

Road Safety Foundation submission of 3 August 2023

PE1992/I: Dual the A9 and improve road safety

Note that the information provided here is broad and general and relates to typical road safety benefits from dualling road sections. The Road Safety Foundation has not undertaken any formal review of the A9 which we would typically undertake using the iRAP star rating protocols to fully understand the extent of the risk on a route.

Dual carriageways have several road safety benefits, largely because the design and layout of the road infrastructure means that crashes are more survivable at typical driven speeds than is the case for single carriageway roads. The main benefit is the near elimination of head on risk when a road section is dualled where a vehicle restraint system installed in the median, or where the median is of significant width, ideally greater than 10 metres.

According to in-depth crash investigation studies collated by Truong et al. (2022¹), the impact speed at which only 10% of crashes result in a severe injury (defined as MAIS 3+² or a whiplash injury greater than six months duration) is 50km/h or 31mph³. Typically, injury curves will show a strong increase in the percentage injured beyond 10% such that small increases in speed above 31mph would result in significant increases in the percentage of people severely injured when a head on crash occurs. So, this means that if vehicle speeds are above 31mph, which they often are on single carriageway roads, vehicle occupants are being exposed to increasingly high levels of risk. Typically within 20mph, the injury curve will have reached 90% severe injury (though the curve hasn't been made available in the cited publication). So it is very possible that by about 50mph impact speed over 90% of people involved in a head on crash will be severely injured.

¹ Truong, J., Standroth, J., Logan, D.B., Job, R.F.S., Newstead, S. (2022). Utilising Human Crash Tolerance to Design an Interim and Ultimate Safe System for Road Safety, Sustainability, 14, 3491 – Table 1

² The group of MAIS 3+ injuries include more life-threatening injuries, such as severe brain injuries, amputations, paraplegia, quadriplegia, multiple rib fractures, complex fractures, and at the most severe end, injuries such as decapitation that guarantees a fatal outcome

³ Risk curves based on relatively modern vehicles and belted occupants rounded to the nearest 5km/h

Older research by Wramborg (2005) highlighted that at 45mph the risk of a head on crash resulting in a fatality is 10%. Beyond this speed fatality risk increased rapidly and, by around 60mph, 90% of head on crashes would result in a fatal injury.

As difficult as it is to remedy, to fulfil the requirements of a *totally* safe system, it would be necessary (in theory) to provide median separation on all roads where vehicle speeds are greater than 31mph.

Median vehicle restraint systems all but eliminate the risk of cross over and therefore head on crashes are treated almost in their entirety. Of course, there are more moderate measures that could be deployed to mitigate for head on risk. For example, centreline raised profile markings (not currently permitted on UK roads) and central hatching could reduce head on risk by around 20%⁴, whilst wide centre lines can reduce risk by about 5%.

Dualled road sections also typically have other road safety benefits. Often junctions are grade separated rather than at-grade T junctions or crossroads. These are a much safer configurations and Truong et al. (2022) also outline 'safe' impact speeds for side impacts that are commonplace on single carriageways with at-grade junctions. As a road is dualled, often roadsides are treated – with clear run off zones being introduced free of hazardous obstacles or vehicle restraint systems are installed. Information on the effectiveness of other road safety countermeasures such as clearing roadsides and changing the junction type can be found on the iRAP website methodology section.

In our work we do find significantly different crash rates and star ratings for rural single carriageway roads versus dual carriageway roads, with the latter being safer on average by far.

This can be shown using the iRAP star rating demonstrator, which is free to use (although you have to register) at [vida.irap.org](https://irap.org). Here you can input information about a typical cross section of a road and as you change descriptors (such as median treatment and number of lanes for example) you can see how risk changes.

⁴ Figures obtained from the iRAP methodology fact sheet on median treatment and centreline rumble strips available at <https://irap.org/methodology/>

It is possible to undertake detailed reviews of inherent risk using the iRAP star rating protocol which has been used on more than 1.4 million kms of roads globally across over 100 countries, and on 32,500km in the UK. The model uses known relationships between road infrastructure attributes/speed and crash risk from studies to quantify the risks present, and multiplies scores by flow to estimate future fatal and serious injuries. This means that it is possible to develop a business case for different treatment scenarios based on known risks and exposure instead of waiting for crashes to accumulate at a given location. This is an approach now adopted by National Highways and the Welsh Government has recently also undertaken a strategic road survey. We would welcome the opportunity to work with Transport Scotland and the Scottish Government on similar high impact programmes helping with the delivery of a safe system in Scotland, of course with the possibility of starting with A9 as a high priority corridor.