

Smart motorways

Incident and infrastructure investigation

M6 Junction 5 to 6

Highways England response



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Executive summary

Last year's *Smart motorway evidence stocktake and action plan* sought to gather the facts on smart motorway safety and set out an action plan to ensure smart motorways are as safe as possible.

The Action Plan included an action to investigate clusters of incidents at locations on the M6 and M1. An evidence-led independent incident and infrastructure investigation was commissioned by us at the four locations and a report produced for each. These investigations produced a series of potential interventions or control measures for the specific issues that have been linked to collisions and / or incidents. The schemes that were reviewed are:

- M6 J5 to 6 dynamic hard shoulder (part of M6 J5 to 8 scheme)
- M1 J10 to 13 dynamic hard shoulder scheme
- M1 J30 to 35 all lane running (ALR) (part of M1 J28 to 35a scheme)
- M1 J39 to 42 ALR scheme

We have now reviewed the potential interventions, proposed by the independent review, to assess their viability and likely impact.

This report is our response to the independent infrastructure and incident investigation¹ report produced as part of the DfT Smart Motorway Safety: Evidence Stocktake and Action Plan and addresses the M6 between junction 5 and 6 in both directions. We have produced equivalent reports for the other three locations.

This section of motorway was included in the evidence stocktake because of concerns about clusters of incidents, and the fact the elevated infrastructure on the viaduct constrains the location of emergency areas. This means that over this short section they are further apart than are typically found across the rest of the smart motorway network.

As outlined in the Highways England Delivery Plan 2020-25 and Stocktake Action Plan, this section of network will be upgraded from a dynamic hard shoulder configuration to the all lane running standard by March 2025.

For the M6 junction 5 to 6 section, our actions focus around stopped vehicles, reducing the number of breakdowns occurring on the viaduct and further improving information and assistance for those who do have to stop. These measures are in addition to the installation of a stopped vehicle detection system, which is part of our project to upgrade this section to ALR.

We will implement the majority of recommendations resulting from the independent review, as well as some additional measures identified through production of this report. We are now carrying out more detailed design work to derive accurate cost estimates and delivery programmes. The small number of recommendation not being progressed were, upon further analysis, determined not to adequately address the identified causes of collisions.

Actions

We have set out a summary of recommendations from the independent review report on the following page. Alongside these recommendations is a summary of the actions we are taking (either already completed, or being taken forward) and the reason why some are not being taken forward.

¹ Published separately

| Independent review | | |
|---|---|---|
| Key findings | Recommended actions | Response actions |
| <p>The key findings relate to live lane stops:</p> <p>a) a minor reduction in overall collisions since conversion to dynamic hard shoulder running based on the five years of operational safety data available.</p> <p>b) three fatal collisions have occurred since the smart motorway became operational in April 2014.</p> <p>c) two of the three fatal collisions involved stops in the hard shoulder when it was open to traffic and further injury collisions are related to live lane stops. These events are not frequent but have the potential to be high severity collisions.</p> | <p>Encourage use of places to stop in advance of viaduct for discretionary stops or limping vehicles, by implementing additional signage on the approach to Bromford Viaduct</p> | <p>Being taken forward: as part of scheme to upgrade this stretch of the M6 to ALR, additional signage will be installed to inform drivers of places to stop in an emergency. Will start later in 2021 with signs installed between junction 4 and 5.</p> |
| | <p>Investigate possibility of constructing an additional place of relative safety on J5 northbound exit slip road</p> | <p>Being taken forward: we have identified a location, and this will be included as part of the upgrade of the M6 Junction 4 to 5 dynamic hard shoulder to ALR. This is due to start later in 2021 (subject to the necessary safety assessment being completed as part of the detailed design).</p> |
| | <p>Continual sequence of signs with distance to next emergency area along the whole viaduct</p> | <p>Being taken forward: additional signage will be installed on the viaduct. Will be complete before April 2022 (subject to sign and structural authorisations).</p> |
| | <p>To better highlight their presence on approach, add larger more conspicuous signs at viaduct emergency areas</p> | <p>Being taken forward: additional signage will be installed on the viaduct. Will be complete before April 2022 (subject to sign and structural authorisations).</p> |
| | <p>Consider hard shoulder monitoring CCTV based stopped vehicle detection system</p> | <p>Being taken forward: Bromford viaduct is within the scope of the scheme to upgrade this stretch of the M6 to ALR which is due to start work in 2023. Stopped vehicle detection will be installed as part of the upgrade. In the meantime, we will implement an interim arrangement to more quickly identify stopped vehicles.</p> |
| <p>Review opening and closing procedures and thresholds of hard shoulder to ensure it consistently matches traffic demand (i.e. not kept open longer when demand falls away)</p> | <p>Complete: description of updated operating procedure included in report.</p> | |

| Independent review | | |
|---|---|--|
| Key findings | Recommended actions | Response actions |
| <p>d) emergency areas are further apart on this section due to the constraints of the viaduct.</p> <p>e) based on the number of live lane stops, the emergency areas appear to be underutilised and the status of the hard shoulder may not be obvious to all road users.</p> <p>f) the presence of emergency telephones adjacent to live lanes when the hard shoulder is open may encourage road users who have had to leave their vehicles to walk along the motorway and their presence could act as encouragement to stop, even when the hard shoulder is open as a running lane.</p> | <p>Review provision / retention of emergency roadside telephones on viaduct</p> | <p>Being taken forward: emergency roadside telephones will be retained until the scheme to upgrade this stretch of the M6 to ALR starts in 2023, at which point we plan to remove them, as stopped vehicle detection will be installed. Telephones in emergency areas will be retained.</p> |
| | <p>Coloured surfacing on 1.2 metre kerbed area between edge of the hard shoulder and parapet, with information signs for those stopped</p> | <p>Not taken forward: coloured surfacing not to be provided as this area is not a place of relative safety and it could encourage road users to use it as a walkway which would present a safety risk. We plan to install information signs as part of the upgrade to ALR which is due to start in 2023 (subject to agreement of a suitable message and structural authorisations).</p> |
| | <p>Investigate the development and provision of a continuous emergency call strip on the parapet, e.g. "Press to alert help"</p> | <p>Not taken forward: there is no proven technology which could be quickly implemented and this could potentially encourage road users to get out of their vehicle which is against our safety advice.</p> |

Introduction

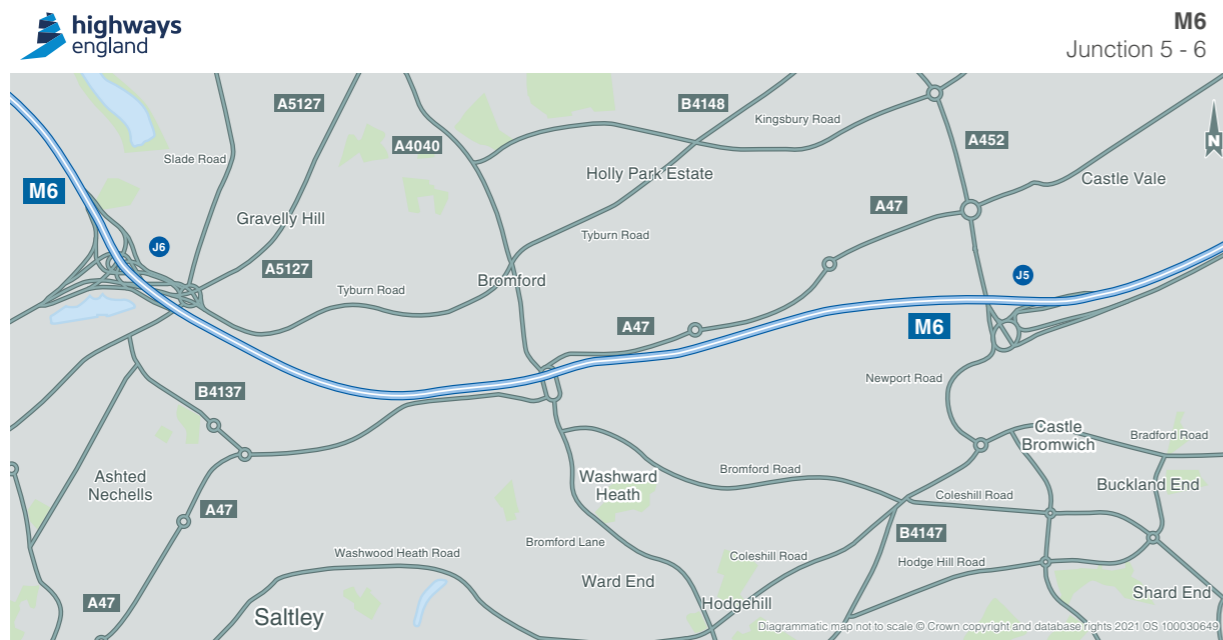
Scheme background

The 9.7 mile stretch of the M6 between J5 and J8 was upgraded in 2014 through the implementation of dynamic hard shoulder running. This is where the hard shoulder is used as a running lane when the motorway is congested.

This was part of a wider programme of upgrades across what is known as the Birmingham Box, where the M6 in the West Midlands links with the M5 and M42, to operate as a strategic 'box' of motorways surrounding Birmingham. Construction work commenced in January 2012 and the scheme was opened to traffic in April 2014. A section of 5.3 miles of this route is elevated, including:

- M6 J5 to J6 Bromford and Gravelly Hill viaducts (including J6 – Spaghetti Junction);
- M6 J6 to J7 Witton viaduct;
- M6 J7 Thornbridge viaduct; and
- M6 J8 Ray Hall viaduct

This investigation focuses on 3.2 miles of the elevated section which includes the M6 J5 to J6 Bromford and Gravelly Hill viaducts, shown below:



Almost all the link is on the Bromford Viaduct above the main Leicester to Birmingham railway line. On the northbound carriageway there are six signal gantries, one advance direction sign and one combined sign, and a signal gantry. On the southbound carriageway there are nine signal gantries.

One emergency area is provided in each direction over Bromford Viaduct between junction 5 and 6.

The central reserve has a double-sided steel vehicle restraint system and lighting columns are also located in the central reserve.

Methodology

Identification of issues

The incident and infrastructure investigation report for the M6 between junction 5 and 6 was produced based on analysis and study of a range of information, including:

- Source data, where necessary, including historic scheme operational safety analysis (Road Safety Audits (RSAs), specific scheme safety reviews, project Post Opening Evaluation reports (POPEs)
- Targeted CCTV analysis to understand traffic conditions that may be influencing the incident clusters
- Discussions with the Regional Operations Centre who manage the network in this location

Review of potential interventions

Each proposed mitigation was reviewed, looking at the:

- Likely impact on safety
- Estimated cost range
- Duration of when the application occurs (including proximity to planned upgrades) and timescales to implement the mitigation
- Other dependencies, for example need for authorisations, change to policy etc

Where potential interventions are not feasible, we have proposed and assessed alternative interventions.

Alternative interventions

Where necessary, alternative mitigations are proposed to target the root cause of the safety concern at this location which is stopped vehicles in the dynamic hard shoulder. We have reviewed these against the same factors as the initial interventions.

Review of potential interventions

Live Lane breakdowns

Issue identified

The analysis of breakdowns by the hour of occurrence has shown that live lane stops are more common during the busiest times of the day. This is when the hard shoulder is more likely to be in use as a running lane, as more vehicles are using the section. The data indicates an overall live lane breakdown rate of approximately 1.1 per day along this 3.2 mile section, averaging 0.34 per mile per day.

Potential interventions

Although vehicles may stop in live lanes for a variety of reasons, the report recommends a combination of related interventions to reduce the likelihood of a live lane stop.

These are:

1. Encourage use of places to stop in advance of viaduct for discretionary stops or limping vehicles, by implementing additional signage on the approach to Bromford Viaduct
2. Investigate possibility of constructing an additional place of relative safety on J5 northbound exit slip road
3. Continual sequence of signs with distance to next emergency area along the whole viaduct
4. To better highlight their presence on approach, add larger more conspicuous signs at viaduct emergency areas

Recommendations one, three and four have been subject to assessment and feasibility work. A summary of the findings is set out below:

Emergency area signing

- The current signing for emergency areas is mainly provided by attaching the signs on available gantries, due to the restrictions in installing standalone signposts on the viaduct. The limitations around sign placement means some of the signing is not at the exact recommended distance, and the distance displayed on the signs is not always the exact distance to the next emergency area.



Figure 1 Emergency area approach sign on Bromford Viaduct mounted on a gantry
© Google

- In both the northbound and southbound directions, signing for the emergency areas will be enhanced. This will reduce the risk of drivers missing the emergency area, or stopping in a live running lane because they are unaware of the distance to the next emergency area
- Signage for the emergency areas will be enhanced

Summary of northbound enhancements:

- Provide additional emergency area distance signing as soon as feasible beyond Junction 5
- Provide a ½ mile approach sign at gantry (first gantry downstream of the J5 exit slip road)
- Relocate the current 200 yards sign to more accurately represent that distance
- Introduce breakdown advice signs along the viaduct

Summary of southbound enhancements:

- Provide a 100 yards approach sign on a stand-alone concrete base

- Additional 300 yards/200 yards emergency area signing subject to structures approval
- Introduce breakdown advice signs along the viaduct

More details of the signage enhancements and locations are set out in Annex A.

We plan to deliver enhanced signing for emergency areas in the 2021-22 financial year subject to sign and structural authorisations. Breakdown advice signs will be included within the scope of the ALR upgrade scheme which is due to start work in 2023.

For the recommendation to provide an additional place of relative safety at the J5 northbound exit slip road, we have completed a review as part of the development work to prepare for the upgrade to ALR of the M6 J4 to J5. This work is due to complete by March 2023. An additional emergency area will be installed on M6 J5 northbound exit slip road as part of the scheme.

The implementation of the emergency area at the northbound exit slip road will fulfil this recommendation.



Figure 2 M6 J5 northbound exit slip road (shown on lower portion of image) an emergency area is to be implemented on this exit slip road © Google

Collision severity

The other main area identified in the incident and infrastructure report was collision occurrence and severity. There were a similar number of collisions recorded before and after the original scheme to upgrade this section to a dynamic hard shoulder smart motorway in 2014. The severity of these show a lower ratio than nationally, although an increase in comparison to the 'before scheme' data.

A number of interventions have been recommended to address collision occurrence and severity.

Consider hard shoulder monitoring CCTV based stopped vehicle detection system

Bromford viaduct is within the scope of the M6 Junction 4 to 5 dynamic hard shoulder to ALR upgrade scheme which is due to start work in 2023. Stopped vehicle detection will be installed as part of the upgrade.

In the meantime, we will implement an interim arrangement to more quickly identify stopped vehicles.

Review opening and closing procedures and thresholds of hard shoulder, to ensure it consistently matches traffic demand (i.e. not kept open longer when demand falls away)

At the time the 'incident and infrastructure investigation' report was being completed, we had already progressed an exercise to review opening and closing procedures for sections of motorway with dynamic hard shoulders. This review evaluated flow and speed behaviours to evaluate delay caused by 60mph speed restrictions. This review originally focused on the M42 and subsequently the M6. We wanted to understand whether benefits could be delivered through a more dynamic approach to opening and closing procedures, subject to network traffic conditions or incidents.

As a result of this research, a work brief for operational staff in the West Midlands was issued in May 2019 for the M42, and updated in November 2019 to cover the M6. Instead of adopting a standard approach, the brief gave a clear indication to operators of when to open and close links to reduce customer delay, and improve network performance based on typical traffic flows. Assessment of this change showed that average speeds increased by more than 5mph at certain times of the day.

We therefore consider this recommendation as implemented.

Review provision / retention of emergency roadside telephones on viaduct

There is a total of 11 emergency roadside telephones between junction 5 and 6 (six northbound and five southbound). There is an emergency roadside telephone in each of the two emergency areas, and the other nine are provided on the top of the parapet. These are not regularly spaced; some are approximately 0.6 miles apart but at the northern end there are two pairs located 328 yards apart. Although the usage figures for the telephones outside of the emergency areas are low, we believe on balance there is no benefit to decommissioning them at this time.



Figure 3 Parapet mounted emergency roadside telephone on Bromford Viaduct
© Google

When the section was converted to smart motorway in 2014, a departure from standard was agreed based on a safety risk assessment about the provision of the telephones. When the section is converted to ALR, we propose that they should be removed as they will be adjacent to a running lane (with the exception of those in an emergency area). The implementation of stopped vehicle detection means that any road users who stop on the viaduct should be identified by the Regional Operations Centre before users have a chance to access the telephone. Retention of the telephones for now will also remove the risk to road workers and potential road user disruption to remove them.

Coloured surfacing on 1.2 metre kerbed area between edge of the hard shoulder and parapet, with information signs for those stopped

The incident and infrastructure investigation report suggested providing coloured surfacing on the area between the nearside road marking in and the viaduct parapet. Information signs at regular points along the parapet edge at a right angle to the carriageway were also proposed. The report suggested that the signs should affirm the coloured area as somewhere to stand, for example “emergency area, await help”. In tandem, an information campaign, for example at local motorway service areas, was also recommended.



Figure 4 1.2 metre kerbed area between the edge of the carriageway and the parapet
© Google

We do not class this ‘hard strip’ as a place of relative safety, and therefore would not wish to create the impression that there is a walkway for road users to use. Therefore we do not intend to pursue this recommendation.

The implementation of this recommendation may conflict with the coloured surfacing used for emergency areas and create confusion for road users. When the ALR scheme is completed, the hard strip will be adjacent to a permanent running lane, which further supports the decision not to pursue this recommendation.

This proposal is deemed not appropriate on the viaduct because it would look like a safe place to get out of the vehicle and wait when it is not. Road users should not be encouraged to exit the vehicle when broken down next to the parapet as this would go against breakdown advice. The [SURVIVE best practice guide](#) is a document agreed with Highways England, the emergency services and the recovery industry. This states ‘normally the safest place to wait for help is away from moving traffic so that they can see the rear of the vehicle and if possible, a safe distance behind the crash barrier.’ Where this isn’t possible, the advice states ‘we would generally advise against attempting to leave the vehicle and suggest that you and any other occupants remain in the vehicle with your seatbelts on.’ Instead, road users should be encouraged to continue, if possible, to a place of relative safety.

Additionally, it would be difficult to communicate what the coloured surfacing means as it is not commonplace to have this on the network (except orange surfacing for emergency areas). Having coloured surfacing along Bromford viaduct may therefore be confusing.

No alternatives have been considered for this recommendation, as it is felt that the introduction of stopped vehicle detection will address the issue this suggestion is looking to mitigate.

As noted above however, we will introduce information signs (see Annex A) along the viaduct for users who breakdown to confirm the SURVIVE best practice advice which is included in the forthcoming update to the Highway Code.

Investigate the development and provision of a continuous emergency call strip on parapet, e.g. “Press to alert help”

This proposal involves the provision of a continuous emergency call strip on the parapet, for example “Press to alert help”. The incident and infrastructure investigation report suggested that this could be similar to a panic strip and be linked to an alarm in our Regional Operations Centre. The strip could be configured into blocks (each block a section between two signal gantries) along the viaduct so that operators receive an alert that provides an approximate location of the stranded person. The report suggests that this would make the setting of upstream signals with “report of stranded vehicle” or similar, quick and efficient. The strip should be coloured orange, set at an easy to reach height and have a repeating instruction along its length i.e. “Press to alert help”.

We do not feel it would be appropriate on the viaduct because it would encourage road users to get out of their vehicle against the SURVIVE advice. Instead, road users should be encouraged to continue along the viaduct to the next place of relative safety. Stopped vehicle detection is already planned to be installed to alert us to live lane stops and will be implemented on this section as part of plans to include it in all dynamic hard shoulder to ALR upgrade schemes by March 2025.

In addition, as this technology in this setting is untested, it would need development for deployment on a viaduct.

We have therefore concluded that the recommendation should not be pursued. There is no existing technology that could be quickly introduced, and there is the potential for misuse and or false alarms for operators in the Regional Operations Centre.

The ALR upgrade will bring full stopped vehicle detection coverage which will identify stopped vehicles quickly, and in less time than it might take to exit a vehicle safely and access the call strip.

As noted above however, we will introduce information signs along the viaduct for users who breakdown to confirm the SURVIVE best practice advice which is also now subject to consultation for inclusion in the revised Highway Code.

No other alternatives have been considered for this recommendation, we feel that the introduction of a stopped vehicle detection system will address the issue this suggestion is looking to mitigate. Prior to the introduction of stopped vehicle detection, we will implement an interim arrangement to more quickly identify stopped vehicles.

Actions

We have set out a summary of the recommendations from the independent review report below. Alongside these recommend actions are the actions we have already completed, are taking forward and those not being taken forward in response to these recommendations:

| Independent review | | |
|---|---|---|
| Key findings | Recommended actions | Response actions |
| <p>The key findings relate to live lane stops:</p> <p>a) a minor reduction in overall collisions since conversion to dynamic hard shoulder running based on the five years of operational safety data available.</p> <p>b) three fatal collisions have occurred since the smart motorway became operational in April 2014.</p> <p>c) two of the three fatal collisions involved stops in the hard shoulder when it was open to traffic and further injury collisions are related to live lane stops. These events are not frequent but have the potential to be high severity collisions.</p> | <p>Encourage use of places to stop in advance of viaduct for discretionary stops or limping vehicles, by implementing additional signage on the approach to Bromford Viaduct</p> | <p>Being taken forward: as part of scheme to upgrade this stretch of the M6 to ALR, additional signage will be installed to inform drivers of places to stop in an emergency. Will start later in 2021 with signs installed between junction 4 and 5.</p> |
| | <p>Investigate possibility of constructing an additional place of relative safety on J5 northbound exit slip road</p> | <p>Being taken forward: we have identified a location, and this will be included as part of the upgrade of the M6 Junction 4 to 5 dynamic hard shoulder to ALR. This is due to start later in 2021 (subject to the necessary safety assessment being completed as part of the detailed design).</p> |
| | <p>Continual sequence of signs with distance to next emergency area along the whole viaduct</p> | <p>Being taken forward: additional signage will be installed on the viaduct. Will be complete before April 2022 (subject to sign and structural authorisations).</p> |
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| Independent review | | |
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| Key findings | Recommended actions | Response actions |
| d) emergency areas are further apart on this section due to the constraints of the viaduct. | Review opening and closing procedures and thresholds of hard shoulder to ensure it consistently matches traffic demand (i.e. not kept open longer when demand falls away) | Complete: description of updated operating procedure included in report. |
| e) based on the number of live lane stops, the emergency areas appear to be underutilised and the status of the hard shoulder may not be obvious to all road users. | Review provision / retention of emergency roadside telephones on viaduct | Being taken forward: emergency roadside telephones will be retained until the scheme to upgrade this stretch of the M6 to ALR starts in 2023, at which point we plan to remove them, as stopped vehicle detection will be installed. Telephones in emergency areas will be retained. |
| f) the presence of emergency telephones adjacent to live lanes when the hard shoulder is open may encourage road users who have had to leave their vehicles to walk along the motorway and their presence could act as encouragement to stop, even when the hard shoulder is open as a running lane. | Coloured surfacing on 1.2 metre kerbed area between edge of the hard shoulder and parapet , with information signs for those stopped | Not taken forward: coloured surfacing not to be provided as this area is not a place of relative safety and it could encourage road users to use it as a walkway which would present a safety risk. We plan to install information signs as part of the upgrade to ALR which is due to start in 2023 (subject to agreement of a suitable message and structural authorisations). |
| | Investigate the development and provision of a continuous emergency call strip on the parapet, e.g. "Press to alert help" | Not taken forward: there is no proven technology which could be quickly implemented and this could potentially encourage road users to get out of their vehicle which is against our safety advice. |

Appendices

References

Annex A – Proposed signing changes

Annex A – Proposed signage changes

Northbound

We are proposing to increase the number of emergency area advance signs on the northbound carriageway of the Bromford Viaduct. Prior to Junction 5, there are a number of emergency areas, but there is a noticeable difference in character in the section prior to the viaduct, and immediately after junction 5 where the viaduct starts. Providing additional advance signs to continue the similar character of this aspect, but extending the distance markers, for example to 1.5 miles and 1 mile, would maintain a regular frequency of signs. It would also highlight to drivers the difference in frequency of the bays themselves.

If drivers miss the current 1 mile emergency area approach sign on the viaduct, there is not another sign to advise of the emergency area location until the 200 yards sign. This is located 121 yards away from the start of the emergency area because of siting constraints. This could mean drivers may stop when they could have potentially reached the emergency area, or drivers who are suffering vehicle issues miss the emergency area when they do reach it.

An additional half mile approach sign will be provided on a sign gantry which is 919 metres (0.57 miles) from the start of the emergency area entry taper. A 1/3 of a mile approach sign can also be provided. This would be subject to structures approval as it would need to be attached to the outside of the parapet.

In addition, the current 200 yards advance sign will be moved. This would increase the distance from the sign to the start of the emergency area entry taper to approximately 170 yards.

Southbound

On the southbound carriageway the recommendations also involve providing additional advance signing for the emergency area at a further distance, and further provision of signs following the emergency area on the viaduct to advise the distance to the next emergency area which is situated immediately prior to junction 4A (there is no off slip at junction 5). The proposal is to introduce new signs in a half mile sequence and then increase the frequency on the approach.

There is a final emergency area sign located approximately 11 metres in advance of the entry taper which is within the recommended 20 metres. However, there is no approach signing between this and the 1/3 mile approach sign therefore an additional emergency

area approach sign displaying 100 yards will be provided. The visibility of the emergency area is restricted from the main carriageway due to the sign gantry, which is 11 metres prior to the start of the entry taper. We have identified a suitable location for the 100 yard sign and the sign will be installed using a standalone concrete base.

A half mile advance emergency area sign will also be included. This would require separate approval as it would have to be attached to the outside of the parapet.

Breakdown advice signs

Highways England and SURVIVE advice if your vehicle has a problem, or you get into trouble on a motorway is to stay calm and try to exit at the next junction or motorway service area. If that's not possible, then you should:

- Put your left indicators on
- Move into the left lane
- Enter the next emergency area or hard shoulder
- Put your hazard lights on
- Get behind a safety barrier where there is one – keep well away from moving traffic
- Call Highways England on 0300 123 5000, then a breakdown provider for help

Motorists who have suffered vehicle failure on Bromford Viaduct are not able to follow this general advice. This is because there is very little room between the hard shoulder and the parapet, and no barrier to stand behind.

Highways England's advice if you are unable to exit your vehicle and get to a safe place, have stopped in a live traffic lane or feel your life is in danger, is:

- Stay in your vehicle with your seatbelts and hazard lights on
- Call 999 immediately

We have established there are no current prescribed signs that readily communicate this advice. Therefore, a recommendation of this report is to provide information along the viaduct parapet reminding drivers and vehicle occupants of this advice. Signs or notices will be located along the inside of the parapet adjacent to the driver location signs. This would mean that if a vehicle did breakdown, the occupants would know what to do and be able to give a precise location when they phone the emergency services.

Precise wording for the sign is being finalised but an illustrated example is shown below:

Example vehicle breakdown information sign



If you need help accessing this or any other Highways England information, please call **0300 123 5000** and we will help you.

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