



North Essex Rapid Transit System (RTS)

Stage 2 Section C Technical Note
February 2020

Document Control Sheet

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Report Title	Stage 2 Section C Technical Note
Project Number	B355363A
Document Number	B355363A-RTS-HGN-SC-RP-001
Status	Final
Revision	-
Control Date	25 th February 2020

Record of Issue

Issue	Status	Author	Date	Check	Date	Review	Date
-	Draft	BA	5/2/20	PW	6/6/20	PN	7/2/20
-	Final	BA	19/2/20	PW	19/2/20	PN	19/2/20

Approved for issue by	Date
Sean Haagman	25 th February 2020

Distribution

Organisation	Contact	Number of Copies
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Essex County Council	Ian Turner	1

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Section C

Section C connects Section B at Greenstead Roundabout, to the proposed Tendring – Colchester Borders Garden Community and A120 / A133 Link Road junction. This junction's location is not yet defined, but will be along the A133 east of the A133 / B1027 Colchester Road Junction.

Essex University is located immediately to the south of the A133 Clingoe Hill. An initial meeting was held with the university management team, where they expressed support for the RTS and acknowledged the benefits it could provide to students and staff. The university has its own private internal road network, predominantly comprising of Boundary Road, which is restricted access. The university management team expressed that they would ultimately like the RTS to be routed via Boundary Road, collecting students from within the university grounds. However, they appreciated this less direct routing would add journey time so would have to be carefully considered. This option, to service Essex University via Boundary Road, is denoted Option 1.

The most direct Section C routing to reach Greenstead Roundabout is therefore along the A133 highway corridor, via the B1027 Colchester Road and Knowledge Gateway Junctions. The outbound route mirroring the inbound. This option is denoted Option 2. Within this route option, there are variants A-C, which are subsequently detailed.

A further route option, Option 3, is to provide a more direct connection into the proposed Tendring – Colchester Borders Garden Community, with its access to be located towards the western extent of the development. This option's feasibility is highly dependent on the layout and development of the Colchester Borders Garden Community Masterplan, with suitable links to the Park & Choose site considered as part of the development's layout.

All three option routings, as well as their connections to Section B, are compiled on a drawing found in Appendix A – Stage 2 Section C Options.

1 Section C Option 1 Overview

Option 1 would utilise Essex University's private internal road, Boundary Road, to allow RTS vehicles to service the university. Initial meetings with the university's management team showed their support for the general scheme, acknowledging the benefits it could provide to students and staff. The university has expressed a preference for the RTS to service the campus as much as possible, ideally at multiple stops throughout the campus. This approach, whilst maximising the potential university associated patronage for the RTS, will increase RTS journey times so will need to be carefully considered alongside the aspirations of the entire system.

The existing B1027 carriageway would be used as part of this route, widening of the existing road to reach Boundary Road is problematic, as the existing carriageway is a single lane and the Highway Boundary does not extend sufficiently far beyond the back of the adjacent footways to accommodate an additional RTS lane in both directions.

The ability to reach Boundary Road offline, via land south of the A133 and immediately east of the B1027 Colchester Road is dependent on the development plans for the area. Additionally, this offline routing is dependent on the, to be defined, location of the proposed development access junction. To connect to Boundary Road in this way, RTS priority measures will be required to cross both the B1027 Brightlingsea Road and the B1027 Colchester Road, to maintain RTS journey time and reliability.

Once on Boundary Road the RTS vehicle can use the private road network to move through the university campus. Existing bus services service the university in this way, so no infrastructure upgrades will be required beyond new, or modified existing, stops that cater for RTS vehicles.

At the western end of Boundary Road, there is a Roundabout with Capon Road connecting to the Knowledge Gateway. Here RTS vehicles could re-join the A133 highway corridor and utilise RTS lanes and RTS priority measures as proposed in Option 2 variants.

Locations of stops, their format and frequency of service will need to be developed in partnership with the university. The additional length of this routing, in relation to other options, and the associated effect on RTS journey time and reliability will have to be carefully considered against the wider scheme aspirations.

2 Section C Option 2 Overview

Section C Option 2 and associated variants all utilise the A133 highway corridor between the proposed Tendring – Colchester Borders Garden Community access junction and Greenstead Roundabout. This access/egress junction is likely to be a roundabout, positioned between the junction with the B1027 Colchester Road and the western edge of Elmstead Market. There are three further variants (A-C) within Option 2, which correspond to different levels of RTS infrastructure. Option 2A provides RTS lanes over the length along almost the entire length of Section C Option 2. The other variants (B&C) feature RTS lanes and provision over shorter portions of Section C. They are described subsequently, with their differences detailed in relation to Option 2A.

For all Option 2 variants, provision for pedestrian / cycle facilities, along with associated lighting, are to be provided along the northern edge of the A133 highway corridor. This will provide connectivity between the proposed development, Essex University (via the existing crossing facilities at the Knowledge Gateway) and Colchester Town Centre (via Greenstead Roundabout). The exact form of this infrastructure to be implemented, either a shared use facility or a hybrid cycle track, will need to be explored at a later design stage once the achievable widths are known. Constraints such as Salary Brook Bridge and the existing Highway Boundary extent may introduce pinch points where the achievable width is reduced after the introduction of RTS infrastructure.

Drawings showing these three Section C Option 2 variants are attached as Appendices B-D of this report. These indicative layouts have been produced based on Ordnance Survey data only. This has been known to differ by up to 1m horizontally from the situation found on site, therefore can only be used for preliminary designs. Definitive conclusions on a suitable alignment and available widths cannot be made until a full topographical survey has been completed. This survey is due to be undertaken in the near future.

3 Option 2A – Route Details – Westbound

A plan showing Section C Option 2A can be found in Appendix B – Section C Option 2A Indicative Layout.

3.1 Garden Community roundabout to B1027 Colchester Rd / A133 Clingoe Hill Junction

The location of the access/egress to the proposed development is not yet defined. However, it is known to be positioned somewhere between the A133 Clingoe Hill / B1027 Colchester Road signalised junction and the western edge of Elmstead Market. This section of the A133 Clingoe Hill / Clacton Road is a dual carriageway, with two lanes in either direction. The likely junction format for access into the development will be a roundabout. A proposed additional RTS lane, forming lane one, will need to develop immediately off the roundabout's western arm. This would allow RTS vehicles to travel at free flow speeds, avoiding any queuing or slow moving traffic west of the roundabout inbound towards Colchester Town Centre.



Figure 1 – Westbound A133, west of proposed development access junction

To provide the width required for an additional westbound RTS lane, carriageway widening into the existing central reservation and nearside verge will be required. Lane narrowing may also be required to keep the widening within the existing Highway Boundary. Constraints include a significant ditch along the nearside verge and the central reserve required to be a minimum of 1.2m wide, to accommodate a vehicle restraint system. This vehicle restraint system now required due to proposed narrowing of the central reserve. Access to side roads and existing properties will need to be carefully considered as part of the proposals.

3.2 B1027 Colchester Rd / A133 Clingoe Hill Junction

The B1027 Colchester Road / A133 Clingoe Hill signalised junction is busy and has a complex arrangement. Vehicles entering Colchester from Wivenhoe, Alresford and Elmstead Market all move through the junction. Additionally, a proportion of university-associated traffic utilises the junction and there are a number of adjacent farm accesses that need to be maintained.



Figure 2 – Westbound approach to the A133 Clingoe Hill / B1027 Colchester Road Junction

To provide an additional RTS lane through the junction, carriageway widening will be required into the wide existing central reservation.

Modifications to existing signal and street lighting layouts will be required and there will be some conflict with existing turning movements. Consequently, 'left out of' and 'left into' the B1027 Colchester Road will be required to cross the RTS lane. Additionally, the RTS vehicle would move through the junction on a phase associated with regular traffic moving westbound through the junction along the A133.

Given the cost implications and conflicts created by this infrastructure, its inclusion will need to be carefully considered alongside journey time and reliability benefits to the RTS.

3.3 B1027 Colchester Rd / A133 Clingoe Hill Junction to Knowledge Gateway

West of the B1027 Colchester Road / A133 Clingoe Hill junction, the A133 continues as a dual carriageway with two westbound lanes. The central reserve is very wide, with trees planted within. There is a narrow footway located within the nearside verge. An additional RTS lane would require carriageway widening into the central reservation with some associated tree felling.



Figure 3 – Westbound A133 Clingoe Hill, B1027 Colchester Road Junction to Knowledge Gateway

There is an existing bus stop hard standing, its location adjacent to the northern edge of Essex University in advance of the westbound left turn lane of the Knowledge Gateway Junction. Repurposing this hardstanding as an RTS stop would not currently allow direct access to the university grounds, requiring students to walk to the Knowledge Gateway before entering university grounds. Placing a university associated RTS stop here along the A133, as opposed to within university grounds, would benefit RTS journey times into the town centre. However, this location might be perceived as too far from the university to encourage usage. Discussions need to be held with the university to understand the feasibility of providing a new and attractive access to link the university and an RTS stop along the A133 Clingoe Hill, along with a review and potential upgrade of pedestrian / cycle facilities.

3.4 Knowledge Gateway Junction

The Knowledge Gateway is a large signalised junction, which caters for the majority of the university's traffic. It has pedestrian and cycling facilities throughout to connect the university with shared use and footpath facilities along the northern side of the A133 Clingoe Hill, providing access into the Town Centre.



Figure 4 – Westbound A133 Clingoe Hill approach to Knowledge Gateway

To provide an additional RTS lane through the junction, carriageway widening will be required into the existing central reservation. Lane narrowing may also be required, due to constraints associated with refuge areas in the central reservation required for pedestrians and cycles.

Modifications to existing signal and street lighting layouts will be required and there will be some conflict with existing turning movements. Consequently, 'left out of' and 'left into' Boundary Road will be required to cross the RTS lane. Additionally the RTS vehicle would move through the junction on a phase associated with regular traffic moving east-west through the junction, along the A133.

Given the cost implications and conflicts created by this infrastructure, its inclusion will need to be carefully considered alongside journey time and reliability benefits to the RTS.

Should RTS vehicles be required to service the university without utilising the length of Boundary Road, as in Option 2, services could join Boundary Road and return to the A133 Clingoe Hill at the Knowledge Gateway. Services could use the Boundary Road / Capon Road roundabout with an RTS stop located to the north of this junction to quickly access the university grounds. The servicing of the university and the provision / location of an RTS stop would need to be agreed with the university. An on-campus stop could potentially negate the need for a stop along the A133 as discussed above.

3.5 Salary Brook Bridge

Salary Brook is a watercourse that is spanned by the A133 Clingoe Hill via an existing structure. The dual carriageway at this location has wide verges and a central reservation. To provide an additional westbound RTS lane, widening would be required into both the verge and central reserve. The central reserve will not be able to be reduced below 1.2m, as narrowing will require the introduction of a vehicle restraint system.

As the structure is existing, its suitability for an additional traffic lane and resultant loading will need to be assessed. Strengthening or replacement of the structure will have significant cost implications.



Figure 5 - Salary Brook Bridge parapet adjacent to westbound A133 Clingoe Hill

3.6 Clingoe Hill

As the A133 approaches Greenstead Roundabout, and Section B, the verge width narrows and the presence of property boundaries mean an additional RTS lane cannot be provided on the approach. Instead, an RTS priority measure can be introduced to allow RTS vehicles to join traffic lanes of the A133 Clingoe Hill on termination of the RTS lane. This would take the form of traffic signals that would hold traffic when an RTS vehicle approaches, allowing it join the queue associated with Greenstead Roundabout uninhibited.



Figure 6 – Narrowing verge and zebra crossing on westbound approach to Greenstead Roundabout

There are zebra crossings across the A133 dual carriageway on the eastern approach to Greenstead Roundabout. Should their use be negatively affecting RTS journey time and reliability sufficiently, they could be replaced by toucan crossings. This would encourage platooning of the pedestrians and cyclists, which could reduce the overall time queuing traffic is held. Additionally, traffic signals could also be linked to the RTS priority measures to ensure traffic is not held for pedestrians / cycles when an RTS vehicle is approaching the crossing and roundabout.

4 Option 2A – Route Details – Eastbound

4.1 Clingoe Hill

A proposed additional nearside RTS lane along the eastbound A133 Clingoe Hill will ideally develop immediately from the Greenstead Roundabout. This would allow RTS vehicles to leave Greenstead Roundabout and immediately begin moving at free flow speed, regardless of traffic levels in the adjacent traffic lanes. To facilitate the carriageway width required for the additional RTS lane, widening into the existing verge and central reserve will be required.



Figure 7 - Zebra crossing and eastbound A133 Clingoe Hill just off Greenstead Roundabout

Off Greenstead Roundabout, there are existing zebra crossings across the dual carriageway. Should their use be negatively affecting RTS journey time and reliability sufficiently, they could be replaced by toucan crossings. This would encourage platooning of pedestrians and cyclists, which could reduce the overall time queuing traffic is held.

The existing footpath on the northern side of the A133 is narrow. As walking and cycling links are to be considered as part of the RTS proposals, improvements should be made to this facility to support cyclists. This would provide links to the development via the proposed access along the A133 and to the university by the existing crossing facilities at the Knowledge Gateway. A wider facility with a dedicated cycle track should be considered if sufficient widths are achievable. It should be noted that there is an existing embankment at the back of the verge. Widening and construction of a pedestrian / cycle facility may require the use of a retaining structure to remain within the Highway Boundary. Existing street lighting will need to be relocated to the back of the pedestrian / cycle facility.

4.2 Salary Brook Bridge

Salary Brook is a watercourse that is spanned by the A133 Clingoe Hill via an existing structure. The dual carriageway at this location has verges and a central reserve, with a link to Salary Brook Trail; a shared use facility just west of the structure, running beneath the A133. To provide an additional eastbound RTS lane, widening would be required into both the verge and central reserve. The central reserve will not be able to be reduced below 1.2m, as narrowing will require the introduction of a vehicle restraint system. Lane narrowing may also be required to keep the widening within the existing bridge deck.



Figure 8 - Salary Brook Bridge parapet, existing shared use facility connecting to Salary Brook Trail, adjacent to eastbound A133 Clingoe Hill

As the structure is existing, its suitability for additional traffic lane and resultant loading will need to be assessed. Strengthening or replacement of the structure will have significant cost implications.

There is an existing shared use facility across the structure. The widening or upgrade of this facility may create a pinch point due to the limited space available if utilising the existing structure. The

available width across the structure and appropriate pedestrian / cycle facility should be explored further once the exact widths are known. The existing bridge parapet may need modification or replacement if its height is insufficient for adjacent cycling, the required height being 1.4m.

There is a BT chamber located within the shared use facility across the structure, it is expected to require relocation / amendment as it will likely be located within the carriageway widening.

East of the Salary Brook structure the provision for the additional RTS lane and pedestrian / cycle facility will require widening into the existing verge and central reservation, with some associated tree felling. It should be noted that there is an existing embankment at the back of the verge.

Widening and construction of a pedestrian / cycle facility may require the use of a retaining structure to remain within the Highway Boundary. Existing street lighting will need to be relocated to the back of the pedestrian / cycle facility.

4.3 Knowledge Gateway Junction

The Knowledge Gateway is a large signalised junction, which caters for the majority of the universities traffic. It has pedestrian and cycling facilities throughout to connect the university with shared use and footway facilities along the northern side of the A133 Clingoe Hill, providing access into the Town Centre.

To provide an additional RTS lane through the junction, carriageway widening will be required into the existing verge and the shared use cycle facility will need to be relocated, with some associated tree felling. It should be noted that there is an existing embankment at the back of the verge. Widening and construction of a pedestrian / cycle facility may require the use of a retaining structure to remain within the Highway Boundary. Existing street lighting will need to be relocated to the back of the pedestrian / cycle facility.

Modifications to existing signal and street lighting layouts will be required that preserve existing pedestrian / cycle movements through the junction.

It should be noted that if it were possible to separate the RTS lane and carriageway lanes by a physical island, eastbound RTS vehicles could move freely through the junction, only being held for pedestrian / cycle phases. This is because the existing traffic lanes associated with the Knowledge Gateway could operate independently of the RTS lane. The separation island would be required to ensure vehicles turning right out of Boundary Road did not stray into the free flowing eastbound RTS lane. The benefits of this arrangement would need to be carefully considered.

Should RTS vehicles be required to service the university without utilising the length of Boundary Road, as in Option 2, services could join Boundary Road and return to the A133 Clingoe Hill at the Knowledge Gateway. Services could use the Boundary Road / Capon Road roundabout with an RTS stop located to the north of this junction to quickly access the university grounds. The servicing of the university and the provision / location of an RTS stop would need to be agreed with the university. An on-campus stop could potentially negate the need for a stop further east along the A133 as discussed below.



Figure 9 - Eastbound A133 Clingoe Hill through Knowledge Gateway

4.4 Knowledge Gateway to B1027 Colchester Rd / A133 Clingoe Hill Junction

East of the Knowledge Gateway, the A133 continues as a dual carriageway with two eastbound lanes. The central reserve is very wide, with trees planted within. There is a narrow footway located within the nearside verge. An additional RTS lane would require carriageway widening into the central reservation with some associated tree felling as well as widening into the nearside verge and footway. Construction of pedestrian / cycle facilities adjacent to the RTS lane will be required to provide connectivity between the proposed development and the university / town centre.



Figure 10 - Eastbound A133 Clingoe Hill, Knowledge Gateway to B1027 Colchester Road Junction

For parity with the westbound infrastructure, an eastbound RTS stop could be placed along the A133 Clingoe Hill. This stop would need to be located closer to the Knowledge Gateway than the inbound RTS stop, as patrons would be required to cross the A133 via the existing facilities at the Knowledge Gateway junction. A stop in this location may be considered too far from the university grounds to attract university-associated patronage.

4.5 B1027 Colchester Rd / A133 Clingoe Hill Junction

To provide an additional RTS lane through the junction, carriageway widening will be required into the wide existing central reservation and nearside verge and footway, with some associated tree felling. Modifications are required to the existing signal layouts. Construction of pedestrian / cycle facilities adjacent to the RTS lane will be required to provide connectivity between the proposed development and the university / the town centre. It should be noted that there are a number of farm accesses that need to be maintained. The proposed pedestrian / cycle facilities across these accesses will require a more robust construction to handle loading associated with farm vehicles.



Figure 11 - Eastbound A133 Clingoe Hill through the A133 / B1027 Colchester Road Junction

It should be noted that if it were possible to separate the RTS lane and carriageway lanes by a physical island, eastbound RTS vehicles could move through the junction uninhibited. This is because the existing traffic lanes associated with the junction could operate independently of the RTS lane. The separation island would be required to ensure vehicles turning right out of The B1027 Colchester Road did not stray into the free flowing eastbound RTS lane. The benefits of this arrangement would need to be carefully considered.

4.6 B1027 Colchester Rd / A133 Clingoe Hill Junction to Garden Community Access Roundabout

The location of the access/egress to the proposed development is not yet defined. However, it is known to be east of the A133 Clingoe Hill / B1027 Colchester Road signalised junction. To provide space for an additional eastbound RTS lane, carriageway widening into the existing central reservation and nearside verge will be required. Lane narrowing may also be required to keep the widening within the existing Highway Boundary. Construction of pedestrian / cycle facilities adjacent to the RTS lane will be required to provide connectivity between the proposed development and the university / town centre. Constraints include an intermittent significant ditch along the nearside verge and the central reserve required to be a minimum of 1.2m wide, to accommodate a vehicle restraint system. This vehicle restraint system now required due to proposed narrowing of the central reserve. There are accesses and side roads along the northern edge of the A133, which will need to be maintained if alternative access points cannot be provided. Additionally there is an existing bus stop, which will need to be located alongside the RTS lane with insufficient space to provide a hardstand.



Figure 12 - Eastbound A133, west of B1027 Colchester Road Junction. Showing Side roads and footway

As the A133 approaches the junction with the proposed development, an RTS priority measure can be introduced to allow RTS vehicles to join traffic lanes along the A133 upon termination of the RTS lane. This would take the form of traffic signals that would hold traffic when an RTS vehicle approaches, allowing it to avoid most of the queue associated with the proposed development junction.

5 Option 2B

A plan showing Section C Option 2B can be found in Appendix C – Section C Option 2A Indicative Layout.

In reality, the budget may not be available to construct all RTS measures described in Option 2A concurrently. Therefore, either a phased approach, or a curtailed scheme, may be required to meet the available budget.

To investigate the best place to provide infrastructure, 2018 Trafficmaster data (the most up to date available) was sourced for the length of the A133 highway corridor covered by improvements details in Section C Option 2A. 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 2018 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.

This Trafficmaster journey time data sourced corresponds to 'with-traffic' movement of an RTS vehicle, with no dedicated infrastructure. With additional dedicated RTS lanes and 'hurry call' technology implemented at junctions along the A133, it is assumed that RTS vehicles will be able to move at 'free flow' speeds. These free flow journey times correspond to where a vehicle can move along the network uninhibited, akin to driving in the early hours of the morning. Breaking both

eastbound and westbound RTS lanes into sections allows each to be examined and compared to see where the largest journey time savings can be made. The available Trafficmaster data allowed journey time data to be extracted for the following sections, which can be found annotated on a plan found in Appendix E – Section C Option 2B Analysed Sections.

Eastbound

- **E1** - Greenstead Roundabout to the eastbound stop line associated with the traffic signal junction at the Knowledge Gateway. The infrastructure proposed at this location would be an additional dedicated RTS lane.
- **E2** - The Knowledge Gateway junction to the divergence of the right turn lane associated with A133/B1027 Colchester Road Junction. The infrastructure proposed at this location would be an additional dedicated RTS lane and modification to traffic signals.
- **E3** - The A133/ B1027 Colchester Road Junction to the proposed location of the development access. The infrastructure proposed at this location would be an additional dedicated RTS lane.

Westbound

- **W1** – The Knowledge Gateway to Greenstead Roundabout. The infrastructure proposed at this location would be an additional dedicated RTS lane with RTS priority measure on the approach to Greenstead Roundabout.
- **W2** - The A133/B1027 Colchester Road Junction to the westbound stop line associated with the traffic signal junction at the Knowledge Gateway. The infrastructure proposed at this location would be an additional dedicated RTS lane and modification to traffic signals.
- **W2 Short** – As per W2, but with the dedicated bus lane developing part way along the section, where Nesfield Road meets the A133, approximately halving the length RTS lanes length and retaining it on the Approach to The Knowledge Gateway.
- **W3** - The proposed location of the development access to the westbound stop line associated with the traffic signal between the A133 and B1027 Colchester Road. The infrastructure proposed at this location would be an additional dedicated RTS lane and modification to traffic signals.

For the above sections, both the morning peak (07:00 – 10:00) and evening peak (16:00 – 17:00) average journey time data was sourced, as well as the free flow journey time. Assuming the infrastructure described above can facilitate the RTS moving at free flow speeds, the difference between these times is the predicted average journey time saving as a result of the implementation of RTS infrastructure. Furthermore, estimated costs have been sourced for the RTS infrastructure (excluding cycle facilities) for each of the sections described above. Dividing the predicted journey time savings in seconds by the estimated cost in millions provides a cost – benefit ratio (with regard to average journey time improvements) for each section so that they can be compared:

Table 1 – Analysis of average journey time savings and associated costs for eastbound Option 2B infrastructure

Eastbound 2018 Trafficmaster Data					
Time Period	Average Journey Time	Free Flow Journey Time	Predicted Average Journey Time Saving	Estimated Cost (M)	Journey Time Saving / Cost Ratio
E1 – Greenstead Roundabout to Knowledge Gateway					
Morning Peak	40s	32s	8s	£1.520	5.8
Evening Peak	40s		8s		5.8
E2 – Knowledge Gateway to A133/B1027 Colchester Road Junction					
Morning Peak	52s	43s	9s	£1.856	5.0
Evening Peak	58s		15s		8.1
E3 – A133/B1027 Colchester Road Junction to Proposed Development Access					
Morning Peak	36s	33s	3s	£1.885	1.6
Evening Peak	34s		1s		0.4

The above table shows there is limited journey time savings to be made with the introduction of any eastbound RTS infrastructure. Traffic is observed to typically flow well outbound from the town the as A133 highway corridor becomes more rural. The predicted average journey time saving to estimated cost ratios are low, meaning a low return on investment with regard to average journey time savings.

Table 2 - Analysis of average journey time savings and associated costs for westbound Option 2B infrastructure

Westbound 2018 Trafficmaster Data					
Time Period	Average Journey Time	Free Flow Journey Time	Predicted Average Journey Time Saving	Estimated Cost (M)	Journey Time Saving / Cost Ratio
W1 – Knowledge Gateway to Greenstead Roundabout					
Morning Peak	3m 17s	31s	2m 46s	£1.801	92.5
Evening Peak	2m 40s		2m 9s		71.6
W2 – A133/B1027 Colchester Road Junction to Knowledge Gateway					
Morning Peak	1m 31s	40s	51s	£2.694	18.9
Evening Peak	1m 37s		57s		21.1
W2 Short – Reduced Length - A133/B1027 Colchester Road Junction to Knowledge Gateway					
Morning Peak	57s	17s	40s	£1.212	33.5
Evening Peak	59s		42s		34.8
W3 – Proposed Development Access to A133/B1027 Colchester Road Junction					
Morning Peak	54s	40s	14s	£2.575	5.7
Evening Peak	59s		19s		7.7

The table shows that there are large journey time savings to be made to W1, westbound from the Knowledge Gateway to Greenstead Roundabout, with an average journey time saving of 2m 46s in the morning peak. For W2, the section between the A133/B1027 Colchester Road junction to the Knowledge Gateway, there are lesser savings of 51 and 57 seconds in the morning and evening peak, respectively. For W2 Short, the average journey time savings are found to be around 75% of W2, meaning that approximately half the length of infrastructure can contribute to the vast majority of average journey time savings. This is reflected in the predicted average journey time saving to

estimated cost ratios, where 'W2 Short' performs much better than W2. Further east, W3, from the proposed development access to the A133/B1027 Colchester Road junction has limited average journey time savings to be made by the introduction of infrastructure. The very low predicted average journey time saving to estimated cost ratios suggesting that even infrastructure placed just on the approach to the A133/B1027 Colchester Road junction, similar to 'W2 Short', would not yield significant values.

Based on the above analysis it is recommended that W1 and 'W2 Short' be combined to form an additional westbound RTS lane, developing between the A133/B1027 Colchester Road and Knowledge Gateway junctions. This dedicated lane would continue until RTS priority measures placed on the approach to Greenstead Roundabout to facilitate existing vehicle movements. This arrangement will form Section C Option 2B, offering the best value for average journey time savings. An indicative layout can be seen in Appendix C – Section Option 2B indicative Layout. Refinements to where the RTS lane should develop can be informed in the next design stage by the Vissim and Vissum models in the next design stage.

It should be noted that the arrangement of Option 2B is recommended for when the RTS system first becomes operational. As congestion and the development evolve over time, other sections of infrastructure may be required to further improve or maintain RTS journey times and reliability.

6 Option 2C

A plan showing Section C Option 2C can be found in Appendix D – Section C Option 2A Indicative Layout.

Option 2C requires no additional RTS lanes to be constructed as existing lanes on both the eastbound and westbound A133 would be repurposed as RTS lanes. The RTS lanes would need to be terminated in advance of left-turning lanes and side roads to allow existing manoeuvres. This would result in the following modifications to the existing arrangement:

- The westbound A133, west of the proposed development access junction, would require the two existing traffic lanes to merge before the commencement of the lane one RTS lane. This is due to A133 east of the junction having two existing traffic lanes on the westbound approach.
- On the westbound approach to the A133 / B1027 Colchester Road Junction, left turning vehicles would be required to cross the RTS lane, requiring its temporary termination. The capacity of the junction for vehicles moving east-west would be greatly reduced as one of the two existing straight ahead lanes would be designated for RTS vehicles.
- On the westbound approach to the Knowledge Gateway Junction, left turning vehicles would be required to cross the RTS lane to reach Boundary Road, requiring its temporary termination. Similarly, vehicles turning left out of Boundary Road would be required to cross the RTS lane to reach lane two, similarly requiring its intermittent termination. The capacity of the junction for vehicles moving east-west would be greatly reduced as one of the two existing straight ahead lanes would be designated for RTS vehicles.
- On the approach to Greenstead Roundabout, the westbound RTS lane will need to be terminated to allow vehicles wanting to turn left to occupy lane one. Despite this arrangement having two lanes discharging onto the roundabout, capacity will be affected as vehicles will not be able to move into lane one until termination of the RTS lane. The earlier the termination of the RTS lane, the longer potential queue the RTS vehicle will join when approaching the roundabout.
- The eastbound RTS lane along the A133 Clingoe Hill would develop on the circulatory of Greenstead Roundabout as a left-turn, bus-only lane. Regular traffic would then access lane two only from Greenstead Roundabout, reducing discharge over the existing arrangement.

- The capacity of the Knowledge Gateway junction for vehicles moving eastbound would be greatly reduced due to the reallocation of a traffic lane to RTS vehicle dedication.
- Designating lane one as an RTS lane through the A133 / B1027 Colchester Road Junction is problematic, this is due to the presence of accesses along the northern edge of the A133 which would need to be maintained. This may require the RTS lane to be for RTS vehicles and 'for access' in the vicinity of the accesses. Due to the presence of diverge hatching between the existing lane one and diverging right turn lane, this carriageway space could be reallocated as a trafficked eastbound lane two. This arrangement would still require localised widening to improve the alignment and provide suitable lane widths, however, it will likely not have a significant effect on capacity.
- Eastbound along the A133, east of the junction with the B1027 Colchester Road Junction, there are a number of road and accesses along the northern edge. These would need to be maintained by either terminating the RTS lane in advance of side roads and accesses to allow vehicles to enter lane one and turn left, or designate the RTS lane for RTS vehicles and 'for access'. The RTS lane will need to be terminated on the approach to the proposed development access junction. This would allow regular traffic to move into lane one and would allow all movements at this junction.

This option, in dedicating an existing lane in both directions to RTS, will be much cheaper than Option 2A & 2B. However, reducing capacity significantly at each of the strategic junctions along this key corridor into Colchester will have far-reaching impacts on congestion. This option, whilst achieving the goals of RTS, would need to be carefully considered in light of associated traffic impacts.

7 Section C Option 3 Overview

Option 3, as well as the other two option routings, are compiled on a drawing found in Appendix A – Stage 2 Section C Options.

Option 3 is to provide a spur north from the A133 Clingoe Hill into the western extent of the proposed Tendring – Colchester Borders Garden Community. This connection would be direct and would likely avoid RTS vehicles being required to travel further east along the A133 than the Knowledge Gateway. Whilst moving along the A133 Clingoe Hill, the RTS service would utilise RTS lanes and RTS priority measures as outlined in Option 2 variants. This would be with the addition of an eastbound spur or left turning lane into the development, as well as, likely modifications to the Knowledge Gateway to allow RTS vehicles to access the A133 westbound.

This options feasibility and design is highly dependent on the layout and development of the Tendring-Colchester Borders Garden Community Masterplan. Routing through the development, provisions for stops and the connection to the proposed Park & Choose location would have to be built into the masterplan. Unfortunately, the Masterplan is not suitably developed at the time of writing this report so this option's feasibility is still undecided.

8 Other Considerations

8.1 Land Acquisition

For Option 2A, to provide an additional RTS lane in both directions as well as a 5m pedestrian / cycle facility on the northern side of the A133, land acquisition will be required. The affected area of land is located in the vicinity of Slough Lane.

Depending on whether this land can be acquired in a timeframe fitting for the scheme and for a suitable cost, alternatives may need to be explored that keep the proposals within the existing Highway Boundary. Alternatives could include termination of the additional RTS lanes in advance of the point where land purchase would be required or narrowing the pedestrian / cycle facilities in the vicinity. Information relating to the exact areas of land acquisition and alternative solutions that remain within the Highway Boundary will be provided when a topographical survey has been completed and the design progressed.

The land acquisition process should be started as soon as defined areas to acquire are known. If the landowner is unwilling to negotiate the sale of the land, a Compulsory Purchase Order may be required to acquire the land. This process can take a significant amount of time to complete.

8.2 Statutory Undertakers' Plant

The presence of statutory undertakers' plant (stats) and any required diversions have the potential to add significant costs to options and variants. To better understand the risks, C2 statutory searches were performed, with the findings summarised in the table below:

Table 3- Statutory Undertakers' plant present along the A133 highway

	Greenstead roundabout to Knowledge Gateway	Knowledge Gateway to A133 / B1027 Colchester Rd Junction	A133 / B1027 Colchester Rd Junction to Proposed Development Access Junction
National Grid (Gas)			
Indigo pipelines (Gas)			
Cadent Gas			
GTC			
NWG Property Solutions (Water)			
Essex and Suffolk Water			
Affinity Water (Asbestos Distribution Main)			
Anglian Water services LTD			
Anglian Water services (Combined Sewer)			
Anglian Water services (Surface Sewer)			
Anglian Water services (foul) LTD			
Overhead High Voltage (UK Power Networks)			
Overhead Low Voltage (UK Power Networks)			
Underground High voltage (UK Power Networks)			
Underground Low voltage (UK Power Networks)			
BT Openreach Overhead Telecom			
BT Openreach Underground Telecom			
Street Lighting			
Structures			
Minor undertakers			
ITS			
Virgin Media			
Vodafone			

Plant not present or unaffected	
Plant present, potential to affect	
Plant present, high likelihood of affecting	

It is clear from the above table that some stats diversions are likely to be required with all options excluding 1C. This is due to the presence of plant between Greenstead Roundabout and the Knowledge Gateway, which all options share. A summary of the most significant issues has been provided below;

- Gas – There is gas plant present along much of the A133 highway corridor. Proposed additional RTS lanes and carriageway widening will have a significant likelihood of requiring diversion. Physical constraints such as Salary Brook Bridge and proposed retaining features will limit the available width for this plant to be diverted into.
- Water supply – Water supply plant is more prevalent at the eastern end of the A133, near Greenstead Roundabout. The location of the the asbestos distribution main indicates that providing RTS lanes east of the B1027 could attract significant additional cost if diversions of this main are required.

- Electricity – High voltages are cables are present throughout the A133 highway corridor. Proposed additional RTS lanes and carriageway widening will have a significant likelihood of requiring the diversion of this plant.
- Telecommunications – Telecommunication plant is present throughout the A133 highway corridor. Proposed additional RTS lanes and carriageway widening will have a significant likelihood of requiring the diversion of this plant.

8.3 Environmental Considerations

The Stage 1 Options Study, informed by the Stage 1a/2 Environmental Risk Assessment report (Jacobs, August 2019) has concluded that, although there would be potential environmental impacts from Section C Options 1 and 2. These are unlikely to be significant and therefore a statutory EIA would not be required for these two options; however, further environmental assessment is required to confirm this. If there are no significant environmental effects, and on the assumption that works remain within the Highway Boundary, then permitted development rights would be applicable for both options, and a planning application would not be required. For Option 3, the construction of a new road may result in significant environmental effects, and a statutory EIA may be required. If an EIA were required, then this would be undertaken as part of the Masterplan. If an EIA were not required, non-statutory environmental assessments would be undertaken to support the planning application, in line with planning authority requirements.

Key environmental constraints identified in the Environmental Report for Section C include:

- Potential adverse impact to the Salary Brook Local Nature Reserve (LNR), located immediately adjacent northeast to /salary Brook bridge on A133 Clingoe Hill;
- The potential widening of the A133 to facilitate additional RTS lanes would have an adverse effect on existing mature roadside trees along the A133, potentially also affecting Clingoe Hill Wood, with has Tree Preservation Order (TPO) status and is designated as a Priority Habitat; and
- Two NIAs are located along the A133, one near Greenstead Roundabout, marking this area particularly sensitive to traffic noise.

Land-take and mitigation requirements cannot be determined until further environmental assessment is undertaken. Option 2 is likely to result in the direct loss of some trees, vegetation and potential habitats, and mitigation to offset any impacts would be identified during the preliminary design stage. It should be noted that if Clingoe Hill Wood is to be impacted, then replacement planting would need to be undertaken at a designated biodiversity compensation site, as agreed with the County Ecologists.

8.4 Budgetary Considerations

It has not been possible to accurately cost Options 1 and 3 with any certainty at this stage:

- Option 1 could well operate satisfactorily within the existing university and highway road network. Therefore could be provided with only minimal capital cost to provide access for RTS vehicles via the existing university barrier system.
- Option 3 could be funded via the Tendring – Colchester Borders Garden Community Masterplan, and as discussed in the report the extent of the infrastructure cannot be quantified until the masterplan develops.

Option 2, however, has been the subject of a high level costing for all variants below, with full costing details available in the cost report provided in Appendix E:

- Option 2A has a total estimated capital cost of £16,251,624.
- Option 2B has a total estimated capital cost of £7,301,962.
- Option 2C has a total estimated capital cost of £4,363,599, which appears better value, as it is cheaper than the other variants. However, it must be noted that this variant would have a significant negative impact on general traffic, which would need to be carefully assessed.

It is clear that Option 2A is unlikely to be achievable in its entirety with the current HIF funding provision, Option 2B is likely to be achievable and could be delivered in two phases if required to fit potential future budget pressures. Option 2C is likely to be achievable within the current budget, however this would have significant detrimental effects on the remaining highway network

9 Conclusions

9.1 Option 1

Option 1 is dependent on the development plans of Essex University and the level of student patronage. It is most likely that some services will travel via Boundary Road, but this will increase journey times and therefore, services along the A133 are likely to also run. As Boundary Road is already in place and general traffic is already restricted, extensive design work should not be required to make this option operational. Therefore, it is recommended that Option 2B is progressed ahead of Option 1, with routing associated with the university to be implemented in the future as the system develops further. The University management team have provisionally agreed with this approach.

It should however be noted that the proposed RTS lane provided by Option 2B on the approach to Greenstead Roundabout, would also benefit the westbound Option 1 journey

9.2 Option 2A, 2B and 2C

Option 2A, although the most comprehensive and the most robust solution for RTS journey time and reliability, will require significant funding to realise compared to Options 2B & 2C. Option 2B attempts to provide infrastructure where the most significant average journey time savings can be achieved at the time of opening when considering capital expenditure. Given that the programme for development of the proposed Tendring – Colchester Borders Garden Community means it will be in its infancy when the RTS becomes operational, limited traffic will be added to the network in the earlier years. Therefore, Option 2B offers the best short-term approach to balancing capital investment and RTS journey time improvements. As the development scales, further sections of RTS lanes found in the robust Option 2A may need to be added to maintain or improve RTS journey times.

Option 2B can be further refined and future proofed using outputs from the Vissum and Vissim models alongside and will also benefit Options 2 and 3 when they develop. This is because the westbound approach to Greenstead Roundabout is common to all options.

Option 2C, in repurposing existing A133 lanes in both directions to RTS, will be significantly cheaper than Options 2A & 2B and achieve the goals of RTS. However, it is believed that such a reduction in capacity along the A133, a strategic route into Colchester, will have far-reaching negative effects on congestion and consequently is likely to be vehemently opposed by residents.

It is therefore recommended that Option 2B is progressed, with additional Option 2A elements incorporated in the future (if/when traffic modelling outputs support their inclusion, and budgetary constraints allow).

It is anticipated that the Vissum and Vissim models will quantify the extent of the congestion impact, and therefore Option 2C should not be progressed to the next design stage at this time. However, this may provide a partial or interim solution, and therefore should not be totally discounted.

9.3 Option 3

Option 3 is dependent on the Tendring - Colchester Borders Garden Community Masterplan, which is not due to be released for the foreseeable future. Due to time pressures associated with the delivery of the project, it is recommended that Option 2B is progressed.

Should the Masterplan align with the RTS for routing through the development, infrastructure associated with Option 2B can be curtailed to improve RTS journey times and reliability west of this connection. Therefore, it is recommended that development of Option 3 is held in abeyance until sufficient details on the Masterplan are made available.

It should however be noted again that the proposed RTS lane provided by Option 2B on the approach to Greenstead Roundabout, would also benefit the westbound Option 3 journey time.

Appendix A – Stage 2 Section C Options

Appendix B – Section C Option 2A Indicative Layout

Appendix C – Section C Option 2B Indicative Layout

Appendix D – Section C Option 2C Indicative Layout

Appendix E – Section C Option 2B Analysed Sections

Appendix F – North Essex Rapid Transit System Feasibility Estimate Report

