FLOOD HAZARD REPORT

1 Mackenzie Drive, Somerset

Client: Brooke McCutcheon (Elton Homes Pty Ltd)

Date: June 2023

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1. Introduction

RMS Spatial has been engaged by the Client – Elton Homes Pty Ltd, for the purpose of a site-specific riverine inundation hazard assessment for the proposed development at 1 Mackenzie Drive, Somerset (CT 35887/1). The development includes a single lot that sits on the corner of Mackenzie Drive and Bass Highway, with a proposed construction of 5 units, 1 stand alone and 4 semi-detached (Figure 2).

The development triggers section 12.0 Flood Prone Areas Hazard Code of the Tasmanian Planning Scheme (TPS) (Waratah - Wynyard Council). The purpose of this report is to assess the risk of development against inundation hazards in line with the planning scheme and Building Act 2016 requirements.

1.1. Report Objectives

The objectives of this report are to ascertain the following:

- Assess the proposed development against TPS riverine inundation code and Building Code of Australia 2016 (BCA).
- Assess the developments risk to inundation hazards for the life of any proposed buildings from a 1% AEP storm event (includes the effects of climate change).
- Undertake a risk assessment to determine the developments tolerable risk to inundation hazard.
- Where applicable, provide recommendations and options to reduce risk to the development and surrounds.

1.2. Planning

1.2.1. Tasmanian Planning Scheme

Development at 1 Mackenzie Drive, Somerset is subject to the flood prone hazards and triggers C12.6.1 Buildings and works, within a Flood Prone Areas Hazard Code, shown in Table 1 below. As there is no acceptable solution for this code, performance criteria are required to be addressed.

Table 1. C12.6.1 Buildings and works, within a Flood Prone Areas Hazard Code

Objectives:	
a) Building and works within a flood-prone hazard area can achieve and maintain a tolerable risk from flood; and b) Buildings and works do not increase the risk from flood to adjacent land and public infrastructure.	
Acceptable Solution	**Performance Criteria**
A1 No Acceptable Solution.	**P1.1** Buildings and works within a flood-prone hazard area must achieve and maintain a tolerable risk from a flood, having regard to: a) the type, form, scale and intended duration of the development; b) whether any increase in the level of risk from flood requires any specific hazard reduction or protection measures; c) any advice from a State authority, regulated entity or a council; and d) the advice contained in a flood hazard report. **P1.2**

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	A flood hazard report also demonstrates that building works: a) do not contribute to flood on the site, on adjacent land or public infrastructure; and b) can achieve and maintain a tolerable risk from a 1% annual exceedance probability flood event for the intended life of the use without requiring any flood protection measures.

1.2.2. Building Code

Additional to the TPS, the development is subject to the Tasmanian Building Act 2016 and the directors' determinations apply to hazardous land (includes riverine inundation) which requires any building to be constructed to have a tolerable risk from inundation for the period of the design life. Under the Australian Building Code Table 3-1 "Design life of building and plumbing installations and their components" places the design life of 50 years for any normal building. As such, giving a approximate 2-year construction period places the expected life span for the assessment of tolerable risk to the year 2075.

2. Site Location and Development

2.1. Location

The development is located at 1 Mackenzie Drive, Somerset in Northern Tasmania, located approximately 28km northwest of Burnie (Figure 1). The site is situated along the Bass Highway and is predominately surround by general residential zoning with general industry to the west.

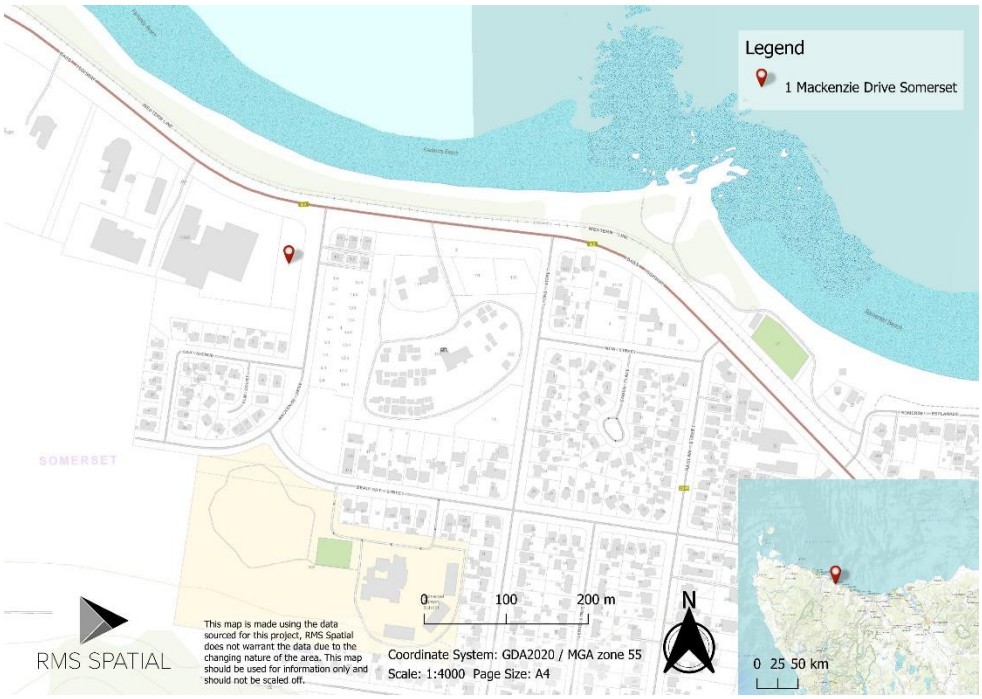


Figure 1, Site Location – 1 Mackenzie Drive, Somerset

2.2. Development

The development is a 5-unit development, proposing 4 semi-detached single storey units and 1 standalone single storey unit. The units are proposed to be 2-3 bedroom units with a shared driveway access and level carport access for each unit. The 5 units are spread over an approximately 3,235m^2 land parcel (CT 35887/1). The development proposes is shown in Figure 2, with the finished floor level shown in Table 2.

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Table 2, Unit finished floor level

Unit	FFL (mAHD)
1	3.03
2	3.33
3	3.33
4	3.69
5	3.69
6	4.10
7	4.10
8	4.35
9	4.35

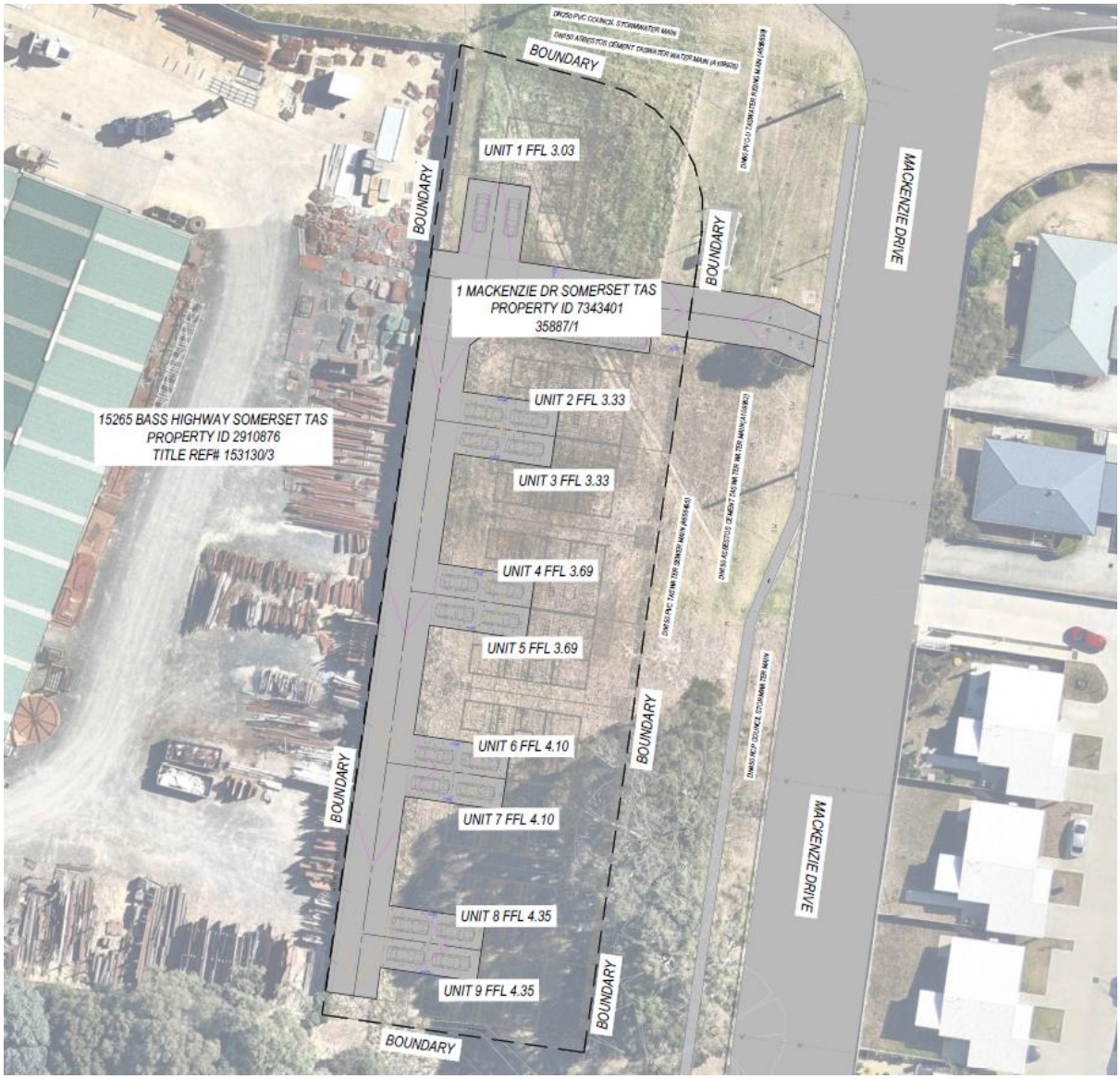


Figure 2, Proposed Unit Development at 1 Mackenzie Drive, Somerset.

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3. Hydrology

3.1. Catchment Area

The development site is located within a catchment of approximate area of 70.7ha sloping to the north with an average gradient ranging from 12% to 2% and discharging via 3 main culverts to Bass Strait. Sub catchments have been derived from Digital Elevation Models (DEM), drainage structures and property boundaries deriving main contributing sub-catchments to each major drainage outlet. The site is located along the central drainage sub catchments with approximately 28ha of contributing residential catchment, with a small portion of the catchment general industrial.

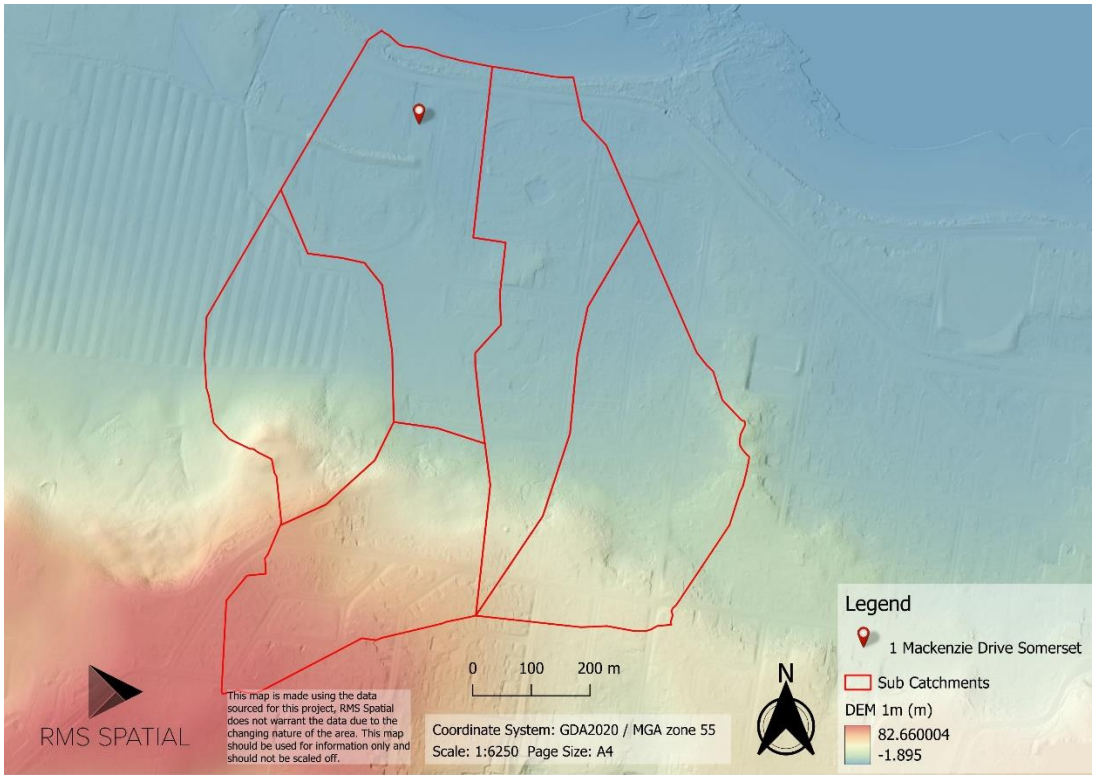


Figure 3, Sub Catchment Delineation

3.2. Design Rainfall and Temporal Pattern

Design rainfall temporal patterns were sourced from the ARR data hub 2016. Combined with the BOM IFD curves (BOM 2016) for their respective 1% AEP frequency durations spanned between 10 min – 24 hours. Given the size of the catchment, durations over 24 hours were removed as unlikely to produce rainfall peaks. This allows a faster processing and post processing of the data. ARR 2016 describes the process for defining the design storm event as being the worst case duration using the median temporal pattern, Figure 4 below shows this case for the contributing catchment to 1 Mackenzie Drive, this shows 30 minute storm was the worst case duration with storm 5 being the median temporal pattern with 4.74m^3/s total discharge.

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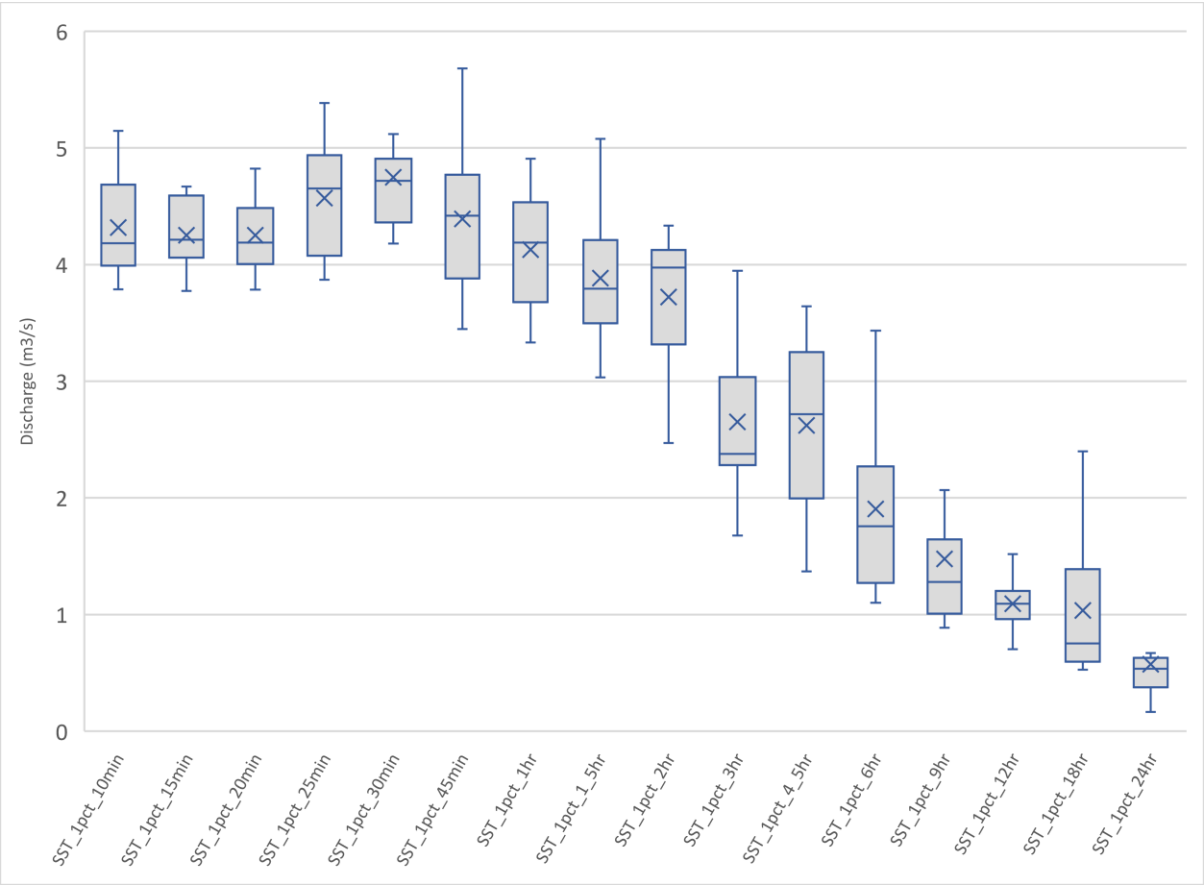


Figure 4, Rainfall Box and Whisker plot

3.3. Climate Change

To accurately represent inundation risk over the life of the development, increases in rainfall due to climate change has been included to year 2100. A study conducted for the ARR guidelines, provides the predicted increase due to climate change for 2100 for Representative Concentration Pathways (RCP). As per ARR guidelines the RCP 8.5 increase was adopted and applied to the peak rainfall depth applied to the worst-case duration and temporal storm event. Table 3 shows the derived rainfall increase derived from ARR datahub for the region of interest.

Table 3, Climate change factor RCP 8.5 for 2100

Location	**ARR Climate Change Adaptation factor**
Tasmania	16.3%

3.4. Pre-Burst Depths

Pre-burst depths considers rainfall depths leading up to the main storm, but not included in the event, falling onto the catchment and filling some storage areas and losses prior to the main storm (ARR 2019). Median pre-burst depths for this report were derived from the ARR data hub, depths were applied to the front of each storm event ensures this is accurately captured within the model.

3.5. Losses

A recent hydrological study conducted by WMA Water for State Emergency Services Tas, used nearby gaged catchment to ascertain design losses for the greater Emu and Cam River catchment,

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including the target catchment of this report (WMA 2023). This report shows an IL of 4.0mm and a continuing loss for soil type A of 6.3 mm/hr and soil type B of 3.28 mm/hr. As this catchment has predominantly soil type B with some type A, a weighted average gave a continuing loss of 4.2mm/hr. These losses were adopted in the model.

As per ARR guidelines, losses have been derived for rural catchments. As a portion of the catchment is classified as urban, ARR recommends applying an effective impervious factor of 60-70% of the rural previous loss and a flat 2.5mm/hr for continuing losses. Table 4 below shows the adopted losses used for this report.

Table 4, Applied Loss Factors for Somerset Catchment

	Initial Loss (mm)	**Continuing Loss (mm/hr)**
Pervious	4.0	4.2
Effective Impervious	0.7*IL=2.8	2.5 (ARR recommended)
Impervious	1	0

3.6. Routing Factors

The hydrologic model uses the RAFTS runoff and routing method to determine peak flows at the development location for the contributing catchment. RAFTS utilises the slope, roughness and non-linearity or RAFTS R to route the rainfall through the catchment to produce total outflows from each catchment. Table 5 shows the three main surface types identified and applied in each catchment providing the following factors.

Table 5, Runoff Routing Factors

Runoff Surfaces	**pervious**	**Effective Impervious**	**Impervious**
Roughness "n"	0.05	0.04	0.02
Slope	Derived from individual catchment		
Non-Linearity	-0.285	-0.285	-0.285

4. Hydrodynamic Model

4.1. Digital Elevation Model

Digital Elevation Model (DEM) was derived from a subset of LiDAR datasets of Wynyard to Somerset undertaken in 2022 (Geoscience Australia). This provides a 1m cell resolution of ground levels with a quoted accuracy of approximately +/- 300mm. The datasets were merged for the purpose of hydrodynamic modelling of Somerset area (Figure 5).

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Figure 5, Digital Elevation Model, Seven Mile Beach

4.2. Roughness Mannings n

Hydraulic roughness values for this model were derived from the ARR 2019 guidelines. The Manning's values are listed in Table 6 below. These values are placed in the model as land use polygons and sampled by the computational grid, applying a roughness factor to each 2D cell.

Table 6, Mannings n values per land use type

Land Use	**Manning's n**
Roads	0.018
Commercial/ Industrial	0.035
Inner Residential	0.04
Residential	0.045
Parks	0.05
Buildings	0.3
Piped Infrastructure	0.013

4.3. 1D Structures

4.3.1. Pipes and Pits

1D structures, such as pipes and pits, were derived from onsite survey and council plans. The information provided included invert levels, lengths and diameters. Where information was not known, best practice design principles are applied to fill the missing information.

4.4. 2D Structures

4.4.1. Walls

Walls located in critical flow paths, including some fences, were included in the model as 2D base linear structures. These structures have a general failure threshold of 300mm in flood depth to

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account for failure points in these structures and partially allow flow through the structure after failure.

4.4.2. Buildings

All existing buildings surrounding the development are applied as defined mesh zones and are raised 300mm to allow for typical design raised threshold, in lieu of known surveyed floor levels. A 0.3 Manning's n factor is also applied to the building. This allows flood water to more accurately mimic flow around and through a building.

4.4.3. Roads

Roads are applied as a defined mesh zone and lowered by 0.1m to allow for flow against a road gutter to be more accurately represented.

4.4.4. Boundaries

As this catchment discharges into Bass Strait, it is appropriate to apply a static tide tailwater level as downstream boundary. The highest astronomical tide (HAT) was derived from the National Tide Centre, as the study include the effects of climate change sea level rise was added to the height to represent this change over time. Table 7 below shows the adopted tailwater level for the model.

Table 7, Adopted Downstream Boundary Level

Level	**Downstream Boundary (mAHD)**
HAT	1.84
Sea Level Rise	0.82
Adopted Tide Level	2.66

5. Riverine Inundation Assessment

5.1. Model Results

Pre and post development scenarios were run through the developed model to understand the effects of riverine inundation on the proposed development and assess the development against the planning and building requirements.

5.1.1. Pre-development

Figure 6 shows the predevelopment model results from a 1% AEP, including climate change event. This shows flooding occurring within a depression found north of the property straddling the boundary with 1 Mackenzie Drive and the Bass Highway Road reserve, depths of approximately 986mm pond within the depression as backflow from the under capacity 900mm diameter council culvert discharging to Bass Strait. Over land flow travel partially along Mackenzie Drive with a portion of flow through the industrial site to the west. This model shows relatively consistent results with modelling undertaken by SES for this area in published in 2023.

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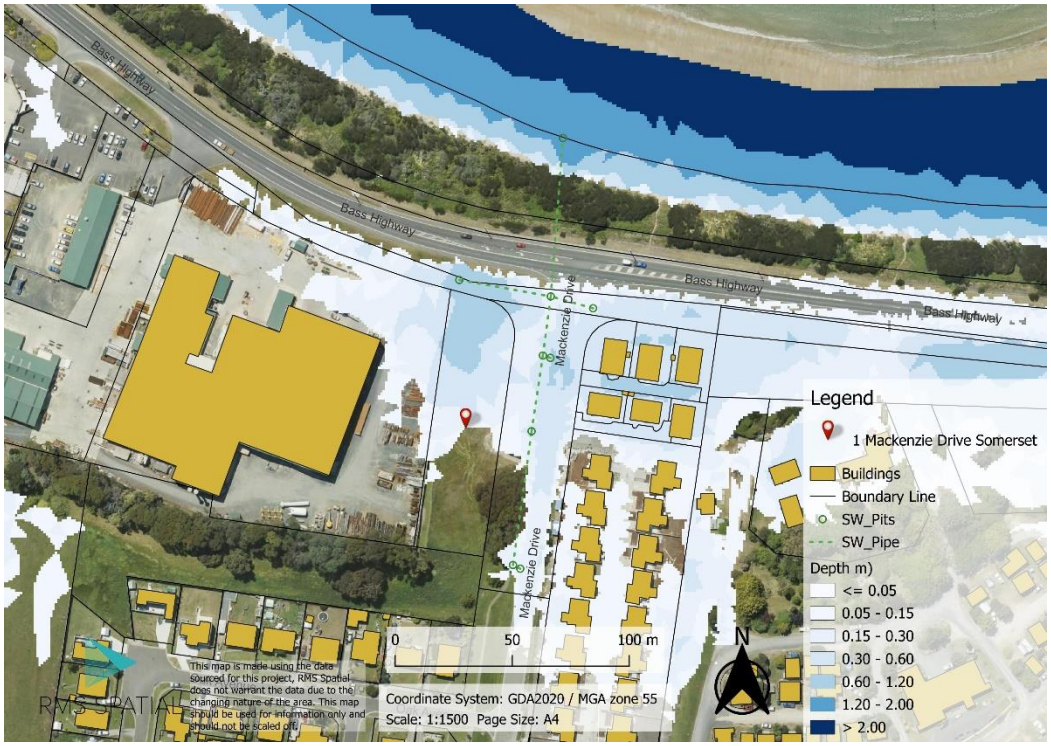


Figure 6, Pre-development 1% AEP @ 2100 depth map

Figure 7 shows the predevelopment model with the proposed units imposed on the map. This shows that proposed units 1 through 4 are affected by localised ponding up to an elevation of 3.77m AHD, with current floor levels for these units between 3.03mAHD and 3.69mAHD these buildings and the driveway access will likely be subject to inundation.



Figure 7, Post development 1% AEP @2100 Depth Map

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5.1.2. Post Development Results

Figure 8, shows the post development scenario with the effected buildings and driveway raised out of the inundation level including a retaining structure for the driveway. The proposed development shows negligible increase in flood depths localised around the property with negligible change to flood extent or demand on infrastructure. A block wall retaining structure or similar has been allowed for to elevate the driveway 300mm above flood level, providing safe egress to the units and maintain a detention basin to the north of the site. Any retaining structure to be designed by a structural engineer to withstand maximum flood elevation of 3.77mAHD and maximum velocities of 0.39m/s and be designed for a 50-year life span.

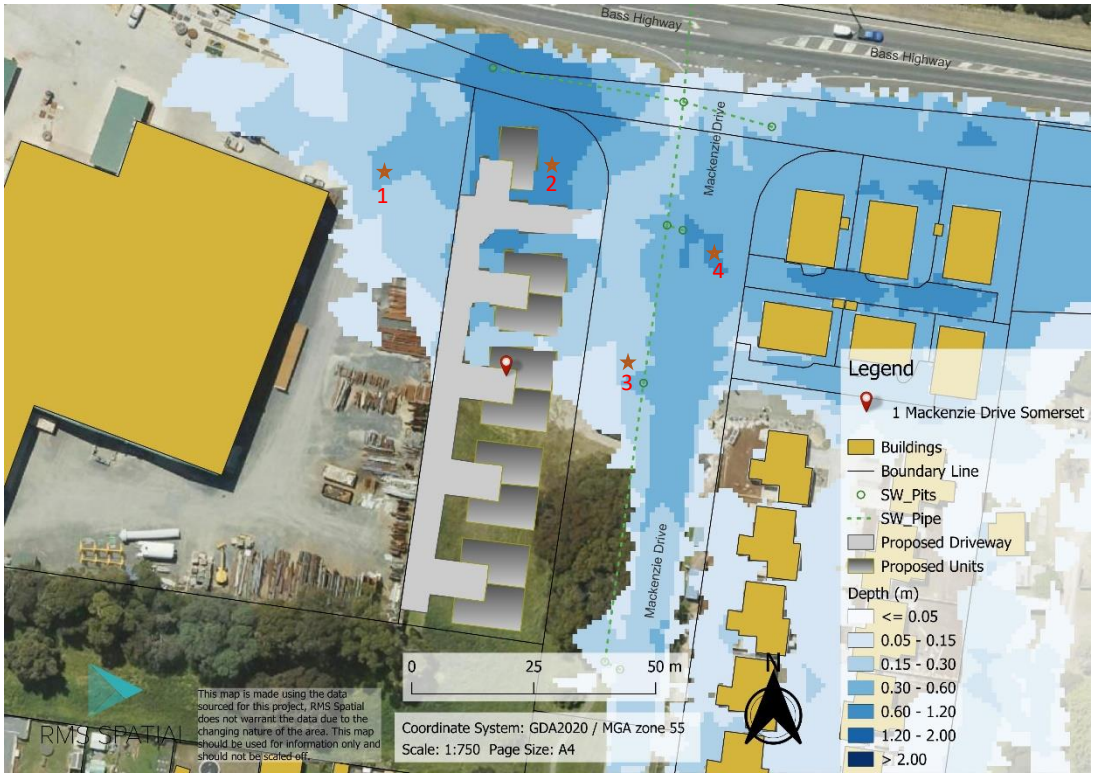


Figure 8, Post-Development 1% AEP @ 2100 depth map with retaining wall

5.2. Building Inundation Levels

Figure 8 shows flood inundation affecting units 1-5 to a depth of 3.77mAHD. To meet the Building Regulations S.53, the construction of a new dwelling is required to have a habitable floor level >300mm above the 1% AEP + CC flood level. Therefore, Table 8 below shows the minimum floor level required to comply (The floor level >1% AEP + CC flood level + 300mm does not apply for non-habitable areas).

Table 8, Minimum Floor level required for each unit.

Unit	Proposed FFL (mAHD)	1% + CC Flood Level (mAHD)	Minimum Floor Level Required (mAHD)
1	3.03	3.77	4.07
2	3.33	3.77	4.07
3	3.33	3.77	4.07

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4	3.69	3.77	4.07
5	3.69	3.77	4.07
6	4.10	-	-
7	4.10	-	-
8	4.35	-	-
9	4.35	-	-

5.3. Overland Flood Behaviour

Pre and post overland flow levels are recorded in Table 9 below. The minor differences in depth and velocity have a negligible effect on the flow and extent of the pre and post model runs and does not change the risk rating on surrounding properties or infrastructure.

Table 9, Overland flow differences pre and post development

Sample Point	**Parameter**	**Pre-Development**	**Post Development**	**Difference**
1	Depth	0.38m	0.35m	-0.03m
	Velocity	0.17m/s	0.25m/s	0.08m/s
	Hazard	2	2	-
2	Depth	0.76m	0.80m	0.04m
	Velocity	0.19m/s	0.33m/s	0.14m/s
	Hazard	3	3	-
3	Depth	0.18m	0.17m	-0.01m
	Velocity	0.39m/s	0.38m/s	-0.01m/s
	Hazard	1	1	-
4	Depth	0.64m	0.62m	-0.02m
	Velocity	0.44m/s	0.52m/s	0.08m/s
	Hazard	3	3	-

6. Inundation Risk Analysis

6.1. Flood Hazard Assessment

As per the Australian Disaster and Resilience Handbook 7, flood hazards are classified into categories of severity dependent upon depth and velocity of the flooding. Figure 9 below describes the risk and levels associated with each category.

The development at 1 Mackenzie Drive has a maximum depth onsite of <1000mm and velocities <1m/s. this places the maximum hazard category to H3 – generally unsafe for vehicles, children and elderly, for both pre and post development. Post development hazard rating on Mackenzie Drive has a maximum category of H3 making it unsafe for ingress and egress from the property in a 1% AEP at 2100 flood scenario. However, by elevating the driveway emergency service could access the property to safely remove residents if required.

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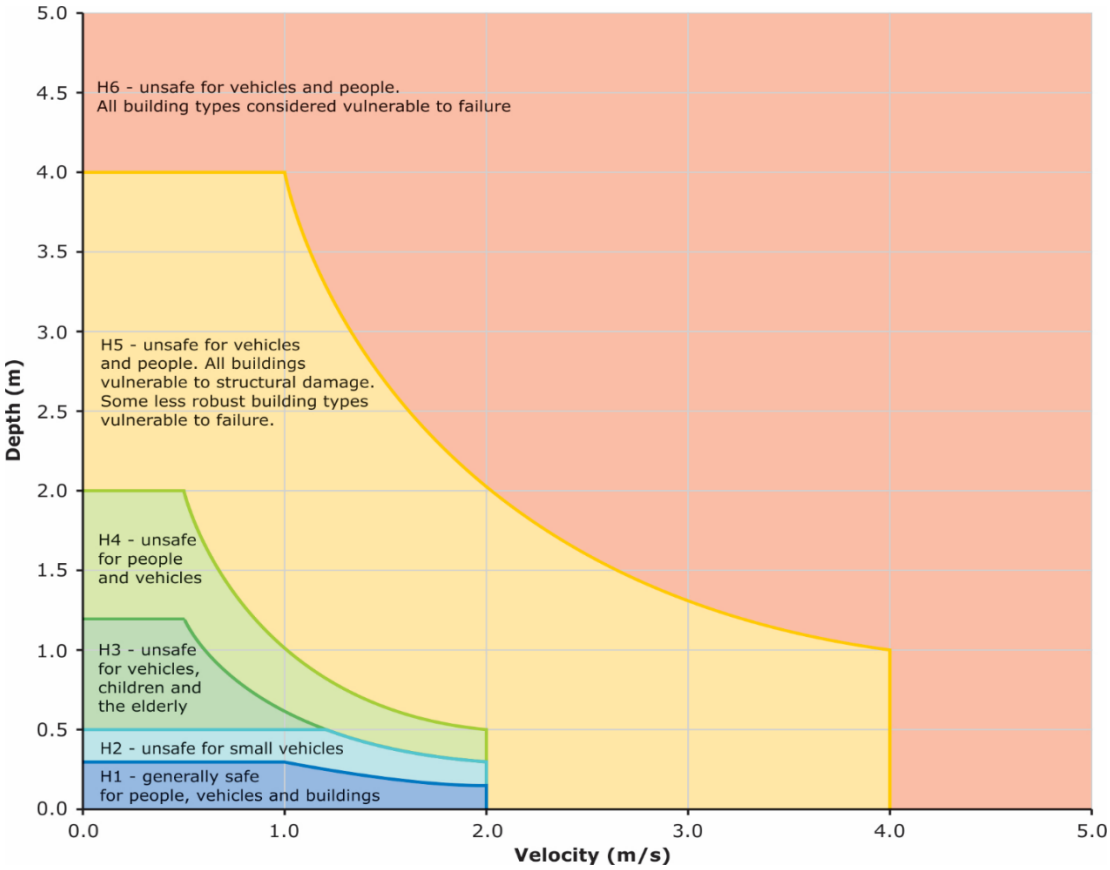


Figure 9, Australian Disaster and Resilience Handbook - Hazard Categories

6.2. Risk Assessment

A qualitative risk assessment has been undertaken to outline risks that may arise from building works in areas that are vulnerable to riverine inundation. The risk assessment is based on the development as described in this report and a fifty-year projected life of the structure to 2075. The qualitative assessment of risk severity and likelihood, in accordance with AS/NZ 4360 Risk Assessment, were used to help provide a qualitative risk assessment based upon the riverine inundation assessment completed for the site. A detailed risk assessment addressing the performance criteria is presented in Appendix 2.

The risk assessment undertaken provides a level of risk demonstrating that the proposed structure can maintain a tolerable risk for the entire life of the structure.

7. Recommendations

RMS Spatial, through the findings of this report, recommends that the proposed development, with the following recommendations will meet the requirements of Tasmanian Planning Scheme - C12.6.1 Flood Prone Areas Hazard Performance criteria and the Building Act 2016. The following recommendations apply:

1. The finished floor levels of habitable units must be 300mm greater than 1%AEP flood level, see Table 8 for individual unit levels.
2. Driveway to be elevated 300mm greater than 1% AEP flood level 3.77mAHD to provide adequate access to the units during a flood event.
3. Driveway retaining structures are to be certified by a structural engineer to withstand hydrodynamic and hydrostatic flood forces as guided by this report.

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    - Alternative materials used outside those outlined in this report are to have a minimum service life of 50 years.
4. Development as per the current design and recommendations of the report displays a tolerable risk to riverine inundation for the life of the development (2075).
5. Hydrodynamic and hydrostatic forces should be considered in the structural assessment of the unit development where applicable.

8. Limitations

This study is limited to the objectives of the engagement by the clients, the availability and reliability of data, and including the following:

- All parameters have been derived from best practice manuals and available relevant studies (if applicable) in the area. This information is subject to change as new information becomes available and as further studies are carried out.
- All provided data by the client or government bodies for the purpose of this study is deemed fit for purpose and has not been checked for accuracy.
- The study is to determine the effects of the new development on inundation behaviour and should not be used as a full riverine inundation study outside the specified area without further assessment.
- The information provided represents the best estimates based on currently available information described and is subject to change.
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9. References

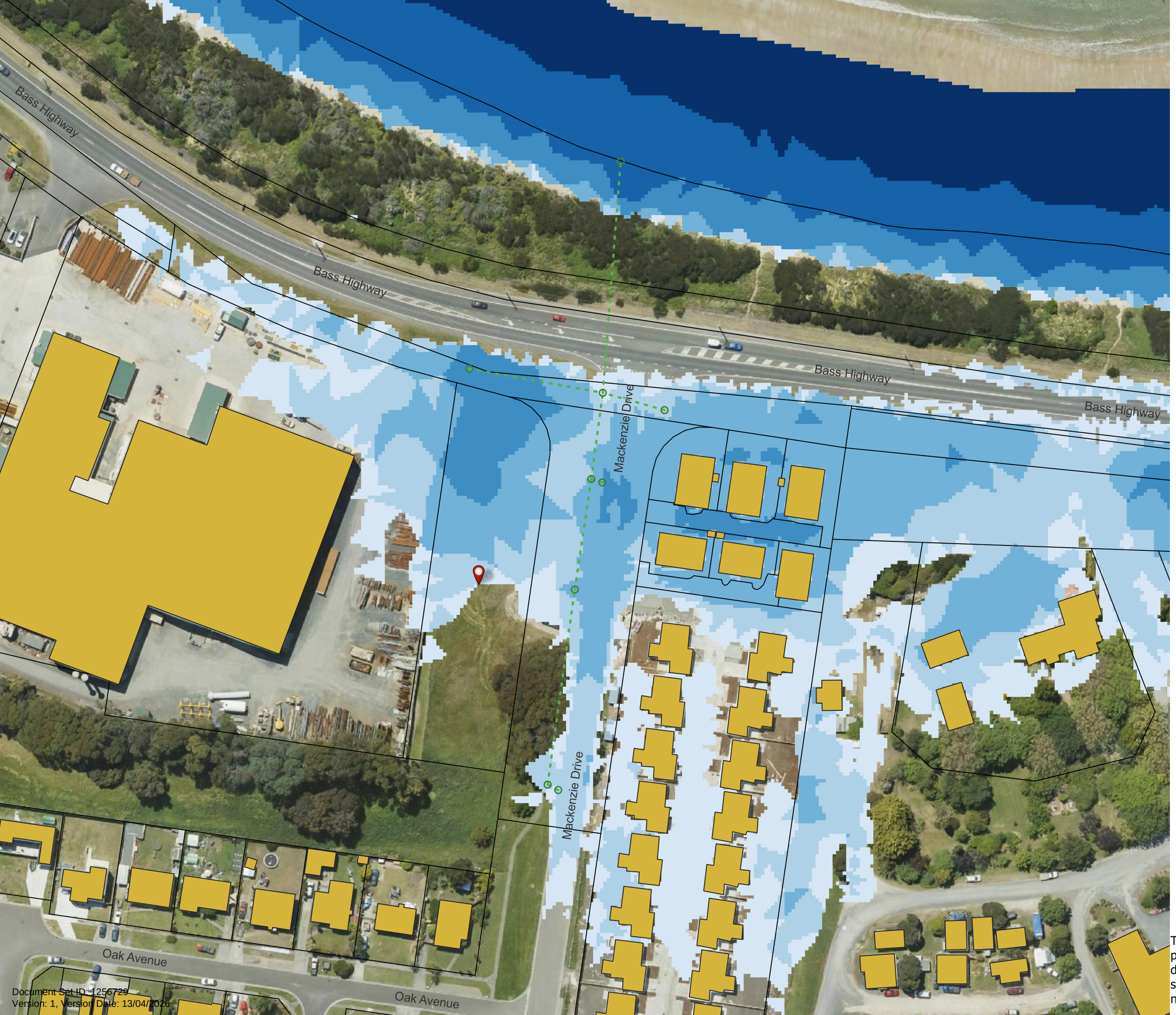
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2. *Ball J, Babister M, Nathan R, Weeks W, Weinmann E, Retallick M, Testoni I, (Editors), 2019, Australian Rainfall and Runoff: A Guide to Flood Estimation, Commonwealth of Australia*
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10. Appendices

Appendix 1 Flood Hazard Maps

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Pre Development
1% AEP at 2100
Depth Map
1 Mackenzie Drive, Somerset

Legend

- 1 Mackenzie Drive Somerset
- Existing Buildings
- SW Pits
- SW Pipe
- Boundary Lines

Depth (m)

- <= 0.05
- 0.05 - 0.15
- 0.15 - 0.30
- 0.30 - 0.60
- 0.60 - 1.20
- 1.20 - 2.00
- > 2.00

N

0 25 50 m

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Pre Development
1% AEP at 2100
Velocity Map
1 Mackenzie Drive, Somerset

Legend

- 1 Mackenzie Drive Somerset
- Existing Buildings
- SW Pits
- SW Pipe
- Boundary Lines

Velocity (m/s)

- <= 0.50
- 0.50 - 1.00
- 1.00 - 1.50
- 1.50 - 2.00
- > 2.00

N

0 25 50 m

CRS: GDA2020 / MGA zone 55
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Pre Development
1% AEP at 2100
Hazard Map
1 Mackenzie Drive, Somerset

Legend

1 Mackenzie Drive Somerset

Existing Buildings

SW Pits

SW Pipe

Boundary Lines

Hazard ARR

1

2

3

4

5

6

N

0 25 50 m

CRS: GDA2020 / MGA zone 55
EPSG:7855
Scale: 1:1000
Page sixe: A3

RMS SPATIAL

This map is made using the data sourced for this project, RMS Spatial does not warrant the data due to the changing nature of the area. This map should be used for information only and should not be scaled off.

Document Set ID: 1256729
Version: 1, Version Date: 13/04/2026

Post Development
1% AEP at 2100
Depth Map
1 Mackenzie Drive, Somerset

Legend

1 Mackenzie Drive Somerset

Existing Buildings

SW Pits

SW Pipe

Boundary Lines

Proposed Units

Proposed Driveway

Depth (m)

<= 0.05

0.05 - 0.15

0.15 - 0.30

0.30 - 0.60

0.60 - 1.20

1.20 - 2.00

> 2.00

N

0 25 50 m

CRS: GDA2020 / MGA zone 55
EPSG:7855
Scale: 1:1000
Page sixe: A3

RMS SPATIAL

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Document Set ID: 1256729
Version: 1, Version Date: 13/04/2026

Post Development
1% AEP at 2100
Velocity Map
1 Mackenzie Drive, Somerset

Legend

1 Mackenzie Drive Somerset

Existing Buildings

SW Pits

SW Pipe

Boundary Lines

Proposed Units

Proposed Driveway

Velocity (m/s)

<= 0.50

0.50 - 1.00

1.00 - 1.50

1.50 - 2.00

> 2.00

N

0 25 50 m

CRS: GDA2020 / MGA zone 55
EPSG:7855
Scale: 1:1000
Page sixe: A3

RMS SPATIAL

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Document Set ID: 1256729
Version: 1, Version Date: 13/04/2026



Post Development
1% AEP at 2100
Hazard Map
1 Mackenzie Drive, Somerset

Legend

- 1 Mackenzie Drive Somerset
- Existing Buildings
- SW Pits
- SW Pipe
- Boundary Lines
- Proposed Units
- Proposed Driveway

Hazard ARR

- 1
- 2
- 3
- 4
- 5
- 6

N

0 25 50 m

CRS: GDA2020 / MGA zone 55
EPSG:7855
Scale: 1:1000
Page sixe: A3

RMS SPATIAL

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Appendix 2 Risk Assessment

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Consequence	Risk from Inundation
Catastrophic	Loss of life. Loss of significant environmental values due to a pollution event where there is not likely to be recovery in the foreseeable future.
Major	Extensive injuries. Complete structural failure of development, destruction of significant property and infrastructure, significant environmental damage requiring remediation with a long-term recovery time.
Moderate	Treatment required, significant building or infrastructure damage i.e. loss of minor outbuildings such as car ports, garages and the like. Replacement of significant property components. linings, hard paved surfaces, cladding, flooring. Moderate environmental damage with a short-term natural or remedial recovery time.
Minor	Medium loss – repair of outbuildings and repair and minor replacement of building components of buildings. Replacement of floor/window coverings, some furniture through seepage (where applicable). Minor environmental damage easily remediated.
Insignificant	No injury, low loss – no replacement of habitable building components, some remediation of garden beds, gravel driveways etc. Environment can naturally withstand and recover without remediation. Inundation of the site, but ground based access is still readily available and habitable buildings are not inundated, including incorporated garages.

Descriptor	Description	Guide
Almost Certain	Consequence is expected to occur in most circumstances	Occurs more than once a month
Likely	Consequence will probably occur in most circumstances	Occurs once every 1 month – 1 year
Occasionally	Consequence should occur at some time	Occurs once every 1 year – 10 years
Unlikely	Consequence could occur at some time	Occurs once every 10 year – 100 years
Rare	Consequence may only occur in exceptional circumstances	Occurs less than once every 100 years

Likelihood of Consequence	Maximum Reasonable Consequence				
	Insignificant	Minor	Moderate	Major	Catastrophic
Almost Certain	High	High	Extreme	Extreme	Extreme
Likely	Moderate	High	High	Extreme	Extreme
Occasionally	Low	Moderate	High	Extreme	Extreme
Unlikely	Low	Low	Moderate	High	Extreme
Rare	Low	Low	Moderate	High	High

C11.6.1 Performance criteria 1.1 **Buildings and works within a flood-prone hazard area must achieve and maintain a tolerable risk from a flood, having regard to**	**Relevance**	**Management**	**Preliminary Risk Assessment**			**Action Required**
			Consequence	**Likelihood**	**Risk**	
Type, form, scale and intended duration of the development;	Development does not increase the level of risk requiring hazard reduction or protection measures	N/A	Insignificant	Unlikely	Low	N/A
Whether any increase in the level of risk from flood requires any specific hazard reduction or protection measures;	No increase in risk onsite from the development is present.	N/A	Minor	Unlikely	Low	N/A
Any advice from a state authority, regulated entity or a council; and	N/A	N/A				
The advice contained in a flood hazard report.	Refer 5.0 Recommendations	FFL of all habitable dwellings must be built at a minimum required as per Table 7 of this report. Driveway elevated above flood level, as per the report recommendations.	Minor	Unlikely	Low	Design to reflect recomendations
C12.6.1 Performance criteria 1.2 **A flood hazard report also demonstrates that building works:**						
Do not contribute to flood on the site, on adjacent land or public infrastructure; and	Development does not contribute to inundation onsite, on adjacent land or infrastructure.	N/A	Insignificant	Unlikely	Low	N/A
Can achieve and maintain a tolerable risk from a 1% annual exceedance probability flood event for the intended life of the use without requiring any flood protection measures.	The development can achieve a tolerable risk from flood for the life without specific flood protection measures.	N/A	Minor	Unlikely	Low	N/A

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