PARSONS BRINCKERHOFF

EAST WEST RAIL – PHASE 2
PRE-FEASIBILITY ENGINEERING
ASSESSMENT OF NEW VARIATIONS TO LONDON ROAD LEVEL CROSSING, BICESTER, OPTIONS A1, C, D1 & D2

Network Rail

Network Rail Contract Number 133735

Draft

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Report Title	:	**EAST WEST RAIL – PHASE 2 PRE-FEASIBILITY ENGINEERING ASSESSMENT OF NEW VARIATIONS TO LONDON ROAD LEVEL CROSSING, BICESTER, OPTIONS A1, C, D1 & D2**
Report Status	:	**Draft**
Job No	:	**3513769A**
Date	:	**May 2015**
Document Number	:	**EWR2-ECV-REP-PBL-210001**

DOCUMENT HISTORY AND STATUS

Document control			
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Revision details			
Version	**Date**	**Pages affected**	**Comments**
2.0	May 2015		2nd Issue

CONTENTS

Executive Summary

This report provides a brief technical note on three variants for replacing the level crossing at London Rd, Bicester, as identified by Oxfordshire County Council. The report assesses recent developments and variations to the previously studied options for alternatives to London Road level crossing, the B4100 in Bicester Town, which crosses the Oxford to Bicester Branch line (NR line reference OXD, 19m 34ch).

The outputs are presented by way of a simple critique of the alternative crossing options, in respect of the short time window available to undertake this work.

Option A1 (Tunnel) – Off line all-modes bypass route from Station Approach to Talisman Road.

The previous Option A1 was a viaduct crossing the railway west of the level crossing. The brief was to investigate a tunnel version of this option route.

The main pros for Option A1 (Tunnel) are:

- An offline route from London Road simplifies traffic management during construction.
- A tunnel with approach cuttings would not cause alteration to the skyline of Bicester Town.

The main cons for Option A1 (Tunnel) are:

- Higher construction costs to that of Option A1 viaduct. The option would cost approximately £XXm (provisional high level estimate) and require a construction period of approximately 30 months.
- Higher disruption and restrictions to local businesses than Option A1 viaduct. The approach ramps will be in cuttings which will utilise more land at grade than a viaduct option. This will affect Bicester Town Station car park, Talisman Business Centre and McKay Trading Estate with possible restrictions to the use of land for these stakeholders.

Option C (Reduced Headroom Tunnel) – On line tunnel to London Road

The previous Option C was an on line traffic only underpass tunnel beneath the railway at the London Road crossing. Pedestrian routing is offered by a footbridge as original Option B. The brief is to consider reduced headroom of the road tunnel to investigate any reduced impact on the footprint and construction for the option.

The main pros for Option C reduced headroom are:

- The option provides an alternative to the level crossing at the existing location.
- Has a slightly reduced footprint area compared to a compliant headroom tunnel potentially offering 10% saving in scheme costs.

The main cons for Option C reduced headroom are:

- Option C has high construction costs in the order of £XXm (provisional high level estimate). Reduced headroom may only offer a 10% saving in overall scheme cost compared to compliant headroom.
- Departures from standard are required to certify the reduced headroom. The risk of collision impact from tall errant vehicles is not mitigated.
- As the underpass is vehicle only, a pedestrian footbridge must also be provided to inclusive mobility standards; this may / may not form part of the new railway station infrastructure.

Option D1 and D2- Offline New link road from A41 to Station Approach

Option D is to provide a new link road from the A41 Bicester Southern Bypass to Station Approach. Variation D1 has its A41 junction just west of the current A41 road over rail bridge, whilst variation D2 has the junction east of the rail over road bridge and requiring the new link road crossing back over the railway with a new road over rail bridge.

A recently approved extension to the high level car park for Bicester Shopping Village impacts on these options. The new Bicester Shopping Village car park occupies the land west of Bicester Town Station on which the proposed Option D will pass directly through. A high level link road over the car park is likely to be unpopular with local properties and will be intrusive. There is also vertical alignment difficulties to achieve an over pass. Alteration of the car park is viable but also has its difficulties.

The main pros of Option D are:

- Little disruption to the existing London Road.

The main cons of Option D are:

- Does not provide a direct bypass for the original London Road Crossing.
- Disruption to Bicester Shopping Village. Compulsory purchase of Bicester Shopping Village extension car park and part demolition of it to fit in the new link road.
- High construction costs now considerably higher than the previous Option D estimate of £XXm (provisional high level estimate) and requiring a construction programme considered to be in the order of 30 months.

1 INTRODUCTION

This technical note has been produced for Oxfordshire County Council's information.

The scope of this report is to investigate alterations and variations to some existing pre-feasibility proposals of alternative option routes to the existing London Road Level Crossing adjacent to Bicester Town Railway Station.

This work was commissioned on 10 April 2015 with a requirement to deliver the investigation findings before Oxfordshire County Council's meeting of 21 April 2015.

1.1 Objective

Oxfordshire County Council held a meeting on 25th March 2015 with NR/PB to discuss their remit for undertaking Engineering Feasibility Assessment of a series of new options for the London Road level crossing in Bicester. The remit required outputs to a comparable detail to that provided by Atkins in earlier studies of potential options (reported in August 2013).The work was expected to be undertaken in March and April 2015.

Given the limitations to the available time window for undertaking the work, NR provided a reduced output remit by way of PMI3.16/0010, on 9th April 2015, with a requirement for the initial technical note on 20th April. The objective of the short study was set out as a Pre-Feasibility Engineering Assessment, covering new variations to The London Road level crossing, with particular scope coverage set out below.

Option A1 (Underpass):

Provide outline description of underpass structure, sketch plan and section, outline construction technique, simple programme, site compound requirements and pros / cons summary.

This option comprises an off-line all-modes underpass from Station Approach to Talisman Road. The route bypasses London Road level crossing, connecting Station Approach with London Road around the junction with Mallards Way.

Option C (Restricted Headroom Underpass):

Provide a commentary on the previously examined Option C (on-line underpass), but with reduced highway clearances to minimise excavation and to reduce impact on the immediate area. In respect of safety, this option is high risk to the NR infrastructure due to the potential vehicle collision with the structure (bridge bash), thus technical approval issues were due to be examined

Option D1 and D2 (New link Bypass Road from A41 to Station Approach):

Provide new highway alignments, their issues, constraints, and opportunities.

Previous options D1 and D2 provided two bypass routes for a new link road from the A41 to Station Approach. It was requested that these options are reassessed to investigate the impact/constraints that an approved multi-storey car park for Bicester Village would now have on constraints to these options.

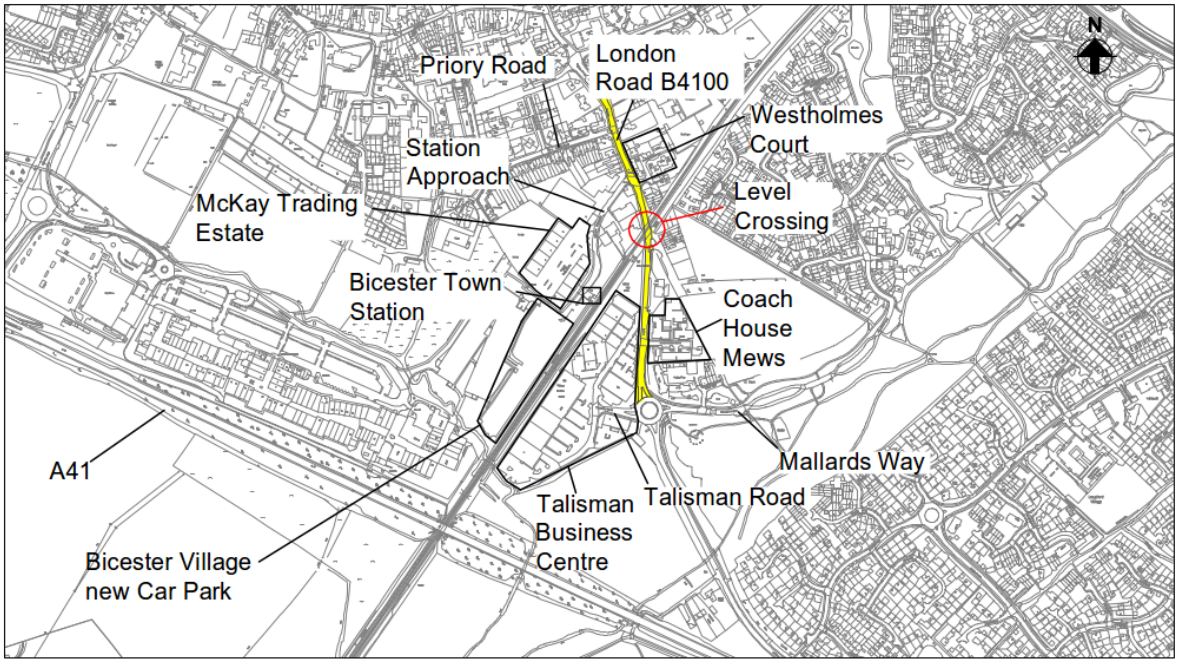
1.2 References

- The previous pre-feasibility options were presented in document:
- Stage 1- Engineering Feasibility Assessment, document reference 5121910/DOC/001, dated 19/08/2013. Titled: Bicester London Road Level Crossing Alternatives, Stage 1 – Engineering Feasibility Assessment, Oxfordshire County council, August 2013.

2 THE SITE

2.1 London Road

The B4100 London Road is a two lane single carriageway which runs north-south and intersects the Chiltern Railway line just south of the Bicester Town centre and just east of Bicester Town Station. The intersection is an at-grade automated level crossing. The road is a route for local bus services and is one of only three roads that cross the railway in Bicester, the other two being the A41 to the west and the A4421 to the east which are located on the perimeter of Bicester Town.



Site Plan of London Road Level Crossing

Limited traffic flow data is available at this time. A traffic survey on the Network Rail level crossing transparency website lists Vehicular traffic as 9072 vehicles per day (Not Classified), and 1792 Pedestrians / Cycles London Road also serves as a bus route and is used by the S5, 22, 23, 30, 94, 95, & 118 buses, however only the S5, 22 & 23 are counted as frequent services (several buses an hour at regular intervals throughout the day). Traffic flows are likely to increase with the introduction of new developments to the South and East of Bicester town planned as part of the new Bicester Garden Town.

2.2 Chiltern Railway

The current railway is operated by Chiltern Railways and is the Oxford to Bicester Branch, line reference OXD. The route is currently under-going improvement from a single track to double track, to improve rail links to the north east of Oxford, referred to as Phase 1 of the East West Rail programme. Bicester Town Railway Station is currently closed as part of the Phase 1 project and is being re-built to provide double track, twin platforms and footbridge, complete with new station building, forecourt and parking.

2.3 Developments in Bicester

Major developments are planned in Bicester including a large site south of Bicester at Graven Hill which will generate a significant travel demand between south east Bicester and the town centre.

3 PROPOSED ALTERNATIVE OPTIONS

3.1 Option A1 (Underpass) – Off Line All-Modes Underpass from Talisman Business Centre to Station Approach Road

3.1.1 Alignment

The route for Option A1 is defined by the OCC brief on drawing S-5121910-FEA-000-001.This shows a route from Station Approach across Bicester Town Station car park and then crossing the railway to connect with Talisman Road within the Talisman Business Centre, south of Bicester Town Station. The route ties into the existing roundabout on London Road at the junction with Mallards Way and Talisman Road. Option A1 previously proposed approach viaducts with a road over rail bridge. The brief is to consider an underpass version of this Option A1 and this has been referred to as Option A1 (Underpass).

The brief discusses a vehicle only solution in order to minimise cost and footprint of the works. However on assessment, the additional width required for a footway will need to be provided in any case to maintain forward visibility through the horizontal alignment. It should also be noted that in relation to the scale of earthworks and structures that are required for a scheme of this size, the additional width for a footway does not substantially increase the cost or footprint.

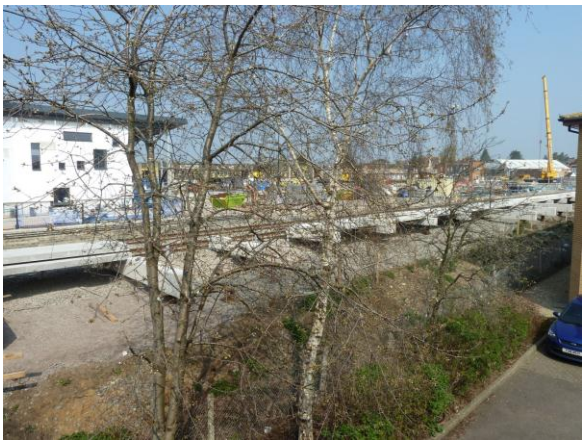
If a footpath is not provided as part of the underpass then a separate root for pedestrians will be required in the form of a ramped footbridge providing for inclusive mobility either at, or adjacent to the current crossing position. This will be visually intrusive and, due to the size of the ramps, is likely to impact on the footprint of the Chiltern station development, or the Grade II listed station house.

The underpass proposal will make the existing access arrangements to the McKay Trading Estate from Station Approach redundant as the existing entrance will be blocked by the retaining wall. An alternate access into the site has not been developed as part of this report as it will either need to cross the Bicester Town station redevelopment site, necessitating a redesign of their car park, or via adjacent roads such as Pingle Drive and the Bicester Village internal road layout, or Priory Road to the North. Any alternate access into the McKay estate will need to take into consideration land ownership, the planning use category of the estate and any existing traffic orders in the area.

Photograph 1: View of Station Approach Road looking towards junction with London Road

Photograph 2: View from Station Approach across Bicester Town Station Car Park showing approximate road alignment

Photograph 3: View at end of Talisman Road looking towards Railway crossing. Both brick buildings are on proposed alignment.



Photograph 4: View from Talisman Business Park across railway past Bicester Town Station.

3.1.2 Horizontal alignment

Option A1 (Viaduct) has a 50m radius which is below the desirable minimum for a road with a 30mph speed limit. For the underpass option, Talisman Road will serve the south side of Talisman Business Centre, and a new access will be provided onto London Road (as Option A1 Viaduct) to serve the north side of Talisman Business Centre. Further development of the junction layout at London Road/ Mallards Way/Talisman Roads, of the layout of Talisman Estate internal roads is required to provide a DMRB compliant solution.

With a northwards realignment of the link road, from that originally proposed, the desirable minimum radii of 90m can be achieved. However, this will impact on more buildings than shown in the original Option A1 (Viaduct). The underpass alignment is presented in the plan sketch for Option A1 (Underpass) in Appendix A.

The tie in between Station Approach and London Road will also need to be developed further as it will now form part of the through route rather than a junction, and therefore will require a 90m radius curved alignment, with a greater impact on the property on the western side of London Road.

3.1.3 Vertical alignment

A desirable maximum slope of 6% has been applied to the approach ramps in order to determine the tie-in to the surrounding network.

DMRB allows for slopes of up to 8% to be used in exceptional circumstances; however this will preclude the use of the underpass by any persons of mobility problems as any extended slope steeper than 6% presents problems to these users and is considered unusable by the majority of wheelchair users.

If this steeper gradient is used, then an alternate footbridge will be required as discussed above.

3.1.4 Forward visibility

The Forward visibility has been checked for both the horizontal and vertical alignments using a design speed of 60kph (as required by DMRB for a road with a 30mph speed limit). The vertical visibility for the underpass is achieved to the relevant standard; however without widening, the horizontal visibility envelope clashes with the retaining walls enclosing the ramp on the northern side of the railway. To satisfy standards, visibility requirements are to be brought into standard the footway on the inside of the bend would need to be widened which will increase the impact on the new station car park.

3.1.5 Land Take

Land requirements for the link road will affect Station Approach, the station car park and the station forecourt entrance area. Additionally, the option will require demolition of buildings within Talisman Business Centre, and to the north of the Junction of Station Approach with London Road, to provide a suitable tie into the existing network for through traffic.

3.1.6 Ground Conditions

The existing ground conditions of the site are simplified in the following record:

Depth	Thickness	Strata Description
	0.5m	Light brown **made ground**.
0.5m	1.0m	Soft light grey mottled brown slightly sandy slightly gravelly **CLAY (Alluvium)**.
1.5m	1.75m	Stiff light grey mottled brown slightly sandy slightly gravelly **CLAY** (Oxford or Kell clays).
3.25m	2.75m	Medium strong grey Medium to coarse grained **LIMESTONE**.

6.0m	0.5m	Very stiff light greenish grey **CLAY**.
6.5m to 16m		Extremely weak light grey **MUDSTONE**. This has artesian water pressure to 0.8m above ground level. Water struck at 11m rising to +0.84m above G.L.

In times of heavy rainfall ground water would become perched on top of the Alluvium clay causing a high water table. The Mudstone holds artesian water pressure to above ground level. Excavation for a tunnel would penetrate into the mudstone and therefore ground water control would be required during the construction process.

It is noted that the area is close to the level 1 flood zone with a predicted flood level reported up to 66.431m AOD downstream of Pingle Brook (NR report: EWR P1 – Level 3 FRA: Bicester Town Station, WHS document WHS1160 V2 29/11/2013). Flood levels are thus 1.159m below the existing track level of 67.5m AOD.

An underpass solution would thus need to be engineered for ground water uplift pressures and constructed using groundwater control measures. Additionally, any underpass scheme would have entrances below the maximum flood level which would leave the route at risk of becoming inoperable during times of heavy flooding or require the need for the construction and operation of a pumping station to ensure operability of the underpass. This would add to construction and future maintenance costs. It may be feasible, however, to raise the road threshold levels at the top of the approach revamps above forecast flood levels and therefore to prevent inundation of the underpass.

3.1.7 Buried Services

The site has two immediately known buried services that may be problematic for a underpass excavation in that diverting them may be problematic. Firstly Bicester Brook Culvert that runs under the railway station and secondly a public foul sewer that runs across the station car park. The manhole of the public sewer can be seen in photograph 2 above. Diversions of these services would need to be planned and it may not be possible to achieve the diversions with a gravity system. Pumped options may therefore need to be employed which will add to both construction and future maintenance costs.

3.1.8 Typical Structural Form

The Approach Roads

From ground levels the approach ramps would typically be formed at 6% gradients down through retained cuttings into an underpass under the railway. Likely forms of construction for the approached ramps would be secant piled retaining walls. Secant piling utilises intersecting piles that would form a water retaining structure. The inside of the walls would be additionally waterproofed and covered by a reinforced concrete wall which would be cast into a ground slab. Waterproof joints would be designed incorporating the necessary water bars and movement joints. The inside of the walls are then finished with brick/masonry cladding or other finishes. The ground slab would need to be thick enough to resist the upward ground water pressure (3.5m thick at it deepest point) or be anchored. Above the ground slab the system will be provided with an active drainage scheme before road base and road finish layers are placed. Near to ground level the secant piling may be replaced with steel sheet piling. Both forms of piling would probably require temporary propping until the base slab is

installed to act as the ground prop. A typical secant pile would be 800mm diameter and approximately 15m long.

The Underpass

Where construction takes place remote from the railway the structural form of the underpass could use the same construction as the ramps. A roof would then be placed on top of the cutting and backfilled to reinstate the ground above. This is typically referred to as a cut and cover construction.

If the railway is operational then there would not be enough time under current possession regimes to allow a cut and cover construction method. A technique would need be used that would allow construction to proceed during railway possessions to ensure hand back of the railway for operational periods. For an underpass of this size, a precast concrete box unit with a cutting edge can be cast inside the approach structures to one side of the railway and then jacked under the railway in a progressive jack and excavation procedure. This is typically done at 150mm increments. To accept the jacking forces and independent piled jacking base is cast, over which the underpass box will slide. The underpass box roof is typically 1.5 to 2m below the railway to allow for services and railway track formation.

To reduce the risk of disturbance to the railway the jacking operation can be achieved within a possession of the order of 3 to 5 days. The Easter or Christmas period is usually planned for to provide between 72 to 100 hour possessions. It is sometimes considered that taking up the track and excavating down to the top of the box, jacking the box into position and then reinstating the track is quicker with reduced risks than jacking under the track in place. This is likely to be the case here as we have the added difficulty of dealing with the platform piling. The removal of the platform piles presents both a difficulty and a risk of slowing the construction process down. The reinforced concrete box would have elements approximately 1m thick with an internal width of 11.4m (7.4m wide carriageway, 2m wide footways on both verges) and an internal height of approximately 7m to allow for the road curvature and road construction. Figure 1 below gives a general longitudinal arrangement showing the jacking slab positioned on the south side of the railway.

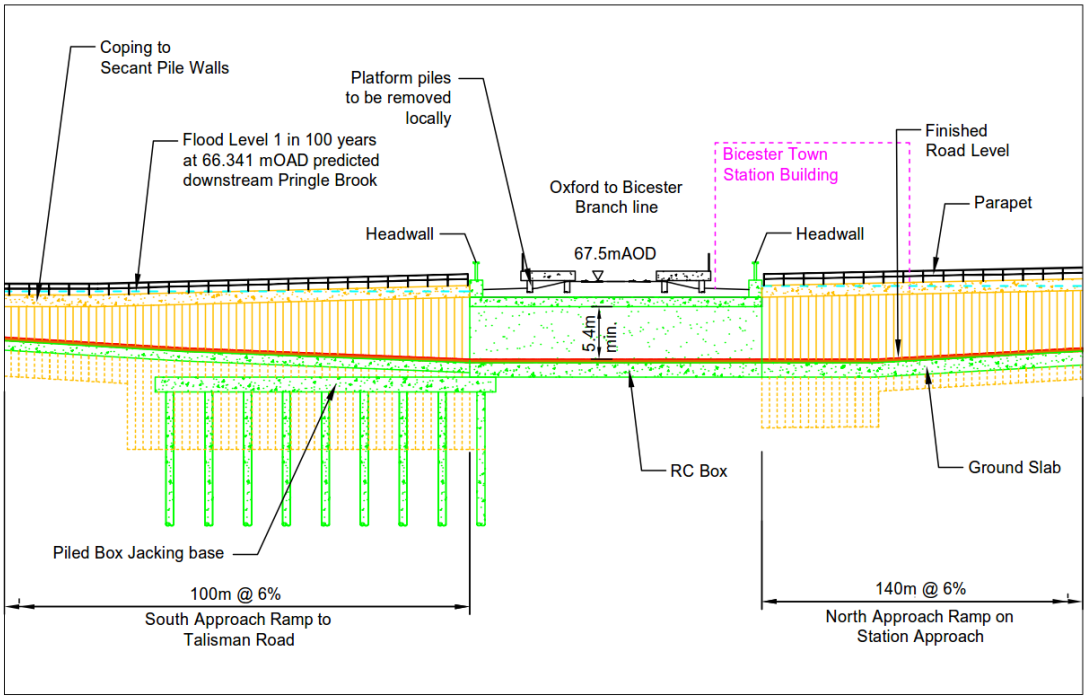


Figure 1. Long section of jacked-box for road under railway tunnel.

3.1.9 Works and Design Cost Estimates - Option A1 (Underpass)

The works cost estimate for Option A1 (Underpass) is in the order of £XXm. The headline breakdown is summarised below:

Item A £XXm (ECH)

Item B £XXm (ECH)

Item C £XXm (ECH)

3.1.10 Indicative Construction Programme

As was previously reported with the viaduct Option A1 a tunnelled version would also follow a similar site programme considered achievable over a 30 month period.

3.1.11 Summary Commentary on Option A1 (Underpass)

The main pros for this option include:

- This solution provides a bypass in close proximity to the existing crossing.
- Mainly offline construction from London Road would simplify traffic management and provide less disruption to the traffic flow on London Road.
- An underpass and approach ramps in cuttings would not cause visual impact at Bicester Town.

The main cons for this option include:

- High construction costs.
- Risk of flooding though it may be feasible to mitigate this through engineering design of approach ramps and structures.
- Restriction to the use of the railway station land and conflicts with new the station layout.
- Restriction to the use of the Talisman Business Centre land and vehicle movements.
- Demolition of existing Talisman Business Centre buildings.
- Disruption of businesses in Talisman Business Centre and compensation/relocation payments for affected businesses.
- Possible restriction to the use of land of the McKay Trading Estate.
- Redesign of the Mallard Way Roundabout to provide access to the new link road and the southern part of the Talisman Trading Estate.
- Redesign of the junction of Station Approach and London Road to allow for through traffic, potentially requiring demolition of properties on the western side of London Road
- A permanent pumping system (i.e. an active drainage system) for the underpass is required. The scale of the permanent pumping system for the underpass may become expensive during detailed design once analysis of the surface water run-off and a location for the pumping outlet are designed. This will also add to maintenance costs. The pumping system would not necessarily be designed to cope with inundation/flooding typically they are for surface water run off for rainwater storm events over a defined local catchment area.

3.1.12 Cut and Cover Alternative

The railway operations forecast during EWR2 build will comprise the new Phase 1 service, which turns back at Bicester, and a roughly daily freight waste train. On the assumption the turn back manoeuvre takes place to the west of Bicester station, and that the freight trains are diverted through Aylesbury, closure of London Rd may be possible, permitting a cut and cover type construction approach to be pursued, at lower cost than a jacked box.

3.2 Option C (Reduced Headroom Underpass) – On Line Underpass London Road

3.2.1 Alignment

The alignment for Option C is defined by the OCC brief on drawing S-5121910-FEA-000-005. This shows an underpass on London Road below the railway with approach ramps within cuttings supported by retaining walls either side. The width of the underpass is defined as 7.4m to accommodate a two lane single carriageway with no accommodation for pedestrians. Pedestrians are to be accommodated by a separate

footbridge previously assessed as Option B. The footbridge is not covered by this report. The brief is to consider a reduced height underpass version of Option C to investigate the magnitude of the reduced impact on the footprint and construction compared to a compliant headroom option.

The brief discusses a vehicle only solution in order to minimise cost and footprint of the works. However on assessment, the additional width required for the footway will need to be provided in order to maintain forward visibility through the horizontal alignment. It should also be noted that in relation to the scale of earthworks and structures that are required for a scheme of this size, the additional width for a footpath does not substantially increase the cost or footprint.

If a footpath is not provided as part of the underpass then a separate provision for pedestrians and persons of limited mobility will need to be provided in the form of a ramped footbridge either at, or adjacent to the current crossing position. This will be visually intrusive and, due to the size of the ramps, is likely to impact on the footprint of the Chiltern station development, land or the Grade II Listed station masters house.

As the alignment is on the line of the existing highway, access to the proposed car park for the southbound platform at Bicester Town station, and Alchester Terrace will be severed by the retaining walls. If these are to be retained then an alternate access will need to be created through third party land such as the Talisman Trading Estate, and Coach House Mews respectively.

3.2.2 Horizontal Alignment

The horizontal alignment will follow the existing London Road alignment as before for Option C. It was noted previously that the option will be very close to the Grade II listed building north-west of the crossing. There will be scope during detailed design to move the road eastwards to provide increased clearance to this building as the properties on the eastern boundary will have been compulsory purchased and demolished to provide room for the retaining walls. It is also worth noting that there is also scope for widening the underpass to provide for pedestrian access this would maintain the current pedestrian route on the east side of the road.

3.2.3 Vertical Alignment

Headroom / Clearance

The brief asks to consider reduced headroom for the carriageway under the railway in order to reduce the earthworks and footprint.

The current UK standard (DMRB TD 27/05) states that all new structures must have a minimum clearance of 5.3m, with an additional allowance for tight vertical curves to accommodate longer large vehicle.. If tight vertical radii are used to minimise the footprint, then the headroom will need to be increased by 80mm to 5.4m to be compliant with the highway standards. Any reduction in this clearance would have to be authorised by Highways England in a formal application for a departure from standards which must set out a case justifying the reduced clearance.

It should be noted that in reality 'tall' vehicles such as buses and HGV's are generally less than 5.4m, with a double decker bus or coach typically being between 4m and 4.6m in height. There no height limit imposed on UK, vehicles with the vehicle height being governed by factors such as load weight, shape and sideways wind profile. Some specialist vehicles such as car transporters can be closer to 5.0m in height and must be measured after each loading to make sure they can fit under motorway structures.

The imposition of a height limit, collision protection beams or other warning systems is unlikely to be sufficient to permit a structure with reduced headroom to be acceptable to Highways England or Network Rail.

The desirable maximum slope of 6% has been applied to the approach ramps in order to determine the tie-in to the surrounding network, as noted in Option A, steeper gradient is permitted in DMRB, but this does have an impact on any persons of limited mobility.

Drawing S-5121910-FEA-000-005 from the original study indicates the extent of carriageway to be lowered for the required headroom. By introducing independent collision protection beams either side of the underpass, Network Rail may not reject sub-standard headroom owing to the fact that the railway under bridge is protected, however getting sub-standard headroom through other legislation may prove more problematic as the design does not mitigate for free traffic movement and presents a collision risk. In reality, transport of construction equipment, double decker buses and fire appliances all present bridge strike risks where reduced headroom is provided. However, to explore the suggestion, a clearance of 4.6m has been used. A sketch for Option C Reduced Height underpass indicating the extent of carriageway to be lowered is contained in Appendix B.

It is considered that the underpass could be built at a level just below the railway. Allowing 343mm for rail and sleeper depth, 300mm minimum ballast depth below sleepers and a typical 1m thick tunnel roof this produces a road level for reduced headroom of 4.6m at 6.243m below rail level. The extent of the ramps has used this depth and a 6% gradient converging with the ground levels that are rising to the north and falling to the south of the crossing.

It is shown that reducing headroom from 5.4m to 4.6m reduces the length of the approach ramps by approximately 14m, i.e. 12%. The footprint reduction does not impact on the problem areas for compulsory purchase up to the junction with Station Approach, but does reduce the geometric issues at the junction of Priory Road. This may save compulsory purchase of two properties on the east boundary. The capital construction costs are therefore estimated to be up to12% lower and along with perhaps less compulsory purchase costs an overall scheme saving is estimated to be up to 10% lower than that for providing for a compliant headroom. It is debatable whether this cost saving is enough justification to warrant the departures from standard for a reduced headroom.

3.2.4 Ground Conditions

The existing ground conditions of the site are presented within the discussion of Option A1 (underpass). The same consideration to ground water equally applies to this option.

3.2.5 Buried Services

London Road has cable/fibre statutory utility services within it including a medium pressure gas main, drainage, BT, Virgin and water mains. All of these services would require diversions from the proposed cutting and underpass area. Of particular difficulty will be the foul sewer which runs across the London Road just north of the level crossing and it is likely that this will need to be diverted with an active pumping system as a gravity diversion would be unlikely. This would add to construction and future maintenance costs.

3.2.6 Typical Structural Form

One structural form for the underpass would be a jacked reinforced concrete box with approach roads in cuttings supported by secant piled walls and sheet piled walls. This form has been discussed in more detail for Option A1 (underpass). A photograph of a similar scheme at Tipton is shown below.

Photograph: The Owen Street Level Crossing at Tipton, 2010. (Proceedings of ICE Feb 2011, Paper 10-00025)

3.2.7 Works and Design Cost Estimates - Option C (Reduced Headroom Underpass)

The works cost estimate for Option C (Reduced Headroom Underpass) is in the order of £XXm. The headline breakdown is summarised below:

Item A £XXm (ECH)

Item B £XXm (ECH)

Item C £XXm (ECH)

3.2.8 Indicative Construction Programme

We consider that a reduced headroom underpass would follow a similar site programme to that already reported for Option A1 (Underpass) and is considered achievable over a 30 month period. Although the construction footprint is somewhat reduced the programme would still need to accommodate services diversions, site set up, demolition and clearance and mobilisation time between multidisciplinary construction phases. The additional task of the collision protection beams would utilise some of the construction time saved from the reduced footprint.

3.2.9 Summary Commentary on Option C (Reduced Headroom Underpass)

The main pros for this option include:

- This solution provides an alternative to the level crossing along the existing location on London Road.
- An underpass and approach ramps in cuttings would not cause visual impact at Bicester Town.
- Slightly reduced footprint area compared to Option C using a compliant headroom underpass.

The main cons for this option include:

- High construction costs.
- Risk of flooding – (See option A1 (Underpass) above)
- On-line works to London Road requiring significant traffic diversions during construction.
- Large number of compulsory purchase buildings and affected stakeholders.
- Departures from standard required to certify the reduced headroom. Does not mitigate against a collision impact from an overnight vehicle hitting a collision protection beam.

3.3 Option D1 & D2 Offline New Link Road from A41 to Station Approach

3.3.1 Alignment

Option D is to provide a new link road from the A41 Bicester Southern bypass to run roughly parallel to the railway and tie into London Road at the current Station Approach / London Road Junction.

Variation D1 has its A41 junction just west of the current A41 road over Rail Bridge, running along the western side of the railway between the Bicester Shopping Village and the track. It then crosses the car park and ties into the new Station Approach road that is part of the Bicester Town Station redevelopment.

Variation D2 has its A41 junction just east of the current A41 road over Rail Bridge and runs roughly parallel on the eastern side of the railway from the A41 for a short distance, before crossing over the railway just south of the Talisman trading estate. The route then crosses the car park to the south of the train station, before tying in to the new Station Approach, as with Option D1.

3.3.2 Junction with the A41

Both the D1 and D2 options will require a signal controlled junction to be created on the A41. A simple priority junction (Give Way) is unlikely to be suitable due to the volume of traffic using the junction, the approach speed of vehicles on the A41, and the restricted forward visibility over the railway bridge. A roundabout would also not be appropriate due to the land take requirements on top of the embankment, and forward visibility over the bridge.

Some widening will be required to create an additional lane for right turning traffic. This widening will have an impact on the railway bridge which acts as a constraint, however there is potential to lessen the impact in the D2 option, as the 3 lane section of the junction will be on the approach to the bridge, and any widening over the structure will be to accommodate the taper back down to the current single carriageway.

3.3.3 Option D1- Offline New Link Road from A41 to Station Approach to the West of the Railway

3.3.3.1 Alignment

Option D1 has least impact on the Talisman Business Park, and on the existing properties along London Road. It has the potential to isolate businesses that rely on passing trade, such as the petrol filling station.

It will also cross land owned by the Bicester Retail Village, including the loading/delivery bays to the units at the eastern end of the Village, and a surface level car park which is currently in the process of having an upper deck added to create a multi-story structure similar to the existing car park to the west.

To retain the current infrastructure at Bicester Village, the new alignment would need to be elevated on a viaduct over the shopping units, Loading bays and new car park. This would have construction and cost implications and would have a significant impact on the operation of the shopping village during the construction phase.

A turning head will need to be created at the end of the southern approach to the former level crossing on London Road to allow any vehicles that approach the crossing in error to turn around. There will also be a requirement for a pedestrian route across the railway at this point to maintain a right of way along London Road.

The current junction of Station Approach and London Road will need to be remodelled to allow for through traffic from the new link road/Station Approach onto London Road which will have an impact on the properties to the north of the current junction of Station Approach and London Road.

3.3.3.2 Horizontal Alignment

The horizontal alignment complies with Highway standards with regard to horizontal radius and visibility. A slight curvature has been introduced to bring the carriageway away from the Bicester Village buildings, however there is a clash with the end building that may require the building to be locally altered or demolished.

The layout sketch in appendix C shows a roundabout at the northern end of the viaduct. This roundabout could be used as a second entry/exit point to the Bicester Village. If it is decided that this scenario is to be considered, then further development is needed to assess the impact of additional traffic on the new link and the junction with the A41.

3.3.3.3 Vertical alignment

Preliminary assessment of existing levels would suggest that although the A41 Bridge over the railway is high compared to the surrounding land, the level difference between the A41 and London Road is much less. A straight grade tie-in between the two roads will mean that there is a shallow downward grade from the A41 to London Road that is less than the maximum permitted in the standards.

The land between the railway and the Bicester Village car park that was a surface overflow car park for the village, is currently being converted into a multi-story car park with two levels. If the new road is to pass over the top of the car park,thus retaining the proposed new facility, the slope down to the tie-in with London Road will be much steeper. This will also mean that the access arrangements to Bicester Town

Station and McKay Trading Estate which are shown on the current Station redevelopment plans will need to be further developed.

A high level link over the car park is likely to be unpopular with adjacent properties and local residents as it will be visually intrusive. It may be considered to create a light blight on buildings at the eastern side of the Bicester Village.

3.3.3.4 Connectivity with Bus Services

The current bus stops in London Road will need to be relocated to provide connectivity with the railway station. The stops would be best located on the realigned station approach as this would become the through route for traffic thereby minimising the delay to the service. If the high level viaduct solution is adopted to minimise the impact on the Bicester Village car park, this solution would not be practical due to the level differences, and therefore the bus stops would need to be incorporated into the revised station car park layout.

3.3.4 Option D2 Offline New Link Road from A41 to Station Approach crossing the Railway

3.3.4.1 Alignment

As with Option D1, the original proposal minimises the impact on the Talisman Industrial Estate and properties along London Road, and by having the Junction with the A41 to the east of the existing railway overbridge it will avoid a clash with the Bicester Retail Village. The land to the East of the railway is shown as Flood Zone 2 on the Environment Agency's website, and has a water course running through it. This will require some additional ecological mitigation and review of construction techniques.

This alignment will encroach into the delivery yard of the southernmost unit of Talisman Business Park before it crosses the railway into the land occupied by the surface level over flow car park for Bicester Village. The current junction of Station approach and London Road will need to be remodelled to allow for through traffic which may have an impact on the properties to the north of the current junction of Station Approach and London Road.

3.3.4.2 Horizontal Alignment

The Atkins alignment uses tight horizontal radii which are generally the minimum in the DMRB standards for a road with a 30mph speed limit. The return radius that aligns the new road with the railway is slightly tighter than permitted, which has been changed in the alignment shown in appendix C and will generally follow the original proposals.

The forward visibility envelope extends outside the boundary of the road, which means that forward visibility will be blocked by any parapet installed along the edge of the elevated section. It will therefore be necessary to widen the footways, or to increase the bend radius.

As with option D1, the junction of Station Approach and London Road will need remodelling to accommodate through traffic which may have an impact on the properties to the north of the existing junction.

3.3.4.3 Vertical Alignment

As with the D1 option it has not been possible for a full vertical profile to be worked up at this time, however interpretation of limited elevation data would suggest a shallow downhill gradient towards London Road.

As discussed in the Option D1, this option will have a significant impact of the proposed car park works currently underway.

3.3.4.4 Bus stops

As with the Option D1, bus stops linking the rail and bus services into the town centre will be required either on the new station approach as shown on the new Bicester Town Station plans, or accommodated within a revised station car park layout depending on if measures are taken to minimise the impact on the Bicester Village car park.

3.3.5 Works and Design Cost Estimate - Options D1 & D2

The works cost estimate for Option D1 (Off Line Highway) is in the order of £XXm. The headline breakdown is summarised below:

Item A £XXm (ECH)

Item B £XXm (ECH)

Item C £XXm (ECH)

The works cost estimate for Option D2 (Off Line Highway) is in the order of £XXm. The headline breakdown is summarised below:

Item A £XXm (ECH)

Item B £XXm (ECH)

Item C £XXm (ECH)

3.3.6 Indicative Construction Programme – Options D1 & D2

The offline link road options would also follow a similar site programme to that in the original study for Option C (viaduct/over-bridge) considered achievable over a 30 month period. The construction footprint is somewhat enlarged, the programme would still need to accommodate services diversions, site set up, demolition and clearance and mobilisation time between multidisciplinary construction phases. The additional task of the elevated highway decking will require construction lay down and craneage areas, which will be disruptive to the Bicester Village parking provision.

3.3.7 Summary Commentary on options D1 & D2

The main pros for these options include:

- Both options D1 and D2 have a minimal impact on the Talisman Trading estate and the properties to the south of the current level crossing.
- Minimal impact on the Current Bicester Town Station redevelopment scheme.

The main cons for this option include:

- High construction costs.
- Both options cross the land to the south of the current station scheme where the Bicester village a multi-storey car park is currently under construction
- Both options will require a major signalised junction (including carriageway widening to create right turn lanes) to be constructed on the A41 which is elevated on an embankment at this location.
- Option D1 crosses over the eastern end of the Bicester Shopping Village and will impact on the Loading Bays and Shopping units.
- Both options create a long diversion route for vehicles travelling from Mallard Way and the housing estates to the South East of Bicester into the town Centre.
- A ramped footbridge will need to be provided at the current Level crossing position to maintain a route across the railway.

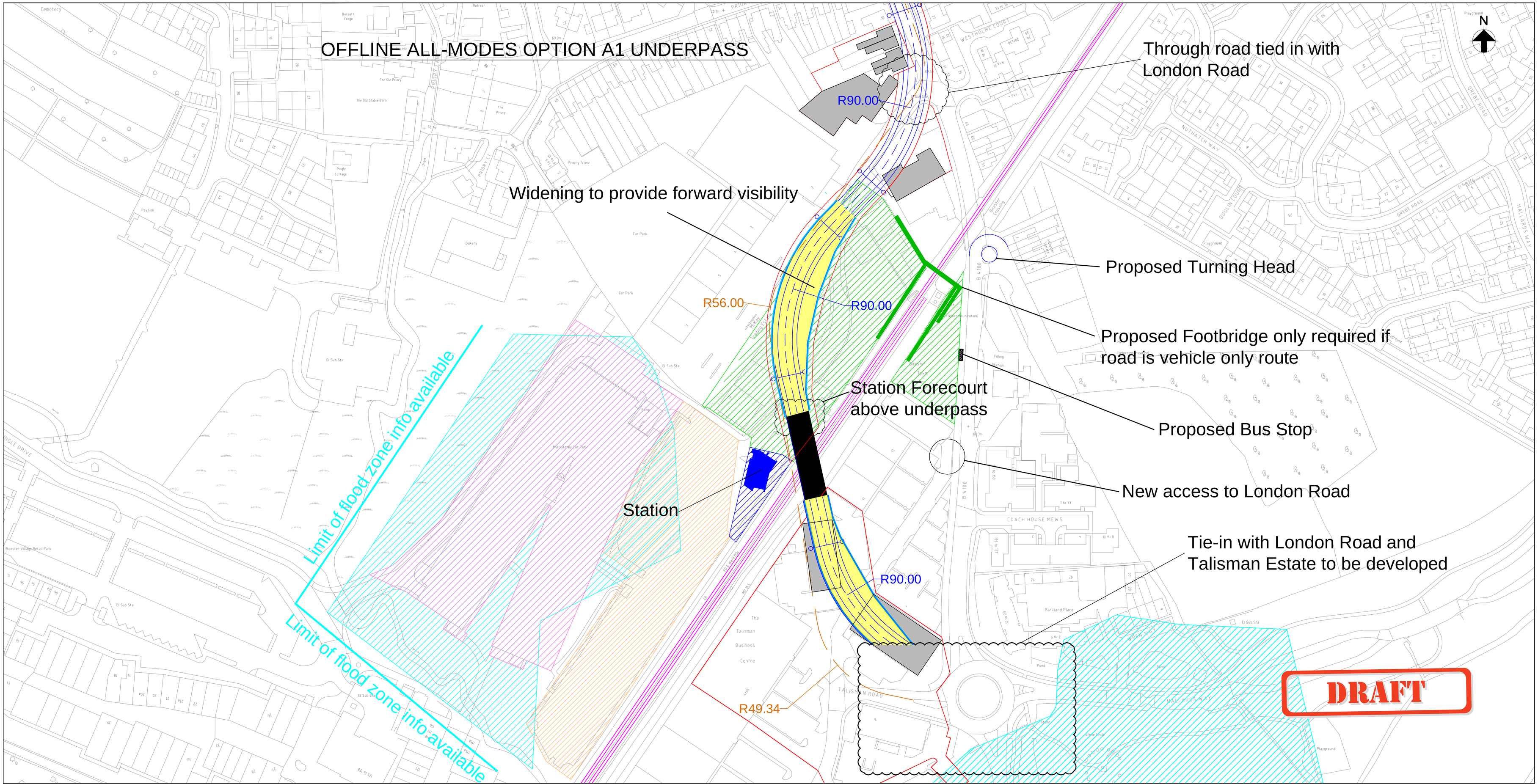
3.4 Next Steps

The limited timeframe for this assessment has dictated that the findings are at a relatively high level. We have concluded that all the options are technically feasible from an engineering perspective, and can be built in similar timescales. There is some variation in construction risk and in operational functionality between the options.

There are a range of other issues that will affect the selection of a preferred option, including cost, traffic patterns, land requirements, visual and other environmental impact, disruption to businesses, consents and regulatory processes and railway operations.

Sufficient consideration of these factors to provide a robust basis for option selection, along with further assessment of structural forms, construction methods, flood risk mitigation, highway geometry, traffic impacts and other engineering issues, requires further investigation over a longer period that was available here. This further investigation is required in order to develop a satisfactory approach to the closure of the existing London Road level crossing.

OFFLINE ALL-MODES OPTION A1 UNDERPASS



SCALE 1:2000 (printed in A3)

SCALE 1:1000 (printed in A1)

Notes:

1-Road Level is 7.40 m below rail level with assumed headroom of 5.4 m, including an additional clearance of 100 mm due to vertical sag radius.156 m long sag curve with a vertical radius of 1286 m, assuming minimum values as in DMRB.

2- For a 23 m span, 14 m wide underpass the following depths have been assumed: 375 mm for rails and sleepers, 300mm for ballast and 1280mm for the bridge deck, 1955mm in total.

3-Cuttings to be contained by retaining walls along the whole length of the underpass and approaches.

4-Highway approach gradient to underpass is 6% in accordance with DMRB standards.

5-The design speed for horizontal alignments is 60B (60 kph) which corresponds to a 30 mph speed limit after assessment of existing alignment. 3 steps relaxation below Desirable Minimum Radius have been considered complying with the maximum 4 relaxation steps as recommended by DMRB for all-purpose band B roads.

6- 3.65 m wide lanes have been widened 0.3 m in curves with 90 m radius with a 1:30 transition as recommended by DMRB.

7-Ground assumed to be flat in terms of calculation of earthworks where no level information is available. No vertical alignment design has been undertaken at this stage.

8-The plan is based on O/S data rather than surveyed. Therefore, any distances shown are approximate.

9-Flood Zone as shown in Chiltern Railway options drawing E094\10

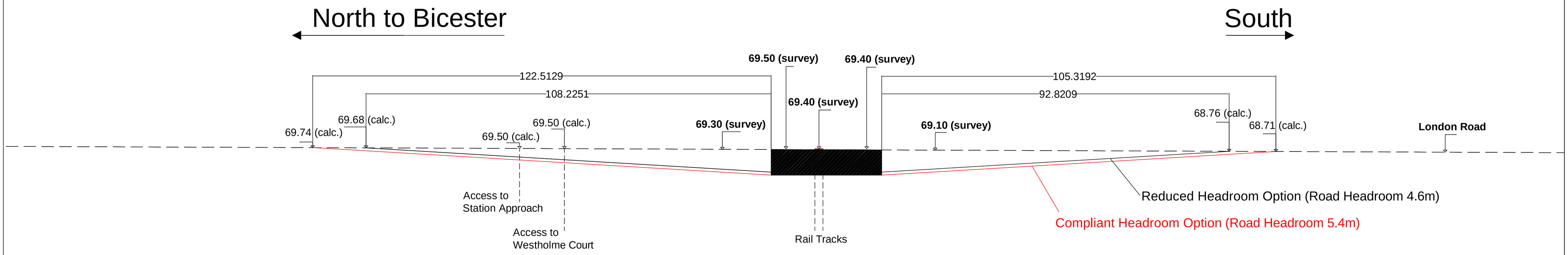
KEY

- A1 Viaduct proposal
- A1 Tunnel proposal
- Proposed Chiltern Station Car Park
- Proposed Retail Village Car Park
- Existing Phase 3 Decked Car Park
- Proposed Bicester Village station
- Proposed Underpass
- Flood Zone (See note 9)
- Buildings to be demolished due to Proposed Alignment
- Area subject to compulsory purchase
- Retaining Walls
- Ramp approach

EWR2 PRE-FEASIBILITY ENGINEERING, ASSESSMENT OF NEW VARIATIONS TO LONDON ROAD LEVEL CROSSING, BICESTER.

PARSONS BRINCKERHOFF

Date	Status	Designer	Checker	Approver
24/04/15	Issue for Information	RAP	SB	CL



Length of approach ramps for Option C - Underpass with Compliant Headroom

DRAFT

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EWR2 PRE-FEASIBILITY ENGINEERING, ASSESSMENT OF NEW VARIATIONS TO LONDON ROAD LEVEL CROSSING, BICESTER.

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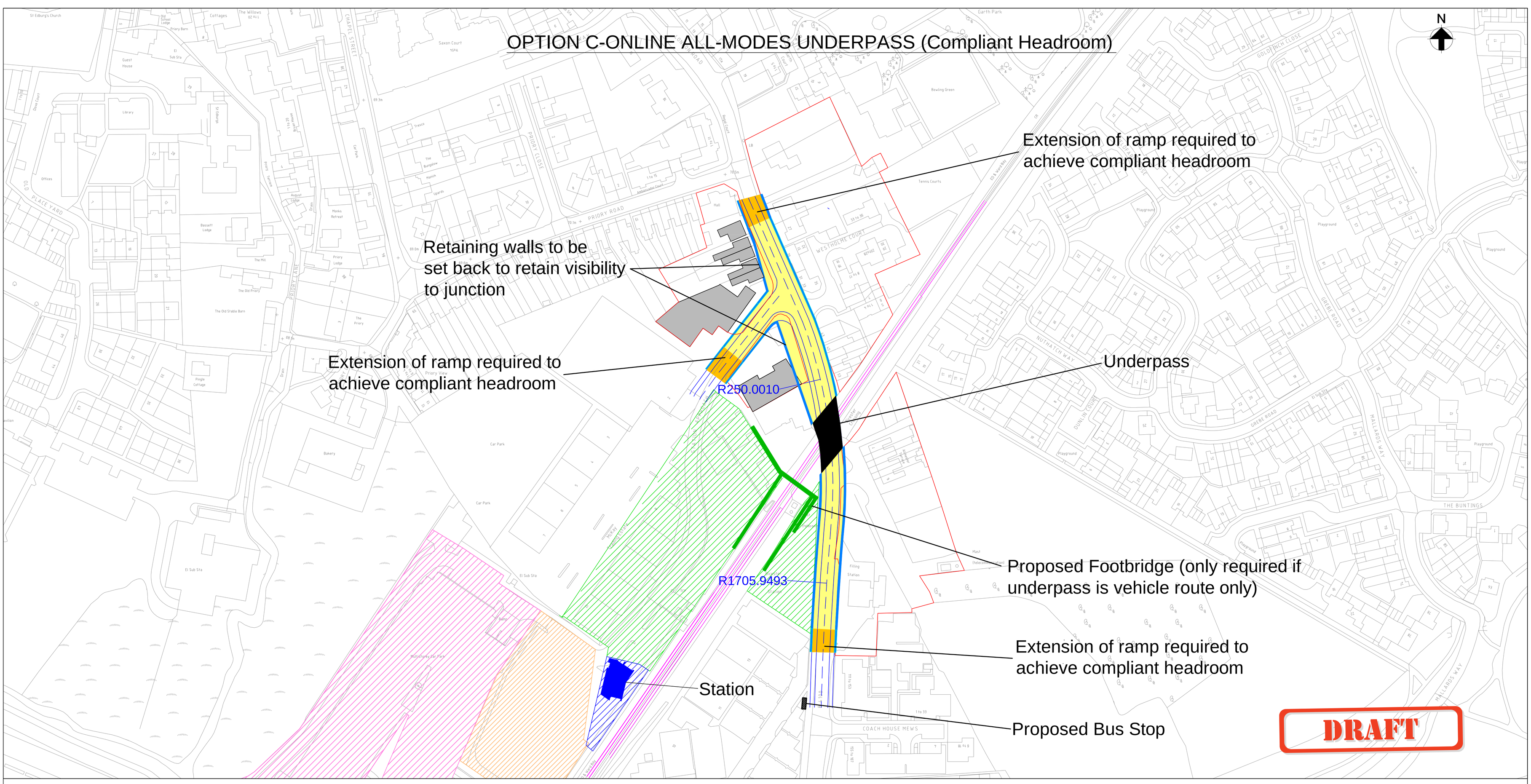
OPTION C-ONLINE ALL-MODES UNDERPASS (Compliant Headroom)



SCALE 1:2000 (printed in A3)

SCALE 1:1000 (printed in A1)

Notes:

1-Road Level is 7.04 m below rail level in case of underpass with compliant headroom (5.4m). 160 m long sag curve with a vertical radius of 1268 m, assuming minimum values as in DMRB.

2-Cuttings to be contained by retaining walls along the whole length of the approaches.

3-Highway approach gradient to underpass is 6% following DMRB indications.

4-The design speed for horizontal alignments is 60B (60 kph) which corresponds to a 30 mph speed limit after assessment of existing alignment. 3 steps relaxation below Desirable Minimum Radius have been considered complying with the maximum 4 relaxation steps as recommended by DMRB for all-purpose band B roads.

5-Ground level estimated following data retrieved from limited 3D survey.

6-The plan is based on O/S data rather than surveyed. Therefore, any distances shown are approximate.

7-Visibility requirements for junction with Station Approach follow the recommendations in Volume 6 Section 2 Part 6 TD42/95 about visibility distance.

KEY

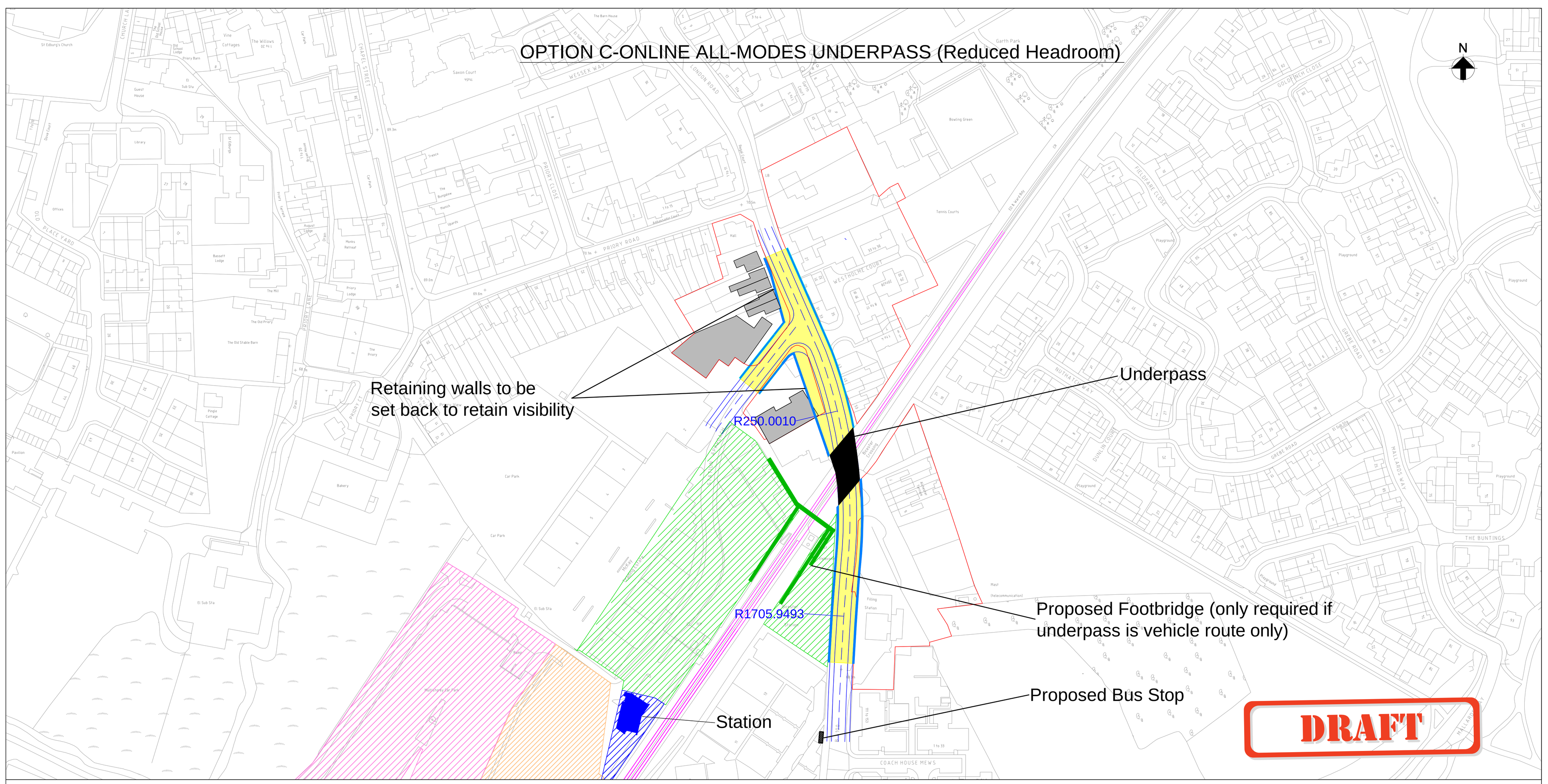
- C1 PB Proposed Alignment
- Proposed Chiltern Station Car Park
- Proposed Retail Village Car Park
- Existing Phase 3 Decked Car Park
- Proposed Bicester Village station
- Proposed Underpass
- Buildings Affected by Proposed Alignment
- Area subjected to Compulsory Purchase Order
- Retaining Walls
- Ramp approach

EWR2 PRE-FEASIBILITY ENGINEERING, ASSESSMENT OF NEW VARIATIONS TO LONDON ROAD LEVEL CROSSING, BICESTER.

PARSONS BRINCKERHOFF

Date	Status	Designer	Checker	Approver
24/04/15	Issue for Information	RAP	SB	CL

OPTION C-ONLINE ALL-MODES UNDERPASS (Reduced Headroom)



SCALE 1:2000 (printed in A3)

SCALE 1:1000 (printed in A1)

Notes:

1-Road Level is 6.24m below rail level in case of underpass with reduced headroom (4.6m).160 m long sag curve with a vertical radius of 1268 m, assuming minimum values as in DMRB.

2-Cuttings to be contained by retaining walls along the whole length of the approaches.

3-Highway approach gradient to underpass is 6% in accordance with DMRB standards.

4-The design speed for horizontal alignments is 60B (60 kph) which corresponds to a 30 mph speed limit after assessment of existing alignment. 3 steps relaxation below Desirable Minimum Radius have been considered complying with the maximum 4 relaxation steps as recommended by DMRB for all-purpose band B roads.

5-Ground level estimated following data retrieved from limited 3D survey.

6-The plan is based on O/S data rather than surveyed. Therefore, any distances shown are approximate.

7-Visibility requirements for junction with Station Approach follow the recommendations in Volume 6 Section 2 Part 6 TD42/95 about visibility distance.

KEY

- C1 PB Proposed Alignment
- Proposed Chiltern Station Car Park
- Proposed Retail Village Car Park
- Existing Phase 3 Decked Car Park
- Proposed Bicester Village station
- Proposed Underpass
- Buildings Affected by Proposed Alignment
- Area subjected to Compulsory Purchase Order
- Retaining Walls
- Ramp approach

EWR2 PRE-FEASIBILITY ENGINEERING, ASSESSMENT OF NEW VARIATIONS TO LONDON ROAD LEVEL CROSSING, BICESTER.

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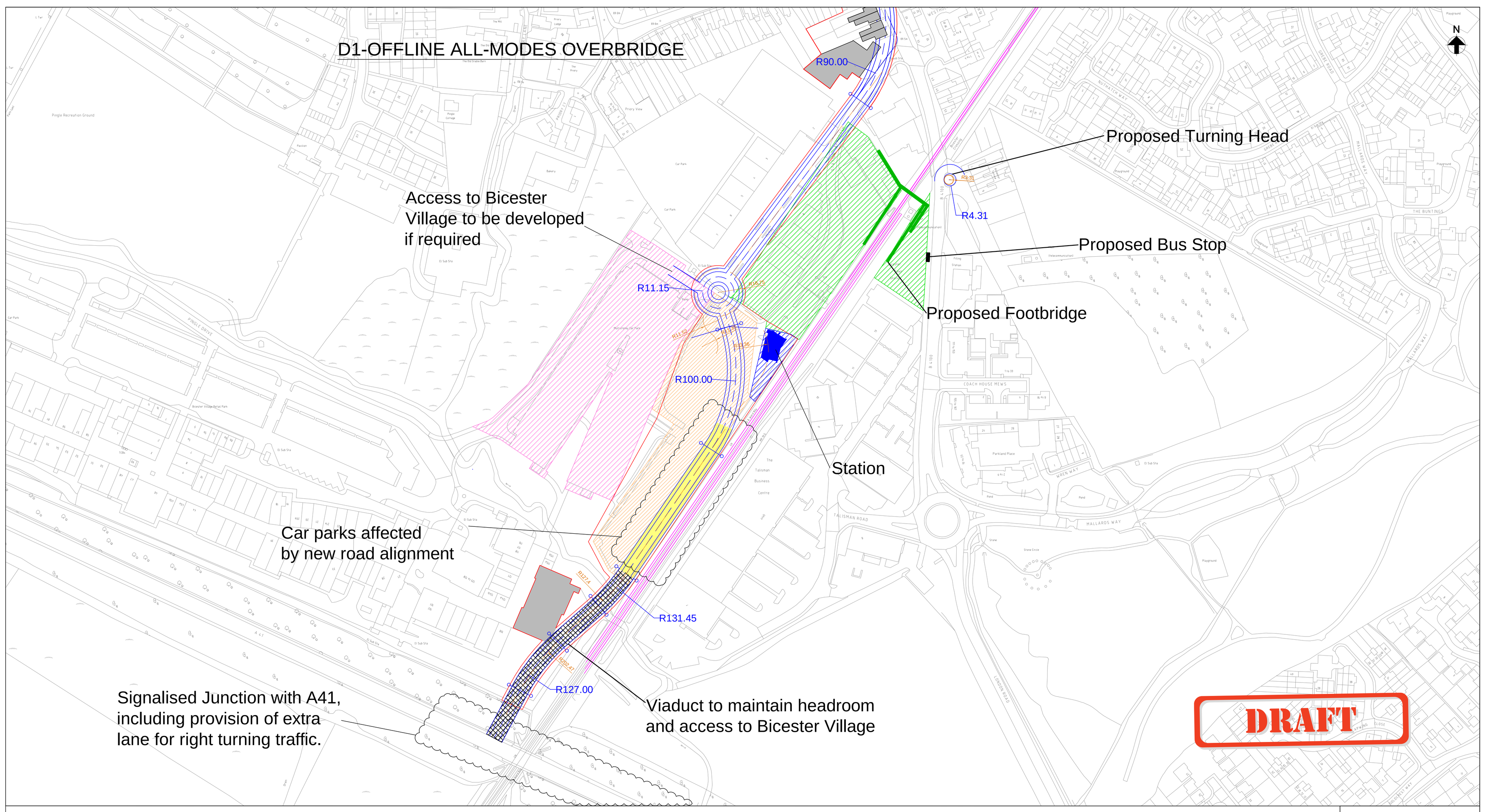
Date	Status	Designer	Checker	Approver
24/04/15	Issue for Information	RAP	SB	CL

D1-OFFLINE ALL-MODES OVERBRIDGE



SCALE 1:2500 (printed in A3)

SCALE 1:1250 (printed in A1)

KEY

- A1 Atkins proposal
- A1 PB Proposed Alignment
- Proposed Chiltern Station Car Park
- Proposed Retail Village Car Park
- Existing Phase 3 Decked Car Park
- Proposed Bicester Village station
- Area subjected to Compulsory Purchase Order
- Buildings Affected by Proposed Alignment
- Approach to viaduct (6%)
- Viaduct

Notes:

1-Road Level is supposed to be 6.90 m above rail level with assumed headroom of 5.4 m. 102 m long crest curve with a vertical radius of 1976 m, assuming desirable minimum crest K value in DMRB.

2-Viaduct deck and road package assumed to be 1.5 m thick.

3-Embankments to be contained by retaining walls along the whole length of the approach.

4-Highway approach gradient to viaduct is considered to be 6% following DMRB indications.

5-The design speed for horizontal alignments is 60B (60 kph) which corresponds to a 30 mph speed limit after assessment of existing alignment. 3 steps relaxation below Desirable Minimum Radius have been considered complying with the maximum 4 relaxation steps as recommended by DMRB for all-purpose band B roads.

6-Ground assumed to be flat in terms of calculation of earthworks where no level information is available. No vertical alignment design has been undertaken at this stage.

7-The plan is based on O/S data rather than surveyed. Therefore, any distances shown are approximate.

8-Flood Zone as shown in Chiltern Railway options drawing E094\10

EWR2 PRE-FEASIBILITY ENGINEERING, ASSESSMENT OF NEW VARIATIONS TO LONDON ROAD LEVEL CROSSING, BICESTER.

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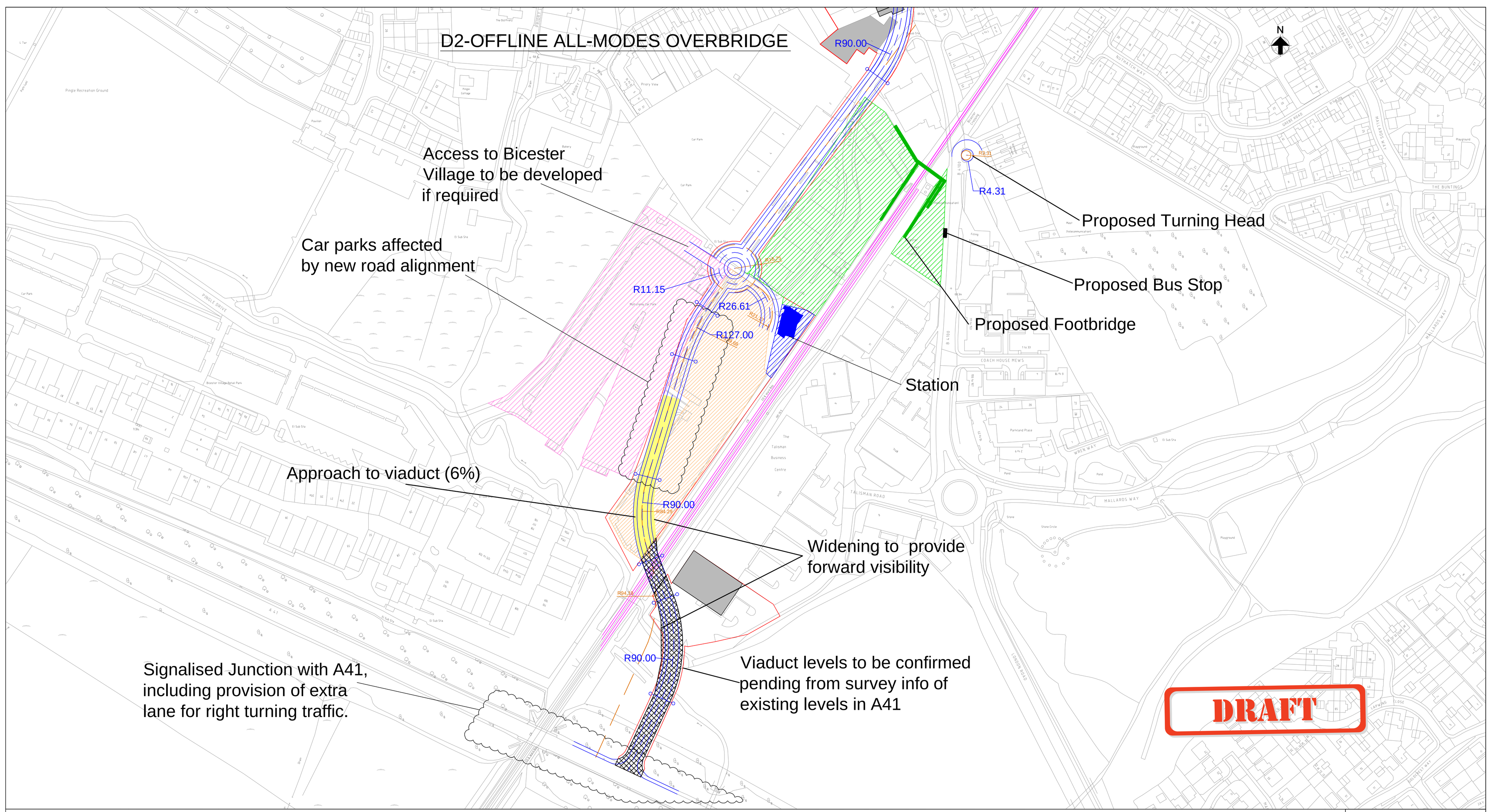
24/04/15	Issue for Information	RAP	SB	CL

D2-OFFLINE ALL-MODES OVERBRIDGE



SCALE 1:2500 (printed in A3)

SCALE 1:1250 (printed in A1)

KEY

- A1 Atkins proposal
- A1 PB Proposed Alignment
- Proposed Chiltern Station Car Park
- Proposed Retail Village Car Park
- Existing Phase 3 Decked Car Park
- Proposed Bicester Village station
- Approach to viaduct
- Viaduct
- Area subjected to Compulsory Purchase Order
- Buildings Affected by Proposed Alignment

Notes:

1-Road Level is 6.60 m above rail level with assumed headroom of 5.1 m. No vertical alignment design has been carried as crucial information is missing.

2- Viaduct deck and road package assumed to be 1.5 m thick.

3-Embankments to be contained by retaining walls along the northern approach to the overbridge.

4-Highway northern approach gradient to viaduct is considered to be 6% following DMRB indications.

5-The design speed for horizontal alignments is 60B (60 kph) which corresponds to a 30 mph speed limit after assessment of existing alignment. 3 steps relaxation below Desirable Minimum Radius have been considered complying with the maximum 4 relaxation steps as recommended by DMRB for all-purpose band B roads.

6-Ground assumed to be flat in terms of calculation of earthworks only in the northern approach.

7-The plan is based on O/S data rather than surveyed. Therefore, any distances shown are approximate.

8-Flood Zone as shown in Chiltern Railway options drawing E094\10

EWR2 PRE-FEASIBILITY ENGINEERING, ASSESSMENT OF NEW VARIATIONS TO LONDON ROAD LEVEL CROSSING, BICESTER.

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