicinity			
20044	70	65	Signals of Hanley Road / A1214 Valley Road
20047	9	116	Roundabout of A1214 Valley Road / B1077 Westerfield Road
Copdock			
30044	49	69	Signals of A1214 / A14 EB off slip
30045	4	62	Priority Junction of A12 NB / Copdock Gyratory
30046	12	166	Priority Junction of Copdock A14 WB / Gyratory

Figure 10 - Average Junction Delay, PM Peak, 2021 with P1 development



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Journey times have also been compared with 2021 Travel Smart for the routes previously specified. These are presented in tabular form in Table 11 for the AM and PM peak hours.

Table 12 also notes the change in passenger car unit pcu -hours and pcu-kilometres across the entirety of the simulation network area (broadly that area shown in the delay plots).

Table 11 - Comparison of journey times (minutes), 2021 TravelSmart and 2021 with P1 development

Route	Direction	2021 TravelSmart		2021, P1		Difference	
		AM	PM	AM	PM	AM	PM
A1214 Valley Road/ Woodbridge Road	Eastbound	21.00	22.43	21.72	23.80	0.73	1.37
	Westbound	23.03	21.36	24.35	23.76	1.32	2.40
A1214 London Road	Eastbound	11.52	12.13	11.48	13.59	-0.04	1.46
	Westbound	9.30	10.81	9.48	11.51	0.18	0.70
Bucklesham Road	Eastbound	7.48	7.48	7.49	7.48	0.00	0.00
	Westbound	7.47	7.47	7.48	7.47	0.00	0.00
Felixstowe Road	Eastbound	11.52	10.79	13.07	10.83	1.55	0.05
	Westbound	11.53	13.89	11.50	15.45	-0.03	1.56
Foxhall Road	Eastbound	12.12	12.57	12.55	13.01	0.44	0.45
	Westbound	12.31	11.37	12.69	11.51	0.39	0.14
Inner Ring Road	Clockwise	13.94	14.03	15.54	16.18	1.61	2.15
	Anti-Clockwise	10.70	9.37	11.45	9.91	0.75	0.54
Norwich Road	Northbound	11.26	11.77	11.32	12.21	0.06	0.44
	Southbound	16.10	16.83	17.66	19.38	1.56	2.56
Westerfield Road	Northbound	8.12	8.22	8.19	9.36	0.07	1.14
	Southbound	7.06	7.03	8.40	7.08	1.33	0.05
Wherstead Road	Northbound	6.95	6.37	7.28	6.39	0.32	0.03
	Southbound	6.15	6.10	6.17	6.11	0.02	0.00

Table 12 - Comparison of simulation network statistics, 2021 Travel Smart and 2021 TravelSmart with P1 development

Time Period	2021 TravelSmart	2021 P1 Development	Absolute Difference	Percentage Difference
PCU-hours				
AM Peak hour	11,949	12,896	9,474	7%
PM Peak hour	12,191	13,724	1,533	11%
PCU-kilometres				
AM Peak hour	475,370	489,706	14,336	3%
PM Peak hour	477,972	496,108	18,136	4%

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3.4. 2021 with P1 development and strong sustainable transport policies (-20%)

Table 13 shows the average junction delay per vehicle for the 20 largest junction delays in the AM peak hour; these are also represented by bandwidth circles with radii proportional to delays in Figure 11. These are repeated for the PM peak hour in Table 14 and Figure 12.

Table 13 - Average junction delay (seconds), AM peak, 2021 with P1 (-20%)

Node	2008	2021 P1 -20%	Location
Town Centre			
10018	66	108	Signals of Star Lane / Grimwade Street
10020	36	128	Signals of Argyle Street / Grimwade Street / St Helens Street
10049	60	64	Signals of Bond Street / St Helens Street
10061	23	79	Priority Junction of Fore Street EB / Grimwade Street
10062	39	79	Priority Junction of Grimwade Street / Fore Street EB
20014	53	78	Signals of London Road / Yarmouth Road / Handford Road / West End Road
20015	67	68	Signals of A1071 Handford Road / London Road
20069	42	85	Signals of St Helens Street / Warwick Road / Spring Road / Grove Lane
East			
20077	62	72	Signals of Derby Road / Foxhall Road
30407	50	89	Signals of A12 NB / Main Road / Park and ride exit
20057	31	38	Signals of Sidegate Lane / Nelson Road / Woodbridge Road
30240	28	38	Signals of Maryon Road / Nacton Road
30407	50	89	Signals of A12 NB / Main Road / Park and ride exit
West			
30142	43	64	Signals of B1067 Bramford Road / Sproughton Road
30155	71	58	Signals of London Road / Sprites Lane / A1071
30024	1	2	Priority Junction of
30025	1	2	Priority Junction of
20025	34	55	Signals of Bramford Road / A1214 Yarmouth Road / A1214 Chevallier Street
30124	60	53	Signals of A1156 Bury Road / Old Norwich Road / A1156 Norwich Road
P1 Development vicinity			
20044	63	90	Signals of Hanley Road / A1214 Valley Road
20047	8	56	Roundabout of A1214 Valley Road / B1077 Westerfield Road
Copdock			
30044	61	63	Signals of A1214 / A14 EB off slip
30045	6	80	Priority Junction of A12 NB / Copdock Gyratory
30046	7	124	Priority Junction of Copdock A14 WB / Gyratory

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Figure 11 - Average Junction Delay, AM 2021 TravelSmart P1 (-20%)

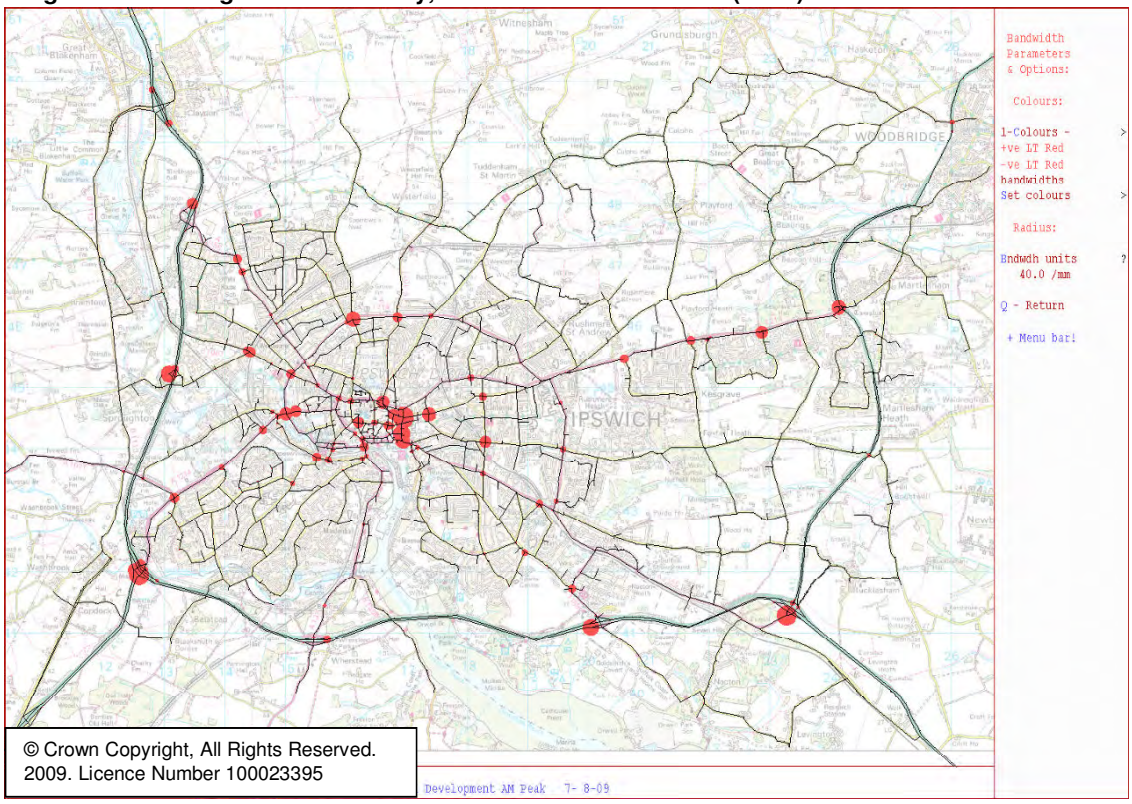

Table 14 - Average junction delay (seconds), PM peak, 2021 with P1 (-20%)

Node	2008	2021 P1 -20%	Location
Town Centre			
10018	83	200	Signals of Star Lane / Grimwade Street
10020	44	69	Signals of Argyle Street / Grimwade Street / St Helens Street
10049	38	82	Signals of Bond Street / St Helens Street
10061	8	70	Priority Junction of Fore Street EB / Grimwade Street
10062	4	79	Priority Junction of Grimwade Street / Fore Street EB
20014	81	145	Signals of London Road / Yarmouth Road / Handford Road / West End Road
20015	51	116	Signals of A1071 Handford Road / London Road
20069	37	82	Signals of St Helens Street / Warwick Road / Spring Road / Grove Lane
East			
20077	59	88	Signals of Derby Road / Foxhall Road
30407	18	25	Signals of A12 NB / Main Road / Park and ride exit
20057	42	70	Signals of Sidegate Lane / Nelson Road / Woodbridge Road
30240	63	99	Signals of Maryon Road / Nacton Road

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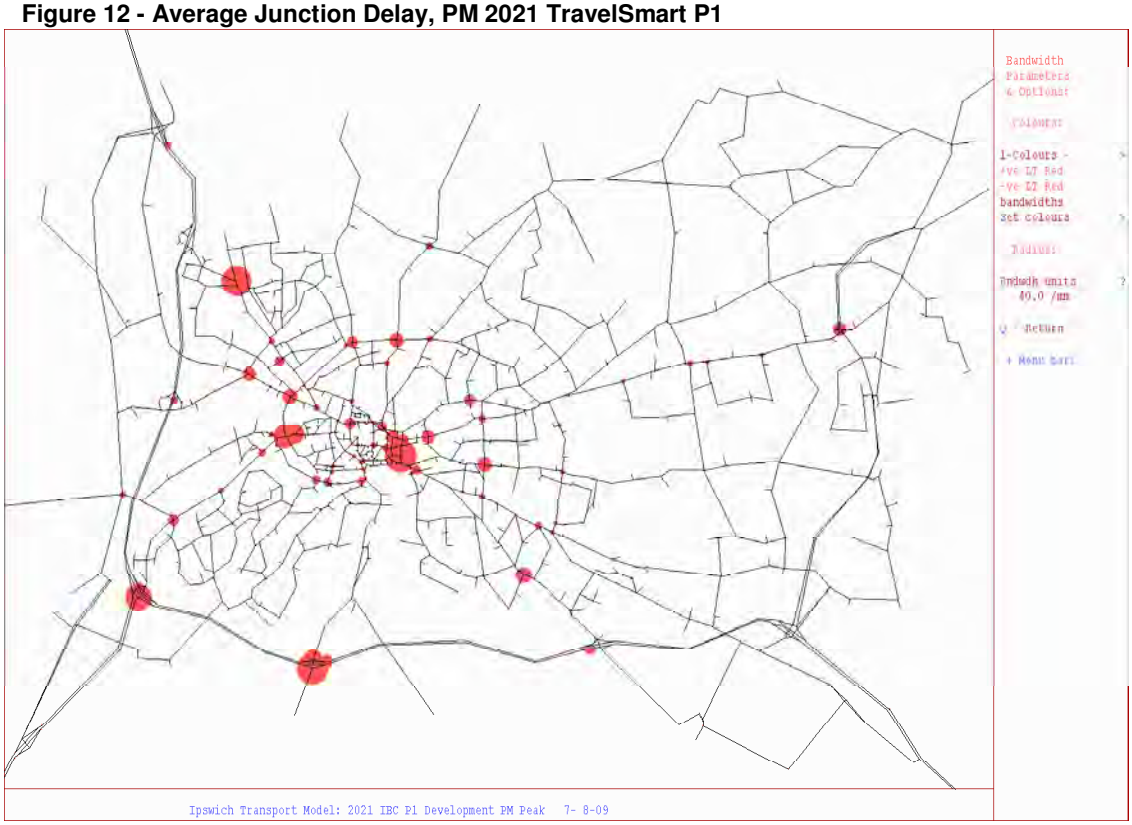
Node	2008	2021 P1 -20%	Location
30407	18	25	Signals of A12 NB / Main Road / Park and ride exit
West			
30142	60	80	Signals of B1067 Bramford Road / Sproughton Road
30155	67	66	Signals of London Road / Sprites Lane / A1071
30024	1	2	Priority Junction of
30025	1	2	Priority Junction of
20025	43	92	Signals of Bramford Road / A1214 Yarmouth Road / A1214 Chevallier Street
30124	53	188	Signals of A1156 Bury Road / Old Norwich Road / A1156 Norwich Road
P1 Development vicinity			
20044	70	66	Signals of Hanley Road / A1214 Valley Road
20047	9	88	Roundabout of A1214 Valley Road / B1077 Westerfield Road
Copdock			
30044	49	49	Signals of A1214 / A14 EB off slip
30045	4	64	Priority Junction of A12 NB / Copdock Gyratory
30046	12	166	Priority Junction of Copdock A14 WB / Gyratory

Figure 12 - Average Junction Delay, PM 2021 TravelSmart P1



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Journey times have also been compared with 2021 Travel Smart P1 development for the routes previously specified. These are presented in tabular form in Table 15 for the AM and PM peak hours. Table 16 also notes the change in passenger car unit pcu -hours and pcu-kilometres across the entirety of the simulation network area (broadly that area shown in the delay plots).

Table 15 - Comparison of journey times (minutes), 2021 with P1 development and 2021 TravelSmart P1 (-20%)

Route	Direction	2021, P1		2021, P1 -20%		Difference	
		AM	PM	AM	PM	AM	PM
A1214 Valley Road/ Woodbridge Road	Eastbound	21.72	23.80	21.70	23.05	-0.02	-0.75
	Westbound	24.35	23.76	23.97	23.22	-0.38	-0.54
A1214 London Road	Eastbound	11.48	13.59	11.54	13.98	0.05	0.39
	Westbound	9.48	11.51	9.48	11.44	0.01	-0.08
Bucklesham Road	Eastbound	7.49	7.48	7.49	7.48	0.00	0.00
	Westbound	7.48	7.47	7.48	7.47	0.00	0.00
Felixstowe Road	Eastbound	13.07	10.83	13.99	11.63	0.93	0.79
	Westbound	11.50	15.45	11.45	13.36	-0.05	-2.09
Foxhall Road	Eastbound	12.55	13.01	12.13	13.13	-0.42	0.12
	Westbound	12.69	11.51	12.35	11.44	-0.34	-0.07
Inner Ring Road	Clockwise	15.54	16.18	14.68	15.61	-0.86	-0.58
	Anti-Clockwise	11.45	9.91	11.01	9.71	-0.44	-0.20
Norwich Road	Northbound	11.32	12.21	11.30	11.96	-0.03	-0.25
	Southbound	17.66	19.38	17.02	19.13	-0.63	-0.25
Westerfield Road	Northbound	8.19	9.36	8.18	8.72	-0.01	-0.64
	Southbound	8.40	7.08	7.81	7.08	-0.59	0.00
Wherstead Road	Northbound	7.28	6.39	7.23	6.37	-0.05	-0.03
	Southbound	6.17	6.11	6.17	6.11	0.00	0.01

Table 16 - Comparison of simulation network statistics, 2021 TravelSmart with P1 development and 2021 TravelSmart P1 (-20%)

Time Period	2021 P1 Development	2021 P1 (-20%)	Absolute Difference	Percentage Difference
PCU-hours				
AM Peak hour	12,896	12,760	-136	-1%
PM Peak hour	13,724	13,313	-411	-3%
PCU-kilometres				
AM Peak hour	489,706	488,097	-1609	0%
PM Peak hour	496,108	493,273	-2835	-1%

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3.5. 2021 with P1 -20% and Wet Dock crossing (Dual-Bridge permutation)

Table 17 shows the average junction delay per vehicle for the 20 largest junction delays in the AM peak hour; these are also represented by bandwidth circles with radii proportional to delays in Figure 13. These are repeated for the PM peak hour in Table 18 and Figure 14.

Table 17 - Average junction delay (seconds), AM peak, 2021 with P1 (-20%) and Wet Dock Dual Bridge

Node	2008	2021 Wet Dock (Dual)	Location
Town Centre			
10018	66	28	Signals of Star Lane / Grimwade Street
10020	36	46	Signals of Argyle Street / Grimwade Street / St Helens Street
10049	60	58	Signals of Bond Street / St Helens Street
10061	23	24	Priority Junction of Fore Street EB / Grimwade Street
10062	39	16	Priority Junction of Grimwade Street / Fore Street EB
20014	53	77	Signals of London Road / Yarmouth Road / Handford Road / West End Road
20015	67	68	Signals of A1071 Handford Road / London Road
20069	42	43	Signals of St Helens Street / Warwick Road / Spring Road / Grove Lane
East			
20077	62	90	Signals of Derby Road / Foxhall Road
30407	50	80	Signals of A12 NB / Main Road / Park and ride exit
20057	31	29	Signals of Sidegate Lane / Nelson Road / Woodbridge Road
30240	28	45	Signals of Maryon Road / Nacton Road
30407	50	80	Signals of A12 NB / Main Road / Park and ride exit
West			
30142	43	56	Signals of B1067 Bramford Road / Sproughton Road
30155	71	58	Signals of London Road / Sprites Lane / A1071
30024	1	123	Priority Junction of
30025	1	60	Priority Junction of
20025	34	53	Signals of Bramford Road / A1214 Yarmouth Road / A1214 Chevallier Street
30124	60	52	Signals of A1156 Bury Road / Old Norwich Road / A1156 Norwich Road
P1 Development vicinity			
20044	63	79	Signals of Hanley Road / A1214 Valley Road
20047	8	31	Roundabout of A1214 Valley Road / B1077 Westerfield Road
Copdock			
30044	61	62	Signals of A1214 / A14 EB off slip
30045	6	96	Priority Junction of A12 NB / Copdock Gyratory
30046	7	174	Priority Junction of Copdock A14 WB / Gyratory

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Figure 13 - Average Junction Delay, AM 2021 TravelSmart P1 (-20%) and Wet Dock Dual Bridge

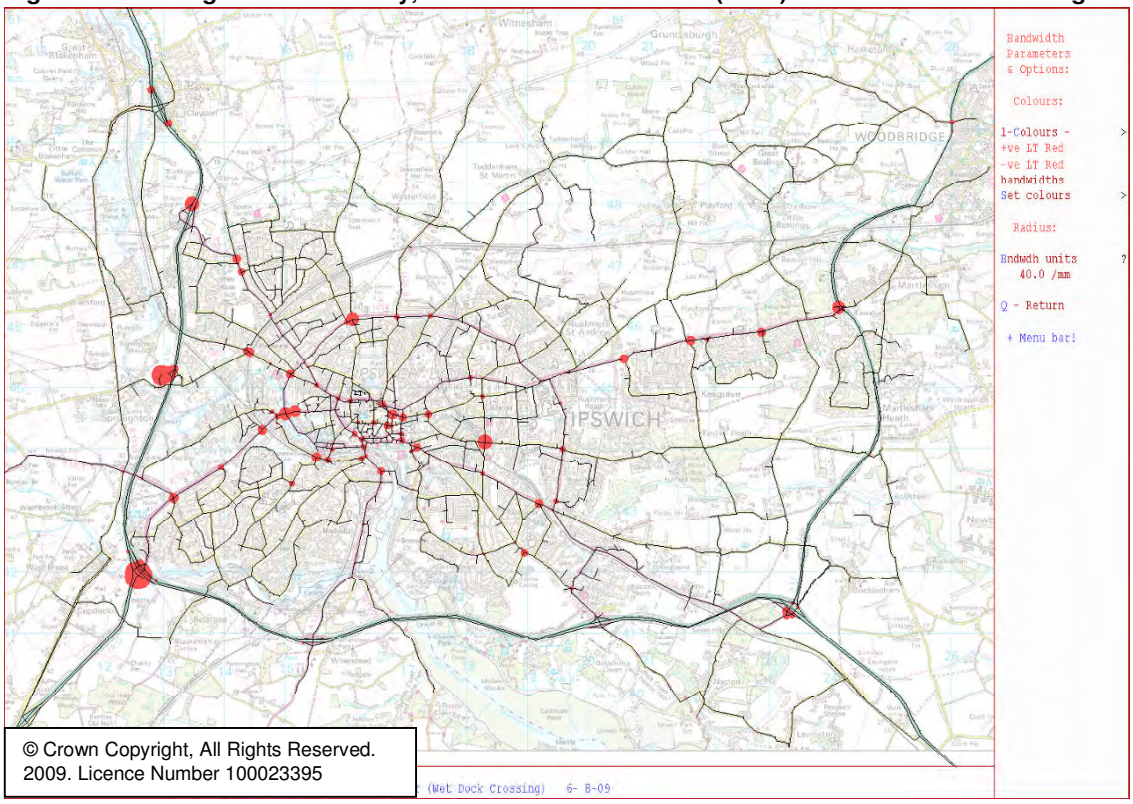

Table 18- Average junction delay (seconds), PM peak, 2021 with P1 (-20%) and Wet Dock Dual Bridge

Node	2008	2021 Wet Dock (Dual)	Location
Town Centre			
10018	83	47	Signals of Star Lane / Grimwade Street
10020	44	49	Signals of Argyle Street / Grimwade Street / St Helens Street
10049	38	44	Signals of Bond Street / St Helens Street
10061	8	24	Priority Junction of Fore Street EB / Grimwade Street
10062	4	3	Priority Junction of Grimwade Street / Fore Street EB
20014	81	116	Signals of London Road / Yarmouth Road / Handford Road / West End Road
20015	51	97	Signals of A1071 Handford Road / London Road
20069	37	39	Signals of St Helens Street / Warwick Road / Spring Road / Grove Lane
East			
20077	59	97	Signals of Derby Road / Foxhall Road
30407	18	48	Signals of A12 NB / Main Road / Park and ride exit
20057	42	55	Signals of Sidegate Lane / Nelson Road / Woodbridge Road

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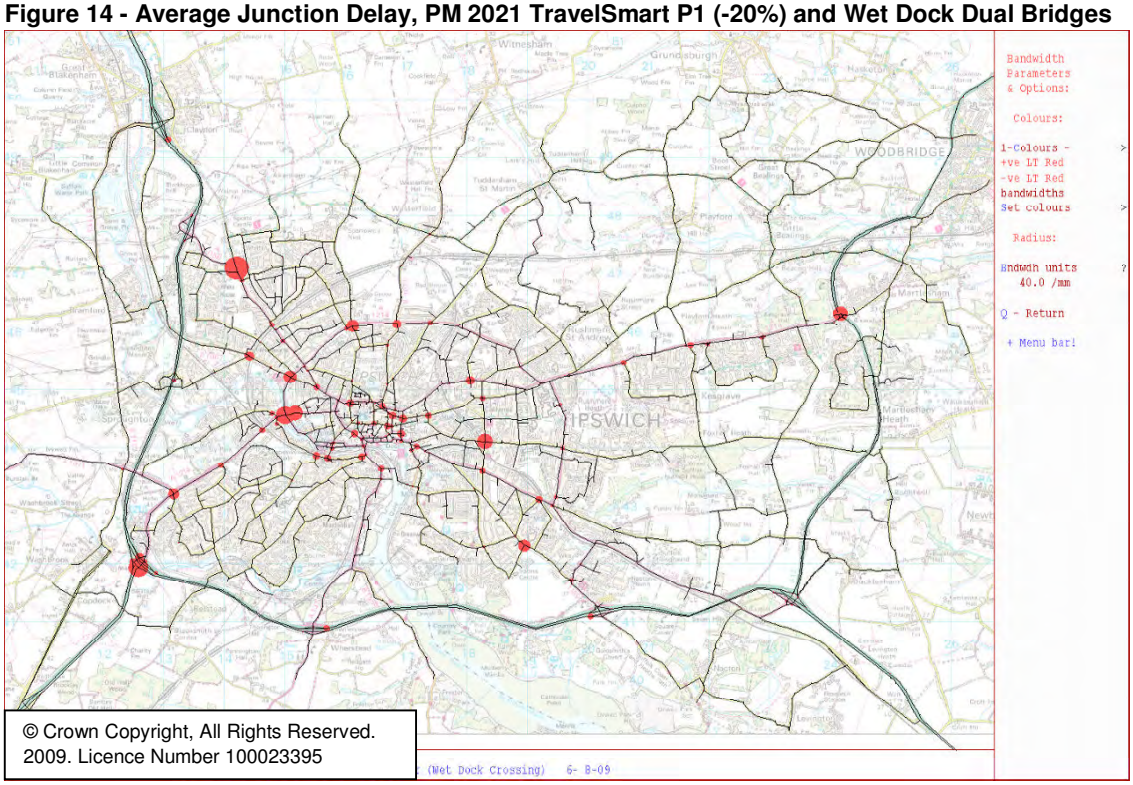
Node	2008	2021 Wet Dock (Dual)	Location
30240	63	75	Signals of Maryon Road / Nacton Road
30407	18	48	Signals of A12 NB / Main Road / Park and ride exit
West			
30142	60	57	Signals of B1067 Bramford Road / Sproughton Road
30155	67	67	Signals of London Road / Sprites Lane / A1071
30024	1	1	Priority Junction of
30025	1	1	Priority Junction of
20025	43	82	Signals of Bramford Road / A1214 Yarmouth Road / A1214 Chevallier Street
30124	53	152	Signals of A1156 Bury Road / Old Norwich Road / A1156 Norwich Road
P1 Development vicinity			
20044	70	77	Signals of Hanley Road / A1214 Valley Road
20047	9	53	Roundabout of A1214 Valley Road / B1077 Westerfield Road
Copdock			
30044	49	49	Signals of A1214 / A14 EB off slip
30045	4	50	Priority Junction of A12 NB / Copdock Gyratory
30046	12	122	Priority Junction of Copdock A14 WB / Gyratory

Figure 14 - Average Junction Delay, PM 2021 TravelSmart P1 (-20%) and Wet Dock Dual Bridges



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Journey times have also been compared with 2021 Travel Smart P1 (-20%) for the routes previously specified. These are presented in tabular form in Table 19 for the AM and PM peak hours. Table 20 also notes the change in passenger car unit pcu -hours and pcu-kilometres across the entirety of the simulation network area (broadly that area shown in the delay plots). Chart 1 demonstrates graphically the change in journey times for the inner ring road, the route with which the Wet Dock crossing is likely to most directly compete with and influence.

Table 19 - Comparison of journey times (minutes), 2021 TravelSmart P1 (-20%) and 2021 P1 development with Wet Dock Dual Bridges

Route	Direction	2021 Wet Dock Dual Bridge		2021 TravelSmart		Difference	
		AM	PM	AM	PM	AM	PM
A1214 Valley Road/ Woodbridge Road	Eastbound	20.92	22.03	21.00	22.43	0.08	0.40
	Westbound	22.64	21.80	23.03	21.36	0.40	-0.44
A1214 London Road	Eastbound	11.81	12.88	11.52	12.13	-0.29	-0.75
	Westbound	9.48	10.86	9.30	10.81	-0.18	-0.05
Bucklesham Road	Eastbound	7.48	7.48	7.48	7.48	0.00	-0.00
	Westbound	7.48	7.48	7.47	7.47	-0.01	-0.00
Felixstowe Road	Eastbound	12.02	11.79	12.32	11.61	0.30	-0.18
	Westbound	13.44	12.71	11.53	13.89	-1.91	1.19
Foxhall Road	Eastbound	12.36	13.13	12.12	12.57	-0.25	-0.56
	Westbound	13.85	11.57	12.31	11.37	-1.54	-0.20
Inner Ring Road	Clockwise	12.49	12.52	13.94	14.03	1.45	1.51
	Anti-Clockwise	9.73	9.07	10.70	9.37	0.97	0.29
Norwich Road	Northbound	11.26	12.37	11.26	11.77	0.01	-0.60
	Southbound	15.83	17.88	16.10	16.83	0.27	-1.05
Westerfield Road	Northbound	8.13	8.54	8.12	8.22	-0.01	-0.32
	Southbound	7.42	7.09	7.06	7.03	-0.36	-0.06
Wherstead Road	Northbound	8.15	8.01	6.95	6.37	-1.19	-1.64
	Southbound	6.40	6.32	6.15	6.10	-0.25	-0.21

Table 20 - Comparison of simulation network statistics, 2021 TravelSmart P1 (-20%) and 2021 P1 development with Wet Dock Dual Bridges

Time Period	2021 P1 (-20%)	Dual Bridge Crossing	Absolute Difference	Percentage Difference
PCU-hours				
AM Peak hour	12,760	12,326	-434	-4%
PM Peak hour	13,313	12,291	-1,022	-8%
PCU-kilometres				
AM Peak hour	488,097	486,944	1,153	0%
PM Peak hour	493,273	490,621	2,652	-1%

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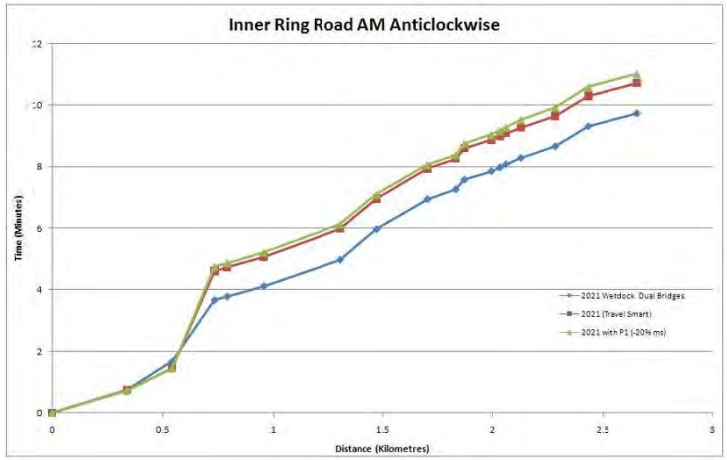
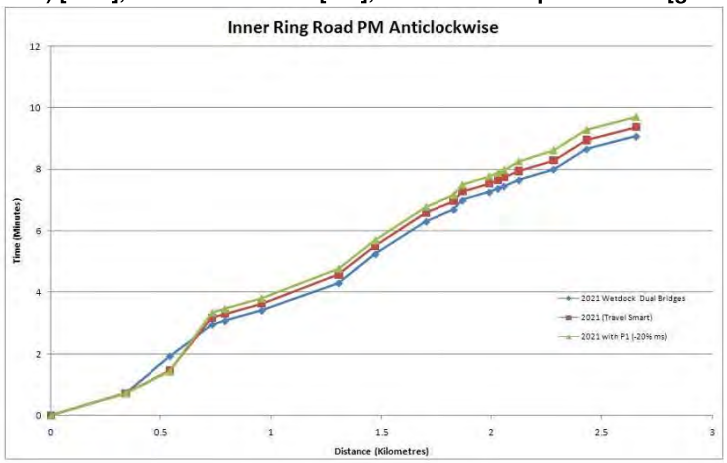
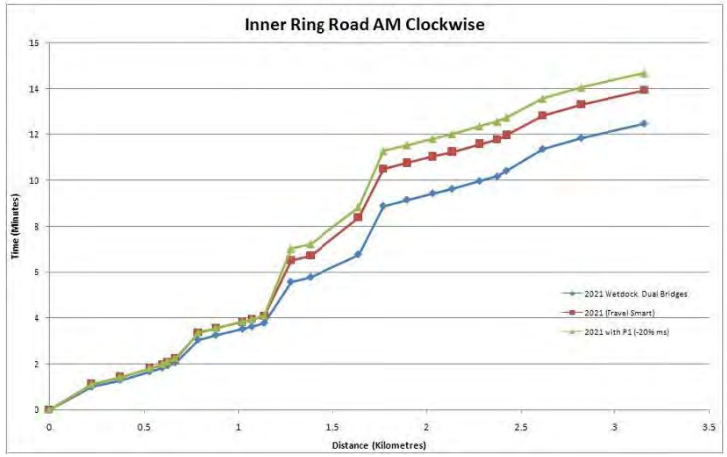
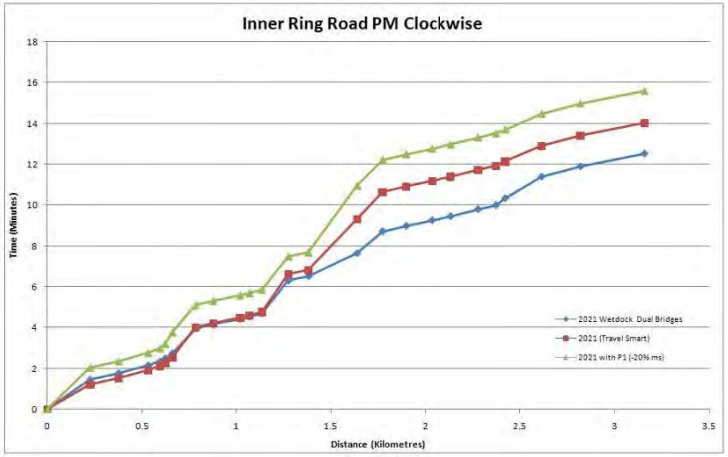
Chart 1 – Comparison of Inner-ring road journey times, Wet Dock crossing (Dual) [blue], 2021 TravelSmart [red], 2021 P1 development -20% [green]









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3.6. 2021 with P1 -20%, Wet Dock crossing (Dual-Bridge) and Star Lane capacity reduction

Table 21 shows the average junction delay per vehicle for the 20 largest junction delays in the AM peak hour; these are also represented by bandwidth circles with radii proportional to delays in Figure 15. These are repeated for the PM peak hour in Table 22 and Figure 16.

Table 21 - Average junction delay (seconds), AM peak, 2021 with P1 (-20%) and Wet Dock Dual Bridge with Star Lane Capacity Reduction

Node	2008	2021 Wet Dock (Dual) [reduction]	Location
Town Centre			
10018	66	26	Signals of Star Lane / Grimwade Street
10020	36	46	Signals of Argyle Street / Grimwade Street / St Helens Street
10049	60	63	Signals of Bond Street / St Helens Street
10061	23	24	Priority Junction of Fore Street EB / Grimwade Street
10062	39	3	Priority Junction of Grimwade Street / Fore Street EB
20014	53	77	Signals of London Road / Yarmouth Road / Handford Road / West End Road
20015	67	67	Signals of A1071 Handford Road / London Road
20069	42	45	Signals of St Helens Street / Warwick Road / Spring Road / Grove Lane
East			
20077	62	91	Signals of Derby Road / Foxhall Road
30407	50	79	Signals of A12 NB / Main Road / Park and ride exit
20057	31	28	Signals of Sidegate Lane / Nelson Road / Woodbridge Road
30240	28	45	Signals of Maryon Road / Nacton Road
30407	50	79	Signals of A12 NB / Main Road / Park and ride exit
West			
30142	43	56	Signals of B1067 Bramford Road / Sproughton Road
30155	71	58	Signals of London Road / Sprites Lane / A1071
30024	1	124	Priority Junction of
30025	1	60	Priority Junction of
20025	34	53	Signals of Bramford Road / A1214 Yarmouth Road / A1214 Chevallier Street
30124	60	52	Signals of A1156 Bury Road / Old Norwich Road / A1156 Norwich Road
P1 Development vicinity			
20044	63	80	Signals of Hanley Road / A1214 Valley Road
20047	8	31	Roundabout of A1214 Valley Road / B1077 Westerfield Road
Copdock			
30044	61	62	Signals of A1214 / A14 EB off slip
30045	6	96	Priority Junction of A12 NB / Copdock Gyratory
30046	7	177	Priority Junction of Copdock A14 WB / Gyratory

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Figure 15 - Average Junction Delay, AM 2021 with P1 (-20%) and Wet Dock Dual Bridge with Star Lane Capacity Reduction

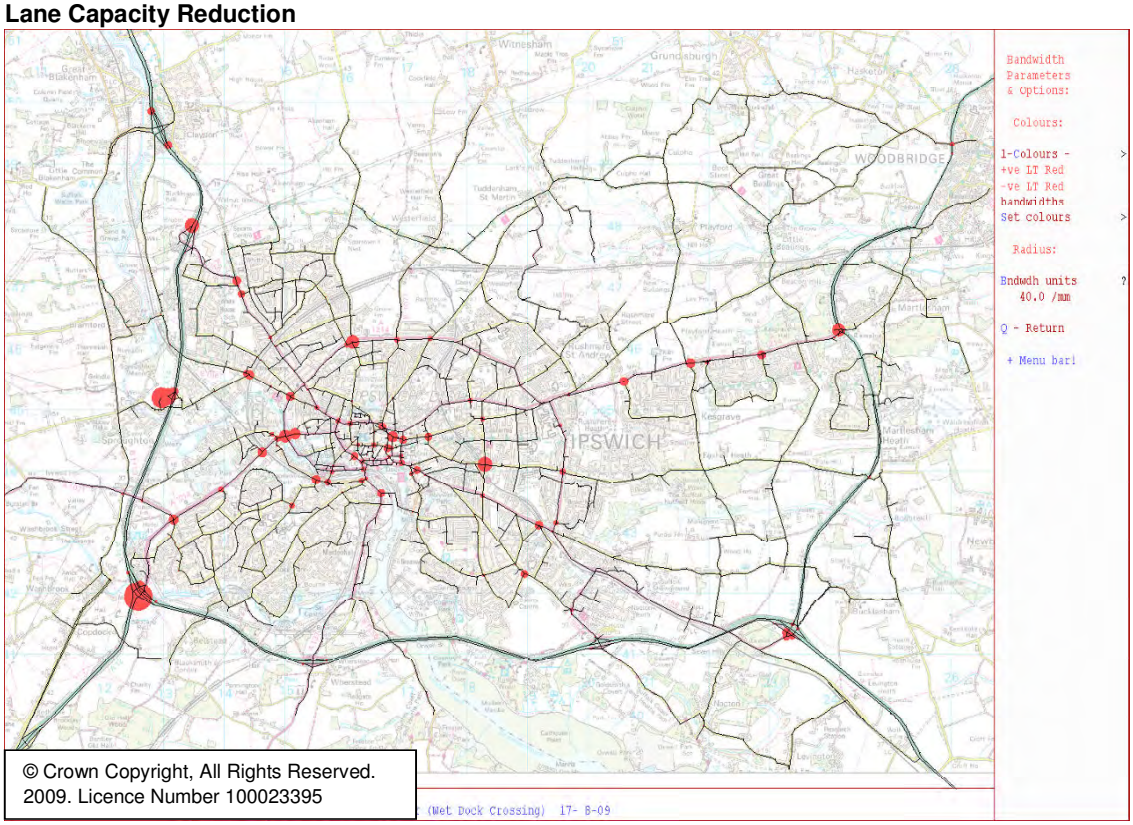

Table 22 - Average junction delay (seconds), PM peak, 2021 with P1 (-20%) and Wet Dock Dual Bridge with Star Lane Capacity Reduction

Node	2008	2021 Wet Dock (Dual) [reduction]	Location
Town Centre			
10018	83	34	Signals of Star Lane / Grimwade Street
10020	44	49	Signals of Argyle Street / Grimwade Street / St Helens Street
10049	38	52	Signals of Bond Street / St Helens Street
10061	8	6	Priority Junction of Fore Street EB / Grimwade Street
10062	4	3	Priority Junction of Grimwade Street / Fore Street EB
20014	81	118	Signals of London Road / Yarmouth Road / Handford Road / West End Road
20015	51	98	Signals of A1071 Handford Road / London Road
20069	37	41	Signals of St Helens Street / Warwick Road / Spring Road / Grove Lane
East			
20077	59	101	Signals of Derby Road / Foxhall Road
30407	18	49	Signals of A12 NB / Main Road / Park and ride exit
20057	42	51	Signals of Sidegate Lane / Nelson Road / Woodbridge

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Node	2008	2021 Wet Dock (Dual) [reduction]	Location
			Road
30240	63	77	Signals of Maryon Road / Nacton Road
30407	18	49	Signals of A12 NB / Main Road / Park and ride exit
West			
30142	60	57	Signals of B1067 Bramford Road / Sproughton Road
30155	67	68	Signals of London Road / Sprites Lane / A1071
30024	1	1	Priority Junction of
30025	1	1	Priority Junction of
20025	43	84	Signals of Bramford Road / A1214 Yarmouth Road / A1214 Chevallier Street
30124	53	152	Signals of A1156 Bury Road / Old Norwich Road / A1156 Norwich Road
P1 Development vicinity			
20044	70	76	Signals of Hanley Road / A1214 Valley Road
20047	9	54	Roundabout of A1214 Valley Road / B1077 Westerfield Road
Copdock			
30044	49	48	Signals of A1214 / A14 EB off slip
30045	4	49	Priority Junction of A12 NB / Copdock Gyratory
30046	12	122	Priority Junction of Copdock A14 WB / Gyratory

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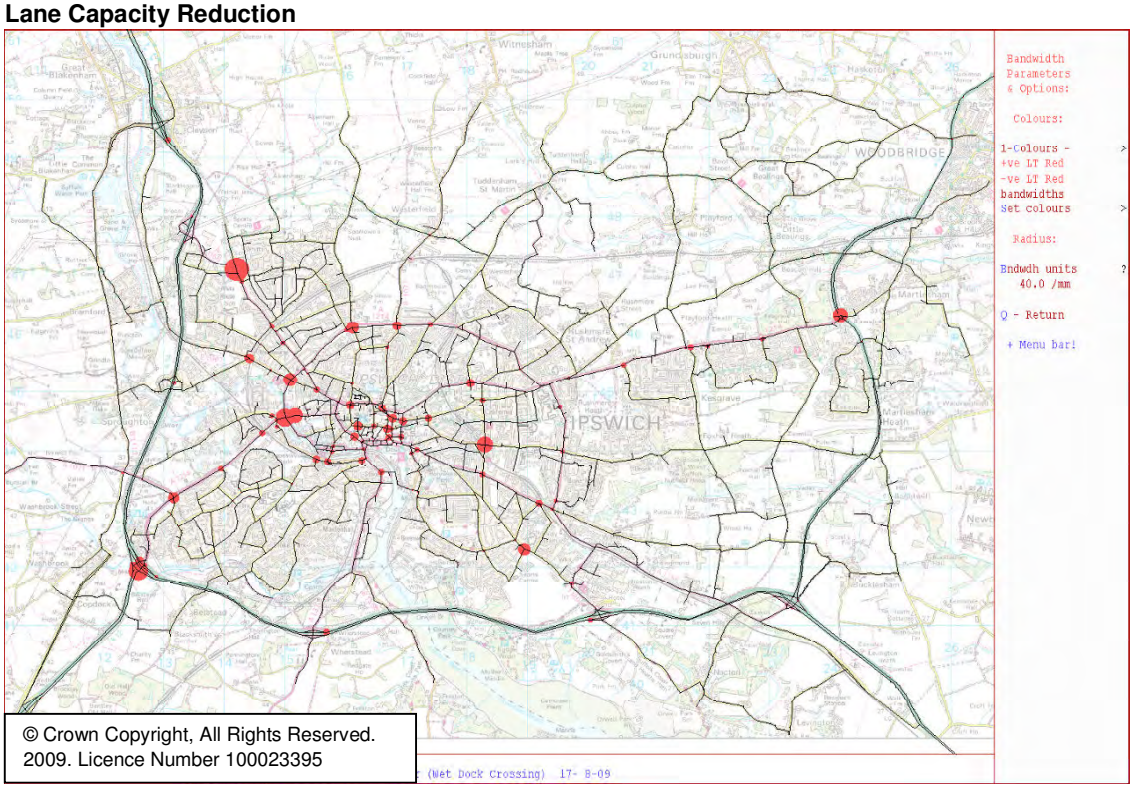
Figure 16 - Average Junction Delay, PM 2021 with P1 (-20%) and Wet Dock Dual Bridge with Star Lane Capacity Reduction



Journey times have also been compared against the Wet Dock Dual Bridges for both with and without the Star Lane capacity reduction for the routes previously specified. These are presented in tabular form in Table 23 for the AM and PM peak hours. Table 24 also notes the change in passenger car unit pcu -hours and pcu-kilometres across the entirety of the simulation network area (broadly that area shown in the delay plots). Chart 2 demonstrates graphically the change in journey times for the inner ring road, the route with which the Wet Dock crossing is likely to most directly compete with and influence.

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Table 23 - Comparison of journey times (minutes), 2021 P1 development with Wet Dock Dual Bridges and 2021 P1 development with Wet Dock Dual Bridges and Star Lane Capacity Reduction

Route	Direction	Without Capacity Reduction		With Capacity Reduction		Differences	
		AM	PM	AM	PM		
A1214 Valley Road/ Woodbridge Road	Eastbound	20.92	22.03	20.93	22.06	0.01	0.03
	Westbound	22.64	21.80	22.67	21.82	0.03	0.01
A1214 London Road	Eastbound	11.81	12.88	11.81	12.97	0.00	0.09
	Westbound	9.48	10.86	9.46	10.93	-0.02	0.06
Bucklesham Road	Eastbound	7.48	7.48	7.48	7.48	0.00	0.00
	Westbound	7.48	7.48	7.48	7.48	0.00	0.00
Felixstowe Road	Eastbound	12.02	11.79	12.04	11.78	0.02	-0.01
	Westbound	13.44	12.71	13.16	12.48	-0.28	-0.23
Foxhall Road	Eastbound	12.36	13.13	12.39	13.27	0.02	0.14
	Westbound	13.85	11.57	13.86	11.58	0.02	0.02
Inner Ring Road	Clockwise	12.49	12.52	12.82	12.47	0.33	-0.05
	Anti-Clockwise	9.73	9.07	10.05	9.97	0.33	0.90
Norwich Road	Northbound	11.26	12.37	11.37	12.47	0.11	0.09
	Southbound	15.83	17.88	15.61	17.65	-0.21	-0.23
Westerfield Road	Northbound	8.13	8.54	8.14	8.53	0.00	-0.01
	Southbound	7.42	7.09	7.42	7.09	0.01	0.00
Wherstead Road	Northbound	8.15	8.01	8.18	7.92	0.03	-0.08
	Southbound	6.40	6.32	6.52	6.41	0.12	0.09

Table 24 - Comparison of simulation network statistics, 2021 P1 development with Wet Dock Dual Bridges and 2021 P1 development with Wet Dock Dual Bridges and Star Lane Capacity Reduction

Time Period	Without cap. Reduction	With capacity reduction	Absolute Difference	Percentage Difference
PCU-hours				
AM Peak hour	12,326	12,326	0	0%
PM Peak hour	12,291	12,339	48	0%
PCU-kilometres				
AM Peak hour	486,944	487,225	281	0%
PM Peak hour	490,621	490,820	199	0%

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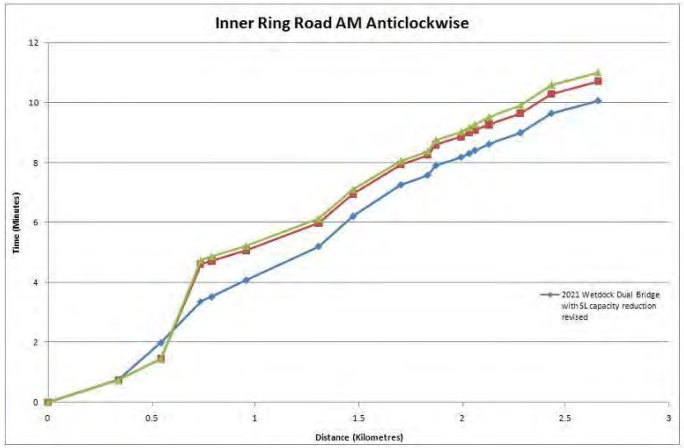
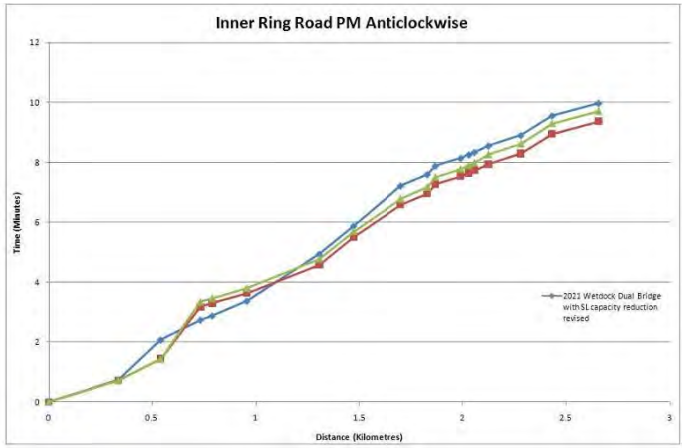
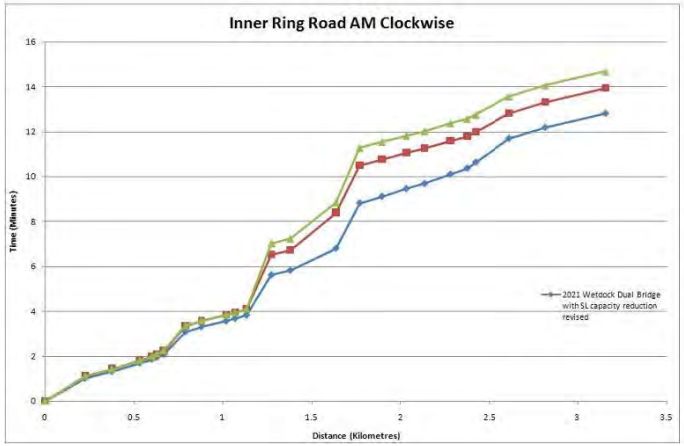
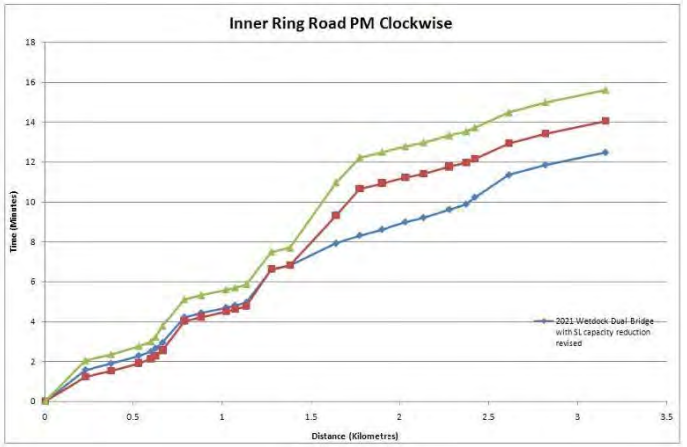
Chart 2 - – Comparison of Inner-ring road journey times, Wet Dock (Dual) with cap. reduction [blue], 2021 TravelSmart [red], 2021 P1 development -20% [green]









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3.7. 2021 with P1 -20% and Wet Dock crossing (Swing Bridge permutation)

Table 25 shows the average junction delay per vehicle for the 20 largest junction delays in the AM peak hour; these are also represented by bandwidth circles with radii proportional to delays in Figure 17. These are repeated for the PM peak hour in Table 26 and Figure 18.

Table 25 – Average junction delay (seconds), AM peak, 2021 Swing Bridge Wet Dock Crossing

Node	2008	2021 Wet Dock (Swing)	Location
Town Centre			
10018	66	32	Signals of Star Lane / Grimwade Street
10020	36	47	Signals of Argyle Street / Grimwade Street / St Helens Street
10049	60	59	Signals of Bond Street / St Helens Street
10061	23	24	Priority Junction of Fore Street EB / Grimwade Street
10062	39	20	Priority Junction of Grimwade Street / Fore Street EB
20014	53	76	Signals of London Road / Yarmouth Road / Handford Road / West End Road
20015	67	66	Signals of A1071 Handford Road / London Road
20069	42	45	Signals of St Helens Street / Warwick Road / Spring Road / Grove Lane
East			
20077	62	88	Signals of Derby Road / Foxhall Road
30407	50	80	Signals of A12 NB / Main Road / Park and ride exit
20057	31	29	Signals of Sidegate Lane / Nelson Road / Woodbridge Road
30240	28	43	Signals of Maryon Road / Nacton Road
30407	50	80	Signals of A12 NB / Main Road / Park and ride exit
West			
30142	43	56	Signals of B1067 Bramford Road / Sproughton Road
30155	71	58	Signals of London Road / Sprites Lane / A1071
30024	1	122	Priority Junction of
30025	1	63	Priority Junction of
20025	34	52	Signals of Bramford Road / A1214 Yarmouth Road / A1214 Chevallier Street
30124	60	51	Signals of A1156 Bury Road / Old Norwich Road / A1156 Norwich Road
P1 Development vicinity			
20044	63	79	Signals of Hanley Road / A1214 Valley Road
20047	8	32	Roundabout of A1214 Valley Road / B1077 Westerfield Road
Copdock			
30044	61	62	Signals of A1214 / A14 EB off slip
30045	6	95	Priority Junction of A12 NB / Copdock Gyratory
30046	7	171	Priority Junction of Copdock A14 WB / Gyratory

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Figure 17 – Average Junction Delay, AM Peak, 2021 Swing Bridge Wet Dock Crossing

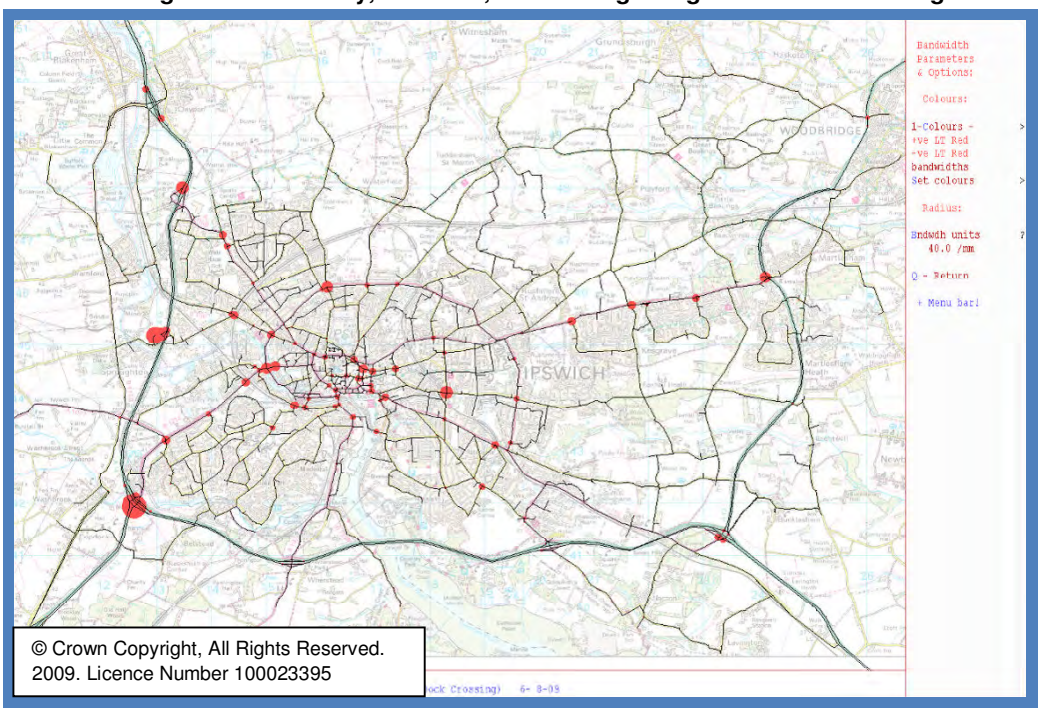

Table 26 – Average junction delay (seconds), PM peak, 2021 Swing Bridge Wet Dock Crossing

Node	2008	2021 Wet Dock (Swing)	Location
Town Centre			
10018	83	54	Signals of Star Lane / Grimwade Street
10020	44	51	Signals of Argyle Street / Grimwade Street / St Helens Street
10049	38	48	Signals of Bond Street / St Helens Street
10061	8	7	Priority Junction of Fore Street EB / Grimwade Street
10062	4	4	Priority Junction of Grimwade Street / Fore Street EB
20014	81	116	Signals of London Road / Yarmouth Road / Handford Road / West End Road
20015	51	96	Signals of A1071 Handford Road / London Road
20069	37	41	Signals of St Helens Street / Warwick Road / Spring Road / Grove Lane
East			
20077	59	95	Signals of Derby Road / Foxhall Road
30407	18	48	Signals of A12 NB / Main Road / Park and ride exit
20057	42	55	Signals of Sidegate Lane / Nelson Road / Woodbridge Road
30240	63	74	Signals of Maryon Road / Nacton Road
30407	18	48	Signals of A12 NB / Main Road / Park and ride exit

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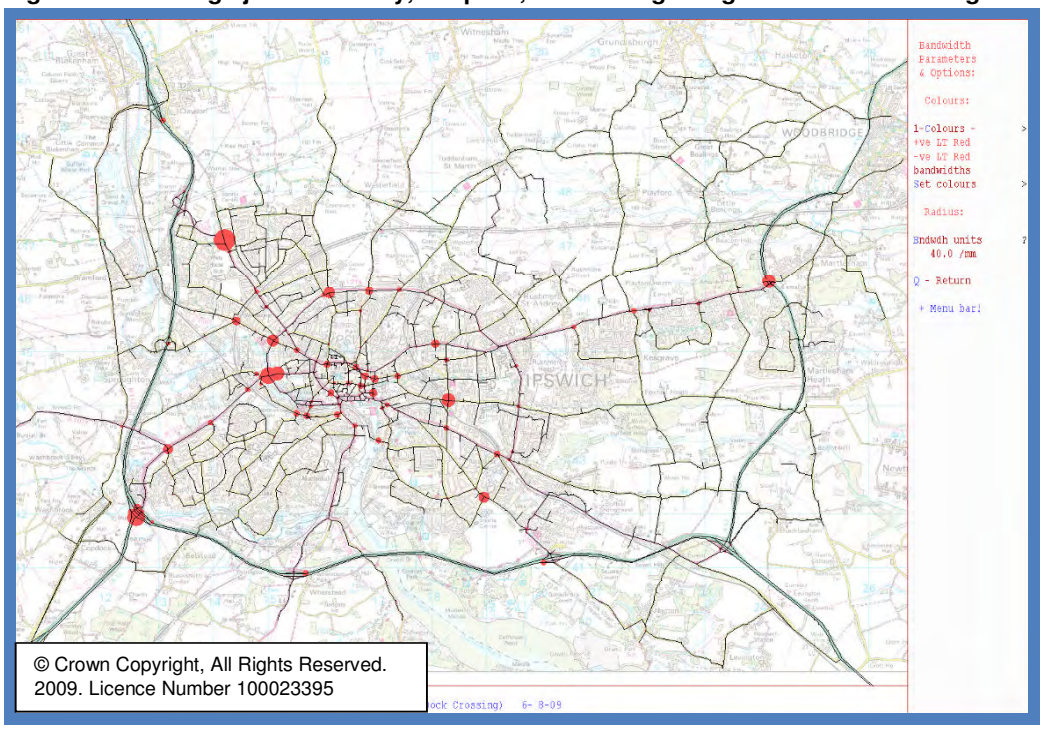
Node	2008	2021 Wet Dock (Swing)	Location
West			
30142	60	57	Signals of B1067 Bramford Road / Sproughton Road
30155	67	67	Signals of London Road / Sprites Lane / A1071
30024	1	1	Priority Junction of
30025	1	1	Priority Junction of
20025	43	82	Signals of Bramford Road / A1214 Yarmouth Road / A1214 Chevallier Street
30124	53	150	Signals of A1156 Bury Road / Old Norwich Road / A1156 Norwich Road
P1 Development vicinity			
20044	70	77	Signals of Hanley Road / A1214 Valley Road
20047	9	54	Roundabout of A1214 Valley Road / B1077 Westerfield Road
Copdock			
30044	49	49	Signals of A1214 / A14 EB off slip
30045	4	50	Priority Junction of A12 NB / Copdock Gyratory
30046	12	122	Priority Junction of Copdock A14 WB / Gyratory

Figure 18 – Average junction delay, PM peak, 2021 Swing Bridge Wet Dock Crossing



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Journey times have been compared against P1 with strong sustainable transport measures and the Wet Dock swing bridge for the routes previously specified. These are presented in tabular form in Table 27 for the AM and PM peak hours. Table 28 also notes the change in passenger car unit pcu -hours and pcu-kilometres across the entirety of the simulation network area (broadly that area shown in the delay plots). Chart 3 demonstrates graphically the change in journey times for the inner ring road, the route with which the Wet Dock crossing is likely to most directly compete with and influence.

Table 27 - Comparison of journey time (minutes), 2021 P1 with strong sustainable transport and 2021 P1 with Swing Bridge Wet Dock crossing

Route	Direction	P1 -20%		Swing Bridge		Difference	
		AM	PM	AM	PM	AM	PM
A1214 Valley Road/ Woodbridge Road	Eastbound	21.70	23.05	20.93	22.07	-0.77	-0.98
	Westbound	23.97	23.22	22.75	21.83	-1.22	-1.39
A1214 London Road	Eastbound	11.54	13.98	11.70	12.82	0.16	-1.16
	Westbound	9.48	11.44	9.49	10.88	0.01	-0.56
Bucklesham Road	Eastbound	7.49	7.48	7.48	7.48	-0.01	0.00
	Westbound	7.48	7.47	7.48	7.48	0.00	0.01
Felixstowe Road	Eastbound	13.99	11.63	10.97	11.78	-3.02	0.15
	Westbound	11.45	13.36	13.36	12.64	1.91	-0.72
Foxhall Road	Eastbound	12.13	13.13	12.37	13.10	0.24	-0.03
	Westbound	12.35	11.44	13.78	11.52	1.43	0.08
Inner Ring Road	Clockwise	14.68	15.61	12.67	11.94	-2.01	-3.67
	Anti-Clockwise	11.01	9.71	9.99	9.10	-1.02	-0.61
Norwich Road	Northbound	11.30	11.96	11.25	12.36	-0.05	0.40
	Southbound	17.02	19.13	16.02	17.80	-1.00	-1.33
Westerfield Road	Northbound	8.18	8.72	8.14	8.55	-0.04	-0.17
	Southbound	7.81	7.08	7.43	7.09	-0.38	0.01
Wherstead Road	Northbound	7.23	6.37	7.95	7.85	0.72	1.48
	Southbound	6.17	6.11	6.36	6.28	0.19	0.17

Table 28 Comparison of simulation network statistics, 2021 P1 with strong sustainable transport and 2021 P1 with Swing Bridge Wet Dock crossing

Time Period	2021 P1 - 20%	Swing Bridge	Absolute Difference	Percentage Difference
PCU-hours				
AM Peak hour	12,760	12,331	-429	-3%
PM Peak hour	13,313	12,307	-1,006	-8%
PCU-kilometres				
AM Peak hour	488,097	487,036	-1,061	0%
PM Peak hour	493,273	490,589	-2,684	-1%

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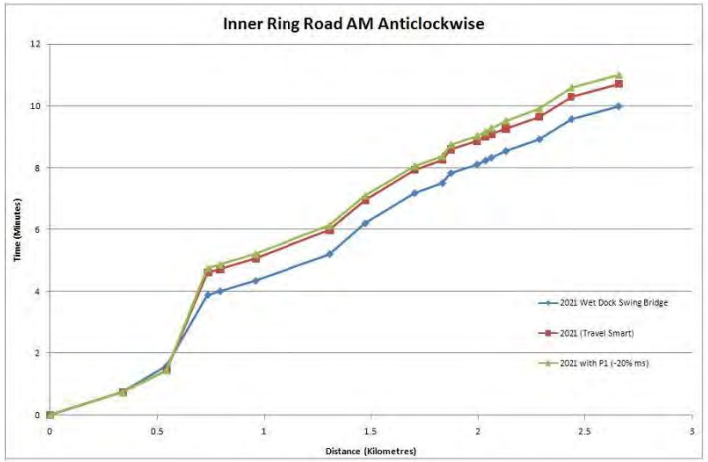
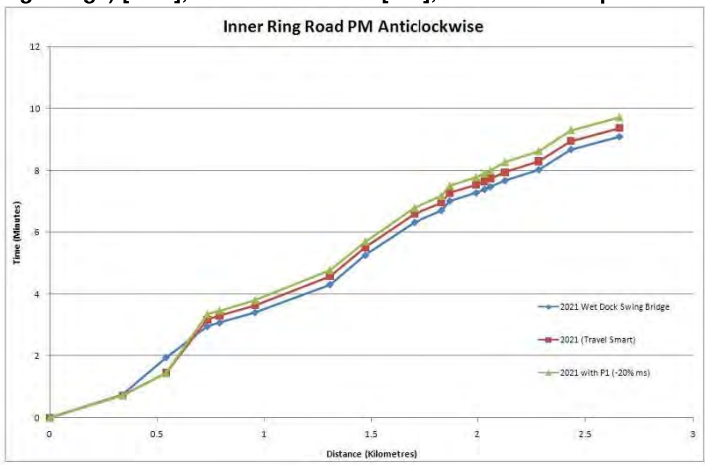
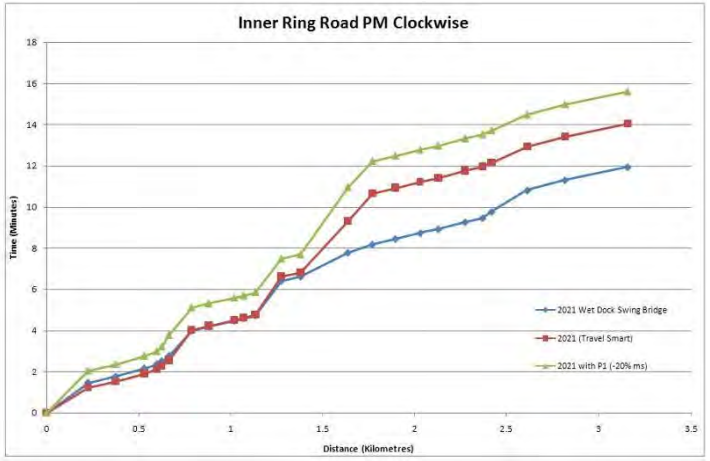
Chart 3 - Comparison of Inner-ring road journey times, Wet Dock (Swing Bridge) [blue], 2021 TravelSmart [red], 2021 P1 development -20% [green]







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3.8. 2021 with P1 -20%, Wet Dock crossing (Swing Bridge) and Star Lane capacity reduction

Table 29 shows the average junction delay per vehicle for the 20 largest junction delays in the AM peak hour; these are also represented by bandwidth circles with radii proportional to delays in Figure 19. These are repeated for the PM peak hour in Table 30 and Figure 20.

Table 29 – Average junction delay (seconds), AM peak, 2021 Swing Bridge Wet Dock Crossing (with Star Lane Capacity Reduction)

Node	2008	2021 Wet Dock (Swing) [reduction]	Location
Town Centre			
10018	66	26	Signals of Star Lane / Grimwade Street
10020	36	46	Signals of Argyle Street / Grimwade Street / St Helens Street
10049	60	62	Signals of Bond Street / St Helens Street
10061	23	24	Priority Junction of Fore Street EB / Grimwade Street
10062	39	10	Priority Junction of Grimwade Street / Fore Street EB
20014	53	77	Signals of London Road / Yarmouth Road / Handford Road / West End Road
20015	67	67	Signals of A1071 Handford Road / London Road
20069	42	47	Signals of St Helens Street / Warwick Road / Spring Road / Grove Lane
East			
20077	62	89	Signals of Derby Road / Foxhall Road
30407	50	79	Signals of A12 NB / Main Road / Park and ride exit
20057	31	28	Signals of Sidegate Lane / Nelson Road / Woodbridge Road
30240	28	41	Signals of Maryon Road / Nacton Road
30407	50	79	Signals of A12 NB / Main Road / Park and ride exit
West			
30142	43	56	Signals of B1067 Bramford Road / Sproughton Road
30155	71	58	Signals of London Road / Sprites Lane / A1071
30024	1	123	Priority Junction of
30025	1	61	Priority Junction of
20025	34	52	Signals of Bramford Road / A1214 Yarmouth Road / A1214 Chevallier Street
30124	60	51	Signals of A1156 Bury Road / Old Norwich Road / A1156 Norwich Road
P1 Development vicinity			
20044	63	80	Signals of Hanley Road / A1214 Valley Road
20047	8	32	Roundabout of A1214 Valley Road / B1077 Westerfield Road
Copdock			
30044	61	63	Signals of A1214 / A14 EB off slip
30045	6	96	Priority Junction of A12 NB / Copdock Gyratory
30046	7	172	Priority Junction of Copdock A14 WB / Gyratory

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Figure 19 – Average Junction Delay, AM, 2021 Swing Bridge Wet Dock Crossing (with Star Lane Capacity Reduction)

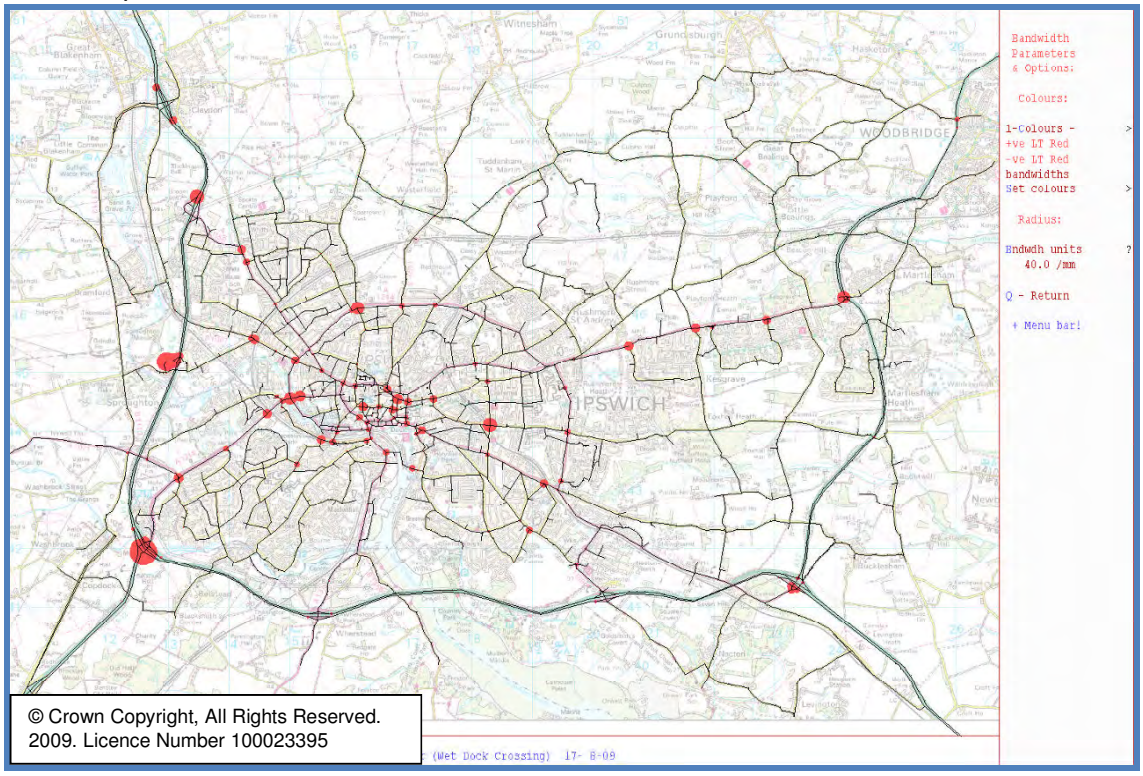

Table 30 – Average junction delay (seconds), PM peak, 2021 Swing Bridge Wet Dock Crossing (with Star Lane Capacity Reduction)

Node	2008	2021 Wet Dock (Swing) [reduction]	Location
Town Centre			
10018	83	39	Signals of Star Lane / Grimwade Street
10020	44	51	Signals of Argyle Street / Grimwade Street / St Helens Street
10049	38	53	Signals of Bond Street / St Helens Street
10061	8	7	Priority Junction of Fore Street EB / Grimwade Street
10062	4	3	Priority Junction of Grimwade Street / Fore Street EB
20014	81	118	Signals of London Road / Yarmouth Road / Handford Road / West End Road
20015	51	95	Signals of A1071 Handford Road / London Road
20069	37	43	Signals of St Helens Street / Warwick Road / Spring Road / Grove Lane
East			
20077	59	98	Signals of Derby Road / Foxhall Road

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Node	2008	2021 Wet Dock (Swing) [reduction]	Location
30407	18	50	Signals of A12 NB / Main Road / Park and ride exit
20057	42	53	Signals of Sidegate Lane / Nelson Road / Woodbridge Road
30240	63	74	Signals of Maryon Road / Nacton Road
30407	18	50	Signals of A12 NB / Main Road / Park and ride exit
West			
30142	60	57	Signals of B1067 Bramford Road / Sproughton Road
30155	67	67	Signals of London Road / Sprites Lane / A1071
30024	1	1	Priority Junction of
30025	1	1	Priority Junction of
20025	43	82	Signals of Bramford Road / A1214 Yarmouth Road / A1214 Chevallier Street
30124	53	150	Signals of A1156 Bury Road / Old Norwich Road / A1156 Norwich Road
P1 Development vicinity			
20044	70	76	Signals of Hanley Road / A1214 Valley Road
20047	9	56	Roundabout of A1214 Valley Road / B1077 Westerfield Road
Copdock			
30044	49	48	Signals of A1214 / A14 EB off slip
30045	4	49	Priority Junction of A12 NB / Copdock Gyratory
30046	12	122	Priority Junction of Copdock A14 WB / Gyratory

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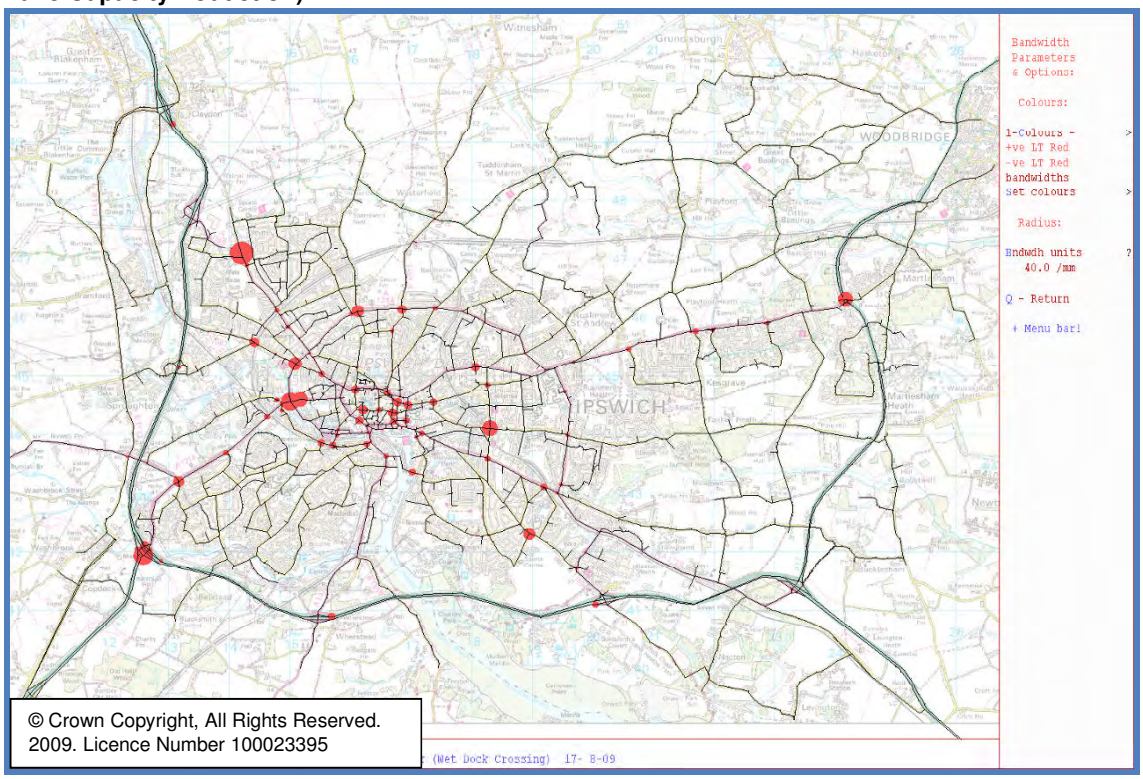
Figure 20 – Average junction delay, PM peak, 2021 Swing Bridge Wet Dock Crossing (with Star Lane Capacity Reduction)



Journey times have also been compared against the Swing Bridge Wet Dock crossing, with and without the capacity reduction on Star Lane for the routes previously specified. These are presented in tabular form in Table 31 for the AM and PM peak hours. Table 32 also notes the change in passenger car unit pcu -hours and pcu-kilometres across the entirety of the simulation network area (broadly that area shown in the delay plots). Chart 4 demonstrates graphically the change in journey times for the inner ring road, the route with which the Wet Dock crossing is likely to most directly compete with and influence.

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Table 31 - Comparison of journey time (minutes), 2021 Swing Bridge Wet Dock Crossing with and without Star Lane Capacity Reduction

Route	Direction	Without Capacity Reduction		With Capacity Reduction		Difference	
		AM	PM	AM	PM	AM	PM
A1214 Valley Road/ Woodbridge Road	Eastbound	20.93	22.07	20.95	22.14	0.01	0.08
	Westbound	22.75	21.83	22.74	21.83	-0.01	0.00
A1214 London Road	Eastbound	11.70	12.82	11.80	12.84	0.10	0.01
	Westbound	9.49	10.88	9.47	10.91	-0.02	0.03
Bucklesham Road	Eastbound	7.48	7.48	7.48	7.48	0.00	0.00
	Westbound	7.48	7.48	7.48	7.48	0.00	0.00
Felixstowe Road	Eastbound	10.97	11.78	12.05	11.73	1.08	-0.05
	Westbound	13.36	12.64	13.20	12.63	-0.16	-0.01
Foxhall Road	Eastbound	12.37	13.10	12.37	13.19	0.00	0.09
	Westbound	13.78	11.52	13.80	11.55	0.02	0.03
Inner Ring Road	Clockwise	12.67	11.94	12.26	12.61	-0.41	0.67
	Anti-Clockwise	9.99	9.10	10.13	10.18	0.15	1.08
Norwich Road	Northbound	11.25	12.36	11.36	12.50	0.11	0.13
	Southbound	16.02	17.80	15.60	17.55	-0.42	-0.25
Westerfield Road	Northbound	8.14	8.55	8.14	8.54	0.00	-0.00
	Southbound	7.43	7.09	7.44	7.09	0.00	0.00
Wherstead Road	Northbound	7.95	7.85	7.86	7.66	-0.10	-0.19
	Southbound	6.36	6.28	6.46	6.34	0.10	0.06

Table 32 – Comparison of simulation network statistics, 2021 Swing Bridge Wet Dock Crossing with and without Star Lane Capacity Reduction

Time Period	Without cap. reduction	With capacity reduction	Absolute Difference	Percentage Difference
PCU-hours				
AM Peak hour	12,331	12,596	265	2%
PM Peak hour	12,307	12,364	57	0%
PCU-kilometres				
AM Peak hour	487,036	486,829	-207	0%
PM Peak hour	490,589	490,635	46	0%

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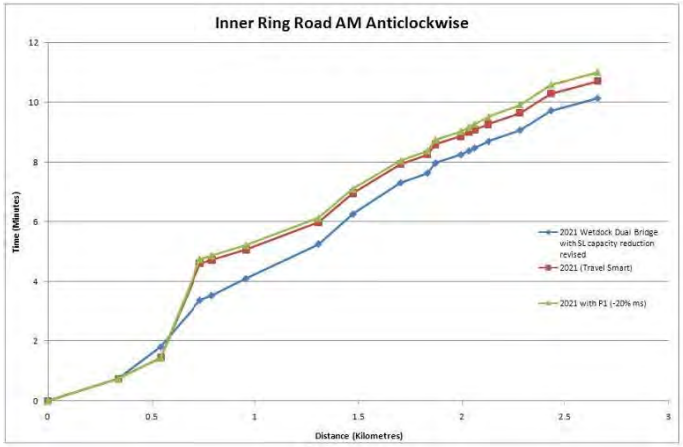
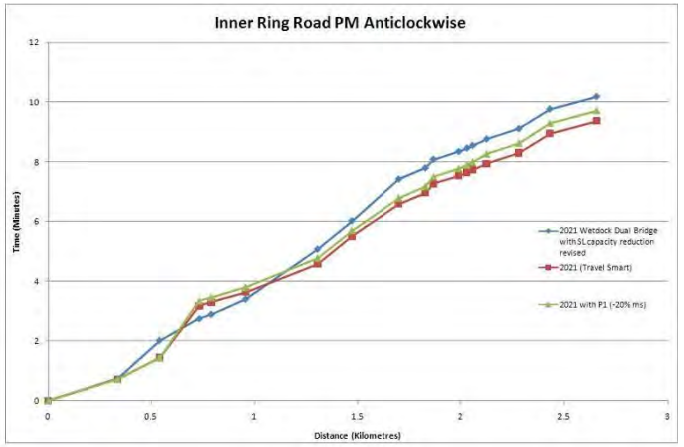
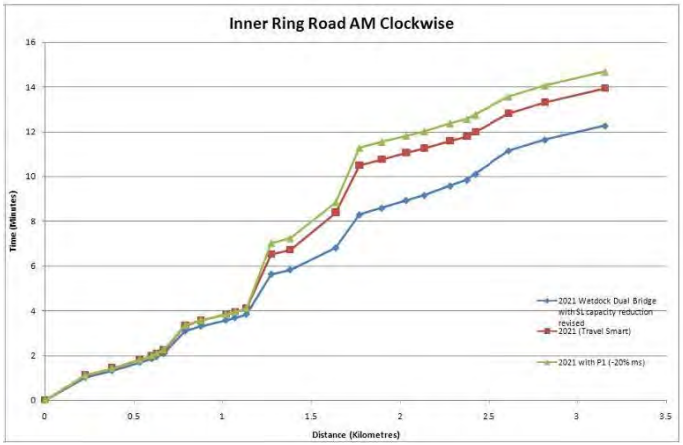
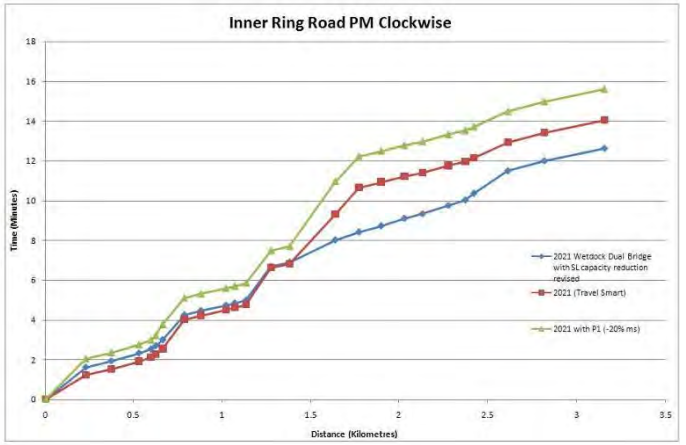
Chart 4 - Comparison of Inner-ring road journey times, Wet Dock (Swing) with cap. reduction [blue], 2021 TravelSmart [red], 2021 P1 development -20% [green]









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3.9. 2021 with P1 -20% and Northern Relief Road

Table 33 shows the average junction delay per vehicle for the 20 largest junction delays in the AM peak hour; these are also represented by bandwidth circles with radii proportional to delays in Figure 21. These are repeated for the PM peak hour in Table 34 and Figure 22.

Table 33 – Average junction delay (seconds), AM peak, 2021 P1-20% and Northern Relief Road

Node	2008	2021 Northern Bypass	Location
Town Centre			
10018	66	117	Signals of Star Lane / Grimwade Street
10020	36	48	Signals of Argyle Street / Grimwade Street / St Helens Street
10049	60	54	Signals of Bond Street / St Helens Street
10061	23	72	Priority Junction of Fore Street EB / Grimwade Street
10062	39	3	Priority Junction of Grimwade Street / Fore Street EB
20014	53	74	Signals of London Road / Yarmouth Road / Handford Road / West End Road
20015	67	63	Signals of A1071 Handford Road / London Road
20069	42	59	Signals of St Helens Street / Warwick Road / Spring Road / Grove Lane
East			
20077	62	74	Signals of Derby Road / Foxhall Road
30407	50	40	Signals of A12 NB / Main Road / Park and ride exit
20057	31	27	Signals of Sidegate Lane / Nelson Road / Woodbridge Road
30240	28	29	Signals of Maryon Road / Nacton Road
30407	50	40	Signals of A12 NB / Main Road / Park and ride exit
West			
30142	43	40	Signals of B1067 Bramford Road / Sproughton Road
30155	71	56	Signals of London Road / Sprites Lane / A1071
30024	1	2	Priority Junction of
30025	1	2	Priority Junction of
20025	34	38	Signals of Bramford Road / A1214 Yarmouth Road / A1214 Chevallier Street
30124	60	35	Signals of A1156 Bury Road / Old Norwich Road / A1156 Norwich Road
P1 Development vicinity			
20044	63	64	Signals of Hanley Road / A1214 Valley Road
20047	8	22	Roundabout of A1214 Valley Road / B1077 Westerfield Road
Copdock			
30044	61	106	Signals of A1214 / A14 EB off slip
30045	6	64	Priority Junction of A12 NB / Copdock Gyratory
30046	7	115	Priority Junction of Copdock A14 WB / Gyratory

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Figure 21 – Average Junction Delay, AM 2021, P1 -20% and Northern Relief Road

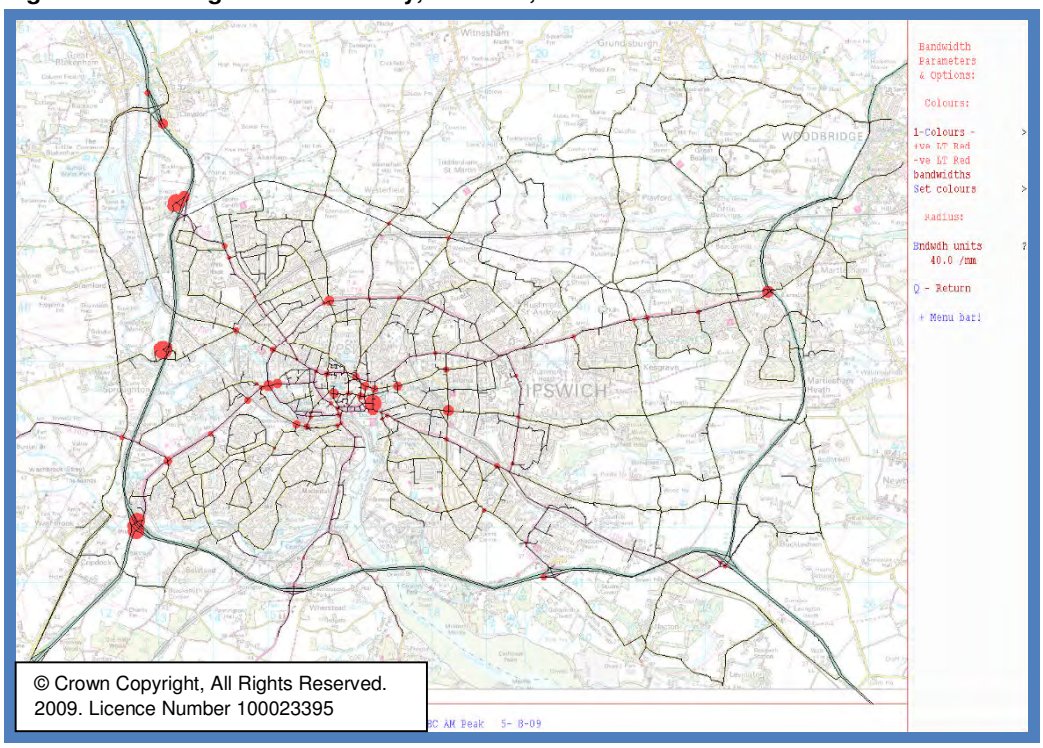

Table 34 – Average junction delay (seconds), PM peak, 2021 P1-20% and Northern Relief Road

Node	2008	2021 Northern Bypass	Location
Town Centre			
10018	83	147	Signals of Star Lane / Grimwade Street
10020	44	57	Signals of Argyle Street / Grimwade Street / St Helens Street
10049	38	48	Signals of Bond Street / St Helens Street
10061	8	8	Priority Junction of Fore Street EB / Grimwade Street
10062	4	53	Priority Junction of Grimwade Street / Fore Street EB
20014	81	95	Signals of London Road / Yarmouth Road / Handford Road / West End Road
20015	51	66	Signals of A1071 Handford Road / London Road
20069	37	60	Signals of St Helens Street / Warwick Road / Spring Road / Grove Lane
East			
20077	59	67	Signals of Derby Road / Foxhall Road
30407	18	30	Signals of A12 NB / Main Road / Park and ride exit
20057	42	55	Signals of Sidegate Lane / Nelson Road / Woodbridge Road
30240	63	88	Signals of Maryon Road / Nacton Road
30407	18	30	Signals of A12 NB / Main Road / Park and ride exit

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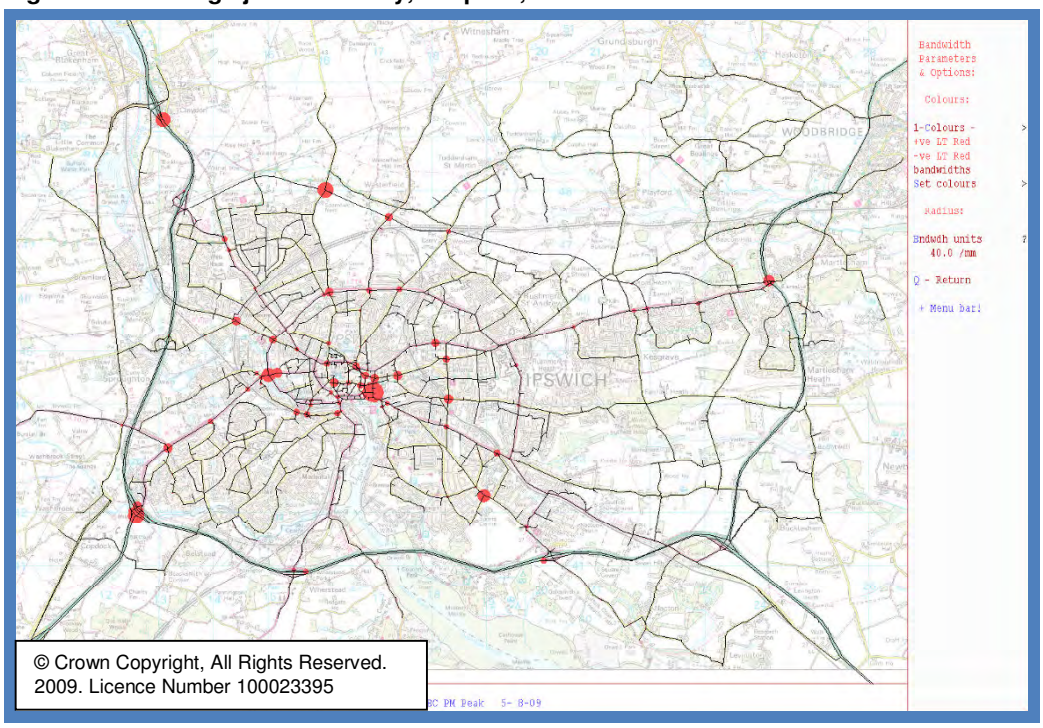
Node	2008	2021 Northern Bypass	Location
West			
30142	60	58	Signals of B1067 Bramford Road / Sproughton Road
30155	67	62	Signals of London Road / Sprites Lane / A1071
30024	1	1	Priority Junction of
30025	1	1	Priority Junction of
20025	43	50	Signals of Bramford Road / A1214 Yarmouth Road / A1214 Chevallier Street
30124	53	34	Signals of A1156 Bury Road / Old Norwich Road / A1156 Norwich Road
P1 Development vicinity			
20044	70	57	Signals of Hanley Road / A1214 Valley Road
20047	9	37	Roundabout of A1214 Valley Road / B1077 Westerfield Road
Copdock			
30044	49	61	Signals of A1214 / A14 EB off slip
30045	4	43	Priority Junction of A12 NB / Copdock Gyratory
30046	12	112	Priority Junction of Copdock A14 WB / Gyratory

Figure 22 – Average junction delay, PM peak, P1 -20% and Northern Relief Road



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Journey times have also been compared against 2021 P1 with strong sustainable transport measures and the inclusion of the northern relief road for the routes previously specified. These are presented in tabular form in Table 35 for the AM and PM peak hours. Table 36 also notes the change in passenger car unit pcu -hours and pcu-kilometres across the entirety of the simulation network area (broadly that area shown in the delay plots). Chart 5 demonstrates graphically the change in journey times for the A1214 Valley Road, Colchester Road, Woodbridge Road), the route with which the Northern Bypass is likely to most directly compete with and influence.

Table 35 - Comparison of journey time (minutes), 2021 P1 with strong sustainable transport and 2021 P1 with Northern Relief Road

Route	Direction	2021 -20%		Northern Bypass		Difference	
		AM	PM	AM	PM	AM	PM
A1214 Valley Road/ Woodbridge Road	Eastbound	21.70	23.05	20.43	21.41	-1.27	-1.64
	Westbound	23.97	23.22	20.04	19.87	-3.92	-3.34
A1214 London Road	Eastbound	11.54	13.98	11.01	11.33	-0.52	-2.65
	Westbound	9.48	11.44	9.25	10.48	-0.24	-0.96
Bucklesham Road	Eastbound	7.49	7.48	7.48	7.48	-0.01	-0.00
	Westbound	7.48	7.47	7.48	7.48	0.00	0.00
Felixstowe Road	Eastbound	13.99	11.63	11.08	11.39	-2.91	-0.23
	Westbound	11.45	13.36	11.83	12.07	0.39	-1.29
Foxhall Road	Eastbound	12.13	13.13	12.22	12.21	0.09	-0.92
	Westbound	12.35	11.44	12.28	11.26	-0.07	-0.18
Inner Ring Road	Clockwise	14.68	15.61	12.42	12.85	-2.26	-2.76
	Anti-Clockwise	11.01	9.71	10.23	9.64	-0.78	-0.06
Norwich Road	Northbound	11.30	11.96	11.07	11.58	-0.22	-0.38
	Southbound	17.02	19.13	14.98	14.24	-2.04	-4.89
Westerfield Road	Northbound	8.18	8.72	8.35	8.62	0.17	-0.10
	Southbound	7.81	7.08	7.60	7.58	-0.21	0.49
Wherstead Road	Northbound	7.23	6.37	6.75	6.58	-0.48	0.21
	Southbound	6.17	6.11	6.14	6.12	-0.03	0.01

Table 36 – Comparison of simulation network statistics, 2021 P1 with strong sustainable transport and 2021 P1 with Northern Relief Road

Time Period	2021 -20%	Northern Bypass	Absolute Difference	Percentage Difference
PCU-hours				
AM Peak hour	12,760	11,810	-950	-8%
PM Peak hour	13,313	11,956	-1,356	-11%
PCU-kilometres				
AM Peak hour	488,097	484,785	-3,313	-1%
PM Peak hour	493,273	488,851	-4,422	-1%

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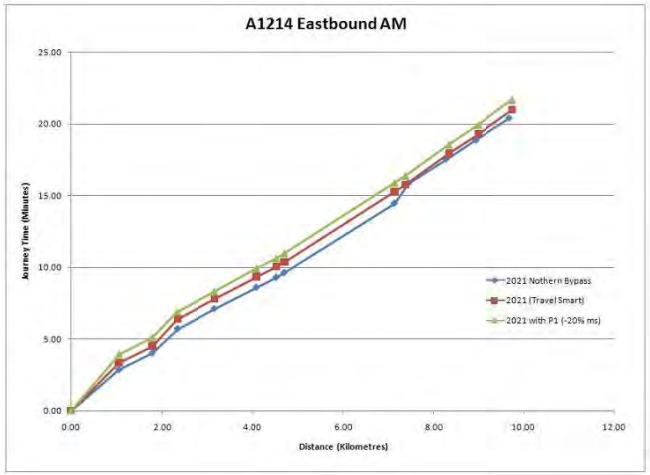
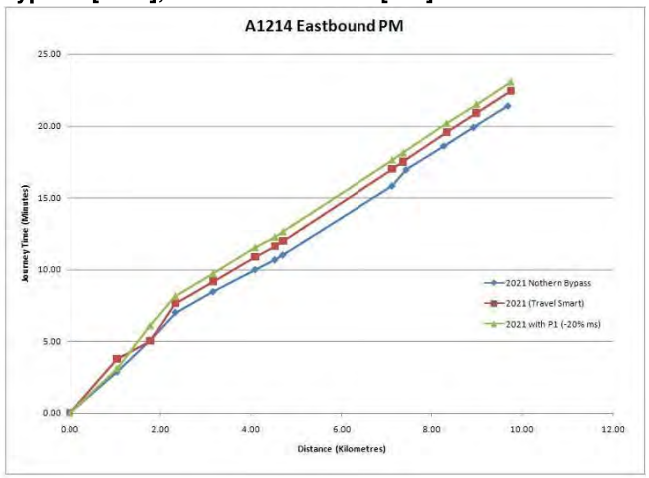
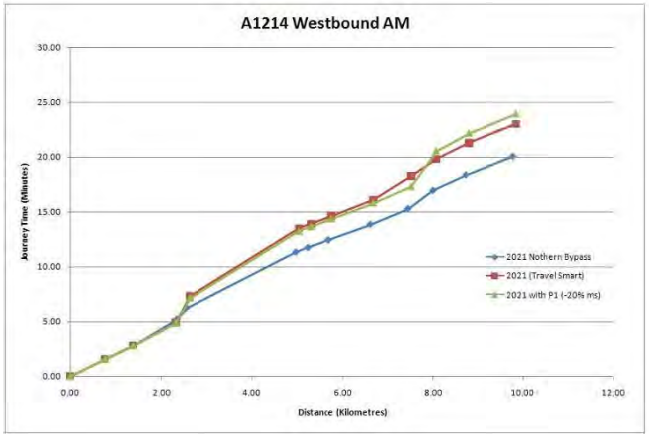
Chart 5 – Comparison of A1214 Journey Times for Northern Bypass [blue], 2021 TravelSmart [red] and 2021 P1 development -20% [green]







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4. Summary

The following points are the key findings of the analysis that are presented within this report, with particular focus to the northern fringe development of 5,000 households (P1) and the various mitigation methods that have been tested.

4.1. P1 development

- Junction delays tend to increase as a result of the introduction of the 5,000 households in the northern fringe.
- As shown by the delay tables presented, delays tend to increase across all areas of Ipswich, however, they are particularly more marked at the junctions along the A1214 Valley Road, particularly at (although not limited to) Henley Road and Westerfield Road.
- Delays away from the town centre, although do increase are less significant compared to the delay increases within the town centre.
- Introduction of the strong sustainable transport measures alone at the development site appears only to have minimal impact on Ipswich-wide delays, with the junctions on the A1214 Valley Road still operating substantially poorer than in the 2021 base-case.

4.2. Wet Dock Crossing (Dual Bridge permutation)

- The Wet Dock crossing appears to successfully mitigate the impacts of the P1 development within the town centre and inner-ring road (particularly on the eastern side), in some cases returning delays at key junctions to pre-2021 levels and some even to base-year conditions.
- A number of junctions both further east and west of the town centre however, experience decreased operational efficiency as a result of traffic re-routing caused by the introduction of the crossing. This is particularly evident at junction 54 of the A14.
- Delays at junctions along the A1214 in the vicinity of the P1 development are partially mitigated, with delays reduced further than if just the strong sustainable transport measures were effectively implemented, but still higher than the 2021 base-case.

4.3. Wet Dock Crossing (Swing Bridge permutation)

- The impact of a swing-operating bridge at Wet Dock crossing is generally akin to that of the dual bridge permutation.
- Some delays within the town centre are slightly higher than those present in the dual bridge permutation of the crossing. Delays elsewhere within the network generally appear to be at a similar level however.

4.4. Northern Bypass/Relief Road

- The introduction of the northern bypass is not as effective at reducing delays in the town centre area as a Wet Dock crossing, due to the nature of the trips that use such a route.

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Delays in the town centre typically remain at levels close to that of the development without any highway infrastructure improvements although there are benefits at some junctions.

- Delays elsewhere within the Ipswich-area however appear to be much better mitigated than with the introduction of a Wet Dock crossing. Certainly, for a number of the junctions presented within this analysis, delays are reduced to a level lower than the 2021 base-case in both the eastern and western fringes.

- The northern bypass also appears to more successfully mitigate the impacts at junctions along the A1214, with average delays here again reduced to levels present in the 2021 base-case, prior to the introduction of the northern fringe development.

- The northern bypass is the only intervention however, that appears to impair the operation of the A12/A14 Copdock Interchange, in some cases doubling the average delays experienced by a vehicle.

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Annex IV
'Ipswich Area Development and Infrastructure Tests - Supplementary'

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Technical Note

AECOM

Project:	**Ipswich Transport Model**	Job No:	**60044295**
Subject:	**Ipswich Area Development and Infrastructure Tests – Supplementary**		
Prepared by:	**Nik Bowyer**	Date:	**08/09/2009**
Checked by:	**Ian Burrows**	Date:	**08/09/2009**
Approved by:	**Ian Burrows**	Date:	**08/09/2009**

1. Introduction

This Technical Note has been prepared by AECOM to provide an evaluation of the results of the recent modelling work that has been undertaken on behalf of both Ipswich Borough Council (IBC) and Suffolk County Council (SCC). In particular, the work has been to assess development in the northern fringe – within the district limits of Ipswich Borough – over and above development specified in the Regional Spatial Strategy (RSS) for the East of England. This note should be considered an extension of – and supplementary to – the previous draft AECOM Technical Note passed to both IBC and SCC on 20th August 2009, which outlined the initial results of model runs from the Ipswich Transport Analysis Modelling Suite (ITAMS).

2. The Tests

The previous Technical Note, dated 20th August 2009, reported on a combination of demand and infrastructure tests assessing the provision of an additional 5,000 households over and above the RSS allocation in the northern fringe for a 2021 horizon year. It has since been ascertained that the development of the 'DoMinimum' 2021 demand matrices included the provision of 450 households in the northern fringe as part of the RSS proposals. The initial tests of an additional 5,000 households in the northern fringe are therefore likely to be a slight over-estimate of the scale of development in the fringe and, as such, are likely to over-estimate the likely impacts on the existing infrastructure.

For the tests reported on herein therefore, the additional development in the northern fringe over-and-above that of the RSS has been reduced to 4,550 households. This allows for the testing of the provision of 5,000 additional households in the area by 2021 whilst taking into account any development as part of the RSS itself. To achieve this, the same trip-rates as used in the previous round of testing have been applied to this reduced additional development.

With regards to infrastructure, the scope of the 2021 'DoMinimum' networks is identical to those specified in the Technical Note of 20th August.

2.1. Specification of the tests

The following tests are hence examined in this Technical Note:

- As per 2021 TravelSmart base, with 4,550 additional households in the northern fringe (P1);
- Assuming strong sustainable transport policy investment at the P1 development;
- P1 with strong sustainable transport and provision of a northern bypass/relief road.

Only the northern bypass infrastructure test has been re-run using the revised P1 demand. This is because the re-tests are essentially a sensitivity test on those reported in the original Technical Note. As the revised additional households are only slightly lower than in the original tests, it was

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decided that one infrastructure test would be undertaken and then in turn compared against the base Do Minimum. The northern bypass test has been re-run, since this test showed that the infrastructure scheme that had the largest delays and therefore the scale of change for this test would be most marked.

2.2. Planning data assumptions, investment policies and infrastructure schemes

Planning data assumptions and investment policies all remain as per the AECOM Technical Note of 20th August. The northern fringe development has again been built on-top of a 2021 base that assumes the successful implementation of TravelSmart policies that reduce car trips by 15% both to and from the town centre and an area at Adastral Park, in-line with major employment and leisure centres.

The high-level allocation of households in the northern fringe has again been distributed across the same zones as previously, although the total in each zone is obviously slightly reduced as per the reduced amount of households (4,550) that are over-and-above the allocations in the RSS. The same surrounding-zones (for underlying trip-distributions to and from the development) and the same TRICS-developed trip rates as previously have been used to convert the development households to highway trips.

The trip-rates used for the northern development have been derived using TRICS and have been shown to be in-line with 2001 Census Journey-to-Work data. A comparison of an existing similar-sized number of households was undertaken; in this case, census data for 5,000 households in the Chantry area, which is a similar distance from the town centre as the proposed northern fringe development and has reasonable public transport provision. Commuting trips at an all-day level from the selected area were 2,824 vehicles; the assumed commuting trips from the P1 development is 2,014 vehicles across both peaks, where the majority of commuting trips are likely to occur. Taking into account the remaining hours of the day that are not represented by the model, the comparison is favourable, showing that the trip rates assumed for the development are realistic and do not represent a pessimistic view of the development.

The investment in strong sustainable transport schemes is again assumed for the P1 development, reducing car trips to and from the site by 20% for both of the peak hours. The 20% reduction is in addition to the assumed trip rates used. The base percentage level assumed for car trips from the P1 development is around 93% of all highway traffic both to and from the development in both the AM and PM peak hours. Given the high proportion of car trips from the development, a 20% reduction could potentially have a large impact in mitigating highway impacts – this will require further investigation should such findings be borne out of the highway modelling. In the case of the P1 development this 20% reduction equates to a reduction of 452 trips (to 1,756 car trips) and 531 trips (to 1,954 car trips) in the morning and evening peaks respectively.

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3. Regional context

It is necessary to assess the scale of household development required in Ipswich, as specified by the Government Office for the East of England in the 'East of England Plan', in a regional context. This allows for a high-level comparative estimate on the impact on urban road networks across the region to be established and, thus, how Ipswich is placed against other regional settlements in addressing and finding solutions to capacity issues within the urban area. Table 1 provides a comparison of the minimum dwelling provision as required by the Regional Spatial Strategy (RSS) between 2001 and 2021 for Ipswich and other comparable urban centres across the region.

Table 1 – Comparison of minimum dwelling provision (RSS) to 2021 for regional settlements

District	Population (2001)	Households (2001)	RSS Minimum Dwelling Provision ('01 – '21)	Minimum Households (2021)
Chelmsford	157,072	64,564	16,000	80,564
Colchester	155,142	63,451	17,100	80,551
Ipswich	**115,033**	**50,023**	**15,400**	**65,423**
Norwich	117,875	54,707	14,100	68,807

As shown in Table 1, the urban centres of Norwich, Chelmsford and Colchester all have relatively similar and comparable levels of development in terms of household and population numbers in 2001 as Ipswich. As it is also shown, the minimum dwelling provision as set out by the RSS to 2021 is similar across all four of these urban centres. Whilst Ipswich does appear to have the greatest number of dwellings to provide in proportion to its 2001 household levels (30% additional houses, as opposed to roughly 25% for the three other urban centres), the scale of growth is very similar to other urban areas.

It can be shown therefore that, whilst Ipswich Borough may have a challenging target to meet in terms of its dwelling provision to 2021, other regional centres are affected to a similar degree. In turn, it can be inferred that the challenges and demands placed on the transport infrastructure systems, whilst being unique to individual urban areas due to road network layout, are again likely to be similar across the region. It is unlikely that Ipswich will face congestion issues to either a greater or a lesser extent than will Chelmsford, Colchester or Norwich. The pressures and demands that are likely to be put-upon Ipswich's transport infrastructure are likely to be experience elsewhere, with other urban centres experiencing similar levels of congestion, if not spatially, then at least at a more global level. Future assessment of Ipswich's transport infrastructure should be considered in light of this.

Furthermore, in order to ensure the impacts of development are minimised and mitigated, there will be a greater pressure to deliver and invest in sustainable policies across the region as well as demand management measures at source.

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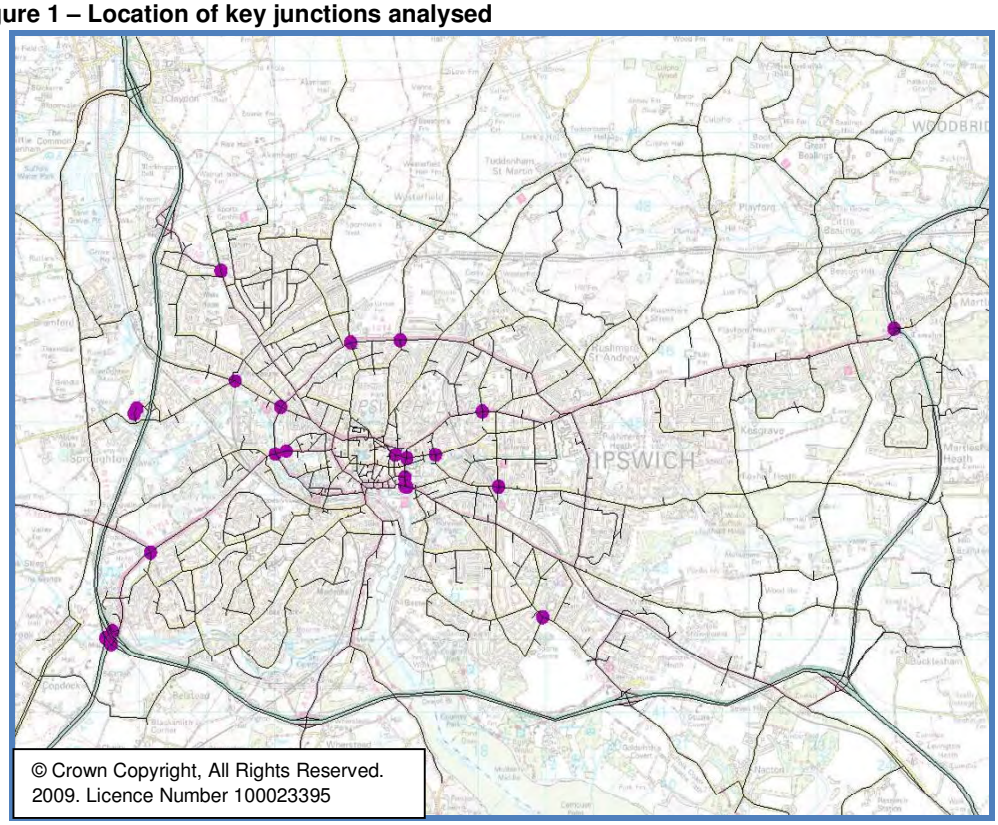
4. Results and analysis

Results of the supplementary tests are presented in the following sections, with interrogation of these results presented in section 5.

As with the previous technical note, the same consistent set of 25 nodes have been presented across the highway network, with delays presented at each of these in both tabular and graphical form, the latter represented using a proportional scale. As previously, these delays are the average delay per vehicle at each junction and do not necessarily reflect delays on each individual approach arm; they are however, a useful diagnostic tool for the identification and sifting of consistent problematic junctions where some improvements may be necessary. Figure 1 shows the location of these key junctions.

Figure 1 – Location of key junctions analysed



As per the initial round of testing, journey times have again been compared for certain links within the highway model. These journey time routes are identical to those in the Technical Note of 20th August. For this supplementary round of testing however, comparisons across some key routes have been made with both 2008 and 2021 where relevant to show the degree of change and – in the case of the northern bypass – the mitigating effects of the scheme on parallel routes.

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4.1. 2021 TravelSmart base with northern fringe (P1) development

Average junction delays are presented for the 25 standard junctions referenced above and compared with those without the P1 development in Table 2 for the AM peak hour, in addition to being graphically represented in Figure 2, by bandwidth circles where radii is proportional to the level of delay. These are repeated for the PM peak in Table 3 and Figure 3.

Table 2 – Average junction delays (seconds), AM Peak, 2021 with P1 development

Node	2021 TravelSmart	2021 P1 Development	Location
Town Centre			
10018	104	104	Signals of Star Lane / Grimwade Street
10020	90	129	Signals of Argyle Street / Grimwade Street / St Helens Street
10049	58	65	Signals of Bond Street / St Helens Street
10061	78	77	Priority Junction of Fore Street EB / Grimwade Street
10062	76	3	Priority Junction of Grimwade Street / Fore Street EB
20014	68	78	Signals of London Road / Yarmouth Road / Handford Road / West End Road
20015	64	67	Signals of A1071 Handford Road / London Road
20069	76	77	Signals of St Helens Street / Warwick Road / Spring Road / Grove Lane
East			
20077	67	76	Signals of Derby Road / Foxhall Road
30407	78	87	Signals of A12 NB / Main Road / Park and ride exit
20057	38	39	Signals of Sidegate Lane / Nelson Road / Woodbridge Road
30240	32	40	Signals of Maryon Road / Nacton Road
30407	78	87	Signals of A12 NB / Main Road / Park and ride exit
West			
30142	75	66	Signals of B1067 Bramford Road / Sproughton Road
30155	59	58	Signals of London Road / Sprites Lane / A1071
30024	2	2	Priority Junction of
30025	2	2	Priority Junction of
20025	50	57	Signals of Bramford Road / A1214 Yarmouth Road / A1214 Chevallier Street
30124	48	52	Signals of A1156 Bury Road / Old Norwich Road / A1156 Norwich Road
P1 Development vicinity			
20044	67	91	Signals of Hanley Road / A1214 Valley Road
20047	24	66	Roundabout of A1214 Valley Road / B1077 Westerfield Road
Copdock			
30044	55	62	Signals of A1214 / A14 EB off slip
30045	70	79	Priority Junction of A12 NB / Copdock Gyratory
30046	112	125	Priority Junction of Copdock A14 WB / Gyratory

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Figure 2 – Average junction delay, AM peak, 2021 with P1 development

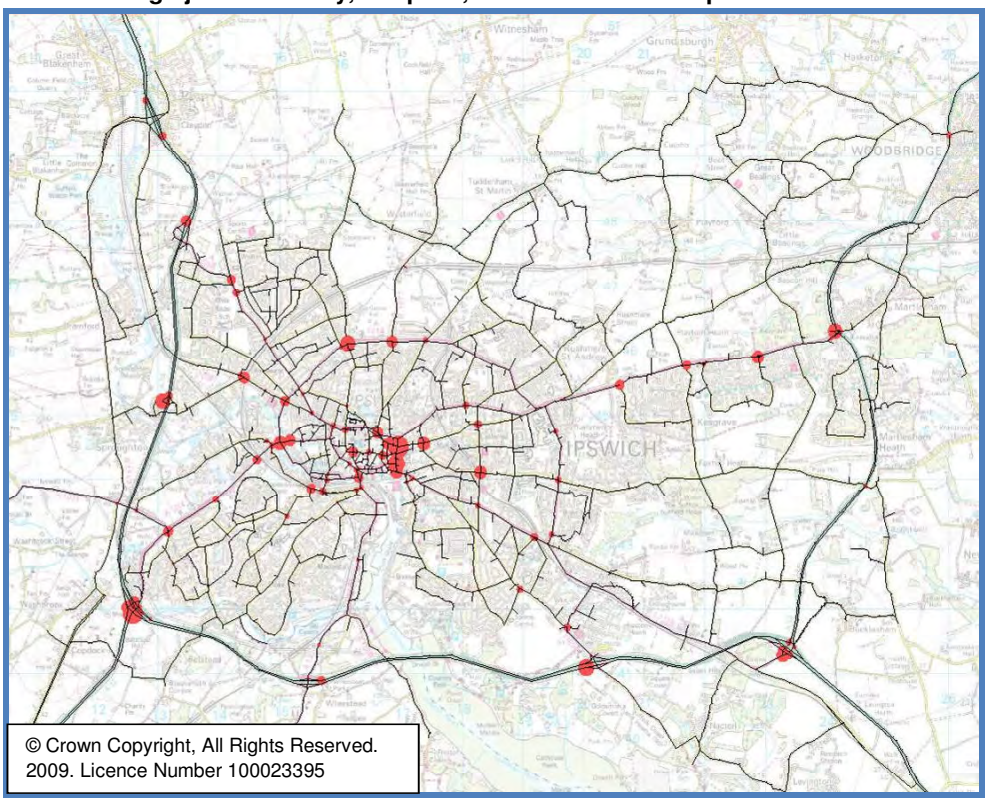

Table 3 – Average junction delay (seconds), PM peak, 2021 with P1 development

Node	2021 TravelSmart	2021 P1 Development	Location
Town Centre			
10018	168	235	Signals of Star Lane / Grimwade Street
10020	69	84	Signals of Argyle Street / Grimwade Street / St Helens Street
10049	51	90	Signals of Bond Street / St Helens Street
10061	39	67	Priority Junction of Fore Street EB / Grimwade Street
10062	53	75	Priority Junction of Grimwade Street / Fore Street EB
20014	112	141	Signals of London Road / Yarmouth Road / Handford Road / West End Road
20015	79	109	Signals of A1071 Handford Road / London Road
20069	72	94	Signals of St Helens Street / Warwick Road / Spring Road / Grove Lane
East			
20077	76	85	Signals of Derby Road / Foxhall Road
30407	35	34	Signals of A12 NB / Main Road / Park and ride exit
20057	68	84	Signals of Sidegate Lane / Nelson Road / Woodbridge Road
30240	95	98	Signals of Maryon Road / Nacton Road

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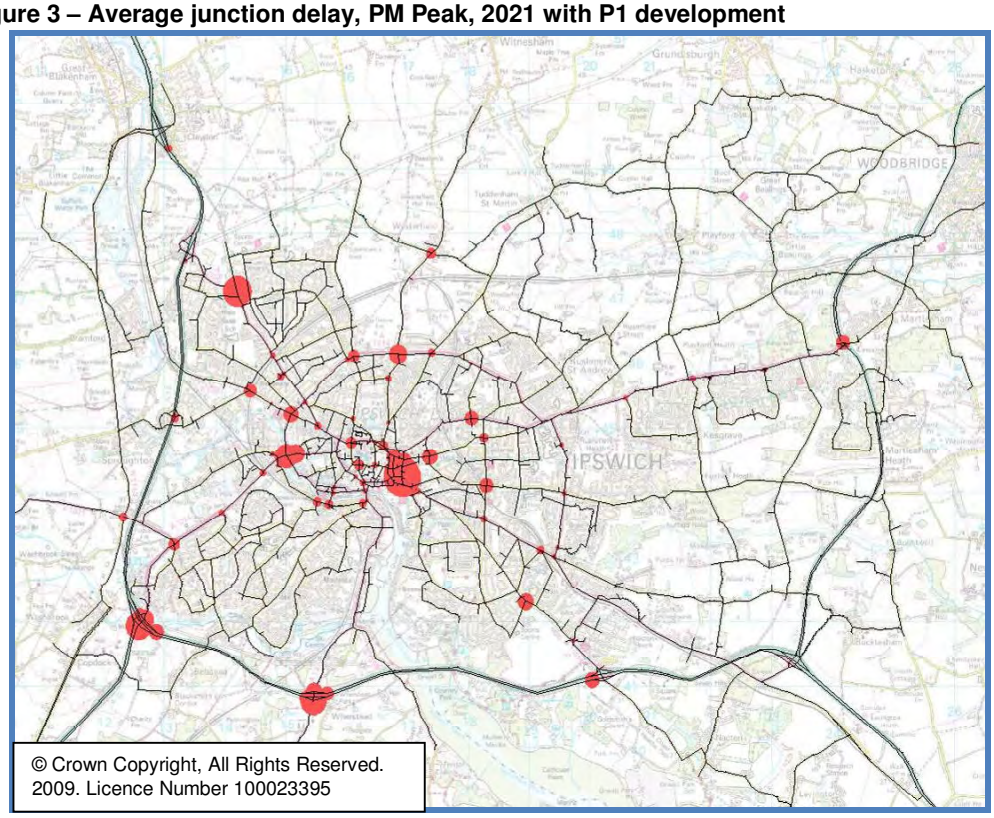
Node	2021 TravelSmart	2021 P1 Development	Location
30407	35	34	Signals of A12 NB / Main Road / Park and ride exit
West			
30142	70	77	Signals of B1067 Bramford Road / Sproughton Road
30155	64	68	Signals of London Road / Sprites Lane / A1071
30024	1	2	Priority Junction of
30025	1	2	Priority Junction of
20025	70	93	Signals of Bramford Road / A1214 Yarmouth Road / A1214 Chevallier Street
30124	119	181	Signals of A1156 Bury Road / Old Norwich Road / A1156 Norwich Road
P1 Development vicinity			
20044	76	68	Signals of Hanley Road / A1214 Valley Road
20047	21	110	Roundabout of A1214 Valley Road / B1077 Westerfield Road
Copdock			
30044	53	64	Signals of A1214 / A14 EB off slip
30045	50	61	Priority Junction of A12 NB / Copdock Gyratory
30046	127	165	Priority Junction of Copdock A14 WB / Gyratory

Figure 3 – Average junction delay, PM Peak, 2021 with P1 development



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Journey times have been compared for all of the routes previously specified with the 2021 TravelSmart scenario. These are presented in tabular form in Table 4 for the AM and PM peak hours. Table 5 also notes the change in pcu-hours and pcu-kilometres across the entirety of the simulation area (the area broadly shown in the delay plots).

Table 4 – Comparison of Journey Times (minutes), 2021 TravelSmart and 2021 P1 development

Route	Direction	2021 TravelSmart		2021, P1		Difference	
		AM	PM	AM	PM	AM	PM
A1214 Valley Road/ Woodbridge Road	Eastbound	21.00	22.43	21.71	23.72	0.72	1.29
	Westbound	23.03	21.36	24.03	23.81	1.00	2.45
A1214 London Road	Eastbound	11.52	12.13	11.55	13.53	0.03	1.40
	Westbound	9.30	10.81	9.52	11.30	0.22	0.49
Bucklesham Road	Eastbound	7.48	7.48	7.49	7.48	0.01	0.00
	Westbound	7.47	7.47	7.48	7.47	0.01	0.00
Felixstowe Road	Eastbound	11.52	10.79	12.09	10.88	0.57	0.10
	Westbound	11.53	13.89	11.52	12.56	-0.01	-1.34
Foxhall Road	Eastbound	12.12	12.57	12.47	12.83	0.35	0.26
	Westbound	12.31	11.37	12.39	11.41	0.08	0.04
Inner Ring Road	Clockwise	13.94	14.03	13.50	16.03	-0.44	2.00
	Anti-Clockwise	10.70	9.37	11.06	10.30	0.36	0.94
Norwich Road	Northbound	11.26	11.77	11.29	12.09	0.03	0.32
	Southbound	16.10	16.83	17.19	19.40	1.09	2.58
Westerfield Road	Northbound	8.12	8.22	8.19	9.10	0.06	0.88
	Southbound	7.06	7.03	8.29	7.08	1.22	0.06
Wherstead Road	Northbound	6.95	6.37	7.18	6.39	0.23	0.03
	Southbound	6.15	6.10	6.16	6.11	0.01	0.00

Table 5 – Simulation network statistics, 2021 TravelSmart and 2021 P1 development

Time Period	2021 TravelSmart	2021 P1 Development	Absolute Difference	Percentage Difference
PCU-hours				
AM Peak hour	11,949	12,716	767	6%
PM Peak hour	12,191	13,734	1,543	13%
PCU-kilometres				
AM Peak hour	475,370	488,845	13,475	3%
PM Peak hour	477,972	494,904	16,932	4%

Figure 4 and Figure 5 show comparisons of journey times along the routes of Westerfield Road and the Inner Ring Road respectively. Westerfield Road has been selected as the development is sited along this route and is one of the major loading points for the development onto the highway infrastructure. The inner ring road is selected as the town centre is likely to experience a number of issues, given that a number of the junctions along the route are close to capacity in 2008.

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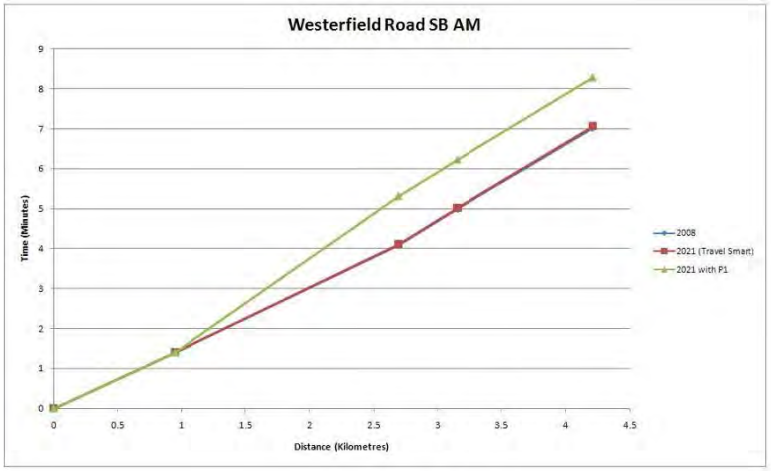
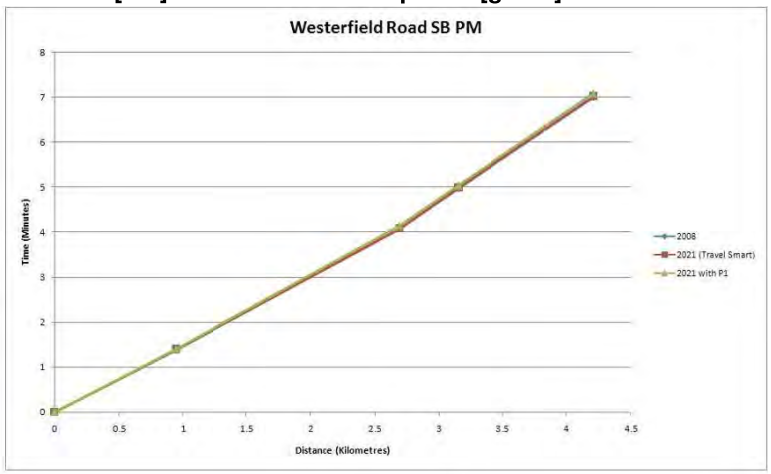
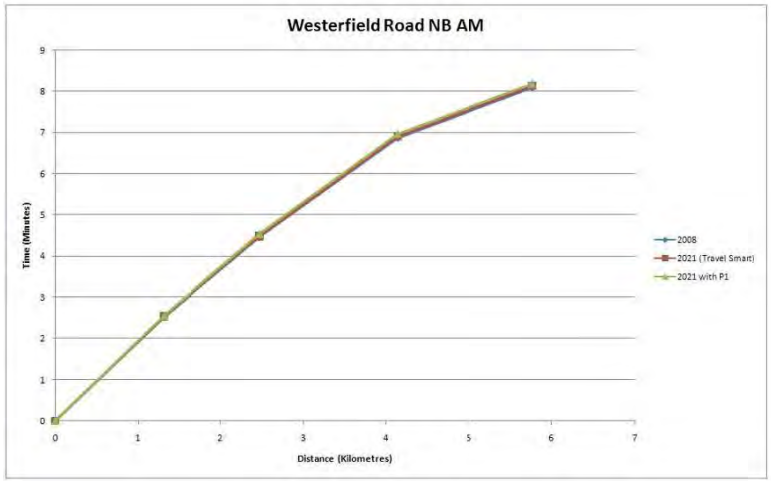
Figure 4 – Journey Times along Westerfield Road for 2008 [blue], 2021 TravelSmart [red] and 2021 P1 development [green]







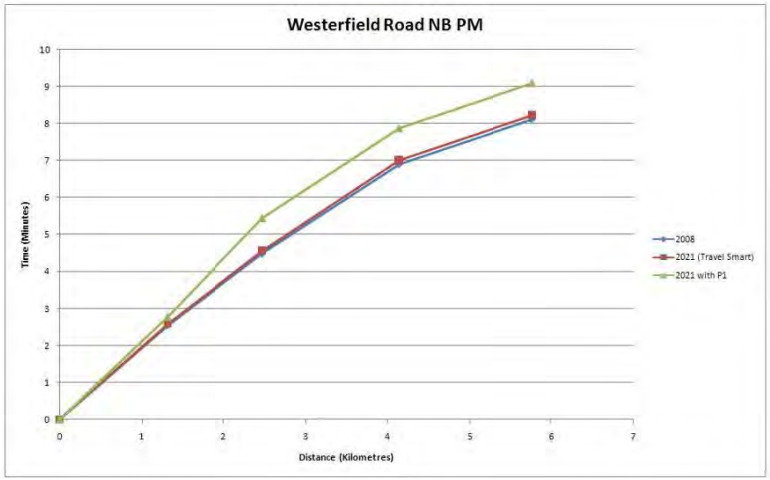


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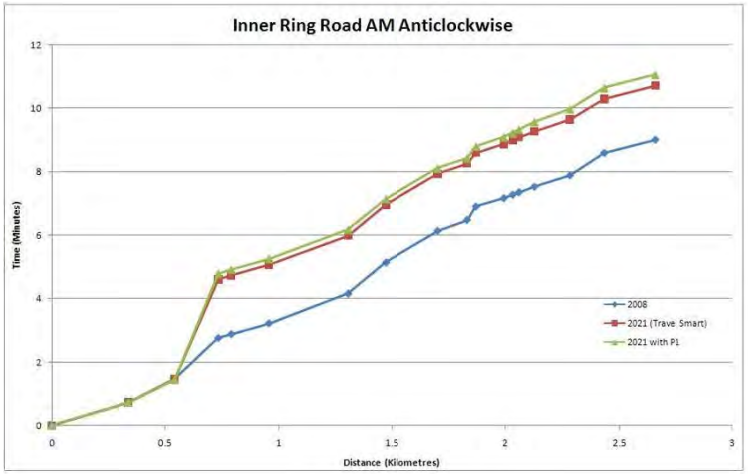
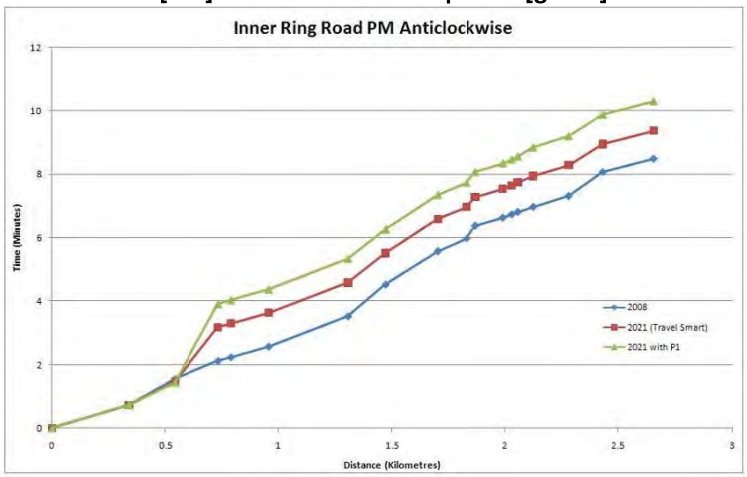
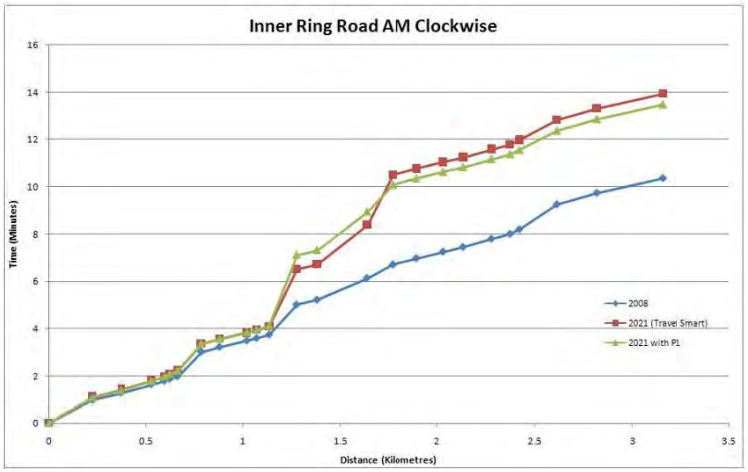
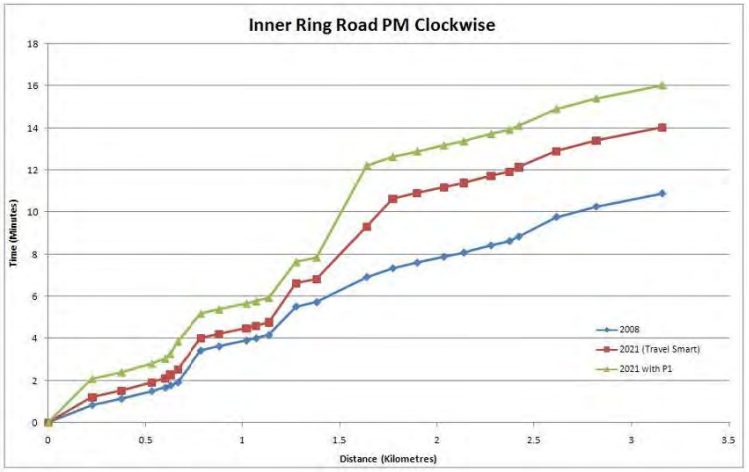
Figure 5 – Journey Times on the Inner Ring Road for 2008 [blue], 2021 TravelSmart [red] and 2021 P1 development [green]









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4.2. 2021 with P1 development and strong sustainable transport policies (-20%)

Average junction delays are presented for the 25 standard junctions referenced above and compared with those without the P1 development in Table 6 for the AM peak hour, in addition to being graphically represented in Figure 6, by bandwidth circles where radii is proportional to the level of delay. These are repeated for the PM peak in Table 7 and Figure 7.

Table 6 – Average junction delays (seconds), AM Peak, 2021 with P1 (-20%) development

Node	2021 TravelSmart	2021 P1 - 20%	Location
Town Centre			
10018	104	106	Signals of Star Lane / Grimwade Street
10020	90	124	Signals of Argyle Street / Grimwade Street / St Helens Street
10049	58	64	Signals of Bond Street / St Helens Street
10061	78	24	Priority Junction of Fore Street EB / Grimwade Street
10062	76	62	Priority Junction of Grimwade Street / Fore Street EB
20014	68	77	Signals of London Road / Yarmouth Road / Handford Road / West End Road
20015	64	67	Signals of A1071 Handford Road / London Road
20069	76	83	Signals of St Helens Street / Warwick Road / Spring Road / Grove Lane
East			
20077	67	75	Signals of Derby Road / Foxhall Road
30407	78	89	Signals of A12 NB / Main Road / Park and ride exit
20057	38	39	Signals of Sidegate Lane / Nelson Road / Woodbridge Road
30240	32	39	Signals of Maryon Road / Nacton Road
30407	78	89	Signals of A12 NB / Main Road / Park and ride exit
West			
30142	75	65	Signals of B1067 Bramford Road / Sproughton Road
30155	59	58	Signals of London Road / Sprites Lane / A1071
30024	2	2	Priority Junction of
30025	2	2	Priority Junction of
20025	50	56	Signals of Bramford Road / A1214 Yarmouth Road / A1214 Chevallier Street
30124	48	51	Signals of A1156 Bury Road / Old Norwich Road / A1156 Norwich Road
P1 Development vicinity			
20044	67	85	Signals of Hanley Road / A1214 Valley Road
20047	24	50	Roundabout of A1214 Valley Road / B1077 Westerfield Road
Copdock			
30044	55	62	Signals of A1214 / A14 EB off slip
30045	70	79	Priority Junction of A12 NB / Copdock Gyratory
30046	112	123	Priority Junction of Copdock A14 WB / Gyratory

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Figure 6 – Average junction delay, AM peak, 2021 with P1 (-20%) development

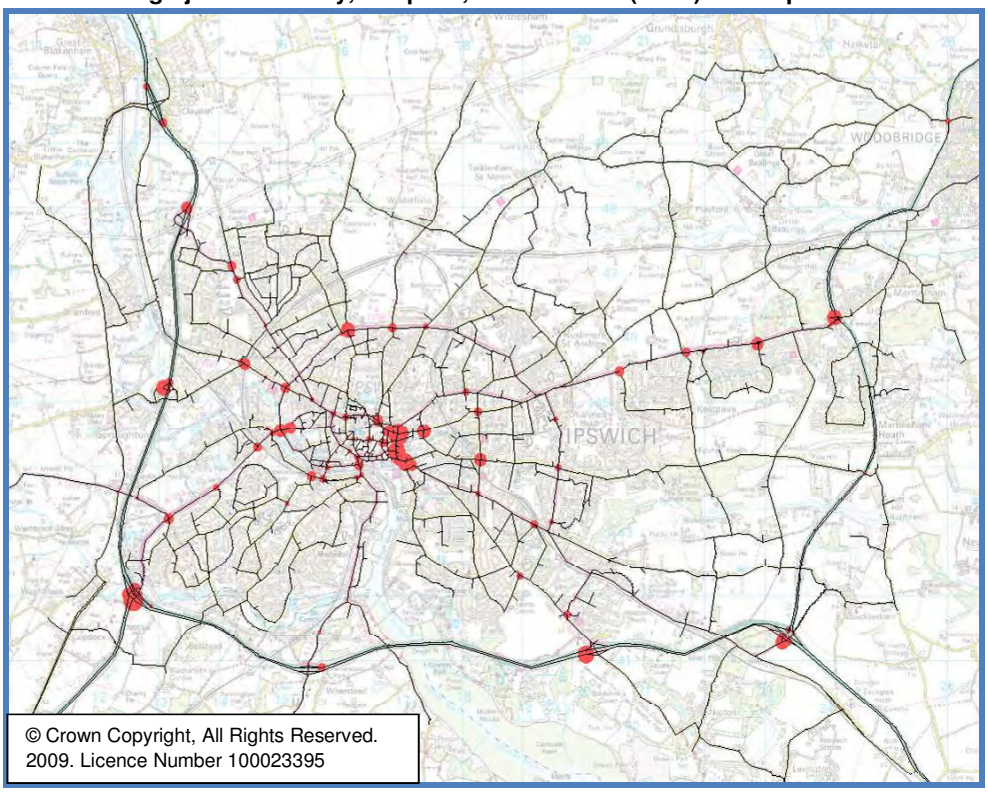

Table 7 – Average junction delay (seconds), PM peak, 2021 with P1 (-20%) development

Node	2021 TravelSmart	2021 P1 - 20%	Location
Town Centre			
10018	168	224	Signals of Star Lane / Grimwade Street
10020	69	75	Signals of Argyle Street / Grimwade Street / St Helens Street
10049	51	75	Signals of Bond Street / St Helens Street
10061	39	40	Priority Junction of Fore Street EB / Grimwade Street
10062	53	66	Priority Junction of Grimwade Street / Fore Street EB
20014	112	134	Signals of London Road / Yarmouth Road / Handford Road / West End Road
20015	79	105	Signals of A1071 Handford Road / London Road
20069	72	79	Signals of St Helens Street / Warwick Road / Spring Road / Grove Lane
East			
20077	76	86	Signals of Derby Road / Foxhall Road
30407	35	35	Signals of A12 NB / Main Road / Park and ride exit
20057	68	79	Signals of Sidegate Lane / Nelson Road / Woodbridge Road
30240	95	94	Signals of Maryon Road / Nacton Road

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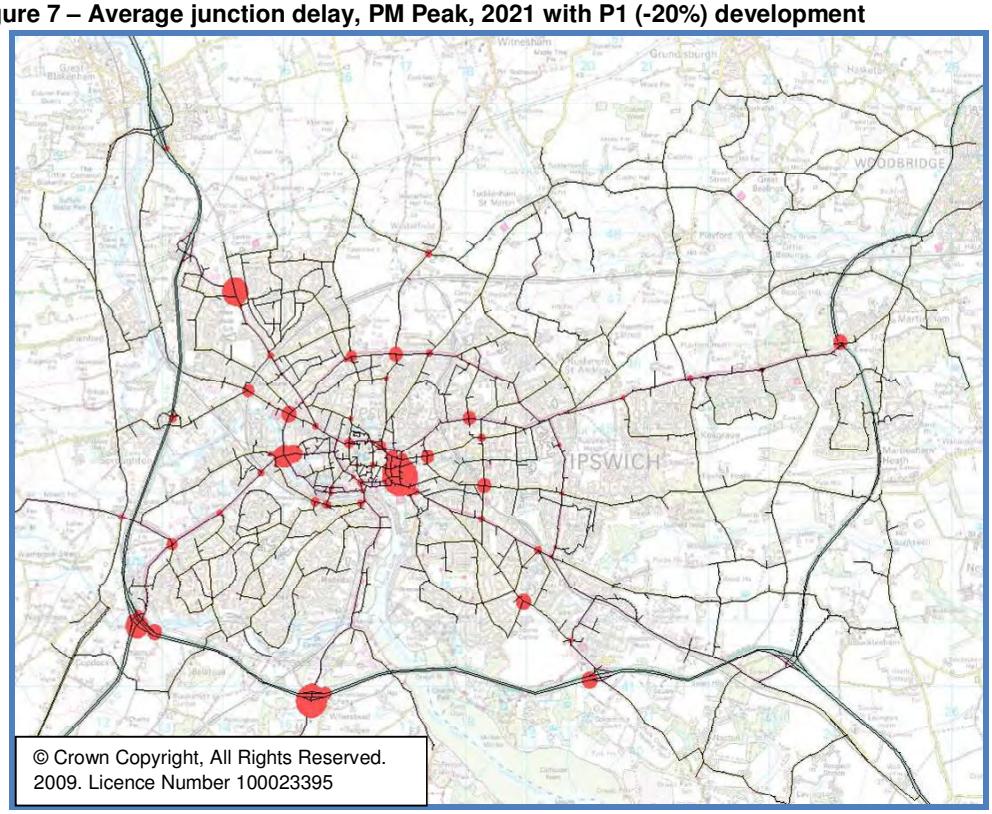
Node	2021 TravelSmart	2021 P1 - 20%	Location
30407	35	35	Signals of A12 NB / Main Road / Park and ride exit
West			
30142	70	74	Signals of B1067 Bramford Road / Sproughton Road
30155	64	67	Signals of London Road / Sprites Lane / A1071
30024	1	2	Priority Junction of
30025	1	2	Priority Junction of
20025	70	94	Signals of Bramford Road / A1214 Yarmouth Road / A1214 Chevallier Street
30124	119	163	Signals of A1156 Bury Road / Old Norwich Road / A1156 Norwich Road
P1 Development vicinity			
20044	76	65	Signals of Hanley Road / A1214 Valley Road
20047	21	84	Roundabout of A1214 Valley Road / B1077 Westerfield Road
Copdock			
30044	53	49	Signals of A1214 / A14 EB off slip
30045	50	60	Priority Junction of A12 NB / Copdock Gyratory
30046	127	141	Priority Junction of Copdock A14 WB / Gyratory

Figure 7 – Average junction delay, PM Peak, 2021 with P1 (-20%) development



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Journey times have been compared for all of the routes previously specified with the 2021 TravelSmart scenario. These are presented in tabular form in Table 8 for the AM and PM peak hours. Table 9 also notes the change in pcu-hours and pcu-kilometres across the entirety of the simulation area (the area broadly shown in the delay plots).

Table 8 – Comparison of Journey Times (minutes), 2021 TravelSmart and 2021 P1 development

Route	Direction	2021 TravelSmart		2021, P1 - 20%		Difference	
		AM	PM	AM	PM	AM	PM
A1214 Valley Road/ Woodbridge Road	Eastbound	21.00	22.43	21.56	23.03	0.56	0.59
	Westbound	23.03	21.36	23.91	23.07	0.88	1.71
A1214 London Road	Eastbound	11.52	12.13	11.59	13.40	0.07	1.27
	Westbound	9.30	10.81	9.52	11.25	0.22	0.44
Bucklesham Road	Eastbound	7.48	7.48	7.48	7.48	0.00	0.00
	Westbound	7.47	7.47	7.48	7.47	0.00	0.00
Felixstowe Road	Eastbound	11.52	10.79	12.19	11.00	0.67	0.22
	Westbound	11.53	13.89	12.79	12.39	1.26	-1.50
Foxhall Road	Eastbound	12.12	12.57	12.41	12.69	0.29	0.12
	Westbound	12.31	11.37	12.35	11.34	0.04	-0.03
Inner Ring Road	Clockwise	13.94	14.03	14.49	16.10	0.55	2.07
	Anti-Clockwise	10.70	9.37	10.94	10.70	0.24	1.33
Norwich Road	Northbound	11.26	11.77	11.27	12.05	0.00	0.28
	Southbound	16.10	16.83	16.89	19.30	0.79	2.47
Westerfield Road	Northbound	8.12	8.22	8.17	8.65	0.05	0.43
	Southbound	7.06	7.03	7.57	7.08	0.51	0.05
Wherstead Road	Northbound	6.95	6.37	7.16	6.40	0.20	0.03
	Southbound	6.15	6.10	6.17	6.10	0.02	0.00

Table 9 – Simulation network statistics, 2021 TravelSmart and 2021 P1 development

Time Period	2021 TravelSmart	2021 P1 -20%	Absolute Difference	Percentage Difference
PCU-hours				
AM Peak hour	11,949	12,696	747	6%
PM Peak hour	12,191	13,248	1,057	9%
PCU-kilometres				
AM Peak hour	475,370	487,012	11,642	2%
PM Peak hour	477,972	491,524	13,552	3%

Figure 8 and Figure 9 show comparisons of journey times along the routes of Westerfield Road and the Inner Ring Road respectively.

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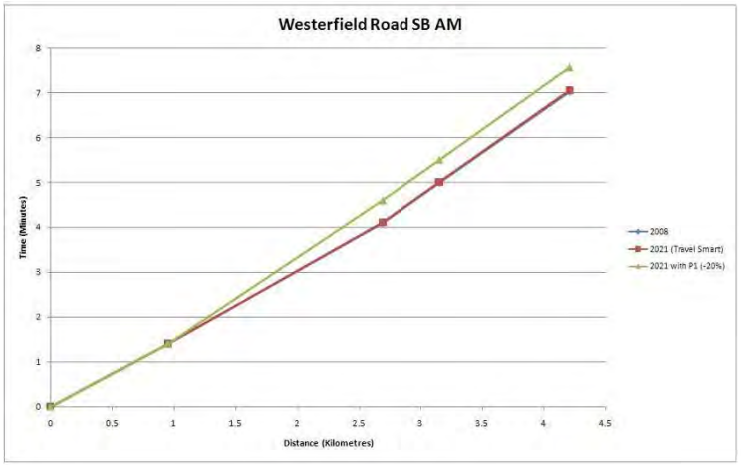
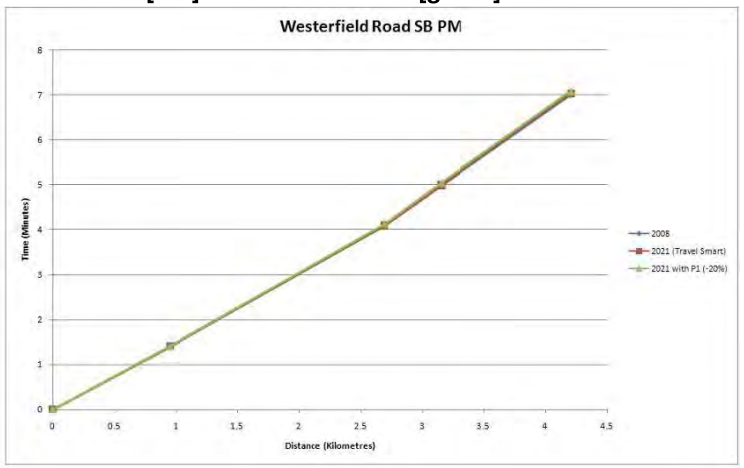
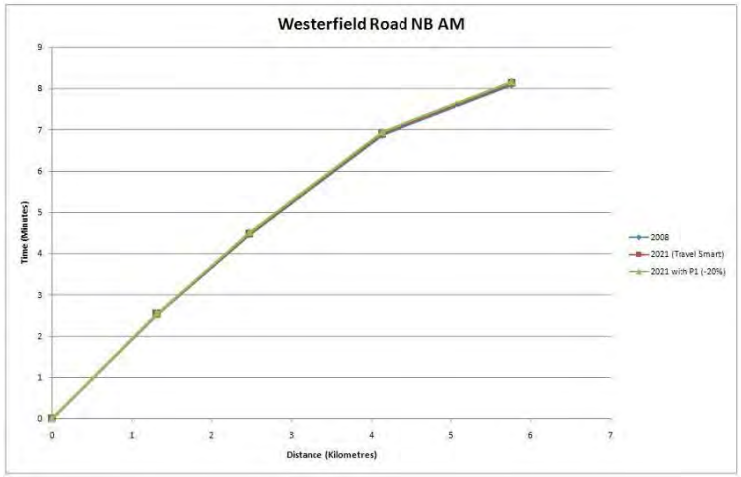
Figure 8 – Journey Times along Westerfield Road for 2008 [blue], 2021 TravelSmart [red] and 2021 P1 -20% [green]







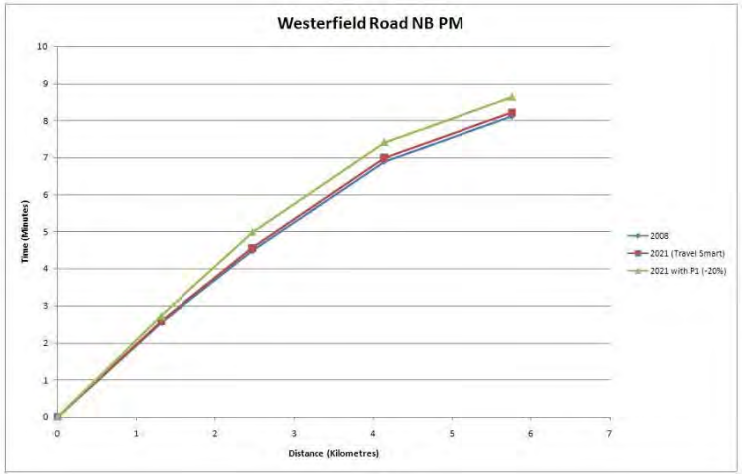


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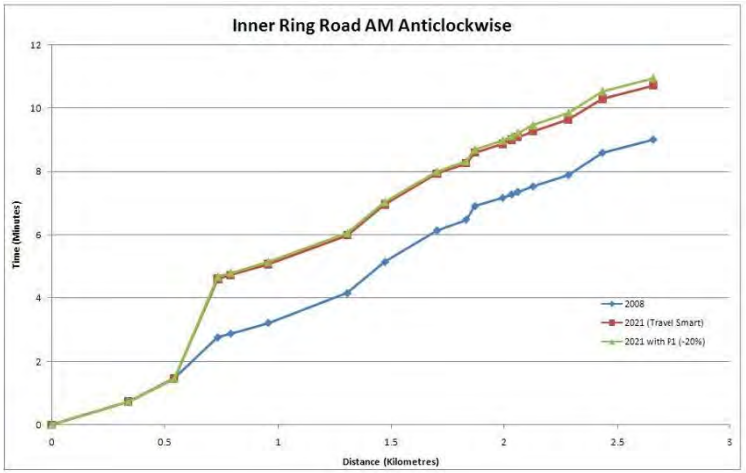
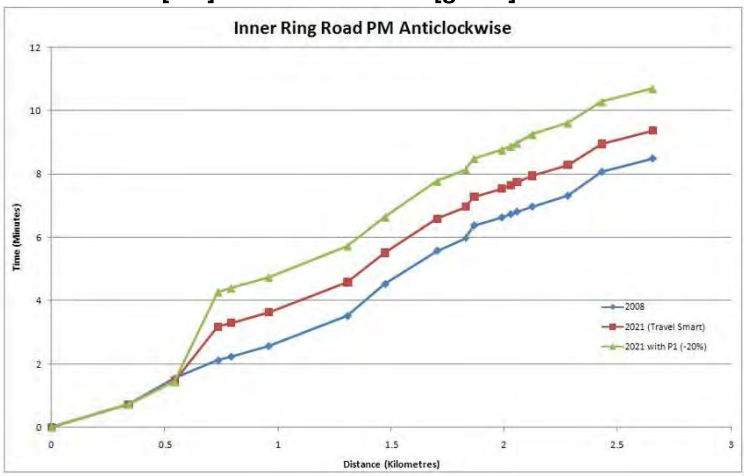
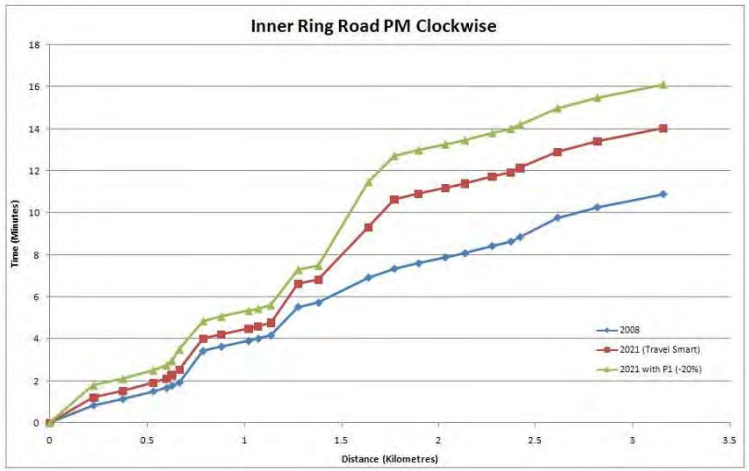
Figure 9 – Journey Times on the Inner Ring Road for 2008 [blue], 2021 TravelSmart [red] and 2021 P1 -20% [green]







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4.3. 2021 with P1 (-20%) and Northern Bypass

Average junction delays are presented for the 25 standard junctions referenced above and compared with those without the P1 development in Table 10 for the AM peak hour, in addition to being graphically represented in Figure 10, by bandwidth circles where radii is proportional to the level of delay. These are repeated for the PM peak in Table 11 and Figure 11.

Table 10 – Average junction delays (seconds), AM Peak, 2021 with P1 Northern Bypass

Node	2021 TravelSmart	2021 North Bypass	Location
Town Centre			
10018	104	120	Signals of Star Lane / Grimwade Street
10020	90	48	Signals of Argyle Street / Grimwade Street / St Helens Street
10049	58	65	Signals of Bond Street / St Helens Street
10061	78	24	Priority Junction of Fore Street EB / Grimwade Street
10062	76	62	Priority Junction of Grimwade Street / Fore Street EB
20014	68	72	Signals of London Road / Yarmouth Road / Handford Road / West End Road
20015	64	63	Signals of A1071 Handford Road / London Road
20069	76	82	Signals of St Helens Street / Warwick Road / Spring Road / Grove Lane
East			
20077	67	69	Signals of Derby Road / Foxhall Road
30407	78	39	Signals of A12 NB / Main Road / Park and ride exit
20057	38	27	Signals of Sidegate Lane / Nelson Road / Woodbridge Road
30240	32	28	Signals of Maryon Road / Nacton Road
30407	78	39	Signals of A12 NB / Main Road / Park and ride exit
West			
30142	75	40	Signals of B1067 Bramford Road / Sproughton Road
30155	59	56	Signals of London Road / Sprites Lane / A1071
30024	2	2	Priority Junction of
30025	2	2	Priority Junction of
20025	50	38	Signals of Bramford Road / A1214 Yarmouth Road / A1214 Chevallier Street
30124	48	35	Signals of A1156 Bury Road / Old Norwich Road / A1156 Norwich Road
P1 Development vicinity			
20044	67	61	Signals of Hanley Road / A1214 Valley Road
20047	24	24	Roundabout of A1214 Valley Road / B1077 Westerfield Road
Copdock			
30044	55	105	Signals of A1214 / A14 EB off slip
30045	70	64	Priority Junction of A12 NB / Copdock Gyratory
30046	112	113	Priority Junction of Copdock A14 WB / Gyratory

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Figure 10 – Average junction delay, AM peak, 2021 with P1 Northern Bypass

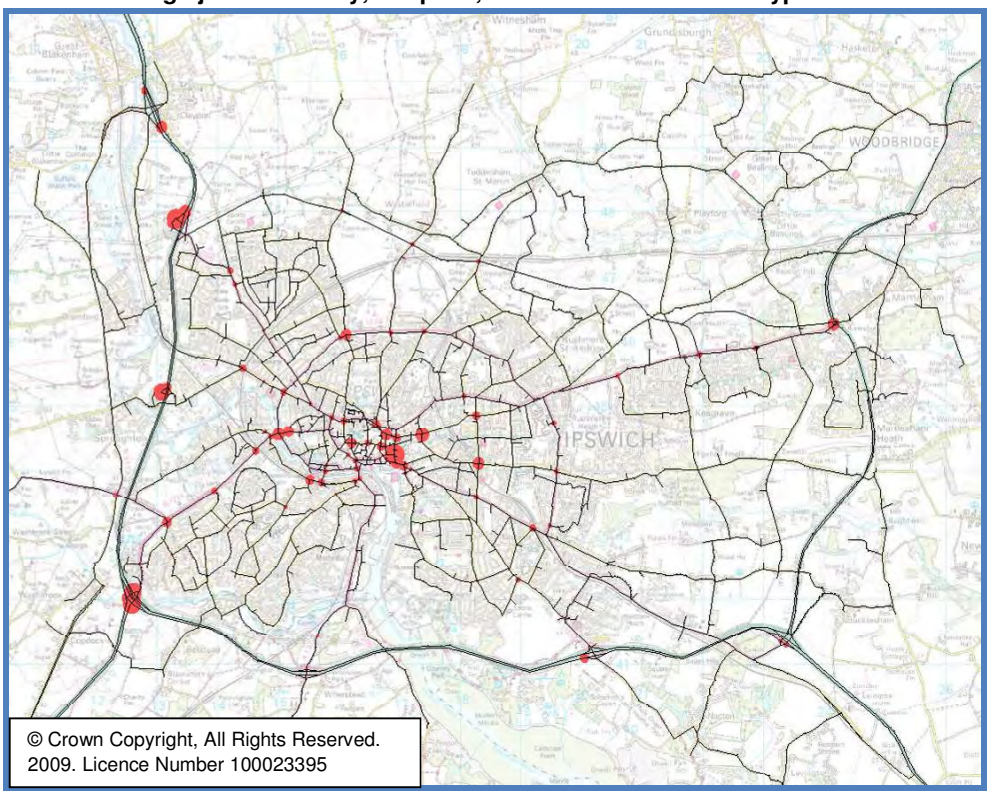

Table 11 – Average junction delay (seconds), PM peak, 2021 with P1 Northern Bypass

Node	2021 TravelSmart	2021 North Bypass	Location
Town Centre			
10018	168	141	Signals of Star Lane / Grimwade Street
10020	69	56	Signals of Argyle Street / Grimwade Street / St Helens Street
10049	51	48	Signals of Bond Street / St Helens Street
10061	39	8	Priority Junction of Fore Street EB / Grimwade Street
10062	53	53	Priority Junction of Grimwade Street / Fore Street EB
20014	112	95	Signals of London Road / Yarmouth Road / Handford Road / West End Road
20015	79	65	Signals of A1071 Handford Road / London Road
20069	72	55	Signals of St Helens Street / Warwick Road / Spring Road / Grove Lane
East			
20077	76	67	Signals of Derby Road / Foxhall Road
30407	35	30	Signals of A12 NB / Main Road / Park and ride exit
20057	68	52	Signals of Sidegate Lane / Nelson Road / Woodbridge Road
30240	95	87	Signals of Maryon Road / Nacton Road

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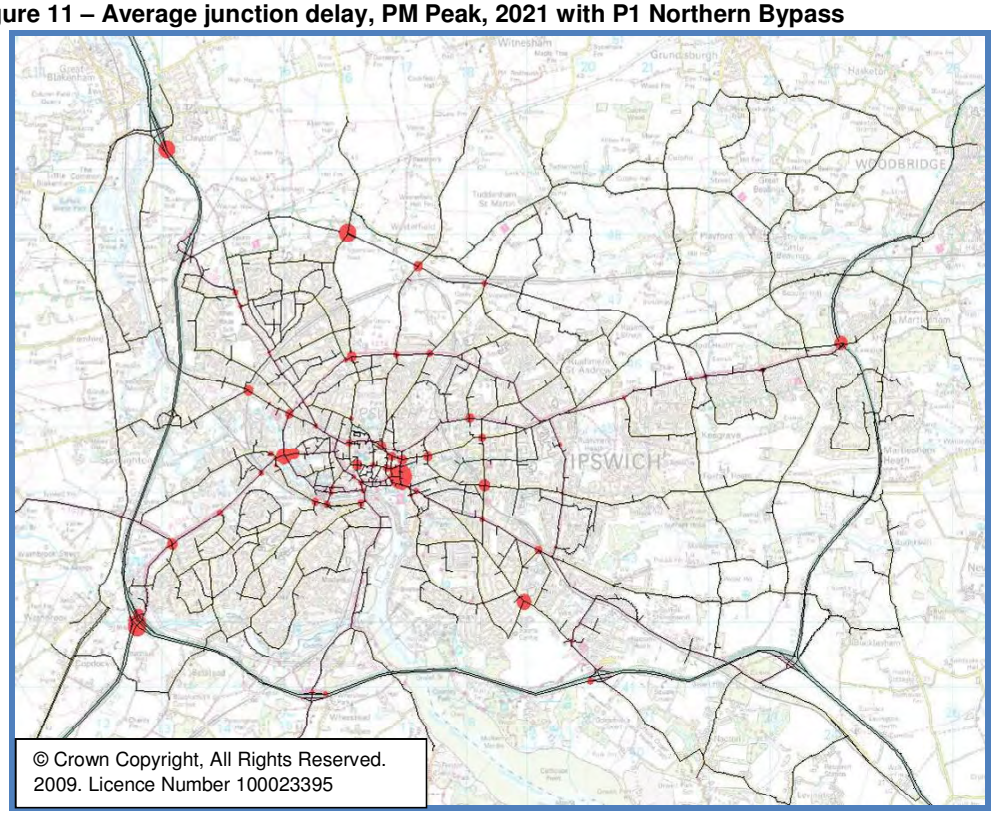
Node	2021 TravelSmart	2021 North Bypass	Location
30407	35	30	Signals of A12 NB / Main Road / Park and ride exit
West			
30142	70	59	Signals of B1067 Bramford Road / Sproughton Road
30155	64	62	Signals of London Road / Sprites Lane / A1071
30024	1	1	Priority Junction of
30025	1	1	Priority Junction of
20025	70	49	Signals of Bramford Road / A1214 Yarmouth Road / A1214 Chevallier Street
30124	119	31	Signals of A1156 Bury Road / Old Norwich Road / A1156 Norwich Road
P1 Development vicinity			
20044	76	57	Signals of Hanley Road / A1214 Valley Road
20047	21	34	Roundabout of A1214 Valley Road / B1077 Westerfield Road
Copdock			
30044	53	61	Signals of A1214 / A14 EB off slip
30045	50	43	Priority Junction of A12 NB / Copdock Gyratory
30046	127	112	Priority Junction of Copdock A14 WB / Gyratory

Figure 11 – Average junction delay, PM Peak, 2021 with P1 Northern Bypass



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Journey times have been compared for all of the routes previously specified with the 2021 TravelSmart scenario. These are presented in tabular form in Table 12 for the AM and PM peak hours. Table 13 also notes the change in pcu-hours and pcu-kilometres across the entirety of the simulation area (the area broadly shown in the delay plots).

Table 12 – Comparison of Journey Times (minutes), 2021 TravelSmart and 2021 Northern Bypass

Route	Direction	2021 TravelSmart		2021, North Bypass		Difference	
		AM	PM	AM	PM	AM	PM
A1214 Valley Road/ Woodbridge Road	Eastbound	21.00	22.43	20.35	21.31	-0.65	-1.13
	Westbound	23.03	21.36	20.19	19.79	-2.84	-1.58
A1214 London Road	Eastbound	11.52	12.13	10.90	11.28	-0.63	-0.85
	Westbound	9.30	10.81	9.23	10.47	-0.07	-0.34
Bucklesham Road	Eastbound	7.48	7.48	7.48	7.48	-0.01	0.00
	Westbound	7.47	7.47	7.47	7.47	0.00	0.00
Felixstowe Road	Eastbound	11.52	10.79	10.29	10.54	-1.23	-0.24
	Westbound	11.53	13.89	11.34	11.93	-0.19	-1.96
Foxhall Road	Eastbound	12.12	12.57	12.12	12.20	0.00	-0.37
	Westbound	12.31	11.37	12.10	11.26	-0.21	-0.11
Inner Ring Road	Clockwise	13.94	14.03	11.84	12.73	-2.10	-1.30
	Anti-Clockwise	10.70	9.37	10.36	9.59	-0.34	0.22
Norwich Road	Northbound	11.26	11.77	11.04	11.57	-0.23	-0.20
	Southbound	16.10	16.83	15.07	14.18	-1.03	-2.65
Westerfield Road	Northbound	8.12	8.22	8.34	8.62	0.21	0.40
	Southbound	7.06	7.03	7.58	7.59	0.52	0.57
Wherstead Road	Northbound	6.95	6.37	6.81	6.56	-0.15	0.19
	Southbound	6.15	6.10	6.14	6.12	-0.02	0.02

Table 13 – Simulation network statistics, 2021 TravelSmart and 2021 Northern Bypass

Time Period	2021 TravelSmart	2021 Northern Bypass	Absolute Difference	Percentage Difference
PCU-hours				
AM Peak hour	11,949	11,852	-97	-1%
PM Peak hour	12,191	11,876	-315	-3%
PCU-kilometres				
AM Peak hour	475,370	483,868	8,498	2%
PM Peak hour	477,972	487,577	9,605	2%

Figure 12 and Figure 13 show comparisons of journey times along the routes of Westerfield Road and the Inner Ring Road respectively. Figure 14 has also been selected as this provides a direct parallel route running east-west across the north of Ipswich that allows traffic to access the A14, A12 and the area of Kesgrave, all routes for which the modelled northern bypass provides access. Journey times along this route are thus likely to be directly impacted by the implementation of a northern bypass.

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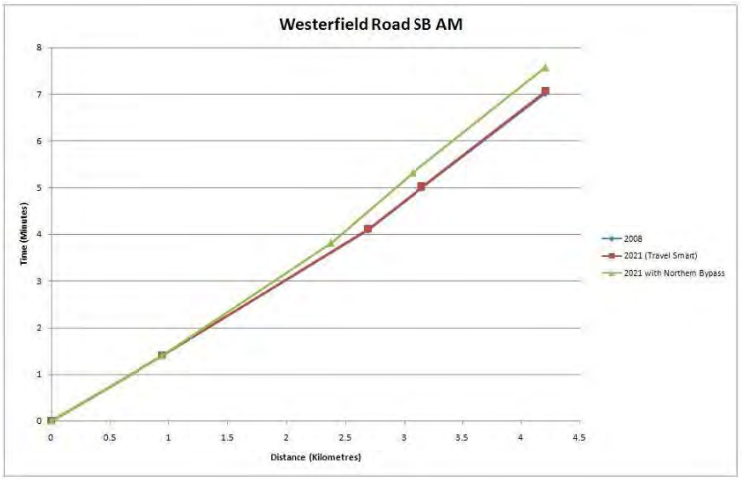
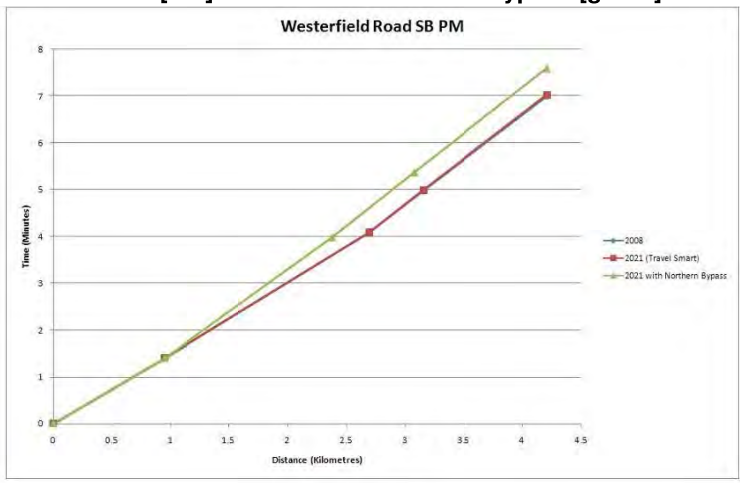
Figure 12 – Journey Times along Westerfield Road for 2008 [blue], 2021 TravelSmart [red] and 2021 P1+Northern Bypass [green]





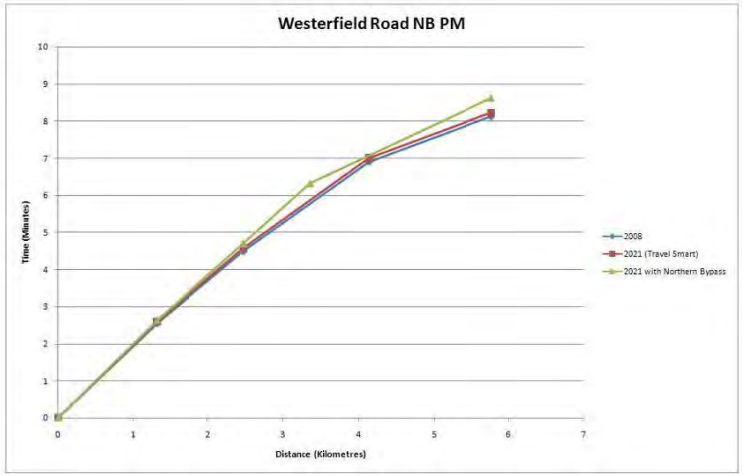


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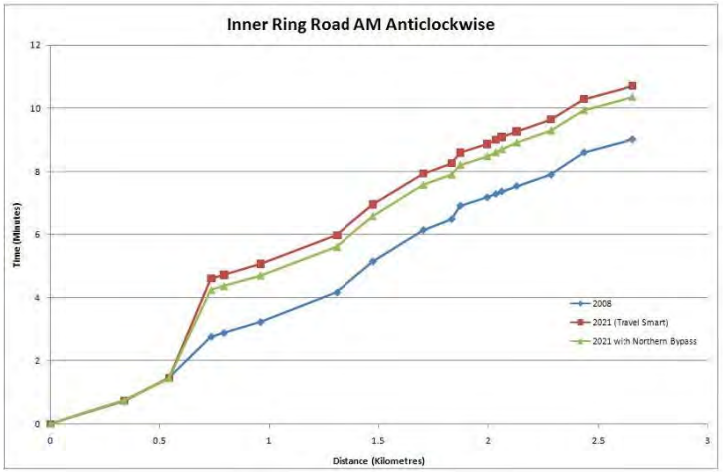
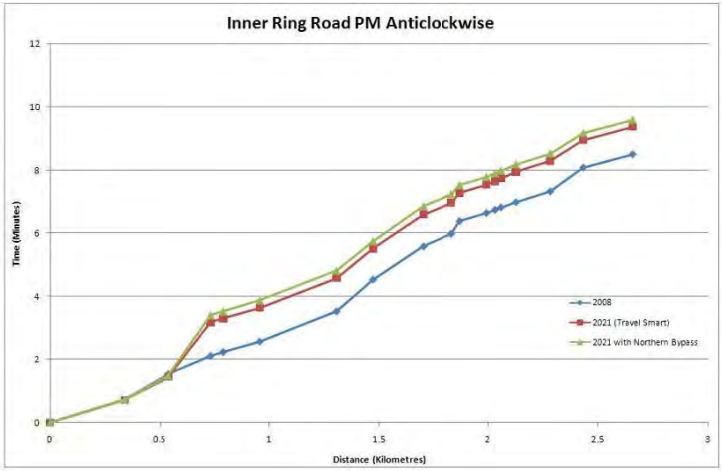
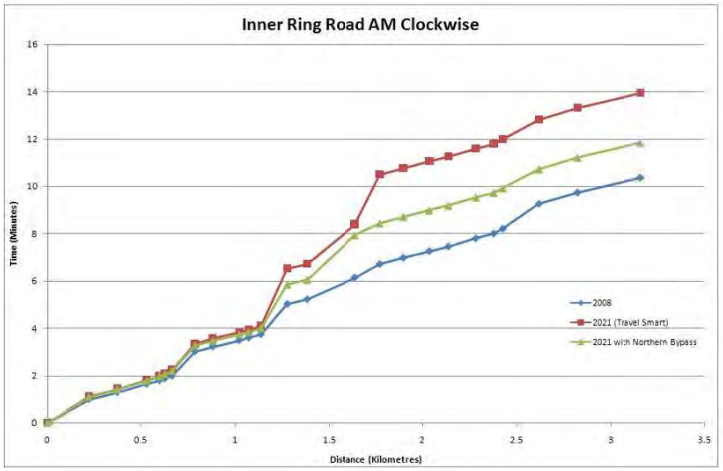
Figure 13 – Journey Times on the Inner Ring Road for 2008 [blue], 2021 TravelSmart [red] and 2021 P1+Northern Bypass [green]







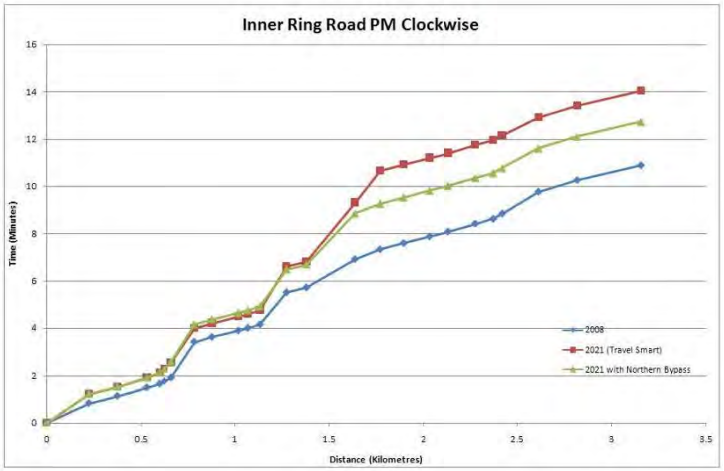


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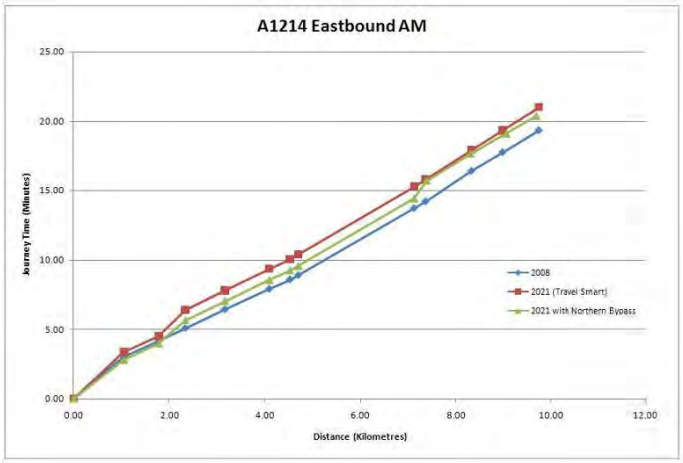
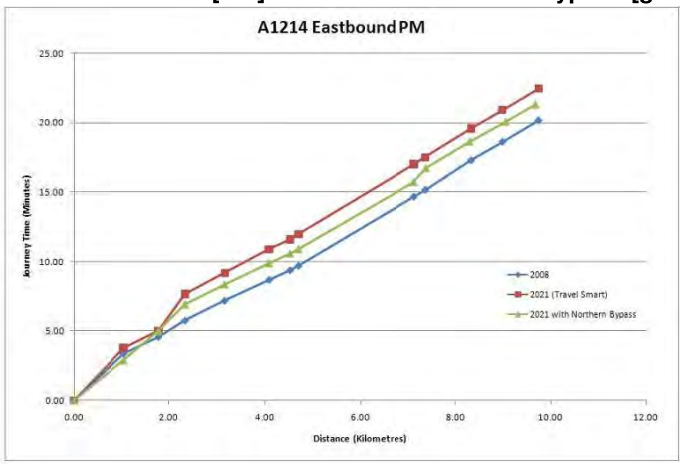
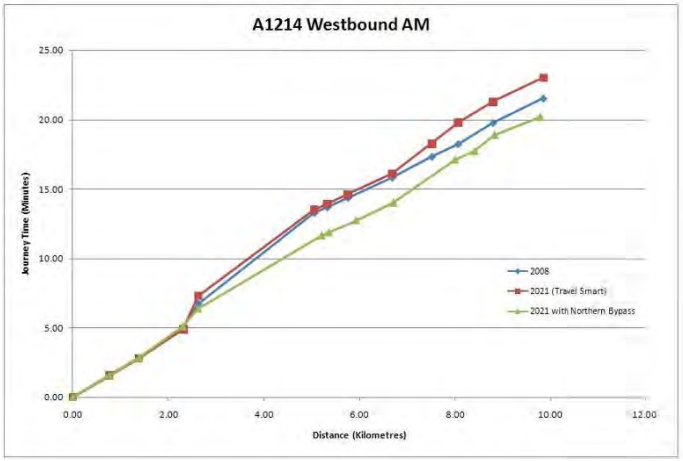
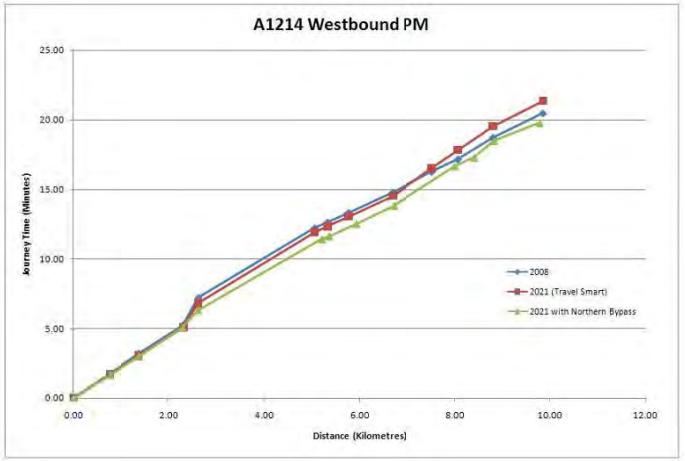
Figure 14 – Journey Times along Woodbridge Road for 2008 [blue], 2021 TravelSmart [red] and 2021 P1+Northern Bypass [green]









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5. Summary

5.1. Comparison of re-run tests

This section explores the differences between the supplementary tests that have been run and the original tests detailed in the Technical Note of 20th August. As previously noted, the only difference between these two sets of tests is the removal of 450 households at the northern fringe (P1) development, owing to their prior inclusion as part of the RSS target growth to 2021.

A comparison of the results for the P1 development for both the re-run model and the original model show that the average junction delays in both the AM and PM peak are of the same order of magnitude and are spatially similar to each other, generally being a few seconds lower – if at all – in the re-run scenarios. This comparison is true of the development both with and without the 20% mode-shift. Comparison of the simulation network statistics between the two sets of models also shows that there is very little change; PCU-kilometres, whilst lower in the revised P1 scenario, still witness a 3% and 4% increase over the 2021 TravelSmart base in the AM and PM peaks, whilst PCU-hours are only slightly changed, decreasing from a 7% increase of the TravelSmart scenario to 6% in the AM Peak and slightly increasing from an 11% increase to a 13% increase in the PM peak as a result of re-routeing. Figure 15 emphasises the minor-levels of change between the assignments as shown by the analysis in terms of flow change across the network, comparing the original assignments (5,000 additional households in the northern fringe) with the revised assignments (4,550 additional households) for the AM peak hour. As shown by Figure 15, the level of flow change is extremely low, with slightly less flow (annotated in blue) on Henley Road and Lower Road in the vicinity of the proposed developments as expected, and then only minor re-routing across the rest of the network, due to slight changes in capacity as a result of the reduced number of trips to/from the P1 development.

Figure 15 – Change in traffic flows, 2021 AM Peak, P1 development (Revised –vs- Original)

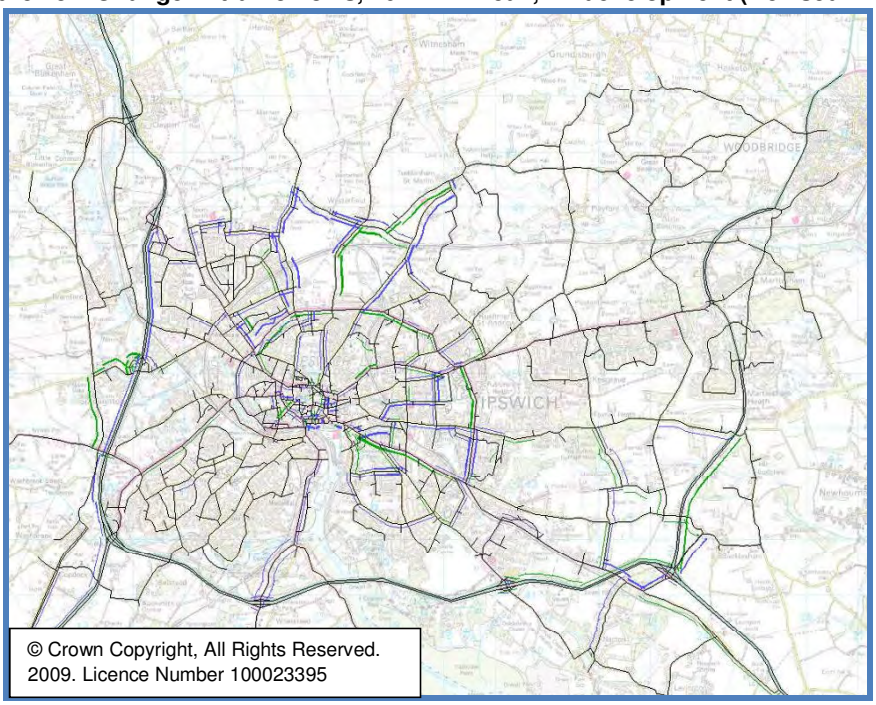

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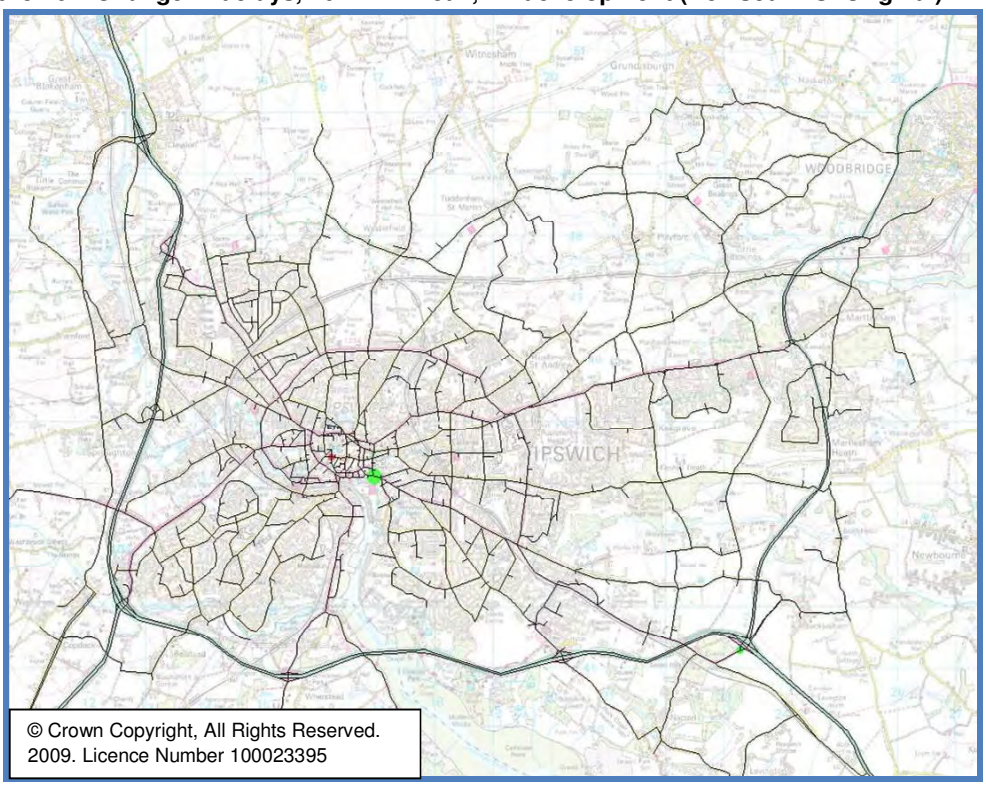
Figure 16 shows the change in delays across the network for the AM peak as a result of the revised northern fringe household numbers. As can be seen from both the figure and from comparing the delay tables in both Technical Notes, delays are consistent across the network with the exception of the junction of Grimwade Street and Fore Street, which experiences a reduction in delay with the revised scenario, demonstrating that the junction is likely to be on the verge of being over-capacity in 2021 and the development has the potential to exacerbate this.

Figure 16 – Change in delays, 2021 AM Peak, P1 development (Revised –vs- Original)



Analysis of the PM peak and of the two other sets of tests also show that the change across the networks across both the statistics shown in the above sections and the actual traffic flows is minor, suggesting that the results of the Technical Note dated 20th August are both sound and are able to be used in assessing the impacts of the potential development upon the road infrastructure expected to be in place by 2021. The tests hence allow for a degree of understanding as to whether the developments are likely to be able to go ahead without major detriment to both the existing and predicted road infrastructure.

By comparing the differences of model outputs between the revised demand levels at the P1 site and the original housing allowance assumed at the site, it has been shown above that the results are quite similar. Therefore, it is possible to infer these marginal changes to all of the original infrastructure tests, without the need to re-running the full complement of tests.

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5.2. Headline analysis

As shown in section 5.1, there is very little difference between the initial tests of the AECOM Technical Note dated 20th August and the latest set of testing. As such, the initial findings from this test are still relevant and can be taken forward; these are reproduced from the original Technical Note here.

5.2.1. P1 development

- Junction delays tend to increase as a result of the introduction of the 5,000 households in the northern fringe (4,550 assumed to be over and above RSS allocations).

- As shown by the delay tables presented, delays tend to increase across all areas of Ipswich, however, they are particularly more marked at the junctions along the A1214 Valley Road, particularly at (although not limited to) Henley Road and Westerfield Road.

- Delays away from the town centre, although do increase are less significant compared to the delay increases within the town centre.

- Introduction of the strong sustainable transport measures alone at the development site appears only to have minimal impact on Ipswich-wide delays, with the junctions on the A1214 Valley Road still operating substantially poorer than in the 2021 base-case.

5.2.2. Wet Dock Crossing (Dual Bridge permutation)

- The Wet Dock crossing appears to successfully mitigate the impacts of the P1 development within the town centre and inner-ring road (particularly on the eastern side), in some cases returning delays at key junctions to pre-2021 levels and some even to base-year conditions.

- A number of junctions both further east and west of the town centre however, experience decreased operational efficiency as a result of traffic re-routing caused by the introduction of the crossing. This is particularly evident at junction 54 of the A14.

- Delays at junctions along the A1214 in the vicinity of the P1 development are partially mitigated, with delays reduced further than if just the strong sustainable transport measures were effectively implemented, but still higher than the 2021 base-case.

5.2.3. Wet Dock Crossing (Swing Bridge permutation)

- The impact of a swing-operating bridge at Wet Dock crossing is generally akin to that of the dual bridge permutation.

- Some delays within the town centre are slightly higher than those present in the dual bridge permutation of the crossing. Delays elsewhere within the network generally appear to be at a similar level however.

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5.2.4. Northern Bypass/Relief Road

- The introduction of the northern bypass is not as effective at reducing delays in the town centre area as a Wet Dock crossing, due to the nature of the trips that use such a route. Delays in the town centre typically remain at levels close to that of the development without any highway infrastructure improvements although there are benefits at some junctions.

- Delays elsewhere within the Ipswich-area however appear to be much better mitigated than with the introduction of a Wet Dock crossing. Certainly, for a number of the junctions presented within this analysis, delays are reduced to a level lower than the 2021 base-case in both the eastern and western fringes.

- The northern bypass also appears to more successfully mitigate the impacts at junctions along the A1214, with average delays here again reduced to levels present in the 2021 base-case, prior to the introduction of the northern fringe development.

- The northern bypass is the only intervention however, that appears to impair the operation of the A12/A14 Copdock Interchange, in some cases doubling the average delays experienced by a vehicle.

5.3. Analysis, initial conclusions and recommendations

As the results presented in both Technical Notes show, the P1 development is likely to increase delays globally across the Ipswich area, on main routes both within the district boundaries of Ipswich Borough Council and outside at major junctions above the assumed 2021 base-case due to the additional traffic travelling both to and from the development. This assumes the implementation of a number of 'DoMinimum' traffic schemes as previously mentioned and the successful implementation of measures proposed in the Major Scheme Business Case.

These general increases across the urban area, however, could be considered relatively minor in comparison to the scale of increase that the ITAMS predicts to occur between 2008 and 2021, which have been shown in some-cases (particularly within, although not limited to, the town centre) to be considerable, although to a similar scale as is likely to be experienced by other major urban centres across the Eastern region. As such, increased delays attributable to additional development in the northern fringe may not be perceived to be so large on many of the major arterial routes.

The key junctions that are likely to experience the greatest increases in delay as a result of the northern fringe development are within the town centre, along the inner-ring road and those junctions directly within the vicinity of the development itself, particularly the junctions of both Henley Road and Westerfield Road with the A1214 Valley Road. Increases of delay between 24 seconds per vehicle and 89 seconds per vehicle at the two junctions along the A1214 demonstrate that substantial delays could be expected here with the introduction of the P1 development which, in all likelihood, are liable to get even worse in the years succeeding the introduction of the development. Increases in delays at junctions within the town centre as a result of the additional development, (although minor increases) such as the A1214 junctions are likely to cause some disruption, particularly along Grimwade Street, where the increases in delay per vehicle of over a minute in the PM peak with the junction of Star Lane could cause some blocking-back through junctions further upstream and also cause wider-scale re-routing through the town centre as driver's look to avoid delays.

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It has been shown by the testing that the only way in which to substantially reduce delays across the network is through the introduction of a 'big-ticket' highway infrastructure scheme (such as a Northern Bypass or Wet Dock Crossing), some of which are very effective in mitigating against the impacts of the additional development. It should be pointed out that, from observing the journey time graphs presented in both Technical Notes, both the Northern Bypass and Wet Dock crossing not only mitigate the impacts of the development, but have the potential to mitigate against the general RSS growth between 2008 and 2021, showing that journey times around the inner- ring road and Woodbridge Road are reduced to pre-2021 levels with the introduction of the schemes. It has been shown that investment in a strong sustainable transport policy, even to the degree of reducing car trips at the development by 20% has little effect on mitigating the impacts of the development. As a reduction of car trips by 20% from the development is considered optimistic, it is likely that the slight benefits shown within this report are indeed likely to be less in reality. It should be noted that the 'big-ticket' infrastructure schemes tend to provide greater relief to town-centre routes than strategic traffic around Ipswich. Traffic with a trip-end in the town-centre and greater Ipswich area is the most affected, with strategic traffic having a lesser tendency to re-route.

The above is not to say however, that additional development in the northern fringe could not go ahead without an associated 'big-ticket' infrastructure scheme. It is quite possible that smaller-scale improvements to the two A1214 junctions for example, could adequately mitigate against the impacts of the additional development and contain levels of congestion and delay to those of the 2021 base-case or perhaps improve upon these dependent upon the improvements made. Similarly, smaller-scale alterations within the town centre that provide some additional could alleviate some of the issues. Further investigation and testing of such improvements would be required, but providing other delays across the Ipswich area are not negatively impacted, it may be that these smaller-scale improvements are adequate. It has already been demonstrated that the levels of growth required by the Regional Spatial Strategy are in-line with other urban centre in the Eastern region.

Whilst, as stated above, it may be possible to mitigate the development impacts by undertaking smaller-scale, individual junction-focused improvements at key problem locations across the highway network, it is advisable that a round of testing should be undertaken in order to sift and identify possible improvements. Such testing would allow for the impact on traffic routing around the town centre, journey times and delays to be understood and to provide a more sound understanding as to the scale of possible mitigation works that may be required. There may also be merit in undertaking further work, related to finer details of the development; for instance, clarification and re-location of development access/egress points or reviewing the development trip distribution. Trip distributions for the development, as previously mentioned, have been taken from existing developed zones in the vicinity of the northern fringe. However, Ipswich Borough Council may have a view to distributions being different to those of the existing developments, dependent upon future policies or investment-schemes; these could be tested if required. Similarly, traffic from the development currently accesses the highway network through a single connection on Westerfield Road and a single connection on Henley Road, connections could be altered to different locations along these routes or, indeed, attached to other roads if required, all of which will have some impact on traffic routing from the development and the re-routing of existing traffic in the area.

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