Smart Motorways Programme

M4 J3 – J12

Package 2 (J3 to 8/9) Designer's Response to Road Safety Audit (Stage 2)

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ARCADIS JACOBS

Working on behalf of Highways England

REVISION SCHEDULE						
Rev	**Reason**	**Author**	**Checker**	**Technical Reviewer**	**Approver**	**Issue Date**
P01	Draft Issue	Charlie Taylor	Brian Waite	Brian Waite	David Pilsworth	24/02/2021

Contents

Acronyms used within the audit report

ADS	Advance direction sign
AMI	Advance motorway indicator
CCTV	Closed circuit television
DMRB	Design Manual for Roads and Bridges
EA	Emergency area
ERT	Emergency roadside telephone
MAA	Maintenance access area
MM-ALR	Managed motorway all lane running
MSA	Motorway service area
TJR	Through junction running
VRS	Vehicle restraint system

1 Introduction

This Response Report results from a Stage 2 Road Safety Audit (RSA) carried out on the proposed upgrade of the M4 motorway to a smart motorway as part of the Smart Motorways Programme (SMP). This section of the upgrade extends between M4 junction 8/9 near Maidenhead and junction 12 near Reading.

The Road Safety Audit Report (Ref: HA514451-CHHJ-GEN-SZ_ZZZZZZZZ_Z-RP-ZX-0009) and Response Report were prepared by Arcadis / Jacobs JV (AJJV) on behalf of Highways England, they are presented based upon the checklist contained in Annex B of HD19/15 for RSA. The AJJV team has examined and reported only on the road safety implications of the design in accordance with HD 19/15.

The RSA Stage 2 report was received by the Design Team and the recommendations made in the RSA report have been reviewed accordingly.

This report is set out in the same format as the previous RSA Stage 2 report with the RSA recommendation explained by the auditor. To show the designer's response an additional grey box has been included below the auditor's recommendation as follows:

RSA RECOMMENDATION: XXX

DESIGNERS RESPONSE: XXXX

Where an exception to the auditor's recommendation is proposed by the design team then the content of the above box will be displayed as follows:

RSA RECOMMENDATION: XXX

DESIGNERS RESPONSE: Exception - XXXX

2 Items Raised in previous Road Safety Audits

2.1 Summary

The road safety aspects of the M4 Smart Motorways Programme Package 2 section, between Junctions 3 and 8/9 have been subject to comment in the following RSAs. The list below indicates any issues raised in the audits that have not been addressed and remain a problem.

2.1.1 Whole scheme combined (J3-J12) Stage 1 and 2 RSA (September 2017)

The road safety aspects of the whole scheme were the subject of comment in this audit. Problems raised during the full scheme combined Road Safety Audit Stage 1 and 2 were captured as part of the Package 2 (J3 to 8/9) Road Safety Audit Stage 2 Rev P01.

2.1.2 Package 2 (J3 to 8/9) Road Safety Audit Stage 2 Rev P01 – June 2019

Problems relating to the M4 Smart Motorways Programme Package 2 section, between Junctions 3 and 8/9 were the subject of comment in this audit. Any outstanding issues raised in this RSA that also relate to the Package 2 (J3 to 8/9) have been raised again (in part or full) as part of this Stage 2 RSA as below:

- Problem 3.1.1 raised in 3.1.7
- Problem 3.1.2 raised in 3.1.8
- Problem 3.1.3 raised in 3.1.9
- Problem 3.1.6 raised in 3.1.10
- Problem 3.1.8 raised in 3.1.12
- Problem 3.1.11 raised in 3.1.34
- Problem 3.1.12 raised in 3.1.19
- Problem 3.1.13 raised in 3.1.20
- Problem 3.1.14 raised in 3.1.21
- Problem 3.1.15 raised in 3.1.22
- Problem 3.1.17 raised in 3.1.23
- Problem 3.1.12 raised in 3.1.19
- Problem 3.1.17 raised in 3.1.23
- Problem 3.1.18 raised in 3.1.24
- Problem 3.1.19 raised in 3.1.25
- Problem 3.1.20 raised in 3.1.25
- Problem 3.1.21 raised in 3.1.26

- Problem 3.1.24 raised in 3.1.31
- Problem 3.1.25 raised in 3.1.32
- Problem 3.1.26 raised in 3.1.35
- Problem 3.2.1 raised in 3.2.1
- Problem 3.3.2 raised in 3.3.2
- Problem 3.3.3 raised in 3.3.3
- Problem 3.3.5 raised in 3.3.5
- Problem 3.3.6 raised in 3.3.6
- Problem 3.3.7 raised in 3.3.4
- Problem 3.3.8 raised in 3.3.7
- Problem 3.3.9 raised in 3.3.8
- Problem 3.3.10 raised in 3.3.9
- Problem 3.3.11 raised in 3.3.10
- Problem 3.3.12 raised in 3.3.11
- Problem 3.3.13 raised in 3.3.12
- Problem 3.3.16 raised in 3.3.13
- Problem 3.4.4 raised in 3.3.29
- Problem 3.4.5 raised in 3.3.30
- Problem 3.4.6 raised in 3.3.34
- Problem 3.4.7 raised in 3.3.35
- Problem 3.4.8 raised in 3.3.36
- Problem 4.1.3 raised in 3.3.40
- Problem 4.1.4 raised in 3.3.41
- Problem 4.2.1 raised in 3.3.27
- Problem 4.3.3 raised in 3.3.42

3 Items Raised at this Stage 2 Road Safety Audit - Mainline

3.1 General

Drainage

3.1.1 PROBLEM

Location: Various Emergency Areas (EA)

Summary: Location of EA spillage containment may lead to poor skid resistance of vehicles making an emergency stop due to uneven or slippery surface leading to injury

Throughout the scheme, spillage containments are positioned within EAs. An example of this is at the proposed eastbound EA E3-B1 located at chainage 18550. The details of these containment facilities are not clear and may pose a risk should they cause an uneven surface or impact on the skid resistance of vehicles making an emergency stop within these areas. This may lead to injury through loss of control collisions.

Recommendation

It is recommended that the EA spillage containment is appropriately sited to ensure it does not impact on vehicles entering the emergency areas.

DESIGNERS RESPONSE:

Designer accepts the RSA problem and recommendation made by the RSA team.

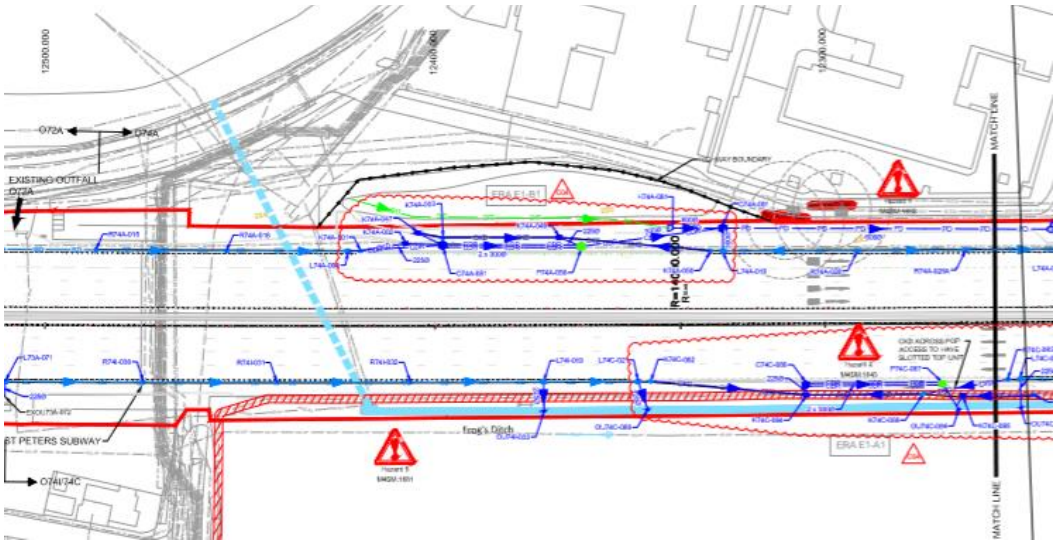
All chamber access covers located in the EAs shall have E600 cover and frames with higher skid resistance, as stated in Appendix 5/1.

3.1.2 PROBLEM

Location: Chainage 12625 to 12255 (Drawing No. HA514451-CHHJ-HDG-S2_DGZZZZZZZZ_Z-DR-CD-5165 Rev C04)

Summary: Lack of drainage provision

No drainage provision along the central reservation is indicated between chainages 12625 and 12255 although a filter drain is shown immediately up and down stream of this location. Without drainage through this section there is a risk of water standing in the carriageway, increasing the risk of loss of control type collisions.



Extract from drawing HA514451-CHHJ-HDG-S2_DGZZZZZZZZ_Z-DR-CD-5165 Rev C04

Recommendation

It is recommended that drainage provision along the central reservation is continued through this section.

DESIGNERS RESPONSE: Exception

Designer disagrees with the RSA problem and recommendation raised.

The carriageway at this location is balanced therefore drainage collection systems are proposed on the verges only. Site investigation during construction of the concrete barrier had confirmed there are no existing filter drains or fin drains located at the central reserve.

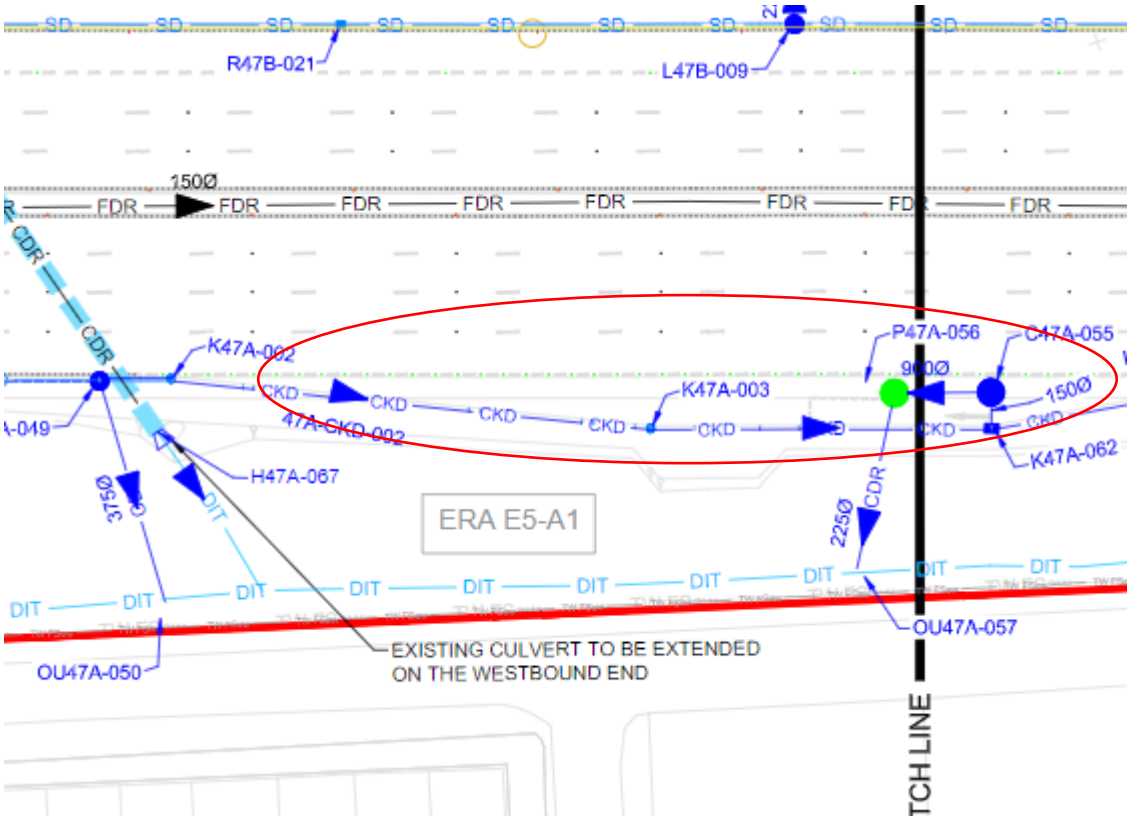
Technology

3.1.3 PROBLEM

Location: EA E5-A1 Chainage 27550 (Drawing No. HA514451-CHHJ-HDG-S2_DGZZZZZZZZ_Z-DR-CD-5121 Rev C02)

Summary: Lack of drainage provision

EA E5-A1 only has combined kerb drainage at the rear of the EA compared to other EAs where there is also a carrier drain provided along the interface with lane 1, for example E5-B1. It is not clear from the provided drawings if the cross section profile of the EA requires drainage along the interface with lane 1. A lack of drainage could result in water standing within the EA and adjacent carriageway increasing the risk of loss of control collisions, particularly at a location where vehicles could be braking.



Extract from drawing HA514451-CHHJ-HDG-S2_DGZZZZZZZZ_Z-DR-CD-5121 Rev C02

Recommendation

It is recommended that drainage provision is provided along the front face of EAs where required.

DESIGNERS RESPONSE: Exception

Designer disagrees with the RSA problem and recommendation raised.

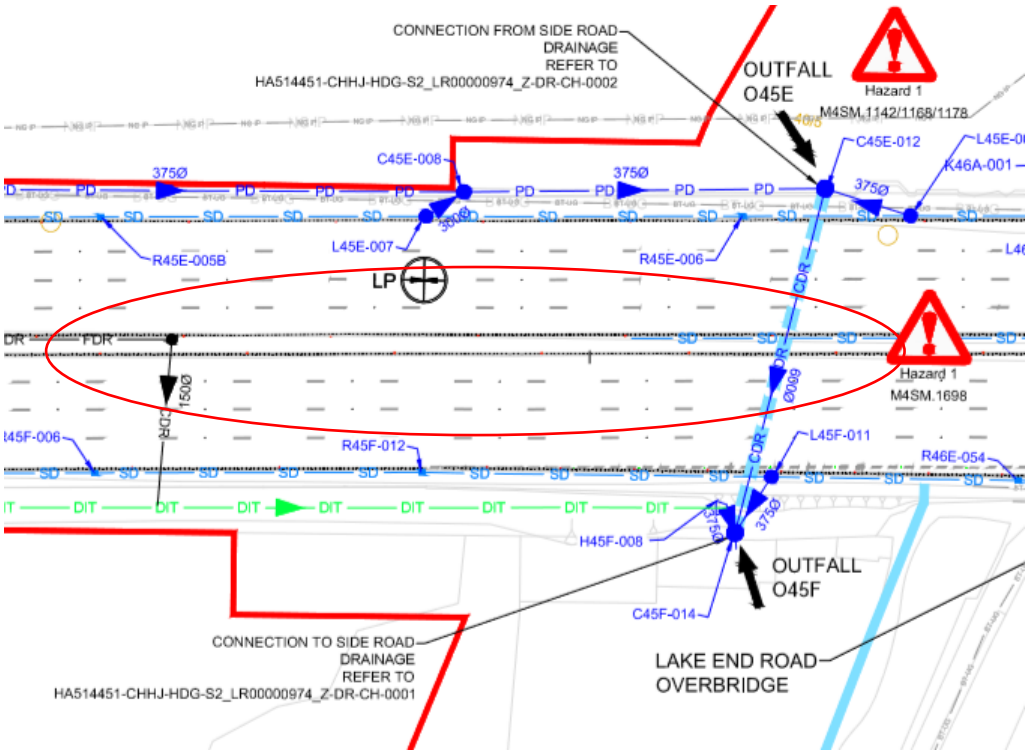
It is the design strategy for the combined kerb and drainage system to drain the width of the carriageways, where the road falls towards the verge. EA E5-B1 has a different layout because at that location the space constraint has meant that the piped ditch needed to route through the EA build-out rather than conventionally at the back of the EA.

3.1.4 PROBLEM

Location: Chainage 29600 and Chainage 17650 (Drawing No. HA514451-CHHJ-HDG-S2_DGZZZZZZZZ_Z-DR-CD-5113 Rev C01)

Summary: Lack of drainage provision

No drainage is provided along the central reservation between chainages 29600 and 17650. Without drainage through this section there is a risk of water standing in the carriageway, increasing the risk of loss of control type collisions.



Extract from drawing HA514451-CHHJ-HDG-S2_DGZZZZZZZZ_Z-DR-CD-5113 Rev C02

Recommendation

It is recommended that drainage provision along the central reservation is continued through this section.

DESIGNERS RESPONSE: Exception

Designer disagrees with the RSA problem and recommendation raised.

The road transitions from a balanced carriageway to super-elevated here, and the start of the proposed slot drain is at the point the eastbound carriageway begins to fall towards the central reserve.

3.1.5 PROBLEM

Location: Scheme wide

Summary: Potential for areas of standing water

The drainage drawings show locations where the drainage provision transfers from one side of the carriageway to the other, particularly near junction merge and diverges. Cross sections have not been provided therefore it has not been possible to fully understand why these layouts have been provided. It is possible that these are flat areas where standing water could accumulate, increasing the risk of loss of control collisions where drivers are braking and making lane changing decisions.

Recommendation

It is recommended that areas where standing water could accumulate are identified and adequate drainage provided.

DESIGNERS RESPONSE:

Designer accepts the RSA problem and recommendation made by the RSA team.

The design has ensured surface road runoff are adequately conveyed and drained by the drainage system and meets the design requirements set out in the Drainage Strategy Report.

Technology

3.1.6 PROBLEM

Location: Scheme wide

Summary: Non-installation of stopped vehicle detection (SVD) may lead to collisions

It is not clear from the RSA Brief documentation whether SVD is included in this scheme. The faster roll out of SVD, one of the commitments in the Smart Motorway Stocktake, is that it is completed within 36 months. Given that this scheme is being constructed over this period it would be preferable if SVD formed part of the technology being delivered to improve the detection of stopped vehicles, potentially reducing the risk of collisions involving vehicles stopped in a live lane. The risk of increased collision severity may become worse during low traffic, high speed periods.

Recommendation

It is recommended that SVD is incorporated into the scheme in accordance with the Smart Motorway Stocktake commitment.

DESIGNERS RESPONSE: Exception

Designer disagrees with the RSA problem and recommendation raised.

SVD is not currently a part of the project scope. It is planned to be retrofitted later by the Smart Motorway Alliance team to suit their national delivery programme and priorities.

Emergency Areas (EAs)

3.1.7 PROBLEM

Location: EAs

Summary: Use of emergency telephones may put users at risk

Emergency roadside telephones (ERT) are provided alongside each EA, behind the vehicle restraint system. The telephones appear to be orientated such that users are not facing oncoming traffic when using them such that they may not be able to observe oncoming vehicles (intentional, errant or otherwise). Furthermore, as the telephones are segregated from the EA's by means of RRS they are likely to be difficult to access for mobility impaired users.

It is also unclear if the ERT and the instructions within the telephone box are suitably illuminated or legible during the hours of darkness.

This could create difficulties for those attempting to use the telephone and in combination could result in vehicle occupants remaining in their vehicle or in the EA rather than standing behind the restraint system. This increases the risk of injury should another vehicle enter the EA.

Recommendation

It is recommended that ERTs are orientated so that users are facing oncoming traffic when using the telephone. Ensure that telephones are accessible to those with mobility impairments. Ensure also that the instructions within the telephone box are legible during hours of darkness.

DESIGNERS RESPONSE:

Designer accepts the RSA problem and recommendation made by the RSA team.

ERT orientation complies with MCX 0983 and users will face the oncoming traffic. Mobility impaired user access is provided by means of a dropped kerb (HA514451-CHHJ-HGN-S2_ML000000_Z-DE-CH-0001 to 0003). Also, ERTs contain internal illumination when in use, and legibility will be as per standard Type 354 ERT provision (as per others SMP schemes).

3.1.8 PROBLEM

Location: All EAs

Summary: Sign posts and sign faces may contribute to collisions

The sign posts at the rear of the EA are likely to impact on the working width of the road restraint system (RRS) reducing the performance of the barrier. Furthermore, should the barrier be struck by an errant vehicle there is a risk that the sign might contribute to increasing the severity of the collision. In addition, the signs appear to be mounted such that people waiting behind the RRS are at increased risk of being struck by the displaced sign faces, resulting in injuries.

Recommendation

Locate the sign posts outside of the working width of the RRS and ensure that sign faces are mounted at the appropriate height.

DESIGNERS RESPONSE:

Designer accepts the RSA problem and recommendation made by the RSA team.

The sign faces at rear of the EA are orientated parallel to the carriageway rather than perpendicular to it (details have been amended for Package 2 HA514451-CHHJ-HGN-S2_ML000000_Z-DE-CH-0001 to 0003).

All signs through the Package 2 scheme extents have been reviewed internally and as part of a RRRAP assessment to ensure that they are located outside of the working width of the RRS, and proposed sign faces are mounted at the appropriate height.

Sign posts within the working width of the barrier are passively safe by their nature at a minimum setback of 600mm, which is permitted (TD 19/06 3.14 and 3.66)

Motorists do not need to go behind the VRS to use the emergency telephone (as per IAN 161/13 cl. 5.30).

3.1.9 PROBLEM

Location: EA E3-B1 on the eastbound approach to Junction 4B (chainage 18550) and EA E2-A1 on the westbound approach to Junction 4B (chainage 15100)) - (Drawing No. HA514451-CHHJ-HGN-S2_ML000000_Z-DR-CH-1046 Rev C01 and HA514451-CHHJ-HGN-S2_ML000000_Z-DR-CH-1056 Rev C03)

Summary: Location of EA could result in late lane changing and collisions

EA E3-B1 is located on the eastbound approach to Junction 4B and EA E2-A1 is located on the westbound approach to Junction 4B. This section of M4 mainline carriageway accommodates five lanes of traffic in both directions, of which the two nearside lanes are auxiliary lanes for the adjacent off slip grade separated junction. In the event of a breakdown or incident, a motorist attempting to access the EA will be required to undertake late lane change manoeuvres across more lanes than expected and slowing down abruptly in a way that other motorists travelling along the auxiliary lane may not be expecting. Drivers may also be unaware of the EA or prevented from accessing the EA should the auxiliary lanes contain high sided and or static/slow moving vehicles. This could result in vehicles stopping in lanes adjacent to the auxiliary lane or beyond the EA as a result of being unable to access the EA, all of which could result in side impact and rear shunt collisions.

Recommendation

Increase the length and / or frequency of the EAs along this section to provide motorists with more opportunity to access EAs. Furthermore, provide additional advance signing to improve conspicuity of the EA.

DESIGNERS RESPONSE:

Designer accepts the RSA problem raised but suggest an alternative solution.

This situation is no different from a 5 lane Smart Motorway without auxiliary lanes where a breakdown or incident could occur in any lane. Advance signing has been provided as per MPI-66.

The eastbound merge at J4b is a Type E (1 lane gain) in accordance with TD22/06, and the proposed road markings have been adjusted for that layout. The 5th lane starts at ch 19150 from the mainline offside lane, therefore the two nearside auxiliary lanes as described in the problem 3.1.3 are not proposed in the IFC design. Also, additional signage has been provided (in accordance with MPI 66, instructed via PMI72) for Emergency Refuge Areas, providing a betterment to the standard IAN 161/13.

The scheme operating solution (which includes 5 lanes from J5 to J4b) was presented and agreed with Operations Technical Leadership Group (TLG) in April 2016, and recorded in the Stage 5 Combined Product: Operating Regime, Implications on Core Responders and Compliance Strategy" 514451-MUG-00-ZZ-RP-OS-300053 which has been endorsed by PSCRG (26th October 2017) and accepted at SGAR 5 (April 2018).

Furthermore, the 5-lane link length runs between Junction 5 to 4B eastbound. Both of these junctions are Non-TJR and have intra-junction hard shoulders. The J5 hardshoulder finishes at Ch.19680 and the J4B starts at Ch 17300, equating to 2380m. IAN 161/13 Para. 5.24 states the distance between refuge areas should not exceed 2.5km. Therefore, the proposed EA E3-B1 is already a betterment to the standards and considered appropriate by the designer, and

the EA strategy was endorsed at PSCRG in Feb 2015. Also, we can confirm the proposed layout for EA E3-B1 is fully compliant with IAN 161/13.

3.1.10 PROBLEM

Location: EA E6-B1 and E2-A1 (chainages 30500 and 15100) – (Drawing No. HA514451-CHHJ-HGN-S2_ML000000_Z-DR-CH-1011 Rev C01 and HA514451-CHHJ-HGN-S2_ML000000_Z-DR-CH-1056 Rev C03)

Summary: Risk of collisions approaching concealed EA's

Forward visibility to EA E6-B1 and E2-A1 is likely to be impacted by the structures and groundworks associated with Marsh Lane (EB) and Harmondsworth Road South (WB) overbridges. This could result in late lane changes side impact and shunt collisions.

Recommendation

It is recommended that adequate forward visibility to the EA's is provided.

DESIGNERS RESPONSE:

Designer accepts the RSA problem and recommendation made by the RSA team.

Adequate forward and exit visibility has been provided to EA's across the scheme to optimise driver safety including to EA E6-B1, E5-A1 and E2-A1. Visibility is in accordance with IAN 161/13 Para 5.42 and 5.45.

When the Regional Control Centre has been advised of a vehicle exiting the Emergency Area, they will set signals to alert approaching drivers.

3.1.11 PROBLEM

Location: Various EA's Scheme wide

Summary: Vehicle occupants waiting close to the RRS may be at risk of injury

Various fencing is detailed close to the back of the RRS, examples of which are found at the following EAs:

- badger fence behind EA E6-B1 eastbound (chainage 30500); and
- standard environmental barrier behind EA E4-A1 westbound (chainage 22150).

There is a risk that vehicle occupants may:

- wait in the area between the RRS and the fencing;
- remain in the EA; or
- seek an alternative locations outside the EA to wait.

This increases the risk of injury if:

- another vehicle enters the EA while occupants are waiting in the working width of the RRS;
- another vehicle enters the EA while occupants are waiting within the EA; or
- those vehicle occupants uncomfortable with waiting in the confined space between the barrier and adjacent fencing decide to seek alternative refuge via walking in the carriageway.

Recommendation

It is recommended that a sufficiently wide area for vehicle occupants to wait, outside of the working width of the RRS, is provided.

DESIGNERS RESPONSE:

Designer accepts the RSA problem and recommendation made by the RSA team.

Current Highways England guidance in the event of a breakdown is not to stand behind the VRS if in an Emergency Area and a widened area has been provided in front of the VRS for customers to stand on.

IAN 161/13 indicates that it is not intended that users of the ERT climb over the VRS. Use of the ERT is to take place from the traffic side of the VRS, and the proposed ERT installation is designed for access over the restraint system. This is in accordance with IAN 161/13 paragraph 5.30.

The provision of the VRS at EA locations (if required) is solely to protect the vehicles from hazards (e.g. retaining solutions, environmental barriers, embankment drops) as per TD 19/06 and RRRAP requirements.

3.1.12 PROBLEM

Location: EA E4-B1 Chainage 22600 22600 (Drawing No. HA514451-CHHJ-HGN-S2_ML000000_Z-DR-CH-1035 Rev C01)

Summary: Risk of mainline motorists conflicting with those accessing / egressing the EA

EA E4-B1 is located on the inside of a bend. Visibility from the EA may be reduced by the horizontal profile of the eastbound carriageway which could increase the risk of rear shunt or lane changing collisions as vehicles re-join the M4 into the path of oncoming vehicles.

Recommendation

Provide the required visibility from the EA.

DESIGNERS RESPONSE:

Designer accepts the RSA problem and recommendation made by the RSA team.

Visibility checks have been undertaken for this EA and is achieved in accordance with IAN 161/13 Para 5.42 and 5.45. , and all permanent vegetation clearance areas are highlighted on the general arrangement drawings. These are referenced in the MRSS as part of the handover to the Maintenance Service Provider.

3.1.13 PROBLEM

Location: Junction 3 eastbound approach (chainage 13150) - (Drawing No. HA514451-CHHJ-HGN-S2_ML000000_Z-DR-CH-1063 Rev C02)

Summary: Risk of conflicts associated with the EA

A 1/2 mile EA sign (PS-B-24/1_73) is located in the eastbound on slip verge from Junction 4. This is the first of two EA signs associated with EA E1-B1. At this location the carriageway is five lanes wide and includes a tiger tail associated with the Junction 4 merge. This arrangement may result in the EA sign being obscured, inadvertently overlooked or seen late, particularly from M4 mainline ahead lanes, increasing the risk of live lane stops, late lane changing manoeuvres or rear shunt type collisions.

Recommendation

It is recommended that additional EA signs are provided on the eastbound approach to EA E1-B1.

DESIGNERS RESPONSE: Exception

Designer disagrees with the RSA problem and recommendation raised.

Signs for the Emergency Areas are provided as per the requirements of MPI-66 and the required visibility has been provided.

A Customer requiring an Emergency Area will be looking out for the signs.

3.1.14 PROBLEM

Location: Scheme-wide

Summary: Insufficient signing of places of relative safety and lack of Emergency Refuge Telephones (ERTs) may lead to collisions

While EAs are signed throughout the scheme, places of relative safety and ERTs are not. As an example, eastbound EA E4-B1 is provided at chainage 22600, with the next EA (E3-B1) located 4km east at chainage 18600. Junction 5 is located between these two EAs, which includes places of relative safety on the diverge and short lengths of mainline hard shoulder. These places of relative safety are not signed and it is not clear if ERTs will be provided. This absence of clarity could increase the potential for live lane stops/breakdowns and rear shunt type collisions.

Recommendation

It is recommended particularly within this 4km section that that signing is provided to advise drivers of all places of relative safety, such as junction diverges and intra junction hard shoulders. Clearly marked ERTs should also be provided at places of relative safety.

DESIGNERS RESPONSE:

Designer accepts the RSA problem and recommendation made by the RSA team.

Forward visibility to the signs as per the Traffic Signs Manual has been provided to these signs including the clearance of existing vegetation where required.

Proposed planting has been designed not to obstruct forward visibility as required.

Additional signage will be provided at identified Places of Relative Safety as per MPI-66.

3.1.15 PROBLEM

Location: Approaches to EAs Scheme wide

Summary: Inconsistent signing of EAs could lead to vehicles stopping in the live carriageway.

The signing of EAs varies, with some signed 1.5 miles in advance and some not signed until half a mile. Inconsistent signing for EAs could result in drivers being unaware of the next EA, increasing the potential for them to stop in a live lane due to lack of information, resulting in live lane stop collisions.

Recommendation

It is recommended that EAs are signed consistently from 1.5 miles in advance where appropriate.

DESIGNERS RESPONSE:

Designer accepts the RSA problem and recommendation made by the RSA team.

Approach signing to Emergency Areas has been provided as per MPI-66 table 2.5.4.

The 1.5 mile signs will be reviewed and removed unless they have been agreed in accordance with Ian 161/13 and TSRGD Schedule 16, item 6

3.1.16 PROBLEM

Location: EA E3-B1 chainage 18550 - (Drawing No. HA514451-CHHJ-HGN-S2_ML000000_Z-DR-CH-1046 Rev C01)

Summary: Provision of footway

A footway connects EA E3-B1 and a technology/utilities area 50m to the east of the emergency area at the end of the taper. There is potential for drivers/passengers using the EA to access this footway while seeking or waiting for help. The technology/utilities area is at the end of the EA taper and therefore closer to the mainline (five lane) carriageway increasing the risk of pedestrian conflict with mainline traffic. It is also possible that the EA will be used inappropriately by maintenance operatives to gain access to the technology/utilities area, thus reducing the availability of the EA for motorists and increase the risk of collisions at or near the EA.

Recommendation

It is recommended that access to the maintenance link between the EA and the technology/utilities area is discouraged and the EA only used for maintenance under TM operation.

DESIGNERS RESPONSE:

Designer accepts the RSA problem and recommendation made by the RSA team.

The RRS will discourage passengers from accessing the footpath.

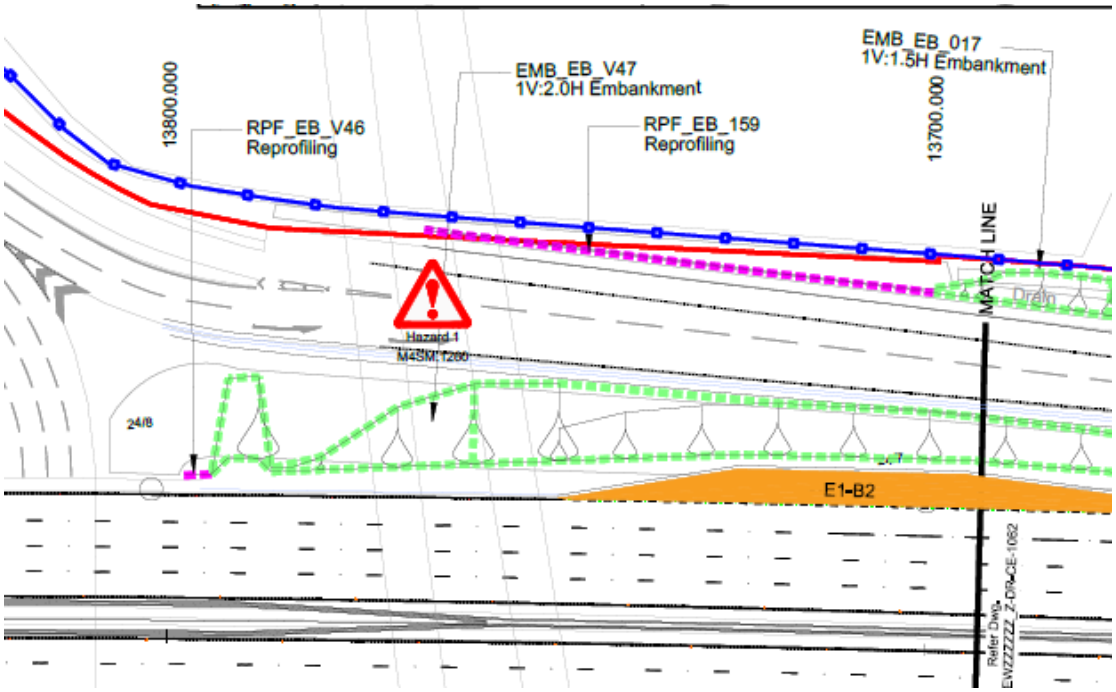
IAN 161/13 indicates that it is not intended that users of the ERT climb over the VRS. Use of the ERT is to take place from the traffic side of the VRS, and the proposed ERT installation is designed for access over the restraint system. This is in accordance with IAN 161/13 paragraph 5.30.

3.1.17 PROBLEM

Location: EA E1-B2 chainage 13700 - (Drawing No. HA514451-CHHJ-HGN-S2_ML000000_Z-DR-CH-1059 Rev C03)

Summary: Lack of pedestrian guardrail at rear of EA may lead to injury

EA E1-B2 is located in an elevated position above the eastbound merge from Junction 4. Immediately behind the EA is embankment down to the merge. In the event that motorists using the EA leave their vehicle to wait behind the vehicle restraint barrier there is a risk of slips and falls down the embankment to the carriageway below. This could result in injuries and potentially collisions involving vehicles on the slip road.



Extract from drawing HA514451-CHHJ-HFE-S2_ZZ000000_Z-DR-CH-3059

Recommendation

It is recommended that pedestrian guard rail is provided at the rear of the EA.

DESIGNERS RESPONSE:

Designer accepts the RSA problem and recommendation made by the RSA team.

PGR is being provided at the back of the EA, as shown in drawing no. HA514451-CHHJ-HRR-S2_ML000000_Z-DR-CH-4059.

Emergency Roadside Telephones (ERTs)

3.1.18 PROBLEM

Location: Intra junction ERTs Scheme wide

Summary: Confusion about the availability of ERTs intra junction may put motorists at risk of collisions

It is not clear from the drawings if existing intra junction ERTs are being retained, specifically where TJR has been removed and hard shoulders are available as places of relative safety. Drivers requiring assistance needing to access a place of relative safety may not be aware of these alternative locations and instead could continue at slow speeds to the next signed EA, and put themselves or others at risk of collisions.

Recommendation

It is recommended that clarification on the status of the intra junction hard shoulder is provided and ERTs provided if necessary. The Audit Team notes that if these sections of hard shoulder are now to be considered as a place of relative safety in terms of the required spacing, they would benefit from ERTs.

DESIGNERS RESPONSE:

Designer accepts the RSA problem and recommendation made by the RSA team.

Emergency Roadside Telephones have been provided at locations which meet the requirements of a Place of Relative Safety, including intra-junction hard shoulders.

Signage has been required for PRS in accordance with MPI-66.

Visibility

3.1.19 PROBLEM

Location: Eastbound approach to Junction 5 (chainage 22200)) - (Drawing No. HA514451-CHHJ-HGN-S2_ML000000_Z-DR-CH-1036 Rev C01 to Drawing No. HA514451-CHHJ-HGN-S2_ML000000_Z-DR-CH-1041 Rev C01)

Summary: Restricted forward visibility may result in late braking collisions

At chainage 22200 to 20500 existing anti-glare vanes are prescribed on the nearside of the eastbound carriageway adjacent to Riding Court Road, in addition to back-to-back RRS and a chain link fence. No specification/detail has been provided for this arrangement.

This arrangement could mean that the performance of the RRS is compromised and the anti-glare vanes, in combination with the left-hand bend, are likely to create a solid screen which from the proposed lane 1 (currently the hard shoulder), may interfere with sightlines and contribute to late braking collisions. This situation is made worse for drivers of left-hand drive vehicles.

In addition, the presence of the auxiliary lane to Junction 5 may result in periods of stationary traffic. Reduced stopping sight distance and restricted forward visibility at this location could lead to an increase in rear shunt type collisions (particularly if vehicles are braking/queuing ahead), and may result in late lane changing manoeuvres if motorists are obscured driver information on signs in the nearside verge. If the RRS cannot perform as intended, this could also increase the severity of a collision.

Recommendation

It is recommended that adequate sightlines are provided and that the RRS provided at this location is installed in a way that doesn't compromise performance.

DESIGNERS RESPONSE:

Designer accepts the RSA problem and recommendation made by the RSA team.

A combined road restraint/anti-glare system is proposed to optimise forward visibility and is detailed in the Road Restraint specification documents.

The SSD visibility checks through this section have taken the front face of road restraint as the limit of visibility to ensure the anti-glare veins play do not obscure the forward visibility.

From 22200 to 20500, there are minor locations with one step or two step relaxations which are acceptable under IAN 161/13 and IAN 149/11 Cl.2.2.2. At these locations the visibility is reduced due to the narrow verge between the M4 and Riding's Court, dictated by land constraints.

3.1.20 PROBLEM

Location: Westbound approach to Junction 6 (chainage 24300-24500) - (Drawing No. HA514451-CHHJ-HGN-S2_ML000000_Z-DR-CH-1030 Rev C01)

Summary: Restricted visibility may result in late braking collisions

The westbound carriageway is on a left hand bend on the approach to Junction 6. It is likely that the left hand bend, in combination with (i) the proposed environmental barrier and (ii) structures/earthworks associated with Datchet Road overbridge, may interfere with forward visibility. This situation is likely to be worse particularly for drivers of left-hand drive vehicles.

This issue could be further exacerbated by the landscaping of this section, the details of which have not been supplied.

Reduced forward visibility could lead to an increase in rear shunt type collisions (particularly if vehicles are braking/queuing ahead to exit at the junction) and may also result in late lane manoeuvres if motorists are obscured from driver information on signs in the nearside verge.

Recommendation

It is recommended that adequate forward visibility is provided.

DESIGNERS RESPONSE:

Designer accepts the RSA problem and recommendation made by the RSA team.

A forward visibility assessment has been undertaken and the adequate visibility has been achieved as per the Traffic Signs Manual. Areas of permanent vegetation clearance have been identified to in order to achieve adequate visibility.

Permanent vegetation clearance has been annotated on the highway general arrangement and landscape detailed drawings. These are referenced in the MRSS and will be part of the handover to the Maintenance Service Provider at the end of the construction stage. Proposed planting has been designed not to obstruct forward visibility as required.

3.1.21 PROBLEM

Location: Junction 6 eastbound merge (chainage 25800-25700)

Summary: Restricted visibility may result in late braking or side-swipe collisions

The proposed eastbound merge layout results in a sharp approach entry angle from lane 2 of the slip road just prior to the merge point. This, in conjunction with level differences between the merge and mainline may result in reduced visibility of merging traffic between on slip and mainline carriageway, leading to merge and late braking collisions.

Recommendation

It is recommended that adequate visibility is achieved for both merge lanes. If this is not possible there may be benefit in removing the offside merge lane and have it instead merge with the nearside on-slip prior to the merge with the mainline. Furthermore, provide informatory road layout merge/diverge signs on both the mainline and slip road.

DESIGNERS RESPONSE:

Designer accepts the RSA problem and recommendation made by the RSA team.

During the recent design stage, which incorporates Value Engineering (VE), the redesign of Junction 6 has been revised to implement a Non-Through Junction Running operational concept. As part of this, a proposed single lane gain has been provided at this merge which will provide safety benefits and is fully compliant with the relevant standards, hence the problem raised (2 lane merging) is now superseded by the VE/IFC design. Also, the geometry of the slip roads tie-in as close to the back of nosing as practicable to retain as much of the existing layout as possible. Also, full SSD checks have been carried out and BOV has been adjusted to eliminate forward visibility departures which would increase the risk to road users joining the motorway.

Alignment

3.1.22 PROBLEM

Location: Various

Summary: Risk of side-swipe collisions

At a number of locations localised horizontal *'kinks'* in the lane alignments have been noted. The locations include, but are not limited to:

- Southbound diverge to Junction 7 at the nosing (no chainage provided - GA sheet 16 of 71)
- Eastbound mainline at Junction 6 (Chainage 26400-26200)
- Eastbound merge from Junction 6 (Chainage 25720)
- Eastbound mainline (Chainage 25140-25170)
- Eastbound diverge to Junction 4 (Chainage 14300-14220)
- Eastbound merge from Junction 4 (Chainage 13550-13400)
- Westbound mainline at Junction 6 (Chainage 26200-26400)
- Westbound mainline east of Junction 6 (Chainage 25200-25500)

These changes in alignment could result in poor lane discipline increasing the risk of side impact collisions.

Recommendation

It is recommended that the lane alignments and markings are modified to remove localised horizontal alignment irregularities.

DESIGNERS RESPONSE:

Designer accepts the RSA problem and recommendation made by the RSA team.

This appears to be a very minor drawing/ PDF presentation issue. The laid road markings

shall be smooth and tie in correctly.

Headroom

3.1.23 PROBLEM

Location: Harlington Bridge (Chainage 12150)

Summary: Risk of bridge strikes

Harlington Bridge is to remain and the existing hard shoulders and widened carriageway will form lane 1 both east and westbound. Headroom above the existing hard shoulders appears to be less than over the running lanes due to the profile of the bridge. The Audit Team notes that there is visual evidence that the structure has been struck in the past. If sufficient headroom is not provided there will be an increased risk of vehicles striking the structure, resulting in injury.

Recommendation

It is recommended that sufficient headroom above all running lanes is provided in both directions.

DESIGNERS RESPONSE:

Designer accepts the RSA problem and recommendation made by the RSA team.

Headroom checks have been carried out and sufficient headroom clearance is maintained under TD 27/05 Table 6-1. A structure free zone has been achieved where in the event of errant vehicles leaving the road pavement a risk of collision with components of the structure is negligible. This is in accordance with TD27/05 Clause 6.3.1.

Landscaping

3.1.24 PROBLEM

Location: Scheme wide

Summary: Risk of reduced sightlines and forward visibility contributing to collisions

The reallocation of carriageway space will result in vehicles in lane 1 being immediately adjacent to the edge of carriageway. While a vegetation 'buffer', in the form of amenity grass, has been provided, it is likely that over time vegetation in the verge (or from outside the highway boundary) will reduce forward visibility to other vehicles and signs. This is likely to be exacerbated where; the carriageway bends to the left, forward visibility is impacted by bridge structures or signage, and for drivers of left-hand drive vehicles.

Reduced forward visibility could increase the risk of rear shunts and side impact collisions due to late lane changing.

Recommendation

It is recommended that existing and reinstated vegetation (either from within or outside the highway boundary), does not adversely impact sightlines or forward visibility to other vehicles or signs at the time of completion and in the future. Suitable visibility splays should be maintained as part of the maintenance management programme.

DESIGNERS RESPONSE:

Designer accepts the RSA problem and recommendation made by the RSA team.

A forward visibility assessment has been undertaken and the adequate visibility has been achieved as per the Traffic Signs Manual. Areas of permanent vegetation clearance have been identified to in order to achieve adequate visibility.

Permanent vegetation clearance has been annotated on the highway general arrangement and landscape detailed drawings. These are referenced in the MRSS and will be part of the handover to the Maintenance Service Provider at the end of the construction stage.

Proposed planting has been designed not to obstruct forward visibility as required.

3.1.25 PROBLEM

Location: Visibility splays to signs scheme wide

Summary: Obscured signs may lead to collision

Visibility splays are detailed to sign faces on the general arrangement drawings. These splays align to the either the edge or centre of the proposed sign faces. There is a risk that this could result in vegetation growth impacting visibility to sign faces shortly after installation, resulting in driver confusion, late lane changes and side impact collisions.

Recommendation

It is recommended that a buffer from the rear sign face edge to the proposed landscaping is provided so that vegetation growth does not impact on visibility to the sign face. Forward visibility splays should be maintained as part of the maintenance management programme.

DESIGNERS RESPONSE:

Designer accepts the RSA problem and recommendation made by the RSA team.

The safety of vehicles has been considered in the design of the scheme and restrictions on the type of planting put in place accordingly as outlined in the landscape strategy to ensure that visibility is not impeded. Vegetation clearance to ensure that visibility to all signs is maintained on an ongoing basis is the responsibility of the maintainer.

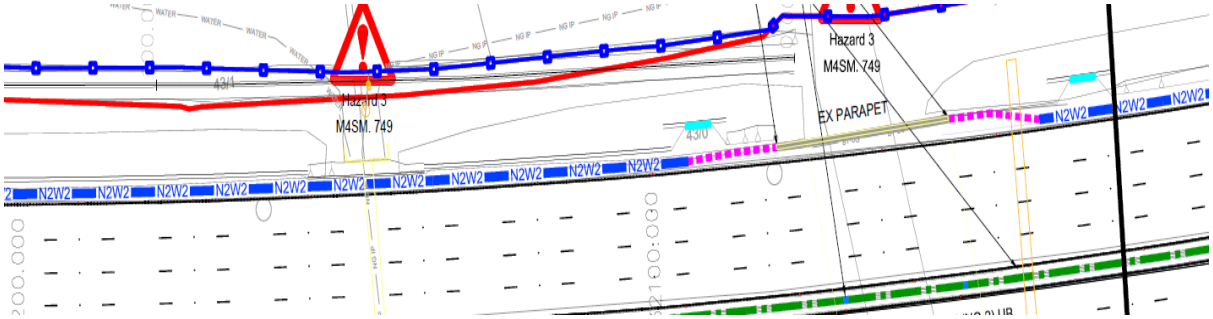
Road Restraint System (RRS)

3.1.26 PROBLEM

Location: Cut Bridge No.2 Underbridge (chainage 32060)

Summary: Risk of unauthorised vehicles stopping in hard verge area

On the north side of the carriageway an existing parapet is to remain. The parapet is set back approximately 2m from the edge of carriageway behind a strip of hard verge. There is a risk that drivers could be tempted to use this area as a place of relative safety, resulting in collisions between vehicles in lane one and the stationary vehicle or a driver/passenger outside of the vehicle. It is noted that this is an existing layout however the risk is increased by virtue of traffic travelling immediately adjacent to the RRS and bridge parapet.



Extract from drawing HRR-S2_ML000000_Z-DR-CH-4006 Rev C01

Recommendation

It is recommended that measures are installed to avoid or discourage unauthorised vehicles stopping in hard verge area.

DESIGNERS RESPONSE:

Designer accepts the RSA problem raised but suggests an alternative solution.

The setback through the underbridge was reviewed during the IFC design stage. There is an Emergency Area 200m downstream of the underbridge, which is appropriately signed upstream of the underbridge. Therefore, road users will be aware of the EA just past the underbridge and will be discouraged them from using the verge as a refuge.

The existing RRS setback tapers from 1.35m through to 1.9m over the 20m (approx) underbridge length, which reduces the risk of unauthorised vehicles stopping. The raised kerb level of the verge helps to further reduce this risk.

The designer has considered the use of collapsible hazard marker but they these elements will introduce additional maintenance activities exposing the road workers to unnecessary risks. The current design is the optimal solution considering the circumstances above.

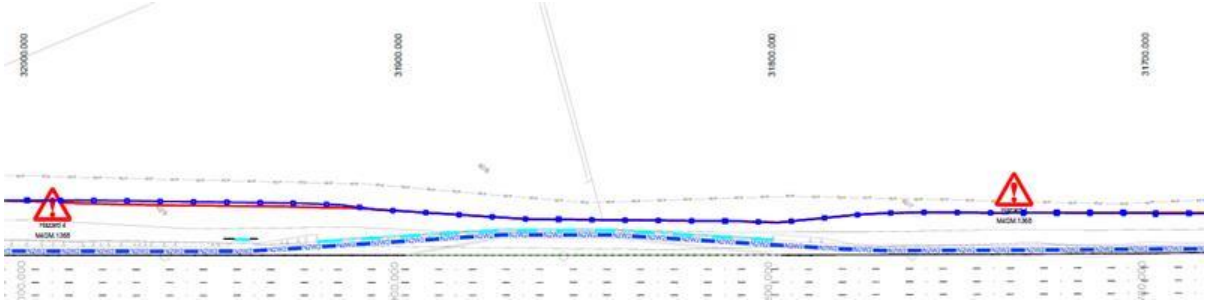
3.1.27 PROBLEM

Location: EA E6-B2 (chainage 31850)

Summary: RRS working width impacted by pedestrian restraint barrier

Pedestrian restraint barrier appears to be detailed within the working width of the RRS at eastbound EA E6-B2 (chainage 31850)

This could increase the severity of a loss of control collision, result in secondary collisions and increase the risk of injuries to pedestrians and operatives who may be between the RRS and the pedestrian restraint barrier.



Extract from drawing HRR-S2_ML000000_Z-DR-CH-4007 Rev C01

Recommendation

It is recommended that all pedestrian restraint barrier is located outside the working width of the RRS.

DESIGNERS RESPONSE:

Designer accepts the RSA problem and recommendation made by the RSA team.

Footways have been provided to single height barrier at 600mm width, and they have been positioned behind RRS working widths.

Pedestrian Guardrail is located at the back of the EA E6-B2, outside the 0.8m W2

working width.

3.1.28 PROBLEM

Location: M4 Westbound Chainage 20400 and 25900

Summary: RRS working width impacted by pedestrian guardrail

Pedestrian guardrail is detailed within the working width of the RRS located south of Junction 5, westbound at chainage 20400 and westbound at chainage 25900.

This could increase the severity of a loss of control collision, result in secondary collisions and increase the risk of injuries to pedestrians and operatives who may be between the RRS and the pedestrian restraint barrier.

Recommendation

It is recommended that all pedestrian guardrail is located outside the working width of the RRS.

DESIGNERS RESPONSE:

Designer accepts the RSA problem and recommendation made by the RSA team.

The Pedestrian Guardrail at ch.20400 and ch.25900 has been reviewed and is located outside the 0.8m W2 working width.

3.1.29 PROBLEM

Location: Various - scheme wide.

Summary: RRS working width impacted by sign posts

At various locations signs and sign posts are detailed within the working width of the RRS. Examples include:

- EA sign for A6-B2 at eastbound chainage 31850;
- PS-A-28/1_90 sign at westbound chainage 17220;
- Merge sign 165 yards PS-A-22/1_68 at westbound chainage 11200
- Merge sign 150 yards PS-A-28/1_90 at westbound chainage 17200
- Existing traffic signals ahead warning sign PS-A-30/7_20 at westbound chainage 1980
- EA 1 1/2 mile sign PS-A-30/7_22 westbound at chainage 19800
- EA 1 mile sign PS-A-31/4_34 westbound at chainage 198000
- Driver location sign PS-A-35/2_08 westbound at chainage 24300
- EA 300 yards sign PS-A-38/1_60 westbound at chainage 27220
- Driver location sign PS-A-39/3_00 westbound at chainage 28360
- Driver location sign PS-A-40/1_45 westbound diverge at chainage 10000
- Bend ahead warning sign PS-A-40/1_68 westbound on-slip at chainage 1080
- Variable speed limit sign PS-A-40/1_79A westbound on-slip at chainage 1090
- No hard shoulder sign for 21 miles PS-A-40/1_79B westbound on-slip at chainage 1090
- EA 1/2 mile sign PS-A-41/6_08 westbound at chainage 30690
- Driver location sign PS-A-43/7_00 westbound at chainage 32790

This could increase the severity of a loss of control collision, result in secondary collisions and increase the risk of injuries to pedestrians and operatives who may be standing behind the RRS.

Recommendation

It is recommended that all signs are located outside the working width of the RRS.

DESIGNERS RESPONSE:

Designer accepts the RSA problem and recommendation made by the RSA team.

The traffic signs mentioned have been reviewed for visibility and all but the following achieve compliant visibility as per the Traffic Sign Manual:

- PS-A-35/2_08 mounting height to be increased to 2.1m in compliance with the Traffic Signs Manual within the working width.

Traffic Signs schedule HA514451-CHHJ-GEN-SZ_ZZZZZZZZZZ_Z-SH-ZK-1201 will be updated to reflect the change.

3.1.30 PROBLEM

Location: Emergency Crossover Point (ECP) at chainage 23570

Summary: Identification of ECP in the event of an incident

An ECP is provided within the central restraint system at chainage 23570. It is unclear from the information provided how this will be marked and identifiable to traffic/police officers who may be travelling through congestion or at speed on the opposing carriageway. Issues in identifying the ECP could increase the risk of secondary collisions involving traffic/police officers.

Recommendation

It is recommended that ECPs are clearly marked and identifiable and that relevant organisations are made aware of their locations.

DESIGNERS RESPONSE:

Designer accepts the RSA problem and recommendation made by the RSA team.

Designer accepts the RSA problem and recommendation made by the RSA team. ECPs have been designed in compliance with Ian 161/13, TD 19/06 and GD 368, locations will be recorded within the MRSS. Furthermore, these will be identifiable by markings on the ECPs.

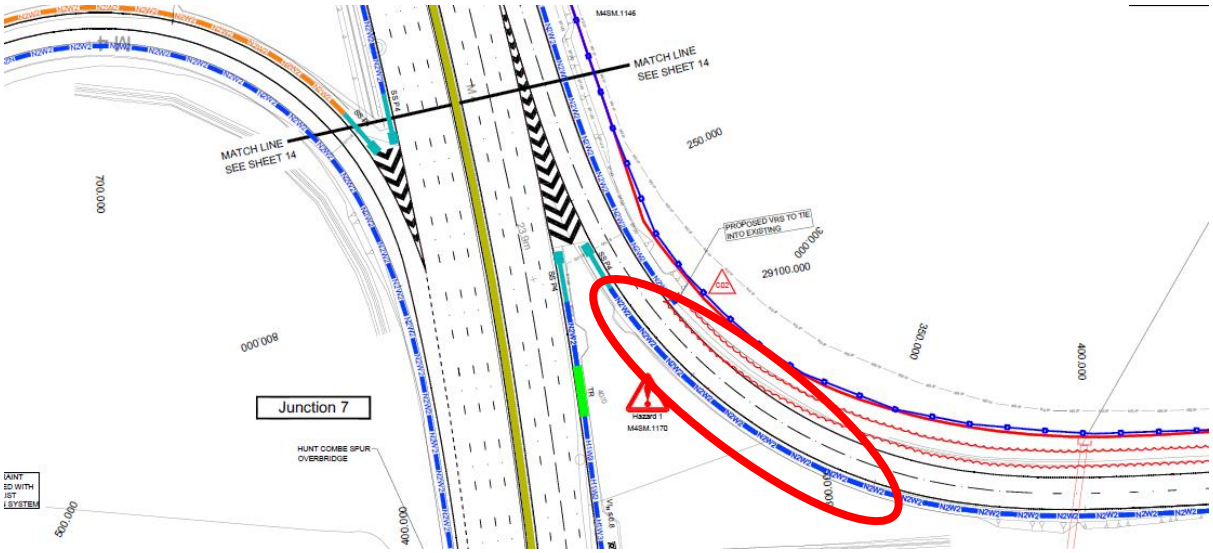
3.1.31 PROBLEM

Location: Junction 7 westbound merge and eastbound diverge

Summary: Risk of increased injuries to motorcyclists

The proposed Junction 7 westbound merge involves a tight left hand bend before aligning with the M4 carriageway, while the eastbound diverge also involves a tight left hand bend before joining the Huntercombe Spur road. The RRS provided on the outside of these bends does not include a motorcycle protection system, which could increase the severity of injuries should a rider be unseated at these locations and collide with the RRS stanchions.

Extract from drawing HRR-S2_ML000000_Z-DR-CH-4014 Rev C02



Extract from drawing HRR-S2_ML000000_Z-DR-CH-4015 Rev C02

Recommendation

It is recommended that motorcycle barriers are incorporated within the RRS at these locations.

DESIGNERS RESPONSE:

Designer accepts the RSA problem and recommendation made by the RSA team.

Change will be made to Series 400 schedule HA514451-CHHJ-HRR-SZ_MLZZZZZZ_Z-SH-CH-0001 to incorporate adequate motorcycle protection with left-hand bends on J7 EB diverge offside slip road and J7 WB merge offside slip road.

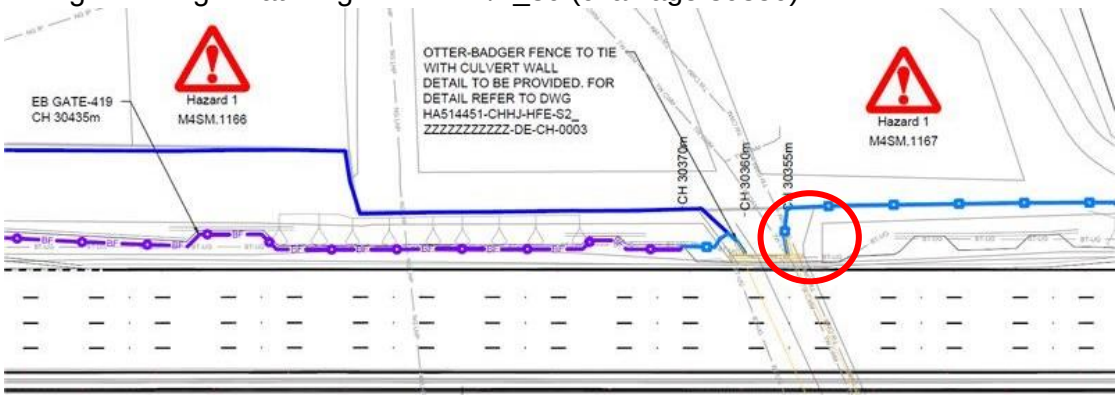
3.1.32 PROBLEM

Location: Various

Summary: Visibility to sign faces partially or fully obscured by orientation of environmental barrier and other fencing

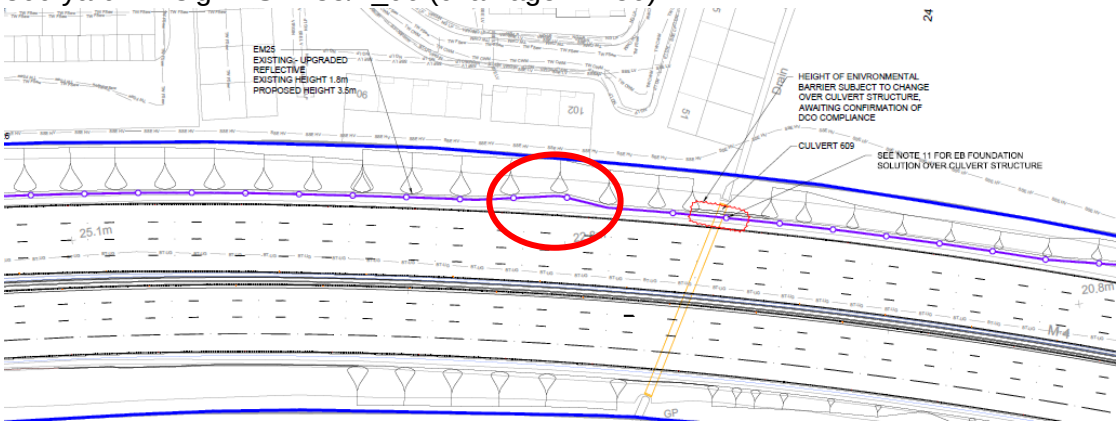
At certain locations the alignment of environmental barrier or other fencing could result in sign faces being partially or fully obscured. Examples of this occur at:

- ‘Slough Trading Estate’ sign PS-B-41/2_80 (chainage 30350)



Extract from drawing HFE-S2_ZZ000000_Z-DR-CH-3011 Rev *C01*

- EA 300 yard sign PS-B-41/7_55 (chainage 30800)
- Lane sign PS-B-37/0_65 (chainage 26130)
- 300 yard EA sign PS-B-35/7_06 (chainage 24750)



Extract from drawing HFE-S2_ZZ000000_Z-DR-CH-3029 Rev *C02*

- Marker sign M4 B 31.9 PS-B-31/8_81 behind visibility vanes (chainage 20930)
- EA ½ mile sign PS-B-30/3_00 (chainage 19400)
- Low emission on slip road zone sign 400 yards PS-A-23/6_80 (westbound chainage 12700) Driver location sign PS-A-27/0_00B (westbound chainage 1600)
- Merge sign 450 yards PS-A-27/9_30 (westbound chainage 16950)
- Driver location sign PS-A_30/8_00A (westbound chainage 19850)
- Driver location sign PS-A-30/8_00A (westbound chainage 1600)
- Merge sign 280 yards PS-A-31/3_83 (westbound chainage 20350)
- EA 1/2 mile sign PS-A-33/9_36 (westbound chainage 23000)

- Existing part time traffic signals ahead warning sign PS-A-37/2_05 (westbound on-slip chainage 26250)
- Driver location sign PS-A-43/9_80 (westbound chainage 33000)
- Marker sign PS-A-43/9_63 (westbound chainage 32990)
- Marker sign PS-A-43/8_91 (westbound chainage 32950)
- Marker sign PS-A-44/0_62 (westbound chainage 33130)

Sign face mounting heights have not been provided so it is not clear if the sign faces will be sufficiently visible, increasing the potential for a wide range of collisions (including live lane stops) due to drivers missing information.

Recommendation

It is recommended that signs are either relocated so that sign faces are not obscured or mounted at suitable heights to ensure adequate forward visibility is provided.

DESIGNERS RESPONSE:

Designer accepts the RSA problem and recommendation made by the RSA team.

The traffic signs mentioned have been reviewed for visibility and all but the following achieve compliant visibility as per the Traffic Sign Manual:

• 'Slough Trading Estate' sign PS-B-41/2_80 (chainage 30350) to be moved in order to achieve visibility in front of the environmental barrier.

• Merge sign 280 yards PS-A-31/3_83 (westbound chainage 20350) will be relocated to achieve compliant visibility.

• EA ½-mile sign PS-A-33/9_36 (westbound chainage 23000) SIGN PS-A-33/8_103 will be relocated to achieve compliant visibility.

Traffic Signs schedule HA514451-CHHJ-GEN-SZ_ZZZZZZZZZZ_Z-SH-ZK-1201 will be updated to reflect the changes.

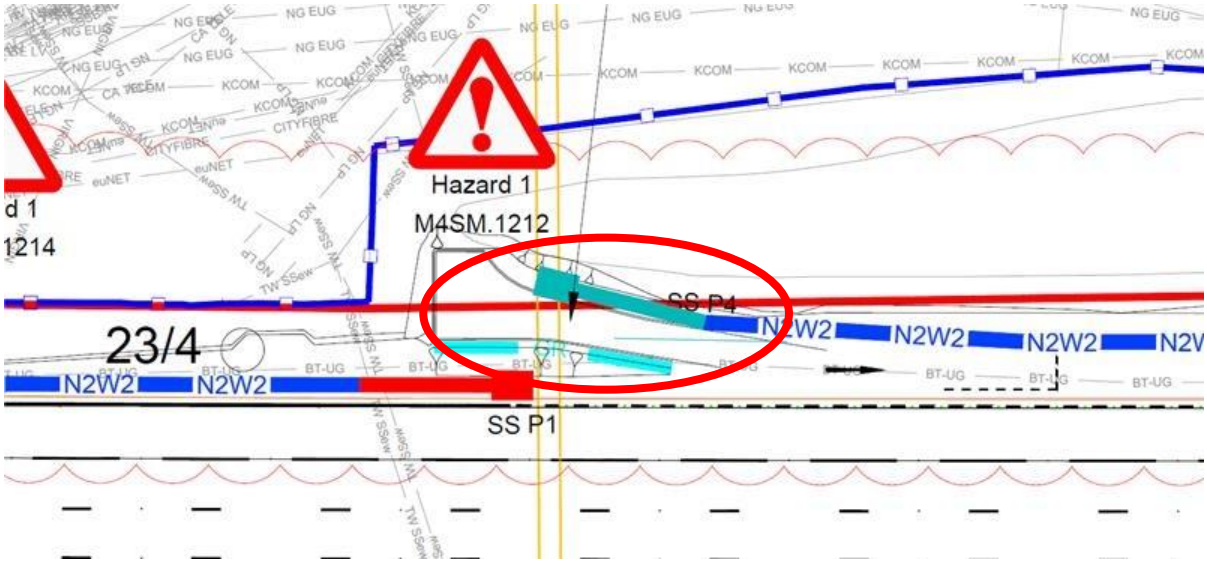
Police Observation Platforms (POPs)/Areas

3.1.33 PROBLEM

Location: Various - scheme wide

Summary: Extent of mainline RRS may lead to vehicles striking infrastructure or users of the EA

The restraint system drawings detail arrangements at some of the EAs, such as EA E1-B1, where the extent of the mainline RRS does not protect the raised platform, observation area or associated infrastructure (such as guard railing). This layout could also result in vehicles being retained by the RRS being directed into the EA, where vehicles, drivers and passengers could be located. This arrangement could increase the severity of a loss of control collision and result in a secondary incident involving users of the POP or EA.



Extract from drawing CHHJ-HRR-S2_ML000000_Z-DR-CH-4065 Rev C02

Recommendation

It is recommended that the mainline RRS at EAs incorporating POPs covers all vertical infrastructure (elevated sections, ramps, guard rails etc.) and provides sufficient overlap.

DESIGNERS RESPONSE: Exception

Designer disagrees with the RSA problem and recommendation made by the RSA team.

Retaining Wall designed for impact loading as per HA514451-CHHJ-HGN-S3_MLZZZZZZ_Z-DR-CH-0002 and provides sufficient containment of all hazards associated with the POP.

This detail is referenced in drawing HA514451-CHHJ-HRR-S2_ML000000_Z-DR-CH-4065.

3.1.34 PROBLEM

Location: POPs

Summary: Risk of traffic management officers over-shooting the POP's

A RRS has not been provided to the rear of the elevated POPs, as shown at EA E4-B2 (chainage 24500) and EA E1-B1 (chainage 12400). There is a risk that a vehicle accessing the POP could overshoot the elevated rear edge, particularly as splayed kerbs are specified, resulting in an overturned vehicle.

Furthermore, some POP locations are adjacent to watercourses, which could introduce additional risks involving a vehicle overshooting a POP.

Recommendation

It is recommended that suitable containment features are provided at the POP's, which may include RRS and full height kerbs.

DESIGNERS RESPONSE:

Designer accepts the RSA problem and recommendation made by the RSA team.

Full height kerbs and Pedestrian Guardrail (PGR) have now been provided covering every raised edge of each POP, and consequently shown on the standard/bespoke details to reflect this to provide suitable restraint for vehicles and pedestrians accessing the site, due to the low speed of the reversing vehicle these features are considered acceptable.

Also, hazard marker post has been provided and "Authorized Vehicle Only" sign is proposed to discourage use.

We can also confirm that The Metropolitan Police have carried out safety assessment of the existing POPs and requested to retain all the existing POPs within their section on M4 (PSCRG meeting 19th June 2014) hence retained as part of the works. Furthermore, a safety assessment has been completed and presented to the PSCRG which has endorsed the provision of POPs on 21/09/2017.

Access

3.1.35 PROBLEM

Location: Risk to maintenance operatives

Summary: Potential for secondary issues relating to maintenance 'footways' and access routes

'Footways' are provided throughout the scheme in order to provide access for maintenance operatives to utilities, sign infrastructure and other elements of the scheme. At a number of locations these 'footways' are protected by pedestrian barrier within the working width of the RRS. In addition, it is unclear if the 'footways' are of adequate width or length, as they vary by location.

A number of footways require off network access agreements. This occurs at chainage 21200, alongside Riding Court Road, but full details of the access agreement have not been provided.

The audit team are concerned that the above problems could result in secondary issues, such as:

- Increased severity should a vehicle leave the carriageway and strike the RRS at a point where working width is compromised;
- Increased potential for collisions if the width of the 'footways' is inadequate; and
- Potential for collisions at the off-network access points if suitable provision is not made for operatives to park maintenance vehicles and access the 'footpaths'.

Recommendation

It is recommended that pedestrian barrier does not impact RRS working width, that maintenance footways are of adequate width and length and that suitable provision is made for maintenance vehicles and operatives at each of the off-network access locations.

DESIGNERS RESPONSE:

Designer accepts the RSA problem and recommendation made by the RSA team.

The design has provided maintenance access off network with full vehicle provision where there are safer alternatives, otherwise access will be gained from the mainline. Footways have been provided to single height barrier at 600mm width, and they have been positioned behind RRS working widths. The proposed footways all lead to separate paved areas where the assets are sited, to avoid operatives remaining on the footway for a prolonged period. This was communicated with the Maintainer throughout design phase and the design is included in the MRSS.

Skid Resistance

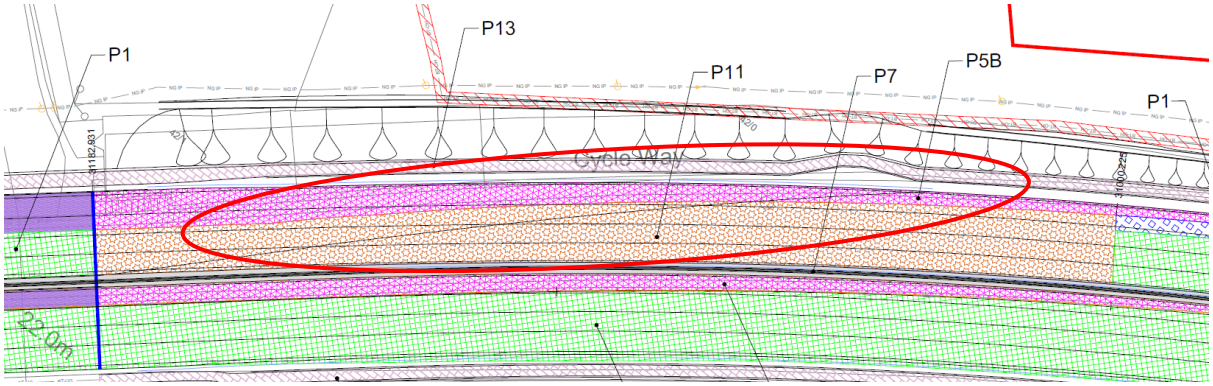
3.1.36 PROBLEM

Location: Various

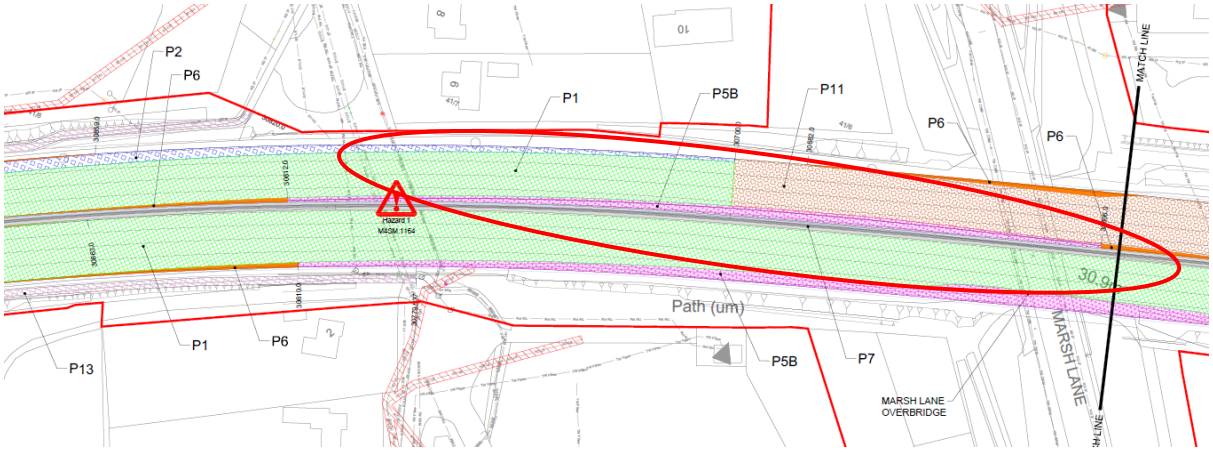
Summary: Surface joints in wheel tracks

Throughout the scheme there are different surfacing arrangements. Where these different surfacing arrangements meet, the drawings provided indicate that both longitudinal and perpendicular surface course joints may be present within the lane extents and in wheel tracks. Examples of where this occur include chainages 31200, 30850, 29950, 28450, at various locations between 27200 and 26500, and around 14600.

The presence of longitudinal and perpendicular surface course joints in wheel tracks increases the potential for joints to fail over time. This can reduce the quality of the surface, effect vehicles under braking conditions and may hold standing water, increasing the risk of loss of control collisions.



Extract from drawing HA514451-CHHJ-HPV-S2_ML000000_Z-DR-CH-7009 *Rev C01*



Extract from drawing HA514451-CHHJ-HPV-S2_ML000000_Z-DR-CH-7010 *Rev C01*

Recommendation

It is recommended that all pavement joints are located outside of wheel tracks.

DESIGNERS RESPONSE:

Designer accepts the RSA problem and recommendation made by the RSA team.

New surface course is proposed across whole lanes and all surface joints are located under proposed road marking.

3.2 Junctions

Traffic Signals

3.2.1 PROBLEM

Location: Various entry slip roads

Summary: Ramp metering measures on entry slip roads could lead to collisions

Ramp metering is being retained but the ramp metering layout, markings, surfacing and signing are often unclear. Details regarding the signal equipment have not been provided. This could lead to driver confusion, hesitation and late braking resulting in shunt type collisions.

Recommendation

It is recommended that details are provided to confirm the layouts and how they interface with the proposed merges.

DESIGNERS RESPONSE:

Designer accepts the RSA problem and recommendation made by the RSA team.

Ramp metering has been designed in accordance with Highways England standards, the layout conforms to MCX 1008.

Appropriate signals, warning signs, stop lines and HFS and PSV 63 have been provided in the IFC design at all locations where ramp metering is being retained / proposed.

The following drawings will be reissued to include stop lines:

-HA514451-CHHJ-HMK-S2_ML000000_Z-DR-CH-1215

-HA514451-CHHJ-HMK-S2_ML000000_Z-DR-CH-1218

-HA514451-CHHJ-HMK-S2_ML000000_Z-DR-CH-1224

-HA514451-CHHJ-HMK-S2_ML000000_Z-DR-CH-1225

-HA514451-CHHJ-HMK-S2_ML000000_Z-DR-CH-1226

-HA514451-CHHJ-HMK-S2_ML000000_Z-DR-CH-1241.

3.3 Road Signs, Carriageway Markings and Lighting

Road Signs

3.3.1 PROBLEM

Location: Scheme wide

Summary: Lack of post and foundation details may present a risk to road users

Sign post and foundation details have not been provided. There are a number of instances where signs and posts appear to be unprotected. If these sign posts are not passively safe it could increase the risk and severity of injuries should a vehicle leave the carriageway.

Recommendation

It is recommended that all unprotected sign posts are passively safe.

DESIGNERS RESPONSE:

Designer accepts the RSA problem and recommendation made by the RSA team.

Signposts which are not protected by VRS are passively safe by their nature at a minimum setback of 600mm, which is permitted (TD 19/06 3.14 and 3.66-3.69).

those within the working width of RRS have a single post at 2.1m+ mounting height and with dimensions of no greater than: 89mm x 3.2 thickness. This ensures the post is passively safe and the sign would not impact with the windshield of the road user.

3.3.2 PROBLEM

Location: Mainline signs

Summary: Mainline signs may present a hazard to errant vehicles

Sign mounting heights have not been provided for signs located alongside the M4 mainline carriageway. Inappropriate and/or conflicting mounting heights in close proximity with adjacent signs could mean unprotected signs may be prone to or may impact on forward visibility to other signs. This could result in increased collision severity if a vehicle leaves the carriageway or late lane changing manoeuvres resulting in collisions.

Recommendation

It is recommended that all signs are mounted at appropriate heights.

DESIGNERS RESPONSE:

Designer accepts the RSA problem and recommendation made by the RSA team.

Sign faces have been mounted in accordance with Traffic Signs Manual and LTN 1/94, and all mounting heights for verge signs have been included in the signs schedule.

3.3.3 PROBLEM

Location: Scheme wide

Summary: Signs may pose a risk to errant vehicles

All signs, regardless of size and post configuration, are represented by the same symbol (usually depicted by a sign on a single post) on the sign drawings provided. It is unclear exactly where signs are to be positioned and therefore whether they may affect the carriageway, RRS working width, environmental barrier or impact forward visibility to other signs. Poorly located signs could result in vehicle strikes, increased collision severity and late lane changing manoeuvres resulting in collisions.

Recommendation

It is recommended that all signs are positioned outside the working width of vehicle restraint systems and such that they don't impact on forward visibility to permanent signs or encroach into carriageway vehicle lanes.

DESIGNERS RESPONSE:

Designer accepts the RSA problem and recommendation made by the RSA team.

The works information drawings provide an indicative location for all traffic signs however, the 3D model includes the exact chainage location and offset from the carriageway. All signs are protected by road restraint systems and located outside of the working width, where possible.

Signposts which are not protected by VRS are passively safe by their nature at a minimum setback of 600mm, which is permitted (TD 19/06 3.14 and 3.66-3.69).

Signs within the working width of RRS have a single post at 2.1m+ mounting height and with dimensions of no greater than: 89mm x 3.2 thickness. This ensures the post is passively safe and the sign would not impact with the windshield of the road user.

All traffic signs visibilities have been reviewed in line with Traffic Signs Manuals and LTN 1/94.

3.3.4 PROBLEM

Location: Various

Summary: Signs located in front of the RRS

A number of signs are located in front of the RRS provision. It is unclear from the information provided whether the signs and post arrangements are passively safe. Examples include:

- Marker sign 'M4 B 33.5 PS-B-33/4_80 at chainage 22550
- Driver location sign PS-A-21/6_00 at chainage 10600
- Driver location sign PS-A-27/0_00A at chainage 16000
- Existing traffic signals ahead warning sign PS-A-30/7_20 at chainage 19800

In the event of a vehicle leaving the carriageway the signs could be struck, potentially increasing the severity of the collision or resulting in a secondary collision.

Recommendation

It is recommended that all signs and post arrangements are located behind RRS and outside of the working width.

DESIGNERS RESPONSE:

Designer accepts the RSA problem and recommendation made by the RSA team.

The signs have also been checked and are behind the working width of proposed RRS in these locations.

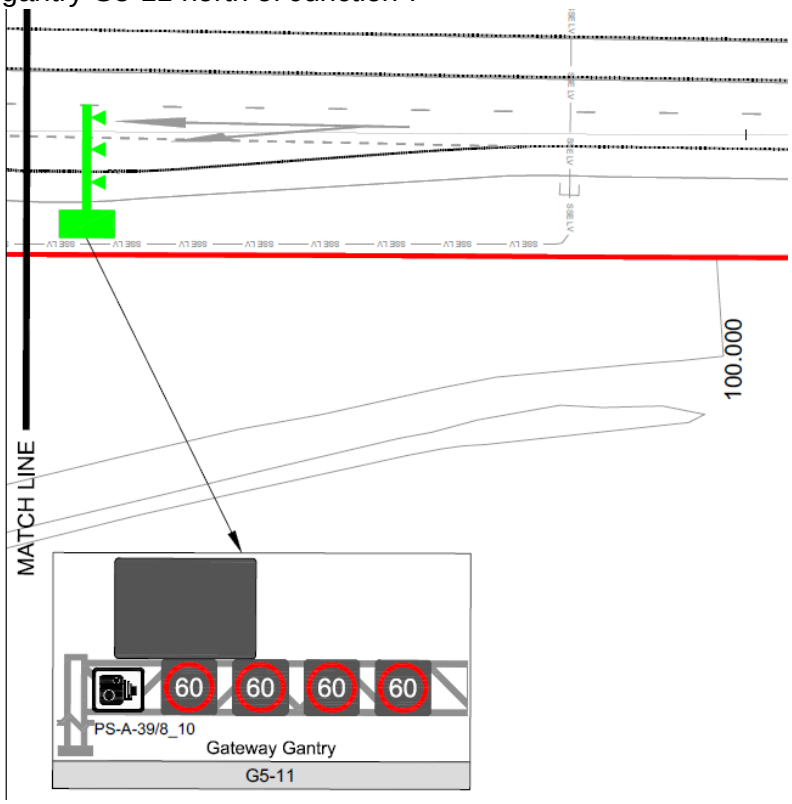
3.3.5 PROBLEM

Location: Gantries

Summary: Misaligned or misleading gantry signage may lead to collisions

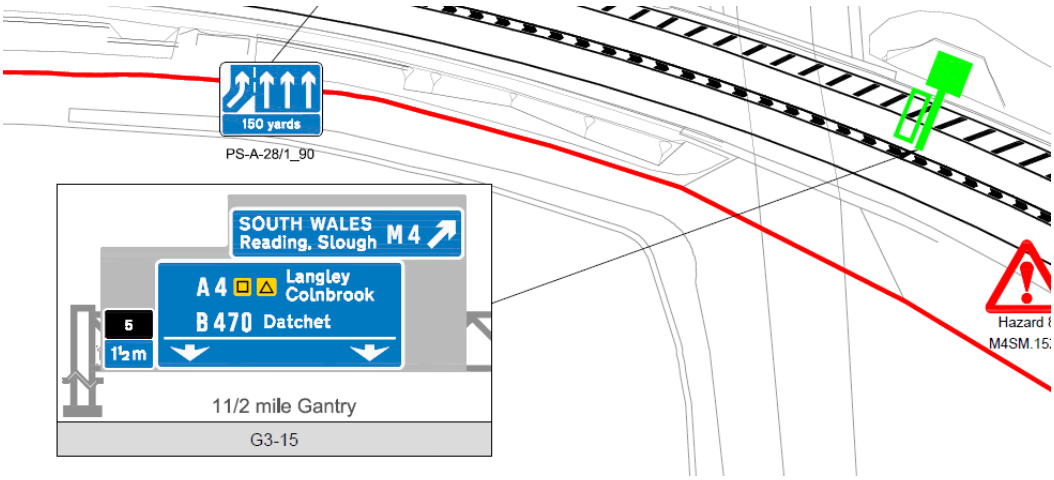
A number of gantry signs include lane designation signage and gantry layouts that do not appear to correspond or align with the carriageway running lanes, as designated by the road markings. This includes instances of where the gantry does not appear to cover the number of lanes required by the sign layout or the sign layout differs to the carriageway layout. Examples include, but are not limited to:

- gantry G5-11 north of Junction 7



Extract from drawing CHHJ-HSN-S2_ZZZZZZZZ_Z-DR-CH-12017 Rev C01

- gantry G4-17 (chainage 25450)
- gantry G4-07 (chainage 22500)
- gantry G3-12 (chainage 19370)
- gantry G3-15 (chainage 17120)



Extract from drawing CHHJ-HSN-S2_ZZZZZZZZ_Z-DR-CH-12050 Rev C01

- gantry G2-15 (chainage 16500)
- gantry G2-02 (chainage 14100)
- gantry G1-11 (chainage 13020)
- gantry G1-04 (chainage 11450)

gantry G6-11a (chainage 31560)

This could result in driver confusion (particularly with regards to 'red-x' emergency lane closures and lane designation), unnecessary and late lane changes and side impact collisions.

Recommendation

It is recommended that all gantry signs align with the intended carriageway running lanes as designated by the road markings.

DESIGNERS RESPONSE:

Designer accepts the RSA problem and recommendation made by the RSA team.

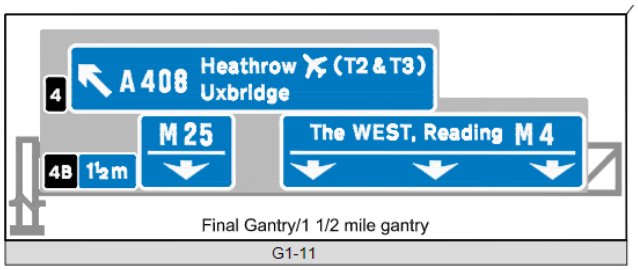
All gantry layouts have been designed and updated in accordance with Traffic Signs Manual Chapter 7. Specifically, Cl.9.1.4 identifies that 'the downward pointing arrows on the lane drop sign should be centred over the traffic lanes to which they apply'. The 2D layout plans are only indicative to confirm chainage and orientation. The lane arrows of all gantry mounted direction signs are checked prior to fabrication as part of the approval of Design Submissions.

3.3.6 PROBLEM

Location: Gantry G1-11 westbound (chainage 13000)

Summary: Information on sign may be conflicting

Junction numbers 4 and 4B are incorporated into the gantry sign at the westbound diverge for junction 4. The x-height and positioning of the junction numbers 4 and 4B could be confusing for motorists resulting in late lane changing conflicts.



Extract from drawing CHHJ-HSN-S2_ZZZZZZZZ_Z-DR-CH-12063 Rev C01

Recommendation

Ensure the sign provides sufficient guidance to motorists by indicating the order of the junctions ahead and that they correspond to the appropriate traffic lanes. There may be scope to reposition the sign faces so that there is more vertical separation between the individual junction destinations.

DESIGNERS RESPONSE:

Designer accepts the RSA problem but suggests alternative solution.

The x-heights are as per Traffic Signs Manual Chapter 7.

Signage strategy at Junction 4/4B considered this challenge and was developed as a best fit solution for this scenario in collaboration with Highways England SES

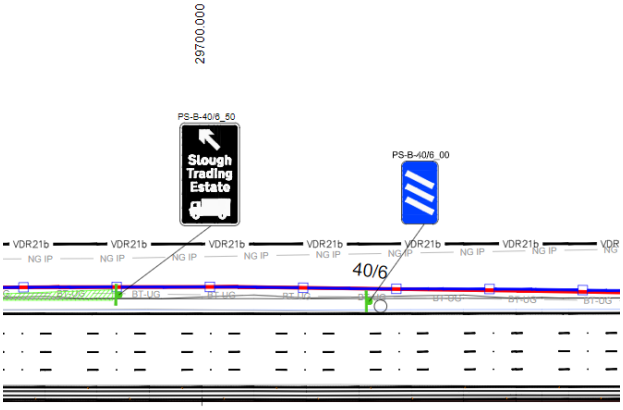
3.3.7 PROBLEM

Location: Various

Summary: Signs obscuring visibility to other signs

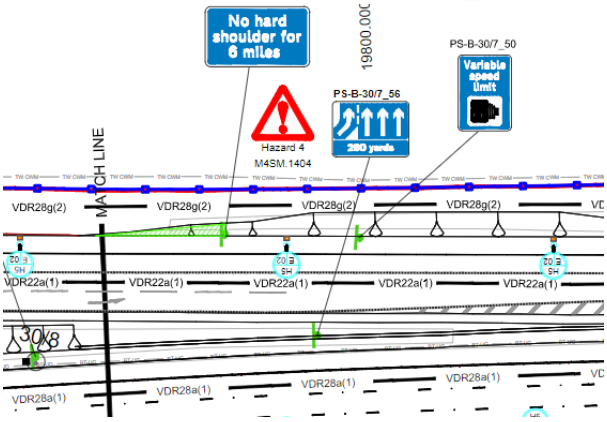
A number of signs are positioned where they are likely to impact on forward visibility to subsequent signs. This includes, but is not limited to, the following obscured sign faces:

- Route marker sign PS-B-44/3_80 (chainage 33450)
- 300 yard countdown sign PS-B-40/6_00 (chainage 29670)



Extract from drawing HGN-S2_ML000000_Z-DR-CH-1013 Rev *C01*

- Variable speed limit and No hard shoulder signs PS-B-39/8_32A & B (chainage 28900)
- Variable speed limit sign PS-B-30/7_50 (chainage 19800)



Extract from drawing HGN-S2_ML000000_Z-DR-CH-1043 Rev *C01*

- Route marker sign PS-B-29/0_00 (chainage 18850)
- EA sign PS-B-24/7_56 (chainage 13770)
- Lane merge sign PS-A-31/2_46 (westbound chainage 20300)

There is a risk that the sign locations could impact on the effectiveness of the signs, increasing late lane changing and sudden braking.

Recommendation

It is recommended that adequate forward visibility is provided to all sign faces.

DESIGNERS RESPONSE:

Designer accepts the RSA problem and recommendation made by the RSA team.

All traffic signs visibilities have been reviewed in line with Traffic Signs Manuals and LTN 1/94.

The following signs have been reviewed and will be subject to the following changes to ensure they are free of visibility obstructions:

- VSL sign PS-B-25/0_00B to be relocated.

Traffic Signs schedule HA514451-CHHJ-GEN-SZ_ZZZZZZZZZZ_Z-SH-ZK-1201 will be updated to reflect the changes.

3.3.8 PROBLEM

Location: M4 westbound carriageway at Junction 5 (chainage 20200)

Summary: Risk of side impact of late braking collisions

Merge layout sign PS-A-31/1_46 is located on the M4 westbound carriageway at Junction 5. Visibility to the sign is likely to be affected by the vertical profile of the M4 carriageway. This could result in drivers being unaware of the merge layout ahead and result in side impact or late braking collisions with vehicles joining the M4 main line.

Recommendation

It is recommended that adequate forward visibility is provided to all sign faces.

DESIGNERS RESPONSE:

Designer accepts the RSA problem and recommendation made by the RSA team.

All traffic signs have undergone clash detection and 3d review as part of the review process implemented for the scheme. Merge layout sign PS-A-31/1_46 achieves full visibility as per the Traffic Signs Manual.

3.3.9 PROBLEM

Location: Merge lane approaches to the M4 mainline

Summary: Risk of motorists travelling at excessive speed

Drivers joining the M4 mainline could be unaware of the current restricted speed limit due to a lack of matrix signs on the merge lane approaches. This could result in inappropriate speeds on the M4 within a period of reduced speed operation, resulting in rear shunts and increased collision severity.

Recommendation

It is recommended that matrix speed limit signs are provided on each merge lane approach to the M4 mainline or ensure that speed limit signage is visible for motorist exiting the merge.

DESIGNERS RESPONSE:

Designer accepts the RSA problem and recommendation made by the RSA team.

Entry Slip Signs (ESS) have been provided at all entry links in accordance with IAN 161/13.

3.3.10 PROBLEM

Location: Diverge slip roads at junctions

Summary: Risk of inappropriate speed

'Variable Speed Limit Ends' and 'End of motorway' signs are not provided consistently through the scheme, for example on the diverge slip roads at Junction 6 and 5. Drivers may be unaware that they have left a variable speed limit section of the M4 or that the motorway regulations have ended, increasing the risk of inappropriate speeds on the local highway network. This could lead to late braking, rear shunts and increased collision severity.

Recommendation

It is recommended that a consistent approach to signing the end of motorway restrictions and the variable speed limit is adopted. Ensure also that drivers are aware of the speed limit of the road they are joining.

DESIGNERS RESPONSE:

Designer accepts the RSA problem and recommendation made by the RSA team.

Geometric constraints and additional infrastructure for each slip road will impact the exact positioning of the signs. The approach for 'Variable Speed Limit End' and 'End of Motorway' signs is consistent throughout the scheme extents ensuring sufficient visibility and consistent messaging with the requirements in IAN 161/13.

3.3.11 PROBLEM

Location: Various

Summary: Risk of late braking and poor lane discipline at merges and diverges

Informatory road layout merge/diverge signs are not provided at every junction. This includes merge/diverges that are restrictive or where the layouts have become more complex and where there is an increase in the number of lanes. This could result in drivers being unsure of the merge/diverge layout and where they include lane gains, lane drops or ghost island arrangements this could increase the risk of collisions associated with vehicles merging/diverging to/from the M4 carriageway.

Recommendation

It is recommended that informatory road layout merge/diverge signs are provided at each merge/diverge.

DESIGNERS RESPONSE:

Designer accepts the RSA problem and recommendation made by the RSA team.

Appropriate merge signing has been provided at lane gains and tiger tail ADS at lane drops in accordance with IAN 144/16.

3.3.12 PROBLEM

Location: Various

Summary: Risk of misleading signs could lead to collisions

A number of junction merge layout signs do not reflect the merge layouts provided. This includes, but is not limited to:

- Sign PS-B-26/9_91 associated with the Junction 4B eastbound merge; and
- Sign PS—24/9_71 and 72 associated with the Junction 4 westbound merge.

This may result in driver confusion, late braking and lane changing, increasing the risk of side swipe and shunt type collisions.

Recommendation

It is recommended that the sign faces are amended to reflect the merge layouts.

DESIGNERS RESPONSE: Exception

Designer disagrees with auditor recommendation

The traffic sign faces mentioned have been reviewed and are compliant with Ian 144/16.

3.3.13 PROBLEM

Location: Junction diverge nosing's

Summary: Risk of late lane changing manoeuvres

The signing at diverge nosing's (to confirm the diverge exit destination) is not consistent throughout the scheme. For example, no signs are provided at the Junction 4 eastbound diverge nosing (chainage 14170) or the Junction 6 eastbound diverge nosing (chainage 26500), which may result in late lane change manoeuvres and increased collisions at the diverge.

Recommendation

It is recommended that direction signs are provided on diverge nosing's.

DESIGNERS RESPONSE:

Designer accepts the RSA problem raised but suggests an alternative solution.

The traffic sign faces mentioned are compliant with Ian 144/16.

A confirmatory gantry (G2-03) has been provided located at Ch.14187 which identifies the diverge exit lanes and destinations. Also, this is supplemented by PS-B-25/0_64 & 72 informatory sign detailing the roundabout layout and destinations, and also full span ADS signage has been provided at ½ Mile gantry G2-11 to assist drivers.

3.3.14 PROBLEM

Location: Junction 6 eastbound diverge (Drawing HA514451-HGN-S2_ML000000_Z-DR-CH-1024 Rev C01 Sheet 24 of 71 chainage 26500)

Summary: Lack of offside traffic signal warning sign on Junction 6 exit slip road

A nearside traffic signal warning sign has been provided on the eastbound diverge for Junction 6 where the new layout has increased from one lane to two lanes on the exit. Drivers in the offside lane may not be fully aware of the signal control at the junction increasing the risk of late braking and rear shunt collisions. It is worth noting that the existing layout consisted of one lane on the exit slip and both a near and off side traffic signals warning sign were provided.

Recommendation

It is recommended that a near and off side traffic warning signal sign is provided on the eastbound exit slip road at Junction 6.

DESIGNERS RESPONSE:

Designer accepts the RSA problem and recommendation made by the RSA team.

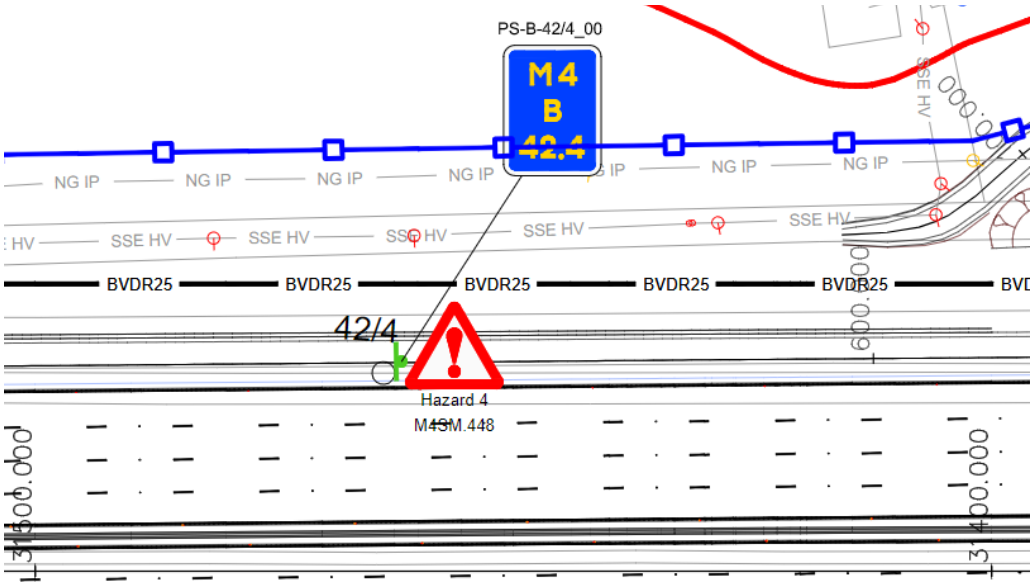
Existing traffic signal warning sign is being retained on Junction 6 offside diverge, as shown in Existing Traffic Sign Drawing HA514451-CHHJ-HSN-S2_ZZZZZZZZ_Z-DR-CH-12125.

3.3.15 PROBLEM

Location: Eastbound carriageway (Drawing HA514451-HGN-S2_ML000000_Z-DR-CH-1008 Rev C01 Sheet 8 of 71 chainage 31450)

Summary: Sign located within adjacent footway

Marker sign M4 B 42.4 is located within the footway which runs adjacent to the eastbound carriageway of the M4 between Monkey Island Lane and Marsh Lane. If the sign is located in the footway pedestrians using the route are at risk of striking the sign, resulting in injuries.



Extract from drawing HA514451- HGN-S2_ML000000_Z-DR-CH-1008 Rev C01

Recommendation

It is recommended that the sign is suitably mounted to ensure that pedestrians using the footway will not strike the sign face and that it is visible to drivers using the M4 eastbound.

DESIGNERS RESPONSE:

Designer accepts the RSA problem and recommendation made by the RSA team.

Mounting height of the sign to be raised to 2.4m to comply with the Traffic Signs Manual. Also sign post to be passively safe.

Traffic Signs schedule HA514451-CHHJ-GEN-SZ_ZZZZZZZZZZ_Z-SH-ZK-1201 will be updated to reflect the change.

3.3.16 PROBLEM

Location: Various

Summary: Overbridges obscuring sign faces

At a number of locations overbridges may restrict forward visibility to EA sign faces beyond the structure. This includes, but is not limited to:

- EA sign east of Monkey Island Overbridge (chainage 31550)
- EA sign east of Marsh Lane Overbridge (chainage 30500)
- EA sign east of Sutton Lane Overbridge (chainage 19350)
- EA sign west of Harington Bridge (chainage 122220)

Restricted visibility to EA sign faces could result in drivers being less aware of the emergency area, increasing the risk of live lane stops and break downs.

Recommendation

It is recommended that the signs are relocated to ensure that clear visibility to the sign faces is achieved.

DESIGNERS RESPONSE: Exception

Designer disagrees with auditor recommendation

The EA signs mentioned have been assessed and achieve the required visibility sightlines as per the Traffic Signs Manual.

3.3.17 PROBLEM

Location: Gantry G6-08 (chainage 31600) and G5-08 (chainage 28100)

Summary: Sign faces obscured by gantry uprights/foundations

The 1/3 mile sign for EA E6-B1 and the 300 yard EA sign for EA E5-B1 appear to be located immediately behind the gantry uprights/foundations for gantry G6-08 and G5-08. Visibility of the sign faces is potentially restricted by the upright/foundation which could result in drivers being less aware of the emergency area, increasing the risk of live lane stops and break downs.

Recommendation

It is recommended that the signs are relocated to ensure that clear visibility to the sign face is achieved.

DESIGNERS RESPONSE:

Designer accepts the RSA problem and recommendation made by the RSA team.

PS-B-41/9_85 will be relocated to achieve compliant visibility. Traffic Signs schedule HA514451-CHHJ-GEN-SZ_ZZZZZZZZZZ_Z-SH-ZK-1201 will be updated to reflect the change.

300-yard Sign PS-B-38/0_88 achieves required visibility distance as per the Traffic Signs Manual.

3.3.18 PROBLEM

Location: Sign PS-B-32/1_62 (chainage 21200)

Summary: Sign face obscured by alignment of the carriageway

The 1.5 mile sign for EA E3-B1 is located on the inside of a left hand bend. The alignment of the carriageway and location of the sign may result in the sign face being obscured on the approach, particularly from lane one and for left hand drive vehicles. This could result in drivers being less aware of the emergency area, increasing the risk of live lane stops and break downs.

Recommendation

It is recommended that the sign is relocated to ensure that clear visibility to the sign face is achieved.

DESIGNERS RESPONSE:

Designer accepts the RSA problem and recommendation made by the RSA team.

Verge has been widened on approach to sign PS-B-32/1_62 and achieves visibility distance required

3.3.19 PROBLEM

Location: Eastbound carriageway (Drawing HA514451-HGN-S2_ML000000_Z-DR-CH-1007 Rev C02 Sheet 7 of 71 chainage 31550)

Summary: Lack of 300 yard or similar EA sign

EA signs at 1 mile and ½ mile have been provided for EA reference E6-B2 on the eastbound carriageway, chainage 31900 but not a sign indicating yardage – often provided at 300 yards. Drivers needing to access the EA may not fully appreciate the location, increasing the risk of live lane stops and break downs.

Recommendation

It is recommended that an EA sign indicating yardage from the EA is provided.

DESIGNERS RESPONSE:

Designer accepts the RSA problem and recommendation made by the RSA team.

A 400yds EA final approach sign will be provided for E6-B2. The Traffic Signs schedule HA514451-CHHJ-GEN-SZ_ZZZZZZZZZZ_Z-SH-ZK-1201 will be updated to reflect the change.

3.3.20 PROBLEM

Location: Eastbound carriageway (Drawing HA514451-HGN-S2_ML000000_Z-DR-CH-1065 C02 Sheet 65 of 71 chainage 12300)

Summary: Lack of 1 mile advance direction signing for Junction 3 eastbound

Signing for Junction 3 eastbound consists of a 1 ½ mile verge sign and ½ mile gantry. Drivers joining the M4 from Junction 4 will only have the ½ mile gantry signing to inform them of the next junction increasing the risk of late lane changing and side swipe type collisions.

Recommendation

It is recommended that additional advance direction signing is provided for Junction 3 eastbound.

DESIGNERS RESPONSE: Exception

Designer disagrees with auditor recommendation.

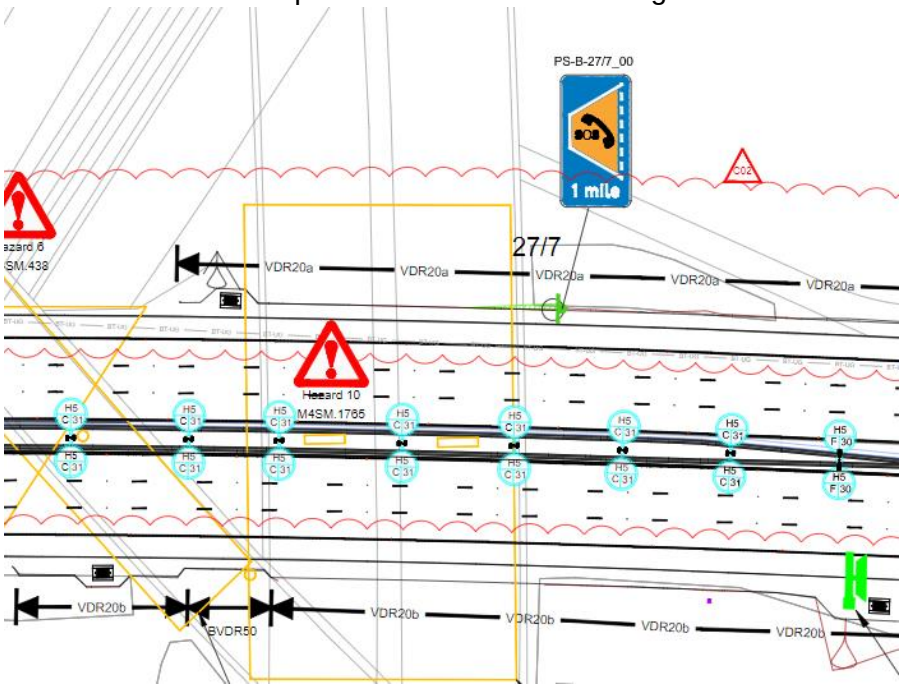
A 1 mile Advanced Direction Sign cannot be provided on the approach to J3 eastbound due to the proximity of J4. The design has been agreed as the best-case solution considering the close proximity of the junctions

3.3.21 PROBLEM

Location: Eastbound carriageway (Drawing HA514451-HGN-S2_ML000000_Z-DR-CH-1051 C02 Sheet 51 of 71 chainage 16700)

Summary: 1 mile EA sign for EA E2-B1

The 1 mile EA sign for EA E2-B1 is located close to the M25 overbridge. At this location the M4 carriageway is in shadow due to the structure and the EA sign may be less obvious to drivers. This could result in drivers being less aware of the location of the next EA increasing the risk of live lane stops and breakdowns resulting in collisions.



Extract from drawing HA514451- HGN-S2_ML000000_Z-DR-CH-1051

Recommendation

It is recommended the sign is relocated out of the shadowed area.

DESIGNERS RESPONSE:

Designer accepts the RSA problem and recommendation made by the RSA team.

PS-B-27/7_00 to be relocated east within the constraints of tolerances for ADS signs in IAN 149/17.

A 400yds EA final approach sign will be provided for E2-B1.

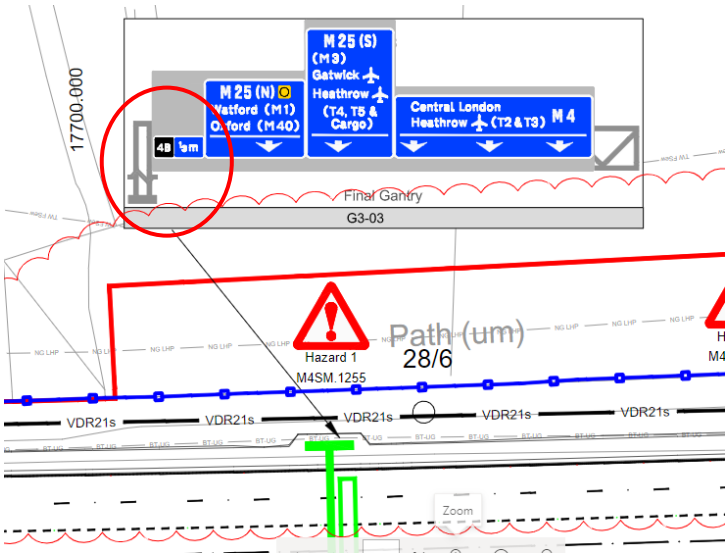
Traffic Signs schedule HA514451-CHHJ-GEN-SZ_ZZZZZZZZZZ_Z-SH-ZK-1201 will be updated to reflect the change.

3.3.22 PROBLEM

Location: Eastbound carriageway (Drawing HA514451-HGN-S2_ML000000_Z-DR-CH-1049 Rev C02 Sheet 49 of 71 chainage 17700)

Summary: Final gantry for Junction 4B (G3-03) has a distance plate

Final gantry sign G3-03 for Junction 4B incorporates a 1/3 mile distance plate. This could be confusing to drivers as this gantry is located immediately prior to the diverge for Junction 4B and could imply that drivers have more time to make any lane changing decisions resulting in side-swipe collisions.



Extract from drawing HA514451- HGN-S2_ML000000_Z-DR-CH-1049 Rev C02

Recommendation

It is recommended that the distance reference is removed.

DESIGNERS RESPONSE:

Designer accepts the RSA problem and recommendation made by the RSA team.

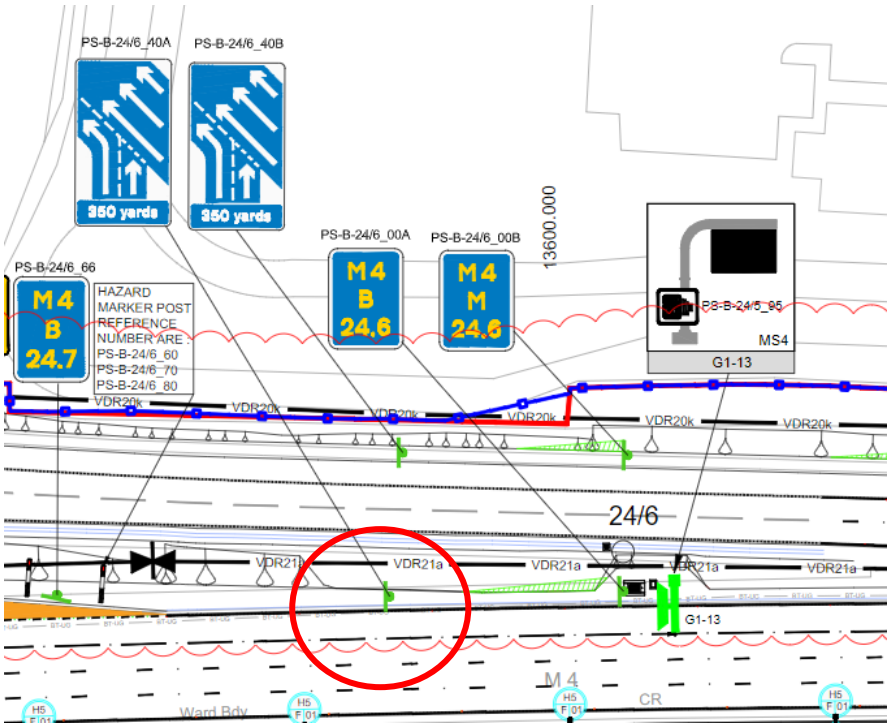
This is a minor drawing error showing the sign face for G3-03a instead of G3-03. This is a CAD error and the sign face for G3-03a has been shown for G3-03 by mistake. Sheet HA514451-CHHJ-HGN-S2_ML000000_Z-DR-CH-1049 will be updated to correct the sign face

3.3.23 PROBLEM

Location: 350 yard slip road merging with mainline sign (Drawing HA514451-HGN-S2_ML000000_Z-DR-CH-1062 Rev C02 Sheet 62 of 71 chainage 13630)

Summary: Position of sign may be misleading

The offside 350 yard side indicating the merge layout from the slip road is located significantly closer to the mainline carriageway than the slip road and drivers may assume it relates to the mainline. This could result in driver confusion and potentially late lane changing manoeuvres.



Extract from drawing HA514451- HGN-S2_ML000000_Z-DR-CH-1062 Rev C02

Recommendation

It is recommended that the sign is positioned so that it is clear that it relates to the merge rather than the mainline.

DESIGNERS RESPONSE:

Designer accepts the RSA problem and recommendation made by the RSA team.

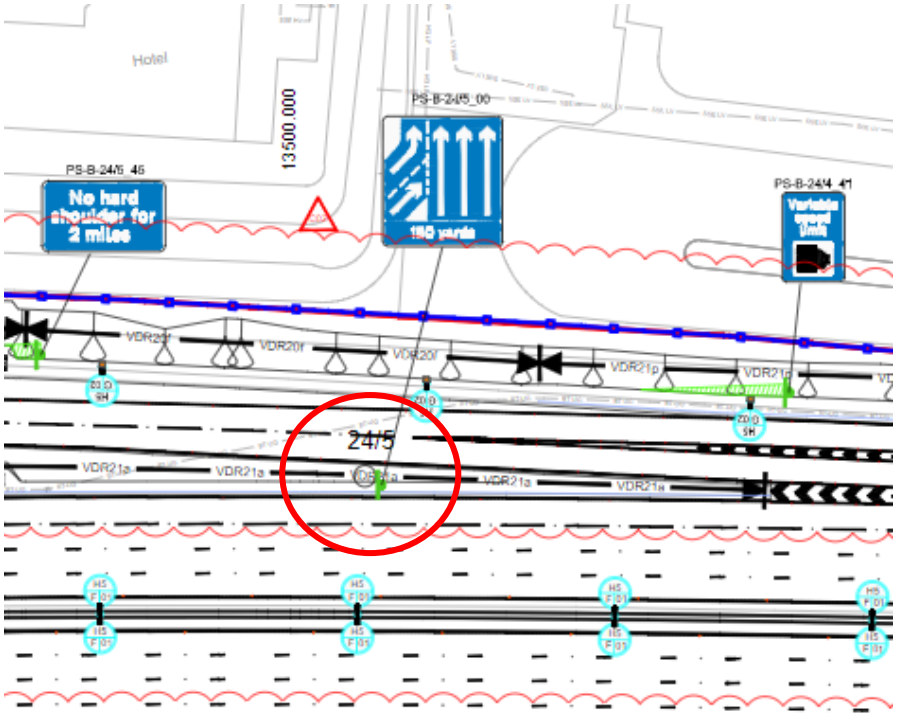
Offside 350-yard PS-B-24/6_40A is located just outside the RRS working width on the slip road and is shown as such in the 3D model. The indicative location on the drawing will be updated to reflect this.

3.3.24 PROBLEM

Location: 150 yard slip road merging with mainline sign (Drawing HA514451-HGN-S2_ML000000_Z-DR-CH-1062 Rev C02 Sheet 62 of 71 chainage 13500)

Summary: Insufficient room to accommodate sign

The 150 yard side indicating the merge layout from the slip road is located within the nosing between the merge and mainline carriageways. At this location it is unlikely that the sign can be accommodated without impacting on the working width of the RRS or potentially overhanging the carriageway. This increases the risk of the sign being struck by vehicles or the RRS not performing effectively in the event of an errant vehicle striking it.



Extract from drawing HA514451- HGN-S2_ML000000_Z-DR-CH-1062 Rev C02

Recommendation

It is recommended that the sign is positioned so that there is sufficient clearance from the edge of carriageway and from the RRS.

DESIGNERS RESPONSE:

Designer accepts the RSA problem and recommendation made by the RSA team.

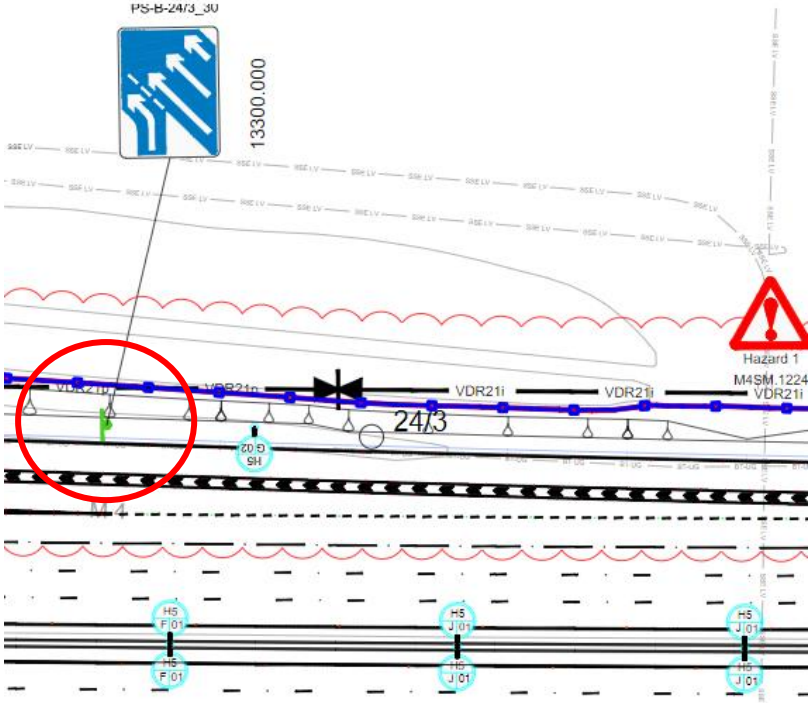
150 yard slip road merging with mainline sign is outside working width of mainline and slip road RRS. The indicative position shown on the drawing is in the incorrect position, whereas the sign is located further west at ch.13529 and designed as such in the 3D traffic signs model. Drawing HA514451-CHHJ-HSN-S2_ZZZZZZZZ_Z-DR-CH12063 will be updated to reflect correct chainage

3.3.25 PROBLEM

Location: Slip road merge sign (Drawing HA514451-HGN-S2_ML000000_Z-DR-CH-1063 Rev C02 Sheet 63 of 71 chainage 13300)

Summary: Incorrect sign face

The proposed sign face for merging traffic indicates three mainline carriageway lanes. At this location there are four lanes on the mainline M4 carriageway which drivers may not appreciate. This could result in driver confusion and potentially late lane changing.



Extract from drawing HA514451- HGN-S2_ML000000_Z-DR-CH-1063 Rev *C02*

Recommendation

It is recommended that the correct sign face is provided to reflect the merge layout.

DESIGNERS RESPONSE:

Designer accepts the RSA problem and recommendation made by the RSA team.

The following signs will be updated to show the correct merge layout:

-PS-B-24/7_80

-PS-B-24/6_40A

-PS-B-24/6-40B

-PS-B-24/5_00

-PS-B-24/3_30

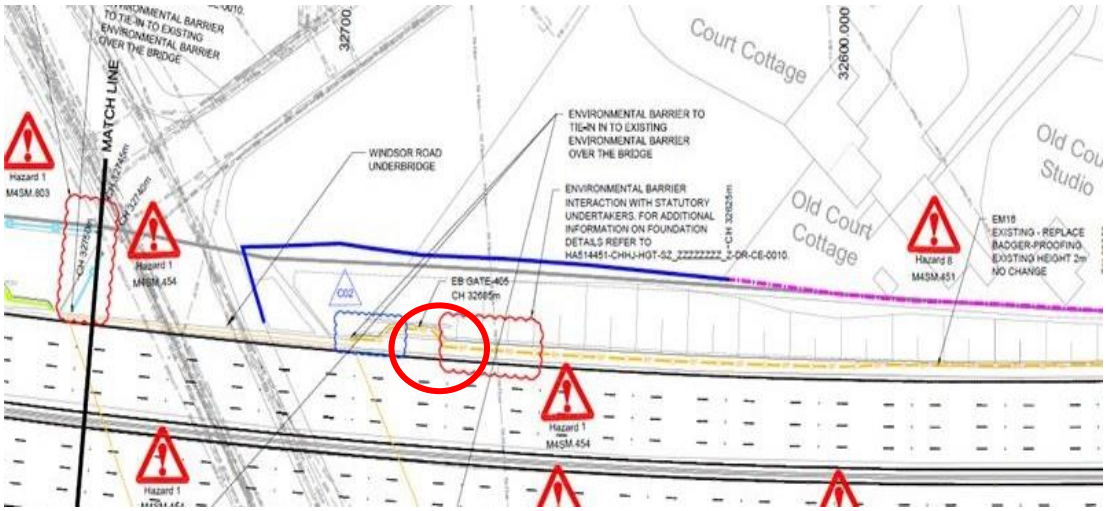
3.3.26 PROBLEM

Location: Various

Summary: Signs located at vulnerable locations, such as diverge nosing's and where there is insufficient offset.

A number of signs are located at vulnerable locations and it is not clear if the signs and post arrangements can be accommodated and/or are passively safe. Examples include:

- 1/2 mile EA sign at eastbound chainage 32650, which is located between fencing and RRS



Extract from drawing HFE-S2_ZZ000000_Z-DR-CH-3005 Rev C02

- A4 nosing sign at eastbound chainage 29100, which is located in the Junction 7 nosing where there is a gap in the RRS provision.

In the event of vehicle leaving the carriageway they could strike the signs and post arrangements, potentially increasing the severity of the collision.

Recommendation

It is recommended that all signs and post arrangements are either located behind RRS (outside of the working width and with adequate forward visibility) or are passively safe.

DESIGNERS RESPONSE:

Designer accepts the RSA problem and recommendation made by the RSA team.

All signs are protected by road restraint systems and located outside of the working width, where possible.

Signposts which are not protected by VRS are passively safe by their nature at a minimum setback of 600mm, which is permitted (TD 19/06 3.14 and 3.66-3.69).

those within the working width of RRS have a single post at 2.1m+ mounting height and with dimensions of no greater than: 89mm x 3.2 thickness. This ensures the post is passively safe and the sign would not impact with the windshield of the road user.

All traffic signs visibilities have been reviewed in line with Traffic Signs Manuals and LTN 1/94.

3.3.27 PROBLEM

Location: Chainage 20500 (EB)

Summary: Risk of existing sign being struck

At chainage 20500 (EB) an existing sign is to remain. It is not clear if sufficient working width is maintained behind the RRS. If there is insufficient working width the effectiveness of the RRS may be compromised in the event of a vehicle leaving the carriageway and striking the barrier, increasing the severity of the collision.

Recommendation

It is recommended that sufficient working width is provided to all existing signs.

DESIGNERS RESPONSE:

Designer accepts the RSA problem and recommendation made by the RSA team.

Signs are only being retained where they are safely outside the working width of proposed RRS or passively safe as per the Traffic Signs Manual.

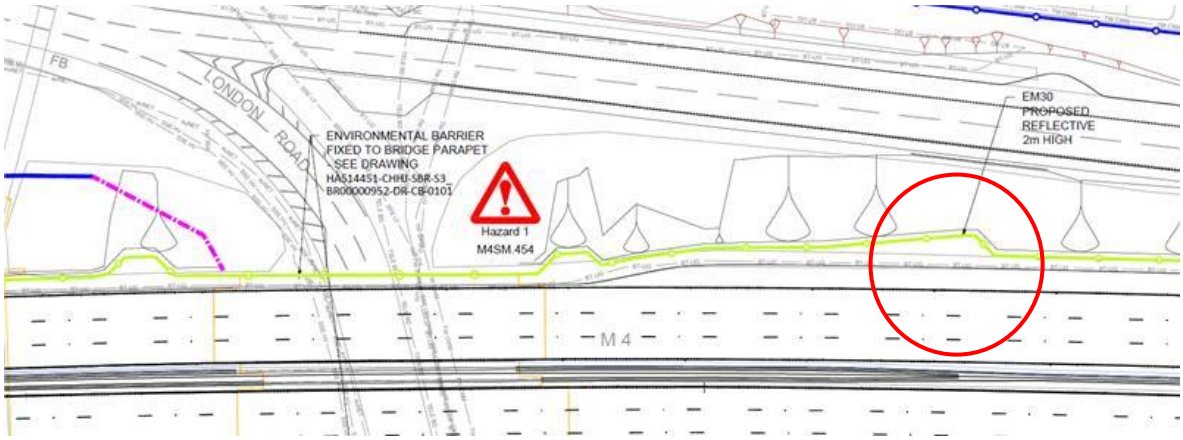
The current Junction 5 Do-Minimum proposals mean that the existing layout will be retained on the diverge slip road at ch.20510. This supersedes the previous proposals at J5.

3.3.28 PROBLEM

Location: M4 eastbound carriageway at chainage 19950

Summary: Risk of late lane changing

The 550 yards lane merge sign for Junction 5 eastbound is set back further from the edge of carriageway due to the introduction of hard shoulder and environmental barrier. This may restrict forward visibility to the sign, reduce driver awareness of merging traffic and increase the risk of side impact and late lane changing collisions.



Extract from drawing CHHJ-HFE-S2_ZZ000000_Z-DR-CH-3042

Recommendation

It is recommended that adequate forward visibility is provided to the sign face.

DESIGNERS RESPONSE:

Designer accepts the RSA problem and recommendation made by the RSA team.

The environmental Barrier has been tapered to achieve the full visibility distance required to the Sign PS-B-32/1_62

Carriageway Markings

3.3.29 PROBLEM

Location: Various

Summary: Risk of motorists stopping within highway boundary

Although the scheme does not incorporate a hard shoulder and 'no hard shoulder' signs are provided, two short lengths of hard shoulder are provided in the vicinity of Junction 5:

- chainage 20550 to 20300 in both directions
- chainage 20000 to 19800 in both directions

Given the lack of opportunity to stop outside of the motorway running lanes, it is likely that these areas will be used as places of relative safety or for non-emergency reasons. This could increase the risk of collisions involving; stationary vehicles, vehicle occupants waiting outside of their vehicle and vehicles re-joining the carriageway resulting in late braking and lane changing.

Recommendation

It is recommended that prohibitive carriageway markings are provided within these short lengths of hard shoulder to discourage vehicles from stopping. The use of collapsible hazard marker posts between the hard shoulder and hardstrip may also help discourage motorist from stopping.

DESIGNERS RESPONSE:

Designer accepts the RSA problem raised but suggests an alternative solution.

The retention of existing hardshoulders and place of relative safety have been endorsed by the PSCRG at Junction 5.

The design of hardshoulders is compliant with Ian 161/13 and is consistent throughout the design. Hatched markings have been provided when hardshoulder <3.0m, and also in accordance with IAN 161/13 clause 5.4 which allows for the retention of hard shoulder on westbound approach to Junction 5.

The hard shoulder is provided for use under regulation 7 of the Motorway Traffic (England and Wales) Regulations to provide a safe refuge for motorists experiencing the circumstances laid out in 7(2) (a), (b) (c) and (d) of the regulations. Hatching out the hard shoulder will deter use of the hard shoulder under conditions (a), (b), (c) and (d) resulting in the possibility of a vehicle broken down in a live traffic lane.

The designer has considered the use of collapsible hazard markers, but these elements will introduce additional maintenance activities exposing the road workers to unnecessary risks.

3.3.30 PROBLEM

Location: Junction 6 westbound diverge (chainage 25850)

Summary: Risk of motorists stopping within highway boundary

The westbound diverge at Junction 6 includes an ambiguous area of hard shoulder/place of relative safety to the nearside of the carriageway, immediately prior to a hatched area and widening of the carriageway to three lanes.

The proximity of the ambiguous hard shoulder/place of relative safety to the widening of the diverge to three lanes may lead to confusion with drivers and riders moving to the left too early, where a stationary vehicle could be located. This could lead to rear end shunt collisions and late lane change manoeuvres.

Similarly, there is a risk that the hard shoulder may be utilised during congested periods by those wishing to turn left at the junction. This could lead to collisions with traffic in lane 1 attempting to access the left turn lane conflicting with unauthorised use of the hard shoulder.

Recommendation

It is recommended that the hatching markings are continued through the ambiguous hard shoulder/place of relative safety to help avoid any confusion while retaining sufficient space for a vehicle to stop.

DESIGNERS RESPONSE:

Designer accepts the RSA problem raised but suggests an alternative solution.

The slip road hardshoulder will be reviewed and brought up to standard as per Ian 161/13 Clause 5.4. HA514451-CHHJ-HMK-S2_ML000000_Z-DR-CH-1226 will be updated to show this.

3.3.31 PROBLEM

Location: Junction 3 eastbound diverge (chainage 11200 to 10900)

Summary: Inconsistency between gantry signing and carriageway markings

On the eastbound approach to Junction 3 proposed gantry signing details the A312 Harrow and Hounslow, Heathrow, but the diverge carriageway markings do not replicate this and only refer to Hayes and Fulham. This discrepancy could increase the risk of driver confusion and late lane changing resulting in side-swipe collisions.

Recommendation

It is recommended that the carriageway markings on the eastbound diverge for Junction 3 are consistent with the gantry signing.

DESIGNERS RESPONSE:

Designer accepts the RSA problem and recommendation made by the RSA team.

Junction 3 Eastbound off-slip works information will be updated between chainage 11200 and 10900 so the road markings and signage is consistent with that shown on the gantry signage.

3.3.32 PROBLEM

Location: Junction 4B eastbound approach (chainage 19100 to 17200)

Summary: Inconsistency between gantry signing and carriageway markings on eastbound approach to Junction 4B

On the eastbound approach to Junction 4B the two nearside lanes for the M25 are marked as M25 ONLY. After the diverge nosing these are detailed as M25 N and M25 S. The gantry signing on this approach indicates lane 1 for M25 N and lane 2 for M25 S. The lack of N and S on the carriageway could result in late lane change on this approach increasing the risk of side swipe collisions.

Recommendation

It is recommended that the carriageway markings on the eastbound approach to Junction 4B are consistent with the gantry signing.

DESIGNERS RESPONSE:

Designer accepts the RSA problem and recommendation made by the RSA team.

Works information will be updated between chainage 19100 and 17200 to reflect the correct carriageway markings as suggested.

3.3.33 PROBLEM

Location: Junction 4B westbound approach (chainage 14900, 15400 and 15620)

Summary: Inconsistency between gantry signing and carriageway markings on westbound approach to Junction 4B

On the westbound approach to Junction 4B the two nearside lanes are dedicated for the M25 and lanes 3 to 5 are for the M4. Lane 1 is for M25 S and lane 2 for M25 N, but also M4. However, the gantry signing on this approach indicates lane 2 is for M25 N only. The inclusion of M4 on lane 2 could result in later lane change on the approach to the junction, increasing the risk of side swipe collisions.

Recommendation

It is recommended that the carriageway markings on the westbound approach to Junction 4B are consistent with the gantry signing.

DESIGNERS RESPONSE:

Designer accepts the RSA problem and recommendation made by the RSA team.

Works information will be updated at chainages 14900, 15400 and 15620 to reflect the correct carriageway markings as suggested.

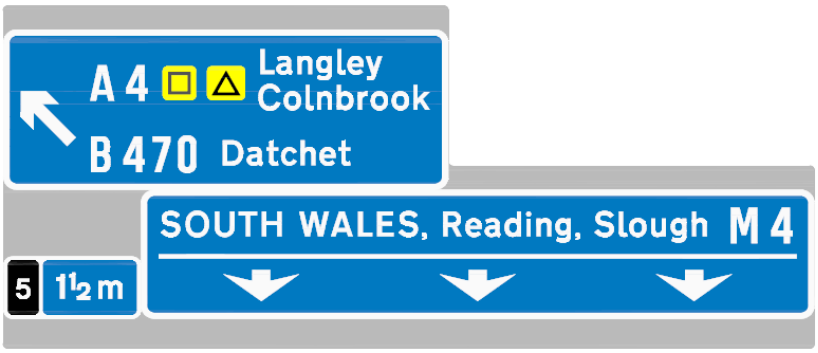
Lighting

3.3.34 PROBLEM

Location: Gantry signs

Summary: Risk of gantry lighting resulting in collisions

It is unclear how a number of irregularly shaped gantry signs faces, such as G03-16 at Junction 5, are to be lit. Inappropriate illumination could result in the sign faces being difficult to read, increasing the risk of late vehicle movements and side impact collisions. If the lighting provided is visible on the opposing carriageway this could result in glare and/or driver confusion, leading to collisions.



Extract from drawing HSN-S2_ZZZZZZZZ_Z-DR-CH-12051 Rev C01

Recommendation

It is recommended that gantry signs are suitably lit and do not impact on the opposing traffic lanes.

DESIGNERS RESPONSE:

Designer accepts the RSA problem and recommendation made by the RSA team.

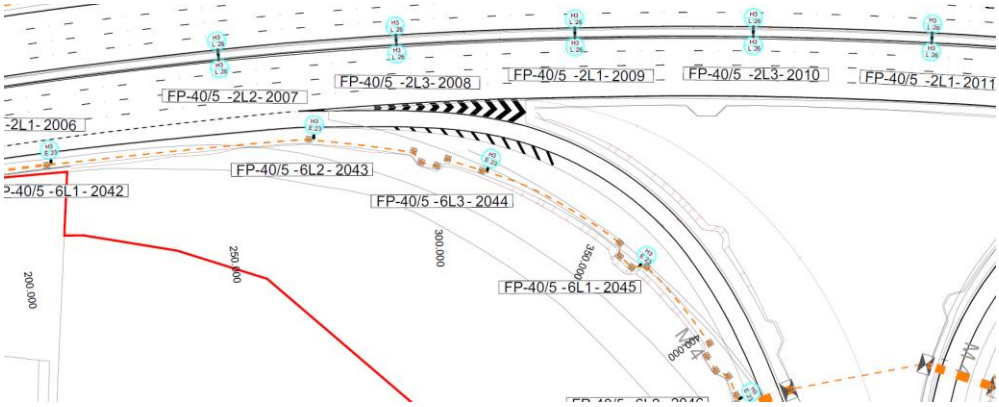
Gantry signs are illuminated as per the levels required in BS EN 12899-1 with sufficient backing board to mitigate glare to drivers on the opposing carriageway.

3.3.35 PROBLEM

Location: Junction 7 westbound merge

Summary: Lighting arrangement may lead to confusion

The street lighting provided at the Junction 7 westbound merge follows the alignment of the existing merge lane rather than the proposed. Locating the columns set back from the proposed carriageway could result in dark areas and driver confusion. This could be exacerbated by the RRS, which also follows the alignment of the existing merge lane. This could increase the risk of night-time collisions and vehicles leaving the carriageway at this location where the lighting doesn't follow the extent of the alignment.



Extract from drawing HEL-S2_ZZZZZZZZ_Z-DR-EE-1314

Recommendation

It is recommended that lamp columns and RRS are relocated and align with the proposed carriageway alignment.

DESIGNERS RESPONSE:

Designer accepts the RSA problem and recommendation made by the RSA team.

The lighting columns have been adjusted to follow the proposed carriageway alignment, as seen on drawing HA514451-CHHJ-HEL-S2_ZZZZZZZZ_Z-DR-EE-1325.

3.3.36 PROBLEM

Location: Various

Summary: Lighting columns could compromise the RRS

The following lighting columns are located within RRS transitions. It is likely that these will be within the working width of the RRS transition, which could increase the severity of a collision in the event of a vehicle striking the barrier.

- Column FP-1(N)-1L1-3455 and 3482 (chainage 19780)
- Column FP-P-1L1-3277 (chainage 17420)
- Column FP-Y(M)A-4L2-3204 (chainage 15870)
- Column FP-37/1B-1L2-2160 (chainage 26240)
- Column FP-37/1B-2L2-2166 (chainage 25960)
- Column FP-Y(M)A-4L3-3234 and FP-P-1L1-3247 (chainage 16670 and 16870)
- Column FP-X-2L3-3133 (chainage 14510)

Recommendation

It is recommended that lighting columns are located so that they do not affect the working properties of the RRS transitions.

DESIGNERS RESPONSE:

Designer accepts the RSA problem and recommendation made by the RSA team.

Lighting columns have been positioned outside the working width of proposed RRS throughout the scheme. The lighting columns mentioned have been reviewed and will be constructed outside the RRS working width as per typical verge details HA514451-CHHJ-HGN-SZ_ZZZZZZZZ_Z-DE-CH-10006 to 10027, aside from locations mentioned below.

There some very constrained areas behind RRS transitions in the central reserve, where there is very limited space in the width behind RRS. These locations have been reviewed and eliminated where possible and designed as the best-case scenario in localised areas to allow a compliant lighting design to be achieved.

The current Junction 5 Do-Minimum proposals mean that the existing layout will be retained, which includes the retention of lighting columns and RRS. This supersedes the previous proposals at J5 and eliminates some clashes mentioned with lighting columns within the working width.

3.3.37 PROBLEM

Location: Various

Summary: Lighting columns potentially located in front of or within working width of RRS

Lighting columns appear to be located in front of or close to RRS. This could increase the severity of a collision in the event of a vehicle losing control to the near side and striking the unprotected column. Examples include:

- Column FP-31/0A-3L3-2370 (chainage 20360)
- Column FP-31/0A-2L1-2377 (chainage 20700)
- Colum FP-1(N)-2L3-3474 (chainage 2000)
- Colum FP-P-3L1-3332 (chainage 17500)

Recommendation

It is recommended that lighting columns are located so that they are behind RRS with sufficient working width.

DESIGNERS RESPONSE:

Designer accepts the RSA problem and recommendation made by the RSA team.

Lighting columns have been positioned outside the working width of proposed RRS throughout the scheme. The lighting columns mentioned have been reviewed and will be constructed outside the RRS working width as per typical verge details HA514451-CHHJ-HGN-SZ_ZZZZZZZZ_Z-DE-CH-10006 to 10027.

The current Junction 5 Do-Minimum proposals mean that the existing layout will be retained on the diverge slip road at ch.20510. This supersedes the previous proposals at J5.

Walking, Cycling and Horse-riding

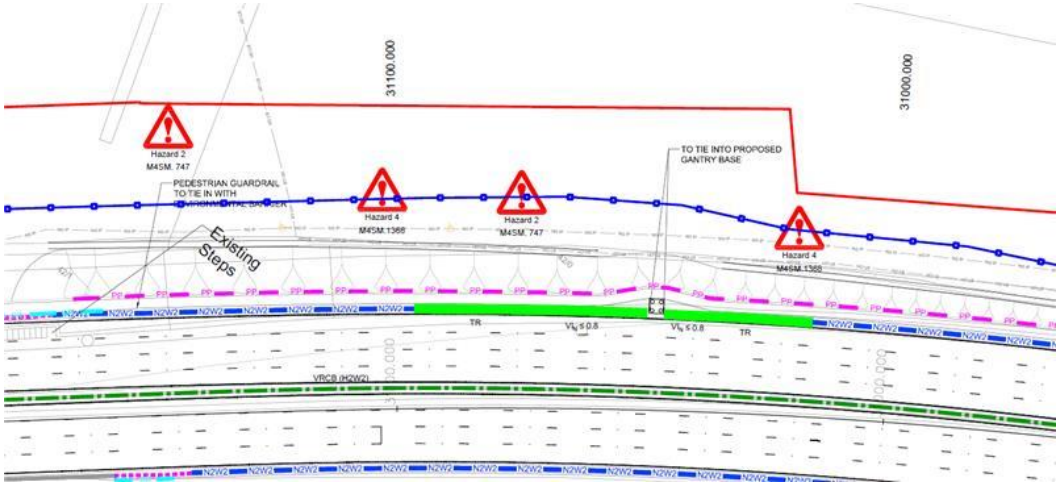
Pedestrians

3.3.38 PROBLEM

Location: Footway adjacent to east and westbound M4 carriageways between Monkey Island Lane and Marsh Lane (Sheets 8 to 10 of 71 Chainage 30800 to 31600)

Summary: Protection for pedestrians

It is unclear from the VRS drawings how pedestrians using the footway adjacent to the M4 will be protected from the carriageway or how access onto the network will be discouraged. Inadequate protection may increase the risk of injury in the event that a vehicle leaves the carriageway at this location. There is also an increased risk that pedestrians will access the network resulting in collisions.



Extract from drawing HGN-S2_ML0000000_Z-DR-CH-1009 Rev C01

Recommendation

It is recommended that adequate protection for both pedestrian and vehicles is provided.

DESIGNERS RESPONSE:

Designer accepts the RSA problem and recommendation made by the RSA team.

A proposed environmental barrier between 31155 and 30620 in both directions is designed just outside the W2 working width of the proposed RRS, which acts as a barrier between the footway and carriageway. The proposed EB then ties into the existing pedestrian guardrail which runs through to Monkey Island Lane and sits outside the working width of new RRS across its length. Therefore protection is provided for both pedestrians and vehicle occupants for the whole length.

3.3.39 PROBLEM

Location: Access steps to the Thames Path adjacent to the eastbound M4 carriageway (Chainage 31150)

Summary: Protection for pedestrians

It is unclear from the drawings how pedestrians using the footway adjacent to the eastbound M4 carriageway will be able to access the Thames path. Currently steps are provided on both sides of the carriageway, however, the steps on the eastbound side are no longer shown on the drawing. There is a risk that pedestrians, finding that access is not possible, may try to access the path via the steps on the opposite side of the M4, encroaching onto the network and at risk of injury.

Recommendation

It is recommended that if access to the Thames path is no longer possible from the eastbound side of the M4 that clear signing is provided at decision points on the footway adjacent to the M4 to ensure that pedestrians intending to access the path are directed to the footway on the westbound side of the M4.

DESIGNERS RESPONSE: Exception

Designer disagrees with auditor recommendation.

Drawing HA514451-CHHJ-SBR-S2_BR00000978-DR-CB-0102 shows new step access to the Thames Path from the footway behind the eastbound carriageway.

3.3.40 PROBLEM

Location: Shared footway/cycleway adjacent to the M4 (chainage 30800 onwards)

Summary: Risk of drainage infrastructure contributing to hazards

It is not clear from the drawings how the shared use path between Monkey Island Road and Meadow Way will be drained. Without adequate drainage there is a risk of water standing within the path resulting in pedestrian slips, trips, falls and cyclists becoming unseated resulting in injury.

Recommendation

It is recommended that the shared footway/cycleway is adequately drained.

DESIGNERS RESPONSE:

Designer accepts the RSA problem raised but suggests an alternative solution.

No dished drainage channels are proposed under the new VE design. Proposed drainage solution for the shared footway/cycleway is over the edge drainage.

3.3.41 PROBLEM

Location: Shared footway/cycleway adjacent to the M4 (chainage 30800 onwards)

Summary: Risk of debris being thrown up from the carriageway striking pedestrians or cyclists

The specification of the fencing/barrier between the shared use footway/cycleway and lane 1 of the M4 has not been provided. Given that the shared use path is immediately adjacent to the live lane (and at times at eye level) there is a risk of debris being thrown up from the carriageway increasing the risk of injury to pedestrians or cyclists.

Recommendation

It is recommended that a mesh is incorporated into the fencing to help minimise the risk of debris from the mainline carriageway coming into contact with users of the shared footway/cycleway.

DESIGNERS RESPONSE:

Designer accepts the RSA problem and recommendation made by the RSA team.

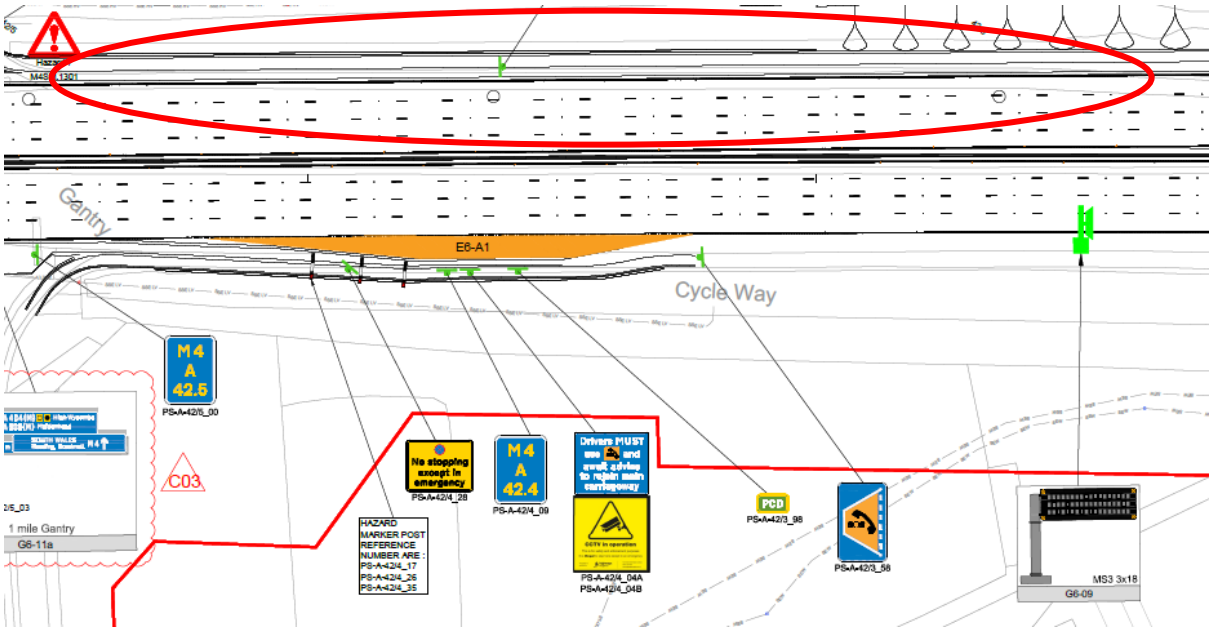
A mesh specification will be incorporated into the pedestrian guardrail adjacent to the carriageway to minimise the risk of debris coming into contact with users of the shared footway/cycleway. This will be provided in accordance with BS 7818:1995 and specified in the Series 400 Specification HA514451-CHHJ-GEN-SZ_ZZZZZZZZZZ_Z-SP-ZK-0301.

3.3.42 PROBLEM

Location: Shared footway/cycleway adjacent to the M4 (chainage 30800 onwards)

Summary: Risk of hazards at the shared use facility

An existing shared use path is provided parallel to the M4 between Monkey Island Road and Meadow Way, which crosses the River Thames and provides access to the Thames path via steps. No cross sections have been provided so it is not clear how this shared use facility will be accommodated within the constraints of the M4 corridor. The inclusion of RRS, pedestrian guard rail and environmental barrier are likely to impact on the effective width of the shared use increasing the risk of conflicts between pedestrians and cyclists.



Extract from drawing HSN-S2_ZZZZZZZZZ-DR-CH-12008 Rev C03

Recommendation

It is recommended that a shared footway/cycleway facility is provided in accordance with current standards.

DESIGNERS RESPONSE:

Designer accepts the RSA problem and recommendation made by the RSA team.

The cycleway has been designed in accordance with TA90 and has the 2.0m acceptable minimum width stated with 0.25m offsets to the fencing at each side. Refer to HGN-SZ_ZZZZZZZZ_Z-DE-CH-10037 for cross sections in this area.

4 Conclusion

All recommendations made within the Stage 2 RSA Report have been reviewed and considered accordingly.

10 No. exceptions have been identified and these relate to the following paragraphs:

1. Paragraph 3.1.2
2. Paragraph 3.1.3
3. Paragraph 3.1.4
4. Paragraph 3.1.6
5. Paragraph 3.1.13
6. Paragraph 3.1.33
7. Paragraph 3.3.12
8. Paragraph 3.3.16
9. Paragraph 3.3.20
10. Paragraph 3.3.39