Essex Highways

North Essex Rapid Transit System (RTS)

Stage 2 Section B Preferred Options Technical Note

February 2020

RINGWAY JACOBS integrated expertise

Essex County Council

Document Control Sheet

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Contents

Tables & Figures

1 Stage One Section B Summary

1.1 Outcome of Stage 1

Of the five options originally identified for Section B, two were discounted at Stage 1: Option 3 (Rail Route) and Option 4 (Southern Route). These were both found to be unachievable within the time and budget available.

This left three options to be considered at Stage 2:

- Option 1 – Via Magdalen Street
- Option 2 – Via Greenstead Road
- Option 5 – Via St Andrews Avenue

A plan showing details of the Stage 2 route options, and the routes for Section A and Section C can be found in Appendix D - Stage 2 Options. This report details the subsequent work completed at Stage 2 regarding Section B:

1 Conclusions of Option Specific Technical Notes

Each route option has been considered individually; with a technical note for each, detailing the findings, provided as appendices A-C of this report.

Appendix A gives full details of route Option 1 (Magdalen Street): The conclusion being whilst the route directly serves all three Colchester railway stations and appears the most direct, it was observed to have the slowest overall journey time during the live public service vehicle trials. There is also very little opportunity to make meaningful improvements to facilities along the sections solely associated with this route option. The proposal for an eastbound RTS lane along Barrack Street would make for marginal improvements, but would likely receive staunch opposition from local residents. The presence of the Hythe Level Crossing means some journeys in either direction could be held up could be held for significant periods. This would likely be viewed negatively as part of a 'rapid' transit system by patrons and undermine the reliability of the system.

Appendix B gives full details of route Option 2 (Greenstead Road): The conclusion being that route serves all three Colchester railway stations (subject to a 100m walk to Hythe Station). The directness of the route contributes to this option having the shortest overall journey time. There is limited opportunity to implement measures along this section. Realistically these are restricted to implementing parking restrictions and/or a RTS/bus gate along Greenstead Road, to marginally improve RTS journey time and reliability. There is no opportunity to provide dedicated RTS lanes with this option due to site constraints. The presence of the Eastgates Level Crossing means that around a third of journeys will be delayed by the crossing, with average level crossing closures of 3m 4s. A very small proportion of level crossing closures were found to be in excess of 6 minutes. However, the presence of the level crossing may be still be viewed negatively as part of a 'rapid' transit system by patrons as it will, to some degree, undermine the reliability of the system.

Appendix C gives full details on route Option 5 (St Andrew's Avenue): The conclusion being that this option does not directly serve all three Colchester Rail Stations, as the route is located approximately 250m from Colchester Hythe Station. Despite the option having a route length approximately half a kilometre longer than the other options, Option 5 has the intermediate overall journey time observed during the live public service vehicle trials. There is the opportunity to provide RTS lanes and bus priority measures along most of St Andrews Avenue, which could make meaningful improvements to RTS journey time and reliability. The lack of level crossings along the route will also be viewed favourably by patrons.

These technical notes have been used, in part, to inform the 'Objective Fulfilment' and 'Engineering Feasibility' columns of the Option Assessment Matrix found subsequently within this report.

2 Live Public Service Vehicle Trials

To better understand and assess the time that an RTS vehicles may take to move along the existing infrastructure, a Public Service Vehicle (PSV) was sourced to drive sections and route options. On Monday 25th November and Wednesday 3rd December 2019, for both the morning and evening peaks, the PSV was used to acquire real-world journey time data. This corresponded to overall journey times for Section A and Section B's remaining options, as well as more detailed information associated with key links and junctions, such as average speeds and reliability.

With the time and resources available, it was possible to complete one or more runs on each section and route option for both flow directions in both the morning and evening peaks. Using a PSV allowed the existing bus priority measures to be utilised. This gives an approximation for the journey time of an RTS vehicle, providing data indicating where average speeds are slow and/or reliability is poor. This information can help inform where further investigation should be targeted to improve the journey time and reliability of the RTS system.

The analysis of these real-world PSV trials are found within the option specific technical notes found as appendices A-C of this report. As well as this, the raw data and any reasoning behind adjustments made to measurements are detailed. For the purposes of this summary report, the journey time findings are summarised below:

Table 1 – Summary of preferred options route lengths and average journey times

Option	Length (combined)	Eastbound	Westbound	Total
Option 1	6.9km	14m 20s	19m 30s	33m 50s
Option 2	6.8km	12m 2s	13m 48s	25m 50s
Option 5	7.5km	11m 22s	17m 49s	29m 11s

It should be noted that the journey times provided are an **indication** only, with a much larger data set required to draw definitive and reliable conclusions on this type of data. To address this issue the Transportation Planning team are in the process of building both Vissim and Vissum models. Between the two models, accurate predictions should be able to be made about both journey times and the implications of any further RTS priority measures implemented along the routes.

The information collected in this live public service vehicle trial has been used, in part, to inform the 'Objective Fulfilment' and 'Value for Money' columns of the Option Assessment Matrix found subsequently within this report.

3 Stage 2 Cost Estimates

As part of Stage 2, cost estimates were produced for each Section B options, with a dedicated report on these costs found in Appendix E – North Essex Rapid Transit System Feasibility Estimate Report. Estimates for the route options are summarised below:

Table 2 – Summary of preferred option stage 2 estimated costs

Option	Estimated Cost
Option 1	£1,510k
Option 2	£1,243k
Option 5	£6,493k

All option estimates include allowances for infrastructure improvements covering the northern end of North Hill until the junction of High Street and Queen Street, as well as, the eastern end of Osborne Street until the junction of Head Street and High Street. This includes:

- Upgrades/modifications to the North Hill/High Street traffic signal junction.
- Modifications to the High Street including the provision for an RTS stop.
- Upgrades/modifications to the St Botolph's Street/ Osborne Street signal junction.
- Provision for an RTS stop along St Osborne Street.
- Conversion of a Zebra crossing along St John's Street to a Puffin crossing.
- Upgrades/modifications to the St John's Street/ Head Street signal junction.

After this point, the route options diverge and the estimates cover different aspects of infrastructure:

- Option 1 covers proposed upgrades/modifications to the Magdalen Street/Brook Street traffic signal junction and the implementation of an eastbound bus gate along Barrack Street.
- Option 2 covers proposed upgrades/modifications to the High Street/East Hill traffic signal junction, upgrades/modifications to the Guildford Road and Brook Street traffic signal junctions and parking restrictions along sections of Greenstead Rd and/or a RTS/bus gate.
- Option 5 covers proposed upgrades/modifications to the High Street/East Hill traffic signal junction, upgrades/modifications to the Guildford Road and Brook Street traffic signal junctions, and provide eastbound and westbound additional RTS lanes along St Andrews Avenue between the Harwich Road junction and Greenstead Roundabout.

These cost estimates have been used, to inform the 'Affordability' and 'Value for 'Money' columns of the Option Assessment Matrix found subsequently within this report.

4 Trafficmaster and Level Crossing Survey Analysis

4.1 Trafficmaster Congestion Data

The two fastest routes from the live PSV trials, Options 2 and 5, both have very similar routes. They diverge at the East Street/Ipswich Road mini-roundabout, with Option 2 routing via Greenstead Road and Option 5 via St Andrews Avenue, respectively, converging again at Greenstead Roundabout. These routes can be seen on a map in Figure 1. As both routes operate 'with-traffic',

with no bus priority measures (unlike sections unique to Option 1 such as the Hythe Station bus gate), it is possible to explore the differences in journey time using Trafficmaster data. This journey time data is taken from black boxes fitted in both commercial and private vehicles that log the vehicles location and speed. This data therefore corresponds to real vehicle journeys around the highway network.

The 2017 data set was used; this decision was made to avoid using a more recent data set that would be influenced by the Ipswich Road works, which commenced in 2018. The significant traffic management placed in the area would greatly effect collected journey time data in the vicinity. The 2017 data set used has been through a process of 'cleaning', where weekends, Fridays, bank holidays and months that have atypical congestion trends are removed to give representative results. The data set was cleaned as a whole prior to specific data relating to this scheme being extracted.

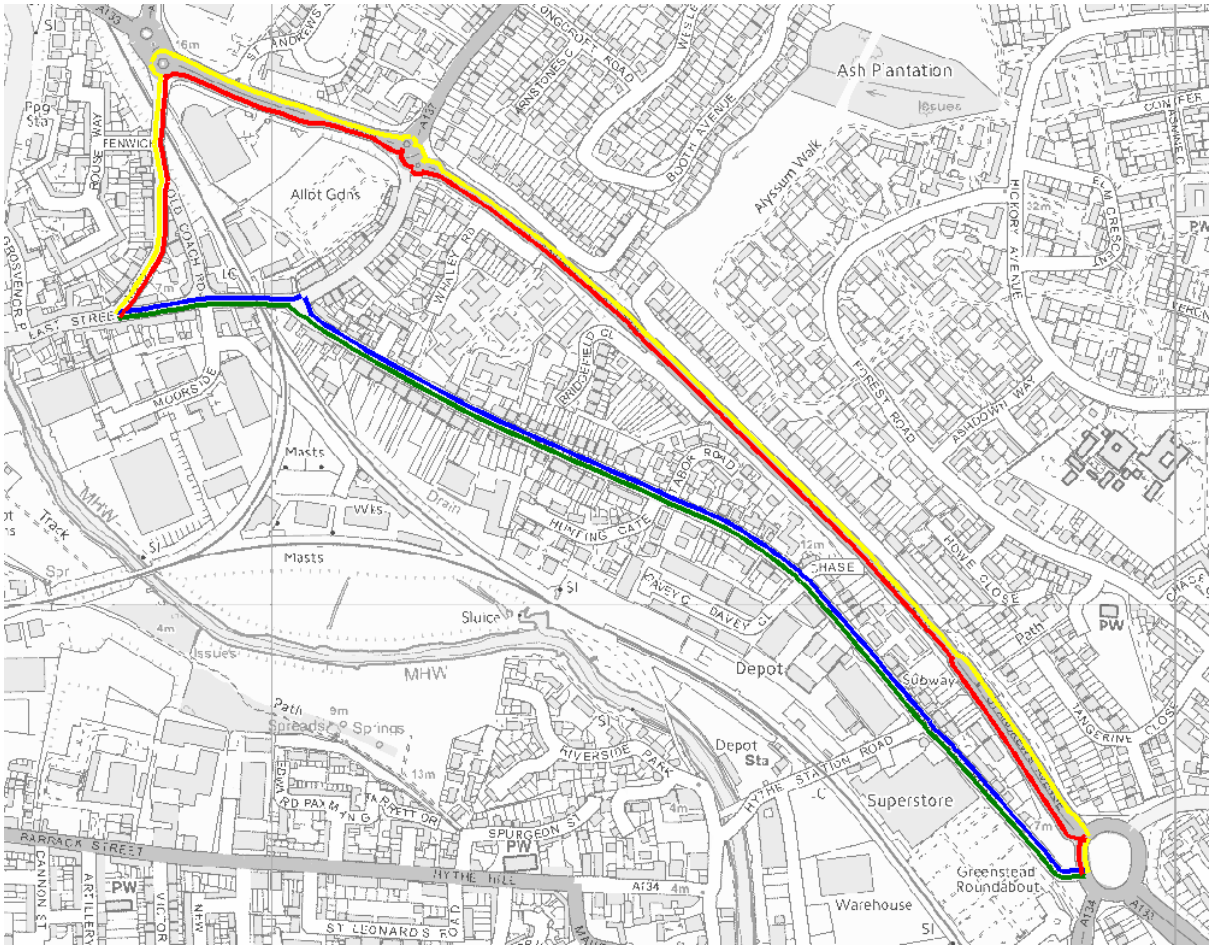

Figure 1 - Map showing the eastbound and westbound routings of Options 2 and 5, where their routings deviate (Yellow – EB Option 5, Red – WB Option 5, Blue EB Option 2, Green WB Option 2)

To understand existing average journey times, 2017 Trafficmaster data was extracted and then averaged across the morning peak (07:00 – 10:00), inter-peak (10:00 – 16:00) and evening peak (16:00 – 19:00), with the results for Option 2 shown in green/blue and Option 5 in yellow/red, corresponding to the map in Figure 1:

Table 3 – 2017 TrafficMaster data for Option 2 between Greenstead Roundabout and the Ipswich Road/East Street Junction

Option 2 Routing - **Eastbound** Ipswich Rd/East St Junction to Greenstead Roundabout 2017 Trafficmaster Data	
Time Period	Average Journey Time
Morning Peak (07:00 - 10:00)	2m 58s
Inter-Peak (10:00 - 16:00)	3m 3s
Evening Peak (16:00 - 19:00)	3m 1s
Free Flow	1m 49s

Option 2 Routing - **Westbound** Greenstead Roundabout to Ipswich Rd/East St Junction 2017 TrafficMaster Data	
Time Period	Average Journey Time
Morning Peak (07:00 - 10:00)	3m 31s
Inter-Peak (10:00 - 16:00)	2m 51s
Evening Peak (16:00 - 19:00)	2m 53s
Free Flow	1m 52s

Option 2 shows a generally consistent average journey time throughout the day of around 3 minutes. There is a small spike in the in-bound morning peak average journey time, likely associated with 'rat-running' to avoid queues along St Andrews Avenue.

Along with average journey times, 'free flow' journey times are also shown; these correspond to journey times achievable where a vehicle can move along the network uninhibited, akin to driving on empty streets in the early hours of the morning. These free flow journey times do not account for delays associated with the Eastgates Level Crossing, giving a journey time achievable where the gates are open. When comparing average journey times with free flow journey times, a combination of congestion and level crossing closures account for difference in time. For Option 2, this amounts to approximately one minute of associated delay, being slightly more in the westbound morning peak.

Similarly, 2017 Trafficmaster data was extracted for Option 5:

Table 4 - 2017 TrafficMaster data for Option 5 between Greenstead Roundabout and the Ipswich Road/East Street Junction

Option 5 Routing - **Eastbound** Ipswich Rd/East St Junction to Greenstead Roundabout 2017 TrafficMaster Data	
Time Period	Average Journey Time
Morning Peak (07:00 - 10:00)	4m 47s
Inter-Peak (10:00 - 16:00)	4m 8s
Evening Peak (16:00 - 19:00)	4m 36s
Free Flow	2m 10s

Option 5 Routing - **Westbound** Greenstead Roundabout to Ipswich Rd/East St Junction 2017 TrafficMaster Data	
Time Period	Average Journey Time
Morning Peak (07:00 - 10:00)	4m 16s
Inter-Peak (10:00 - 16:00)	3m 8s
Evening Peak (16:00 - 19:00)	3m 15s
Free Flow	2m 5s

This shows that there is significantly longer average journey times eastbound than westbound, with average journey times of approximately 4m 30s eastbound and 3m 10s westbound. This is however not the case for the westbound morning peak, where the average journey time increase to 4m 16s. The average journey times are found to be considerably longer than the free flow journey times in both directions, meaning there is significant congestion causing an increase in average journey times of approximately 2 minutes in the morning peaks and inter-peaks, and a minute and two minutes to westbound and eastbound evening peaks, respectively.

When comparing the average journey times for Option 2 and 5 in Table 3 & Table 4, the data shows that even with the presence of a level crossing along Option 2, average journey times are always shorter routing this way, when compared to Option 5. **This data is caveated in that it is possible for vehicles to reroute from Option 2 when approaching and in clear view of the level crossing. This means that some data points associated with vehicles being held at a closed level crossing may be lost, as drivers upon seeing the crossing is down can divert. This could skew Option 2 average journey times to be shorter than observed in reality.**

4.2 Eastgates Level Crossing Survey

As the Trafficmaster data has the potential to be skewed for Option 2, a survey of the Eastgates level crossing was undertaken on Tuesday 28th January 2020, to understand its operation. The survey was conducted over 16 hours between 06:00 and 22:00. It was found that over this period the level crossing was closed 98 times, for a total of 5h 27s, accounting for 31.3% of the 16-hour survey duration. This proportion of closure time was found to be largely consistent across hourly intervals, with the results shown in Figure 2:

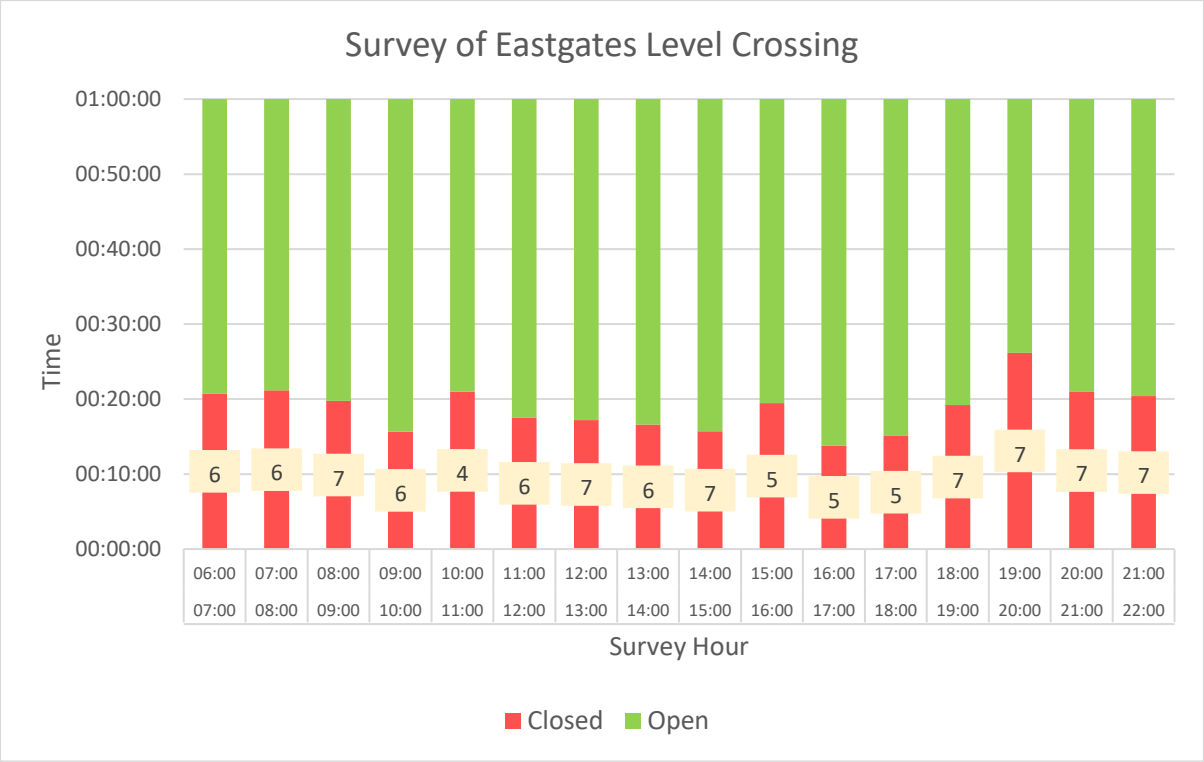

Figure 2 –Survey undertaken at Eastgates Level Crossing on Tuesday 28th January 2020 between 06:00 and 22:00, with the number of closures per hour shown on the chart bars

It was found that the average duration of a closure was 3m 4s, with closure durations being observed as such:

Table 5 – Closure and 'typical' wait times extracted from the Tuesday 28th January 2020 06:00 – 22:00 Eastgates Level Crossing survey

Duration	Closure Observations	Cumulative Closure Observations	Typical Wait Time Count*	Cumulative Typical Wait Time Count*
0 – 1 minute	2	2	21	21
1 – 2 minutes	19	21	52	73
2 – 3 minutes	41	62	20	93
3 – 4 minutes	11	73	4	97
4 – 5 minutes	12	85	1	98
5 – 6 minutes	8	93	0	98
6 – 7 minutes	3	96	0	98
7 – 8 minutes	1	97	0	98
8 – 9 minutes	1	98	0	98

This shows that 74% of all closure durations are less than 4 minutes, with only 5% of closure durations being above 6 minutes. *It is important to consider that RTS vehicles would typically not arrive at the level crossing just as it closes. Instead, it can be assumed an RTS service not synchronised with the level crossing would reach it, if closed, on average, halfway through this closure duration. Consequently, each observed closure duration has been halved to produce the values in the 'Typical Wait Time' columns. Taking account of this, the overall likelihood of an RTS vehicle being held by a closure of the level crossing would be 31.3%, with a 95% likelihood of the associated delay being less than 3 minutes.

Using the outputs from the level crossing survey it is possible to calculate the average level crossing associated delay:

$$Average\ Level\ Crossing\ Delay = Likelihood\ of\ Closure \times Average\ Wait\ Time$$

$$Average\ Level\ Crossing\ Delay = \frac{Duration\ of\ Closures}{Total\ Survey\ Duration} \times \frac{\left(\frac{Duration\ of\ Closures}{No.of\ Closures}\right)}{2}$$

$$Average\ Level\ Crossing\ Delay = \frac{5h\ 27s}{16h} \times \frac{\left(\frac{5h\ 27s}{98}\right)}{2} = 29\ seconds$$

It is worth considering that the longest delay associated with the level crossing was 8m 45s, therefore in the very unlikely scenario that the RTS arrived at the level crossing as it closed for this period, the RTS vehicle would be held for this full 8m 45s. It may be possible in the future to organise the RTS service timetable to better align with scheduled level crossing closures, and this should be explored in the later design stage. This could help further reduce the likelihood of an RTS vehicle being held at the level crossing for significant periods. Despite efforts to do this, the reliability of the service would be sometimes unavoidably undermined by the presence of the level crossing, with RTS vehicles being held in rare instances for significant durations.

As this survey was only conducted over one day, it is recommended that a full weeklong survey is undertaken. This would give a better understanding of the reliability implications of using this option's routing.

Knowing existing condition data regarding the two options makes it possible to explore the benefits of proposed infrastructure improvements, these benefits being made to journey time and reliability.

4.3 Infrastructure Journey Time and Reliability Improvements

There are proposals for infrastructure along both Option 2 and Option 5:

- Option 2 – Provide journey time and reliability improvements along Greenstead Road, through the implementation of a bus gate to remove through-traffic, or the removal /modification of parking to lessen congestion associated with restricted carriageway space.
- Option 5 – Provide journey time and reliability improvements along St Andrews Avenue between the Harwich Road Junction and Greenstead Roundabout, through the implementation of additional eastbound and/or westbound RTS lanes.

Option 2

Infrastructure proposals associated with Option 2 attempt to provide nearly uninhibited RTS movements along the length of Greenstead Road. The existing Trafficmaster data shown in Table 3 is caveated with regard to average journey times, as it is possible to divert from the routing in advance

of the level crossing upon seeing that it is closed. To estimate journey time improvements that can be made; a mixture of free flow journey times and level crossing survey outputs have been used.

Assuming the 2017 Trafficmaster free flow journey time can be achieved (with a +15 second contingency) along Option 2's unique sections of route, the only delays to this journey will be associated with the level crossing. It is anticipated that a bus gate and/or parking modifications, along with associated signage/enforcement would cost around £50k. This infrastructure, when discounting the level crossing, would be expected to achieve an average journey time close to that of the free flow journey time. Using level crossing survey data found in Table 5, the implementation of RTS infrastructure as described above along Option 2 is predicted to result in the following average journey times, and associated average journey time savings:

Table 6 –Predicted average journey times and associated journey time savings for RTS vehicles as a result of the implementation of Infrastructure along Option 2, for both eastbound and westbound flows

Option 2 Routing - **Eastbound** Ipswich Rd/East St Junction to Greenstead Roundabout			
2017 Trafficmaster Free Flow Journey Time (s)	+15s contingency	Average Level Crossing Delay	Predicted Average RTS Journey Time
1m 49s	2m 4s	29s	**2m 33s**

Time Period	2017 Trafficmaster Average Journey Time	Predicted Average RTS Journey Time	Predicted Average Journey Time Saving
Morning Peak (07:00 - 10:00)	2m 58s	**2m 33s**	25s
Inter-Peak (10:00 - 16:00)	3m 3s	**2m 33s**	30s
Evening Peak (16:00 - 19:00)	3m 1s	**2m 33s**	28s

Option 2 Routing - **Westbound** Greenstead Roundabout to Ipswich Rd/East St Junction			
2017 Trafficmaster Free Flow Journey Time	+15s contingency	Average Level Crossing Delay	Predicted Average RTS Journey Time
1m 52s	2m 7s	29s	**2m 36s**

Time Period	2017 Trafficmaster Average Journey Time	Predicted Average RTS Journey Time	Predicted Average Journey Time Saving
Morning Peak (07:00 - 10:00)	3m 31s	**2m 36s**	55s
Inter-Peak (10:00 - 16:00)	2m 51s	**2m 36s**	15s
Evening Peak (16:00 - 19:00)	2m 53s	**2m 36s**	17s

The above table shows that, with a 15-second contingency, journey times for Option 2 are predicted to reduce to an average of 2m 33s and 2m 36s for eastbound and westbound flow, respectively. This corresponds to a predicted journey time saving over the previously caveated 2017 Trafficmaster average journey time of between 15s and 55s across the peaks. This predicted saving would be achieved through the introduction of a bus gate and/or parking modifications along this section's length.

Option 5

Infrastructure proposals associated with Option 5 are for dedicated additional RTS lanes provided alongside St Andrews Avenue between Greenstead Roundabout and the Harwich Road junction in the eastbound and/or westbound directions:

- The eastbound lane would commence east of the Harwich Road junction and continue alongside St Andrews Avenue until remerging with regular traffic in advance of an existing underpass. This merge would be via a bus priority measure.
- The westbound lane would commence west of Greenstead Roundabout and continue until the approach to the Harwich Road Junction where the lane would need to be terminated to allow regular traffic to enter the left turning lane.

To calculate predicted average journey times and associated savings, 2017 Trafficmaster average journey and free flow times have been extracted for the proposed RTS lane extents detailed above. It is assumed that when moving in an RTS lane the vehicle will be travelling at free flow speeds. Comparing the average journey time to this free flow journey time for the extent of the proposed RTS lanes provides predicted journey time savings associated with the implementation of these lanes:

Table 7 – Predicted average journey time savings for RTS vehicles as a result of the implementation of infrastructure along Option 5, for both eastbound and westbound flow

Option 5 Routing - **Eastbound** Ipswich Rd/East St Junction to Greenstead Roundabout			
Time Period	2017 Trafficmaster Average Journey Time **RTS Lane Extent**	2017 Trafficmaster Free Flow Journey Time **RTS Lane Extent**	Predicted Average Journey Time Saving
Morning Peak (07:00 - 10:00)	58s	49s	9s
Inter-Peak (10:00 - 16:00)	53s	49s	4s
Evening Peak (16:00 - 19:00)	54s	49s	5s

Option 5 Routing - **Westbound** Greenstead Roundabout to Ipswich Rd/East St Junction			
Time Period	2017 Trafficmaster Average Journey Time **RTS Lane Extent**	2017 Trafficmaster Free Flow Journey Time **RTS Lane Extent**	Predicted Average Journey Time Saving
Morning Peak (07:00 - 10:00)	2m 1s	1m 6s	55s
Inter-Peak (10:00 - 16:00)	1m 28s	1m 6s	22s
Evening Peak (16:00 - 19:00)	1m 24s	1m 6s	18s

The above table shows that that the predicted journey time savings are more significant in the westbound direction, most notably the morning peak where it's predicted nearly 1 minute could be saved. The eastbound predicted journey time savings are short across the time periods, suggesting an eastbound RTS lane is of limited benefit. This is in part due to site constraints, which require the lane to terminate in advance of Greenstead Roundabout. This means the RTS vehicle does not bypass where vehicle speeds are typically lowest.

Comparison of Options

To help compare the options it is important to consider the existing average journey times, predicted average journey times, associated cost and predicted journey time savings. To do this information has been compiled from Table 3, Table 4, Table 6 and Table 7, as well as estimated costs for the above described infrastructure, derived from the overall option costs found in Appendix E – North Essex Rapid Transit System Feasibility Estimate Report. This information has been used to populate the below table which combines both eastbound and westbound flows for Options 2 and 5.

Table 8 – Existing and predicted journey times for combined eastbound and westbound flow for Option 2 and Option 5, with associated infrastructure costs and journey time saving/cost ratios

Option 2 Routing - **Combined** Eastbound & Westbound - Ipswich Rd/East St Junction to Greenstead Roundabout					
Time Period	Existing Average Journey Time	Predicted Average Journey Time	Predicted Average Journey Time Saving	Estimated Cost	Predicted Journey Time Saving/Cost Ratio
Morning Peak	6m 29s	5m 9s	1m 29s	£126k	0.7
Inter-Peak	5m 54s	5m 9s	45s		0.4
Evening Peak	5m 54s	5m 9s	45s		0.4

Option 5 Routing - **Combined** Eastbound & Westbound - Ipswich Rd/East St Junction to Greenstead Roundabout					
Time Period	Existing Average Journey Time	Predicted Average Journey Time	Predicted Average Journey Time Saving	Estimated Cost	Predicted Journey Time Saving/Cost Ratio
Morning Peak	9m 3s	7m 59s	1m 4s	£4,681k	0.014
Inter-Peak	7m 16s	6m 50s	26s		0.005
Evening Peak	7m 51s	7m 28s	23s		0.005

The above table shows that despite sizeable investment in Option 5, the predicted average journey times are still significantly higher than Option 2 with a modest investment. This difference in journey times being 2m 50s in the morning peak, 1m 41s in the inter-peak and 2m 19s in the evening peak. These differences mean that Option 2, subject to level crossing delays that exceed the 29-second average, could still be quicker than routing via option 5. This is achieved with a significantly lesser investment that could be utilised to improve journey times elsewhere along the route option.

Option 5's average journey time is closest to Option 2's in the inter-peak, where a level crossing associated delay of more than 1m 41s would result in Option 2 being slower. The likelihood of this occurring is equal to the likelihood of meeting a closed level crossing (33%), multiplied by the proportion of delay durations greater than or equal to 1m 41s seconds (29%), giving a likelihood of 10%. This percentage likelihood would be further reduced in the morning and evening peaks, where increased congestion along Option 5 increases the difference in predicted average journey times between the two options.

Furthermore, the predicted journey time saving/cost ratio has been calculated by dividing the predicted average journey time saving in seconds, by the estimated infrastructure cost in £1,000's. The results show that the cost-benefit of Option 2 is considerably better than Option 5.

If efforts could be made to avoid the longer planned level crossing closures, this would further support Option 2 and increase reliability. Despite efforts to avoid closures, the reliability could still be undermined when train services were disrupted or RTS vehicles were delayed to become uncoordinated with the rail services.

As the referenced Eastgates level crossing survey was only conducted over a single day, it is recommended that a full weeklong survey is undertaken. This would give a better understanding of the reliability implications of using this option's routing. It should also be noted, if the number of rail services utilising the level crossing increase in future years, this could further undermine the reliability of the system and increase the average delay and average RTS journey time. However, Option 5's congestion will also likely increase year on year, increasing RTS journey times for the with-traffic sections of the route.

This analysis has been used, in part, to inform the 'Objective Fulfilment' and 'Value for Money' columns of the Option Assessment Matrix found subsequently within this report.

5 Stakeholder Engagement

Public consultation events were held throughout November and December 2019, with route preference a key topic consulted on. As part of the questionnaire, which was completed by 92 individuals, the question *"Please indicate your most preferred and least preferred option for the Rapid Transit System Section B"* which yielded the following results:

Table 9 – Results of public consultation questionnaire to question "Please indicate your most preferred and least preferred option for the Rapid Transit System Section B"

Option	Most Preferred	Second Preferred	Least Preferred
Option 1	16%	16%	30%
Option 2	12%	32%	11%
Option 5	30%	8%	21%

It should be noted that the above percentages do not total 100%, as a portion of respondents did not rank all three options.

This information has been used to inform the 'Stakeholder Feedback' column of the Option Assessment Matrix found subsequently within this report.

A stakeholder at a particular exhibition suggested that a 'satellite route' be considered that by-passed the town centre via Cowdray Avenue, providing an even faster link to Colchester North Station from the Park & Choose site. Unfortunately, there was not sufficient time to trial this route with the PSV. However, as this route has no bus priority measures, it should be possible to use available traffic data to explore this opportunity. The client has requested that this option be investigated further.

6 Environmental Considerations

The Stage 1 Options Technical Note, informed by the Stage 1A/2 Environmental Risk Assessment (ERA) report (Jacobs, August 2019), have concluded that the majority of Section B is urban, with less prevalent environmental impacts. The ERA took a high-level look at the environmental constraints present, and an early look at the potential impacts of each design option, if it was progressed to construction and operation.

The key environmental constraints that were identified include:

- Existing sensitivity to air quality; the 'Area 1 – Central Corridors' AQMA covers North Hill, Head Street, High Street, Queen Street, St Botolph's Street, Osborne Street, and St John's Street;
- The 'Colchester Area 1' Conservation Area covers all town centre routes, where all trees are afforded TPO-level protection. All proposals would need to be sympathetic to the surroundings, taking into account any conservation area requirements;
- Existing sensitivity to high traffic noise levels at various NIAs in close proximity to the town centre routes;
- Potential disruption to a national cycle route; National Cycle Network 1 runs along High Street, Queen Street, St Botolph's Street, Osborne Street, and St John's Street;
- Potential adverse impact to existing urban landscape character where the roads have wide grass verges, mature trees and shrubs forming a green corridor which screen adjacent housing from the St. Andrew's Avenue, the majority of trees here are TPO-protected;

- Changing the existing highway layout here could have adverse effects on the noise environment and nearby NIAs; and
- Potential adverse impact to the Salary Brook Local Nature Reserve, located approximately 130m east of Elmstead Road and 220m southeast of Greenstead Roundabout.

The ERA was able to inform our decision to halt further progress for Options 3 and 4, for reasons including land-take of allotment gardens and/or land with potential to be contaminated.

The presence of trees with 'Memorial Tree' status along the Avenue of Remembrance has been highlighted as a key constraint to Option 5; removal of these trees is considered to have adverse effects on the local community and would affect the landscape character and visual amenity to adjacent sensitive residential receptors. Having been identified early on, the presence of these important trees will inform the design development for the proposed scheme. The preferred Option chosen will take into account key environmental constraints identified, the potential impacts on the environment and the potential to mitigate against these. In the first instance, and where possible, the design of the proposed scheme will aim to avoid any impact on the environment. Where, however, this is not possible, measures would be considered to minimise the impacts and provide appropriate mitigation when weighing up the benefits of the proposed scheme. A more detailed environmental impact assessment would be undertaken at Stage 2/3a to further inform detailed design of the proposed scheme; this will include, but is not limited to the following studies and activities:

- A scoping air quality assessment;
- A scoping noise and vibration assessment;
- A scoping heritage assessment;
- An ecological appraisal, including site survey(s); and
- Consultation with Colchester Borough Council regarding Memorial Trees and landscape, air quality, noise and cultural heritage issues.

This information has been used to inform the 'Environmental Constraints' column of the Option Assessment Matrix found subsequently within this report.

7 Geotechnical Considerations

A Stage 2 Geotechnical Desk Study has been completed to identify the anticipated ground conditions, geotechnical risks and to assist planning of subsequent ground investigation works. For the study, construction areas associated with Option 5, along St Andrews Avenue between the Harwich Road and Greenstead roundabouts, were considered.

The Section B Option 5 construction area will require ground investigation works, and geotechnical design input, to:

- Develop the ground model for materials management and road foundation design.
- Assess the potential impact of the scheme on existing structures (mainly an existing subway and large retaining wall).
- Design potential structures / earthworks to enable memorial trees to be retained.
- Assess stability of existing slopes and new earthworks.

The general ground model of Section B comprises Made Ground overlying areas of Alluvium, Head, possible River Terrace Deposits and Kesgrave Catchment Subgroup above London Clay.

The geotechnical risks in the identified construction area, as well as scheme wide geotechnical risks are identified in the Geotechnical Risk Register in the Stage 2 Geotechnical Desk Study. The main risks in the Section B construction areas are:

- Soft, compressible and low strength ground (mainly from alluvial deposits)
- Made Ground and soil contamination
- Existing sloping ground, including adjacent to properties
- Existing structures (retaining walls, subway)

Although not all the options in Section B have been assessed as part of the Geotechnical Desk Study due to the scope of the proposals, a brief review of the geological map indicates that there is some variation in ground model between the options, with more alluvial deposits present beneath Section B Options 1 and Option 2. This would increase the risk of encountering soft clays with lower shear strength and increased settlement potential should earthworks or structures be required.

The information collected in this stage 2 geotechnical study has been used, in part, to inform the 'Engineering Feasibility' column of the Option Assessment Matrix found subsequently within this report.

8 Option Assessment Matrix

Using the information found above and in the option specific appendix reports, the following matrix has been produced to directly compare options:

Table 10 - Option Assessment Matrix

Option	Option Description	Comments	Objective Fulfilment	Engineering Feasibility (e.g. physical constraint, land availability and design standards)	Environmental Constraints (e.g. impact on Environmental factors)	Affordability	Value for Money	Stakeholder Feedback	Total
Section B - Option 1	Magdalen Street	Original HIF bid routing Hythe Level Crossing Limited opportunity along Barrack Street	0	1	2	2	0	1	**6**
Section B - Option 2	Greenstead Road	Eastgates Level Crossing Opportunities along Greenstead Road	3	4	2	3	4	2	**18**
Section B - Option 5	St Andrews Avenue	No level crossing Opportunities along St Andrews Avenue	3	2	0	0	0	3	**8**

Qualitative assessment against identified objectives	
4	Beneficial
3	Slight Beneficial
2	Neutral / Marginal Impact
1	Slight Adverse
0	Adverse
-1	Very Adverse

9 Conclusions

9.1 Option 1 – Magdalen Street

Option 1 performs the weakest in the option assessment matrix, receiving an overall score of 6. This score is significantly lower than Option 2 and slightly lower than Option 5:

- 'Objective Fulfilment' – Score: 0 – Adverse – Option 1 had a significantly slower journey time observed in the live Public Service Vehicle trials and a very limited opportunity to improve this journey time along sections unique to its routing. Additionally the presence of the Hythe Level Crossing would undermine reliability.
- 'Engineering Feasibility' – Score: 1 – Slight Adverse – Option 1, has limited opportunities for implementation of infrastructure along sections unique to its routing beyond an eastbound RTS lane along Barrack Street, which would likely receive staunch opposition from local residents.
- 'Environmental Constraints' – Score: 2 – Neutral – Option 1, in proposing limited infrastructure improvements along sections unique to its routing, is unlikely to have positive or negative environmental impacts.
- 'Affordability' – Score: 2 – Neutral – Option 1 had the second largest estimated cost, a value which is thought to be covered by the budget.
- 'Value for Money' – Score: 0 – Adverse – Option 1 has limited opportunities for infrastructure that will improve journey times along sections unique to its routing. This infrastructure is limited to an eastbound RTS lane along Barrack Street, which will only provide journey time savings in one flow direction and improvements to the Brook Street junction which is diluted by the RTS vehicle having to approach the junction with-traffic. As the observed existing slow average journey times cannot be reduced significantly for the estimated capital investment, this option is considered poor value for money.
- 'Stakeholder Feedback' – Score 1 – Slight Adverse – Option 1 was marginally the least favourable option amongst stakeholders.

Given the relatively low overall score of this option and the prevalent issues in reducing the observed, long existing journey time, it is recommended that Option 1 is not progressed to the next stage.

9.2 Option 2 – Greenstead Road

Option 2 performs the best in the option assessment matrix, receiving an overall score of 18. This score is significantly higher than both Option 1 and 2:

- 'Objective Fulfilment' – Score: 3 – Slight Beneficial – Option 2 had the lowest observed overall journey time in the live Public Service Vehicle trials. Additionally, improvements along Greenstead Road have the potential to reduce journey times further. The presence of the East gates Level Crossing does undermine reliability, but analysis of a survey undertaken at the level crossing shows the vast majority of delays would result in this option still be faster than Option 5.
- 'Engineering Feasibility' – Score: 4 – Beneficial – Option 2's proposals, being modifications to parking and/or the implementation of an RTS/bus gate along Greenstead Road, will not involve modifying kerb lines. Therefore, implementation of sections unique to Option 2's routing will be feasible and have limited associated risks.

- ‘Environmental Constraints’ – Score: 2 – Neutral – Option 1, in proposing limited infrastructure improvements along sections unique to its routing, is unlikely to have positive or negative environmental impacts.
- ‘Affordability’ – Score: 3 – Slight Beneficial – Option 2 had the lowest estimated cost, a value which is thought to be covered by the budget.
- ‘Value for Money’ – Score: 4 – Beneficial – Option 2 has the shortest observed existing average journey time with improvements along Greenstead Road able to reduce this further. This option was found to offer significantly better value in providing journey time improvements for capital spend compared to Option 5.
- ‘Stakeholder Feedback’ – Score 2 – Neutral – Option 2 was the second preferred option amongst stakeholders.

Option 2 gained the highest overall score in the option assessment matrix, receiving an overall score of 18. This option received the highest score in almost all categories except Objective Fulfilment, and Stakeholder Feedback. For Objective Fulfilment it scored the same as Option 5, although the quickest, it was marked down because of the reliability concerns introduced by the level crossing. This option was the second preferred option by 32% of responders to the consultation, but only 12% suggested it would be the most preferred, hence the score was less than Option 5.

Given that this option has the highest overall score, lowest estimated cost, lowest observed existing journey time and lowest average predicted journey time; it is recommended that Option 2 be progressed to the next stage, Preliminary Design. Despite this recommendation, concerns remain around journey time reliability due to the presence of Eastgates level crossing along the routing. Further modelling, surveys and discussions with Network Rail should be undertaken to better understand the impact of the level crossing and potential mitigation measures to ensure this option meets the objectives of the RTS.

9.3 Option 5 – St Andrews Avenue

Option 5 performs the second best in the option assessment matrix, receiving an overall score of 8. This is 10 points less that Option 2, and only two more that Option 1, which scored the least.

- ‘Objective Fulfilment’ – Score: 3 – Slight Beneficial – Option 5 had the second lowest observed existing journey time in the live Public Service Vehicle Trials, due to the current levels of congestion. There are however, opportunities to provide RTS infrastructure along St Andrews Avenue that would benefit RTS journey time and reliability. This infrastructure would still give a slower predicted average journey time compared to Option 2. This option would however, benefit from improved journey time reliability compared to the other options, due to lack of a level crossing on the routing.
- ‘Engineering Feasibility’ – Score: 2 – Neutral – Option 5’s proposals, are achievable, however the site constraints will make this costly and difficult to implement. This option is further complicated by the presence of the Memorial trees.
- ‘Environmental Constraints’ – Score: 0 – Adverse – Option 5 will likely impact on Memorial trees along St Andrews Avenue. It is anticipated that at least 32 would be affected by the proposals, which is considered a significant negative environmental impact.
- ‘Affordability’ – Score: 0 – Adverse – Option 5 has the highest estimated cost by a considerable margin, a value which is thought to exceeded the current budget, therefore requiring further funding to deliver.
- ‘Value for Money’ – Score: 0 – Adverse – Option 5 currently has the median journey time and the highest capital cost for implementing the proposed measures. Initial analysis of the available

existing condition data suggests that even with the measures proposed, the average journey time achieved is longer than Option 2. Consequently Option 5 has been scored low in this category

- 'Stakeholder Feedback' – Score 3 – Slight Beneficial- Option 5 was the preferred route option amongst 30% of responders.

Option 5's overall score is significantly less than the highest scorer in the option assessment matrix; Option 2. This option did however receive the highest score Stakeholder Feedback, as well as an equal score to Option 2 for Objective Fulfilment, due to the reliability of journey times it provides by avoiding level crossings.

This option did perform well in the 'Objective Fulfilment' and 'Stakeholder Engagement' categories, however given the intermediate overall existing and predicted average journey times, significant capital cost and environmental concerns result in the overall score being considerably less than Option 2. However, given the concerns around journey time reliability of Option 2 due to the presence of Eastgates level crossing, it is recommended that Option 5 is progressed to the preliminary design stage.

In summary, it is recommended that Option 2 and 5 be progressed to the Preliminary Design stage, with further development of both options required before a single option can be selected. It is recommended that Option 1 is discounted and not developed further.

9.4 Further Considerations

In addition to the original options, Cowdray Avenue is also recommended to be progressed to the next stage. This could well provide an alternative 'by-pass' route between the proposed Park & Choose and Colchester North Station without negotiating the Town Centre.

Appendix A - Section B Option 1 Technical Note

Appendix B - Section B Option 2 Technical Note

Appendix C - Section B Option 5 Technical Note

Appendix D – Stage 2 Options Plan

Appendix E – North Essex Rapid Transit System Feasibility Estimate Report