TOOKER+ ASSOCIATES

MIRVAC GEORGES COVE MARINA (SITE D)

MODIFIED PLANNING PROPOSAL

146 NEWBRIDGE RD MOOREBANK

FLOOD IMPACT ASSESSMENT AND

FLOOD EMERGENCY RESPONSE PLAN

AUGUST 2023

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1. Introduction

The proposed Mirvac Georges Cove Marina (Site D) site is located at 146 Newbridge Road, Moorebank (refer *Figure 1*).

2. Background

The Benedict Georges Cove Marina development on Site D (DA – 611/2018 and DA 611/2018/A) along with the Mirvac Georges Cove Residences (Site C – see Figure 2 below) have been approved by Liverpool Council. A Planning Proposal for the Georges Cove Village (Site A) is with Liverpool Council as is the Mirvac Georges Cove Marina Planning Proposal (Site D). Given the common land ownership, these three sites have been considered as an overall development when assessing the flood and evacuation related aspects of these developments. Site B is the former Flower Power site which is not integrated with the Benedict landholding and has been treated separately by Council.

Figure 2 Moorebank East Precinct

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A letter from Liverpool Council dated 14 June 2023 requested that the Planning Proposal for the Mirvac Georges Cove Marina be updated in various technical areas including flooding and flood evacuation. This report addresses the issues requested by Council in *Section 2d* of Attachment A to their letter. A copy of Council's letter is attached at Attachment A to this report.

Given the integration of sites A, C and D, the proponent (Benedict Industries) has been working with Liverpool Council since 2012 on the flooding issues contemplated for these three sites, together as an integrated site. Cardno (now Stantec) have undertaken all the flood modelling for these three developments, the sites are interrelated for wider flood modelling purposes, and the models have been provided and previously accepted as accurate by Council Flood Engineering staff.

The benchmark pre-development land ground levels were formulated by Council and adopted in the Cardno 29 January 2013 Flood Assessment as the base landform for the pre-development combined flood modelling of the three sites. The details of this landform are shown on Figure 3. Council required that this basis must be used for the flood impact assessment by Cardno of the three proposed developments and all future flood models.

As a result, Liverpool Council required that there be no reduction in flood storage capacity (compared to the base landform) over the combined area of the three developments for the 100yr ARI flood event.

In the 13 April 2018 Cardno Flood Impact Assessment, integrated flood impact modelling was undertaken for the proposed development on the three sites incorporating changes to landforms and works to ensure that the required "no change in flood storage volume" was achieved. On the Georges Cove Village site (site A), some existing fill was to be removed to compensate for fill elsewhere over the integrated sites and the proposed building on the Georges Cove Village site was designed to have a void at lower levels to accommodate the extra flood storage. The landform design was then established after extensive modelling, whereupon the Cardno flood report was prepared and submitted to Council. After careful consideration, the modelling and design results (and compliant landform) were then accepted by Liverpool Council.

The combination of the three developments provided an additional flood storage of 22,600m3 compared to the base. The 12 April 2022 Cardno Flood Impact Assessment (refer Attachment B) investigated two different scenarios for filling within the Mirvac Marina proposal without causing any adverse impacts on the flooding behaviour. Modification 1 was for filling under the proposed terraces from RL 1.6m AHD to the underside of the basement carpark floor level at RL 3.6m AHD which would utilise 16,185m3 of the surplus flood storage. Modification 2 provided extra fill to Modification 1 with filling under the proposed boatshed from RL 1.6m AHD to the underside floor level at RL 3.95 AHD. This filling under the boatshed utilised all the surplus flood storage giving an equivalent flood storage outcome as the base set by Council.

3. Site Description

This Planning Proposal for the Mirvac Georges Cove Marina (site D) adopts the Council approved landform, basement carpark, southern area ground car park and Boatshed from the approved Benedict Georges Cove Marina development and provides retail and open space on the ground floor and apartments and terraces on level 1 and above.

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Access to the site is from Brickmakers Drive over the bridge constructed as part of the Mirvac Georges Cove Residences development on Site C. The elevated pedestrian bridge is being constructed at present over Brickmakers Drive to Paine Park from Site C. These two bridges provide adequate infrastructure for the flood evacuation of cars and people from the three proposed developments on Sites A, C and D.

As stated above, the benchmark pre-development site ground levels (see Figure 3) set by Council in which the ground levels over Site D sloped from the natural RL 1.9m AHD at the river bank to RL 1.7m AHD at the western side. In reality, NSW Govt aerial surveys prove that the pre-1980's levels were some 2.9m AHD at the western edge of the site, however the land was surface mined of the 1m of topsoil but, nevertheless, the proponent agreed to use an average RL 1.65m AHD as the base for the flood modelling.

In the proposed integrated development of the three sites, the post development ground levels on the marina site (site D) were lowered to form the marina basin, buildings were supported on piles to form more flood storage. Also, part of Site A was lowered to form more flood storage such that over the three development sites there was no loss of flood storage as required by Liverpool Council. Council has accepted the Cardno Flood Impact Report (13 April 2018) and it's conclusion that the proposed design creates no flood storage loss over the integrated three sites (sites A, C and D).

In the 12 April 2022 Cardno Flood Impact Assessment, the final post-development landform would be as proposed in Modification 2 at RL 3.6m AHD for the terraces (under basement carpark), RL 3.95m AHD under the boatshed and RL 1.6m AHD under the retail/apartment buildings. The basement carpark would extend under the terraces and apartment buildings, and flood flows would be designed to pass under the carpark over the width of the apartment buildings. The overall building platform at RL 7.6m AHD was retained from the Council approved Benedict Georges Cove Marina development.

4. Flood Characteristics

The predicted benchmark pre development flood levels for the Georges Cove Marina site (site D) are (Cardno 29 Jan 2013):-

- 20 year ARI RL 4.6m AHD
- 100 year ARI RL 5.6m AHD
- Probable Maximum Flood (PMF) RL 10.2m AHD
- Flood Planning Level (FPL) RL 6.1m AHD

A PMF flood event is estimated (by Cardno) to occur on average **every 1,600,000 years.**

5. Proposed Development

The proposed development consists of an apartment building with 1000m2 of retail uses on the ground floor and 319 apartments on Level 1 and above sited on the previously DA approved building platform at RL 7.6m AHD. At this ground level, there will be numerous open space areas in and through the ground floor of the apartment buildings. There are 21 terraces in a separate building with open areas on the ground floor and habitable living in Level 1 and above. The Boatshed building

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remains as per the DA approval along with the basement parking and open carpark at the southern end (see Figures 4 - 9).

The ground level for both the apartment and terrace buildings will be at RL 7.6m AHD which is **equivalent to a 1 in 5000yr flood**. This floor level is 1.5m above the flood planning level and 2m above the 100yr ARI flood level. This building platform provides a low flood hazard setting on the site.

The minimum floor level for all the apartments and terraces will be RL 11.6m AHD. **This is 1.4m above the PMF** or the highest estimate of possible flooding that could ever occur. **Therefore, all of the habitable floor levels in the apartments and terraces will be flood free.**

The basement carpark has capacity for 500 cars. The basement carpark is a tanked construction with an entry level at RL 7.6m AHD which limits inundation of the carpark **to the 5000yr ARI flood.** There are 62 additional carparks in the at-grade parklands carpark in the southern part of the development as well as 30 ground floor parking spaces at the terraces at RL 7.6m AHD (1:5000yr flood level).

Car access to the proposed development will be from Brickmakers Drive over the recently dedicated vehicle bridge into the Mirvac Georges Cove Residences (site C) and then to the entry road to the marina. The car egress in a flood emergency 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 Ave and Nuwarra Road. Nuwarra Road is above the Probable Maximum Flood (PMF) level.

Pedestrian egress in a flood emergency will be via the Mirvac Georges Cove Residences (site C) residential area and via the high-level pedestrian bridge leading to Paine Park at a ground level of RL 7m AHD (which is at the equivalent to a 2000yr flood level) and then to flood-free land along Horizon Circuit towards Nuwarra Rd.

6. Flood Impact Assessment

6.1 Flood Levels and Velocity

The flood assessment by Cardno (12 April 2022) compared the benchmark pre development flood conditions with the integrated development of the three sites A (Georges Cove Village), C (Georges Cove Residences) and D (Mirvac Georges Cove Marina). The assessment included use of surplus flood storage to fill some areas of the Council approved marina development in Modifications 1 and 2 but still maintaining a zero increase above the Liverpool Council mandated benchmark pre development base.

The findings of the extensive Cardno Flood Impact Assessment's (12 April 2022) modelling were that there were **no significant adverse impacts on flood levels nor velocities** caused by the landform as per this planned development on the three sites compared to the Council's benchmark pre-development case (refer Figures 10 – 13).

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6.2 Flood Storage

The Cardno Flood Impact Assessment (12 April 2022) determined that the Modification 2 for the proposed integrated development over sites A, C and D would use the surplus flood storage without any adverse impacts on the flooding behaviour. **Therefore, there will be no loss of flood storage over the three sites A, C and D with the landform and levels as proposed in this PP.**

6.3 Flood Risk

The proposed development has the benefit of providing all residential floor levels which are readily (1.4m) above the PMF level and therefore flood free. The retail floor areas are 1.5m above the Flood Planning Level (FPL is adopted as the minimum habitable floor level) which means that the retail floor levels **would not be inundated in floods up to a 5000yr flood**. This ensures that these floor levels are well above levels expected by the State and Council governments as sufficient to manage the flood risks.

The parking areas for the apartments and terraces are also 1.5m above the flood planning level (FPL). All of the areas of the buildings below the FPL will be built with flood compatible materials to minimise any flood damage. A *Flood Safe Plan* has been devised within Sections 6.4, 16 and Attachment C to further minimise the risk to life by providing a three-stage flood evacuation plan adequate for the three proposed developments on Sites A, C and D.

The requirements of the *NSW State Government Floodplain Development Manual 2005* and *Flood Risk Management Manual 2023* are designed to minimise risk to life and flood damage and these documents have been considered when assessing this revised Planning Proposal.

Flood damage will be minimised by locating all habitable areas 1.4m above the PMF level and would be as such, flood free. The retail areas would be located on floor levels **1.5m above the Flood Planning Level**. The typical minimum, otherwise required floor level for retail areas would be at the Flood Planning Level. This development would therefore minimise the flood risk to people and property damage.

All of the building structures below the Flood Planning Level will be constructed with flood compatible materials, so flood damages will therefore be minimised. The risk to life due to flooding has been minimised by having all apartment/terrace habitable floor levels flood free and retail areas located 1.5m above the Flood Planning Level. Importantly, a Flood Safe Plan for flood evacuation has been prepared for the proposed development which would incorporate training and flood evacuation practices so that the risk to life during a severe flood is well minimised.

6.4 Flood Emergency Response Plan

Risk to life will be minimised by having all residential habitable floor levels above the PMF flood level and by engaging in a *Flood Emergency Response Plan* (refer Section 16 and Attachment C). This Plan has a three-stage response to a flood warning alert. The same Three Stage Evacuation Plan approved by Liverpool Council for the Mirvac Georges Cove Residences development (site C) and has been adopted for the Mirvac Georges Cove Marina

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development. The flood evacuation routes and flood signs for the Georges Cove Residences development are detailed on Figure 14.

The first stage evacuation of the Mirvac Georges Cove Marina (site D) is by car via the Mirvac Georges Cove Residences (site C) development to Brickmakers Drive, up Maddecks Ave to Nuwarra Rd and to the regional flood refuge or local flood refuges. If this evacuation were to become impossible at some point, then a second stage pedestrian flood evacuation will be possible via the elevated pedestrian bridge over Brickmakers Drive to Paine Park and up Horizon Circuit to flood free land and local refuges. The third stage is shelter in place on flood free floor levels (PMF) with access to all amenities, should for some reason, people refuse to leave the development (there is societal data suggesting that up to 20% of people will refuse to leave). This third stage will not be encouraged but will be there as a fall-back, extreme emergency response during a PMF event.

The BoM currently provide a **12-Hour Warning** for floods likely to rise **above** RL 4m AHD in the Georges River and there is a further 1.6 hours until floodwaters reach the 100 yr ARI flood level (RL 5.6m AHD). If it rises further (to say RL 6m AHD) it will eventually hinder the vehicle evacuation on Brickmakers Drive. This nevertheless provides a minimum of 13.6 hours advance warning to evacuate the site by vehicle. However, a further time of 1 hour (a total of 14.6 hours) is available for the pedestrian evacuation because the pedestrian bridge allows access to land at RL 7m AHD which is equivalent to a 1 in 2000yr ARI flood.

Using the very conservative SES flood evacuation model, the SES allows evacuation to commence 8 hours **after** the flood warning to account for mobilising of SES door knockers to alert people (6 hours) and a further 2 hours for people to act. For the proposed development (being a commercial and strata development-unlike separate freehold house lot subdivisions) there are 24 hour managers who have a duty of care to manage the risk to life and damages **before** the onset of flooding. The commercial/retail managers would be allocated to flood warden roles responsible for management of the flood evacuation. A digital flood warning alert would be sent from BoM to the Chief Flood Warden so that flood evacuation actions could start immediately - far sooner than the 8 hours nominated by SES.

The vehicular flood evacuation via the road crossing to Brickmakers Drive would be used by the three related developments being the Georges Cove Village (site A), Mirvac Georges Cove Residences (site C) and the Mirvac Georges Cove Marina (site D). The total number of car parking spaces in these developments will be 1311 (marina – 592, residences – 358, village – 361). The SES recommend that the very conservative road carrying capacity in a flood evacuation would be 600 vehicles per lane per hour. At this very conservative SES rate (versus the actual road design that is required to allow for 1400 vehicle/lane/hr) and taking the very conservative view that the number of cars onsite to be 100% (all spaces full when the flood warning is issued), then the time to evacuate the three developments would be 2.2 hours. The SES however, require that a safety factor of 1 hour be added, to give a total time SES required for car evacuation of 11.2 hours (8+2.2+1) **for the entire 3 Benedict/Mirvac Sites(A/C/D).** This represents a very conservative required time for vehicular evacuation, yet, it is still appreciably less than the SES's nominated available time of 13.6 hours.

If a pedestrian flood evacuation was required (because the vehicular flood evacuation failed at some point), it would be via the elevated pedestrian bridge over Brickmakers Drive from the Mirvac Georges Cove Residences development (site C). The number of people using the

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pedestrian bridge has been estimated by using the very conservative assumption that there would otherwise be two people in each car for all of the cars possible that could be parked in the development. This provides a very conservative estimate of an available 2,622 people on foot, because it theoretically assumes that **no** people leave the three sites in cars and **all** of them instead walk out.

For the pedestrian evacuation, the SES uses the same 6 hours for door knocking and another 2 hours for people to leave the development. The SES assumes that people walk at a rate of 2km/hour in an evacuation. The pedestrian bridge would be the logical pinch point for this evacuation. It is approximately 230m long and using a conservative walk rate, and that they cross the bridge in single file (although the bridge is actually some 3.4m wide and easily capable to have three people walking adjacent each other), then 230 people would cross the bridge in 7 minutes. As such, 2,622 people would cross the bridge in 1.33 hours. If the people were exiting two abreast on the bridge (the bridge is easily wide enough), the travel time for the entire population to walk across the bridge would be 0.7 hours.

The people would then complete the remaining average walking distance of 970m (1200m minus 230m) in 0.5 hours leading to a total walking time (again using the very conservative single file exiting across the bridge) of approximately 1.9 hours. The SES require that a safety factor of 1 hour be added, to give a total time required for pedestrian evacuation of **all three of the Benedict/Mirvac sites** of 10.9 hours (ie.8+1.9+1). This very conservative required time for pedestrian evacuation of the entire three developments (sites A, C and D) is still significantly less than the SES available time of 14.6 hours. This does not include the data from the NSW State Government surveys that suggests that some 20% of dwellings are unoccupied at any given time of the day due to travel/holidays/work, etc.

This analysis, even using the overly conservative SES methodology, indicates that the infrastructure provided in the three developments is adequate and as such, the infrastructure and Plans are capable of minimising the risk to life from flooding.

The Molino Stewart Flood Evacuation Analysis report prepared for Liverpool Council examined the evacuation capacity for the Moorebank East precinct. This report had many very conservative assumptions (that in our view are not tested nor supported by modern urban demographic data) leading to predictions of possible evacuation issues for the precinct. *The Tooker + Associates* and *Risk-e* assessments and critiques of this report and its findings is contained at Attachments D and E.

The Molino Stewart report recommended the provision of the elevated pedestrian bridge over Brickmakers Drive to enable pedestrian evacuation and this bridge installation is currently being completed.

A Flood Emergency Response Plan has been prepared (see Section 16 and Attachment C) for the proposed Mirvac Georges Cove Marina (site D) development which incorporates the following:

- Flood signs directing people to their cars in the case of a flood evacuation order;
- Audible and visual alarms throughout the development once a BoM warning of a flood above RL 4m AHD;

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- Flood emergency response plan provided to each apartment, terrace and retail tenant and attached to leases and body corporate documents;
- Nomination of Wardens to organise people at times of floods;
- Annual training of Wardens and tenants on flood emergency response activities;
- A Plan which will include a three-stage evacuation strategy including vehicle and pedestrian evacuation and an absolute last case option to shelter in place.

The buildings will be designed to structurally withstand both the flood flow and debris loads.

In summary, the design of the proposed development would readily exceed the flood risk management requirements of both Council and the NSW State government.

7 Molino Stewart

Since the approval of the R3-Zoned Mirvac Georges Cove Residences (DA-24/2017), the *Georges River Regional Flood Evacuation Study* (**Molino Stewart**) was finalised by Liverpool Council in consultation with the Department of Planning & Environment (DPE), Planning Delivery Unit (PDU) and relevant state agencies. The *Flood Evacuation Study* was completed by Molino Stewart on behalf of Council and titled '*Georges River Evacuation Modelling – Flood Evacuation Analysis, Final*', being Version 4 and dated 17/03/2022.

A summary of the main issues raised in the Tooker + Associates peer review of the Molino Stewart report are noted below. The detailed responses are provided in Attachments D and E.

The Molino Stewart Flood Evacuation Studies' evacuation capacity is a flawed assessment which grossly underestimates the designed vehicle evacuation capacity for the Moorebank East Precinct in the following ways:

1. That the Georges Cove Residences (site C) site has an approved evacuation strategy that has been designed to accommodate the Georges Cove Marina Proposal,
2. In their *Study*, Molino Stewart has artificially reduced the lane capacity to **below half** capacity (600cars/lane/hr) of the standard 1400cars/lane/hr capacity required by Council's design rules for all of the sites' built roads. This is despite Molino Stewart having the technical capability to instead utilise a more accurate/realistic dynamic traffic model to determine the actual road capacity, and therefore determine **if there was any actual reduction** of capacity. Instead, Molino simply applied an outdated SES rural road criteria, which is less than half of the as-built actual design road capacity;
3. Molino Stewart has adopted unrealistic assumptions of full residential occupation, i.e. that no one is away from their homes (traveling/holidays/away for work), and that 100% of people working in the precinct are still coming to work (regardless of days of inclement weather or flood warnings), and all cars in every household are used in the flood evacuation for the car usage numbers, and that all residences own cars (contrary to recognised survey data);
4. Molino does not factor in that the warning time available to residents to evacuate via car is in excess of 12 hours,
5. Molino Stewart makes no allowance for pedestrian evacuation even though they recognise that up to 30% of households in some areas do not have cars (particularly apartment dwellers). Obviously, people will walk out should they decide to leave but importantly, will therefore obviously **not** add to vehicle traffic that reduces the car carrying capacity of the roads;

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6. Molino Stewart does not account for flood evacuation orders which can be provided more quickly and efficiently in residential developments by both electronic means (SMS) and door knocking by Community Management (such as the Georges Cove Residences community site C and Marina management – site D), so that evacuation proceeds much faster than public stand-alone residential subdivisions,
7. Molino Stewart's basis for this evacuation assessment is the PMF flood event -which has a probability of occurring in **1 in 1,600,000 years**- which is the most extreme of flood conditions and compounding this extreme is the unjustified more-than-halving of the designed road lane actual vehicle capacity.
8. Molino Stewart uses an unrealistically rapid rate of flood level rise above 1:100 to PMF, thereby understating the actual period that people will have to evacuate during a greater than 1:100 year flood. The reality is that the rise of waters rise slower as the flood magnitude grows above the 100 year ARI due to the widening of the floodwater flow path.

The *Risk-e Business* peer review report concluded:

It is our expert opinion that as it currently stands, the Molino Stewart Report is based on either overly conservative or unrealistic assumptions, and incomplete/out of date data, that mainly have been provided by the NSW SES (our understanding). Our expert opinion is that the report ***did not accurately*** *consider the following:*

- *A phased approach to evacuation considering pedestrian, vehicle, occupancy vacancies, and shelter in place.*
- *Assumptions made by the NSW SES (and adopted unquestioned by Molino) indicate that they appear to be out of touch with the realities of urban living in a city that must be designed to cater for future population growth, based on the modes of transport that the growing population is adopting (alternates to owned-vehicular transport).*
- *Traffic lane capacity based on an unreasonably conservative figure of 600 per lane/hour when they are well aware that the roads around the proposed development are not rural and will be familiar to the majority of road users.*
- *Referring to expected traffic delays caused by vehicles making their way north on the M7 to Homebush when their own comments, supported by independent research, clearly indicate that only a small proportion of residents would follow this path. Also, they have not factored into the modelling, the Liverpool evacuation centre or travelling to or sheltering with nearby family and friends.*
- *100% evacuation compliance is a known fallacy that cannot be achieved, yet Molino Stewart used this as a base assumption.*

It is in our expert opinion that had the correct assumptions, along with current evacuation triggers, been provided to Molino Stewart by the NSW SES (and adopted) and consideration was given to the phased approach to evacuation modelling, different, more realistic conclusions would have been reached.

8. Conformance to Flood Policy

8.1 NSW Government Flood Policy

The *NSW Government's Flood Prone Land Policy 2005* and *Flood Risk Management Manual June 2023* support the wise and rational development of flood prone land. The policy

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acknowledges that flood prone land is a valuable resource that should not be sterilized by unnecessarily precluding its development and that development should be treated on its merits rather than through the application of rigid and prescriptive criteria.

The aim of the Policy and the Manual is to appropriately manage the risk to personal safety and damages from floods. These aims are adopted in the *Liverpool Local Environmental Plan 2008*. The way in which the proposed development conforms to these aims and objectives is discussed in Sections 8.2 and 8.3.

8.2 *Flood Risk Management Manual June 2023*

The primary objective of this policy is to reduce the impacts of flooding and flood liability on communities and individual owners and occupiers and to reduce private and public losses from floods.

The Manual deals with the responsibilities of state and local governments as well as developers as setout in ten principles of flood risk management. The principles are listed below and text is provided in the relevant principles as to how the proposed development conforms to these principles.

Principle 1 – Establish sustainable governance arrangements.

The State has Floodplain Risk Management (FRM) and Emergency Management (EM) systems in place which will be improved by the implementation of the requirements in the Manual. The proposed development complies with the LGA and State FRM and EM flood requirements.

Principle 2 – Think and plan strategically.

The FRM information and controls in place in the LGA have been improved by our site-specific flood modelling so that we well understand the flood behaviour and risks on the site and Council has provided specific flood controls for the proposed development of Sites A, C and D.

Principle 3 – Be consultative.

Liverpool Council has consulted widely with the community in the FRM processes and also in the local area as a result of many Planning Proposals and DAs for the Moorebank East Precinct.

Principle 4 – Make flood information available.

Liverpool Council has provided FRM information for the local and wider areas affected by flooding on the Georges River and the developer has provided to Council, FRM specific to the site to demonstrate that the proposed development conforms with the Manual.

Principle 5 – Understand flood behaviour and constraints.

Extensive flood modelling has been undertaken specifically for the subject site by Cardno (now Stantec) so that there is a detailed understanding of the flood behaviour and constraints for the full range of floods from the 20-year ARI to the PMF flood. The building platform proposed

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provides an area of low flood hazard for the development. The building platform at RL 7.6m AHD will be 1.5m above the FPL and will be at the 1:5000 yr flood level.

Principle 6 – Understand flood risk and how it may change.

Extensive flood modelling was undertaken for the pre and post development conditions to show that there was no loss of flood storage and the proposed development would not adversely impact the flood behaviour on adjacent sites. There will also be sufficient infrastructure and flood evacuation management to minimize risk to life and flood damages.

Principle 7 – Consider variability and uncertainity.

Uncertainties in flood behaviour have been minimized by the use of very experienced flood practitioners Cardno who developed a fit for purpose flood model which was calibrated and validated considering historical flood information.

A freeboard of 0.5m has been adopted to provide a Flood Planning Level (FPL) for the minimum habitable floor levels in the development. This FPL is the 100yr ARI flood plus 0.5m freeboard which is Council's minimum level for habitable floors. The FPL for the proposed Mirvac Marina development is RL 6.1m AHD. The proposed development has a minimum retail habitable floor level at RL 7.6m AHD which is 1.5m above the FPL and equivalent to a 1:5000yr flood. All the apartments and terraces have flood-free floor levels **which are 1.4m above the PMF flood level**. These minimum floor levels are more than acceptable compared to that required by the state and local governments.

This provides an additional freeboard between 1.5m to 5.5m for the uncertainties in the 100yr ARI and PMF flood levels which is significantly above the freeboard recommended by both the NSW Government and Liverpool Council (0.5m). This freeboard will readily accommodate flood level increases due to climate change and any uncertainties in flood behaviour.

Principle 8 – Maintain natural flood functions.

The proposed development maintains the natural flood functions. Liverpool Council required that the proposed developments on Sites A, C and D should not result in any loss of flood storage as well as no adverse flood impacts on adjacent sites. It has been demonstrated in the extensive flood modelling by Cardno that these two requirements have been met by the proposed development. Council has accepted these flood model results in the approval of development on Sites C and D.

Principle 9 – Manage flood risk effectively.

A *Flood Emergency Flood Plan* (FERP) has been prepared for the development and will be implemented by the retail and strata managers as flood wardens in a similar fashion to Fire Risk Management. This Plan will minimize the risks to people's lives in all floods.

The FERP has two main flood evacuation strategies which consists of evacuation by car and evacuation on foot. The primary evacuation will be by car and if for some reason this strategy fails, then a pedestrian evacuation will be implemented.

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The development includes the provision of an elevated pedestrian bridge across Brickmakers Drive to Paine Park (which has ground levels equivalent to a 1:2000yr flood) which will allow access to flood free land and facilities. These strategies have been accepted by Council in the approval of developments on Sites C and D. The FERP requires regular review of the FERP and training of flood wardens and staff in all aspects of flood risk management.

A fall-back strategy, which is not recommended, is for people who for some reason have not evacuated Site D; these people can shelter in place on floor levels well above the PMF flood level with access to full amenities.

Use of the very conservative SES model for flood evacuation identifies that evacuation of people from the combined developments at Sites A, C and D would be possible easily within the time provided from the initial warning to the time the flood waters reach the 100 yr ARI flood level.

The FERP has been developed to cater for the flood evacuation of all people from the combined developments on Sites A, C and D (the combined Mirvac Residences, E3 Shopping Centre, and the Mirvac Marina sites).

The FERP provides effective management of the flood risk to people's lives for all floods.

The proposed development will be constructed of flood compatible materials below the FPL. This will minimise the risk to flood damages on the site.

Principle 10 – Continually improve management of flood risk.

The FERP will be regularly upgraded as required as result of lessons learnt in floods or changes to flood regulations. The FERP requires regular training and can be upgraded if this training identifies better ways of doing the flood evacuations or when new technologies are available to assist with evacuation. Flood warning systems may improve over time which provide more relevant information to make flood evacuations more efficient and these improvements could be incorporated in the FERP as required.

8.3 Liverpool LEP 2008

8.3.1 Clause 5.21 LEP Objectives for Flood Planning

The *Liverpool Local Environmental Plan 2008* (LEP) specifies the following objectives of flood planning (see text in bold italics).

5.21 Flood planning

(1) The objectives of this clause are as follows—
(a) to minimise the flood risk to life and property associated with the use of land,

Risk to life has been addressed by locating all residential uses a minimum of 1.4m **above** the PMF – they are flood free. The retail floor level will be 1.5m above the FPL and equivalent to a 5000yr flood level. The Risk to property will be minimised by use of flood compatible materials below the FPL and locating residential areas in flood free areas.

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(b) ***to allow development on land that is compatible with the flood function and behaviour on the land, taking into account projected changes as a result of climate change,***

The building platform will provide a low flood hazard environment suitable for the proposed residential and retail development at a minimum level of RL 7.6m AHD which is equivalent to a 1:5000yr flood and 1.5m above the FPL. The proposed development maintains the flood behaviour without adverse impacts on adjacent properties. The additional freeboards provided to minimum floor levels (FPL), which range from 1.5m to 5.5m readily cater for possible climate change impacts on flood levels.

(c) to avoid adverse or cumulative impacts on flood behaviour and the environment,

The development will not have an adverse or cumulative impacts on flood behaviour because the flood storage would not be reduced by the three developments.

(d) to enable the safe occupation and efficient evacuation of people in the event of a flood.

The residential habitable areas of the development are flood-free and the retail floor levels are 1.5m above the required level at the FPL. The efficient evacuation of the site is possible by both vehicle and foot.

(2) 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—
(a) is compatible with the flood function and behaviour on the land, and

The building platform forms a low flood hazard site for the proposed development. The development does not have any adverse impacts on the flood behaviour and as such, is compatible with the flood function and behaviour.

(b) will not adversely affect flood behaviour in a way that results in detrimental increases in the potential flood affectation of other development or properties, and

The proposed development has been demonstrated in the extensive flood modelling to not adversely impact existing flood conditions on adjacent sites or development.

(c) 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, and

This report identifies that the addition of this Marina development (site D) will not adversely impact the safe evacuation by vehicle or pedestrian means of the Georges Cove Village (shopping centre - site A) or the Mirvac Georges Cove Residences (site C), even based on the very conservative SES assessment methodology. The infrastructure of the road to Brickmakers Drive and elevated pedestrian bridge to cross Brickmakers Drive have adequate capacity for the flood evacuation strategies for the three developments.

(d) incorporates appropriate measures to manage risk to life in the event of a flood, and

A Flood Emergency Response Plan has been prepared for the development and will be implemented by the retail and strata Flood Wardens.

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(e) will not adversely affect the environment or cause avoidable erosion, siltation, destruction of riparian vegetation or a reduction in the stability of river banks or watercourses.

The proposed development will not adversely impact on erosion or stability of river banks.

(3) In deciding whether to grant development consent on land to which this clause applies, the consent authority must consider the following matters—

(a) the impact of the development on projected changes to flood behaviour as a result of climate change,

The proposed development has a minimum retail floor level at RL 7.6m AHD. This will be 2m above the existing 100 yr ARI flood level and 1.5m above the FPL, which will readily cater for climate change impacts on flood levels to the year 2100. The minimum residential floor level is at RL 11.6m AHD. This will be **6m above** the 100yr ARI flood level and 5.5m above the FPL which will readily cater for climate change to 2100.

(b) the intended design and scale of buildings resulting from the development,

The design and scale of the development is compatible with the site and surrounding development.

(c) whether the development incorporates measures to minimise the risk to life and ensure the safe evacuation of people in the event of a flood,

This report identifies that the addition of this Mirvac Georges Cove Marina development (site D) will not adversely impact the safe evacuation by vehicle or pedestrian for the Georges Cove Village (site A) or the Mirvac Georges Cove Residences (site C) based on the very conservative SES assessment methodology. The infrastructure of the road to Brickmakers Drive and elevated pedestrian bridge to cross Brickmakers Drive are adequate for the three developments.

(d) the potential to modify, relocate or remove buildings resulting from development if the surrounding area is impacted by flooding or coastal erosion.

The surrounding area is impacted by flooding and the flood emergency response plan caters for this flooding in terms of safe evacuation plans. The surrounding sites are not affected by coastal erosion.

9. Liverpool DCP

9.1 Merits Based Approach

The Liverpool DCP identifies in Section 9 that the *NSW Government Floodplain Development Manual 2005* and the *Flood Risk Management Manual June 2023* are based on a merit-based approach to flood-prone land planning. It recognizes that it is about risk management in terms of personal safety and flood damages. The aim is to minimize these risks within acceptable bounds and the flood planning level (100yr flood level plus 0.5m freeboard-RL 6.1m AHD) is recommended as the acceptable bound for management of flood damages and the need for adequate evacuation up to the PMF level for personal safety.

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The DCP is a guideline document prepared for a broad range of developments. The flood planning matrix takes these broad land uses and provides guidelines for acceptable land uses in three flood hazard categories. The aim is to achieve the above objectives.

The proposed development provides a development platform above the flood planning level which has a low flood hazard.

The proposed development conforms to the nine flood planning objectives as listed in Section 9 of the DCP. In Section 9.2 below, there is discussion as to how the proposed development, based on its merits, conforms to the flood planning objectives in the DCP.

9.2 Flood Planning Objectives

a) to minimize the potential impact of development and other activity upon the aesthetic, recreational and ecological value of the waterways corridors.

The site has already been approved by Council for use as a marina with associated retail, restaurant and commercial uses. The proposed development has been designed by Mirvac who has well regarded urban designers which will ensure that the proposed development will enhance the potential aesthetic, recreational and ecological attributes of the site.

b) to ensure essential services and land uses are planned in recognition of all potential floods.

There are no essential services for the broader community incorporated into the development however the proposed uses of the development have been planned in recognition of all potential floods.

c) to reduce the risk to human life and damage to property caused by flooding through controlling development on land affected by potential floods

The proposed development complies with this objective and goes further by reducing the flood risks to below that normally accepted in floodplains in the following manner:-

- all residential habitable floor levels are considerably above the PMF flood level;
- all retail area floor levels are located 1.5m above the FPL;
- majority of the parking is protected up to the 1:5000yr flood;
- internal access is available to floor levels above the PMF level;
- there is pedestrian and vehicular flood evacuation access on routes above the 100yr ARI flood level to areas external to the site above the PMF;
- All sections of the building below the FPL will be constructed with flood compatible materials; and
- the building will be designed to withstand the hydraulic forces due to a PMF flood.

As such, the proposed development readily conforms to this objective.

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d) to ensure that the economic and social costs which may arise from damage to property due to flood is minimized and is not greater than that which can be reasonably managed by the property owner and general community.

All retail areas are located at the 1:5000yr flood level and all the residential floor levels are flood free. The majority of parking is protected up to the 1:5000yr flood and the building will be constructed of flood compatible materials below the FPL. This exceeds the Council's DCP requirements. Because the proposed development is designed to be beyond that typically conforming to the DCP (as described above for c), the economic and social costs are minimized beyond that normally considered acceptable.

As such, the proposed development conforms to this objective.

e) to limit developments with high sensitivity to flood risk (eg critical public utilities) to land with minimal risk from flooding

The proposed development does not have uses with a high sensitivity to flood risk.

f) to prevent intensification of inappropriate use of land within high flood risk areas or floodways.

The proposed development will be located in a low flood risk development platform which has already been approved by Council. All residential habitable land uses will be located on floor levels above the PMF flood level and will be flood free. On this basis, there is no intensification of inappropriate land use.

As such, the proposed development conforms to this objective.

g) to permit development with a lower sensitivity to the flood hazard to be located within the floodplain, subject to appropriate design and siting controls.

The proposed development conforms to this objective because it is located in a low flood hazard platform. The access to the site will not be overtopped by the 100yr ARI flood and all the residential habitable floors will be above the PMF level. All retail uses will be located 1.5m above the FPL. There is a Flood Safe Plan should the site need to be evacuated.

As such, the development will have appropriate land uses given the low flood hazard and the appropriate design and siting controls.

h) to ensure that development should not detrimentally increase the potential flood affectation on other development or properties either individually or in combination with the cumulative impact of development that is likely to occur in the same floodplain.

The proposed development site will not have significant adverse impacts on flooding behaviour on adjoining sites. Extensive flood modelling of these three development sites (A, C and D) has demonstrated that no adverse flood impacts would occur and thereby conforms to this objective.

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i) to ensure that development does not prejudice the economic viability of any Voluntary Acquisition Scheme.

The proposed development would not affect or prejudice the economic viability of a voluntary acquisition scheme.

In summary, the proposed development conforms to all of the Council's DCP flood planning objectives and hence, based on a merits-based approach as recommended in the *NSW Government's Floodplain Development Manual 2005/Flood Risk Management Manual 2023* and Council's DCP, the Georges Cove Marina development (Mirvac PP-site D) should be permitted.

10. Ministerial Directions under Section 9.1 EP&A Act

Section *4.1 Flooding* of the Ministerial Directions under Section 9.1 EP&A Act were updated on 20 February 2023.

Liverpool Council has given DA approval for the developments on sites C and D. The development platform for the Benedict Georges Cove Marina (site D) development is located at RL 7.6m AHD which is 1.5m above the Flood Planning Level. This is the platform on which the Mirvac Georges Cove Marina development will be located and as such, will be located above the Flood Planning Level.

Justification is given below which ensures that the proposed development conforms to the State and Council flood policies such that the risks to personal safety and flood damages are appropriately managed and even managed beyond the requirements of these policies.

The objectives of the planning of flood prone land are outlined in the Section 4.1 Flooding Clauses (1) to (5). The degree to which the development would conform to these clauses is discussed as follows.

(1) shall be consistent with the NSW Flood Prone Land Policy and principles of the Floodplain Development Manual 2005/Flood Risk Management Manual June 2023

The proposed development does conform to these documents/policies in that it minimizes the potential flood risk to personal safety and property damages. It is to be located on a low flood risk area as per the Council DCP which is compatible with retail and residential development.

(2) not rezone the land within the flood planning area

The Planning Proposal is for development on land above the FPL and hence this outside the flood planning area.

(3) not contain provisions that apply to the flood planning area

These following requirements do not apply to the proposed development because it will be located above and outside the flood planning area. Nonetheless, justification is provided to these clauses.

(3)(a) does not permit development in floodways.

The development would not be located within a Floodway. It is located in an area of Flood Storage and Flood Fringe.

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(3)(b) not permit development that will result in significant flood impacts to other properties.

Extensive flood modelling by Cardno (which has been previously provided and accepted by Liverpool Council) has demonstrated that the development would not have any adverse flood impacts on other properties.

(3)(c) not permit residential accommodation in high flood hazard areas.

The proposed development does not include dwellings in a high flood hazard area.

(3)(d) not permit a significant increase in the development and/or dwelling density of that land.

This requirement relates to land below the FPL and hence is not relevant to the proposed Mirvac development. The building platform above the FPL has already been approved by Liverpool Council.

(3)(e) not permit flood sensitive uses where the occupants of the development cannot effectively evacuate.

The development does not propose any sensitive uses of the site for which occupants cannot effectively evacuate.

(3)(f) not permit development without consent.

The proposed development requires Development Consent.

(3)(g) not impose significantly increased requirement government spending on flood management.

The proposed development does not impose significant increase in government spending of flood management. The development has been specifically designed to manage the flood risk and has a detailed Flood Safe Plan to manage any flood evacuation required for the site.

(3)(h) not permit hazardous materials that cannot be effectively contained in a flood

All the commercially habitable floor levels are above the FPL. No hazardous materials will be stored at lower levels.

(4) not contain provisions that apply to Special Flood Considerations

There are no uses within the proposed development that apply to the Special Flood Considerations.

(5) not determine a flood planning level that is inconsistent with the Floodplain Development Manual 2005.

The flood planning level adopted for this development is consistent with the *Floodplain Development Manual 2005*.

The proposed development therefore conforms with requirements for flooding in the Section 9.1 Ministerial Directions which commenced on 20 February 2023.

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11. Considering Flooding in Land Use Planning Guideline

This guideline provides recommendations to Council's to adopt revised flood related development guidelines under two headings into their Local Environment Plan. The first heading is *Flood Planning Areas* and this has been adopted into the Liverpool LEP. The proposed development complies with these requirements as detailed in Section 8.3 above.

The second heading recommended to Council was for Special Flood Considerations. This was related to requirements for flood sensitive and hazardous landuses such as hospitals, child care centres etc. Council has not adopted these Special Flood Considerations into the LEP, however, the proposed development does not contain any of the listed sensitive or hazardous land uses listed under the Special Flood Considerations in the guideline and as such, is not relevant to this development.

12. Planning Circular PS 21-006 14 July 2021

This circular provides advice on Council adoption of the revised Clauses 5.21 and 5.22 into their LEPs. Liverpool Council has adopted Clause 5.21 but not Clause 5.22. The requirements of Clause 5.21 have been dealt with in Section 8.3 of this report. Clause 5.22 deals with requirements for flood sensitive uses which make flood management and evacuation difficult. The proposed development does not have any of these flood sensitive uses.

The other recommendation in the *Planning Circular* is for Councils to use the Considering Flooding in Land Use Planning Guideline. The requirements of the guideline have been dealt with in Section 11 of this report.

13. DPE Draft Shelter in Place Guidelines

The DPE draft guidelines for *flood shelter in place* recommend that use of shelter in place is for flash flooding which the guideline recommends should be for an elevated flood level duration not longer than 6 hours in which evacuation is not possible from the site.

The proposed development could experience flood durations longer than 6 hours however, would nevertheless comply with this draft guideline in that the recommended flood evacuation strategy is for use of cars as the first stage and if for some reason this method fails, then pedestrian evacuation would be initiated as a second stage response. The use of a third stage, shelter place is not recommended but is readily and abundantly available on site should this be required. The minimum residential floor level is at RL 11.6m AHD. **This level is 1.4 metres above the worst-case RL 10.2m AHD PMF level** and has availability to all amenities.

14. DPE Support for Emergency Management Planning 2022

This Flood Risk Management Guide EM01 from 2022 sets out seven principles for Flood Emergency Management (EM). The proposed development complies with the guiding principles in the following ways:

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Principle 1 Any proposed EM strategy should be compatible with any existing community EM strategy

The proposed development flood emergency response plan integrates into the regional response plan with vehicular evacuation and integrates into the local pedestrian evacuation strategy approved for the Mirvac Georges Cove Residences (site C) development.

Principle 2 Decisions should be informed by understanding the full range of flood EM risks to the community

The proposed development and the flood emergency response plan has been informed by a knowledge of the behaviour of all floods up to the PMF, the inclusion of a three-stage flooding response to cater for all eventualities and a development design which will minimize flood damage.

Principle 3 Development of the floodplain does not impact on the ability of the existing community to safely and effectively respond to a flood

The proposed development uses the same vehicular and pedestrian evacuation routes and infrastructure as for the evacuation of the Mirvac Georges Cove Residences (site C) and Georges Cove Village (shopping centre - site A) and this infrastructure has been provided to service these three developments on Sites A, C and D. Liverpool Council has approved the flood evacuation strategy for the Georges Cove Residences (site C) and the Georges Cove Marina (site D).

There will be no adverse impacts on the ability of existing communities to safely and effectively respond to a flood (refer Section 16).

Principle 4 Decisions on redevelopment within the floodplain are supported by an EM strategy that does not increase risk to life from flooding

The development provides a two stage flood response plan which has been approved for two other developments (sites C and D) with infrastructure with sufficient capacity to accommodate the proposed development. As such, the proposed development will not increase the risk to life from flooding.

Principle 5 Risks faced by the itinerant population need to be managed

All people onsite are considered in the Emergency Response Plan, including itinerant people. The development is a retail and strata development and the plan is instigated and managed by business related managers whose responsibility will be to ensure that all people respond appropriately to the warnings and instructions.

Principle 6 Recognize the need for effective flood warning and associated limitations

There will be regular training of the Flood Wardens and workers so that they are familiar with the flood warnings and timing to leave the proposed building. The BoM and SES will issue digital warnings which provide significant durations for the flood response. The Flood Wardens will be trained to initiate the first stage response in cars and if this appears to fail, then to initiate the second stage response which is a pedestrian evacuation. There will be information available regarding flood refuges and the potential dangers to people who do not initially wish to evacuate the site.

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Principle 7 Ongoing community awareness of flooding is critical to assist effective emergency response

Regular training of all flood wardens and people working onsite will be undertaken along with practice evacuations so that all workers on site can assist with an evacuation in a flood.

15. *2022 Flood Inquiry Report* findings

There were 28 recommendations from the *2022 Flood Inquiry Report*. The majority of these recommendations relate to government and community agencies. The recommendations which relate more directly to the subject development were essential services and flood education.

The development will need to provide essential services such as power, water and sewerage services during a flood. This can be achieved through design and appropriate location of these services. A backup generator may be considered necessary to ensure supply of emergency power and the provisions of potable water dispensers.

With regard to flood education, all residential and retail owners/tenants will each have a copy of the Flood Emergency Response Plan and Flood Safe Plan and the lease will require training of the flood wardens and annual training of all workers on the site in terms of flood behaviour and managing the flood evacuations. These requirements will be similar to the requirements for fire management.

These inclusions in the proposed development will address the relevant flood recommendations from the *2022 Flood Inquiry Report*.

16. Flood Emergency Response Plan

16.1 Flood Protection Measures

A Site Manager will be appointed by the retail and strata managers to be responsible for the site operations and maintenance. The Site Manager will be responsible for the management, training and implementation of the flood responses on the site. This person will be the Chief Flood warden. The Site Manager on behalf of the building owners, will appoint Flood Wardens and Assistant Flood Wardens should any of the Flood Wardens be unavailable during a flood event. These wardens would be drawn from the retail and tenant principals.

The Site Manager and Wardens would be trained by flood engineers as organised by the building owner as to the flood behaviour and flood response. The site manager would also be trained as to the building electrical and maintenance operations. People suited to this work are available from the large real estate companies who manage many different types of commercial and industrial buildings.

Training of the Site Manager and Wardens would be repeated on an annual basis so that they were familiar with any revisions or updates to the flood responses on the site.

Vehicle access to the site is available from the existing Mirvac Georges Cove Residences (site C) development onto Brickmakers Drive at RL 6m AHD.

Signage will be provided near the car parking spaces to warn that during significant storms cars will have to evacuate the site. The cars would then be directed to the Mirvac Georges Cove Residences

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(site C) evacuation route. Signage for the flood evacuation will be provided in the Mirvac Georges Cove Residences development indicating vehicular and pedestrian flood evacuation routes (refer Figure 16).

16.2 Flood Warning Actions

The BoM will provide a 12 hour flood warning for floods likely to rise above RL 4m AHD. This warning would be provided digitally to the Chief Flood Warden who would forward the warning to all Flood Wardens onsite. An alarm would then be activated to initiate a flood evacuation according to the Flood Emergency Response Plan. A message over the loudspeakers would be given over all levels for people to go to their cars and evacuate the site via Mirvac Georges Cove Residences (site C) access to Brickmakers Drive. The Flood Wardens would ensure that people were directed out of the retail areas to the carparks and out of the development.

There would be some 13.6 hours warning time until flood waters would be expected to impact on access to Brickmakers Drive (100 yr flood level RL 5.6m AHD). As such, the time available for the vehicular evacuation from the site would be 13.6 hours. The exit of all the cars from the Georges Cove Village (shopping centre-site A) carpark and the other two developments (Mirvac Georges Cove Residences – site C and Georges Cove Marina – site D) would rely on the same flood infrastructure and should take no longer than 2 – 3 hours which provides considerable extra time for the evacuation based on the 13.6 hour warning time (refer Section 6.4). This duration is based on the very conservative SES evacuation road half-capacity for vehicular evacuation, rather than the actual design/as-built actual car capacity rating for these roads.

If the vehicle evacuation fails for some reason during the 2 - 3 hour period, the Chief Flood Warden would review the situation and if necessary, would instigate the pedestrian flood evacuation. There would be 14.6 hours warning for flood waters to reach RL 7m AHD which is the level in Paine Park at the end of the elevated pedestrian bridge over Brickmakers Drive.

The pedestrian flood evacuation would involve people walking from the Marina to the elevated pedestrian bridge over Brickmakers Drive and north up Horizon Circuit until the ground levels are above the PMF flood level. This distance is approximately 1.2km and at the very conservative SES walking rate (2km/hr) and allowing for the bridge to be a pinch point, would take approximately 1.8 hours to evacuate all people from the local area including the Village (site A), Marina (site D) and Mirvac Georges Cove Residences (site C). This leaves considerable time (9.7 hours) for safe evacuation (based on the SES evacuation methodology) even if it starts after a failed vehicular evacuation say after 3 hours for the initiation of the flood evacuation.

It should be remembered that each of the three Benedict/Mirvac developments (sites A, C and D) have design levels that provides fall back security for everyone to shelter in place above the PMF (however, this will not be the recommended).

16.3 Other Sources of Flood Information

16.3.1 Observation of Local Rainfall

An important indication of likely imminent flood activity would be intense local rainfall over a long duration.

16.3.2 Bureau of Meteorology

As discussed above, the Bureau of Meteorology does provide flood predictions for the subject area.

Severe Thunderstorm Warnings are issued together with maps indicating the current location and predicted

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path of thunderstorms. Severe Weather Warnings are for severe weather not related to thunderstorms, cyclones or fire, such as “east coast lows” or other causes of intense rainfall or storm surge.

These warnings are available at http://www.bom.gov.au/nsw/warnings/. The warnings for the Georges River would be provided digitally via a SMS to the flood wardens on site.

16.3.2 The NSW SES

The SES issues Local Flood Advices. These are issued on the basis of localized valley watch information for locations for which the BoM does not issue Flood Warnings. They normally predict which class of flooding (minor, moderate or major) will occur, and must not contradict any Flood Warnings provided by the BoM for other gauges on the same river. Local Flood Advices are to be clearly identified as being issued by the SES.

16.3.3 Flood Warning Actions

A. Heavy rainfall is experienced

During heavy rainfall a designated Flood Warden to monitor Bm warnngs.

B. The alarm sounds or flashes to confirm BoM or SES warnings

The Flood Wardens commence movement of people to their cars and directing them to the exits. The Flood Wardens monitoring car evacuation to ensure it occurs smoothly. Cars are to be directed to the Mirvac Georges Cove Residences exit route. The Chief Flood Warden to decide after three hours if the pedestrian evacuation should be initiated. If so, then Flood Wardens manage pedestrian evacuation to the elevated pedestrian bridge over Brickmakers Drive. The Wardens are to ensure that all people leave the site.

16.3.4 Local Emergency Management

Liverpool Council works in collaboration with emergency service organisations to ensure the safety of the community. Council is required to appoint a Local Emergency Management Officer (LEMO) who in the event of an emergency in the Liverpool Local Government Area will act as the coordinator who will liaise with other emergency services such as NSW Police, Fire & Rescue and State Emergency Services.

Council’s LEMO also acts as the chair of the Local Emergency Management Committee. Council provides executive support to the committee which facilitates an effective communication network with all emergency response agencies and ensures that resources will be available to respond to emergencies if the need arises.

16.3.5 Local Television and Radio Stations

Local television and radio stations would disseminate warnings from the Bureau of Meteorology, SES and other relevant sources. Increasingly, mass SMS messaging is used to quickly communicate with nearly everyone.

16.4 Flood Response

16.4.1 Flood Awareness

Workers, visitors, shoppers, tenants and owners on site will be made aware of the flood hazard and evacuation procedures through a combination of measures.

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Signage will be placed at key locations to raise flood awareness among all people on site. The signage is to raise awareness to flooding on site and flood evacuation procedures.

Evacuation plans detailing the evacuation procedures will be provided to each tenant and owner along with placement at other key locations.

Flood warning signs may be provided to raise awareness of flooding during dry times, but also to alert visitors and workers to the depth of floodwaters during flood events.

16.4.2 Flood Safe Plan

A *Flood Safe Plan* for the property has been prepared and supplied as Attachment C. The *Flood Safe Plan* will need updating with relevant information following occupation of the buildings and annually in the future as appropriate. This review would be arranged by the Site Manager.

This includes the first aid training of Flood Wardens including the use of a battery-operated defibrillator.

16.4.3 Hazardous Materials

Possible hazardous materials should only be stored above the flood planning level. The hazardous materials might include:

- Cleaning chemicals eg chlorine bleach; disinfectants, etc and
- Petrochemical fuels eg petrol, oil, diesel.

16.4.4 Utilities

The following items have been identified as infrastructure relevant in flood emergencies: electricity and water. During significant storms, interruptions may be experienced to electricity and pumps for water supply. Local substations may be affected by floodwaters in extreme events approaching the PMF. A backup generator is proposed for the site to provide emergency power supply should there be a blackout in the area during a flood.

Water and gas may also become unavailable during severe flood events due to offsite network issues.

16.4.5 Operations and Responsibilities

Flood Wardens will co-ordinate the emergency response to flooding at all times. There will be up to 6 designated Flood Wardens, plus a Site Manager, who is the Chief Flood Warden.

Flood Wardens will be trained by the Site Manager with assistance from flood engineers. A training register will be maintained by the Site Manager with annual audits to ensure that sufficient Flood Wardens are trained in the procedures.

Notwithstanding warnings and orders given by the SES, Police or other authorities, Flood Wardens are responsible for issuing directions and warnings to all residents, workers and visitors.

A copy of this FERP or future version(s) will be stored on site in hardcopy in a weather proof, easily accessible location that is clearly marked and available to emergency services. Additional

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copies will be given to each office/shop/apartment and will be available for staff training and reference in an emergency.

16.4.6 Emergency Procedure

16.4.6.1 Informal Monitoring

Weather conditions can be monitored informally at http://www.bom.gov.au/nsw/warnings/ and the BoM also provides real time rain radar coverage for Sydney at http://www.bom.gov.au/products/IDR713.loop.shtml.

16.4.6.2 Flood Warden Actions

In accordance with the flood warnings, the following actions must be co-ordinated by the Flood Wardens.

A. *Heavy rainfall is experienced*

During heavy rainfall a designated flood warden to commence visual monitoring and monitoring of BoM warnings.

B. *The Flood alarm sounds or flashes*

The Flood Wardens instruct shops to cease trading and shoppers, residents and workers commence movement of people to their cars and directing them to the exits. The Flood Wardens monitoring car evacuation to ensure it occurs smoothly. The Chief Flood Warden to decide after three hours or sooner if the pedestrian evacuation should be initiated. If so, then Flood Wardens manage pedestrian evacuation towards the elevated pedestrian bridge over Brickmakers Drive. Wardens must ensure that all people leave the site.

16.4.7 Recovery

Following a flood event, people on site should notify family and friends of their location. The Site Manager and/or the Flood Wardens will inspect the site to organise any repairs, removal of debris and other works to ensure safe operations.

17. Conclusions

The retail and residential development proposed in the Mirvac Georges Cove Marina Planning Proposal for Site D has been designed to exceed the State and Local Government requirements for flood management including considering the recent recommendations for the *2022 Flood Inquiry Report, Flood Risk Management Manual June 2023* and revisions to the flood-related State and Council Planning requirements. In addition, it conforms to the *Planning Circular PS 21-006 14 July 2021*, *DPE Shelter in Place Guidelines Draft*, *DPE Support for Emergency Management Planning* and *Considering Flooding in Land-use Planning*. It also complements the adjacent development sites at Georges Cove Village PP (shopping centre-site A) and Mirvac Georges Cove Residences (site C).

There is sufficient vehicular and pedestrian infrastructure to provide safe flood evacuation from the site. A *Safe Flood Plan* has been formulated and would be instigated by trained Flood Wardens in case evacuation is required during severe flooding. There is also a fall-back emergency (but not recommended) shelter-in-place option available above PMF flood levels (if required) and additionally, the same option is provided in the approved Georges Cove Village (shopping centre-site A) and Mirvac Georges Cove Residences (site C) developments.

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FIGURES

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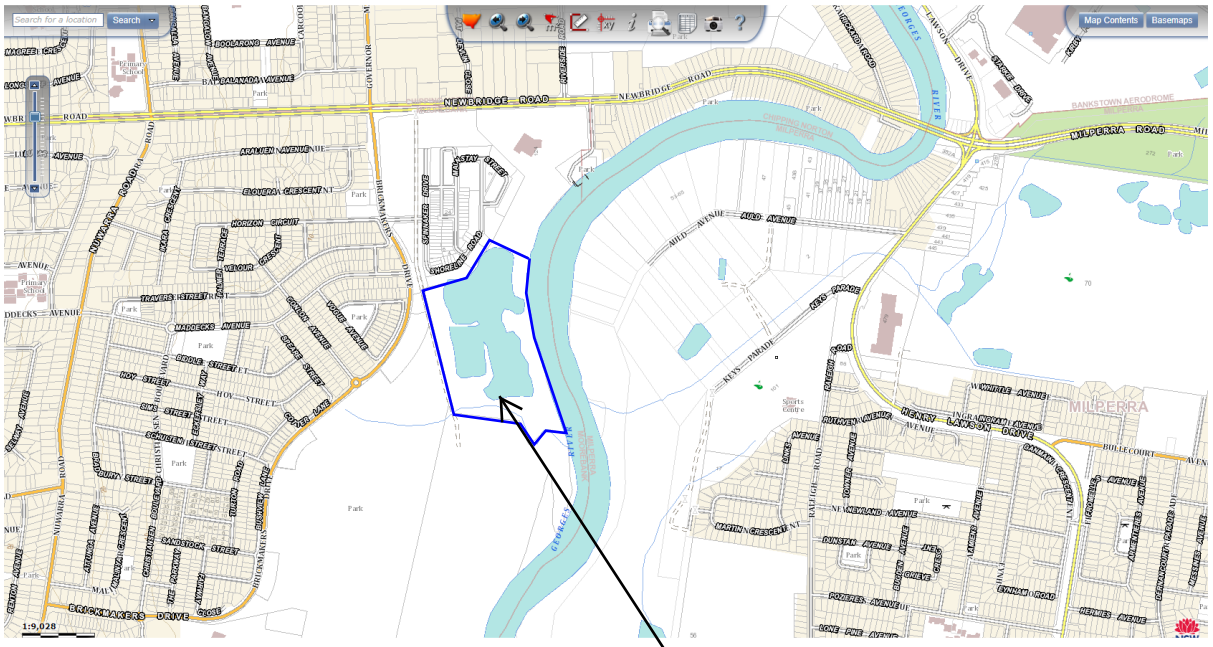
FIGURE 1



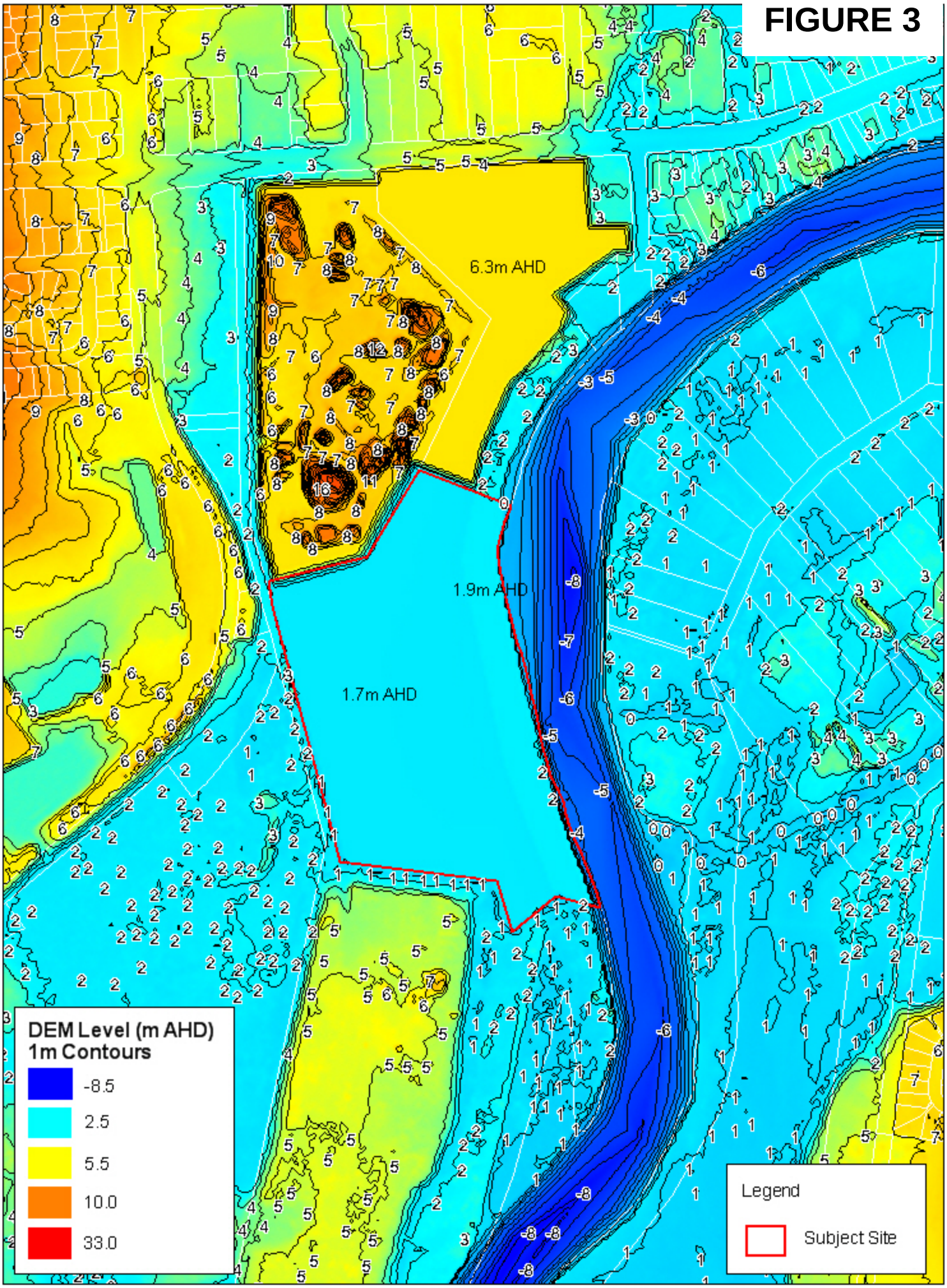
Site D
Mirvac Georges Cove Marina

LOCALITY PLAN

FIGURE 2

MOOREBANK EAST PRECINCT

FIGURE 3



Cardno

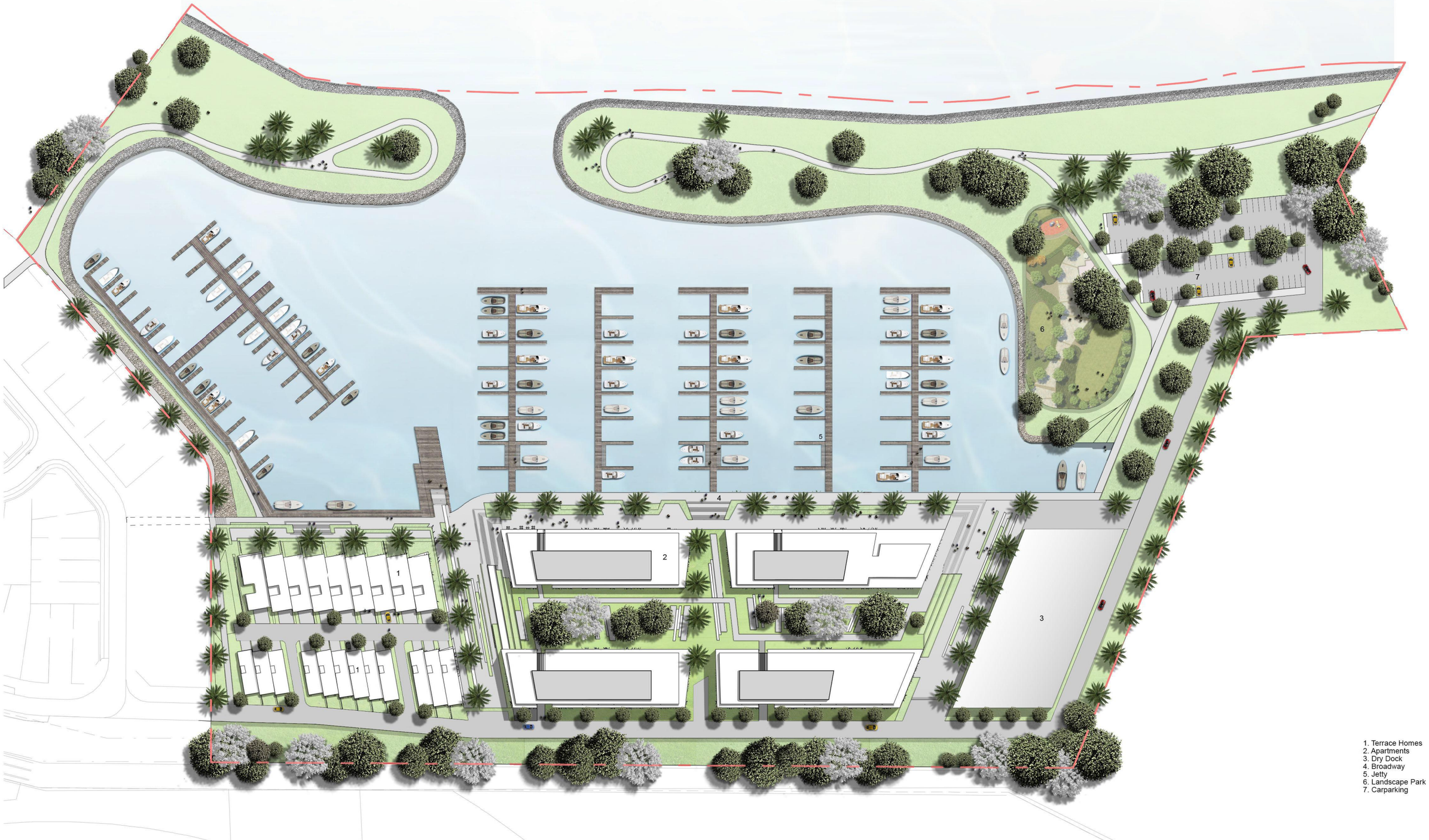
Georges Cove
Flood Impact Assessment

Figure 2-5
Benchmark (Pre-Development) DEM

NA49913037
January 2013

FIGURE 4

MIRVAC DESIGN



1. Terrace Homes
2. Apartments
3. Dry Dock
4. Broadway
5. Jetty
6. Landscape Park
7. Carparking

Georges Cove Marina

0 18.75 37.5 75

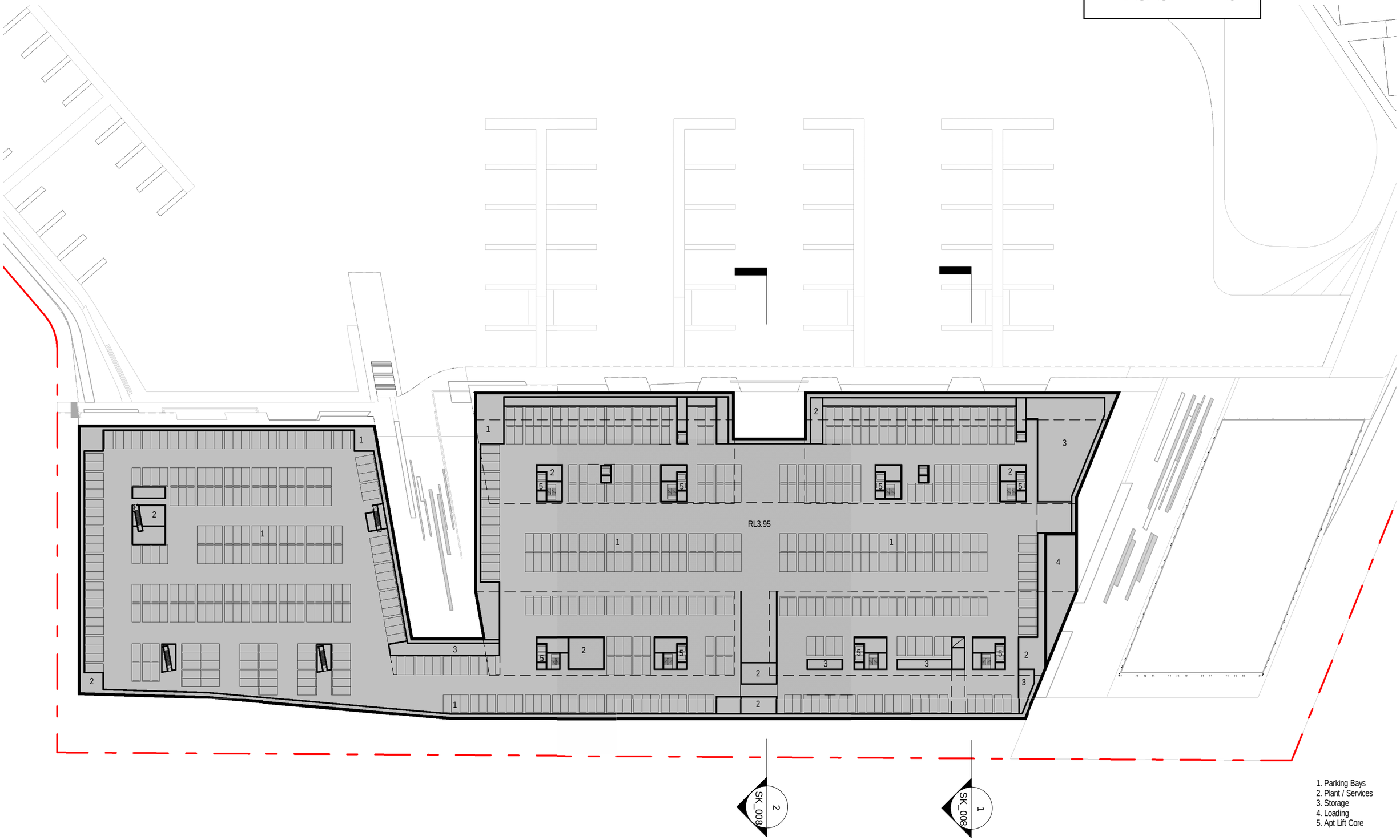
Scale 1 : 1500

SITE PLAN

SK_001

MIRVAC DESIGN

FIGURE 5



1. Parking Bays
2. Plant / Services
3. Storage
4. Loading
5. Apt Lift Core

Georges Cove Marina

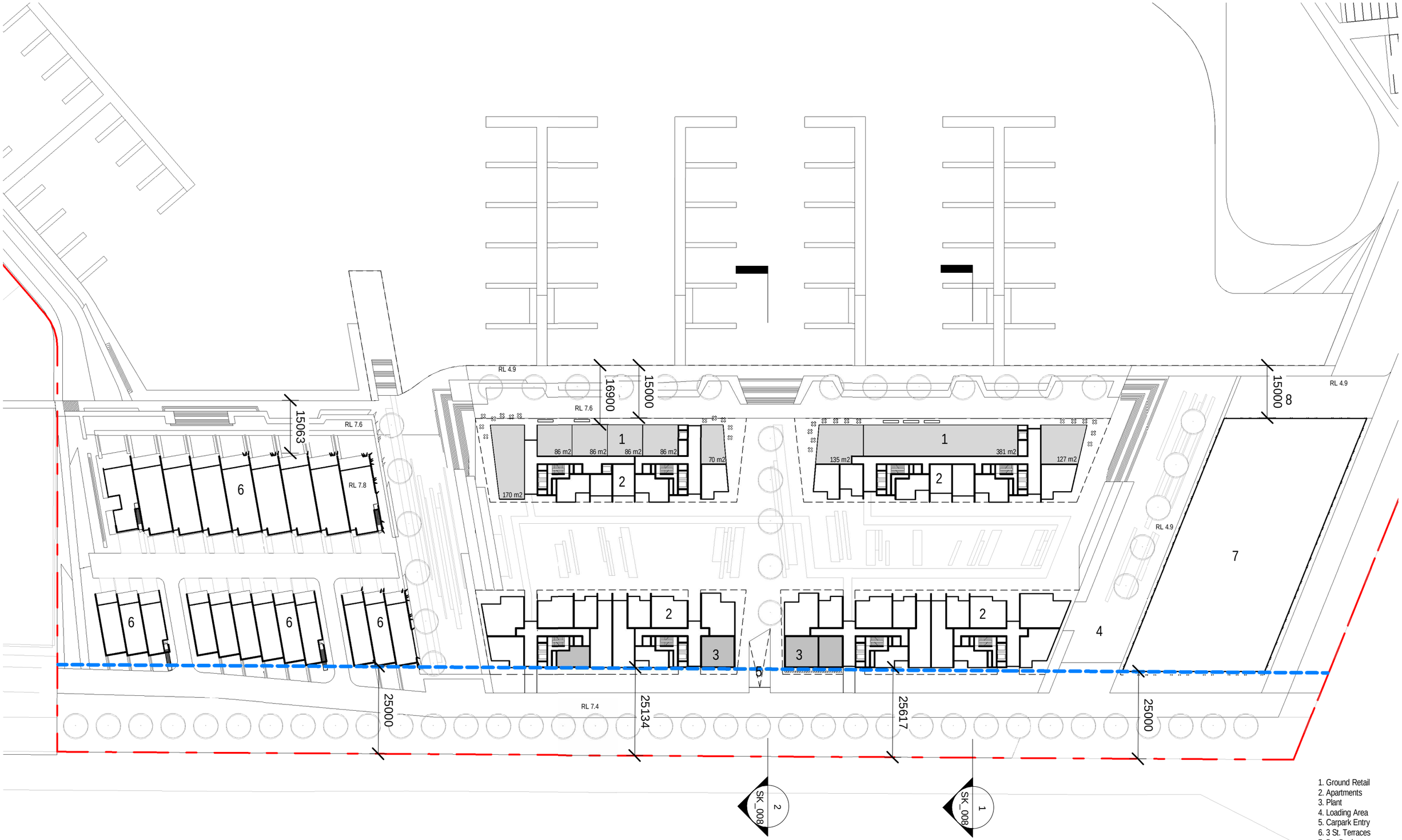
0 12.5 25 50
Scale 1 : 1000

BASEMENT

SK_002 E

FIGURE 6

MIRVAC DESIGN



1. Ground Retail
2. Apartments
3. Plant
4. Loading Area
5. Carpark Entry
6. 3 St. Terraces
7. Dry Dock
8. Dry Dock Loading

Georges Cove Marina

0 6.25 12.5 25

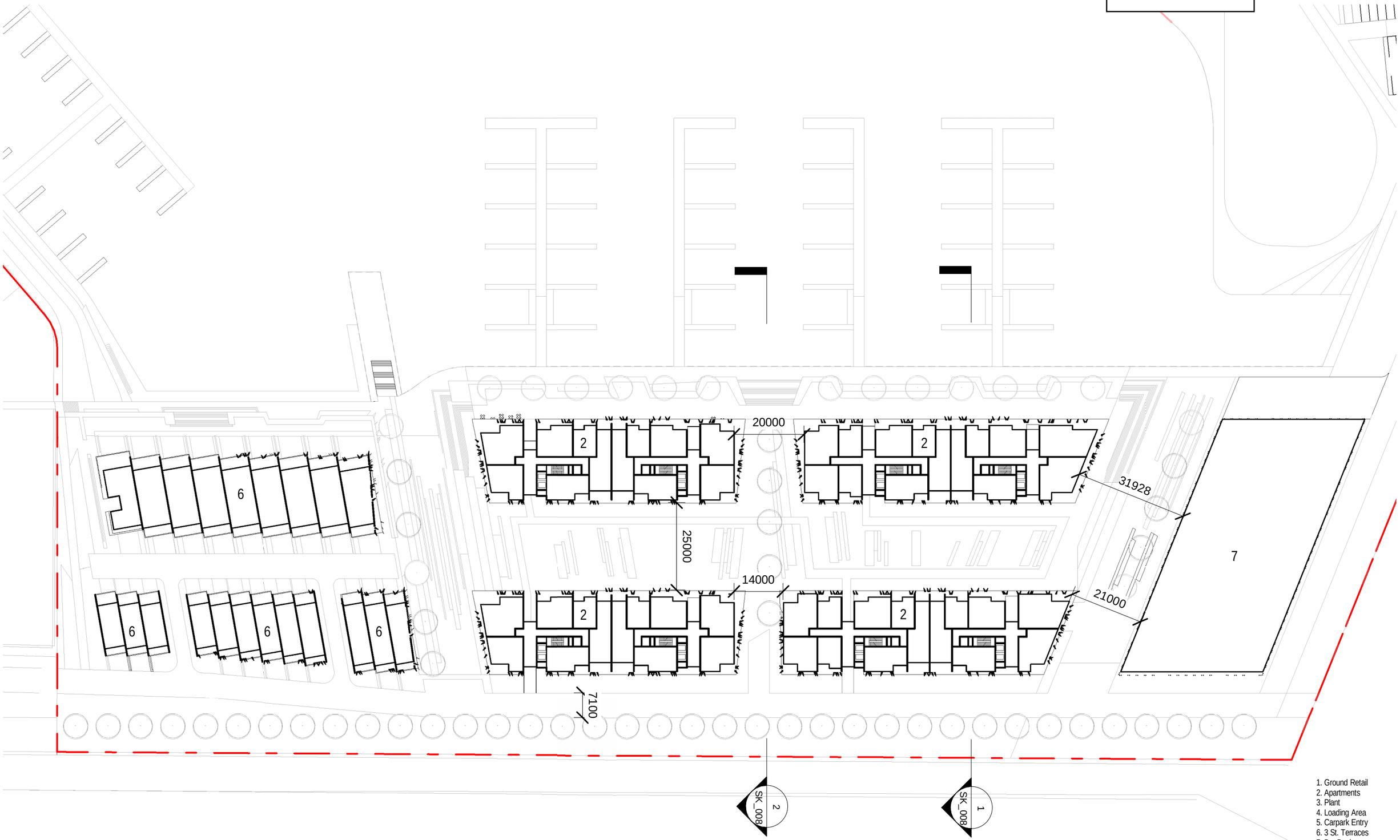
Scale 1 : 500

LEVEL 1

SK_003 E

MIRVAC DESIGN

FIGURE 7



1. Ground Retail
2. Apartments
3. Plant
4. Loading Area
5. Carpark Entry
6. 3 St. Terraces
7. Dry Dock
8. Dry Dock Loading

Georges Cove Marina

0 6.25 12.5 25

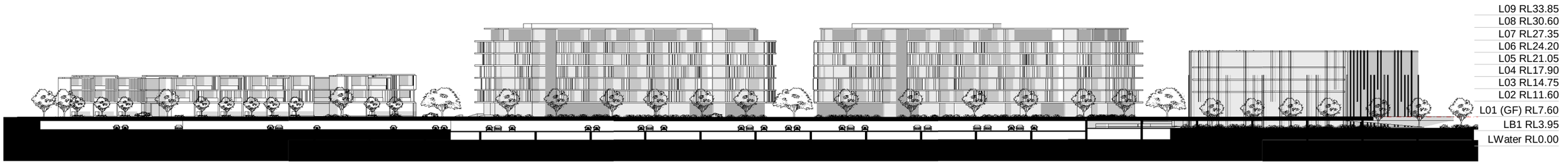
Scale 1 : 500

LEVEL 2-6 (excl. Terraces)

SK_004 E

FIGURE 8

MIRVAC DESIGN



Georges Cove Marina

0 12.5 25 50

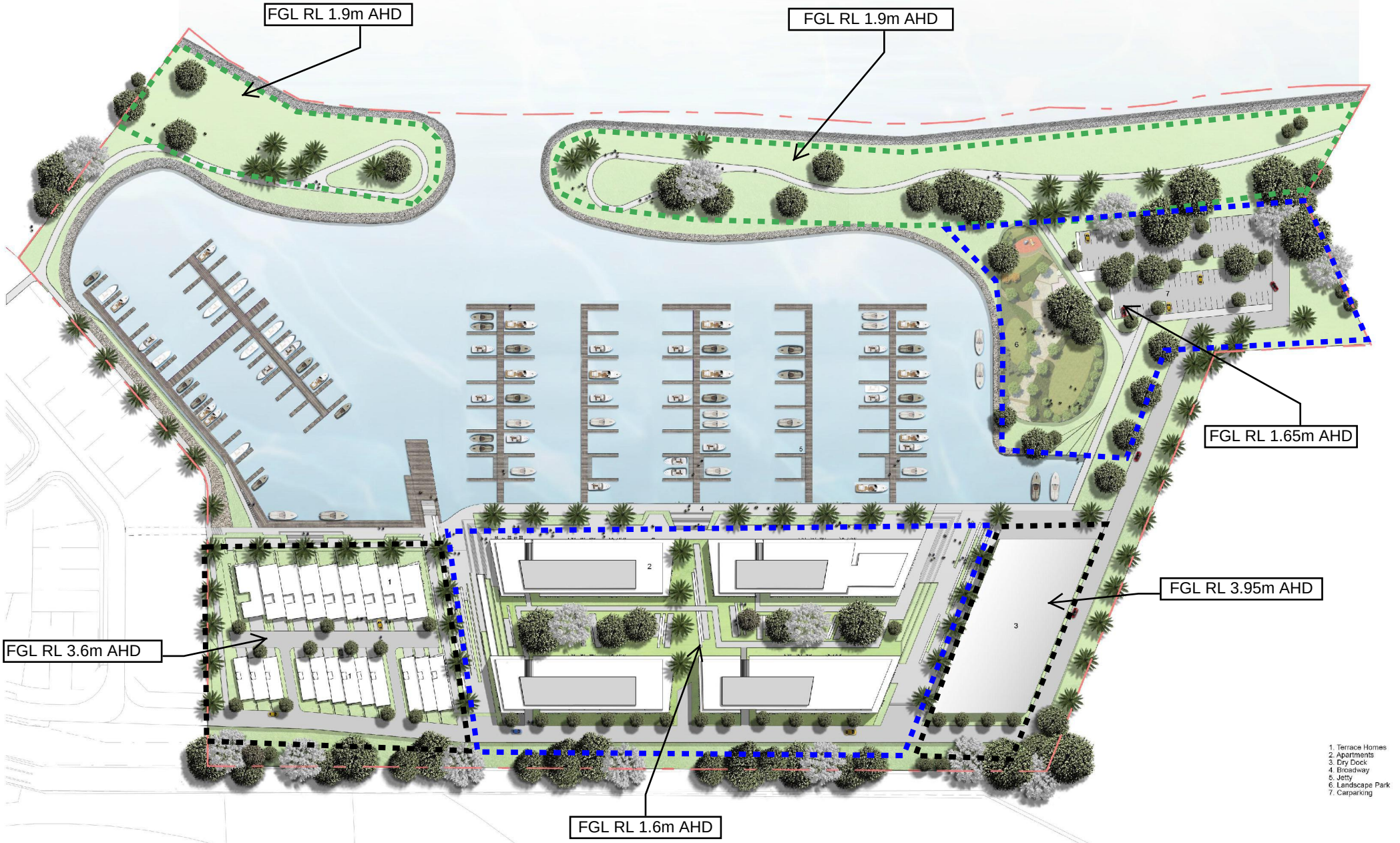
Scale 1 : 1000

ELEVATIONS

SK_007 E

FIGURE 9

MIRVAC DESIGN



Georges Cove Marina

0 18.75 37.5 75

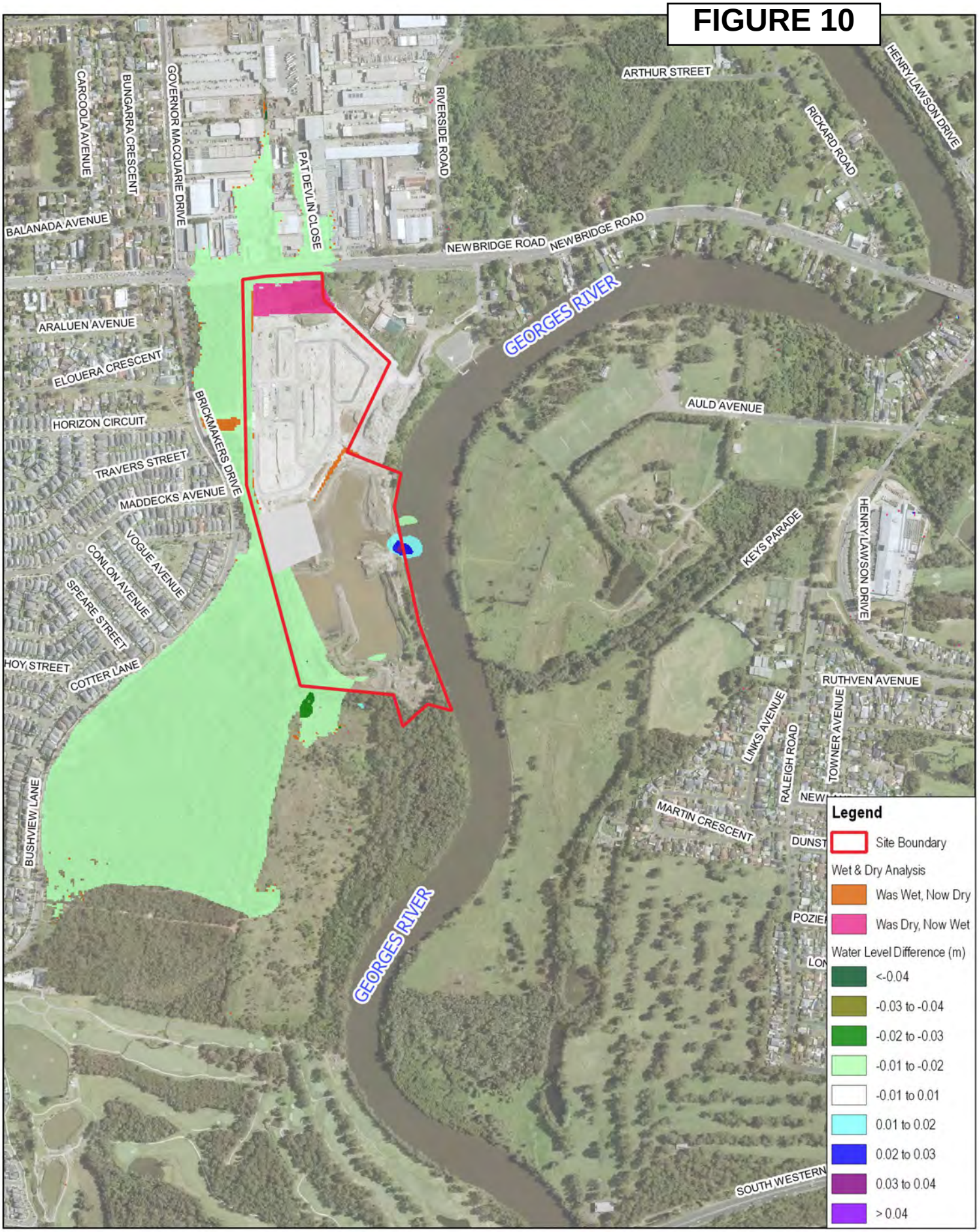
Scale 1 : 1500

SITE PLAN

FINAL GROUND LEVELS
MODIFICATION 1 + 2

SK_001

FIGURE 10



Georges Cove Marina

Flood Level Differences

20 Year ARI
Modification 2 Conditions - Existing
Figure M2-7

N

1:10,000 Scale at A4

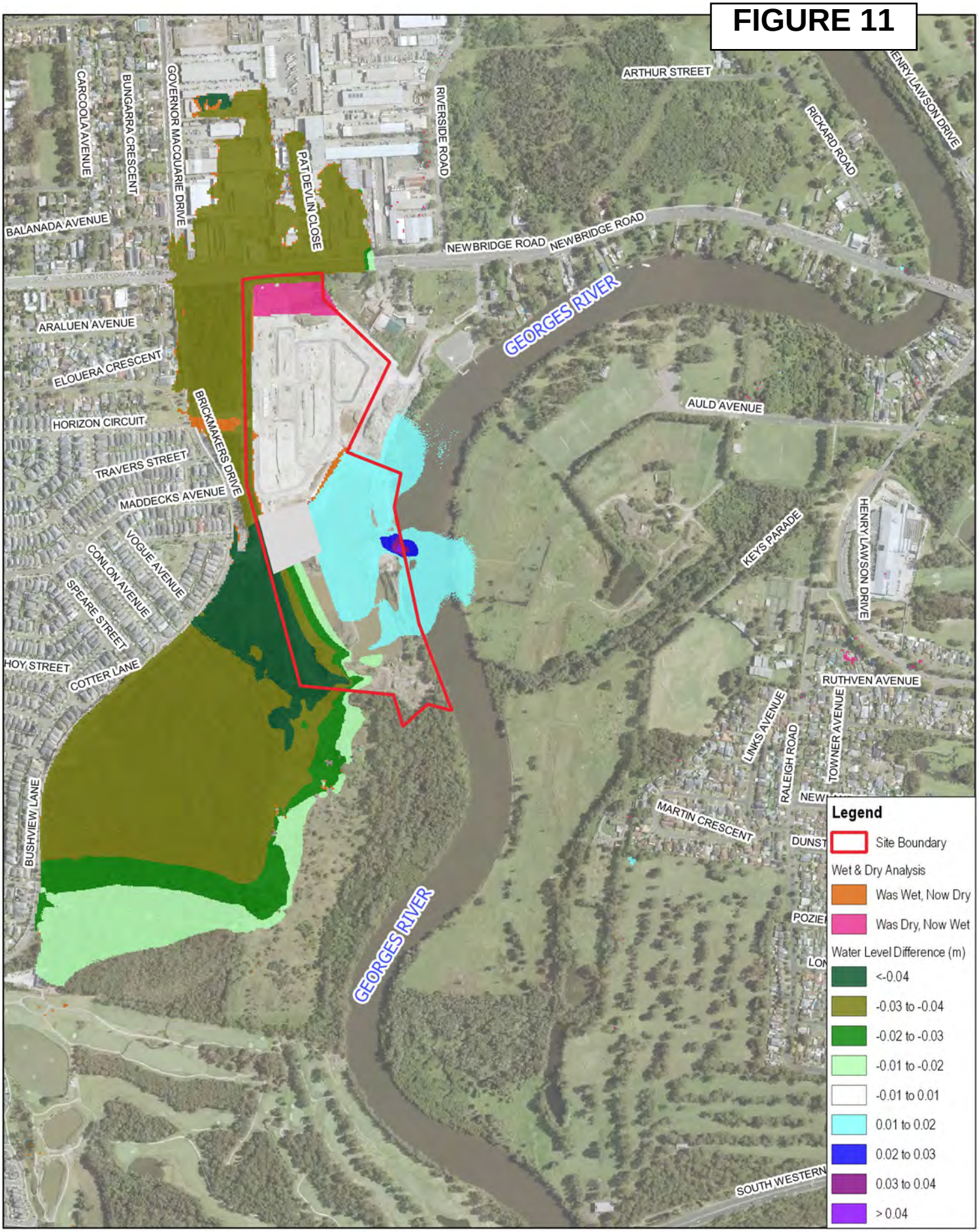
m

0 200 400 m

Cardno now Stantec

Map Produced by Cardno Now Stantec (NatW&E)
Date: 2022-3-18
Coordinate System: GDA94/MGA56
Project: nw30126
Map: NW30126

FIGURE 11



Georges Cove Marina

Flood Level Differences

100 Year ARI
Modification 2 Conditions - Existing
Figure M2-8

N

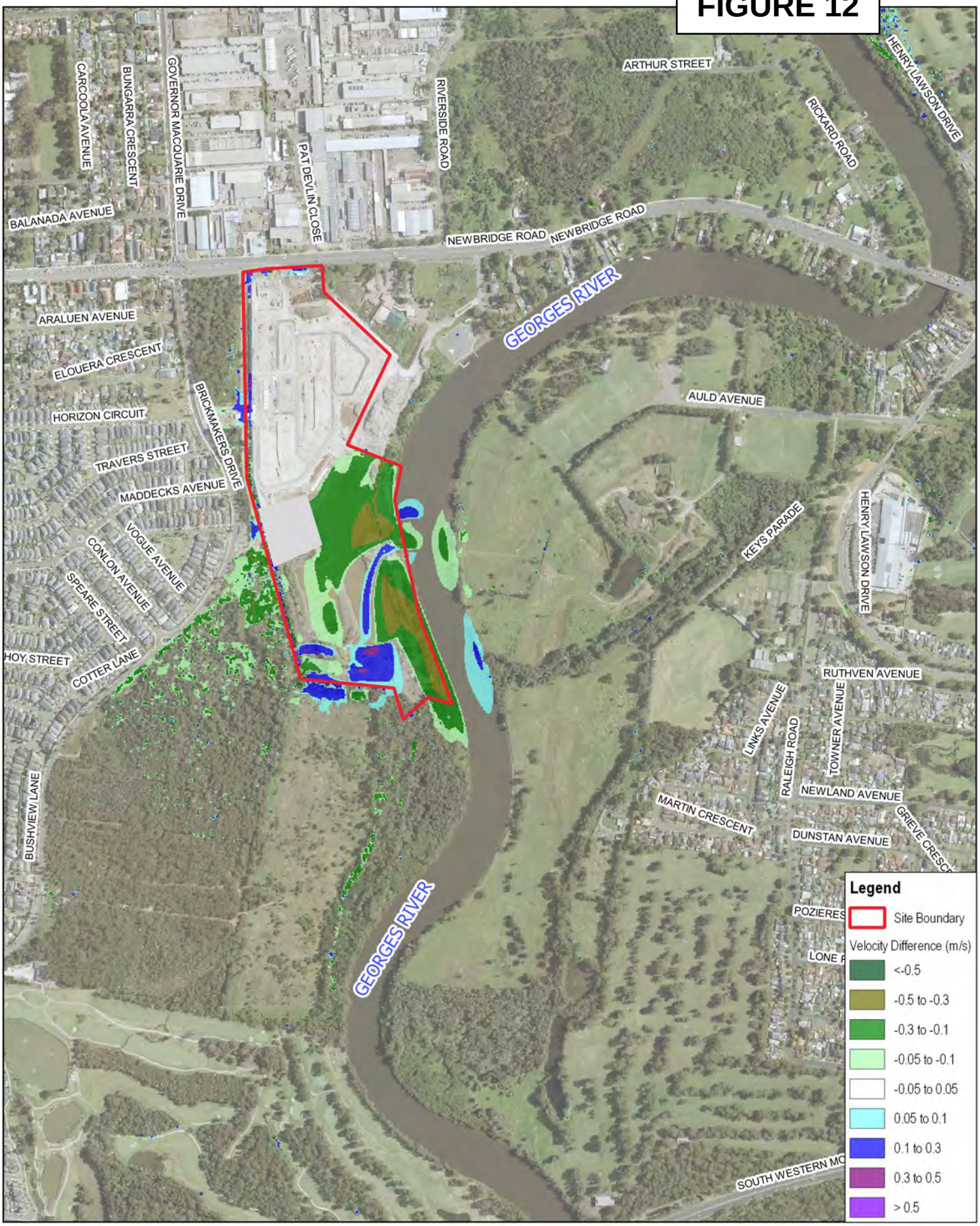
1:10,000 Scale at A4

m
0 200 400 m

Cardno now Stantec

Map Produced by Cardno Now Stantec (NatW&E)
Date: 2022-3-18
Coordinate System: GDA94/MGA56
Project: nw30126
Map: NW30126

FIGURE 12



N

1:10,000 Scale at A4

m

0 200 400 m

Georges Cove Marina

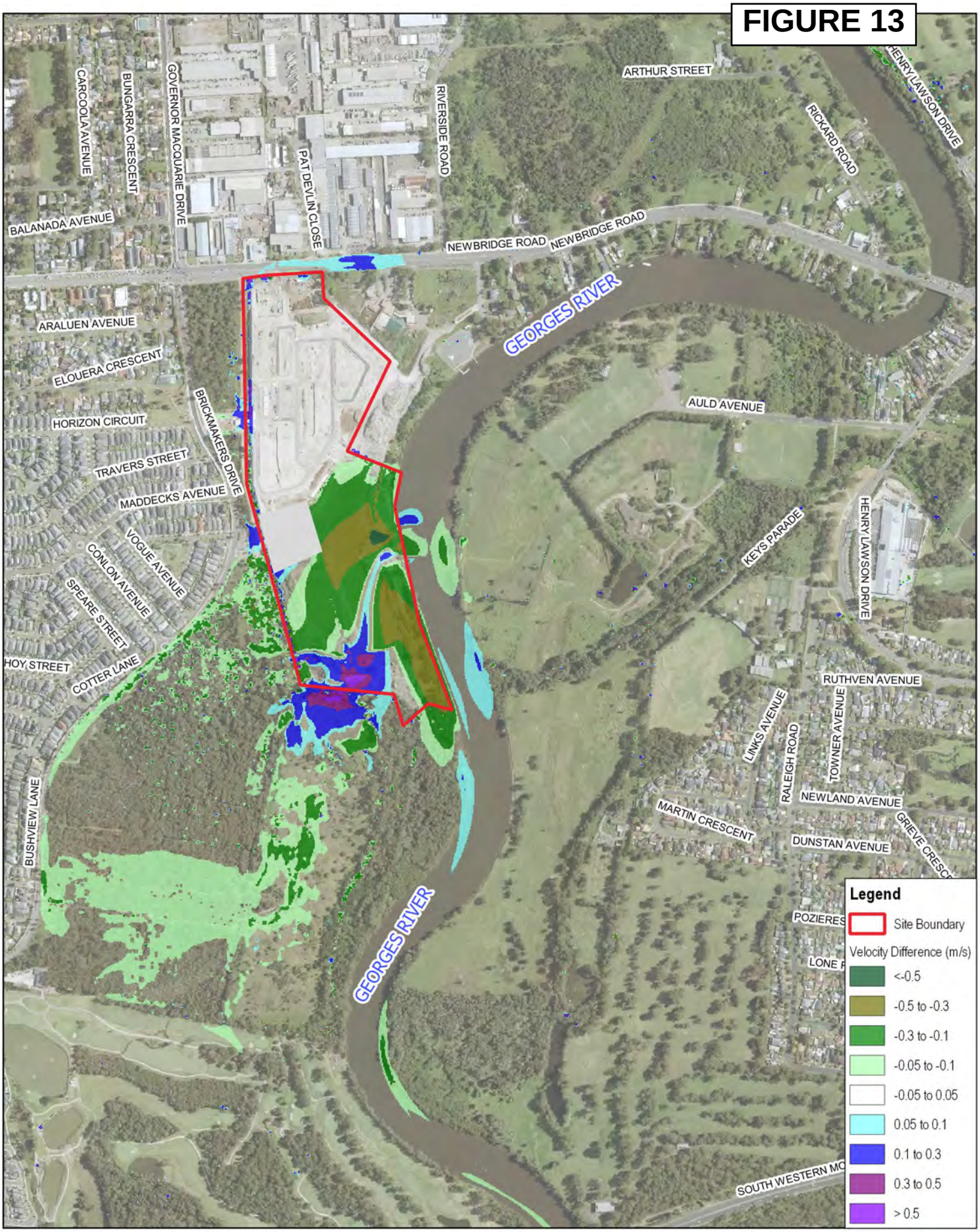
Flood Velocity Differences

20 Year ARI
Modification 2 Conditions - Existing
Figure M2-9

Cardno now Stantec

Map Produced by Cardno Now Stantec (NatW&E)
Date: 2022-3-18
Coordinate System: GDA94/MGA56
Project: nw30126
Map: NW30126

FIGURE 13



N

1:10,000 Scale at A4

m

0 200 400 m

Georges Cove Marina

Flood Velocity Differences

100 Year ARI
Modification 2 Conditions - Existing
Figure M2-10

Cardno now Stantec

Map Produced by Cardno Now Stantec (NatW&E)
Date: 2022-3-18
Coordinate System: GDA94/MGA56
Project: nw30126
Map: NW30126

FIGURE 14

LEGEND

DENOTES EMERGENCY FLOOD EVACUATION ROUTE & DIRECTION

9.14 X — DENOTES PROPOSED DESIGN LEVEL

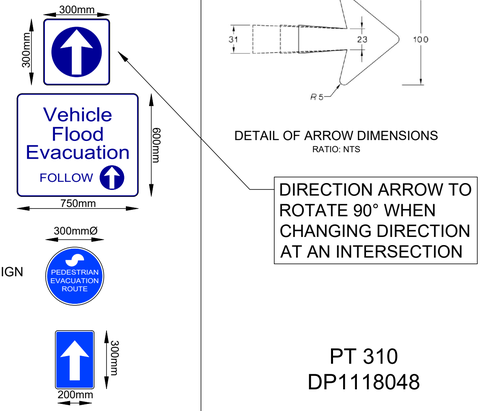
DENOTES VEHICULAR FLOOD EVACUATION ROUTE

VEHICULAR FLOOD EVACUATION DIRECTIONAL SIGN & DIRECTION OF VIEWING (160mm LONG ARROW)

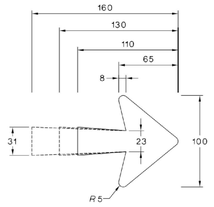
VEHICULAR FLOOD EVACUATION START SIGN & DIRECTION OF VIEWING

PEDESTRIAN FLOOD EVACUATION INFORMATION SIGN (SIGN TO BE PLACED ABOVE DIRECTIONAL SIGN)

PEDESTRIAN FLOOD EVACUATION DIRECTIONAL SIGN & DIRECTION OF VIEWING (160mm LONG ARROW)



DIRECTION ARROW TO ROTATE 90° WHEN CHANGING DIRECTION AT AN INTERSECTION



DETAIL OF ARROW DIMENSIONS
RATIO: NTS

PT 310
DP1118048

PEDESTRIAN BRIDGE

PAINE PARK

ROAD NO. 1

13

12

PT1

MAINSTAY STREET

11

10

9

15

14

MULLOWAY LANE

ANGLER AVENUE

SPINNAKER DRIVE

PT 19

17

KETCH LANE

2

5

6

STREET

SHORELINE ROAD

MAINSTAY STREET

2
DP602988
(FLOWER POWER)

MAST PLACE

PROMONTORY WAY

MAINSTAY

8

3

18

LOWEST LEVEL IN THE SOUTHERN PORTION OF THE SITE

4

7

16

LOT 3 (Stage 1)
(FUTURE MARINA)

X 10.25
X 11.53
X 11.53
11.04 X
X 10.35
X 10.04
X 8.46
X 7.30
X 6.39
X 7.20
X 7.08
X 9.01
X 8.33
X 7.63
X 7.12
X 11.46
X 10.48
X 9.47
X 8.86
X 8.60
X 8.37
X 8.16
X 8.00

ROAD
HORIZON
CIRCUIT
MARBLE
TRAVERS
STREET
NUVO STREET
MADDECKS
AVENUE
BRICKMAKERS DRIVE
HORIZON CIRCUIT

PT 310
DP1118048

PT 200
DP1117280

DIRECTION ARROW TO ROTATE 90° WHEN CHANGING DIRECTION AT AN INTERSECTION

PRELIMINARY PRINT
NOT FOR CONSTRUCTION

REV	DESCRIPTION	DATE	DRN.	APP.
E	SIGNAGE AMENDED	24-08-2022	J.O.	S.G.
D	SIGNAGE ADDED	10-08-2022	J.O.	S.G.
C	REISSUED WITH MINOR NOTES AMENDMENTS	07-03-2020	S.G.	S.G.
B	ISSUED FOR INFORMATION	06-03-2020	S.G.	S.G.
A	ISSUED FOR INFORMATION	26-08-2020	S.G.	S.G.
G	AMENDED SIGN LOCATIONS	08-09-2022	S.G.	S.G
F	ISSUED FOR INFORMATION	31-08-2022	S.G.	S.G.

Client:
MIRVAC HOMES
(NSW) PTY LTD.

0 16 32 48 64
SCALE 1:800 AT A1 SIZE

Designed S.GRAY 26-03-2020
Drawn S.GRAY
Approved -
Date -
PS Number

Beveridge Williams
32 Iolanthe Street
Campbelltown NSW 2560
ph: 02 4625 5055
www.beveridgewilliams.com.au

Project Details: MOOREBANK COVE
NEWBRIDGE ROAD, MOOREBANK

Drawing Title: FLOOD EMERGENCY EVACUATION ROUTE

Sheet 1 of 1
Scale 1:800 @ A1

Project Ref	Stage No	Drawing No	Rev
14005	E45	350	E

S:\JOBS\14\14005\14005 EMW\ENG\CAD\E45 - FLOOD EVAC\14005E45-FLOOD EMERGENCY.dwg

LIVERPOOL CITY COUNCIL

Ref No.: RZ-9/2017
Contact: Stephen Peterson
Ph: 02 8711 7856
Date: 14 June 2023

Mirvac Homes (NSW) Pty Ltd
C/- Adam Perrott
Level 28
200 George Street
SYDNEY NSW 2000

Sent via E-mail: adam.perrott@mirvac.com

RE: RZ-5/2018 Planning proposal to amend *Liverpool Local Environmental Plan 2008* to permit residential accommodation, and increase Height of Building and FSR 146 Newbridge Road, Moorebank

Dear Adam,

I refer to the above application. The planning proposal in its current form as submitted to the Department of Planning & Environment (DPE) on 2 November 2020, seeks the following:

- Amend the Key Sites map to include a designated area for residential accommodation in the RE2 Private Recreation zone at 146 Newbridge Road;
- Include a site-specific provision under Schedule 1 to enable residential accommodation as an additional permitted use (limited to multi-dwelling housing and residential flat buildings) within the key site.
- Amend the maximum permissible Floor Space Ratio from 0.25:1 to 0.4:1 (limited to the key site).
- Amend the maximum permissible Height of Building from 21m to 35m (limited to the key site).

Following the proposal being referred to the Local Planning Panel on 31 August 2020 and a Council meeting of 30 September 2020, Council forwarded the proposal to DPE for Gateway determination as noted above. In December 2020, the Department advised that the planning proposal be resubmitted following the findings of Council's Regional Flood Study. Since this time, a number of new documents and policies regarding flooding and evacuation have been developed by Council and DPE.

Council has also met with DPE to discuss the subject planning proposal, Moorebank East Precinct as a whole and the wider Liverpool Local Government Area (LGA) regarding development on flood prone land.

Given the above timeframe since the initial planning proposal was reported to Council meeting, DPE feedback and subsequent policies which have been developed since December 2020, it is essential the planning proposal and supported documentation is updated in response to all relevant documents, policies, and procedures.

Therefore, upon receipt of all required information outlined in this letter, Council will assess the amended/additional information and if satisfactory, report the planning proposal to an upcoming Council meeting. Dependent upon the outcome of that Council meeting, the planning proposal will be forwarded to DPE for a Gateway determination request.

Please refer to **Attachment A** of this letter below for information required to be submitted to Council in order for the planning proposal to progress to an upcoming Council meeting.

If you require any further information on this matter, please contact Stephen Peterson on 02 8711 7856. A response to this letter is to be emailed to petersons@liverpool.nsw.gov.au. To assist in progression to an upcoming Council meeting, can updated documentation please be submitted to Council by **30 June 2023.**

Yours sincerely,

Nancy-Leigh Norris
Executive Planner

Attachment A: Additional Information Required to be submitted to Council

Attachment A – Additional Information Required to be submitted to Council

1. Updated Planning Proposal Document

A. It is noted that the subject site is zoned entirely RE2 Private Recreation, and the proposal in its current form seeks to include a key site map for the subject area and seeks a site-specific provision under Schedule 1 to enable residential accommodation as an additional permitted use (limited to multi-dwelling housing and residential flat buildings) within the key site area.

The planning proposal is to provide justification as to why a site-specific provision under Schedule 1 to enable residential accommodation as an additional permitted use is sought, instead of rezoning the area identified on the key site map to R4 – High Density Residential including reference to both the R4 High Density Residential and RE2 Private Recreation zone objectives.

Further justification is to be provided as to why a rezoning of the area of the subject site for the previously approved Marina development (approved under DA-611/2018 and DA-611/2018/A) from RE2 Private Recreation to W1 Natural Waterways is not sought to permit better alignment with the zone objectives for the intended use of the site.

B. The planning proposal is to be updated to address current State Environmental Planning Policies including:

- State Environmental Planning Policy (Biodiversity and Conservation) 2021
- State Environmental Planning Policy (Housing) 2021
- State Environmental Planning Policy No 65—Design Quality of Residential Apartment Development
- State Environmental Planning Policy (Planning Systems) 2021
- State Environmental Planning Policy (Precincts—Western Parkland City) 2021
- State Environmental Planning Policy (Resilience and Hazards) 2021
- State Environmental Planning Policy (Sustainable Buildings) 2022
- State Environmental Planning Policy (Transport and Infrastructure) 2021

C. The planning proposal is to be updated to address current Ministerial directions including 4.1 Flooding, 4.2 Coastal Management and 4.4 Remediation of contaminated lands.

2. Updated Supporting Information

A. <u>Updated Traffic Impact Assessment</u>

The most recent Traffic Impact Assessment report is prepared by EMM, dated 10 April 2018. Due to the timeframe which has lapsed since the Traffic Impact Assessment Report was prepared, being over 5 years a revised Traffic Impact Assessment Report is to be submitted to Council. This may be in the form of an addendum as the development intensity of the subject site remains the same of approximately 353 apartments and 21 terrace dwellings.

The Traffic Impact Assessment report is to consider traffic impacts from the proposed development and correlation with the wider Moorebank East precinct which has various separate planning proposals currently under assessment.

The Traffic Impact Assessment report is to update chapter 2 (Existing traffic conditions) including the most recent locality traffic volume surveys and an updated traffic study for accurate traffic volume data. An updated electronic copy of the SIDRA models is to be submitted.

B. Flooding, evacuation, and updated Flood Impact Assessment

The most recent Flood Impact Assessment report for the subject planning proposal is prepared by Cardno, dated 13 April 2018. It is noted that various letters since lodgement of the planning proposal have been submitted to Council from the proponent, including a letter dated 10 August 2022 in response to the Regional Flood Study undertaken by Council (Georges River Evacuation Modelling Flood Evacuation Analysis, prepared by Molino Stewart, dated March 2022.

Further it is noted that discussion has occurred through the planning proposal assessment with Council, Office of Environment & Heritage, the Department and Environment, Energy and Science Group (EES) and NSW State Emergency Service (SES) and that the Department is aware that there are unresolved issues regarding flooding and evacuation in this part of the local government area.

Since the lodgement of the planning proposal, the following regarding flooding has been undertaken regarding flooding and evacuation by Council and the Department:

i. Council has undertaken the Regional Flood Study (Georges River Evacuation Modelling Flood Evacuation Analysis, prepared by Molino Stewart, dated March 2022);

ii. Planning Circular PS 21-006 came into force on 14 July 2021;

iii. Planning direction regarding flooding under section 9.1 of the Environmental Planning and Assessment Act 1979 (the Act) (Section 4.1 – Flooding);

iv. Considering Flooding in Land Use Planning guideline 2021;

v. 2022 Flood Inquiry Report findings; and

vi. DPE Draft shelter in place policy.

In addition to previous existing flood planning policies, the following are to be considered:

i. NSW Flood Prone Land Policy

ii. Floodplain Development Manual 2005

iii. Clause 5.21 and 5.22 of Liverpool Local Environmental Plan 2008.

Due to the significant number of new documents and policies outlined above, the planning proposal including the Flood Impact Assessment Report and an Evacuation Strategy is to be updated to include the above outlined documentation in the assessment. This is to include the Regional Flood Study undertaken by Council, the 2022 Flood Inquiry Report findings and DPE Draft shelter in place policy.

In terms of evacuation, all evacuation routes are to be located above the worst case scenario flood level including for pedestrian and vehicle evacuation. An Adaptive Management Strategy Plan and if deemed necessary, a Flood Emergency Response Plan are to also be considered.

If the subject sites flood emergency response plan nominates to use existing flood emergency evacuation procedures and structures approved for the adjoining Georges Cove Residences site (DA-24/2017), such as the new vehicle bridge connection to Brickmakers Drive and pedestrian bridge evacuation, the amended documentation such as Flood Impact

Assessment report and Flood Emergency Response Plan is to demonstrate that the structures approved under DA-24/2017 have the capacity for additional pedestrian and vehicular movements in an emergency.

C. Preliminary Site Investigation and Site Audit

The most recent Preliminary Site Investigation report is prepared by Douglas Partners, dated May 2018. A revised Preliminary Site Investigation report or addendum is to be submitted addressing the latest guidelines including NSW EPA guidelines, *State Environmental Planning Policy (Resilience and Hazards) 2021* and relevant approvals of the previously approved Marina development (Approved under DA-611/2018 and DA-611/2018/A).

D. Acoustic Report

The 'Georges Cove Marina Residential Planning Proposal Acoustic Study' (Report J17357RP1, Final, Version v3) prepared by EMM dated 24th April 2018 focuses primarily on amenity noise impacts arising from the adjoining Moorebank Recycling Facility. In addition to amenity impacts, consideration must be given to intrusive noise impacts on future residential receivers occupying the proposed marina site.

The NSW EPA's Noise Policy for Industry (2017) confirms that the project amenity noise level for industrial developments = recommended amenity noise level (Table 2.2) minus 5 dB(A). EMM is requested to confirm how the project amenity noise levels within their report were derived as they are consistent with the recommended amenity noise levels and were not adjusted as outlined in the Noise Policy for Industry (2017).

The inclusion of residential uses within the proposed Georges Cove Marina has the potential to generate additional traffic on surrounding roads. Road traffic noise impacts associated with the proposed marina development comprising residential uses must be assessed in accordance with the NSW Road Noise Policy published by the Department of Environment, Climate Change and Water NSW in March 2011.

3. Additional Considerations

A. Site Audit

Due to the complexity of the proposed development and site contamination issues, a site audit is required. Council will recommend that a future Gateway determination condition the requirement for a site auditor to be engaged to confirm adherence to relevant standards, procedures and guidelines, and to provide greater certainty about the information on which the consent authority is basing its decision. A Section B Site Audit Statement and Site Audit Report prepared by a NSW EPA Accredited Site Auditor confirming that:

- The nature and extent of contamination has been appropriately determined at the proposed development site;
- The investigation, remediation or management plan is appropriate for the intended purpose;
- The site can be made suitable for the proposed land use in accordance with the submitted Remediation Action Plan (Report J14149RP1, Version V2, Final) prepared by EMM Consulting dated 11th March 2016 or any modified Remediation Action Plan as required; and
- The preliminary investigation of the land was carried out in accordance with the contaminated land planning guideline and satisfactorily addresses the Land and Environment Court's findings dated 28th February 2018.

It is requested that the NSW EPA accredited site auditor also verifies whether the Applicant was required to provide a report on a detailed investigation (as referred to in the contaminated land planning guidelines) to obtain sufficient information to develop the Remediation Action Plan. If remediation is to include a cap and contain strategy, it is requested that the site auditor reviews the Long-Term Environmental Management Plan for ongoing management of the site.

B. Development Control Plan

It is recommended that Part 2.10 Moorebank East of the Liverpool Development Control Plan 2008 is reviewed in alignment with this Planning Proposal. An update to the Development Control Plan can occur concurrently with the Planning Proposal process, and a DCP amendment is encouraged to be submitted with the revised Planning Proposal.

C. Voluntary Planning Agreement

At the Council meeting of 30 September 2020, it was resolved, amongst other things, that Council "negotiate a possible VPA with the developer". Any offer to enter into a VPA to provide a public benefit in accordance with the development to be facilitated by the planning proposal will be considered in accordance with Council's resolution.

ATTACHMENT B
CARDNO LETTER REPORT 12 APRIL 2022

m 0409 912 631 e mark.tooker@tookerandassociates.com.au a 30 Walworth Avenue, Newport abn 39 619 046 070

Our Ref: NW30126 – L01-R03:BCP/bcp
Contact: Dr Brett C. Phillips

12th April 2022

The Manager
Benedict Industries Pty Ltd
PO Box 431
FRENCHS FOREST NSW 1640

Attention: Ernest Dupere
E: Ernest@benedict.com.au

Cardno (NSW) Pty Ltd
ABN 95 001 145 035

Eastern Core, Level 4,
2 Constitution Ave,
Canberra ACT 2601
Australia

Phone +61 2 6112 4500

www.cardno.com.au

Dear Ernest,

UPDATE OF FLOOD IMPACT ASSESSMENT FOR GEORGES COVE DEVELOPMENT, NEWBRIDGE ROAD, MOOREBANK

Cardno now Stantec has been requested to assess the flood impacts of the two possible modifications of the Georges Cove marina development (former Benedict Sands site) at Lot 7 DP 1065574, 146 Newbridge Road, Moorebank.

1. BACKGROUND

1.1 Georges River Hydraulic Model Context

In 2012 Cardno prepared a detailed two-dimensional flood model of the Georges River floodplain in Moorebank within the Liverpool City Council Local Government Area (LGA). The model extended from upstream of the Newbridge Road crossing to downstream of the Western Highway crossing. The purpose of the model was to undertake a flood impact assessment of the proposed Georges Cove Marina development.

The establishment of the Georges River model for the Moorebank area is detailed in the report *Flood Impact Assessment for the Proposed Georges Cove Marina, Moorebank* (Cardno, dated 30 October 2014). This hydraulic model of the Georges River has been reviewed in detail by Liverpool City Council. The 20 year ARI and 100 year ARI events were established for the floodplain with the 36 hour duration event being critical for the floodplain based on flows extracted from the MIKE-11 models which were prepared as part of the 2004 *Georges River Flood Risk Management Study.* The Assessment's results and conclusions were agreed as being accurate by Liverpool Council Engineers.

Council has nominated the development sites on the Moorebank Peninsula as shown in **Figure 1**. The sites are described in this report as follows:

- Site A – B6 commercial/residential development Benedict Planning Proposal;
- Site B – Flower Power site;

- Site C – Moorebank Cove Mirvac residential site. This development has been approved by Council; and
- Site D – Georges Cove marina site is the Benedict development approved by Council. This site is also referred to the Mirvac marina site which is a Planning Proposal to incorporate residential development into the marina site.

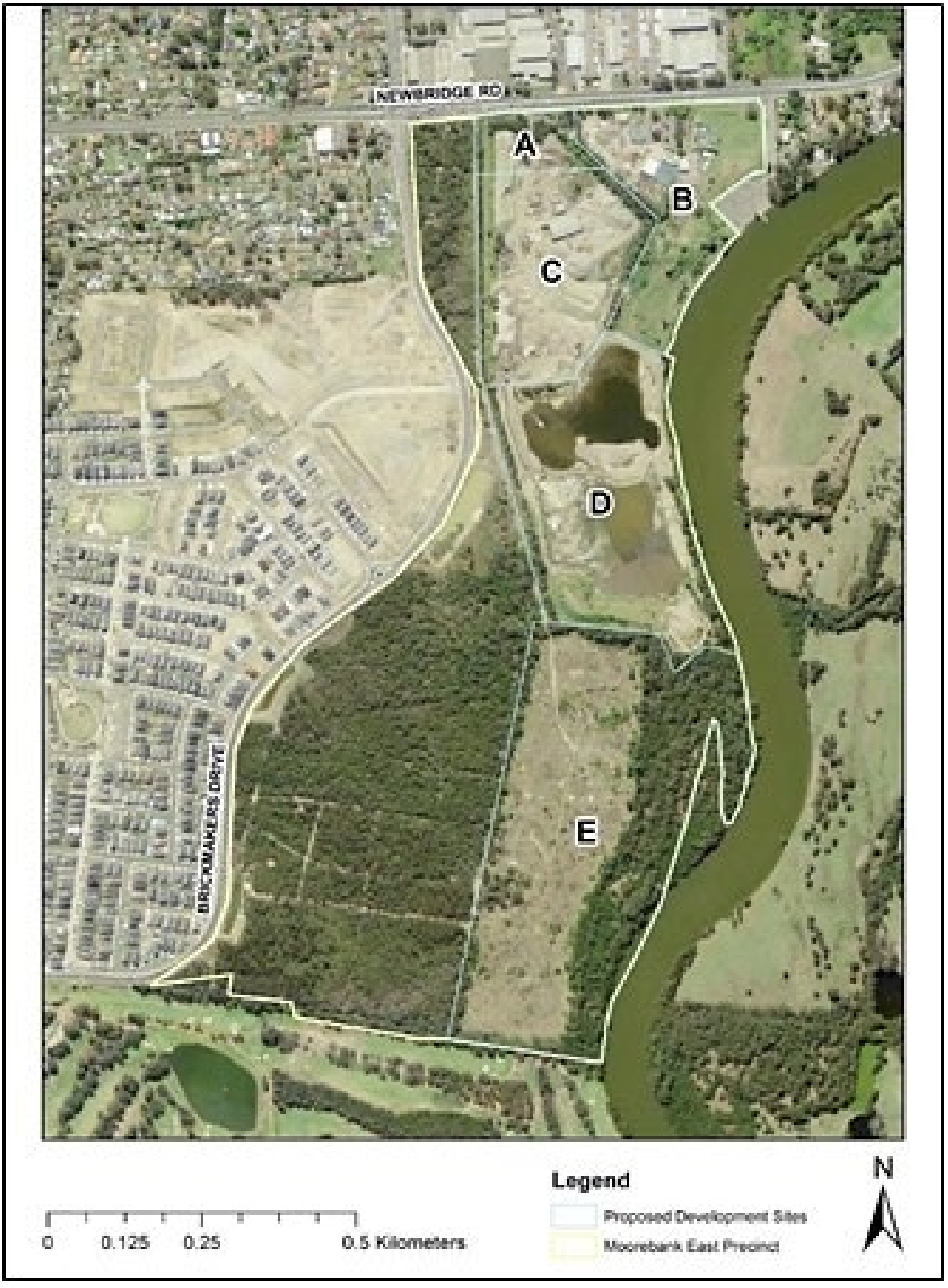


Figure 1 Development Sites A, B, C and D

1.2 Moorebank Cove

The Moorebank Cove site is a residential Mirvac development site (Site C) lying on the portion of the elevated former Benedict Sands site at Newbridge Road, Moorebank. The site adjoins the Georges Cove Marina site which is located immediately to the south (Site D), with both sites being previously part of the same cadastral lot.

The development of the Moorebank Cove and the Georges Cove marina sites have been divided into a number of stages, with the following Development Applications approved by Liverpool City Council:

- DA for Georges Cove Marina site: A number of design iterations of the Georges Cove Marina site were prepared and submitted to Council, the first being prepared in October 2012. Cardno prepared a number of flood impact assessments for the Georges Cove site with impacts documented within a number of addendum reports, the last dated 3 August 2015. The flood reports were submitted and their findings were accepted by Liverpool Council Flood Engineers.
- DA 1558/2006B – Site access bridge from Brickmakers Drive: A previous DA was submitted and approved by Liverpool Council for a 32 metre span bridge connecting Brickmakers Drive to the Moorebank Cove site and crossing over the access road to the Moorebank Recyclers site. The flood modelling of this bridge was incorporated in a Flood Impact Assessment Report dated 23 May 2014 (Cardno, 2014) which was submitted and its findings accepted by Liverpool Council Flood Engineers.
- DA 510/2016 for the initial works in the Moorebank Cove development site: The initial development of the Moorebank Cove site involved landform works on the elevated portions of the site, including a proposed retaining wall to be constructed along the western edge of the site. No flood impact assessments were prepared as part of the original DA, however in response to objections by neighbouring land owners during exhibition, a flood impact assessment was then prepared for the retaining wall structure. The details of this assessment are summarised in the report prepared by Cardno and dated 15 July 2016; *Flood Impact Assessment for Retaining Wall Construction, Moorebank Cove Development, Newbridge Road, Moore*bank, which was submitted to Council and its findings accepted by Liverpool City Council Flood Engineers.

DA 24/2017 for Moorebank Cove was for the first residential development of the site as defined within the Plan of Works drawings prepared by JMD Development Consultants on behalf of Mirvac (drawings 14005E6-RevA, dated 15 June 2016). The following changes to the approved retaining wall works were proposed:

- Re-grading of the site to include local roads within the site. The majority of re-grading is proposed on the elevated portions of the site outside of the floodplain;
- Extension of the retaining wall on the western edge of the site from that proposed in DA 510/2016;
- Extension of the raised development platform to the south-west. This includes a temporary driveway connecting the two site at a grade of 1V: 6H.
- The north-eastern landscaped areas of the Georges Cove Marina are to be left at an elevation of 1.6m AHD to facilitate raingardens to service the Moorebank Cove development site.

The details of this assessment are summarised in the report prepared by Cardno and dated 4 August 2016; *Flood Impact Assessment Stage 2 DA for Moorebank Cove Site, Newbridge Road, Moorebank* which was submitted to Council and its findings accepted by Liverpool Council Flood Engineers.

1.3 Mirvac Marina Planning Proposal

In 2018 Cardno was requested to assess the flood impacts of the Mirvac Marina Planning Proposal planned modifications to the Georges Cove Marina development and the Moorebank Cove residential development in the following terms:

> The preliminary model included the finished ground surface of the entire area including the approved Benedict Georges Cove marina, the approved Mirvac Moorebank Cove residential subdivision and the B6 development. JMD have completed preliminary compensatory storage calculations based on this model compared to the Council agreed pre development base model. The Council agreed pre development base model was created following instructions from Mark Tooker (NPC).
>
> Key points to note are:
>
> - The whole area of Sites A, C and D have been modelled including the B6 land to the north in order to achieve the target compensatory storage; and
> - The B6 land to the north will be developed into a commercial / residential complex. The model adopted an estimated floor level of below ground carpark (at RL 3.5 m AHD) which will be allowed to flood.
>
> The entire length of the Mirvac Marina Planning Proposal including the residential, commercial and boatshed are proposed to sit on piers. The area contains a "tanked" carpark starting at RL 3.6 m AHD underneath the entire residential length of the project. The proposed Marina boat shed's floor will be RL 3.95 m AHD.

2. 2018 ASSESSMENT SCENARIO

2.1 Benchmark Scenario

The benchmark scenario model used to inform the 2018 assessment of the Mirvac Marina Planning Proposal included:

- The approved post-development scenario of the Bendict Georges Cove Marina site as modelled within the report dated 3 August 2015. The approved Georges Cove site included:
  - A large marina located in the middle of the site with an assumed an invert level of RL -3.5m AHD for the marina;
  - A series of wetlands with a finished level of RL 0.6m AHD, and vegetated areas with a finished level of 1.9 m AHD located along the eastern side of the site located within the 40m buffer zone of the Georges River;
  - A portion of landscaped area in the north-west corner of the site raised to RL 4.6 m AHD;
  - A proposed 6 storey building on the western side of the site with car parking on the ground floor at RL 6.3m AHD with a portion of the building suspended above a RL 1.65 m AHD finished ground level at the southern end; and
  - A car park located on the southern side of the site with a ground level of at RL 1.65 m AHD.
- As per advice from Liverpool City Council as part of the original flood study for Georges Cove Marina (30 October 2012) the future finished levels of the Flower Power site, to the east of the Moorebank Cove site has been modelled at RL 6.3 m AHD in the benchmark scenario.

- The approved access bridge design has been accounted for in the benchmark scenario as modelled within the assessment dated 23 May 2014. The latest access bridge design includes a bridge abutment to the west of the bridge and a 32 metre span that passes over the existing access road to the Moorebank Recyclers site.

2.2 Post-development Scenario

The modelling of the Mirvac Marina Planning Proposal landform was based on a post-development design of the Mirvac Moorebank Cove site received from JMD on behalf of Mirvac on 23 January 2018. The extent of the landform was guided by advice received from JMD on 23 January 2018.

The major differences between the ground levels of the benchmark conditions and the Mirvac Marina Planning Proposal were:

(i) The residential/commercial portion of the marina is proposed to sit on piers. The area contains a "tanked" carpark starting a RL 3.6 m. The proposed ground level beneath the suspended car park is open down to RL 1.65 m AHD, thus creating a 1.95 m high void under the complete footprint of the car park. It was proposed that the car park be supported by 750 mm x 750 mm square columns at 7.5 m spacings; and

(ii) The B6 land to the north will be developed into a commercial / residential complex. The model adopts an estimated floor level of below ground carpark (at RL 3.5 m AHD) which will be allowed to flood in a 20 yr ARI event (refer **Attachment B**).

2.3 Flood Impact Assessment

The approach adopted to the representation of the key features of the 2018 Mirvac Marina Planning Proposal development were as follows:

(i) The void beneath the elevated car park was represented in the 2D domain using the "layered flow method". Hydraulic losses were represented by a form loss which reflects the proposed dimensions and spacing of the columns;

(ii) The proposed boat storage facility located south of the elevated car park was represented as a high roughness zone with a hydraulic roughness value of 0.08;

(iii) While the level of the B6 land in the northeastern corner has been lowered it has also been modelled with a high roughness (0.12) which represents the planned building development.

The hydraulic model was run for the 20 year and 100 year ARI events. The flood model results from the post development scenario were compared to the Council approved benchmark scenario to assess whether there were any adverse flood impacts. The assessment of impacts is presented in the following sections.

Flood Level Impact

In both the 20 yr ARI and 100yr ARI flood it was assessed that the Mirvac Marina Planning Proposal has nil adverse impact on water levels (less than 0.01 m) at any location in the floodplain in comparison to the Council approved benchmark conditions.

Flood Velocity Impact

In both the 20yr and 100yr ARI events the velocity impacts are modest west of the northern section of the elevated car park. Notwithstanding these local changes in velocity the overall velocity remains much lower than 1 m/s and consequently does not pose a scour risk and are considered acceptable.

Flood Storage

The change in 100 yr ARI flood storage as a result of the works proposed under the Mirvac Marina Planning Proposal was also assessed. The 100 yr ARI flood storage under the Benchmark Scenario was estimated to be 499,200 m^3. The 100 yr ARI flood storage under the Post-development Scenario (Mirvac Marina Planning Proposal) was estimated to be 521,800 m^3. This calculation accounted for the volume of floodwaters displaced by the proposed suspended car park and the columns which will support the car park.

It was concluded that the Mirvac Marina Planning Proposal would increase the 100 yr ARI flood storage by 22,600 m^3 (create a benefit) in comparison with the previous approved land form and development (Benchmark Scenario).

3. FLOOD IMPACT ASSESSMENT - MODIFICATION 1

The objective was to assess the feasibility of filling part of the Mirvac Marina Planning Proposal site under the proposed building development to use 22,600 m^3 of the surplus flood storage without causing significant adverse flood impacts on adjoining properties. The concept plan appended in Attachment C1 showed the proposed filling of the flood void under the terraces tanked carpark (ie. the void between RL 1.65 m AHD and RL 3.6 m AHD) would use up 16,185 m^3 of the surplus flood storage (plan area – 83m x 100m, depth – 1.95m). This would leave a flood storage surplus of 6,415 m^3.

The approach adopted to the modify the 2018 Mirvac Marina Planning Proposal was as follows:

(i) The void beneath the terraces below the elevated car park is proposed to be filled and this was represented in the 2D domain as 100% blocked using the “layered flow method”;

(ii) The void beneath the remaining section of the elevated car park which will remain open was represented in the 2D domain using the “layered flow method”. Hydraulic losses were represented by a form loss which reflects the proposed dimensions and spacing of the columns;

(iii) The void beneath the proposed boat storage facility below the elevated car park would remain open and was represented as a high roughness zone with a hydraulic roughness value of 0.08;

The hydraulic model was run for the 20 year and 100 year ARI events. The flood results for this Modification 1 were compared to the Council approved base model for the pre development Existing Conditions in 2012 and these model results are summarised in the following sections.

3.1 Flood Behaviour

The estimated 20 yr ARI flood levels, depths and velocities under Modification 1 are plotted respectively in **Figures M1-1, M1-2** and **M1-3** in **Attachment A.**

The estimated 100 yr ARI flood levels, depths and velocities under Modification 1 are plotted respectively in **Figures M1-4, M1-5** and **M1-6** in **Attachment A.**

3.2 Water Level Impacts

The estimated flood level differences under Modification 1 are plotted in in **Figures M1-7** and **M1-8** for the 20yr ARI and 100yr ARI respectively. These flood level differences are in comparison to Existing Conditions in 2012.

Figure M1-7 shows no adverse flood level impacts on adjacent development sites. It shows a small local area of impact contained within the site and river and a far more extensive area of benefit with a lowering of 20 yr ARI flood levels downstream (west) of the proposed development.

Figure M1-8 shows no adverse flood impacts on adjacent development sites. It shows a local area of impact contained within the site and river and a far more extensive area of benefit with a lowering of 100 yr ARI flood levels downstream (west) of the proposed development.

3.3 Velocity Impacts

The estimated velocity differences under Modification 1 are plotted in in **Figures M1-9** and **M1-10** for the 20yr ARI and 100yr ARI respectively. These flood velocity differences are in comparison to Existing Conditions in 2012.

The changes in velocity are minor and the overall velocity remains lower than 1 m/s and consequently does not pose any adverse scour risk.

3.4 Flood Storage

Modification 1 would leave a flood storage surplus of 6,415 m^3.

3.5 Conclusions

It is concluded from the hydraulic modelling of Modification 1 that:

- Modification 1 generates a small local area of impact and a far more extensive area subject to a slight lowering of 20 yr ARI flood levels downstream (west) of the proposed development;
- Under Modification 1, a local area of impact is largely contained within the site while a far more extensive area is subject to a slight lowering of 100 yr ARI flood levels downstream (west) of the proposed development;
- The local increases under Modifications 1 do not adversely impact on any adjoining development;
- The changes in velocity are minor and the overall velocity remains lower than 1 m/s and consequently does not pose any adverse scour risk.

Overall, Modification 1 results in a significant improvement (lowering) in flood levels on adjacent properties and does not cause any adverse flooding impacts on adjacent development sites and in fact provides a benefit.

4. FLOOD IMPACT ASSESSMENT - MODIFICATION 2

Modification 2 includes Modification 1 plus filling under the boatshed. The concept plan is appended in **Attachment C2**. The proposed filling of the flood void under the terraces tanked carpark would use up 16,185 m^3 of the surplus flood storage (plan area – 83 m x 100 m, depth – 1.95 m) leaving 6,415 m^3 of storage increase.

Under Modification 2 it is proposed to fill under the boat shed from RL 1.65 m AHD to RL 3.95 m AHD. This would leave a total flood storage difference of 0 m^3 during a 100 yr ARI flood event ie. no loss or gain in flood storage.

The approach adopted to the modify the 2018 Mirvac Marina Planning Proposal was as follows:

(i) The void beneath the elevated car park under the terraces was represented in the 2D domain as 100% blocked using the "layered flow method";

(ii) The void beneath the remaining section of the elevated car park was represented in the 2D domain using the "layered flow method". Hydraulic losses were represented by a form loss which reflects the proposed dimensions and spacing of the columns; and

(iii) The floor level of the proposed boat storage facility located south of the elevated car park was filled from RL 1.65 m AHD to RL 3.95 m AHD and was represented as a high roughness zone with a hydraulic roughness value of 0.08.

The hydraulic model was run for the 20 year and 100 year ARI events. The model results are summarised in the following sections.

4.1 Flood Behaviour

The estimated 20 yr ARI flood levels, depths and velocities under Modification 2 are plotted respectively in **Figures M2-1, M2-2** and **M2-3** in **Attachment A.**

The estimated 100 yr ARI flood levels, depths and velocities under Modification 2 are plotted respectively in **Figures M2-4, M2-5** and **M2-6** in **Attachment A.**

4.2 Water Level Impacts

The estimated flood level differences under Modification 1 are plotted in in **Figures M2-7** and **M2-8** for the 20yr ARI and 100yr ARI respectively. These flood level differences are in comparison to Existing Conditions in 2012.

Figure M2-7 shows no adverse flood impacts on adjacent development sites. It shows a small local area of impact contained within the site and river and a far more extensive area of benefit with a lowering of 20 yr ARI flood levels downstream (west) of the proposed development.

Figure M2-8 shows no significant adverse flood impacts on adjacent development sites. There is a small increase in flood levels onto a small part of riparian land on the other side of the river which is already significantly flooded. It shows a local area of impact contained mainly within the site and river and a far more extensive area of benefit with a lowering of 100 yr ARI flood levels downstream (west) of the proposed development.

4.3 Velocity Impacts

The estimated velocity differences under Modification 1 are plotted in in **Figures M2-9** and **M2-10** for the 20yr ARI and 100yr ARI respectively. These flood velocity differences are in comparison to Existing Conditions in 2012.

The changes in velocity are minor and the overall velocity remains lower than 1 m/s and consequently does not pose any adverse scour risk.

4.4 Flood Storage

Modification 2, if built, would leave a total flood storage of 0 m^3 during a 100 yr ARI flood event ie. no loss or gain in flood storage. Simply put, in terms of flood storage, this is as though the site was undisturbed and none of the developments were constructed.

4.5 Conclusions

It is concluded from the hydraulic modelling of Modification 2 that:

- Modification 2 generates a small local area of impact and a far more extensive area subject to a slight lowering of 20 yr ARI flood levels downstream (west) of the proposed development;
- Under Modification 2 the local area of impact extends east and north in comparison to Modification 1 and is largely contained within the site and river while a far more extensive area is subject to a slight lowering of 100 yr ARI flood levels downstream (west) of the proposed development;
- The local increases under Modifications 2 do not adversely impact on any adjoining development;
- The changes in velocity are minor and the overall velocity remains lower than 1 m/s and consequently does not pose any adverse scour risk.

Overall, Modification 2 results in a significant improvement (lowering) in flood levels on adjacent properties and does not cause any significant adverse flooding impacts on adjacent development sites.

Yours faithfully

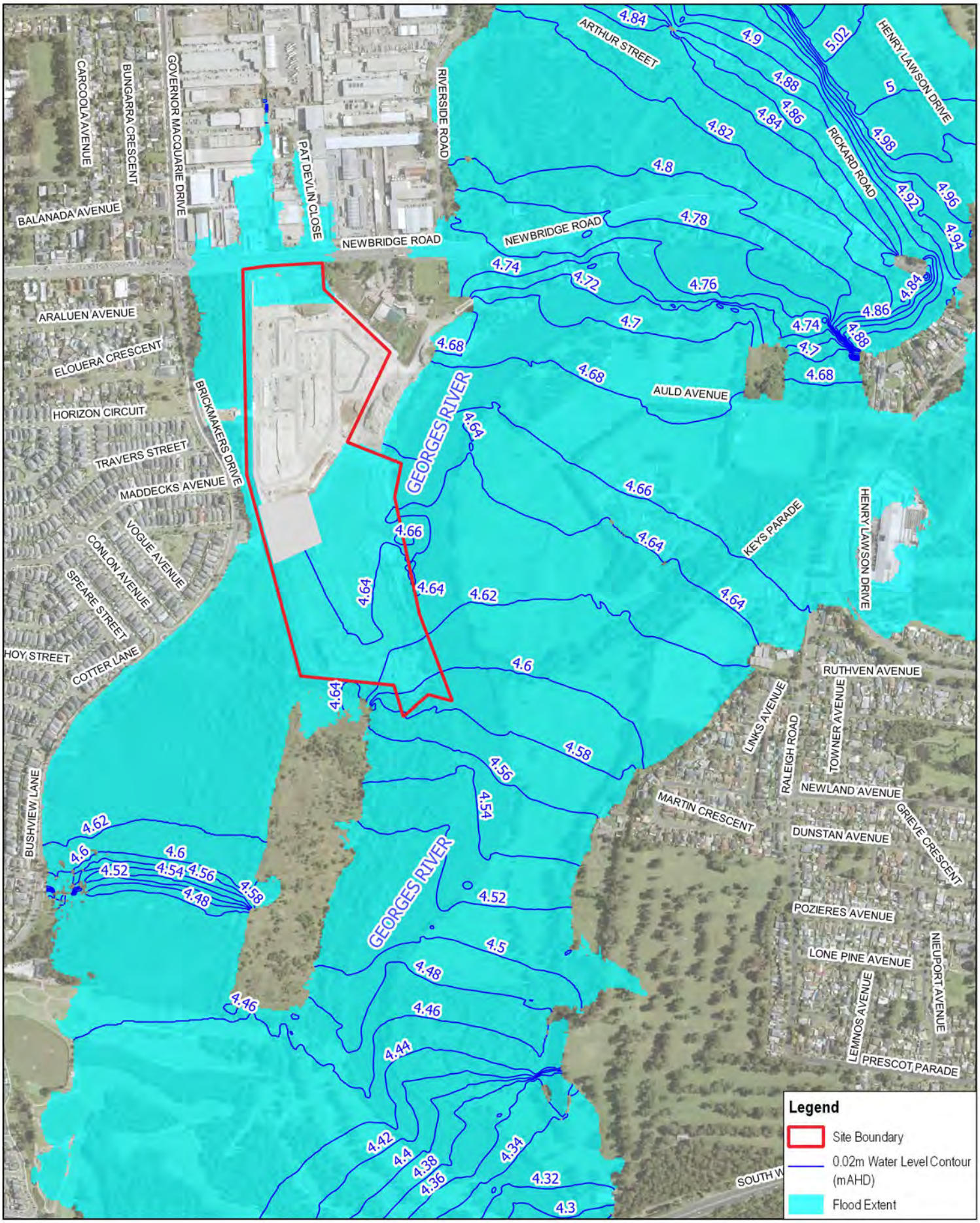
Brett C. Phillips

……

Dr Brett C. Phillips
Senior Principal
for **Cardno now Stantec**

Annexure A

Modification 1 Conditions



Georges Cove Marina

Flood Extents and Flood

20 Year ARI
Modification 1 Conditions
Figure M1-1

N

1:10,000 Scale at A4

m

0 200 400 m

Cardno now Stantec

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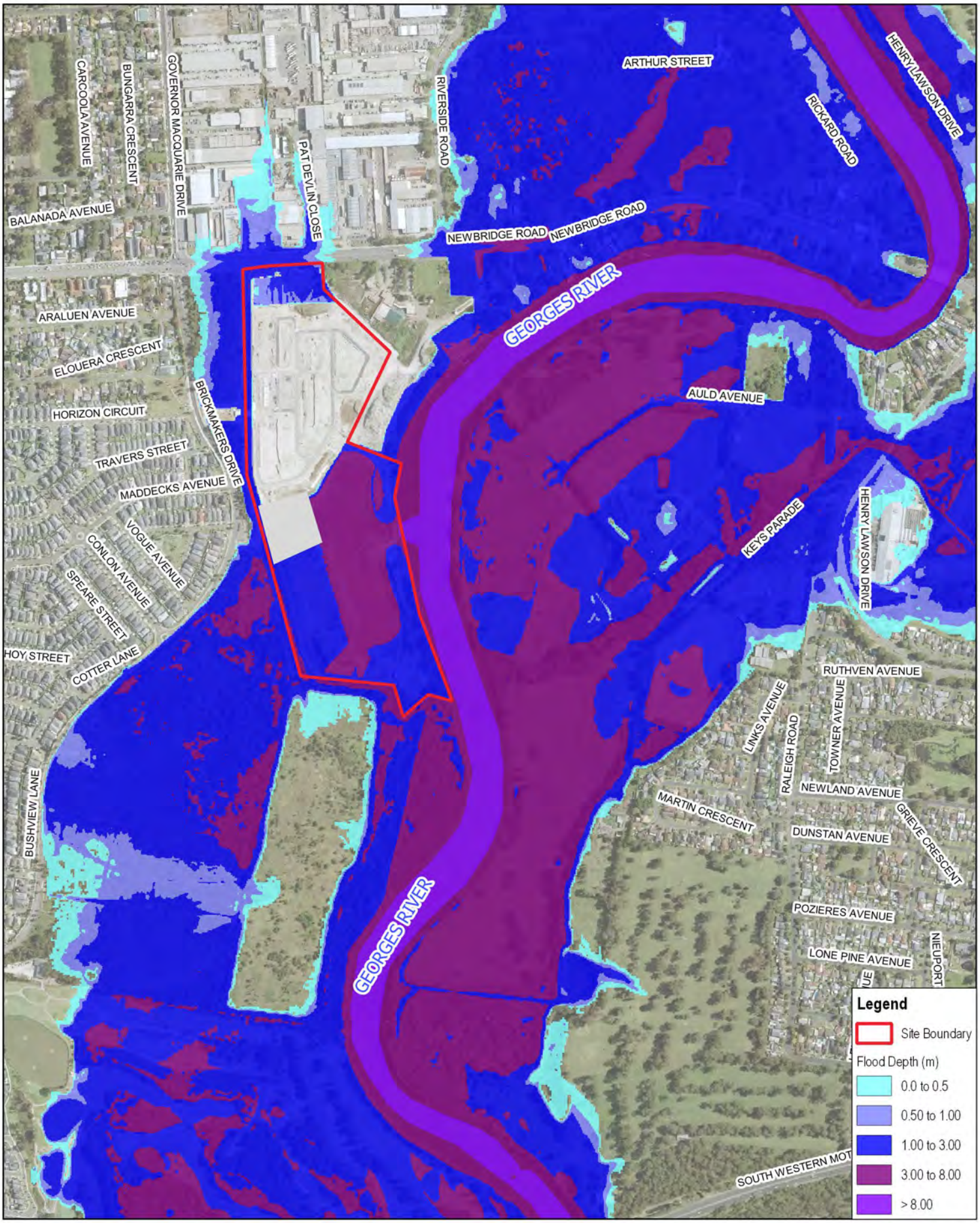

Georges Cove Marina

Flood Depth

20 Year ARI
Modification 1 Conditions
Figure M1-2

N

1:10,000 Scale at A4

m

0 200 400 m

Cardno now Stantec

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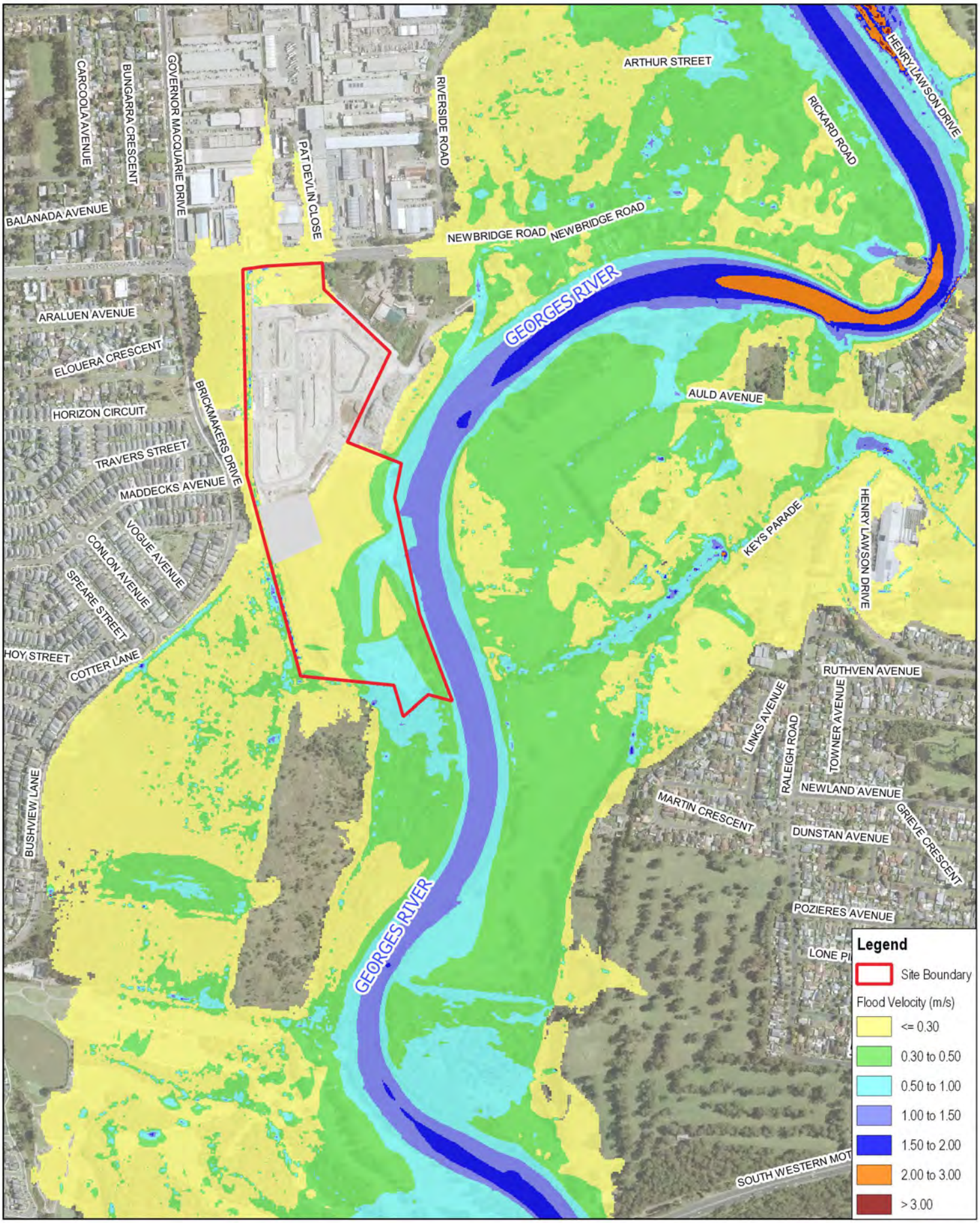

Georges Cove Marina

Flood Velocities

20 Year ARI
Modification 1 Conditions
Figure M1-3

N

1:10,000 Scale at A4

m

0 200 400 m

Cardno now Stantec

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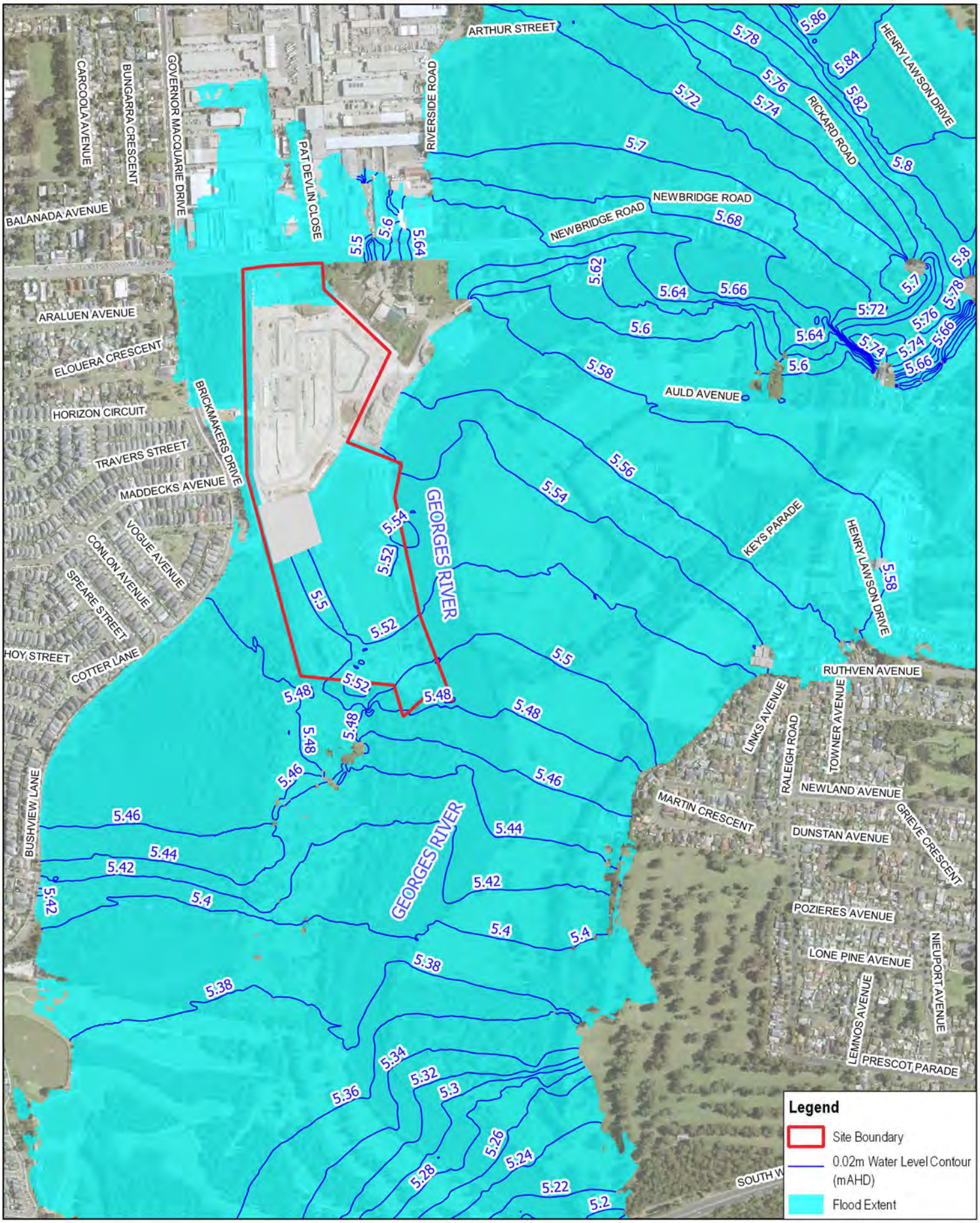

Georges Cove Marina

Flood Extents and Flood

100 Year ARI
Modification 1 Conditions
Figure M1-4

N

1:10,000 Scale at A4

m

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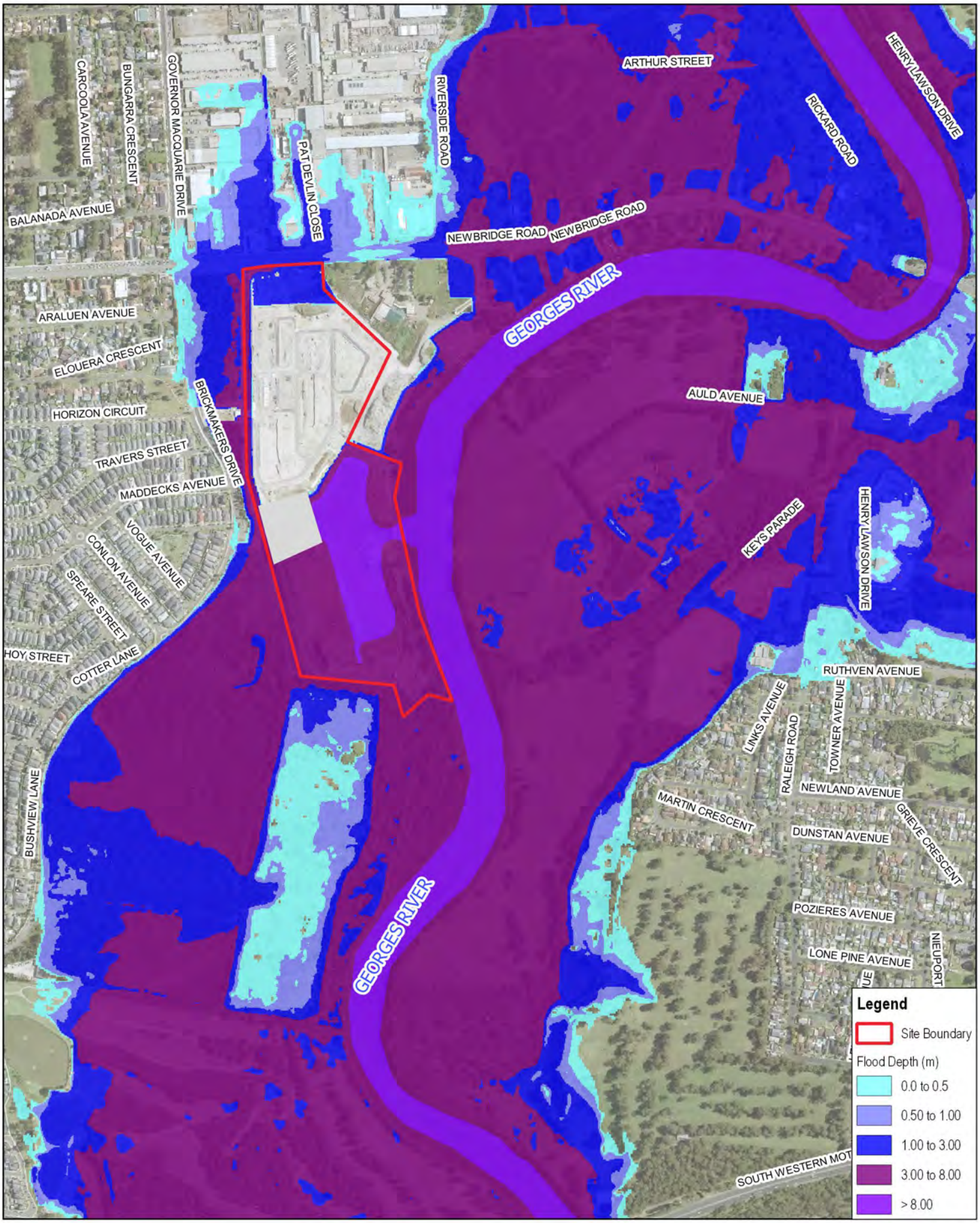

Georges Cove Marina

Flood Depth

100 Year ARI
Modification 1 Conditions
Figure M1-5

N

1:10,000 Scale at A4

m

0 200 400 m

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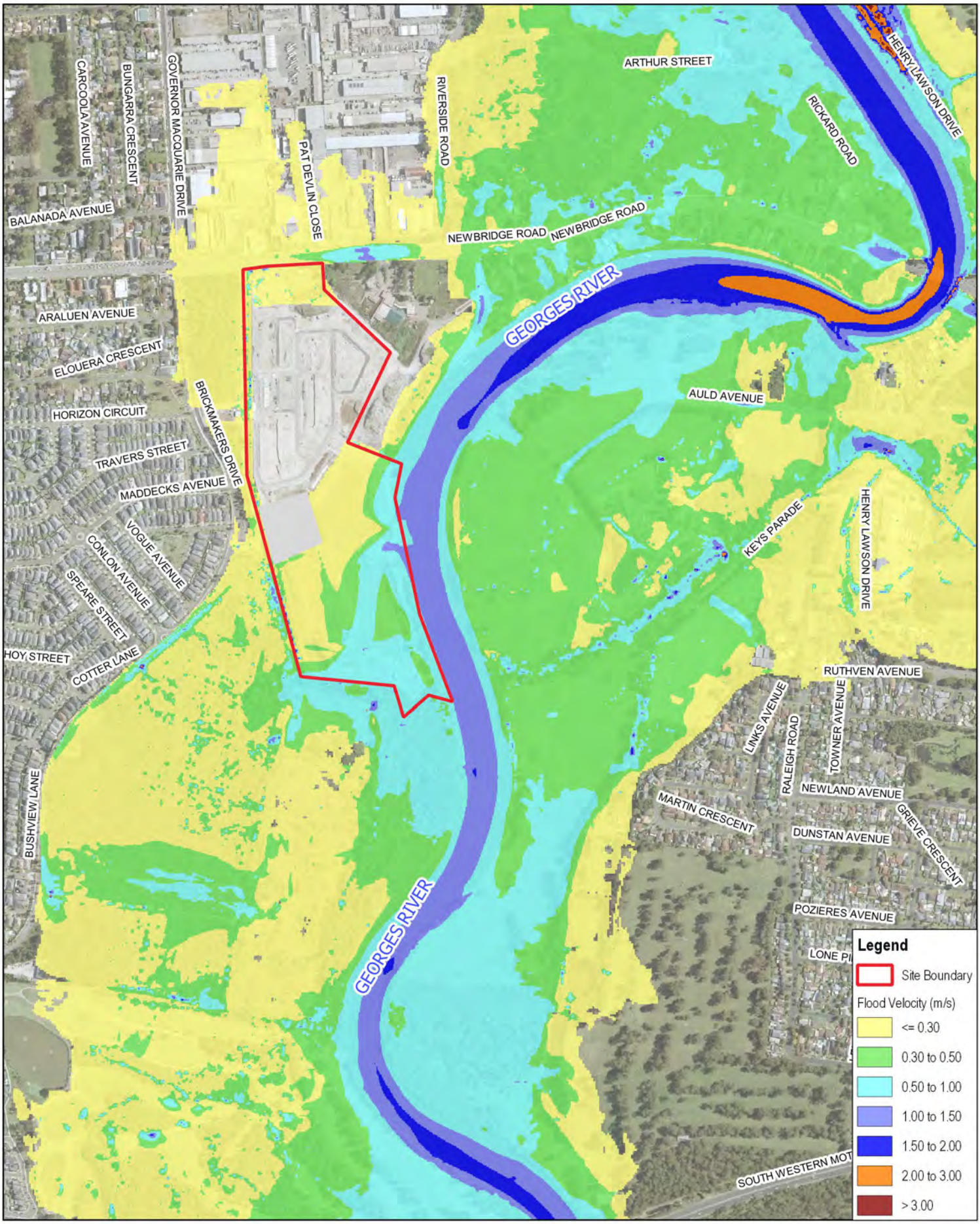

Georges Cove Marina

Flood Velocities

100 Year ARI
Modification 1 Conditions
Figure M1-6

N

1:10,000 Scale at A4

m

0 200 400 m

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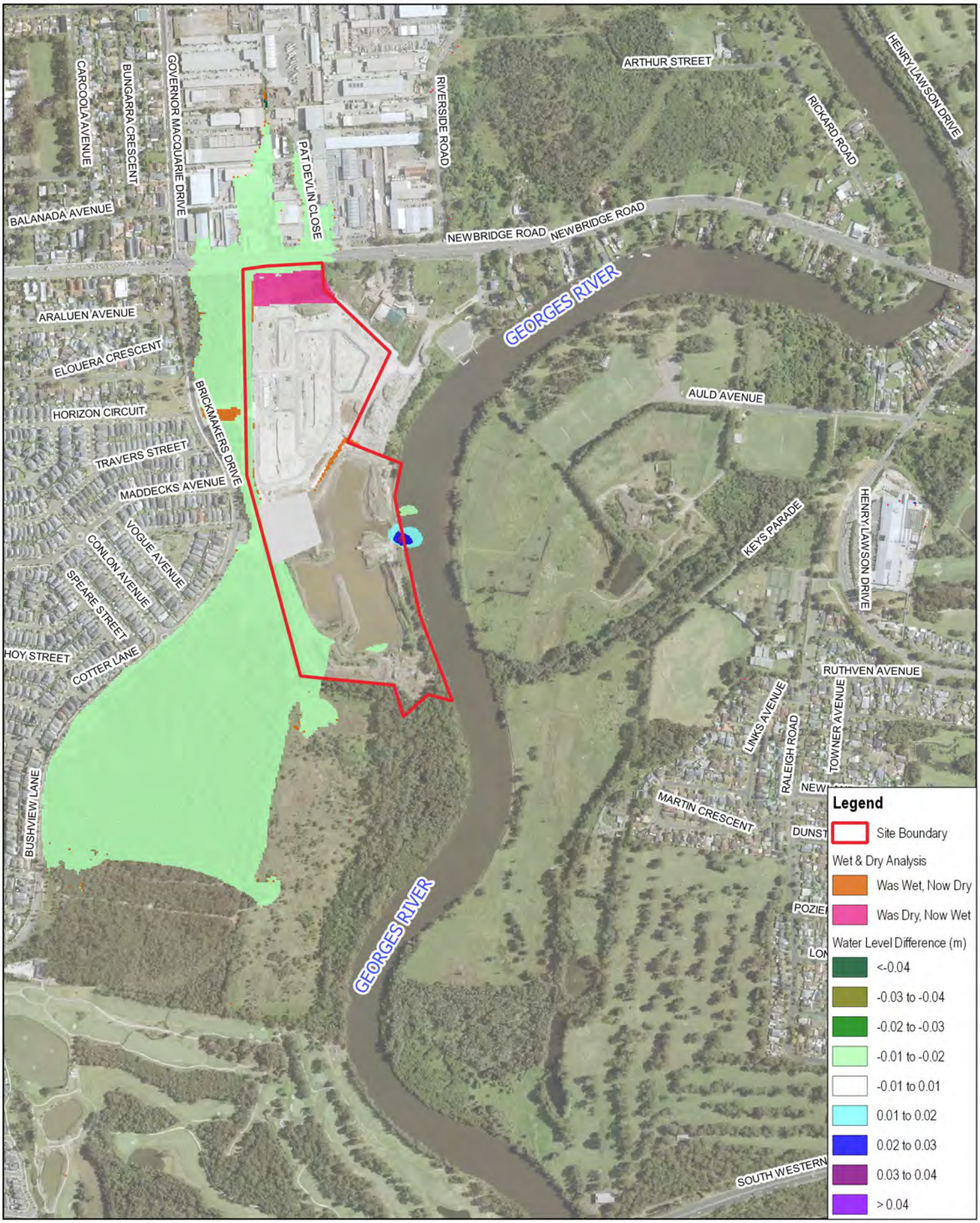

N

1:10,000 Scale at A4

m

0 200 400 m

Georges Cove Marina

Flood Level Differences

20 Year ARI
Modification 1 Conditions - Existing
Figure M1-7

Cardno now Stantec

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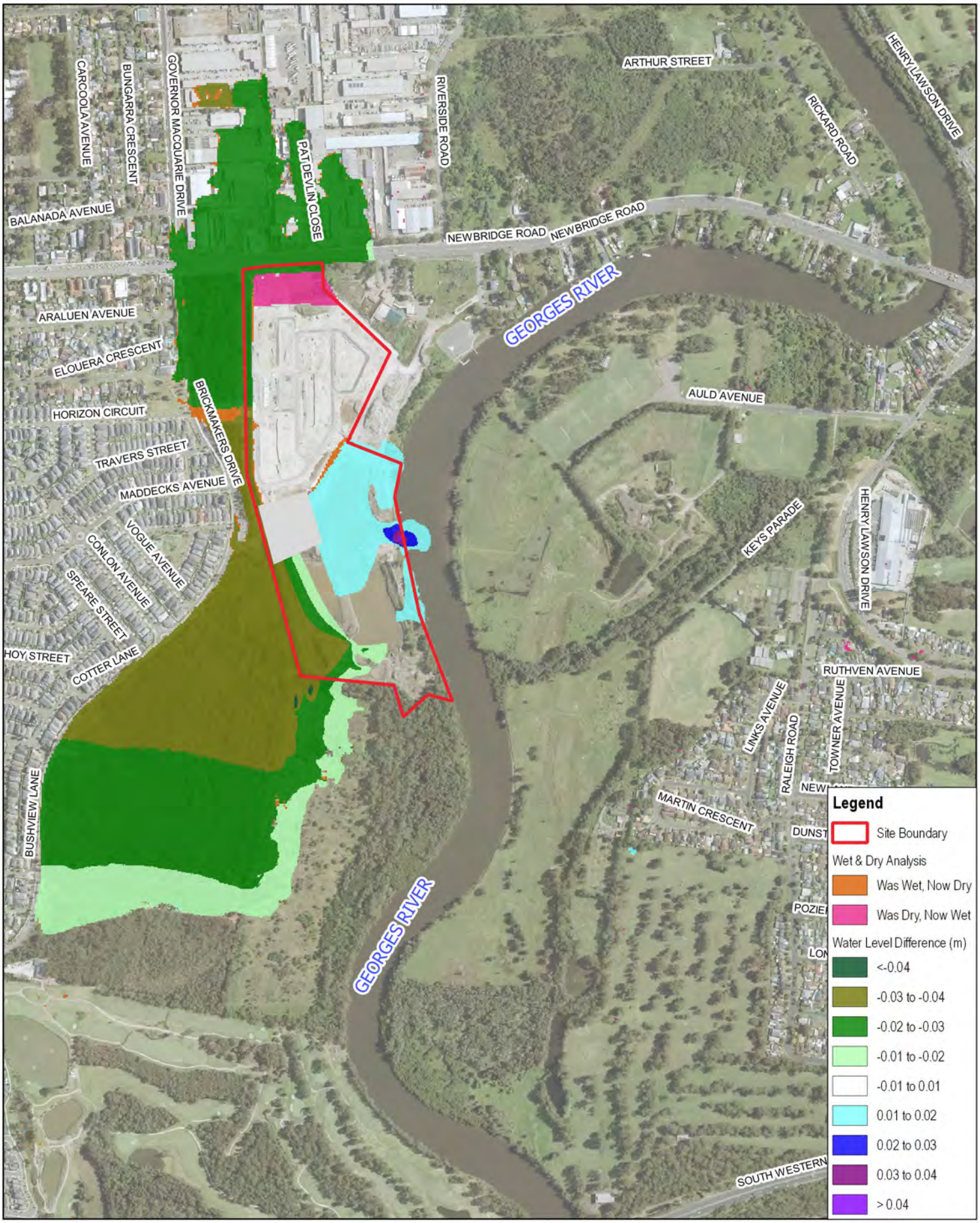

N

1:10,000 Scale at A4

m

0 200 400 m

Georges Cove Marina

Flood Level Differences

100 Year ARI
Modification 1 Conditions - Existing
Figure M1-8

Cardno now Stantec

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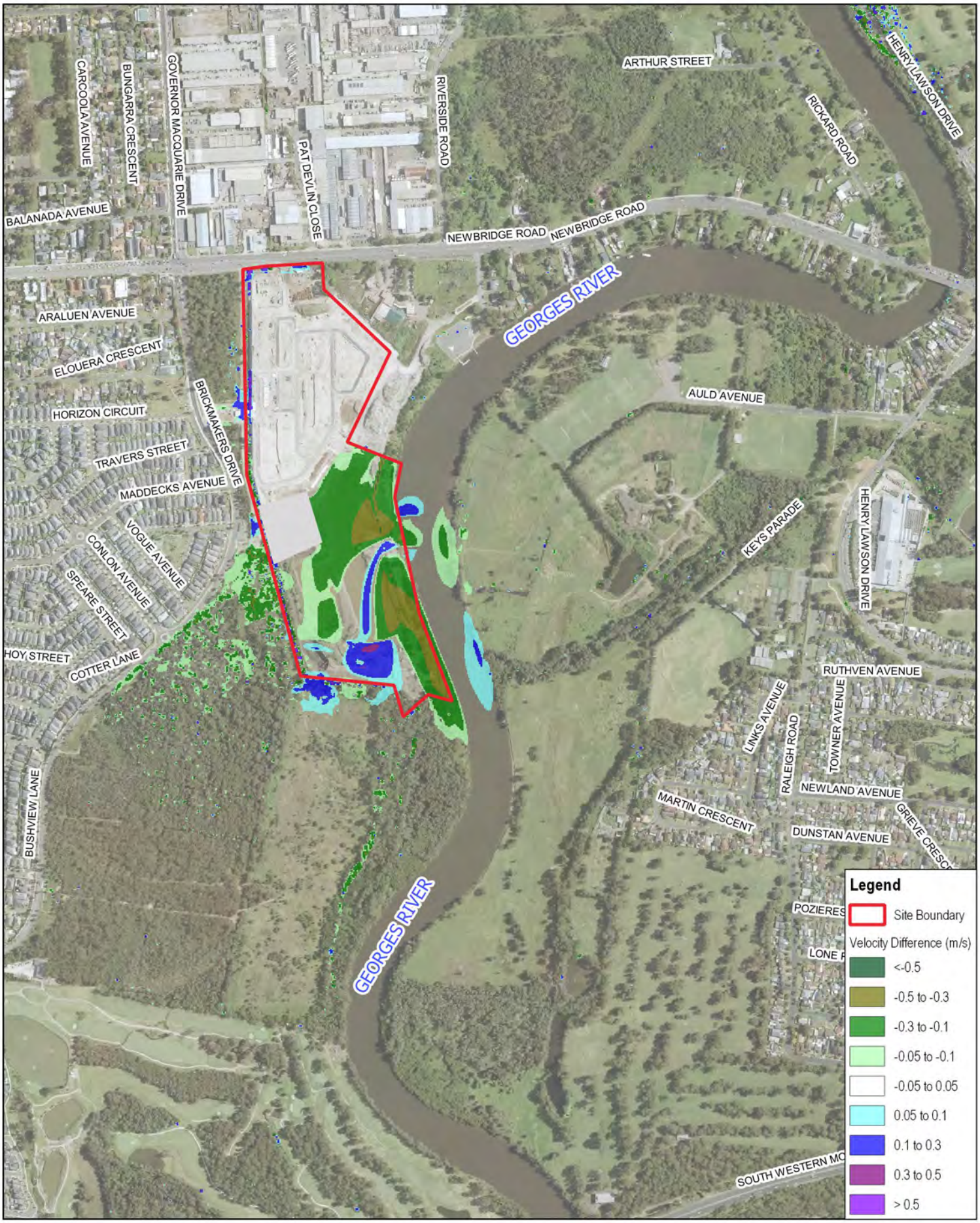

N

1:10,000 Scale at A4

m

0 200 400 m

Georges Cove Marina

Flood Velocity Differences

20 Year ARI
Modification 1 Conditions - Existing
Figure M1-9

Cardno now Stantec

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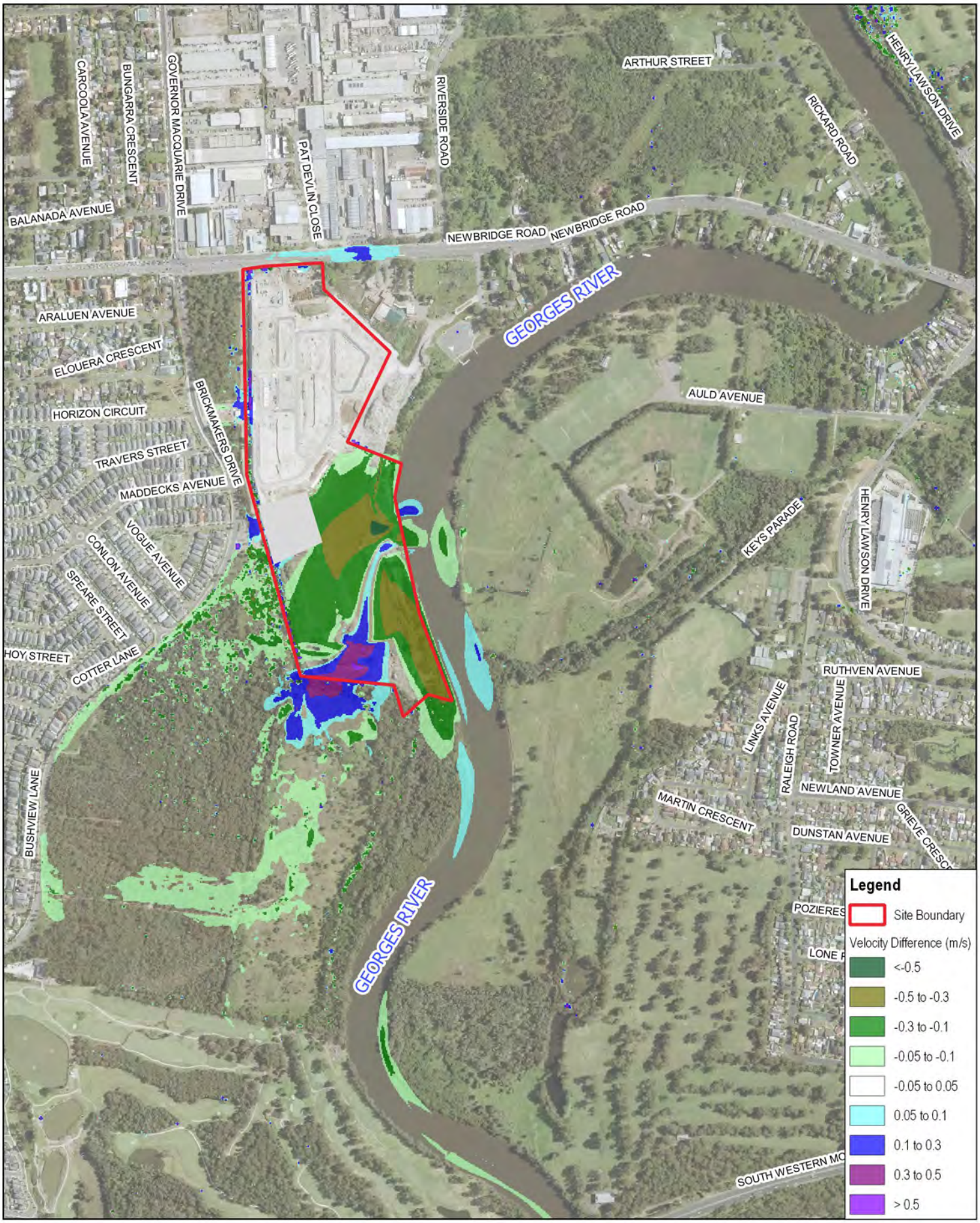

Georges Cove Marina

Flood Velocity Differences

100 Year ARI
Modification 1 Conditions - Existing
Figure M1-10

N

1:10,000 Scale at A4

m

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Cardno now Stantec

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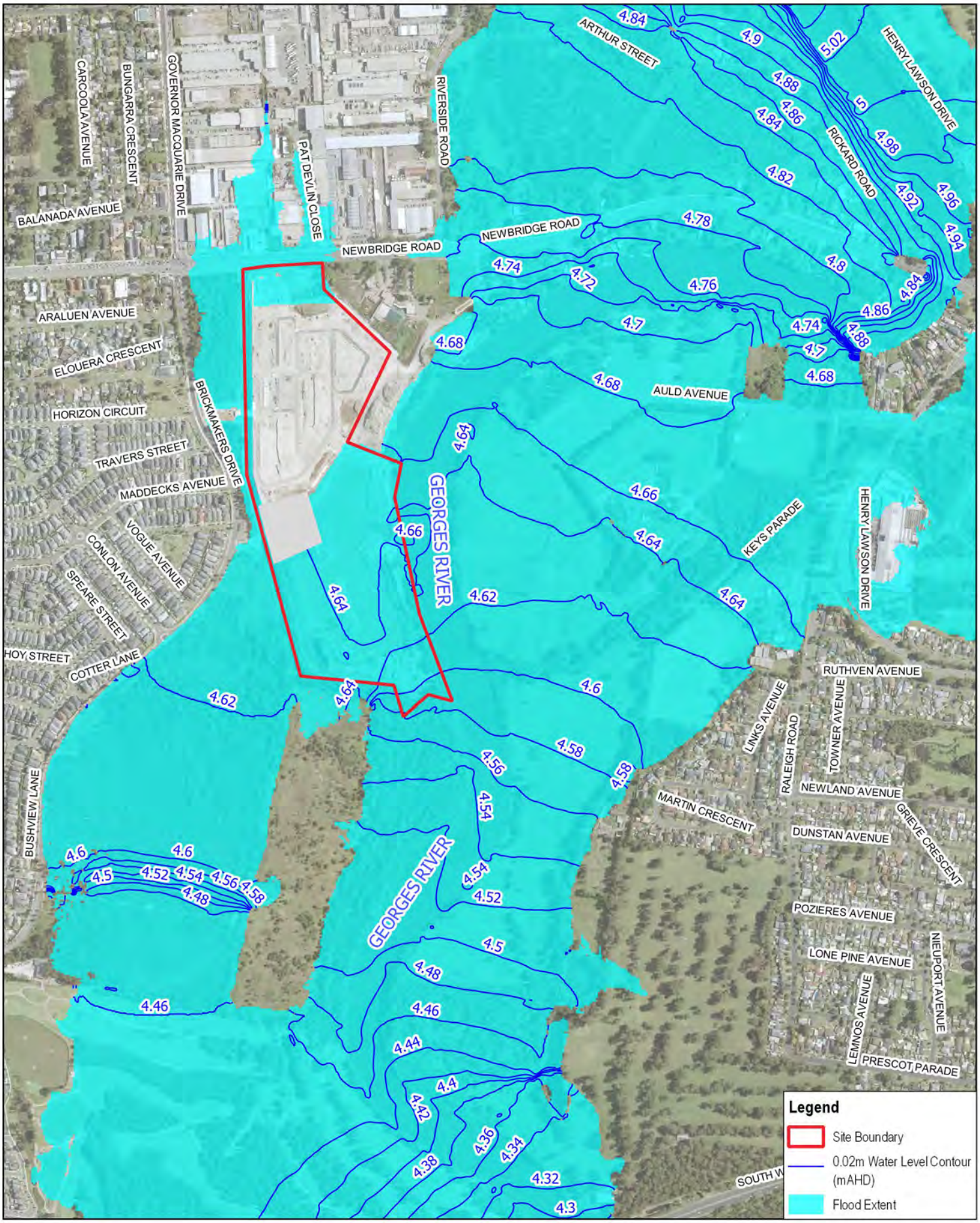
Annexure B

Modification 2 Conditions



N

1:10,000 Scale at A4

m

0 200 400 m

Georges Cove Marina

Flood Extents and Flood

20 Year ARI
Modification 2 Conditions
Figure M2-1

Cardno now Stantec

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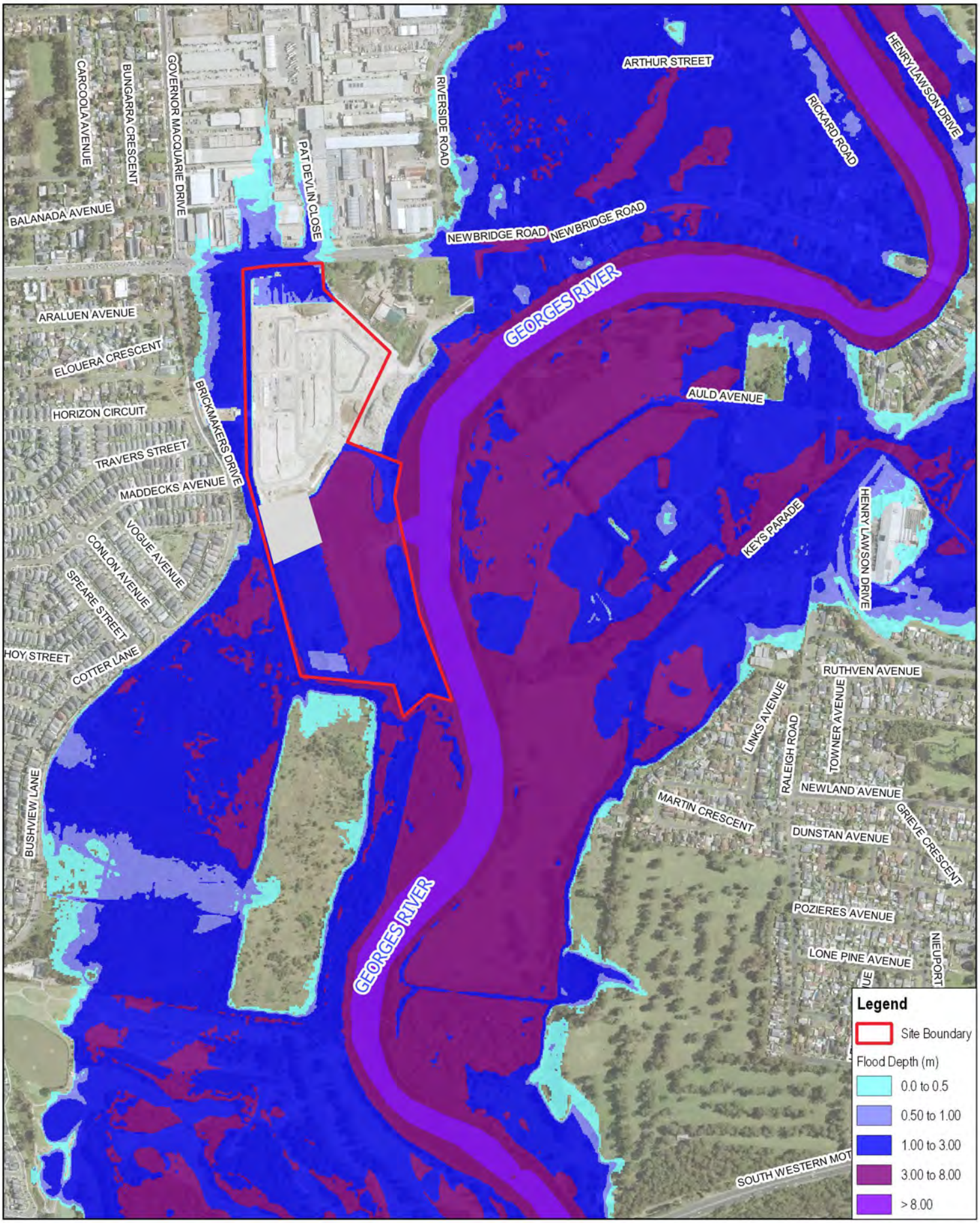

Georges Cove Marina

Flood Depth

20 Year ARI
Modification 2 Conditions
Figure M2-2

N

1:10,000 Scale at A4

m

0 200 400 m

Cardno now Stantec

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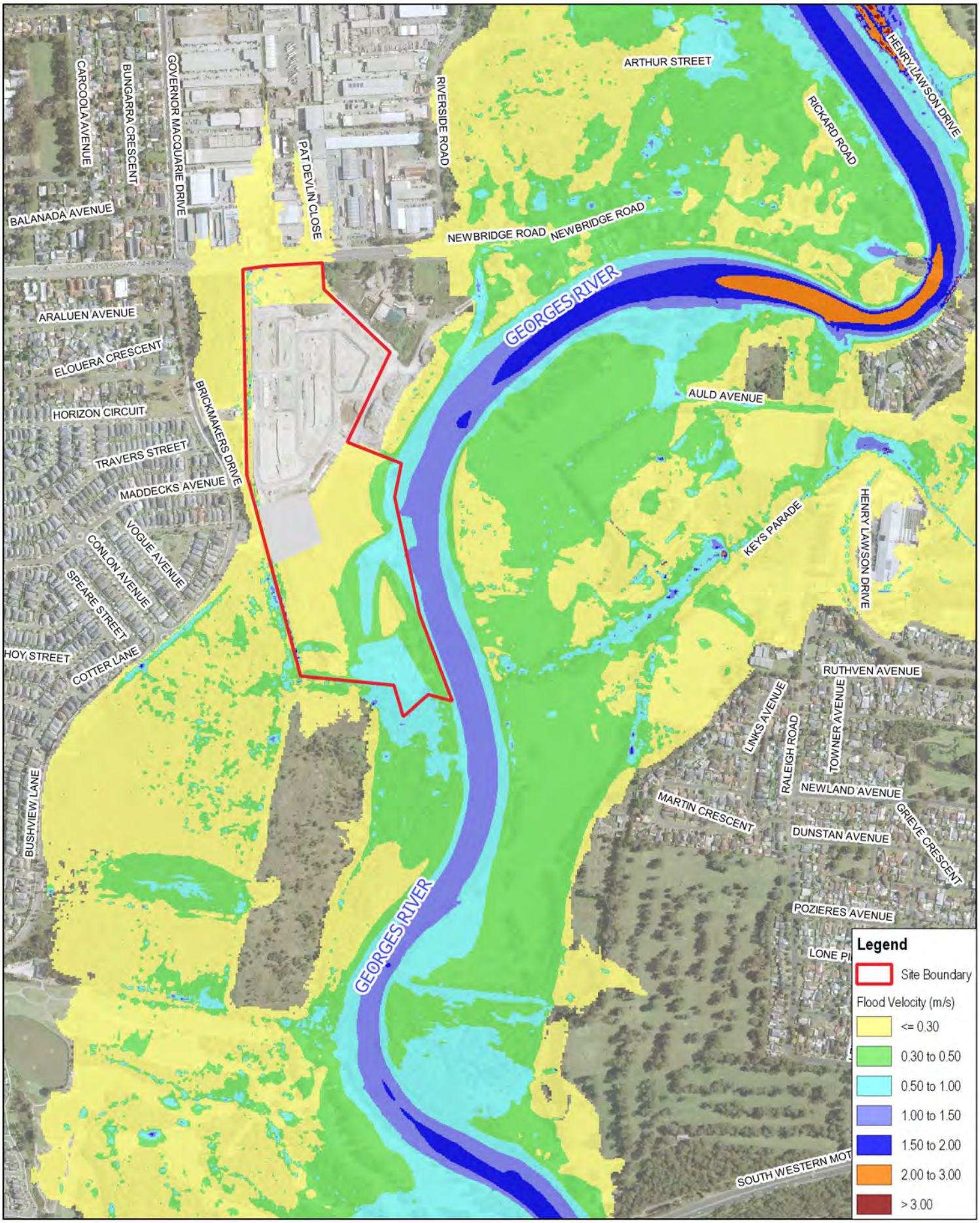

Georges Cove Marina

Flood Velocities

20 Year ARI
Modification 2 Conditions
Figure M2-3

N

1:10,000 Scale at A4

m

0 200 400 m

Cardno now Stantec

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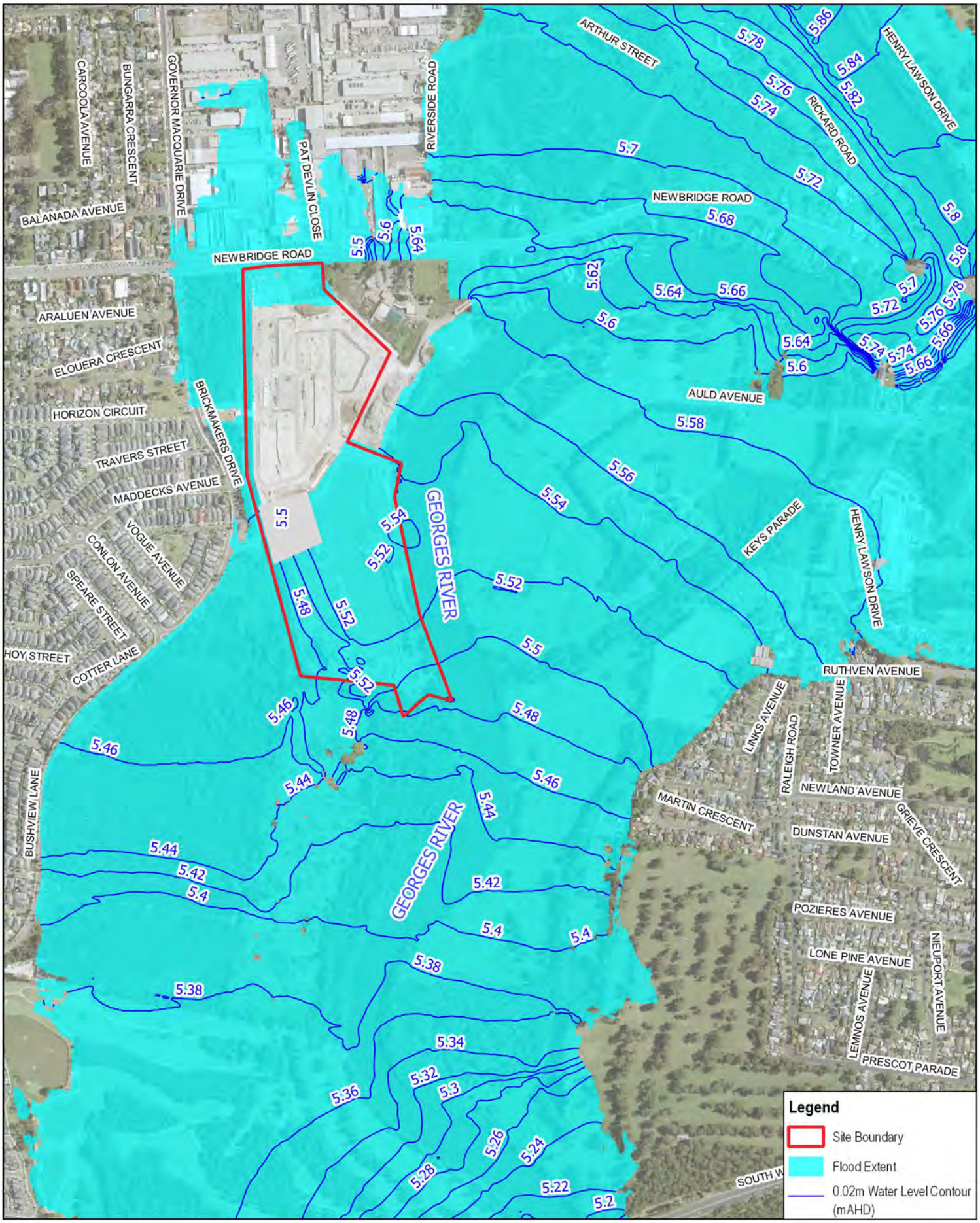

N

1:10,000 Scale at A4

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Georges Cove Marina

Flood Extents and Flood

100 Year ARI
Modification 2 Conditions
Figure M2-4

Cardno now Stantec

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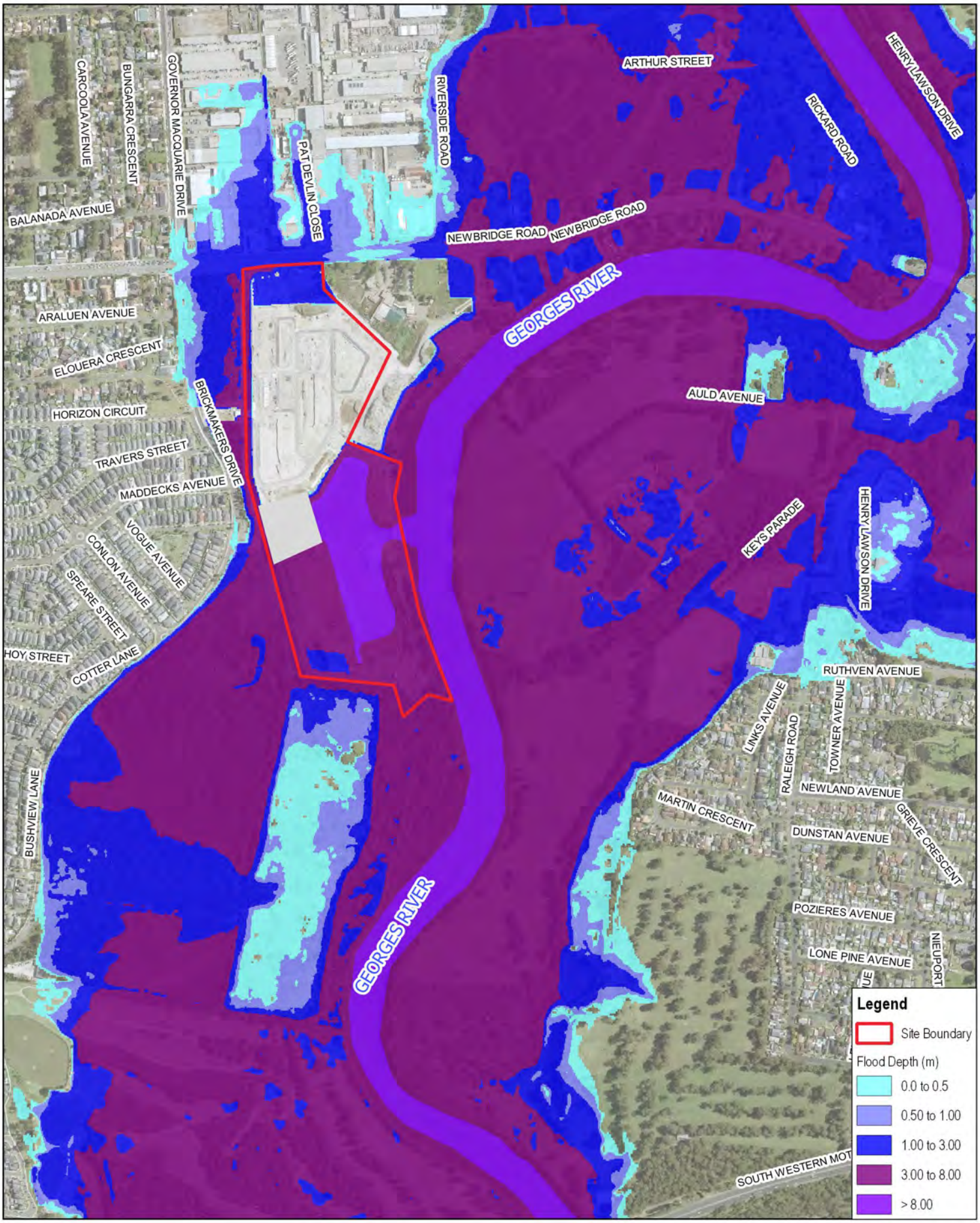

Georges Cove Marina

Flood Depth

100 Year ARI
Modification 2 Conditions
Figure M2-5

N

1:10,000 Scale at A4

m

0 200 400 m

Cardno now Stantec

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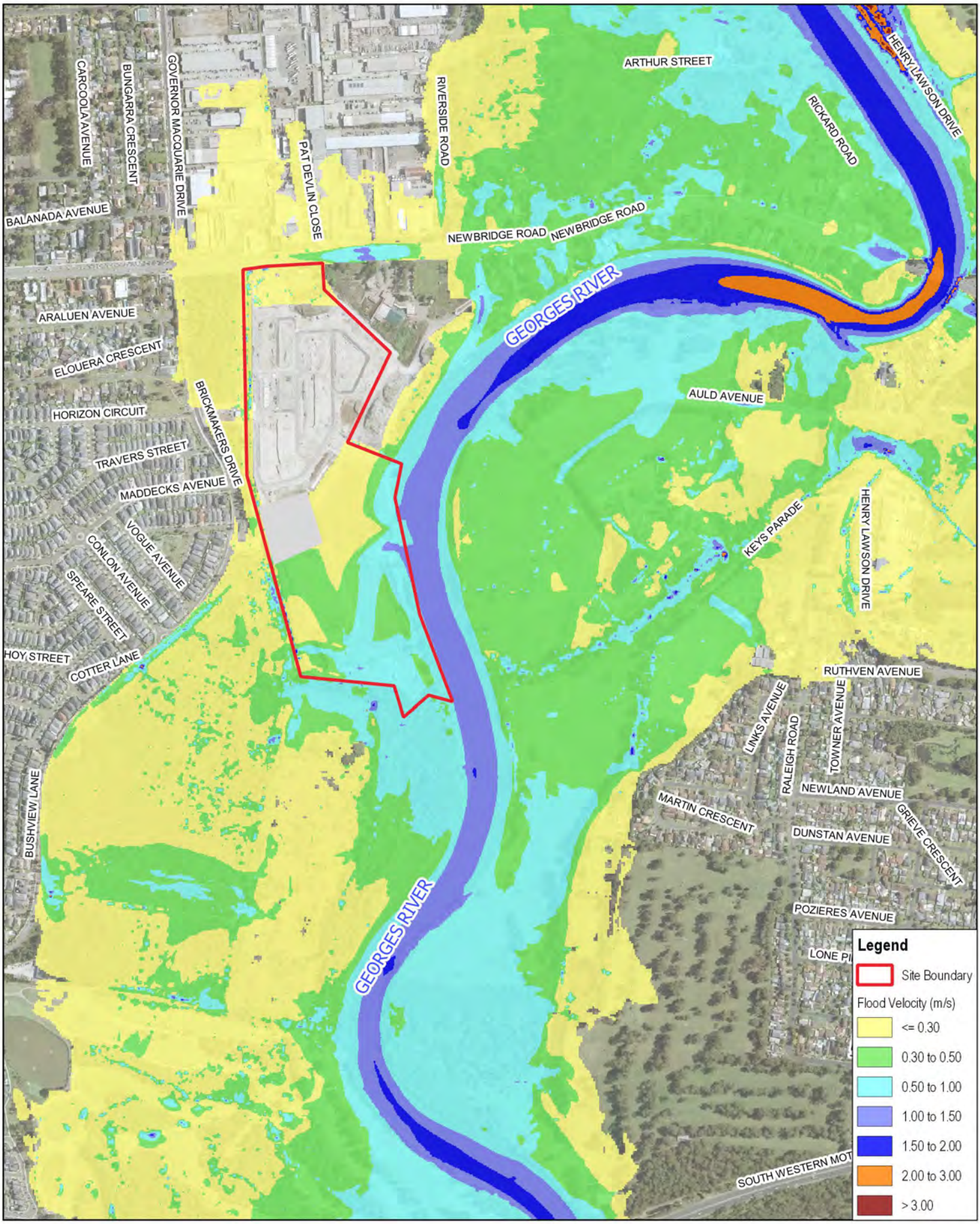

Georges Cove Marina

Flood Velocities

100 Year ARI
Modification 2 Conditions
Figure M2-6

N

1:10,000 Scale at A4

m

0 200 400 m

Cardno now Stantec

Map Produced by Cardno Now Stantec (NatW&E)
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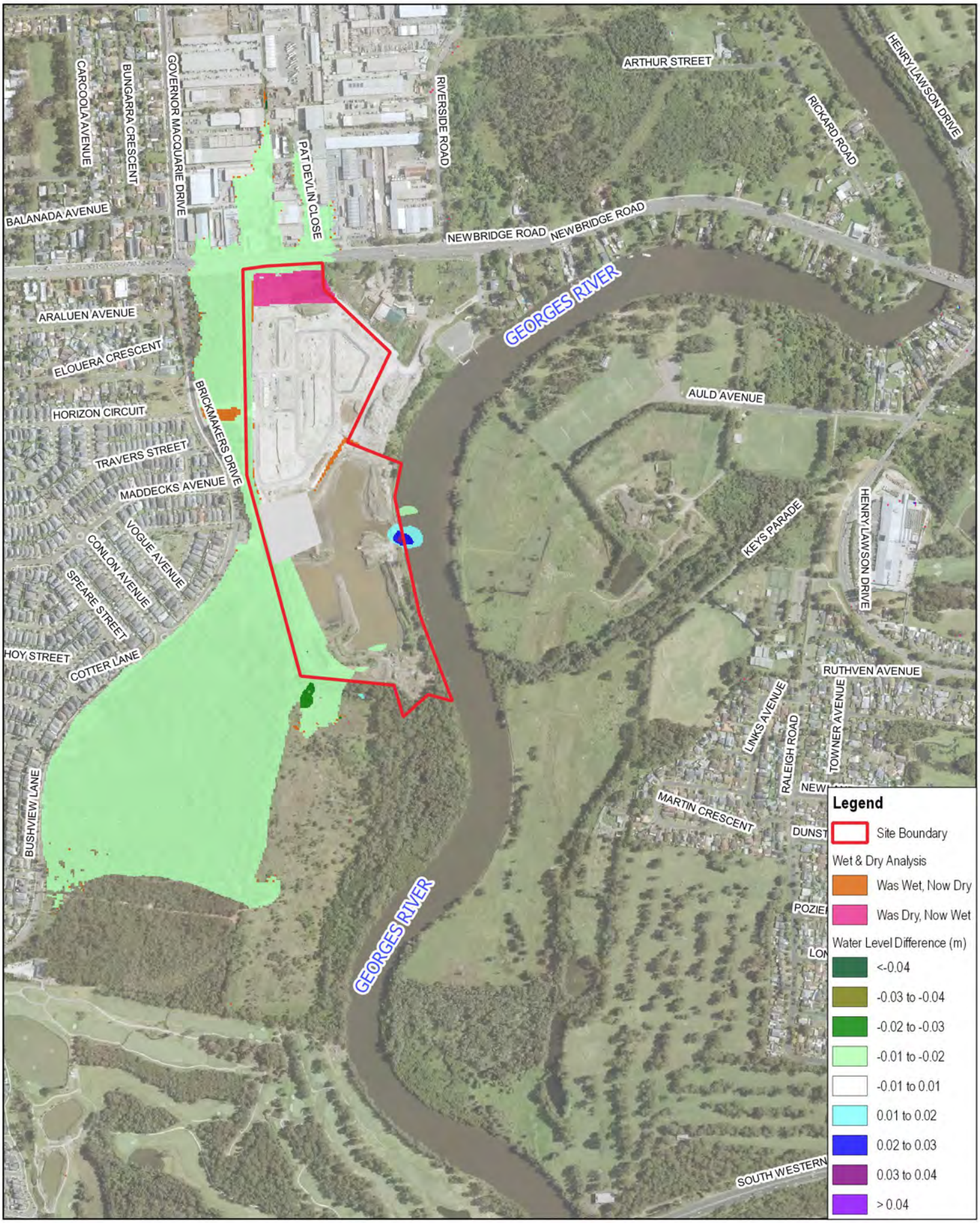
Map: NW30126



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1:10,000 Scale at A4

m

0 200 400 m

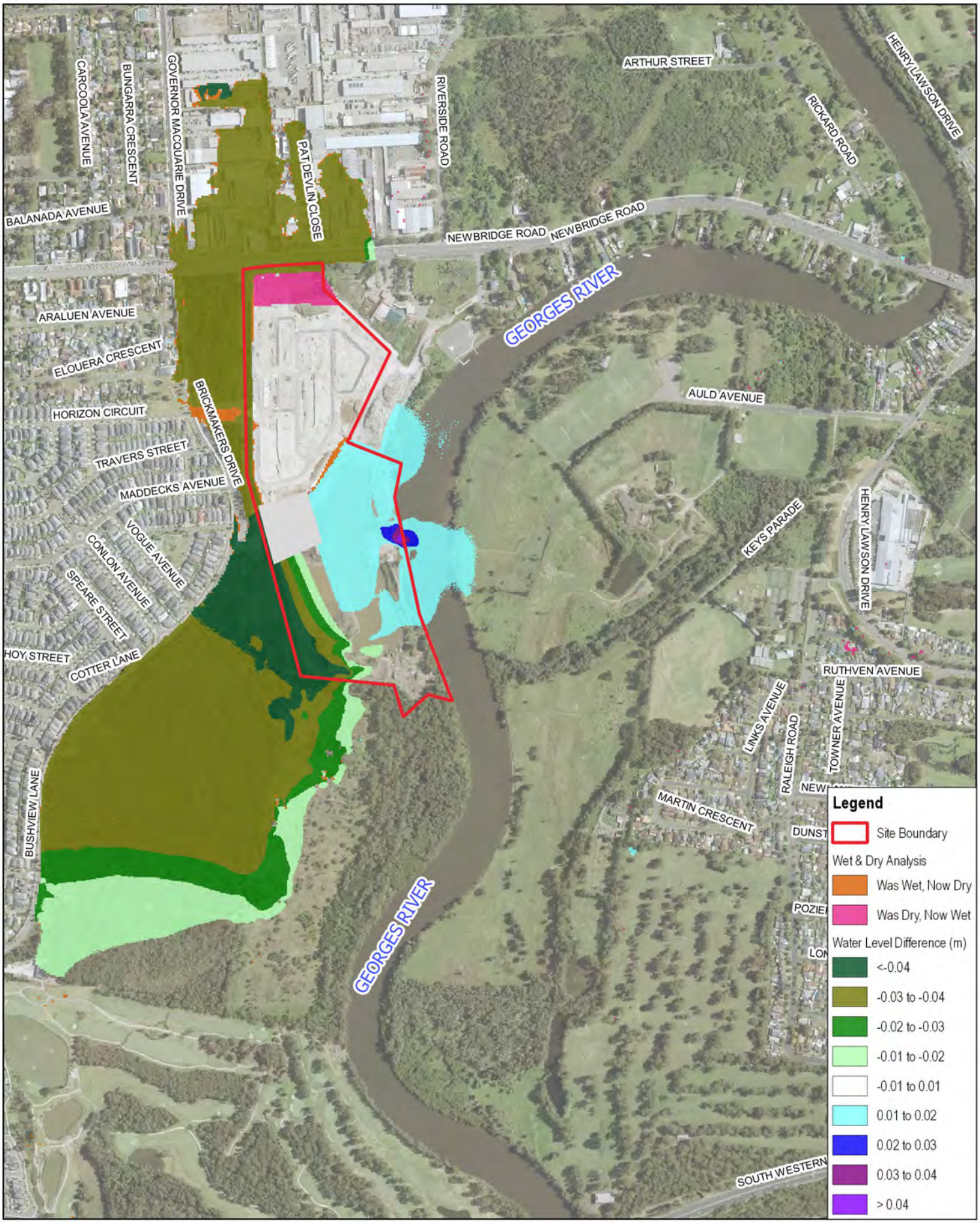
Georges Cove Marina

Flood Level Differences

20 Year ARI
Modification 2 Conditions - Existing
Figure M2-7

Cardno now Stantec

Map Produced by Cardno Now Stantec (NatW&E)
Date: 2022-3-18
Coordinate System: GDA94/MGA56
Project: nw30126
Map: NW30126



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Georges Cove Marina

Flood Level Differences

100 Year ARI
Modification 2 Conditions - Existing
Figure M2-8

Cardno now Stantec

Map Produced by Cardno Now Stantec (NatW&E)
Date: 2022-3-18
Coordinate System: GDA94/MGA56
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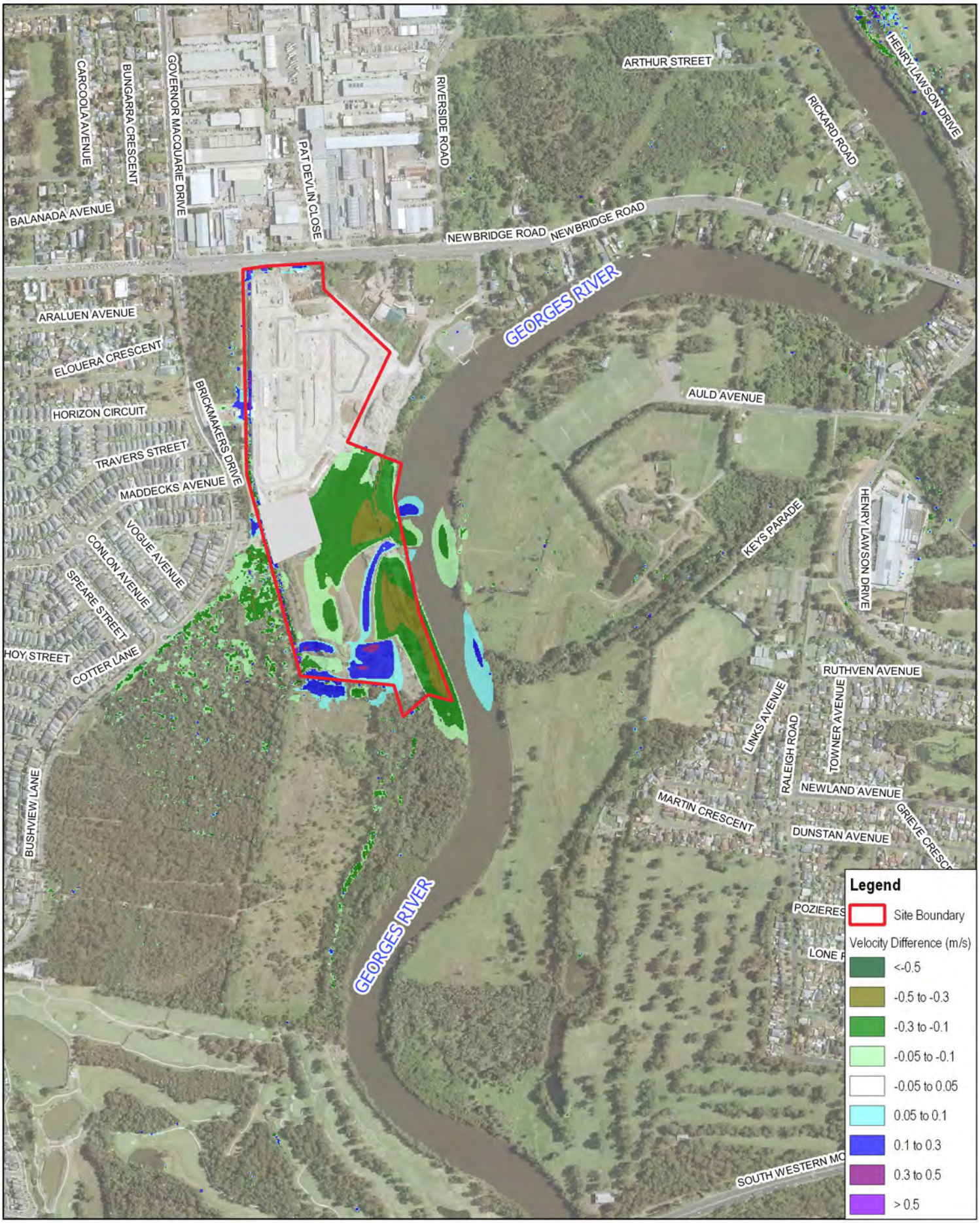

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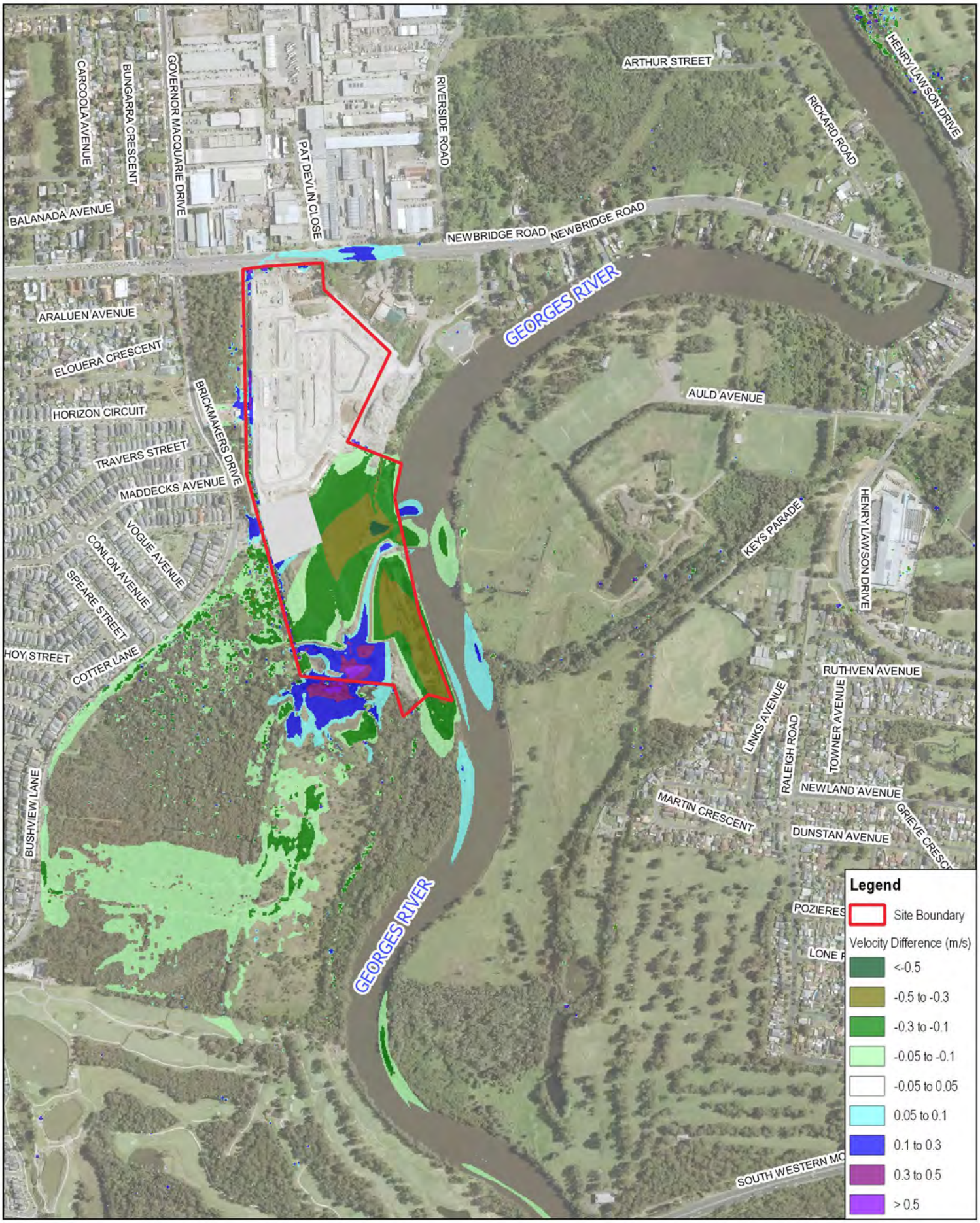
Georges Cove Marina

Flood Velocity Differences

20 Year ARI
Modification 2 Conditions - Existing
Figure M2-9

Cardno now Stantec

Map Produced by Cardno Now Stantec (NatW&E)
Date: 2022-3-18
Coordinate System: GDA94/MGA56
Project: nw30126
Map: NW30126



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1:10,000 Scale at A4

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0 200 400 m

Georges Cove Marina

Flood Velocity Differences

100 Year ARI
Modification 2 Conditions - Existing
Figure M2-10

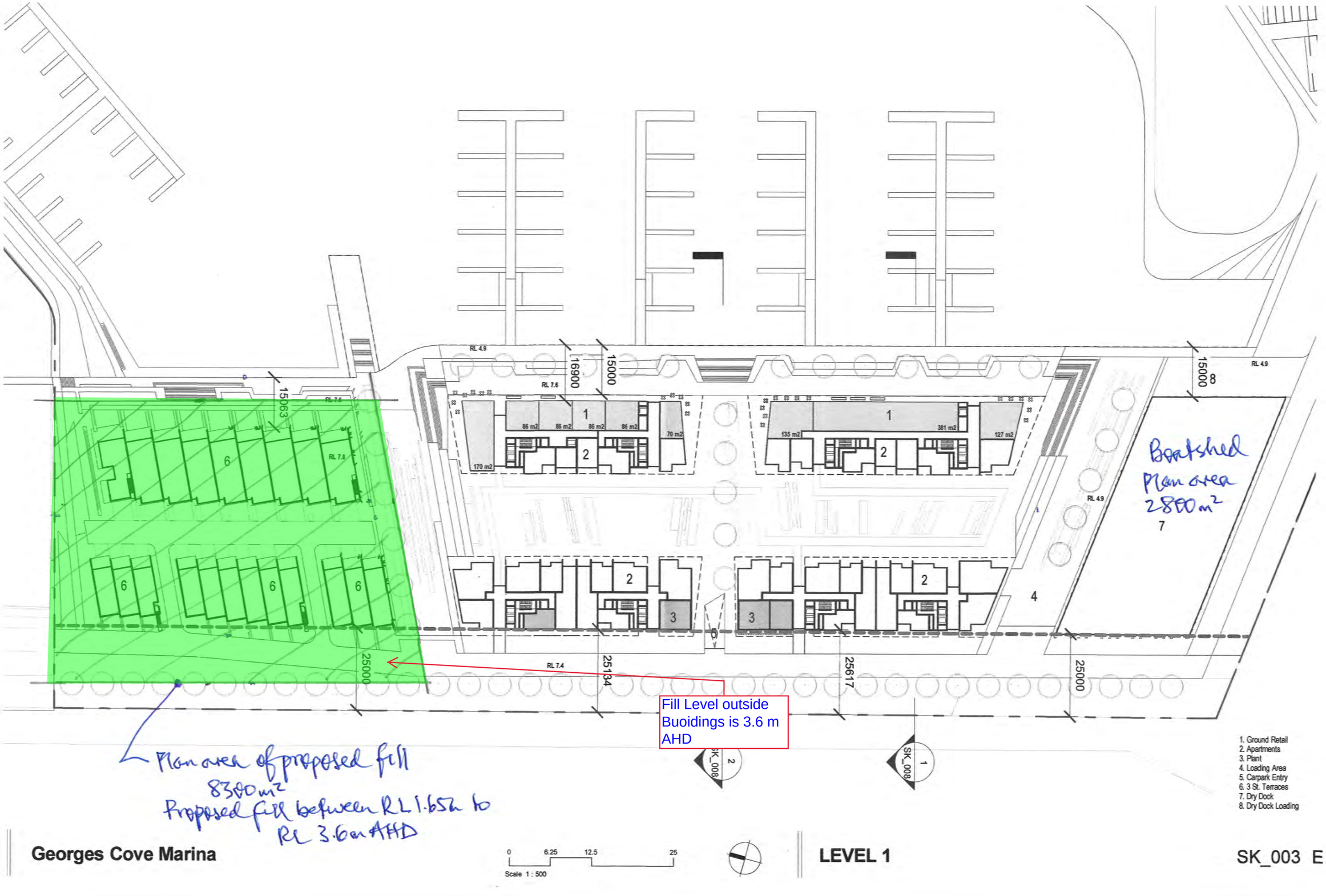
Cardno now Stantec

Map Produced by Cardno Now Stantec (NatW&E)
Date: 2022-3-18
Coordinate System: GDA94/MGA56
Project: nw30126
Map: NW30126

Annexure C

Modifications 1 and 2

Modification 1



Georges Cove Marina

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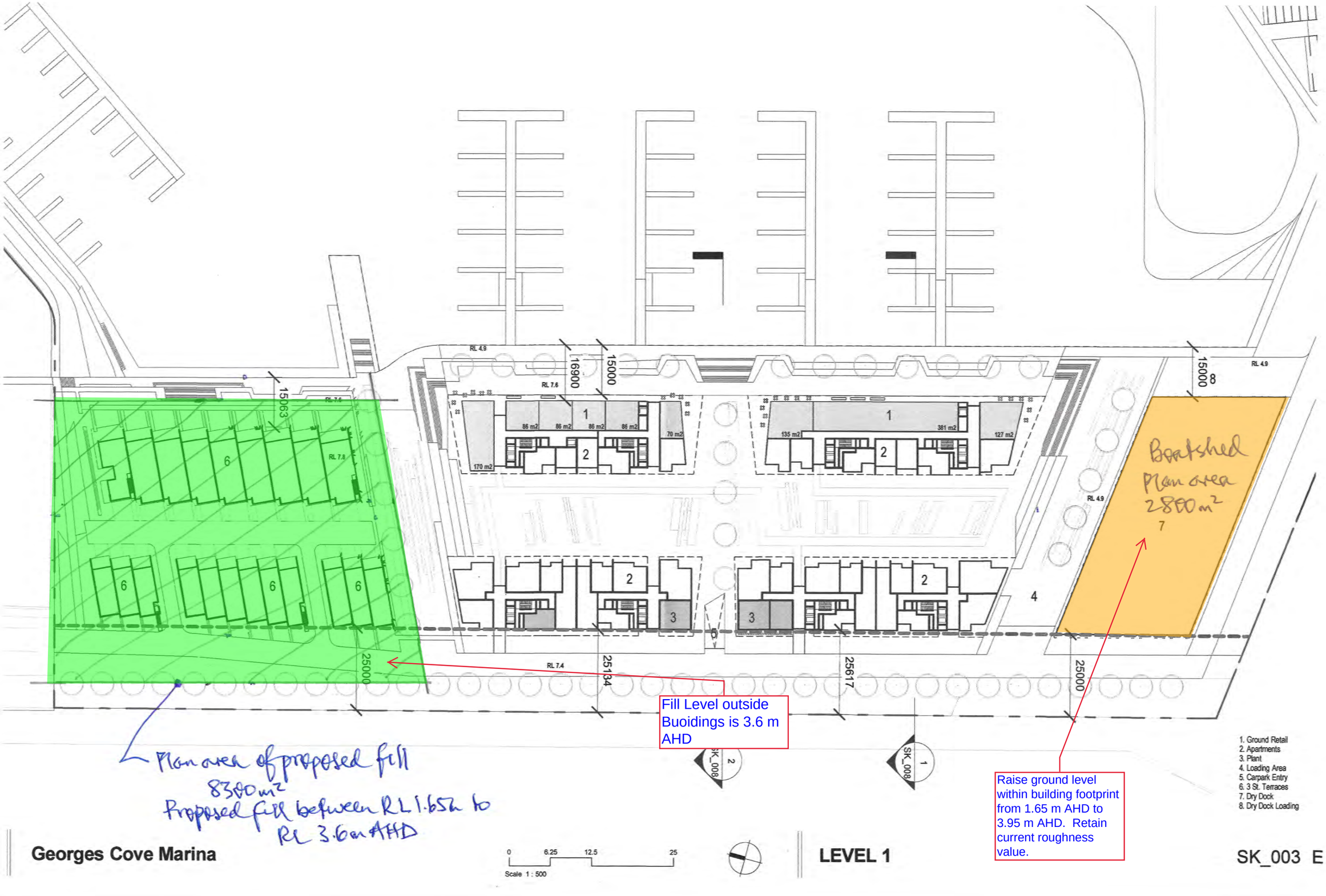
Scale 1 : 500

LEVEL 1

SK_003 E

Modification 2



Georges Cove Marina

0 6.25 12.5 25
Scale 1 : 500

LEVEL 1

SK_003 E

ATTACHMENT C
FLOOD SAFE PLAN

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Flood Safe Plan

Attachment C

Mirvac Georges Cove Marina 146 Newbridge Rd Moorebank

Potential impacts of flooding on workers and visitors	Severity level
People's health and safety are compromised	Low
Frail and elderly customer evacuation	Low
Property is damaged or destroyed	Low
Cars and other property in car park damaged	Low
Profits are lost or service provision stopped	Low
Retail goods are damaged or ruined	Low

Triggers for actions now and always

Actions that can be done immediately and maintained to reduce the potential impact of flooding are detailed as follows.

Actions

Action	How to do it	Who will do it	What you will need	Estimated time needed	Completed
Inform residents, workers and visitors that flooding is a real risk	Use signage in car park and entry, and train flood wardens	Site Manager, Flood Wardens	Training procedures and policies, this plan	1 hour for training	[ ]
Display the FloodSafe Plan and poster	Display Flood Safe Plan in car park and entry and with each tenant/owner	Site Manager	Copy of the flood safe plan	30 minutes	[ ]
Encourage residents and staff to participate in development & implementation of this plan	Site resident and tenant Meeting	Site Manager, Flood Wardens	Flood safe plan and computer	2 hours	[ ]
Ensure OH&S procedures cover specific risks associated with floods	Management meeting to review existing plans and modify where necessary	Site Manager	Copies of all the plans and site audit to identify risks	2 hours	[ ]
Maintain an up to date list of emergency contact numbers for residents and tenants	Management meeting	Site Manager	Various updated contact details and maintain data base	30 minutes	[ ]
Train residents and tenants in flood procedures	Management meeting and training sessions	Site Manager	Copies of the flood safe plan	1 hour	[ ]
Incorporate flood awareness in tenant management and resident induction training	Staff induction manual	Site Manager	Staff induction manual	1 hour	[ ]
Prepare an Emergency Kit	Gather items and store in suitable	Site Manager	Emergency kit to contain torch with	2 hours	[ ]

	location on site and accessible.		spare batteries, portable radio with spare batteries, first aid kit, candles, waterproof matches, waterproof bag for valuables and mobile phone, and a copy of the emergency contacts list and a copy of the flood safe plan		
Ensure flood wardens know flood evacuation actions	Staff training and emergency drills	Site Manager	Building plans	2 hours	[ ]
Store backups of important computer files and critical paper records in suitable location	Create computer backups and paper copies of critical documents and store in suitable location or off-site.	Business owners, Site manager, staff	On-site storage and off-site storage location	1 hour	[ ]

Triggers for actions when flooding is likely

- Heavy rainfall
- The Bureau of Meteorology issuing a Flood Watch
- The Bureau of Meteorology issuing a Severe Weather Warning or Severe Thunderstorm Warning indicating a likelihood of flash flooding
- The Bureau of Meteorology issues flood warning for flood levels above RL 4m AHD
- The State Emergency Service issues flood evacuation order

Actions

Action	How to do it	Who will do it	What you will need	Estimated time needed	Completed
Notify tenants and resdents of any warnings	In person and using wardens	Site Manager, Flood Wardens	Broadcast system for verbal warnings to tenants	30 minutes	[ ]
Keep radio tuned to local radio station, keep in contact with BoM, SES and monitor relevant websites	http://www.bom.gov.au/nsw/warnings/ http://www.bom.gov.au/products/IDR713.loop.shtml http://new.mhl.nsw.gov.au/Site-213435	Site Manager	Radio, 4G/5G enabled device and spare batteries	While flooding is likely	[ ]
Ensure flood wardens and staff are aware of Flood Watch or a Severe Weather Warning	In person and using wardens	Site Manager / Flood Wardens			[ ]
Flood wardens initiate flood evacuation	When flood warning received from BoM	Site Manager and flood wardens	Flood wardens remove tenants/residents from site	Up to 3 hours	[ ]
Evacuate workers / residents	Announce flood evacuation order over PA system and direct people to their cars for vehicular evacuation.	Site Manager and flood wardens			[ ]

Back up important computer files and critical paper records and take to the mezzanine level		Site manager or designated staff member			[ ]

Triggers for actions during a flood

Heavy rainfall is experienced

During heavy rainfall a designated flood warden to commence monitoring of BoM flood warnings.

The alarm sounds or flashes to confirm BoM or SES flood warnings

The flood wardens commence movement of people to their cars and directing them to the exits. The flood wardens monitoring car evacuation to ensure it occurs smoothly. Chief flood warden to decide after three hours if the pedestrian evacuation should be initiated. If so, then flood wardens manage pedestrian evacuation to the elevated pedestrian bridge over Brickmakers Drive. Wardens ensure all people leave the site.

Action	How to do it	Who will do it	What you will need	Estimated time needed	Completed
Keep in contact with tenants/residents and keep them updated on the situation	Implement staff contacting strategies using tenant meetings, telephone calls or briefings	Site Manager	Radio to obtain up to date information and liaison with the SES if needed; computer or 4G/5G	On going during event	[ ]

			device to check websites		
Do not enter flood water	Ensure wardens are trained and providing relevant information to tenants/residents	Site Manager and flood wardens	Latest information and Flood Safe Plan	On going during event	[ ]
Keep radio tuned to local radio station, keep in contact with SES and monitor relevant websites	Tune radio to ABC Local Radio 702 AM; http://www.bom.gov.au/nsw/warnings/ http://www.bom.gov.au/products/IDR713.loop.shtml	Site manager and flood wardens	Radio, spare batteries, phone, computer and 4G/5G mobile device	During event	[ ]
Monitor tenant and residents to ensure safety	Ensure all people onsite are well informed and adhering to flood response actions	Site manager and flood wardens	Undertake regular inspections of floor/tenants	During flood event	[ ]

Triggers for actions after a flood

- Site Manager or flood wardens issue all clear
- The NSW State Emergency Service issue an all clear

Actions

Action	How to do it	Who will do it	What you will need	Estimated time needed	Completed
Before re-occupying the premises undertake an OH&S risk assessment	Conduct a visual risk assessment of external areas, the car park and ground level if appropriate, looking for structural damage, damage to services, dangerous debris, etc.	Site Manager and flood wardens	Any safety equipment that is deemed necessary		[ ]
Remove debris and clean, repair and disinfect any levels which were inundated	With appropriately skilled personnel	Site Manager to organise			[ ]
Replace any essential plant, equipment that is damaged as soon as possible	With appropriately skilled personnel	Site manager to organise			[ ]
Restore critical records, computer equipment and files	With appropriately skilled personnel	Site manager to organise			[ ]

Staff Contact List

Name	Number	Mobile	Flood role / issues
Site Manager			
Flood Warden 1			
Flood Warden 2			
Flood Warden 3			

Emergency Contact List

Name	Number	Mobile
Ambulance	000	
Gas		
NSW SES	132 500	
Sydney Water - Faults	13 090	
Fire - Emergency	000	
Police - Emergency	000	
Electricity		
Bureau of Meteorology (for flood warnings)	1300 659 219	
Liverpool Council Wet Weather Line		
Liverpool Police Station or Cronulla Police Station		
Electrician		

For emergency help in floods and storms phone the SES on 132 500

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ATTACHMENT D
Tooker and Associates Review

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TOOKER+ ASSOCIATES

Liverpool City Council
Attn: Cameron Jewell
ostel@liverpool.nsw.gov.au

4 February 2022

JewellC@liverpool.nsw.gov.au

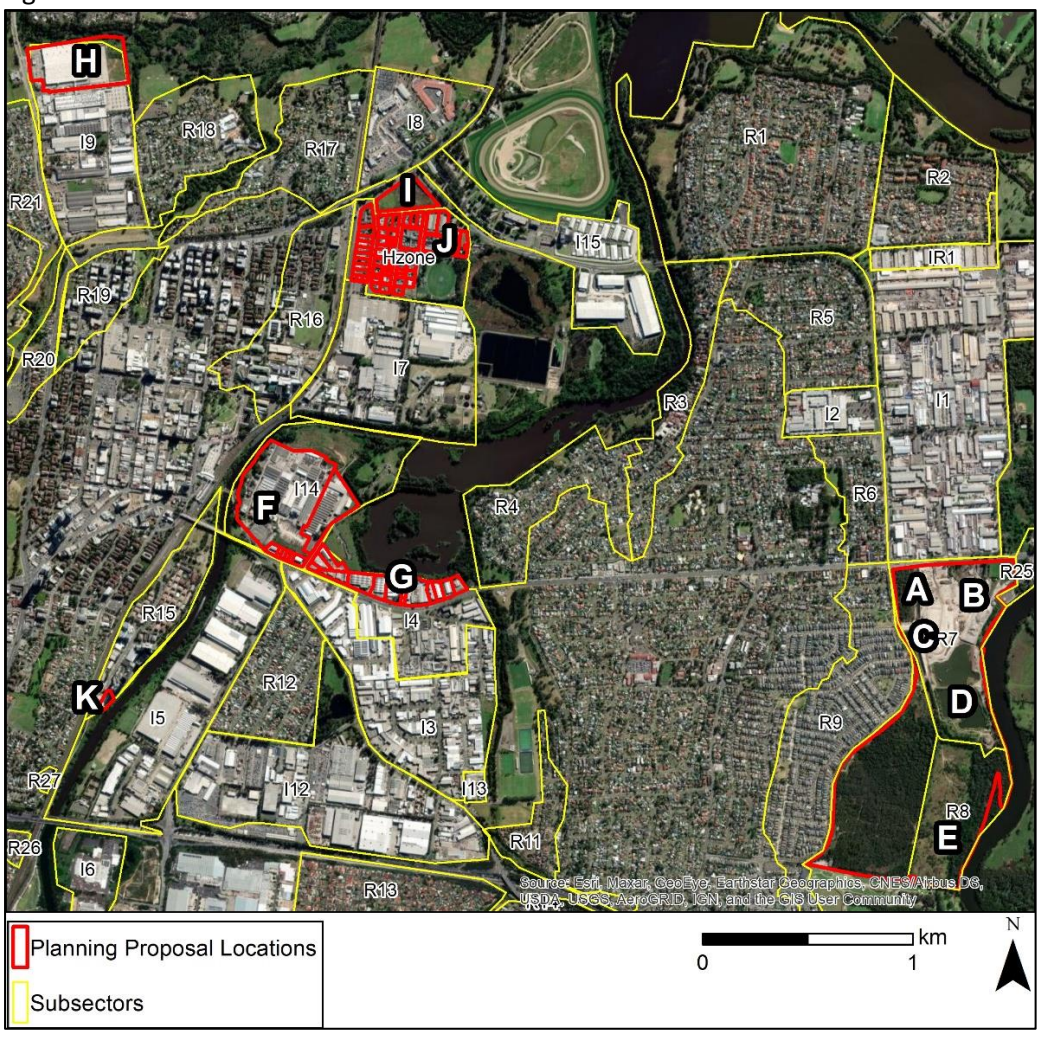
Dear Sir,

Re: Review of Georges River Evacuation Modelling, Flood Evacuation Analysis Draft, December 2021, Molino Stewart – Mirvac Review

With reference to your email dated 17 December 2021, we are pleased to provide an initial response to the above Molino Stewart report on behalf of Mirvac who are the developer for sites C and D in the Moorebank East precinct (see Figure 1).

This report has been created to bring attention to the assumptions made in the Molino Stewart Report and model that are either incorrect, incorrectly applied or create an unrealistically conservative outcome when combined with other overly conservative assumptions in the same model that ultimately impacts the development capacity for the Moorebank East area.

Figure 1



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1. Site Description

The Mirvac sites C and D are located in region R7 in Figure 13 of the Molino Stewart report.

The sites are generally known as follows:

- Site C – Mirvac residential development referred to as Moorebank Cove in the Molino Stewart report (under construction {DA-24/2017});
- Site D – Mirvac marina development (marina approved (DA-611/2018) with Mirvac Planning Proposal for residential development on top (RZ-5/2018) – well supported by Council).

The proposed development details included in the Molino Stewart report are summarised in the following Table 1.

Table 1. Proposed Moorebank East Developments

Site	Development Type	Commercial Space (ha)	Employees	Dwellings	
				Houses	Apartments
Site A: Tanlane P/L(Benedict)	B6 Mixed use	0.89	857	0	126
Site B: Flower Power	Mixed use and commercial strip	2.32	361	0	602
Site C: Mirvac Moorebank Cove	Low density residential	0	N/A	179	0
Site D: Mirvac Georges Cove Marina	Apartments Restaurants Marina services	1	N/A	21	374
Site E: EQ Riverside	Apartments and commercial/ retail	0.18	207	0	1,500

2. Approved Evacuation Strategy

The evacuation strategy approved by Council for the three Benedict/Mirvac sites A, C and D is as follows:

a. Car evacuation;
b. Pedestrian evacuation in case of failed car evacuation;
c. Shelter in Place above the PMF.

An overhead pedestrian bridge over Brickmakers Drive has been approved by Council as part of the Site C (Mirvac Resi) development (under DA-24/2017) which has capacity and access for all the Benedict/Mirvac developments including Sites A, C and D. This provides pedestrian access to land above the PMF level for evacuation if the vehicle evacuation fails. The developments all have many floor levels above the PMF level suitable for the tertiary evacuation option (shelter in place) if the first two strategies fail.

The Moorebank Cove (Site C) approval under DA-24/2017 also includes a Flood Emergency Response Plan (FERP) that outlines the flood evacuation strategy and hierarchy noted above, notes the

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evacuation routes and flood signage, and notes the role of the Community Manager (under the Community Title structure) in flood evacuation training and evacuation assistance.

A similar FERP would be formulated for the developments on Sites A and D that would also be managed through Strata and Building managers.

So, all the Benedict/Mirvac sites within the Moorebank East precinct have legitimate flood evacuation strategies which conform with the SES guidelines.

3. Response to Molino Stewart Draft Evacuation Strategy

The consideration of the Mirvac Planning Proposal for site D (Marina) is well advanced and supported by Council compared to other sites (Flower Power and EQ Riverside) in the Moorebank East precinct. The Mirvac Residential development on Site C has already been approved under DA 24/2017 and is well under construction. These sites add a comparatively small increase in vehicle numbers compared to the proposed Flower Power and EQ sites in the precinct.

Most importantly, these sites (Sites A, C & D) have a multi-faceted evacuation strategy which conform to the SES guidelines.

Molino Stewart makes a reference in Section 7.2.5 to the need for a pedestrian evacuation route in case vehicular evacuation failed when referring to the Moorebank East precinct. We note that this route has already been approved for the Benedict/Mirvac sites by Council under DA-24/2017 (refer below) and is soon to be under construction.

3.1 Development in Areas C and D should be included in Scenario 2 (Infill development)

The freestanding residential development in Area C was rezoned in 2008 and the DA was approved via DA-24/2017 in 2020. The marina development on Area D is an allowable development for the existing zoning and a DA was recently approved (DA-611/2018). As such, these developments should be included in Scenario 2 which includes infill development between 2016 and 2036. These developments offer the three levels of emergency response to the PMF flood as required by SES. The primary response is evacuation by car, the secondary response is an approved pedestrian access route to flood free land and the third response is to shelter in place at levels above the PMF flood. The development in these areas has been approved by Council and should not be part of Scenario 3 which examines existing Planning Proposals.

3.2 Unrealistically conservative, cumulative assumptions adopted in evacuation modelling

a. Road capacities

The maximum lane capacity adopted in the Molino Stewart (MS) modelling traffic evacuation model should not be 600cars/hr/lane but the normal rate of 1200 to 1400cars/hr/lane (say 1400cars/hr/lane).

The SES recommend in their simple evacuation model (TEM) a maximum car capacity of 600cars/hr/lane. This model has no way of accommodating influences such as road congestion, merging or intersections. This rate was selected as a general rule to take account of all these influences. However, these influences vary considerably depending on the road layout and configuration and as such, is a broad generalization.

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During the early stages of the evacuation, and especially for those strata and community titled developments which will receive an early electronic evacuation warning, the local road capacities may be much higher than 600cars/hr/lane. Furthermore, the capacities of the major multi lane roads could be significantly higher than 600cars/hr/lane.

The model adopted by MS (LSM) uses traffic modelling which is able to model these influences and derive every changing road capacity specific to each site. As such, MS do not need to use the SES 600cars/hr/lane as the maximum road capacity in all circumstances because the model can assess the degree of changes in road capacity for every time step in the model. Therefore, the maximum lane capacity adopted in the MS LSM model should be 1400cars/hr/lane and the model will determine the actual capacity at every time step.

In Scenario 2, there are only 399 vehicles trapped on the Moorebank Peninsula. This could be readily solved by not limiting the maximum road capacity to 600cars/hr/lane when the model determines the maximum road capacity rate which could be as high as 1400cars/hr/lane.

b. Full capacity at work and home

The duration of the evacuation will be at least 12 hours and has a high probability it will overlap to some extent with the non work hours. Assuming full capacity of the numbers of people to be evacuated is unrealistic and requires a more realistic assessment.

Some of the possible reasons why full capacities would not occur for evacuation are:

- People are on holidays outside the area;
- Flood warnings are given in non work hours and people do not travel into the area for work;
- People who evacuate to local friends and family or to friends and family not located on selected evacuation routes;
- People on the edge of the PMF zone who do not evacuate;
- Increased use of public transport since the travel to work surveys used in the study for people travelling from areas outside; and
- Two car households only using one car for evacuation or multiple car households not using all cars for evacuation.

c. Warning times

The SES evacuation approach is that door knocking is required to initiate flood evacuation. The SES assumes that it will take 6 hours to mobilise people to undertake door knocking. This 6 hours is half the minimum warning time for the Moorebank Peninsula. This may be necessary for standalone residential areas however, for strata and community titled developments and work places, an electronic warning to the management with associated alarms could be sent instantaneously to initiate evacuation and provide at least 12 hours warning.

For every saving of 1.5 hours until evacuation is initiated, this would allow extra capacity of say an extra 900 cars at 600cars/hr/lane or extra 2100 cars at 1400cars/hr/lane. This means of evacuation initiation is unlikely to be affected by power outages as flood levels would not be anywhere near critical at that stage. This means that strata and community type developments (which have flood evacuation plans and training incorporated in their strata and community documents) could take advantage of the early capacity availability on local roads. Door knocking would still have to be done

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for stand alone Torrens Title residences in areas outside of the Moorebank East developments impacted by the PMF.

The warning times will be longer than 12 hours for these types of developments with electronic warnings. The 12 hours warning is for floods to reach RL 4m AHD. A further 1.5hrs warning time would be available to many areas prior to flood levels reaching evacuation tripping points/levels. This could allow up to a further 2100 (at 1400/hr/lane) vehicles to evacuate in the early stages of the evacuation.

d. Rate of flood level rise

Again, the rate of flood water rise adopted is the absolute worst case which when added to all the other very conservative assumptions, you end up with a very unrealistic presentation of risk.

In Section 5.3 Applying the Life Safety Model to the Georges River in the MS study it is asserted, in part that:

> *While it is recognised that this is an extremely rare event, more frequent events could rise this quickly ….*

This is not correct. A comparison of the rate of rise of the 36 hour Extreme Flood Event (EFE) and 100 yr ARI flood is given in Figure 2 on the next page. This indicates that more frequent events are not as likely to rise at the rate of the EFE. There is a stark difference in the rate of rise for the 100 year ARI flood which takes 16 hours to achieve any similar rate of rise as for the PMF type flood as demonstrated in Figure 2 below. This would provide a significantly longer flood warning time and greatly increased capacity for evacuating vehicles from the area.

3.3 Area D – Marina and Mirvac Planning Proposal

The marina development approved recently by Council (DA-611/2018) should be included in Scenario 2 as discussed in point 3.1 above. The marina has parking for 637 vehicles to support the marina and recreational uses. The Mirvac Planning Proposal for this site (RZ-5/2018) incorporates 758 parking spaces which is an increase of only 121 vehicles on the already approved marina allowance. These extra vehicles could be accommodated in extra warning time of 12 minutes at 600/hr/lane or 5 minutes at 1400/hr/lane. This could be readily achieved given that evacuation for this development will not rely on door knocking and can be initiated electronically for this strata/commercial development.

The Mirvac Planning Proposal has very little impact on the flood evacuation capacity compared to already approved developments and could be readily included in Scenario 2 given the cumulative conservative nature of all the evacuation model assumptions. As mentioned in point 3.2a above, in Scenario 2, only 399 vehicles would be trapped on the Moorebank Peninsula. The Mirvac Area D Planning Proposal would only add a further 121 vehicles. This is a very small number given the leeway available in the very conservative assumptions in the evacuation model. These vehicles could be accounted for with a small increase in warning time and/or a small increase in road capacity.

The evacuation modelling shows that use of multiple evacuation routes significantly improves evacuation and tends to reduce interference between the two main areas of Moore Point and Moorebank Peninsula. There is also significant potential for resident evacuation in the future

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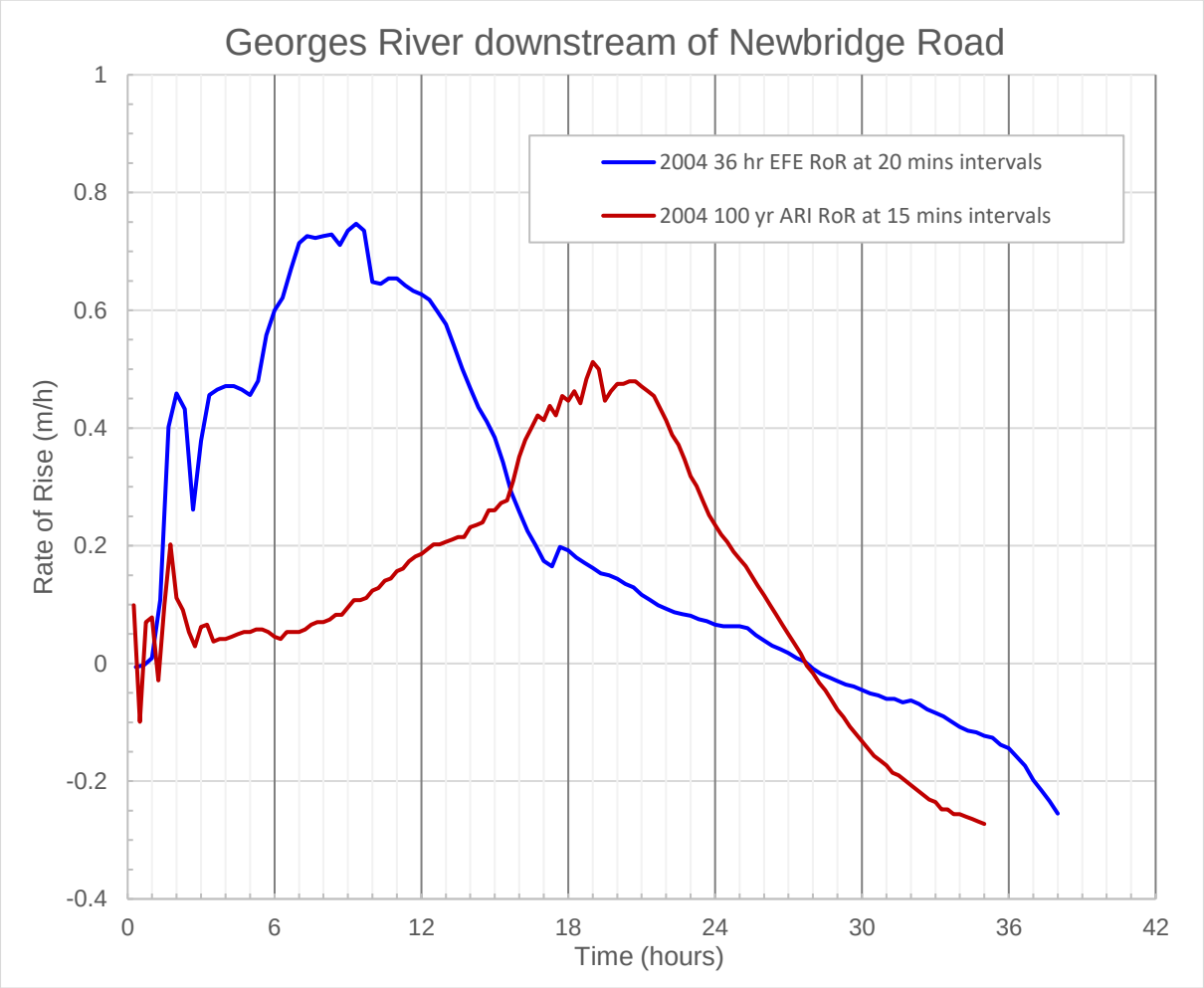

Figure 2 Rates of Rise in floodwaters downstream of Newbridge Road

Liverpool CBD as is occurring in the Parramatta CBD with increasing provision of apartments above the PMF flood levels.

3.4 Three Stages of Evacuation

The Molino Stewart report, in many locations, emphasises the SES requirement for a three stage evacuation capability. The approved developments on Areas A, C and D have these three stages of evacuation available to the residents. These three stages of evacuation would also be available for the Planning Proposal development at the Marina in Area D.

These three stages include vehicular evacuation, pedestrian evacuation and shelter in place with floor levels above the PMF level.

The sole focus of the Molino Stewart 2022 study is vehicular evacuation to undisclosed locations remote to the floodplain. This ignores the potential for a number of safe refuge areas (as noted in 4.3.1 of the MS report) at local public properties and commercial properties to provide parking for

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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
- Moorebank High School
- Newbridge Heights Public School
- Hammonvile Public School
- 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. Also, there would be those workers who live outside the local area and those residents who would still want to evacuate to friends and family living elsewhere in Sydney which would further reduce the vehicular evacuation to the regional refuge locations.

3.5 Factual Flood Information

3.5.1 Flood Gauges and warning times

In Section 4.3.5 of the MS report:

Table 7 appears to be in error. The Milperra Gauge is not in the Sutherland LGA rather it is located in Canterbury-Bankstown LGA.

Reported levels in Table 8 appear to be incorrect. The 1% AEP (100yr ARI) flood level at Milperra Gauge is around 6.0 m AHD (6.5 m gauge reading) not 9.1 m.

The MS report indicates that the flood warning time is based on flood levels reported from the Liverpool and Milperra flood gauges and if these are damaged or malfunction in a flood, then the warning time may be less than 12 hours. However, this is incorrect. The extreme flood warning is provided by BoM and they rely upon modelling of forecast rainfall and do not rely on flood gauge readings. This is why they can provide a minimum of 12 hours flood warning before there are noticeable rises in the flood level at the gauges. Damage or malfunction of flood gauges is not a potential risk to reduce the 12 hour minimum flood warning time.

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3.5.2 2020 Flood Study

The key study and information includes, in part:

- Georges River Flood Study 2020 2D TUFLOW model for flood behaviour information and flood impact probabilities

It is noted that this study is not in the public domain which precludes a review of the adopted PMF time series or any other flood related behaviour within the study area.

Given past practices, it is expected that the 2020 Georges River Flood Study has adopted the 2004 Georges River Floodplain Risk Management Study inflows which in turn were estimated in the 1991 Georges River Flood Study.

In relation to the Probable Maximum Flood, it appears that the 2022 Evacuation Modelling is relying on an Extreme Flood Estimate which is more than 30 years old and the accuracy of which has not been confirmed by assessing the PMF in accordance with current practice as outlined above.

The likely occurrence of the PMP flood recommended by ARR2019 for the Georges River based on the catchment area to East Hills is around 1 in 1,600,000 AEP. This evacuation assessment is based on a very rare event which is likely to occur once in 1.6 million years (first homo erectus occurs in Asia 1.6 million years ago) or once in 21,333 generations (75 years each).

To illustrate this in other words, the likelihood that residents and workers located within the PMF flood extent within the study area would experience a PMF, the probability of residents and workers experiencing a 1 in 100 AEP (100 yr ARI) flood in a 100 year period is 63.4%. The workers and residents and their descendants would need to reside on the floodplain for 1,600,000 years (21,333 generations based on an average generation life of 75 years) in order to have the same probability of experiencing the PMF ie. 63.2%.

The risks in terms of evacuation are further exaggerated in the Molino Stewart study due to very conservative assumptions with respect to road capacities, availability of roads, numbers of vehicles and availability of alternative refuges.

4. Conclusions

The approved developments in Areas C and D and the Mirvac Planning Proposal for Area D (marina) have been dealt with unfairly by not being included in Scenario 2. Both developments are able to comply with the SES three stage evacuation strategy and should be included in Scenario 2.

There has also been no realistic consideration of the results for the Moorebank Peninsula in that the trapping of 399 vehicles for Scenario 2 is a minor problem when you consider the worst of the worst assumptions included in the evacuation model. There could be no trapped vehicles with small variations to assumptions such as road capacities. These 399 vehicles could be accommodated in 20 minutes with a road capacity of 1400cars/lane/hr. The Mirvac Planning Proposal for Site D (marina) would only add 121 cars to the already approved number. These additional vehicles could be accommodated in just 5 minutes.

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Models are as only as good as their assumptions and experienced flood modelling expertise needs to be applied to the results in order to assess the realistic flood risks. We need to appropriately manage risks so that the costs to society for flood evacuation is balanced with our approach to risk to life in all other areas of society. This will provide surety and the least risk during severe floods in the Georges River.

This evacuation assessment is based on a very rare event which is likely to occur once in 1.6 million years (first homo erectus occurs in Asia 1.6 million years ago) or once in 21,333 generations (75 years each) however, the risks in terms of evacuation are further exaggerated due to very conservative assumptions with respect to road capacities, availability of roads, numbers of vehicles and availability of alternative refuges.

These assumptions with respect to already approved developments and the Mirvac Planning Proposal for Site D need to be reviewed particularly in terms of road capacities and longer available flood warning times for strata/community developments so that the adoption of worst cases for all these factors does not occur because it distorts the actual risks and will place an unrealistic and unaffordable burden on development.

The MS study needs to be revised as required in this letter and further information is required to clarify the errors or mis statements in the report. Based on this study and in terms of flood risk, there is no technical reason why Council could not approve the Mirvac Planning Proposal for Site D.

It would be appreciated if Mirvac representatives could meet with Council and Molino Stewart to discuss our above concerns to find a realistic way forward for the Mirvac Planning Proposal at Site D.

Yours sincerely

Mark Tooker
Director

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ATTACHMENT E
Risk-e Business Review

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GEORGES COVE MARINA - MOOREBANK

MIRVAC DEVELOPMENT

Risk-e Business Consultants Pty Ltd

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Executive Summary

Risk-e Business Consultants Pty Ltd was requested to review documentation that was provided to Liverpool City Council, including the Molino Stewart Flood Report and link the information to sound research and analysis to provide a more accurate picture of the proposed development that considers all aspects of the present and future development and NSW SES evacuation information.

The Reports and documents have been reviewed by Mr Dave Owens APM (CV attached) and Mr Pat Paroz APM. Mr Owens and Paroz are both subject matter experts on flooding and evacuation management. Mr Owens has been accepted by the NSW Coroners Court as a Subject Matter Expert in Emergency Management and holds two master's Degrees in this area. He has also provided numerous report and reviews on emergency management and combat agency response. Mr Owens & Paroz co-developed the current version of the Hawkesbury Nepean Valley Flood Plan on behalf of the NSW SES.

There are a number of inconsistencies within the Molino Stewart Report identified within our review that are covered in the body of the document. These have been placed together under the headings of:

- Phased approach to evacuation management
- Vehicle capacity per lane during evacuation
- Proposed Evacuation Strategy
- Assuming full capacity of residents and/or workers requiring evacuation
- Assuming a 100% evacuation warning compliance rate
- Evacuation route modelling not taking into consideration local evacuation centre in Liverpool
- Warning times

It is our recommendation, that using this information, that Mirvac Development is now in a position to write to Liverpool City Council outlining the considerable concerns with the Molino Stewart Report which is based on the assumptions provided by the NSW SES. The information provided by us should accompany the letter as a technical addendum to support Mirvac's request for development approval.

David Owens APM
Managing Director
Risk-e Business Consultants
30 June 2022

Pat Paroz APM
Senior Consultant
Risk-e Business Consultants
30 June 2022

Background

The Georges Cove Residences is a low-density Community Title development consisting of 179 Mirvac built homes, community facilities and parks. The development application for this site has been approved and homes are already under construction.

The Georges Cove Marina (Benedict) development application has been granted and allows for construction and operation of the commercial Marina which includes the approval of 637 associated car parking spaces. An alternate (Mirvac) planning approval is being pursued for the same site for a residential development of 21 homes and 374 apartments with fewer car spaces.

Liverpool City Council has approved an evacuation strategy for these sites which involves:

- Car evacuation as the primary strategy
- Pedestrian evacuation in case of failed car evacuation
- Shelter in Place above the PMF.

The staged or phased approach to evacuation conforms with the NSW SES evacuation guidelines.

An overhead pedestrian bridge over Brickmakers Drive has been approved by Liverpool City Council as part of the Georges Cove development. There is easy pedestrian access to this bridge from the Georges Cove Marina, Mirvac residential (being built) and Village developments. The bridge provides pedestrian access to land above the PMF level for evacuation if the vehicle evacuation fails, or if pedestrian evacuation is sought early in the phased approach to evacuation. We would recommend the optionality of a combination of pedestrian and vehicle evacuation in the early stages of evacuation.

Where vehicular and pedestrian options have not been taken by residents, safe refuge can be found on site as the developments **all** have many floor levels above the PMF level suitable for the tertiary evacuation option (shelter in place).

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. This has not been considered in the Molino Stewart Report and should be.

NSW SES – Not legislated authority on flood planning development

Unlike the NSW Rural Fire Service in bushfires, the 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.** The resources and expertise of the NSW SES in this area is limited as demonstrated by its inability to maintain up-to-date flood Sub Plans including the Hawkesbury-Nepean Valley Flood Plan. This demonstrated by the fact that NSW SES required an external

organisation be engaged to undertake this task (being our organisation Risk-e Business Consultants).

The NSW State Flood Plan states:

> *NSW SES will work with land use planning and consent authorities to inform and influence the consideration of the risks arising from flood, storm and tsunami, **to prevent the creation of intolerable impacts** of these hazards on the community*

NSW SES-Basing evacuation modelling on outdated or incomplete Flood Sub Plans

The evacuation modelling undertaken for the Georges Cove Marina and surrounding areas relies entirely on the 2018 Sub Plan, of which Volumes 2 and 3 were incomplete (and still remain incomplete). Volumes 2 and 3 of the Liverpool Sub Plan are important to any evacuation analysis as they contain the "triggers" for emergency response actions/evacuation. Therefore, the evacuation modelling is based on outdated data in what is a dynamic and rapidly growing area. The NSW State Flood Plan clearly articulates that it is the responsibility of the NSW SES to maintain these plans. The Molino Stewart Report acknowledges this fact, yet this has not occurred, leading to inaccurate outcomes.

Vehicle capacity per lane during evacuation

The NSW SES Timeline Evacuation Model for estimating traffic movement 'does not attempt to dynamically model traffic demand for flow rates. The purpose of the model is to produce a best estimate of how much time is expected to be needed for traffic clearance from the area being evacuated'.

The assumption used for the purposes of the Molino Stewart Report by the NSW SES is based on an average flow of 600 vehicles/lane/hour. This figure is *'derived from a **typical rural road design flow** (our emphasis) rate of 1200 vehicles/lane/hour, downrated by a factor of two to account for the adverse driving conditions such as heavy rain, darkness and driver unfamiliarity that will probably prevail in a flood.*'[1]

The roads in the vicinity of the proposed developments (Moorebank East) do not include 'typical rural' roads. Much of the roadworks used in any evacuation routes are or will be newly constructed urban roadways which link with motorways (M5 and M7) and major arterial roads such as Newbridge Road and Heathcote Road.

According to the NSW Roads and Maritime Service[2], the operational capacity for basic motorway segments on an unmanaged motorway (where all or some motorway entries are not controlled by ramp metering), is 1800 vehicles/lane/hour. This is reduced to 1640 vehicles/lane/hour to allow for the inclusion of 10% of trucks and other commercial vehicles in the traffic flow. The separated lanes of traffic on these major roads and motorways 'will also increase per-lane capacity when compared to a single

[1] *The Application of Timelines to Evacuation Planning* (2004). Steve Opper, State Planning Coordinator, NSW SES.

[2] Motorway Design Guide – *Capacity and Flow Analysis* (2017)

carriageway'[3]. The 'typical rural road design' referred to by the NSW SES and used in their modelling is highly unlikely to include divided roadways.

Austroads is the collective of the Australian and New Zealand transport agencies, representing all levels of government. The organisation provides 'high-quality, practical and impartial advice, information, tools and services to help our members to deliver efficient, reliable and safe mobility to their customers'.

Austroads[4] advises that '*peak flow capacity of a freeway with a speed limit of 100 km/h is 2300 vehicles/lane/hour and that there are a number of factors which can affect this capacity*.' These factors include:

- Road functionality
- Land width
- Terrain
- Human behaviour

The driver population can have a significant impact on traffic capacity. Local knowledge and regular use of a road network is a protective factor, whereas '*where weekend or recreation drivers are a significant portion of the traffic stream, the capacity may be reduced*'[5]. This is not the case with the development proposal.

We submit that this is particularly relevant to the NSW SES Timeline Evacuation Model, based as it is on the traffic capacity of a **rural road.** It is more likely that a rural road will have less frequent users and this may have an adverse impact on traffic capacity, thus supporting the reduction in capacity to 600 vehicles/lane/hour.

However, the same cannot be said for the road network in and around the proposed development. These roads will be used predominantly by residents and/or workers on a daily basis. They will be familiar with the roads and local traffic issues and their presence alone is highly unlikely to contribute to reduced traffic capacity.

There is a need to consider and model higher road usage during evacuations (900 vehicles per lane per hour). Currently Molino Stewart is using a blanket approach to all roads and does not consider the advanced city infrastructure that accompanies this proposed development.

It is noted that there appears to be some confusion as to the origin of the 600 vehicles/lane/hour figure. The definition used above is taken from a document prepared by Steve Opper in his role as NSW SES State Planning Coordinator[6] (February 2004). In a report dated 2011[7], the authors (all employees of the NSW SES), state that '*The figure of 600 vehicles/lane/hour was not developed by the SES. It has*

[3] VicRoads Managed Motorway Design Guide, Volume 2 Part 1, page 29.
[4] www.austroads.com.au *Austroads Traffic Analysis Concepts*. Accessed 8/6/22
[5] www.austroads.com.au *Austroads Guide to Traffic Management* – Part 3, page 36. Accessed 9/6/22
[6] *The Application of Timelines to Evacuation Planning* (2004). Steve Opper, State Planning Coordinator, NSW SES.
[7] *Timeline modelling of flood evacuation operations* (2011). Stephen Opper, Peter Cinque & Belinda Davies. NSW SES

been adopted based on similar numbers quoted in other sources such as military convoy planning.' For a factor as important as the acceptable traffic capacity for flood modelling, this matter should be clarified. There is no NSW SES Policy or peer reviewed research that support this assumption.

Proposed Evacuation Strategy

Liverpool City Council has approved an evacuation strategy for the three Benedict/Mirvac sites A, C and D. The evacuation strategy involves a multi-layered approach based on primary evacuation by vehicle (*for those residents who own a vehicle*), with a secondary option being pedestrian evacuation (via the approved pedestrian bridge which provides a safe walking route from the site to Paine Park). Additionally, the developments all have buildings with many floor levels above the PMF which will be safe for those residents who refuse to leave or decide to leave after it is too late.

This approach to an evacuation strategy is in accordance with the 2021 NSW SES Liverpool City Flood Emergency Sub Plan – Volume 1, which states, in part:

- Evacuation is the NSW SES's primary response strategy for managing the population at risk of flooding (section 5.8.1), and
- People who are reluctant or refuse to comply with any Evacuation Order will be referred to the NSW Police Force (section 5.8.4).

While **vehicular evacuation is historically** the preferred primary response to a major flood, changes over time in relation to vehicle ownership make **it essential that pedestrian evacuation is included as a phased approach to evacuation.** Phased evacuation is a strategy used in either total or partial evacuation when, due to the slow onset of a hazard or to avoid congestion on roads, affected communities are encouraged or directed to evacuate at different times[8].

We recommend that a phased approach to evacuation is adopted in these circumstances where pedestrian, vehicular and shelter in place are all considered in the modelling process.

The Molino Stewart Report (March 2022) includes the comment that '*while the NSW SES evacuation planning for the Georges River relies upon motor vehicle evacuation, there are currently thousands of people within the floodplain that do not have access to a vehicle (over 30% of dwellings in some areas).*'[9] The same report also states that '***it is emphasised that the modelling is only as good as the model's inputs and assumptions'***. This is further supported by ABS census data (2021) for the Liverpool LGA that **7.7% of the population don't own motor vehicles**, and therefore would not be able to evacuate in the manner assumed by Molino Stewart and steadfastly stipulated by the NSW SES[10]. This highlights again that due to poor assumptions provided to Molino Stewart by the NSW SES, a less than accurate report has been produced.

[8] Australian Disaster Resilience Handbook collection – Evacuation Planning (2017)
[9] Molino Stewart – Georges River Evacuation Modelling. *Flood Evacuation Analysis*. Final. March 2022.
[10] ABS census data https://www.abs.gov.au/census/find-census-data/quickstats/2021/127031523

Another *Austroads* report[11] refers to *Mobility as a Service (MaaS),* describing it as '*a shift away from personally owned modes of transportation and towards mobility solutions that are provided as an on-demand service. Examples of MaaS in recent years includes the growing popularity of Uber or Ride Sharing applications which has transformed the transport industry away from traditional taxis and reduced the need to own a car.*' This is reflected in the increasing number of households where residents do not have their own vehicles. **This highlights that the NSW SES appears to be out of touch with the realities of urban living** in a city that must/should be designed to cater for future population growth, based on the modes of transport that the growing population is adopting (alternates to vehicular transport).

The same report (page 25) also refers to 'active transport', which typically refers to walking and cycling. The report states that '*for future planning and investment decisions, it is important that active transport modes are duly considered as another element of the transport network and assessed accordingly.*' We submit that the same consideration needs to be given to active transport, particularly pedestrians, when planning for evacuations.

It is acknowledged that the NSW SES generally does not support pedestrian evacuation – but with increasing numbers of residents not owning motor vehicles, we submit that this option must necessarily be included in any suite of evacuation strategies (**phased approach to evacuation**). If the Evacuation Timeline Model is to accurately include relevant factors, then the likelihood of pedestrian evacuation must be included as a factor.

'Shelter in Place' is not supported by the NSW SES **as a primary evacuation strategy**. However, given all the variables involved in the evacuation process, **the most notable being human behaviour,** the capacity for people to seek refuge in appropriately designed and constructed buildings with provision of adequate space above the PMF, is becoming increasingly relevant.

A Victorian SES submission to an Inquiry into Flood Mitigation Infrastructure in Victoria (2011) stated, in part, 'Recent work by NSW and Victoria SES's (*Community Safety Decision Making in Flash Flood Environments* – Presented at FMA Conference Tamworth 2011) has produced a draft evidence-based guideline to assist planners and incident controllers to make appropriate planning and operational decisions for flash flood environments. This guideline recognizes evacuation as a primary strategy where possible, however also examines the safety of building occupants if they become trapped by fast rising flood waters and recommends that if such cases arise building occupants should seek shelter in the highest section of their building and if necessary, call '000' if emergency rescue is required'.

The Australasian Fire and Emergency Service Authorities Council Limited, developed a guideline for the Emergency Planning and Response to Protect Life in Flash Flood Events (2018). This guideline was developed based on research carried out by NSW

[11] Austroads – *Management of Traffic Modelling Processes and Applications*, page 24. (2021)

SES that investigated risk to life factors in flash flood environments, and operational experience.

The guideline states, in part, '*Because of the rapid onset of flash flooding and associated high-velocity floodwaters, up to* ***75% of flash flood deaths occur while people are outside buildings attempting to leave or return****, and directly exposed to floodwater. This suggests that if evacuation has not occurred prior to the arrival of floodwater, taking refuge inside a building may generally be safer than trying to escape by entering the floodwater.*'

The above advice is reflected in a message on the NSW SES website:

'*When flash flooding is likely, leaving low-lying homes and businesses (evacuation) well before flash flooding begins is the best action to take, but only if it is safe to do so. If you are trapped by rising floodwater, seek refuge in the highest part of a sturdy building.'*

While this advice refers to 'flash flooding' (defined in Australia as flooding occurring within six hours of heavy rainfall that causes it), we submit that it supports the inclusion of residents sheltering in place as a legitimate option in support of the primary strategies of vehicle and/or pedestrian evacuation.

The applicant's proposal does not suggest that sheltering in place be the primary flood emergency response. Rather, it is a final option available to persons where both vehicular and pedestrian evacuation options have failed or not been attempted. However, if done correctly it is a safe option that needs to be considered and factored into any phased evacuation model.

It is also highlighted that within the Parramatta City CBD, Shelter in Place has been accepted as an evacuation strategy by the NSW SES and Parramatta City Council.

Assuming full capacity of residents and/or workers requiring evacuation

The 2016 Census (2021 Census data not available at time of writing this report) indicates that just over 90% of the residents of the Moorebank suburb travel to work by vehicle (as driver or passenger 76.6%) or public transport (13.8%). The 2011 Census indicates that approximately 80% of Moorebank residents travelled to work.

In the event of a flood warning, it is highly likely that many of these persons would already be away from their residence and their evacuation would therefore not need to be included in terms of traffic capacity.

The 2021 Census also revealed that 4.2% of dwellings in the suburb of Moorebank were unoccupied on the night the census was conducted. The 2016 Census revealed that 5.2% of dwellings were unoccupied[12].

[12] ABS data https://www.abs.gov.au/census/find-census-data/quickstats/2021/127031523

The proportion of unoccupied dwellings (4.7% on average across the 2021 and 2016 Census data) therefore, should be factored into any evacuation modelling. Molino Stewart did not do this.

Further, given the large proportion of residents who travel to work by vehicle or public transport, it is likely that many of these people will be away from their residence when/if an evacuation warning is delivered and the vehicle cannot be used for the purposes of evacuation as stipulated by the NSW SES.

Assuming a 100% evacuation warning compliance rate

While acknowledging the NSW SES planning for the evacuation of all flood affected residents, evidence from operational responses clearly indicate that a 100% compliance rate is extremely unlikely.

The March 2022 Molino Stewart report (page 74), referring to post-flood surveys undertaken for the NSW and Victorian SES, suggest that the '*vast majority of residents do not evacuate at all when ordered to do so.* ***Most would probably await the arrival of floodwaters at their doorstep before leaving*** *and then it would be too late for vehicular evacuation and, for those who get isolated by floodwaters, too late for pedestrian evacuation'*.

Elsewhere in the same report (page 33), reference is made to research which shows:

- Less than 25% of people evacuate when told to do so
- About 10-20% of people say they will not evacuate under any circumstances.

A blanket policy of evacuation of all buildings is not feasible or realistic. Experience shows that residents are unwilling to evacuate even when instructed to do so. This is the position put in a report titled, *Update of Parramatta Floodplain Risk Management Plans* (*in draft*), where Molino Stewart state:

a) *Residents have demonstrated an unwillingness to evacuate when orders have been given to evacuate in floods throughout Australia in recent years, so it may be especially difficult to get people to leave an elevated dwelling in a high rise building on foot in torrential rain.*
b) *Residents will tend to remain in their dwellings for several hours or more even if they are without services such as electricity.*

In a paper[13] prepared for the Australian and New Zealand Disaster and Emergency Management Conference (2014), the authors wrote, in relation to the Flood Evacuation Timeline Model, that '*the guideline for the use of the FETM tool makes it clear that some, or all, of the evacuees may be unable, or unwilling to evacuate by motor vehicle even when the modelling indicates that everyone should be able to evacuate.*' One of the authors was S. Molino from Molino Stewart Pty Ltd and another was P. Cinque from the NSW SES.

[13] Are There Better Ways to Quantify Flood Risk to Life? by S Molino; M Davison; A Tagg; and P Cinque

Newgate Research[14] indicates that up to 50% of those evacuated or who reside within the evacuated area will attempt to return during the evacuation period. Therefore, it follows that even if a proportion of the at-risk population can be "evacuated", up to half of that evacuated population will seek to return to their dwellings during the flood, thereby placing them at increased risk.

The assumption imposed on Molino Stewart (we believe by the NSW SES) that shelter-in-place is an unacceptable emergency response in a flood is flawed where that shelter comprises habitable areas located above the predicted peak level of the PMF and where the residents of those premises would be isolated for less than 2 days. **There is no formal government policy** that states that shelter in place is not a viable or acceptable mode of emergency response in floods.

As previously stated, **evacuation needs to be viewed as a scalable activity** which can be **partial, phased, involve self-evacuation and shelter in place.** We contend that the Molino Stewart report ignores valid opportunities for phased evacuation by pedestrian/foot to transport hubs, as well as the feasibility of shelter in place.

While the proposed and approved Benedict/Mirvac development sites provide safe pedestrian access for evacuation if required, the evidence contained in the report by Molino Stewart clearly supports the position that a 100% compliance rate with evacuation warnings is unrealistic.

As mentioned earlier in this report, the 2021 NSW SES Liverpool City Flood Emergency Sub Plan includes the strategy that '*people who are reluctant or refuse to comply with any Evacuation Order will be referred to the NSW Police Force'*.

We submit that this is an acknowledgement by the NSW SES of the very real scenario where a proportion of residents will refuse to leave even when directed to do so. As demonstrated in the recent Covid 19 response, many residents in these areas will also not open their doors to a uniformed person, due to their past interactions or experiences in the country that they have come from. Therefore, you will never achieve 100% evacuation compliance as sought by the NSW SES. It is clearly an unrealistic assumption as it disregards known human behaviour.

Evacuation route modelling not taking into consideration local evacuation centre in Liverpool

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).

[14] Newgate Research (June 2018) *Flood Evacuation Social Research*

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.

While evidence[15] shows that most affected residents will make their own arrangements to stay with family, friends or at alternative accommodation outside of flood affected areas, the provision of an evacuation centre in nearby Liverpool is a far more attractive proposal for those seeking refuge than a lengthy trip to the larger evacuation centre at Homebush. This would have an immediate impact on the volume of traffic travelling north along the M7 towards the M4. The Newgate Research indicated that only 17% would travel to designated evacuation centres and only 7% would use the M7 to get to safety.

The recent flood experience in 2022, where evacuation orders were given to nearly 500,000 residents in the Hawkesbury Nepean Valley/Georges River area, identified that a Mass Care Facility at Homebush was not opened. Instead, localised evacuation centres as described above were opened and managed.

Warning times

In a presentation at the First International Conference on Evacuation Modelling and Management[16], the authors (all then employees of NSW SES) state '*the modelling has guided the development of a strategic flood response plan for the Hawkesbury-Nepean Valley'* and '***the modelling showed that flood evacuation capability as it stood in 1997, was seriously deficient in terms of road traffic carrying capacity***.' We submit there are two significant issues identified in these comments – **the model was developed in 1997, and for an area of NSW that was then very much a rural location and massive Government investment in the region since, has significantly improved its road and transport infrastructure.**

The NSW SES Timeline Evacuation Model assumes that an evacuation order is not received at a property until it is doorknocked. This may have been appropriate in a rural setting in 1997, although the authors of the presentation referred to above also stated that '*in a real flood situation the SES will also use other warning methods including television, radio, and telephone. The time frame for warning delivery by these methods is likely to be shorter than for doorknocking but there is no way of assessing beforehand how long it will take for the community to receive the warning'*. The presentation also highlights what we consider are further limitations of the Timeline Evacuation Model:

- for clarity and ease of analysis, each time element has been shown as a discrete element and some of these are indicated to be entirely sequential and independent. In practice most elements will be, to some extent, concurrent
- experience of actual flood evacuation operations within the SES has shown that the elements of warning the community and the resulting traffic movement usually take place concurrently.

[15] Newgate Research (June 2018) *Flood Evacuation Social Research*

[16] Opper, S., Cinque, P. & Davies, B. (2010) *Timeline modelling of flood evacuation operations*

The presentation further states that '*the estimated warning time should not be reduced by relying on technological approaches or the uncertain outcomes of public flood education without reliable evidence justifying this reduction*'. Given that the presentation was delivered in 2010, **we submit that such evidence now exists** to justify the acceptance of more innovative means of delivering evacuation warnings and orders.

The Victorian SES, in a submission to an Inquiry into Flood Mitigation Infrastructure in Victoria (2011), advised that '*It is essential that flood warnings be disseminated through multiple mediums. Improved technologies such as Emergency Alert and social media have provided additional tools for VICSES to deliver warnings and community information during events. Warnings systems should also communicate to people from Culturally and Linguistically Diverse (CALD) backgrounds and vulnerable groups in communities.*'

The Queensland Government[17] advises that **'***A variety of warning sources increases the likelihood that warnings will be maintained throughout a flood event.*'

The NSW SES website also refers to multiple means of delivering flood and evacuation warnings and orders – of which doorknocking is one.

It should be noted that Liverpool council has previously approved 'The Marina' development parking for 637 vehicles to support the marina and recreational uses. The alternate Mirvac Planning Proposal for this site (RZ-5/2018) incorporates 624 parking spaces (which is 13 less parking spaces) on the already approved marina consented allowance. The actual number of vehicles on the site could be accommodated in extra warning time through the increase of 600 vehicles per hr/lane to a more realistic number such as 900 vehicles per hr/lane. This could be readily achieved given that evacuation for this development will not rely on door knocking and can instead be initiated electronically (SMS and Sirens) for this strata/commercial development and the Marina facility Management would be in control of the operation and hence, the customers using the facility.

The evacuation time should also be considered in terms of impact of the Mirvac Planning Proposal and would in fact be the same as for the already approved Benedict Marina Project (637 car parking spaces).

In relation to the proposed developments, additional protective factors will be implemented. These include:

- a 'community manager' who would assist NSW SES personnel in the management of the flood evacuation procedures by communicating with all residents using SMS and social media
- Residents as Flood Wardens. The wardens would assist with explaining details of the flood evacuation procedures to residents and assist in the annual flood evacuation training exercises

[17] www.chiefscientist.qld.gov.au *How do we communicate and warn about floods*

- Audible and visual alarms. It is recommended that automated SMS messaging to residents be prepared in multiple languages to cater for residents from non-English speaking backgrounds
- Vehicle and pedestrian flood evacuation route signage permanently in place

Conclusion

It is our expert opinion that as it currently stands, the Molino Stewart Report is based on either overly conservative or unrealistic assumptions, and incomplete/out of date data, that mainly have been provided by the NSW SES (our understanding). Our expert opinion is that the report **did not accurately** consider the following:

- A phased approach to evacuation considering pedestrian, vehicle and shelter in place.
- Assumptions made by the NSW SES indicate that they appear to be out of touch with the realities of urban living in a city that must be designed to cater for future population growth, based on the modes of transport that the growing population is adopting (alternates to vehicular transport).
- Traffic lane capacity based on a unreasonably conservative figure of 600 per lane/hour when they are well aware that the roads around the proposed development are not rural and will be familiar to the majority of road users.
- Referring to expected traffic delays caused by vehicles making their way north on the M7 to Homebush when their own comments, supported by independent research, clearly indicate that only a small proportion of residents would follow this path. Also, they have not factored into the modelling, the Liverpool evacuation centre or travelling to or sheltering with nearby family and friends.
- 100% evacuation compliance is a known fallacy that cannot be achieved, yet Molino Stewart used this as a base assumption.

It is our expert opinion that had the correct assumptions, along with current evacuation triggers, been provided to Molino Stewart by the NSW SES (and adopted) and consideration was given to the phased approach to evacuation modelling, different, more realistic conclusions would have been reached.

Annexure – CV Dave Owens APM

David Owens APM MLshipMgmt MEmergMgmt DipCrim
Managing Director
Risk-e Business Consultants

David established Risk-e Business Consultants, an Executive Level Management Consultancy, when he retired as Deputy Commissioner of the NSW Police Force after over 30 years of service. The NSW Police Force is Australia's oldest and largest policing organisation and one of the biggest in the English-speaking world. As the Deputy Commissioner, David was responsible for the leadership and management of nearly 13,000 police and 1200 public servants, with responsibility and accountability of a budget of $3 billion.

David has demonstrated that he clearly understands that large organisations must establish robust accountability mechanisms for crisis & emergency management, fiscal responsibility, project and performance management. Whilst strategically focused on the areas of human resources, operations and finance, he also ensured that innovation and project management was incorporated into all aspects of his work. This leadership was recognised in the awarding of the 2012 Australian Business Awards for Innovation and Project Management (project Eyewatch).

David worked with all levels of Government (Federal and State) along with private organisations and volunteer groups. David has effectively worked with Senior Executives at The Federal Bureau of Investigations, The Vatican, The Olympics, Ministers of Parliament (Federal & State) and Boards of Companies/ Emergency Services. In 2009, David was selected as the only Australasian representative to attend the National Executive Institute conducted by the FBI with participants selected from around the world for their leadership abilities.

David has performed in various roles which include Venue Commander for the Sydney 2000 Olympics, Operation Commander, Operation CONTEGO (APEC 2007 Leaders Week) having responsibility for policing & security arrangements. He was also the overall Operation Commander, Operation ANGELUS (World Youth Day 2008) during which His Holiness Pope Benedict XVI conducted services for over 500 000 pilgrims in Sydney.

David was appointed to the legislative role of State Emergency Operations Controller (SEOCON) on 01 December 2007 and performed this position for some four years, making him the longest serving officer in this role. As SEOCON, he was responsible for overall emergency management responses within the New South Wales. A sample of some of the Operations that he conducted are: Sydney 2000 Olympics, Venue Commander, Sailing; Equine Influenza (2007) with Department of Primary Industries; Pasha Bulka and North Coast Floods (2007); Black Saturday Bushfires Victoria (2009) 150 staff deployed; Emergency Management for World Youth Day and APEC Leaders Week; Christchurch New Zealand Earthquake 2011; Japanese Tsunami (2011) Urban Search & Rescue Deployment and United Nations Urban Search & Rescue accreditation Turkey (2011).

In addition, he **represented the NSW Police Force on the State Emergency Management Committee and State Rescue Board respectively, significantly contributing to planning and policy development.** David was the corporate sponsor and driving force behind the implementation of the NSW Police Force Mental Health Intervention Team (MHIT) which is now recognised as International best practice. He also implemented the Incident Commanders

course and the standardisation of Operational Risk Management for the NSWPF. David was responsible for the introduction of the *EyeWatch* project in 2011 which is a platform for the delivery of information to the community utilising *Facebook* as the network tool. This effectively created 21st Century Neighbourhood Watch Communities. This project won the 2012 Australian Business Awards for Project Management and Innovation.

Transitioning from Government to the Private sector, David has been a consultant to the NSW and ACT Governments on Investigations, Policy Development and Emergency Management. David has also worked with the Office of Liquor, Gaming and Racing (investigations and policy advice); Ambulance NSW (Strategic reviews and leadership development); Customer Service (Investigations), Sydney Metro Trains (Emergency and Crisis Management Exercises and coaching) and in **2015 was the independent Chair for the NSW Government on Loose Fill Asbestos Insulation (a $280m project), all recommendations accepted by NSW Government.** David has also consulted to private industry on a range of issues in the security and emergency management arenas and in 2014 David completed accreditation as an OGC Gateway Review Team Member. In 2015 David was appointed by the State Emergency Management Committee as the facilitator for the Greater Sydney Mass Care Exercise. In June 2016, appointed as the NSW State Recovery Coordinator for the East Coast Low and in September 2016 as the Regional Recovery Coordinator for the Central Western floods. In 2017, David was appointed by the NSW Government to the NSW Energy Security Taskforce. State Emergency Management Committee (Exercise Lumen Tenebris) 2018 – largest public/private partnership exercise conducted NSW. 2018 facilitation of NSW Health Influenza Pandemic Exercise and ANSTO Health Supply Workshop. 2018 – NSW Govt Summer Readiness Review. 2019 ANSTO (Executive mentoring), **2019 State Emergency Management Committee Catastrophic Flood Exercise Hawkesbury Nepean (4 months planning & facilitation). 2020 Co-Lead NSW Independent Bushfire Inquiry (76 Recommendations accepted by NSW Govt) and rewrite of the Hawkesbury Nepean Valley Flood Emergency Sub Plan (highest insurance risk in Australia).** Fresh Hope – Master EM, BCP and 8 Individual BCP Plans. Georges River LEMC – EM Plan, Lecturer, National Centre for Emergency Management Studies. Exercise Development & Facilitation Big Fat Smile Childcare, WestConnex M4/M5 tunnel extension and New Haven Farm Home Disability Services. 2021 Review Response Wingecarribee Shire Council 2019/20 Bushfires. Consultant Subject Matter Expert LEAMAC Property Group on flood plain management. **Commonwealth National Resilience & Recovery Agency (10 Emergency Management Exercises – 2021/22)**

QUALIFICATIONS:

David holds two (2) Masters in Emergency Management (2013) and Leadership and Management (2011); Diploma in Criminology (1998); Graduate Certificate in Management (1999) and attended the National Executive Institute Session XXXIV, Federal Bureau of Investigation (FBI), 2009. Certificate IV in Training & Assessment (2015); Diploma of Security & Risk Management (2017); Master Licence (Security Industry Act) and Master Licence (Commercial Agents and Private Inquiry Agents Act). Mental Health First Aid Australia (2017).

Lecturer, National Centre for Emergency Management Studies (2021 – current) Professor/Lecturer Rabdan Academy UAE Integrated Emergency Management (2021 – current)

AWARDS:

David has received the following awards: National Medal (1997 & 1st Clasp)), NSW Police Medal (1st, 2nd & 3rdClasp); Three Commissioner's Unit Citations; Commissioner's Olympic Commendation; Two Commissioners Commendations; Australian Police Medal (2007) and the NSW State Government Service Medal. 2012 Australian Business Awards for Project Management and Innovation. Resilient Australia Award Government Category – Activate Wollondilly project (2018)

AFFILIATIONS:
Member International Association of Emergency Managers; Risk Management Institute of Australia; ASIAL (Australian Security Industry Association Ltd) and NSW Police Legacy – Backup for Life Program. Westpac Helicopter Rescue Service (Chair/Board Member 2012-2018) NSW Ambulance Board (2019 – current). Career Transition Program Worksafe Solutions (2019 – 2021)

PUBLISHED:

- Public Private Partnerships Exploring the opportunities (2014 – ASIAL Security Insider);
- Independent Review of the NSW SES Operational Response Northern River Floods 2017;
- Harnessing the power of Social Media in Emergency Management and Community Engagement (2013 Disaster Management conference paper);
- Exercise Lumen Tenebris (Australian Police Journal Sept 2019);
- NSW Bushfire Inquiry (August 2020)
- Wingecarribee Shire Council Response to 2019/2020 Bushfires (August 2021)