Our Ref: ID 2373
Your Ref: PP-2024-658

29th April 2024

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Dear Elizabeth,

Planning Proposal for 146 Newbridge Road, Moorebank

Thank you for the opportunity to provide comment on the additional flood reports by Tooker and Associates and Risk-e-Business Consultants in support to the Planning Proposal for 146 Newbridge Road, Moorebank. We refer also to our previous advice dated 29 January 2024.

In summary,

- The revised proposal seeks to enable residential development using Clause 2.5 of the Liverpool LEP (2008) to include an additional permitted use. The proposal argues the airspace above the site is above the Probable Maximum Flood (PMF) and therefore that residential development is feasible and desirable. NSW SES does not support this proposition, as outlined in Appendix A.

- **Based on the available information, it appears the proposal is inconsistent with the Directions issued by the Minister for Planning** under section 9.1 (2) of the Environmental Planning and Assessment Act 1979, Planning Direction 4.1 Flooding, Sections 2, 3(a), 3(c) and 3(g)[1]. Further details are provided in Appendix A of this document.

- **The flood risk at the site poses a risk to human life and property**. While we acknowledge that the proposed floor levels are raised, the land on which the buildings are proposed is impacted by floods as frequently as 5% AEP events, below the current Flood Planning Level. In 1% AEP events, the flood depth in parts of the site can reach above 5 meters [2] and the flood hazard level reaches H5 – H6 [3], which is "*unconditionally dangerous and unsuitable for any type of development*." [4] In a

[1] NSW Department of Planning and Environment. Local Planning Directions, page 44.
[2] BMT. 2020. Georges River Flood Study - Final Draft Mapping Compendium. Figure A-05
[3] BMT. 2020. Georges River Flood Study - Final Draft Mapping Compendium. Figure A-13
[4] BMT. 2020. Georges River Flood Study - Final Draft Report. Section 7.4 - Flood Hazard. Page 140

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Probable Maximum Flood (PMF), the flood depth on the entire site can reach above 10 meters[5], with a flood hazard level of H6 for the entire site[6], and parts of the site becoming a floodway.[7] This is inconsistent with the intent of the Ministerial Directions for flooding.

- **This proposal would increase the residential population on the site** from nil dwellings to up to 340 residences, with associated vehicular traffic of 592 cars for all proposed uses. We acknowledge there is an approved DA on the site for the purpose of a Marina. However, the site is not currently approved for any *residential* development, which would have a different risk profile to a Marina which may not be occupied during a flood. This is further detailed in Appendix A.

- By increasing the number of vehicles on this site from the current number of zero (not including those approved in the previously approved DA),[8] [9] this proposal, as part of the Moorebank East Precinct[10], **would restrict the number of vehicles able to safely evacuate from Chipping Norton[11]**. The cumulative impacts of development should be considered, particularly in light of recently approved development such as Moore Point which further constrains evacuation in the area, regardless of which evacuation model is used.

- Although we recognise the benefits of having a refuge above the PMF as a back-up strategy if people are unable or willing to evacuate, sheltering in place should not be used to create new communities[12]. Further complicating sheltering at this site, the supports for the proposed residential building and lower levels[13] would be exposed to high hazard (H6) flooding during flood events as frequent as the 1% AEP [14] [15] [16], and

[5] BMT. 2020. Georges River Flood Study - Final Draft Mapping Compendium. Figure A-8
[6] BMT. 2020. Georges River Flood Study - Final Draft Mapping Compendium. Figure A-15.
[7] BMT. 2020. Georges River Flood Study - Final Draft Mapping Compendium. Figure A-11
[8] Molino Stewart. 2022. Georges River Evacuation Modelling – Flood Evacuation Analysis. Table 2, Page 11
[9] Molino Stewart. 2022. Georges River Evacuation Modelling – Flood Evacuation Analysis. Section 5.5.3, Page 55
[10] Molino Stewart. 2022. Georges River Evacuation Modelling – Flood Evacuation Analysis. Table 11, page 52
[11] Molino Stewart. 2022. Georges River Evacuation Modelling – Planning Proposals. Table iii. Constraints on Future Development. Page vii
[12] NSW Government. 2023. Flood Risk Management Guideline EM01: Support for Emergency Management Planning.
[13] Tooker and Associates. 2023. Mirvac Georges Cover Marina PP Flood Impact Assessment and Flood Emergency Response Plan v4 010823, Section 3, Page 3
[14] Tooker and Associates. 2023. Mirvac Georges Cover Marina PP Flood Impact Assessment and Flood Emergency Response Plan v4 010823, Sections 3 and 4, Page 3
[15] BMT. 2020. Georges River Flood Study - Final Draft Mapping Compendium. Figure A-3, Page 5
[16] BMT. 2020. Georges River Flood Study - Final Draft Mapping Compendium. Figure A-13

would therefore be considered vulnerable to failure[17], regardless of if *"floods (..) will pass beneath the building"*[18]. If part or all of the building were to fail, the risk to life could be catastrophic[19], due to the proposed high-density population at risk and the hazardous floodwater surrounding the building.

- Given the risk to life, evacuation constraints, potential structural risks, and historical flood rescues along Newbridge Road and other roads in the vicinity, we **do not support** the proponent's proposed complex reliance on SES-led evacuations[20], private evacuation plans[21], pedestrian evacuation and shelter in place as being sufficient to justify the proposed introduction of risk by increasing the residential population on this site. We note the BCS (now known as the Department of Climate Change, Emergency, the Environment and Water) letter dated 9/2/2024 supports the NSW SES advice, stating that:

  "BCS agrees with the SES advice including the parameters and assumptions to be considered in the assessment of emergency conditions and the development of an emergency response plan to address and manage flooding risks during major flooding events (such as the PMF)"

We note that one of the reports states that[22]

> "*NSW SES is not legislated as the authority for flood planning development. Currently, the NSW SES is providing advice in a process where its representatives are not subject matter experts*."

We would like to re-emphasise that NSW SES is the agency responsible for dealing with floods, storms and tsunami in NSW[23] and provides technical advice under the NSW Flood Prone Land Policy. As such, the NSW SES has an interest in the public safety aspects of the development of flood prone land, particularly the potential for changes to land use to either exacerbate existing flood risk or create new flood risk for communities in NSW. NSW SES' experience and expertise in providing emergency management advice for land use referrals includes:

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[17] Department of Planning and Environment, 2023, Flood risk management guideline FB03, page 3
[18] Tooker + Associates, 2024, *RE: SES Correspondence to DPHI (29 Jan 2024) regarding Mirvac Georges Cove Marina Planning Proposal, 146 Newbridge Rd, Moorebank*, Low flood Island, page 4
[19] Australian Institute for Disaster Resilience. 2020. National Emergency Risk Assessment Guidelines. Page 3-4
[20] Tooker + Associates, 2024, *RE: SES Correspondence to DPHI (29 Jan 2024) regarding Mirvac Georges Cove Marina Planning Proposal*, 146 Newbridge Rd, Moorebank, SES: Increased Risk to Life, Page 3
[21] Tooker + Associates, 2024, *RE: SES Correspondence to DPHI (29 Jan 2024) regarding Mirvac Georges Cove Marina Planning Proposal*, 146 Newbridge Rd, Moorebank, SES: Increased Demand for Emergency Services, Page 5
[22] Owens, D. 2022. Georges Cove Marina – Moorebank, Mirvac Development. P3
[23] *SES Act, 1989 (NSW), s8(1)(aa) and 8(1)(a)*

- The provision of advice for the last 30 years via several experienced and technically proficient staff members during that time.
- Significant contributions to the development of floodplain management manuals and guidelines over the last 25 years, which also influences the planning process.
- NSW SES staff have been requested as expert witnesses to the Land and Environment Court.
- Several of our staff are lecturers for the University of Technology Sydney (UTS) Floodplain Management course.
- A dedicated and multi-disciplinary team of planners to provide advice, with qualifications ranging from Advanced Diplomas, Bachelors, Masters and PhD graduates.
- Working closely with the Department of Planning, Housing and Infrastructure (DPHI) and NSW Department of Climate Change, Energy, the Environment and Water (DCCEEW) on a wide range of land use planning matters, Infrastructure NSW on Hawkesbury Nepean and now the Reconstruction Authority regarding Northern Rivers and Central West.
- Regular peer meetings with the NSW DCCEEW and DPHI teams.
- Regular Director level meetings with the Department of Planning, Housing and Infrastructure (DPHI) strategic planning areas.

Please feel free to contact Peter Cinque via email at rra@ses.nsw.gov.au should you wish to discuss any of the matters raised in this correspondence. The NSW SES would also be interested in receiving future correspondence regarding the outcome of this referral via this email address.

Yours sincerely,

Nicole Hogan
Assistant Commissioner, Director Emergency Management
NSW State Emergency Service

Appendix A – NSW SES Detailed Advice

Site

The site at 146 Newbridge Road, also known as Georges Cove Marina (Site D) (the "Site"), is located on land that is a low flood island adjacent to the Georges River within the Liverpool LGA, subject to high hazard flooding.

We acknowledge there is an approved Development Application (DA611/2018) for the Georges Cove Marina, a commercial development, inclusive of carparking. However, we note that, in its current state, the Site is not developed and there is no carparking currently on site. We note that the site is not currently approved for any residential development.

Proposed Residential Development

The Site is currently zoned as RE2- Private Recreation and is situated in the flood planning area[24] [25].

The Proposal seeks to include residential accommodation, along with restaurants or cafés, and increase the density of the at-risk population by amending the height of buildings and maximum floor space. We understand that the proposal seeks to justify the development by using the "air space" within the Flood Planning Area, however it must be noted that the proposed buildings will still be located on and surrounded by extremely high hazard flooding for up to one or more days. In some instances, it may take longer for any damaged roads, bridges or services to be made safe for access, as was the case in the 2022 Northern Rivers flooding.

To enable this, the proponents are seeking to use Clause 2.5 of the Liverpool LEP (2008) to permit this additional use. It is not clear that Clause 2.5 can or should be used in this context to disregard the Ministerial Direction embodies in Clause 5.21. No evidence has been provided if Liverpool Council is planning to excise the Site from the Flood Planning Area to which Clause 5.21 applies.

Relevant Flood Studies

The relevant flood studies for this site include:

- Georges River Flood Study – adopted by Council
- Georges River Floodplain Risk Management Study and Plan 2004 – adopted by Council

[24] https://eplanning.liverpool.nsw.gov.au/Pages/lcc.maps/maps.aspx
[25] Liverpool Local Environmental Plan 2008 maps FLD014 (Identification 4900_COM_FLD_014_020_20130228) and FLD015.

- Georges River Flood Study 2020 – commissioned by Council via NSW Floodplain Risk Management grant funding but not yet adopted by Council.

We note that the Council commissioned Evacuation Study used the Georges River Flood Study 2020.

The proposed residential development is not consistent with the Ministerial Planning Direction 4.1 Flooding

Based on the available information, it appears that the proposal is not consistent with the Ministerial Planning Directions for Flooding. The Site is not only located within the current Flood Planning Area[26] [27], both the recently completed Georges River Flood Study (2020) [28] and the currently adopted (2004) floodplain risk management study[29] show that a significant part of the site is located on land that is a floodway.

The following paragraphs address each of the Ministerial Planning Directions for flooding.

> **(2)** *A planning proposal must not rezone land within the flood planning area from Recreation, Rural, Special Purpose or Conservation Zones to a Residential, Employment, Mixed Use, W4 Working Waterfront or Special Purpose Zones.*

We note that it was stated previously that the *"Mirvac Planning Proposal seeks to rezone the land to provide supporting residential uses in conjunction with the uses which are already approved."*[30]

The Site is currently zoned as RE2- Private Recreation and is situated in the flood planning area which precludes rezoning to residential as per Clause 5.21 of the Liverpool LEP (2008).

However, the revised proposal seeks to enable residential development, within zoned land that does not currently permit this type of development, by seeking additional permitted uses via Clause 2.5 of the Liverpool LEP (2008) (schedule 1).[31]

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[26] https://eplanning.liverpool.nsw.gov.au/Pages/lcc.maps/maps.aspx
[27] Liverpool Local Environmental Plan 2008 maps FLD014 (Identification 4900_COM_FLD_014_020_20130228) and FLD015.
[28] BMT. 2020. Georges River Flood Study - Final Draft Mapping Compendium. Figure A-11
[29] Bewsher Consulting. 2004. Georges River Floodplain Risk Management Study and Plan.
[30] Tooker + Associates, 2024, *RE: SES Correspondence to DPHI (29 Jan 2024) regarding Mirvac Georges Cove Marina Planning Proposal*, 146 Newbridge Rd, Moorebank, Increased Flood Risk to Life, page 3.
[31] EMM Consulting, 2023, Georges Cove Marina Modified Planning Proposal, Section 4.2, page 10

The proposal appears to contradict the Ministerial Direction by proposing to allow for residential uses on RE2 zoned land, that would otherwise not be permitted under the Ministerial Direction.

> **(3)** *A planning proposal must not contain provisions that apply to the flood planning area which*:
> **(a)** *permit development in floodway areas;*

The proponent is seeking to classify the airspace above the Marina as above the Flood Planning Area so that residential development can occur in that airspace. This appears to be at odds with the intent of Ministerial Direction 4.1.

Further part of the Site is in the floodway. In contrast we note that other parts of the floodway along Newbridge Road have a Voluntary Acquisition Scheme, to reduce residential development exposed to the high hazard flooding within the floodway, as a voluntary house raising scheme was deemed not appropriate due to the significant flood risk.[32] Adding additional (raised) residential development elsewhere within the floodway appears to be contrary to the objectives of reducing flood risk in the floodway.

> ***(c)*** *permit development for the purposes of residential accommodation in high hazard*;

As detailed in our previous response, the proposed residential development would be located in a high flood hazard area. The flood modelling shows:

- That high hazard (H5) floodwater would be present on the site as frequently as the 20% AEP flood events.[33]
- The site becomes inundated by floodwater with depths of 3-4m or greater in a 5% AEP event.[34]
- In 1% AEP events, the flood depth in parts of the site can reach above 5 meters[35] and the flood hazard level reaches H5 – H6[36], which is ***"unconditionally dangerous and unsuitable for any type of development."*** [37]

[32] Liverpool City Council. 2022. Minutes of the Ordinary Meeting held on 30 March 2022. Item No: QWN 02, Page 27
[33] BMT. 2020. Georges River Flood Study - Final Draft Mapping Compendium. Figure A-1, Page 3
[34] BMT. 2020. Georges River Flood Study - Final Draft Mapping Compendium. Figure A-3, Page 5
[35] BMT. 2020. Georges River Flood Study - Final Draft Mapping Compendium. Figure A-05
[36] BMT. 2020. Georges River Flood Study - Final Draft Mapping Compendium. Figure A-13
[37] BMT. 2020. Georges River Flood Study - Final Draft Report. Section 7.4 - Flood Hazard. Page 140

- In a Probable Maximum Flood (PMF) event the flood depth on the entire site can reach above 10 meters[38], with a flood hazard level of H6 for the entire site[39], and parts of the site becoming a **floodway**.[40]

> ***(g)*** *are likely to result in a significantly increased requirement for government spending on emergency management services, flood mitigation and emergency response measures, which can include but are not limited to the provision of road infrastructure, flood mitigation infrastructure and utilities*

In trying to alleviate some of the evacuation constraints to allow for this development to proceed, additional government spending on roads and transport infrastructure will be required; roads identified as part of the proposed evacuation route as stated in the Georges River Evacuation Modelling, *"An additional lane on Nuwarra Road should be investigated to see whether it would provide sufficient additional evacuation capacity to enable further development at Moorebank East without compromising the safe evacuation of existing development in Chipping Norton"*[41].

Part (g) of the Ministerial Direction is expanded upon in the following sections, including its impact on NSW SES.

Increase in risk to life by introducing residential development

The proposed residential usage of the site, as compared to either the existing use on the site or the approved use of a Marina, would increase the likelihood of persons (and vehicles) being on the site during poor weather conditions. We understand that under the approved DA for a marina development on the site, the majority of the usage for the site would be recreational. As stated in the Proponents Flood Consultants Response to pre Gateway SES and BCS State Agency Comments *"Historically, when the weather conditions are inclement for sustained periods (which will give rise to even minor flooding), these recreational related facilities (picnic areas and adjoining carparks) are largely unused."*[42] The proposed addition of 340 residential dwellings on the site, consisting of 21 terraces[43] and 319 apartments[44], would change the usage on the site away from being primarily recreational, and therefore lead to a change in

[38] BMT. 2020. Georges River Flood Study - Final Draft Mapping Compendium. Figure A-8
[39] BMT. 2020. Georges River Flood Study - Final Draft Mapping Compendium. Figure A-15.
[40] BMT. 2020. Georges River Flood Study - Final Draft Mapping Compendium. Figure A-11
[41] Molino Stewart. 2022. Georges River Evacuation Modelling. Recommendations B. Planning Proposals. Page 10
[42] Tooker and Associates. 2024. Response to Pre Gateway SES and BCS Agency Comments, SES: "Increased Flood Risk to Life". Page 3
[43] EMM Consulting. 2023. Georges Cove Marina Modified Planning Proposal. Section 5.3.4 Traffic. Page 47
[44] Liverpool Council. 2024. Request for Gateway determination for a Planning Proposal at Lot 3 of 146 Newbridge Road, Moorebank NSW 2170

usage of and long-term population at the Site during inclement weather and associated flooding.

This is highlighted in the Proponents Flood Consultants Response to pre-Gateway SES and BCS State Agency Comments, *"In relation to the approved car parking spaces, we make the observation that during a usually prolonged weather event that is likely to lead to a flooding emergency, it is highly unlikely that the Marina would be in operation and/or customers would be using the facility."*[45] Therefore, allowing residential development at the site, which is a high flood risk area, is not suitable. As opposed to recreational facilities that people will most likely choose not to visit during severe weather events, residential buildings are people's homes where they must feel safe. Having to evacuate during a flood can have significant emotional impacts on people[46].

Private Evacuation Plans

The NSW SES is opposed to the imposition of development consent conditions requiring private flood evacuation plans rather than the application of sound land use planning and flood risk management[47].

This is also supported in the case McBurney v Penrith City Council [2014] NSWLEC 1100 (28 May 2014) where it was deemed there were not fail-safe systems in place to achieve safe and effective evacuation, particularly for new residents.

Risks to building structure due to exposure to high hazard floodwater

The supports for the proposed building would be exposed to high hazard (H6) flooding during flood events as frequent as the 1% AEP [48] [49] [50]. The proponent states that *"floods… will pass beneath the building"*[51], however we note from the Planning Proposal that the building is proposed to be *"supported on piles to form more flood storage"*[52]. Therefore, by definition,

[45] Tooker and Associates. 2024. Response to Pre Gateway SES and BCS Agency Comments, SES: "Increased Flood Risk to Life".
[46] Natural Hazards Research Australia. 2023. Community experiences of the January-July 2022 floods in New South Wales and Queensland. Page 123
[47] NSW Government. 2023. Flood Risk Management Guideline EM01: Support for Emergency Management Planning
[48] Tooker and Associates. 2023. Mirvac Georges Cover Marina PP Flood Impact Assessment and Flood Emergency Response Plan v4 010823, Sections 3 and 4, Page 3
[49] BMT. 2020. Georges River Flood Study - Final Draft Mapping Compendium. Figure A-3, Page 5
[50] BMT. 2020. Georges River Flood Study - Final Draft Mapping Compendium. Figure A-13
[51] Tooker + Associates, 2024, *RE: SES Correspondence to DPHI (29 Jan 2024) regarding Mirvac Georges Cove Marina Planning Proposal, 146 Newbridge Rd, Moorebank*, Low flood Island, page 4
[52] Tooker and Associates. 2023. Mirvac Georges Cover Marina PP Flood Impact Assessment and Flood Emergency Response Plan v4 010823, Section 3, Page 3

this part of the building (supporting structure) exposed to H6 hazard flooding **would be considered vulnerable to failure**.[53]

If part or all of the building were to fail, the risk to life would be catastrophic[54], due to the proposed high-density population at risk and the hazardous floodwater surrounding the building. For example, although investigations are still ongoing[55], water damage to structural supports has been listed as a possible contributor to the devastating partial collapse of the Surfside Champlain Towers South Condominium[56], which resulted in the deaths of 98 people.

The proposed building support piles would be exposed to flood forces and debris, including the potential for boats located at the proposed marina becoming unmoored during storm and flood events and striking the piles. As per Flood Risk Management Guideline FB03 *"floodwater and debris can undermine structures or damage or destroy structural and non-structural elements of buildings and infrastructure and affect contents.[57]"*

Additionally, the footings of any supporting piles could be subject to hydrodynamic scour, when fast flowing water can carve out scour holes by removal of sediment around the base of a structure, particularly during flood events. It has been noted that "*80% of bridge failures are due to scour, often during floods and peak flow events which are becoming more common with climate change*[58]". Should similar conditions impact the proposed supporting piles it would present a significant risk to life.

If the Planning Proposal proceeds to a Gateway Determination, then a condition would need to be added to properly assess the stability of the proposed building supports to the high hazard. Given the high hazard and potential risk at this site, this assessment should not be left to the DA stage.

Secondary risks are significant and can pose a risk to life. These secondary risks become residual risk transferred to NSW SES

[53] Department of Planning and Environment, 2023, Flood risk management guideline FB03, page 3
[54] Australian Institute for Disaster Resilience. 2020. National Emergency Risk Assessment Guidelines. Page 3-4
[55] https://www.nist.gov/news-events/news/2023/09/nist-provides-update-investigation-collapse-champlain-towers-south
[56] Mehrooz Zamanzadeh and Peyman Taheri, 'Surfside Champlain Towers South Condominium Collapse and Condition Assessment of Nearby Aging High-Rise Buildings from a Corrosion Engineering Perspective', n.d.
[57] Department of Planning and Environment, 2023, Flood risk management guideline FB03, page 1
[58] Flint, M. M., Fringer, O.,Billington, S.L., Freyberg,D., and Diffenbaugh, N. S., 2017 Historical Analysis of Hydraulic Bridge Collapses in the Continental United States, ASCE Journal of Infrastructure Systems, 2017, 23(3),ASCE, ISSN 1076-0342.

The area is an existing flood rescue hotspot for NSW SES, which would be exacerbated by increasing the density of the population at risk.

Several flood rescue jobs have historically been responded to by the NSW SES in the area, as recently as 2020, 2021, 2022 and most recently 2024 (which was a very small event). This includes NSW SES volunteers responding to people requiring evacuation, trapped in their cars and properties by floodwaters, people who were neck deep in floodwater and ambulances being unable to reach patients to provide emergency medical assistance.

Warnings delivery

Whilst the Molino report mentions doorknocking it should be noted that the NSW SES does not solely rely on this method and distributes warnings via radio, TV, SMS, Hazards Near Me app, SES website, Council emergency web sites, email to key networks and social media. We also know that telecommunications can degrade during large flood events. Doorknocking is a strategy to do one final check of the area to be evacuated as belts and braces approach.

A high number of NSW SES resources are also required to deliver warnings to the community and coordinate evacuations across the Georges River.

An insufficient vehicle evacuation capacity, as demonstrated below in the Evacuation Constraints and Assumptions section, coupled with high-hazard floodwaters at the site (above 5 meters in 1% AEP events), and human behaviour factors could lead to fatalities.

"The literature frequently highlights risk-taking behaviours as a critical factor in flood-related fatalities" [59]. People often enter floodwaters due to incorrect risk perception and/or social influences; and even when individuals are aware of the risks, the actual depth and speed of the floodwaters can catch them off guard due to an underestimation of these factors.

When evaluating potential impact, the risk of isolation, secondary risks and human behaviour should be considered. There is no known safe period of isolation in a flood, though the longer the period of isolation, the greater the risk to occupants. Risk to occupants may be compounded by secondary risks such as fires or medical emergencies. There is also the risk that people will not follow emergency management plans, for example they may refuse to remain isolated from family for an extended duration. The duration for Georges River is much longer than Parramatta River, as used to justify the development[60].

People tend to resist calls to evacuate before the land around them is obviously flooded. Unfortunately, our experience is that people change their mind about this option after they have been surrounded by flood water or when essential services such as water, power and

[59] Petrucci, O. 2022. Review article: Factors leading to the occurrence of flood fatalities: a systematic review of research papers published between 2010 and 2020. *National Hazards and Earth System Sciences.* 22, 71-83.
[60] Tooker and Associates. 2024. Response to Pre Gateway SES and BCS Agency Comments, p2

sewer cease to function. Rescue, resupply and medical responses are difficult and can be dangerous under these conditions.

In such situations, NSW SES resources will be required to rescue and/or resupply occupants, in addition to other emergency services that may be required to respond to situations arising from secondary risks such as fires and medical emergencies.

Evacuation constraints and assumptions

In summary, the proposed development will exceed the capacity of the available evacuation infrastructure for the Moorebank East Precinct and the broader surrounding area in a flood event**, which is not compliant with the Clause 5.21 of the Liverpool Local Environmental Plan 2008:** *"Development consent must not be granted to development on land the consent authority considers to be within the flood planning area unless the consent authority is satisfied the development (..) will not adversely affect the safe occupation and efficient evacuation of people or exceed the capacity of existing evacuation routes for the surrounding area in the event of a flood."*[61]

The Molino Stewart report highlights that "*there is insufficient road capacity to cater for the evacuation of the planning proposals"*[62] and that the proposals *"far exceed the capacity of the road network to cater for their evacuation during a flood. Together they would result in nearly 32,000 vehicles having to evacuate in advance of a flood under the current settings and the modelling suggests that more than 26,000 of them would not be able to evacuate by vehicle in time."*[63] Further, "*Development at Moorebank East should be restricted, considering it is estimated that half of the potential evacuation capacity is taken up by the already-approved Site C development.",* and also states that *"planning proposals for Moorebank East (..) would take up road capacity currently used by Chipping Norton evacuees and thousands would be caught by floodwaters who would otherwise have time to escape"* [64].

The cumulative impacts of adjacent approved development limits evacuation capacity and constrains the ability for people in the proposed development to evacuate safely and successfully. Further, if the proposed development were to go ahead it would further significantly impact the evacuation capacity of surrounding areas, including existing and already approved development. This would transfer additional risk to emergency services who will be called upon for rescue of those unable to evacuate.

Road evacuation routes

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[61] NSW Government. 2024. Liverpool Local Environmental Plan 2008. S5.21 (c).
[62] Molino, S. 2022. Georges River Evacuation Modelling – Key Findings, Existing and Infill Development, Page vii
[63] Molino, S. 2022. Georges River Evacuation Modelling – Key Findings, Existing and Infill Development, Page viii
[64] Molino S. 2022. Georges River Evacuation Modelling – Flood Evacuation Analysis, Final. Pages viii - ix.

NSW SES' Moorebank East C Subsector encompasses the Georges Cove residential development and the proposed Georges Cove marina development. The road evacuation routes for the proposed development leads on to Spinnaker Drive, through the approved development Georges Cove residential area, to Promontory Way and then on to Brickmakers Drive.

The height of Promontory Way bridge from Spinnaker Drive to Brickmakers Drive has a low point of 5.6m AHD at Brickmakers Drive and a high point of 10.04m at Spinnaker Drive. Therefore, residents and visitors of this area would need to evacuate prior to 5.6m AHD which is at the 1:100 flood level.

We also note from the Georges River Evacuation Modelling that "*where traffic converges onto a single lane at the intersection of Brickmakers Drive and Nuwarra Road, there is insufficient road capacity for timely evacuation.*"[65]

Evacuation models

Given the location of the proposed development it is not appropriate to only use the simple SES timeline evacuation model (TEM) given that nearby areas could be also evacuating to the main evacuation routes, resulting in converging traffic. The TEM was only designed for areas which have only one evacuation route with no interaction with adjacent or nearby evacuation areas.

Instead, an agent-based model is more appropriate. The Hawkesbury Nepean FEM was developed to address the need to better model complex areas. The FEM is being applied to other areas in the future.

In the case of the Georges River, we support the findings from Molino Stewart's evacuation model and his expertise in developing appropriate agent-based models to understand complex evacuation scenarios. This evacuation model report is independent of the publicly available NSW SES Flood Plan, cited as out of date and incomplete[66]. We note that the Georges River Flood Plan 2018, Volume 1, is an endorsed flood plan which sets out the flood emergency arrangements for the Georges River. This plan sits above the Liverpool Local Flood Plan, endorsed in April 2021 and again in April 2023.

NSW SES Flood Plans are not the sole repository of flood behaviour, SES flood intelligence, evacuation triggers, analysis and operational planning. This information is determined by analysis of spatial and other datasets. The evacuation model draws from these and other sources of contemporary information.

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[65] Molino, S. 2022. Georges River Evacuation Modelling – Flood Evacuation Analysis Final, Section 1.1, page 2

[66] Owens, D. 2022. Georges Cove Marina – Moorebank, Mirvac Development. Page 3

Scenarios must assume full compliance for evacuation capacity planning purposes

As identified in the NSW Government Flood Evacuation Model Report for the Hawkesbury Nepean Valley[67], 100% evacuation compliance should be assumed for evacuation capacity planning purposes to ensure all future occupants have equal opportunity to evacuate, even if achieving 100% response rate is currently difficult.

It would be perverse to assume that evacuation compliance is less than 100% and that road transport capacity need only be provided for the current percentage of the population that complies with evacuation advice. Designing in a reliance on pedestrian evacuation is flawed, particularly at this site where the prevailing weather conditions during a flood would not be favourable for walking.

Vehicle ownership

Residences with no motor vehicle in the Liverpool LGA was 7.4% in 2021 (lower than greater Sydney average of 10.8%) and has remained consistent since 2016[68]. This is much lower than 17% as quoted in the Owens report. This lower level is consistent with Liverpool being at the periphery of the Metro area where public transport options are limited compared to the inner part of Sydney.

Further, during inclement weather, people without a motor vehicle often request assistance with evacuation via other means (for example neighbours, taxi or ride share) or from NSW SES. In the latter case, transport services would be provided for people without vehicles consistent with the approach taken in NSW SES evacuation planning. During flood operations the Transport Services Liaison Officer would coordinate additional transport options.

Evacuation Flow Rate

In 1997 the evacuation traffic flow rate was set at 600 vehicles per lane per hour for evacuation timelining in a supplementary report to the Hawkesbury Nepean Strategy report presented to Government[69]. This supplementary report provided the first analysis of evacuation traffic flow rates for the Hawkesbury Nepean.

Sections C2.3.1, C2.3.2 and C2.3.3 of the report provide a rationale and analysis of the evacuation flow rate from the traffic engineering and emergency management perspectives.

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[67] NSW Government. 2023. Hawkesbury-Nepean Valley Flood evacuation modelling to inform flood risk management planning. Page 40

[68] profile.id.com.au/Liverpool <accessed 23 April 2024>

[69] Danielson & Associates Inc, Patterson Britton & Partners Pty Ltd, and Masson and Wilson Pty Ltd, 'Emergency Response Planning and Traffic Infrastructure (Extract)' (Hawkesbury Nepean Flood Management Advisory Committee, September 1997).

The analysis considers the capacity according to guidelines (AUSTROADS), observed capacity of roads within the floodplain and evacuation design capacity considerations.

The report concludes that *"On balance, the previously assumed 600 vehicles per hour is a good planning base. While it is lower than the AUSTROADS Level of Service D, it clearly accounts for the high flows achieved on Sydney's roads while allowing for a degree of unfamiliarity by the driver."* (Danielson & Associates Inc, Patterson Britton & Partners Pty Ltd and Masson and Wilson Pty Ltd, 1997)

The report notes:

> *C2.3.3 Evacuation Design Capacity*
> *The goal for establishing an appropriate design capacity should be to provide conditions such that free flow conditions are maintained throughout the evacuation period. Drivers should not be subject to a stressful driving environment. The design capacity should have regard to:*

- *the need to sustain a constant flow of traffic for an extended period of time*
- *evacuation may take place during the night and/or wet and rainy conditions*
- *the driver's likely uneasy state of mind*
- *the need to provide a traffic flow regime that allows occasional side street or property access to the evacuation route*
- *the need to build in recovery potential in the event that traffic incident or water damage to*
- *road pavement should cause a temporary blockage or reduce capacity, and*
- *the high proportion of drivers who may be unfamiliar with the evacuation routine.*

Note that Austroad 2020 definitions have not changed significantly since 1997.

In the implementation of the Flood Strategy the Road Evacuation Working Group was formed which had representatives from the then NSW Department of Land and Water Conservation, the NSW Roads and Traffic Authority (RTA), NSW State Emergency Service and Councils.

The Working Group engaged consultants to prepare the Interim Road Upgrade Plan (Patterson Britton & Partners Pty Ltd, 2000) who also reviewed the evacuation flow rate. An initial evacuation model was prepared (Patterson Britton & Partners Pty Ltd, 2000) which was used to help determine road upgrade options and priorities. This model used the previously determined 600 vehicles/lane/hr flow rate.

A recent summary of research into evacuation flow rates states[70] [71]:

> *Section 9.3.2.1*
>
> *Later studies, based on additional evacuation traffic data, continued to show that evacuation traffic flow, even in conventionally flowing lanes and particularly at near-capacity levels, differs from that in nonemergency periods (Wolshon and McArdle 2009). Because of the consistent and compelling evidence of the flow rate variation, FDOT recently recommended the use of Maximum Sustainable Evacuation Traffic Flow Rates (MSETFR) for modeling evacuation traffic in the Florida Keys. Although contraflow might never be used, establishing standard evacuation flow rates for conventionally flowing lanes is particularly important for this chain of islands because, as noted earlier, there is only a single route of egress for over 80,000 residents and visitors. Research designed to provide a quantitative basis and explanation*
>
> *Research designed to provide a quantitative basis and explanation of evacuation flow phenomena was conducted by Dixit and Wolshon (2014). Using field data collected during the evacuations from Hurricanes Ivan (2004), Katrina (2005) and Gustav (2008), along with observations from routine non-emergency conditions, the researchers found that a consistent and fundamental difference exists between traffic dynamics under evacuation conditions and those under routine non-emergency periods. Based on the analysis, two quantities were introduced including "maximum evacuation flow rates" (MEFR) and "maximum sustainable evacuation flow rates" (MSEFR). Based on observation of prior hurricanes, flow rates during evacuations were found to reach a maximum value of MEFR followed by a drop-in flow rate to a MSEFR that was able to be sustained over several hours, or until demand dropped below that necessary to completely saturate the section. The researchers suggested that MEFR represents the true measure of "capacity". These findings are important to a number of key policy shaping factors that are critical to evacuation planning. Most important among these is the strong suggestion of policy changes that would shift away from the use of traditional capacity estimation techniques and toward values based on direct observation of traffic under evacuation conditions.*

Flow rates of 1200 to 1400 cars per hour are not achievable for this site

With respect to the proponent's assertion that "*The maximum lane capacity adopted in the Molino Stewart (MS) modelling traffic evacuation model should not be 600cars/hr/lane but*

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[70] Michael K. Lindell Baker Pamela Murray-Tuite, Brian Wolshon, Earl J., *Large-Scale Evacuation: The Analysis, Modeling, and Management of Emergency Relocation from Hazardous Areas* (Boca Raton: CRC Press, 2018), https://doi.org/10.4324/9781315119045.

[71] Vinayak V. Dixit, Brian Wolshon, and Thomas Montz, 'Evacuation Traffic Dynamics and Development of Maximum Sustainable Evacuation Traffic Flow Rates', 2011, https://trid.trb.org/view/1093433.

the normal rate of 1200 to 1400cars/hr/lane (say 1400cars/hr/lane)[72]", conditions allowing for a flow rate of 1200 to 1400 cars per hour are not achievable for the proposed evacuation route as detailed below.

The vehicle evacuation route proposed "*will be via the Mirvac Georges Cove Residences (site C) residential area (which is already at a higher than the 100-year ARI flood level) and then onto the existing high level road bridge leading to Brickmakers Drive and then onto Maddecks Avenue and Nuwarra Road. Nuwarra Road is above the Probable Maximum Flood (PMF) level.*[73]" Maddecks Avenue is a suburban street which is primarily a single lane in each direction. It includes several intersections, turning lanes and roundabouts, plus surface parking and a speed limit of 50km/h[74].

This presents a 'pinch point' at the start of the evacuation route which limits traffic flow to a single lane, it is therefore not appropriate to apply "*the operational capacity for basic motorway segments*"[75] as traffic flow will be greatly reduced by several factors:

- Design capacity of a single lane, 50km/h road
- Reduction in traffic capacity due to impacts of on-street parking[76]
- Reduction in traffic capacity due to roundabouts[77]
- Impacts of weather conditions
- Background traffic from surrounding area not inside evacuation zone
- Cumulative impacts of other evacuating traffic noting that Nuwarra Road forms part of a major evacuation route for Chipping Norton and surrounding areas

This road environment is defined in the Austroads Guide to Traffic Management as an urban arterial road with interrupted traffic flow[78]. While we acknowledge "*Peak-period mid-block traffic volumes may increase to 1200 to 1400 pc/h/ln on any approach road when the following conditions exist or can be implemented:*

- *adequate flaring at major upstream intersections*
- *uninterrupted flow from a wider carriageway upstream of an intersection approach and flowing at capacity*
- *control or absence of crossing or entering traffic at minor intersections by major road priority controls*

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[72] Tooker and Associates. 2024. Response to Pre Gateway SES and BCS Agency Comments, Attachment A, Review of the Molino Stewart Flood Evacuation Report, Section 3.2, Page 13
[73] Tooker and Associates. 2023. Flood Impact assessment and Flood Emergency Response Plan. Section 5, Proposed Development, Page 4
[74] Google Maps 2023 imagery of Maddecks Road between Brickmakers Drive and Nuwarra Road
[75] Tooker and Associates. 2023. Flood Impact assessment and Flood Emergency Response Plan. Attachment E. Risk-e Business Review - Vehicle capacity per lane during evacuation, Page 4
[76] Wijayaratna, S. 2015. Impacts of On-Street Parking on Road Capacity. Australian Transport Research Forum Proceedings, 30 September -2 October 2015, Sydney Australia.
[77] Austroads. 2020. Guide to Traffic Management Part 3: Transport Study and Analysis Methods. Section 7.2 Roundabouts
[78] Austroads. 2020. Guide to Traffic Management Part 3: Transport Study and Analysis Methods. Section 6 Interrupted Flow Facilities. Page 73

- *control or absence of parking*
- *control or absence of right turns by banning turning at difficult intersections*
- *high-volume flows of traffic from upstream intersections during more than one phase of a signal cycle*
- *good co-ordination of traffic signals along the route"*[79].

These conditions do not exist on the proposed evacuation route and cannot be met under evacuation conditions.

Evacuation centres

Attachment A of the proponents' response states there are "*local public properties and commercial properties to provide parking for vehicles and facilities to provide temporary refuge to local residents forced to evacuate. For the Moorebank East area, these possible locations around Nuwara Rd could include:*

- *Moorebank Library*
- *Moorebank Shopping Centre*
- *Moorebank Hotel*
- *Nuwurra Public School* [sic]
- *Moorebank High School*
- *Newbridge Heights Public School*
- *Hammonvile Public School* [sic]
- *St Joseph's Primary School*
- *St Joseph's Church*

The utilization of these facilities in situations of an extreme flood (far rarer than a 100 yr ARI flood) would be expected to reduce the need for vehicular evacuation to regional refuge sites[80]*."*

This statement disregards the evacuation centre guidelines[81] and Liverpool EMPLAN which includes only Moorebank Library from the above list as an evacuation centre. Of note, Moorebank Library evacuation centre has a capacity of 100 and many primary schools are not suitable as evacuation centres as they lack facilities for adults and have limited parking.

Regarding the paragraph contained within the 2022 Owen Report pertaining to evacuation centres[82]:

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[79] Austroads. 2020. Guide to Traffic Management Part 3: Transport Study and Analysis Methods. Section 6.2.1 Capacity. Page 75

[80] Tooker + Associates, 2022, *Re: Review of Georges River Evacuation Modelling, Flood Evacuation Analysis Draft, December 2021, Molino Stewart – Mirvac Review*

[81] 'Evacuation Management Guidelines Version 2.1' (NSW Government, December 2023), https://www.nsw.gov.au/sites/default/files/noindex/2024-03/Guideline_Evacuation_Management_Dec_2023.pdf.

[82] Owens, D. 2022. Georges Cove Marina – Moorebank, Mirvac Development. Page 10.

For the purpose of the modelling, it has been assumed that all residential evacuees will head north on the M7 towards the M4 and the Homebush Evacuation Centre. The Molino Stewart March 2022 report, (page 75) provides contradictory statements in relation to this assumption. The report states 'It is noted that in reality, most people will make their own accommodation arrangements with only the residual travelling all the way to evacuation centre/s', but in the next paragraph states 'it is reasonable to assume that most residential traffic will travel north on the M7' (towards Homebush). This assumption fails to take into consideration the establishment, when necessary, of a Flood Evacuation Centre in Liverpool. During flooding in April 2022, an evacuation centre was established at the Whitlam Leisure Centre, 90 Memorial Avenue, Liverpool.

These are not necessarily contradictory statements, as most people do not go to evacuation centres. Instead, it is estimated that 80% of evacuees relocate to family or friends[83], which is also the recommended approach within the NSW Evacuation Management Guidelines[84]. However, unlike that case with journey to work data, there is no data available for journey to friends and family. Therefore the best approximation of where evacuees will travel is used acknowledging that they would also need to travel away from areas that are already flooded. As Liverpool is at the periphery of the Metropolitan area, most people would travel north easterly and north westerly rather than to south.

Pedestrian evacuation and 'shelter in place' are not appropriate primary flood risk management strategies.

We understand that the proposal would be relying on *"a multi-faceted evacuation strategy: vehicular evacuation, pedestrian evacuation and shelter in place which is the same as the approved and delivered Mirvac Georges Cove Residences development which adjoins the current proposal.[85]"*

'Shelter in place' is not an endorsed flood management strategy by the NSW Government for the creation of new communities through zoning[86].

Such an approach is only considered for **existing dwellings** where the risk of staying is lower than the risk of evacuating, without increasing the number of people subject to such risk/s.

A basic principle of emergency management is to separate people from hazards. Given that it is rare to be able to move the hazard, the most widely accepted method of doing so is to

[83] Suk Na, H., Grace, R. 2022. Influence of social networks and opportunities for social support on evacuation destination decision-making. Safety Science, Volume 147.
[84] NSW Government. 2021. Evacuation Management Guidelines.
[85] Mirvac, 2024, Proponents Cover Letter Response to Pre Gateway SES and BCS State Agency Comments. Page 1
[86] NSW Government. 2023. Flood Risk Management Guideline EM01: Support for Emergency Management Planning

implement evacuation, whether it be phased, partial or otherwise. When the option for evacuation is denied and the hazard cannot be moved then a dangerous situation remains that requires the highest level of monitoring and intervention. This will be at a time when SES resources are in abnormally high demand, therefore will cause increased pressure on emergency response resources.

It is unacceptable to expect people to escape from a flood on foot

As identified in section 7.1.5 of the Georges River Evacuation Modelling Report and our previous response, it is unacceptable to expect and require people to escape from a flood on foot. This is particularly concerning, with the high likelihood of ongoing poor weather conditions and that the site is surrounded by high hazard floodwaters for more than 24 hours[87]. The lessons from the 9/11 attack on the multi-model evacuation identified the complexities and large number of resources required for such a strategy. Pedestrian evacuation is a backup strategy and **should not be used to justify new development.**

Further, when people reach the end of the pedestrian bridge at Maddecks Avenue, there is no additional transport from there. The closest bus stops in the vicinity of the site are on Newbridge Road and are served by bus route M90, which operates from Liverpool Station to Burwood Station via Bankstown.[88] Newbridge Road at Brickmakers Drive becomes inundated with flood water up to 2m in depth as frequently as a 5% AEP event[89]. This means evacuees would need to travel a greater distance to access public transport which is running out of the area.

NSW SES also holds significant concerns regarding the stability of pedestrian bridge proposed for pedestrian evacuation for flood heights to 7.12m AHD (the height at the exit onto Maddecks Avenue) as it will be exposed to flood hazards of H6.

Managing Residual Risk

As identified in our previous correspondence, Moorebank is currently serviced by the NSW SES Liverpool Unit, supported by the Metro Zone. The resources of the Zone cover several high-risk river systems that can flood singly or in combination, along with flash flooding in the numerous creek systems.

Managing evacuations in the Georges River Valley is already complex. Adding additional people and multi-modal evacuation procedures would further result in increased complexity and reliance on human behaviour. If the proposed development proceeded, there would be

[87] Molino, S. 2022. Georges River Evacuation Modelling – Key Findings, Existing and Infill Development, Page viii
[88] EEM, 2023, Georges Cove Marina Modified Planning Proposal, Section 5.3.4 Traffic, i Existing traffic and transport
[89] BMT, 2020, Georges River Flood Study, Final Draft Mapping Compendium, Figure A-3 5% AEP Modelled Peak Flood Depths, Velocities and Water Levels

a substantial cumulative increase in residual risk to life. **This increase requires even more community engagement and preparedness programs along with stretching resources in an already complex response operations environment.** The NSW SES would therefore require a substantial **increase in response capability** and resources and **additional Community Engagement and Safety programs** for the Liverpool LGA, for the proposed development's life span.