Cockle Bay Park – SSD-9978934
Response to GHD Landbridge Peer Review

Table 1 Attachment 1 Peer Review Findings

Report Section	GHD Findings	Response
Attachment 1 Peer Review Findings		
Section 1: Introduction	Safety studies previously done and considered are references 6, 7, 8, 9, 10 and 11. These are part of Attachment 2. Arriscar have completed a gap analysis of the previous reports and addressed them in this report. This approach reviews and builds on existing information to extend the understanding and address stakeholder concerns.	Noted. No response required.
Section 2: Issues raised by regulatory agencies	The main concerns relate to potential consequences of a DGV accident and loss of containment, particularly explosions associated with ammonium nitrate (AN) and AN emulsion, and explosives that could result in undermining the structural integrity of the land bridge and cause harm to road users and the public.	Noted. No response required.
Section 3: Gap analysis	There are 14 issues raised by Agencies, and the gap analysis identified that most will be addressed by Arriscar's report (Attachment 1). Only one issue (issue number 13) appears to not have been addressed, as it is noted as requiring further discussion. From a safety risk perspective, these items will not be changed as a result of the land bridge and are incorporated into the accident frequency data. ***This omission is considered minor in relation to the peer review purpose.***	Noted. No response required.
Section 4: Brief description of proposed land bridge	Whilst the traffic data used within the report is based on 2017 survey data, it does provide a required breakdown of the traffic volumes into vehicle types. It also gives an overview of dangerous goods movements on the WD. Given the data is being used sparingly to inform a likelihood, rating on a risk matrix is a commonly used approach.	Noted. No response required.
Section 5: Dangerous goods transported	Table 4 is comprehensive, however, a conclusion at the end of this section (i.e. a column at the end of the table) would have been useful to demonstrate what dangerous goods data will be relevant moving forward. The table has provided the facts but has no indication of how these	Refer Section 4, Item1 of Arriscar's revised report ("Safety Review of DG Vehicles traffic under proposed Landbridge in Cockle Bay", Revision 1 dated 11th April 2025).

	were interpreted. Whilst the summary indicates that some dangerous goods classes were not seen during the 7-day survey, they are assessed in later sections. This inconsistency is a minor item in relation to the purpose of the peer review and some clarity is provided in later sections.	The 7-day survey does not identify types of dangerous goods. The data is presented only to show the relative proportions of DGV against heavy vehicle traffic and total traffic volume.
Section 6: Hazardous scenarios and safeguards	The 10% loss of containment (LOC) is a conservative value – potentially overly conservative i.e. 10 out of a hundred accidents result in a LOC seems high. However, given the lack of other guidance, this is a reasonable assumption. Table 6 provides a summary of the relevant scenarios to be considered for each class of dangerous good. A statement to this effect would have been useful prior to the commentary on the potential hazardous events (sections 6.4 to 6.14) as there is inconsistency within the descriptions regarding plausible scenarios (some have it and others do not).	Refer Section 4, Item 2 of Arriscar's revised report ("*Safety Review of DG Vehicles traffic under proposed Landbridge in Cockle Bay*", Revision 1 dated 11th April 2025). A statement has been included before Table 6 of the revised. Missing descriptions of plausible scenarios are included.
Section 7: Hazard consequence analysis	Reference to the major hazard facilities (MHF) terminology of major accident events (MAEs) is relevant. The indication of whether the MAE is modelled within this report or not is aligned with industry practices.	Noted. No response required.
	• MAE1 A 45 kg TNT equivalent explosion releases significant energy (approximately 170 MJ as per reference 6 in Attachment 2). Given the nature of class 1.3 and 1.4 explosives, the assumption that the structural assessment completed in reference 6 can be attributed to an explosion from class 1.3 and 1.4 dangerous goods is in line with industry practice.	Noted. No response required.
	• MAE2 The assumptions made in modelling an LPG cylinder leak are in line with industry practice. Whilst there is no description of the impact of a BLEVE, reference 6 in Attachment 2 has discussed an LPG tanker BLEVE (MAE3) and noted that the impact is less than that of a ULP tanker BLEVE, so a structural failure of the land bridge is not expected.	Noted. No response required.
	• MAE3 The assumptions made in modelling an LPG tanker leak are in line with industry practice. Given the modelled impacts of a jet fire, the control to make the structure rated for a two-hour fire duration is aligned with fire design expectations. Again, there is no description of impact of BLEVE. But the ULP tanker BLEVE assessment completed in reference 6 in Attachment 2 indicates that with structural reinforcement of the roof beams/concrete planks, structural failure of the land bridge is not expected.	Noted. No response required.
	• MAE4	Noted. No response required.

The impacts to the bridge are qualitatively discussed, with no modelling. The comment is made that the risk profile pre and post the land bridge construction does not materially change for toxic gas LOC, given that the gases are heavier than air in nature. The bow-tie tool is commonly used in industry for the assessment of MAEs.	
• MAE5 Assumptions made in modelling a ULP tanker leak are in line with industry practice, noting that they have only considered a LOC of one compartment. However, when discussing the impacts of a pool fire, increasing the quantity release does not fundamentally change the outcomes/impacts. It is not unusual to assume that a simultaneous release of multiple compartments is implausible. This highlights that the FFFS control is important to mitigate escalation. Whilst the statement that the thermal radiation consequence is the same as on the open road is true, it could be seen as misleading, given the influence of the land bridge on egress. This aspect is somewhat addressed in the discussion on smoke generation and the assessment completed in reference 7 in Attachment 2, which indicates that egress is possible without experiencing untenable conditions.	Noted. No response required.
• MAE6 This scenario should be modelled; the model has been completed as a catastrophic rupture, which is not considered plausible (in a vehicle accident, it is more likely that a sharp object will puncture a drum with a hole size less than 50 mm). However, as this is considered a worst case scenario and the impacts are also worst case, the conclusions drawn from the model are still relevant (but are conservative).	Refer Section 4, Item 3 of Arriscar's revised report ("Safety Review of DG Vehicles traffic under proposed Landbridge in Cockle Bay", Revision 1 dated 11th April 2025). Since impact from a larger event (catastrophic rupture) has no adverse impact on the land bridge, modelling of a smaller event (50mm leak) was not considered necessary. This has been agreed to in the peer review.
• MAE7 (toxic spill is listed as MAE8 in Table 7) The discussion is relevant. Whilst not assessed further, it is expected that this incident scenario is included in the ERP in order to manage mitigation requirements.	Noted. No response required.
• MAE8 (clinical waste spill is listed as MAE9 in Table 7) The discussion is relevant. Whilst not assessed further, it is expected that this incident scenario is included in the ERP in order to manage mitigation requirements.	Noted. No response required.
• MAE9 There is no MAE9 listed in the document, however, this should be ammonia nitrate LOC (MAE7 in Table 7) which is not modelled or discussed as it is not transported.	Noted. No response required.
• MAE10 The discussion is relevant. Whilst not assessed further, it is expected that this incident scenario is included in the ERP in order to manage mitigation requirements.	Noted. No response required.

	• MAE11 The decision to not consider this MAE further is unexpected. Transportation of a large lithium-ion battery could result in radiant heat from thermal runaway, particularly if it is damaged in an accident. Modelling of a battery fire should be completed to show the impacts of a battery fire are expected to be less than that of a petrol fire. Again, the FFFS control is important to mitigate escalation.	Refer Section 4, Item 4 of Arriscar's revised report ("Safety Review of DG Vehicles traffic under proposed Landbridge in Cockle Bay", Revision 1 dated 11th April 2025). MAE11 has been modelled and included in the revised report (i.e. fire of a large Li-ion battery). Refer to section 8.11 of the revised report.
Section 8: Estimation of incident likelihood	Given the frequency data uncertainty, it is common to use a semi quantitative risk assessment process. The approach to review available DGV accident data (national and international) rather than WD data is aligned with industry practice, and the frequency estimation process is correct. This section reviewed the data from a number of sources, but these were not empirically used, noting: On review of the Australian tunnels fire data source referenced, it is potentially the least relevant data set for this assessment, mainly because the data is skewed towards passenger car fires and not dangerous good fires. The data is inconsistent between sources. Class 3 bulk product releases is at least one order of magnitude more likely compared to other dangerous goods releases. The observation that there is an increased uncertainty within the data sets is correct and the benefit of a fully quantitative risk assessment is limited. The approach to assess the consequence and the likelihood separately using semi quantitative processes and then draw conclusions within a risk matrix is relevant and can provide similar insights to a quantitative risk value.	Noted. No response required.
Section 9: Risk assessment	***Original document commentary:*** The comment on difficulty with justifying assumptions is irrelevant. Regardless of the process, qualitative or quantitative, assumptions still need to be made. The sensitivity to changes in assumptions will impact the confidence of the outputs. Given the sensitivity to changes, the approach proposed for the quantitative safety and risk assessment (QSRA) is in line with industry practice. Using the Transport for NSW (TfNSW) matrix is relevant given the nature of the risks under consideration. The 6 by 6 matrix proposed also provides greater differentiation between risks than 5 by 5 matrices used by many organisations.	Refer Section 4, Item 5 of Arriscar's revised report ("Safety Review of DG Vehicles traffic under proposed Landbridge in Cockle Bay", Revision 1 dated 11th April 2025).

	Table 22 would have benefited from including details on the consequence category, e.g. service disruption or safety. Regardless, the designated consequence levels (e.g. C2) are suitable based on the information presented in section 7.	Comments have been added before Table 24 (Updated Table number)
	Using a blanket L5 for all scenarios, however, is not typical, particularly for a bulk petrol release. Given the discussions around incident frequency in section 8 of the report (estimation of incident likelihood), a rating of L4 for scenario 5 (petrol tanker) should be considered. Leaving the remainder of the likelihood ratings at L5 would be suitable based on the information presented in section 8.	Refer Section 4, Item 6 of Arriscar's revised report ("*Safety Review of DG Vehicles traffic under proposed Landbridge in Cockle Bay*", Revision 1 dated 11th April 2025).
	Potential changes by peer review Using a L4 with C2 for scenario 5 changes the risk rating to a B, which is high and would need a SFAIRP justification/demonstration.	Arriscar has considered the comment and agree that a rating of L4 for scenario 5 is more appropriate. Section 10.4 (Risk Evaluation) and 11 (SFAIRP Assessment) of the report has been revised accordingly.
Section 10: SFIARP assessment	***Original document commentary***	
	The SFAIRP criteria is clear but would suggest that SFAIRP is applied for scenarios with safety implications (as done in the rail industry) rather than for non-safety impacts (e.g. asset damage). Completing the SFAIRP demonstration using bow-tie methodology is common.	
	In Table 25, the prevention side of the bow-tie for toxic gas release is strong, and as noted in section 7, this scenario is not dramatically different to any other road location. Communication to road users is a possibility but would require a method that could be implemented to achieve high effectiveness.	
	Whilst the report indicates that emergency response should not be included in a SFAIRP justification, Table 25 includes/counts emergency response, although it is not captured as a high effectiveness, so does not influence the final SFAIRP outcome.	
	From the discussion on land bridge evacuation, it was difficult to ascertain how the evacuation would work. However as emergency evacuation document still needs to be finalised during the later stages of the project, better clarity is expected.	
	Potential changes by peer review Based on experience, some of the effectiveness ratings appear overly optimistic and it is recommended that CCTV and drainage should be rated moderate, rather than high. The fire incident and fire safety operational data for major Australian road tunnels paper from AusRoads (reference 29 from Attachment 1) highlights the importance of the CCTV and could support leaving the rating at high. However, this would require the WD to be monitored 24/7, as is the	Refer Section 4, Item 7 of Arriscar's revised report ("Safety Review of DG Vehicles traffic under proposed Landbridge in Cockle Bay", Revision 1 dated 11th April 2025).

	case for the true tunnels considered in the paper. If this is not the case, the effectiveness of CCTV should reduce to moderate. A check on the bow-ties to consider the implications of changing this effectiveness shows this would influence the SFAIRP rating for some of the scenarios. Where the change is an asset damage impact, this is considered still acceptable (taking application of SFAIRP as per the rail industry where only safety impacts need a SFAIRP justification). Changing the CCTV effectiveness rating to moderate would change the SFAIRP justification of the MAE for class 2.1 for asset damage only but would suggest this is acceptable (as done in the rail industry). Changing the CCTV effectiveness rating to moderate would not change the SFAIRP justification of the MAE for class 2.3 but does mean that there is no high or very high rated barrier on the right side of the bow-tie. This makes the inclusion of an in-vehicle communication method critical. Changing the CCTV and drainage effectiveness ratings to moderate would not change the SFAIRP justification of MAE for class 3 bulk and packages for asset damage. Bow-ties for class 3 bulk include a design element (as a high effectiveness), which has little influence on the impact (potential fatality) as the consequence modelling that was used to determine the impact was already restricted. However, including a design element associated with structural reinforcement of the land bridge roof beams/concrete planks (as noted in reference 6 of Attachment 2) would provide a high effectiveness design mitigation control. Changing the CCTV effectiveness rating to moderate would not change the SFAIRP justification of MAE for class 3 bulk for safety. High effectiveness of controls is needed for bulk, as the peer review suggests that the risk rating be reassessed to a “B”, meaning it is only acceptable if it is at SFAIRP. Changing the CCTV effectiveness rating to moderate would change the SFAIRP justification of MAE for class 3 packages for safety. This makes the inclusion of an in-vehicle communication method critical.	Table 23 of Ref. [12] has been reviewed for CCTV and Drainage and bow ties have been revised where applicable, including in-vehicle communications requirement.
Section 11: Safety critical activities	The identified Safety Critical Activities (SCAs) are typical for an asset of this nature.	Noted. No response required.
Section 12 & 13: Conclusions and recommendations	The conclusion statements are accurate based on the existing report. In relation to the peer review, the risk evaluation has no high or very high risks, and the risks are SFAIRP provided additional mitigation treatments are included.	Refer Section 4, Item 8 of Arriscar’s revised report (“Safety Review of DG Vehicles traffic under proposed Landbridge in Cockle Bay”, Revision 1 dated 11th April 2025).

	The recommendations reflect the contents of the report. However, the following control should be included (based on the Attachment 2 reports): Inclusion of structural reinforcement of the land bridge roof beams/concrete planks.	The recommendations have been reviewed and updated.
Appendix A	It is unclear what the relevance of assumption No. 5 is to this report. This is the first reference to "pipelines" and the "Melrose Park precinct master plan layout". Assumption No. 7 contradicts earlier statements that indicated it was class 1.1 and 1.2 that were prohibited, and that 1.3 and 1.4 were possible. Doesn't change the modelling outcome. All other assumptions are relevant.	Refer Section 4, Item 9 of Arriscar's revised report ("*Safety Review of DG Vehicles traffic under proposed Landbridge in Cockle Bay*", Revision 1 dated 11th April 2025). Assumption no.5 of the Arriscar report is not relevant to this project and has been removed from the report. The wording in Assumption no.7 regarding transportation prohibition has been corrected to state class 1.1 and 1.2.
Appendix B	The bow-ties in this Appendix are not in the same order as the list in Table 25 which makes it difficult to follow and can confuse the reader. Table 25 is incorrect for the class 3 MAE bow-ties (No. 4 is actually No. 5 and vice versa). The bow-ties are drawn as expected and are in line with industry practice.	Refer Section 4, Item 10 of Arriscar's revised report ("*Safety Review of DG Vehicles traffic under proposed Landbridge in Cockle Bay*", Revision 1 dated 11th April 2025). The error has been corrected.
Attachment 2 peer review findings		
Highlighted references	References 6 to 11 are relevant to Attachment 1. This means that these reports were completed prior to Attachment 1.	Noted. No response required.
Reference 6 – DG blast assessment (page 34 – 82)	The approach is logical and the figures very helpful. The assessment used a TNT equivalent figure that was rounded up (41 to 45), so this is a conservative assessment of petrol blast effects analysis (BEA). Additionally, the explosion of the ignition considered the full tanker (not compartments, as updated in Attachment 1). The use of CFD modelling to assess overpressure distribution is typical. A threat-barrier diagram (TBD) was completed using the longer enclosed area (150m), so the calculated frequency is conservative. The structural collapse population density approach and fatality calculations methodology are commonly used. In conclusion, it is recommended that: • The structural enhancement of the roof beams/concrete planks be re-worded as a requirement • The extent of the enhancement be determined in detailed design as the benefit (preventing 880 fatalities) makes the enhancement reasonably practicable.	Section 14 (Recommendations) of the revised report has been updated to include a requirement to implement the structural enhancement referred to in the ARUP report.

Reference 7 – technical note, additional scenarios for CFD modelling (page 84 – 494)	The approach is logical and the figures very helpful. Their results show evacuation of the people in vehicles adjacent to a DGV fire in land bridge is possible, and access by Fire and Rescue NSW is possible from at least one direction for all scenarios. The use of CFD modelling to assess temperature and smoke dispersion (visibility) is typical. The tenable conditions assessment is based on longer enclosed area (150m), so the evacuation time is conservative.	Noted. No response required.
Reference 8 – FSS (page 496 – 523)	This is a basic assessment, and reference 7 (which was written after reference 8) expands on the FSS work in much more detail. The tenable conditions assessment is based on longer enclosed area (150m), so the evacuation time is conservative.	Noted. No response required.
Reference 9 – Bow-tie (page 525 – 525)	This is a very basic assessment (actually an appendix to reference 11), and attachment 1 expands on the work, making this bow-tie redundant.	Noted. No response required.
Reference 10 – Risk register (page 527 – 530)	The document is pixilated and cannot be read (also this is an appendix to reference 11). However, the process used to obtain the risk register is described in reference 11, and the approach aligns with the Australian Standard for risk management (AS 31000). Given a risk assessment workshop and associated risk register is dependent on the people involved, it is difficult to challenge the output. This omission (pixilated content) is considered minor in relation to the peer review purpose.	Reference 10 Risk Register is legible if you zoom in on screen.
Reference 11 – Dangerous Goods Vehicles Safety Risk Assessment Summary Report (page 532 – 635)	This is a high level assessment, with qualitative discussion only and Attachment 1 expands on the work. The SFAIRP approach is in line with industry practice, although a summary table of the written output would have been welcomed. It is suggested that the practicality of an Emergency Services Marshalling Area be reassessed for the land bridge.	The Proponent will accept a condition of consent requiring consideration of a Marshalling Area, in consultation with Transport for NSW.
Remaining document peer review findings		
Attachment 3 drawings	Having the land bridge void does not change the risk of the nominated scenarios in attachment 1. It does reinforce the designation as a land bridge. However, given the assessment in reference 7 in Attachment 2 shows no untenable conditions (as per AS 4825-2011 section 1.6.31) for a 150 m land bridge, the current design of an 84 m land bridge suggests the void is unnecessary.	Noted. No response required.
CBP planning letter	The letter has no relevance to the risk peer review as it merely refences that attachment 1 and 2 have been completed. The key discussion is around the void design, which is already reviewed (see attachment 3 drawings comments), so comment is not provided for this document.	Noted. No response required.

Table 2 GHD Recommendations

GHD Recommendation	Response
Design Recommendations	
Bow-ties are a great tool for visualising the layers of control and allow an indication of each control's effectiveness. The controls listed in the bow-ties must be implemented to manage the risk SFAIRP. In addition, mitigation controls discussed within the safety reports, but not listed in the bow-ties should also be included, as they have a direct benefit in reducing the impact of DGV accidents. These additional mitigation measures are: • An appropriate in-vehicle communication system and • An appropriate level of structural reinforcement of the land bridge roof beams/concrete planks From a safety risk perspective, the inclusion of a void within the land bridge provides no risk reduction for the DGV accident scenarios identified.	Noted. The Proponent will accept a condition of consent that requires the incorporation of these mitigation measures into the development.
Land Bridge Safety	
The documentation reviewed indicates that: • The inclusion of a land bridge does not change the risk profile of a DGV accident and a subsequent LOC event on the WD • The land bridge does change the ability of road users to safely egress from the area The content and conclusions reached by the authors of the documents peer reviewed, particularly the 2024 reports within Attachment 2 on structural integrity and untenable conditions, provide evidence that the inclusion of a land bridge still allows safe egress. These and the bow-tie SFAIRP assessment provided in Attachment 1, with the associated inclusion of controls, indicate that the proposed land bridge is acceptable.	Noted. No response required.
Section 3 captures the design recommendations identified within the documents peer reviewed. An additional mitigation measure that does not appear to have been identified in the documents is to extend the in-vehicle communication system to the open space above the land bridge to enable targeted evacuation. This system will be of benefit for the emergency response, evacuation and recovery plans and procedures that must be developed to manage incidents on or under the land bridge.	Noted. The Proponent will accept a condition of consent that requires the incorporation of this mitigation measure into the development.