

DfT Reference: TWA/24/APP/03

Document Reference: CD26-01-APP-W8-2

The Cambourne to Cambridge Order

Cambridgeshire County Council

Transport and Works Act 1992

Transport and Works (Inquiries Procedure) Rules 2004

Inquiry into:

THE CAMBOURNE TO CAMBRIDGE ORDER

APPENDICES TO THE PROOF OF EVIDENCE

of

John Lonergan, *MSc, BEng (Hons), BSc (Hons), CEng, FICE, FGS, MCIHT, MPWI, MAPM*

of WSP

On behalf of Cambridgeshire County Council

5th August 2025

Planning Inspectorate Reference: DPI/E0535/25/1

CONTENTS

Section	Page
Appendix A – Technical Note 2: Preliminary Geotechnical Assessment.....	3
Appendix B – Technical Note 1: Cambourne to Cambridge Park & Ride Capacity...	17

Appendix A – Technical Note 2: Preliminary Geotechnical Assessment

TECHNICAL NOTE TN2

DATE:	22 March 2023	CONFIDENTIALITY:	Internal
SUBJECT:	Preliminary Geotechnical Assessment		
PROJECT:	Cambourne to Cambridge	AUTHOR:	Liam Barber/ Ruth Gibson
CHECKED:	Ben Denning	APPROVED:	Mark Wheeler

1. INTRODUCTION

Greater Cambridge Partnership (GCP) are giving consideration to a guided busway scheme between Cambourne and Cambridge. WSP have been appointed to provide input to the outline design for this scheme. As part of that input WSP's geotechnical team initially conducted a desk study to determine the anticipated ground conditions along the proposed route and subsequently designed a preliminary ground investigation to confirm these conditions and to recover samples for laboratory testing to assist in the assessment of the feasibility of the outline design proposals.

Following completion of the exploratory holes Technical Note 1 was issued to provide early feedback on the ground conditions revealed by the boreholes in relation to the proposed key features of the scheme.

This Technical Note has been produced as an update to Technical Note 1 following completion of the laboratory testing and a period of groundwater monitoring. The intrusive investigation, laboratory testing and groundwater monitoring are reported in the Ground Investigation Contractor's Factual Report (Ref Endeavour Drilling Report Number END22-079, Dated February 2023).

This technical note covers a high-level review of ground conditions and proposed geotechnical solutions for the proposed works based on current understanding. A detailed assessment of geotechnical test data and derivation of geotechnical properties and parameters is not included.

2. GROUND INVESTIGATION

The proposed ground investigation originally comprised 12 No. boreholes to depths between 15m and 25m below ground level (bgl). and 6 No. window sampler holes to depths of 6m bgl. Due to land access issues the investigation was reduced to 11 No. boreholes and 3 No. window sample holes.

Piezometer standpipes were proposed in 10 of the boreholes.

The location of these exploratory holes is indicated on the attached plans (Figures 1 and 2).

The actual as drilled depth of the exploratory holes together with the depths of piezometer installations are presented in Table 1. Full details are presented in the Factual Report.

The exploratory hole logs, in-situ testing and laboratory testing have been used to provide a preliminary geotechnical assessment for the proposed scheme.

Table 1 – Exploratory hole depths

Exp. Hole No.	Exp. Hole Depth (m bgl)	Piezometer Depth (m bgl)	Comments
BH101	25.45	13	
BH102	15.45	10	BH 102A was drilled to a depth of 2.4m at the same location to enable a soakage test to be carried out.
BH103	15.45	4	
BH104	15.45	9	
BH105	15.45	4	
BH106	20.00	-	
BH107	15.45	12	BH 107A was drilled to a depth of 2.5m at the same location to enable a soakage test to be carried out.
BH108	15.45	9	BH 108A was drilled to a depth of 2.5m at the same location to enable a soakage test to be carried out.
BH109	25.45	5	
BH110	25.45	21	BH 110A was drilled to a depth of 3.5m at the same location to enable a soakage test to be carried out.
BH111	15.45	4	
BH112	-	-	Borehole cancelled - land access permission not given (Plot No. 58, Dry Drayton Estates Ltd.)
WS201	3.6	-	Depth limited due to very stiff clay
WS202	6.45		
WS203	-		Cancelled – no land access permission.
WS204	-		Cancelled – no land access permission.
WS205	6.45	-	
WS206			Cancelled due to access issues.

3. GROUND CONDITIONS

Based on the ground conditions encountered, the scheme has been sub-divided into four sections as follows

3.1 Chainage 2600 (Childerley Lodge) to ch 8400.

In this section it was anticipated from the geological maps of the area that cohesive Glacial Till (Oadby Member) would be encountered near the surface.

Seven boreholes (BH101 to BH107) and three window sampler holes WS201, WS202 and WS205 were carried out in this section of the route. Two additional window sampler holes (WS203 and WS204) were proposed in the vicinity of the drainage ditch at ch7530, although these were cancelled due to land access permission not being available for these locations.

The exploratory holes confirmed the anticipated geology of cohesive Glacial Till beneath topsoil, typically recorded as between 0.1 and 0.2m in thickness.

In the west of this section the Glacial Till was present for the full depth of the borehole (BH101) to 25.45m bgl. It was typically described as a firm clay, becoming stiff then very stiff with depth, and contained fragments of chalk and/or flints.

At the eastern end of this section the Glacial Till was encountered to depths of 6.3m bgl and 2.4m bgl in BH107 and WS205 respectively. At these locations the Glacial Till was underlain by a layer of sandy clay, possibly Chalk Marl to a depth of 14m in BH107 and 4.9m in WS205, beneath which Gault Clay was present.

At two locations (BH101 and BH105) Made Ground was encountered beneath topsoil to a depth of 0.5m bgl, described as firm clay with fragments of chalk, flint and brick.

Groundwater was encountered in three boreholes during drilling.

- In BH101 groundwater was struck in a sand layer at 12.7m bgl rising to 11.2m bgl in a 20-minute pause in drilling.
- In BH104 and BH105 groundwater seepages were recorded at depths of 2.43m and 2.6m bgl respectively.

Monitoring standpipes were installed in exploratory holes BH 101 to 105 and BH 107 within this section of the scheme. The maximum recorded level/minimum depth to groundwater during six monitoring visits between December 2022 and February 2023 are recorded in the following table.

Table 2 – Groundwater Monitoring Results BH 101 to BH 107

Exp. Hole No.	Installation Depth (m bgl)	Response Zone (m bgl)	Min. Depth to Water Level (m bgl)	Max. Water Level (m aOD)	Date
BH101	13	12.0 to 13.0	1.95	68.92	15:02:2023
BH102	10	7.0 to 10.0	2.12	62.70	05:12:2022
BH103	4	2.0 to 4.0	0.30	64.52	16:01:2023
BH104	9	1.0 to 9.0	0.25	59.44	16:01:2023
BH105	4	2.0 to 4.0	2.34	59.58	05:12:2022
BH107	12	2.0 to 12.0	DRY	DRY	All visits

3.2 Chainage 8400 to ch 8770.

The geological mapping for this section indicated that the West Melbury Marly Chalk Formation (Chalk Marl) is present. A single exploratory hole, BH108 was located within this section. This borehole did encounter material which is considered to be Chalk Marl, however, this was at a depth of 1.0m beneath a layer of material provisionally identified as cohesive Glacial Till. The Chalk Marl was described as a stiff becoming very stiff sandy silty clay and was present to a depth of 9.6m beneath which Gault Clay was encountered.

Groundwater was struck at 7.5m bgl rising to 5.2m bgl during a 20-minute pause in drilling.

A groundwater monitoring installation was installed in exploratory hole BH 108 within this section of the scheme. The maximum recorded levels/minimum depths to groundwater during six monitoring visits between December 2022 and February 2023 are recorded in the following table.

Table 3 – Groundwater Monitoring Results BH 108

Exp. Hole No.	Installation Depth (m bgl)	Response Zone (m bgl)	Min. Depth to Water Level (m bgl)	Max. Water Level (m aOD)	Date
BH108	9	2.0 to 9.0	3.62	27.61	16:01:2023

3.3 Chainage 8770 to ch11600

A review of the geological mapping for this area indicated that the Gault Clay is anticipated to outcrop. This section is crossed by Bin Brook and although the mapping does not show any alluvial deposits associated with this watercourse, localised softening and increased weathering of the Gault Clay may have occurred.

Three boreholes were drilled within this section of the scheme, BH109, BH110 and BH111.

Boreholes BH109 and BH110 were positioned to obtain preliminary indications of the ground conditions at the location of the proposed approach embankments and bridge over the M11 Motorway.

- BH109 to the west of the M11 encountered 0.3m of Topsoil over lying clay described as weathered Gault Clay, this was recorded as being stiff to 2.2m then as firm to 5.0m. Beneath this the Gault Clay was stiff and fissured, becoming very stiff from 15m to the end of the borehole at 25.45m.
- BH110 to the east of the M11 encountered a layer of made ground from the surface to 1.1m depth, this was described as clay with fragments of flint, brick, concrete and charcoal. Beneath this firm becoming stiff clay logged as Glacial Till (Oadby Member) was present to 4.0m depth, then stiff grey Gault Clay to 15m becoming very stiff until the end of the borehole at 25.45m depth.
- No groundwater was encountered in either of these boreholes during drilling.

Oadby Member clay was not anticipated at the location of BH110, a review of the logs indicates that flint gravel was recorded hence this material was considered to be Glacial Till rather than Gault Clay. Laboratory testing indicates the material logged as Oadby Formation also has a lower plasticity than the material logged as Gault Clay. Dead rootlets were recorded at 2.0m depth so there may be some bioturbation of this strata, alternatively the material could potentially be made ground. It is recommended that as the project progresses trial pits are excavated to better determine the nature of this material.

Borehole BH111 was located to the west of Bin Brook. At this location beneath a 0.2m layer of Topsoil the borehole revealed a firm clay with chalk and flint fragments, this could possibly be clay fill. Beneath this, firm weathered Gault Clay was present to 4.6m bgl, stiff fissured Gault Clay to 10.5m depth, underlain by very stiff fissured Gault Clay until the end of the borehole at 15.45m.

Groundwater was recorded at a depth of 1.2m bgl. during the drilling of this borehole.

Monitoring installations were installed in exploratory holes BH 109, BH 110 and BH 111 within this section of the scheme. The maximum recorded level/minimum depth to groundwater during six monitoring visits between December 2022 and February 2023 are recorded in the following table.

Table 4 – Groundwater Monitoring Results BH 109 to BH 111

Exp. Hole No.	Installation Depth (m bgl)	Response Zone (m bgl)	Min. Depth to Water Level (m bgl)	Max. Water Level (m aOD)	Date
<i>BH109</i>	<i>5</i>	<i>2.0 to 5.0</i>	<i>2.98</i>	<i>16.81</i>	<i>15:02:2023</i>
<i>BH110</i>	<i>21</i>	<i>18.0 to 21.0</i>	<i>7.10</i>	<i>12.69</i>	<i>03:02:2023</i>
<i>BH111</i>	<i>4</i>	<i>1.0 to 4.0</i>	<i>0.72</i>	<i>7.57</i>	<i>20:12:2022</i>

3.4 Chainage 11600 to ch 11791(Grange Road)

The geological mapping indicates that River Terrace Deposits (RTD) comprising sand and gravel are present in this area, underlain by Gault Clay.

No exploratory holes were located within this short section of the route however it is anticipated that the RTD deposits thicken from west to east, based on historical borehole logs present in the vicinity of Grange Road and that they are estimated to be approximately 3m deep at the eastern end of the scheme.

4. ENGINEERING IMPLICATIONS OF GROUND CONDITIONS ENCOUNTERED

Based upon the findings of the preliminary ground investigation an assessment will be made for the following key elements of the scheme:

- Retaining Structures at Childerley Lodge.
- M11 Bridge and approach embankments.
- Bin Brook Crossing and approach embankments.
- Earthworks for the Scheme.

To enable detailed design to be undertaken in accordance with the appropriate design standards it will be necessary to undertake further ground investigation. Additional boreholes will be required at proposed structure locations and trial pits will be required to further assess the earthwork excavated material re-use potential.

4.1 Childerley Lodge Retaining Structures.

The preliminary design indicates that, due to limited land availability, in the Childerley Lodge area of the scheme consideration is being given to the construction of two retaining walls, one to the north and one to the south of the proposed route.

- The northern wall is approximately 200m long with a maximum height in the order of 4m
- The southern wall is approximately 55m long with a maximum height in the order of 2.5m

The present proposal is that these walls will be constructed using a geo-grid reinforced soil. The fill to the wall is likely to be granular to provide the necessary degree of interaction between the infill and reinforcing elements. Site excavated material will be predominantly cohesive therefore import of granular material will be required.

Beneath a superficial layer of Topsoil, the ground conditions in the vicinity of these walls will predominantly be cohesive Glacial Till (Oadby Formation), although Made Ground was encountered to 0.5m depth in BH 101.

Plasticity tests on the clays indicated that they had a medium to high plasticity. The results indicate that the clay would have a medium shrinkage potential, as defined by the NHBC Guidance document Chapter 4.2 Building Near Trees. In order to reduce the risks of ground movements associated with shrinkage and swelling of these clays due to seasonal moisture content changes, a minimum foundation depth of 0.9m below ground level is likely to be required, this should be increased where the foundations are in the zone of influence of existing, recently removed or proposed trees.

After stripping topsoil and removing any localised made ground/soft material, the underlying firm becoming stiff clays are likely to have undrained shear strengths in the order of 100kPa at this location and will have the necessary strength to support reinforced soil structures of the heights proposed.

A preliminary assessment of the anticipated settlement indicates that the coefficient of volume compressibility (m_v) will be in the order of 0.2m²/MN therefore it would be anticipated that settlements would likely be less than 50mm, and this should be acceptable for the type of structure proposed. The actual values will require confirmation at detailed design stage once the actual structural loads and foundation layouts are available.

The results of groundwater monitoring in BH 101 and BH 102 indicate that groundwater would be expected at 1.95m below current site ground level,

Testing of pH and water soluble sulphates indicate that the soils in this area will be within category DS-2 as defined by BRE Special Digest 1 – Concrete in Aggressive Ground. Therefore, special precautions for the protection of buried concrete may be required.

4.2 M11 Motorway Bridge and Approach Embankments.

The proposed busway will cross the M11 Motorway on a bridge. At the crossing location the motorway is in cutting, the bridge deck level and the associated approach embankments will be approximately 7m above the ground level at the top of the existing cuttings.

It is most likely that the bridge abutments will require piling to accommodate the magnitude of load anticipated from the bridge deck. The strata beneath the abutment locations show an increase in strength with depth, and bored or continuous flight auger (CFA) piles are likely to provide the most suitable piling technique. Whilst piles would rely predominantly on shaft friction within the stiff clay, the very stiff clay encountered from 15m below existing ground level is likely to provide a beneficial increase in end bearing for piles designed to penetrate into this material.

The bridge abutments will be in areas where trees are currently present. These trees are likely to have caused a significant level of desiccation within the clays at this location such desiccation could lead to swelling of the clay. Desiccated clays swell following removal of trees and recovery of moisture content, it will therefore be necessary to determine the extent of desiccation by additional exploratory holes at the abutment locations once access to these areas is available.

A preliminary assessment has been made of the ground conditions beneath the location of the proposed approach embankment and it is considered that, providing topsoil and any localised softened ground is removed prior to embankment construction, then the bearing capacity of the ground is adequate. An estimation of anticipated settlement of the embankments indicate that this would be within acceptable limits.

Section 3.3 of this Technical Note also identifies the need to further investigate the extent of the material logged as Oadby Formation clay at the east side of the M11. This will be necessary to input into the abutment and the embankment design in this area.

At this stage the stability of the existing motorway cuttings has not been assessed.

The stability of the side slopes of the proposed new embankment will depend on the materials used for construction.

- Embankment slopes in cohesive Glacial Till are likely to be in the order of 1vertical(v) to 3 horizontal (h).
- For embankments formed from Gault Clay the embankment slopes are likely to be 1v to 4h.

Testing of pH and water soluble sulphates indicate that the soils in this area will be within category DS-3 as defined by BRE Special Digest 1 – Concrete in Aggressive Ground. Special precautions for the protection of buried concrete are likely to be required.

4.3 Bin Brook Crossing

The preliminary proposal for the crossing of Bin Brook is for a 10m span bridge. The bridge deck and approach embankments will be some 2.6m above existing ground level. Detailed bridge loadings are not available however the strength of the ground near Bin Brook is potentially too low to accommodate typical bridge abutment loads and due to the presence of relatively high groundwater levels digging out these materials to place foundations in stronger deeper materials may not be feasible.

The ground is anticipated to have an appropriate strength to support the proposed embankment, providing any localised soft areas are excavated and replaced. Embankment side slopes will be dependent on the fill material used and guidance is given in Section 4.2 on their likely gradients.

Testing of pH and water soluble sulphates indicate that the soils in this area will be within category DS-3 as defined by BRE Special Digest 1 – Concrete in Aggressive Ground. Therefore, special precautions for the protection of buried concrete are likely to be required. It is recommended that more sulphate testing is carried out in this area.

4.4 Soakage Tests

At the time the ground investigation was designed it was not determined if drainage for the scheme would comprise infiltration to the ground. It was proposed that some indicative soakage tests would be carried out in selected boreholes to give an indication of the ground conditions for soakage. The results of the tests are presented in the Factual Report and are qualitatively assessed in the following Table.

All the soakage tests were carried out in a dedicated borehole adjacent to the associated exploratory borehole. The boreholes with soakage tests are identified with the suffix A.

Table 5 – Qualitative Summary of Borehole Soakage Tests

Exp. Hole No.	Test Depth (m bgl)	Water Depth Test Start (mbgl)	Water Depth Test End (mbgl)	Change in water level during test (m)	Test Time (mins)	Qualitative Soakage Rate	Soakage Strata
BH102A	0.4 to 2.4	0.47	0.48	0.1	120	Low	Clay (Oadby Formation)
BH 107A	0.5 to 2.5	0.52	0.65	0.13	120	Low	Clay (Oadby Formation)
BH 108A	0.5 to 2.5	0.55	0.71	0.16	120	Low	Clay (Oadby Formation)
BH 110A	0.5 to 3.5	1.50	1.54	0.04	120	Low	Clay (Oadby Formation)

As the outline design progressed it was considered that soakaways are unlikely to be generally used throughout the scheme, although one area where groundwater soakage may be adopted is in the vicinity of Scotland Road, however this investigation location was postponed (BH 112) due to access permission issues.

In areas where ground soakage is to be used soakage tests should be conducted in trial pits and should be carried out following the procedures given in Building Research Establishment (BRE) Digest 365, Soakaway Design.

4.5 Formation Conditions for Preliminary Pavement Design

The material at formation level for much of the scheme is likely to be predominantly cohesive comprising either Oadby Formation or Gault Clay. The typical Plasticity Index test results for these materials have been reviewed and compared to the recommendations in Table C1 of TRL Report LR1132 which assesses the likely California Bearing Ratio (CBR) for various materials based on their potential equilibrium moisture content. The actual CBR can vary and is dependent on the groundwater level and construction conditions.

- Oadby Formation (cohesive Till) Plasticity Indices were in the range 23 to 33% and CBR values are likely to be in the order of 3 to 4%.
- Gault Clay Plasticity Indices were in the range 30 to 50% and a CBR in the order of 3% is anticipated except for the Bin Brook area where this is likely to reduce to 2.5% due to relatively high groundwater levels.
- In the more limited areas where the Marly Chalk and the River Terrace Deposits are present insufficient investigation was carried out to determine CBR values, therefore additional investigation should be undertaken as the scheme develops.

5. EARTHWORKS

The vertical alignment for the scheme has not been finalised at the time of writing. It is recommended that once the vertical alignment is determined further investigation is carried out to assist in the design of earthworks and road pavements for at detailed design stage.

5.1 Earthworks - Cuttings

There is one significant area of proposed cutting, between chainage 8050 and ch 8400. The ground investigation indicates that most of this cutting will be within cohesive Glacial Till, the eastern most part may encounter the Chalk Marl.

There are other areas of shallow cutting along the length of the route. In these areas and in areas where the route is at grade, it will be necessary to excavate material to the depth of the pavement formation level. It is anticipated that a significant quantity of excavated material will be generated, where this material is excavated from shallow depth it would be anticipated that a proportion of the material would not be suitable for re-use in structural embankments. For initial assessment it should be assumed that approximately 25% of the material excavated from below the topsoil and which is within 1m of present ground level, would be unsuitable for re-use as general cohesive (Class 2) fill. It is considered likely that clean material which is unsuitable for use as general fill could be re-used as landscaping (Class 4 material).

Table 6 gives a preliminary indication of potential cutting side slopes in the various geological strata encountered.

5.2 Earthworks - Embankments

Each of the three structures mentioned in the previous section will have significant approach embankments. Elsewhere along the route low embankments are proposed.

Whilst the cohesive Glacial Till from the main area of cutting is likely to be the better of the on-site materials available for embankment fill, as it is likely to be less moisture susceptible and will stand at a steeper slope gradient, it is not likely to be practical to transport this material to locations east of the M11. Therefore, material derived from the Gault Clay is likely to be the material source for embankments in that area.

Table 6: Summary of Preliminary Earthwork Slope Gradients Estimates for Various Geologies

Geology	Cuttings		Embankments	
	0 to 2m Depth	2m to 5m Depth	0 to 2m Height	2m to 5m Height
Glacial Till (cohesive)	1v to 2h	1v:3h	1v to 2h	1v:3h
Chalk Marl	1v to 2h	1v:3h	1v to 2h	1v:3h
Gault Clay	1v to 3.5h	1v:4h	1v to 3.5h	1v:4h
<i>This table excludes localised areas of alluvium which may occur.</i>				

6. CONCLUSIONS

This Technical Note provides a review of the Preliminary Ground investigation carried out for the proposed Cambourne to Cambridge guided busway. In particular it gives an early stage indication of the suitability of the ground as revealed by the investigation for the construction of the type of structures and their associated earthworks proposed at the following locations:

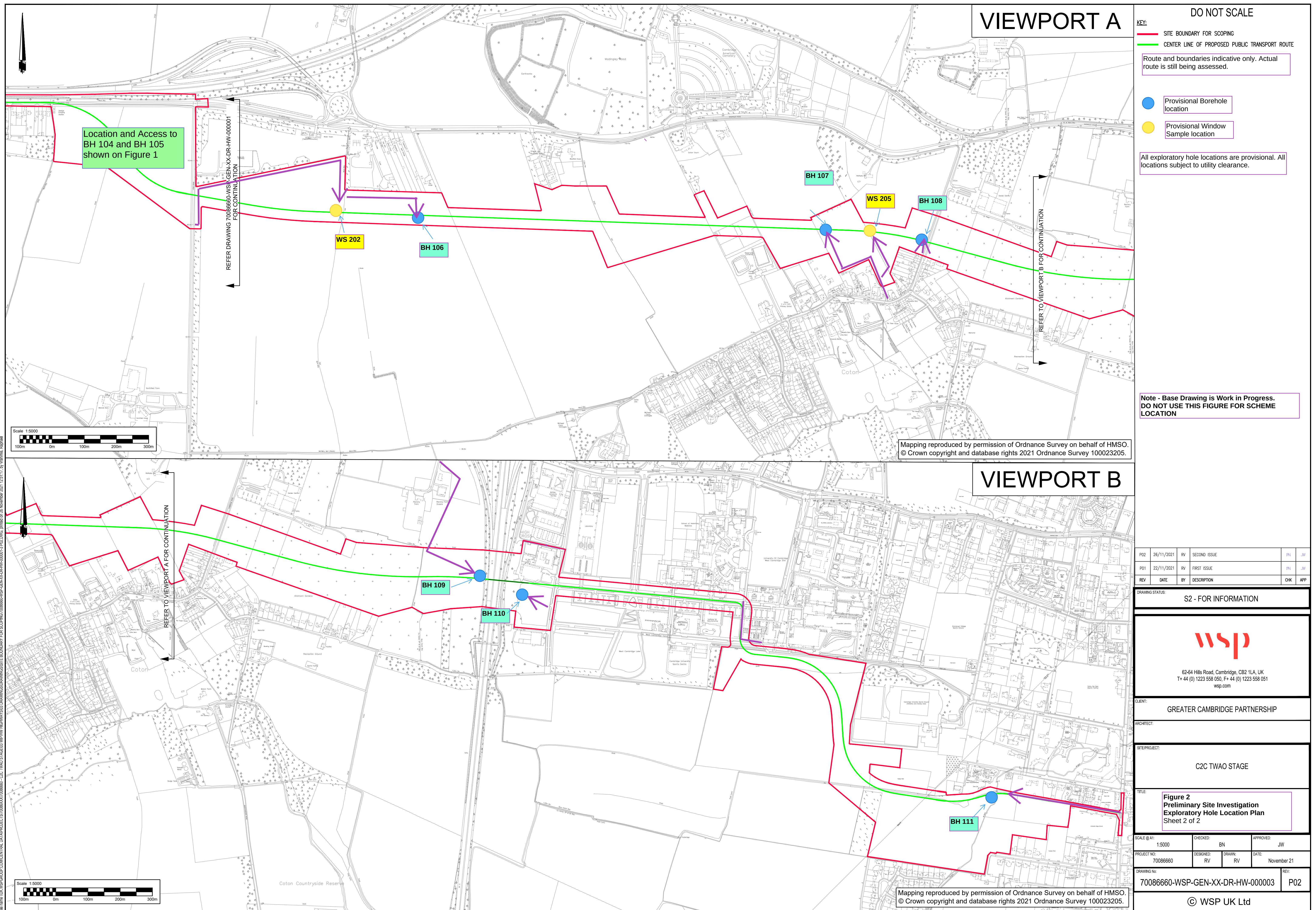
- Retaining Structures at Childerley Lodge.
- M11 Bridge and Approach Embankments.
- Bin Brook Crossing and approach Embankments.

It will be necessary to undertake further investigation to enable the detailed design to be carried out.

This investigation should include:

- Additional boreholes at the locations of Bin Brook Crossing and the M11 overbridge.
- Trial Pits at the locations of cuttings to provide bulk samples for earthwork testing and at regular intervals along the route to determine the necessary parameters for pavement design,
- Trial Pits at the locations of approach embankments to the structures.
- Laboratory testing has indicated that high soluble sulphates are present in the Glacial Till (Oadby Member) and the Gault Clay. Additional sulphate testing is recommended so that the extent of any special requirements to protect buried concrete can be more accurately assessed.

ATTACHMENT – FIGURES 1 AND 2



Appendix B – Technical Note 1: Cambourne to Cambridge Park & Ride Capacity

TECHNICAL NOTE 1

DATE:	11 April 2023	CONFIDENTIALITY:	Public
SUBJECT:	C2C P&R capacity		
PROJECT:	70086660 - C2C TWAO	AUTHOR:	Heather Clarke
CHECKED:	Gerry Corrance	APPROVED:	Graham Higgins

C2C P&R CAPACITY

The preferred option for C2C agreed at OBC (Dec 2020) includes a Travel Hub to be located at Scotland Farm. This Technical Note considers the possible requirements for parking capacity at the Travel Hub.

CSRM Modelling

CSRM2 F-series Model Runs were carried out for the following scenarios:

2041 Do Minimum (**without** C2C scheme and Scotland Farm Travel Hub); and

2041 Do Something (**with** C2C scheme and Scotland Farm Travel Hub).

Both scenarios were run both with and without Making Connections in place.

All scenarios assumed the following:

Table 1 – Development

	Dwellings	Population	Jobs
<i>Bourn Airfield</i>	2,460	5,071	2,506
<i>Cambourne West</i>	2,350	4,844	2,173
Total	4,810	9,915	4,679

This is not the full buildout at either site but represents what could be completed by 2041. It is noted that at least part of this development is considered dependent on the C2C scheme being delivered, but has been included in both scenarios to give a more accurate comparison (and represents a 'worst case' scenario in terms of numbers of trips accessing the network in the Cambourne area).

In all scenarios it is also assumed that the Madingley Road P&R remains open. Bus fares from the two sites have been assumed to be:

- Madingley Road - £1.35 (Rider City fare zone)
- Scotland Farm - £2.05 (Rider Cambs fare zone)

Due to slight changes in the preferred option after the model runs being initially carried out – the forecast demand was re-assigned to a revised SATURN highway network so that an accurate assessment could be carried out.

These changes comprised:

- Buses would travel on-road along St Neots Road through Hardwick, but the bus gate to the east of Hardwick is no longer proposed
- The route has also been moved to avoid the Waterworks site and Comberton Plantation

TECHNICAL NOTE 1

DATE:	11 April 2023	CONFIDENTIALITY:	Public
SUBJECT:	C2C P&R capacity		
PROJECT:	70086660 - C2C TWAO	AUTHOR:	Heather Clarke
CHECKED:	Gerry Corrance	APPROVED:	Graham Higgins

Neither of these changes would affect the demand for the scheme therefore the forecast demand was still valid. However the removal of the bus gate would mean small changes in local re-routing to avoid it – which would be picked up by re-assigning to a revised network as described.

P&R capacity calculation

Automatic Number Plate Recognition (ANPR) surveys were carried out at all existing Cambridge P&R sites in June 2017. Because of the pandemic no more recent surveys have been carried out and the 2017 surveys are felt to be the most representative of a ‘normal’ situation. The June 2017 figures have been factored up by 10% to take account of the observed effect of removing the parking charges in 2018.

The profile at Madingley Road is shown in Table 2, along with the resultant occupancy of the 930 spaces.

Table 2 – ANPR survey (Madingley Road P&R)

Hour starting	Inbound	Outbound	Occupancy	% full
06:00	201	18	189	20%
07:00	303	58	434	47%
08:00	165	39	560	60%
09:00	166	38	689	74%
10:00	124	39	774	83%
11:00	99	52	821	88%
12:00	73	75	819	88%
13:00	60	90	790	85%
14:00	46	119	716	77%
15:00	46	179	584	63%
16:00	44	304	324	35%
17:00	35	209	150	16%
18:00	27	134	43	5%
Total	1,398	1,355	max. 821	max. 88%

The calculation for the number of spaces required at Scotland Farm then took the number of cars entering the site in the modelled AM peak hour (08:00-09:00) and applied the profile of in/out from Table 2 to give maximum occupancy throughout the day. The same process was carried out for Madingley Road as this is

TECHNICAL NOTE 1

DATE:	11 April 2023	CONFIDENTIALITY:	Public
SUBJECT:	C2C P&R capacity		
PROJECT:	70086660 - C2C TWAO	AUTHOR:	Heather Clarke
CHECKED:	Gerry Corrance	APPROVED:	Graham Higgins

assumed to remain open. A factor of 1.176 is applied to the maximum occupancy figure to give the required number of spaces. This takes account of a maximum acceptable occupancy threshold of 85% of capacity.

CSRM2 does not apply any capacity constraints to P&R sites and therefore calculates the maximum demand that would like to use each site, regardless of the number of spaces available. With a new site this can therefore show the number of spaces that need to be provided. With an existing site obviously if demand exceeds existing capacity and no expansion is planned any surplus demand would in reality be expected to be latent, or might consider parking elsewhere.

Using the method described above, the number of spaces 'required' at the two sites was calculated as follows:

Table 3 – Spaces required (unconstrained capacity)

	Without Making Connections		With Making Connections	
	Do Minimum	Do Something	Do Minimum	Do Something
<i>Madingley Road</i>	1,797	1,640	3,383	3,281
<i>Scotland Farm</i>	-	1,250	-	1,394
Total	1,797	2,890	3,383	4,675

It is clear that the level of demand predicted for Madingley Road could not be accommodated in the existing 930 spaces, but it remains the more attractive option due to its location and the lower bus fare.

Further consideration was therefore given to whether there were any trips that might transfer to Scotland Farm if they knew that spaces would not be available at Madingley Road.

The Do Something AM models were interrogated to determine the origins of trips wanting to park at Madingley Road.

TECHNICAL NOTE 1

DATE:	11 April 2023	CONFIDENTIALITY:	Public
SUBJECT:	C2C P&R capacity		
PROJECT:	70086660 - C2C TWA0	AUTHOR:	Heather Clarke
CHECKED:	Gerry Corrance	APPROVED:	Graham Higgins

Figure 1 – 2041 AM DS without Making Connections

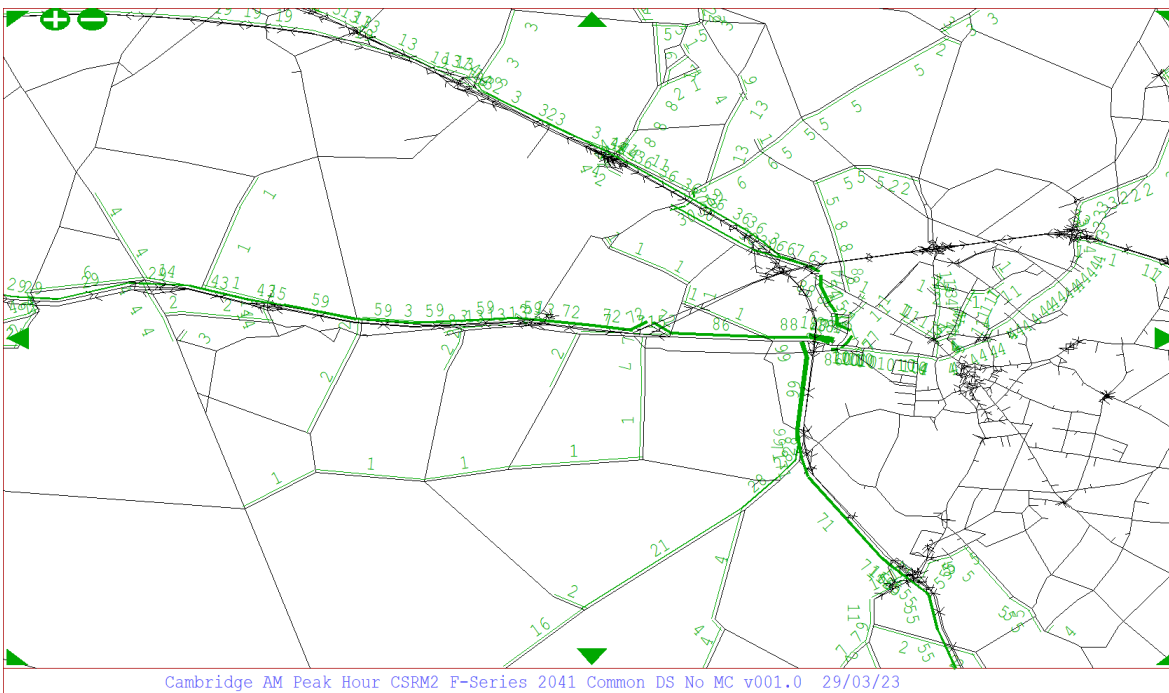
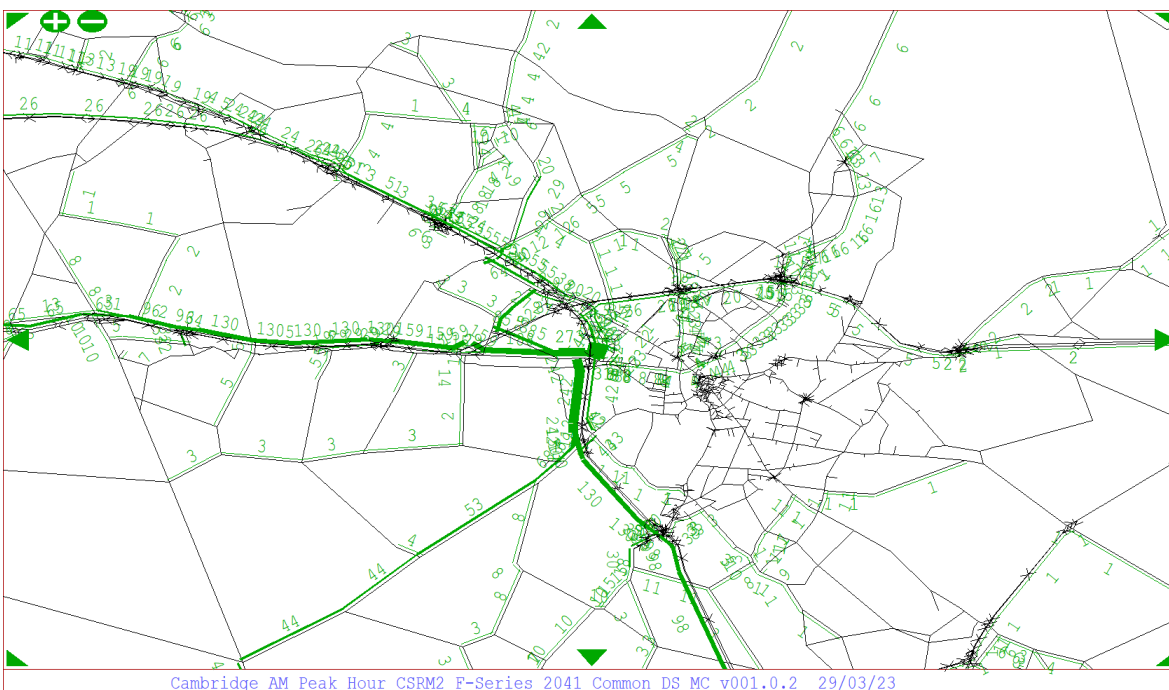


Figure 2 – 2041 AM DS with Making Connections



TECHNICAL NOTE 1

DATE:	11 April 2023	CONFIDENTIALITY:	Public
SUBJECT:	C2C P&R capacity		
PROJECT:	70086660 - C2C TWAO	AUTHOR:	Heather Clarke
CHECKED:	Gerry Corrance	APPROVED:	Graham Higgins

Figures 1 and 2 show the origins of trips wanting to park at Madingley Road in the 2041 AM Do Something (with and without Making Connections).

The greatest percentage of trips come from the northbound M11 – it is unlikely that these trips would consider Scotland Farm as a viable alternative. However, there are 72 trips that are travelling east along the A428 from west of Scotland Farm (without Making Connections) and 159 when Making Connections is in place, which would ‘choose’ to park at Madingley Road if spaces were available.

It is considered reasonable therefore that these trips can be added to the number in the model choosing to park at Scotland Farm. The calculation of spaces needed was then re-done and gave the following:

Table 3 – Spaces required (adjusted)

	Without Making Connections		With Making Connections	
	Do Minimum	Do Something	Do Minimum	Do Something
<i>Madingley Road</i>	1,797	1,208	3,383	2,325
<i>Scotland Farm</i>	-	1,706	-	2,349
Total	1,797	2,914	3,383	4,675

In conclusion therefore, it is expected that the required capacity at Scotland Farm (by 2041) would be between 1,700 and 2,300 spaces.

There are a number of sensitivities that could affect these calculations:

- Completion of the A428 Black Cat to Caxton Gibbet scheme (included in the model but may not go ahead).
- Buildout of Cambourne West / Bourn Airfield
- Making Connections
- East-West Rail (not included in model runs)
- 2,000 additional dwellings North of Cambourne (not included in model runs)
- Madingley Road P&R (could be closed)

Given the number of uncertainties (particularly Making Connections) it is possible that additional P&R capacity may be required over the next 18 years. However, the current assessment shows that the C2C plans are logical.