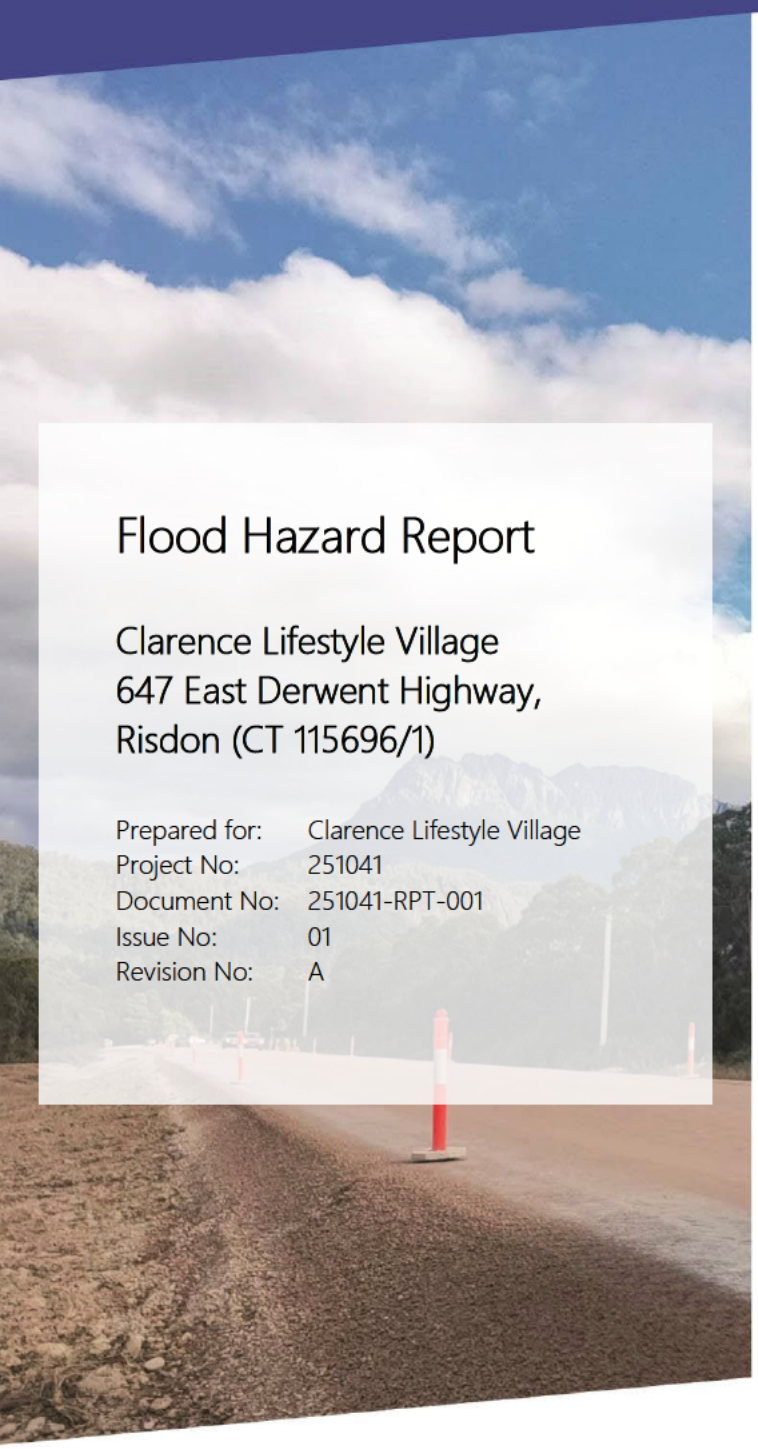








Flood Hazard Report

Clarence Lifestyle Village
647 East Derwent Highway,
Risdon (CT 115696/1)

Prepared for:	Clarence Lifestyle Village
Project No:	251041
Document No:	251041-RPT-001
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22-24 Paterson Street
Launceston, TAS 7250

PO Box 1898,
Launceston, TAS 7250

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Company	Name & Address	Contact	Copies
Craig Swan C/- Phil Gartrell (IreneInc)	Phil Gartrell 49 Tasma Street, North Hobart, TAS, 7001	E [redacted] Ph: [redacted]	1 (elec)

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1. INTRODUCTION

Rare Innovation have been engaged to provide a flood hazard report for the proposed extension of the existing Clarence Lifestyle Village at 647 East Derwent Highway, Risdon. The purpose of this flood hazard report is to undertake a desktop review and analysis of the existing site and proposed works as undertaken by others, to assess the likely hazard to structures and persons due to flooding and to address the Flood Prone Areas Code of the Tasmanian Planning Scheme. This report has been prepared based on available data for the site at the time of investigation.

This report should be read in conjunction with the *Stormwater Design Proposal* by JSA (JSA reference: 17L99-118-4 dated 24/10/23), *Hydraulic Design Report* by Flussig (Doc No. FE-24035 Rev 1 dated 18/07/24) and the JSA Planning Approval issue design drawings (dated 08/11/24).

2. SITE EVALUATION

2.1. Location & Property Details

The proposed development is located on a single existing land title at 647 East Derwent Highway, Risdon (Property ID: 5116539, Title Reference: 115696/1) as shown in Figure 1 and is proposed as part of an extension to the existing Clarence Lifestyle Village located on the adjacent land title of 2 Piper Road, Geilston Bay. The site is currently zoned as Rural Living and noted to be part of a rezoning application. The site is bounded by The East Derwent Highway to the north-east, an existing holiday park to the north-west, the existing Clarence Lifestyle Village to the south-east and existing undeveloped bushland to the south-west.



Figure 1 – Existing Site Aerial Image

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2.2. Land Description

The site is currently largely undeveloped but contains a single residential dwelling and garage structure. An additional single dwelling is located on a separate land title that abuts into the property outline on the north-western side. Access to the site is currently provided via a gravel driveway from the East Derwent Highway along the northern side of the property through the adjacent property title.

The site's topography generally falls towards the north and north-east with moderate grades of typically 7% - 14%.

An existing mapped watercourse is located along the north-eastern boundary which is noted to not contain permanent running water but is instead a natural topographical low point that drains runoff during rainfall events from the surrounding catchments including the East Derwent Highway.

An additional minor natural depression/swale runs through the site from the south-western boundary to the north alongside the existing adjacent residential property and is expected to direct flows from the south-western natural/rural catchment during rainfall events.

Both existing drainage paths through the property discharge via multiple culverts to a series of existing open drains along the northern side of the driveways outside the north of the property before continuing down the length of the East Derwent Highway.



Figure 2 – Surrounding Topography & Drainage

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2.3. Proposed Works

The proposed development includes the construction of 54 new prefabricated dwellings as part of an expansion of the existing Clarence Lifestyle Village. The development also includes construction of associated services and internal road infrastructure to service the new dwellings. The existing dwelling and garage currently located on-site are proposed to be demolished.

The new dwellings are to be prefabricated off-site before being installed and are proposed to be installed with raised floor levels at a minimum within areas subject to potential flooding.

New drainage infrastructure including the construction of two stormwater detention basins within the north-eastern drainage course and a cut-off drain with check dams along the south-western boundary are also proposed.

An image of the proposed works plan by JSA is shown in Figure 3.

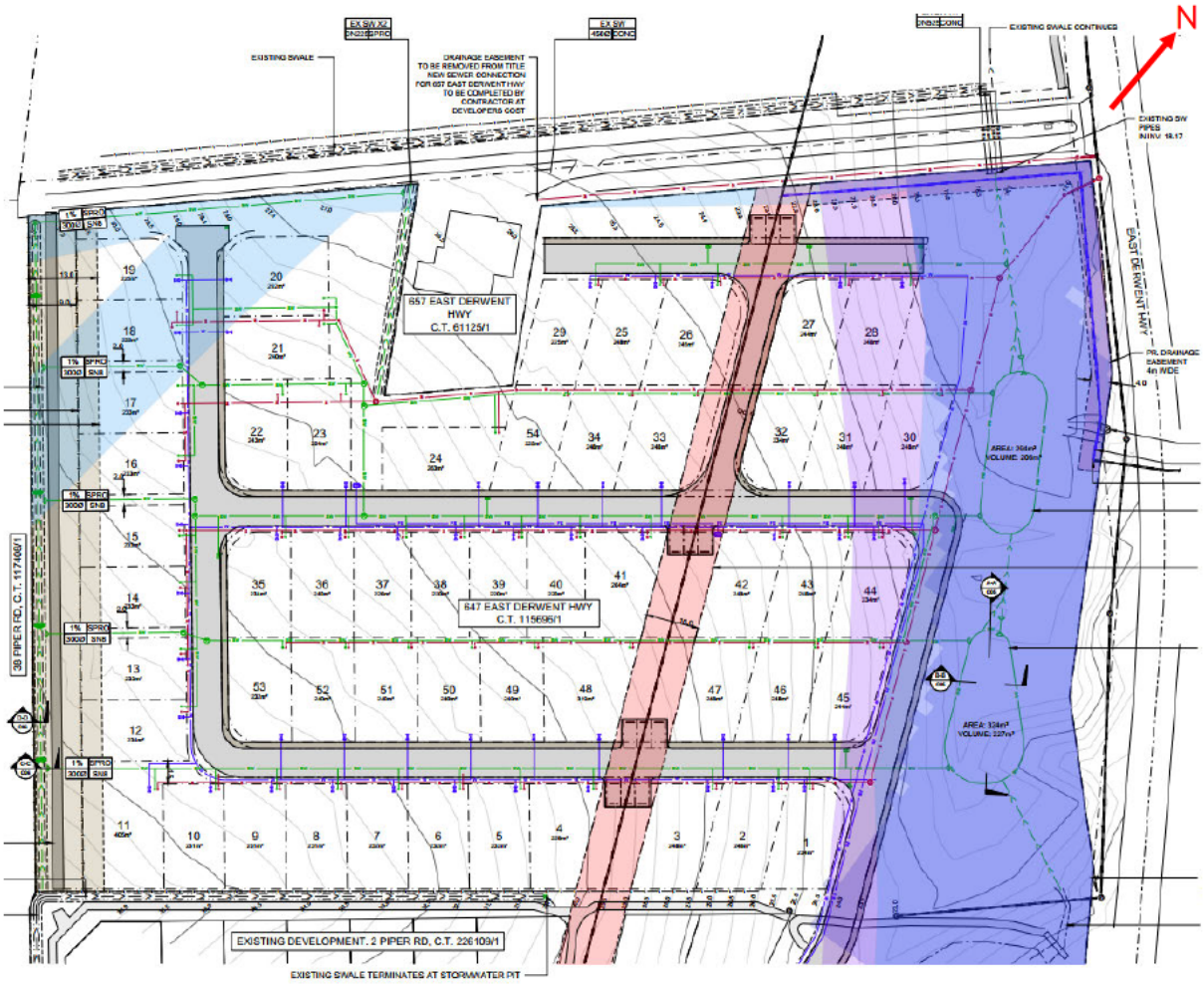


Figure 3 – Proposed Site Plan – JSA

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3. FLOOD RISK

3.1. Existing Flood Risk

Clarence City Council have undertaken flood modelling for the municipality for the 1% AEP (Annual Exceedance Probability) event, inclusive of climate change loading. The resulting flood mapping produced from this modelling is available through council's website and indicates that portions of the development site are potentially subject to flooding in such 1% AEP event. A screenshot of the flood mapping for the development area is shown in Figure 4 along with annotations of the observed typical maximum flood depths.

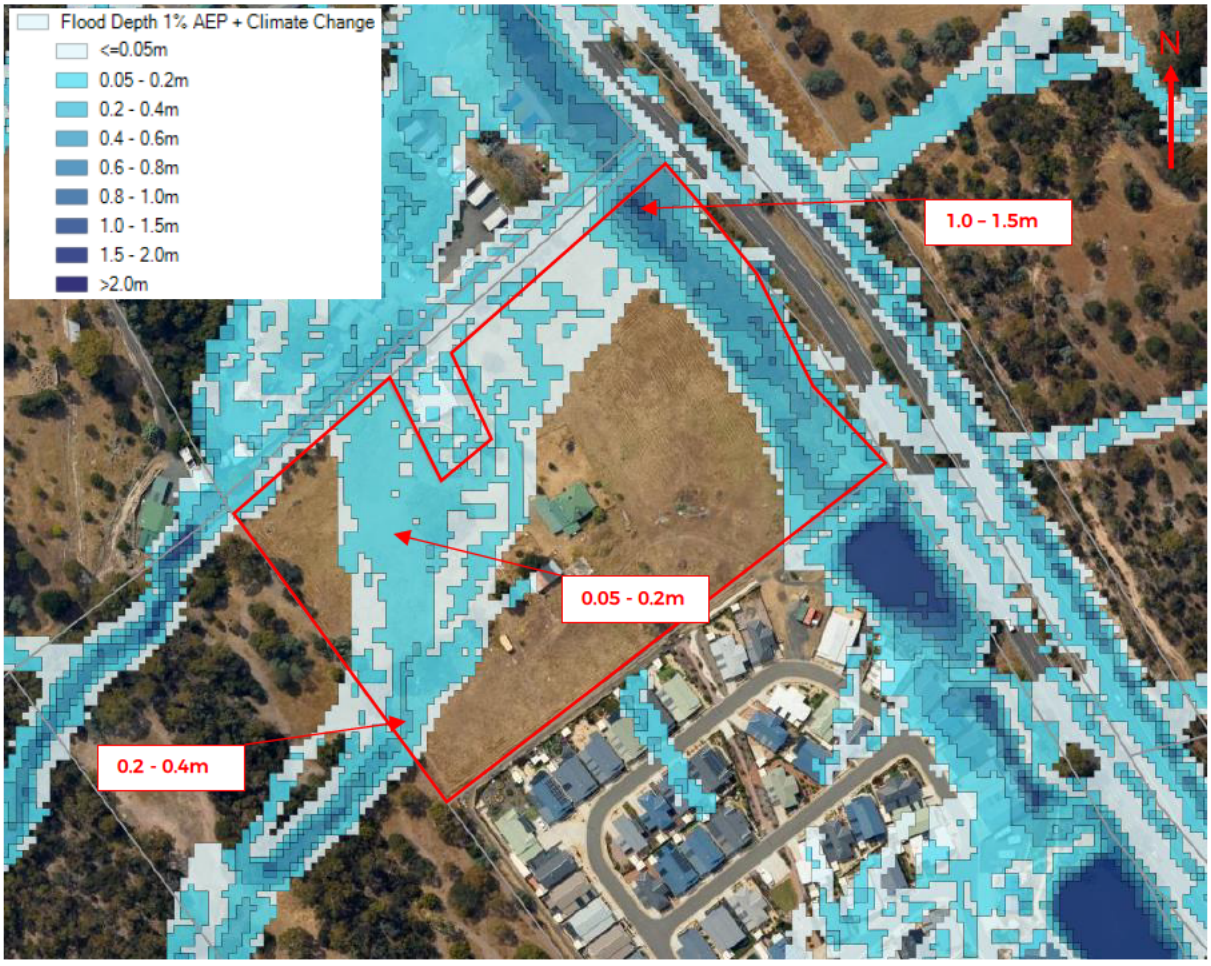


Figure 4 – Clarence City Council 1% AEP Flood Extents/Depths

The flooding is shown to occur in two primary locations including within the existing drainage course along the north-eastern boundary and from the south-west, through the existing minor depression/swale, with all flows heading in a northerly direction.

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Mapped flows within the north-eastern drainage course are shown to predominantly reach maximums in the range of 0.4-0.6m depth with a concentrated area of increased depth at the northern corner of the site reaching 1.0-1.5m depth as shown in Figure 4. These flows are shown to be largely contained within the existing drainage course and originate from the drain alongside the existing Clarence Lifestyle Village and upstream rural and East Derwent Highway catchment areas.

Mapped flows across the western side of the site originate from a largely rural/natural catchment area extending up near Piper Road as shown in Figure 5. The flows enter the site at the location of the existing minor depression/swale and are shown to spill across the site with predominantly shallow sheet flows of 0.05-0.2m depth, before collecting at the existing open drain running outside the northern boundary of the site alongside the existing driveways.



Figure 5 – Approximate South-Western Catchment

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3.2. Flood Hazard Vulnerability Classification

To determine the likely risk posed to both persons and structures due to flooding, a Flood Hazard Vulnerability Classification has been used in accordance with Australian Rainfall & Runoff (AR&R) 2019 Guidelines Book 6 Chapter 7. A summary of these classifications is shown in Figure 6, ranging from H1 to H6, and is based on flow depths and velocities.

Likely flood depths for the 1% AEP rainfall event (climate change inclusive), as previously shown in Figure 4, have been sourced from Council's flood mapping data. To determine likely velocities for these flows, Council's flood mapping has been overlaid onto freely available lidar data for the site to determine a representative cross section of flow at the locations shown in Figure 7, and subsequently a resulting velocity based on a Manning's Equation calculation. It is to be noted that the resulting velocities from these calculations are approximate only in the absence of detailed flood modelling data (or additional flood mapping data from Clarence City Council) and are used to demonstrate an indicative existing flood risk. Further discussions in this report on the impact of proposed works may necessitate further modelling and hazard assessment if residual risks are expected to be sufficiently high.

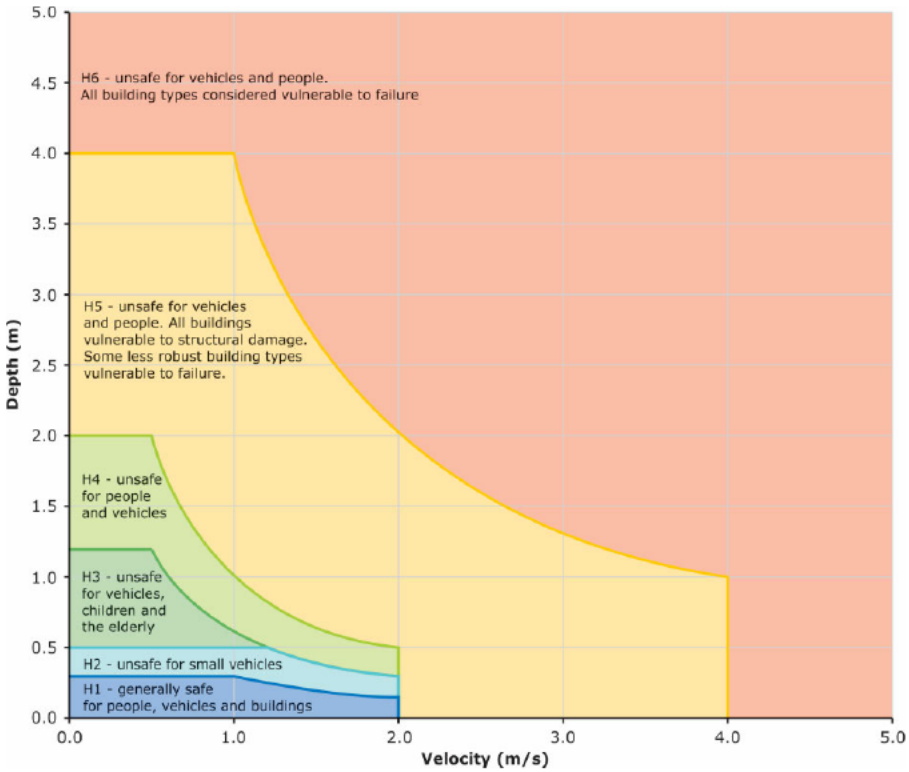


Figure 6 – *Combined Flood Hazard Curves (AR&R 2019 Figure 6.7.9)*

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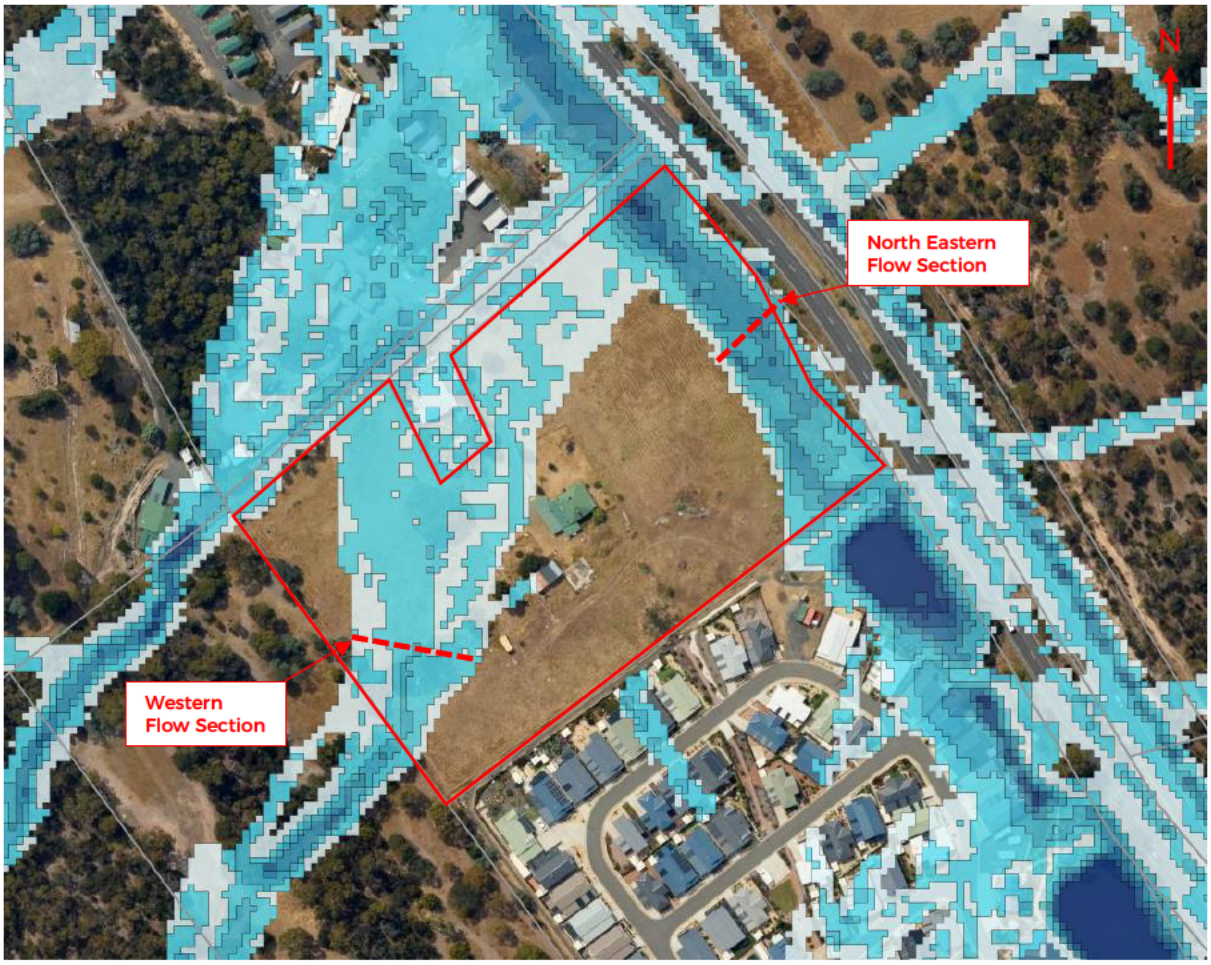


Figure 7 – Flood Cross Section Locations

Manning's Equation:

$$V = (1/n)\ R^{2/3}\ S^{1/2}$$

Where:

V= Velocity (m/s)
n = Manning's roughness coefficient
R = Hydraulic radius
S = Slope

Western Flows:

n = 0.035
R = 0.155
S = 0.07 (7%)

V = 1.69 m/s

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An approximate flow velocity of 1.69 m/s with a maximum depth up to 0.4m for the flows through the western portion of the site indicate a flood hazard classification of up to H2 – 'Unsafe for small vehicles' is likely.

North-Eastern Flows:

n = 0.040
R = 0.339
S = 0.022 (2.2%)

V = 1.80 m/s

An approximate flow velocity of 1.80 m/s with a maximum depth up to 0.8m for the flows through the north-eastern portion of the site indicate a flood hazard classification of up to H5 – 'Unsafe for vehicles and people. All buildings vulnerable to structural damage. Some less robust building types vulnerable to failure.' is likely. Further increased depths towards the northern corner of up to 1.5m also indicate a likely hazard classification of H5.

3.3. Development Effects & Building Works

The proposed development works are detailed on JSA's design drawings and both JSA and Flussig's hydraulic design reports which include provisions for new drainage infrastructure and alterations to the existing drainage courses within the site to manage stormwater flows.

Both of the above-mentioned reports detail the design intent for the minor and major stormwater systems to convey flows for the 5% and 1% AEP (climate change loading inclusive) rainfall events. A stormwater detention system has been detailed to limit flows to pre-development levels and consists of two new proposed detention basins to be situated within the existing north-eastern drainage course. Checks/calculations have not been undertaken on the design as part of this report and it is assumed that the design as described in both the JSA and Flussig reports is true and correct.

The proposed works plan has been overlaid onto Council's flood mapping to highlight which areas may be affected by flood waters and is shown in Figure 8.

All building works are proposed to remain clear of the mapped flood extents from the north-eastern drainage course. One minor section of the proposed internal road is shown to be impacted by the flood mapping near the connection to the existing Clarence Lifestyle Village site, although the indicated flood depth in this location is only ≤0.05m and so is expected to be of H1 flood classification only and not expected to pose a risk to use. The addition of the stormwater detention basins is also expected to provide some benefit in reducing flow velocities through the north-eastern drainage channel by effectively acting as check dams for through flows from the upstream catchment. This will assist in reducing downstream impacts such as scouring and overtopping of culverts from excessive flow velocities. The precise effect of this has not been assessed in this report and is an informed observation only that conditions are likely to improve from pre-development conditions in this respect.

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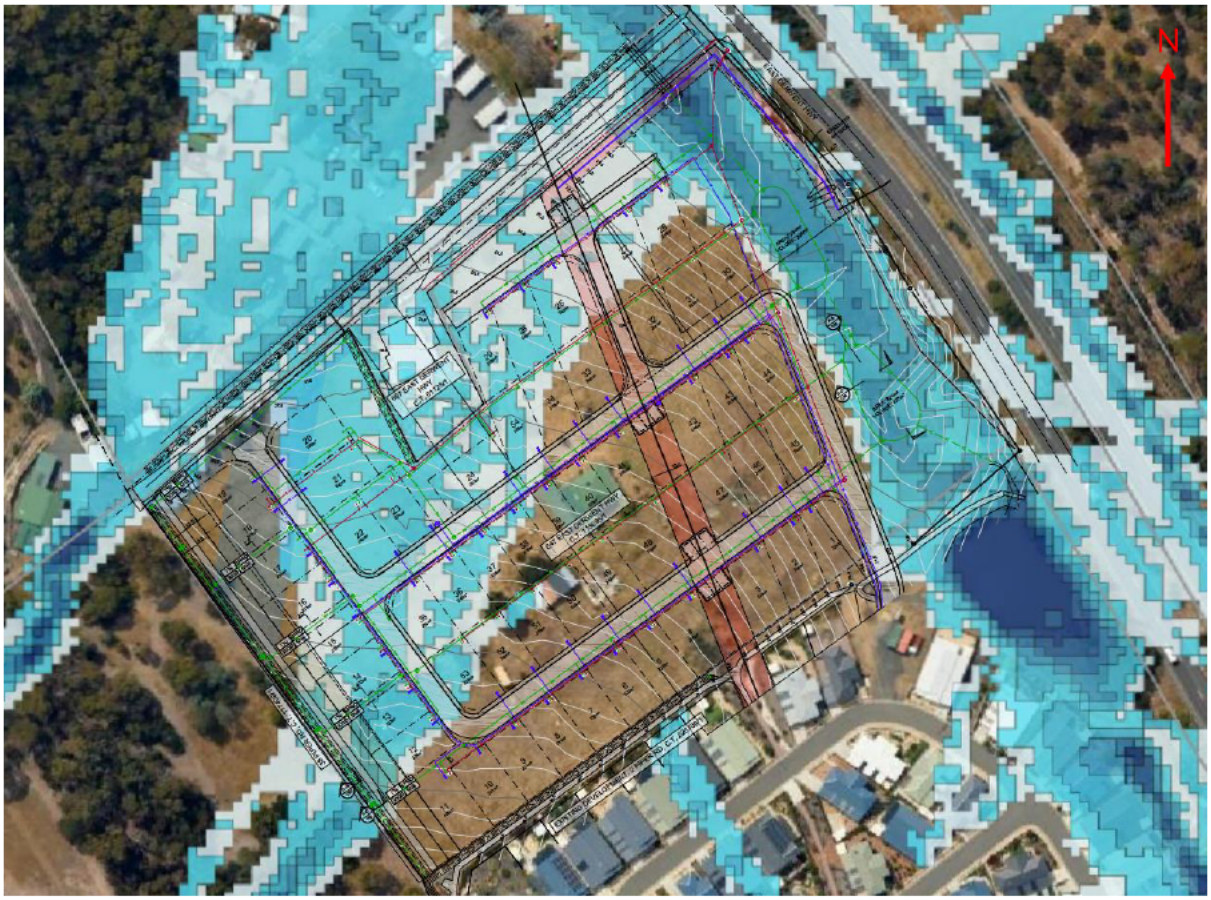


Figure 8 – JSA Site Plan Overlaid onto Clarence City Council Flood Mapping

To manage flood flows potentially entering the site from the south-west, a new cut-off drain is proposed to extend along the length of the south-western boundary. This new drain is proposed to feature check dams at regular intervals with individual stormwater headwalls to drain flows into the reticulated system at each check dam location. Each check dam is expected to slow the velocity of flows through the channel. Flows that are captured into the reticulated system are directed to the proposed detention basins, however the final discharge pipe located at the northern end of the new cut-off drain continues to discharge into the existing open drain adjacent to 657 East Derwent Highway. It is expected that the multiple headwall collection points will reduce the overall quantity of flows that ultimately reach the end of the new cut-off drain and that the discharges to the existing open drain and culvert adjacent to 657 East Derwent Highway will be reduced compared to pre-development levels. This is expected to assist in reducing overtopping of the existing drain along the northern driveway outside of the site which is shown to be at capacity and spill across the neighbouring holiday park as shown in Figure 4.

The addition of the new internal road network is also expected to assist in intercepting and directing flows towards the north-eastern drainage course in large rainfall events. This will further reduce the risk of any overland flows that do enter the site due to being in excess of the capacity of the new cut-off drain or from the existing Clarence Lifestyle Village, from continuing to flow downhill and into neighbouring properties.

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In the event that overtopping of the new cut-off drain does occur and that flows overtop into the site, the floor levels of the dwellings within the flood path are proposed to be raised above ground to provide additional safety. The existing flood mapping indicated maximum typical flood depths of up to 0.2m within the western flood path. Any overtopping flows are expected to be significantly less that those mapped with a large portion of the flows being directed underground through the new reticulated system. Minimum floor levels set at 200mm above surface level would be expected to remain clear of potential flood waters. Any additional floor height would be beneficial in providing additional safe freeboard allowance with a floor level of 300mm above surface level considered optimal, as this would provide 300mm freeboard to the top of the cut-off drain at a minimum.

3.4. Residual Risk

With the proposed building works located clear of the north-east portion of the mapped 1% AEP flood extents, it is expected that the residual risk from flooding to buildings and persons will be low. Flows within the drainage course itself are still expected to remain at higher levels of risk classification (Up to H4) due to depths within the channel and detention basins, however are not a usable space and will not impact on the proposed structures or intended site use.

The western portion of the site, as described in Section 3.2 of this report, was potentially subject to flood hazard classification of H2 – 'Unsafe for small vehicles.' This is predominantly due to overtopping of the existing minor depression/swale causing flood flows to sheet across the site. These flows are considered low risk to structures and persons, however have the potential to cause some shifting or inundation of small vehicles which would be best managed to be reduce potential financial damage to property.

The addition of the cut-off drain and multiple flow collection points as described previously are expected to more effectively capture, control and discharge these flows through the site to the controlled detention systems and site discharges elsewhere. With the cut-off drain located along the full length of the south-western boundary, any flows that are not immediately captured at the top of the system can be intercepted further down the boundary line. It is to be noted that the flow rate of flood waters from the south-west and the full capacity of the cut-off drain and the combined headwall inlets has not been assessed as part of this report, so it cannot be determined if the system will fully capture flood flows or if some minor overtopping will still occur. It is therefore recommended as a minimum additional control measure (unless design calculations are provided to prove the drain/culvert capacity against actual flows) that the drain be locally deepened or a low berm be constructed alongside the inside edge of the cut-off drain for the length of drain coinciding with mapped flood inflows. This will assist in full capture of the overland inflows and help prevent flows from directly passing over the drain when full, reducing further risk to the site. A minimum drain deepening or berm height of 300mm is recommended. It is noted however that the size of the proposed cut-off drain is at a minimum equal to or larger than the existing minor drainage depression/swale at the lower end of the site and so is expected to improve capture rates with the addition of five DN300 piped outlets. Any flows above the capacity of the reticulated stormwater network which continue to spill into the site in large rainfall events are expected to be low velocity after initially being intercepted by the cut-off drain. These flows can then be safely conveyed by the proposed internal road network to the site discharge locations as noted in the JSA report. With a reduction in overland flow volumes and velocity, it is expected that a maximum flood hazard of H1 – 'Generally safe for people, vehicles and buildings,' would be present for any flows that continue to enter the site. With the dwellings proposed to be constructed above ground, the previously recommended minimum floor level of 300mm above surface level will provide sufficient freeboard to enable a low risk from flood waters.

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3.5. Recommendations

With the proposed flood mitigation measures in place, the identified flood paths are likely to pose a low risk to persons and structures for the proposed development, however some measures are recommended to ensure that overland flows in large events do not cause a nuisance and that long-term effects are minimised.

- It is noted that it is already proposed to construct dwellings with a floor level above ground. It is recommended that an optimal minimum floor level of 300mm above the existing surface be adopted to ensure any remaining overland flows do not impact on habitable areas.
- It is recommended to locally deepen by 300mm or construct a 300mm high berm/wall on the inside edge of the proposed cut-off drain for the length of drain that coincides with the mapped flood path from the south-west to improve flow capture and reduce the risk of flows directly passing over the drain when already full.
- It is recommended that the final levels of the internal access road on the eastern side of the site (near where connecting into the adjacent existing Clarence Lifestyle Village site) be constructed above the levels at the mapped flood extents to ensure these continue to remain clear of potential inundation to enable safe egress from the site.

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4. FLOOD CODE ASSESSMENT

Tasmanian Planning Scheme
C12.0 Flood Prone Areas Hazard Code
C12.5 Use Standards

C12.5.2 Critical use, hazardous use or vulnerable use

Objective: That critical, hazardous and vulnerable uses, located within a flood-prone hazard area can achieve and maintain a tolerable risk from flood.	
Acceptable Solutions	Performance Criteria
A1 No Acceptable Solution	P1 A critical, hazardous, or vulnerable use within a flood-prone hazard area must achieve a tolerable level of risk from flood, having regard to: (a) the type form and duration of the use; and (b) a flood hazard report that demonstrates that: (i) any increase in the level of risk from flood does not warrant any specific hazard reduction or protection measures; or (ii) the use 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.
A4 No Acceptable Solution	P4 In addition to the requirements in clause C12.5.2 P1, a vulnerable use within a flood-prone hazard area, must be protected from flood, having regard to: (a) any protection measures, existing or proposed; (b) the ability and capability of people in a flood event who may live, work or visit the site, to:

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	(i) protect themselves; (ii) evacuate in an emergency; and (iii) understand and respond to instructions in the event of an emergency; (c) any emergency evacuation plan; (d) the level of risk for emergency personnel involved in evacuation and rescue tasks; (e) the advice contained in a flood hazard report; and (f) any advice from a State authority, regulated entity or a council.

Response

P1

As discussed in this report and responses to previous clauses, the design has demonstrated along with the recommendations in this report that the proposed development can maintain a tolerable risk from flood for the life of the development, noting that Council's flood data on which assessments have been based is inclusive of future climate change loading.

It is expected that the level of risk from flooding for the users of the site will decrease from current levels with the various measures of stormwater control implemented. The recommendation to position habitable floor levels 300mm above existing surface level will also ensure that risk to users is minimised in the event that site controls fail or larger storm events than those assessed are encountered.

Existing likely flood risks for the south-western flows were assessed to be up to hazard classification H2 – 'unsafe for small vehicles'. Hazard classification H3 specifically describes the point at which flows become unsafe for the elderly which relates to the use of the site as a retirement village. With existing flows not considered to pose a significant risk to the elderly (not exceeding H2), the likely further reduced risks due to the implementation of stormwater controls is considered to maintain a tolerable risk for vulnerable use.

P4

The proposed use of the site as an extension to the existing Clarence Lifestyle Village (retirement village) ensures that the use remains consistent for implementation of existing emergency procedures and training of staff to ensure the safety of residents in the event of flood. Existing procedures and evacuation plans are to be updated to include the additional site expansion.

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Should flooding be encountered, the site is situated such that safe uphill areas located clear of any mapped flooding can be reached from all parts of the site. Minimum floor levels in flood-prone mapped areas of 300mm above existing surface level will ensure residents who may not be able to self-evacuate can be protected from flooding until assisted. The proposed flood protection measures (e.g. cut-off drain) as discussed in this report will assist in reducing the risk of flooding and increasing the warning time for staff and residents to react to potential flooding and evacuate if required.

C12.6 Development Standards for Buildings and Works

C12.6.1 Buildings and works within a flood-prone hazard area

Objective: That: (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 Solutions	**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** A flood hazard report also demonstrates that the building and works: (a) do not cause or 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

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	flood event for the intended life of the use without requiring any flood protection measures

Response

P1.1

In conjunction with the discussions within this report, the proposed development maintains a tolerable risk from flood. The form of development is an extension to the existing Clarence Lifestyle Village located on the neighbouring property and intends to maintain the same form of use with construction of 54 residential dwellings and associated internal road access infrastructure and services infrastructure.

The site is potentially subject to two separate sources of flood waters, one within the north-eastern existing drainage channel and one from the south-west which sheet flows across the western portion of the site. The development intends to maintain the existing north-eastern drainage channel along with improvements in the form of two new stormwater detention basins which ensure stormwater runoff generated from the site is maintained at pre-development levels. The proposed building works are to be located clear of this portion of mapped flooding. A small portion of the entry access road is encroached by the outside extents of the flood mapping, however is indicated to be ≤0.05m in depth and is expected to maintain a low hazard classification of H1 – 'generally safe for people, vehicles and buildings,' which is considered a tolerable risk should no further risk reduction measures be undertaken here.

A new stormwater cut-off drain is proposed along the south-western boundary of the site to intercept flood water from the south-west and is an improvement to the existing informal minor depression/swale drain that runs through the site. The addition of multiple new headwall discharges along the length of this drain as well as check dams at regular intervals will improve safe passage of these flow by slowing, capturing and discharging flood water underground to the north-eastern drainage channel. This will reduce the occurrence of overland flows through the site due to flood waters and reduce risk. Proposed dwellings are to be constructed with raised floor levels to reduce any residual risk of overland flows, with recommendations made in this report to provide an optimal minimum floor level of 300mm above existing surface levels. Should this recommendation be followed and as discussed previously in this report, the residual risk is expected to be reduced to H1 – 'generally safe for people, vehicles and buildings,' in this portion of the site, which is considered a tolerable risk.

P1.2

As discussed further in this report, the proposed development is expected to improve the risk of flooding on downstream properties in addition to providing a lower risk to the site itself. Council's flood mapping indicates that flooding may occur in a 1% AEP event (climate change inclusive) across the site which also has impacts on downstream properties. Existing flows from the south-west are shown to impact the entire property of the neighbouring 657 East Derwent Highway residence as well as overflowing from the open drain located next to the northern driveways which spills into the holiday park. By intercepting these flows in a more controlled manner with the new cut-off drain, check dams and multiple headwall inlets, the flows can be largely redirected towards the north-eastern drainage course in a safer manner. The major overland drainage routes (internal roads) proposed within the development site will direct any remaining overland flows east also and have been designed for the 1% AEP storm event as detailed in JSA's report. A reduction

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in the flows reaching the existing neighbouring residence and northern driveway swales is expected and is expected to reduce the risk or severity of inundation to neighbouring downstream properties.

The proposed stormwater detention basins will ensure that any increase in runoff generated by the proposed development's increase in impervious areas is controlled and discharged at pre-development levels as detailed in the associated JSA and Flussig reports and will not cause additional nuisance to neighbouring properties.

As discussed in the response to P1.1 above, the proposed mitigation measures for control of the south-western overland flows as well as remaining clear of the existing north-eastern drainage channel ensure that the proposed development maintains a tolerable risk from flood for a 1% AEP event (climate change inclusive).

C12.7 Development Standards for Subdivision

C12.7.1 Subdivision within a flood-prone hazard area

Objective: That subdivision within a flood-prone hazard area does not create an opportunity for use or development that cannot achieve a tolerable risk from flood.	
Acceptable Solutions	**Performance Criteria**
A1 Each lot, or a lot proposed in a plan of subdivision, within a flood-prone hazard area, must: (a) be able to contain a building area, vehicle access, and services, that are wholly located outside a flood-prone hazard area; (b) be for the creation of separate lots for existing buildings; (c) be required for public use by the Crown, a council or a State authority; or (d) be required for the provision of Utilities.	**P1** Each lot, or a lot proposed in a plan of subdivision, within a flood-prone hazard area, must not create an opportunity for use or development that cannot achieve a tolerable risk from flood, having regard to: (a) any increase in risk from flood for adjacent land; (b) the level of risk to use or development arising from an increased reliance on public infrastructure; (c) the need to minimise future remediation works; (d) any loss or substantial compromise by flood of access to the lot, on or off site; (e) the need to locate building areas outside the flood-prone hazard area;

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	(f) any advice from a State authority, regulated entity or a council; and (g) the advice contained in a flood hazard report.

Response

P1

The rezoning of the land will allow for additional use and development types on the existing title. The proposed use/development being of expansion to the existing Clarence Lifestyle Village (retirement village) demonstrates a vulnerable use of the site. This proposed use, as outlined in this report and from supporting information and design by others, has shown that the site can achieve a tolerable risk to flood for a development that encroaches into the mapped flood-prone hazard area without the need to locate buildings entirely outside of the mapped flood-prone hazard areas.

Additional stormwater controls are proposed, with further recommendations made in this report that show that the site can be fully developed while maintaining adequate control and risk mitigation of regular stormwater and flood waters. The proposed development limits controlled site discharges to pre-development levels through the use of detention infrastructure to ensure the site does not negatively impact on downstream infrastructure or increase the reliance on public infrastructure to accommodate these flows.

As detailed in this report, the proposed works demonstrate that overland flows across the site can be controlled in a manner that lowers the risk to neighbouring properties by managing previously uncontrolled external flooding passing through the site. Access to the site is proposed to be provided through the adjacent Clarence Lifestyle Village and maintains an acceptable risk of use. Potential improvements to the severity of flooding across the northern driveway are expected and demonstrate that risks can be lowered here, however should any other alternative developments be proposed on the site in the future, further assessment and controls may be required to ensure safe access to the site if not provided through the adjacent retirement village.

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22-24 Paterson Street
Launceston, TAS 7250

P. 6388 9200

rarein.com.au

5. SUMMARY

The proposed development site has been identified by Clarence City Council mapping as being situated within a flood prone area for a 1% AEP event. The mapping indicates that the flows may enter the site from the south-west and within the existing north-eastern drainage course. The proposed development has been assessed using available council flood information, design reports by JSA and Flussig as well as additional flow analysis to determine approximate hazard vulnerability classifications in line with mapped flood depths. With structures proposed to remain clear of the north-eastern drainage channel and flooding occurring there, the remaining risk is expected to come from the south-western flood waters. New drainage infrastructure has been proposed to intercept and control these flows, with raised floor levels also proposed for new dwellings (recommendations of 300mm minimum above existing surface level made in this report). With these mitigation measures in place, the residual risk to persons, vehicles and buildings in considered low and at a tolerable level.

The development is not considered to worsen the effect of flooding or contribute to flooding on adjacent properties, with improvements expected.

The proposed development works are considered acceptable in regard to flood risk for the site.

Should you have any further queries please do not hesitate to contact us.

Yours faithfully,



Jack W. Saunders
Civil Engineer
B Eng (Civil)

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