

# North Wales Transport Commission

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Improving the Resilience of  
Connections Across the Menai Strait



December 2023

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# Background

Following the publication of the Roads Review Panel's 'The future of road investment in Wales'<sup>1</sup> on February 14th, 2023, the remit of the North Wales Transport Commission was extended to consider how the connections to and from Ynys Môn can be made more resilient. We were asked to provide options that align with the purposes and conditions for investment in roads set out in the Welsh Government's response to the Roads Review Panel's recommendations. Our considerations have been in the context of the upgrading of the Menai Suspension Bridge commenced in 2023, and recurrent incidents and bad weather events that affect the crossings.

**Resilience.** The Britannia Bridge and the Menai Suspension Bridge operate as a combined system, with Britannia Bridge carrying about three-quarters of the traffic. Actual and perceived resilience issues with the crossings have a negative impact on the attractiveness of Ynys Môn for economic investment. Britannia Bridge closures have more significant consequences than closures elsewhere on the strategic road network. Recent Britannia Bridge closures have been exacerbated because of works on the Menai Suspension Bridge. Both bridges need to be resilient.

**High winds.** Britannia Bridge is vulnerable to high winds. At some wind speeds Britannia Bridge is closed to high-sided vehicles and lower driving speeds are advised. There have been 27 occasions in the five years between 2017 and 2021 when heavy goods vehicles (HGVs) have been unable to cross the bridge, that is an average of just over five occasions a year.

The Menai Suspension Bridge is nearly 200 years old. Refurbishment work is taking place between 2023 and 2025. It has narrow lanes and is not well suited to being a relief road when the Britannia

Bridge is closed, particularly for high sided vehicles. It has a speed limit of 30mph and a capacity of about half of the Britannia Bridge capacity.

**Collisions and incidents.** There are a high number of collisions on the Britannia Bridge which can cause restrictions or closure of the bridge. There are several possible explanations linked with the geometry of the bridge and its approaches, the lane layouts and the layouts of the merges and diverges and lane drops, and the speed of traffic.

**Consequences of restrictions and closures.** Events, such as adverse weather, collisions or other incidents, lead to restrictions or closures - of one bridge on occasion, and more rarely, both bridges. These events and closures have a significant impact on people's ability to cross the Menai Strait to access employment, education, health and other services, and they make it difficult for emergency services and businesses to operate.

A closure will typically also lead to congestion on the surrounding road network approaching both bridges. This is

exacerbated by the roundabouts on both sides of the A55 at Junction 9.

The management of weather closures and incidents on the bridge requires complex partnership working between several organisations and there are procedures in place to do this. We think leadership, communication and traffic management can be improved.

**Traffic flow.** Daily variations in traffic flow are typical of the use of the crossings for commute journeys. The pattern of HGVs to the Port of Holyhead does not significantly affect the flow profiles at the bridge. For much of the day, the bridges operate at a level close to their capacity. The volume of traffic can lead to delay and congestion, and hence long journey times, especially during the summer tourist season. Delays can affect emergency vehicle response times.

**Public transport.** The communities on Ynys Môn are not well served by the rail network. Ynys Môn has six rail stations but only Holyhead has significant footfall as the other stations are not near to the centres of population. Almost a third of Transport for Wales (TfW) operated trains between Holyhead and Bangor do not stop at LlanfairPG station, the closest station to the Menai Strait, and many services do not call at the smaller stations between LlanfairPG and Holyhead. This limits the potential for travel across the Menai by rail for work, health and other services.

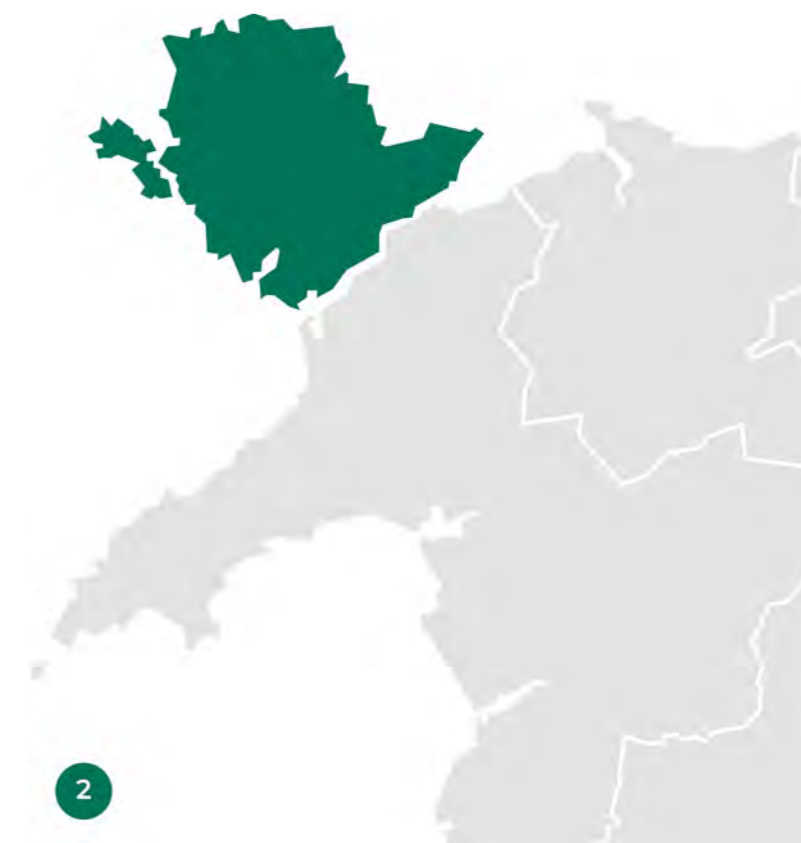
Given the limitations of rail, bus services are the main mode of public transport for many residents of, and visitors to, Ynys Môn. The local bus network is operated by several companies, serving the towns, villages, and attractions on the island, providing connections to larger settlements and to other transport

connections. Currently, bus journey times are uncompetitive with the car which limits the potential to achieve mode shift.

Overall, public transport does not provide a good level of service for crossing the Menai Strait.

**Active travel.** There are journeys under 5km in length that are currently undertaken by car but could be suited to active travel if suitable routes were available. These include journeys between major employers and settlements such as LlanfairPG and Ysbyty Gwynedd and between Bangor and Menai Bridge. However, the lack of good separation from motor traffic on both bridges means that walking and cycling journeys are not comfortable or attractive. Beyond the bridges, there is also a lack of direct, safe and attractive network of routes.

**Travel planning and management.** Public sector organisations in Gwynedd and Ynys Môn are significant generators of trips across and around the Menai Strait area, especially at peak times. Travel planning and management can reduce the need to travel and reduce travel at peak times.



<sup>1</sup> - [The future of road investment in Wales](#)

**Recommendations.** We have made sixteen recommendations. We think the first six recommendations should be prioritised and these deal with reducing the probability of bridge closures: the deployment of wind deflectors; the introduction of variable speed limits to manage traffic; road layout changes; and improvements to the side road junctions at Junction 9 and Junction 8A. We also recommend that the Multi-agency Response Framework is enhanced especially in relation to leadership, communication, and traffic management. We have made a further recommendation that a study is undertaken of a three-lane tidal system for Britannia Bridge.

We recommend that additional trains call at LlanfairPG, and that the planned

enhanced bus network for Ynys Môn is supported before franchising takes place with multi-year funding. In addition, bus priority measures and park-and-ride sites should be investigated.

We suggest that a comfortable and attractive active travel route is installed on Britannia Bridge preferably at rail deck level, but otherwise at road deck level. In addition, we recommend traffic management improvements on Menai Suspension Bridge to assist cyclists and a comprehensive, comfortable, attractive and safe active travel network extending from both ends of both bridges.

We recommend partnership working to plan and manage travel in the area involving the public, private and thirdsectors.

## Summary of the case for change

Britannia Bridge is vulnerable to restriction or closure because of high winds.

- ◆ The road layout, junction arrangement and speeds create a high collision rate, which can create restrictions or bridge closures.
- ◆ Bridge restrictions and closures have a significant impact on everyday journeys for work, education, health and other services and make it difficult for emergency services and businesses to operate.
- ◆ Britannia Bridge and Menai Suspension Bridge are used to a high proportion of their capacity.

- ◆ Ynys Môn is not well served by the rail network with few trains stopping at LlanfairPG.
- ◆ There is limited availability of fast, frequent and affordable bus services in the area.
- ◆ There are no safe, comfortable and attractive active travel routes in the area or across either bridge.



# 1 Introduction

## 1.1 The Commission's Remit

The Roads Review Panel's report 'The future of road investment in Wales' was published on 14th February 2023. The report recommended that the A55 Third Menai Crossing should not proceed. The Panel thought that the case for change was not well-aligned with Welsh Government's aim to reduce car mileage. The scheme would lead to increased traffic and carbon dioxide emissions, and a mode shift from public transport to car travel, inconsistent with the target to increase sustainable transport mode share.

Because of the Panel's report, the North Wales Transport Commission's remit was extended to consider the following:

- ◆ How the connections to and from Ynys Môn can be made more resilient in the context of recent maintenance and the impact of bad weather events on the existing infrastructure.
- ◆ How the use of existing infrastructure can be maximised.

- ◆ The role of connections to and from Ynys Môn in ensuring the movement of goods within and through Wales.
- ◆ How the connections to and from Ynys Môn can support our modal shift aims.
- ◆ How these connections fit in the wider context of transport connectivity across North Wales.
- ◆ Potential options for improvement in light of the above considerations, when taking a perspective of multi-modal transport across North Wales as a whole.
- ◆ The Commission should consider options that support modal shift and align to the purposes and conditions for investment set out in the Welsh Government's response to the Roads Review Panel's recommendations.

## 1.2 The Nature of the Existing Crossings

Ynys Môn is known for its agricultural sector, a thriving tourism industry, and the Port of Holyhead, the major gateway to Ireland. Ynys Môn and Gwynedd share economic, social and cultural connections and the majority of the population speaks the Welsh language. Ynys Môn is connected to the mainland by the Britannia Bridge to the west and the Menai Suspension Bridge to the east.

The Menai Suspension Bridge is a Grade I listed structure completed in 1826 and reconstructed in 1938-40. A 7.5 tonne weight limit was imposed in June 2022, and the bridge was closed to motorised vehicles between 21st October 2022 and 2nd February 2023 for emergency works. Continuing work to replace the hangers that support the bridge deck started on 4th September 2023 and will be finished in August 2025. A single lane is open to motorised traffic under signal control. Bus services are diverted to the Britannia Bridge for the duration of the works. 44 tonne HGVs will be able to cross again once the refurbishment is complete, but

the stone arches at the bridge piers limit vehicle widths to 2.6 metres and heights to 4.7 metres.

The Britannia Bridge is a Grade II listed structure completed as a rail bridge in 1850. The bridge was extensively damaged by a fire in May 1970 and the bridge was re-opened in 1980 with a different configuration comprising a lower rail deck and an upper road deck. There are no height or width restrictions on the Britannia Bridge. Maintenance work can require temporary closures or lane restrictions.

Network Rail owns Britannia Bridge. Both Britannia Bridge and the Menai Suspension Bridge are operated and maintained by UK Highways A55 Ltd as part of a Design, Build, Finance and Operate (DBFO) contract which ends in 2028. Bridge management involves the preservation of historical structures and provision for traffic demand to current highway and structural engineering standards.



## 1.3 The Economy, Employment, and Access to Services

Although separated by the Menai Strait and in different local authority areas, the towns on both sides of the Strait form a single economic area. Many people travel between locations across the Strait for employment and to access education and healthcare services, as well as for leisure, shopping and entertainment opportunities.

The Port of Holyhead plays a vital role in freight and cargo transportation to Ireland and is the next busiest roll on /roll off (RORO) port in the UK after Dover.

The UK and Welsh Government announced in March 2023 that the Anglesey Freeport will be one of two new freeports to be established in Wales. The establishment of a freeport on Ynys Môn could bring benefits to the region specifically relating to job creation and economic growth, but also by providing the impetus for infrastructure development. Such developments could include improvements to logistics facilities and digital connectivity and, potentially, to transport networks.

The Anglesey Freeport covers the whole of Ynys Môn although the focus is expected to be around the Port of Holyhead, Rhosgoch, Menai Science Park and Anglesey prosperity zone which, if designated as tax and/or customs sites, will benefit from trade and customs simplifications and hence provide incentives for investment and trade. This means that goods entering the Anglesey Freeport will not be subject to the UK's usual tax and customs regime, with the

idea that this supports long-term business investment, and boosts the prosperity of Ynys Môn as well as north Wales. Other sites will have tax incentives and regulatory easements for investors.

The now-decommissioned Wylfa Nuclear Power Station is a large industrial site and there remains a prospect of a new facility, Wylfa Newydd, which would be a significant contributor to Wales' energy infrastructure and provide employment opportunities.

Whilst the Commission is aware of possible development on Ynys Môn associated with the Anglesey Freeport and modular nuclear reactors, it has been unable to secure firm evidence of the potential impact on traffic demand across the Menai Strait.

Other major employers include Bangor University, Coleg Menai, Ysbyty Gwynedd and the two local authorities. As well as being major employers, these organisations (along with the emergency services) provide essential services and infrastructure that are crucial to the residents of Ynys Môn. Approximately one third of the over 3,700 staff at Ysbyty Gwynedd live on Ynys Môn, and therefore regularly cross the Menai Strait.

We can see that Ynys Môn's position as an island, with a major port and strong economic links with Gwynedd, can be subject to multiple disruptions to businesses, residents, visitors, and service providers when there is a problem with the crossings.

We also recognise that opportunities for non-car travel between settlements, employment opportunities, and services, is limited by accessibility, cost, service frequencies, reliability, and a lack of infrastructure for bus, rail and active travel.

## 1.4 Our Approach

The Commission set up a sub-group that was provided with technical support from Welsh Government strategic route network officials and TfW. We have reviewed a significant number of documents from previous studies. We undertook site visits and engaged with stakeholders including the emergency services, local members of the Senedd, and local councillors and officers. We also sought the views of communities and businesses in the locality through written feedback, meetings, and survey responses. We received a significant number of representations that have informed our understanding of the challenges and opportunities and shaped the recommendations presented in this report.

Stakeholders, including the emergency services and Ynys Môn County Council, have advised us that their main concerns relate to the impact of incidents that restrict use or cause closure of one or more of the bridges and prevent residents from accessing employment, education and health facilities.

Resilience in relation to bridge closures, maintenance and weather events is the first consideration in our extended remit from Welsh Government and a primary issue we have considered.

Therefore, we have identified in this report a suite of measures to improve the resilience of the existing infrastructure. It is recommended that these should be implemented in phases, or packages, allowing government, the relevant local authorities and stakeholders to understand how well each measure contributes to addressing problems and disruption to traffic across the Menai Strait.

We have also been asked to consider ways to maximise the use of existing infrastructure. We have set out how can be achieved through better management of traffic on the bridges and on their approaches, including the junctions at either end of the Britannia Bridge. Improving public transport and active travel is also important because this can help reduce the volume of motor traffic using the bridge.



We have concluded that such an approach allows for some changes to be implemented quickly, while other interventions are still being planned. The Commission has therefore focused on developing packages of interventions as follows:

1. Enhance resilience to reduce the number of bridge closures including the fitting of wind deflectors and installation of a variable speed management system to limit collisions.
2. Update the multi-agency framework to manage incidents in the most effective way possible.
3. Take further steps if required to amend the layout of lane gains and drops and merges and diverges depending on the benefit already gained from the variable speed management system.
4. Undertake a study of a three-lane tidal system so that it can be introduced if required and depending on the benefits already resulting from the actions above.
5. Improve public transport and active travel to help reduce the volume of motor traffic using the bridges by:
  - ◆ Increasing opportunities to use the train especially from LlanfairPG station.
  - ◆ Improving bus frequency across the bridges.
  - ◆ Developing active travel routes across the bridges and beyond that are comfortable, attractive and safe.
6. Support the public transport and active travel improvements with travel planning and management to enable mode shift away from the private car.

# 2 Resilience of the Crossings

## 2.1 The Two Bridges as a Combined System

To understand the resilience of the Menai Strait crossings, it is important to understand that the Britannia Bridge and the Menai Suspension Bridge operate as a combined system. The Britannia Bridge carries about three-quarters of the traffic and the Menai Suspension Bridge carries a quarter of the traffic. Figure 1 shows the layout of the bridges and the wider highway network within north Gwynedd and on Ynys Môn.

The A55 is trunk road with a two-lane dual carriageway with a speed limit of 70 mph that narrows to a wide single carriageway across Britannia Bridge with a speed limit of 50 mph. The A487 from Junction 9 and the A5 to Junction 8 are the diversion route when Britannia Bridge is closed and lead to the Menai Suspension Bridge, which has a speed limit of 30 mph.

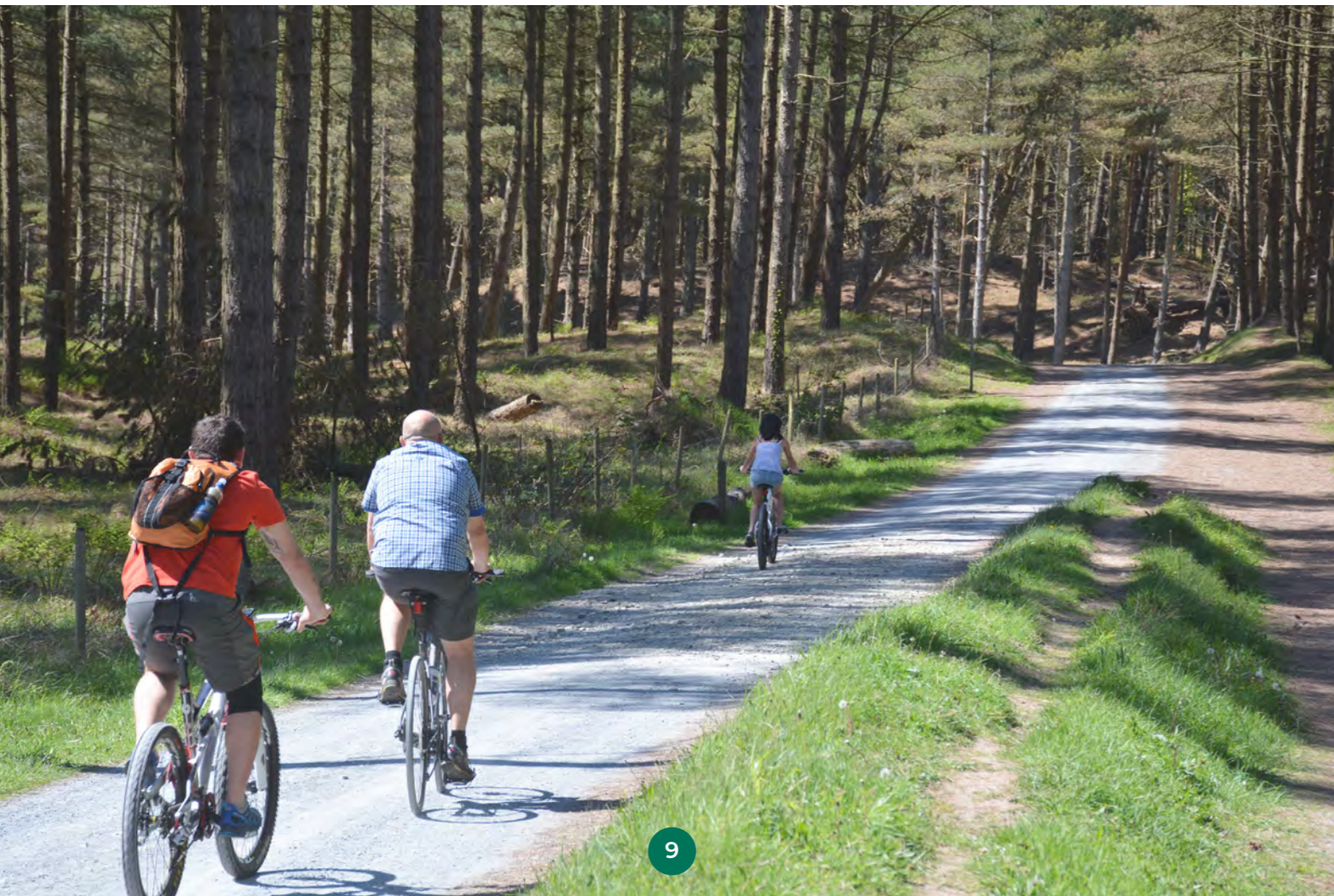


Figure 1: Map of the Menai Strait and the Two Bridges

Ynys Môn County Council has told us that actual and perceived resilience issues with the crossings impact negatively on the attractiveness of the island for economic investment. Whilst there are times when congestion occurs on the approaches to the Britannia Bridge, particularly at peak hours and at other times during the main tourist season, this is of lesser concern than the resilience issue. However, congestion can increase the likelihood of certain types of collision, and hence, indirectly, congestion can affect resilience.

Incidents that result in closure of the Britannia Bridge have more significant consequences than closures elsewhere on the strategic road network, since they result in the closure of more than half of the road capacity to the island.

The concerns we have heard about resilience have been exacerbated by the impacts of the temporary closure of the Menai Suspension Bridge in autumn 2022, the 7.5 tonne weight limit reducing the potential for its use as a diversion route,

and the single lane working controlled by traffic signals whilst the bridge hangers are replaced.

As a recent example, the closure in May 2023 of Britannia Bridge eastbound for six hours and westbound for a shorter period following a fatal accident resulted in widespread congestion on the A55 and local roads with people unable to reach employment, schools and hospital appointments.

The Commission recognises that the current refurbishment work on the Menai Suspension Bridge should create a bridge that is structurally resilient. In addition, and as noted below, the Menai Suspension Bridge has a lower collision record than Britannia Bridge and is not usually affected by high wind. Hence, the focus on resilience is mainly on the Britannia Bridge.

We now discuss each issue which affects resilience.

## 2.2 High Wind Vulnerability of Britannia Bridge

Britannia Bridge is vulnerable to high winds. At some wind speeds it must be closed to high-sided vehicles and lower driving speeds are advised.

Table 1 shows the four stages of high wind restrictions on Britannia Bridge and the number of restrictions imposed in the five years between 2017 and 2021. Responsibility for implementing wind related restrictions is undertaken by the North and Mid Wales Trunk Road Agent on behalf of Welsh Government. It is planned that responsibility for wind related closures will be transferred to UK Highways Ltd.

There have been 27 occasions in the five years from 2017 to 2021 when a Stage 3 or 4 closure has occurred, that is an average of just over five occasions a year. There may be fewer Stage 3 restrictions in future because of the higher wind speed of 62 mph now being used for such a closure. However, this may be offset by climate change which may create more occasions with higher wind speeds. Table 2 shows the restrictions by quarter of the year and indicates that most high wind events occur between October and March.

*Table 1: Adverse Weather Restrictions on Britannia Bridge 2017 to 2021*

Stage	Wind Speed	Type of Restriction	Number of Restrictions	Average Duration
1	31-39mph	Advisory 30 mph speed limit	91	6hrs 42 mins
2	40-54 mph	Closed to motorcycles, cycles & caravans	109	10hrs 9 mins
3	55*-69	Closed to all vehicles except cars and car derived vans	25	7hrs 49 mins
4	70 mph +	Full Closure	2	3hrs 43 mins

\* Wind speed for implementation of Stage 3 restrictions was raised from 55 mph to 62mph in September 2022





Table 2: Restrictions by Quarter of Year 2017-2021

Stage	Jan - Mar	Apr - Jun	Jul - Sept	Oct - Dec
Stage 1	44	7	1	39
Stage 2	55	2	4	48
Stage 3	15	0	1	9
Stage 4	1	0	0	1

An advisory 30mph speed limit is implemented for every restriction stage. However, we understand that compliance with the advisory 30mph limit is low. Speed management is discussed in the next section.

The installation of wind deflectors has been studied in the past. We have concluded that the installation of wind deflectors on Britannia Bridge would address a significant resilience issue with the bridge. The feasibility and benefit of installing wind deflectors should be investigated further and measures implemented as appropriate. Any scheme will need to provide benefit for high sided vehicles such as HGVs by reducing the number of times when HGVs cannot cross because of high winds and when lower speed limits are required. The loading and visual impacts on the structure of wind deflectors need to be considered. Approval would be required of Network Rail as owner of the structure. In addition, the approval of Gwynedd and Ynys Môn Councils and CADW would also be required because the bridge is listed.

**Recommendation: We recommend a scheme is developed and delivered to provide wind deflectors on Britannia Bridge with the aim of reducing the number of times the bridge needs to be closed.**

## 2.3 Collisions and Speed Management

Collisions result in delay and congestion for vehicles, and can sometimes result in bridge closures. Table 3 show the number of casualties in the five-year period 2017 to 2021. The number of casualties in 2020 and 2021 will have been affected by the Covid-19 pandemic lockdowns.

The casualty rate per billion vehicle miles in Table 4 indicates relative risk, and this has been estimated for the years 2017-2019 to avoid the abnormal years of 2020 and 2021. The collision rate at the A55 Britannia Bridge is around twice as high as other sections of the trunk road network in north Wales.

There are slightly more collisions in the westbound direction compared to the eastbound direction in the ratio of approximately 60/40. The reason for

the higher number of collisions in the westbound direction may be due the nature of the merge onto the A55 at Junction 9, and the 50 mph section on the main carriageway starting close to the Junction 9 merge, discussed below.

Rear-end shunts are frequent on the westbound bridge approach, which is symptomatic of conditions where some vehicles are travelling at higher speeds than are appropriate. The serious and fatal collisions on Britannia Bridge involved head-on collisions occurring on the bridge and there is some evidence of side-swipe collisions at merges.

There are no recorded recent collisions or casualties on the A5 Menai Suspension Bridge.

Table 3: Road Traffic Collisions and Casualties 2017-2021

Location	Collisions	Casualties	Killed or Seriously Injured
A55 Britannia Bridge	10	18	3
A5 Menai Suspension Bridge	0	0	0
A55 J19-J20 (Llandudno)	15	25	3
A55 J32-J33 (Northop)	18	23	4
A494 Aston Hill (Deeside)	13	19	4
A483 J5-J6 (Wrexham)	12	15	7

Table 4: Road traffic collision and casualty rates per billion vehicle miles, 2017-2019

Location	Collision rate	Casualty rate	Killed or seriously injured collision rate
A55 Britannia Bridge	106.9	200.5	26.7
A5 Menai Suspension Bridge	0.0	0.0	0.0
A55 J19-J20 (Llandudno)	48.0	74.6	10.7
A55 J32-J33 (Northop)	40.7	57.7	3.4
A494 Aston Hill (Deeside)	41.1	70.4	11.7
A483 J5-J6 (Wrexham)	50.5	64.9	14.4

Managing speed effectively in the vicinity of Britannia Bridge should have a positive impact on reducing the number of collisions that occur in the area, hence enhancing the resilience of the crossings.

A speed management option is to extend the length of carriageway within the permanent 50 mph speed limit on both the westbound and eastbound approaches to Britannia Bridge, and possibly reducing the speed limit to below 50 mph on the bridge. Driver compliance with the speed limits, especially at times of the day when the flow is low, may continue to be an issue.

A more comprehensive option is to install and operate a system that allows for the mandatory speed limit on Britannia Bridge to be temporarily lowered, and for the management of the reduction in speed of traffic on the approaches to the bridge. Such a system would use variable mandatory speed limit signs with enforcement by average speed cameras. Variable speed limits provide flexibility because they allow different levels of speed reduction, and speed limits can be stepped down in stages on the approaches to the bridge.

The installation of a variable speed limit system with speed camera control would manage different flow conditions in a better way than fixed speed limits and will improve the flow. Speed limit signs are mounted over the nearside lane on cantilevered posts or on gantries with a speed limit sign over each lane.

The varying of speed limits is a technique which can be used to delay the onset of congested conditions and potentially reduce the number of times there are congested conditions. Flow and speed are constantly monitored by induction loops typically set at 500 metre intervals in the carriageway. Data from the loops can be used to automatically reduce speed limits to protect the back of slower moving traffic as the wave of that slower moving traffic propagates backwards along a carriageway. In addition, operators can use cameras to confirm that speed limits are set appropriately.

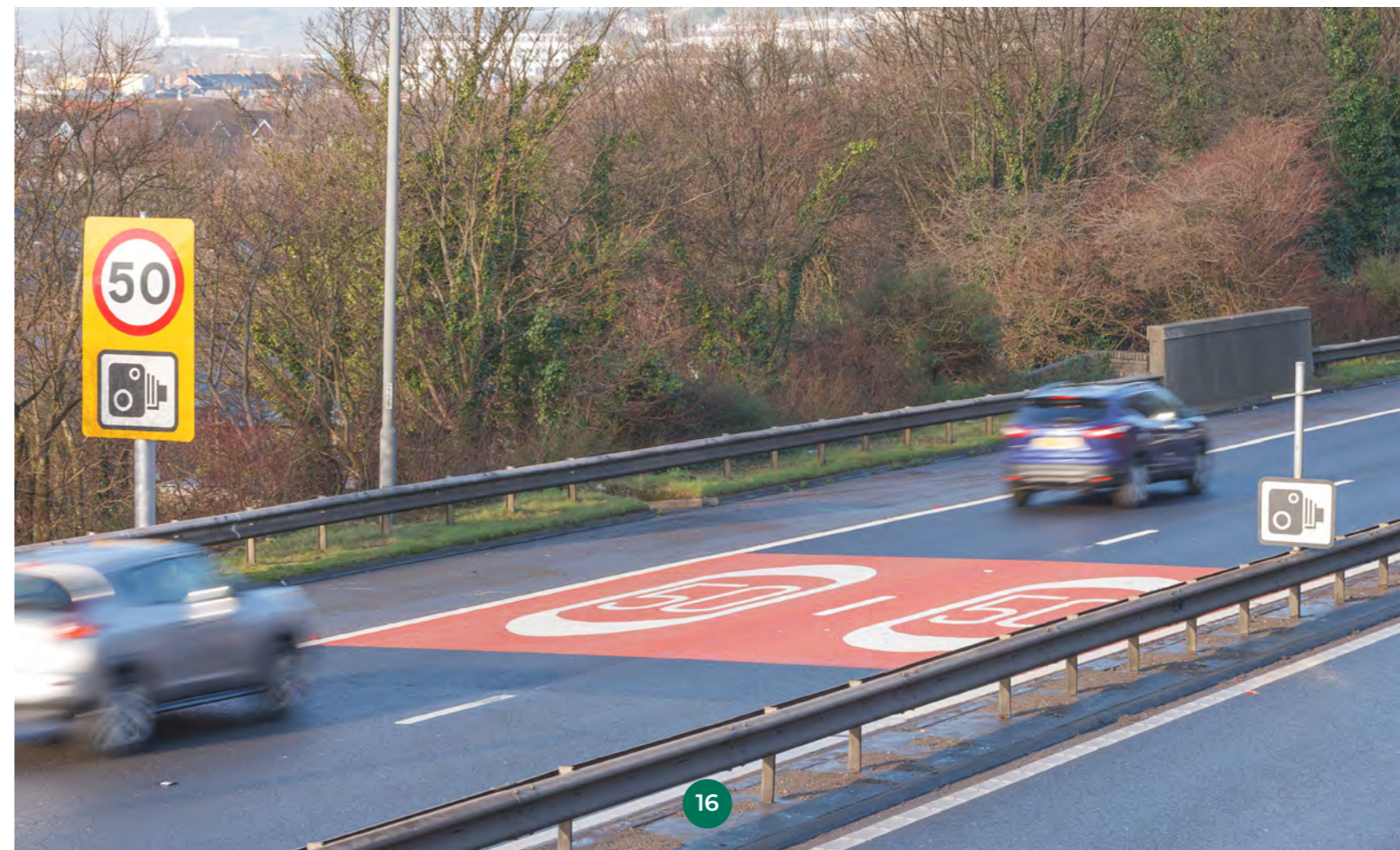
Speed limits may also be set during periods of lower flow, but where environmental conditions mean that it is safer to travel at lower speed, for example in high wind, rain, fog, or snow, or when conditions are icy.

**Recommendation: We recommend the introduction of a system for temporarily lowering the mandatory speed limit on Britannia Bridge and the management of the reduction in speed of traffic on the approaches to the bridge. This will involve using variable mandatory speed limit signs with enforcement by average speed cameras, which will reduce the probability of collisions and mitigate the effect of high wind on moving vehicles.**

## 2.4 Highway Geometry and Speed Management

The geometry on both approaches to Britannia Bridge is quite complex. We think that the layout of the A55 and its junctions affects the probability of congestion and collisions occurring.

As shown in Figure 2, in an eastbound direction the carriageway is first on a tight right-hand curve, and then immediately a tight left curve in the final 700 metres of approach to the western Britannia Bridge abutment. The carriageway is on a quite steeply descending gradient. In a westbound direction, the carriageway is on a right-hand bend through Junction 9.



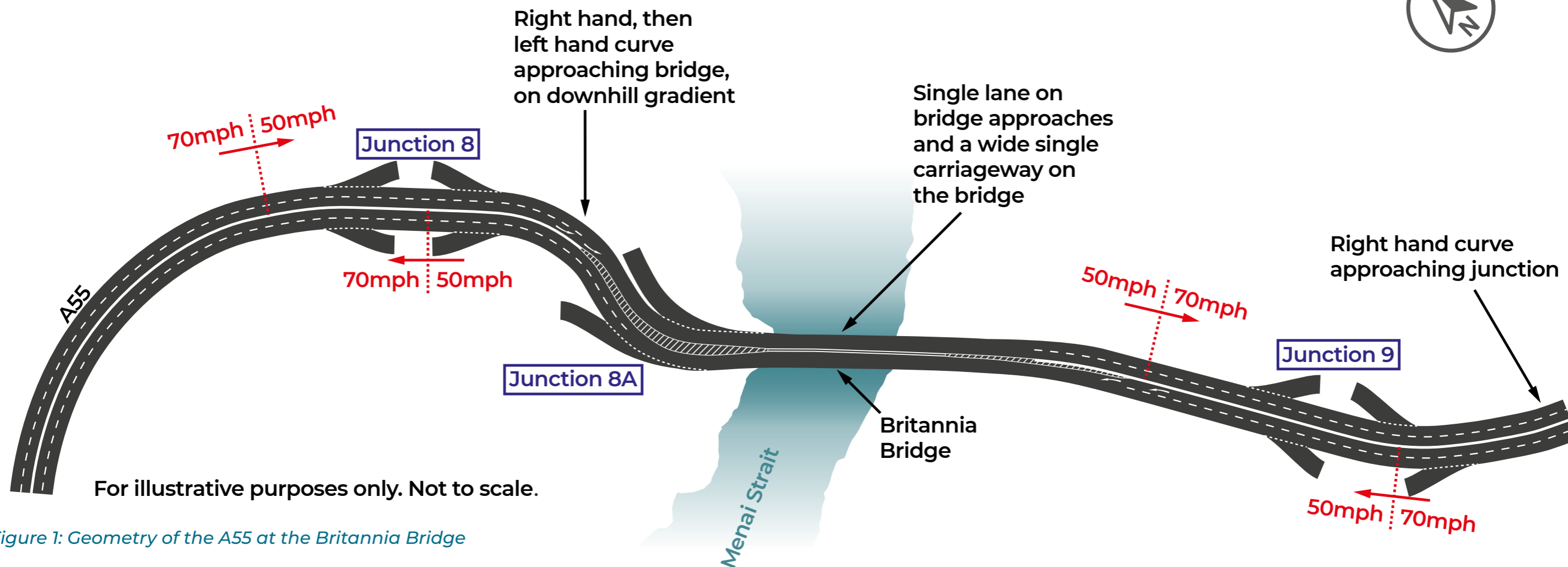


Figure 1: Geometry of the A55 at the Britannia Bridge

The dual carriageway reduces from two lanes to one lane in an eastbound direction 30 metres after the end of the Junction 8 merge. In a westbound direction, the carriageway reduces from two lanes to one lane 300 metres after the end of the Junction 9 merge. A further potential hazard is that traffic leaving the A55 and travelling towards Menai Bridge at junction 8A turns right onto the A5 at a priority junction.

Other concerns are that drivers will have been used to seeing a vehicle restraint system in the central reserve of the A55. After the carriageways have reduced to one lane in each direction, and over the bridge, there is no central barrier on the bridge. There is the possibility for drivers not having fully understood the road layout changes from dual to single

carriageway. With the two lanes in each direction being 5m wide, there could be the propensity for some drivers to seek to overtake in a risky manner. This could then result in head-on collisions.

The national speed limit of 70 mph applies on the westbound carriageway of the A55 until a point around 120 metres after the diverge at Junction 9. In an eastbound direction, the speed limit is reduced from 70 mph to 50 mph at the start of the diverge to junction 8.

In addition to the introduction of variable speed limits noted above, there therefore may be other changes to lane layouts to help manage flow and reduce the potential for collisions. For example, introducing a lane reduction from two lanes to one lane in advance of Junctions

8 and Junction 9 may assist with a smoother pattern of merging at a greater distance from the bridge and the complex geometry noted above. These options may also make it easier for traffic to join the A55 safely from Junction 8, Junction 8A and Junction 9 on both approaches to the bridge.

There have been some head-on collisions on Britannia Bridge. A central barrier may solve this problem; however, it would

make it more difficult for emergency service vehicles to access incidents in queueing traffic. An alternative may be to introduce central hatched road markings to provide greater physical separation and to create a visually narrowed lane which would help maintain lower speeds. This would have a more powerful effect if accompanied by the reduced speed limits suggested above.

**Recommendation: We recommend a study to consider layout changes to the mainline across Britannia Bridge, the position of lane drops, and the merges and diverges at Junction 8, Junction 8A and Junction 9, with the purpose of smoothing flow and reducing the probability of collisions.**

There are roundabouts on both sides of the A55 at Junction 9. At peak times traffic leaving Parc Menai can experience long delays waiting to enter the roundabout, which can result in driver frustration, risky behaviours and increased incidence of collisions, adding to congestion. General levels of congestion at these pair of roundabouts will also delay buses.

Traffic is diverted through these roundabouts when the Britannia Bridge is restricted or closed, resulting in significantly increased traffic flows, and delay and congestion. At these times it is particularly important to provide priority for buses.

Introducing traffic signal control at the roundabouts at Junction 9, together with yellow box junction markings to prevent blocking, may help manage congestion and create priority for buses.

Drivers leaving the A55 westbound at junction 8A wishing to turn right to travel towards Menai Bridge travel through a difficult and potentially risky junction with the A5. Introducing traffic signal control of this junction may assist.

**Recommendation: We recommend that a study is undertaken to investigate improvements to traffic management at both roundabouts at Junction 9 to assist particularly when there is a bridge closure and create priority for buses.**

**Recommendation: We recommend that a study is undertaken to investigate improvements to the layout and control of the A55 slip roads with the A5 at junction 8A.**

## 2.5 Incident Response Procedures

The management of weather closures and incidents on the bridge requires partnership working between several organisations and there are procedures in place to do this.

The Commission has had conversations with stakeholders relevant to incident management (Ynys Môn County Council, North Wales Police (NWP), North Wales Fire and Rescue Service (NWFRS), Ysbyty Gwynedd, North and Mid Wales Trunk Road Agent (NMWTRA) and Welsh Government (WG)). We have also received feedback from stakeholders, and reviewed the current policies and procedures for incident management.

North Wales Police lead the response to incidents involving road traffic collisions or vulnerable people on the bridge or carriageways. UK Highways A55 Ltd is responsible for decision making about traffic management for bridge closures for incidents on Britannia Bridge and its approaches. A separate procedure exists in the event of high winds with NMWTRA currently being responsible for monitoring wind speeds and making decisions on the implementation of restrictions in accordance with an operational plan.

The Commission has been provided with three documents containing the emergency procedures for incidents and high wind events affecting the two bridges. The North Wales Local Resilience Forum (LRF) has adopted the Multi-agency Response Framework (2011) in the event of the closure of one, or both, bridges because of a major traffic collision, threatened terrorism, severe weather, significant damage to the infrastructure, a rail accident or fire, or a maritime incident.

UK Highways A55 Limited's Liaison Procedures (June 2022) set out the way they manage incidents and emergencies usually declared by the Police. They take direction from the Police and/or Welsh Government for dealing with the safe operation of the A55. The North and Mid Wales Trunk Road Agent's Operational Plan (November 2019) deals with high wind events sets out the protocols for implementing road closures and traffic management.

We have reviewed these documents and think they need to be revised and updated particularly in relation to leadership, communication, and traffic management. Ultimate responsibility for leadership within the Multi-agency Response Framework needs to be made clearer and the Commission thinks that Welsh Government should identify an appropriate operational body to own the document and co-ordinate inputs and updates. Part of the leadership role will be to review incidents to capture lessons for improvement, and receive input from businesses, education establishments, the health sector, and the community. The framework should reflect the Local Resilience Forum risk register, published in 2020.

A more effective and up-to-date approach to communication and the timeliness of communication with the public is required. Communication should be directed at travellers already on the network, and people at home or work and about to travel. In addition, the use of permanent Variable Message Signs (VMS) could be expanded beyond their use just at Junction 8 and Junction 9. Schools, colleges and Bangor University are not



referenced in the Framework, Procedures or Plan, but that they can suffer significant disruption during bridge closures, and they should be specifically included in communications plans. Communication is also important between the relevant bodies and each document should state nominated officers, or officer roles, and the list should be reviewed and updated on a frequent basis.

We think there is a lack of detail about how the local authorities manage the local road network during bridge closures. A unified approach across all the responsible authorities to managing traffic is required. Methods, possibly including adjustments to parts of the road network, need to be developed to minimise impact on emergency service vehicles and buses.

We support the extension of the role of the Welsh Government Traffic Officers beyond the current 7am to 7pm period of operation.

We think that public transport can play a more prominent role during incidents, including rail services to / from LlanfairPG station, and bus services. TfW and appropriate train and bus operators should contribute to incident planning and procedures. There is a need to re-assess HGV stacking capacity on each side of the Menai Strait and support the provision of safety enhancements and welfare facilities in appropriate locations.

**Recommendation: We recommend that the Multi-agency Response Framework relating to Britannia Bridge and Menai Suspension Bridge incidents and closures is updated and enhanced particularly in relation to leadership, communication, and traffic management.**

## 3 Traffic Flows

The Commission has analysed traffic flows and Table 5 summarises the average daily traffic flows on the two bridges in 2021 and 2022.

Traffic flows were generally higher in 2022 than 2021 reflecting the removal of Covid restrictions. During the closure of the Menai Suspension Bridge between 21st October 2022 and 2nd February 2023 there was a substantial increase in traffic volumes on Britannia Bridge compared with other periods in the year. Overall, there was a decrease in traffic crossing the Menai Strait compared with the same period in 2021. People possibly chose to travel by different modes, to different destinations, or not to make certain trips at all.

Weekday traffic flows on both bridges are characterised by a peak during the morning and evening periods, with the evening peaks being over a longer period than the morning peaks. These patterns indicate a significant amount of commuting. Around 80 percent of journeys occur in the 12-hour period from 7am to 7pm. Over a 24-hour period, total flows are higher westbound on Britannia Bridge and eastbound on the Menai Suspension Bridge, which indicates different route choices at different times of day. The annex shows charts of the flow profiles.

Traffic profiles are different on a Saturday. Traffic flows on both bridges increase gradually over the morning to a peak around the middle of the day and then reduce during the afternoon. The Sunday profile is similar to the Saturday profile, but with a slightly later peak.

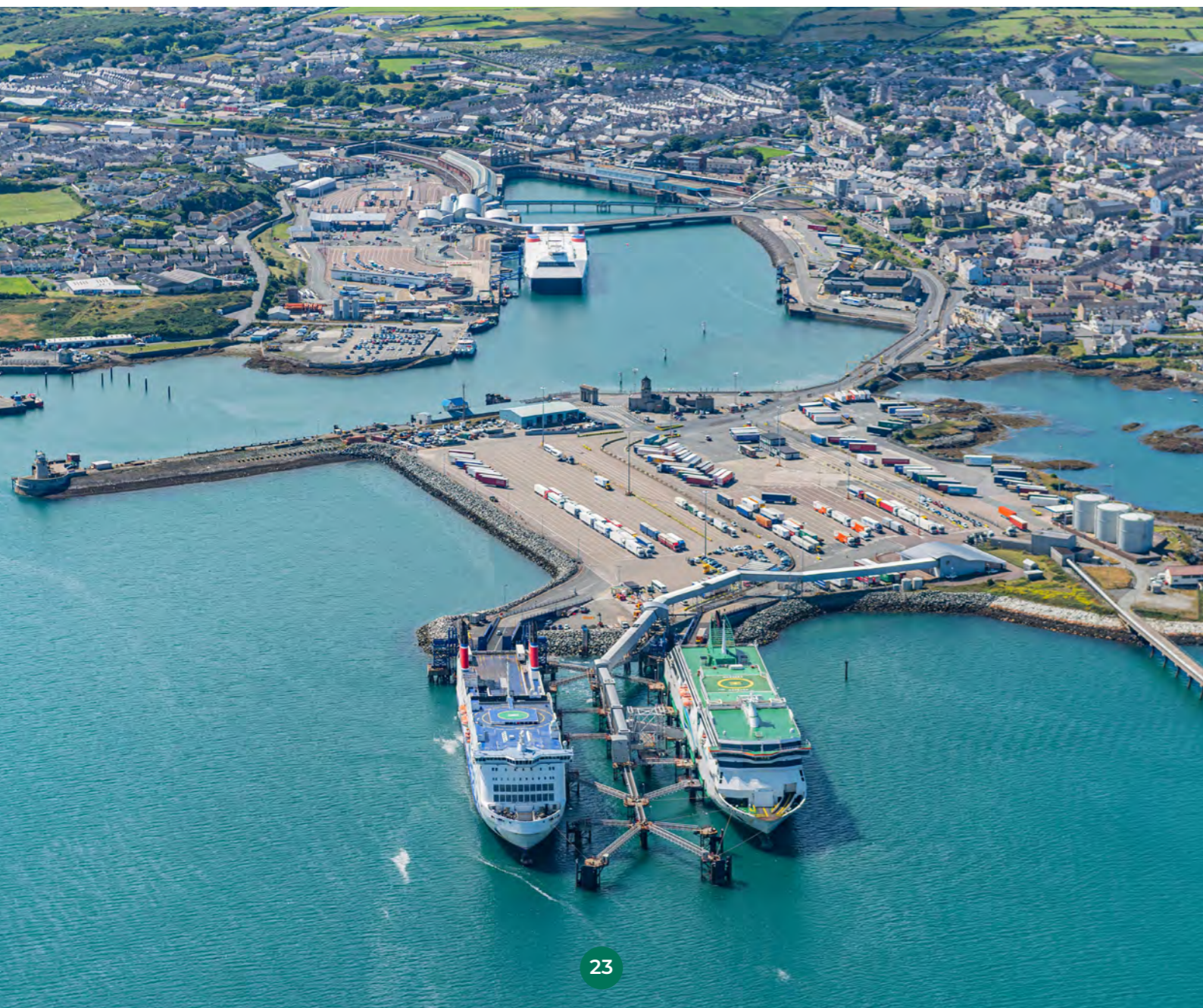
Origin-Destination data for trips across the Menai Strait have been obtained from the North Wales Transport Model. Trips to and from the Bangor and Caernarfon area using Britannia Bridge are estimated at between 51 and 62 percent of the total bridge crossings, depending on direction and time of day. In contrast, trips to and from the Bangor and Caernarfon area on the Menai Suspension Bridge are estimated at between 82 and 97 percent of the total, demonstrating the more local nature of trips on this bridge.

There are ten weekday ferry arrivals and departures at the Port of Holyhead spread across the night and day. Westbound flows towards the port may have a greater time spread than flows heading eastbound because HGVs and other traffic comes off the ferry in a concentrated period. The timings of the sailings indicates that the effect of ferry traffic on peak periods on weekday is likely to be limited, but there is an overlap with weekend day flows during the middle of the day. We have found no evidence that ferry traffic has a detrimental impact on network performance.



Table 5: Average daily traffic flow in 2021 and 2022 on the bridges in thousands

LOCATION	ANNUAL	1 JAN - 30 APRIL	1 MAY - 22 OCT	23 OCT - 23 DEC
Britannia Bridge 2021	29.9	23.1	34.9	30.4
Britannia Bridge 2022	33.2	29.9	34.4	37.1
Menai Suspension Bridge 2021	10.7	7.5	12.6	11.8
Menai Suspension Bridge 2022	9.6	11.3	12.4	0.0
Combined 2021	40.6	30.6	47.5	42.2
Combined 2022	42.9	41.2	46.8	37.1



# 4 Public Transport Provision

## 4.1 Rail

As noted in the main Commission report, the rail stations on Ynys Môn are not near to the centres of population. Ynys Môn’s most populated towns are Holyhead, Llangefni, Amlwch, Llanfair-Mathafarn-Eithaf and Menai Bridge – and out of those, only Holyhead has a rail station.

Ynys Môn has six train stations on the North Wales Main Line, providing direct train services to various cities in the UK, including London and Cardiff. Of these only Holyhead has significant footfall, with none of the other five exceeding 10,000 entries and exits annually according to 2021-22 data.<sup>2</sup>

Few services call at the smaller stations. Many residents will cross the Menai to catch a train at Bangor. Nearly a third of Transport for Rail operated services between Holyhead and Bangor do not call at LlanfairPG station on Ynys Môn (the first station west of Britannia Bridge) and none of the Avanti West Coast operated trains stop there. This limits the potential for people to use rail to access work, health and other services. The potential for Avanti West Coast services to stop at LlanfairPG is restricted by the short platform length at the station.

The Commission’s view is that consideration should be given to increasing regular services calling at LlanfairPG station to enhance frequency between Ynys Môn, Bangor, Llandudno and beyond. Parking provision at the station would need to be addressed as existing parking primarily serves the adjacent retail business.

Communities and stakeholders have been lobbying for the reinstatement of the Amlwch – Llangefni - Gaerwen rail line which we consider in our main report. We stated that we support the creation of an active travel link between Amlwch and Llangefni in line with low carbon modal shift, travel to work and leisure.

**Recommendation: We recommend increasing the frequency of trains calling at LlanfairPG station to enhance frequency between Ynys Môn, Bangor, Llandudno and beyond.**

<sup>2</sup> According to Estimates of station usage | ORR Data Portal total entries/exits in 2021-22 for Ynys Môn stations were: Llanfairpwll 7,158, Bodorgan 4,302, Ty Croes 3,902, Rhosneigr 9,592, Valley 5,254, Holyhead 138,730

# 4.2 Buses

There is limited availability of fast, frequent and affordable bus services in the area.

With limited train services, bus services are the main mode of public transport for many Ynys Môn residents and visitors. The local bus network is operated by several companies, serving the towns, villages, and attractions on the island, providing connections to larger settlements and to transport connections. Currently, bus journey times are uncompetitive with the car which limits the potential to achieve mode shift.

The wider range of bus network improvements is discussed in our main report. Here we have considered buses serving Ynys Môn from the mainland in more detail. Important destinations include rail stations, Ysbyty Gwynedd, Bangor University and Coleg Menai campuses, Bangor and Caernarfon town centres, Holyhead and other important centres of employment.

A number of services currently cross the Menai Strait. There is the 4A hourly service 6am to 10pm between Bangor and Llangefni. This is reinforced to a half hourly service during the day by the 4L which also serves Parc Menai. The 4 service operates an hourly service between Llangefni and Holyhead. In addition, there are up ten 42 and 42A services a day connecting Bangor, Llangefni and Menai Bridge. The 543, 545 and X43 are school and college buses. The 4A and 4L operate at the same minutes past each hour but other services are irregular.

TfW, in consultation with Welsh Government, local authorities and bus operators, is developing an improved bus network for north Wales that would provide faster, more frequent bus services connecting communities with places they wish to travel to. A draft proposed network for the Menai area developed by TfW is shown in Figure 3.

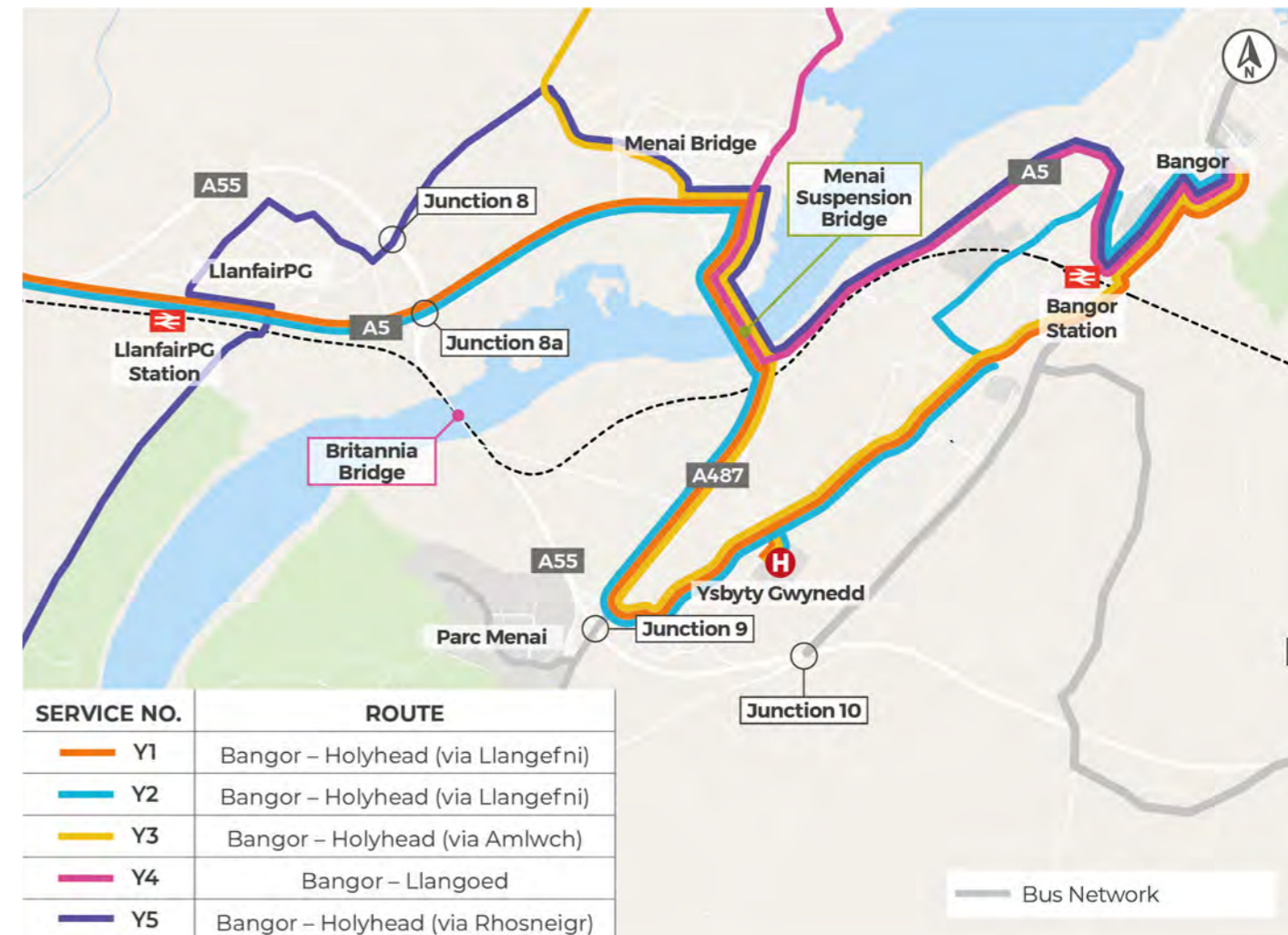


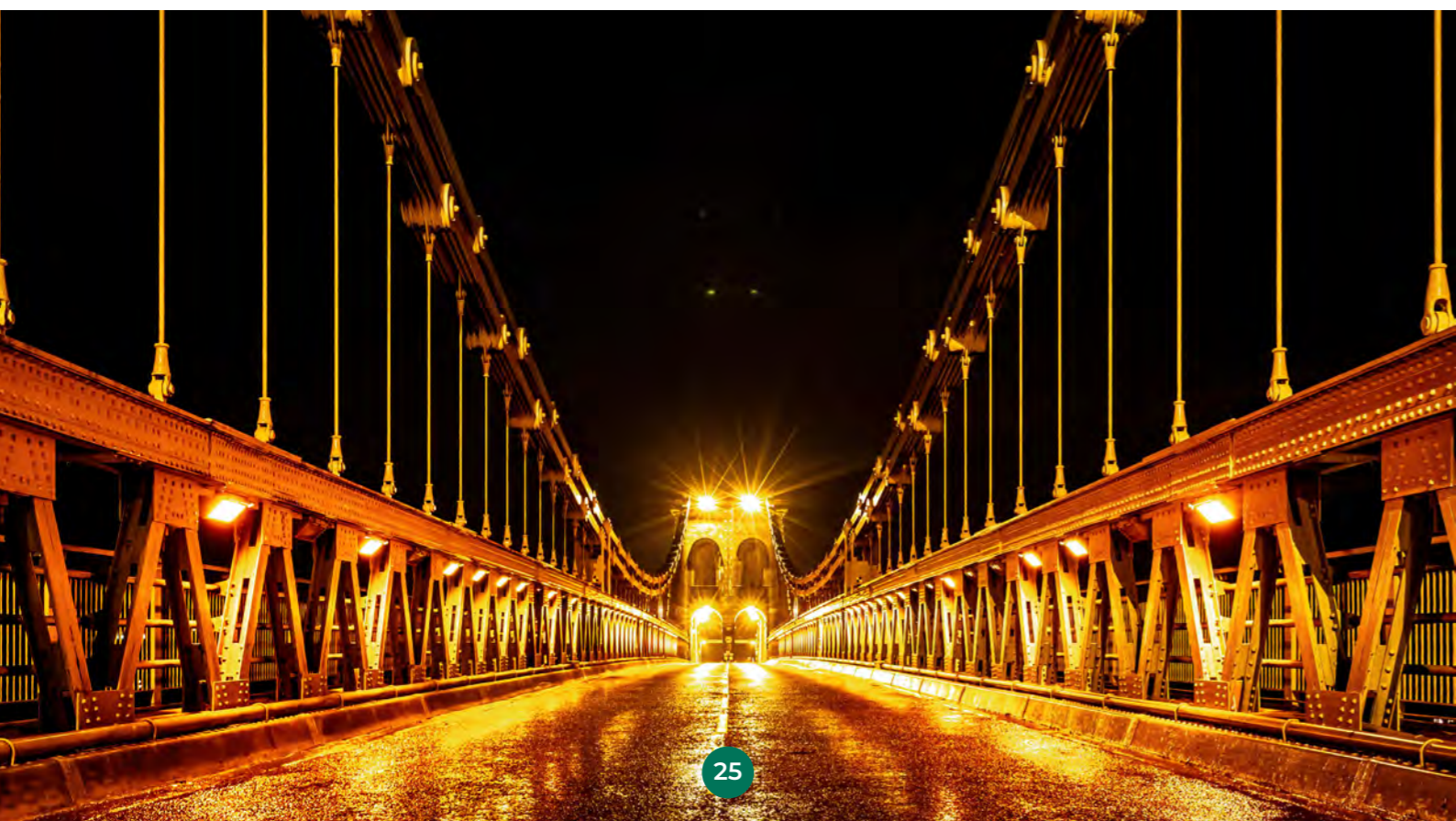
Figure 3: Proposed Revised Bus Network

These services would provide the equivalent of 6.5 buses per hour in each direction across the Menai. Smaller settlements would be connected by feeder routes into the regional services, and it is important that the timetables are co-ordinated to allow easy interchange between services.

Having reviewed the plans for services to, from and on Ynys Môn, we think there is potential for an early roll-out of the Ynys Môn bus network before the franchising legislation comes into force. However, we understand that this would need multi-annual (5-6 year) funding, this is because the transformation of the services is so significant it would be difficult to revert to prior service patterns if funding was not forthcoming after a single year of funding.

There are a number of benefits to doing this which include early introduction of better services across the Menai Strait, trialing the proposed franchised network and building patronage ahead of franchising.

**Recommendation: We recommend the introduction of the enhanced bus network and frequencies for Ynys Môn developed by TfW supported by multi-year funding.**



Whilst, currently, buses are crossing the Menai Strait on Britannia Bridge due to the 7.5 tonnes weight limit on Menai Suspension Bridge, it is envisaged that services will return to the bridge once the structural improvement works are completed. However, there is an option to consider retaining one or more of the Bangor to Holyhead services across the Britannia Bridge to shorten journey times.

To ensure the reliability of bus services that cross the Menai, minimise journey times and improve competitiveness with the private car it is important that buses are not delayed by congestion. The Commission thinks that the proposed bus network should be assessed to identify locations where congestion may delay buses, and for bus priority schemes to

developed at those locations. There may be particular additional measures that should be put in place to create priority during times when there is a Britannia Bridge closure.

There are currently limited park and ride opportunities for trips across the Menai. There is a small, combined park & ride and park & share (a car ride) site on the A5025 to the east of the A55 Junction 8 at LlanfairPG. Bus services connect to Bangor. With the introduction of an enhanced bus network and frequencies there is potential to significantly increase park and ride as a travel choice. As part of the work to develop an improved bus network consideration should be given to opportunities to develop new or improved park and ride facilities in Ynys Môn.

**Recommendation: We recommend that locations where buses may be delayed are identified and bus priority schemes developed and implemented accordingly.**

**Recommendation: We recommend that opportunities to develop new or improved park and ride sites are explored on Ynys Môn to complement the enhanced bus network.**

# 5 Active Travel Provision

There are journeys under 5km in length that are currently undertaken by car but could be suited to active travel if routes were available. These include journeys between major employers and settlements such as LlanfairPG, Bangor and Menai Bridge.

Walking across Britannia Bridge is prohibited. Cycling is permitted on the carriageway across Britannia Bridge but there is no separation provided from the carriageway for cyclists. Consequently, conditions are suited to only the most confident and experienced cyclists. Only 24 cycle trips were recorded on Britannia Bridge in 2019.

The Menai Suspension Bridge is part of the National Cycle Network Route 5 that connects Chester to Holyhead but there is little to the bridge (other than its age and character) that make it attractive to cycle across. Pedestrians can cross using the narrow footway on both sides of the bridge and cycle traffic shares the carriageway with motor traffic. There is a narrow kerbed central reservation approaching the two bridge piers where the carriageway divides to go under the two arches at each pier. There is a no overtaking ban 'except bicycle by bicycles' at both pier locations.

The active travel network on both sides of both crossings is limited and there are steep gradients and an absence of direct, safe and attractive routes. There is no

doubt that creating active travel routes across the Menai Strait is challenging, but the Commission has considered ways to improve active travel on Britannia Bridge, Menai Suspension Bridge and also by a separate new active travel bridge.

We think there are three options for improving the conditions for active travel journeys across Britannia Bridge as follows:

## 1 Road deck level route cantilevered across the full bridge length

The addition of a full-length cantilever structure on the side of the road deck to create a shared use pedestrian footway and cycle track 3.0 metres wide. This is the typical minimum width that would be considered for a shared route. This option permits the retention of a 10m carriageway width, and the potential for three lane running at reduced speed (see later discussion on this topic).

## 2 Road deck level route cantilevered around the bridge piers

The creation of a shared use pedestrian footway and cycle track 2.5m wide which is within the current width of the bridge deck, but with two cantilevered structures around the outside of the two bridge piers. This width of 2.5 metres is narrow for shared use. It would leave a carriageway width of 8.0m and therefore remove any potential for three lane running. The Commission does not support this option.





### 3 Rail deck level route

Creation of a 3.0 metre wide shared use pedestrian footpath and cycle track on the un-used rail track bed. Network Rail approval would be required.

Each option has potential concerns with personal safety, particularly in the darker winter months. Whilst the Commission thinks both Options 1 and 3 are worth considering, the third option is the Commissioners' preferred option because it would create a route that is more comfortable and attractive than options at road deck level. Mitigating measures to address any personal safety concerns could include the provision of clear sight lines, good lighting, and potentially the use of CCTV cameras for monitoring.

Access to the rail deck level on the Ynys Môn side of the bridge would need some consideration of the vertical alignment to link the route to the remainder of the cycle network on the island, but a suitable alignment appears to be achievable. There are a few options on the mainland side for creating a route from the bridge to the A487, Ysbyty Gwynedd and Bangor. It would require a crossing of the rail line at some point. Further consideration needs to be given to route options.

We recognise that the lifespan of an active travel path on the rail deck may be limited if re-doubling of rail track across Britannia Bridge is required to deliver the desired rail service frequency between Holyhead and Bangor outlined in our main report and we therefore recommend that both Options 1 and 3 are considered further.

The potential for creating an active travel route that could also be used by at least some emergency service vehicles, if necessary, in the event of a

closure of Britannia Bridge, could also be investigated. This would help address concerns about emergency services resilience. Access control measures would be required to prevent misuse and ensure safety of users whilst adhering to Active Travel Act Guidance standards.

**Recommendation: We recommend that an active travel route is provided across Britannia Bridge preferably at rail deck level but possibly on a cantilever structure at road deck level.**

We think there could be traffic management improvements on the Menai Suspension Bridge to make cycling across the bridge more attractive. As a minimum we think that the ban on overtaking at the bridge piers should be extended to the whole bridge with the existing double solid white line extended across the full length of the bridge deck.

**Recommendation: We recommend a ban on overtaking along the full length of the Menai Suspension Bridge.**

In addition, it may be possible to enhance the road layout and access onto Menai Suspension Bridge for people walking and cycling. This includes enhancements at the roundabouts at the junction of the A5 and the A545 (north side) and the A5 / A487 Antelope Roundabout (south side) and the sections of road between the roundabouts and the bridge.

Enhanced comfort and attractiveness would also be achieved for cyclists if they were separated them from general traffic as they cross the bridge. This could be achieved with gating operated by signal control. Cyclists detected approaching a separate stop line and signal heads would trigger the carriageway signals turning to a red signal. Cycle traffic would start to cross, and then after an appropriate interval the signals would turn green for general traffic on the carriageway.

**Recommendation: We recommend investigating the potential for implementing signal-controlled gating to allow cycle traffic to cross the Menai Suspension Bridge separately from motor traffic.**

The Commission has considered constructing a third bridge across the Menai Strait to cater solely for people walking and cycling. The search area included the area between the two existing bridges, and to the east side of the Menai Strait Bridge. The topography is challenging, and it is difficult to determine the most appropriate location and likely costs. The Commission therefore does not recommend this is pursued further at this time.

The difficulties in travelling actively extend beyond the crossing of the Menai Strait itself. The Commission has reviewed the existing and proposed networks on the approaches to the two bridges and it is evident that there is an absence of a safe, convenient walking and cycling network of routes between key settlements and

areas of employment that are otherwise, in terms of distance and potential journey time, suitable for these modes, particularly for cycling.

Communities on Ynys Môn that could be served include Menai Bridge, LlanfairPG, and with suitably fast longer distance routes and with use of e-cycles, possibly also Llangefni. Communities on the mainland include Bangor, including its large student population and important destinations are the various university campuses, Ysbyty Gwynedd, Bangor railway station and Parc Menai employment site.

Active Travel Network Maps have been developed for Ynys Môn and Gwynedd that show existing and potential future routes. However, there are gaps and, in some cases, only high-level desire lines in some locations - for example between Ysbyty Gwynedd and Britannia Bridge. Current and draft Active Travel Network Maps need to be further developed and strengthened to reflect a network that would support crossing the Menai Strait.

**Recommendation: We recommend the development of a comprehensive, comfortable, attractive and safe active travel network extending from both ends of both bridges to connect communities and important destinations in Ynys Môn and north Gwynedd.**

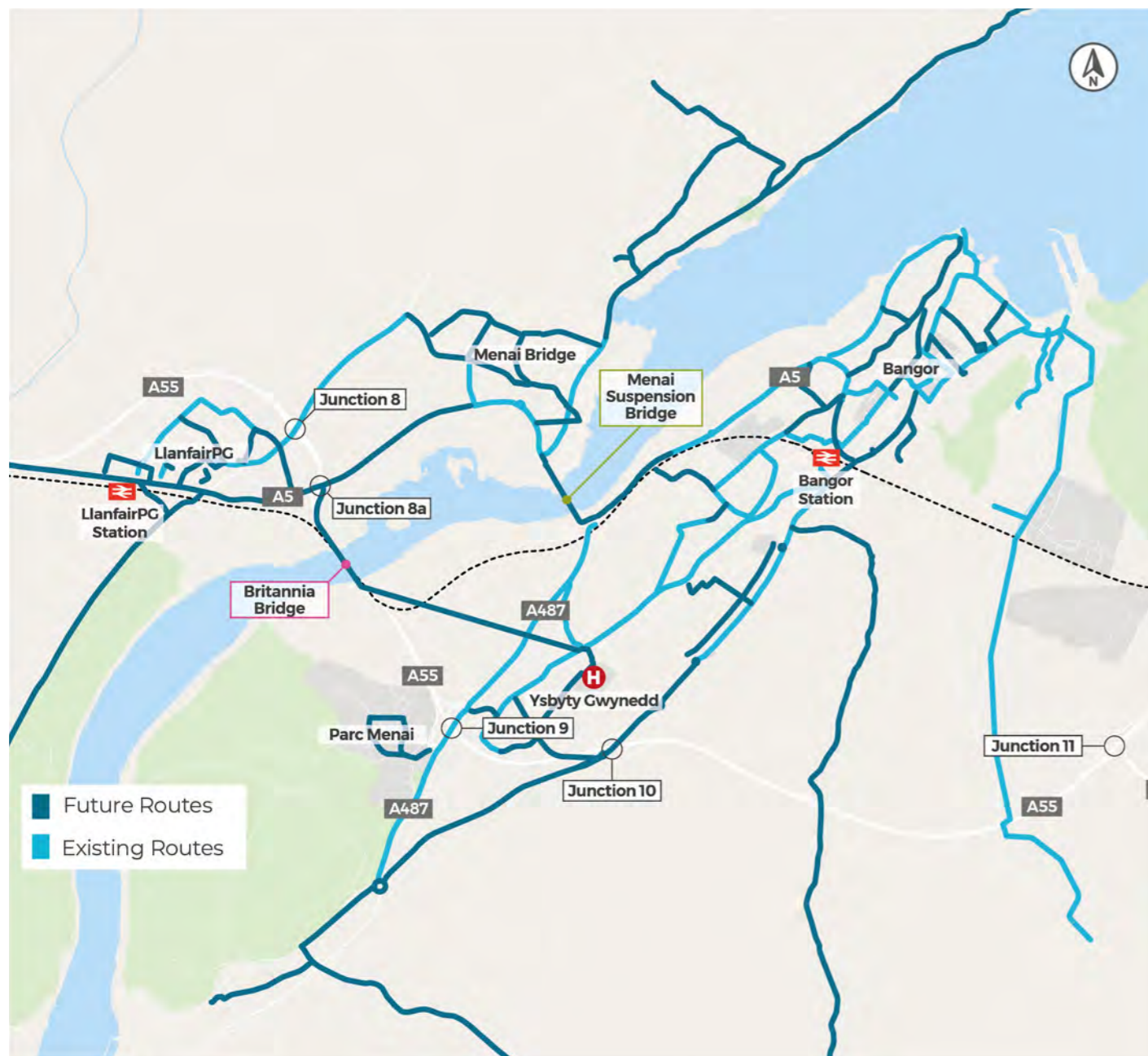


Figure 2: Extract of Ynys Môn and Gwynedd Active Travel Network Maps

# 6 Travel Planning & Management

The public sector organisations in Gwynedd and Ynys Môn are significant generators of trips across and around the Menai Strait area, especially at peak times. As mentioned in our main report, the Commission thinks there are opportunities for employers, and those in the public sector particularly, to do more to help reduce commuter car trips.

Working in partnership with employers to reduce the need to travel, reduce travel at peak times and other behaviour change measures are important components of the overall package of interventions required to improve resilience and reduce vehicle demand on the Menai crossings.

The development of local work hubs, provision of bus services that connect communities to major employment sites

at frequencies and times that facilitate shift working, lower fares and promotion of car sharing all have the potential to reduce car trips and pressure on parking.

In addition to new and improved active travel routes, increasing access to cycles through a cycle hire scheme that includes e-cycles, will increase choice and reduce dependence on the private car. Encouragement of use of e-cargo bikes for local deliveries through working with local businesses could reduce the number of light delivery vans on the road network.

The measures will require dedicated, multi-year (5-6 years) revenue funding and comprehensive partnership working between the public, private and third sector agencies.

**Recommendation: We recommend the development of comprehensive partnership working between the public, private and third sectors to develop and deliver travel behaviour change measures including travel planning partnerships, local work hubs, cycle and e-cycle hire schemes, support for e-cargo bikes for local deliveries, and provision of dedicated multi-year (5-6 years) revenue funding.**

# 7 Further Traffic Management Options

We think that the recommendations we make in the report above will sufficiently enhance the resilience of Britannia Bridge and Menai Suspension Bridge. The measures should be monitored, and evidence considered as to whether they are succeeding in reducing the number of incidents, reducing the impact of incidents when they occur, and managing congestion and disruption.

## 7.1 Three Lane Tidal Flow on Britannia Bridge

A three-lane tidal flow system would increase the capacity in one direction of travel to a level nearer to the capacity of the dual-carriageway approach to the bridge, and hence reduce to some extent the size of the restriction because of a single lane. The direction with two-lanes of flow would be reversible.

A 2015 assessment of a three-lane tidal flow scheme concluded that mitigation measures identified would not reduce sufficiently the level of risk associated with the proposals. Technology developments and experience since then may allow for an approach with lower risks. To understand the possibilities,

Further interventions may still be required to deal with the restriction at the Britannia Bridge. Therefore, we have also considered two further options that may need be taken forward at some future date if monitoring suggests resilience needs to be improved further.

the Commission has compared the A55 Britannia Bridge with the A38 Tamar Bridge in Plymouth and the A470 North Road in Cardiff. The annex to this report provides more detail on the analysis undertaken.

Neither the Tamar Bridge nor the A470 North Road are directly comparable with the A55 Britannia Bridge. In addition to the three-lane tidal-flow on the A38, the Tamar Bridge has an additional separated eastbound lane. The bridge is tolled with toll barriers and booths for eastbound traffic at its eastern end. The A470 North Road is an urban road.

Traffic flows are broadly comparable between the Tamar Bridge and the A55 Britannia Bridge – although there is a slightly larger seasonal fluctuation on Britannia Bridge, and probably a higher number of foreign drivers. The casualty rate is lower on the Tamar Bridge than the Britannia Bridge. Collisions on the A470 North Road are primarily associated with pedestrian movements and side road junctions.

A peak time three-lane tidal flow arrangement on the A55 Britannia Bridge, coupled with a suitable speed limit, may reduce congestion. Lane widths of 3.5m for each of the nearside lanes with a central lane width of 3.0m could be achieved, although that would require a departure from standards. Significant design work will be required to ensure a safe road layout and safe speed management.

A tidal flow scheme would be expensive to implement and have ongoing substantial revenue costs. Its benefits would be seen only during weekday peak periods.

We considered the feasibility and merit of using a moveable barrier to separate the

two travel directions. The barrier could be moved from one side of a lane to the other by a vehicle travelling along the length of the tidal flow section. Such a system is used on the Golden Gate Bridge in San Francisco and was used on the M20 in Kent during Operation Brock.

A barrier on the Britannia Bridge moveable by a vehicle in this way would require the two nearside lanes in each direction to be narrowed to 3.25m to maintain the centre lane at 3.0m. In addition to the capital costs of the system there would be revenue costs in addition to a tidal flow system without a barrier. We think that such a system is unlikely to be useful on Britannia Bridge because of the narrow lane widths, revenue costs, and limited time in the day when benefits will accrue.

We think that there would be value in understanding more fully the conditions in which a tidal system could be of benefit and the limitations that such a system would have. This would allow for rapid deployment at some future date if that were deemed appropriate.

**Recommendation: We recommend a study is undertaken for Britannia Bridge of a three-lane tidal system with and without a moveable barrier so that such a system could be deployed quickly if appropriate for resilience and incident management in the future.**

## 7.2 Third Menai Bridge

We recognise that there may be reasons in the future to again consider a Third Menai Crossing. This may be because of significant economic development on Ynys Môn, such as a nuclear facility at the Wylfa Newydd site. Such economic development may provide opportunities for cost sharing, especially if the bridge carries the electricity grid as well as transport routes. The development and construction of such a bridge would need to meet Welsh Government's four tests for road building. It would take a considerable period of time to deliver and there are many outstanding planning issues connected with heritage and biodiversity.



# 8 Conclusion

We have developed sixteen recommendations (collected in a list below) which address the resilience issues of the Menai Strait crossings and improve travel options that would encourage more public transport and active travel use.

Priority should be given to the first six recommendations which will reduce the likelihood of restrictions or closures of Britannia Bridge and improve the management of incidents and closures when they occur.

Whilst it is for the Welsh Government to consider how it wishes to move forward to delivery of any interventions, the Commission recognises the potential benefits a delivery unit or similar mechanism would be to ensure the recommendations are carried out.

## List of Recommendations

1

**We recommend a scheme is developed and delivered to provide wind deflectors on Britannia Bridge with the aim of reducing the number of times the bridge needs to be closed.**

2

**We recommend the introduction of a system for temporarily lowering the mandatory speed limit on Britannia Bridge and the management of the reduction in speed of traffic on the approaches to the bridge. This will involve using variable mandatory speed limit signs with enforcement by average speed cameras, which will reduce the probability of collisions and mitigate the effect of high wind on moving vehicles.**

3

**We recommend a study to consider layout changes to the mainline across Britannia Bridge, the position of lane drops, and the merges and diverges at Junction 8, Junction 8A and Junction 9, with the purpose of smoothing flow and reducing the probability of collisions.**

4

We recommend that a study is undertaken to investigate improvements to traffic management at both roundabouts at Junction 9 to assist particularly when there is a bridge closure and create priority for buses.

9

We recommend that locations where buses may be delayed are identified and bus priority schemes developed and implemented accordingly.

5

We recommend that a study is undertaken to investigate improvements to the layout and control of the A55 slip roads with the A5 at Junction 8A.

10

We recommend that opportunities to develop new or improved park and ride sites are explored on Ynys Môn to complement the enhanced bus network.

6

We recommend that the Multi-agency Response Framework relating to Britannia Bridge and Menai Suspension Bridge incidents and closures is updated and enhanced particularly in relation to leadership, communication, and traffic management.

11

We recommend that an active travel route is provided across Britannia Bridge preferably at rail deck level but possibly on a cantilever structure at road deck level.

7

We recommend increasing the frequency of trains calling at LlanfairPG station to enhance frequency between Ynys Môn, Bangor, Llandudno and beyond.

12

We recommend a ban on overtaking along the full length of the Menai Suspension Bridge.

13

We recommend investigating the potential for implementing signal-controlled gating to allow cycle traffic to cross the Menai Suspension Bridge separately from motor traffic.

8

We recommend the introduction of the enhanced bus network and frequencies for Ynys Môn developed by Transport for Wales supported by multi-year funding.

14

We recommend the development of a comprehensive, comfortable, attractive and safe active travel network extending from both ends of both bridges to connect communities and important destinations in Ynys Môn and north Gwynedd.



15

We recommend the development of comprehensive partnership working between the public, private and third sectors to develop and deliver travel behaviour change measures including travel planning partnerships, local work hubs, cycle and e-cycle hire schemes, support for e-cargo bikes for local deliveries, and provision of dedicated multi-year (5-6 years) revenue funding.

16

We recommend that a study is undertaken for Britannia Bridge of a three-lane tidal system with and without a moveable barrier so that such a system could be deployed quickly if appropriate for resilience and incident management in the future.



- 1 Wind deflectors.
- 2 Speed reduction.
- 3 Layout changes.
- 4 Junction improvement.
- 5 Traffic signal control.
- 7 Increased rail service frequency.
- 10 New and improved park and ride facilities.
- 11 Active travel route.
- 12 Restriction on overtaking.
- 13 Cycle priority measures.
- 16 Three-lane tidal flow system.

**General-non location specific**

- 6 Improved multi-agency response.
- 8 Improve bus service frequency and operating hours.
- 9 Bus priority infrastructure at pinch points.
- 14 Implement active travel network map proposals.
- 15 Behaviour change measures delivered through partnership working between the public, private, and third sectors.

# Annex 1: Three-Lane Tidal Flow Comparison

## Introduction

This annex compares the A55 Britannia Bridge to the following two routes where three-lane tidal flow layouts currently operate:

- ◆ Tamar Bridge in Plymouth; and
- ◆ A470 North Road in Cardiff.

The comparison with the Tamar Bridge is for traffic flow and collisions, but with the A470 North Road is for collisions only because no flow data was available. The findings of the 2015 Safety Assessment Report of a three-lane tidal flow system on the A55 Britannia Bridge are summarised. Finally, a discussion of kerblines-to-kerblines cross-sections for each location is presented.



## Description of the Two Comparator Locations

### Tamar Bridge, Plymouth

The 600 metre long Tamar Bridge carries the three lanes of the A38 trunk road and a single lane of the B3271 in an eastbound direction across the River Tamar between Saltash in Cornwall and Plymouth in Devon. The A38 and B3271 merge in advance of the eastbound tollbooth beyond the eastern bridge abutment. The A38 westbound is not tolled.

Immediately east of the toll booth is a roundabout connecting the A38 to Pemros Road. There is an off-slip 100 metres west of the western bridge abutment that connects to the B3271. The A38 remains a three-lane undivided carriageway for the 400 metres before it enters the Saltash Tunnel to the west, and throughout the 400 metre length of the Saltash Tunnel.

A speed limit of 30 mph exists from east of the eastern roundabout to the western tunnel portal of the Saltash Tunnel and on the B3271. As shown in Figure 1, The length of route considered for the comparison with the A55 Britannia Bridge is the 1.5 kilometres between the toll booth to the east and a junction of the A38 with the B3271 to immediately to the west of the Saltash Tunnel portal.

There are notable differences between the Tamar Bridge and the Britannia Bridge, including the tunnel and the toll booth.

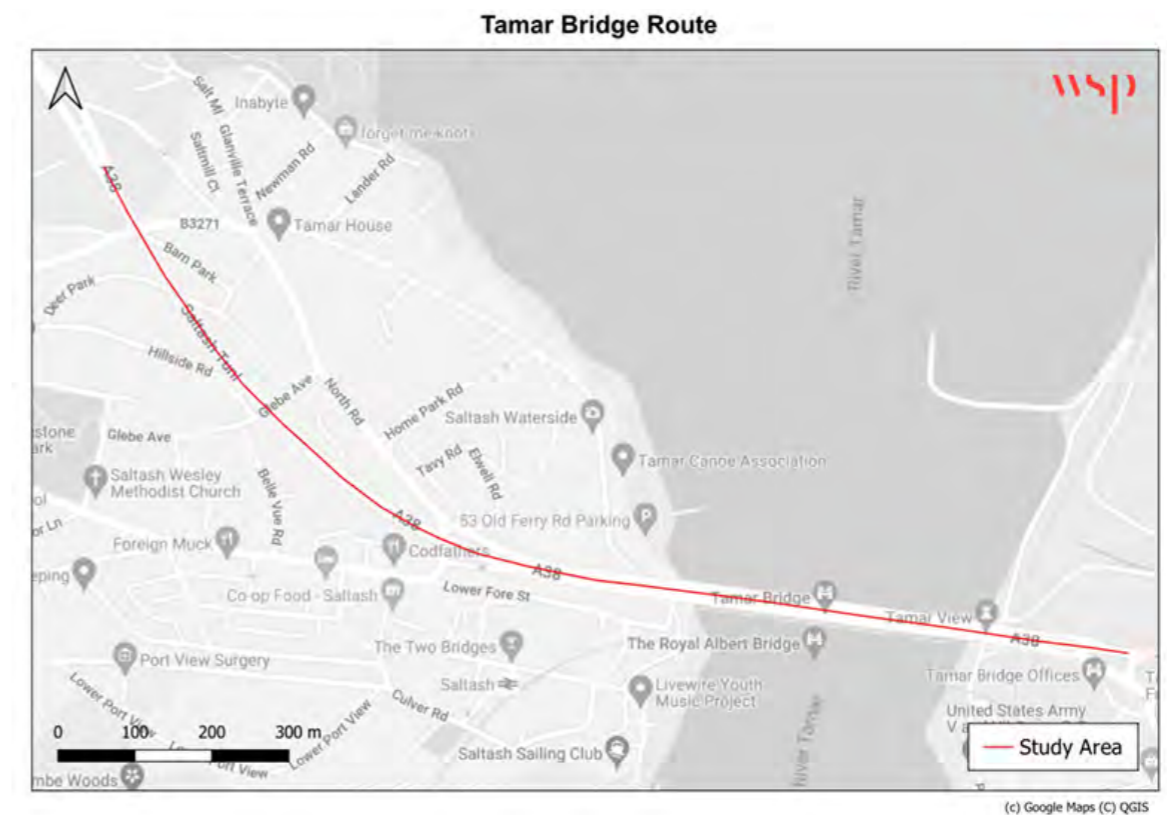


Figure 1: Tamar Bridge three-lane tidal flow length

## A470 North Road, Cardiff

The A470 North Road operates with 750 metres section of three-lane tidal flow between the traffic signal-controlled junction at Corbett Road and Blackweir Terrace, where the road becomes a dual carriageway. The route is shown in Figure 2. It is the principal route out of Cardiff City Centre to the north and connects with the M4 and carries on to Merthyr Tydfil. There is a signal-controlled junction with Colum Road, a number of Give Way side road junctions and private accesses, a zebra crossing and a pelican crossing.

The speed limit is 30 mph. A speed camera is located within the tidal flow system. The road is an urban road and hence it is again notably different to Britannia Bridge.

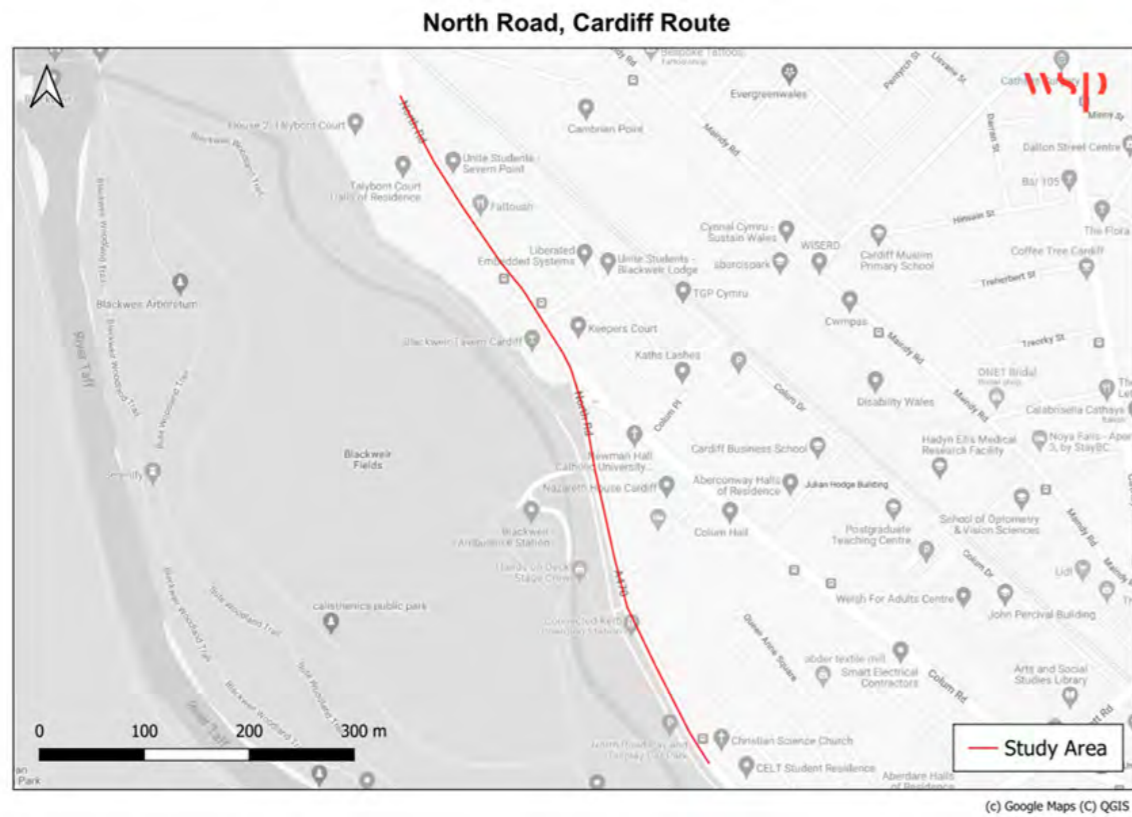
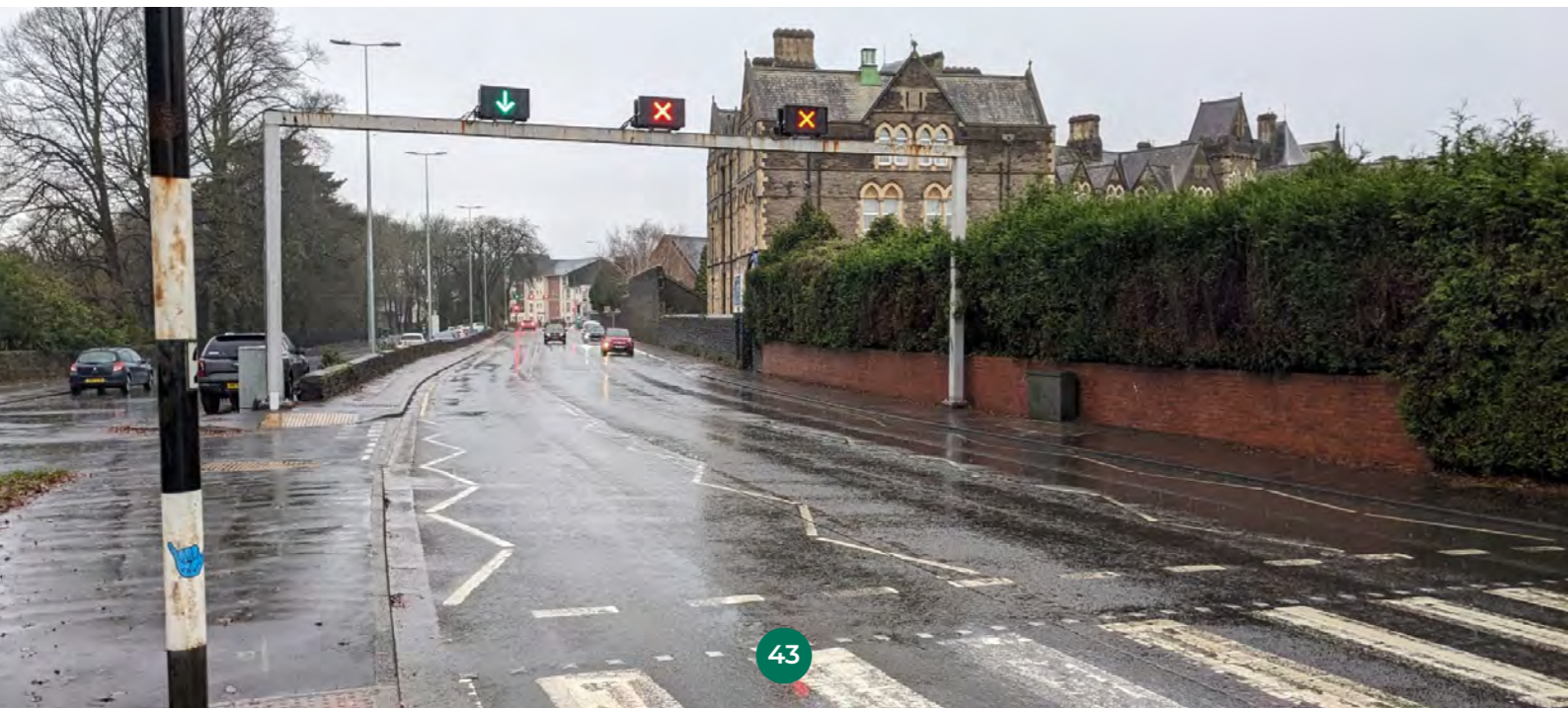


Figure 2: A470 North Road three-lane tidal flow length



## Traffic Flows

Traffic flow data for 2022 has been obtained from Traffic Wales for the A55 Britannia Bridge and the Tamar Crossing operator for the Tamar Bridge. Bank holidays are excluded from the data. The A55 Britannia Bridge data used is for the period 1st January to 21st October 2022 to avoid the period when the A5 Menai Suspension Bridge was closed.

### Average Weekday Traffic Profiles

Figure 3 shows the weekday traffic flow and Figure 4 shows the weekend profile for the Tamar Bridge and the Britannia Bridge. Only eastbound data is available for the Tamar Bridge. The flows include the B3271 and hence the flow through the three-lane tidal flow system will be lower than the totals shown.

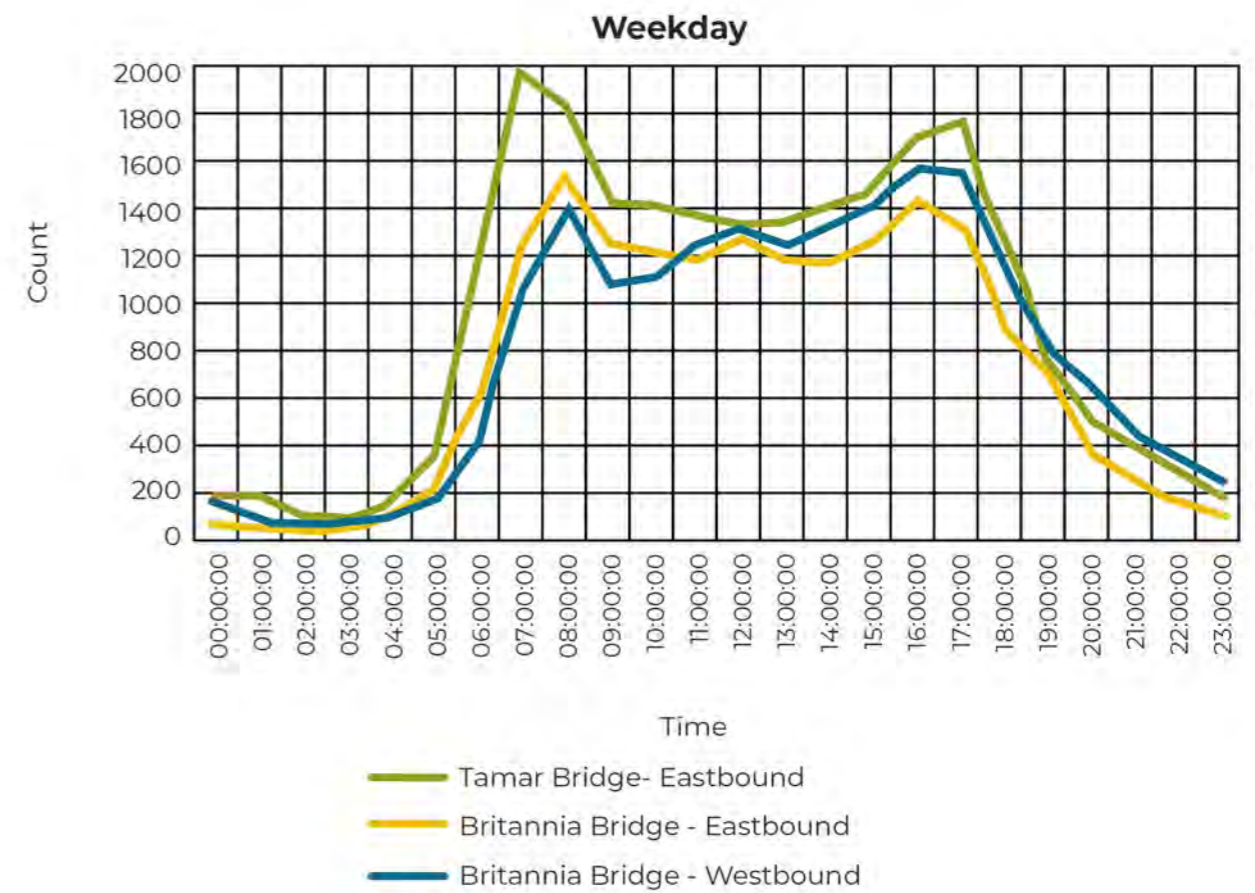


Figure 3: Weekday traffic flow profiles for Tamar Bridge eastbound and the Britannia Bridge east and westbound



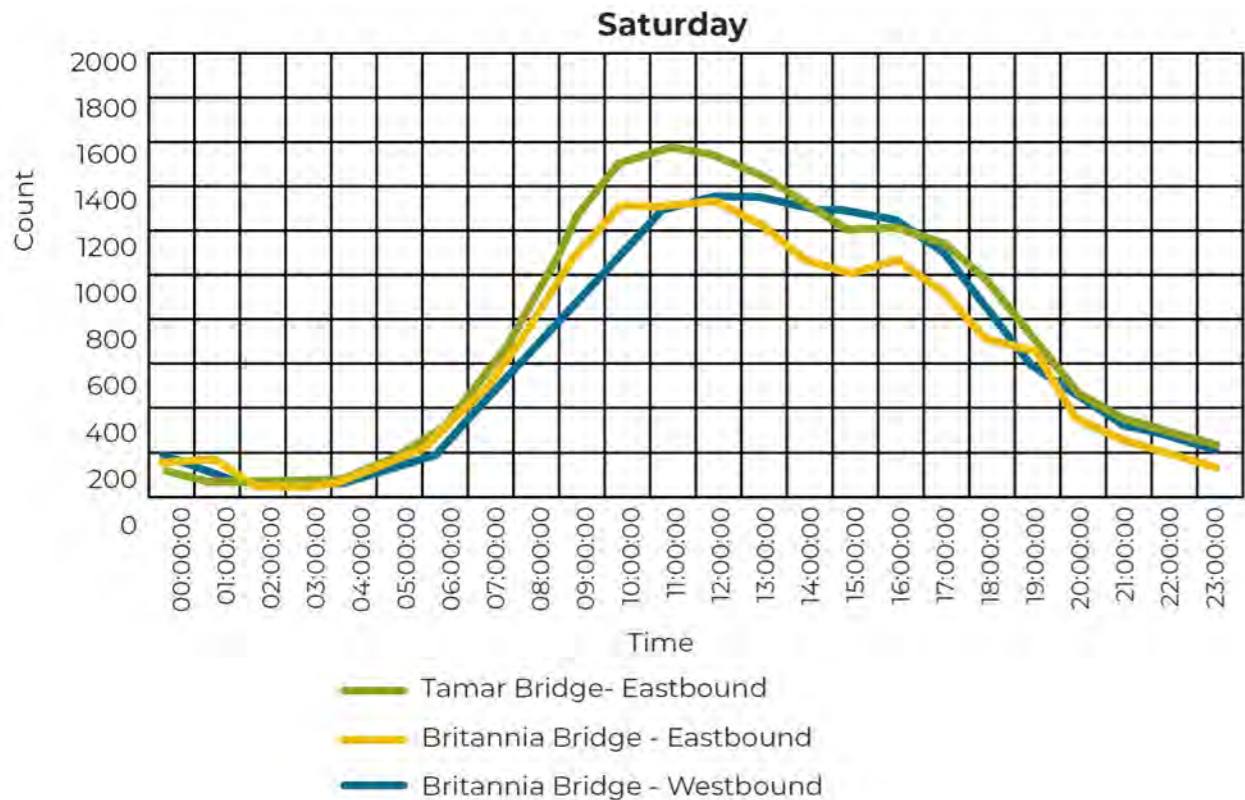


Figure 4: Saturday traffic flow profiles for Tamar Bridge eastbound and the Britannia Bridge east and westbound

### Variation in Average Weekday and Saturday Flows by Month

Figure 5 shows the variation in average weekday and Saturday two-way flows by month. The Tamar Bridge data has been estimated by doubling the eastbound flow.

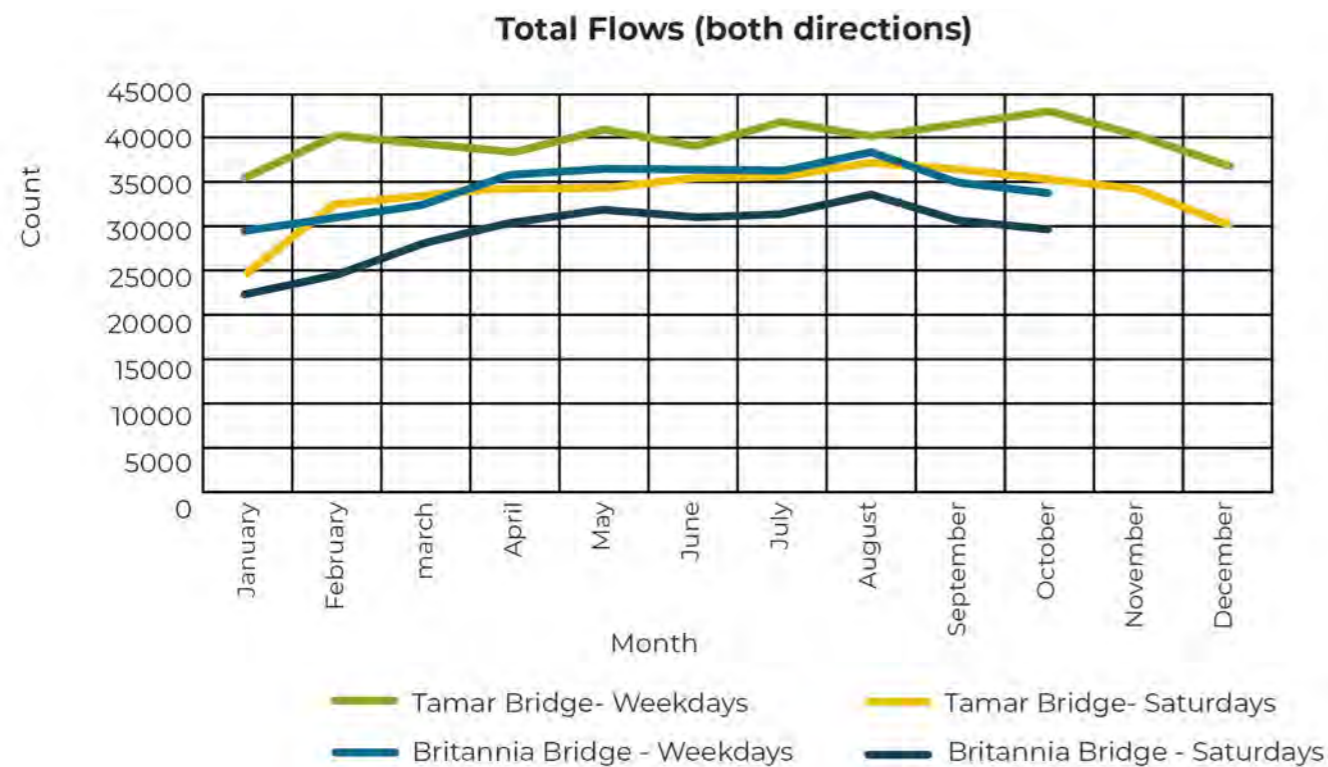


Figure 5: Variation in average weekday and Saturday flows by month

### Flow Summary

The Britannia Bridge and the Tamar Bridge weekday profile of traffic indicates a good deal of commuting, but with high inter-peak flows. There is an element of tidality on Britannia Bridge with a larger eastbound flow in the morning and a larger westbound flow in the evening. Both bridges have a peak on a Saturday in the late morning with a slow decline in flow during the afternoon.

The average weekday daily flow on Britannia Bridge (34,822) is approximately 19% lower than on the Tamar Bridge (42,476), but the Tamar Bridge flow includes the additional B3271 eastbound lane. The difference between the A55 flow and just the A38 flow is less than this but is most likely higher than the A55 flow. The daily traffic flows on the two bridges are therefore broadly comparable.

Flows are higher in August on the Britannia Bridge, but there is less of an effect of summer season traffic on the Tamar Bridge.

A three-lane tidal flow system would work best where there is considerable tidality of flow, and where for some periods of the year there could be significantly higher flows. The level of tidality on the Tamar Bridge is unknown and is of modest scale on the Britannia Bridge. There are periods of the year, during the summer, when flows on both bridges are higher than at other times of the year. Less frequent users of a three-lane tidal flow arrangement may be more cautious and therefore safer, however, contrariwise, lack of familiarity with a three-lane tidal system may create some confusion and therefore risk. The proportion of infrequent users of a route should be a consideration.



## Collision Data

Table 1 summarises the number of casualties by year for the Britannia Bridge, Tamar Bridge and the A470 and the casualty rate per billion vehicle miles.

*Table 1: Casualty data for the Britannia Bridge, Tamar Bridge and the A470, 2017 to 2019*

Location	Annual average daily traffic	Route length (miles)	Casualty Rate (per bn veh miles)	Killed and seriously injured rate (per bn veh miles)	Slight Casualties	Serious Casualties	Fatal Casualties
A55 Britannia Bridge	37,744	1.81	200.5	26.7	13	1	1
Tamar Bridge	43,203	0.96	132.1	0.0	6	0	0
A470 North Road	36,824	0.45	330.7	0.0	6	0	0

Table 2 summarises the number of collisions by year for the Britannia Bridge, Tamar Bridge and the A470 and the collision rate per billion vehicle miles.

*Table 2: Collision data for the Britannia Bridge, Tamar Bridge and the A470, 2017 to 2019*

Location	Annual average daily traffic	Route length (miles)	Collision Rate (per bn veh miles)	Killed and seriously injured collision rate (per bn veh miles)	Slight Casualties	Serious Casualties	Fatal Casualties
A55 Britannia Bridge	37,744	1.81	106.9	26.7	6	1	1
Tamar Bridge	43,203	0.96	88.1	0.0	4	0	0
A470 North Road	36,824	0.45	330.7	0.0	6	0	0

The casualty rate is highest on the A470, and this is to be expected based on it being an urban road. The casualty rate and the killed and seriously injured rates are higher on the Britannia Bridge than the Tamar Bridge. This is to be expected because the Tamar Bridge has a speed limit of 30 mph while the Britannia Bridge approaches are 70 mph reducing to 50 mph near to the bridge.

It is not possible to say whether the casualty rates are higher on the Tamar Bridge and the A470 than they would be without a three-lane tidal flow system.

The commission has been provided, and analysed, details of the collisions on the Britannia Bridge over this period, including details of likely contributory factors, as determined by the police.

The collisions at the Britannia Bridge reflect merges and diverges, occasionally queueing traffic and the possibility for head-on collisions at the one location on the A55 that does not have a central vehicle restraint system. Five of the seven collisions on the A470 North Road involved pedestrians or cyclists. No head-on collisions are recorded on the A470 three-lane tidal flow system.

In summary, based on the data given above, reducing the speed limit on the A55 at Britannia Bridge would be expected to reduce the collision rate. It is more difficult to judge whether that rate would be affected by the addition of a tidal flow system.



# Atkins 2015 Safety Assessment Report

## Options Considered

A Safety Risk Assessment was completed in 2015 by Atkins and involved a review of the risks associated with the following three-lane options to improve the flow of traffic on the A55 Britannia Bridge:

- ◆ **Option 1:** Fixed traffic lanes with two lanes eastbound and one lane westbound.
- ◆ **Option 2:** Three lanes operating as 24-hour tidal flow with two lanes eastbound (primarily during the morning peak period) and one lane westbound, or with two lanes westbound (primarily during the evening peak period) and one lane eastbound.
- ◆ **Option 3:** Three lanes operating as tidal flow during peak periods only. Two lanes would be provided eastbound (tidal flow in the AM peak) or two lanes westbound (tidal flow in the PM peak). During off-peak times, the central lane would be unused, with a single lane for the eastbound direction and a single lane for the westbound direction.

Both tidal flow options (Option 2 and Option 3) assume two lanes 3.5m wide, with the central lane 3.0m wide. The review referenced Design Manual for Roads and Bridges (DMRB) GD 04/12, which was updated to GG 104 'Requirements for safety risk assessment' in June 2018.

## Main Safety Issues

The carriageway width over the Britannia Bridge is 10m. A standard trunk road lane width is 3.65 metres. The introduction of three lanes would therefore require the use of narrow lanes. Narrow lanes and a tidal flow system would result in operational and safety challenges.

The most catastrophic safety risk noted was a technology failure during peak period tidal flow operation, leading to driver confusion that could result in conflicts primarily between vehicles travelling in opposite directions in the central traffic lane.

The following 'high risk' hazards were identified in the risk assessment:

- ◆ All options – An incident during narrow lanes or tidal flow operation could block access for emergency vehicles travelling along the A55.
- ◆ All options – There is the risk of abnormal loads encroaching into the central traffic lane.
- ◆ Option 1 – Drivers may deliberately ignore the '2+1' carriageway layout and enter the middle lane to overtake, resulting in possible head-on collisions.
- ◆ Option 3 – During off-peak periods, road users could ignore the closure of the central lane in order to use it for overtaking movements, which could result in head-on collisions.

The following 'medium risk' hazards were identified:

- ◆ All options – Increased risk of collisions with cyclists, side swipe collisions (especially at the Junction 8A eastbound merge), and collisions with broken-down vehicles and risk in high wind of moving into the path of other vehicles.
- ◆ All options – Increased risk of side swipe collisions due to the narrow lanes resulting in reduced separation between vehicles.
- ◆ All options 2 and 3 – Risks associated with driver unfamiliarity, and using the middle lane to overtake
- ◆ All options 2 – vehicles using the same lane in opposite directions at time of activation and vehicles leaving the tidal flow could accidentally pass to the wrong side of the central reserve
- ◆ All options 3 – Drivers may use the central traffic lane when it is closed



## Proposed Mitigation

The list below identifies the proposed mitigation measures for the risks identified:

Incident detection equipment.

Camera enforcement of vehicle speeds and lane misuse.

Full suite of gantries, and variable message signs.

Illuminated road studs (IRS).

Variable speed limits including a 30mph limit at any time that the central lane is in operation.

Ability to close the central lane at any time

Road restraint system upgrades where appropriate throughout the extents of the scheme.

Closure of the police/maintenance access east of the bridge.

Close the central lane when abnormal loads are using the bridge.

Link the closure of the central lane and one-way flow operation with weather event protocol.

Road layout improvements at / closure of J8A eastbound on-slip.

Road layout improvements at the westbound approach to the central reserve on leaving the bridge.

Prohibition of cyclists from using the bridge

## Discussion of Cross-Sections

In order to understand lane widths on the Tamar Bridge and the A470 North Road, carriageway cross-sections have been compared with the A55 Britannia Bridge. The A55 Britannia Bridge width has been taken at the bridge towers, which are the most constrained part of the road. A summary of the cross-section analysis is presented in Figure 6 below.

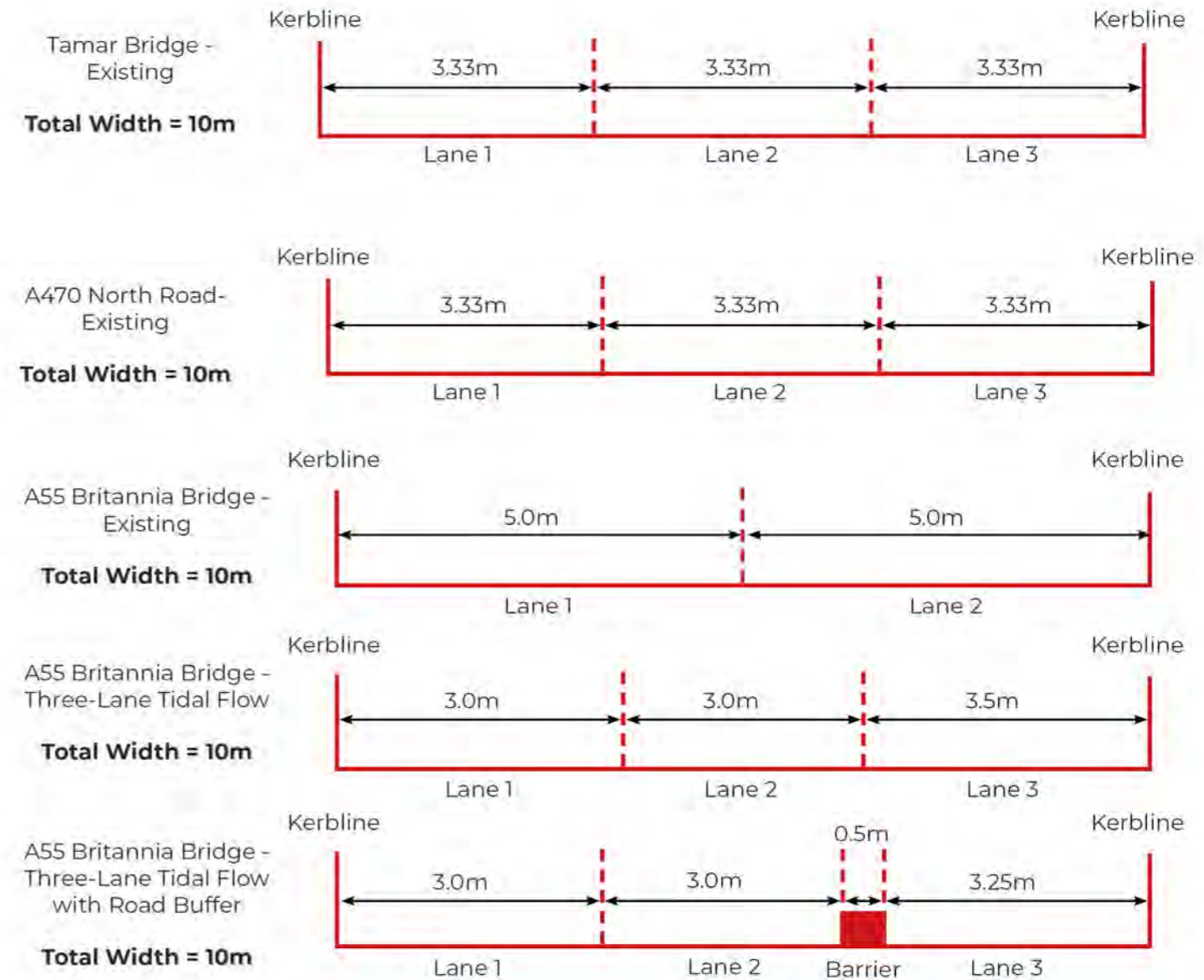


Figure 6: Summary of cross-sections

## Tamar Bridge Comparison and Study Findings

The A38 Tamar Bridge in South-West England has a layout with three narrow traffic lanes and a tidal flow system. The Atkins report concluded that the collision record suggests the middle tidal flow lane is may be mis-used for overtaking. It also concluded that the Britannia Bridge's operation differs in a number of fundamental ways from the Tamar Bridge, for example the 30mph speed limit and the speed-reducing features of the tunnel and the roundabout on the approaches and the fact that abnormal loads are diverted to other routes away from the Tamar Bridge. There may be fewer international HGV drivers because the A38 does not lead to an international port.

The Atkins report suggested that Option 3 (three-lane tidal flow operational during the peak periods only) was the most viable option. However, it concluded that the potential mitigation measures identified would not reduce the level of risk associated with the narrow lane proposal to an acceptable level, and that tidal flow should not be progressed. It noted that further consideration of the hazards and mitigation would be needed to determine whether the risks could be reduced sufficiently.

The planning and design of a three-lane tidal flow system on the A55 Britannia Bridge has not been progressed further. Instead, the preferred option at the time of a third crossing of the Menai Strait was taken forward.



## Conclusion

Neither the Tamar Bridge nor the A470 North Road are directly comparable with the A55 Britannia Bridge. The Tamar Bridge has a 30 mph speed limit from a roundabout to the east of the east bridge pier to a point 1.5 km to the west, beyond the Saltash Tunnel. The three-lane tidal flow operates across the bridge and all the way through the tunnel. The A470 is urban in nature. The A55 is a dual carriageway with a 70 mph speed limit which reduces to 50 mph at the bridge where the road narrows to a wide single two lane carriageway with no central reserve or vehicle restraint system on the bridge. There are grade separated junctions immediately to the north and the south the Britannia Bridge.

The traffic flows are broadly comparable on Tamar Bridge to the A55 Britannia Bridge, although there is more pronounced seasonal fluctuation on the Britannia Bridge. There is little tidality of flow on the Britannia Bridge between the morning and the evening peak periods, and hence that reduces the value of a tidal system.

The Britannia Bridge has the highest casualty rate of all three locations. A lower speed limit would reduce this casualty rate, and it is not clear whether a three-lane tidal flow would have the effect of increasing collisions and casualties even with a lower speed limit.

The risks of a three lane tidal flow system can be clearly articulate but mitigated to some extent. Careful consideration would need to be given to the division of the carriageway into three separate lanes and those lane widths would be narrower than the standard lane width of 3.65 metres. They would be narrower still if a moveable barrier were to be used to separate the directions of flow.

If tidal flow is progressed further, it is likely to consist of a range of measures including: variable speed limits with average speed camera enforcement, incident detection, road layout improvements including remodelling of junction merges, and prohibition of cycling on the bridge carriageway.

A three-lane tidal flow arrangement on the A55 Britannia Bridge may be an appropriate solution and could reduce congestion and hence the onset of incidents. With careful speed management, it may also be possible to create a system with a lower collision rate than the current collision rate.

