Plumpton Level Crossing Renewal GRIP3 Study

Final Issue

28th February 2011

Plan Design Enable

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Plumpton Level Crossing Renewal

GRIP3 Study

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1. Executive Summary

Plumpton level crossing is located in East Sussex between Keymer and Lewes on the Eastbourne line. The crossing is over 100 years old and is due for renewal due to the condition and obsolescence of the existing gate operated and locking equipment. The signal box (and station) is grade II listed, and so any alteration of the signal box or removal of the gates requires building consent. There is also significant local opposition to any proposals to replace the gates with barriers.

This report outlines the different options under consideration for the crossings renewal. The options are: a like for like renewal of the existing gated crossing (option B); remote control of the gated crossing (option C); and replacement of the gated crossing with a modern MCB crossing (option A). The report reviews and discusses the technical, reliability, heritage and regulatory issues and considerations associated with each of the options, and then recommends a preferred option.

Option B was discounted as it would involve the refurbishment and renewal of the existing crossing which is over 100 years old. Retaining the existing crossing would present a significant maintenance concern and would require a supply of bespoke parts to prevent any major delays during repairs. This would also incur increased maintenance costs. As the existing crossing is non compliant with modern standards it is also considered to present a greater risk to its users compared to a modern day equivalent i.e. an MCB crossing.

Option C was discounted as it was considered to present a greater risk to both road and railway users due to its non standard system – the mixture of old and new equipment and the remote control of the gates (i.e. no local signalman). The reliability of the crossing was also expected to be lower than that of an MCB due to the non standard system. Significantly, the option would require numerous changes to standards to allow for its implementation and this would be costly, time consuming and unlikely to be successful. Whilst the option would retain the existing gates, they could still potentially require alteration to accommodate new footpaths on either side of the road. The crossing would also need to be fitted with RTL’s, audible alarms, 3 No. CCTV cameras, floodlights on the crossing and on the approach roads, and an REB in the ZN corner. All of which would detract from the exiting character of the crossing.

Option A was selected as the recommended option as it provides a fully compliant crossing that is widely used on Network Rail infrastructure today. The crossing would not require any product approvals, derogations or changes to standards. The maintenance regime would also be standard and no bespoke parts would need to be produced or stocked specifically for the crossing. For all of the above reasons, the crossing presents the lowest reliability and risk concerns of all three options, and would most likely incur the lowest maintenance costs. The major drawback to the option relates to planning considerations as the existing gates would be replaced and the gate wheel mechanism would be taken out of service, although it could still be retained in the gate box, and the gate box itself would be retained. PPS5 Policy HE9.4 recognises that harm to heritage significance should be balanced with wider public benefits. The public benefits in this case would by the addition of footpaths, floodlighting and CCTV (improved security), more reliable barriers (i.e. can’t get stuck on road surface and if they were to fail, they would do so by closing the road off i.e. fail safe), and if any repairs were required they would be likely to be fixed more quickly due to the standard nature of the equipment and thus reduce the overall disruption to the public.

2. Introduction

2.1. Background

Plumpton Level Crossing is located in the village of Plumpton in East Sussex. It is situated beyond the end of the platforms at Plumpton Station which lies on the Keymer to Lewes section of the Eastbourne Line, and is also located near to Plumpton to racecourse.

Plumpton Signal Box is located adjacent to the level crossing and operates the crossing gates by means of a gate wheel. Wicket gates were also originally provided for pedestrians when the signal box first opened, however they have since been taken out of use and the controlling lever in the box is now painted as a spare. In 1985, the Signal Box became a Gate Box within the Three Bridges Signal Control Centre area and the crossing gates were retained.

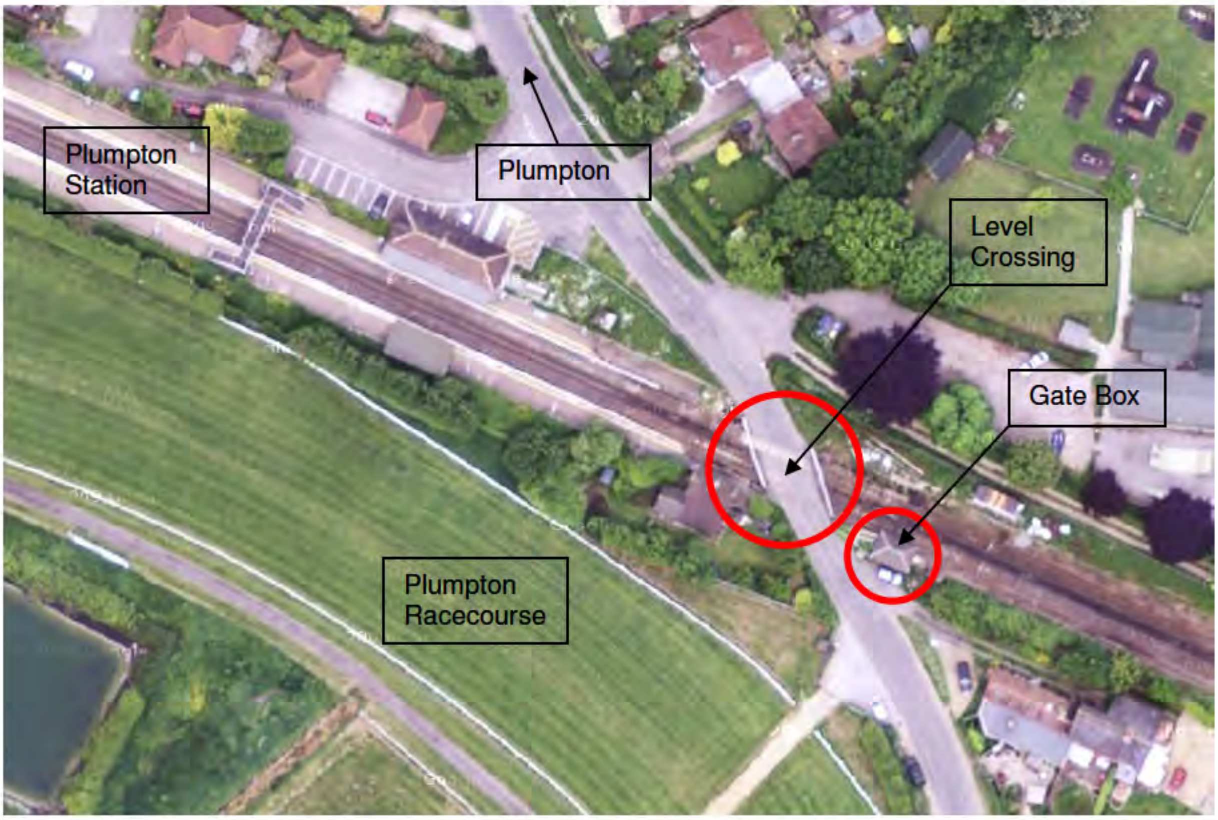


Figure 2.1. Plan view of Plumpton Level Crossing and Station

In 1979 the signal box was made a grade II listed building, cited as *a good example of a small mid 19th century signal box*. It is also deemed that anything within the curtilage of the box (which includes the gates) are also considered to be listed.

Under the normal conditions the crossing is lightly used by road vehicles and pedestrians, however on race days there can be considerable pedestrian traffic over the crossing.

Figure 2.2. View of Signal Box from South side of crossing (level crossing can be seen to left of signal box)

Figure 2.3. View of Level Crossing from Signal Box (Plumpton Station is in background of picture)

2.2. Scope of Study

Plumpton crossing is over 100 years old and requires renewal. Under normal circumstances Network Rail would convert the crossing to a remotely controlled manual barrier crossing using CCTV (MCB-CCTV) or the new Obstacle Detection System (MCB-OD). However, as the gate box is a grade II listed building, building consent is required for removal of the gates and any alterations to the box. Additionally there is significant local opposition to any proposal for replacing the gates with barriers.

The renewal project is driven by condition and obsolescence of the gate operating and locking equipment. The gate wheel, gears, guides and road stops are worn; most of the components are obsolete or non-standard and are unavailable from stock, meaning that specialist manufacture would be required to refurbish or renew the crossing like for like.

The purpose of this GRIP3 study is to assess the significance of the gate box as a heritage asset and the impact that replacing the gates with barriers would have on the heritage asset, and to assess the practicality of a complete renewal of the crossing as a gated crossing in its current form and the feasibility of renewing the crossing as a gated crossing but remotely controlled from another location.

In summary the following three options are to be considered:

a.) Barrier crossing remotely operated with either CCTV or Obstacle Detection

b.) A gated crossing locally operated – like for like renewal

c.) A gated crossing remotely operated – novel solution

Each option will also be reviewed against some or all of the following areas:

- Technical (all options)
- Compliance (all options)
- Reliability (all options)
- Use of additional protective measures (options b and c)
- Feasibility (option c)
- Safety (option c)

Conclusions will be made for each option and an overall recommended option will be identified.

Further activities required during GRIP stage 4 and 5 will also be highlighted.

3. Existing Arrangement

3.1. General Description

3.1.1. History of Plumpton Level Crossing

The Keymer to Lewes line of the London Brighton & South Coast Railway (LB&SCR) opened in 1847, with a level crossing at Plumpton Green. It is likely that the crossing keeper's house, No. 16, also dates from 1847 (figure 3.1).[1] The house is of a standard design found along the coast line; for example a historic photograph of 1906 shows a similar crossing keeper's house at Southbourne Halt in Sussex (figure 3.2). It is not known how the crossing gates were opened and closed when the railway first opened before the wheel mechanism was installed but is likely that this was done manually on foot by the crossing keeper.

A station and goods yard opened at Plumpton in 1863. These structures are evident on the OS map of 1873 (figure 3.3). The station and waiting room on the other side of the line are weatherboarded buildings, the former has a wide eaves cornice with iron brackets and the latter with a wide overhanging canopy over the platform. It is likely that these structures and the iron footbridge across the line date from 1863 (see figures 3.6 and 3.7).

The signal box was constructed in 1891, so is evident on the OS map of 1897 (figure 3.4). This was designed by LB&SCR but copied Saxby & Farmer designs, the company which supplied most signal boxes to the Railway; for example an historic photograph of c. 1910 shows a signal box by Saxby & Farmer at Streatham which is similar to that at Plumpton (figures 3.8 and 3.9). There is a similar, earlier example of a signal box designed by LB&SCR at Bedhampton Crossing, which was also built in brick to the window line with a decorative roof ventilator, but has ornamental valance work which Plumpton signal box does not (note; neither Streatham or Bedhampton Signal Boxes are listed, and the latter has been converted to an MCB-CCTV crossing). The Plumpton signal box originally contained a 21-lever frame, also designed by LB&SCR and emulating Saxby & Farmer designs (figure 3.10).[2] It is likely that the wheel operated mechanism for the crossing gates was installed at this point and dates from 1891 (figures 3.12, 3.18 and 3.19).

Figure 3.1 (left). The crossing keeper's house, No. 16, is likely to date from 1847

Figure 3.2 (right). The crossing keeper's house at Southbourne Halt is of a similar design

[1] In *The Railways of Southern England: The Main Lines* Edwin Course states that the crossing keeper's house at Plumpton is: 'probably contemporary with the opening of the line.'
[2] http://www.signalbox.org/gallery/s/plumpton.htm

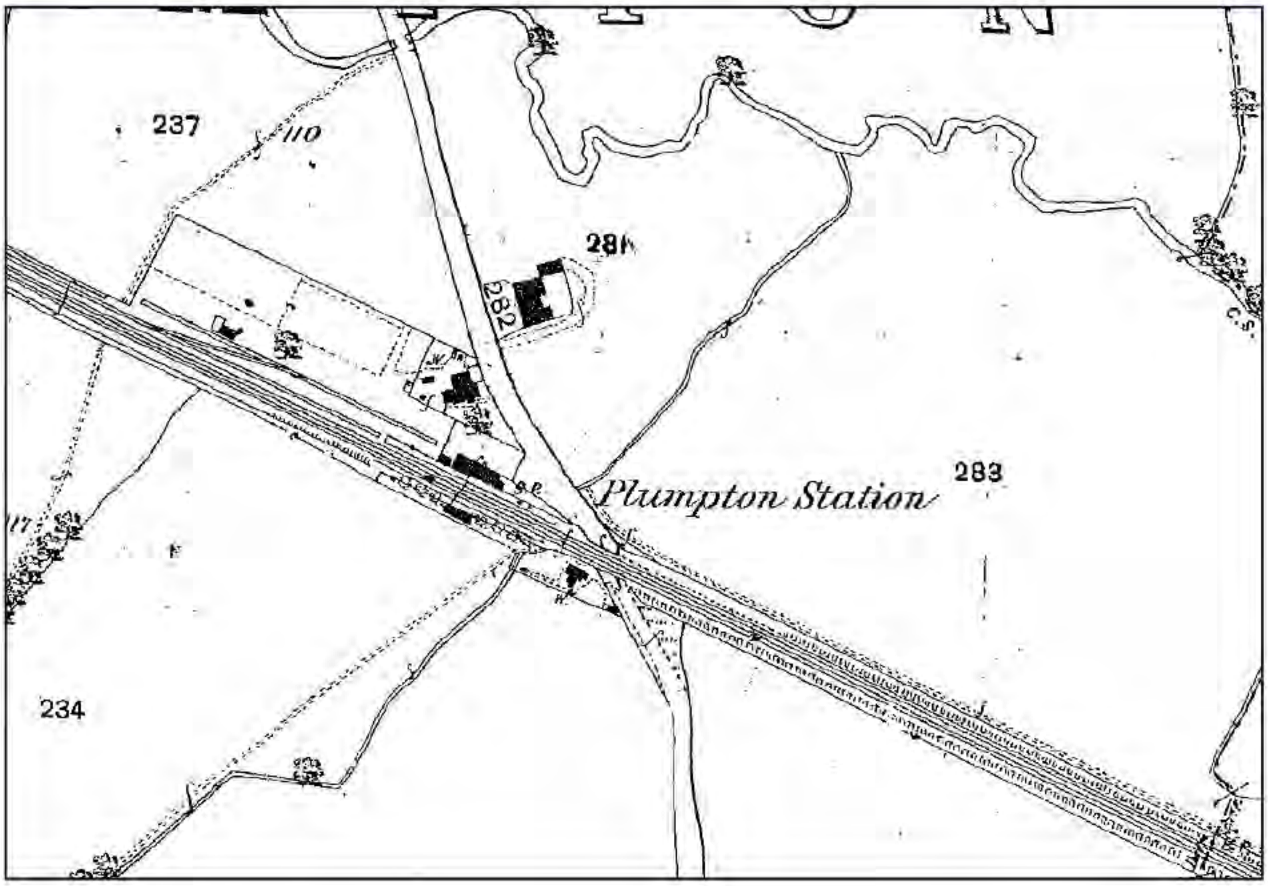


Figure 3.3. 1873 OS map

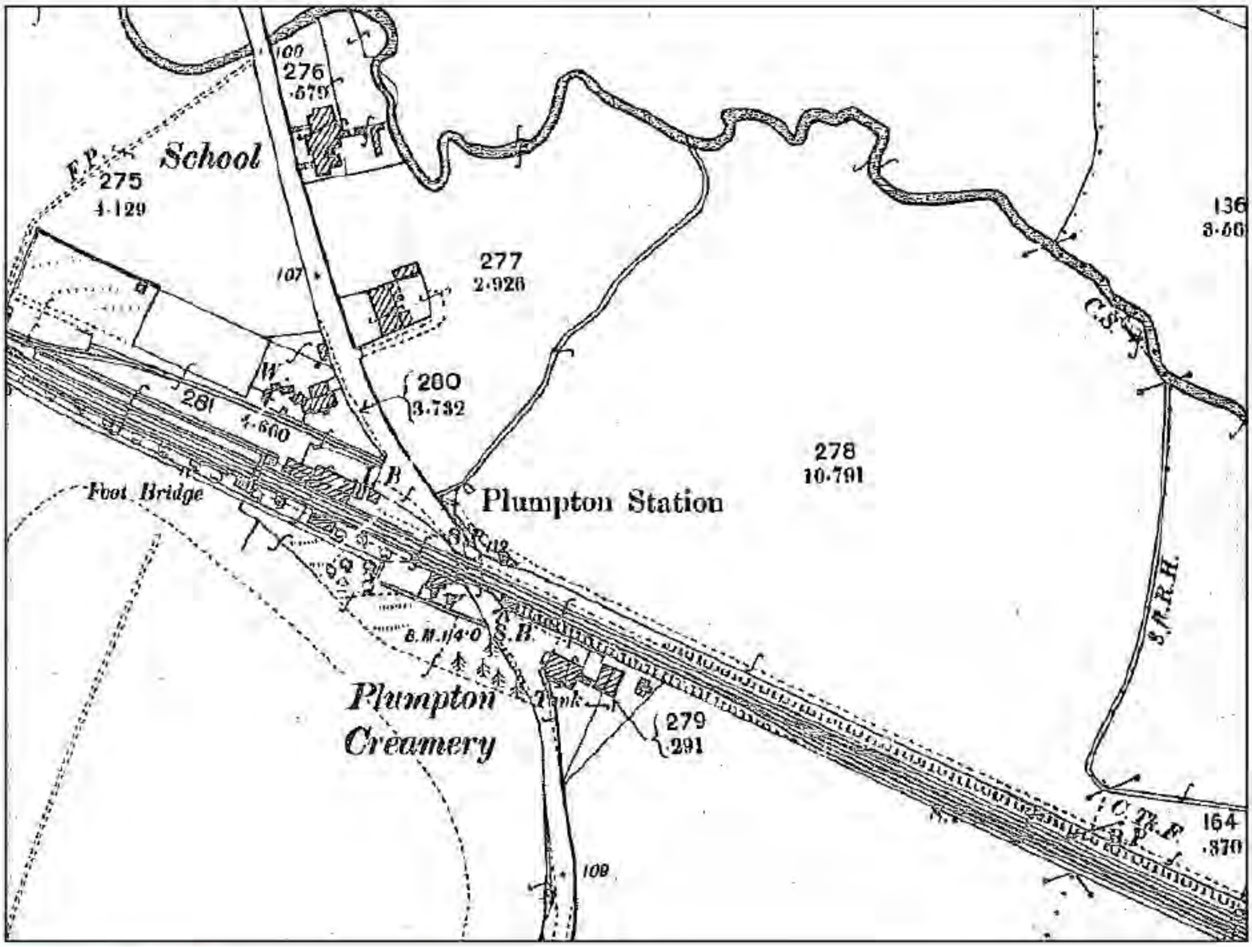


Figure 3.4. 1897 map

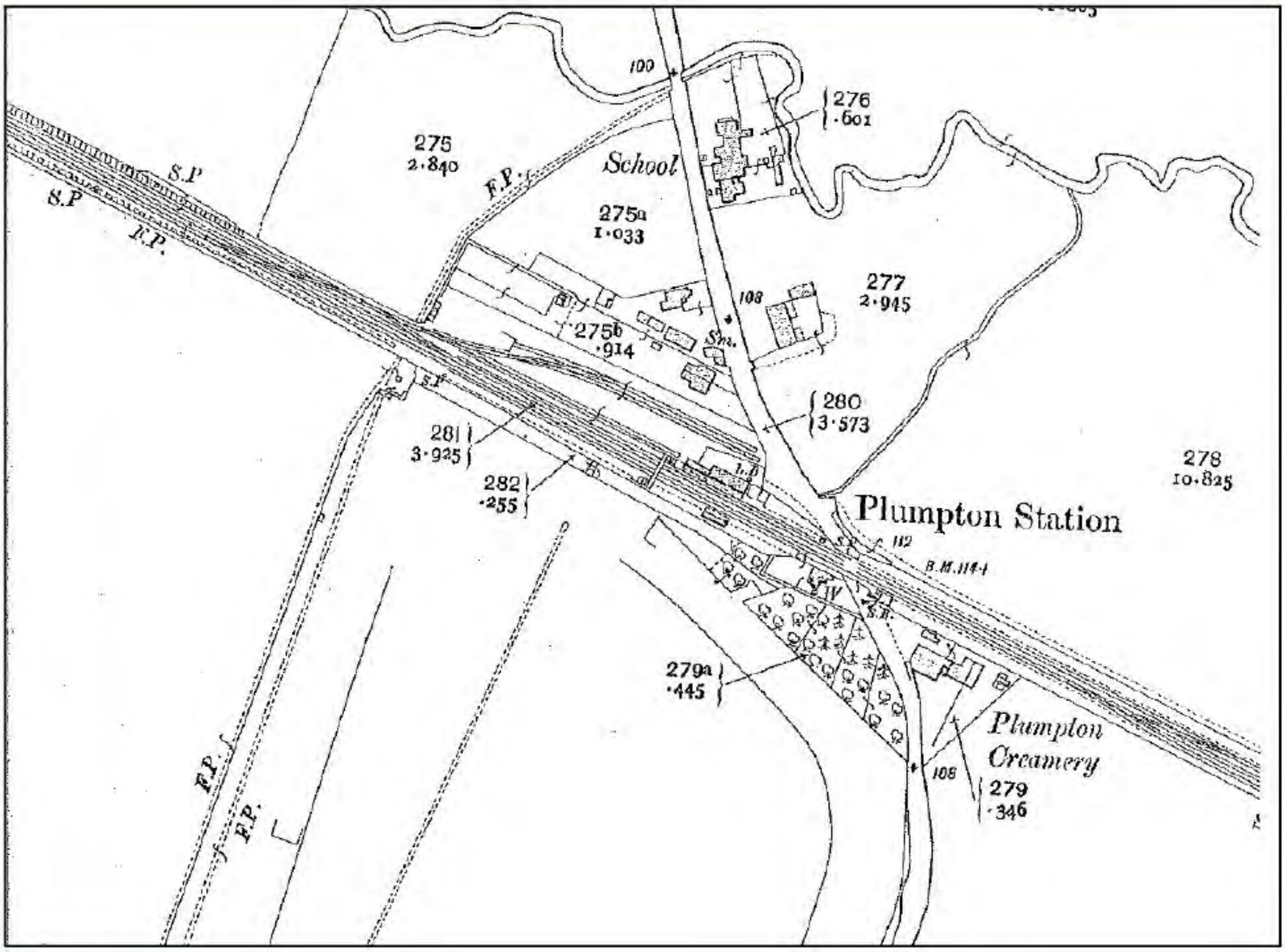


Figure 3.5. 1910 map

Figure 3.6 (left). Plumpton Station dates from 1863

Figure 3.7 (right). The footbridge at Plumpton is also likely to date from 1863

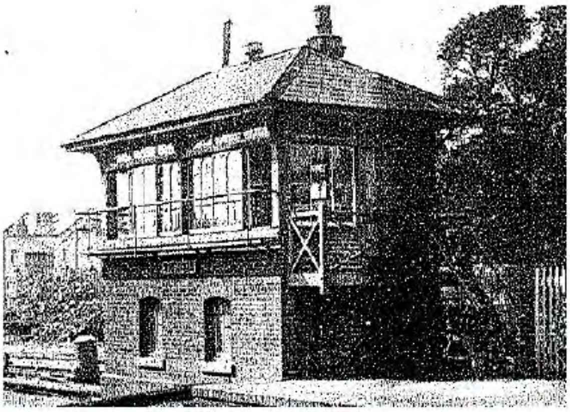


Figure 3.8. Streatham signal box, constructed 1885. Photo c.1910. Saxby and Farmer design 5

Figure 3.9. Plumpton signal box was designed by LB&SCR but copies to Saxby and Farmer design

A horse race was first held in Plumpton in 1884. The success of the race course meant that *c.* 1950 the station platforms were extended and a new footbridge added across the tracks to the west of the original footbridge to deal with race crowds.[3]

Following the Beeching Review in 1963 it was proposed that Plumpton Station would close. However, following a local campaign the station was saved, but the goods yard closed at this point.[4]

Circa 1985 the majority of the signals were automated at Plumpton and as a result the majority of the levers were removed from the signal box (see figures 3.10 and 3.11); however, the signal box continued to be used to manually operate the crossing gates. At this point British Rail proposed to demolish and then to relocate the signal box but both proposals were rejected on heritage grounds and due to local opposition (see further details in section 7.4).

Figure 3.10. The original 21 lever frame in Plumpton signal box

Figure 3.11. Most of the levers were removed c. 1985 and only four survive

3.1.2. Description of the signal box and gates

A visual inspection of Plumpton signal box and gates was carried out on 25 November 2010 to assess the date of the fabric.

3.1.3. Signal box

The signal box is two storeys, with the upper storey in weatherboarded timber on a single storey brick base. The base is constructed from stock brick with red brick quoins and lacing courses. The upper storey has sliding sash windows to three sides and is topped with a hipped roof with a decorated ventilator cowl with a pointed finial in its centre. The staircase is located on the west elevation and is in very good condition suggesting that it may have been restored, although it retains the original iron brackets. There is evidence that there was originally a window in the ground floor of the west elevation, which is now blocked. The brackets of the staircase are fixed to this blocked window (figure 3.13), which may indicate that the position

[3] *About Plumpton*, 1996
[4] *Ibid*

of the stair has changed. However, the OS map of 1910 (figure 3.6, which is more detailed than the earlier OS maps) indicate that the stair was in the current position at this date, so the analysis is inconclusive.

The interior of the signal box was altered when the levers operating the signals were removed *c.* 1985; however it retains the original lever frame, four original levers and the original capstan wheel mechanism, which control the signals, points and crossing gates. These controls are used to shut the crossing to vehicular traffic when trains are passing through, and to allow engineering trains to change tracks.

Figure 3.12. The original 1891 capstan wheel for operating the gates survives

Figure 3.13. There was originally a window at ground floor level which has been blocked, which may indicate the position of the stairs has changed.

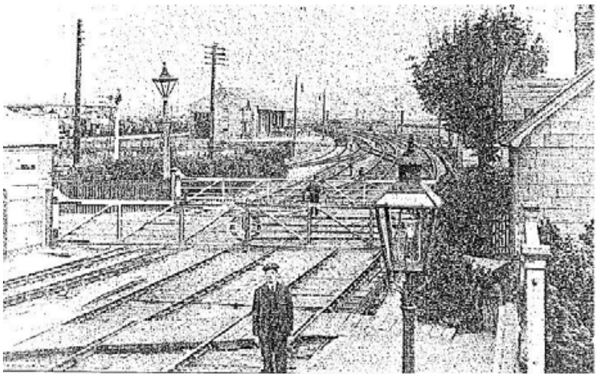
3.1.4. Crossing gates

The crossing gates at Plumpton are crossbar stile gates (figure 3.1). The gates are also of the same style as those used at Isfield crossing, East Sussex, which was constructed in the 1840's. According to the listing for Isfield level crossing and gates it states that "the same set of level crossing gates that were in existence before 1969 remain intact, and are included in the listing. They are of a traditional design that dates from the 1840's". This would suggest that the design of the gates at Plumpton are also of the original design. The gates at Isfield level crossing are shown in figure 3.14.

Figure 3.14. Gates at Isfield Signal box in East Sussex (constructed circa 1840)

Historic photographs of gates at Southbourne (figure 3.2), Newhaven (figure 3.15) and Woodgate (figure 3.16) are shown below. All these crossing have six bar stile gates, however they are located on a different branch line.

A visual inspection of the gates suggests that the majority of the fabric has been replaced during repairs and restoration. The gate posts are of reinforced concrete suggesting they are postwar replacements (see figure 3.17). The ironwork on the gates appears to be original and includes heavy strap hinges; however, the timber has been replaced during repair work (see figure 3.18). A handwritten note on the timber lever frame states that all four gates were last renewed in August 2004 by RJB Engineering.



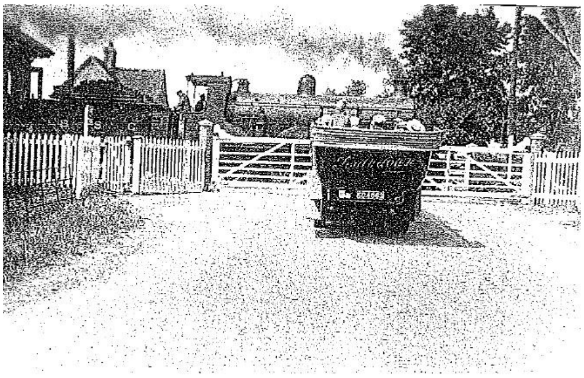


Figure 3.15. Note six bar stile gates at Newhaven in 1909

Figure 3.16. Similar six bar stile gates at Woodgate Crossing c. 1920

The mechanism dates from 1891 (see figures 3.19 and 3.20), although the signalman on site explained that the cog closest to the crossing keeper's house was replaced recently with a salvaged cog from another crossing. A handwritten note on the timber lever frame states that the gate equipment was renewed and refurbished in June 1997 by RJB Engineering.

Figure 3.17. The gate posts have been replaced with reinforced concrete posts in the postwar period

Figure 3.18. The ironwork on the gates appears to be original although the timber was replaced in 2004

Figure 3.19. The 1891 mechanism for opening the gates survives and is still in use.

Figure 3.20. A system of cogs open the gates.

3.1.5. Listed Status

Plumpton Station and the signal box were grade II listed in 1979. They are separately listed. While the crossing gates are not mentioned in either list description, they are associated with the station and signal box and date from prior to 1948 so are considered to be curtilage listed structures. Further details regarding the implications of this listed status are provided in section 7.

3.2. Mechanical and Electrical Description

The hand-operated gate wheel in the gate box operates a worm drive mechanism installed in the under croft of the box. This in turn operates the ground lever system from a single point at the signal box which moves the crossing gates and operates other ancillary components, including the gate stops in the middle of the road via an escapement arrangement. As the road crosses the railway on the skew, the angle through which the gates swing differs from one gate to another. This is accommodated by having different stroke on the gate cranks.

The frame interlocking confirms that the drive rod has moved the required distance to have moved the gates to the required position but there is no detection on the gates to prove that they have moved to the correct position. The Crossing Keeper observes that the gates have moved fully and that they are held in position by the gate stops. He also observes that the gate lights are illuminated.

The wicket gates are locked by a separate lever and are no longer in use.

There are currently 2 No. TP&N DNO electrical supplies to the site. These are housed in stainless steel metering/distribution cubicles on land adjacent to the railway station. One cubicle serves domestic LV electricity to the station areas and the second serves the signal box and the CSR mast. The supply to the second cubicle is a 100A TP&N metered service and there is a large percentage of spare capacity available.

Record data held in the signalling REB in the downside cess to the East of the level crossing confirms that provision for a 650V signalling supply has also been made at the crossing. It is understood that this was for the provision of automatic half barriers that were never installed.

Figure 3.21. Hand Operated Gate Wheel in Plumpton Gate Box

Figure 3.22. Ground Lever System on Up Side (West Side of Crossing)

Figure 3.23. Worm Drive in under croft of Plumpton Gate Box

3.3. Signalling Description

The line is currently controlled from Three Bridges Area Signalling Control (ASC). An extract of the current signalling plan is shown as figure 3.24.

The control panel at Three Bridges incorrectly shows an AHB crossing at Plumpton as shown in figure 3.25. The Up Line siding and Ground Frame are shown on the panel but have been removed from site and no longer appear in the Sectional Appendix.

Signal T645 on the Down Line is slotted by Plumpton Signal Box. The signal is plated as a Semi Automatic signal on site and has controls associated with a Semi Automatic signal on the panel at Three Bridges. It is assumed that the signal was designated a Semi Automatic signal due to the presence of a Ground Frame in the route even though Signal T800 is situated between T645 and the ground frame.

Signal T800 on the Up Line appears to have been added relatively late in the design of the scheme as the number is out of sequence. The signal is shown on a temporary patch on the panel. Signal T648 on the Up Line is plated as a Semi Automatic even though T800 is between T648 and the ground frame. The current arrangement is also unusual in that the track circuits between T648 and T646 are indicated at Three Bridges as a single track.

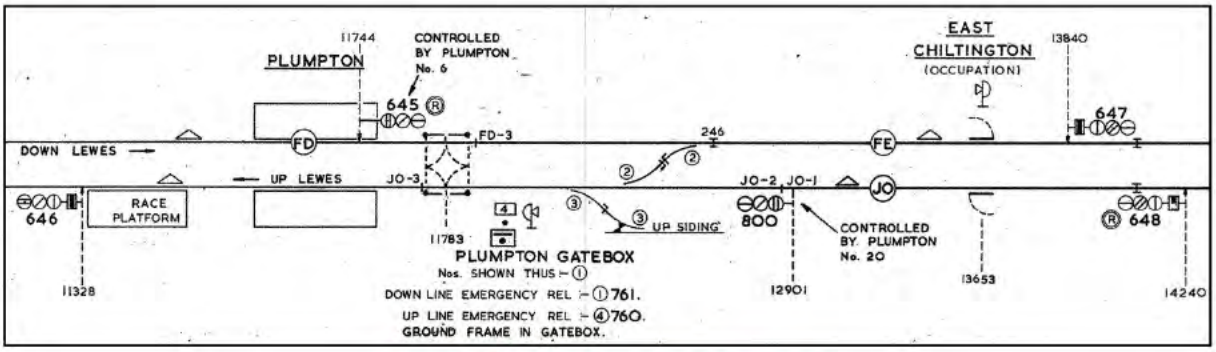


Figure 3.24 Extract of current signalling plan

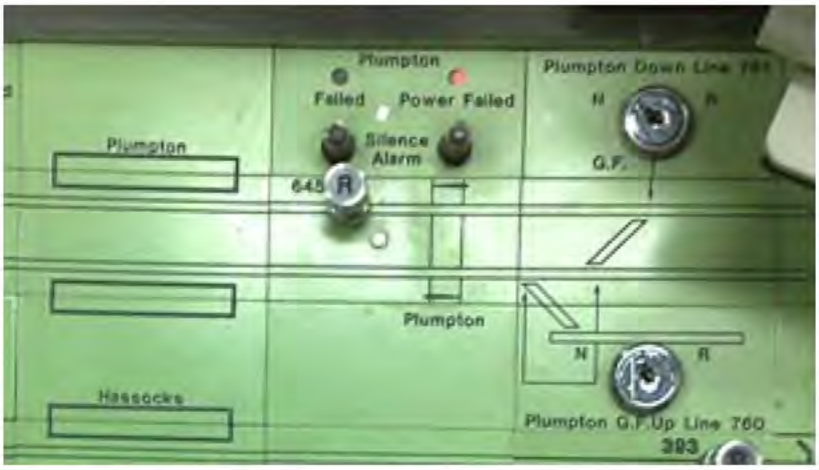


Figure 3.25 Three Bridges panel – Plumpton Crossing

Figure 3.26 Three Bridges indication panel for Plumpton Crossing

The Indication panel at Three Bridges (figure 3.26) has ‘temporary’ type patches applied that correctly show Plumpton as a Gated Crossing with local Gatebox. However even these patches are slightly incorrect as they show the now disused wicket gates as present on site.

Plumpton area is controlled from a remote interlocking at Haywards Heath. The interlocking is Westpac Mk IVA. It is linked to Three Bridges by a TDM 69 remote control link. FDM Type RR systems at Plumpton for the ground frame releases and the AHB controls and indications.

Plumpton gate box controls the two signals protecting the crossing. Signal T645 is 25 metres from the nearest part of the crossing on the Down Line and Signal T800 is 1021 metres from the crossing on the Up Line. There is an emergency crossover worked from the Gate Box between the protecting signal on the Down Line and the level crossing. Moves over this crossover are unsignalled.

Plumpton Signal Box has a 21 level frame with 5 levers remaining in-situ. 4 remain in use and one is spare. The illuminated diagram in the signal box correctly shows the signalling arrangement with the exception of the out-of-use wicket gates which are shown as being present. The illuminated diagram also shows all three sections of Track Circuit JO separately, whereas they are shown as combined at Three Bridges.

The Ground Frames consist of a switch panel on the block shelf.

Figure 3.27 Plumpton Signal Box showing illuminated diagram

Figure 3.28 Plumpton Signal Box showing lever frame and wheel

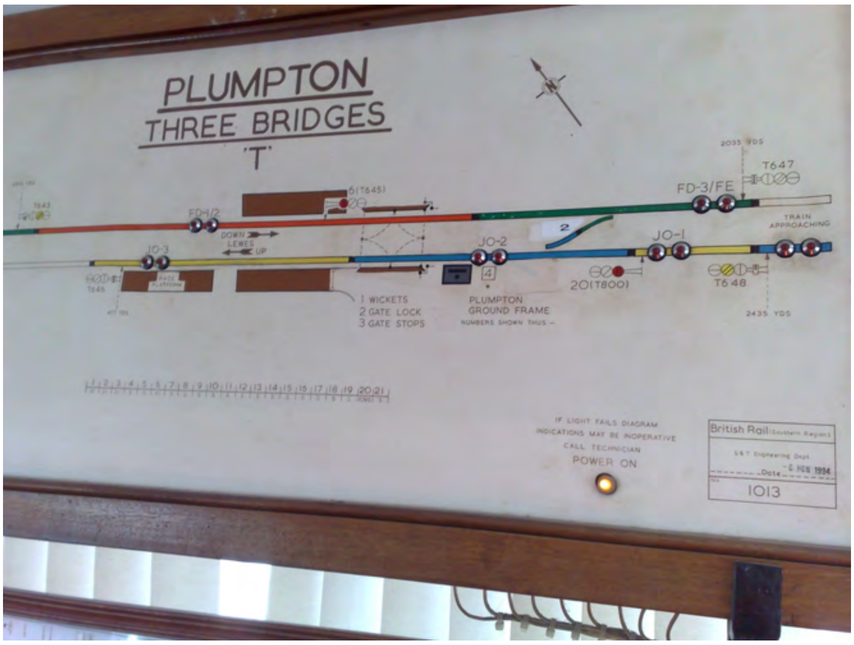


Figure 3.29 Plumpton Signal Box illuminated panel

There is also a switch panel on the block shelf (figure 3.29) that controls the Up line and Down line points for the emergency crossover and the recovered siding. Separate releases are provided from Three Bridges for:

- Up Line – siding (now recovered) and Up Line end of crossover
- Down Line – Down Line end of the crossover.

Figure 3.30 Plumpton Signal Box Ground Frame

Circuitry for the proposed AHB was discovered to be present at both Plumpton and Three Bridges even though the AHB was never installed. Partial recoveries of some cabling and external equipment at Plumpton appeared to have been undertaken and were marked up on the maintenance copies present on site. At least some of the AHB circuitry appeared to remain operational but further investigation of this was outwith the scope of the site survey.

A full condition assessment was not within the scope of the project. However the site surveys identified the following issues:

- Poor cross track cable routes.
- Poor cable management within Plumpton Gatebox.
- Lack of space in the superloc HH230.
- Drawings that do not match the current infrastructure.

Insulation degradation was recorded as Category 1 (Normal) or Category 2 (Fair)

The present arrangements do not meet current standards apparently due to the late decision to retain a gated crossing rather than install an AHB at the time of resignalling.

3.4. Telecoms Description

The existing Telecoms equipment for Plumpton level crossing has been identified and is listed below.

Plumpton Signal Box

- ETD Telephone (Tel No. 00 60476)
- Direct line to Three Bridges Area Signalling Centre

- ETD FAX (Fax No. 00 68201)
- ADSL Link 01273-891715 (BT Broadband link to support NR Intranet and TRUST)

Plumpton REB (Located at the opposite side of the track to Plumpton SB)
- ETD 00 60456 (SD1+ Voice recorder Eltek PSU Alarms)
- NiceCall Voice Recorder which records the above 5x Circuits
- 30 pr 0.9 copper cable with Approx 14 spare pairs.

Plumpton Level Crossing
There are no telephone facilities on Plumpton Level Crossing itself (i.e. no public all-weather telephones and no LCU – Local Control Unit telephone).

FTN Facilities
There is an FTN access node (Called Plumpton Station - 2270) located at 44miles 177Yards on ELR KJE1 which is positioned 790m Haywards Heath side of Plumpton Level crossing. This site is scheduled for completion on 30/6/11 and will be served by an STM-1 Subtend ring.

Three Bridges Area Signalling Centre (relative to Plumpton LC):
- Telephone Concentrator – Siemens series 300 HiCom touchscreen
- FTN Transmission access – STM-16 Core Node (2264) at Three Bridges Station
- Accommodation – There is a large S&T equipment room at Three Bridges Area Signalling Centre

3.5. Reliability Data

Faults
Information on faults at Plumpton LX covering the period from the beginning of 2005 to early 2010 (six years) has been provided by the National Level Crossings Delivery Unit, York. Also provided was similar information for the Haydon bridge crossing which was converted from a gated to a barrier crossing four years into the above period (this has been provided to allow comparison with an MCB crossing and will be further discussed in section 4).

The data has been reviewed to determine which faults are relevant to the crossing gates for both crossings. A summary of the date and relevance data for both crossings is provided as table 3.3 and table 3.4, which provides a month by month total of these incidents. An Excel workbook of both the full and extracted data, including the relevance review, is supplied as a separate file (Plumpton and Haydon Bridge Failure Data, 05 to 10 - plus relevant totals.xlsm) contained in Appendix G.

The total for these data are provided in Table 3.1 below.

	Period (months)	Period (hours)	Failures
Relevant Plumpton Failures	72	52584	101
Relevant Haydon Bridge Failures as MCG	48	35064	39
Relevant Haydon Bridge Failures as MCB	24	17520	4

Table 3.1 Total numbers of Failures for Plumpton and Haydon Bridge.

Faults are noted for the period spanning 01/01/05 to 31/12/10 inclusive. Taking time as the parameter for assessing failure rate, the average failure rate can be calculated.

However, with significant variations in intervals between failures or a small sample a more reliable failure rate is predicted using a Chi-squared distribution. For prediction of failure data, failure rates have been estimated using a Chi-squared distribution at 60th upper percentile, with degrees of freedom set at 2(n + 1), where n = no. of failures observed in test period/time at risk. On this basis, the predicted failure rates are as given in table 3.2, below.

	Failures / hour	
	Average	Chi squared
Relevant Plumpton Failures	1.9E-03	2.0E-03
Relevant Haydon Bridge Failures as MCG	1.1E-03	1.1E-03
Relevant Haydon Bridge Failures as MCB	2.3E-04	3.0E-04

Table 3.2 Failure rates for Plumpton and Haydon Bridge.

Note that, for a wholly mechanical system, the assumption of a constant failure rate is approximate for a system where wear can be significant. However, plots of the failures with time for both crossings do not show a trend that could be attributed to wear.

Repair times

Regarding repair times or times to return to service, although the repair completed time has been provided, the time to repair is often over 100 hours and in several cases over a 1000 hours. Clearly in these cases operation continued with the fault or a temporary repair made and the time to complete repair is not an indication of the out-of-service time.

Additionally, failure occurred time is always given as midnight – in other words, a date was recorded but not a time. So a failure repaired at 15:00 on the same day only indicates that the failed duration is between 0 and 15 hours (the shortest indicated time is 6.25 hours). As most failures will occur after service starts, and certainly won't have an effect on service until then, it would be reasonable to subtract, say, 6 hours from all times, but this would still be and would not address the significant aspect given in the paragraph above,

For these reasons no repair times, or mean repair times, have been calculated. In order to estimate the impact of failures at these crossings, it will be necessary to obtain an estimate of typical time to return to service from operational staff.

In order to make a comparison between local and remote control, the corresponding time to return to service should be obtained for both types of control.

Plumpton	
Occurred, date	Relevant?
04-Jan-05	Yes
04-Feb-05	Yes
18-Feb-05	
24-Feb-05	
14-Mar-05	
14-Mar-05	
15-Mar-05	
15-Mar-05	
19-Mar-05	
04-Apr-05	
11-Apr-05	Yes
14-Apr-05	
18-Apr-05	Yes
29-Apr-05	Yes
02-May-05	
11-May-05	Yes
21-May-05	Yes
25-May-05	Yes
21-Jun-05	Yes
22-Jun-05	Yes
24-Jun-05	Yes
06-Jul-05	
11-Jul-05	Yes
21-Sep-05	Yes
20-Nov-05	Yes
02-Dec-05	Yes
13-Dec-05	
23-Dec-05	
13-Feb-06	Yes
23-Feb-06	
25-Feb-06	
02-Mar-06	
29-Mar-06	
17-Apr-06	
20-Apr-06	Yes
26-Apr-06	Yes
03-May-06	Yes
25-May-06	
30-May-06	
10-Jun-06	Yes
14-Jun-06	Yes
30-Jun-06	
03-Jul-06	Yes
06-Jul-06	Yes
10-Jul-06	
10-Jul-06	
19-Jul-06	Yes
02-Aug-06	
11-Aug-06	Yes
29-Aug-06	
11-Sep-06	Yes
18-Sep-06	
19-Sep-06	Yes
27-Sep-06	
05-Oct-06	
12-Oct-06	
14-Oct-06	
17-Oct-06	
21-Oct-06	
27-Oct-06	Yes
07-Nov-06	
21-Nov-06	
04-Dec-06	
12-Dec-06	Yes
13-Dec-06	
15-Dec-06	
02-Jan-07	Yes
05-Jan-07	
15-Jan-07	
26-Jan-07	
04-Feb-07	
08-Feb-07	

Plumpton	
Occurred, date	Relevant?
13-Feb-07	Yes
16-Feb-07	
21-Feb-07	Yes
21-Feb-07	Yes
13-Mar-07	Yes
14-Mar-07	Yes
21-Mar-07	
10-Apr-07	Yes
12-Apr-07	
14-Apr-07	Yes
19-Apr-07	
19-Apr-07	
02-May-07	
03-May-07	
21-May-07	Yes
21-May-07	Yes
01-Jun-07	Yes
08-Jun-07	
16-Jun-07	Yes
22-Jun-07	Yes
25-Jun-07	
18-Jul-07	
11-Aug-07	
20-Aug-07	Yes
30-Aug-07	
04-Sep-07	Yes
08-Sep-07	
12-Sep-07	Yes
27-Sep-07	Yes
03-Nov-07	
08-Nov-07	
13-Nov-07	Yes
14-Nov-07	
01-Dec-07	Yes
21-Dec-07	
07-Jan-08	
09-Jan-08	Yes
15-Jan-08	
28-Jan-08	
31-Jan-08	
04-Feb-08	
20-Feb-08	Yes
02-Mar-08	
03-Mar-08	Yes
23-Apr-08	Yes
28-Apr-08	Yes
12-May-08	Yes
16-May-08	
17-May-08	Yes
30-May-08	Yes
02-Jun-08	
10-Jun-08	
18-Jun-08	Yes
30-Jun-08	
30-Jun-08	
05-Jul-08	Yes
09-Jul-08	
14-Jul-08	
14-Jul-08	
16-Jul-08	
24-Jul-08	
28-Jul-08	Yes
30-Jul-08	
05-Aug-08	Yes
20-Sep-08	
15-Oct-08	Yes
27-Oct-08	
08-Nov-08	Yes
06-Dec-08	Yes
10-Dec-08	Yes
13-Dec-08	
16-Dec-08	

Plumpton	
Occurred, date	Relevant?
07-Jan-09	
12-Jan-09	
17-Jan-09	
28-Jan-09	
18-Feb-09	Yes
05-Mar-09	
09-Mar-09	
15-Mar-09	Yes
17-Mar-09	Yes
31-Mar-09	Yes
01-Apr-09	Yes
02-Apr-09	Yes
10-Apr-09	
10-Apr-09	
13-Apr-09	Yes
16-Apr-09	Yes
20-Apr-09	Yes
21-Apr-09	
24-Apr-09	Yes
27-Apr-09	Yes
30-Apr-09	Yes
09-May-09	Yes
28-May-09	Yes
15-Jun-09	Yes
18-Jun-09	
19-Jun-09	Yes
30-Jun-09	Yes
16-Jul-09	
05-Aug-09	
23-Aug-09	Yes
03-Sep-09	Yes
13-Sep-09	Yes
24-Sep-09	
07-Oct-09	
11-Nov-09	
20-Nov-09	
23-Nov-09	
03-Dec-09	Yes
05-Dec-09	
07-Dec-09	Yes
09-Dec-09	Yes
10-Dec-09	
16-Dec-09	
19-Dec-09	
20-Dec-09	Yes
04-Jan-10	Yes
06-Jan-10	Yes
10-Jan-10	Yes
12-Jan-10	
01-Feb-10	
10-Feb-10	Yes
24-Feb-10	
01-Mar-10	Yes
05-Mar-10	Yes
11-Mar-10	
16-Mar-10	
29-Apr-10	
14-May-10	Yes
02-Jun-10	Yes
12-Jun-10	Yes
30-Jun-10	
19-Jul-10	
27-Jul-10	Yes
12-Aug-10	
13-Aug-10	Yes
01-Sep-10	Yes
17-Sep-10	
29-Sep-10	
24-Oct-10	
16-Nov-10	
29-Nov-10	
01-Dec-10	Yes

Haydon Bridge	
Occurred, date	Relevant?
21-Mar-05	
13-Apr-05	Yes
23-Apr-05	Possible?
09-May-05	Yes
04-Aug-05	Yes
28-Nov-05	Yes
29-Dec-05	Yes
17-Mar-06	Wicket
19-Apr-06	Wicket
23-Apr-06	Yes
11-May-06	Yes
22-May-06	Possession incident
28-May-06	Yes
04-Jun-06	Possible?
08-Jun-06	Yes
26-Jun-06	Yes
16-Jul-06	Yes
22-Jul-06	Yes
28-Nov-06	Yes
13-Dec-06	Yes
04-Jan-07	Yes
13-Feb-07	Yes
22-Feb-07	Yes
28-Feb-07	Yes
12-Mar-07	Yes
15-Mar-07	Yes
01-Apr-07	Yes
17-Apr-07	Not a failure
07-Jun-07	Yes
14-Jun-07	Yes
15-Jun-07	Yes
01-Aug-07	Yes
19-Sep-07	Yes
23-Sep-07	Wicket
09-Oct-07	Yes
16-Dec-07	Yes
18-Jan-08	Yes
28-Jan-08	Yes
06-Feb-08	Yes
14-Feb-08	Yes
21-Feb-08	Yes
04-May-08	Yes
28-May-08	
04-Jul-08	Wicket
14-Jul-08	Wicket
27-Aug-08	Yes
29-Sep-08	Yes
19-Oct-08	Yes
02-Nov-08	
20-Nov-08	Maintenance
27-Nov-08	Yes
12-Dec-08	Yes
13-Feb-09	Yes
16-Feb-09	Yes
09-Apr-09	Yes
31-May-09	Yes

Table 3.3 All failures by date for Plumpton and Haydon Bridge and their relevance.

Failures by month - both crossings			
Month	Plumpton	Haydon Bridge	
	failures	LC type	failures
Jan-05	1	MCG	
Feb-05	1	MCG	
Mar-05		MCG	
Apr-05	3	MCG	1
May-05	3	MCG	1
Jun-05	3	MCG	
Jul-05	1	MCG	
Aug-05		MCG	1
Sep-05	1	MCG	
Oct-05		MCG	
Nov-05	1	MCG	1
Dec-05	1	MCG	1
Jan-06		MCG	
Feb-06	1	MCG	
Mar-06		MCG	
Apr-06	2	MCG	1
May-06	1	MCG	2
Jun-06	2	MCG	2
Jul-06	3	MCG	2
Aug-06	1	MCG	
Sep-06	2	MCG	
Oct-06	1	MCG	
Nov-06		MCG	1
Dec-06	1	MCG	1
Jan-07	1	MCG	1
Feb-07	3	MCG	3
Mar-07	2	MCG	2
Apr-07	2	MCG	1
May-07	2	MCG	
Jun-07	3	MCG	3
Jul-07		MCG	
Aug-07	1	MCG	1
Sep-07	3	MCG	1
Oct-07		MCG	1
Nov-07	1	MCG	
Dec-07	1	MCG	1

Failures by month - both crossings			
Month	Plumpton	Haydon Bridge	
	failures	LC type	failures
Jan-08	1	MCG	2
Feb-08	1	MCG	3
Mar-08	1	MCG	
Apr-08	2	MCG	
May-08	3	MCG	1
Jun-08	1	MCG	
Jul-08	2	MCG	
Aug-08	1	MCG	1
Sep-08		MCG	1
Oct-08	1	MCG	1
Nov-08	1	MCG	1
Dec-08	2	MCG	1
Jan-09		MCB	
Feb-09	1	MCB	2
Mar-09	3	MCB	
Apr-09	8	MCB	1
May-09	2	MCB	1
Jun-09	3	MCB	
Jul-09		MCB	
Aug-09	1	MCB	
Sep-09	2	MCB	
Oct-09		MCB	
Nov-09		MCB	
Dec-09	4	MCB	
Jan-10	3	MCB	
Feb-10	1	MCB	
Mar-10	2	MCB	
Apr-10		MCB	
May-10	1	MCB	
Jun-10	2	MCB	
Jul-10	1	MCB	
Aug-10	1	MCB	
Sep-10	1	MCB	
Oct-10		MCB	
Nov-10		MCB	
Dec-10	1	MCB	

Table 3.4 Number of failures by month for Plumpton and Haydon Bridge.

4. Barrier Crossing Remotely Operated with CCTV or Obstacle Detection (Option A)

4.1. Overview

Option A involves the conversion of the crossing to a standard full barrier crossing that would be controlled from Three Bridge ASC. This would require the removal of the existing gates and replacing them with full barriers with either CCTV cameras or obstacle detection equipment depending on if an MCB-CCTV or MCB-OD crossing is specified. Additionally, Road Traffic Lights (RTL's), Audible Alarms, CCTV cameras and Floodlights would be installed and a new REB would be provided. The gate box would become redundant as a gate box but due to its listed status the structure would remain in situ, and a local control panel would be installed inside. See drawings in Appendix A for further details.

4.2. Technical Discussion

4.2.1. Mechanical and Electrical

Standard MCB barriers with motors would be provided. These would be the Mk 2 type barriers which are used widely on Network Rail infrastructure today and it is expected that 7.6m long barriers with a supporting section to the boom would be the most suitable size. No mechanical issues are anticipated with the use of this barrier; however additional land take would be required in each corner of the crossing to accommodate the barrier motors. Refer to drawings in appendix A for more details.

As discussed in section 3, a 650V power supply has already been provided to the site for the introduction of automatic half barriers that were never installed. Therefore, the required power supply already exists at the crossing and so no other significant electrical works would be required. This supply would also be used for the other additional electrical equipment required i.e. floodlights, RTL's, alarms and CCTV cameras. The CCTV cameras and alarms would be standard level crossing equipment specified by the Telecoms and Signalling disciplines. It is considered that only 1 No. floodlight would be required at the site, located in the YO corner. A lux level survey would be required at GRIP4 to confirm the specific lighting requirements.

In summary, the following equipment would require a power supply:

- 4 No. barrier machines and barriers (Mark 2 type)
- 4 No. RTL's (one at each corner)
- 2 No. Audible Alarms (mounted on RTL posts)
- 1 No. (min) Floodlight
- 1 No. REB
- 2 No. CCTV cameras (for MCB-CCTV option)
- 1 No. OD sensor (for MCB-OD) option

4.2.2. Signalling

The existing control and indication panels at Three Bridges will require updating to reflect the new arrangements.

Plumpton Signalbox would be closed as a signalbox, however it would be used to house the local control unit for the level crossing and to provide the operations accommodation at the level crossing. The lever frame, gate wheel and block shelf equipment could be left in place if required for Heritage reasons, but the local control unit would have to be positioned so that the operator had an adequate view of the crossing and approach roads.

The protecting signals for the level crossing (T645 on the Down Lewes and T800 on the Up Lewes) would have to be converted to controlled signals as would the signal preceding T645 (T643) as the overlap of T645 extends beyond the ground frame.

The signal preceding T800 (T648) would be converted from a Semi Automatic signal to an automatic signal. T800 signal is 1021m from the level crossing, which is excess of the 600m specified in GK/RT0192 and therefore requiring a risk assessment. It would be possible to move signal T800 towards the level crossing to comply with the 600m requirement however this would require the relocation of several other signals to maintain acceptable signal spacing. Alternatively, T648 could be converted to an isolated 4 aspect signal, or T800 could be approach released from red with T646 at red. It is not clear from the signalling records which braking curve has been used for the existing spacing, however the spacing from T648 and T800 and from T800 to T646 is only compliant to Appendix C of GK/RT0034. A full assessment of the options for relocating with the signals is outwith the scope of this report.

A new free wired interlocking would be provided at Plumpton Level Crossing housed in a new REB along with the circuitry and equipment associated with the MCB crossing. A standby-battery room would be provided as part of the REB. The interlocking would require a remote control system from Three Bridges to Plumpton to carry the control and indications, there appears to be sufficient space for such a system in Three Bridges Relay Room with one suitable location being in a spare rack adjacent to Haywards Heath circuitry as shown in figure 4.1.

Figure 4.1 Spare rack in Three Bridges RR

It is proposed this system would be a TDM using FTN for communication. Suitable product approved systems are the Invensys Westronic 1024 and GETS Delphin 1024. The GETS system is already in use at Three Bridges for Gatwick Interlocking so may have advantages in terms of training and spares holdings. The remote control system would require additional failure indications and alarm on the panel.

4 barrier machines would be provided for the crossing together with Road Traffic Lights and Audible Alarms.

Auto Lower and Auto Raise could be provided for Plumpton however it is noted that Keymer level crossing only has Auto Raise controls. Network Rail have undertaken a site visit and stated that ‘No significant issues were anticipated in the management of crossing from a workload perspective’. This is subject to confirmation following a full assessment of the existing workload and the workload for the proposed crossing arrangement.

Down Line Signal T645 is approximately 25 m from the level crossing and therefore additional controls will be required. As trains stopping at Plumpton are normally only stationary for less than a minute, these controls would be a treadle sited not less than 100m on approach to the level crossing that will operate the Road Traffic Lights and Audible warning when a train activates it with the protecting signal at Red and the crossing open to road traffic. If the route is set but the signal has not cleared then the barriers sequence will operate as normal. If the route is not set, then the barriers will remain raised and the Road Traffic Lights and Audible warning will cease after 30 seconds.

It should be noted that, in normal circumstances, the crossing will be closed to road traffic and the signal showing a proceed aspect prior to the train reaching the 100m point.

A data logger would be required to be provided at the level crossing.

Conversion to MCB-CCTV

If the crossing was to be converted to MCB supervised by CCTV from Three Bridges, the requirements for MCB locally operated would apply except for the following;

Duplicated CCTV cameras will be provided in the YO corner of the crossing together with floodlighting. The YO corner has been selected to ensure the cameras face as close to North as possible to reduce the risk of sun glare off a wet road.

Colour cameras and monitors would normally be provided for new works however the same signaller also controls Keymer level crossing which has black and white monitor. It is therefore recommended that an assessment of the potential implications of mixing colour and black and white CCTV systems on the same signaller’s panel is assessed and if this is not acceptable, consideration be given to upgrading Keymer Level Crossing to colour CCTV.

There is insufficient space on the signallers panel to accommodate two monitors however a single monitor and associated controls can be provided within the current panel layout without moving any other controls. It would be possible to provide a power socket and video plug-in facilities to enable a portable spare monitor to be connected when required. The Horsham panel in Three Bridges already has this type of arrangement. Figure 4.2 shows the current panel layout including Keymer Level Crossing. It should be noted that the panel layout diagrams do not accurately reflect the current panel and that the CSR monitor restricts access to some panel buttons.

Figure 4.2 Three Bridges control panel including Plumpton Level Crossing.

It is recommended that the controls for Plumpton crossing are designed to be consistent with those for Keymer crossing to avoid any potential confusion to the signaller. Keymer level crossing is not provided with

Auto Lower facilities but does have Auto Raise. Subject to a satisfactory human factors assessment, it is recommended that both auto lower and auto raise are provided at Plumpton level crossing. Strike-ins for the auto lower need to ensure that the distant signals show an unrestricted aspect sequence 10 seconds before the train reaches the AWS for the distant signal.

Using the 90MPH linespeed at the crossing, and a 44 second equipment operation time (note Table 19 in NR/L3/SIG/30018 incorrectly states 40 seconds should be used) this would require strike ins at 4590m from the crossing in the Up direction and 4495m from the crossing in the Down direction. The Down direction strike in has the 75MPH restriction for Spatham Lane AHB, within the strike in which means the strike in can be moved towards the crossing by at least 250m. Strike-ins must be positioned so that trains approaching at 30MPH arrive at the crossing within three minutes of the crossing activating, this would not be achieved in either direction, requiring the use of speed discrimination to adjust the initiation point of the auto lower. This can be achieved using a predictor, or treadles, track circuits and timers to achieve a series of speed related activation points. The system chosen needs to consider the presence of Cooksbridge station in the Up Direction which may give rise to trains accelerating through the activation points.

The Auto Raise shall be inhibited if another train, either a following train or one in the opposite direction, are close enough to the strike ins that a 30 second road open time could not be achieved.

A Local Control Unit (LCU) would be installed in the existing Plumpton Signal Box for use in the event of failure and potentially on race days if the crossing is staffed on those days.

A video recorder would be required to be provided at Three Bridges that records the CCTV from the point the monitor activates until the barrier regaining up detection. Local operating staff shall be consulted as to whether the monitor should extinguish when the crossing clear button is pressed or when barrier up detection is gained.

Conversion to MCB-OD

The strike ins for the MCB-OD would be approximately 362m closer to the crossing than for the MCB-CCTV crossing as the equipment operation times do not need to include the signallers reaction time. Despite being closer to the crossing, speed discrimination would still be required to ensure that a 30MPH train arrives at the crossing within 3 minutes of initiation of the crossing.

As with the MCB-CCTV option, the Auto Raise shall be inhibited if another train, either a following train or one in the opposite direction, are close enough to the strike ins that a 30 second road open time could not be achieved.

The controls and indications required for the MCB-OD could be positioned in the area identified for the CCTV monitor and controls on Three Bridges. The use of an MCB-OD would require training of all signalling staff that operate the relevant section of Three Bridges panel as well as maintenance and operation staff.

A Local Control Unit (LCU) would be installed in the existing Plumpton Signal Box for use in the event of failure and potentially on race days if the crossing is staffed on those days.

The normal layout of the LCU at an MCB-OD level crossing is shown in figure 4.3:

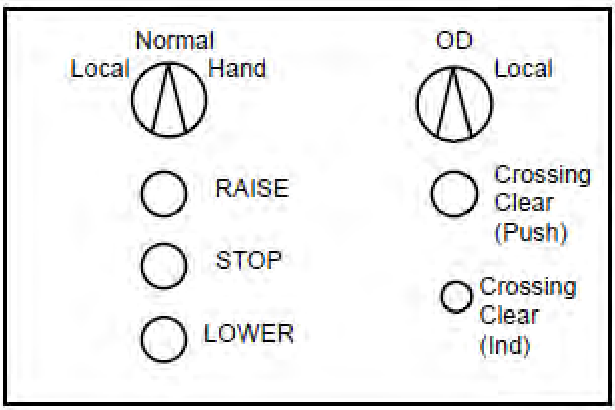


Figure 4.3 Local control unit for an MCB-OD crossing.

The usual arrangement in local operation would be for the lower button to initiate the level crossing lower sequence, however due to the high level of pedestrian usage on race days, a push and hold method of barrier operation should be considered where the barriers only lower whilst the lower button is pressed.

Plumpton Level Crossing has a significant skew and this may be increased by a proposed realignment of the road at the crossing. The technical details available for MCB-OD do not give any limits on the degree of skew that can be accommodated on an MCB-OD crossing. The obstacle detector itself is capable of covering an arc of 140 degrees with a radius of up to 60m. This is sufficient to cover Plumpton Level Crossing. It should be possible to meet the constraints on positioning of reflectors and shapes of surveillance area as the required surveillance area at Plumpton is a simple rhombus.

4.2.3. Telecoms

Conversion to MCB-CCTV

A single CCTV camera view will be required to monitor the crossing with an associated video link from the crossing back to Three Bridges ASC.

A Level Crossing CCTV system (COE 300 equipment) would currently require a single dark fibre link from the level crossing site back to the controlling Area Signalling Centre at Three Bridges.

Work is ongoing (Pen Coed and Belmont trial sites) to source CCTV Codec equipment that can be multiplexed onto the FTN SDH transmission system with multiple 2Mbit/s links or using IP technology. These solutions would avoid dedicating a fibre to carrying only a CCTV video link. But to date no kit is formally product approved by NR for these methods of working.

Signalling TDM Links

Signalling TDM links would be required from the crossing (REB) back to Three Bridges Area Signalling Centre, this would take the form of discrete “Main” and “Diverse” routed modem links. These modem links would be supported on dedicated 4 Wire lines. It has been assumed that the existing, legacy, 30 pair copper cable can be utilised for supporting these links in both directions to access FTN nodes to route back to Three Bridges ASC. Providing new copper cable would have cost implications.

Conversion to MCB-OD

Obstacle Detection would be managed within the signalling domain, the Obstacle Detection controls and indications are managed as an overhead on the signalling TDM system. Hence there would be no direct requirement for any telecom facilities for this item.

Level Crossing Telephones

Should an LCU (Local Control Unit) facility be required by the signalling design then an LCU telephone could be provided by using the existing Plumpton SB Direct Line.

- ETD Telephone 00 60476 (No longer required). – CHECK SPEC
- ETD FAX 00 68201 (No longer required).
- ADSL Link 01273-891715 (BT Broadband link to support NR Intranet and TRUST) (No longer required).
- ETD 00 60456 (SD1+ Voice recorder Eltek PSU Alarms) (Retain).

The existing NiceCall Voice recorder would be retained for the LCU telephone and the ETD 00 60456 (SD1+ Voice recorder Eltek PSU Alarms) only.

The existing REB would be replaced with a new, larger item adjacent to the existing position by Signalling. This would necessitate relocating the Telecom Voice Recorder equipment and cable terminations into the new REB.

This option selection report assumes that the Plumpton level crossing renewal project will be programmed for a date post 30/06/11 to take advantage of the new FTN transmission and cabling infrastructure.

This would enable the CCTV requirements to be “backhaul“ cabled to the nearest node (Plumpton station: 2270, 790m away) where the new “backhaul” fibre cable would be spliced into nominated spare fibres on the 24 fibre FTN cable.

Similarly the TDM links can be supported on 2x copper “backhaul” cables to both Plumpton Station: 2270 (B Route) and Keymer Junction RS3:2267 (A Route), where they would be presented to the FTN transmission node and routed back to Three Bridges ASC.

At Three Bridges ASC the following works will be required:

- Alter Direct line telephone nomenclature on telephone concentrator key.
- Uplift FTN core Node (THIC) to access TDM links (A and B) and break out fibres for CCTV link.

4.2.4. Civils

The crossing area would be widened to accommodate footpaths along each side of the road as it is a requirement of RSPG (Section 2E) and DMRB (Vol 3, Section 6) that 1.5m wide footpaths are provided each side of a level crossing for pedestrians and with an approach funnel for each footpath. With justification (less than 25 pedestrians per day) and prior approval from the Railway Inspectorate, it may be possible to reduce the footpath width to 1.0m each side of the crossing and not provide the approach funnels. Due to limited census information at the time of writing, it has been assumed that 1.5m wide footpaths will be required at this stage however this should be clarified at GRIP4.

The existing gates and gate posts would be removed and new barrier machine bases would be installed at each corner as indicated on the drawings in appendix A. Due to the introduction of the footpaths and the size of the barrier machines, a greater land take would be required in each corner than presently used. This would not present any difficulties on the Down side, but on the Upside corners the space is more congested so careful consideration would need to be given to the layouts, particularly in the YN corner where there is a public footpath to platform 1 at Plumpton station.

The available footpath width in the YN corner is restricted by the barrier machine and associated fencing and the boundary of House No. 16. In order to maximise the width of the footpath it is necessary to install the barrier base as close as possible to the track. The option drawing in appendix A shows that with a standard track gauge clearance of 1624mm (as specified in the Track Design Handbook), then approximately a minimum 1000mm clearance between No. 16 and the boundary fence could be provided. However, this falls some way short of the minimum 1600mm footpath width required by the DfT Code of Practice “Accessible Train Station design for Disabled People”. Therefore, we propose that the barrier is positioned such that no part of the unit in the closed (down) position is closer that 1470mm (for parts greater than 1100mm high above rail level) or 1000mm (for parts less than 1100mm high). This will allow a footpath width of approximately 1400mm to be created. A more detailed clearance exercise during GRIP stage 4 would need to be performed to prove that these clearances would be adequate.

(Note that by positioning the barrier machine as close to the track as proposed, the barrier in the open position would be closer to the track than structure gauge, however trains can only pass under normal conditions when the barrier is down and the situation where trains pass with the barrier up are likely to be restricted to works trains. A clearance of 1000mm can be proved to be acceptable for this scenario during detailed design.)

There would also be the addition of the floodlight and CCTV cameras in the YO corner. The equipment for both would be installed on high posts that would require substantial bases. New bases would also need to be installed for the 4 No. RTL’s and would require some extra land from the garden of building No. 16. See option drawings for details.

A new REB would be installed in the ZN corner, requiring the provision of a concrete base for the REB to stand on, and a compound and access route for the REB.

Previous plans to upgrade the crossing to an MCB crossing have proposed that the road alignment over the crossing is straightened. It is not considered that straightening the road is necessary to accommodate an MCB crossing and in fact by maintaining the existing alignment, it is more likely that the approach speed of vehicles to the crossing will be reduced. It is also know that the Parish Council would prefer for the existing alignment to remain. It is suggested that if option A is selected, the road alignment is reviewed at GRIP4.

The RTLs’ could be positioned adjacent to the road alignment in each corner without too much difficulty, with the exception of the YN corner where the RTL would need to be located in the garden of No. 16, so additional land take would be required. Refer to option drawings for details.

4.3. Reliability

From the information contained in section 3 relating to Haydon Bridge (an MCB crossing that was converted from a gated crossing in January 2009), it can be concluded that changing from MCGs to MCBs will reduced the failure rate by a factor of 3.7. In fact, as all failures at Haydon Bridge occurred in the first five months of operation and for the following 19 months was fault free, the long term failure rate should be significantly lower.

Applying this ratio to the Plumpton failure rates would result in the average number of failures per year (based on the Chi-squared distribution) dropping from 17.5 to 4.8. Note that the failure rate for Plumpton is higher than the failure rate for Haydon Bridge with MCGs. This ratio has been assumed to apply to the two crossings with MCBs as the reason cannot, without further data, be assumed to be due to the existing mechanisms at Plumpton.

In conclusion the figures above suggest that replacing the MCGs at Plumpton with MCBs would result in a reduction in failures of around 13 per year.

4.4. Heritage Appraisal

This option would involve the following direct impacts on the signal box and gates:

- the wheel mechanism for opening the gates would be taken out of use and removed
- demolition of the existing gates and replacement with an automatic barrier
- conversion of the signal box for emergency or engineering use;

The fact that the original wheel mechanism for opening the crossing gates survives and is still in use is rare and of historic significance. There is also a communal significance associated with the perceived safety benefits of having a manned crossing. If the wheel mechanism is taken out of use this would diminish these aspects of the significance of the signal box and gates. This would not result in total loss or substantial harm of the signal box and gates, therefore PPS5 Policy HE9.4 applies, which requires that the public benefit of the proposals are weighed against the harm. The fact that manned gates are rare is due to the necessary modernisation of the railways; this technology has become obsolete as the railways have been improved by electrification and automation of processes previously carried out by staff. Network Rail provides a public service and this alteration would allow Network Rail to operate more effectively. The automated system would be more reliable than the mechanical system, and it is fail safe: if the barriers fail they drop and prevent traffic from crossing the railway, unlike the existing mechanical gates. The automated gates are the standard system used across the railway network and Network Rail maintenance staff are trained to repair this system, whereas maintenance of the existing gates requires specialist knowledge. However, these benefits of an automated system should be weighed in balance with the communal and historic value of the wheel mechanism remaining in use.

The loss the gates would diminish the historic interest and group value of the signal box, station, waiting room and footbridge. However, with the exception of the ironwork the gates and gate posts are not original fabric, and may not be in the original design. The gates are not separately listed but are curtilage listed structures which indicates that they are less significant than the signal box. The significance of the gates partly derives from the fact that they are still operated by the original mechanism, but the loss of the gates themselves is less of an issue than the fact that the wheel mechanism would be taken out of use (which is discussed in the previous paragraph). However, there is a communal significance associated with the perceived safety benefits of the gates. Appropriate recording of the gates, in line with PPS5 Policy HE12, would help mitigate their loss.

The introduction of an automatic barrier would impact on the setting of the listed signal box, station and waiting room in the following ways:

- Two 8-10m posts would be erected adjacent to the signal box for floodlights and CCTV cameras.
- Road traffic lights would be erected either side of the crossing, these would flash with an audible alarm when the crossing is closing.
- A section of the existing picket fence adjacent to the signal box would be removed to accommodate the new barrier, lights, posts and wider crossing.
- A Relocatable Equipment Building (REB) would be constructed opposite the signal box on the north side of the railway; this would be a single storey shed measuring 8.4m by 2.4m.

The posts for the floodlights and CCTV camera will be particularly visible because of their height, but are required in order to operate the automatic gates safely. The impact on the listed signal box and station could be reduced by combining the floodlights and CCTV on a single post, which would reduce visual clutter from two posts. Although the picket fence is in keeping with the historic character of the signal box it is likely that the fabric of the fence is not original but has been renewed; sensitive alterations to fence to incorporate the new automatic crossing should not affect the overall significance of the signal box. The REB would be a small scale structure, so although it would be visible from and in views of the signal box, this would not have a detrimental impact on its setting given the railway context. The signal box and station are railway structures and so these interventions, which are characteristic of the modern railway, will not adversely affect the setting of the historic railway structures, when in a different context (not by a railway) they might have a detrimental impact. PPS5 Policy HE10 encourages proposals that preserve or enhance the setting of listed buildings; any harm to setting should be balanced with the public benefits of the scheme as set out above.

Although the original use of the signal box would be lost, conversion to a new use for emergency or maintenance use is beneficial because it will ensure that the building remains in use and is maintained. The interior of the signal box was altered c. 1985 when most levers were removed, therefore internal alterations would be more acceptable than if the interior was intact. It is likely that the wheel mechanism, and gates could remain (to be confirmed at GRIP4). If it is necessary to remove the wheel mechanism and levers in order to accommodate the new use, the mechanism and levers should be recorded before they are removed to help mitigate the impact (consistent with PPS5 Policy HE12). The mechanism and levers could also be offered for reuse at a railway museum such as the Bluebell Railway.

The design of this option presented at the April and May Plumpton Parish meetings required the repositioning of the signal box stairs to accommodate the proposed realignment of the road. The design has been refined so that there is now no impact on the stairs.

4.5. Regulatory

MCB crossings are in wide use on Network Rail infrastructure and so no regulatory issues are anticipated with this option.

4.6. Summary of Key issues

The conversion to MCB with either CCTV or Obstacle Detection can be achieved. The technical issues are discussed in the previous sections, however the key issues impacting the public and local community are:

- The existing road alignment can be retained. This is seen as an advantage by local residents as it forces vehicles to slow to negotiate the bends
- New footpaths would be provided improving pedestrian safety on the crossing
- Likely reduction in number of incidents resulting in delays at the crossing
- Access to the station platforms in the YN corner would be restricted by the barrier machine position and the access width reduced to approximately 1400mm or less over a short length
- Some land take will be required to accommodate the new footpaths
- Road traffic lights with audible alarms will be required
- Floodlighting and high mast CCTV will be required unless the OD option is proposed

5. Gated Crossing Locally Operated (Option B)

5.1. Overview

Option B involves maintaining the existing gates and the local operation from the gate box, i.e. a like for like renewal. This option would involve a like for like replacement or refurbishment of the gates and operating equipment.

As a sub option to the above, the mechanical system is replaced by motors at each gate which are controlled by a PLC system. The gates and local control from the signal box would remain. This option is described in section 5.3.

5.2. Like for Like with existing mechanical system

5.2.1. Technical Discussion

A technical description of the gated crossing in its existing arrangement is provided for all disciplines in section 3.

The availability of spares for the current mechanism is questionable as replacement parts would have to be of bespoke manufacture and the failure of a major component could lead to long term shutdowns and disruption. A regular maintenance regime would need to continue at the crossing.

The provision of RTL's should also be considered. There is anecdotal evidence that the use of RTL's will improve the behaviour of road users when approaching a crossing and reduce the likelihood of a road user still trying to use the crossing after the gates have started to close across the road. The RTL's will also be visible from further away from the crossings gates and reduce the risk of road users approaching too fast and not stopping in time. The appearance of the crossing would be altered with bases and RTL's being installed in each corner, but as RTL's would enhance the safety of the crossing it seems hard to provide a convincing argument against their introduction, particularly on the basis of their appearance only.

5.2.2. Reliability

Reliability data for the existing gated crossing is provided in section 3.

Comprehensive replacement of existing components with new would seem, intuitively, to offer an opportunity for some improvement in reliability by using improved materials, bearings, seals etc. but the extent to which this could be realised is almost impossible to quantify. It should be noted, though, that many of the faults recorded involve the existing gates dragging. It is unclear whether the construction and hanging of the gates themselves could be improved without changing their appearance or resulting in knock-on changes to the drive mechanism. If not, then dragging gates would presumably continue to occur with a similar frequency to that at present. Such events, however, probably do not – and would not - result in significant loss of availability of the crossing and hence disruption to traffic – as it seems reasonable to assume that in some cases the gates can still be operated with more effort and some fault records imply that the gates were simply pushed by staff.

5.2.3. Heritage Appraisal

This option would involve no adverse impacts on the heritage value of the signal box and gates, but in fact would be beneficial because it would involve repair and refurbishment of the historic fabric.

5.2.4. Regulatory

As no changes are being proposed to the crossing, it is assumed that there will be no regulatory requirements to overcome. If any alterations were proposed, then modern standards would apply and the crossing may then be subject to additional requirements.

The HSE's publication **Railway Safety Principles and Guidance Part 2 Section E Guidance on level crossings** says:

"9 Railway safety principles and guidance does not apply retrospectively to existing level crossings. However, new or altered level crossings might introduce incompatibilities or inconsistencies with the existing crossings. In this case, approval may only be given if appropriate arrangements have been made to address these safety implications which may include modifications to the existing level crossings."

Regarding the use of RTL's it says:

37 Where road traffic light signals are provided, they should be arranged to show before any attempt is made to close the gates to road traffic and should continue to show when the gates are not across the railway. "

The addition of RTL's are not considered to cause any difficulties as they would be installed to modern standards. The RTL status would need to be indicated in the signal box however this would not affect the signalling infrastructure.

Some of the existing non compliances of the crossing in its existing arrangement are listed below:

- Panel at Three Bridges does not correctly depict the arrangement at Plumpton (showing an AHB on the control panel and having temporary type patches applied to the indication panel). The temporary patches are now out of date as they show the wicket gates. (GK/RT0025 clause C1.2 refers)
- Protecting signal on the Up line is in excess of 600m specified in GK/RT0192 (although this is allowable subject to risk assessment).
- Records that do not reflect the current state of the infrastructure. (NR/GN/SIG/11701 refers)
- The arrangement of signals on the Up line is 'unusual' in that separate track circuits between T648 and T646 are not indicated on the panel at Three Bridges, they are however indicated at Plumpton so this may not be non compliant.
- Redundant circuitry present. (B3:3 of NR/GN/SIG/11600 refers)

Some of the non compliances highlighted in Section 6.6 (for option C) would also become applicable if any alterations to the existing crossing are made.

5.3. Like for Like with motorised gates

5.3.1. Technical Discussion

This option is as described in section 5.2, except that each gate would be operated by its own motor and they would be controlled by a digital PLC from the gate box. Further details of the motorised gate system proposed are provided in section 6.2.1. (excluding the discussion relating to remote operation).

As described under option C in section 6, using this mechanism the gates would be proved locked by sensors. This gives the opportunity to add the proving of this into the signalling system holding the gates locked until the train has cleared the associated track circuit. Currently this is not possible and there is a risk that the signaller at Plumpton could attempt to open the gates into the path of an oncoming train.

5.3.2. Reliability

As section 5.2.2 and section 6.3 for option (ii) (excluding CCTV cameras)

5.3.3. Heritage Appraisal

As section 6.5.

5.3.4. Regulatory

The equipment proposed under this option would require product approval for use on the railway. Although the components utilised will be well proved items from other industries it is likely that product approval could take a long time and success in achieving approval is not guaranteed.

Note; as this option involves making changes to the level crossing, then further non-compliances would need to be addressed. Refer to sections 5.2.4 and 6.6 for further details.

5.4. Summary of Key issues

Maintaining the existing gates with local control can be achieved with minimal work. The main issues associated with this option are:

- The exiting crossing is non compliant with modern standards for level crossings, including inadequate provision of public footpaths over the crossing. If no alterations are made to the crossing, then these non compliances will not need to be addressed, but if the sub option of motorising the operation of the gates is pursued, then these non-compliances would become relevant.
- Less reliable than an MCB-CCTV crossing (refer to section 4.3 for basis of this statement)
- Stockpile of bespoke parts required to prevent significant delays during breakdowns. If any equipment not available for repairs, then could lead to significant “out of service” time when crossing is broken, causing increased disruption to users.
- Higher maintenance and running costs required if the crossing is to continue to be manned.
- Crossing will continue to come under further scrutiny every time repairs are required, due to its high maintenance costs, age and non compliance with modern standards.

6. Gated Crossing Remotely Operated (Option C)

6.1. Overview

This option was suggested by Lewes District Council and by members of the public as a means of retaining the gates and the character of the building. The existing gates, gate box and crossing would remain the same but the operation of the gate would be motorised and operated remotely from the crossing in a similar way to an MCB. No other similar crossings are known to exist on Network Rail infrastructure and as such this would be a novel solution developed specifically for Plumpton.

6.2. Technical Discussion

6.2.1. Mechanical and Electrical

As discussed in section 3, there is already a large percentage of spare capacity available to accommodate supplies to new crossing gate drive systems, floodlighting and CCTV and other ancillary equipment. The existing hand operated gate wheel arrangement was also discussed. Refer to section 3 and appendix H for details of the existing system.

It is envisaged that power operation of the gates could be achieved either by the installation of individual electrically operated cam drives installed at the gate pivots with synchronised gate stops, or by a single mechanism that acts on the existing worm drive rod as the gate wheel does currently. The drive or drives would require a facility to vary the speed so that the gates are travelling more slowly at the end of the operation.

The forces involved in the drive associated with an emergency stop of the gates or the gates meeting an obstruction would need to be taken into account.

In summary, the requirements for the operation of the gates would be as follows:

- A fully programmable digital PLC control system for the gate and locking mechanism operation
- Motor drives suitable to open and close gates at variable low speeds against the maximum anticipated wind resistance. This has been estimated by Atkins mechanical engineer at 10kNm of torque applied at the gate hinge posts. The plant should be as compact as possible as space accommodation is limited.
- A locking mechanism to ensure that the gates cannot be moved accidentally into the path of a train
- Sensors fitted to prove that the gates are in open position and initiate the locking mechanism operation
- Sensors fitted to confirm that the gates are fully in closed position against the gate stops and that locks are in place.

The option of a single motor driving the existing worm drive is the most simple, however it will perpetuate the reliability issues with the existing link rod arrangement and given the increased power available form the motor drive, may lead to increased failure rates for these components In the present mode of operation, the Crossing Keeper is able to detect when excessive force is being applied and is able to take appropriate action, whereas a motor could just force the components causing damage. In addition it would not have the supplementary detection and locking capabilities of the individual drives described below. For these reasons the option has been discounted.

Details of Proposed Drive and Detection mechanism

The proposals to install drives at each of the gates would make use of the existing gear drive to each of the gates as shown in the photograph below. These are robust parts of the existing installation and their reuse would reduce the amount of work required to the existing infrastructure.

Figure 6.1 Existing Gear Drive to Gates

Each gate post would be fitted with two number electronically controlled servo motors each driving a 600mm stroke in line cylinder in a push pull arrangement linked to the existing gear drives. Each cylinder would have a maximum capacity of 21kN giving more than enough force to operate the gates against the highest wind load.

The motors would be controlled by a PLC Controller with a VCP 35 HMI Operator terminal in the Three bridges signal box. The PLC will be programmed to synchronise movement between each pair of actuators and the operator terminal programmed to visualise the operation and confirmation of gate status.

The installed position of the EMC units will have a suitable drainage system and fabricated covers to allow access for maintenance and to prevent build up of moisture or debris.

The motors and cylinders are standard units, however due to the long stroke required on the cylinders these items would need to be kept in stock as spares, however the push pull arrangement proposed means that the gates would still operate under normal conditions with one cylinder missing.

Maintenance of the units would be annual and would require little more than oiling and cleaning.

The motors come with a number of features which make them suitable for the proposed installation:

- They are equipped with absolute encoders so the position of the gates can be determined from the position of the motors.
- They can be programmed to operate in torque mode so that they will hold the gates against a stop with a specified force and any movement away from that position will cause them to react and close the gates again.
- They can be controlled throughout the opening and closing cycle to move at variable speed.

The motor drives themselves would be able to provide detection and locking superior to the existing link rod arrangement, however it would also be possible to provide supplementary detection and locking if considered necessary. A number of simple proximity detectors are available which could be incorporated into the gates to prove that they are closed against each other. A magnetic locking mechanism could easily be installed to provide additional security. A magnetic lock is quick to engage and release and operates on a very low wattage. The PLC system would include for detection of these sensors and locks.

The back stop mechanism for the gates could either be controlled by mechanical linkages as existing or more simply by a separate actuator linked into the PLC system. The motors will negate the need for a front stop to the gates.

We would emphasise at this point that the above solution is a preliminary proposal and that a site-specific development would be required to specify, approve, procure and test such an arrangement and the full safety product acceptance process and safety approval in accordance with Network Rail's Engineering Safety Management process, the 'Yellow Book' and would be required.

On a historical note, power operated gates of this type are novel. Power operated gates have been used where the gate is operated by a Toe-Motor – an electrically driven pneumatic-tyred wheel. These gates were operated locally. They were predominantly used on the former BR Eastern Region. The gates were of a lightweight construction, similar in appearance to modern lifting barriers, but operating in the horizontal plane. The toe-motor arrangement used for these gates would not be strong enough to support and operate traditional heavy wooden level crossing gates.

Wicket Gates

If the wicket gates were brought back into use, some form of electrically-operated wicket-gate lock would be required. Although an approved electro-magnetically operated wicket gate lock exists, it provides only a locking function and relies on a strong spring to ensure that the wicket gate is up against the clapping post. To the best of Atkins' knowledge, these devices have been used only as a substitute for a chain-operated mechanical wicket-gate lock at manned crossings. There is no mechanism other than manual intervention by the signaller or crossing keeper for forcing the gate closed if the magnetic lock fails to engage because the gate is not properly closed. Such an arrangement at Plumpton would therefore have the propensity to cause extensive delay if public misuse, mal-adjustment, deterioration or obstruction of the wicket-gate mechanism prevented the wicket gates from closing properly. To reduce this risk, some form of electrical drive to force and maintain the wicket gates closed could be considered, but again there is no proprietary device available and development work and the full safety approvals and product acceptance process would be required.

There is an existing system of UTX's, cable duct and services routes at the level crossing and the signal box area which would most likely be able to accommodate any cabling associated with the new crossing automation equipment. This would be confirmed at GRIP4 Outline Design Stage.

Manual operation of the gate box would be relinquished. The existing gate mechanism would be replaced with electrical or hydraulic drives operated from Three Bridges Signalling Centre. Interface between the PLC and railway compliant remote monitoring and connection systems would need to be incorporated into any design. This option would require CCTV and floodlighting to be installed and the extent of these would need to be more extensive in the absence of an onsite observer/operator. Wig wag lights and audible sirens would also be required.

6.2.2. Signalling

Detection would need to be provided to confirm gate position and to confirm that the gates are held by the gate stops. Lamp proving would be required or the gates would need to be fitted with electrically-operated lamps, which would also need to be proved and the proving incorporated into the protecting signal controls. The CCTV coverage provided would need to enable the operator to see that the swept area ahead of the gates is clear as a gate striking a person could cause serious injury. In particular, a child could be partially concealed by the gates.

As the HSE requirements include the need for the operator to have a good view of approaching road traffic (a requirement that does not appear to be removed if road traffic lights are provided), then there would be additional requirements on the CCTV to provide views of the approach in both directions. Road traffic lights would be required to stop approaching vehicles which the Crossing Keeper is currently able to see.

If the crossing was to be operated from Three Bridges Panel, there would need to be at least 2 monitors so that before initiating the crossing closure, the Signaller could observe the approaches to the crossing. (note it is normal practice to provide spare monitors for level crossing so at least 4 and possibly 6 monitors would be required). The panel at Three Bridges only has space for a single monitor for Plumpton crossing without major alterations. The provision of only one monitor would be consistent with Keymer level crossing on the same section of the panel and also with the recently installed Horsham panel, also in Three Bridges ASC. It is noted that the Horsham panel has provision for a standby monitor to be plugged in the event of a monitor failure.

Once initiated, the Signaller would then need to observe the gates as they moved to ensure that nothing was likely to be struck by the swinging gates.

An indication proving that the gates were fully secured in either position would be required, which would be interlocked with the signalling. This would also require some method of proving the integrity of the gate (similar to the barrier displacement detection provided on barriers).

The Signaller would be fully occupied from the initiation of the crossing closure until the gates were proved to be in the correct position. During this time, the Signaller would not be able to undertake any other tasks. The operation of the gates would take longer than the operation of barriers and gates would not be able to be closed and opened automatically as barriers can do using the Auto Lower/Raise functionality inherent in modern barrier control applications.

Because of the non-standard nature of the equipment, training courses and competence assessments will need to be developed for those carrying out the installation and commissioning of the crossing and those required to operate and maintain it.

It is noted that with the wicket gates being out of use, the current crossing layout has no provision for pedestrians which is contrary to para 156 of the Railway Safety Principles and Guidance – Level Crossings.

Even with the wicket gates, provision for pedestrians would only exist on one side of the carriageway which would also not be in accordance with para 156 of RSPG. Any widening of the road to provide this provision for pedestrians, would also require the gates to be widened and also the corner posts moved further from the railway to ensure the gates met when the crossing was open to road traffic. Alternatively the out of use wicket gates could be reinstated and a similar arrangement provided on the opposite side of the carriageway.

6.2.3. Telecoms

It is assumed that a single CCTV camera view will be required to monitor the crossing to ensure that the swept area of the gates is clear as well as the requirement for a further two cameras to view approaching road traffic. Hence this will necessitate a total of three CCTV level crossing compliant video links from the crossing back to Three Bridges ASC.

A Level Crossing CCTV system (COE 300 equipment) would currently require 3x single dark fibre links from the level crossing site back to the controlling Area Signalling Centre at Three Bridges.

It is understood that work is ongoing (Pen Coed and Belmont trial sites) to source CCTV Codec equipment that can be multiplexed onto the FTN SDH transmission system with multiple 2Mbit/s links or using IP technology. These solutions would avoid dedicating fibres to carrying only a single CCTV video link. But to date no kit is formally product approved by NR for these methods of working. This technology solution can be further explored at the GRIP 4 stage of the project

Signalling TDM links would be required from the crossing (REB) back to Three Bridges Area Signalling Centre, this would take the form of discrete “Main” and “Diverse” routed modem links. These modem links will be supported on dedicated 4 Wire lines. It has been assumed that the existing, legacy, 30 pair copper cable can be utilised for supporting these links in both directions to access FTN nodes to route back to Three Bridges ASC. Providing new copper cable would have cost implications.

Should an LCU (Local Control Unit) facility be required by the signalling design then an LCU telephone could be provided by using the existing Plumpton SB Direct Line for this purpose.

ETD Telephone [redacted] (No longer required)

ETD FAX [redacted] (No longer required)

ADSL Link [redacted] (BT Broadband link to support NR Intranet and TRUST) (No longer required)

ETD [redacted] (SD1+ Voice recorder Eltek PSU Alarms) (Retain)

The existing NiceCall Voice recorder would be retained for the LCU telephone and the ETD 00 60456 (SD1+ Voice recorder Eltek PSU Alarms) only.

As a new REB will be provided for signalling equipment, the Telecom Voice Recorder equipment and cable terminations would be relocated into the new REB.

This option selection report assumes that the Plumpton level crossing renewal project will be programmed for a date post 30/06/11 to take advantage of the new FTN transmission and cabling infrastructure.

This would enable the CCTV requirements to be “backhaul“ cabled to the nearest node (Plumpton station: 2270, 790m away) where the new “backhaul” fibre cable would be spliced into nominated spare fibres on the 24 fibre FTN cable.

Similarly the TDM links can be supported on 2x copper “backhaul” cables to both Plumpton Station: 2270 (B Route) and Keymer Junction RS3:2267 (A Route), where they would be presented to the FTN transmission node and routed back to Three Bridges ASC.

At Three Bridges ASC the following works will be required:

- Alter Direct line telephone nomenclature on telephone concentrator key.
- Uplift FTN core Node (THIC) to access TDM links (A and B) and break out 3x fibres for CCTV links.

6.2.4. Civils

As described in section 4.2.4, the latest RSPG and DMRB standards require 1.5m footpaths on each side of a level crossing. This would result in either the reinstatement of the wicket gate on the east side and the addition of a new wicket gate on the west side of the crossing, or alternatively the crossing and gates being widened to accommodate the new footpaths. This latter option would increase the size of the crossing and require the gate posts to be relocated away from the centre of the crossing so that the longer gates could be accommodated when positioned across rail line as well as the road. This would then lead to alterations to gates posts and theirs bases.

RTL's, CCTV cameras, audible alarms and floodlights, with associated posts and bases would also be introduced to the site. The option would necessitate the introduction on an REB to accommodate the additional signalling and telecoms equipment required on site, with a concrete base and surrounding compound.

6.3. Reliability

The possibilities for remote operation of the gated crossing at Plumpton could involve two variants:

(i) one in which the manually operated wheel in the signal box is replaced by a remotely controlled electric motor, with the rest of the mechanism unchanged (or replaced/refurbished as in (3) above);

(ii) one with individual, remotely controlled drives to each gate.

The above already imply components additional to the current system, viz.: the motors, their power supplies and control circuits and the display and warning elements at the remote location. Other sections in this report have identified further functions or considerations which would need to be added to, or superimposed on, the existing system, principally to satisfy safety requirements. These include:

The forces involved in the drive associated with an emergency stop of the gates or the gates meeting an obstruction would need to be taken into account. Detection would need to be provided to confirm gate position and to confirm that the gates are held by the gate stops.

Lamp proving would be required or the gates would need to be fitted with electrically-operated lamps, which would also need to be proved and the proving incorporated into the protecting signal controls.

CCTV coverage would be required to enable the operator to see that the swept area ahead of the gates is clear as a gate striking a person could cause serious injury. In particular, a child could be partially concealed by the gates.

As the HSE requirements include the need for the operator to have a good view of approaching road traffic (a requirement that does not appear to be removed if road traffic lights are provided), then there would be additional requirements on the CCTV to provide views of the approach in both directions.

Road traffic lights would be required to stop approaching vehicles which the Crossing Keeper is currently able to see.

Track circuit or treadle inputs to confirm that a train has cleared the crossing would also have to be incorporated in the interlocking.

Overall, the above should maintain, or even improve, the safety of the crossing but the additional components and their fail-safe configuration imply a higher disabling fault rate than at present, at least for variant (1) above, where the current drive mechanism would be maintained in its entirety. For variant (2), with individual motors for each gate the likely reliability effects are discussed below.

Reliability of Individual Motor drive option

The components that make up the proposed drive mechanism have very predictable life spans to failure. The motor drives themselves are dependent on the life of the bearing races. The lifespan can be calculated as a number of cycles for a specific load based on a normal distribution and can be quoted to 99%confidence limits. In most industrial applications these units are designed to operate almost continuously at a set load. In the proposed situation at Plumpton the units will operate only a few times a day and for the most part the loads applied will be far lower than the maximum design load. The lifespan of the units is increased exponentially al lower load levels. It can therefore be concluded that the motor drives will have a high reliability.

The failure rates of the in line cylinders are less predictable, however the proposed push pull arrangement gives a degree of redundancy that allows for the failure of one cylinder at each gate without affecting normal operation except in severe weather conditions. Provided that the units are equipped with sensors that inform the signaller of a failure then these should have a high reliability.

The torque drive and absolute encoder capability of the motors meads that even in the event of failure of supplementary detection the gates can be proved shut and effectively locked.

The weakest part of the system may well be the PLC system. Whilst this uses well proven and robust technology it is not as robust as a signalling system. However the motors will be equipped with manual override which will allow the signaller to operate the gates even if the PLC were to fail.

In conclusion then the individual motor drive option should have a high reliability

Key Risk for Remote controlled gated option

The unavailability of the crossing and the disruption to traffic is likely to be greater than at present for both remote variants as local intervention to temporarily alleviate faults may not be practicable with the operator removed from site. Information on typical times for maintainers to reach site has been requested but is not yet available, so it is difficult to estimate what such effects may be. The ‘dragging gate’ fault might perhaps be overcome in some instances by increased torque from the motor(s) but otherwise could result in significant traffic disruption unless an authorised person continued to be present to manually push the gates.

(Given the additional electrical and electronic components in this option and variants which could be continuously powered, any future reliability estimates for them may be most appropriately based on hours at risk and the corresponding hours-based estimate in section (2) be considered for any comparisons. This, however, would also be influenced by whether MCB data is hours or operations-based.)

6.4. Safety / HAZOP

A HAZOP workshop was held for on 15th of December 2010 to review Option C in relation to the generic concerns .The meeting was attended by members of the Network Rail and Atkins project teams and members of Network Rail Operations.

In summary the result of the HAZOP concluded that option C would not impose significant additional safety risks to trains or road vehicles compared to barriers provided that the mitigations discussed were put in place. However, the risk to pedestrians is considered to be increased as they may not be seen as clearly by the Signaller.

Meeting Minutes and the output from the workshop is contained appendix F.

6.5. Heritage Appraisal

Potentially this option would involve the following impacts on the signal box and gates:

- The wheel mechanism for operating the gates would be taken out of use and removed.
- Conversion of the signal box for emergency or engineering use.
- A minimum of three 8-10m high posts would be erected adjacent to the signal box and crossing for floodlights and CCTV cameras (more posts are required than Option A because of additional CCTV cameras).
- Road traffic lights would be erected either side of the crossing, these would flash with an audible alarm when the crossing is closing.

- Possible alterations to the existing picket fence and gates adjacent to the signal box to allow pedestrian access across the crossing
- A Relocatable Equipment Building (REB) would be constructed opposite the signal box on the north side of the railway; this would be a single storey shed measuring 8.4m by 2.4m.

The fact that the original wheel mechanism for opening the crossing gates survives and is still in use is rare and of historic significance. There is also a communal significance associated with the perceived safety benefits of having a manned crossing. If the wheel mechanism were to be taken out of use this would diminish these aspects of the significance of the signal box and gates. This would not result in total loss or substantial harm of the signal box and gates, therefore PPS5 Policy HE9.4 applies, which requires that the public benefit of the proposals are weighed against the harm. The fact that manned gates are rare is due to the necessary modernisation of the railways; this technology has become obsolete as the railways have been improved by electrification and automation of processes previously carried out by staff. Network Rail provides a public service and this alteration would allow Network Rail to operate more effectively. The automated system would be more reliable than the mechanical system, and it is fail safe: if the barriers fail they drop and prevent traffic from crossing the railway, unlike the existing mechanical gates. The automated gates are the standard system used across the railway network and Network Rail maintenance staff are trained to repair this system, whereas maintenance of the existing gates requires specialist knowledge. However, these benefits of an automated system should be weighed

As for Option A the posts for the floodlights and CCTV camera will be particularly visible because of their height, but are required in order to operate the automatic gates safely. The impact on the listed signal box and station could be reduced by reducing the number of posts and combining the floodlights and CCTV onto the same posts, which would reduce some of the visual clutter. Although the picket fence is in keeping with the historic character of the signal box it is likely that the fabric of the fence is not original but has been renewed; sensitive alterations to fence to incorporate a pedestrian crossing should not affect the overall significance of the signal box. The REB would be a small scale structure, so although it would be visible from and in views of the signal box, this would not have a detrimental impact on its setting given the railway context. The signal box and station are railway structures and so these interventions, which are characteristic of the modern railway, will not adversely affect the setting of the historic railway structures, when in a different context (not by a railway) they might have a detrimental impact. PPS5 Policy HE10 encourages proposals that preserve or enhance the setting of listed buildings; any harm to setting should be balanced with the public benefits of the scheme as set out above.

Although the original use of the signal box would be lost, conversion to a new use for emergency or maintenance use is beneficial because it will ensure that the building remains in use and is maintained. The interior of the signal box was altered c. 1985 when most levers were removed, therefore internal alterations would be more acceptable than if the interior was intact. It will be necessary to remove the wheel mechanism and levers in order to accommodate the new use. The mechanism and levers should be recorded before they are removed to help mitigate the impact (consistent with PPS5 Policy HE12). The mechanism and levers could also be offered for reuse at a railway museum such as the Bluebell Railway.

This solution would retain the existing gates; in heritage terms it is therefore preferable to Option A which replaces the gates with an automatic barrier. Although the fabric of the gates is largely not original, the gates have group value with the station, waiting room, footbridge and signal box, as well as communal value associated with the perceived safety benefits of having gates that block access to the railway tracks when they are open. Retention of the gates will therefore protect these aspects of the significance of the gates and signal box.

6.6. Regulatory

The current standards do not appear to support power-operated level crossing gates.

6.6.1. HSE Publications

The HSE's publication **Railway Safety Principles and Guidance Part 2 Section E Guidance on level crossings** says:

"9 Railway safety principles and guidance does not apply retrospectively to existing level crossings. However, new or altered level crossings might introduce incompatibilities or inconsistencies with the existing crossings. In this case, approval may only be given if appropriate arrangements have been made to address these safety implications which may include modifications to the existing level crossings."

Modification to remotely controlled power operation would constitute an alteration and would be subject to approval.

"27 All equipment and circuits used for the operation of crossing equipment should be designed and documented to appropriate safety standards."

As regards Gates it says:

"Method of operation

35 The gates may be operated by one of the following methods:

(a) by assigned railway staff who are permanently stationed at a control point adjacent (within 50 m) to the level crossing when the line is open to rail traffic; or

(b) by a member of the train crew of an approaching train at a control point adjacent to the level crossing after the train has been stopped short of the crossing.

36 The person operating the gates should have a good view of approaching road traffic and the whole of the crossing area.

37 Where road traffic light signals are provided, they should be arranged to show before any attempt is made to close the gates to road traffic and should continue to show when the gates are not across the railway. "

This does not appear to allow for remote control of gates.

The requirement to have a good view of approaching road traffic (36) appears to apply whether or not road traffic lights are provided (37). Should remote control be allowed, it would appear that the CCTV would have to provide a good view of approaching road traffic in both directions.

6.6.2. RSSB Documents

RSSB document **GK/RT0192 Issue 1 Feb 2010 Level Crossing Interface Requirements** places the following requirements on controlled level crossings:

2.1.1.1 A stop signal or ETCS block marker shall be provided on each signalled approach to controlled level crossings that require movement authorities to be withdrawn before being opened to road traffic. Further requirements for stop signals are set out in GK/RT0045. Further requirements for ETCS block markers are set out in GI/RT7033.

2.1.1.2 Stop signals and ETCS block markers shall be located within 600 m of the level crossing, except where the risk associated with an increased distance is acceptable.

2.1.1.3 Stop signals and ETCS block markers shall be positioned at least 50 m from the level crossing, except where either:

a) The level crossing is immediately beyond a station platform, in which case the stop signal or ETCS block marker associated with the platform shall be positioned at least 25 m from the level crossing, or

b) The signalling system is configured so that movement authorities towards the stop signal or ETCS block marker are only displayed when the level crossing is closed to road traffic.

Signal T800 is 1021m from the crossing requiring a risk assessment to be undertaken if this is not to be moved. This would apply should any change be made at the crossing.

Signal T645 is 25m from the crossing and therefore any widening of the crossing to provide footways would have to extend the signalbox side of the crossing surface. Whilst NR/L3/SIG/30018 relaxes the 25m minimum distance from signals to MCB level crossings at stations this does not apply to gated crossings.

As regards controlled level crossings with gates it has the following requirement:

2.3.1 Visibility of level crossing gates

2.3.1.1 When level crossing gates are closed across the railway, they shall be visible to drivers when the train has stopped at the stop board protecting the level crossing.

RSSB document **GE/RT8000/TS9 Rule Book Level crossings - signallers' instructions** provides instructions for locally and remotely controlled barriers. The section on operation of level crossing gates by a signaller does not provide for remote operation.

6.6.3. Network Rail Standards

The following Network Rail Standards are relevant to level crossings:
NR/L2/OPS/100 Issue 02 1/6/08 Provision, risk assessment and review of level crossings details the risk assessment and management processes that shall apply to new and existing level crossings.

5.2 Existing level crossings
5.2.1 Existing level crossings shall conform to the appropriate configuration outlined in Appendix A, so far as is reasonably practicable.

Appendix A - Minimum combinations of control measures for new crossings.

	Controlled by	*Type of barrier required*	*Current crossing type meeting these requirements*
K	*Signaller or crossing keeper, remotely (by CCTV)*	*Lifting full barrier*	*CCTV monitored barrier crossing*
L	*Signaller or crossing keeper locally*	*Gate or lifting full barrier*	*Staffed gated crossing. Staffed barrier crossing*

Appendix A does not appear to allow a remote controlled gated crossing.

NR/L3/SIG/30018 Issue 1 5/9/09 Signalling Design: Technical Details: Level Crossings

4.4 Gated Crossings operated by Railway Staff
4.4.1 These comprise a set of gates to close off the road or rail approaches. The gates may be directly closed by hand or may be closed by a wheel located in the Signal/gate box.

This does not allow for remote operation by power.

6.7. Summary of Key issues

The remote operation of the existing gates could be achieved technically, however there are many issues associated with pursuing this option and these have been listed below:

- Existing standards do not cater for a remotely operated gated crossing. Therefore, existing standards may need to be changed to permit the use of such an arrangement. Changes to standards could be both timely (taking several years) and costly to achieve

- Training courses required for maintenance staff and signallers due to the non standard nature of the crossing

- Road traffic lights would be provided at the crossing (Note; no existing standards cover option C, but existing standards that cover remotely operated / monitored crossings require RTL's)

- Floodlights and CCTV cameras would be provided both at the crossing and on the approach to the crossing. Therefore, there would be an increased number of masts on and around the crossing (most likely to be 3 No.) creating significant light pollution and increasing the "clutter" around the crossing.

- The existing road layout and does not comply with standards and so footpaths for pedestrians would need to b e provided on each side of the crossing – this would result in lengthening of the gates across the road (to also include the footpaths) or the addition of new wicket gates on each side of the crossing, thus affecting the existing configuration and potentially requiring alterations to the gates (further diminishing their Heritage value)

7. Heritage

7.1. Introduction

Each of the three options has been appraised from a Heritage perspective and this has been included in the previous relevant sections. This section of the report has been included to further inform the option appraisals by:

- Reviewing Planning policies relevant to proposals to alter the signal box and gates
- Assessing the significance of the signal box and gates
- Providing details of two previous unsuccessful planning applications to demolish and relocate the signal box in the 1980's

7.2. Planning Policy Context

Plumpton Station and the signal box were grade II listed in 1979. They are separately listed. While the crossing gates are not mentioned in either list description, they are associated with the station and signal box and date from prior to 1948 so are considered to be curtilage listed structures. The following national and local planning policies on the historic environment should be considered when considering proposals to alter the signal box and gates.

7.2.1. PPS5

Planning Policy Statement 5: Planning for the Historic Environment (PPS 5) was published in March 2010 by the Department for Communities and Local Government (DCLG). The *Historic Environment Planning Practice Guide* was also published by DCLG, English Heritage and DCMS in March 2010 as best-practice guidance to accompany PPS5.

PPS5 sets out planning policies relating to the conservation of the historic environment. It classifies 'heritage assets' all those parts of the historic environment that are important because of their historic, archaeological, architectural or artistic interest. In Annex 2 the term 'heritage asset' is defined as:

> *"A building, monument, site, place, area or landscape positively identified as having a degree of significance meriting consideration in planning decisions…They include designated heritage assets and assets identified by the local planning authority during the process of decision-making or through the plan-making process (including local listing)".*

Its policies cover heritage assets which are designated and those which are undesignated. Policies relate to both the treatment of the assets themselves and their settings, both of which are a material consideration in development management decision making.

The core philosophy which underpins PPS5 is to have a sound evidence base on which to make informed decisions, to understand the significance of heritage assets and how proposals may affect this significance.

Policy HE6 and HE7 require that any applications or proposals which may affect the significance of a heritage asset should be accompanied by a description of the significance and the contribution of their setting to that significance. Information on this significance should be submitted along with an assessment of the impact on that significance set out. HE7 also sets out that the work undertaken on understanding the significance should be used to avoid or minimise harm.

Policy HE9 sets out the principles which guide the consideration of applications for consent which relate to designated heritage assets. In general there should be a presumption in favour of the conservation of designated heritage assets and the total loss of or substantial harm to grade II listed buildings should only be allowed in exceptional circumstances. Policy HE9.4 relates to alterations to listed buildings:

> *Where a proposal has a harmful impact on the significance of a designated heritage asset which is less than substantial harm, in all cases local planning authorities should:*
>
> *(i) weigh the public benefit of the proposal (for example, that it helps to secure the optimum viable use of the heritage asset in the interests of its long-term conservation) against the harm; and*

(ii) *recognise that the greater the harm to the significance of the heritage asset the greater the justification will be needed for any loss.*

Paragraph 95 of English Heritage's Practice Guide provides further guidance on proposals affecting curtilage listed structures:

> *Some buildings are deemed designated as listed buildings by being fixed to the principal building or by being within its curtilage and pre-dating 1948. Whether alteration or demolition of such buildings amounts to substantial harm to the designated heritage asset (i.e. the listed building together with its curtilage and attached buildings) needs considering carefully. These buildings may on occasion be of limited individual or group value.*

Policy HE10 sets out additional policy principles for guiding the consideration of applications for development which may affect the setting of a designated heritage asset citing that local planning authorities should treat favourably applications which preserve or better reveal the significance of an asset. Again any harm to the setting should be weighed against the wider benefits of a scheme.

Policy HE12 sets out the principles guiding the recording of information related to heritage assets. It accepts that whilst a documentary record of heritage assets is not as valuable as their retention, should change be acceptable in line with PPS5, then developers should be required to record and advance the understanding of the significance of the heritage asset which is being lost. This can be detailed as part of planning conditions where appropriate and can determine the level and nature of any recording which is required.

7.2.2. Lewes District Local Plan, 2003

Policy H2 on listed buildings was saved from the Lewes District Local Plan:

> Consent will not be granted for any proposal which:
>
> (a) **involves the demolition of a listed building unless the Council is satisfied that every possible effort has been made to continue its present use or find a suitable new use; that preservation in some form of charitable or community ownership is not suitable or possible; or that redevelopment would produce substantial benefits for the community which would decisively outweigh the loss resulting from demolition. Where demolition can be justified, consent will not be granted until there are approved detailed plans for redevelopment and development is about to commence. The Council will seek, by legal agreement or condition, to ensure that demolition will be immediately followed by redevelopment. Consent will not be granted for the partial demolition of a listed building, except the removal of additions which are of no historic or architectural interest, and where there is an overall improvement to the listed building**
>
> (b) **would adversely affect the architectural or historic character of a listed building, its internal or external features of special architectural or historic interest, or its setting.**

7.3. Statement of significance

7.3.1. Purpose

The purpose of assessing significance is to help manage change. By understanding what is important about the signal box and gates it is possible to make an informed decision about how to renew the level crossing. Furthermore PPS5 Policies HE6 and HE7 require that applications for listed building consent are accompanied by a statement of significance to aid determination. Section 1.7 assesses the impact of the possible renewal options on the significance of the signal box and crossing.

7.3.2. Criteria

PPS5 defines significance as:

> *'The value of a heritage asset to this and future generations because of its heritage interest. That interest may be archaeological, architectural, artistic or historic.'*

English Heritage's PPS5 best-practice guidance and Conservation Principles also refer to communal value, which relates to what places mean to people, which can be symbolic/commemorative, social or spiritual.

Recent guidance on Principles of Selection for Listing Buildings (DCMS, March 2010) provides a useful definition of values:

> Architectural interest. To be of special architectural interest a building must be of importance in its architectural design, decoration or craftsmanship; special interest may also apply to nationally important examples of particular building types and techniques (e.g. buildings displaying technological innovation or virtuosity) and significant plans forms;
>
> Historic interest. To be of special historic interest a building must illustrate important aspects of the nation's social, economic, cultural, or military history and/or have some close historical associations with nationally important people. There should normally be some quality of interest in the physical fabric itself to justify the statutory protection afforded by listing. (para. 9)

The guidance then goes onto set out further principles for the selection of listed buildings:

- Age and rarity. The older a building is, and the fewer the surviving examples of its kind, the more likely it is to have special interest... Before 1700, all buildings that contain a significant proportion of their original fabric are listed; from 1700 to 1840, most buildings are listed; after 1840, because of the greatly increased number of buildings erected and the much larger numbers that have survived, progressively greater selection is necessary...(para. 12)

- Aesthetic merit. The appearance of a building – both its intrinsic architectural merit and any group value...(para 13)

- Selectivity... a building may be listed primarily because it represents a particular historical type in order to ensure that examples of such a type are preserved. (para .14)

7.3.3. Assessment of significance

The signal box and gates are of **historic** interest because they illustrate the development of the railways in England in the mid to late 19th century. The signals were originally manned, but since 1985 have been automated. This therefore illustrates a wider trend for the electrification and automation of the railways in the 20th century. However, the crossing remains manned and the original mechanism (of 1891) is still operational. Manned crossings are now relatively rare because in the last few decades they have been replaced with automated crossings which can be operated remotely via CCTV. There is one other manned crossing in Sussex, at Littlehaven, which is due for renewal in January 2012. The fact that the signal box remains in use contributes to its historic interest. The signal box, gates, opening mechanism and remaining levers are all of historic interest.

The signal box was designed by LB&SCR, but imitates similar signal boxes by Saxby & Farmer. The **architectural** design was therefore not innovative. However, this imitation is of historic interest because it illustrates that by the end of the 19th century railway companies were designing their buildings 'in house' rather than outsourcing to specialist companies. However, the signal box is of architectural merit: the combination of brick and timber weatherboarding, the detailing of the staircase, the sliding sash windows, the wide eaves cornice and ventilator cowl with pointed finial form an attractive composition in this rural setting.

The signal box and gates also have **group value** with the station, waiting room, footbridge and the crossing keeper's house. With perhaps the exception of the crossing keeper's house, there is a consistent architectural style to these buildings which are weatherboarded on brick bases with wide eaves. The railway buildings also have group value because of their interrelated uses. There is also group value with other similar buildings elsewhere on the LB&SCR network.

The signal box is not particularly old or **rare**. There are at least 88 other listed signal boxes in England, and the signal box in Instow, North Devon dates from 1861, so predates Plumpton signal box by 30 years.[5] The fact that the signal box was used to operate the crossing as well as the signals is more unusual; however, there are other examples of signal boxes containing wheels to operate crossings, including a number in North Lincolnshire (in Appleby, Boston and Elsham), as well as in Drayton-in-the-Clay, East Staffordshire and in Knaresborough, North Yorkshire. There are also instances where the crossing gates are listed, such as at Brimscombe St Mary's, Gloucestershire and Isfield, East Sussex, and the latter is on the LB&SCR; whereas Plumpton crossing gates are only curtilage listed structures.

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[5] Listed Buildings Online http://lbonline.english-heritage.org.uk

The signal box and gates are also not entirely **intact**. The wheel and mechanism to open the gate survive, and are highly significant features. However, there were originally 24 levers in the signal box and now only four survive; whereas a 24 lever frame survived in the signal box at Drayton-in-the Clay when it was listed in 1991. A window has been blocked in the ground floor of Plumpton signal box, which in itself does not damage the significance of the signal box, but may indicate that the stair has been moved (although the evidence is not conclusive). The fabric of the gate posts and the timber gates has been replaced, and there is evidence that the design of the gates is not original; however, it is likely that the iron work is original.

The signal box and gates clearly have **communal value**. At a public consultation event held in April 2010 84% of the attendees opposed the proposal to replace the manually operated gates with an automatic barrier. Previous attempts to demolish and relocate the signal box in 1985 and 1987 to straighten the road and install an automatic barrier were unsuccessful due to local opposition. Discussion at public consultation events suggests that the signal box and gates have communal value for the following reasons:

- they contribute to the historic character of the village;
- the fact that the gates prevent access to the railway line when they are open is safe;
- the presence of the crossing keeper provides a safety and security oversight.

It is also important to understand the **relative significance** of the signal box and gates:

- The signal box is more significant than the gates because it is listed, whereas the gates are only curtilage listed structures. There are examples of listed crossing gates, but in this instance DCMS did not consider the gates warranted listing in their own right. The signal box is of more architectural and historic interest than the gates.
- The opening mechanism and wheel are highly significant because they are original and relatively rare: although there are at least five other listed signal boxes containing wheels to operate crossings, these are relatively few in comparison with the 88 other listed signal boxes. The fact that the mechanism and wheel are still operational also contributes to their significance because this is rare; there is only one other manned crossing in Sussex.
- The majority of levers have been removed from the signal box so the interior is not as intact or significant as other signal boxes which retain the entire lever frames (or other features such as fireplaces).
- With the exception of the ironwork, the fabric of the gates and gate posts is not original and it is likely that the design does not replicate the original design, which has diminished the significance of the gates. However, the fact that the gates are still operated by the original wheel mechanism is significant.

7.4. Planning History

There were two applications by Network Rail in the 1980s for listed building consent to demolish and relocate the signal box associated with the resignalling programme.

7.4.1. Application to demolish the signal box, 1985

The first application was submitted on 4 July 1985 to demolish the signal box to allow a realignment of the road to install automatic half barriers. The signal box was offered to the Bluebell Railway (a railway museum), but not accepted because of the costs involved in relocating the signal box. Various national amenity societies were consulted on the proposals; the Victorian Society recommended refusal:

> *While we realise that with the proposed resignalling programme, buildings of this type are becoming obsolete, we believe it is important that some of the best examples of the type should remain.*[6]

The proposals also met with local opposition. As a result Lewes District Council refused the application because they were:

[6] Letter from Victorian Society to Lewes District Council, 14 August 1985

not satisified that there is adequate justification for the demolition of this Grade II Listed Building, which forms part of the Listed Buildings at Plumpton Station being a valuable example of Victorian Railway architecture.[7]

7.4.2. Application to relocate the signal box, 1987

In response to this British Rail prepared a second application, which was submitted on 9 February 1987, to relocate the signal box from the south side to the north side of the track and to convert it into an artist's studio. This would have involved rebuilding the brick base in new materials to match existing, the rotation of the upper timber structure by 180º and refurbishment of the interior and installation of a toilet. This application was rejected due to local opposition. The decision notice states:

The proposed relocation is considered to be in appropriate having regard to the use now proposed and its close proximity to the adjoining railway and if erected would have an adverse visual impact on the nearby residential properties.[8]

This is an unexpected decision: the signal box is grade II listed for its architectural and historic interest, so it is difficult to understand how its new location, adjacent to the railway, would have an adverse visual impact on nearby buildings. It seems more likely that second application was rejected due to local opposition rather than genuine heritage grounds.

[7] Lewes District Council decision notice, 13 August 1985
[8] Lewes District Council decision notice, 10 March 1987

8. Capital Costs

8.1. Summary of costs

The capital cost of each option has been estimated and a breakdown of the costs is provided in Appendix D.

A summary of the costs is shown in table 8.1 below.

Option	Estimated Capital Cost
Option A (MCB-CCTV)	£1,085,883
Option B (Locally Operated Gates)	£58,934
Option C (Remotely Operated Gates)	£1,261,604

Table 8.1 Estimated Capital Cost of each Option

Note:

The assumptions used in estimating the capital costs are included in appendix D.

The Option B cost is for like for like crossing renewal only. Costs for additional items (i.e. provision of motors for each gate) are shown as optional items on the cost breakdown.

Whilst the capital cost of option B is significantly lower than the capital costs of options A and C, the anticipated maintenance and running costs associated with the option are far greater.

9. Conclusions and Recommendations

9.1. Technical and Regulatory

Option A is the preferred solution from a technical and regulatory perspective. The technology is in wide use on Network Rail Infrastructure today and the latest railway and technical standards have been developed for the use of MCB barriers. The site could accommodate the new equipment required and the power supply is already available. It would also be the most straightforward option to maintain as it would consist of the same equipment and arrangement as many other existing crossings, and the option would most likely be the quickest to design and install as no product approval or standard changes would be required.

Option B would involve refurbishment and replacement of the existing gate system that is over 100 years old. A level crossing is a portentous situation where the rail and road networks come into close contact with each other. It is imperative that the technical systems that are installed to ensure public safety in these locations should be of the most modern and reliable standard achievable. Additionally, the availability of spares for the current mechanism is questionable as replacement parts would have to be of bespoke manufacture. Regular maintenance of the gate mechanism would also be required and the gate box would continue to be manned, requiring significant running costs. If the sub option was chosen and motorised gates were provided, then product approval would be required for the motors which could take significant time.

If Option C was pursued, there would be a significant amount of work involved in the development of the equipment to interface a power unit with the existing level crossing gates that will ensure safe and reliable operation. The existing standards do not envisage that gates would be remotely operated by power. To permit this arrangement would require that the HSE, RSSB and Network Rail revise their standards.
The timescales for producing an approved design for the crossing are likely to be extensive, probably in the region of three to five years, even without the time involved in getting the contents of standards changed. There could be no guarantee that any attempt to have the standards amended or alternatively attain a derogation for this site, would be successful. It is the professional opinion of the Signalling and M&E disciplines that such an attempt would ultimately prove unsuccessful. Additionally, the costs of the design, installation, and training and the associated safety-case and product approval works would be considerable.

9.2. Reliability

Current information on the options for future installations at the Plumpton crossing do not permit reliability estimates which are sufficiently robust to be used as primary discriminators between them. At this stage, only the following, qualitative observations may be made:

- Option A - The reliability of the current installation has been estimated from historic data but numeric estimates for possible remotely operated variants cannot yet be made.

  From the Haydon Bridge failure information, a small sample, it can be concluded that changing from MCGs to MCBs reduces the failure rate of a crossing by a factor of about 3.7. This may be an underestimate as all failures at Haydon Bridge occurred in the first five months of operation and for the following 19 months was fault free. Applying this ratio to the Plumpton failure rates would suggest that replacing the MCGs at Plumpton with MCBs would result in a reduction in failures of around 13 per year (from 17.5 to 4.8).

- Option B - Like for like replacement of the current installation is likely to afford some opportunities for reliability enhancement using modern materials, bearings, seals etc. but these will probably be limited by the unavoidable environment to which the mechanism is subject. Additional gains would also be achieved by replacing the mechanical equipment with modern motors, as proposed by the sub option but this would still be limited as the original gates would remain n use.

- Option C - The remote option variant which retains the current drive system but with a motor replacing the manual operating wheel should also accrue any benefits from refurbishing the mechanism. It may well, however, incur higher unavailability and disruption to traffic than at present, simply as a result of the additional subsystems and components necessary to ensure safe operation and the probable absence of local maintainers. In addition the high forces imposed by a motorised drive may increase the likelihood of breakages of the drive system.

The variant incorporating individual gate motors would dispense with the existing operating mechanism. This would offset the effect of additional components but it is not possible to say whether its reliability and availability to traffic would be greater than at present.

9.3. Heritage

Option A - The automatic barrier option is the least preferred in heritage terms because this involves the loss of the gates and would bring to an end the use of the use of the gate wheel and lever frame system.

Option B (Like for like with existing Mechanical System) - The preferred option in heritage terms is to retain the locally operated gates with like-for-like renewal. This involves no adverse impacts on the listed signal box and gates and involves the repair and refurbishment of historic fabric which is of conservation benefit. The fact that the original wheel mechanism has survived in continuous use is probably the most significant aspect of the signal box and gates; this option retains the wheel and mechanism in use so this is the preferred option in heritage terms. However, PPS5 Policy HE9.4 recognises that harm to heritage significance should be balanced with wider public benefits, so if there is a convincing case for the public benefits of the other options then these could be justified.

Option B (Like for like with Motorised Gates) - If this option was selected, then the situation described in option C below would apply.

Option C – This option retains the remotely operated gates which have some group and communal value. The remotely operated gates are therefore preferable to the automatic barrier in heritage terms. Again, PPS5 Policy HE9.4 recognises that harm to heritage significance should be balanced with wider public benefits, so if there is a convincing case for the public benefits of the automatic barrier then this could be justified.

9.4. Recommended Option

The main advantage of option B is that the level crossing would remain as it is today with the original gate box and gates remaining in use. However, the crossing is over 100 years old and presents a significant maintenance concern and would require a supply of bespoke parts to prevent any major delays during repairs, and thus poses a reliability concern. The existing crossing is also non compliant with many modern standards and so also has to be considered to present a greater risk to its users than a modern day equivalent i.e. an MCB crossing.

The main advantage of option C is that it would allow the existing crossing gates to be retained. However, the option is considered to present a greater risk to both road and railway users due to its non standard system, the mixture of old and new equipment and the remote control of the gates (i.e. no local signalman). For the same reasons, the reliability of the crossing is also expected to be less than that of an MCB crossing. The option would require significant changes to standards to allow for its implementation and this would be costly, time consuming and unlikely to be successful. Whilst the option would retain the existing gates, they could still potentially require alteration to accommodate footpaths on either side of the road. The crossing would also be fitted with RTL's, audible alarms, 3 No. CCTV cameras, floodlights on the crossing and on the approach roads, and an REB in the ZN corner. All these items would detract from the existing character of the crossing.

Option A would provide a fully compliant crossing that is widely used on Network Rail infrastructure today. The crossing would not require any product approvals, derogations or changes to standards. The maintenance regime would also be standard and no bespoke parts would need to be produced or stocked specifically for the crossing. For all of the above reasons, the crossing presents the lowest reliability and risk concerns of the three options. The major drawbacks relate to Heritage considerations as the existing gates would be replaced and the gate wheel mechanism would be taken out of service, but the gate box would remain. However, as highlighted within the Heritage sections, PPS5 Policy HE9.4 recognises that harm to heritage significance should be balanced with wider public benefits. Allowing the gates to be replaced with barriers would enable an MCB crossing to be installed, and for the public to benefit from greater safety and reliability of the crossing.

For the reasons discussed above and contained within this report, Option A is the recommended option for renewal of Plumpton level crossing.

9.5. GRIP4 and 5 activities

Activities that have been identified for future GRIP stages are listed below:

- Commence discussion local planning authorities (all options)
- Ground Investigations for any new bases or barriers (options A and C)
- Type approval (options C or B - motorised gates option)
- Open discussions regarding land purchase in the YN corner (options A or C)
- Assessment of the signallers existing workload and workload for the proposed crossing arrangement (options A or C)
- Determine if existing REB to be retained or if all equipment could be relocated into the new REB (option A or C)
- Lux level survey for floodlights (options A or C)
- Determine final road alignment if option A is selected. It does not appear necessary for road alignment to be straightened to accommodate an MCB crossing, however previous MCB proposals have shown a straightened alignment and so this requirement should be further reviewed if option A is selected (option A). There are also some non compliances with the existing road alignments (e.g. road width should be constant across the crossing).
- Determine if Local Control Unit could be accommodated with the signal box without removing the gate wheel and levers. If gate wheel and levers do require removal, then review options for their removal and relocation (option A, C or B – motorised gates)

10. References

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- Lewes District Council decision notice, 13 August 1985
- Letter from Victorian Society to Lewes District Council, 14 August 1985
- Lewes District Council decision notice, 10 March 1987

Maps

- Ordnance survey 1873
- Ordnance survey 1897
- Ordnance survey 1910

Online sources

- Listed Buildings Online http://lbonline.english-heritage.org.uk
- www.signalbox.org

Appendices

A. Option Drawings

A.1. Barrier Crossing Remotely Operated with CCTV (Option A) – Plan View

Drawing 5098868-RLS-PLN-CST-00003

A.2. Barrier Crossing Remotely Operated with CCTV (Option A) – Elevation Views

Drawing 5098868-RLS-PLN-CST-00004

A.3. Gated Crossing Locally Operated (Option B) – Plan View

Drawing 5098868-RLS-PLN-CST-00005

A.4. Gated Crossing Locally Operated (Option B) – Elevation Views

Drawing 5098868-RLS-PLN-CST-00006

A.5. Gated Crossing Remotely Operated (Option C) – Plan View

Drawing 5098868-RLS-PLN-CST-00007

A.6. Gated Crossing Remotely Operated (Option C) – Elevation Views

Drawing 5098868-RLS-PLN-CST-00008

B. Signalling Sketches

B.1. Upgrade to MCB-CCTV Signalling Sketch

B.2. Upgrade to MCB-OD Signalling Sketch

C. Product Information

Product Information for equipment required to motorise operation of gates

D. Cost Breakdown

Cost breakdown information for Options A, B and c

E. Topographical Survey Drawings

E.1. Topographical Survey – Plan View

5098868-Plumpton-Plan-01

E.2. Topographical Survey – Long Section of Road

5098868-Plumpton-Rd centre Section-01

E.3. Topographical Survey – Survey Report

5098868-510-0002 Survey Report

F. HAZOP workshop

F.1. HAZOP Workshop Meeting Minutes

G. Reliability data

G.1. Plumpton and Haydon bridge Failure Data

H. Selection of Survey Photos

H.1. Mechanical and Electrical Engineering Photos

Photo H1 – View of Level Crossing from North East

Photo H2 – Operation and Observation of Level Crossing Gates by Signalman

Photo H3 – Ground lever system at Up (West) side of level crossing

Photo H4 – Ground lever system at Up (West) side of level crossing

Photo H5 – North side URX access ICs and gate stop mounting plate.

Photo H6 - Southside URX access ICs and gate stop mounting plate.

Photo H7 – Operation of gates

Photo H8 – Operation of gates, note gate stop raised.

Photo H9 – Road closed, gate stop in place wicket gate locked.

Photo H10 – Signalling REB downside cess opposite signal box

Photo H11 – DNO metering and distribution cubicles

Photo H12 – LV Distribution Switchgear for signal box and CSR DNO cubicle

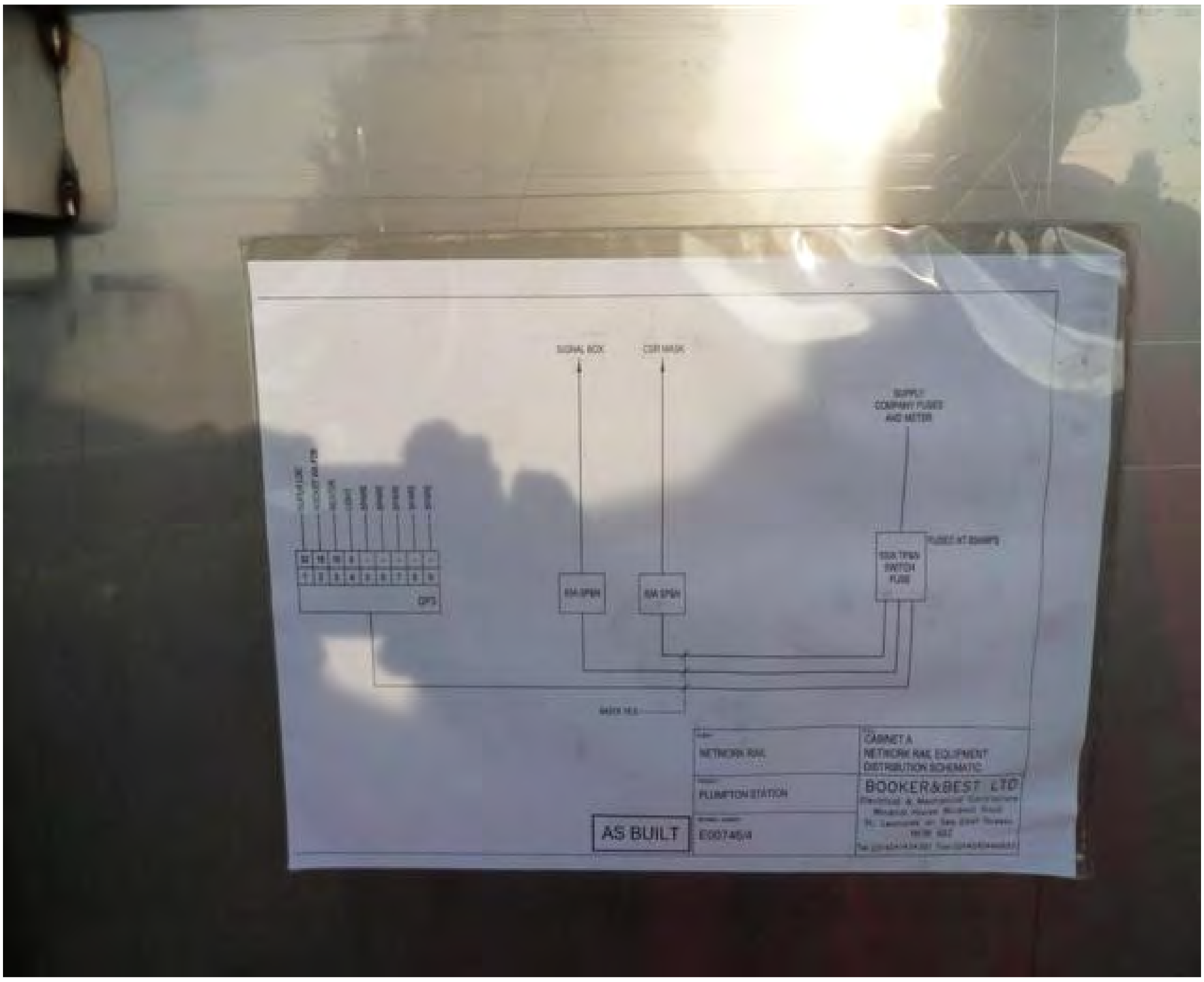

Photo H13 – LV Distribution schematic.

[redacted]
Atkins
Northern House
7 – 9 Rougier Street
York
North Yorkshire
YO1 6HZ
Email: [redacted]
Telephone: [redacted]
Direct telephone: [redacted]
Fax: [redacted]