Smarter Cambridge Transport

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To: Public Inquiry Inspector
Subject: Proof of Evidence for Application for the Proposed Network Rail (Cambridge South Infrastructure Enhancements) Order
Objector: OBJ/22
Date: 7 January 2022
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About Smarter Cambridge Transport

Smarter Cambridge Transport is a volunteer-run think tank and campaign group. It was formed in 2015 to advance sustainable, integrated and equitable transport for the Cambridge region. It is run by a team of around 30 people, with a wide range of expertise and interests, and led by Edward Leigh, a qualified transport economist. Its website is at www.smartertransport.uk.

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Abbreviations used

- CBC: Cambridge Biomedical Campus
- CPICC: Cambridgeshire & Peterborough Independent Climate Commission
- CPIER: Cambridgeshire & Peterborough Independent Economic Review
- CSET: Greater Cambridge Partnership Cambridge South East Transport busway scheme
- CSRM: Cambridge Sub Regional Model of traffic movements, using SATURN software
- DfT: Government Department for Transport
- DDG: Demand Driver Generator: network of models used to derive rail demand elasticities
- GCP: Greater Cambridge Partnership, joint committee of Cambridgeshire County Council, South Cambridgeshire District Council and Cambridge City Council, delivering the City Deal
- MSOA: Middle Layer Super Output Area
- NR07, NR13, NR16: Network Rail (Cambridge South Infrastructure Enhancements) Order application documents
- NTEM: National Trip End Model (Department for Transport, 2017)
- OBC: Outline Business Case for Cambridge South Station (not yet published)
- ORR: Office of Rail and Road, the statutory regulator of the rail industry
- pcu: passenger-car unit: the road space occupied by the equivalent of an average car
- SOBC: Strategic Outline Business Case for Cambridge South Station (Mott MacDonald 2017)
- TA: Transport Assessment (NR16 Environmental Statement Appendix 17.2)
- TEMPro: Trip End Model Presentation Program
- TNR2: Cambridge Biomedical Campus Transport Needs Review Part 2 (Atkins, October 2018, included as Appendix R in NR16 Environmental Statement Appendix 17.2)
- TNR3: Cambridge Biomedical Campus Transport Needs Review Part 3 (Atkins, December 2018, included as Appendix R in NR16 Environmental Statement Appendix 17.2)
- TWAO: Transport and Works Act Order
- ULEZ: Ultra Low Emission Zone

Executive Summary

We contend that:

1. The travel demand data (NTEM and local surveys) and growth models (TEMPro and DDG) used to determine the station design capacity are incomplete, inconsistent, and have not been explicitly calibrated or validated.
2. The TEMPro outputs for 'car driver' trips into the CBC in the morning peak in 2021 exceed the theoretical road capacity, which is extremely unlikely to be the case in practice, calling into question the reliability of the model for demand forecasting.
3. The modal share assignment model is critically important – in particular for multimodal trips (rail plus walking, cycling or bus) – but appears not to have been explicitly validated.
4. The car trip data in the TNR2 is not broken out by driver, passenger and taxi, which means it can only be compared with CSRM and NTEM data by making assumptions about vehicle occupancy that are not described and appear not to have been tested.
5. TNR3 uses a first-principles approach to modelling station usage, and arrives at a figure about two-and-a-half times that forecast by the applicant. The OBC provides no analysis or commentary on this.
6. The TNR3 modelling ultimately fails to achieve local policy targets for road traffic reduction, which implies that demand management measures will be required to enable the CBC's growth ambitions. These in turn will have a significant impact on rail demand.
7. The OBC takes no account of the modal shift required to achieve local and national targets for transport decarbonisation or public health (notably, air quality and physical activity).
8. The user benefits of tighter integration between rail and bus services have been overlooked.
9. There is little scope to enlarge the proposed design at a later date should demand grow to exceed the safe and efficient operation. The entrance and ticket hall will be hemmed in by the Guided Busway Bridge. There will be no scope to add additional staircases or lifts between the platforms and the main overbridge connecting the entrances. Nor is there space into which to widen the approach footways, or increase the number of cycle parking spaces on the east side. (Cambridge station has experienced 'growing pains' but, in contrast, has space to expand.)
10. The access arrangement at Francis Crick Avenue is highly conflicted. Potentially large crowds of people arriving and leaving by foot and cycle will have to negotiate a complex crossing of Francis Crick Avenue, which is planned to comprise two general traffic lanes, two bus lanes and two cycle lanes (see Figure 4).
11. The main station entrance is some considerable distance from the nearest bus stops. This contravenes government policy and best practice for promoting public transport as an attractive alternative to driving.

Conclusions

A. If current modelling forecasts are correct, then growth of the CBC as currently planned will not be viable in transport terms because it will attract more trips to the site by car than the road or parking capacity, or local policies will permit. It is incumbent upon the applicant and all stakeholders to acknowledge this and inform government, as the project funder.
B. If our analysis is correct, rail demand in the initial years could be nine million passenger-journeys per year, compared with the applicant's forecast of just over two million; and growth throughout the rest of the next Local Plan period (to 2041) is likely to be considerably higher than 1.3% per annum.
C. The combination of higher demand and tighter integration of rail and bus services would generate very much higher user benefits, warranting a larger investment in the station's operational capacity, closer integration with bus services, and more cycle parking.

Recommendations

1. We believe that the scale of investment (£177.1–190.4m) warrants more robust modelling of rail demand. We therefore recommend the applicant develop, with CBC and local transport authorities, a consistent and reliable model for trip mode allocation that can accept as inputs:
   - Physical constraints on parking spaces, road capacity, and railway capacity (track, signalling and trains).
   - Separate figures for staff and patient/visitor trips.
   - Trip quantities for active travel, calculated separately using existing active travel demand modelling tools and planned NMU infrastructure connecting the CBC to local settlements.
   - Generalised costs for car travel, including per-trip price premiums applied using demand management measures (ULEZ, Workplace Parking Levy or a congestion charge).
   - Generalised costs of rail-plus-bus trips, with parameters for interchange times and costs.
2. Using this customised model, we recommend the applicant build and test plausible future scenarios to obtain a rough probability distribution of rail demand.
3. Our contention is that this will demonstrate that there is a high probability of rail demand being much higher than the applicant's forecast of around 2 million passenger-trips per year in 2031 and a lifetime maximum requirement for 1,000 cycle parking spaces.
4. Any increase in rail usage will strengthen the business case for Cambridge South station. That in turn will justify the design, construction and operation of a larger station along the lines we have proposed (see Figure 6). This would see the station ticket hall and cycle parking located above the tracks. The main entrance would be from the rebuilt busway bridge, which would be widened to include a bus station immediately opposite the station entrance. There would be very limited vehicular access for private vehicles, so as to minimise conflicts and congestion on and around Francis Crick Avenue.

Questions for the applicant

The context of each of these questions is set out below.

Q1. How has the applicant incorporated constraints (including road, parking, railway and station access capacity) into its demand modelling?

Q2. How has the applicant demonstrated that NTEM, DDG and CSRM figures are consistent?

Q3. How does the applicant explain or correct for overestimations for motor vehicle trips in the demand modelling?

Q4. How has the applicant demonstrated that its modelling is fit for purpose?

Q5. How has the applicant modelled and tested growth scenarios, as recommended by [TAG Unit M4] (Forecasting and Uncertainty)?

Q6. How has the applicant modelled and tested policy scenarios?

Q7. Why does the OBC not acknowledge and discuss the modelling findings in TNR3?

Q8. How has the applicant modelled multimodal trips?

Q9. How does the applicant believe the proposed station configuration meets the government's policy objectives on transport integration?

Q10. Has the applicant appraised the increased rail patronage and improved user benefits of having bus stops within 20 metres of the station entrance?

Q11. Why does the TA not use the higher figure for jobs from the SOBC when that, rather than TNR2, has been signed off by DfT?

Q12. What vehicle occupancy rates have been assumed for modelling purposes?

Q13. How does the applicant justify this slow rate in patronage growth when expansion of CBC and other sites reachable from Cambridge South is planned well beyond 2031, and climate change policies will require a large modal shift from driving to public transport?

Q14. How has the applicant modelled or sensitivity-tested all variables that may significantly affect rail demand?

Q15. What demand should be attributed to origins/destinations that are outside the four MSOAs on which the TA is based, but potentially within convenient reach of Cambridge South station by bus or e-bike?

Q16. What modelling has the applicant conducted of the pedestrian crossing on Francis Crick Avenue at peak times?

Q17. What contingency has the applicant made for an underestimation of demand for cycle parking?

Q18. What modelling has the applicant conducted of vehicular movements in and out of the station access road?

Q19. Does the applicant agree that the proximity of bus stops imposes an undesirably, and even unacceptably, large time and convenience penalty on interchanging between rail and bus services?

Q20. Which base and target years have been examined, as TEMPro operates on calendar years?

Q21. Which zones have been used? Since TEMPro uses MSOAs, there is only one zone that includes the CBC (Cambridge 013).

Q22. What is the explanation for the apparent discrepancies between reported and actual TEMPro outputs?

Q23. We understand that the applicant has now obtained some data on staff home locations (trip origins). Will this extrapolate sufficiently accurately to the entire workforce? What about patient and visitor origin data?

Q24. What consideration, if any, has the applicant given to supporting NHS England's policy commitment to reduce the carbon emissions of its staff, patient and visitor trips to hospitals on the CBC?

Q25. What steps has the applicant taken to validate forecast trips from other rail stations?

Notes

Although we have added detail to our objections, the essential points remain unchanged from those we made in our consultation responses of March and November 2020, and in our objection to the TWAO application in August 2021.

We have collated most of the data referred to in this document into a single spreadsheet (OBJ/22/2) for ease of reference and verification.

Demand forecasts

O1. The applicant has modelled demand primarily on the basis of Generalised Journey Times. This is just one factor that determines mode choice. In this instance, it may not be the most salient factor. Scarcity of parking spaces is already a binding constraint on car trips and a major factor in mode choices by employees. Furthermore, it is current local policy to introduce more residents parking schemes, which remove on-street parking from use by commuters, patients and visitors.

O2. The capacity of roads entering and connecting to the CBC is also likely to be a binding constraint on growth in motor traffic. As may be the capacity of the eastern access for pedestrians, cycles, taxis and other cars picking up and dropping off.

This is critically important because road capacity, car parking capacity and local policy targets on traffic reduction all impose constraints on the future number of vehicles that can or will be entering the CBC.

O3. Where model outputs fall outside capacity constraints, it will be necessary to run switching tests to establish what inputs will keep outputs within constraints. Decision-makers should be informed of the conclusions – for instance, that they must accept a cap on growth, or commit to introducing policies that rebalance the costs and incentives that govern travel choices (see O11).

Q1. How has the applicant incorporated constraints (including road, parking, railway and station access capacity) into its demand modelling?

O4. The applicant has based their forecasting on NTEM, DDG (which uses NTEM as inputs) and CSRM models. NTEM does not relate car trips to vehicle numbers (a 'car passenger' generates an additional vehicle trip if the driver is a chauffeur rather than, for instance, a co-worker). TNR2 does not break out 'car' trips into 'car driver' and 'car passengers.' CSRM only deals with vehicles (or, more accurately, passenger-car units). Therefore, none of these data sets is directly comparable for forecasting or validating motor traffic.

Q2. How has the applicant demonstrated that NTEM, DDG and CSRM figures are consistent?

O5. The TEMPro output for 'car driver' trips onto the CBC between 07h00 and 10h00 in 2021 is 7,539. In 2031, it is 8,256. With a jobs total of 27,000 in 2031, the figure is 12,675.

O6. However, the theoretical bidirectional capacity of the roads entering the CBC is 4,420 pcu/hour. That means the theoretical road capacity for vehicles entering the CBC is 2,210 pcu/hour, or 6,630 over a three-hour period. All The TEMPro outputs for the morning peak appear to exceed the theoretical road capacity. This is before adding chauffeured trips and deliveries. This calls into doubt the reliability of TEMPro outputs for demand modelling.

Q3. How does the applicant explain or correct for overestimations for motor vehicle trips in the demand modelling?

O7. The *TEMPro & NTEM data Release Notes Additional guidance* (February 2017) warn that NTEM should be used in conjunction with a reliable model for assigning modal shares:

> *Non-car figures need to be treated with caution because they assume constant travel costs and the estimates are based on NTS data which is dominated by car trips. These figures are intended for use in conjunction with a forecasting model capable of mode choice and might represent a good starting point but users need to satisfy themselves that they are fit for purpose in individual applications.*

O8. It is unclear whether the applicant has used such a localised model that covers all modes, singly and in combination, to calibrate the NTEM model and validate the outputs. For instance, it appears that NTEM severely underestimates the mode-share for cycling and overestimates the mode-share for walking.

Q4. How has the applicant demonstrated that its modelling is fit for purpose?

O9. There is considerable uncertainty in the pattern and pace of future growth of the CBC and future travel patterns:

- Future growth in population, employment and visitor numbers. In particular, two new specialist hospitals, for children and cancer treatment, are planned for the site, which will draw more staff, patients and visitors to the CBC.
- The CBC 2050 Vision, which could see between 36,450 and 42,450 jobs on the CBC by 2050 (see O50).
- Future provision for car parking.
- Future working patterns: a continuation of home-working will go hand-in-hand with more intensive use of office space (i.e. a higher ratio of staff to desks), so the number of trips generated per square metre of office space may return to pre-COVID levels.

O10. The standard growth models, based on ONS data, have been demonstrated to underestimate growth in the Cambridge region because they treat natural population growth as the principal driver. The CPIER report acknowledges that employment growth is drawing people into the region, from other parts of the UK and from outside the UK. Both the local employment and population growth rates are much higher than the 1.3% rate assumed in the demand modelling (see the O26).

Q5. How has the applicant modelled and tested growth scenarios, as recommended by TAG Unit M4 (Forecasting and Uncertainty)?

O11. There is also considerable uncertainty about what policies will be applied over the coming years:

- The GCP has a target of reducing motor traffic in Cambridge by 10–15% on 2011 levels, which is equivalent to 17–21% on 2019 levels. This is acknowledged in TNR3, but not actually achieved in any scenario tested (see O57).
- The Combined Authority has accepted Transport Recommendation 3 in the CPICC report: *"Reduction in car miles driven by 15% to 2030 relative to baseline."*
- Future parking costs, including the possibility of a Workplace Parking Levy being applied.
- ULEZ and/or congestion charge on traffic entering and moving within Cambridge.
- Other national and local transport policies, in particular relating to decarbonising road transport and reducing air pollution.

O12. Any of these policies will increase the generalised cost of car trips, which will make rail travel relatively more attractive.

O13. Other policies, for instance on improving the PlusBus (train plus bus ticket) offering, could reduce the monetary cost of trips involving rail.

O14. Demand modelling should test these policy scenarios as rigorously as growth scenarios. If outputs hit new constraints (e.g. railway or station capacity, or bus stop capacity), then these too will need to be reported to decision-makers.

Q6. How has the applicant modelled and tested policy scenarios?

O15. TNR3 used a first-principles approach to modelling demand, and arrived at a demand that is two-and-a-half times the applicant's demand forecast (see O56).

O16. Even when including motor traffic demand management measures, the modellers were unable to reduce forecast road traffic to return to 2017 levels, yet alone to the GCP target of a 10–15% reduction in 2011 traffic levels.

Q7. Why does the OBC not acknowledge and discuss the modelling findings in TNR3?

O17. Multimodal trips will constitute an increasingly large proportion of all trips as sustainable transport infrastructure, services and integration improve. The cycle parking at Cambridge South station will facilitate first- and last-mile trips over a wide area – especially as the popularity of e-bikes grows. Bus services that call at Cambridge South station, including via the planned CSET busway, further extend the catchment area for the station – potentially enabling trips by rail and bus to/from many employment and residential areas (this is covered in more detail in the commentary below on the Transport Assessment). As in the Netherlands, rail will be an increasingly important segment of multimodal trips because of its relatively high speed, capacity and reliability. Therefore, modelling multimodal trips is an essential part of modelling rail demand.

Q8. How has the applicant modelled multimodal trips?

Station capacity

O18. The principal (eastern) station entrance is highly constrained by the eastern busway abutment. The narrow access corridor creates an environment that will be highly conflicted at peak times, when there are large volumes of pedestrian, cycle and motor vehicle movements. Adjacent junctions with Francis Crick Avenue for the busway and station access road will create further conflicts and increase delays for people walking and cycling. Modelling for the TA shows that congestion on Francis Crick Avenue will delay buses travelling south from Long Rd.

O19. The constrained location of the station makes future expansion difficult, costly and disruptive. The high degree of uncertainty about future usage translates into high financial risk in the event that the design capacity proves inadequate during the station's operational life. This risk has not been quantified in the application. A prudent approach would be to design the station with sufficient capacity at the outset for a high-end demand forecast (e.g. one standard deviation above the 2040 median forecast), and make passive provision for expansion in the future.

Station integration with bus services

O20. The bus stops on Francis Crick Ave will be 200m from the station entrance. For someone alighting from the rearmost carriage of a northbound train, the walk to a bus stop would be 450m, taking seven minutes – or considerably longer for someone with reduced mobility. This does not accord with the government's *National Bus Strategy* guidance or best practice.

O21. The government's National Bus Strategy for England and The Williams-Shapps Plan for Rail both demand tight integration of transport modes:

> *Railway stations should be hubs for connecting services with high quality stops close to station entrances.* – National Bus Strategy for England

> *Railway stations will increasingly be hubs for local bus services, with full information displayed about connecting buses and greater availability of integrated ticketing between rail, light rail and bus services.*
> – The Williams-Shapps Plan for Rail

Q9. How does the applicant believe the proposed station configuration meets the government's policy objectives on transport integration?

Q10. Has the applicant appraised the increased rail patronage and improved user benefits of having bus stops within 20 metres of the station entrance?

Transport Assessment (TA)

The TA is focused primarily on forecasting the number of car trips to the CBC that will be replaced with rail travel to Cambridge South station, and the number of first/last-mile trips by all modes to and from the station.

O22. The TA is based on a forecast of 26,000 jobs on the CBC in 2031. This figure, cited in TA §5.2.2, is drawn from the TNR2 §2.3.1. However, the SOBC and OBC provide a figure of 27,000 (OBC §1.1, SOBC §3.1.2 et al).

Q11. Why does the TA not use the higher figure for jobs from the SOBC when that, rather than TNR2, has been signed off by DfT?

O23. TA §5.5.9 states, *"The Future 2031 Baseline + Development (Do Something) Scenario would therefore see a 39% increase in daily car trips to the CBC, between 2017 and 2031."*

This increase of 17,925 car trips (up from 28,475 in 2017 – stated in TA §5.2.4) is based on naïve modelling, before consideration is given to whether this growth in motor traffic can be accommodated. Capacity is constrained by the local highway network (covered in SOBC §3.1.2: "Without the new station, highway congestion is assumed to act as a limiting factor on the Biomedical Campus.") and on-site car-parking provision (covered in TNR2 §3.2.1).

O24. The theoretical capacity of the roads into the CBC would support an absolute maximum of about 35,000 car trips onto the CBC, assuming access roads were saturated in both directions from 6am to 9pm. The actual maximum throughput is of course considerably lower than this, once allowance is made for junction capacities and the tidal nature of some trips.

O25. The number of trips allocated to 'car' in 2031 is 46,400. This is not broken out into driver and passenger trips, even though the implied number of vehicle-trips is likely to exceed the road capacity. Based on a jobs total of 27,000 on CBC in 2031, TEMPro forecasts 33,388 car trips onto the CBC. This is implausibly close to the theoretical maximum road capacity.

This figure is also more than three times the demand assumed for car parking in TNR3 (9,381 vehicles, equating to 7,160 parking spaces once allowance is made for turnover of spaces).

Q12. What vehicle occupancy rates have been assumed for modelling purposes?

O26. TA Table 6.1 lists the forecast annual patronage for each year up to 2043, reproduced here with year-on-year growth rates:

Year	Passengers	Growth rate
2026	1,006,019	

Year	Passengers	Growth rate
2027	1,499,804	49.1%
2028	1,753,040	16.9%
2029	1,933,681	10.3%
2030	1,998,794	3.4%
2031	2,024,779	1.3%
2032	2,051,101	1.3%
2033	2,077,765	1.3%
2034	2,104,776	1.3%
2035	2,132,138	1.3%
2036	2,159,856	1.3%
2037	2,187,934	1.3%
2038	2,216,377	1.3%
2039	2,245,190	1.3%
2040	2,274,378	1.3%
2041	2,303,945	1.3%
2042	2,333,896	1.3%
2043	2,364,236	1.3%

It can be seen from this table that the growth rate from 2030 to 2043 is assumed to be 1.3% per annum. For context, Cambridge station's patronage growth has averaged 5.1% over 2009/10 to 2018/19 (based on ORR Estimates of station usage). Recent history, adopted and draft Local Plans (in Cambridgeshire, Hertfordshire, Essex and Suffolk), the Cambridge Children's Hospital, Cambridge Cancer Hospital, CPIER report (see Figure 2), Devolution Deal growth targets, and the emerging CBC 2050 Vision all support a reasonable expectation that growth in station patronage will be far higher than 1.3% per annum.

Q13. How does the applicant justify this slow rate in patronage growth when expansion of CBC and other sites reachable from Cambridge South is planned well beyond 2031, and climate change policies will require a large modal shift from driving to public transport?

O27. Many factors about the Cambridge South catchment area are atypical:

- the composition and pace of growth at the CBC and around the south of Cambridge;
- the large proportion of patient/visitor trips to the CBC;
- the distribution of journey times, many of which depend on hospital shift patterns;
- the high proportion of trips where cycles are likely to be used for first/last-mile connections;
- mayoral powers and policies around public transport integration – in particular to remove time and cost penalties of combining rail and bus journeys;
- the large geographic area to the south-east (out to Haverhill) that currently has poor access to rail services;
- the adopted target to reduce motor traffic in Cambridge.

Furthermore, GCP targets for improving air quality, and national targets on decarbonisation of transport, all require absolute reductions in motor traffic. This will support strong, non-linear growth in use of sustainable modes, including rail.

Together, these create an overwhelming case to use bespoke modelling of employment and population growth in the catchment area for the railway station.

Q14. How has the applicant modelled or sensitivity-tested all variables that may significantly affect rail demand?

O28. TA §6.3.5 considers only four MSOAs as potential destinations for trips via Cambridge South station. This overlooks major local destinations, with journeys completed by bus, including via the CSET busway, hire cycle or e-scooter from Cambridge South station. These will include people arriving on Thameslink, Great Northern and East West Rail services, and West Anglia line services not calling at Shelford or Whittlesford Parkway stations, wishing to reach:

- Great Shelford and Stapleford (social visits)
- Sawston (social visits and business trips)
- Wandlebury (leisure visits)
- Babraham (social visits)
- Babraham Institute (commuting and business trips)
- Granta Park (commuting and business trips)
- Abingtons (social visits)
- Linton (social visits)
- Haverhill (social and leisure visits, and business trips)

O29. Similarly, TA §6.3.7 omits those same settlements as potential origins for commuting, social, leisure and business trips via Cambridge South station.

Q15. What demand should be attributed to origins/destinations that are outside the four MSOAs on which the TA is based, but potentially within convenient reach of Cambridge South station by bus or e-bike?

O30. TA §8.7.3 indicates that with a 15-second inter-green time for pedestrians to cross, an 87m queue is likely to form southbound on Francis Crick Avenue in the evening peak. As this route is used by buses, this will degrade service performance. The alternative of a 5-second inter-green time would be unacceptable for the large number and mix of people walking and cycling across this junction at peak times.

Q16. What modelling has the applicant conducted of the pedestrian crossing on Francis Crick Avenue at peak times?

O31. TA §9.4.10 states, *"this results in demand for 800 cycle parking spaces per day."* If the number of people using the station is underestimated then demand for cycle parking will also be underestimated. The absence of any space into which to extend the 500-space cycle park on the east side places a hard limit on the number of people who can conveniently cycle to or from the station's main entrance. That risk is incompatible with national and local policies that are increasingly strongly supporting more people cycling.

Q17. What contingency has the applicant made for an underestimation of demand for cycle parking?

O32. TA §10.2.2 states, *"three taxi bays are anticipated to provide sufficient capacity to meet average demand."* If the number of people using the station is underestimated then demand for taxis will also be underestimated. The pattern of taxi movements at Cambridge station is uneven, with a queue of taxis building up before the arrival of each train at peak times.

O33. The number of private pick-up/drop-offs (which have use of another three bays) will also depend on the accuracy of forecasts for station usage and mode shares. The pattern of movements is also uneven.

O34. Any underestimation in demand or significant deviations in demand from the average will lead to congestion on the access road (see Figure 3), potentially causing blocking back onto Francis Crick Avenue. It is unclear whether this has been modelled.

Q18. What modelling has the applicant conducted of vehicular movements in and out of the station access road?

O35. TA §11.6.2 states that the bus stops "are located to minimise passengers' walking distances to and from … the proposed station." This is patently untrue. The claim in the consultation report (NR07 p120) that "the distance to Francis Crick Avenue is short and could safely be navigated by all user groups," is also debatable.

O36. The bus stops on Francis Crick Avenue (see Figure 4) will be 200m from the station entrance. If alighting from the rearmost carriage of a 12-car train, the walk will be 450m (see Figure 5), taking 7 minutes at a typical walking pace of 4km/hour, not including time spent waiting for space on the stairs or lifts.

O37. The stop on the busway opposite the Royal Papworth Hospital entrance (which are not referred to in the application) is 280m from the station entrance.

O38. These distances do not accord with the government's *National Bus Strategy* guidance, which states, *"Railway stations should be hubs for connecting services with high quality stops close to station entrances"* (p32).

Q19. Does the applicant agree that the proximity of bus stops imposes an undesirably, and even unacceptably, large time and convenience penalty on interchanging between rail and bus services?

Outline Business Case (OBC)

From pages 2–3:

> *"Over the next two years (2019/20-2021/22) approximately 1,000 additional jobs will be based at Addenbrooke's Hospital and the Cambridge Biomedical Campus. For the same period, 700 additional jobs are included in the TEMPRO forecast for the zones covering the Biomedical Campus, therefore an allowance for an additional 300 jobs has been made in our forecast.*
>
> *"Between 2021/22 and 2031/32, an additional 6,000 jobs will be based on the Biomedical Campus. For the same period, only 860 additional jobs are included in the TEMPRO forecast for the zones covering the Biomedical Campus, therefore an allowance for an additional 5,140 jobs has been made in our forecast. Total additional jobs estimated over the 2017/18-2031/32 period is therefore 7,000, bringing the total number of employees based at the Biomedical Campus to an estimated 27,000 by 2031/32."*

O39. The TEMPro figure for jobs in MSOA Cambridge 013 (see Figure 1) grows by 289 from 2019 to 2022, not by 700 as reported.

O40. The TEMPro figure for jobs in MSOA Cambridge 013 (see Figure 1) grows by 468 from 2021 to 2031, not by 860 as reported.

O41. The uplift of 300 + 5,140 = 5,440 jobs does not close the gap between TEMPro's forecast for jobs in 2031 (17,568) and the estimate used in the OBC (27,000).

Q20. Which base and target years have been examined, as TEMPro operates on calendar years?

Q21. Which zones have been used? Since TEMPro uses MSOAs, there is only one zone that includes the CBC (Cambridge 013).

Q22. What is the explanation for the apparent discrepancies between reported and actual TEMPro outputs?

From page 8:

> *We also requested data from local employers on the origin of employees and visitors, as a useful means of sense checking the CSRM information. At the time of writing this had not been supplied to us.*

Q23. We understand that the applicant has now obtained some data on staff home locations (trip origins). Will this extrapolate sufficiently accurately to the entire workforce? What about patient and visitor origin data?

O42. The OBC makes no mention of NHS England's policy commitments to decarbonisation:

> *"For the emissions we control directly (the NHS Carbon Footprint), we will reach net zero by 2040, with an ambition to reach an 80% reduction by 2028 to 2032;*
>
> *"For the emissions we can influence (our NHS Carbon Footprint Plus), we will reach net zero by 2045, with an ambition to reach an 80% reduction by 2036 to 2039."*

Carbon emissions associated with travel by hospital staff, patients, visitors and deliveries fall under the second or both of these targets. This has a direct impact on travel mode choices, and hence travel demand at Cambridge South Station.

Q24. What consideration, if any, has the applicant given to supporting NHS England's policy commitment to reduce the carbon emissions of its staff, patient and visitor trips to hospitals on the CBC?

O43. §2.5.1 lists railheads for travel to Cambridge South station. It would appear that 'West Hertfordshire' includes the towns Royston, Baldock, Letchworth Garden City, Hitchin, Stevenage, Welwyn Garden City and Hatfield. All of these towns will be within an hour's commute of Cambridge South station. They have a combined working-age population of over 160,000. The draft North Herts Local Plan sees large extensions to Baldock, Hitchin, Stevenage and Knebworth.

It is therefore probably that these will generate many more trips than the 28,000 per annum forecast, which is just 25% of the forecast number of trips from Ely city and environs, which has a working-age population of just 13,000.

Q25. What steps has the applicant taken to validate forecast trips from other rail stations?

Strategic Outline Business Case (SOBC)

Although the OBC supersedes the SOBC, there are few material differences between them. Our commentary, submitted with our objection to the TWAO application, is still relevant.

O44. SOBC §3.1.3 states, "Define Do-Minimum and Do-Something scenarios for forecasting purposes, taking account of proposed housing and employment developments in close proximity to the proposed station, background growth, rail service stopping patterns, and access/egress times to Cambridge and Cambridge South stations from surrounding areas."

For a scheme adjacent to a site in a state of rapid growth, and in the context of a climate emergency, it is wholly inappropriate to use just one set of growth assumptions.

O45. SOBC §3.1.2 states, "Over the next four years (2017-21) approximately 3,750 additional jobs will be based at Addenbrooke's Hospital and the Cambridge Biomedical Campus, representing a growth rate of approximately 940 additional jobs per year Assuming a slightly lower job growth rate over the following ten years then between 2021 and 2031 an additional 5,900 jobs will be based on the Biomedical Campus. Total additional jobs estimated over the 2017-31 period is therefore 9,650, bringing the total number of employees based at the Biomedical Campus to an estimated 27,000 by 2031."

O46. No justification is provided for the assumption of a lower growth rate post 2021 in the face of evidence that growth will continue at pace. It is also not clear which new developments will account for the additional 5,900 jobs beyond 2021. There is, for instance, no mention of Cambridge Children's Hospital or Cambridge Cancer Hospital. Hospitals a large number of patient and visitor trips (in excess of staff trips), so they need to be treated differently to business and research sites.

O47. SOBC §3.1.2 states, "20% (1,180) of the additional jobs during the 2021-2031 period are assumed to be reliant on Cambridge South station delivery. Without the new station, highway congestion is assumed to act as a limiting factor on the Biomedical Campus. The transport user benefits associated with the new station are therefore excluded from the core appraisal scenario for these 1,180 jobs, as these jobs would otherwise not exist or would exist elsewhere."

The implication is that the holders of at least that number of jobs will have to travel by train. Using the 79% ratio of daily trips to jobs (given in TNR3 §7.2.4), which allows for staff absences, that translates to at least 1,850 station entries and exits each weekday. The figure will be higher if "employment" in this case means full-time-equivalent posts, which may be shared by more than one person.

O48. SOBC §3.2 states, *"Approximately 70% of these passengers (1.3 million per year) would otherwise have used Cambridge Station."* As a proportion of the 5,800 weekday station entries and exits (TA §5.5.7), that equates to 4,200.

The sum of the above two figures (1,850 and 4,200) is 6,050. This already exceeds the 5,800 figure used as the forecast demand in the TA. Yet it does not include new trips for other purposes: new inbound trips by patients, hospital and business visitors, and people visiting nearby family and friends; new outbound trips by local residents and employees.

It appears therefore that the SOBC forecast should have produced a significantly higher target design capacity than the approximately 2 million passenger entries and exits per year.

O49. SOBC §3.2 further states, "The number of passengers forecast to be abstracted from Cambridge station is likely to represent around 10% of Cambridge station's annual patronage. This is reasonable given that by the mid-2020s Cambridge Biomedical Campus could be home to more than 15% of all employment within the Cambridge City boundary."

This implies a patronage figure for Cambridge station of around 13 million entries and exits. The figure reported for the year 2018/19 was 12 million (ORR Estimates of station usage). Growth in patronage between 2009/10 and 2018/19 was 56% or 5.1% per annum. If growth in patronage were to continue at 5% per annum after returning to the 2018/19 level in 2022/23, patronage in 2031 would be at around 18.5 million. In that case, the abstraction of 1.3 million passenger-journeys would amount to just 7% of the 2031 patronage of Cambridge station. These figures need to be reviewed and sense-checked.

Cambridge Biomedical Campus Transport Needs Review (TNR2/3)

These reports by Atkins are dated October and December 2018, and therefore post-date the SOBC. They are included in the TA as Appendix R.

O50. TNR2 makes no reference to the Cambridge Children's Hospital or the Cambridge Cancer Hospital, so it is unclear whether the figure of 26,000 employees in 2031 (TNR2 §2.3.1) includes these.

O51. Furthermore, it does not refer to the emerging Cambridge Biomedical Campus 2050 Vision, which states, "Over the next 20 years, this would equate to an additional workforce of between 14,000 and 20,000 – approximately double the staff presently working on campus." Starting with the 22,450 jobs stated for 2022 (i.e. with the AtraZeneca building occupied, but no other new developments), the range expected in 2050 could be between 36,450 and 42,450 jobs. This is between 40% and 63% higher than the 26,000 figure used in the Transport Assessment (TA §5.2.2). Although the envisaged expansion is not yet committed development, the TA should have tested the scenario against the currently proposed station capacity.

O52. TNR2 §2.3.2 extrapolates visitor numbers from historical data based on the existing hospitals and visitor patterns. There appears to have been no attempt to estimate visitor numbers for the new hospitals planned for the site. As specialist hospitals, these are likely to have a wider catchment area than the existing hospitals. The Cambridge Children's Hospital *"will be the first dedicated children's hospital in the east of England."* The Cambridge Cancer Hospital will be pioneering novel detection and treatment techniques, and therefore is likely to draw patients from across the country.

O53. TNR2 §2.3.2 states, *"This additional number does not include people accompanying patients, so the increase in trips to the site for patients and visitors combined will be considerably higher."*

The TNR appears not to estimate what that additional number would be. Whereas people accompanying patients and visitors in a car do not add to the number of motor vehicle trips, they do increase the number of passenger-trips if arriving by public transport. Therefore, this figure should be estimated and included in the station demand.

O54. TNR2 §2.3.2 makes no mention of visitors to the research centres. These will be hosting meetings, seminars and conferences for people arriving from all over the country, and indeed the world. Whether the numbers will be significant as a proportion of total trips needs to be determined so that they may be explicitly included or discounted.

O55. TNR2 §3.2.1 lists the car parks completed and with outline planning consent. Although it acknowledges that *"plans and strategies to develop the multi-storey may be subject to change."* the TA does not test a scenario in which the unbuilt car parks are not built. For instance, two hospital multi-storey car parks with outline consent account for 1,894 parking spaces. If these are not built and the corresponding trips have to be completed by some other mode, a significant number will necessarily shift to rail. Since the TA's estimate equates to 2,900 daily users of the station, a variance in the number of parking spaces of nearly 2,000 must have a significant impact on rail travel demand.

O56. TNR3 §7.2.4 states a maximum rail demand for employees, patients and hospital visitors of *"6,624 one-way trips per day in 2031."* Add 1,558 inbound trips where the destination is not the CBC and 1,100 outbound trips (from TNR3 §5.1), the daily total is 9,282. This is 60% higher than the figure of 5,800 given in TNR3 §5.1 (and also TA §5.5.7). This would equate to 5.1 million entries/exits per year rather than 2.0 million forecast in the OBC.

O57. Furthermore, TNR3 §7.3 indicates that, even this "maximum rail demand" leaves a requirement to mode-shift 5,154 daily highway trips just to restore traffic levels to 2017. To meet the GCP "stretch target" of 10–15% below 2011 traffic levels (TNR3 §7.2 et al), the number of daily highway trips would need to be reduced by 11,350 to 12,550 (TNR3 §2.2). A proportion of those would have to shift to rail.

Conclusion

O58. Almost all future growth in travel demand to the CBC will have to be met by sustainable modes of travel. That is in part because the local highway network is saturated at peak times now. Additionally, local government targets on traffic reduction and air quality, and national targets on decarbonisation of transport will require absolute reductions in motor traffic.

Therefore, in future, a much larger proportion of trips to the CBC will have to be made by sustainable modes than is the case now. That means that naïve predict-and-provide modelling, based on historical mode shares and elasticities of mode choice, and standard population and employment growth rates, is not appropriate.

O59. It is also important for the business case to include an assessment of the financial risk of under-provision of capacity leading to unsafe and/or inefficient operation requiring expansion of the station on a highly constrained site.

O60. We recommend the design capacity be determined through multiple scenario testing using bespoke estimates for growth and mode shares, and detailed risk analysis. We fully expect this approach to demonstrate the design should accommodate a multiple of the proposed capacity of around 2 million entries/exits per year, and include passive provision for future expansion.

O61. Integration between the proposed station and bus services is poor, and does not create the high-quality hub needed to support a large modal shift from private cars to public transport. The conflicted junctions with Francis Crick Avenue and limited capacity for cycle parking (500 spaces on each side of the station) will fail to create an environment that promotes sustained, long-term growth in active travel.

O62. All of the above leads us to conclude that Network Rail must reconsider the option of building a larger station above the railway tracks, integrated with a bus station on a rebuilt busway bridge to the north, and an expandable cycle park to the south.

Proposed alternative design

O63. Smarter Cambridge Transport, in its submission to the second public consultation, proposed a station design that integrates closely with bus services, provides high-capacity pedestrian and links to the east and west, and separate high-capacity cycle links to the east and west, linked directly to a large and extendable cycle park. This is achieved by building the station entrance, ticket hall and cycle parking above the platforms, integrated with a rebuilt busway bridge, also serving as a rail–bus interchange. The footprint of the station would lie almost entirely over Network Rail land, and require minimal land take from Hobson's Park.

O64. We understand this configuration was rejected on grounds of cost, complexity and other reasons:

> *A station interface with Addenbrooke's [busway] Bridge was considered at option development stage and not taken forward as it would result in the need to rebuild the whole structure, which would incur considerable cost and disruption from closure, complexity of maintenance, and would cause safety issues related to bridge strength and the mix of pedestrian, cycle and bus traffic in a constrained area at height. – NR07 Consultation Report p107*

O65. However, if demand is significantly higher than forecast, more space will be needed within the station and on its eastern approach. More users means larger benefits in the cost–benefit equation, justifying a larger investment. A tighter integration of rail and bus services will also increase user benefits by reducing the time and convenience penalty of interchanging.

O66. Disruption during construction would be unavoidable, but a temporary bus and cycle diversion via Addenbrooke's Rd and Hobson Ave and, for cycles and pedestrians, Whittle Ave (see Figure 7), would be feasible and not overly burdensome for a few weeks. The supposed complexity of maintenance and safety issues are not explained, and can almost certainly be overcome with an appropriate design and budget. Any concerns about the visual impact may be addressed through the use of sympathetic architecture and landscaping.

O67. We recommend (see Figure 6):

- Build the station ticket hall above the tracks.
- Rebuild the busway bridge connected to, and at the same level as, the station.
- Move the platforms north so that the ticket hall is above the midpoint of the platforms.
- Install back-to-back staircases between the platforms and ticket hall.
- Have the main station entrance on the rebuilt busway bridge, with lift access also provided on each side of the tracks.
- Include a bus station on top of the bridge immediately in front of the main station entrance.

- As part of rebuilding the bridge, widen the non-motorised user path, segregate it for pedestrians and cycles, and separate it from the busway by a buffer strip.
- Locate the cycle park behind (south of) the ticket hall with its own entrance to the station, and connected directly to the cycleway on each side of the bridge.
- Provide parking bays at ground level only for disabled people, railway workers and deliveries.
- Do not provide a taxi rank or private pick-up/drop-off area. Limit vehicular access to disabled users and railway workers. All train services that stop at Cambridge South also stop at Cambridge station, which will continue to be accessible by taxi and private cars. Therefore, there is no need for provision for car pick-up or drop-off at Cambridge South station.

O68. This has the following advantages over the proposed station configuration:

- It accommodates a much high flow of people into and out of the station, and onto and off the platforms.
- Pedestrian flow capacity between the ticket hall and platforms is doubled without widening the platforms.
- The furthest walking distance from one end of a 12- or 10-car train to the ticket hall is half that of the proposed station design, or approximately 120 metres less.
- The walking distance between bus stops and the station entrance is under 20 metres.
- There is minimal conflict between people walking and cycling to or from the station, as the approach routes are fully segregated from Francis Crick Avenue and the Trumpington busway.
- The junction of the busway and Francis Crick Avenue can be engineered optimally for buses without creating additional conflicts or inconvenience to people walking and cycling.
- The footprint of the station is mostly within the boundary of land owned by Network Rail, with minimal incursion into Hobson's Park.
- The cycle park may be extended relatively inexpensively in the future, entirely above land owned by Network Rail.
- As vehicle access from Francis Crick Avenue would be used only by disabled station users, railway workers and delivery vehicles, there would be minimal conflict with people walking or cycling, and with bus services.
- The single-entrance design requires fewer staff than the proposed two-entrance design.

For all the reasons given above, we believe this option needs to be given serious reconsideration.

Illustrations

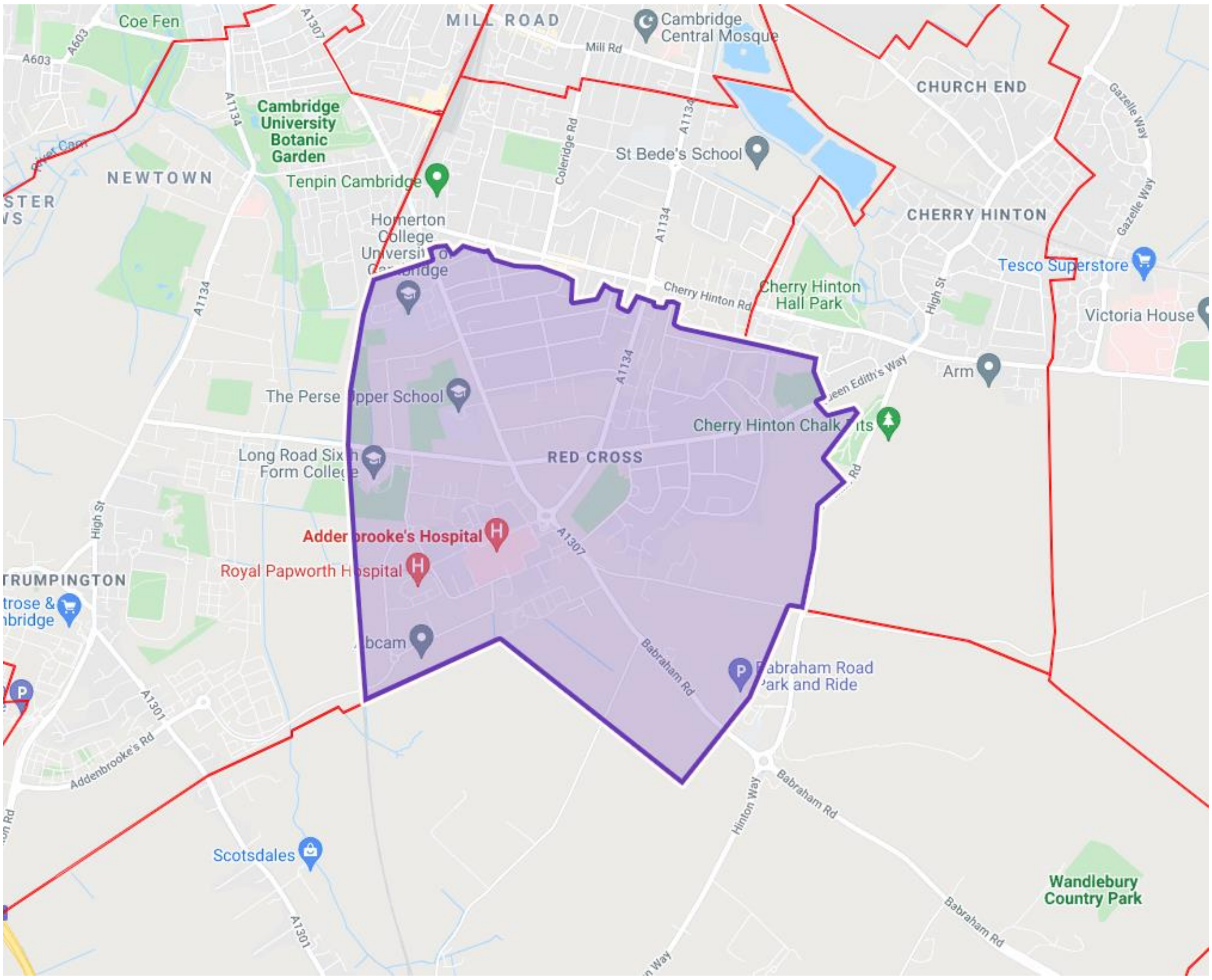

Figure 1: MSOA zone Cambridge 013

Comparison with BRES	6yrs 2010-2016	
District	**ONS (BRES) Data**	**CPIER/BRES Blended Data**
Cambridge	2.4%	2.4%
South Cambridgeshire	2.3%	4.2%
East Cambridgeshire	3.9%	4.4%
Huntingdonshire	1.5%	2.1%
Peterborough	2.5%	3.5%
Fenland	2.3%	3.1%
Cambridgeshire & Peterborough	**2.4%**	**3.3%**

Figure 2: Extract for CPIER report showing average employment growth rates per annum in Cambridgeshire and Peterborough. The left column lists growth figures based on ONS Business Register and Employment Survey (BRES); the right column uses a new methodology for quantifying growth.

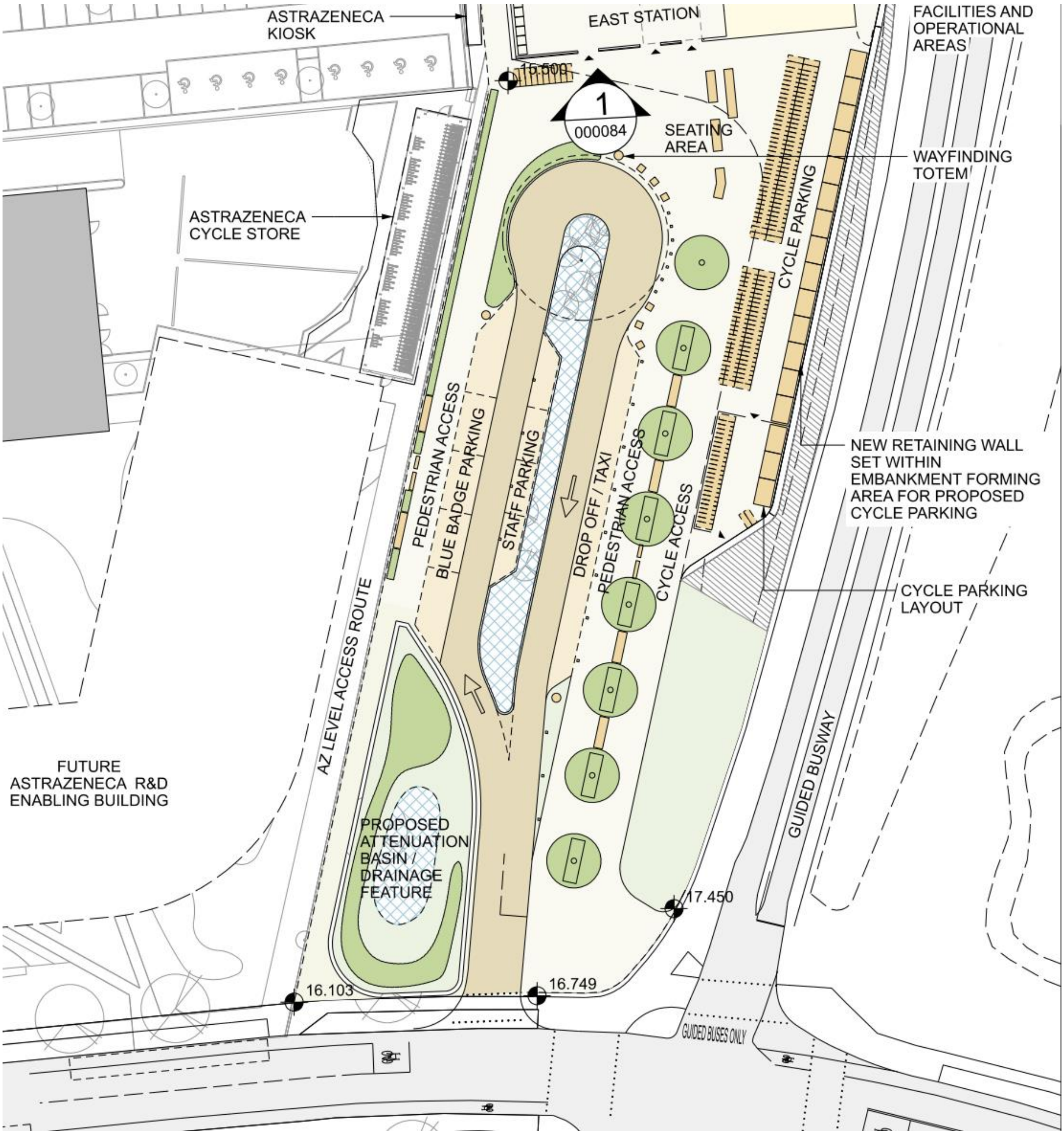

Figure 3: Proposed design for station access junction with Francis Crick Avenue (from NR13 Deemed Planning Drawings)

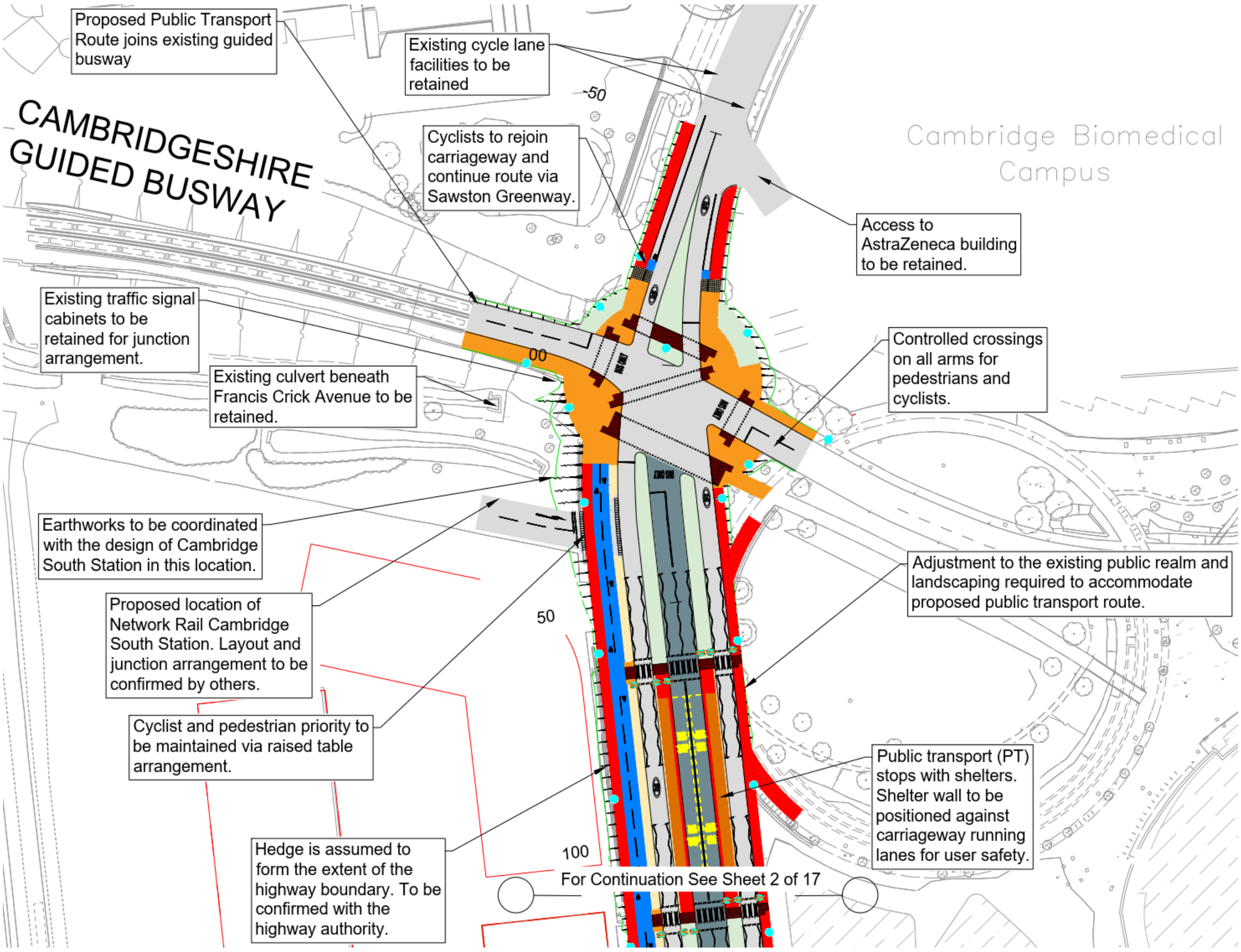

Figure 4: Diagram of busway junction with Francis Crick Avenue (from CSET plan dated 12 Feb 2021)

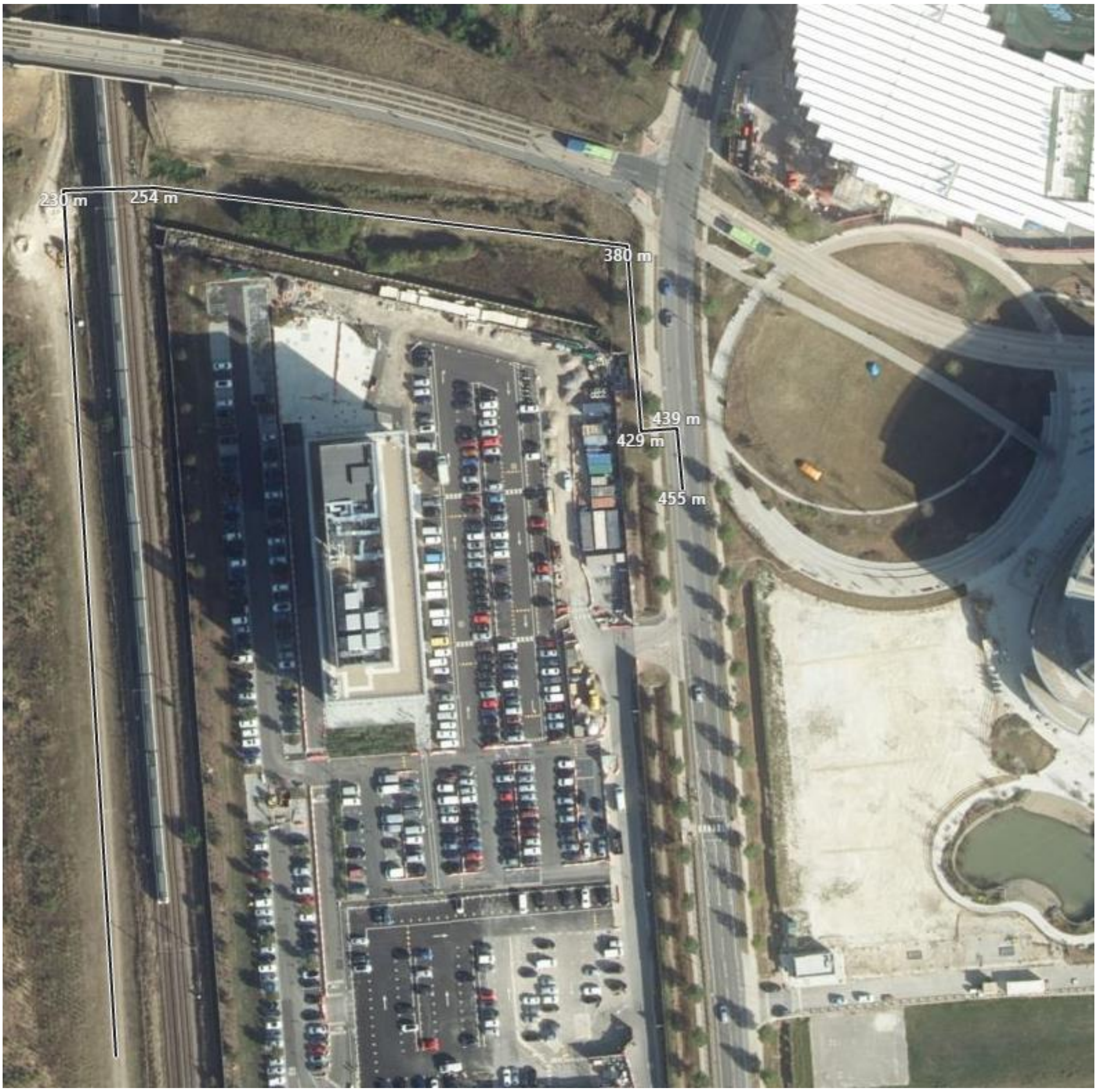

Figure 5: Path showing 450m distance from back end of 12-car train to bus stops on Francis Crick Avenue (aerial image courtesy of Ordnance Survey)

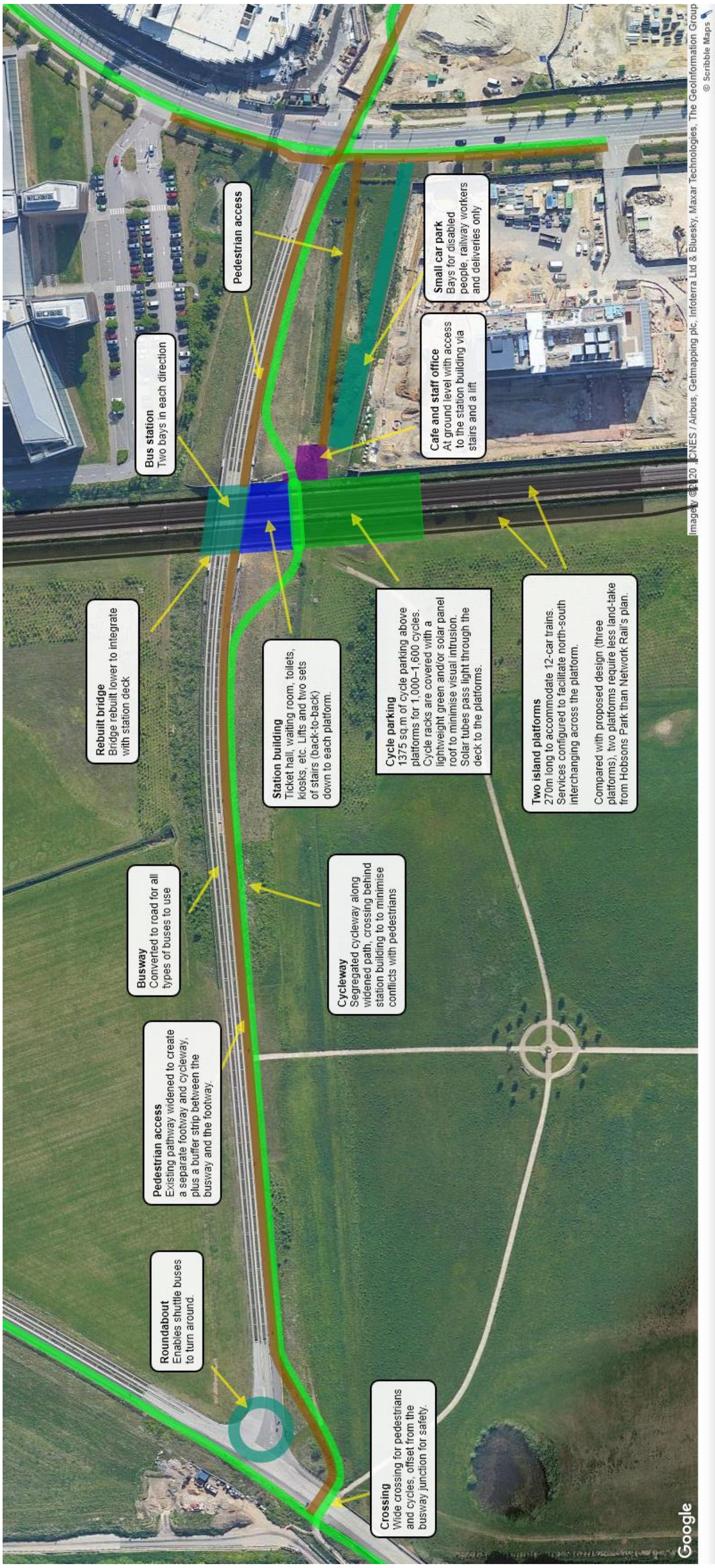

Figure 6: Schematic representation of alternative station configuration and access arrangements

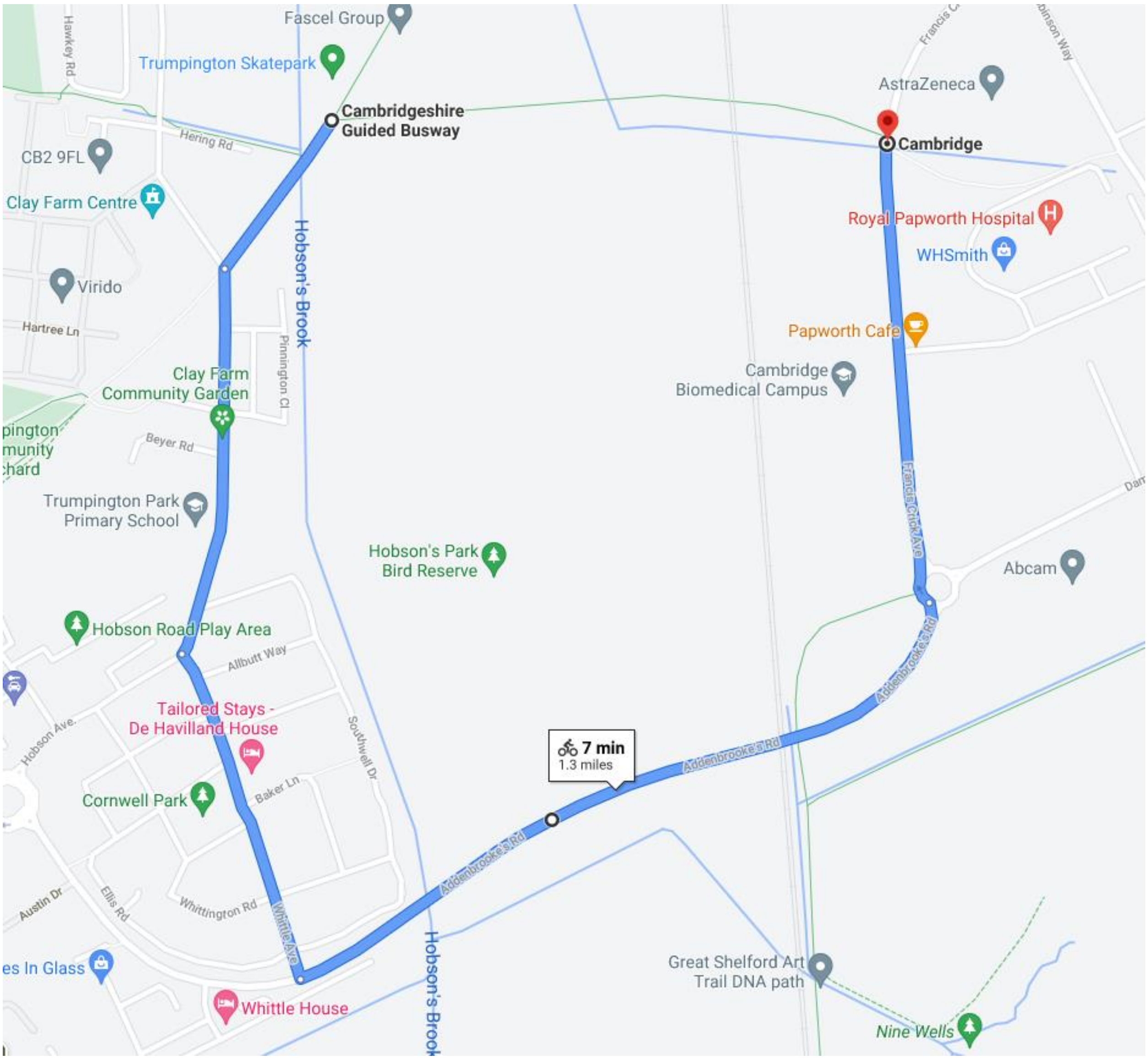

Figure 7: Diversionary route for cycles and pedestrians while the busway bridge is closed. Buses would travel via the Addenbrooke's Rd–Hobson Ave roundabout.