

Adran yr Economi a'r Seilwaith
Department for Economy and Infrastructure



Llywodraeth Cymru
Welsh Government

This document is an update to the 'Proof of Evidence – Engineering Design' document WG 1.5.1. It contains an update following the addition of the bridge protection measures in the DRAFT AMENDMENT (NO.2) SCHEME ORDER and a general update on the works to address the allegation of serious detriment upon Newport Docks by Associated British Ports (ABP).

Scheme Evidence Update

Ben Sibert, BEng CEng FICE MIStructE MCIHT

Welsh Government, Engineering Design

Document Reference: WG 1.5.7

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1. AUTHOR

- 1.1 I am Benjamin Sibert. I am a Director of Ove Arup and Partners Ltd (Arup), a multi-disciplinary consultancy. My professional qualifications are set out in my main Proof of Evidence and are not repeated here.

- 1.2 The evidence which I have prepared and provided in this Scheme Evidence update has been prepared and is given in accordance with the guidance of my professional institution and I confirm that the opinions expressed are my true and professional opinions.

2. SCOPE AND PURPOSE OF THIS PROOF OF EVIDENCE 2.1

This Scheme Evidence Update provides updated evidence for the Welsh Government's Scheme, as modified by the August 2017 draft Orders Supplement to include proposals for bridge protection measures in the vicinity of the Junction Cut and works to address the impact of the Scheme upon Newport Docks.

2.2 Matthew Jones describes in his Scheme Evidence Update (WG 1.1.8) the new draft Supplementary, modified and amendment Orders.

2.3 This evidence provides an update to my previous evidence in respect of the proposed works in Newport Docks. The following sections of my main evidence are thus withdrawn, to be replaced with this evidence:

Ben Sibert Engineering Design Main Evidence (WG 1.5.1)

Section 4.158

Sections 5.257 to 5.262

Ben Sibert Engineering Design Main Evidence Appendices (WG 1.5.2)

Appendix F – Summary of ABP Land Areas in the CPO

2.4 Aspects of my evidence interface with the evidence of other witnesses including:

- a) Mr Matthew Jones (Chief Witness)
- b) Mr Barry Woodman (Construction)
- c) Mr Jonathan Vine (Shipping)
- d) Mr Bryan Whittaker (Traffic)

2.5 For simplicity of reference, throughout my evidence I will refer to the following abbreviations:

- a) Draft Compulsory Purchase Order (Doc. 2.1.5 and its supplements and modifications) as the “CPO”;
- b) The draft Side Roads Order (Doc. 2.1.3 and its supplements and modifications) as the “SRO”;
- c) The Environmental Statement and its Supplements (Docs. 2.3.2, 2.4.4, 2.4.14 and 2.5.1) as the “ES”;
- d) The Design Manual for Roads and Bridges (Doc. 6.1.8) as the “DMRB”.

2.6 My evidence is presented in the following structure, with a detailed contents provided at the start of the document.

- 1. Author
- 2. Scope and Purpose of this Proof of Evidence
- 3. Scheme Evidence Update
- 4. Conclusions

3. SCHEME EVIDENCE UPDATE

3.1. Bridge Protection Measures

- 3.1.1. I explain in section 4.157 of my main evidence (WG 1.5.1) the need identified for bridge protection measures as part of the Scheme. Since publication of my main evidence document, dialogue between the Welsh Government and ABP has progressed on the principles of the bridge protection measures and the risk assessment methodology.
- 3.1.2. To inform the risk assessment process, Jonathan Vine has assessed the geometric arrangement between the proposed Scheme works and sample vessels to evaluate the potential for and nature of contact. Jonathan Vine explains this work in his evidence update (WG 1.22.5).
- 3.1.3. In assessing the level of risk to people, I have referred to guidance from the DMRB¹ and Eurocodes².
- 3.1.4. The DMRB GD04/12 document defines three population groups when assessing risk:
- a) *Workers* – People directly or indirectly employed to work on the road.
 - b) *Users* – Road users, including all motorised and non-motorised users.
 - c) *Other Parties* – Third parties who could be affected by the road. I have assumed this to include persons working on a vessel or within the docks.

¹ Standard for Safety Risk Assessment on the Strategic Road Network' issued by the Highways Agency as part of the Design Manual for Roads and Bridges, Volume 0, Section 2, Part 3 (Document GD 04/12, November 2012)

² BS EN 1990: 2002 – Eurocode – Basis of Structural Design, Incorporating Amendment No. 1.

- 3.1.5. The specific risks to people which are mitigated by the Scheme proposals I have identified are:
- a) risk of injury or death of people on the bridge (*Users*) or in the Docks (*Other Parties*) arising out of bridge collapse from a vessel strike;
 - b) risk of injury or death of people on vessels or on the quayside (*Other Parties*) arising out of collapse of part of the superstructure of a vessel following an impact with the bridge, e.g. aerials, masts, cranes or vessel superstructure (accommodation, control rooms and the like).
- 3.1.6. The DMRB GD04/12 also gives three regions of safety risk:
- a) *Unacceptable* – Risk cannot be justified save in extraordinary circumstances
 - b) *Tolerable* – Reasonably practicable control measures must be introduced for risk in this region to drive residual risk towards the broadly acceptable region
 - c) *Broadly Acceptable* – Level of residual risk regarded as insignificant – further effort to reduce risk is not likely to be required.
- 3.1.7. The proposed physical bridge protection measures to mitigate the risks identified at 3.1.5 associated with these scenarios would be quayside build-outs located in the South Dock to narrow the Junction Cut to 11m wide, and to move the quayside further south of the bridge by 50m. Refer to drawing in Appendix A to this evidence update for a layout of the proposed works³. The new build-outs would be constructed from sheet pile walls with backfill.

³ Note that the Welsh Government and ABP are continuing discussions on the preferred width of the narrowed Junction Cut – see later section 3.1.13 of this evidence.

- 3.1.8. These measures would prevent all vessels with beam greater than the new Junction Cut width from directly impacting with the bridge.
- 3.1.9. The build-outs would also act to dissipate any impact with the quay walls so that the lateral capacity of the bridge foundations would not be exceeded.
- 3.1.10. The build-outs would also narrow the width of the Junction Cut to reduce the maximum size of vessels which could pass beneath the bridge.
- 3.1.11. In respect of 3.1.8 and 3.1.10 above, Mr Jonathan Vine advises that there is a relationship between vessel beam (the width of the hull) and the height of the vessel. By restricting the maximum beam that is able to pass through Junction Cut, the height is thus also restricted. Jonathan Vine advises in his evidence (WG 1.22.5) that a beam restriction of 11.0m would be sufficient to prevent all vessels with an air draft greater than 26.2m from passing through the narrowed Junction Cut. This relates to the ballast air draft, with the vessel in its highest position in the water.
- 3.1.12. The inclusion of the bridge protection measures build-outs above mitigates the risks and adverse effects of potential vessel impact with the River Usk Crossing. My team and I have assessed the residual risk of this proposal as *Broadly Acceptable* and this is my advice to the Welsh Government, ABP and the Inquiry.

- 3.1.13. As a result of the Junction Cut narrowing, there would be a restriction in the vessels that could access the North Dock. Jonathan Vine will explain the detail of these restrictions and the resulting impacts on movements of vessels in his evidence update (WG 1.22.5). Notwithstanding the proposals for a narrowing of the Junction Cut to 11m, which provides certainty of risk combined with reduction in shipping movements, the Welsh Government and ABP are continuing to explore further the option of a 13.5m Junction Cut width, which could lessen the impact on shipping movements.
- 3.1.14. Jonathan Vine also advises in his evidence (WG 1.22.5) that a beam restriction of 13.5m would be sufficient to prevent a hard impact scenario (impacts from elements of a vessel other than mast/whip aerials) for a clearance of 26.2m. With the hard impact scenario eliminated, the risk of bridge collapse remains at zero. However, the potential for mast impact (and therefore risk of injury to *Other Parties*) still exists. My team and I have undertaken a probabilistic assessment to determine what the residual level of risk would be if the narrowing was set at 13.5m rather than 11m.
- 3.1.15. A recent workshop between the Welsh Government and ABP discussed the methodology for the probabilistic assessment. The Welsh Government has shared the completed assessment with ABP and their consultants and their comments have been incorporated.
- 3.1.16. The assessment shows that the residual risk due to the physical bridge protection measures, incorporating a beam restriction of 13.5m, was in the *tolerable* safety risk region. For a *tolerable* risk the DMRB states that further consideration should be given to “any reasonably required safety risk controls that are not already implemented”.

- 3.1.17. The risk assessment shows that intended vessel movements through Junction Cut contribute to the majority of the residual risk. Therefore, in order to bring the residual risk towards the *broadly acceptable* region, a virtual trip wire system would be constructed in conjunction with this Junction Cut width of 13.5m. This would independently verify that a vessel meets the height acceptance criteria for passage beneath the River Usk Crossing into the North Dock. Jonathan Vine describes the workings of this system in his updated evidence.
- 3.1.18. With the inclusion of a virtual trip wire system, the probabilistic assessment indicates that the annual probability of death falls within the *broadly acceptable* region.
- 3.1.19. In addition to the bridge protection measures listed above, the WG and ABP have discussed further non-physical mitigation measures, which Jonathan Vine describes in his evidence update section 8.
- 3.1.20. Matthew Jones explains in his updated evidence that a modification to the draft supplementary (No.3) CPO will be issued to remove areas, in the vicinity of the Junction Cut, which are no longer required to construct the bridge protection measures. The Welsh Government has issued a draft supplementary (No.4) CPO in respect of for the additional land required to constructed the narrowing of the extended Junction Cut. They have also issued an amendment to the Scheme Order to narrow the navigable waters of the Junction Cut to 11m.
- 3.1.21. Matthew Jones notes that any lessening of the 11m cut width reduction would be within the rights obtained by draft Supplementary (No.4) CPO as it would not require any additional land. This would reduce the degree of impediment to vessel access to the North Dock whilst maintaining a *Broadly Acceptable* level of risk.

3.2. Mobile Crane Movements

- 3.2.1. ABP currently use mobile cranes to handle cargo from vessels. These cranes transit around the perimeter of the North and South Dock on the dock internal road network to service different quays. The cranes are movable with their jibs upright, which stand approximately 50m tall above ground level in this position. With the Scheme's River Usk crossing in place, ABP would not be able to move their mobile cranes across the line of the proposed new motorway.
- 3.2.2. In addition to the build-out constructions to form the bridge protection measures, a new moveable swing bridge would be provided across the new entrance to the Junction Cut. This would facilitate the passage of ABP's mobile cargo handling cranes around the perimeter of South Dock. This means that instead of dividing the docks up in to three zones for servicing by mobile cranes, it is instead, divided in to two zones: one zone around the whole perimeter of South Dock and one zone around North Dock.
- 3.2.3. The route for the cranes is identified on the Supplementary (No. 3) CPO and Supplementary SRO as a new Private Means of Access for ABP. The CPO would also provide the Welsh Government with S.250 Highways Act 1980 rights of access along this new PMA for construction and maintenance of the Scheme.

3.3. Land Interests in the Compulsory Purchase Order

3.3.1. The following is a list of objections referred in my original evidence WG 1.5.1 which are now withdrawn:

- a) Pencarn Farms (OBJ0019)
- b) Network Rail (OBJ0025)
- c) LDH Plant (OBJ0047)
- d) Vodafone (OBJ0090)
- e) Tarmac & Cambrian Stone Limited (OBJ0097)
- f) Bovis Homes (OBJ0103)
- g) Cargo Services (UK) Ltd (OBJ0137)
- h) National Grid (OBJ0205)
- i) Mr C W Jones, Barnetts Cottage (OBJ0226)
- j) Mr Paul & Mrs Karen Clatworthy (OBJ0257)
- k) Air Products (OBJ0289)
- l) Ashtenne (OBJ0301)
- m) Liberty Steel (OBJ 0308)
- n) Dwr Cymru Welsh Water (OBJ0321)
- o) BT Openreach (OBJ6897)

Newport Docks – Associated British Ports (OBJ 0031)

- 3.3.2. Refer to my main evidence (WG 1.5.1) sections 5.245 to 5.256.
- 3.3.3. A replacement to Table 6 in this section of my main evidence, providing a summary of ABP land areas in the CPO, is provided below as Table 1 to this evidence. Appendix F in my main evidence, referred in 5.248, is replaced by Appendix B to this evidence.

Table 1 - Summary of ABP Land Areas in the CPO

<u>Land designation</u>	<u>Acres</u>	<u>Hectares</u>	<u>Percentage of Total ABP Freehold (%)</u>	<u>Percentage of ABP's accessible land area (%)</u>
Total land take required during construction (accessible land)	85.9	34.8	12.41	19.1
Title to be purchased permanently by WG for Highway Operation & Maintenance (accessible land)	37.1	15	5.36	8.3
Title to be purchase permanently by WG for Highway Operation & Maintenance (within the dock)	1.7	0.6	0.25	n/a
Total S250 Rights required by WG for Highway Maintenance. (accessible land)	8.2	3.3	1.18	1.8
Total S250 Rights required by WG for Highway Maintenance (within the dock)	104.3	42.2	15.07	n/a
Essential Licence land to return to ABP (assuming total land designated in CPO is returned) (accessible land)	38.1	15.4	5.50	8.5
Essential Licence land to return to ABP (assuming total land designated in CPO is returned) (within the dock)	0.2	0.1	0.03	n/a
Essential Licence Land to be returned, of which WG would still require S250 Rights for Highway Maintenance (accessible land)	2.6	1	0.38	0.6
Essential Licence Land to be returned, of which WG would still require S250 Rights for Highway Maintenance (within the dock)	0.06	0.02	0.01	n/a

- 3.3.4. The land required for the Welsh Government to construct the bridge protection measures outlined in this evidence is required as Title so that the Welsh Government has control over these measures to protect its assets.
- 3.3.5. To construct the bridge protection measures, as Barry Woodman explains in his evidence update (WG 1.6.5), a marine jack up platform to drive piles would be required. Such a platform could be brought to the work site from the Severn Estuary through the Newport Docks south lock and South Dock. The draft supplementary (No. 3) CPO includes S.250 Highways Act 1980 rights to construct and maintain an access route through the lock and dock to the site of the bridge protection measures.
- 3.3.6. In respect of land beneath the bridge deck, section 5.250 of my main evidence describes how the intention would be an offer back of suitable lesser interest in or rights to the land, to: minimise the land required from and disruption to ABP and its tenants; manage the interests of the Welsh Government and the travelling public in respect of safety, fire and security risks arising from land based operations beneath the bridge; to ensure that the Welsh Government has access available beneath the bridge for inspection and maintenance. I have instructed fire risk assessments by expert members of my team to advise the Welsh Government of the risks of fire affecting the bridge structure or users of the bridge. I describe in the following paragraphs the key findings of these risk assessments.
- 3.3.7. There are 2 main effects that a fire could present to the Usk Crossing:
- a) Heat from a fire below, or directly adjacent to the bridge, could inflict damage on the structure; and
 - b) Smoke from such a fire could harm bridge users through toxic fumes, or through impairing visibility for drivers.

3.3.8. In summary, the key fire hazards that have been identified as leading to fires that could impact the stability and/or operation of the bridge are as listed in Table 2.

Table 2 - Fire Risk Hazards

Hz ID		Hazard Description	Source of Hazard
Hz1	a	A general goods HGV fire on the bridge deck.	Users
	b	A general goods HGV fire on a road or in an industrial yard beneath the bridge	Other Parties
	c	A petrol tanker HGV fire on the bridge deck.	Users
	d	A petrol tanker HGV fire on a road or in an industrial yard beneath the bridge	Other Parties
Hz2	a	A ship fire (fuel spill) on the River Usk, or in the Newport Docks area	Other Parties
	b	A ship fire (cargo) on the River Usk, or in the Newport Docks area	Other Parties
Hz3		A fire in a timber storage yard in an industrial Tenancy underneath the bridge	Other Parties
Hz4		A train fire (Locomotive and/or cargo) on one of the three rail lines that pass under the bridge	Other Parties
Hz5		A wildfire in wasteland (significant smoke hazard) under the bridge on the East bank of the River Usk	Other
Hz7		A road LNG tanker on the bridge deck	Users

- 3.3.9. Of the 7 hazards identified, 5 are transport related and only 2 relate to land use.
- 3.3.10. It is likely to be impractical to impose fire related restrictions on types of cargo and transport of goods under the bridge (HGV, train and ship). The design of the bridge would take in to account the hazards which could affect the structure of the bridge through provision of structural redundancy or structural fire protection where necessary.
- 3.3.11. One of the two land uses listed in Table 2 relates to an area of wild land. This is not in the Newport Docks but is on the east bank of the River Usk.⁴
- 3.3.12. Timber is the only flammable material currently identified as being stored beneath or adjacent to the bridge. International Timber (the current tenant of the site) has confirmed that their storage stacks do not exceed 5m in height. The risk assessment uses this as a principal input parameter and it would need to be specified in the documentation of the lesser interest or rights described in section 3.2.5 of this evidence when those are granted back to ABP, which could be enforced by the Welsh Government. There is however also a practical restriction on storing materials above this height, since it would be difficult to access such storage without specialist equipment. Any changes to this parameter in the future would require a revised risk assessment to be undertaken and the findings duly taken in to account by Welsh Government, before it agrees to any revisions in the restriction on use.

⁴ Wildland is the term used by my team of fire experts to refer to land which does not have hardstanding or buildings upon it and which might be grown over with trees or scrub plants. There is no inference as to the environmental designation of such land; it is purely a matter of whether there is a source of fire from wild vegetation.

3.3.13. ABP has reported a potential for future storage of other flammable materials, such as baled waste for energy production, timber products and bulk storage of wood chips and pellets. Any future proposal by ABP, or their tenants, to change the characteristics of the material or storage configuration present on the site would need to be assessed to be no worse, in terms of fire impact on the bridge, than 5m high stacks of timber. Alternatively, additional fire protection materials would need to be retrofitted to the bridge structure to address the increased severity of fire exposure. The responsibility for design and funding of any such retrofit systems would need to be decided on a case by case basis following risk assessment and agreed with Welsh Government before implementation.

3.3.14. My team of experts have assessed the risk associated with fire from a 5m high timber store beneath the bridge at the location shown in Figure 1 bounded by the red line.

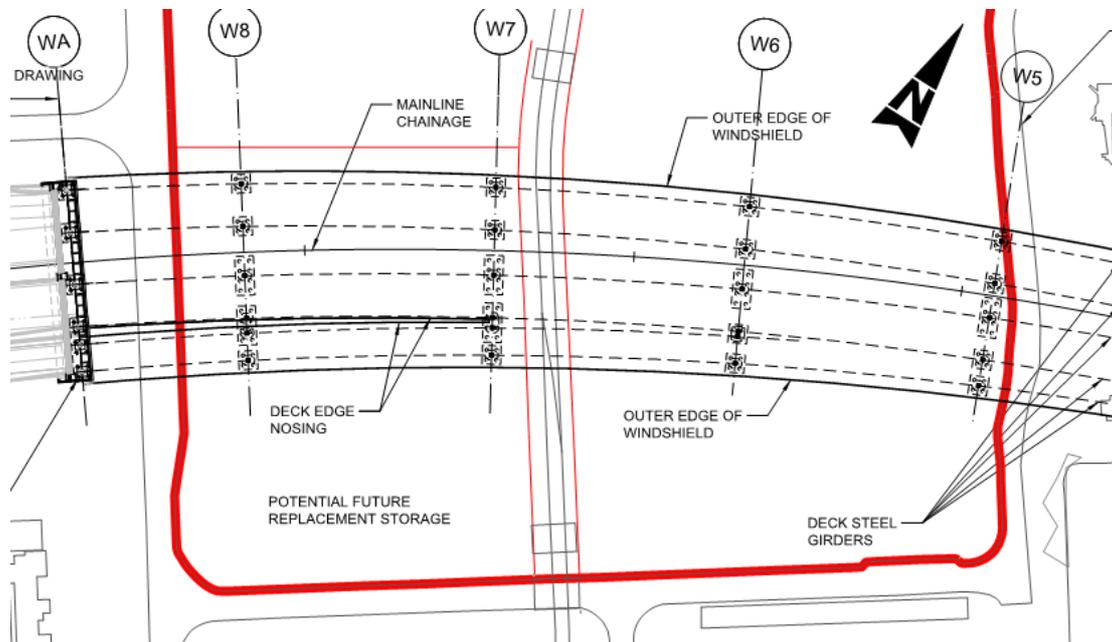


Figure 1 - International Timber plot in relation to the River Usk Crossing Bridge

- 3.3.15. My experts' preliminary recommendation, with timber storage beneath the bridge up to 5m high in the location shown in Figure 1, is to provide fire protection locally to the steel girders of the approach viaduct over the area where timber will be stored. The preliminary assessment suggests that the most suitable method of fire protection is intumescent paint. This would mitigate the risk of collapse of the bridge in the case of fire. Detailed design would establish an appropriate level of protection.
- 3.3.16. Acceptance of storage of timber beneath the bridge would additionally require management of the motorway such that the bridge would be able to be closed to traffic as early as practically possible when a fire below the bridge is identified, since this could generate a significant smoke plume which could affect bridge users. This would be achieved with the aid of the Intelligent Transport Systems identified in section 4.237 of my main evidence (WG 1.5.1).
- 3.3.17. In summary, my advice is that storage of timber beneath the river Usk Crossing is feasible and practical, subject to the mitigation measures described above and an appropriate level of protection would be established through detailed design.

Newport Docks – LDH Plant (OBJ 0047)

- 3.3.18. Since writing my main evidence, CPO MOD2 has been superseded by Supplementary (No. 3) CPO. The Supplementary (No. 3) CPO included the proposed retaining structure at the rear of LDH Plant's plot as described in my main proof of evidence. This retaining structure reduces the amount of land to be acquired from LDH Plant's premises.
- 3.3.19. LDH Plant Ltd. have since withdrawn their objection to the draft Orders. Sections 5.257 to 5.262 of my main evidence are thus withdrawn.

Newport Docks – Other Land Interests who have objected to the draft Orders

- 3.3.20. In my main evidence sections 5.263 to 5.298, I described the land required in the CPO from objectors with land interests in the Newport Docks.
- 3.3.21. Since writing my evidence, the Welsh Government has been developing proposals for relocation of affected tenants to mitigate the effects of the Scheme on their operations. Matthew Jones will provide updates to each of these land interests in his evidence update (WG 1.1.8).

3.4. Scheme Highway Design

- 3.4.1. As explained by Mr Jones in his evidence update (WG 1.1.8), the date of when the new section of motorway would be open to traffic is intended to be December 2023.
- 3.4.2. Mr Bryan Whittaker provides an update on the changes to the traffic forecasts in his evidence update (WG 1.2.8) where he advises that the net effect of this change to the programme is that in the revised opening year, model flows are 1.7% growth and all future years.
- 3.4.3. I have led the further re-evaluation of the Scheme highway design, including junctions, for the revised traffic data provided by Mr Whittaker and can confirm that no changes to the Scheme engineering proposals or draft Orders are required as a result.
- 3.4.4. In my evidence update for the removal of the Severn Crossings Tolls (WG 1.5.6), I provided replacement tables below for those in my main evidence (WG 1.5.1) at sections 4.32 Table 1, 4.39 Table 2 and 4.66 Table 3. The relative small changes in traffic growth as indicated in Bryan Whittaker's proportionate assessment of 1.7% do not change my conclusions presented in respect of the proposed carriageway standards, which are satisfactory as published in draft.

- 4. CONCLUSIONS**
- 4.1 The draft amendment (No. 2) Scheme Order and the draft supplementary (No. 3 & 4) CPO would provide for title and rights to construct and maintain bridge protection measures in the South Dock to protect the bridge against impact from errant vessels, by providing build-outs located in the South Dock to physically extend and narrow the Junction Cut to 11m.
- 4.2 These measures would provide adequate mitigation to reduce the risk of death or injury to people arising out of such impacts. The resulting level of risk would be *Broadly Acceptable: the level of residual risk regarded as insignificant and further effort to reduce risk is not likely to be required.*⁵
- 4.3 The land required for these measures is essential for the Scheme.
- 4.4 To construct the bridge protection measures, Barry Woodman will explain that a marine jack up platform to drive sheet piles would be required. Such a platform would be brought to the work site from the Severn Estuary through the Newport Docks south lock and South Dock. The draft supplementary (No. 3) CPO includes S250 rights to construct and maintain an access route through the lock and dock to the site of the bridge protection measures.
- 4.5 The draft supplementary (No.3) CPO provides for a new Private Means of Access route and a moveable swing bridge to complete a perimeter access route around the South Dock. This would provide access around south dock for ABP's mobile cranes and reduce the need for extra cranes.
- 4.6 My advice is that storage of timber beneath the river Usk Crossing is feasible and practical subject to the mitigation measures of limits of storage location and height, together with fire protection to steelwork.

⁵ Standard for Safety Risk Assessment on the Strategic Road Network' issued by the Highways Agency as part of the Design Manual for Roads and Bridges, Volume 0, Section 2, Part 3 (Document GD 04/12, November 2012)

- 4.7 The Welsh Government and ABP are working collaboratively with regard to whether the junction cut narrowing could be built at 13.5m rather than 11m. This would reduce the degree of impediment to vessel access to the North Dock. I have led a probabilistic risk assessment, which shows that with the further inclusion of a virtual trip wire system at the South Lock, a junction cut width of 13.5m would maintain a *Broadly Acceptable* level of risk.
- 4.8 The draft Scheme Engineering proposals and layout are satisfactory for the latest traffic forecasts presented by Bryan Whittaker taking in to account most recently the removal of the tolls on the Severn Crossings and the change to the years of first operation and of design being 2024 and 2039 respectively.