



NRE 1.3

Appendices to Proof of Evidence – Scheme Overview and Construction Management / Methodology (Mr Andy Barnes)

(Inquiries Procedure (England & Wales) Rules 2004)

January 2022

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Appendix A

A GLOSSARY OF TERMS

1. **Authorised Track Access Points** – an official access point onto the railway for authorised users. These are secure, access points for authorised key holders. Where vehicular access to the railway infrastructure isn't considered to be safe, an authorised track access point will preferably include space to park a maintenance vehicle.
2. **Booster transformers** - used in electrified railway AC catenary feeders to collect the return current from the rails and the earth to the return conductor. In railways, the electric current is taken from the catenary conductor to the locomotive, where the energy is used by electric motors, and fed to the earth connected rails, which are part of the return circuit. From the rails, however, the return current may deviate around to unintended or harmful places like metallic pipelines, bridges, communication cables, etc. The stray currents bring about interference in communication systems and other electronic devices due to passing trains. Booster transformers are used to eliminate the stray currents and the disturbances, obliging the return current to flow to the return conductor.
3. **Down Line** typically carries services towards “country” or in this case towards Cambridge. These should be considered to be the western lines.
4. **Earthworks Examination Reports** – Periodic condition reporting of 110 yards of railway earthwork to manage risk and support asset management.
5. **Fixed Telecoms Network (FTN)** - supporting network of lineside telephones and a communication channel for railway assets. Note that FTNx is a more recent digital overlay of the legacy FTN system to provide greater capacity for data heavy application such as SCADA (defined below).
6. **Global System for Mobile Communications-Railway (GSM-R)** - Delivers digital, secure and dependable communications between drivers and signallers. This helps to increase safety, reduce delays and improve performance.

7. **Headways** – a railway signalling term. The signalling headway between trains is defined as the time between two trains passing the same location on a railway line at a defined speed profile. In other words, the allowed interval between trains.
8. **High Mileage** – furthest from London. At Cambridge South Station, this is at the northern end of the site
9. **Low Mileage** – closest to London. At Cambridge South Station, this is at the southern end of the site
10. **Neutral sections** – a section of overhead line infrastructure without any current. These sections are just a few yards long and keep wires fed from different sources electrically separate from each other
11. **Level Crossings** - where a railway crosses a road or right of way without the use of a tunnel or bridge.
12. **Manually Controlled Barrier Crossing with CCTV (MCB-CCTV)** - a manually controlled barrier that is operated remotely from the controlling signal box. CCTV cameras mounted in close proximity to the crossing enables the signaller to monitor the road closure and to determine the crossing is clear, before releasing the protecting signals.
13. **Overhead Line Equipment** or OLE – is the assembly of masts, gantries and wires to provide traction power for electric trains.
14. **Reception Lines** – The entry line from a main line to a set of sidings
15. **Relay Based Interlocking** – Electrically powered Interlockings consist of complex circuitry made up of relays in an arrangement of relay logic that ascertain the state or position of each signal appliance. . This is the current method of signal control and is old technology
16. **Shunt Spur** - a short length of track laid parallel to the main line for the purpose of allowing a train to manoeuvre whilst typically out of service without occupying the main running-line.

17. **Supervisory Control and Data Acquisition (SCADA) system** - Controls traction power and distribution across the national network. The system includes full voice and data communications that operate over Network Rail's fixed transmission network system.
18. **Uni Directional** - A line that is signalled to take trains in a single direction.
19. **Up Line** - typically carries services towards London. At Cambridge South Station, these should be considered to be the eastern lines.
20. **User-worked crossings (UWC)** – a locally operated gated crossing often requiring users to telephone a signaller to check that it is safe to cross.
21. **3-aspect signalling** - a colour-light signal capable of displaying three aspects. From top to bottom the lights are green, yellow, and red. A red indication means that the next section contains a train. A yellow indication means that the next section is clear but there is a train in the following one. A green indicates that the next two sections are clear. A train will need to commence slowing on a yellow signal.
22. **4-aspect signalling** - a colour light signal capable of displaying four aspects. From top to bottom the lights are yellow, green, yellow, and red. A red indication means that the next section contains a train. A single yellow indication (using the lower yellow) means that the next section is clear but there is a train in the following one. A double yellow indication means that the next two sections are clear but there is a train in the one beyond that. A green indicates that the next three sections are clear. Depending on the speed of the train, it will need to commence slowing on either a single or double yellow.

Appendix B

B Railway Infrastructure

B.1 Earthworks

23. The site is predominantly at grade on a low embankment with heights of up to 2m. No Earthwork Examination reports exist as these are not managed assets. The earthwork classification is therefore assumed to be 'At Grade' with no ongoing problem earthwork sites.

B.2 Civil Assets

B.2.1 Significant Structures

24. Within the proposed "red line" area of the CSIE Order are a number of assets that were considered when producing the design options. Mainly, these are structures that are identified as constraints and few will need to be modified, removed or replaced. Where this is the case, this is explained underneath the relevant figure.

B.2.1.1 SBR - 55 miles 0055 yards – SBR/34 – Overbridge Shelford Road

Figure 1 - Photo of SBR/34 from Low Mileage Facing North



B.2.1.2 BGK - 53 miles 0000 yards - BGK/1543b - Footbridge - Hobson's Brook - Granhams Road (Websters)

Figure 2 - Photo of BGK/1543b from Low Mileage Facing North



25. The footbridge will need to be modified. Additional screening will be required alongside the Down side staircase where overhead line equipment will be reconfigured and will be closer to the bridge.

B.2.1.3 BGK - 53 miles 0000 yards - BGK/53 - Culvert - 600mm Dia. Concrete Culvert

Figure 3 - Photo of BGK/53 Downside Headwall



B.2.1.4 BGK - 53 miles 0179 yards - BGK/3079 - GSMR Masts - Websters L/C

Figure 4 - BGK/3079 - GSMR Mast Elevation from Down side Cess



Figure 5 - BGK/3079 - GSMR Mast Details and Attachments



Mast General View



Foundation Connection -
GV



Column Connections - GV



Radio Attachments - GV

26. The mast and the adjacent control cabinet will need to be re-located clear of the proposed works to increase linespeeds through Shepreth Branch Junction.

B.2.1.5 BGK - 53 miles 1254 yards - BGK/1544 - Underline Bridge - Stream Conduit, Nine Wells

Figure 6 - Upside Elevation BGK/1544



B.2.1.6 BGK - 53 miles 1506 yards - BGK/1544c - Overline Bridge - Nine Wells Bridge on Addenbrooke's Road

Figure 7 – Low Mileage Elevation BGK/1544c



B.2.1.7 BGK - 54 miles 0406 yards - BGK/1544b - Overline Bridge – Addenbrooke's Bridge on the Busway.

Figure 8 – High Mileage Elevation BGK/1544b



27. Alterations will be required to the bearing galleries on the structure to recognise the addition of two new lines through the structure.

B.2.1.8 BGK - 54 miles 1034 yards - BGK/1544a - Overline Bridge - Long Road

Figure 9 – High Mileage Elevation BGK/1544a



B.2.1.9 BGK - 55 miles 0660 yards – BGK/1545 - Overline Bridge - Hills Road

Figure 10 – High Mileage Elevation BGK/1545



B.2.2 Culverts

B.2.2.1 BGK - 53 miles 0000 yards and SBR - 55 miles 0342 yards - Culvert

Figure 11 - Photo of Downside Headwall (SBR side)



B.2.2.2 BGK/93 - 54 miles 0396 yards – Tibbets Culvert

Figure 12 – Downside Elevation BGK/93 with Irrigation Main shown capped off



Figure 13 – Upside Elevation BGK/93 with Irrigation Main located in the left culvert



Figure 14 – Irrigation Main present in BGK/93 left culvert pipe



28. Tibbets culvert must be replaced to accommodate revised drainage arrangements for the proposed station infrastructure including the extension of Hospital Culvert below the station forecourt.

Figure 15 - Locations of Structures in Station Area



Appendix C

C Railway Systems

C.1 Track

29. Shepreth Branch Junction connects Engineers Line Reference (ELR): SBR Down Royston and Up Royston lines to the Down Main and Up Main lines between Shelford Station and Cambridge Station on ELR: BGK at 53miles 132yards.
30. On the approach to Shepreth Branch Junction the permissible speed on the Down Royston line is 60mph slowing to 40mph near the junction before dropping further to 30mph through the switch and crossing (S&C). The Up Royston line crosses the S&C at 30mph before increasing first to 50mph before reaching 60mph.
31. The permissible speed on the Up Main line is 90mph throughout. The permissible speed on the Down Main line is 90mph to the south of Long Road and reduces to 80mph at Long Road.
32. The Down Royston line directly joins the Down Main line through the trailing 1044 points, the Up Royston joins the Down Main via 1042 points before crossing over to the Up Main through the 1043A/B crossover. The requirement of rolling stock to crossover and run in the wrong direction temporarily conflicts with the running of through trains on the Down Main & Up Main lines creating a bottle neck in capacity.

C.1.1 SBR Line

33. Figure 16 and Figure 17 have been annotated with the salient features.
34. From the south (low mileage) end of the site the Royston lines (ELR: SBR) approach Shepreth Branch Junction (55 miles 572 yards) on a left-hand curve with an approximate radius of 500m and cant of 50mm. Cant is the height of one rail above the other and is used to assist passenger comfort and the safe running of trains around curves.

Figure 16 – RouteView Image on Royston Lines on approach to Shepreth Branch Junction



35. The line speed on the Royston lines is 60mph on the Up Royston, with a differential speed on the Down Royston of 90mph for Electrical Multiple Units (EMUs) and 60mph for all other trains. This line speed is reduced around Shepreth Branch Junction, where only 30mph is allowed due to the S&C. The speed profile going north on the Down Royston reduces first to a short section of 40mph, followed by 30mph on the approach to Shepreth Branch Junction as mentioned above.

Figure 17 – RouteView Image on Shepreth Branch Junction



36. The Royston lines are on a track gradient of 1 in 270 falling towards the junction and main lines. It is assumed that turnout(s) on the Down Royston (1044pts), Up Royston (1042pts) and the 1043A/B crossover are all DV15 30mph S&C units.

C.1.2 `BGK Line

37. Figure 18, Figure 19, Figure 20 and Figure 21 have been annotated with the salient features. From the south (low mileage) end of the site the main lines (ELR: BGK) approach Shepreth Branch Junction (53 miles 132 yards) on a series of left-hand compound curves.

Figure 18 – RouteView Image on Granhams Level Crossing



Figure 19 – RouteView Image on Webster's Level Crossing



38. From Granham's Level Crossing (52 miles 1408 yards) the track reverses to a flat right-hand curve with an approximate radius of 4500m and cant of 35mm before crossing Dukes Nr. 2 Level Crossing and transitioning to a straight after Nine Wells Stream Underbridge BGK/1544. Note that the underbridge structure is identified as a key constraint for the track designs through this area. The underbridge isn't sufficiently wide or sufficiently strong to accommodate changes in track configuration.
39. Track gradient on the Main lines is on a falling gradient of 1 in 1701 at the south end.

Figure 20 – RouteView Image on Dukes Nr. 2 Level Crossing



Figure 21 – RouteView Image across Nine Wells Stream Underbridge



40. Figure 22 and Figure 23 have been annotated with the salient features.
41. Immediately north of Nine Wells Stream Bridge Underbridge, BGK/1544, the Main lines are straight. Track gradient on the Main lines steepens through this area for a short duration to 1 in 470 from the 54-mile post. The line speed is 90mph on the Up and Down Main throughout this area.

Figure 22 – RouteView Image through Addenbrooke's Bridge.



42. Note that the current Cambridge Biomedical Campus (CBC) works are not shown in this aerial photograph taken from Network Rail's Route View system.

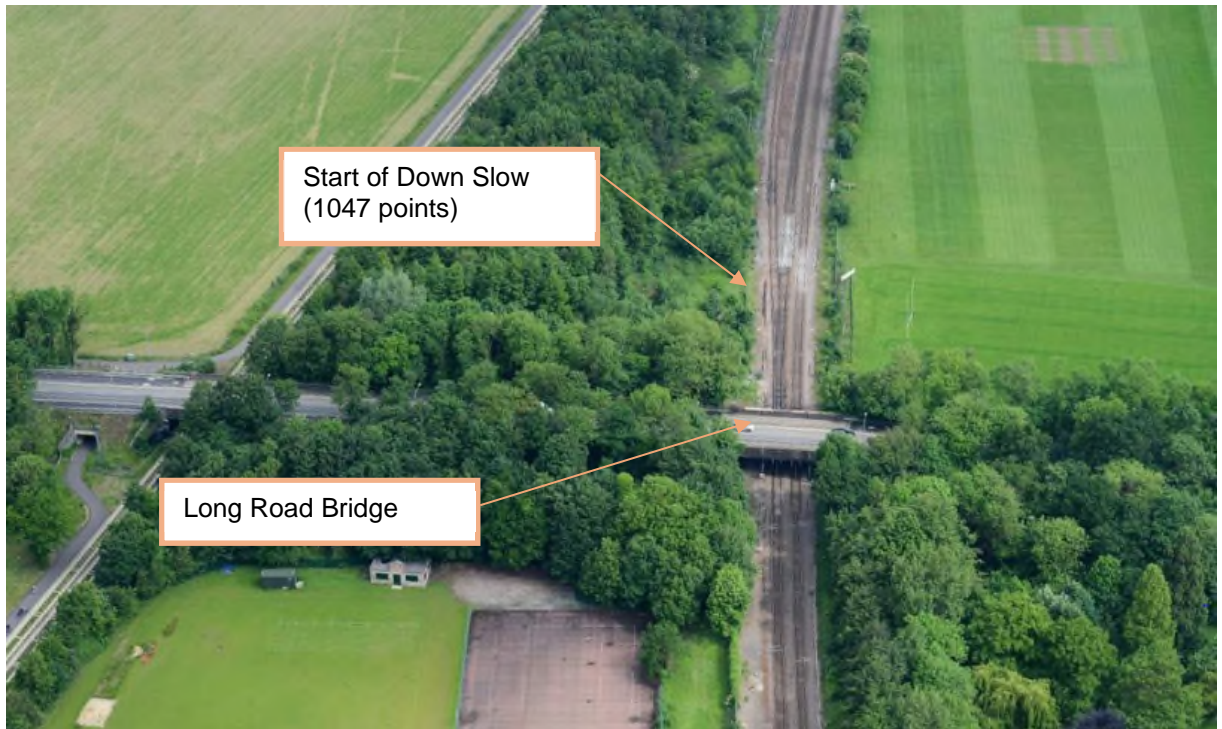
Figure 23 – RouteView Image through Guided Busway Bridge.



43. Note that again the current CBC works are not shown.

44. The line speed is 90mph on the Up and Down Main, reducing to 80mph on the Down Main just before Long Road Bridge. The Down Slow has a 40mph line speed.

Figure 24 – RouteView Image towards Slow Line Loop



45. Turnout 1047A pts into the Down Slow at 54 miles 1034 yards is an EV21 40mph S&C unit.
46. From Long Road Bridge the Main lines follow a series of right-hand compound curves. On approach to Cambridge Station, the curve has an approximate radius of 2200m and cant of 45mm before transitioning to a straight through the station limits.
47. Track gradient on the Main lines reach a plateau at the commencement of the Down Slow loop. The gradient then rises at 1 in 241 from the 55-mile post before reducing to 1 in 2310 through the station limits.
48. Information in this area is material to the proposals for a new crossover south of Cambridge Station.

Figure 25 – RouteView Image towards north



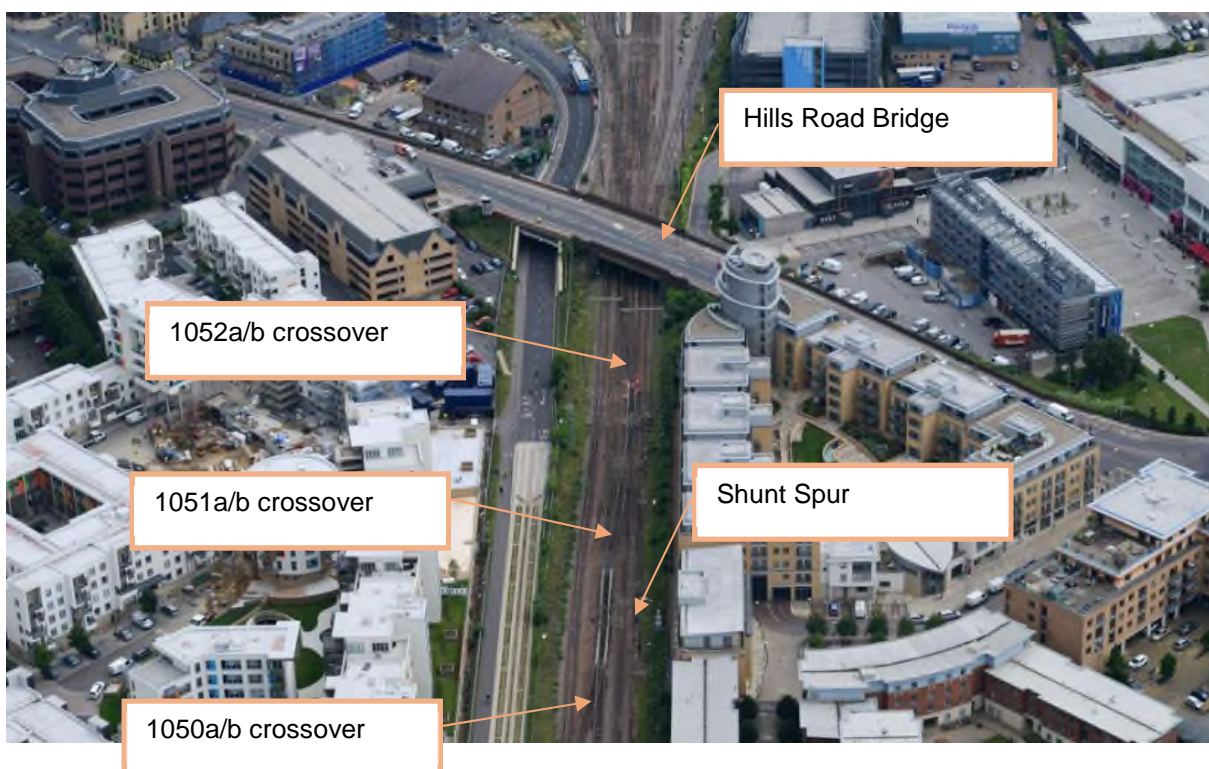
Figure 26 – RouteView Image towards north



Figure 27 – RouteView Image towards north

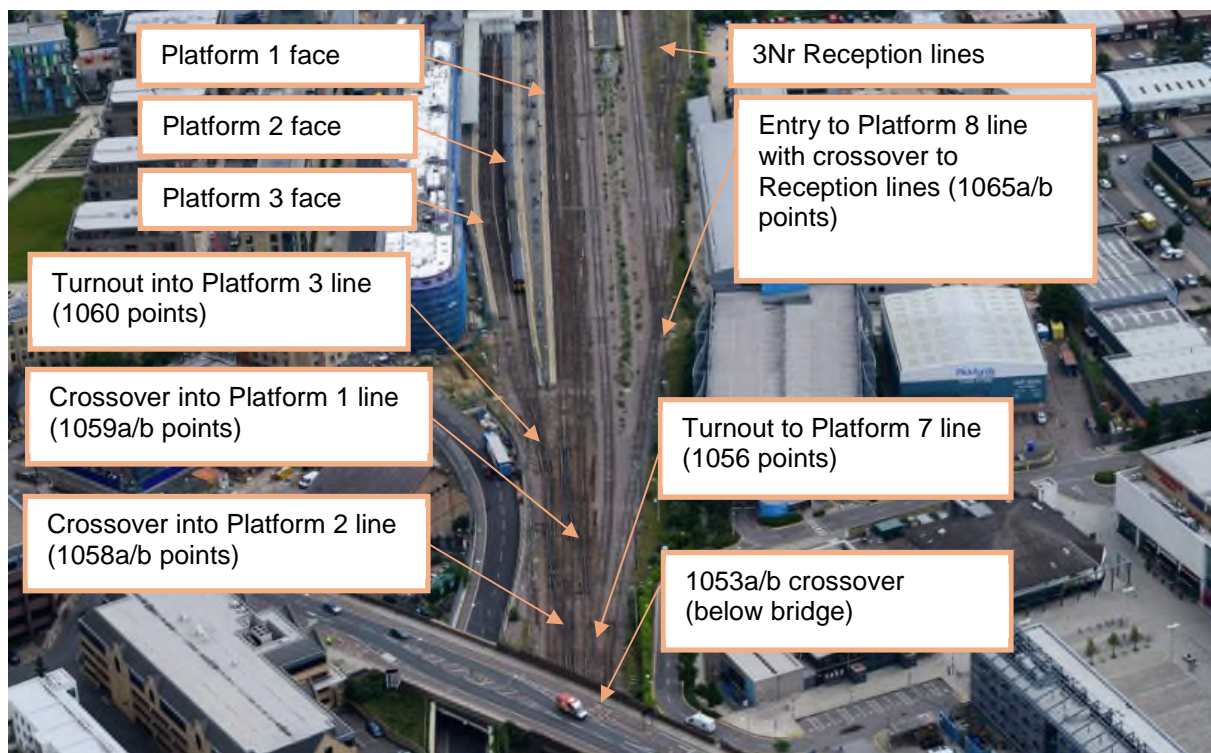


Figure 28 – RouteView Image on Cambridge Station Throat



49. Figure 29 towards Cambridge Station has been annotated with the salient features. This shows the Shunt Spur to the south of the station and Hills Road Bridge.
50. Cambridge Station has 8 platforms. The Down Main (Platform Line) has direct access to all except Platform(s) 5 & 6, whilst the Up Main (Through Line) has direct access to all except Platform(s) 2 & 3.
51. Platforms 2 and 3 are bay platforms for trains from/to the south, while Platforms 5 and 6 are bay platforms for trains from/to the north. All these platforms are located to the west of the through platforms.
52. This leaves Platforms 1, 4, 7 to 10 for through trains. Platforms 1 and 4 are located on the same line, behind each other, but with the possibility between them to cross over to the through line adjacent to Platform 1 and 4.
53. The carriage sidings to the north are used mainly for overnight stabling of empty Carriage Stock. In the morning, stock is shunted from the carriage sidings directly to the platforms from the services starting at Cambridge. Similarly, terminating trains are routed back into the sidings in the evening.
54. The Reception Lines on the Up side of the station are currently used for looping freight trains clear of the passenger services. Reception 3 has recently been re-wired and is used by GTR as stabling for their trains.
55. The line speed at Cambridge Station is generally 35mph with crossovers capable of 20mph or 15mph. In Figure 29, the 1053B points lead into the Shunt Spur are proposed to become part of a new turnout and cross over to permit parallel moves into and out of the Up side of Cambridge Station to create additional capacity required in addition to the proposed track alterations around the Cambridge South Station area and at Shepreth Branch Junction. The permitted speed into the Shunt Spur is 15mph, restricted by the abutment to Hills Road overbridge. The Shunt Spur runs up to a buffer stop.

Figure 29 – RouteView Image on South End of Cambridge Station



56. In Figure 29, Hills Road is in the foreground.

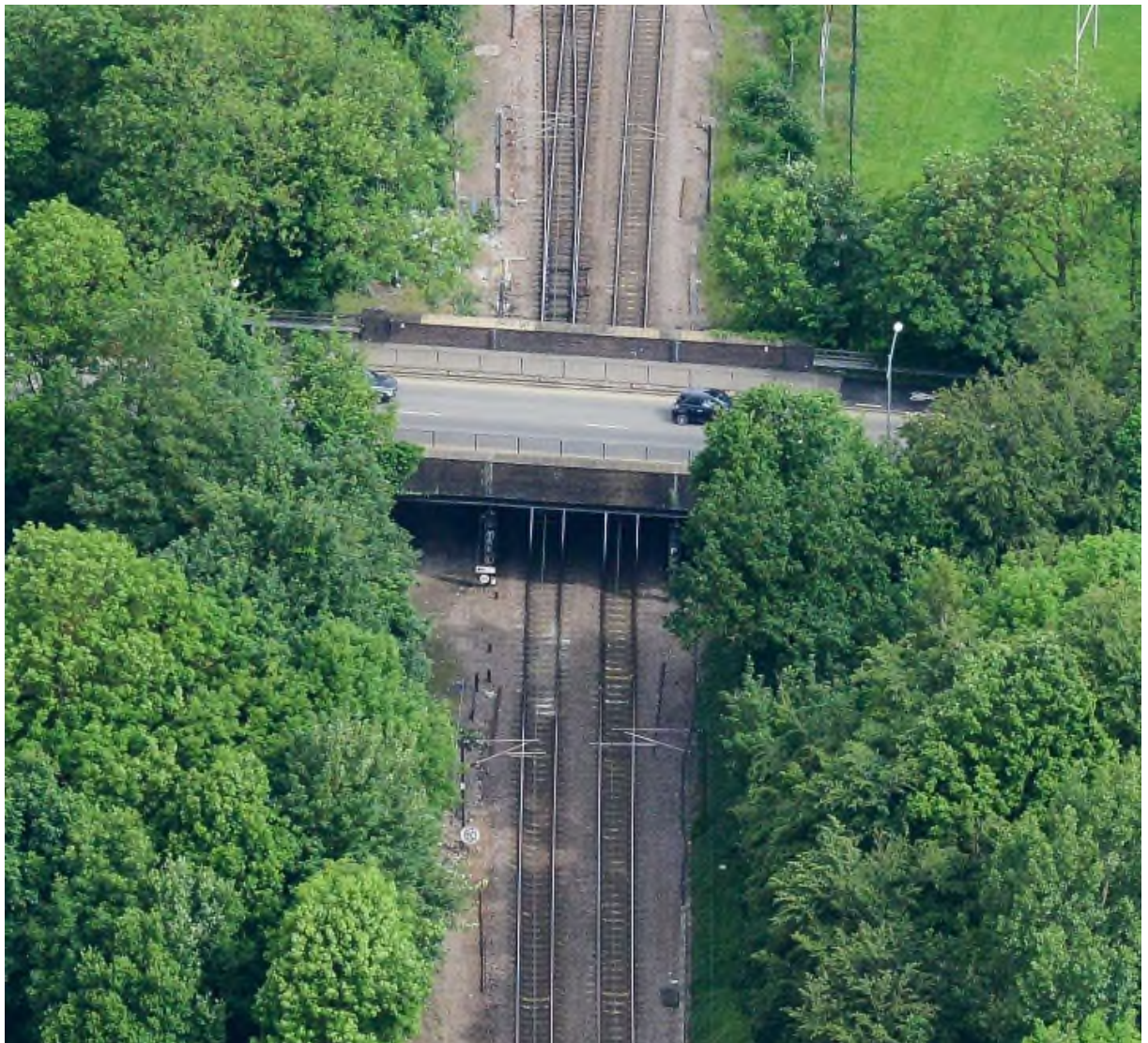
C.2 Track Drainage

57. There is limited track drainage within the CSIE study area. There is:
- A short run of catch pits on the SBR branch between 54 miles 1735 yards and 55 miles 260 yards. Refer to Figure 30.
 - Another short length of catch pits to either side of Long Road Bridge between 54 miles 1005 yards to 54 miles 1105 yards. Refer to Figure 31.

Figure 30 - RouteView Image on SBR Branch Adjacent to Cambridge Road Bridge Showing Drainage Catch Pits on the Down Side.



Figure 31 - RouteView Image on BKR Line Adjacent to Long Road Bridge Showing Drainage Catch Pits on the Up Side.



C.3 Signalling

58. The signalling system consists of colour light signals, where appropriate fitted with the Train Protection Warning System (TPWS) and the Automatic Warning System (AWS).
59. The signalling uses 4-aspect signalling on the Up and Down Main lines, and 3-aspect signalling on the Up and Down Royston lines.
60. The signalling is controlled from Cambridge Power Signal Box located immediately south of Cambridge Station.

- 61. These lines are all signalled uni-directional, with the possibility provided on both Up and Down Main, as well as the Down Slow, to signal trains just out of Cambridge Station and turn back into the station again for shunting purposes.
- 62. The relay-based interlocking is located in Cambridge Power Signal Box. It is a GEC Geographical interlocking system built up of standard modules which are linked according to the geographical sequence of signalling assets.
- 63. There are 'free wired' racks present, which would make this a hybrid relay interlocking. This type of interlocking is now obsolete, and therefore the opportunities for large scale alterations are very limited. The internal wiring is categorised as 2(C) – Fair (Moderate dry degradation seen). Therefore, it is thought not advisable to attempt updating the existing interlocking to accommodate the changes as a result of the layout alterations proposed.
- 64. For those reasons, a new interlocking will be required to support the railway infrastructure changes demanded for the CSIE project. This will be a Computer Based Interlocking (CBI) with interface relays in the section south of Cambridge. The proposals make provision for a signalling REB facility within the Nine Wells Railway Systems Compound.
- 65. The signal positions around Shepreth Branch Junction are partially dictated by the presence of OLE neutral sections, which requires certain distances between signals and the neutral sections on the approach as well as beyond these neutral sections. Neutral sections are discussed further in Section C.5.1.

C.3.1 Level Crossings

- 66. Figure 32 summarises the level crossings that will be affected as a direct result of the physical alterations to the rail infrastructure proposed by the CSIE Project.

Figure 32 – Affected routes crossing the railway

Crossing	Type of crossing	Location	Comments
Sawston LC	MCB-CCTV	BGK, 50 miles 1034 yards	
Shelford LC	MCB-CCTV	BGK, 52 miles 704 yards	
Granhams LC	MCB-CCTV	BGK, 52 miles 1408 yards	
Websters LC	UWC	BGK, 53 miles 0 yards	Power Operated Gate Openers (POGO) installed
Dukes No.2	UWC	BGK, 53 miles 748 yards	

67. Apart from Websters UWC level crossing, all level crossings listed in Figure 32 are currently crossing 2 tracks, in all cases the Up and Down Main lines of the West Anglia Main Line (WAML), which is signalled for 90mph in both directions.
68. Websters UWC Level Crossing is located in the middle of Shepreth Branch Junction, and although classed as a 4-track crossing (Up & Down Main and Up & Down Royston), the crossing length is slightly limited due to its position close to where these lines come together. At the level crossing, the Up and Down Main lines are signalled for 90mph, whereas the Up and Down Royston lines are signalled for 30mph.
69. All three MCB-CCTV crossings will not be physically affected by the scheme proposals, but the indications to the signaller of trains approaching are the same for all three crossings (the same track circuits in the Up and Down direction are shared and only a single indication is provided to the signaller).

C.4 Telecoms OPS inc. Buried Cable Surveys

70. Telecoms Infrastructure within the area include
 - a. Fixed Telecoms Network (FTN) / Global System for Mobile Communications (Railway) (GSM-R) cables and equipment,

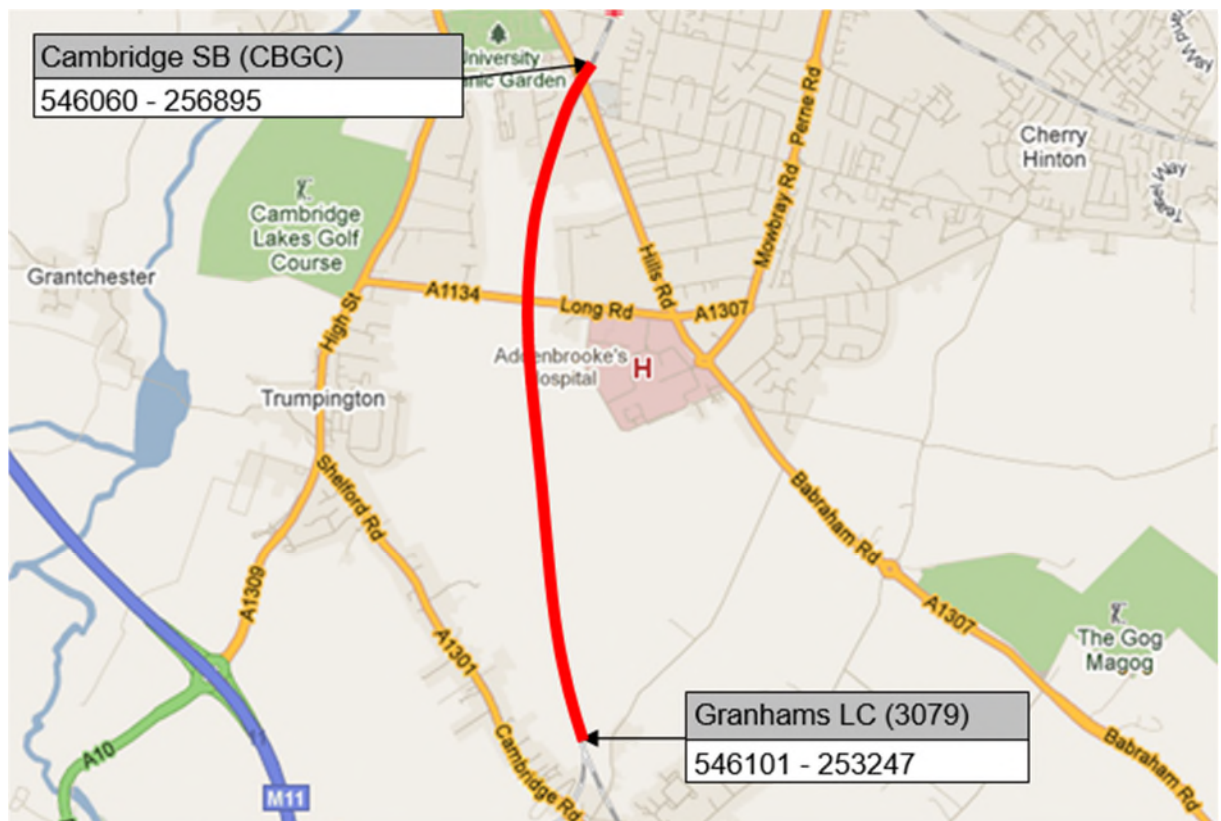
- b. Cable routes,
- c. Lineside cables and telephones.

71. The FTN node 3079-GSM-R colo (Graham LC) is located at 53 miles 0179 yards in the vicinity of Shepreth Branch Junction. It is a Civils asset and is shown in Figure 4 and Figure 5.
72. From Shepreth Branch Junction, the legacy S&T cable route runs in the Up Cess and is in poor condition. A C/1/7 bypass route was installed as part of FTN project to accommodate FTN 24F fibre between FTN node 3079 (Granhams LC) and CBGC (Cambridge Signal Box). Refer to Figure 33 and Figure 34.

Figure 33 - Legacy route in poor condition and C/1/7 bypass route installed as part of FTN project.



Figure 34 - FTN Coverage.



73. Legacy copper exists in the area serving lineside telephones and local services. The copper infrastructure has distribution points along the route in the form of stump boxes as shown in Figure 35.

Figure 35 – Stump Box



74. Lineside telephones (signal post telephones and level crossing phones) are connected to Cambridge Power Signal Box via legacy copper. Refer to Figure 36.

Figure 36 – Lineside Telephones



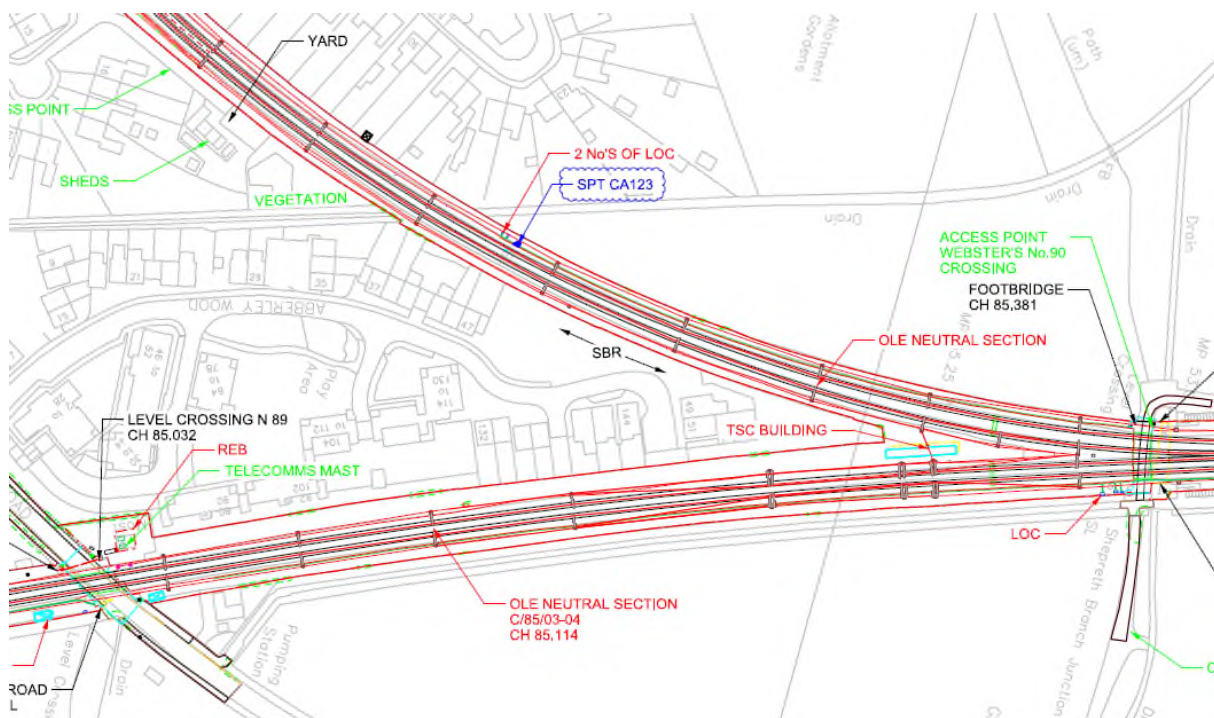
C.5 OLE Contact System

75. Note that Overhead Line Equipment (OLE) assets are identified by track kilometres and not mileage.
76. The existing railway in this area is electrified on all lines using Mark 3b equipment (MK3B-00-AT-S) along with booster transformers and return current conductor system. The equipment at the existing Cambridge Station and to the south was originally installed in 1987 for the Bishop's Stortford to Cambridge electrification works and the equipment north of the existing station was installed in 1992 for the Cambridge to King's Lynn electrification.
77. There is an In-Line type neutral section located on Up & Down Mains and Up & Down Royston lines, in a close proximity to the Track Sectioning Cabin (TSC) at Shepreth Branch Junction (Chainage 85.286 km). The neutral section on the Up & Down Main lines is segregating supplies from Milton Feeding Station and Ugley Feeding Station. The neutral section on the Up & Down Royston is current by-passed through TSC and OLE switch to continue the feed from Milton Feeding Station until Neutral section at Hitchin Feeding Station.
78. Booster transformers are located on OLE structures C/86/30, C/86/31 and south of Cambridge Station.
79. Generally, OLE in the area from Shepreth Branch Junction until Long Road Overbridge are installed on single track cantilevers with a few head span structures adjacent to Shepreth Branch Junction. From Long Road Overbridge (BGK-1554A) to Cambridge Station approach area, all the OLE is installed on head span structures.
80. Existing OLE constraints between Shepreth Branch Junction and Cambridge Station are identified as:
 - a. Position of neutral section and TSC. Refer to Section C.5.1
 - b. Overbridge electrical clearances.
 - c. Overbridge parapet heights.

C.5.1 Neutral Sections

81. The neutral sections are located at the south of the site on the Up Royston, Down Royston, Up Main and Down Main. Refer to Figure 37.

Figure 37 - Position of neutral sections within site



82. The neutral sections are positioned on the structures listed in Figure 38.

Figure 38 - Table showing positions of neutral sections

Structure with neutral section	Track	Chainage (km)
C/85/03A	Down Main	85.133
C/85/04A	Up Main	85.133
EC/88/37	Down Royston	88.914
EC/88/38	Up Royston	88.914

C.5.2 Technical Parameters

83. The location of a neutral section is set out as per Major Feeding Diagram (MFD). Positioning of a neutral section depends on various factors, some of them which are currently applicable for this project are:
- Signal spacing on approach and beyond.

- b. Track gradient.
- c. Line speed.
- d. Location relative to mid-point anchor or tensioning device.
- e. Automatic Power Control (APC) magnet positions.
- f. Proximity to the TSC to avoid long live bare feeder connections (ideally as close as reasonably practicable).

84. The distance from signals to the neutral section constrains both the permissible rolling stock and the allowable track grading. The existing railway infrastructure was assessed to check the compliance of existing neutral section positioning. This was repeated for each option and used to support the option selection process for the railway operational layout.

C.5.3 Assessment

85. As part of GRIP 3 stage, we have identified the constraints for track gradient, and new signal position based on GLRT 1210 standard requirements. The standard details the maximum permissible track gradient at distances from the preceding signal (in direction of travel) before the neutral section to the start of neutral section.

86. The project has assessed the minimum distance required between the approach signal and the signal beyond the neutral section. This is to determine whether the neutral section is currently compliant with the signal position, where compliant this means that there is no risk of a train coming to rest with the longest rolling stock pantograph between Automatic Power Control (APC) magnets. Figure 39 summarises the minimum required values.

Figure 39 - Table of Minimum distance required from Signal to neutral section

Track Name	Minimum required Distance from approach signal to N/S	Minimum required Distance beyond N/S to signal
Down Royston	CA123 – 151 m	CA839 – 260 m
Up Royston	CA 840 – 120 m	CA838 – 260 m
Down Main	CA99 – 123 m	CA139 – 260 m
Up Main	CA140 -123 m	CA100 – 260 m

87. The study concluded that existing signal positions were clear of neutral sections and this information has been used to support the design of proposed changes to the signalling layout to incorporate an additional signalling section between the proposed Cambridge South station and Shepreth Branch Junction.

C.5.4 Overbridges

C.5.4.1 Description of existing overbridges

88. Over-bridges place a constraint on the permissible height of the OLE and compliance with electrical clearances. The following over bridges have been analysed:
- a. SBR/34A Shepreth Road – Free Running (where the wires pass below the bridge without support)
 - b. BGK/1543b Footbridge Websters (Shepreth) - Free Running.
 - c. BGK/1544c Nine Wells Bridge - Free Running.
 - d. BGK/1544b Addenbrooke's Bridge - Free Running.
 - e. BGK/1544a Long Road Bridge – Fitted (where the wires are supported from the bridge to maintain clearance).
 - f. BGK/1545 Hill Road – Fitted.

C.5.4.2 Technical Parameters

89. Figure 40 lists the electrical clearances between live equipment and non-electrified infrastructure.

Figure 40 - Electrical Clearance Category

Electrical Clearance Category	Minimum Values		Comments
	Static	Passing	
Reinforced insulation	≥600	≥600	All designs should aim to achieve reinforced electrical clearances
Basic insulation	≥370	≥200	Electrical clearances 370 mm and above provide basic insulation as noted in Section 2.1.8.1.a of GL/RT1210

Electrical Clearance Category	Minimum Values		Comments
	Static	Passing	
Normal	≥270	≥200	<p>Electrical clearances 270 mm and above provide functional insulation.</p> <p>As per section 3.1.7.3 of GLRT 1210, Where it is not reasonably practicable to provide clearances in the 'normal' category, it is permissible for smaller clearances to be used where justified by a risk assessment complying with the CSM RA and the application of appropriate safety measures.</p> <p>As per section 4.1 of NR/L2/ELP/27715 module 04, Where it is proposed to implement clearances less than the minimum specified in Table 1 then this shall be agreed with the Route Asset Manager (RAM) [E&P] and Professional Head of Contact Systems prior to Approval in Principle (AiP) for the OCS or other interfacing asset, e.g. overline structure</p>
Reduced	≥200	≥150	<p>A special engineering solution is required for clearances in the reduced category and a CSM risk assessment in addition and the application of appropriate safety measures.</p>

C.5.4.3 Assessment

90. The assessment was done through use of the existing OLE drawings and a full OLE heights and stagger survey will be required to verify the data at a later stage.
91. This section of the report gives an assessment of clearances at these overbridges.

Figure 41 – SBR/34 Shelford Road



Figure 42 - SBR/34 Shelford Road – Free Running Clearances

Track	Soffit (mm)	CW Height Low Chainage (mm)	Cat Height Low Chainage (mm)	CW Height High Chainage (mm)	Cat Height High Chainage (mm)	Assumed electrical Clearance Category
Down Royston	4820	4530	4810	4530	4810	Basic insulation
Up Royston	4820	4530	4810	4530	4810	Basic insulation

92. Dependent on the extent of the OLE renewals required, further assessment of the electrical clearance requirements at this overbridge will be conducted in GRIP 4.

Figure 43 – BGK/1543b Footbridge Websters (Shepreth)



Figure 44 – BGK/1543b Footbridge Websters (Shepreth) - Free Running Clearances

Track	Soffit (mm)	CW Height Low Chainage (mm)	Cat Height Low Chainage (mm)	CW Height High Chainage (mm)	Cat Height High Chainage (mm)	Assumed electrical Clearance Category
Down Royston	7800	5920	7325	5760	7090	Reinforced insulation
Up Royston	7570	5895	7100	5705	6755	Reinforced insulation
Down Main	7630	5860	7130	5655	6815	Reinforced insulation
Up Main	7650	5890	7140	5770	6940	Reinforced insulation

93. The high soffit on this bridge gives more than sufficient electrical clearance and does not currently present a limitation on the design from an OLE perspective. However, any adjustment in track position associated with the performance improvement measures at Shepreth Branch Junction must consider the inclined soffit of the footbridge at its supports.

Figure 45 – BGK/1544c Nine Wells Bridge



Figure 46 – BGK/1544c Nine Wells Bridge - Free Running Clearances

Track	Soffit (mm)	CW Height Low Chainage (mm)	Cat Height Low Chainage (mm)	CW Height High Chainage (mm)	Cat Height High Chainage (mm)	Assumed electrical Clearance Category
Down Main	6800	5230	6130	5350	6250	Reinforced insulation
Up Main	6800	5230	6130	5350	6250	Reinforced insulation

94. The high soffit on this bridge gives more than sufficient electrical clearance and does not currently present a limitation on the design from an OLE perspective.

Figure 47 – BGK/1544b Addenbrooke's Bridge



Figure 48 – BGK/1544b Addenbrooke's Bridge - Free Running Clearances

Track	Soffit (mm)	CW Height Low Chainage (mm)	Cat Height Low Chainage (mm)	CW Height High Chainage (mm)	Cat Height High Chainage (mm)	Assumed electrical Clearance Category
Down Main	6400	5410	6310	5280	6180	Reinforced insulation
Up Main	6400	5410	6310	5280	6180	Reinforced insulation

95. The high soffit on this bridge gives more than sufficient electrical clearance and does not currently present a limitation on the design from an OLE perspective.

Figure 49 – BGK/1544a Long Road Bridge



Figure 50 – BGK/1544a Long Road Bridge – Fitted Clearances

Track	Soffit (mm)	CW Height Low Chainage (mm)	Cat Height Low Chainage (mm)	Clearance Category
Down Main	4550	4165	4165	Reduced
Up Main	4550	4165	4165	Reduced

96. The OLE wire heights attached at Long Road Bridge are minimum wire heights.
97. The static electrical clearance from top of the bridge arm (120mm construction depth of the bridge arm) to bridge soffit is less than 270mm leaving no possibility of raising the wire heights further. Also, the clearance from underside of the contact wire to the Kinematic vehicle gauge is less than 200mm which represents a reduced electrical clearance.
98. This bridge is not impacted by the proposed design of the CSIE Project however some of the options presented in this report were constrained by this clearance.

Figure 51 – BGK/1545 Hills Road



Figure 52 – BGK/1545 Hills Road – Fitted Clearances

Track	Soffit (mm)	Bridge Arm Low Chainage (mm)	Bridge Arm High Chainage (mm)	Clearance Category
Down Tracks	4555	4230	4300	Reduced
Up Tracks	4555	4230	4300	Reduced

99. Note: Clearance is from top of the bridge arm to bridge soffit.
100. Dependent on the extent of the OLE renewals required, further assessment of the electrical clearance requirements at this overbridge will be conducted in GRIP 4.

C.5.4.4 Bridge Parapets

101. The existing bridge parapet heights have been assessed with respect to NR/BS/LI/331 Clause 10.10 Parapets over OLE.
102. Figure 53 provides details of existing bridge parapet and NR/BS/LI/331 requirements:

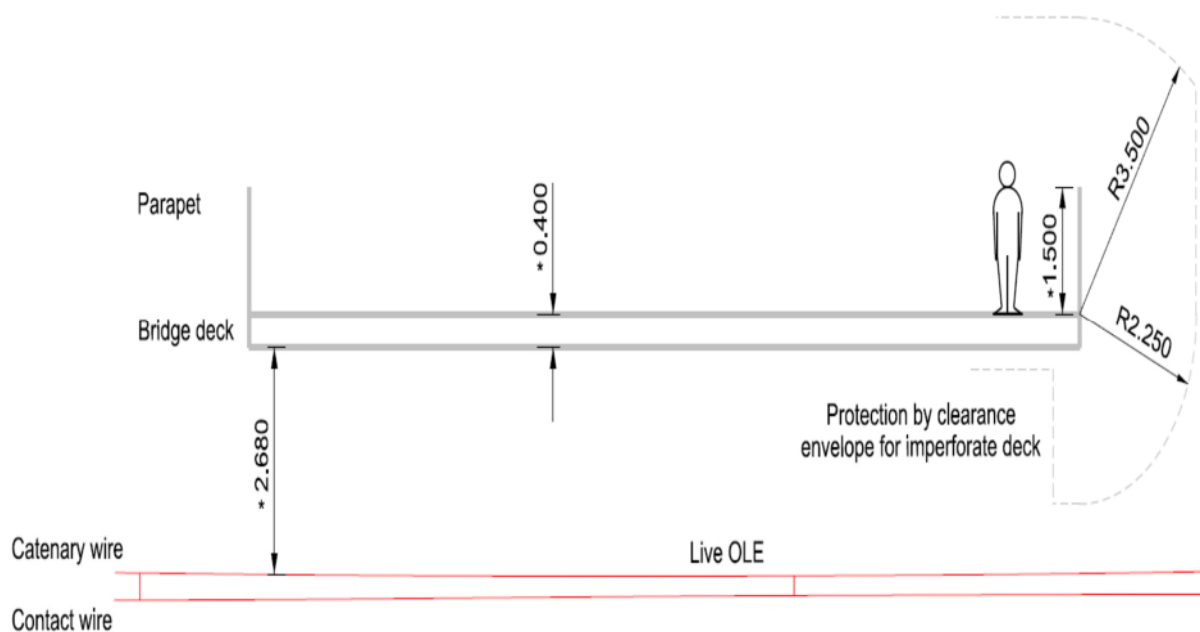
Figure 53 – Assessment of Electrical Clearances at Bridge Parapets

Bridge Number and Name	Is footway to OLE vertical clearance $\geq 2.25\text{m}$?	Existing parapet height $\geq 1.8\text{m}$?	Actions
SBR/34 Shelford Road	No	To be confirmed by additional site measurement.	No OLE Modifications proposed at this bridge.
BGK/1543b Footbridge Websters (Shepreth)	No	Yes	No modifications required as the parapet height is $\geq 1.8\text{m}$ and fully covered.
BGK/1544c Nine Wells Bridge	Yes	No	Existing 1.25m-1.8m parapet permitted – protection by clearance (Refer to Figure 54 for more details)
BGK/1544b Addenbrooke's Bridge	Yes	No	Existing 1.25m-1.8m parapet permitted – protection by clearance (Refer to Figure 54 for more details)

Bridge Number and Name	Is footway to OLE vertical clearance $\geq 2.25\text{m}$?	Existing parapet height $\geq 1.8\text{m}$?	Actions
BGK/1544a Long Road Bridge	No	No	No OLE Modifications proposed at this bridge, existing non-compliance will be retained. Bridge parapet to be modified if OLE is modified through the bridge.
BGK/1545 Hill Road	No	Yes	No modification required as the parapet height is $\geq 1.8\text{m}$

103. Figure 54 is provided to demonstrate 'Safe by Clearance' scenario based on Figure 10.10.1 & 10.10.3 from NR/BS/LI/331. This demonstrates that none of the bridges across the railway are judged to require parapet modifications to maintain electrical clearances

Figure 54 – Protection by Clearance for bridge parapets over OLE in public areas



C.5.5 Electrification and Plant (E&P)

C.5.5.1 Existing Power Supplies

104. There are 3 Nr. DNO supplies in the vicinity of the CSIE Project, as shown in **Error! Reference source not found..**

Figure 55 – DNO Supplies

DNO Supply	Existing Loads
Grahams Road Level crossing	Level Crossing, Points Heating and TSC (assumed)
Cambridge Signal Box	Signalling power
Clifton Way	Points Heating

105. At GRIP 4 stage, these supplies must be surveyed to confirm existing loads, their condition, characteristics, ratings, spares availability and suitability for re-use.
106. There is no existing supply in the vicinity of proposed Cambridge South Station. There are additional power requirements from the proposed railway infrastructure and so one must be created.

C.5.5.2 Hot Axle Bearing Detection

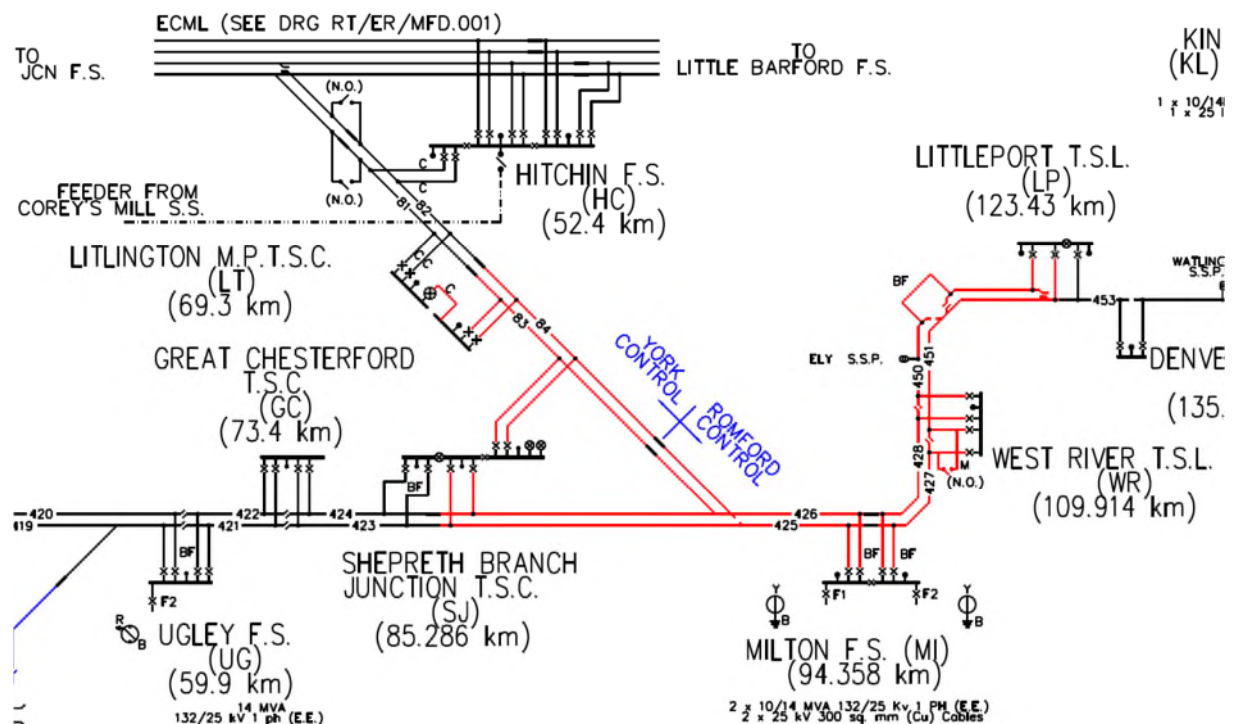
107. A Hot Axle Bearing Detection system (HABD) is located in the Down Main for northbound trains, just north of Shepreth Branch Junction. The position of this HABD has been chosen so trains from both the Down Main and Down Royston lines pass this HABD. In case of any hot axle bearing alarms, the trains can be stopped on the Down Slow just south of Cambridge, taken in on the Through Line at Cambridge Station, or be signalled to the freight Reception Sidings to the east of the platforms to allow an inspection of the affected bearing.

C.5.6 Traction Power

108. In normal mode, the railway through the CSIE project area is fed from Milton Feeder Station.

109. That feeder station includes two 132 kV to 25 kV traction transformers, both of which are used in normal mode. As per the Major Feeding Diagram [Ref. QH/EP/MFD/01.01, revision C, dated 16/04/2015(*)], each transformer has a capacity of 10 MVA (14 MVA in case air-forced cooling is used) and are connected between the same phases, with the busbar coupler closed, as shown on Figure 56. The electrical section is represented in red.

Figure 56 - Section fed by Milton Feeder Station (extract from the Major Feeding Diagram)



110. All areas of the Project are currently electrified with Mark 3b OLE. This is a type of overhead line system. The traction current return path is via return conductors and booster transformers. It is a project proposal that alterations to traction power arrangements are engineered on a like for like basis. This means that new catenary support structures are selected from the same range of products as are on site today and that the return conductor wires continue to be routed aerially. (The return conductor is the return path for electricity passing through the train). Whilst there are newer solutions available, the approach simplifies maintenance of the new traction power equipment.

Appendix D

D Buried Services

D.1 Existing Utilities

A review of the existing buried services within the affected project area was undertaken

Buried services present within the project boundary as indicated in Figure 57 are scheduled in Figure 58, the following being identified for each asset:

- Type and category of utility,
- Assigned reference number for each utility,
- Reference to buried services pack and applicable page number,
- Approximate location description and railway ELR and mileage; and
- Whether the service is impacted by the preferred option.

Extracts of services record information are compiled in Figure 60 to Figure 83.

Figure 57 – Area of Utilities Assessment

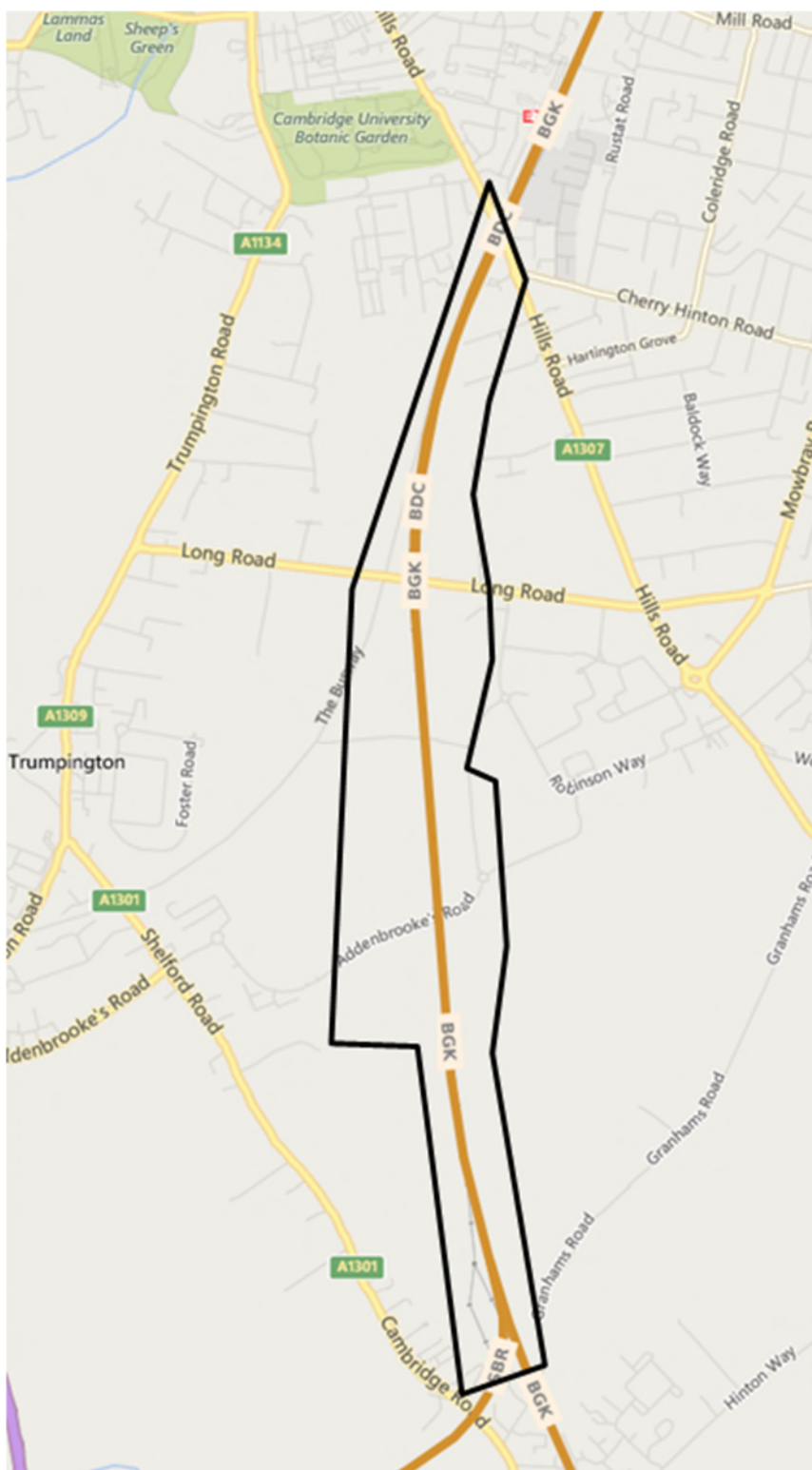


Figure 58 – Schedule of Known Utilities Assets within the Project Boundary

Asset Owner	Cat.	Description	Ref.	Figure No	Service Pack Number	Service Pack (Pg.)	Where is it located?	Approx. Mileage
National Grid Gas	Gas	National Grid Pipeline, 250mm HP	G101	Figure 61	CSIE01, SET194333	446, 544, 545	Crosses perpendicular to the railway south of BGK-1544c Nine Wells Bridge, following cycle route 11 to the east.	53 miles 1409 yards
GTC Plant	Gas	Gas Main	G102	Figure 61	CSIE01, SET194333	426	To the southeast of Addenbrooke's Road at bottom of embankment.	53 miles 1529 yards
National Grid Gas	Gas	National Grid Pipeline	G103	Figure 60	CSIE01, SET194333	545, 546	Service runs North/South to the east of the railway north of BGK-1544c Nine Wells Bridge before crossing beneath the tracks and running west below the Great Kneighton Development	54 miles 0123 yards
GTC Plant	Gas	Gas Main	G104	Figure 61	CSIE01, SET194333	426	Gas Main within Francis Crick Avenue, connects to service G101	54 miles 0681 yards

Asset Owner	Cat.	Description	Ref.	Figure No	Service Pack Number	Service Pack (Pg.)	Where is it located?	Approx. Mileage
National Grid Gas	Gas	National Grid Pipeline	G105	Figure 62	CSIE01, SET194333	548	Service within the footpath to the southern verge of BGK-1544a Long Road.	54 miles 1058 yards
AZ	Gas	LP Gas Main	G106	Figure 63	19-05-28-LR-AZGlobalU GU	N/A	Service runs adjacent to AZ site, parallel to track.	54m 0125y
Cambridge Water Company	Water	Water main – various sizes (400 - 450mm HP PE)	W101	Figure 64 Figure 65 Figure 66 Figure 67	CSIE01, SET194333	562 - 565	Travels parallel to track through entire area of interest, from Shepreth Branch Junction and splitting under both BGK-1544c Nine Wells Bridge and BGK-1544b Addenbrooke's bridge. Service runs on the Eastern side crossing to the west in the centre of the Great Kneighton Development area.	54 miles 0129 yards
Cambridge Water Company	Water	Water	W102	Figure 65	CSIE01, SET194333	563	Runs east – west round the back of the molecular biology laboratory,	54 miles 0681 yards

Asset Owner	Cat.	Description	Ref.	Figure No	Service Pack Number	Service Pack (Pg.)	Where is it located?	Approx. Mileage
							crosses railway then runs on northwest towards long road.	
Cambridge Water Company	Water	Cambridge Water	W103	Figure 64 Figure 65	CSIE01, SET194333	562 – 563	Service within the footpath to the northern verge of BGK-1544a Long Road.	54 miles 1069 yards
Anglian Water	Foul Sewer	Foul Sewer	FS101	Figure 67 Figure 68	CSIE01, SET194333	558	Follows the route of cycle route 11 running north/south parallel to the railway, then turns east, south of BGK-1544c Nine Wells Bridge	53 miles 1437 yards
Anglian Water	Foul Sewer	Foul Sewer	FS102	Figure 68	CSIE01, SET194333	558	Crosses perpendicular to the railway south of BGK-1544c Nine Wells Bridge, approximately follows the local authority boundary.	53 miles 1458 yards
BT	Telecoms	BT Openreach	TC101	Figure 69	CSIE01, SET194333	610, 611	Assumed within highway of BGK-1544a Long Road, appears to be in northern elevation footpath.	54 miles 1071 yards

Asset Owner	Cat.	Description	Ref.	Figure No	Service Pack Number	Service Pack (Pg.)	Where is it located?	Approx. Mileage
Virgin Media	Telecoms	Virgin Media	TC102	Figure 70	CSIE01, SET194333	627	Service within the footpath to the southern verge of BGK-1544a Long Road.	54 miles 1060 yards
Virgin Media	Telecoms	Virgin Media	TC103	Figure 70	CSIE01, SET194333	628	Service within the footpath to the northern verge of BGK-1544a Long Road.	54 miles 1071 yards
City Fibre	Telecoms	City Fibre	TC104	Figure 71	CSIE01, SET194333	634	Service within the footpath to the southern verge of BGK-1544a Long Road.	54 miles 1060 yards
Vodafone	Telecoms	Vodafone	TC105	Figure 72 Figure 73 Figure 74 Figure 75	CSIE01, SET194333	590, 591, 592, 593, 594, 595	Line follows along track through entire area of interest, splitting into three after Long Road Bridge.	53 miles 1069 yards - 54 miles 1101 yards
Vodafone	Telecoms	Vodafone	TC106	Figure 76	CSIE01, SET194333	594	Service within the footpath to the southern verge of BGK-1544a Long Road.	54 miles 1060 yards
Vodafone	Telecoms	Vodafone	TC107	Figure 76 Figure 77	CSIE01, SET194333	595	Service within the footpath to the northern verge of BGK-1544a Long Road.	54 miles 1071 yards
Vodafone	Telecoms	Vodafone Point	TC108	Figure 73	CSIE01, SET194333	591	In line with track to the west of the existing lines,	53 miles 1625 yards

Asset Owner	Cat.	Description	Ref.	Figure No	Service Pack Number	Service Pack (Pg.)	Where is it located?	Approx. Mileage
							just north of BGK-1544c Nine Wells Bridge, on Vodafone line TC105.	
Vodafone	Telecoms	Vodafone Point	TC109	Figure 76	CSIE01, SET194333	594	In line with track to the west of the existing lines, just south of BGK-1544a Long Road., on Vodafone line TC105.	54 miles 1045 yards
Vodafone	Telecoms	Vodafone Point	TC110	Figure 76 Figure 77	CSIE01, SET194333	595	In line with track to the west of the existing lines, below BGK-1544a Long Road next to track, on Vodafone Line TC105.	54 miles 1075 yards
Vodafone	Telecoms	Vodafone Point	TC111	Figure 77	CSIE01, SET194333	595	Adjacent BGK-1544a Long Road, on Vodafone Line TC105.	54 miles 1075 yards
Vodafone	Telecoms	Vodafone Point	TC112	Figure 77	CSIE01, SET194333	595	Adjacent BGK-1544a Long Road, on Vodafone Line TC105.	54 miles 1081 yards
Vodafone	Telecoms	Vodafone Point	TC113	Figure 77	CSIE01, SET194333	595	Adjacent BGK-1544a Long Road, on Vodafone Line TC105.	54 miles 1081 yards

Asset Owner	Cat.	Description	Ref.	Figure No	Service Pack Number	Service Pack (Pg.)	Where is it located?	Approx. Mileage
Vodafone	Telecoms	Vodafone Point	TC114	Figure 77	CSIE01, SET194333	595	West of track to the north of BGK-1544a Long Road, on Vodafone Line TC105. It is believed this point is within a building to which Vodafone have access rights over NR infrastructure to access (this has been communicated by the Network Rail Operations team)	54 miles 1077 yards
Vodafone	Telecoms	Vodafone	TC115		CSIE01, SET194333	594	Along access track into St Margaret's College	54 miles 1045 yards
UK Power Networks	Electricity	LV 3 Core Cable	E101	Figure 78	CSIE01, SET194333	114	Crosses perpendicular to the railway south of BGK-1544c Nine Wells Bridge, following cycle route 11 to the east.	53 miles 1428 yards
GTC Plant	Electricity	11Kv or 6.6Kv Cable	E102	Figure 79	CSIE01, SET194333	357	Buried electrical cables within Addenbrooke's Road.	53 miles 1542 yards

Asset Owner	Cat.	Description	Ref.	Figure No	Service Pack Number	Service Pack (Pg.)	Where is it located?	Approx. Mileage
GTC Plant	Electricity	LV	E103	Figure 79	CSIE01, SET194333	357	Buried electrical cables within Addenbrooke's Road.	53 miles 1542 yards
GTC Plant	Electricity	11Kv or 6.6Kv Cable	E104	Figure 79	CSIE01, SET194333	357	To the southeast of Addenbrooke's Road at bottom of embankment, connecting from sub-station to E102.	53 miles 1529 yards
GTC Plant	Electricity	Multiple Cables	E105	Figure 79 Figure 80	CSIE01, SET194333	357	Buried cables within western footpath of Francis Crick Avenue, connects to services in Addenbrooke's Road E101.	54 miles 0681 yards
GTC Plant	Electricity	Multiple Cables	E106	Figure 79 Figure 80	CSIE01, SET194333	357	Buried cables within eastern footpath of Francis Crick Avenue, connects to services in Addenbrooke's Road E101.	54 miles 0681 yards
UK Power Networks	Electricity	TBC	E107	Figure 81 Figure 82	CSIE01, SET194333	91	Service within the footpath to the southern verge of BGK-1544a Long Road.	54 miles 1060 yards

Asset Owner	Cat.	Description	Ref.	Figure No	Service Pack Number	Service Pack (Pg.)	Where is it located?	Approx. Mileage
UK Power Networks	Electricity	TBC	E108	Figure 81	CSIE01, SET194333	91	Services below Long Road, believed to be the DNO connection at this location, also links to sports pavilion.	54 miles 1069 yards
UK Power Networks	Electricity	TBC	E109	Figure 82. Figure 83	CSIE01, SET194333	90, 92	Service in the eastern embankment approach to BGK-1544a, runs under sports field to the sports pavilion.	54 miles 1069 yards
UK Power Networks	Electricity	TBC	E110	Figure 81	CSIE01, SET194333	91	Services into telecoms enclosure either side of Long Road	54 miles 1069 yards

D.2 Impact on Utilities

A review of the existing buried services within the affected project area has identified whether each of the services in Figure 58 is affected by the preferred option. This information is summarised in Figure 59

Figure 59 – Impact on Known Utilities Assets within the project Boundary

Asset Owner	Cat.	Description	Ref.	Project Impact (RAG) +comment
National Grid Gas	Gas	National Grid Pipeline, 250mm HP	G101	Crosses railway. Protect
GTC Plant	Gas	Gas Main	G102	Adjacent to construction compounds and access roads. Protect
National Grid Gas	Gas	National Grid Pipeline	G103	High Pressure Gas Main. Design has been based on a 20m exclusion zone. Note that the main crosses the tracks
GTC Plant	Gas	Gas Main	G104	Probably crosses station entrance within Francis Crick Avenue Protect
National Grid Gas	Gas	National Grid Pipeline	G105	Crosses below access road at junction Protect
AZ	Gas	LP Gas Main	G106	Partial relocation
Cambridge Water Company	Water	Water main – various sizes (400 - 450mm HP PE)	W101	Needs to be diverted
Cambridge Water Company	Water	Water	W102	Crosses railway within area of 3 tracks north of proposed station
Cambridge Water Company	Water	Cambridge Water	W103	Not affected
Anglian Water	Foul Sewer	Foul Sewer	FS101	Adjacent to construction compounds and access roads. Protect

Asset Owner	Cat.	Description	Ref.	Project Impact (RAG) +comment
Anglian Water	Foul Sewer	Foul Sewer	FS102	Crosses below track and adjacent to construction compounds and access roads. Protect
BT	Telecoms	BT Openreach	TC101	Not affected
Virgin Media	Telecoms	Virgin Media	TC102	Crosses below access road at junction Protect
Virgin Media	Telecoms	Virgin Media	TC103	Not affected
City Fibre	Telecoms	City Fibre	TC104	Crosses below access road at junction Protect
Vodafone	Telecoms	Vodafone	TC105	Possibly crosses track around Nine Wells Bridge. Runs close to line of new Down Loop Divert clear of railway corridor
Vodafone	Telecoms	Vodafone	TC106	Crosses below access road at junction Protect
Vodafone	Telecoms	Vodafone	TC107	Not affected
Vodafone	Telecoms	Vodafone Point	TC108	Relocate
Vodafone	Telecoms	Vodafone Point	TC109	No track works at this location.
Vodafone	Telecoms	Vodafone Point	TC110	Possible interface with track drainage
Vodafone	Telecoms	Vodafone Point	TC111	Possible interface with track drainage
Vodafone	Telecoms	Vodafone Point	TC112	Possible interface with track drainage
Vodafone	Telecoms	Vodafone Point	TC113	Possible interface with track drainage
Vodafone	Telecoms	Vodafone Point	TC114	Possible interface with track drainage
Vodafone	Telecoms	Vodafone	TC115	Alongside construction access Protect

Asset Owner	Cat.	Description	Ref.	Project Impact (RAG) +comment
UK Power Networks	Electricity	LV 3 Core Cable	E101	Crosses railway and runs alongside construction access Protect
GTC Plant	Electricity	11Kv or 6.6Kv Cable	E102	Possibly impacted by works to cycle crossing at roundabout
GTC Plant	Electricity	LV	E103	Runs across construction access Protect
GTC Plant	Electricity	11Kv or 6.6Kv Cable	E104	Runs alongside construction access Protect
GTC Plant	Electricity	Multiple Cables	E105	Runs across station access Protect
GTC Plant	Electricity	Multiple Cables	E106	Runs across construction access at roundabout Protect Also possibly impacted by works to public crossing at Guided Busway Junction Protect
UK Power Networks	Electricity	TBC	E107	Not affected by preferred option
UK Power Networks	Electricity	TBC	E108	Runs across construction access Protect
UK Power Networks	Electricity	TBC	E109	Not affected by preferred option
UK Power Networks	Electricity	TBC	E110	Runs across construction access Protect Possible interface with track drainage

Figure 60 – Gas Utilities to the south of BGK-1544c Nine Wells Bridge

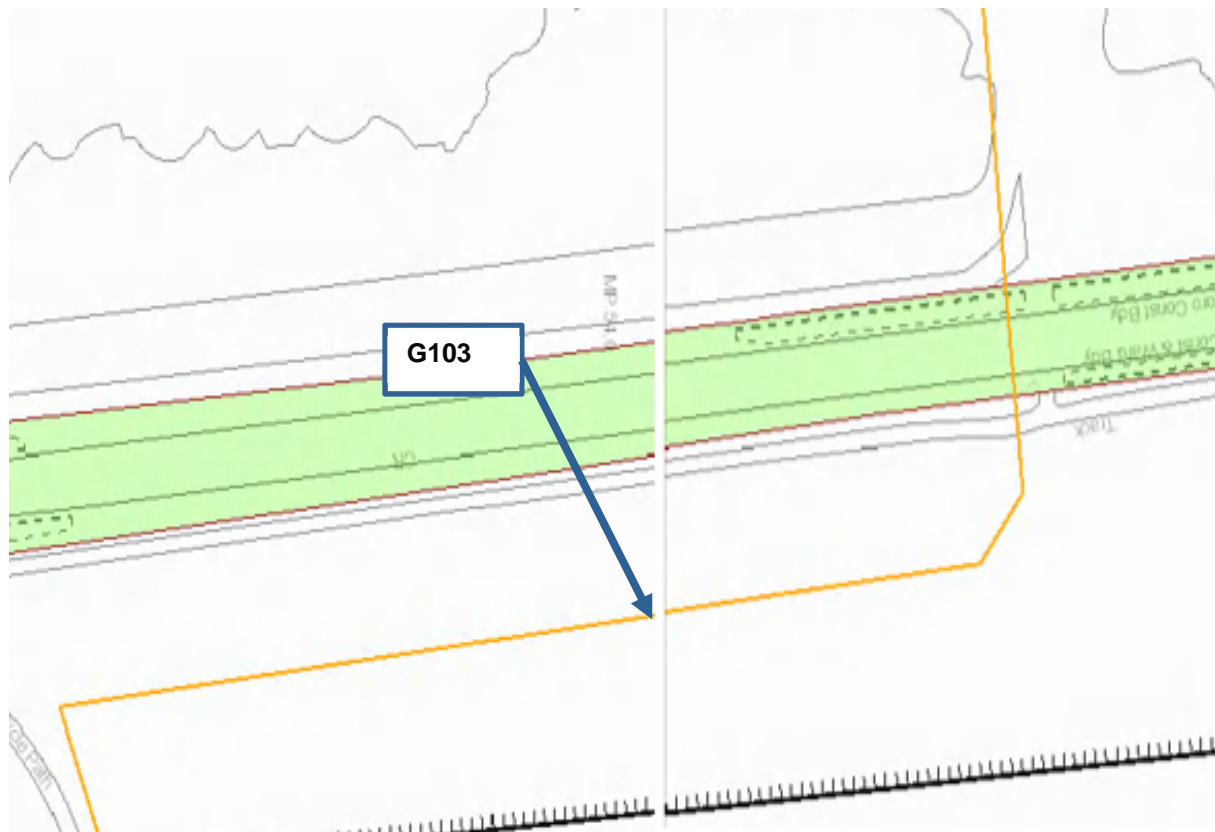


Figure 61 – Gas Utility between BGK-1544c Nine Wells Bridge and BGK-1544b Addenbrooke's Bridge

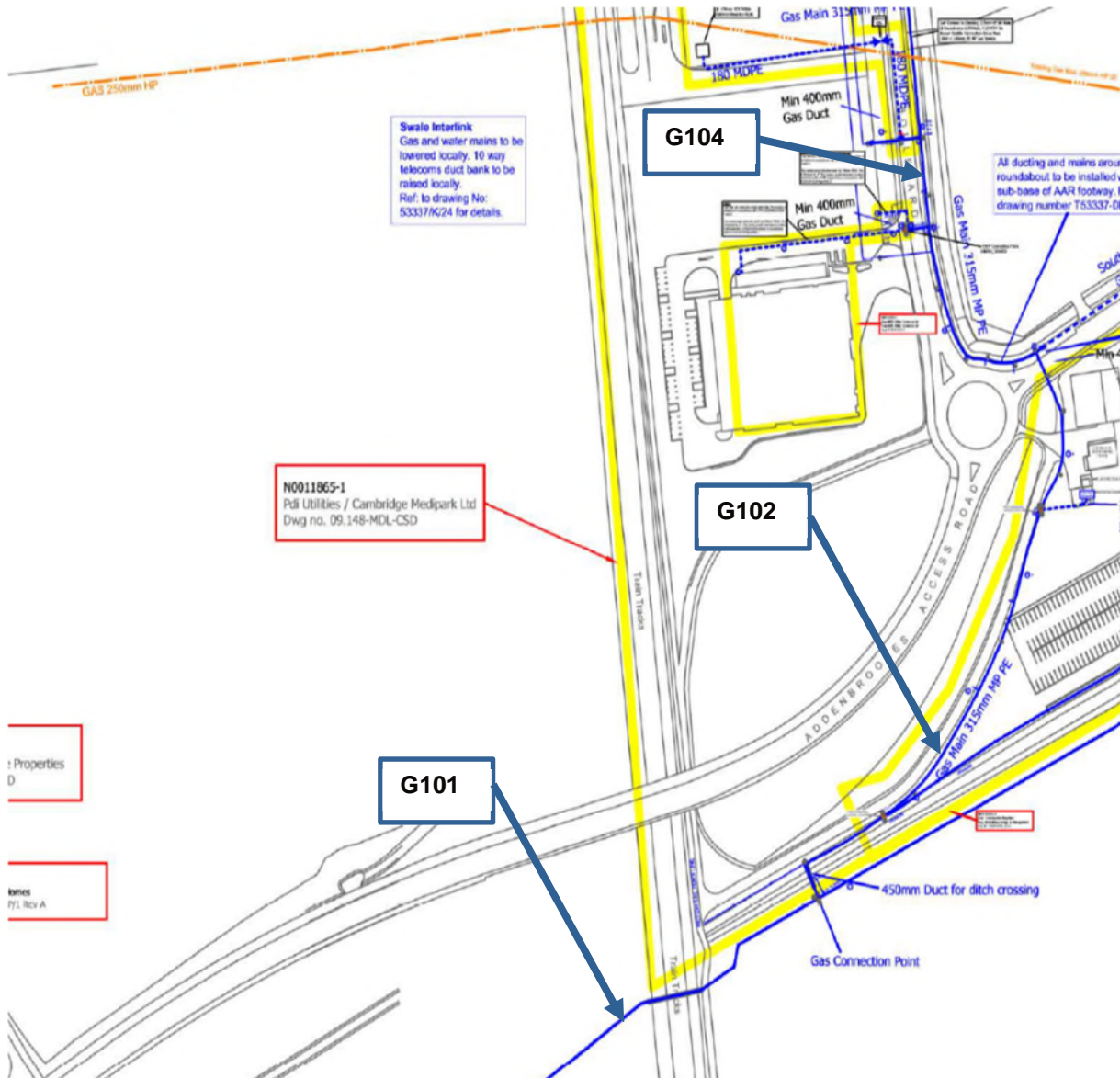


Figure 62 – Gas Utility at BGK-1544a Long Road Bridge

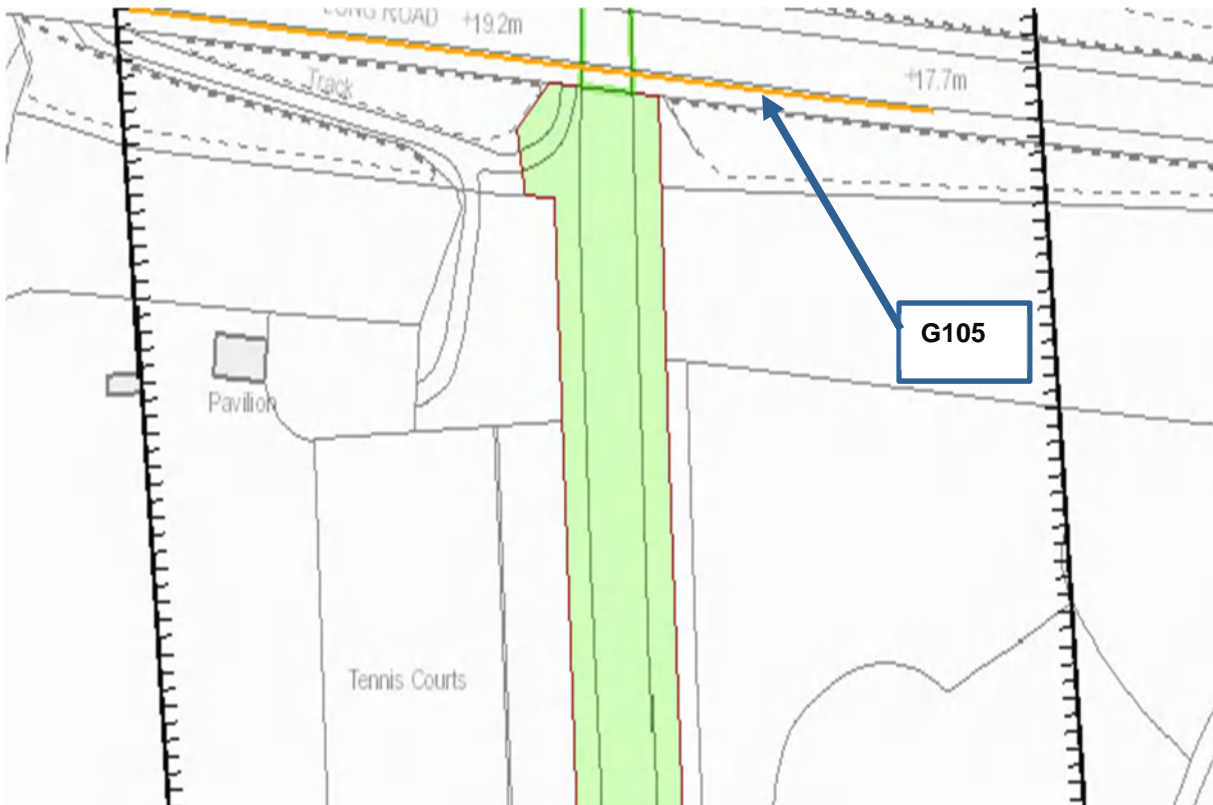


Figure 63 – AZ LP Gas Main

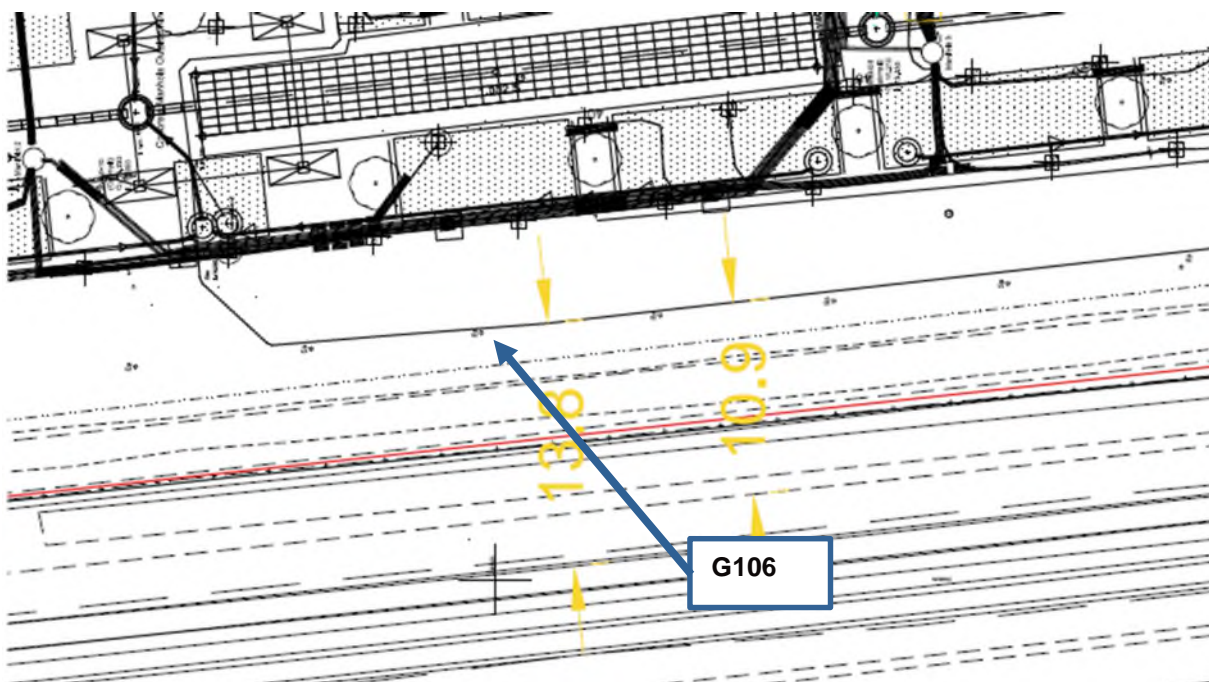


Figure 64 – Water Services north of BGK-1544a Long Road Bridge

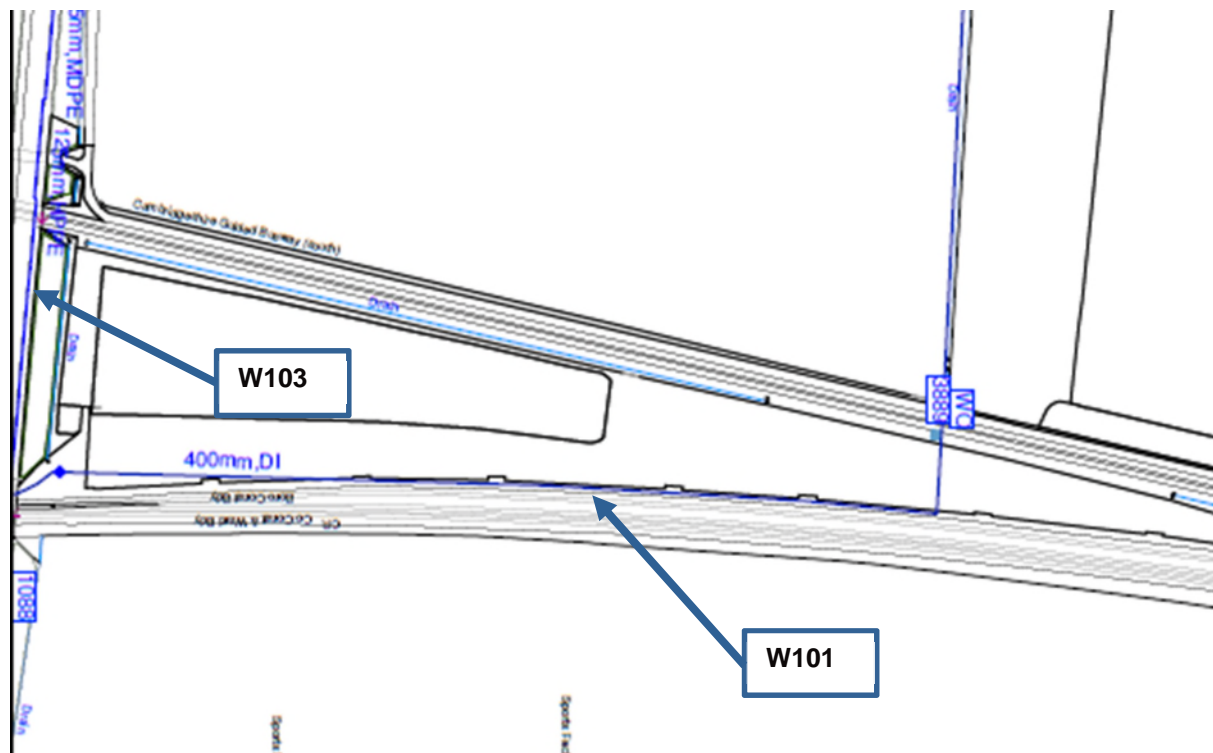


Figure 65 – Water Services south of BGK-1544b Addenbrooke's Bridge to BGK-1544a Long Road Bridge



Figure 66 – Water Services in the vicinity of BGK-1544c Nine Wells Bridge

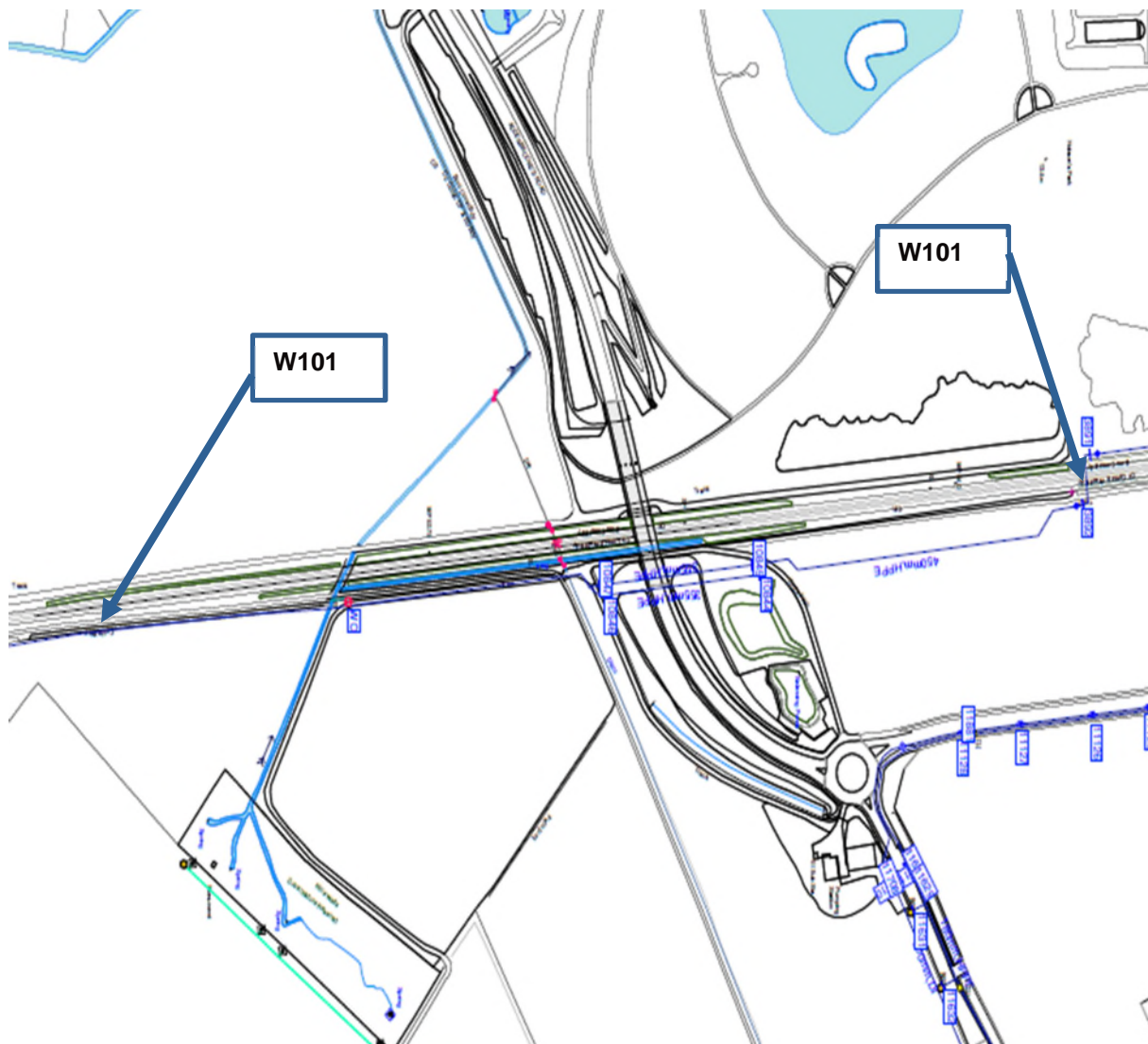


Figure 67 – Water Services at Shepreth Branch Junction

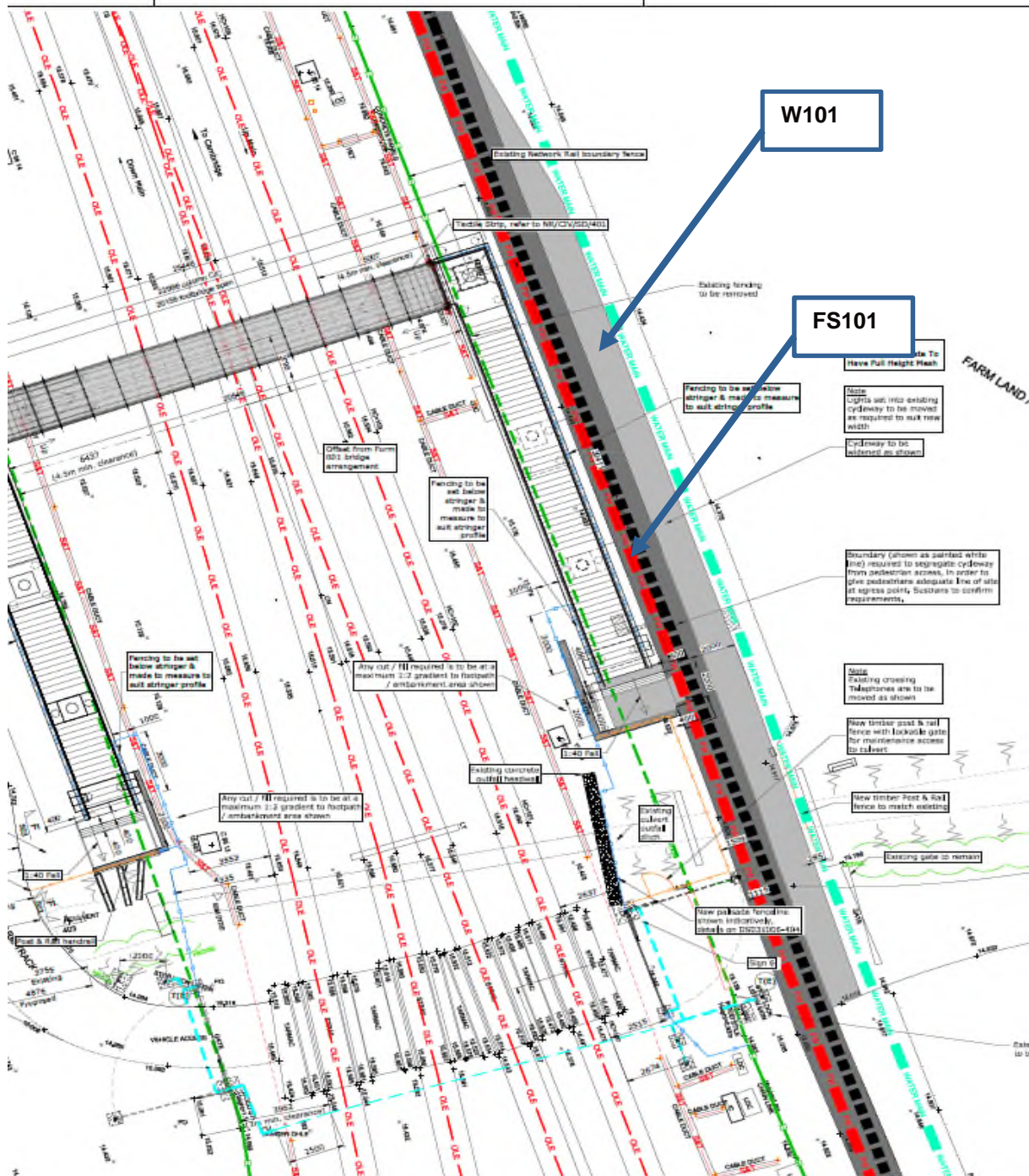


Figure 68 – Foul Sewers south of BGK-1544c Nine Wells Bridge

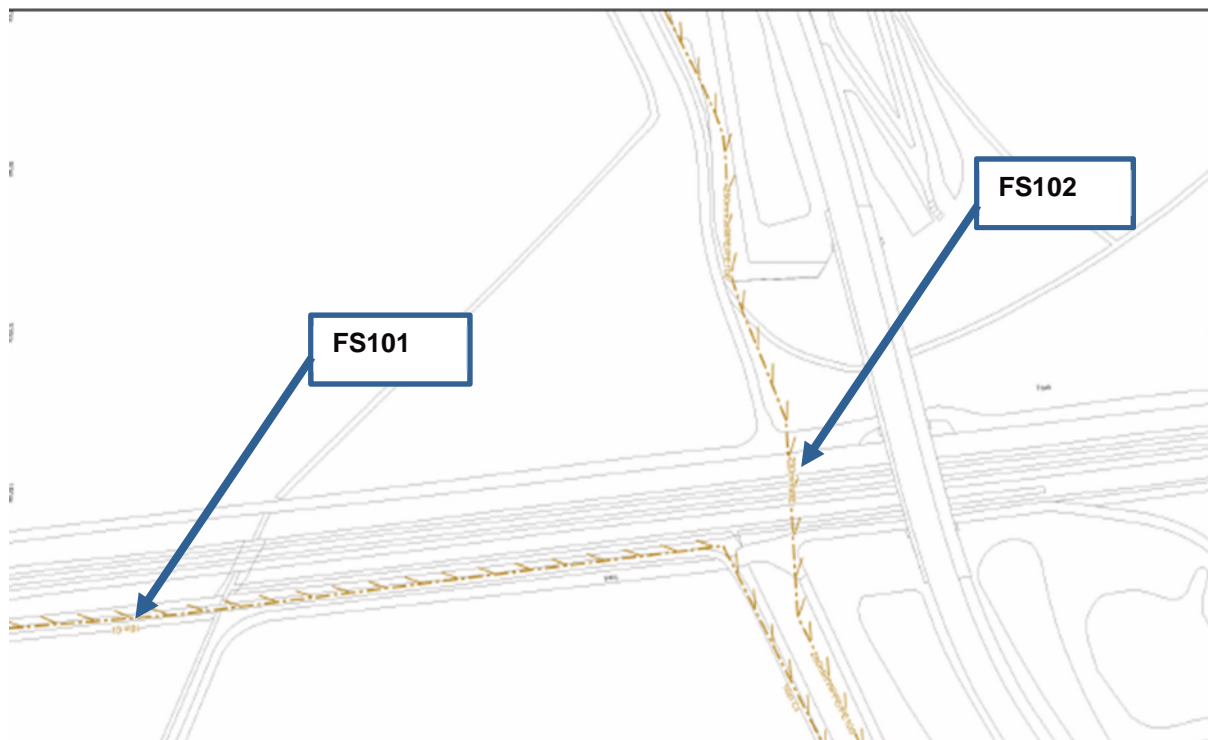


Figure 69 – BT Telecoms north side of BGK-1544a Long Road

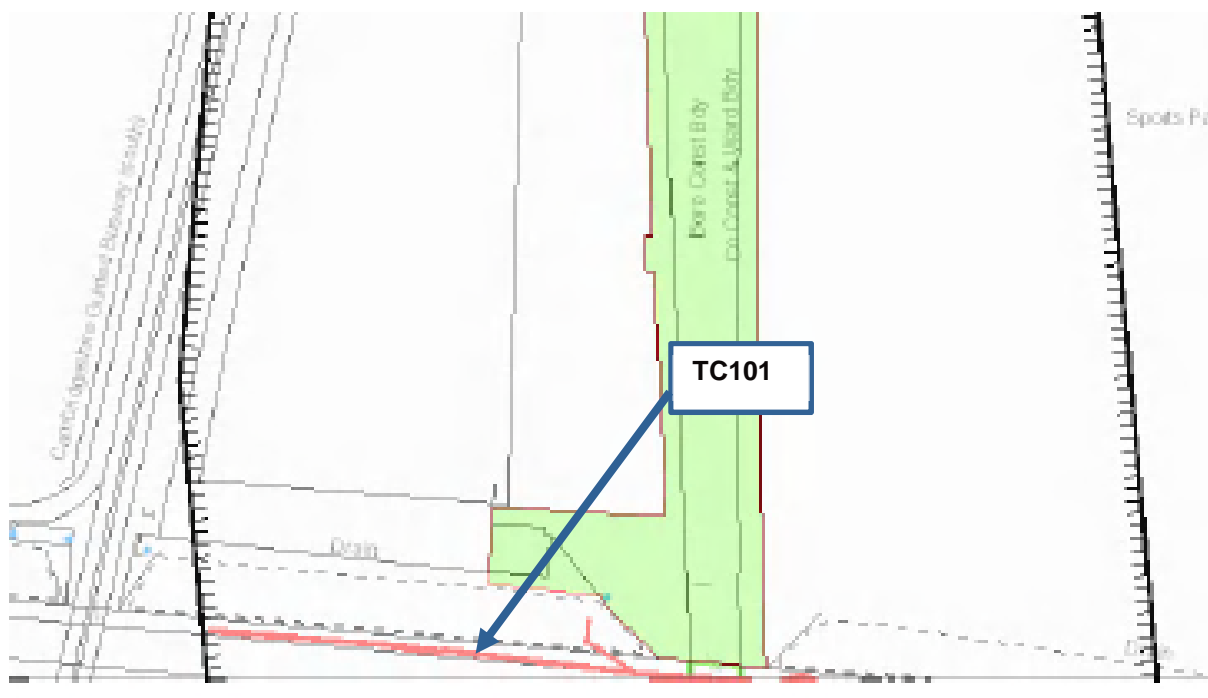


Figure 70 – Virgin Media network utilities at BGK-1544a Long Road



Figure 71 – City Fibre Cable at BGK-1544a Long Road

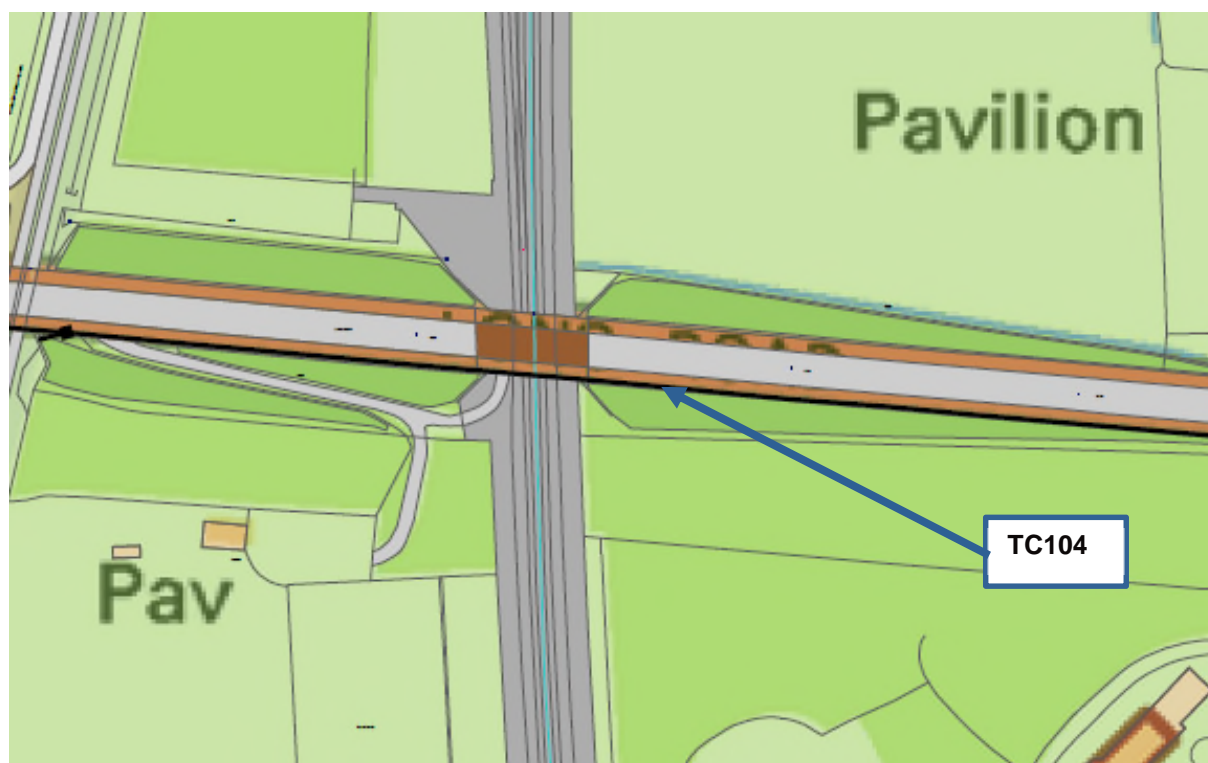


Figure 72 – Vodafone utility south of BGK-1544c Nine Wells Bridge

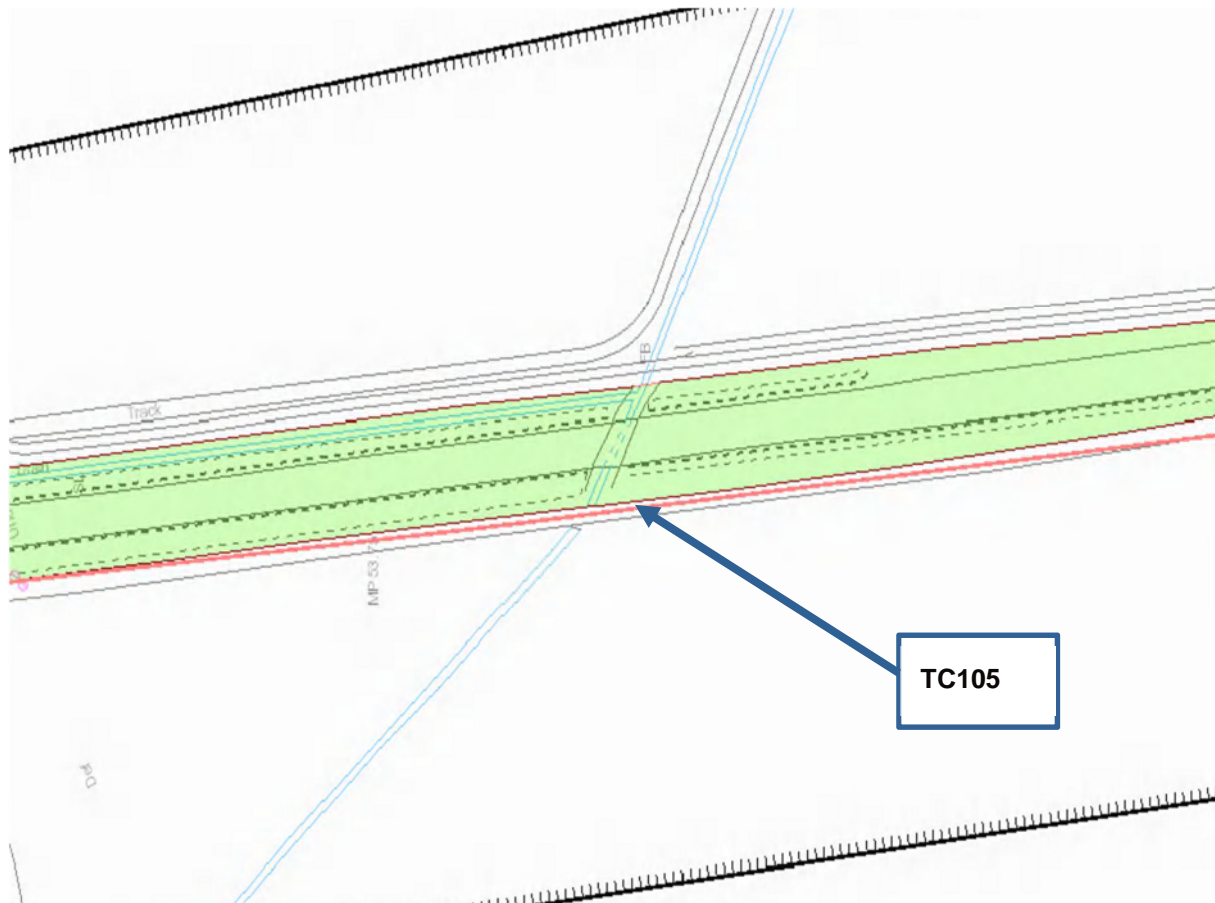


Figure 73 – Vodafone utilities in the vicinity of BGK-1544c Nine Wells Bridge

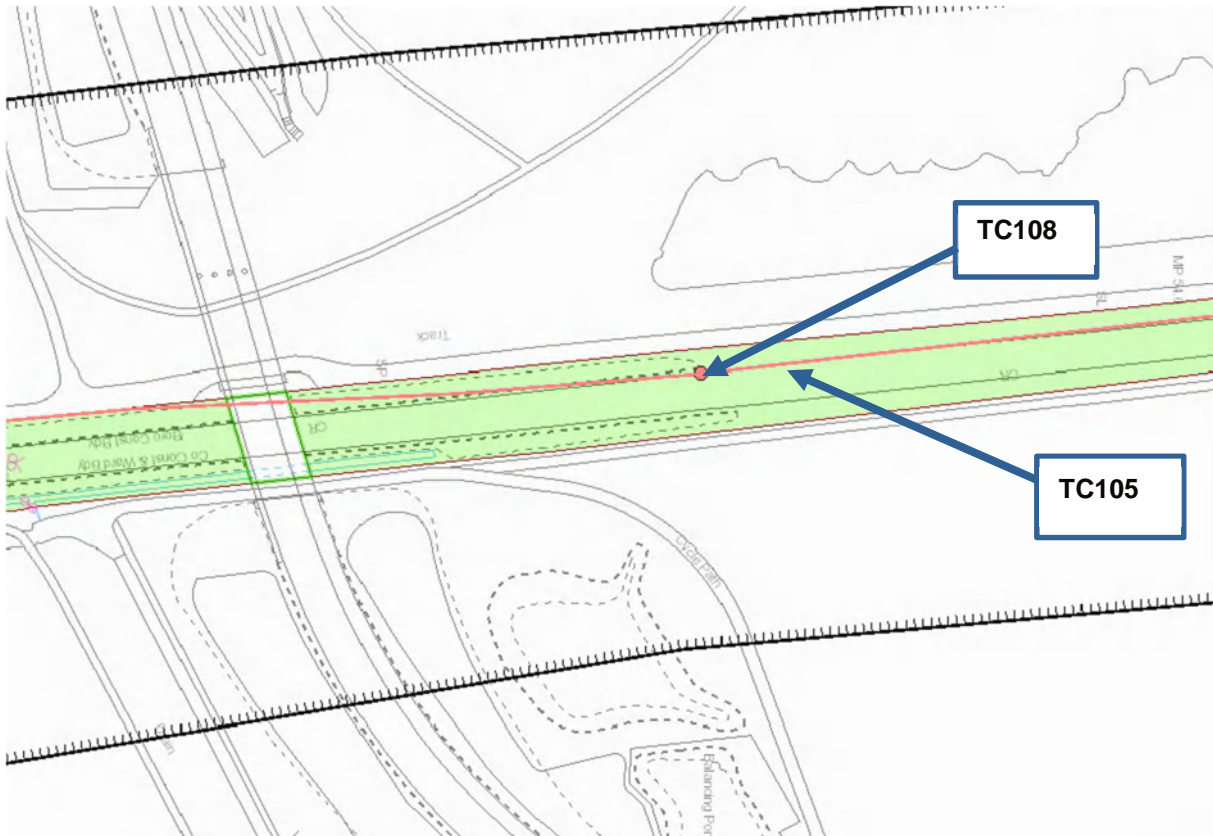


Figure 74 – Vodafone utility between BGK-1544c Nine Wells Bridge and BGK-1544b Addenbrooke's Road

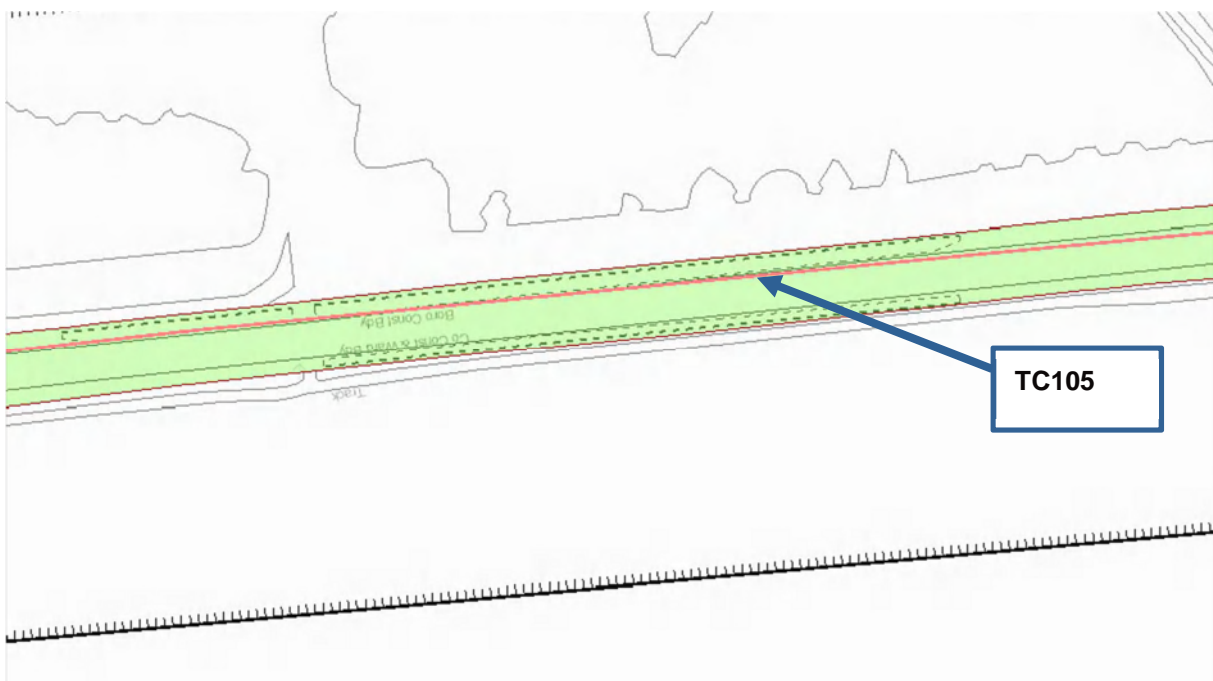


Figure 75 – Vodafone utility in the vicinity of BGK-1544b Addenbrooke's Road

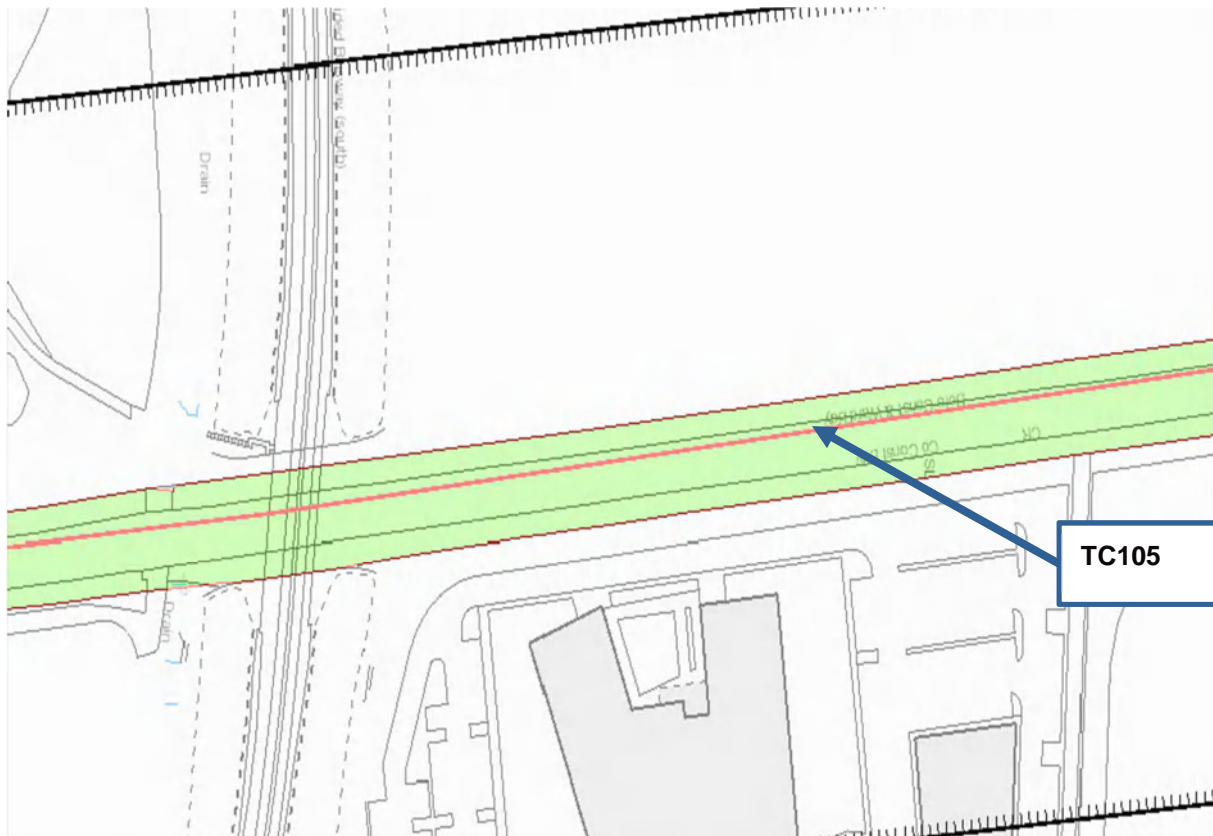


Figure 76 – Vodafone utilities south of BGK-1544a Long Road

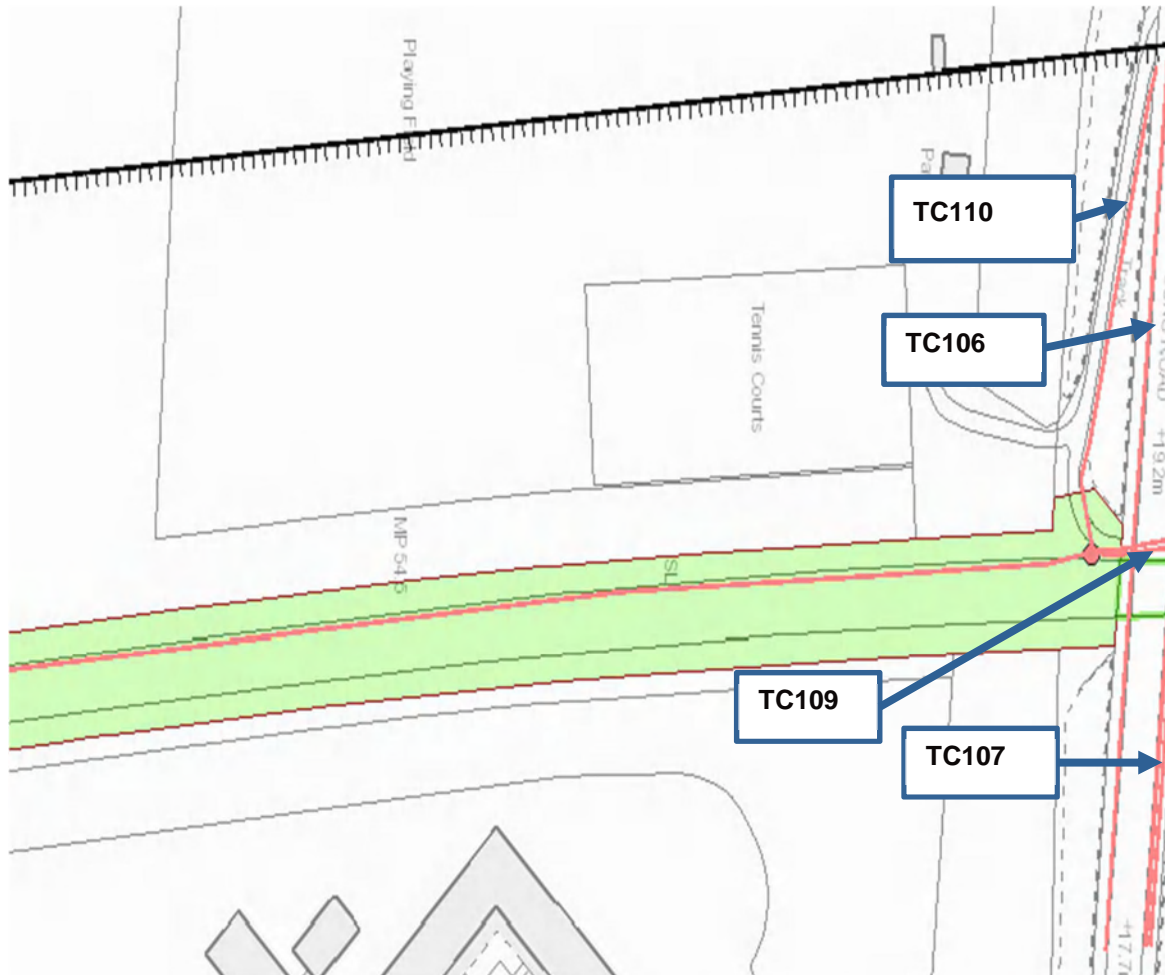


Figure 77 – Vodafone utilities north of BGK-1544a Long Road

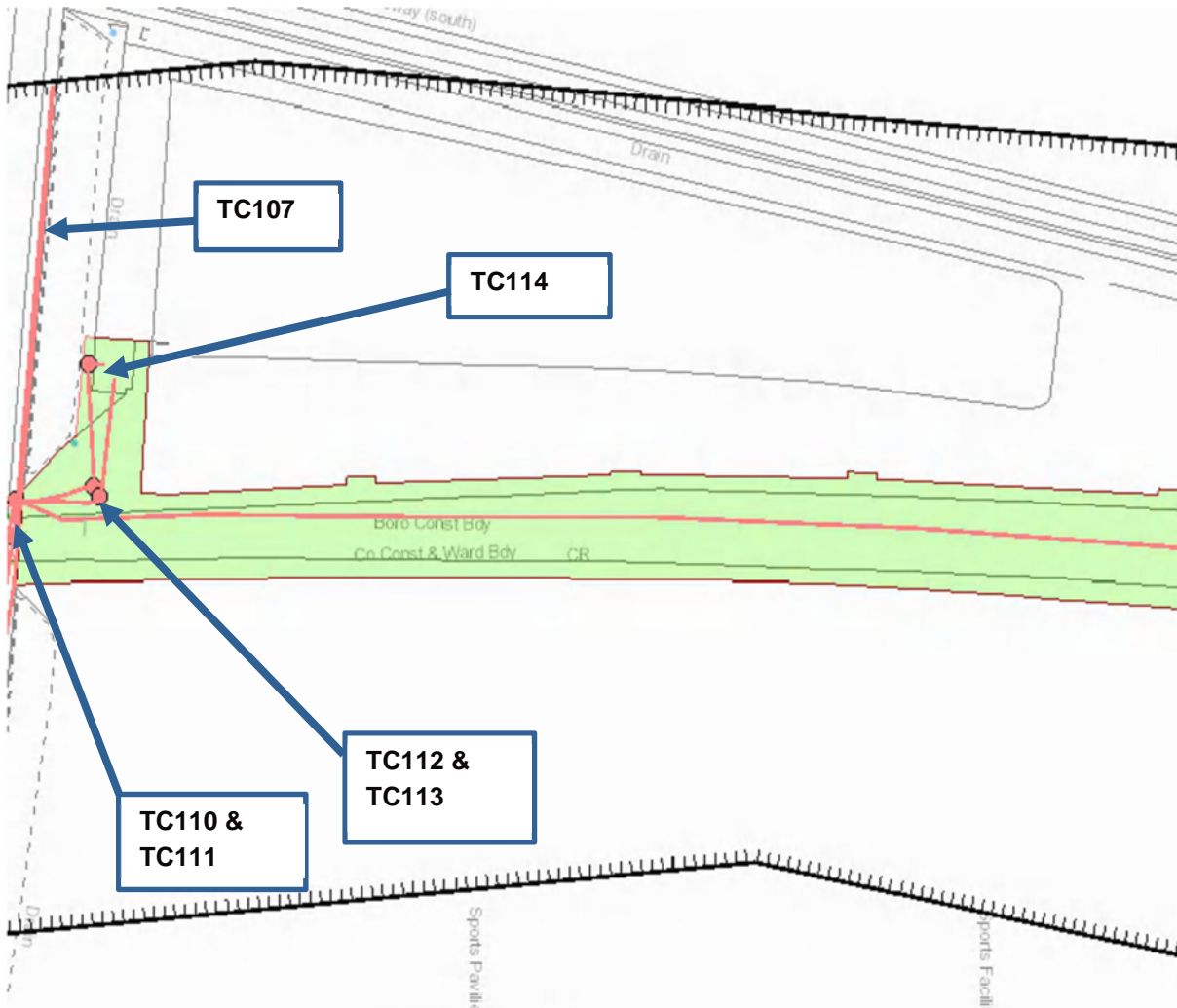


Figure 78 – Electric cables south of BGK-1544c Nine Wells Bridge

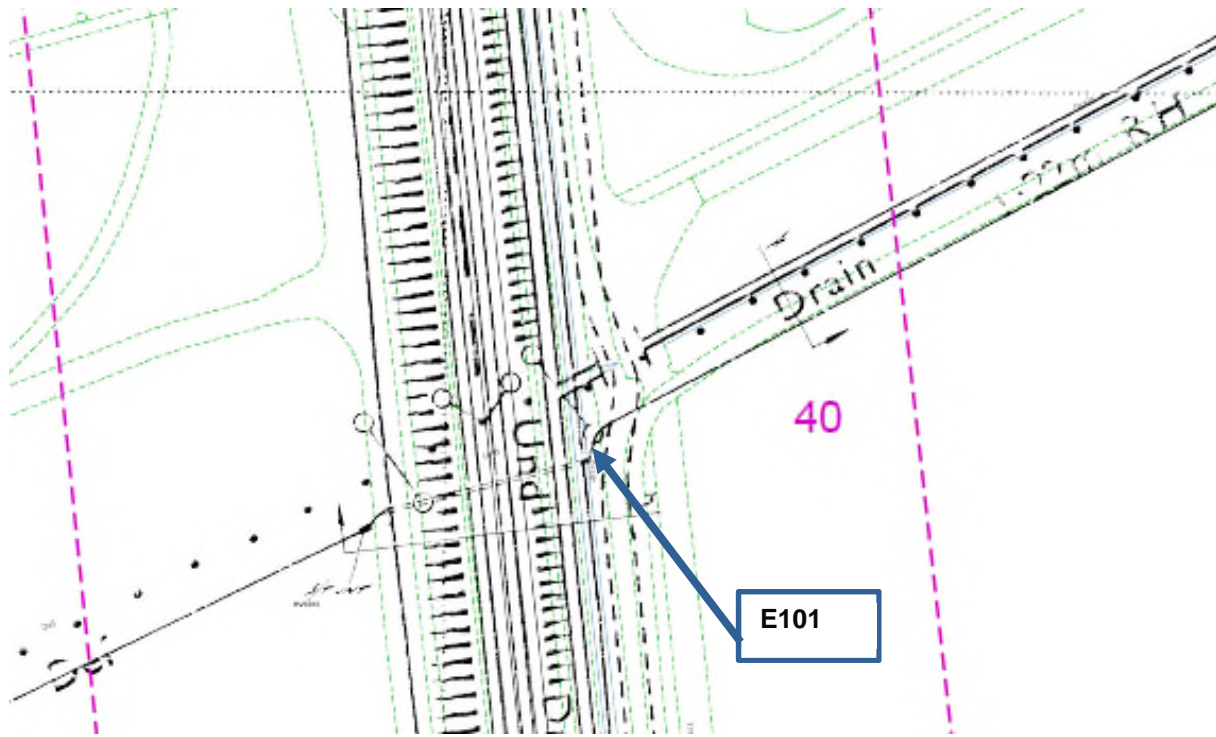


Figure 79 – Electric cables in the area surrounding BGK-1544c Nine Wells Bridge and Francis Crick Avenue

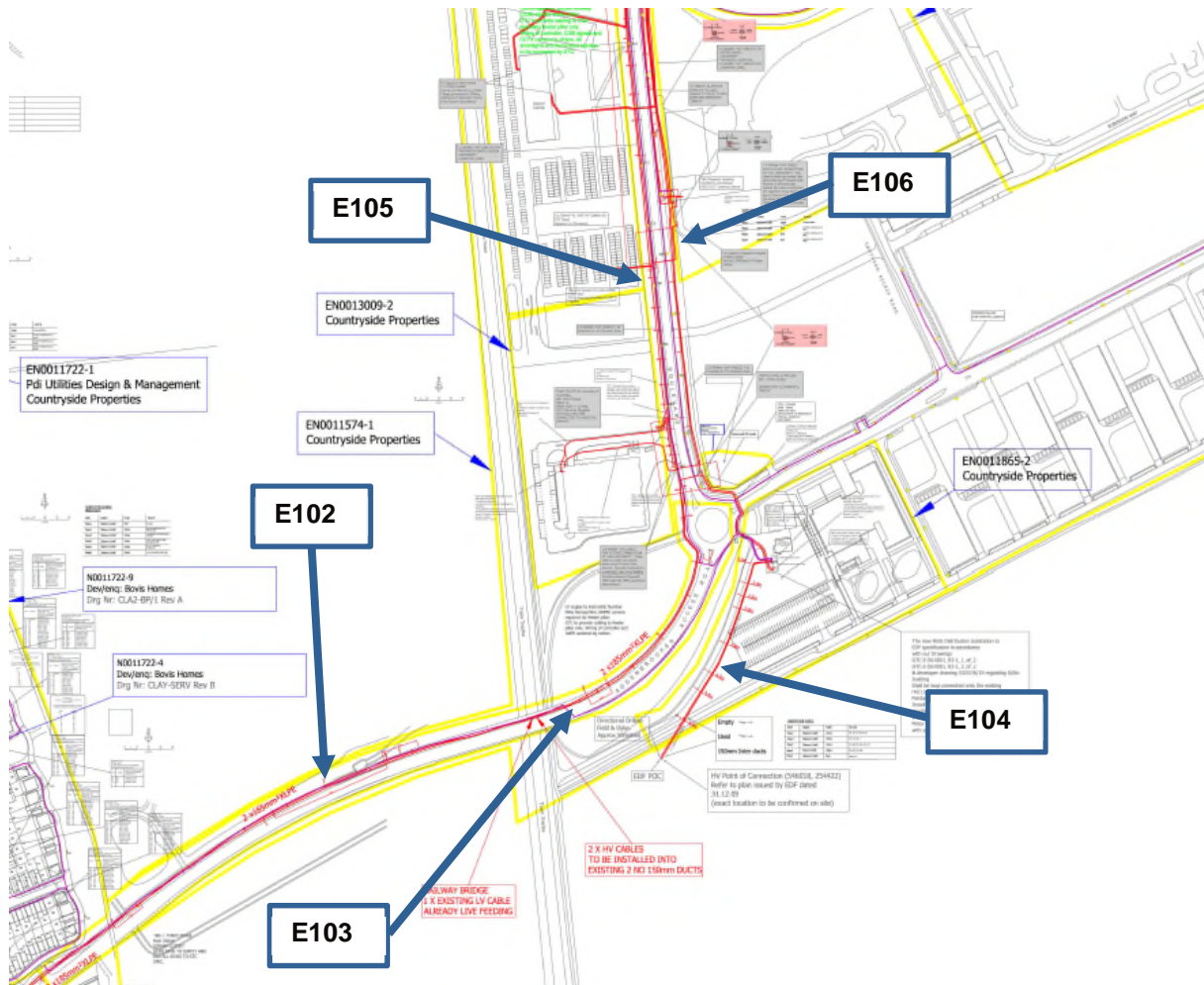
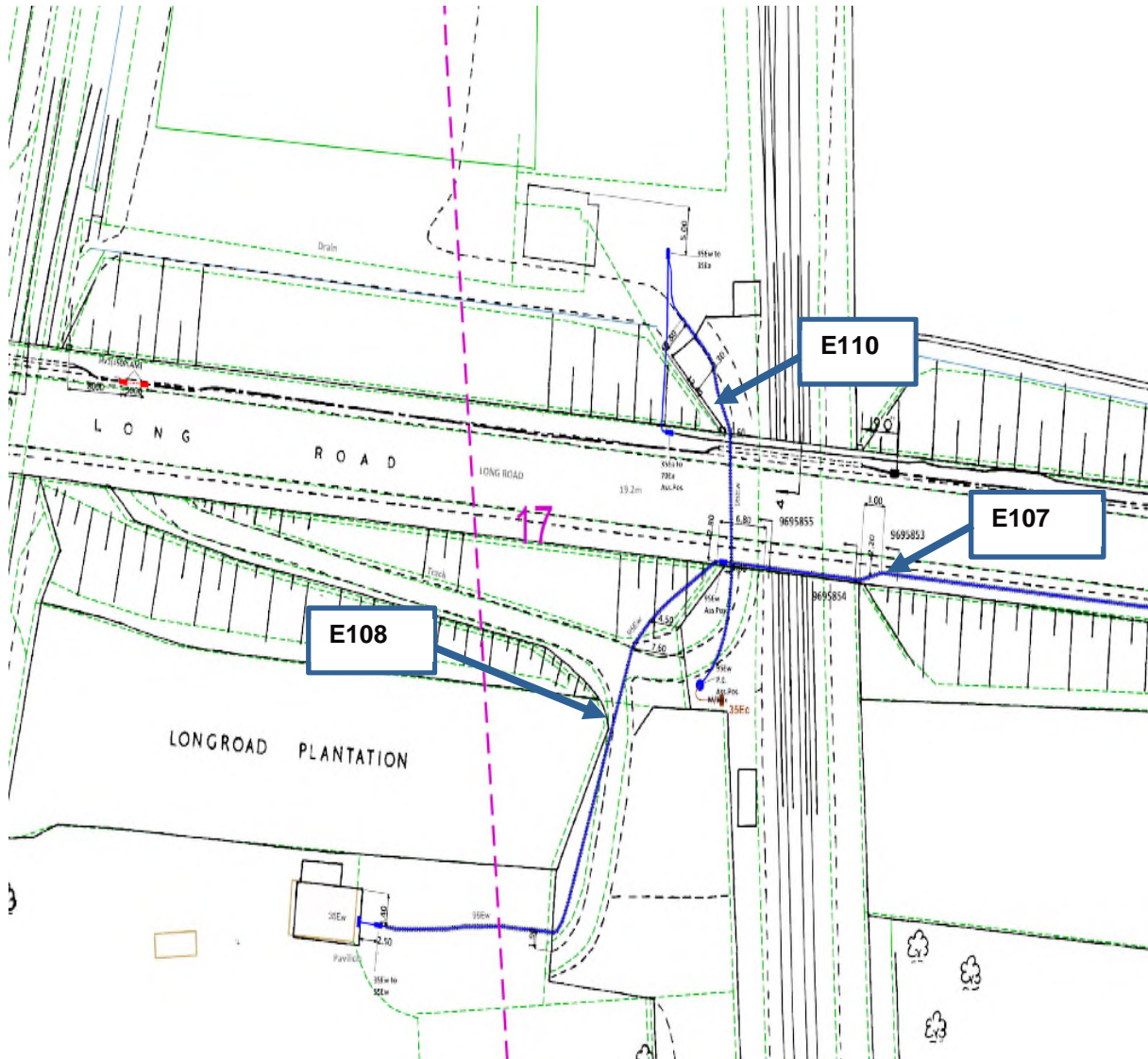




Figure 81 – Electric cables in the vicinity of BGK-1544a Long Road



[illegible]

Appendix E

Illustrative schedule of accommodation for station buildings

Figure 84: Indicative Room Schedules

Room No	Description	Area m2
Eastern Building		
E0.01	East Concourse	499
E0.02	Ticket Office including Station Control	27
E0.03	Cashing up area	6
E0.04	Manager's Office	6
E0.05	Staff Mess	16
E0.06	Staff WC and Shower	7
E0.07	Baby Change	5
E0.08	First Aid / Prayer Room	9
E0.09	Accessible WC	4
E0.10	Public WC (Ambulant)	3
E0.11	Public WC	3
E0.12	Changing Places WC	12
E0.13	Cleaners Room	4
E0.14	Mechanical Plant Room	16
E0.15	COMMS Room	13
E0.16	LV 2	9
E0.17	Gate line Equipment Room	3
E0.18	Storage / Water Booster (if required)	10
E0.19	Bin Store	15
E0.20	Retail Unit 1	16
E0.21	Riser	4
E1.01	Lift Motor Room 1	16

Room No	Description	Area m2
E1.02	Riser	4
E1.03	Area for potential Retail Kiosk	19
Island Platform		
P0.01	Lift Motor Room 2	14
P0.02	Cleaners Room	12
P0.03	Water Pressure Room	4
P0.04	Waiting Room 1	34
P0.05	Waiting Room 2	34
P1.01	Overbridge	314
Western Building		
W0.01	West Concourse	552
W0.02	Accessible WC	4
W0.03	Cleaners Room	5
W0.04	Staff Room	7
W0.05	Staff Room	10
W0.06	Retail Unit 2	16
W0.07	Substation	25
W0.08	LV1	16
W0.09	Back up supply	21
W0.10	Meter Room	3
W0.11	Store	9
W0.12	Gate line Equipment Room	3
W0.13	Riser	4
W1.01	Lift Motor Room 3	16
W1.02	Riser	4
W1.03	Area for potential Retail Kiosk	19