



**RGH  
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# **FLOODING ASSESSMENT REPORT FOR PLANNING PROPOSAL**

**Associated with the  
Caravan Park Development  
At 7 Pomona Road, Empire Bay**

**For Barnes Property Investments  
Ref. 20130284\_R03 Rev C, August 2020**

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## EXECUTIVE SUMMARY

Barnes Property Investments Pty Ltd (the Client) has engaged RGH Consulting Group Pty Ltd (RGH) to prepare a Flood Risk Assessment Report for the planning proposal to rezone the site for a future masterplan to the existing mobile home park at Lot 1 DP 610629, 7 Pomona Road, Empire Bay (the Subject Site). The site lies within the Central Coast (formerly Gosford) Council (Council) Local Government Area (LGA).

RGH has previously prepared a Water Cycle Management Plan (WCMP) Report, Civil Engineering Design Drawings and a Flood Assessment for the development (DA55854/2018). This Report references these documents and should be read in conjunction with the civil engineering series.

The planning brief states:

*“This Planning Proposal will seek to amend Schedule 1 of Gosford Local Environmental Plan 2014 or Central Coast Local Environmental Plan 2019 (whichever is relevant) to permit a caravan park as an additional permitted use on the Subject Site. The Planning Proposal will be accompanied by a draft Masterplan for the area which identifies potential development and open space areas. Council may choose to incorporate this Masterplan into a separate Chapter of Part 5 Location Specific Development Controls of Gosford Development Control Plan 2013 or Central Coast Development Control Plan 2019 (whichever is relevant).”*

RGH has prepared this Flood Risk Assessment Report for the planning proposal in accordance with the Central Coast Council Development Control Plan 2013 (DCP2013), the Central Coast Council Local Environmental Plan 2014 (LEP2014) and the NSW Government’s Ministerial Directions issued under Section 9.1 (formerly 117(2)) of the Environmental Planning and Assessment Act 1979 Direction 4.3 Flood Prone Land.

Section 9.1 Direction 4.3 Flood Prone Land as mentioned above requires that the development of flood prone land be consistent with the principles of the NSW Government’s Floodplain Development Manual (2005). The following points from the Floodplain Development Manual require consideration and are addressed within this Report.

1. *“Size of the Flood*
2. *Effective Warning Time*
3. *Flood Readiness*
4. *Rate of Rise of Floodwaters*
5. *Depth and Velocity of Floodwaters*
6. *Duration of Flooding*
7. *Evacuation Problems*
8. *Effective Flood Access*
9. *Type of Development”*

RGH have carried out previous analysis of the existing overland flow. The details of the modelling were provided within the Flood Study Report for DA, Ref: 20130284\_R02. Velocity



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parameters calculated have been adopted for this current model and applied to the correlation of the Council flood contours and site 12d survey terrain model.

Council have provided 1% AEP and PMF Flood Models and extract ASCII data. The Council data has been correlated with the previous modelling to further assess the flood hazard zones in the vicinity of the planning proposal, and overlayed in comparison has allowed the assessment and preparation of the Flood Hazard Identification. An integrated flood hazard plan has been compiled and attached to this Report at Appendix B and derived from 2d survey data terrain model simulated with the Council electronic flood data.

From analysis, RGH have identified zones of the site in hazard areas which forms the discussion within Section 3.5 of this Report. This provides an understanding of the flood hazard across the site in order for the planning proposal and rezoning to be assessed on its merits in accordance with Council's requirements.

Therefore, this Report was prepared by RGH to assess the flooding characteristics of the Subject Site as detailed in flood modelling by Council to consider the results with respect to Section 9.1 of the of the Environmental Planning and Assessment Act 1979 Direction 4.3 Flood Prone Land. Direction 4.3 points to development and planning requiring assessment and design in accordance with the NSW Government's Floodplain Development Manual (2005).



## 1. INTRODUCTION

Barnes Property Investments Pty Ltd (the Client) has engaged RGH Consulting Group Pty Ltd (RGH) to prepare a Flood Risk Assessment Report for the planning proposal to rezone the site for a future masterplan to the existing mobile home park at Lot 1 DP 610629, 7 Pomona Road, Empire Bay (the Subject Site). The site lies within the Central Coast (formerly Gosford) Council (Council) Local Government Area (LGA).

RGH has previously prepared a Water Cycle Management Plan (WCMP) Report, Civil Engineering Design Drawings and a Flood Assessment for development (DA55854/2018). This Report references these documents and should be read in conjunction with the civil engineering design series.

The planning brief states:

*“This Planning Proposal will seek to amend Schedule 1 of Gosford Local Environmental Plan 2014 or Central Coast Local Environmental Plan 2019 (whichever is relevant) to permit a caravan park as an additional permitted use on the Subject Site. The Planning Proposal will be accompanied by a draft Masterplan for the area which identifies potential development and open space areas. Council may choose to incorporate this Masterplan into a separate Chapter of Part 5 Location Specific Development Controls of Gosford Development Control Plan 2013 or Central Coast Development Control Plan 2019 (whichever is relevant)”.*

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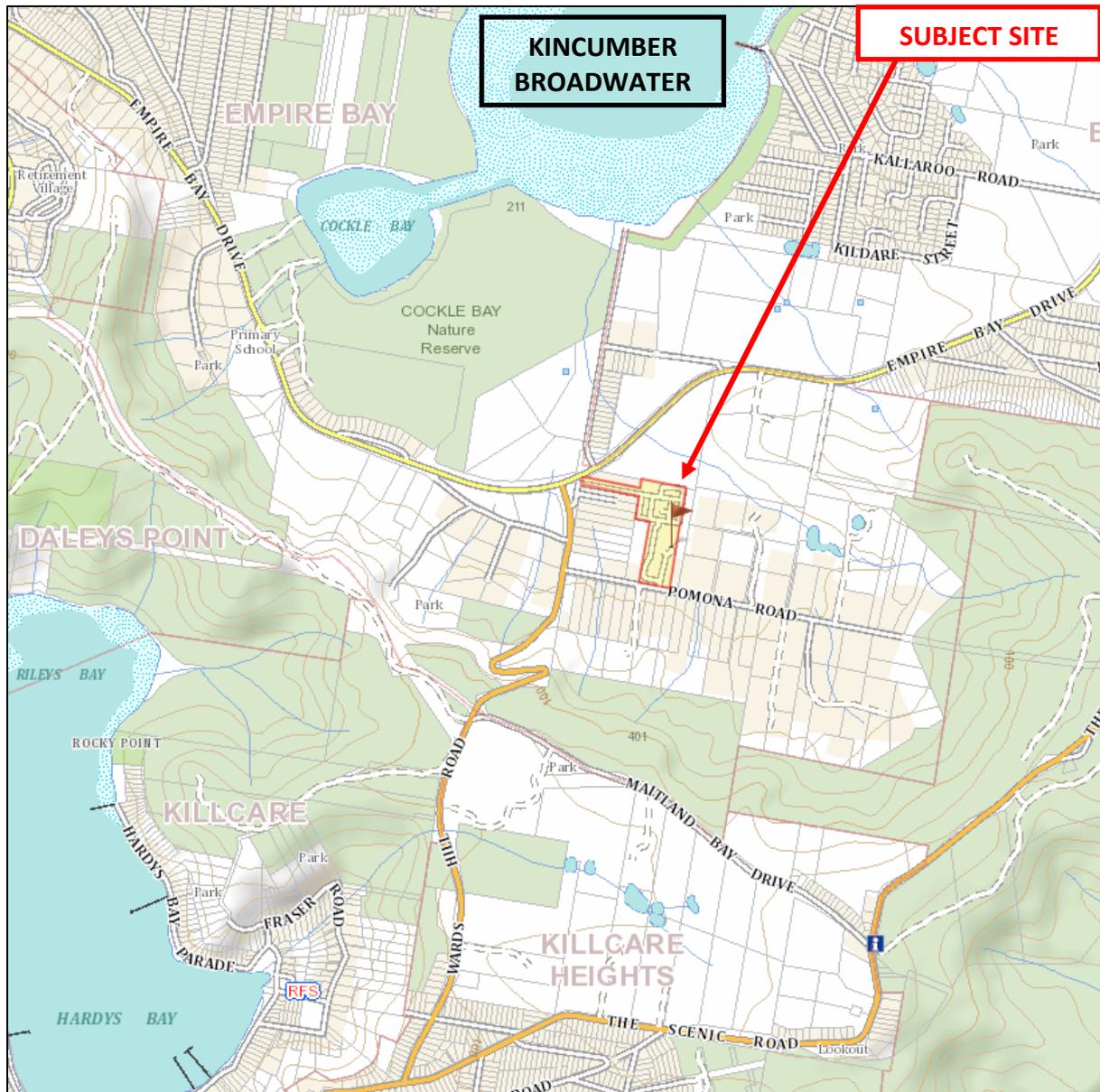
1. *“Size of the Flood*
2. *Effective Warning Time*
3. *Flood Readiness*
4. *Rate of Rise of Floodwaters*
5. *Depth and Velocity of Floodwaters*
6. *Duration of Flooding*
7. *Evacuation Problems*
8. *Effective Flood Access*
9. *Type of Development”*

The Flood Risk Assessment Report aims to satisfy both Council’s and the Department of Planning and Environment’s requirements for planning proposals, and with regard to the NSW Government’s Floodplain Development Manual.



## 2. SITE AND CATCHMENT DESCRIPTION

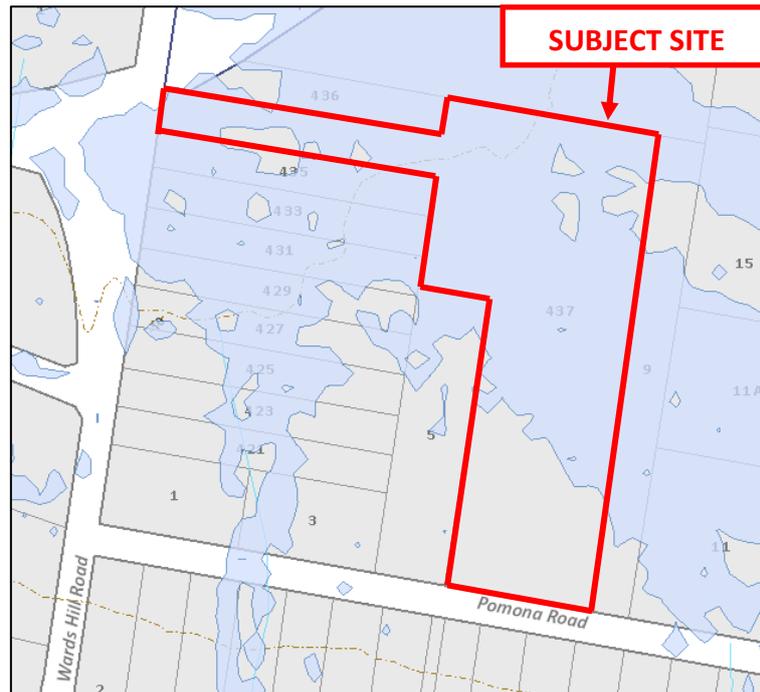
The subject site area in total is approximately 1.58 hectares (ha) and is located approximately 1 kilometre (km) south of Kincumber Broadwater as shown in Figure 1 below.



**Figure 1 – Locality Map of the Subject Site**

An existing channel dissects the site and separates the existing developed caravan park from the area to the south. The site has been identified as flood affected in the 1% Annual Exceedance Probability (AEP) flood event within both Council's Online Mapping Tool and the Empire Bay Catchment Flood Study prepared by Cardno Lawson Treloar for Council. The Council Flood Mapping extents of the 1% AEP is shown below in Figure 2.

Hydraulic modelling and calculations were conducted by RGH to determine the extent of this flood and expected flood heights within the development area and were presented in the previous RGH Flood Study Report under separate cover. (Ref: 20130284\_R02).



**Figure 2 – Council Flood Mapping Extents (1% AEP)**

The catchment directed to the-site is estimated to be approximately 36.7 Hectares (ha) as shown in Figure 3 below and consists of natural bushland and rural residential site coverage. It is considered to be steep and with a northerly aspect from the ridgeline on which Maitland Bay Drive traverses.





### 3. FLOOD RISK MANAGEMENT PLAN

The Subject Site and flooding characteristics have been assessed in accordance with Section 9.1 Direction 4.3 – Flood Prone Land and the NSW Floodplain Development Manual. As discussed within Section 1, the following points require address within this Flood Risk Management Plan from the requirements of the NSW Floodplain Development Manual:

1. *“Size of the Flood*
2. *Effective Warning Time*
3. *Flood Readiness*
4. *Rate of Rise of Floodwaters*
5. *Depth and Velocity of Floodwaters*
6. *Duration of Flooding*
7. *Evacuation Problems*
8. *Effective Flood Access*
9. *Type of Development”*

Therefore, the below sections of this Report address the above points to allow Council to assess the planning proposal for the zoned land use on the Subject Site.

#### 3.1. Size of the Flood

As the planning proposal subject to this Flood Risk Assessment Report intends to coordinate development as existing and proposed land use, both the 1% Annual Exceedance Probability (AEP) and the probable maximum flood (PMF) have been considered in the preparation of this flooding assessment.

The 1% AEP event is defined as the storm with a probabilistic chance of occurrence of 1% in a particular year.

Similarly, ARR1987 and ARR2001 both define the PMF as:

*“The greatest depth of precipitation for a given duration that is physically possible over a given size storm area at a particular geographical location at a certain time of year”.*

The most recent version of ARR, ARR2019, defines the PMF as follows:

*“The Probable Maximum Flood (PMF) is a hypothetical flood estimate relevant to a specific catchment whose magnitude is such that there is negligible chance of it being exceeded. It represents a notional upper limit of flood magnitude and no attempt is made to assign a probability of exceedance to such an event.”*

The overall extents of the flood are isolated to the localised catchment only, with flood limits covering the northern segment of the site. The 1% AEP and PMF flood contours were provided by Council and used by RGH to correlate the flood extents. Specifically, the 1% AEP flood is used to determine the hazard category over the Subject Site whilst the PMF was utilised to determine the distance for safe evacuation and strategies for evacuation outside of high hazard zones, in accordance with Council DCP.



The Flood Extents and Flood Hazard Identification plan is enclosed with this Report at Appendix B, and outlines the results of the analysis and flood hazard for overbank velocities on the site and identified hazard zones.

### **3.2. Effective Warning Time**

Effective warning time defines the time period that an intermittent flow path reaches its peak flood height, flow width and flow velocity. Through review of the Empire Bay Catchment Flood Study (Cardno, 2010), the critical storm duration is provided as being 120 minutes (2 hours) for the majority of the points modelled within the study. The critical storm duration is the time that it will take during the design storm event for the flood level to reach its peak value.

The Subject Site is affected by local catchment flooding with relatively low warning time (2 hours) and small duration; the effective warning time based on the Council DCP relates to times of concentration <2hours provide limited warning time. Residents and occupants are recommended to seek refuge on-site where available, and evacuate prior to road network inundation, in these circumstances. These situations align with the statements within the council DCP. The Integrated flood hazard plan MP01 identifies a 200m low hazard evacuation zone at the North East and the masterplan provides for safe refuge via a development community centre proposed as flood compatible and an elevated culvert or bridge/culvert to the south for safe evacuation- low hazard. Future buildings will need to incorporate flood compatible and safe structures conforming with Council's DCP and Australian Building Codes Board (ACBC) structures in flood liable areas guidelines.

### **3.3. Flood Readiness**

Flood readiness within a caravan park development is to be in accordance with the following provisions from the NSW SES' Gosford City Local Flood Plan (GCLFP), as outlined within their Flood Response provisions:

*a. "Information Provision and Warning*

- *Provision of warnings, information and advice to communities.*
- *Inform the community regarding the potential impacts of a flood and what actions to undertake in preparation for flooding.*
- *Inform the community regarding the potential impacts of coastal erosion and what preparatory actions to undertake.*
- *Provide timely and accurate information to the community.*

*b. Property protection*

- *Protect the property of residents and businesses at risk of flood damage.*
- *Assistance with property protection by way of sandbagging and the lifting or transporting of furniture, personal effects, commercial stock and caravans.*
- *Assistance with the relocation of readily moveable household goods and commercial stock and equipment from properties threatened by coastal erosion.*
- *Assistance with the protection of essential infrastructure.*



c. *Evacuation*

- *The temporary movement of people from a dangerous or potentially dangerous place to a safe location, and their eventual return. It is a safety strategy which uses distance to separate people from the danger created by the hazard.*

d. *Rescue*

- *The rescue or retrieval of persons trapped by floodwaters.*

e. *Resupply*

- *Minimise disruption upon the community by resupplying towns and villages which have become isolated as a consequence of flooding.*
- *Ensure supplies are maintained to property owners by coordinating the resupply of properties which have become isolated as a consequence of flooding.”*

The above points should be provided and maintained by caravan park owners and permanent occupants in the event that the caravan park is used and developed on the Subject Site. Response and monitoring shall follow relevant government departments;

- NSW Govt Bureau of Meteorology, [www.bom.gov.au](http://www.bom.gov.au)
- NSW SES, [www.ses.nsw.gov.au](http://www.ses.nsw.gov.au)
- Central Coast Council, [www.centralcoast.nsw.gov.au](http://www.centralcoast.nsw.gov.au)
- NSW Govt Emergency, 000 – Police, Fire, Ambulance.

### **3.4. Rate of Rise of Floodwaters**

As stated above in Section 3.2, the effective warning time for the catchment draining through the Subject Site is approximately 120 minutes. Although this does not allow for effective warning, RGH is of the opinion that the site characteristics, the flood extents modelled hydraulically and the floodplain development controls that are to be imposed during both the planning proposal and the Development Application (DA) stage will provide controls in accordance with Council’s and FDM requirements.

Council policy requires that any structures proposed within the Subject Site be designed to withstand the hydrostatic, hydrodynamic, hydraulic and debris loading for the 1% AEP and PMF so to allow occupants to seek refuge on site, temporary shelter in place for a short period of time, in the event that safe evacuation is not permitted above the 1% AEP and in extreme events.

### **3.5. Depth and Velocity of Floodwaters**

The depth and velocity of floodwaters varies along the length of the flood zone as expected. Correlation between the flood contours provided by Council for both the 1% AEP and PMF storm events and the topographic site survey has enabled the preparation of Flood Extents and Flood Hazard Identification to assess the site. The Flood Hazard Identification Plan has been provided at Appendix B to this Report for planning review.

The hydraulic properties of floodwaters were assessed in accordance with ARR (2019) as previously mentioned within this Report. ARR (2019) provides a hazard categorisation chart

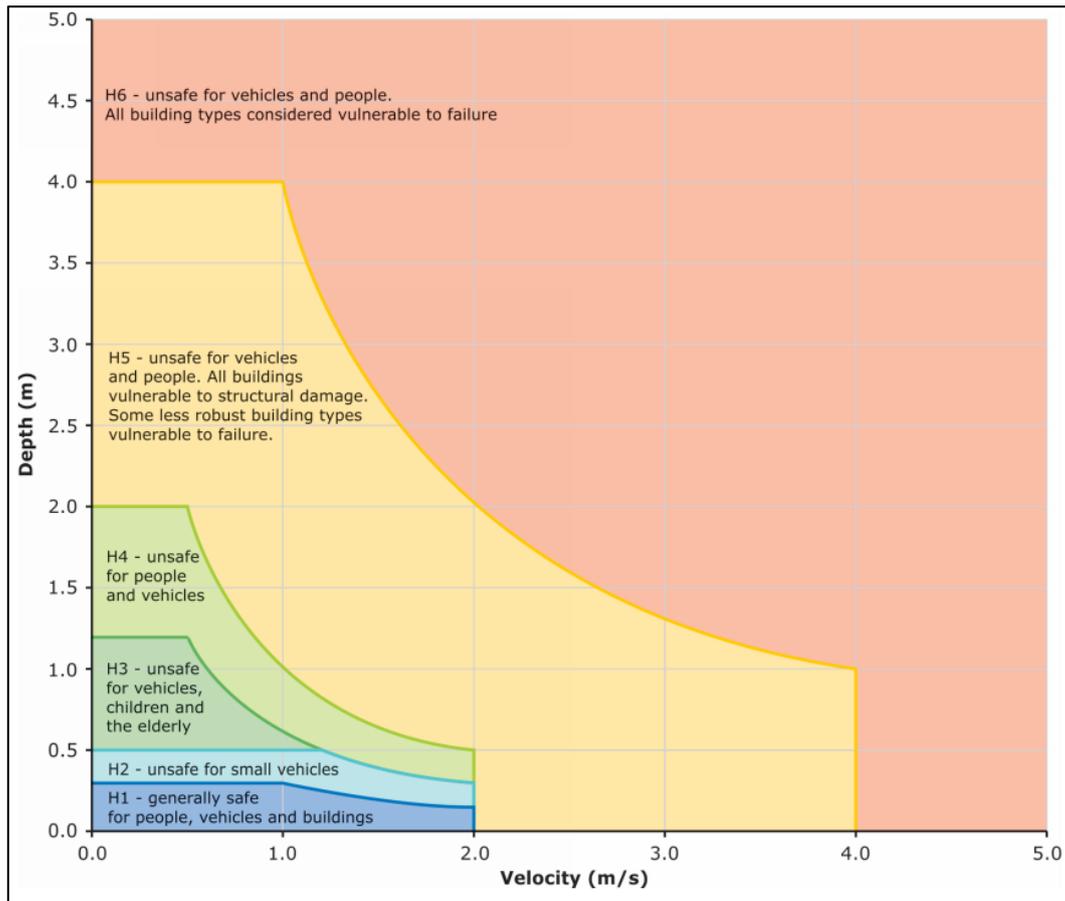


that stipulates flood depth and flow velocity criteria to provide a hazard category and vulnerability description. The hazard combined flood categorisation chart is provided below in Figure 4.

RGH considers that the hazard categories labelled 'H1 – Generally Safe for People, Vehicles and Buildings' and 'H2 – Unsafe for Small Vehicles' are both encapsulated by the 'Low' Hazard Category, which has been adopted for flood risk assessment and management within Council and the FDM for some period of time. Hazard categories labelled between 'H3' to 'H6' inclusive are deemed 'High' Hazard for the purposes of this Flood Risk Assessment Interim Report, and as defined by the FDM.

Velocities are not specified within the Empire Bay Catchment Flood Study (2010). Therefore, RGH has adopted the maximum flow velocity that was determined through the hydraulic modelling calculated within the RGH Flood Report, Ref: 20130284\_R03. This allowed RGH to assess the flood regime with corresponding velocities to define flood hazard category over the Subject Site.

As can be seen within the Flood Hazard Identification Plan at Appendix B, the flood hazard category for the 1% AEP varies over the site. The planning proposal seeks to outline areas of permissible development that are considered 'Low Hazard', i.e. flood hazard in the H1 and H2 categories. Previous Flood Study modelled by RGH has calculated the maximum flow velocity in the channel as 1.69 – 2.30m/s and 0.44 – 0.93m/s on overbank areas. Therefore 1m/s has been applied as an appropriate velocity parameter for flows, excluding the main defined channel, for 1% AEP Flow Depth to velocity relationship and mapped on the Integrated Flood Hazard Plan 20130284\_C01 at Appendix B. Council data provided has identified 0.84m/s as the defining 1% AEP velocity.



**Figure 4 – Combined Flood Hazard Curves (ARR, 2019)**

The Flood Hazard Identification Plan has been specifically prepared to match the colours and categories provided in Figure 4 above, detailing the specific areas based on the flood depth and velocity. Council flood data has also been combined with the RGH mapped hazards and correlates with the defined high hazard zones. Plans MP01 to MP12 at Appendix B show the described data and information.

### **3.6. Duration of Flooding**

The duration of flooding within the flow path is considered by RGH to be the same as the effective warning time, and peak flood levels will only exist for a short time period, as is the nature of large to extreme floods (greater than 1% AEP storm events) within the relatively small catchment.

Therefore, RGH is of the opinion that occupants will likely not be trapped on-site during a large to extreme flood events for long periods of time and will be able to safely egress and evacuate from the site should the need arise, whether it be voluntary evacuation or in consultation with the NSW SES. Evacuation should be undertaken when the road network exiting the Subject Site is free of floodwaters. Furthermore, evacuation should not be carried out through floodwaters. The maximum distance to safe ground levels from the centre of the site is less than 200m. Planning provisions are recommended to provide staged and levels of flood safety, including allowable shelter in place-refuge in extreme events.



### **3.7. Evacuation Problems**

Evacuation is to be conducted prior to inundation of the Subject Site and the evacuation via the road network to the south and west. Evacuation to ground higher than the PMF is approximately 250m to Pomona Road and approximately 290m to Empire Bay Drive based on the information provided to RGH from the further most north east corner of the site. However, the flood duration is not expected to be significant due to the nature of the catchment and associated flood regime. The primary evacuation route, travelling along Pomona Road to higher ground is recommended as the primary route.

Flood refuge is provided on site during the PMF event and per Section 3.3 above, Flood Readiness is a major consideration within the Empire Bay catchment area, and risks are minimised. Staged response strategies including safe evacuation <200m, safe egress across a flood free structure/bridge, and temporary refuge meets with Council's DCP and NSW FDM guidelines.

### **3.8. Effective Flood Access**

Effective flood access, in accordance with the NSW Floodplain Development Manual, is defined as *"the availability of effective access routes from flood prone areas and developments can directly influence personal danger and potential damage reduction measures. Effective access means an exit route that remains trafficable for sufficient time to evacuate people and possessions, or any other appropriate boat-based or air-based means of evacuation."*

Therefore, as discussed previously, effective flood access and evacuation can be found within the Subject Site to the south and west, with the Pomona Road carriageway acting as a flood free route to higher ground via Wards Hill Road. In accordance with the above definition, Pomona Road provides an exit route than remains trafficable for sufficient time to evacuate people and possessions if required.

Additionally, PMF refuge is present on the Subject Site. Flood refuge is considered a suitable flood management method due to the relatively short duration times in short response catchments.

### **3.9. Type of Development**

The planning proposal provides Flood Risk Management Planning to seek continuing land use for the Subject Site and therefore, although no development is proposed at this stage, caravan parks be assessed to determine suitability for the Subject Site during a range of flood events.

Caravan and manufactured home parks have varying demographics, however, the flood risk management measures provided, as discussed below, dependent population as this will be the critical case for flood response and flood risk management. The 1% AEP will provide safe access (<H2) and PMF will be the critical storm analysed and considered in the flood response assessment and flood risk management for the proposed development on the Subject Site.

### **3.10. Further Considerations**

Evacuation and vehicle egress, for the storm events up to the 1% AEP storm event should be conducted prior to inundation of the Subject Site and the road network. RGH recommends



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this occur to the south and west along the Pomona Road carriageway. This evacuation route allows occupants to reach high level safety (above the 1% AEP) in a short distance to Wards Hill Road.

Therefore, Council's requirements in regards to flooding have been reviewed and addressed accordingly with reference to Section 9.1 Direction 4.3 – Flood Prone Land, Council LEP2013 and the NSW Floodplain Development Manual.



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## 4. CONCLUSION

RGH Consulting Group Pty Ltd has been engaged by Barnes Property Investments Pty Ltd to prepare a Flood Risk Assessment Report associated with a planning proposal for the existing 'caravan park' land use on the title of Lot 1 DP 610629, 7 Pomona Road, Empire Bay (the Subject Site).

RGH has previously prepared a Water Cycle Management Plan (WCMP) Report, Civil Engineering Design Drawings and a Flood Report for development (DA55854/2018). This Report supplements these documents and should be read in conjunction with the civil engineering design suite.

From detailed computational and survey analysis, RGH have ascertained zones of the site in correlated hazard areas per the discussion within Section 3.5 of this Report. This provides an understanding of the flood hazard across the site in order for the planning proposal and rezoning to be assessed on its merits in accordance with Council's requirements. Integrated flood hazard plans outline potential flooding affects for possible and rare flood events across the site for flood planning and correlated with data supplied by Council. Integrated flood diagrams are enclosed and should be read in conjunction with descriptions contained within this assessment report.

This Report has been prepared by RGH to assess the flooding characteristics of the Subject Site to consider the results with respect to Section 9.1 of the of the Environmental Planning and Assessment Act 1979 Direction 4.3 Flood Prone Land, and with regard to development and planning requirements of the NSW Government's Floodplain Development Manual (2005).



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## 5. REFERENCES

- Cardno Lawson Treloar, ***“Empire Bay Catchment Flood Study”***, Gosford City Council, 2010.
- Central Coast Council, ***“Civil Works Specification”***, 2018.
- Gosford City Council, ***“Development Control Plan”***, 2013.
- Gosford City Council, ***“Local Environmental Plan”***, 2013.
- NSW Department of Infrastructure, Planning and Natural Resources, ***“Floodplain Development Manual”***, NSW Government, 2005.
- NSW State Emergency Service, ***“Gosford City Local Flood Plan”***, February 2014.
- Pilgrim, D.H., ***“Australian Rainfall and Runoff”***, Engineers Australia, 2001.



**APPENDIX A**  
**Detailed Site Survey**



**APPENDIX B**  
**Integrated Flood Hazard Identification Plan**  
**MP01-MP12**