Derwent River Foreshore Coastal Hazards and Risk Assessment - FINAL

Prepared for Brighton Council

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SGS Economics & Planning

Certified B Corporation

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OFFICES IN CANBERRA, HOBART, MELBOURNE, AND SYDNEY ON THE COUNTRY OF THE NGAMBRI/NGUNNAWAL/NGARIGO, MUWININA, WURUNDJERI, AND GADIGAL PEOPLES.

Front cover image Old Beach by Sam Shelly photographers 2019.

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Acronyms

AEP	Annual Exceedance Probability
CBA	Cost Benefit Analysis
DEM	Digital elevation model
IPCC	International Panel on Climate Change
LGA	Local Government Authority
LiDAR	Light detection and ranging
LISTmap	Land Information System Tasmania map
mAHD	Australian Height Datum mean
MHT	Mean high tide
MNHLUP	Mitigating Natural Hazards through Land Use Planning
RCP	Representative concentration pathways
SLR	Sea level rise
SLRPA	Sea Level Rise Planning Allowance
SSP	Shared Socio-economic Pathway
TCAP	Tasmanian Costal Adaptation Pathways
TSPA	Threatened Species Protection Act

Glossary

Annual exceedance probability (AEP)	The probability that a flood of a given (or larger) magnitude will occur within a period of one year.
Coastal erosion	Coastal erosion, sometimes referred to as shoreline retreat, occurs when a net loss of sediment or bedrock from the shoreline results in landward movement of the high-tide mark.
Coastal inundation	The temporary or permanent flooding of land by the sea due to storm surge, tides or sea-level rise.
Ecosystem services	Ecological processes or functions having monetary or non-monetary value to individuals or society at large. These are frequently classified as (1) supporting services such as productivity or biodiversity maintenance, (2) provisioning services such as food or fibre, (3) regulating services such as climate regulation or carbon sequestration and (4) cultural services such as tourism or spiritual and aesthetic appreciation.
Freeboard	The height difference between the 100-year flood level and the floor level of a building.
Radiative forcing	Radiative forcing is what happens when the amount of energy that enters the Earth's atmosphere is different to the amount of energy that leaves it.
Representative concentration pathways (RCP)	RCPs portray possible future greenhouse gas and aerosol emissions scenarios. The four RCPs range from very high (RCP8.5) through to very low (RCP2.6) future concentrations. The numerical values of the RCPs (2.6, 4.5, 6.0 and 8.5) refer to the concentrations in 2100.[1]
Scenario RCP8.5	Scenario RCP8.5 is the highest baseline future greenhouse gas and aerosol emissions scenario. It is generally referred to as the basis for the 'worst case' climate change scenarios based on current policies and practices.
Shared Socio-economic Pathway (SSP)	SSPs expand on RCPs to allow for a standardised comparison of society's choices and their resulting levels of climate

[1] CoastAdapt, (n.d), 'What are the RCPs?', accessed at: https://coastadapt.com.au/infographics/what-are-rcps

	change. Unlike RCPs, SSPs include socioeconomic narratives and trends to indicate a range of plausible futures. The SSPs are based on five narratives: 1.a world of sustainability-focused growth and equality (SSP1) 2. a “middle of the road” world where trends broadly follow their historical patterns (SSP2) 3. a fragmented world of “resurgent nationalism” (SSP3) 4. a world of ever-increasing inequality (SSP4); and 5. a world of rapid and unconstrained growth in economic output and energy use (SSP5).
Scenario SSP5-8.5	Scenario SSP5-8.5 is the highest baseline future greenhouse gas and aerosol emissions scenario and correlates to Scenario RCP8.5.

Source: IPCC, 2022

Executive summary

Climate change is expected to exacerbate coastal hazards in the Derwent River Foreshore, increasing the frequency and severity of storm events, flooding and erosion. Brighton Council identified three sites of most concern:

1. Sunrise Avenue (Site A),
2. Riverside Drive (Site B), and
3. Old Beach (Site C).

The aim of this project is to understand and plan for coastal hazards at these three sites along the Derwent River foreshore and in doing so, build the capacity of Brighton Council and the community to make key decisions. To build this capacity, this project is expected to provide information about the risks and adaptation options and improve community understanding about risk reduction. The project broadly reflects the Tasmanian Costal Adaptation Pathways (TCAP) process to provide an assessment of existing and projected coastal hazards, an assessment of risk and values, indicate adaptation pathways and conduct a Cost Benefit Analysis (CBA) of the pathways.

The Brighton Council Derwent River Foreshore Coastal Hazards Project has been funded, in part, by the Australian Government's, *Preparing Australian Communities – Local Stream Program*. This project responds to the issues of coastal inundation along the Derwent River Foreshore where it is reported that residential backyards regularly flood, rare saltmarsh communities experience habitat restriction, and government assets and infrastructure are impacted.

Coastal hazard management and land use planning

The Tasmanian Government initiated the *Mitigating Natural Hazards through Land Use Planning* (MNHLUP) project in 2011 to help mitigate risks from natural hazards. Through the MNHLUP, the State Government adopted a hazard treatment approach, where stakeholders collectively define the hazard, consider available evidence and identify options for mapping areas that might be exposed to hazards. Then further define the boundaries of hazard bands, and develop planning, building, and emergency management outcomes that apply within each hazard band.

In 2012, the Tasmanian Government implemented Sea Level Rise Planning Allowances (SLRPAs) across the state so that sea level rise (SLR) could be considered in planning decisions, and to reduce uncertainty around sea level rise management in coastal areas. In 2016, the State Government commissioned coastal hazard modelling. In response to this modelling, the Tasmanian Government identified and implemented hazard bands for erosion and inundation. The bands are based on hazard planning matrices[2], which describe hazard exposure, control intent (whether planning or building

[2] Tasmanian Government Department of Premier and Cabinet 2016, *Coastal Hazards in Tasmania – Summary Report of Coastal Hazards Technical Report*, https://www.dpac.tas.gov.au/__data/assets/pdf_file/0027/63855/Coastal_Hazards_report_Version_7_20161201_-_Summary_report.pdf

controls are necessary) and strategic planning considerations for each hazard band. The *C10.0 Coastal Erosion Hazard Code* and *C11.0 Coastal Inundation Hazard Code* of the Brighton Planning Scheme outline the purpose and application of the coastal hazard bands, as well as use and development standards.

This report utilises the SES 2016 coastal hazard modelling. New coincidental flood modelling for the Derwent River has come to light during the project which may influence the risk assessment. A request for this flooding information has been made and is expected to be resolved by report finalisation end of year.

Values at risk from erosion and inundation

The three study sites encompass public and private infrastructure, Aboriginal heritage items as well as natural assets. Understanding these values is critical to determine the nature and magnitude of risks, and to inform appropriate adaptation pathways in line with protecting what the community values.

Coastal erosion

Across the three sites, modelling indicates that there are no properties currently at risk of coastal erosion. By 2050, 22 residential properties may be at medium risk of land erosion. These properties have a combined building value of $6.6 million, with most (18) of these properties being in Site B – Riverside Drive. By 2100, 51 residential properties across the three sites may be at risk of erosion with a combined capital value of $23.2 million (low risk hazard band). 30 of these properties are within Site C – Old Beach.

TABLE 1: SUMMARY OF RESIDENTIAL PROPERTIES POTENTIALLY AT RISK – COASTAL EROSION[3]

	High Risk Hazard Band		Medium Risk Hazard Band		Low Risk Hazard Band	
	Capital Value ($)	Count	Capital Value ($)	Count	Capital Value ($)	Count
Site A	0	0	0	0	0	0
Site B	0	0	6,607,500	18	7,290,000	21
Site C	0	0	2,180,000	4	15,907,500	30
Total	**0**	**0**	**8,787,500**	**22**	**23,197,500**	**51**

Source: SGS Economics and Planning, 2023

[3] Value is the adjusted capital value of a property after deducting land value, which considers for improvements to the property over time. SGS has only considered the impact of coastal hazards on properties and have excluded where only land parcels or additional infrastructure (greenhouses/sheds) are at risk.

Additional assets at risk across the three sites are:

- Site A: The erosion risk mainly affects the foreshore area. Seven additional residential plots of land (not buildings) are at risk of erosion.
- Site B: coastal erosion is likely to be relatively mild. No residential properties are currently at risk. The boat ramp and some public lands zoned for utilities and open space, are at risk of present-day and future coastal erosion. A small level of risk of erosion has been indicated for the railway track and playground area.
- Site C: By 2050, projected erosion could lead to a recession of up to 110 meters inland. A boat ramp, a minor section of a vehicle track, and segments of a hiking trail are likely to be affected. Open space, especially the foreshore adjacent to the hiking trail, is also expected to be at risk.
- Across all three sites, 18 identified Aboriginal Heritage items are at risk of erosion. 12 of these are in Site C, while the remaining six are in Site B.

Inundation

The modelling indicates that there is no immediate threat of inundation to properties across the three sites. However, the risk of inundation intensifies significantly, as areas become susceptible to a 1% storm event by 2050, and/or face the prospect of a 0.8m sea level rise by 2100. A total of 22 residential properties, valued at approximately $9.3 million, will be susceptible to these hazards. Notably, residential homes situated in the south of Site C are particularly susceptible to inundation. As the risk progresses, categorised within the low-risk hazard band, the number of properties at risk is anticipated to quadruple in impact. This escalation will result in $38.2 million worth of properties, or a total of 89 homes at risk of inundation caused by storm events in 2100.

TABLE 2: SUMMARY OF RESIDENTIAL PROPERTIES POTENTIALLY AT RISK – INUNDATION[4]

	High Risk Hazard Band		Medium Risk Hazard Band		Low Risk Hazard Band	
	Capital Value ($)	Count	Capital Value ($)	Count	Capital Value ($)	Count
Site A	0	0	0	0	0	0
Site B	0	0	900,000	3	2,540,000	8
Site C	0	0	8,400,000	19	35,680,800	81
Total	**0**	**0**	**9,300,000**	**22**	**38,220,800**	**89**

Source: SGS Economics and Planning, 2023

[4] Value is the adjusted capital value of a property after deducting land value, which considers for improvements to the property over time. SGS has only considered the impact of coastal hazards on properties and have excluded where only land parcels or additional infrastructure (greenhouses/sheds) are at risk.

Across all the sites, other assets at risk of inundation are:

- Site A: Modelling indicates present risk to other assets is minimal. By 2050, a proportion of the marshland could become inundated. This risk would be limited to the area below the railway track. By 2100, inundation risk will increase and affect some areas beyond the railway track boundary, primarily open space and railway tracks with limited existing uses.
- Site B: At present, the anticipated inundation risk to public infrastructure is minimal. The level of risk is anticipated to rise in the medium term. Assets at risk in the medium term include the disused boat ramp, playground, open space and roads (1% AEP in 2050). In the long term (1% AEP in 2100), there is an increased risk to additional roads and sections of the hiking track.
- Site C: In the area south of Site C, the risk of inundation is significantly higher and could substantially impact the community in the medium to long term. Open space and parts of the hiking trail are at risk in the present day. As the risk increases, more of these areas could become inundated, along with other assets, including several roads and the boat ramp.
- Across all three sites, 25 identified Aboriginal Heritage items are at risk of inundation. 21 of these are in Site C, while the remaining four are in Site B.

This assessment will inform stakeholder engagement across the three sites to determine acceptable risk, the value the community places on those assets at risk and how the community may choose to respond (informing the development of adaptation pathways).

Stormwater

There are no stormwater hazards present in Site A

The majority of Site B is vulnerable to stormwater drainage hazards. Several hundred houses and other buildings are at a very low risk from stormwater. The area of stormwater hazard overlaps with areas assessed with natural values ranging from lowest to high priority along the coastline. Notably there is a small pocket of open space that is of moderate-to-high priority. There are six Aboriginal Heritage items that are at very low risk of stormwater damage.

A significant area of land in Site C is vulnerable to stormwater hazards. For Site C, several hundred houses and buildings are at very low risk of stormwater. About 11 Aboriginal Heritage items are at a very low risk from Stormwater hazards. The area of stormwater hazard overlaps with areas assessed with natural values ranging from lowest to moderate priority along the coastline. There are 11 Aboriginal Heritage items that are at very low risk of stormwater damage.

1. Introduction

1.1 Purpose of this report

Climate change is expected to exacerbate coastal hazards within the Derwent River Foreshore. This includes increases in the frequency and severity of storm events, rainfall flooding and sea level rise. Using the LIST-map coastal hazard layer, Brighton Council has identified three sites where exposure and vulnerability to coastal hazards is most acute: Sunrise Avenue (Site A), Riverside Drive (Site B), and Old Beach (Site C).

The aim of this project is to understand and plan for coastal hazards at these three sites along the Derwent River foreshore and in doing so, build the capacity of Brighton Council and the community to make key decisions. To build this capacity, this project is expected to provide information about the risks and adaptation options and improve community understanding about risk reduction. The project broadly reflects the Tasmanian Costal Adaptation Pathways (TCAP) process to provide an assessment of existing and projected coastal hazards, an assessment of risk and values, indicate adaptation pathways and conduct a Cost Benefit Analysis (CBA) of the pathways.

The Brighton Council Derwent River Foreshore Coastal Hazards Project has been funded, in part, by the Australian Government's, *Preparing Australian Local Communities Program*. This project responds to the issues of coastal inundation along the Derwent River Foreshore where residential backyards regularly flood, rare saltmarsh communities experience habitat restriction, and government assets and infrastructure are impacted.

To build Brighton Council's capacity to respond and adapt to existing and projected coastal hazards, this report provides:

- Hazard mapping and assessments of each of the three sites to generate consistent and clear maps of coastal hazards at present and projected changes to 2050, 2075 and 2100[5].
- Assessment of Values at Risk, and the cost of doing nothing to manage the risk. This considers the private, public, and natural land, assets, infrastructure, and services that are, or will be, at risk in the three sites if nothing is done to manage the risk[6].

This report represents Stage 1 of the project, the findings of which will feed into Stage 2 (community engagement) and Stage 3 (adaptation planning) to provide a better understanding of the issues and possible responses.

[5] Spatial layers have been produced by SGS that map out the study areas based on pdf illustrations. As such, it should be noted that there may be a small margin of difference.

[6] The impact on Crown/State owned land has been considered as this may be managed by Brighton Council.

1.2 Project approach

This project has three stages. This report is part of Stage 1 – Coast hazards and risk assessment. The outcomes of this stage, namely identifying risks and assets at risk will inform community and stakeholder engagement. The engagement will subsequently inform the development of adaptation pathways. The cost benefit analysis will assess the costs and benefits of different options of how the community chooses to respond and adapt to identified risks (see The asset risk assessment considers the public assets, infrastructure, essential services and other values that are or will be at risk if nothing is done. This assessment utilised Council's rates database, asset and infrastructure database, data on natural and recreation assets and values. SGS estimated the value of infrastructure from *Rawlinson (2022): Australian Construction Handbook* and escalated figures to represent 2023 costs and additional expenses associated with regional locations.

Figure 1).

Within Stage 1, the hazard mapping and risk assessment has utilised LIST, LiDAR data and related GIS layers to indicate sea level rise impacts and erosion impacts across the three sites. Despite updated modelling by the IPCC, the LISTmap projections have been deemed sufficient. The current coastal hazard mapping has been verified using Climatics modelling which mostly aligns with the current coastal hazard mapping available.

The asset risk assessment considers the public assets, infrastructure, essential services and other values that are or will be at risk if nothing is done. This assessment utilised Council's rates database, asset and infrastructure database, data on natural and recreation assets and values. SGS estimated the value of infrastructure from *Rawlinson (2022): Australian Construction Handbook* and escalated figures to represent 2023 costs and additional expenses associated with regional locations.

FIGURE 1 PROJECT METHOD

1.3 Study areas

Brighton Council has identified the following three key sites where assets and residential properties are most affected using LIST-map coastal hazard layers.

Site A: Sunrise Avenue

Site A includes the foreshore/marshlands area around Sunrise Avenue north of Bridgewater Bridge. The area is low-lying in nature with numerous foreshore properties. Brighton Council maintains the road of Sunrise Avenue. The Derwent Valley Railway line runs along the foreshore area.

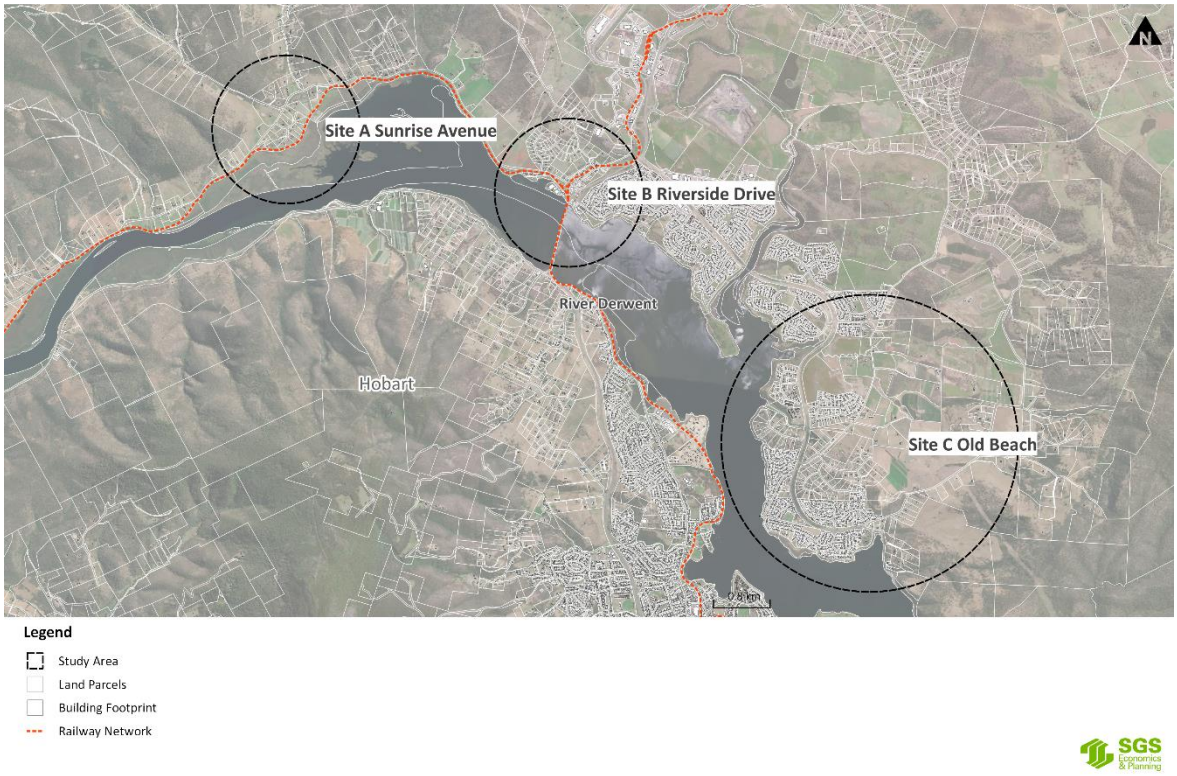
Site B: Riverside Drive

Site B includes the foreshore area around Riverside Drive, a road maintained by Brighton Council. The site is subject to frequent inundation of the road area and some foreshore properties. The site is located immediately adjacent to Bridgewater Bridge. An upgrade of the Bridge is underway. This Project ***does not*** include an assessment of the land and infrastructure associated with the upgrade of the Bridgewater Bridge – climate change impact assessments are a separate piece of work being carried out by Brighton Council (see Appendix A – Bridgewater Bridge for a summary of works and potential impacts).

Site C: Old Beach

Site C includes the foreshore area between the north end of Morrisby Road, Old Beach and the southern boundary of the Brighton municipality (see Figure 2). It also includes the Jetty and the end of Jetty Road and East Derwent Highway, which is a primary route of entry/exit to the municipality. The site is subject to frequent inundation of the walking paths, the foreshore (Crown Land), and some private properties. Brighton Council maintains the walking track and has a licence to conduct maintenance works in an approximately one metre area surrounding the walking track.

FIGURE 2: STUDY SITES



Source: SGS Economics and Planning, 2023

2. Coastal Hazard Planning in Tasmania

2.1 Overview

The Tasmanian Government initiated the Mitigating Natural Hazards through Land Use Planning (MNHLUP) project in 2011 to help managing risks from natural hazards. Through the MNHLUP, the State Government intends to adopt a hazard treatment approach, where stakeholders:

- Collectively define the hazard
- Consider available evidence and identify options for mapping areas that might be exposed to hazards
- Define the boundaries of hazard bands; and
- Develop planning, building, and emergency management outcomes that apply within each hazard band.

In 2012, the Tasmanian Government implemented Sea Level Rise Planning Allowances (SLRPAs) across the state so that sea level rises (SLR) are considered in planning decisions, and to reduce uncertainty around sea level rise management in coastal areas. The State Government then commissioned CSIRO in 2016 to model hazards in coastal council areas in line with Scenario RCP8.5 - the highest baseline future greenhouse gas and aerosol emissions scenario – set out in the International Panel on Climate Change (IPCC)'s Fifth Assessment Report (AR5).

In response to this modelling, the Tasmanian Government's hazard planning matrices[7] for both coastal erosion and coastal inundation were created that describe hazard exposure, control intent (whether planning or building controls are necessary) and strategic planning considerations for each hazard band.

> Hazard bands indicate the risk posed in specific locations and determine what planning and building controls are needed. They do not indicate that land *will* be inundated or eroded, only that the land is *susceptible*.[8]

This report utilises the 2016 coastal hazard modelling. New coincidental flood modelling for the Derwent River has come to light during the project which may influence the risk assessment. A request for this flooding information has been made and is expected to be resolved by report finalisation end of year.

[7] Tasmanian Government Department of Premier and Cabinet 2016, *Coastal Hazards in Tasmania – Summary Report of Coastal Hazards Technical Report*, https://www.dpac.tas.gov.au/__data/assets/pdf_file/0027/63855/Coastal_Hazards_report_Version_7_20161201_-_Summary_report.pdf

[8] Tasmanian Government Department of Justice (2021), 'State planning provisions – coastal hazards'.

2.2 Coastal Erosion Hazards

The Tasmanian Government's 2016 *Coastal Hazards Technical Report*[9] defines coastal erosion as:

> 'the wearing away of coastal land by water, wind, general weather conditions or human intervention'.

Coastal erosion may take the form of:

- hazardous erosion (short-term erosion of sandy or soft shorelines),
- coastal recession (long-term erosion of sandy or soft shorelines) and
- landslides (downslope movement of land usually caused by storms or waves removing material at the foot of the landslide).

Areas along Tasmania's coastline have been classified into coastal erosion hazard bands using coastal geomorphology and sea level rise data. The bands describe susceptibility to coastal erosion and shoreline recession when considering current and anticipated conditions by 2100.

The coastal erosion bands are:

- Acceptable – area is unaffected by coastal recession until after 2100; not subject to controls,
- Low – areas vulnerable to coastal recession by 2100 or is protected by coastal defences,
- Medium – areas vulnerable to coastal recession by 2050,
- High – areas is currently vulnerable to coastal recession; typically on sand dunes.

In addition, areas without erosion risk are identified as 'acceptable', and areas with unknown hazard exposure due to limited data on geomorphological conditions, are identified as 'coastal erosion investigation areas'.

The Coastal Erosion Hazard Code applies to land that is either in a low, medium, high or unknown hazard band. The code requires that planning application submissions include a Coastal Erosion Hazard Report for properties in these bands. If a site within a Coastal Erosion Investigation Area is assessed and determined to be in a low, medium or high hazard band area, a Coastal Erosion Investigation Area Report will be required in addition to a Coastal Erosion Hazard Report when submitting a planning application.

2.3 Coastal Inundation Hazards

Coastal inundation occurs when low-lying coastal land is flooded by the sea and can be either temporary or permanent. Temporary coastal inundation is caused by floods, tides, storm surge and

[9] Tasmanian Government Department of Premier and Cabinet 2016, *Coastal Hazards Technical Report*, https://www.dpac.tas.gov.au/__data/assets/pdf_file/0025/63853/Coastal_Hazards_Report_version_7_-_20161201.pdf

storm events, which is usually measured by annual exceedance probability (AEP). Whereas permanent coastal inundation is a result of sea level rise (SLR) and measured from the mean high tide (MHT) line.[10]

A range of data was used to assess coastal inundation in Tasmania, including sea level rise planning allowances (SLRPAs), storm tide event information, the median high tide line, 10m contour line and the LiDAR digital elevation model (DEM). Areas along the coastline were also classified into coastal inundation hazard bands according to their vulnerability to coastal inundation when considering current and anticipated conditions by 2100:

- Acceptable – area is unaffected by coastal inundation until after 2100
- Low – area is vulnerable to a 1% AEP storm event in 2100; medium-term flooding issue
- Medium – area is vulnerable to a 1% AEP storm event in 2050; will be impacted by a 0.8m SLR by 2100
- High – area will be within 0.2m SLR from MHT line by 2050; currently impacted by the Highest Astronomical Tide; or
- Coastal Inundation Investigation Areas – area is not covered by LiDAR and is below the 10m contour line and within the coastal zone; yet to be classified due to incomplete or unavailable elevation data.

The Coastal Inundation Hazard Code applies to land that is either in a low, medium, or high hazard band, and requires a Coastal Inundation Hazard Report for planning application submissions. If a site within a Coastal Inundation Investigation Area is assessed and determined to be in a low, medium, or high hazard band area, results from the assessment will be required to accompany the Coastal Inundation Hazard Report when submitting a planning application.

2.4 Brighton Planning Scheme

Hazard Codes

The *C10.0 Coastal Erosion Hazard Code* and *C11.0 Coastal Inundation Hazard Code* of the Brighton Planning Scheme outline the purpose and application of the coastal hazard bands, as well as use and development standards.

Table 3 shows the coastal inundation hazard bands and the projected water level heights of different localities in the Brighton municipality. Hazard bands and areas are then visualised in the Land Information System Tasmania map (LISTmap).

These areas are subject to the planning requirements set out for each band by State Planning Provisions. The Brighton Planning Scheme does not currently contain any additional local provisions relevant to coastal hazards.

[10] Ibid.

Hazard bands indicate the risk posed in particular locations and determine what planning and building controls are needed. They do not indicate that land *will* be inundated or eroded, only that the land is *susceptible*.[11]

TABLE 3: BRI-C11.1 COASTAL INUNDATION HAZARD BANDS AND PROJECTED SEA HEIGHTS (AHD LEVELS)

Locality	High Hazard Band (mAHD)	Medium Hazard Band (mAHD)	Low Hazard Band (mAHD)	Defined Flood Level (mAHD)
	Sea Level Rise 2050	1% annual exceedance probability 2050 with freeboard	1% annual exceedance probability 2100 (design flood level) with freeboard	1% annual exceedance probability 2100
Bridgewater (Site B)	0.9	2.0	2.6	2.3
Dromedary (Site A)	0.9	1.9	2.6	2.3
Gagebrook (Site C)	0.9	2.0	2.6	2.3
Old Beach (Site C)	0.9	2.0	2.6	2.3
All other locations	0.9	2.0	2.6	2.3

Source: Brighton Planning Scheme, Tasmanian Government n.d.

Notes: Freeboard is the height difference between the 100-year flood level and the floor level of a building.

[11] Tasmanian Government Department of Justice (2021), 'State planning provisions – coastal hazards'.

2.5 Local Strategies and Plans

Analysis of Brighton Council's strategies and plans indicates how the Council is responding to current, and future, coastal hazards. In Table 4, the following documents are summarised:

- Brighton Climate Change Resilience Strategy 2017
- Open Space Strategy 2012
- Bridgewater Parkland 2016-2026
- Weed Management Strategy 2021-2026
- Greening Brighton Strategy 2016-2021

TABLE 4: SUMMARY OF COUNCIL PLANS AND STRATEGIES

Plans and Strategies	Summary
Brighton Climate Change Resilience Strategy 2019	The Climate Change and Resilience Strategy is Council's framework to help mitigate and plan for climate change, with directions to achieve greater sustainability and resilience. In this strategy, Council recognises the need to manage climate related risks and prepare the community for climate change. As part of this, Council is helping to develop the Regional Coastal Hazards Strategy, which will be relevant to the study areas in this project. Council's objectives that are relevant to coastal hazards are to: 4. improve Council's understanding of climate change risks and opportunities, and 5. improve the resilience of Council infrastructure. The strategy identifies a key action to achieve these objectives, which is to *ensure future asset maintenance and replacement programs consider climate change, including coastal hazards and inundation modelling*. This project gives effect to the strategy in helping Council to understand the risk impacts of the study area.
Open Space Strategy 2012	The Open Space Strategy intends to guide Council with the planning, development and management of open space in the LGA. Open space (including coastal fore dunes) has been identified as a means to mitigate climate change adaptation and mitigation through its role as a foreshore buffer to rising sea levels and ability to absorb impacts of storm surge. This strategy lists opportunities to improve gaps in the provision of local parks, which fall outside of the study areas of this project and are unlikely to be impacted by coastal recession and coastal inundation.

Bridgewater Parkland 2016-2026	This masterplan of Bridgewater Parkland provides an idea of what the parkland could look like, to improve its current usage. It includes a section of study area Site B, which is proposed to be an extension of a foreshore trail upon development of the land. The area is likely to be affected by coastal erosion and inundation in the future.
Weed Management Strategy 2021-2026	The Weed Management Strategy guides priority weed management and investment in Brighton Council. Sites A and B are part of the foreshore-walking trail weed eradication zone, and weeds will need to be removed for native vegetation to help combat rising sea levels.
Greening Brighton Strategy 2016-2021	The Greening Brighton Strategy sets a framework for Council to increase the number of trees across urban areas of the LGA, which will improve amenity and help tackle climate change. The strategy identifies high, medium, and low priority streets to be planted with trees in Bridgewater, Gagebrook and Herdsman's Cove. As these priority areas do not fall into the costal erosion or costal inundation hazard bands, they are unlikely to be impacted by coastal recession and coastal inundation.
Natural Resource Management Strategy 2023	The Natural Resource Management (NRM) Strategy provides strategic direction to enable Brighton Council and other stakeholders to work collaboratively to improve NRM. It outlines directions for climate, natural resources, cultural landscapes, water, biodiversity, people and context for delivering NRM. Relevant to this study is incorporating NRM into managing risks and planning adaptation pathways.

Source: SGS Economics and Planning 2022

The development of adaptation pathways (Stage 3 of this project) will take into consideration Council's existing policies and strategies.

2.6 Natural hazard and climate projections used in this report

Principles

The natural hazard data on present day and projected future risks that informed the coastal hazard bands (inundation and erosion) were developed some years ago (between 2014 and 2016 indicatively). The projections are based on the Fifth Assessment Report from 2014. While unavailable, it should be noted that the climate modelling under the hazard layers is due to be updated as per the Tasmanian Climate Change Action Plan Tasmania's Draft Climate Change Action Plan 2023-25.

Since, new climate change projections have been published by the ICCP as part the Sixth Assessment Report from 2022. In general terms, this report confirms the earlier projections and adds further detail. It does appear that the rate of climate change assessed in the latest publication is higher than the earlier version.

In consultation with the Department of Premier and Cabinet, it was suggested that while the rate of sea level rise is faster, the implications in terms of the accuracy and applicability of the existing hazard bands is small. Similarly, the information for decision makers climate modelling undertaken by Climate Futures, University of Tasmania for local government in 2019, outlines sea level rise figures consistent with other comments on accuracy and applicability of hazard bands.

Further, in 2022, State Emergency Services embarked on a project to undertake flood modelling for all main rivers in Tasmania, including the Derwent River. This work is currently underway, and the full results are not yet available.

To gain a better understanding of the accuracy of the coastal risk data, SGS therefore decided to use an alternate source of information: Climatics, which is a comprehensive database of historical to present day severe weather events. Climatics is a product from the Early Warning Network, and its data can be used to identify changes in the intensity and severity of weather events in specific locations.

A verification process was applied to understand if the present-day risks (i.e., likelihood of inundation) as recorded by Climatics align with the hazard bands. Please note that the Climatics data only refer to present-day risk, and therefore the verification process is limited to confirming whether locations are within the 'high hazard band' or not. The process enables to identify for the locations whether they are correctly identified as being in or outside the high hazard band.

Where the verification process identified discrepancies, this is incorporated into the report. Overall, the differences were small: areas identified as being in the high hazard band were confirmed by the data, and some areas identified as being in the medium hazard band were deemed to at risk today and should therefore be in the high hazard band.

While the results largely confirm the hazard bands are applicable and suitable to the current situation, it also shows that coastal risks are worsening. It should be noted that the hazard bands as used by the planning system, when they refer to 'present-day' it refers to the baseline year of 2010. It is therefore logical that now, in 2023, the high hazard band starts to shift as it includes 13 more years of climate change.

In conclusion, the hazard bands as used in the planning system remain largely accurate. In some areas, risk levels have increased since the base-year of the hazard bands, which is 2010.

3. Site A – Sunrise Avenue

3.1 Site overview

Site A is located in Dromedary, approximately 14 kilometres west of the suburb of Brighton. The following features as described are shown in Figure 3 overleaf. The site contains land zoned Rural Living. There are numerous dwellings, some situated in the low-lying land abutting the foreshore marshlands (see Figure 3). There are no commercial businesses located in Site A.

There is one Aboriginal Heritage item on Site A, inland from the Derwent River (see Figure 3).[12]

The site includes a substantial foreshore area around Sunrise Avenue which consists of marshlands, much of the area is classified threatened native vegetation and is a designated environmental management zone. Two waterways flow into the site from the north, Dean Brook and Millvale Creek. Both waterways, the marshlands and the Derwent River foreshore, are covered by a waterway and coastal protection area overlay. Figure 4 shows the coastal vegetation while Natural values refer to the variety of life-forms, including plants, animals, and micro-organisms, and the ecosystems they belong to, including land forms, soils, and water. One of the crucial natural values in Site A are the wetlands to the south of the rail line, which, the Derwent Estuary Natural Values dataset (see Figure 5) lists the majority of the wetlands as a high priority site, the highest importance rating. Similarly, the wetlands, are deemed to have a Very High integrated conservation value, as determined by the Conservation of Freshwater Ecosystem Values (CFEV). This is the highest classification which expresses the relative importance of an ecosystem.

Figure 5 shows the natural values of the site.

A state road, B10 (Boyer Road), passes through the site from south-east to south-west. At the centre of the site is Sunrise Avenue, a road maintained by Brighton Council. The Derwent Valley Railway line also runs through the site, dividing the private land and foreshore on either side. The railway line is currently an in-operational heritage line, having closed its service in 2005. The railway line has been in government ownership since 2006, however a non-profit group (The Derwent Valley Railway) is actively campaigning to gain access to the railway and fundraise to refurbish the tracks and sleeper carriages. with the aim of re-establishing the railway line to service the tourist industry.[13]

[12] Brighton Council (2022), Aboriginal Heritage Tasmania Sunrise Avenue Map.

[13] Derwent Valley Railway (2023), https://www.dvr.org.au/

FIGURE 3: SITE A CONTEXT MAP

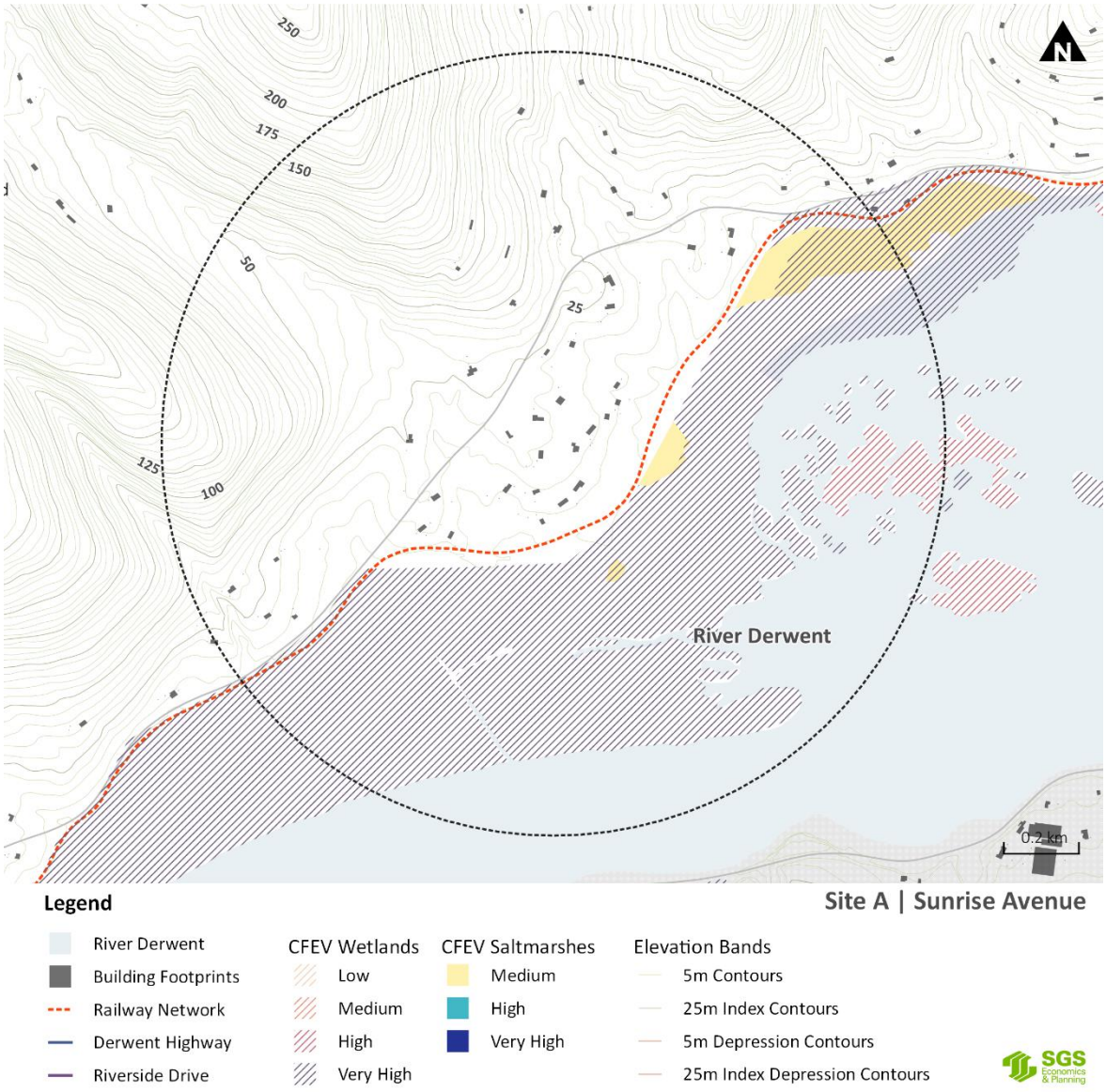
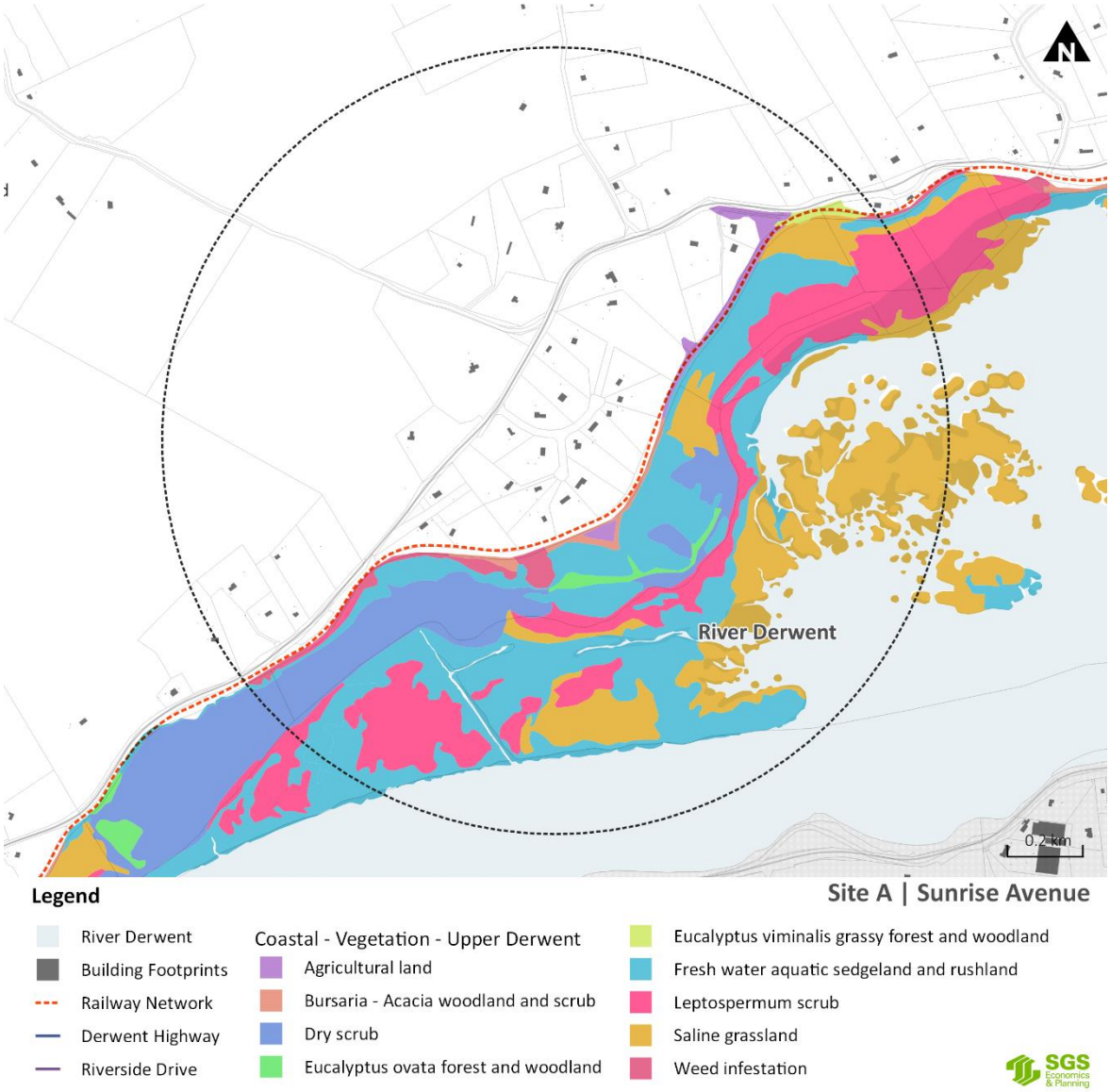
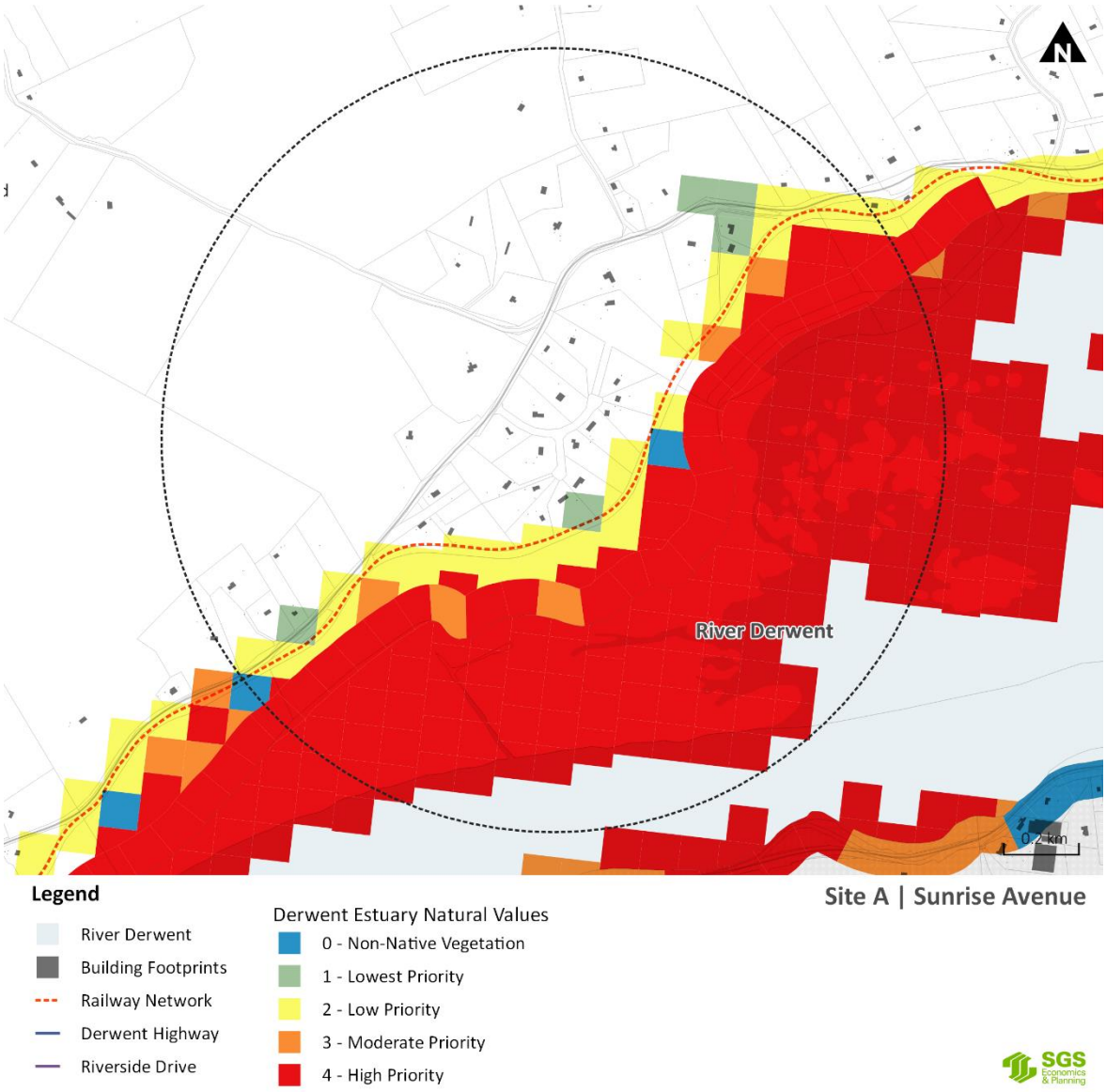


FIGURE 4: SITE A CONTEXT - COASTAL VEGETATION



Natural values refer to the variety of life-forms, including plants, animals, and micro-organisms, and the ecosystems they belong to, including land forms, soils, and water. One of the crucial natural values in Site A are the wetlands to the south of the rail line, which, the Derwent Estuary Natural Values[14] dataset (see Figure 5) lists the majority of the wetlands as a high priority site, the highest importance rating. Similarly, the wetlands, are deemed to have a Very High integrated conservation value, as determined by the Conservation of Freshwater Ecosystem Values[15] (CFEV). This is the highest classification which expresses the relative importance of an ecosystem.

FIGURE 5: SITE A CONTEXT - NATURAL VALUES



[14] https://services.thelist.tas.gov.au/arcgis/rest/services/Public/NaturalEnvironment/MapServer/106

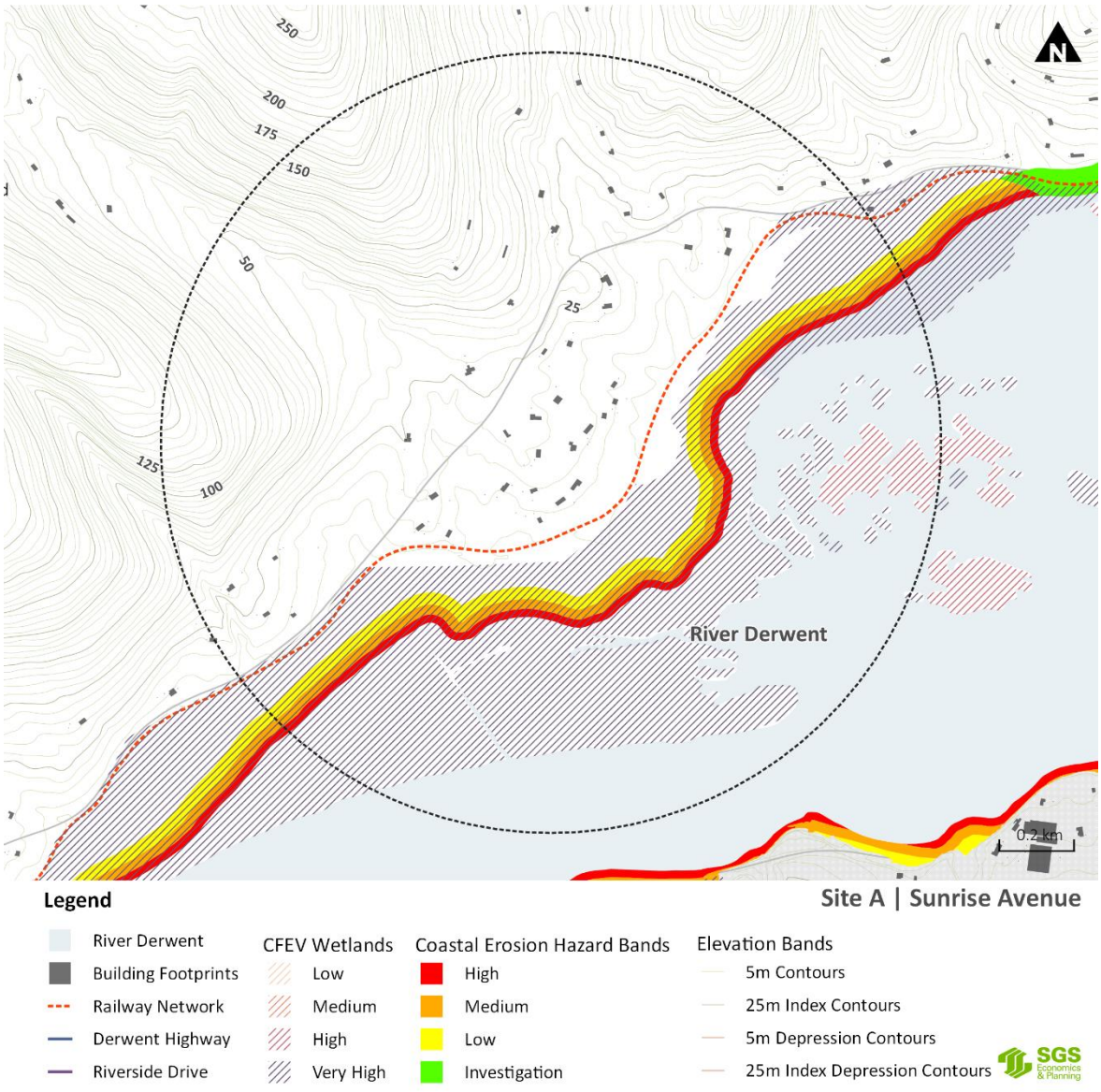
[15] https://services.thelist.tas.gov.au/arcgis/rest/services/Public/NaturalEnvironment/MapServer/60

3.2 Coastal Erosion Hazards

The potential coastal erosion susceptibility hazard bands for the study area are shown in Figure 6. The map shows that there are areas within the high, medium, and low coastal erosion hazard bands:

- High hazard band: the area along the low-lying public land of the Derwent River foreshore is *currently* vulnerable to coastal recession, that is without further sea level rise.
- Medium hazard band: directly abutting the area defined as a high hazard band, moving inland. This land is vulnerable to coastal recession to 2050 as sea level rise progresses to 0.2m.
- Low hazard band: set back from the medium hazard band, moving inland, the area is vulnerable to coastal recession to 2100 as sea level rise progresses to 0.8m.

FIGURE 6: SITE A - COASTAL EROSION



Source: SGS Economics and Planning, 2023

3.3 Coastal Erosion Assets at Risk

The modelling indicates that no residential properties are directly at risk of erosion at present or in the future. Seven residential plots of land may be susceptible to some level of erosion but at these sloping properties, where the dwellings are located at higher ground away from the foreshore. The houses themselves are not at risk, now or in the future to 2100. No risk to public infrastructure has been identified.

Some of the foreshore is at risk. Most of the area classified at risk is crown land; a small amount is privately owned. The size of the open space at risk is indicated in Table 5.

TABLE 5: NON-VALUED ASSETS AT RISK - EROSION

	High Risk Hazard Band	Medium Risk Hazard Band	Low Risk Hazard Band
Open space (ha)	6.49	10.96	13.09

Source: SGS Economics and Planning, 2023

The Aboriginal Heritage item located inland in Site A is not expected to be affected by coastal erosion.

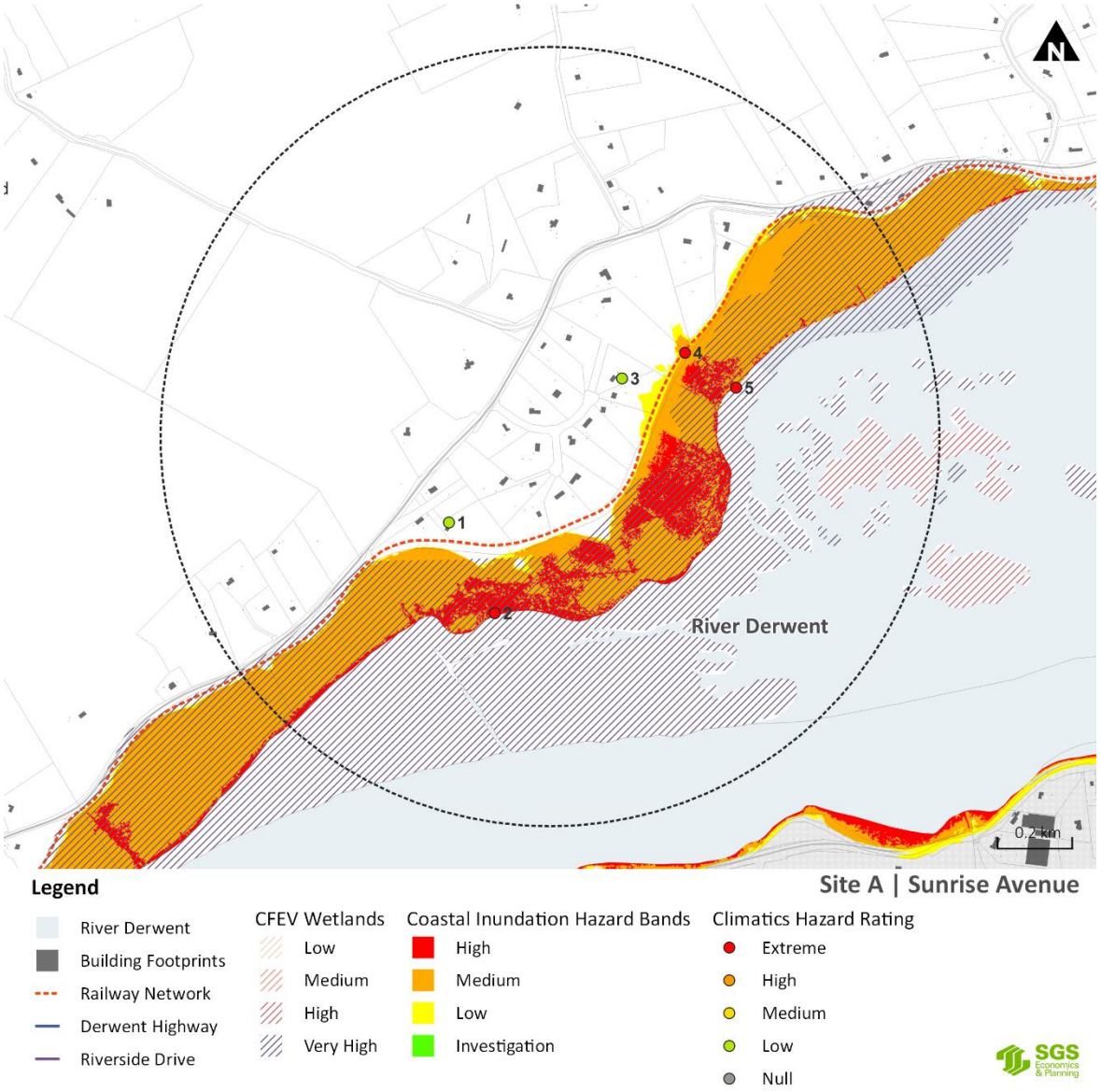
The wetlands which are classified as Very High CFEV classifications extend up to the rail line, where the risk of coastal erosion intersects this critical ecosystem, as shown in Figure 6. This indicates that the wetlands area located in the high-risk hazard band and beyond are currently vulnerable to recession, while the areas at risk of recession will encroach further inland by 2100.

3.4 Coastal Inundation Hazards

Future coastal inundation risks will increase as climate change leads to sea levels rising. Coastal sea level rise mapping of Site A (Figure 7) reveals areas with low, medium, and high coastal inundation hazard bands:

- High hazard band: a significant area of land between the Derwent Valley Railway line and the marshlands will be within 0.2m SLR from MHT line by 2050 and is currently impacted by the Highest Astronomical Tide.
- Medium hazard band: all land between the Derwent Valley Railway line and the marshlands is classified as a medium hazard band (where it is not classified as 'high'), meaning the area is vulnerable to a 1% AEP storm event in 2050 and will be impacted by a 0.8m SLR by 2100. In some areas, the medium hazard band applies to the Derwent Valley Railway line.
- Low hazard band: land abutting the medium hazard band, inland and adjacent to the Derwent Valley Railway line, is vulnerable to a 1% AEP storm event in 2100 and medium-term flooding issues. In some areas, the low hazard band applies to the Derwent Valley Railway line.

FIGURE 7: SITE A – COASTAL INUNDATION HAZARDS AND WETLANDS CONSERVATION VALUE



Source: SGS Economics and Planning, 2023

Verification with Climatics

SGS used Climatics data to verify the coastal inundation risk ratings identified by the Department of Premier and Cabinet (DPAC) by distinguishing several representative locations within the site to assess their exposure to fluvial flooding. In Figure 7 above, five sites are listed showing risk ratings for fluvial flooding at these locations from Climatics. Overall the risk analysis from Climatics at site A broadly aligns with the Coastal Inundation Hazard bands, which demonstrates that most of the wetlands to the south of the railway are at medium to high risk of inundation. However, specifically at location 4, Climatics does predict a higher risk of flooding than the coastal inundation hazard band at that location. North of the rail line, the risk of fluvial flooding is low, while there are no coastal inundation hazard bands applicable to this area. Table 6 below summarises the alignment between the two risk rating systems.

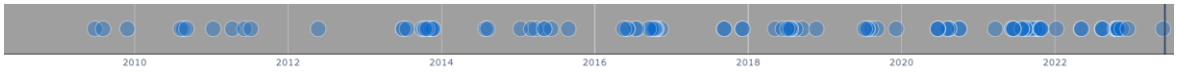
TABLE 6: RISK RATING ALIGNMENT BETWEEN CLIMATICS AND DPAC, SITE A

Location	Climatics risk rating	DPAC Hazard band	Alignment
1	Low: no direct impact on this site from river flooding	Null	Both predict no direct impact from flooding
2	Extreme: Flooding impact on this site with 5% AEP	High	Both fall into respective highest risk category.
3	Low: no direct impact on this site from river flooding	Null	Both predict no direct impact from flooding
4	Extreme: Flooding impact on this site with 5% AEP	Medium	Climatics (5% AEP currently) predicts greater risk than DPAC (1% AEP by 2050)
5	Extreme: Flooding impact on this site with 5% AEP	High	Both fall into respective highest risk category.

Source: Climatics; DPAC; SGS Economics and Planning, 2023

Throughout site A, Climatics generally predicts a somewhat higher risk of fluvial flooding at these locations than DPAC does for coastal inundation. The hazards being assessed are not identical and this may cause some of the misalignment in risk ratings between the two datasets, rather than one systematically overstating or understating risk. In any case, the outlook for the wetlands to the south of the rail line is poor, with both datasets assigning their respective highest risk ratings to areas within the wetlands for each hazard. Figure 8 below shows the incidence of flood events at site A and demonstrates a trend of increasing frequency, even in the last decade.

FIGURE 8: TIMELINE OF FLOOD EVENTS AT SITE A



Source: Climatics

3.5 Coastal Inundation Assets at Risk

No dwellings are projected to be affected by coastal inundation up to 2100. However, eight residential plots of land are likely to be at risk of partial inundation. These are sloping properties, where the dwellings are located at higher ground away from the foreshore. The houses themselves are not at risk, now or in the future to 2100.

With climate change and sea level rise, the marshlands will increasingly be at risk of inundation. Most of the marshland is at risk of inundation during extreme storm events by 2050. As sea levels continue to rise, the marshlands will become more permanently wet as the drainage capacity deteriorates and will become more frequently inundated towards 2100. If nothing is done to manage the marshlands, the character will change, and its ecosystem values diminish. Marshlands are often important as breeding and nursery grounds for bird and fish species. The presence of the rail line may prevent the marshlands from moving landward (if nothing is done to manage the risks).

By 2100, a larger area will be at risk of inundation due to extreme storm events including areas beyond the railway track boundary. Inundation would likely affect open space and railway tracks. The railway tracks may become overtopped or undermined if nothing is done to manage the risk.

TABLE 7: NON-VALUED ASSETS AT RISK - INUNDATION

Asset	High Risk Hazard Band	Medium Risk Hazard Band	Low Risk Hazard Band
Open space (ha)	18.59	40.67	40.67
Railway network (m)	0	162	689

Source: SGS Economics and Planning, 2023

The Aboriginal Heritage item which is located inland in Site A is not expected to be affected by coastal inundation.

The wetlands to the south of the rail line have a Very High integrated conservation value. Throughout Site A, this Very High classifications extends up to the rail line, overlapping almost entirely with the medium and high-risk hazard bands for coastal inundation, suggesting that these wetlands are potentially wholly at risk from sea level rise by 2100, if not damaged or destroyed by 1% AEP events before then. These wetlands are also considered to be a threatened native vegetation community, a state-wide mapping layer showing the indicative extent of these vegetation communities[16]. The same mapping layer shows that there is a pocket of Eucalyptus ovata forest and woodlands to the south of the rail line within the wetlands, which is covered by the high-risk coastal inundation hazard band. There are salt marshes adjacent to the rail line which are part of the wetlands, which are likewise at risk of coastal inundation, predominantly medium risk.

There are no flora or fauna species for conservation significance within Site A.

3.6 Stormwater Hazards

There are no stormwater hazards present in Site A.

3.7 Summary

Many of the land and assets at risk are exposed to both natural hazards, but inundation is the most predominant risk. There is a substantial foreshore area in Site A that is expected to be at risk of erosion, storm events and inundation[17], along with parts of the Derwent Valley Railway network. While this has not been valued in monetary terms due to limited data, the area impacted by risk has been summarised in the following table.

TABLE 8: NON-VALUED ASSETS AT RISK – OF INUNDATION AND/OR EROSION

Asset	High Risk Hazard Band	Medium Risk Hazard Band	Low Risk Hazard Band
Open space (ha)	18.66	40.67	40.67

[16] https://services.thelist.tas.gov.au/arcgis/rest/services/Public/NaturalEnvironment/MapServer/2

Railway network (m)	0	162	689

The Aboriginal Heritage item in Site A is unlikely to be affected by coastal erosion, inundation or stormwater.

The wetlands to the south of the rail line are entirely covered by coastal inundation hazards bands Medium and High, while having a Very High integrated conservation value, the highest importance classification. These critical wetlands are in areas that will likely be entirely inundated by sea-level rise alone (if not storm-tide events), by 2100. The threat of coastal erosion already affects some of the wetlands, with parts of them already vulnerable to coastal recession, while by 2100, wetland area further inland will also be vulnerable to encroachment.

4. Site B – Riverside Drive

4.1 Site overview

Site B, Riverside Drive, is in Bridgewater, a suburb approximately 19 kilometres north of Hobart. The site contains a diverse range of land uses, including grazing pastures, rural residential, urban residential, horticulture, transport and communication, and nature conservation. There are 614 residential properties within the site. These consist of a mix of rural living and general residential areas. A parcel of land to the east of the site, is zoned for future urban development and contains a heritage registered property (Genappe - 50 Boyer Road).

There are also numerous businesses that form a small activity centre in the mixed-use zone along Old Main Road and the Midland Highway and a high school (Northern Christian School) is situated to the north of the site.

The site has several open space and recreational areas, including the Nielsen Esplanade Park and Bridgewater Memorial Reserve. Abutting Riverside Drive Road along the Derwent River is an area of marshlands that are managed according to a waterway and coastal protection overlay. At the end of Riverside Drive is a popular fishing jetty and parking area. The jetty located in Nielsen Esplanade is to be replaced in a similar location as part of the Bridgewater Bridge project. It also marks the start of the Riverside Drive Foreshore Trail, a 2.7-kilometre trail which stretches west towards Boyer.[18]

The site is located directly adjacent to the Bridgewater Bridge which is a crucial transport link connecting the area to Granton in the south via the Midland Highway. The construction of the new Bridgewater Bridge is currently underway, and its impacts on erosion and inundation appear to be negligible according to a technical report[19] prepared as part of the new bridge project. The South Line railway also runs across the bridge and north through the site, however the line is no longer operational since the purpose-built Brighton Transport Hub. The Derwent Valley Line, not in operation intersects the site.

Also contained within the site are six Aboriginal Heritage items (see Figure 9). [20]

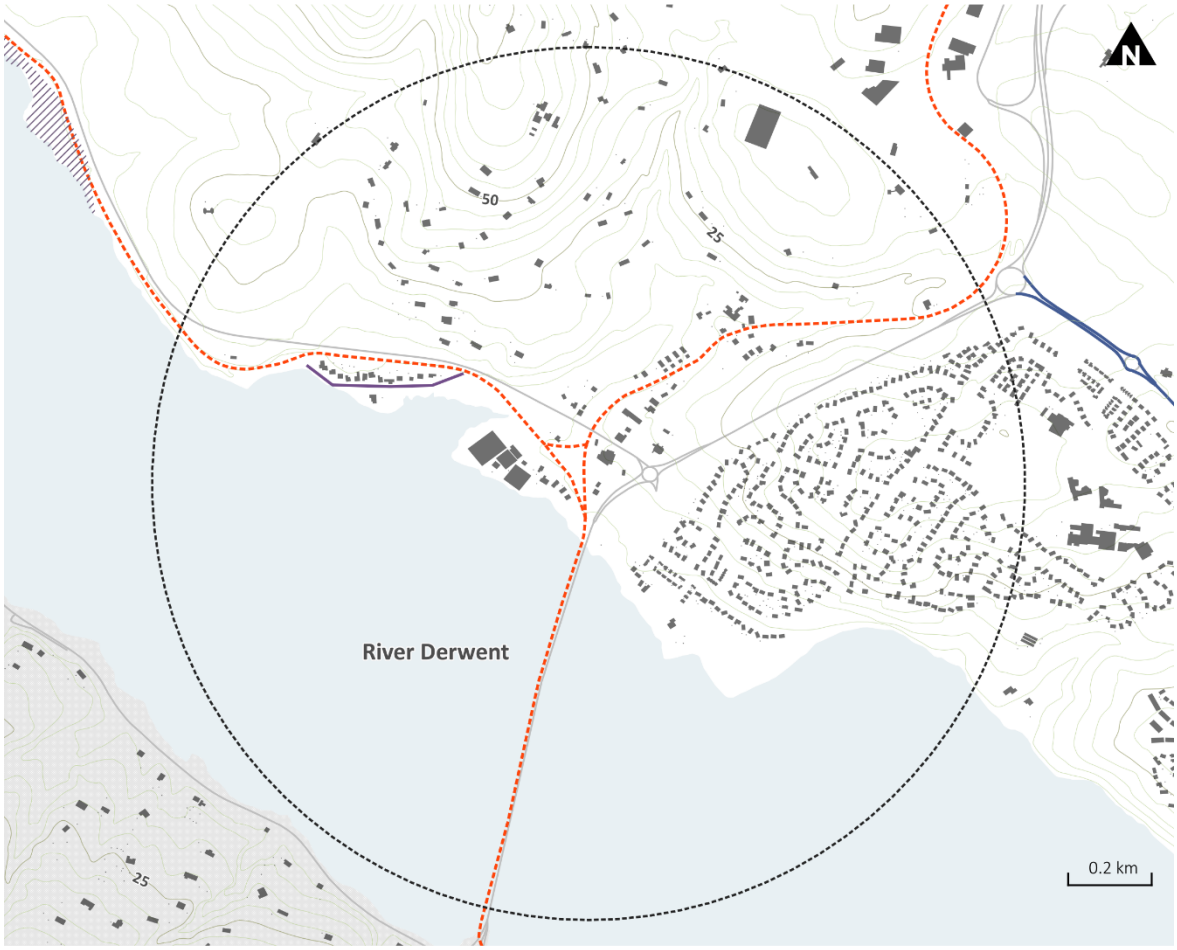
The site contains threatened wetland vegetation (see Figure 9). The environment contains natural values as illustrated in Figure 10.

[18] Great Hobart Trails (2023) https://www.greaterhobarttrails.com.au/tracks/riverside-drive-foreshore-trail

[19] Hydo-Electric Corporation, 2021, New Bridgewater Bridge Flood Hazard Report.

[20] Brighton Council (2022), Aboriginal Heritage Tasmania Riverside Drive Map.

FIGURE 9: SITE B CONTEXT MAP



Legend

Site B | Riverside Drive

- River Derwent
- Building Footprints
- Railway Network
- Derwent Highway
- Riverside Drive

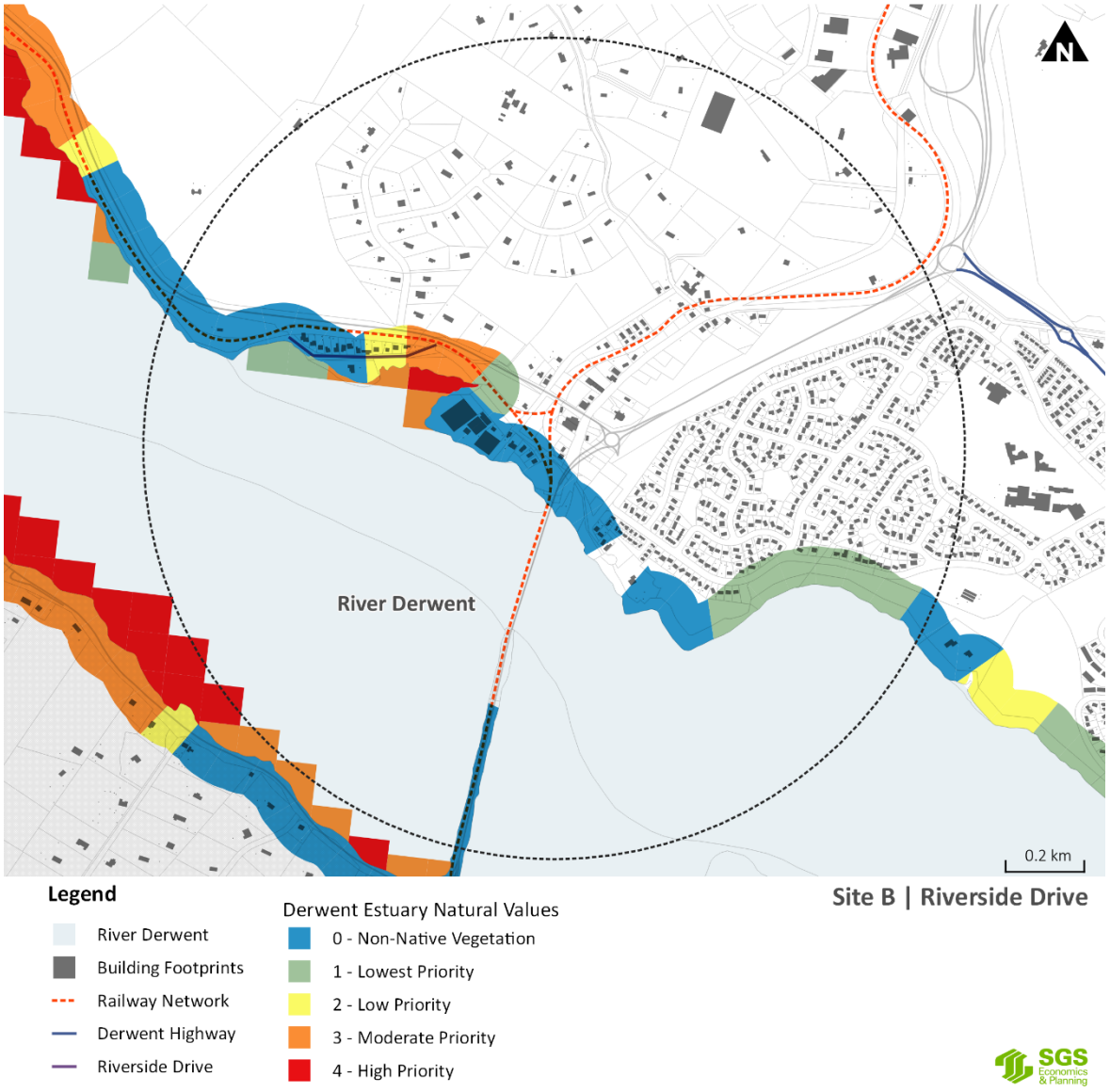
CFEV Wetlands
- Low
- Medium
- High
- Very High

CFEV Saltmarshes
- Medium
- High
- Very High

Elevation Bands
- 5m Contours
- 25m Index Contours
- 5m Depression Contours
- 25m Index Depression Contours

SGS Economics & Planning

FIGURE 10: SITE B CONTEXT - NATURAL VALUES



4.2 Coastal Erosion Hazards

Erosion modelling and spatial data enable the identification of areas that are at risk of erosion. The potential coastal erosion susceptibility hazard bands for the study area are shown in Figure 11. The map shows that there are high, medium, low and investigation coastal erosion hazard bands all present in Site B:

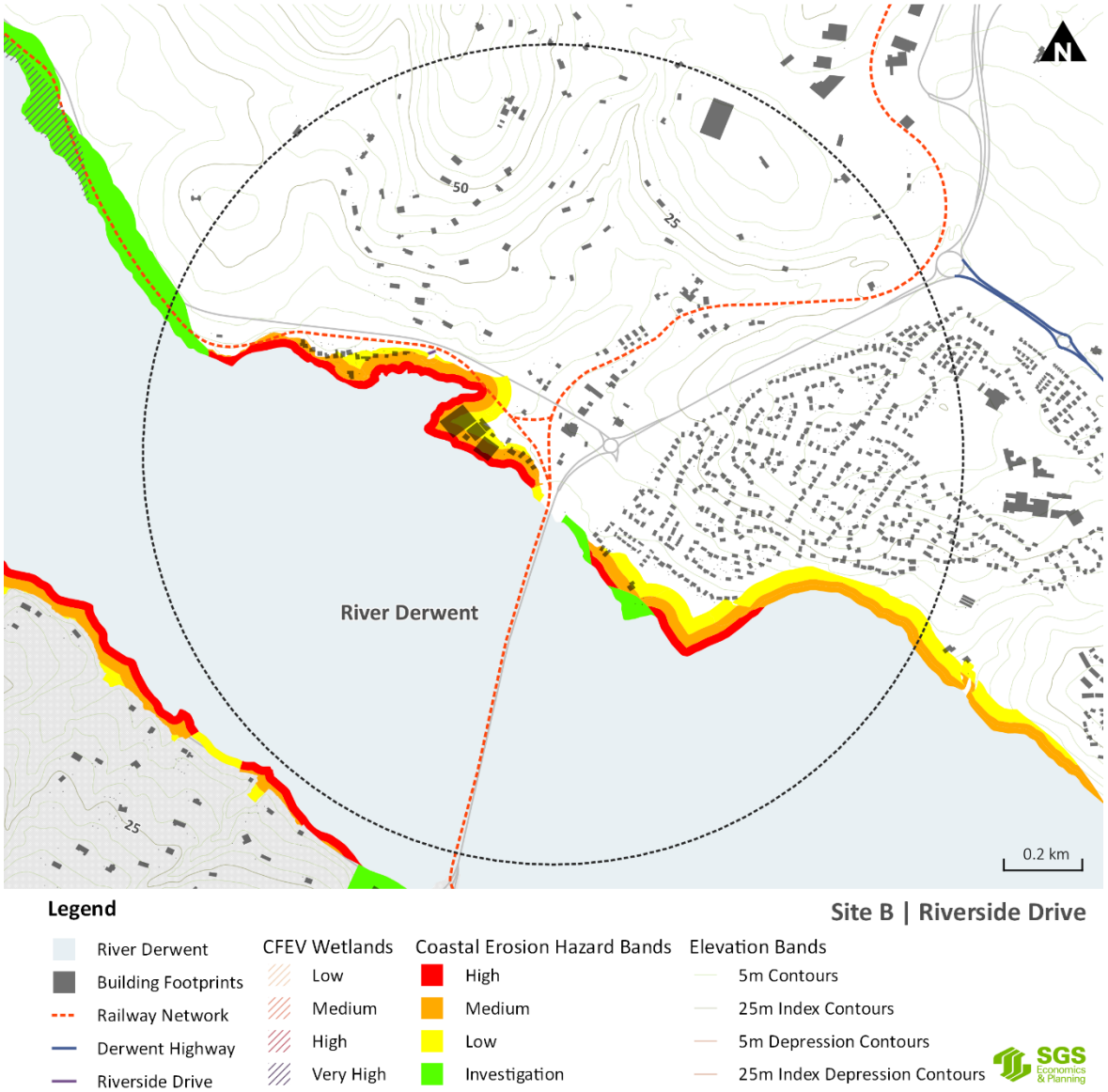
- High hazard band: a significant area of public land to the north west of the Bridgewater Bridge along the low-lying land of the Derwent River foreshore is *currently* vulnerable to coastal erosion. This includes private properties on Wallace Street. A smaller area along Nielsen Esplanade along the foreshore, south of the bridge, is also classified as a high coastal erosion hazard band.

- Medium hazard band: Along Riverside Drive and Wallace Street, north of the Bridgewater Bridge, several private properties are within the medium hazard band, exposing them erosion risk by 2050. South of the bridge, an area to the east of the site boundary is also within the medium erosion band, including Bridgewater Parkland.
- Low hazard band: set back from the medium hazard band, moving inland, the area is vulnerable to coastal erosion to 2100 as sea level rise progresses to 0.8m.

Investigation hazard band: two areas within Site B contain an investigation hazard band, the first to the north east along the Derwent River foreshore and Dromedary walking path, the second to the south of the Bridgewater Bridge. These areas are adjacent to coastlines but yet to be classified due to incomplete or unavailable landform data.

The map shows that the primary area of concern are the private properties along Wallace Street. As sea levels rise, the properties are at increasing risks, to the extent that a high tide could lead to erosion by 2100 (if nothing is done to manage the risk).

FIGURE 11: SITE B - COASTAL EROSION



Source: SGS Economics and Planning, 2023

4.3 Coastal Erosion Assets at Risk

While at present no buildings are at risk of erosion, with climate change and associated sea level rise, this is set to change towards 2050. By then, approximately 18 buildings (dwellings and greenhouses) with a total capital value of $6.6 million will be at risk if nothing is done to manage the risk. As sea levels continue to rise, buildings on another 21 properties may be at risk if nothing is done to manage the risk.

TABLE 9: CAPITAL VALUES OF BUILDINGS AT RISK – EROSION RISK

	High Risk Hazard Band	Medium Risk Hazard Band	Low Risk Hazard Band

	Capital Value ($)	Count	Capital Value ($)	Count	Capital Value ($)	Count
Private properties	0	0	6,607,500	18	7,290,000	21

Source: SGS Economics and Planning, 2023

The boat ramp, a small section of the hiking track and the playground are currently at risk of erosion. Sections of road and the track are likely to be exposed to erosion as sea levels rise. Overall, the capital values at risk, is estimated to be $112,585 in 2050, to increasing to $482,482 in 2100.

TABLE 10: VALUES OF PUBLIC INFRASTRUCTURE AT RISK – EROSION RISK

	High Risk Hazard Band		Medium Risk Hazard Band		Low Risk Hazard Band	
	Capital Value ($)	Count	Capital Value ($)	Count	Capital Value ($)	Count
Boat Ramp	$37,433	1	$37,433	1	$37,433	1
Roads	$4,917	0.0km	$21,552	0.1km	$334,749	0.8km
Hiking Track	$22,300	0.2km	$53,600	0.5km	$110,300	1.1km
Total	**$64,650**	**N/A**	**$112,585**	**N/A**	**$482,482**	**N/A**

Source: SGS Economics and Planning, 2023
Note: Boat Ramp derived from costs of land backed wharve (precast concrete interlocking piles and reinforced concrete ground slab) (no electrical and water services), Roads based on composite price of suburban road with in situ concrete kerbs (6m wide), Trail calculated based on paved footpath (1500mm wide)

Overtime, an increasing amount of open space is likely to be at risk of erosion including the playground.

TABLE 11: NON-VALUED ASSETS AT RISK – EROSION RISK

	High Risk Hazard Band	Medium Risk Hazard Band	Low Risk Hazard Band
Open space (ha)	1.42	3.76	4.81

Source: SGS Economics and Planning, 2023

Four Aboriginal Heritage items are located within the High Erosion Hazard Band, while a further two straddle the High/Medium Erosion Hazard band, indicating that all six items are at high risk of erosion.

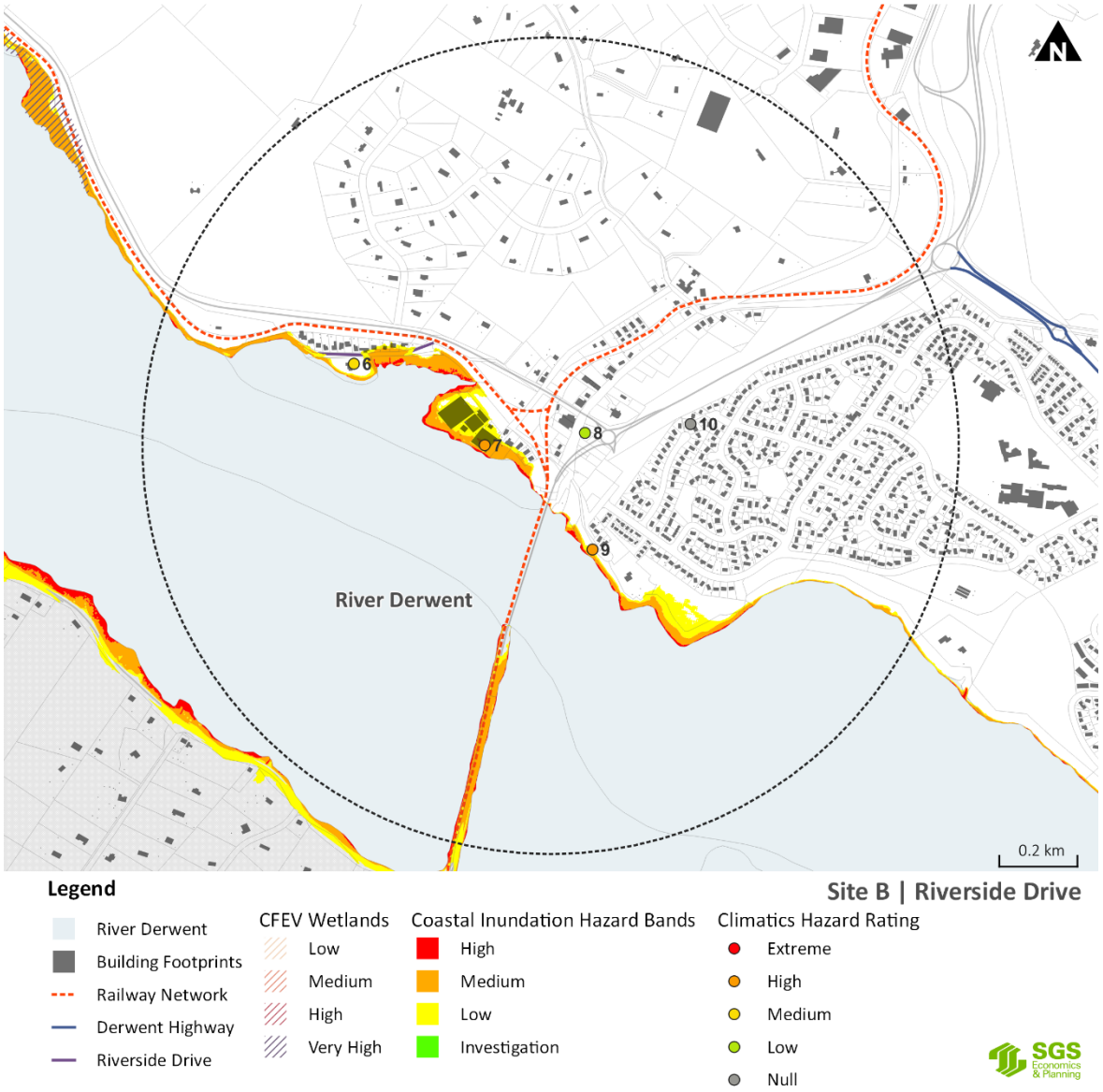
Much of the natural value in Site B is identified by the Derwent Estuary Natural Values dataset to be either non-native vegetation or the in the lowest priority band. There is a pocket of moderate and high priority natural value to the south of the intersection between Riverside Drive and Boyer Road, at the mouth of Derwent River. The entire shoreline of Site B is vulnerable to coastal erosion of low to high risk. This natural value site is on the shoreline and therefore overlaps with the high-risk hazard band for coastal erosion, indicating that this pocket of high priority vegetation is currently at risk of coastal recession.

4.4 Coastal Inundation Hazards

Future coastal inundation risks will increase as climate change leads to sea levels to rise. Coastal sea level rise mapping of Site B (Figure 12) shows areas with low, medium and high coastal inundation hazard bands:

- High hazard band: Several properties on Riverside Drive and Wallace Street (including private properties), and south side of the Bridgewater Bridge. The width of the high hazard band is limited, meaning there are no direct threats to buildings on the land parcels identified.
- Medium hazard band: all land along the Derwent River foreshore in Site B is within the medium hazard band, meaning the area is vulnerable to a 1% AEP storm event by 2050 and will be inundated at a regular basis by 2100. The medium hazard band encompasses private properties on Wallace Street and Riverside Drive, as well as the south side of the Bridgewater Bridge. By 2050, some of the buildings on these parcels will be at risk.
- Low hazard band: land abutting the medium hazard band, inland, is vulnerable to a 1% AEP storm event in 2100 and medium-term flooding issues. In some areas, the low hazard band applies to private properties on Wallace Street and Riverside Drive.

FIGURE 12: SITE B - COASTAL INUNDATION



Source: SGS Economics and Planning, 2023

Verification with Climatics

SGS has analysed several representative locations within Site B using Climatics to assess their exposure to fluvial flooding. As Figure 12**Error! Reference source not found.** shows, the coastal land surrounding B ridgewater Bridge is at risk of coastal inundation, as well as from fluvial flooding, represented by the numbered locations on the map. Land immediately adjacent to the bridge entrance is at high risk of fluvial flooding, which is to say that these sites have a predicted 2% AEP for a direct impact from the Derwent River flooding. One site identified is a greenhouse to the northwest of the Bridge entrance, while on the other side, the foreshore walk south of Gunn Street is at the same risk level. Both sites are directly on the foreshore, while locations further inland are at medium, low or no risk. This aligns with the high-risk rating along the foreshore identified by DPAC, while the drop off in risk further inland also

holds. Nevertheless, certain locations analysed in Climatics are shown to be at some level of risk from flooding, with no coastal inundation hazard band coverage. This is summarised in Table 12 below.

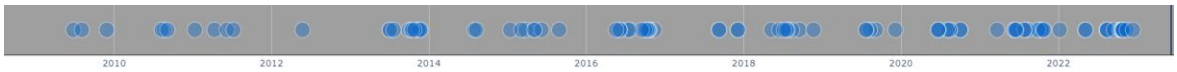
TABLE 12: RISK RATING ALIGNMENT BETWEEN CLIMATICS AND DPAC, SITE B

Location	Climatics risk rating	DPAC Hazard band	Alignment
6	Medium: flooding impact on this site with 1% AEP	Null	Climatics identifies flooding risk at this site while DPAC does not.
7	High: Flooding impact on this site with 2% AEP	Medium	Both fall into respective second highest risk category, but Climatics risk rating is more severe.
8	Low: no direct impact on this site from river flooding	Null	Both predict no direct impact from flooding
9	High: Flooding impact on this site with 2% AEP	Low	Climatics (2% AEP currently) predicts greater risk than DPAC (1% AEP by 2100).
10	Null	Null	Both datasets identify no flooding or inundation risk at this location.

Source: Climatics; DPAC; SGS Economics and Planning, 2023

The coastal inundation hazard bands from DPAC do not extend far inland but do suggest that there is a high risk on the coast around Bridgewater Bridge. Climatics analysis of locations within site B predicts that the risk of fluvial flooding extends somewhat further inland, with medium and high risk ratings applying to locations not covered by the DPAC hazard bands. Figure 13 below shows a timeline of flood events at the coastline of site B. It demonstrates that flood events are becoming more frequent, even within the last decade.

FIGURE 13: TIMELINE OF FLOOD EVENTS AT SITE B



Source: Climatics

4.5 Coastal Inundation Assets at Risk

Inundation risk is contained mainly in areas also facing coastal erosion risk. The present risk of inundation is very minimal, with an impact on one greenhouse. The extent exacerbates when the risk moves to medium risk, with the risk of a 1% AEP storm event in 2050, or 0.8m sea level rise by 2100 developing up 50m from the riverbanks, at its most vulnerable point. Three properties will be at risk in this scenario. As the risk of 1% AEP storm event approaches in 2100, there may be a further five properties at risk of inundation and will inundate the large parcel of land at the end of Wallace Street.

TABLE 13: VALUES OF PROPERTIES AT RISK (ADJUSTED CAPITAL, EXCLUDING LAND VALUES) – INUNDATION RISK

	High Risk Hazard Band		Medium Risk Hazard Band		Low Risk Hazard Band	
	Capital Value ($)	Count	Capital Value ($)	Count	Capital Value ($)	Count

Private properties	0	0	900,000	3	2,540,000	8

Source: SGS Economics and Planning, 2023

Similarly, with coastal erosion, the disused boat ramp and roads may be marginally affected on Site B. Impact of potential inundation on public infrastructure is likely to be negligible with present-day risk. However, this impact is expected to grow by approximately four folds in the medium term (1% AEP in 2050). More roads and parts of the walking track will be at risk of inundation in the long term (1% AEP storm event in 2100).

TABLE 14: VALUES OF PUBLIC INFRASTRUCTURE AT RISK – INUNDATION RISK

	High Risk Hazard Band		Medium Risk Hazard Band		Low Risk Hazard Band	
	Capital Value ($)	Count	Capital Value ($)	Count	Capital Value ($)	Count
Boat Ramp	$0	0	$37,433	1	$37,433	1
Roads	$8,820	0.2km	$158,572	0.4km	$726,694	1.8km
Hiking Track	$461	0.0km	$183,173	1.8km	$218,086	2.2km
Total	**$9,281**	**N/A**	**$379,178**	**N/A**	**$982,213**	**N/A**

Source: SGS Economics and Planning, 2023
Note: Boat Ramp derived from costs of land backed wharve (precast concrete interlocking piles and reinforced concrete ground slab) (no electrical and water services), Roads based on composite price of suburban road with in situ concrete kerbs (6m wide), Trail calculated based on paved footpath (1500mm wide)

The likelihood of inundation risk affecting open space is expected to be low across various inundation hazard bands, although it may have an impact on the local playground.

TABLE 15: NON-VALUED ASSETS AT RISK – INUNDATION RISK

	High Risk Hazard Band	Medium Risk Hazard Band	Low Risk Hazard Band
Open space (ha)	0.32	1.64	1.64

Source: SGS Economics and Planning, 2023

In total, four Aboriginal Items are at risk of inundation. Three Aboriginal Heritage Items are located within the Medium Inundation Hazard Band (774, 1384, 1381), one straddles the High/Medium Inundation Hazard band (7776). Two items (7775, and 1383) appear to not be at risk of inundation.

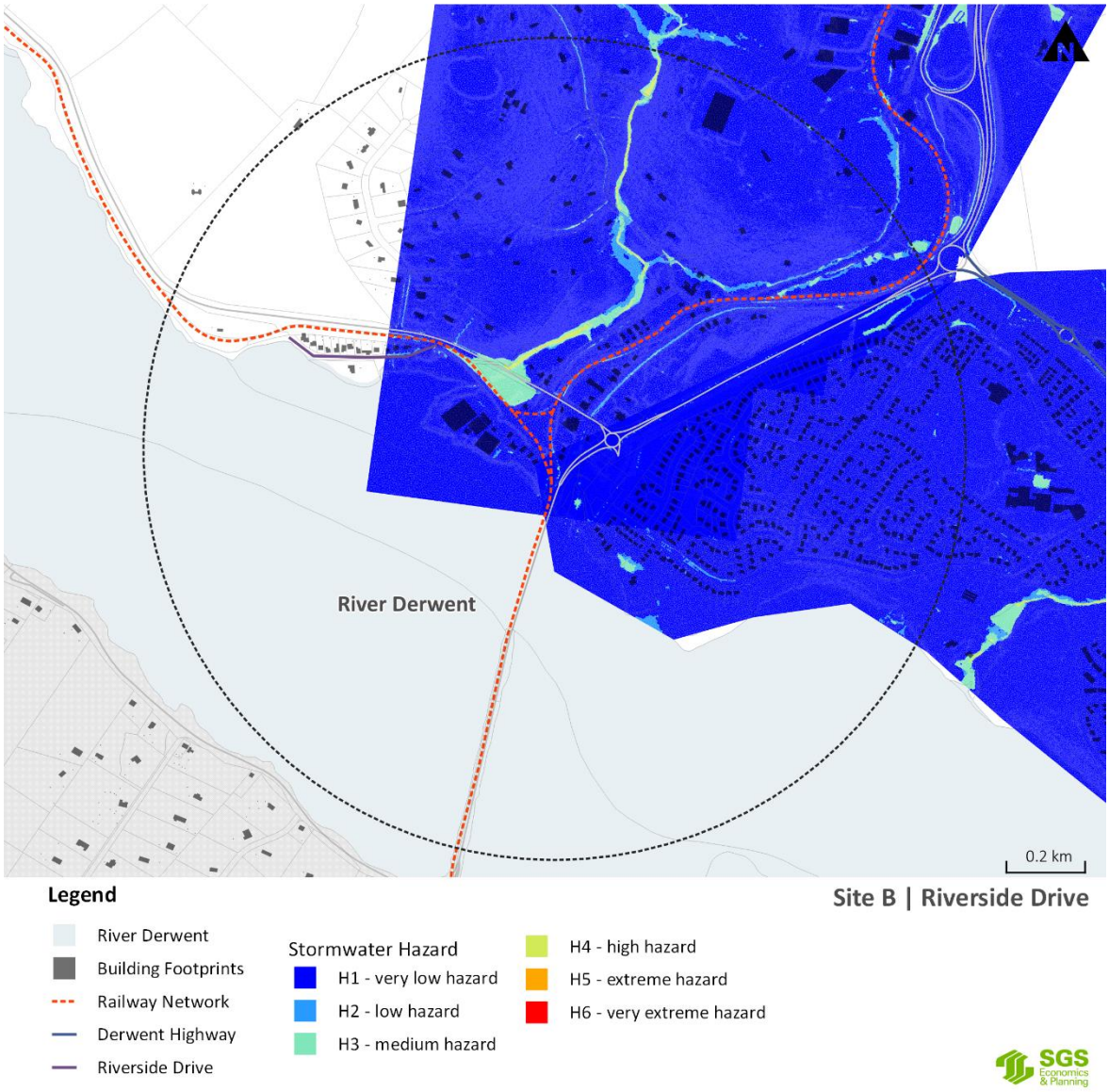
Coastal inundation proves to be less threatening to the vegetation in Site B than at Site A, due to a more severe slope from the banks of the river. Nevertheless, the area to the south of Riverside Drive and Boyer Road, which is considered moderate to high priority in the Derwent Estuary Natural Values dataset, is also covered by medium to high-risk hazard bands for coastal inundation. This means that

this pocket of open space is vulnerable to sea-level rise by 2100, and parts of it will be vulnerable by 2050, if not already damaged or destroyed by a 1% AEP storm event before then.

4.6 Stormwater Hazards

The majority of Site B is vulnerable to stormwater drainage hazards (Figure 14). This area includes recreation and urban uses. With sea level rise it is reasonable to assume that stormwater drainage issues, such as the need to manage stormwater via the overflow, will gradually increase over time. Contributing factors are an increased water table and higher storm surges.

FIGURE 14: SITE B - STORMWATER HAZARDS



Source: SGS Economics and Planning, 2023

A few hundred houses and other buildings are at a very low risk from stormwater.

All six Aboriginal Heritage items are at very low risk from stormwater hazards.

As Figure 14 shows, the majority of land within Site B is vulnerable to stormwater hazards, predominantly low to very low risk. However, there is a pocket of medium to high risk which intersects with the high priority area identified in the Derwent Estuary Natural Values dataset. This is shown in Figure 14 at the intersection between the railway network, Riverside Drive and Boyer Road. With sea level rise and increasing storm surge resulting from climate change, the vulnerability of this site will likely increase over time.

4.7 Summary

Site B is susceptive to coastal hazards, however, both inundation and coastal erosion are likely to be relatively mild due to the geographical location of the study area, as well as due to land utilisation. Similar to Site A, the land is relatively low density and is characterised by limited land uses.

Most assets are likely to be exposed to both coastal erosion and inundation risks.

Currently, no residential properties are at risk of coastal hazards. As the potential for erosion and inundation escalates to the medium hazard band, approximately 18 residential properties may be at risk, with a total value of about $6.6 million. This value is expected to grow with a low-risk hazard band, whereby, a total of 22 properties are potentially at risk of erosion and inundation due to extreme events. The total value of these properties is around $7.5 million.

TABLE 16: VALUES OF PROPERTIES AT RISK (ADJUSTED CAPITAL, EXCLUDING LAND VALUES)

	High Risk Hazard Band		Medium Risk Hazard Band		Low Risk Hazard Band	
	Capital Value ($)	Count	Capital Value ($)	Count	Capital Value ($)	Count
Private properties	0	0	6,607,500	18	7,535,000	22

Source: SGS Economics and Planning, 2023

Built public infrastructure are also at risk of coastal hazards, such as roads and footpaths. Infrastructure in the study area that carries some level of risk include a hiking trail, roads, boat ramp and a local playground[21].

TABLE 17: VALUES OF PUBLIC INFRASTRUCTURE AT RISK

	High Risk Hazard Band		Medium Risk Hazard Band		Low Risk Hazard Band	
	Capital Value ($)	Count	Capital Value ($)	Count	Capital Value ($)	Count

[21] Note: Playgrounds have not been measured as this has not been detailed in Rawlinson's.

Boat Ramp	37,433	1	37,433	1	37,433	1
Roads	197,475	0.5km	421,935	1.0km	599,888	1.5km
Hiking Track	22,761	0.1km	184,550	0.7km	243,382	0.7km
Total	**257,668**	**N/A**	**643,918**	**N/A**	**880,702**	**N/A**

Source: SGS Economics and Planning, 2023
Note: Boat Ramp derived from costs of land backed wharve (precast concrete interlocking piles and reinforced concrete ground slab) (no electrical and water services), Roads based on composite price of suburban road with in situ concrete kerbs (6m wide), Trail calculated based on paved footpath (1500mm wide)

There is also foreshore area in Site B that is expected to be at risk of erosion, storm events and inundation[22], along with parts of the Derwent Valley Railway and the South Line network. While this has not been valued due to limited data, the area impacted has been summarised in the following table.

TABLE 18: NON-VALUED ASSETS AT RISK

	High Risk Hazard Band	Medium Risk Hazard Band	Low Risk Hazard Band
Open space (ha)	1.42	3.76	4.82

Source: SGS Economics and Planning, 2023

All six Aboriginal Heritage items in Site B are at very low risk from stormwater hazards, and high/medium risk of erosion. Four of the items are at risk of inundation.

The urban development at Site B extends towards the shore line across much of its river banks, meaning that there are relatively fewer natural values at risk from coastal hazards. However, a small pocket of open space that is considered moderate to high priority is at risk particularly from coastal inundation, as a low-lying area on the banks of the Derwent River. It is vulnerable to sea level rise by 2050 to 2100, if not storm events before then. This site is also currently at the intersection of low to medium stormwater hazard risk.

[22] Willingness to pay (WTP) through comparable studies can suggest the value of public-owned foreshores, through the benefit transfer approach. However, this has not been valued at this stage as it is unclear about the significance of the marshlands that reside in this study area and whether this WTP value can be applied. This will be informed and investigated through stakeholder engagement in a later stage of the study.

5. Site C – Old Beach

5.1 Site overview

Situated on the southern boundary of Brighton LGA, Site C (Old Beach) is the largest of the three sites. The site has a diversity of land uses close to the river foreshore, mostly residential and open space. An electricity transmission corridor also runs through the site.

The Derwent River foreshore stretches along the site from the south of Herdsman's Cove to Old Beach at the boundary of the LGA and is covered by a waterway and coastal protection overlay. The popular council-maintained Old Beach walking track lines the foreshore. This area is Crown land and maintained according to its waterway and coastal protection overlay. The site boasts natural assets including the Clarrie's Creek and Gagebrook tributary, saltmarshes, and numerous open spaces. There is threatened native vegetation within the site (see Figure 16). The natural values within the site are shown in Figure 17.

The site also contains 25 known Aboriginal Heritage Shell Middens[23] and several Artefact Scatters[24] predominantly along the Old Beach walking track[25] (Figure 15).

The East Derwent Highway is the primary route of entry/exit to the municipality and Jetty Road provides boat access to the Derwent River via the Old Beach Jetty. There is a walkway planned (currently a sand footpath) for the north of the Jetty.

[23] Distinct concentrations of discarded shell that have accumulated as a result of past Aboriginal camping and food processing activities.
[24] A stone artefact is any stone or rock fractured or modified by Aboriginal people to produce cutting, scraping or grinding implements.
[25] Brighton Council (2022), Aboriginal Heritage Tasmania Old Beech Map.

FIGURE 15: SITE C CONTEXT MAP

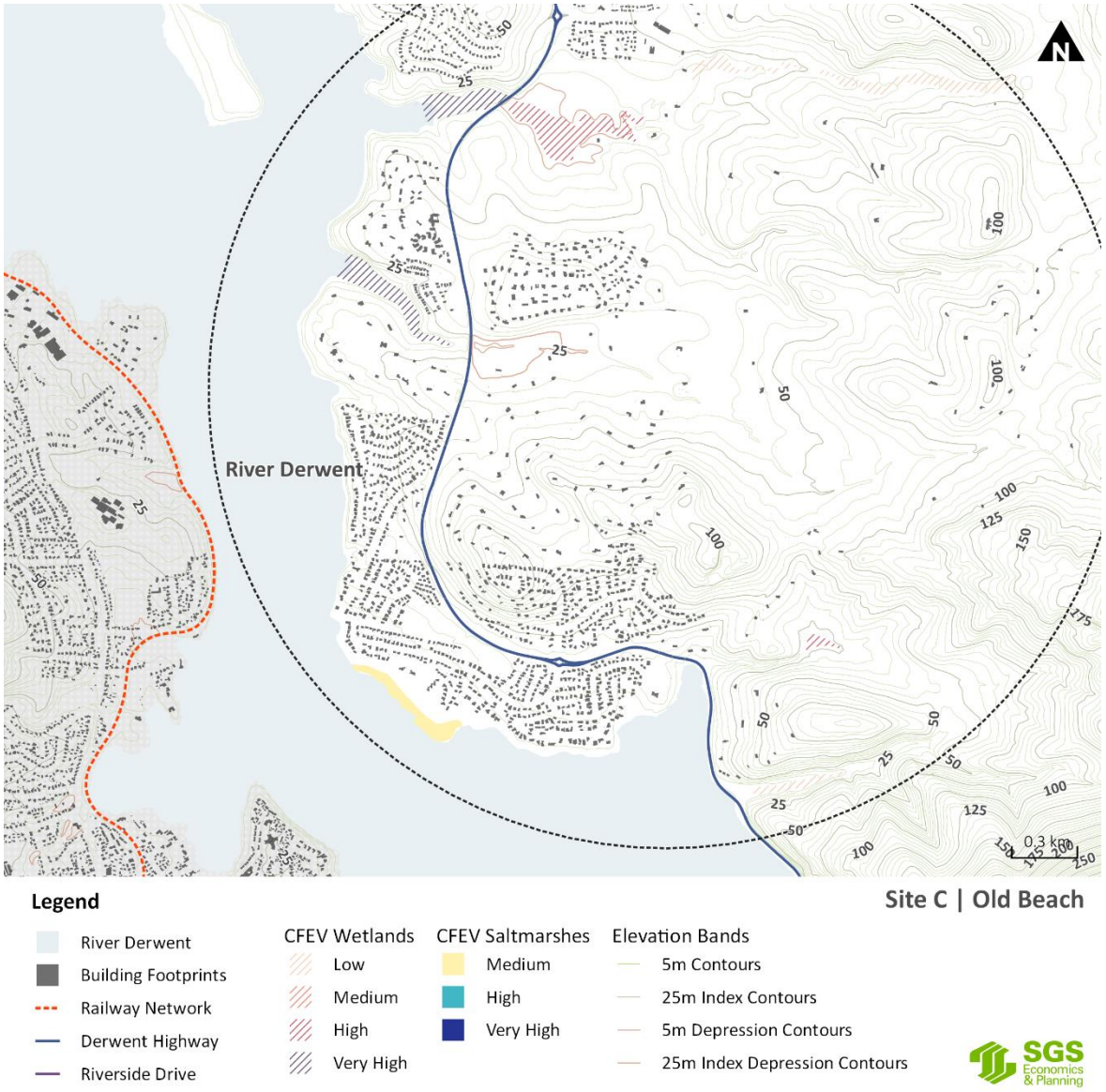


FIGURE 16: SITE C CONTEXT - THREATENED NATIVE VEGETATION

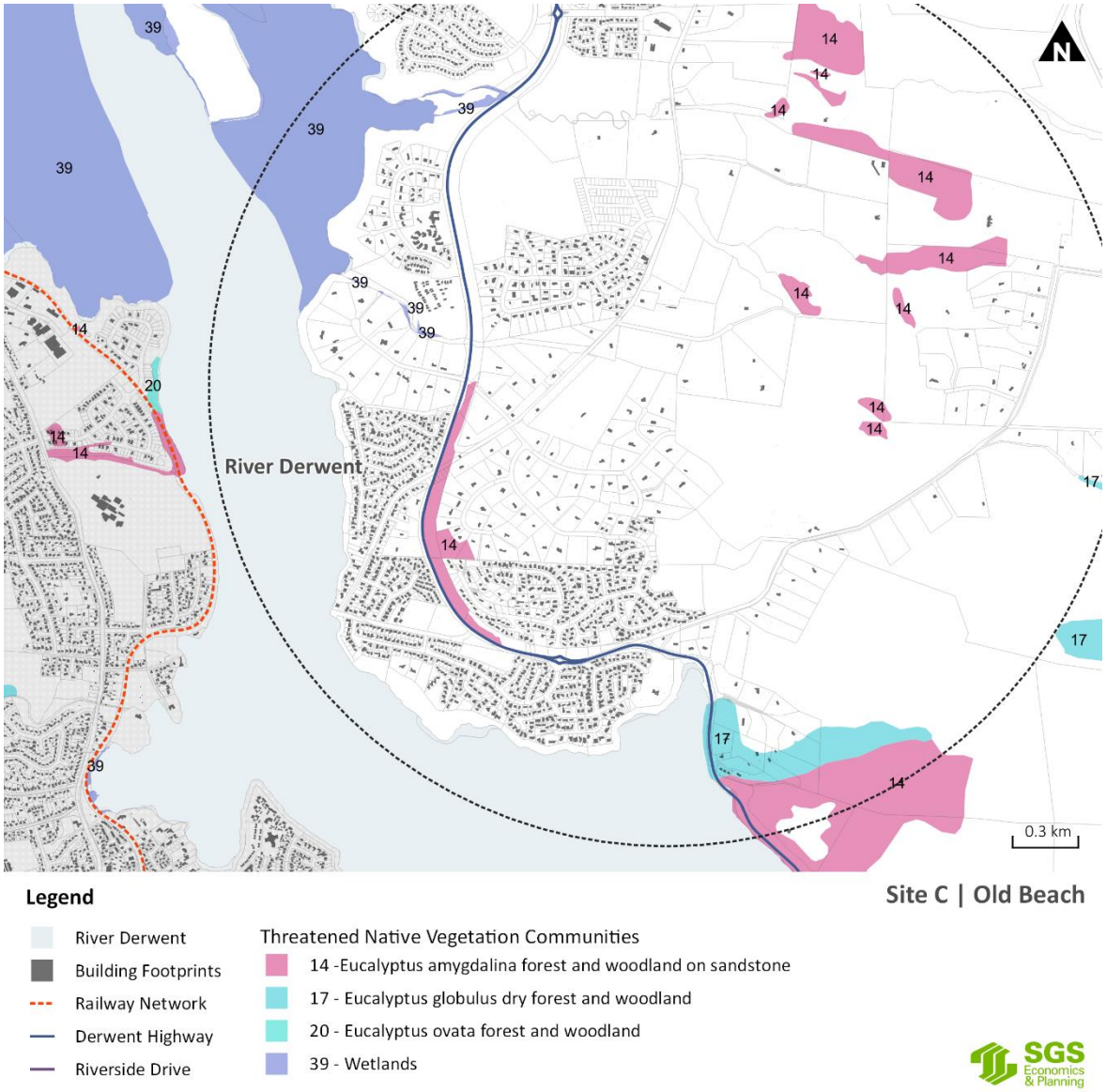
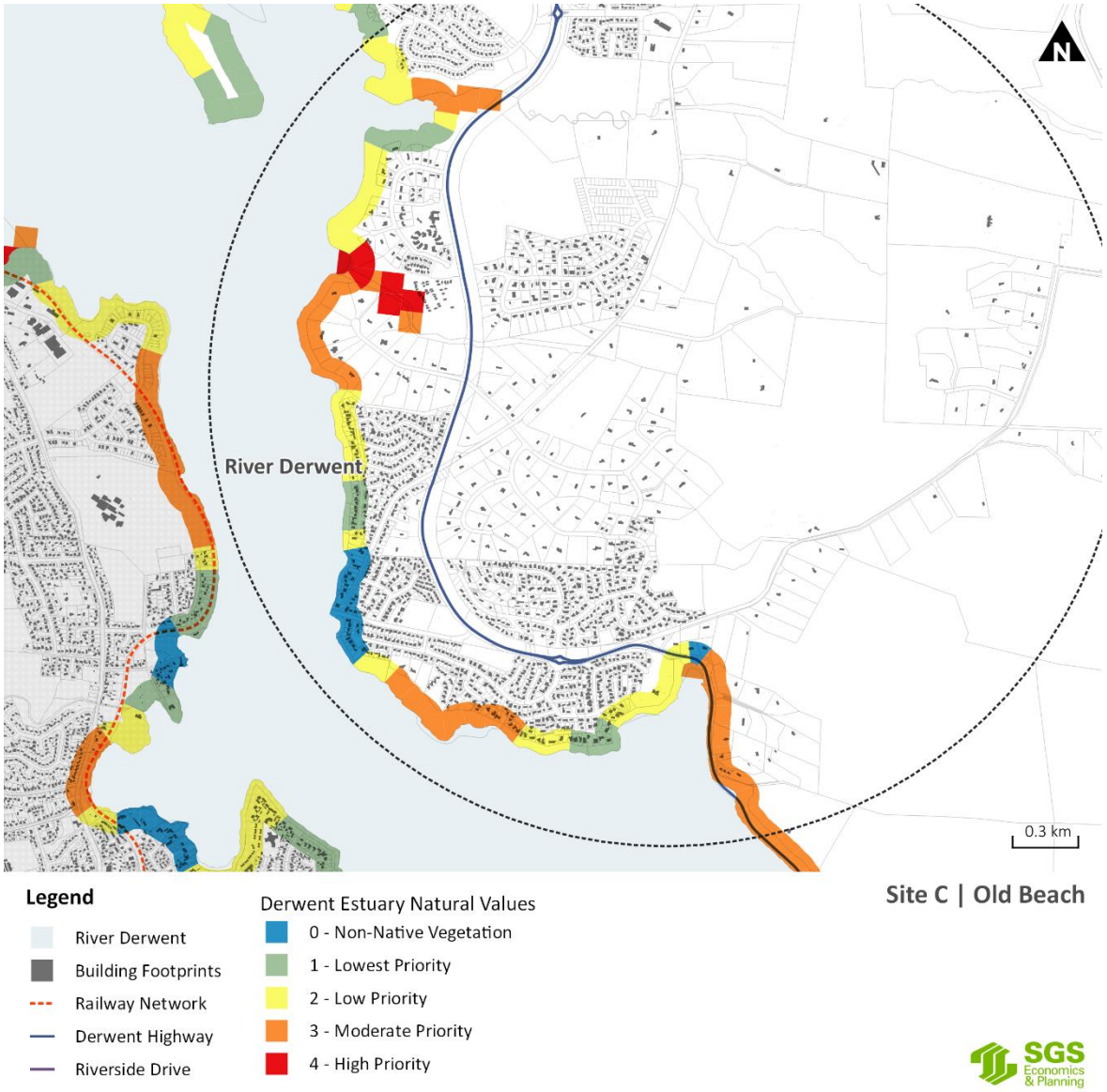


FIGURE 17: SITE C CONTEXT - NATURAL VALUES



5.2 Coastal Erosion Hazards

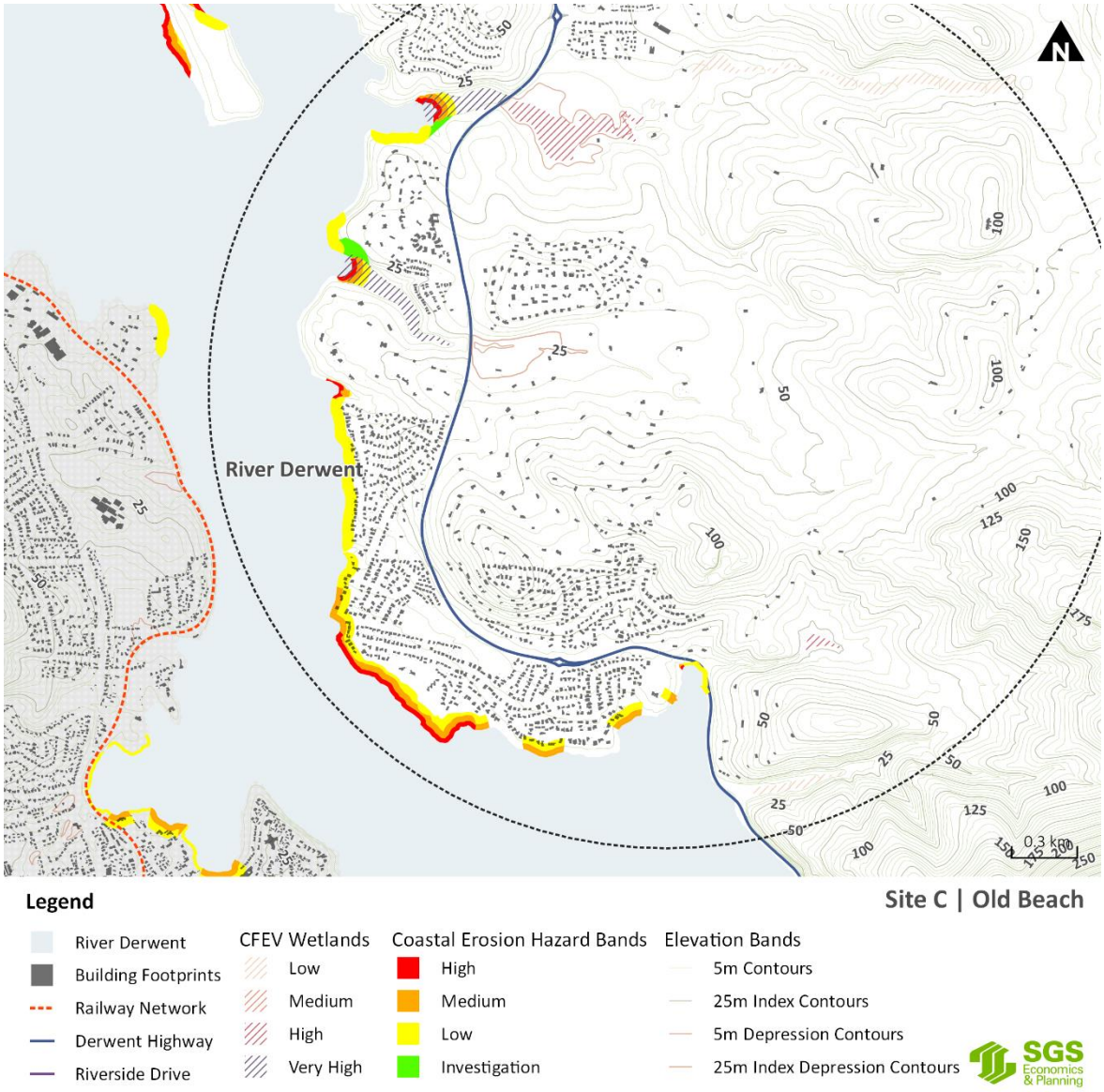
The coastal erosion susceptibility hazard bands for the study area are shown in Figure 18. The map shows that there are high, medium, low and investigation coastal erosion hazard bands all present in Site C:

- High hazard band: four sections of land along the Derwent River foreshore are *currently* vulnerable to coastal recession. The most significant of these is the open space south of the boat ramp (off Jetty Road) and along the Old Beach walking track. Over time, with sea level rise, erosion will increasingly become a risk, if nothing is done to manage the risk.

- **Medium hazard band**: directly abutting the area defined as a high hazard band, moving inland, is vulnerable to coastal recession to 2050 as sea level rise progresses to 0.2m. Most significantly, the medium coastal erosion hazard band encompasses the Old Beach walking track itself, several private properties and the boat ramp on Jetty Road.
- **Low hazard band:** set back from the medium hazard band, moving inland, the area is vulnerable to coastal erosion by 2100 as sea level rise progresses to 0.8m. There is also a significant stretch of land along the River Derwent foreshore, north of the boat jetty, that is classified as a low hazard band. This area captures private properties on Morrisby Road.

Investigation hazard band: two areas to the north of Site C contain an investigation hazard band, two of which encompasses the Clarries Creek tributary and Gage Brook tributary. These areas are adjacent to coastlines yet to be classified due to incomplete or unavailable landform data.

FIGURE 18: SITE C - COASTAL EROSION



Source: SGS Economics and Planning, 2023

5.3 Coastal Erosion Assets at Risk

In terms of present-day risk, coastal erosion is relatively sparse, primarily limited to marshlands located south of the Jetty Road Boat Ramp or within a small section of Site C's coves. A small section of the East Derwent Highway (State Government owned) at the southern end of the Old Beach site is within the low erosion hazard band.

Currently, the land is expected to recede by approximately 20 meters from the riverbanks. However, by 2050, this recession is projected to grow, affecting not only these areas but also other parts of the study area. With the potential erosion, the land may recede by up to 30 meters inland. As a result of this progression, three residential properties, a boat ramp, a minor section of a vehicle track, and a few segments of a hiking trail are likely to be impacted.

The projected impact in 2100 suggests that not only the current areas but also additional regions will be negatively affected, with exacerbated risk. The land may recede by 60 meters inland at its most vulnerable point. As a result, the community will experience significant consequences, particularly as 30 residential properties face long-term risks.

TABLE 19: VALUES OF BUILDINGS AT RISK – EROSION RISK

	High Risk Hazard Band		Medium Risk Hazard Band		Low Risk Hazard Band	
	Capital Value ($)	Count	Capital Value ($)	Count	Capital Value ($)	Count
Private properties	0	0	2,180,000	4	15,907,500	30

Source: SGS Economics and Planning, 2023

TABLE 20: VALUES OF PUBLIC INFRASTRUCTURE AT RISK – EROSION RISK

	High Risk Hazard Band		Medium Risk Hazard Band		Low Risk Hazard Band	
	Capital Value ($)	Count	Capital Value ($)	Count	Capital Value ($)	Count
Boat Ramp	$0	0	$126,294	1	$126,294	1
Roads	$4,917	0.0km	$21,552	0.1km	$334,749	0.8km
Hiking Track	$22,300	0.2km	$53,600	0.5km	$110,300	1.1km
Total	**$64,650**	**N/A**	**$201,446**	**N/A**	**$571,343**	**N/A**

Source: SGS Economics and Planning, 2023
Note: Boat Ramp derived from costs of land backed wharve (precast concrete interlocking piles and reinforced concrete ground slab)

(no electrical and water services), Roads based on composite price of suburban road with in situ concrete kerbs (6m wide), Trail calculated based on paved footpath (1500mm wide)

The foreshore area is likely to see a moderate impact from erosion, which is expected to increase as land recession risk develops in the future.

TABLE 21: NON-VALUED ASSETS AT RISK – EROSION RISK

	High Risk Hazard Band	Medium Risk Hazard Band	Low Risk Hazard Band
Open space (ha)	5.13	8.02	15.53

Source: SGS Economics and Planning, 2023

Two shell middens appear to lie in land marked in high erosion hazard band, three are in the medium risk band, while seven are in the low hazard band. Altogether this indicates that twelve items in Site C are at risk of erosion.

Most of the shoreline at Site C is vulnerable to coastal erosion to some degree, while there are a variety of natural values with which these hazard bands intersect. There are multiple inlets along the shoreline, the northernmost two of which are considered to have Very High integrated conservation value by CFEV. These inlets also have high risk hazard band coverage for coastal erosion, suggesting that they are currently vulnerable to coastal recession. These sites are also considered to have moderate to high priority in the Derwent Estuary natural values dataset. There are also multiple threatened native vegetation communities, including wetlands which incorporate the above-mentioned vulnerable inlets, along the northern coast of Site C, which is vulnerable to coastal erosion. This is shown in Figure 16, which also highlights pockets of threatened Eucalyptus amygdalina and Eucalyptus globulus dry forest and woodland, at the southern end of Site C's coastline. However currently, these natural values are not at risk of coastal erosion.

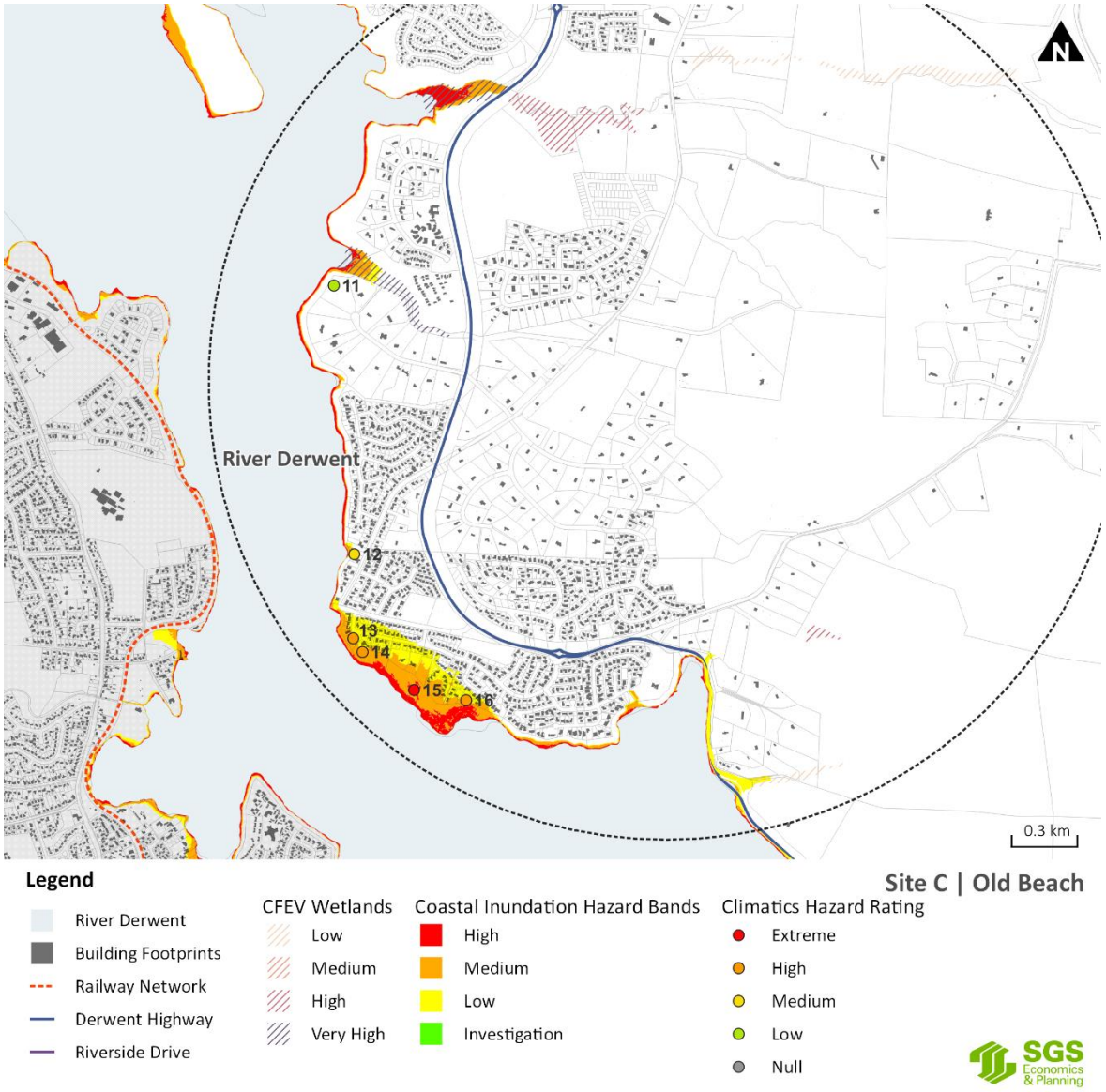
5.4 Coastal Inundation Hazards

Future coastal inundation risks will increase as climate change leads to sea levels to rise. Coastal sea level rise mapping of Site C (Figure 19) reveals areas with low, medium and high coastal inundation hazard bands:

- High hazard band: the entire length of the foreshore along the Derwent River is classified as a high coastal inundation hazard band and will be within 0.2m SLR from MHT line by 2050 and is currently impacted by the Highest Astronomical Tide. During extreme events, inundation affects land across the walking track, and in some cases, water has already flowed over the track without causing (substantial) damage.
- Medium hazard band: set back from the medium hazard band along the Derwent River foreshore, moving inland, land is classified as a medium hazard band, meaning the area is vulnerable to a 1% AEP storm event in 2050 and will be impacted by a 0.8m SLR by 2100. Most significantly, the medium hazard band encompasses private properties on Sun Valley Drive and Fouche Avenue, south of the boat ramp. The medium hazard band also covers the Gage Brook tributary, to the north of the site, and stretches inland to the East Derwent Highway.

- **Low hazard band**: land abutting the medium hazard band, inland, is vulnerable to a 1% AEP storm event in 2100 and medium-term flooding issues. Most significantly, the low hazard band encompasses private properties on Jetty Road, Sun Valley Drive and Fouche Avenue, south of the boat ramp.

FIGURE 19: SITE C - COASTAL INUNDATION



Source: SGS Economics and Planning, 2023

Verification with Climatics

As Figure 19**Error! Reference source not found.** shows, effectively the entire foreshore of Site C is at s ome level of risk from coastal inundation. The worst affected area is the council-maintained Old Beach foreshore walk, where the inundation risk extends inland further than along the rest of the foreshore. SGS used Climatics data to verify these hazard risks, by identifying several representative locations within Site C to assess their exposure to range of climate hazards. The open space to the south of the

foreshore walk is assessed to be at extreme risk, or that there is a theoretical direct impact from a 1-in-20-year flooding event. Elsewhere along the foreshore, areas are at medium to high risk, including residential land near the foreshore walk. This aligns with the coastal inundation hazard bands identified by DPAC, some of which cover residential land adjacent to the foreshore walk.

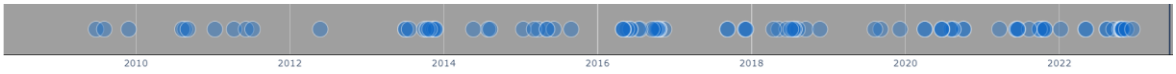
TABLE 22: RISK RATING ALIGNMENT BETWEEN CLIMATICS AND DPAC, SITE C

Location	Climatics risk rating	DPAC Hazard band	Alignment
11	Low: flooding impact on this site with 1% AEP	Null	Both predict no direct impact from flooding
12	Medium: Flooding impact on this site with 1% AEP	Low	Climatics (1% AEP currently) predicts greater risk than DPAC (1% AEP by 2100).
13	High: Flooding impact on this site with 2% AEP	Medium	Climatics (2% AEP currently) predicts greater risk than DPAC (1% AEP by 2050).
14	High: Flooding impact on this site with 2% AEP	Medium	Climatics (2% AEP currently) predicts greater risk than DPAC (1% AEP by 2050).
15	Extreme: Flooding impact on this site with 5% AEP	Medium	Climatics (5% AEP currently) predicts greater risk than DPAC (1% AEP by 2100). This is the biggest deviation across all locations.
16	High: Flooding impact on this site with 2% AEP	Medium	Climatics (2% AEP currently) predicts greater risk than DPAC (1% AEP by 2050).

Source: Climatics; DPAC; SGS Economics and Planning, 2023

The Derwent river foreshore walk is an area of particular concern, identified by both datasets. The coastal inundation hazard bands extend further inland in this area than along the rest of the foreshore, and the sites analysed using Climatics data all demonstrated high to extreme risk. Figure 20 below demonstrates a trend of increasing frequency of flood events over the last decade along the Derwent River foreshore walk.

FIGURE 20: TIMELINE OF FLOOD EVENTS AT SITE C



Source: Climatics

5.5 Coastal Inundation Assets at Risk

Inundation is the most significant risk to this study area, and over time will increasingly expose both public assets and private dwellings, if nothing is done to manage the risk. Especially the number of dwellings at risk in the future is a point of concern. Initially Crown land and public assets such as the walking track will be at risk, but as sea levels continue to rise, these risks will also affect dwellings. Notably, a small section of the East Derwent Highway (State Government owned) at the southern end of the Old Beach site is also at risk.

Currently, the extent of inundation is very limited and does not affect existing residential dwelling, although parts of the land of properties is at a low-level risk (i.e., gardens). There are several vacant land parcels that will need to consider inundation risk in their design to withstand 1%AEP events in the future. However, as the risk increases, it is anticipated that 19 properties may face the possibility of

being inundated by a 1% AEP storm event in 2050. And these properties would be regularly inundated by 2100 or a sea level rise of 0.8m.

Over the long term, the risk of a 1% AEP storm event in 2100 will continue to escalate, leading to a significant number of additional houses being at risk of inundation, which include an additional 62 properties. As well, a larger amount of public infrastructure will also be susceptible to inundation as the timeframe progresses.

TABLE 23: VALUES OF PROPERTIES AT RISK (ADJUSTED CAPITAL, EXCLUDING LAND VALUES) – INUNDATION RISK

	High Risk Hazard Band		Medium Risk Hazard Band		Low Risk Hazard Band	
	Capital Value ($)	Count	Capital Value ($)	Count	Capital Value ($)	Count
Private properties	0	0	8,297,500	18	35,577,500	79
Government-owned properties	0	0	102,500	1	103,300	2
Total	**0**	**0**	**8,400,000**	**19**	**35,680,800**	**81**

Source: SGS Economics and Planning, 2023

Note: Includes 20 properties that may be affected by a low risk of inundation on Morrisby Rd. Values have been estimated based on average prices for Site C.

Certain parts of the hiking trail are at risk at present day, and this will increase substantially over time with greater parts of the Crown land and public infrastructure at risk.

TABLE 24: VALUES OF PUBLIC INFRASTRUCTURE AT RISK – INUNDATION RISK

	High Risk Hazard Band		Medium Risk Hazard Band		Low Risk Hazard Band	
	Capital Value ($)	Count	Capital Value ($)	Count	Capital Value ($)	Count
Boat Ramp	$0	0	$37,433	1	$37,433	1
Roads	$0	0	$110,934	0.27km	$489,050	1.19km
Hiking Track	$0	0	$26,144	0.3km	$26,144	0.3km
Total	**$0**	**N/A**	**$174,511**	**N/A**	**$552,627**	**N/A**

Source: SGS Economics and Planning, 2023

Note: Boat Ramp derived from costs of land backed wharve (precast concrete interlocking piles and reinforced concrete ground slab) (no electrical and water services), Roads based on composite price of suburban road with in situ concrete kerbs (6m wide), Trail calculated based on paved footpath (1500mm wide)

The study area has a relatively large parcel of foreshore Crown land which is particularly vulnerable to inundation, particularly the area adjacent to the hiking trail. Most highlighted in the table below is that inundation from a 1% AEP storm event poses a high risk to the present day.

TABLE 25: NON-VALUED ASSETS AT RISK – INUNDATION RISK

	High Risk Hazard Band	Medium Risk Hazard Band	Low Risk Hazard Band
Open space (ha)	12.55	15.03	15.03

Source: SGS Economics and Planning, 2023

Approximately, 21 Aboriginal Heritage items are covered by high coastal inundation hazard bands in Site C. About four items are not at risk of inundation.

The northern inlets which are considered to have Very High integrated conservation values are also at risk from coastal inundation, high and medium hazard bands. This suggests that these wetlands and other natural values at these locations are vulnerable to sea level rise by between 2050 and 2100, if not affected by storm events prior. The threatened native vegetation clusters containing eucalyptus globulus and eucalyptus amygdalina dry forest and woodland communities are threatened by low to medium hazard bands for coastal inundation, indicating vulnerability to sea level rise by the end of the century. At the Derwent River foreshore walk, there is a pocket of medium integrated conservation value saltmarsh identified by CFEV that are covered by medium to high coastal inundation hazard bands.

5.6 Stormwater hazards

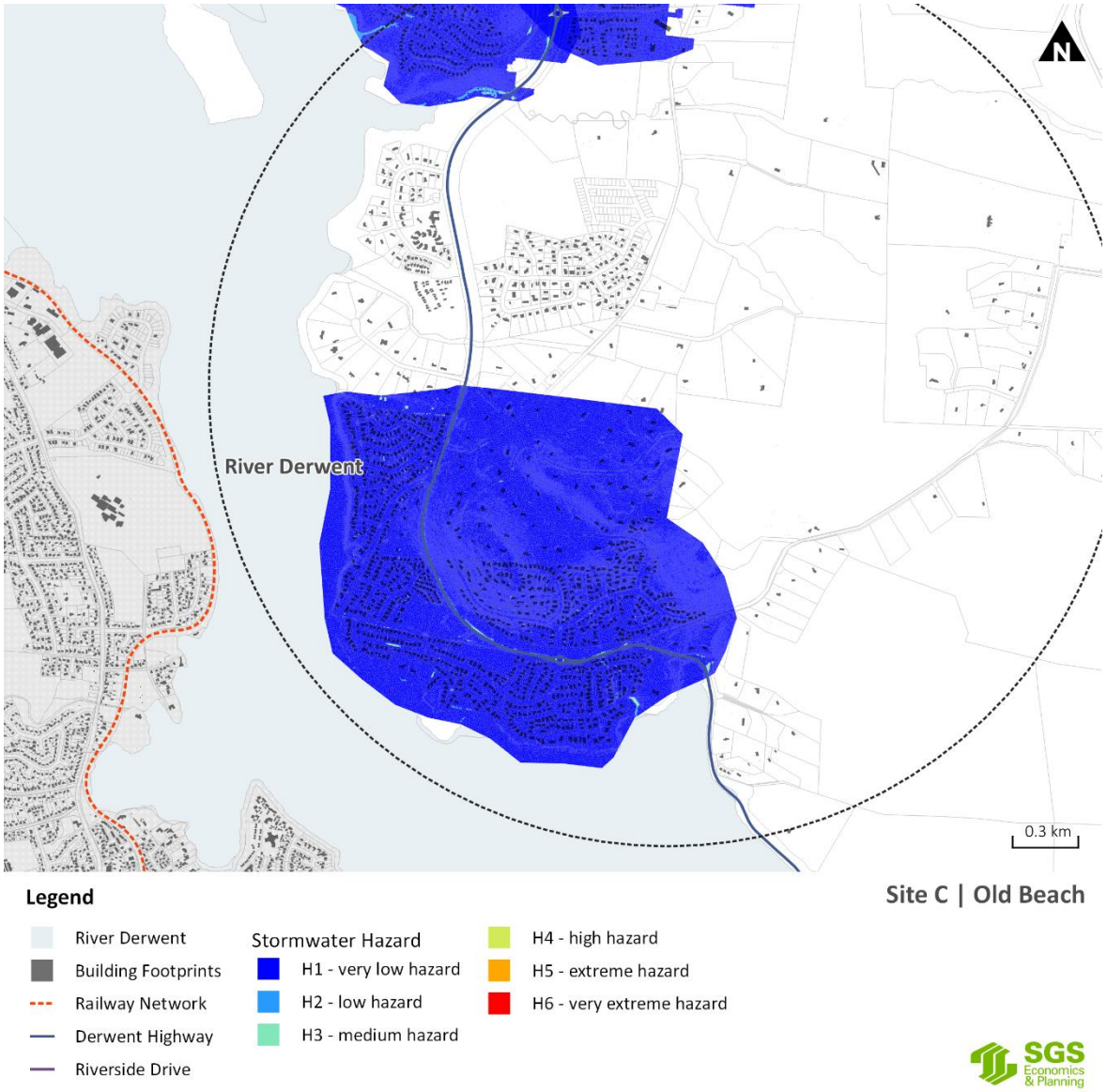
A significant area of land in Site C is vulnerable to stormwater drainage hazards (Figure 21). This area includes residential, recreational, and private uses. With sea level rise it is reasonable to assume that stormwater drainage issues, such as the need to manage stormwater via the overflow, will gradually increase over time. Contributing factors are increased water table and higher storm surges.

Several hundred houses and other buildings are at very low risk. Public infrastructure at very low risk includes the East Derwent Highway (State Government owned) and the Old Beach Jetty.

About 11 Aboriginal Heritage items are at a very low risk from Stormwater hazards.

The area of stormwater hazard overlaps with areas assessed with natural values ranging from lowest to moderate priority along the coastline, including the Old Beach saltmarshes.

FIGURE 21: SITE C - STORMWATER HAZARDS



Source: SGS Economics and Planning, 2023

5.7 Summary

Site C stands out as the most concentrated and densely populated area compared to the other sites and is home to a relatively larger community. Consequently, the risk of both coastal erosion and inundation, although primarily confined to the vicinity of the riverbank, is projected to have a more significant impact on the community residing in Site C. Despite numerous businesses and organisations located here, they are unlikely to be affected by coastal hazards as they are located inland away from hazards.

At present day, there are no residential properties potentially at risk of either erosion or inundation. As the potential for erosion and inundation escalates to the medium hazard band, approximately 20

residential properties may be impacted, with a total value of about $9.6 million. This value is expected to grow with a low-risk hazard band, whereby, a total of 101 properties is potentially at risk of erosion and inundation due to extreme events. The total value of these properties is around $47.1 million.

TABLE 26: VALUES OF PRIVATE PROPERTIES AT RISK (ADJUSTED CAPITAL, EXCLUDING LAND VALUES)

	High Risk Hazard Band		Medium Risk Hazard Band		Low Risk Hazard Band	
	Capital Value ($)	Count	Capital Value ($)	Count	Capital Value ($)	Count
Private properties	0	0	9,500,000	20	46,998,300	100
Government-owned properties	0	0	102,500	1	103,300	1
Total	**0**	**0**	**9,602,500**	**21**	**47,101,600**	**101**

Source: SGS Economics and Planning, 2023

Site C is also home to public assets that is expected to be at risk of erosion, storm events and inundation, including roads, footpaths and a boat ramp.

TABLE 27: VALUES OF PUBLIC INFRASTRUCTURE AT RISK

	High Risk Hazard Band		Medium Risk Hazard Band		Low Risk Hazard Band	
	Capital Value ($)	Count	Capital Value ($)	Count	Capital Value ($)	Count
Boat Ramp	0	0	126,294	1	126,294	1
Roads	4,917	0.0km	93,343	0.2km	1,079,989	2.6km
Track	22,761	0.2km	184,550	1.8km	243,382	2.4km
Total	**153,971**	**N/A**	**404,187**	**N/A**	**1,449,664**	**N/A**

Source: SGS Economics and Planning, 2023
Note: Boat Ramp derived from costs of land backed wharve (precast concrete interlocking piles and reinforced concrete ground slab) (no electrical and water services), Roads based on composite price of suburban road with in situ concrete kerbs (6m wide), Trail calculated based on paved footpath (1500mm wide)

The foreshore is expected to be at risk of erosion, storm events and inundation, summarised in the following table.

TABLE 28: NON-VALUED ASSETS AT RISK

	High Risk Hazard Band	Medium Risk Hazard Band	Low Risk Hazard Band

Open space (ha)	12.83	15.61	19.65

Source: SGS Economics and Planning, 2023

12 Aboriginal Heritage items are at varying risks from coastal erosion, while 21 are at high risk from inundation. About 11 Aboriginal Heritage items are at a very low risk from stormwater hazards.

Site C is home to a variety of natural values, including threatened native vegetation communities, in particular wetlands in the north of the site, which include inlets that are considered to have Very High integrated conservation value. These natural values are particularly vulnerable to both coastal erosion – being at risk of coastal recession currently – and coastal inundation, with sea level rise posing the risk of submerging the sites by between 2050 and 2100.

Appendix A: Bridgewater Bridge

Bridgewater Bridge

The Bridgewater Bridge (the bridge) is Tasmania's largest transport project.

This Project ***does not*** include an assessment of the land and infrastructure associated with the upgrade of the Bridgewater Bridge – climate change impact assessments are a separate piece of work being carried out by Brighton Council.

The bridge, which will replace an existing crossing and will be completed by the end of 2024. It is a critical part of the transport and freight link between the northern and southern regions of Tasmania. The bridge will consist of a four-lane road for vehicles and crossing for pedestrian and cyclists.

The new bridge crosses the Derwent River, a major freshwater inflow to the Derwent Estuary. As such, the following marine and coastal works associated with the project include:

- Temporary works including access structures, hardstands and piled structures for the construction of the bridge substructure and superstructure
- Formation of new bridge abutments landside of the river (Granton and Bridgewater)
- Piling works within the waterways including concrete pile caps and piers
- Demolition of the existing bridge and rehabilitation of areas
- Land reclamation on coastal areas for construction access and temporary works
- Modifications to existing and creation of new stormwater infrastructure
- Barge and work boats for construction activities
- New load out ramps and structures for construction access from land to river.[26]

The Department of State Growth commissioned a series of assessments to assess the implications of the project on coastal hazards, the key findings are summarised in the table below.

TABLE 29: BRIDGEWATER BRIDGE COSTAL HAZARDS

Assessment	Implications for coastal hazards
Coastal Inundation Assessment	– The bridge extents are generally outside the inundation and erosion risk areas. – The bridge will not increase the risk of inundation to the upstream or downstream causeway areas or banks.
Coastal Erosion Assessment	– There will be no measurable increase risk in erosion of the coastal areas the planned works are constructed on or adjacent to due to the construction or operation of the bridge.

[26] Burbury Consulting, 2021, 'New Bridgewater Bridge Costal Inundation Assessment', Department of State Growth, pp. 4-6.

	– The bridge will not lead to worsening of the flow regime of the Derwent River and consequent erosion. – Any new shoreline reclamation or building pads constructed into the waterways should be armoured with appropriate rock protection to minimise the risk of erosion from waves,, stormwater or flooding.
Aquatic Risk Assessment	– The construction of the bridge poses considerable risks to the aquatic environment. The key risks are through sediment disturbance and changes to hydrodynamics. – The project will cause an unavoidable loss of a relatively large area of *Ruppia megacarpa* (TSPA-listed rare plant species) directly beneath the bridge. It is possible that this plant may also be lost further downstream as a result. – Plants and animals may be impacted by the project due to elevated metal concentrations, reduced light through suspended sediment, reduced dissolved oxygen and epiphytic algal overgrowth. – If construction follows mitigation measures, the aquatic risk and long-term impact of the project can be considered 'low'.
Flood Hazard Report	– The bridge will not significantly alter the water levels in the Derwent River. – Future flooding caused by 1% AEP events and exacerbated by climate change water-level and rain intensity increases, is expected to cause increased flooding throughout the Derwent Estuary and River system regardless of the development. – The design of the new bridge should include provision for water level rises anticipated due to climate change and, additionally, for flooding associated with 1% AEP events.
Hydrodynamic Modelling	– The impacts of the project on water quality are mostly confined to be close to the works, and mainly to the southern shore of the Derwent River downstream to the confluence with the Jordan River.

Source: Burbury Consulting (2021), Marine Solutions (2021), Entura (2021).

Notes: Annual Exceedance Probability (AEP) 1% translates to a 1 in 100-year occurrence.

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