Clarence... a brighter place

DEVELOPMENT APPLICATION

PDPLANPMTD-2024/044195

PROPOSAL: Additions & Alterations (Outbuilding)

LOCATION: 47 Balook Street, Lauderdale

RELEVANT PLANNING SCHEME: Tasmanian Planning Scheme - Clarence

ADVERTISING EXPIRY DATE: 10 July 2024

The relevant plans and documents can be inspected at the Council offices, 38 Bligh Street, Rosny Park, during normal office hours until 10 July 2024. In addition to legislative requirements, plans and documents can also be viewed at www.ccc.tas.gov.au during these times.

Any person may make representations about the application to the Chief Executive Officer, by writing to PO Box 96, Rosny Park, 7018 or by electronic mail to clarence@ccc.tas.gov.au. Representations must be received by Council on or before 10 July 2024.

To enable Council to contact you if necessary, would you please also include a day time contact number in any correspondence you may forward.

Any personal information submitted is covered by Council's privacy policy, available at www.ccc.tas.gov.au or at the Council offices.

Clarence City Council

Clarence... a brighter place

APPLICATION FOR DEVELOPMENT / USE OR SUBDIVISION

*The personal information on this form is required by Council for the development of land under the Land Use Planning and Approvals Act 1993. We will only use your personal information for this and other related purposes. If this information is not provided, we may not be able to deal with this matter. You may access and/or amend your personal information at any time. How we use this information is explained in our **Privacy Policy**, which is available at www.ccc.tas.gov.au or at Council offices.*

Proposal: EXTENSION TO EXISTING OUTBUILDING

Location:
Address 47 BALOOK STREET
Suburb/Town VAUDERDALE Postcode

Current Owners/s:

Applicant:

Personal Information Removed

Tax Invoice for application fees to be in the name of:
(if different from applicant)

Estimated cost of development $10,000

Is the property on the Tasmanian Heritage Register? Yes [ ] No [X]

(if yes, we recommend you discuss your proposal with Heritage Tasmania prior to lodgement as exemptions may apply which may save you time on your proposal)

If you had pre-application discussions with a Council Officer, please give their name: HOWY

Current Use of Site: RESIDENTIAL DWELLING.

Does the proposal involve land administered or owned by the Crown or Council? Yes [ ] No [X]

Declaration:

- *I have read the Certificate of Title and Schedule of Easements for the land and am satisfied that this application is not prevented by any restrictions, easements or covenants.*
- *I authorise the provision of a copy of any documents relating to this application to any person for the purposes of assessment or public consultation. I agree to arrange for the permission of the copyright owner of any part of this application to be obtained. I have arranged permission for Council's representatives to enter the land to assess this application*
- *I declare that, in accordance with Section 52 of the Land Use Planning and Approvals Act 1993, that I have notified the owner of the intention to make this application. Where the subject property is owned or controlled by Council or the Crown, their signed consent is attached. Where the application is submitted under Section 43A, the owner's consent is attached.*
- *I declare that the information in this declaration is true and correct.*

Acknowledgement:

- *I acknowledge that the documentation submitted in support of my application will become a public record held by Council and may be reproduced by Council in both electronic and hard copy format in order to facilitate the assessment process; for display purposes during public consultation; and to fulfil its statutory obligations. I further acknowledge that following determination of my application, Council will store documentation relating to my application in electronic format only.*

Applicant's Signature:

Signature J. Matter *Date* 12/5/2024.

PLEASE REFER TO THE DEVELOPMENT/USE AND SUBDIVISION CHECKLIST ON THE FOLLOWING PAGES TO DETERMINE WHAT DOCUMENTATION MUST BE SUBMITTED WITH YOUR APPLICATION.

RESULT OF SEARCH

RECORDER OF TITLES

Issued Pursuant to the Land Titles Act 1980

SEARCH OF TORRENS TITLE

VOLUME	FOLIO
13725	49
EDITION	DATE OF ISSUE
1	28-May-2008

SEARCH DATE : 16-Mar-2023
SEARCH TIME : 11.51 AM

DESCRIPTION OF LAND

City of CLARENCE
Lot 49 on Plan 13725
Being the land described in Conveyance No.43/2867
Derivation : Part of 700A-0R-0P Loc.to E.S.P Bedford.
Derived from A21063

SCHEDULE 1

C631788 TRANSFER to PHILLIP JAMES HUTCHEON Registered 28-May-2008 at 12.01 PM

SCHEDULE 2

Reservations and conditions in the Crown Grant if any

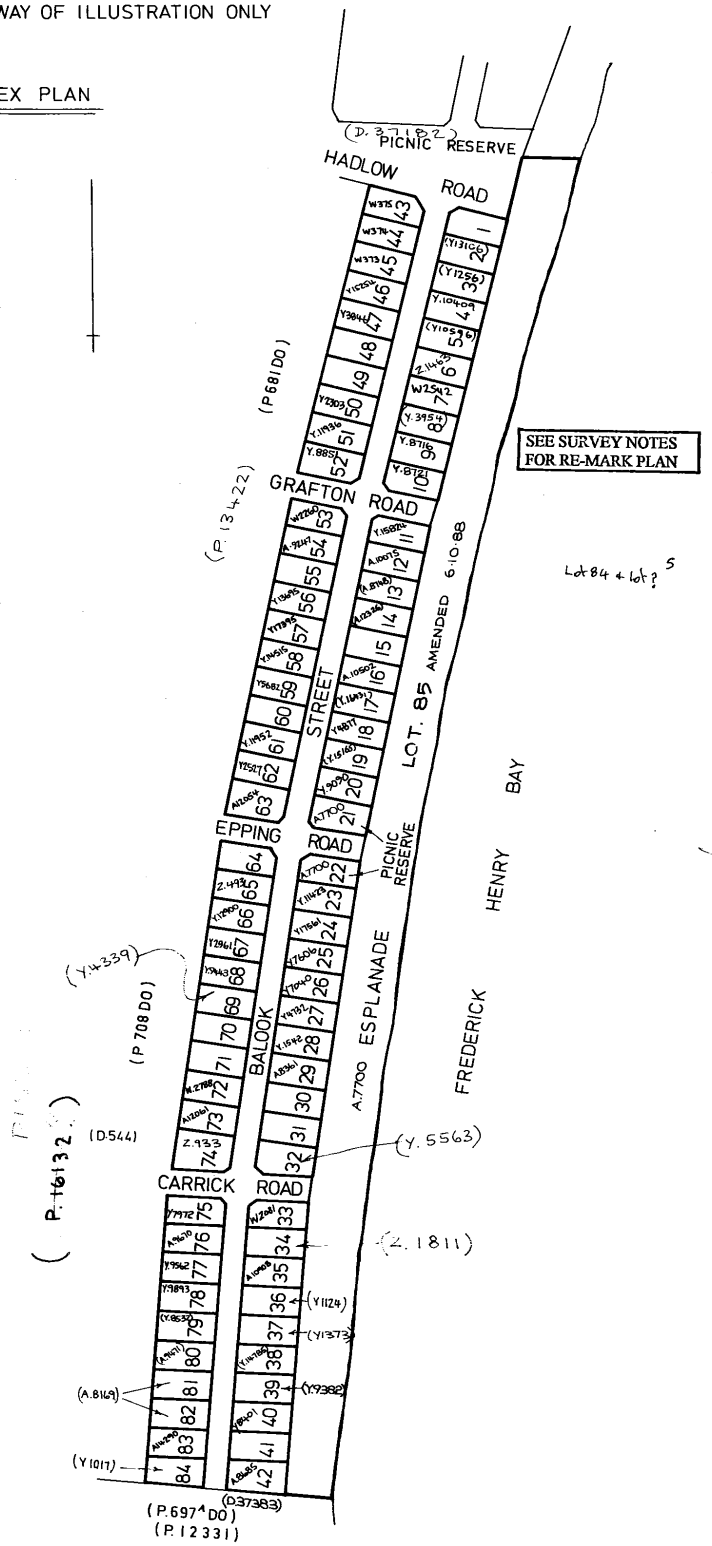
UNREGISTERED DEALINGS AND NOTATIONS

No unregistered dealings or other notations

Owner: DECEASED PERSONS ESTATE	**PLAN OF SURVEY** by Surveyor ..... of land situated in the ~~TOWN OF LAUDERDALE~~ CITY OF CLARENCE	**Registered Number:** P.13725
Title Reference: Z 933 (LOT 74) Z. 493 (LOT 65)		APPROVED 14 FEB 1980 ~~Effective from~~ ACTING Recorder of Titles
Grantee: PART OF 700 Ac. LOC. TO E. S. B.P. BEDFORD	NOT TO SCALE	

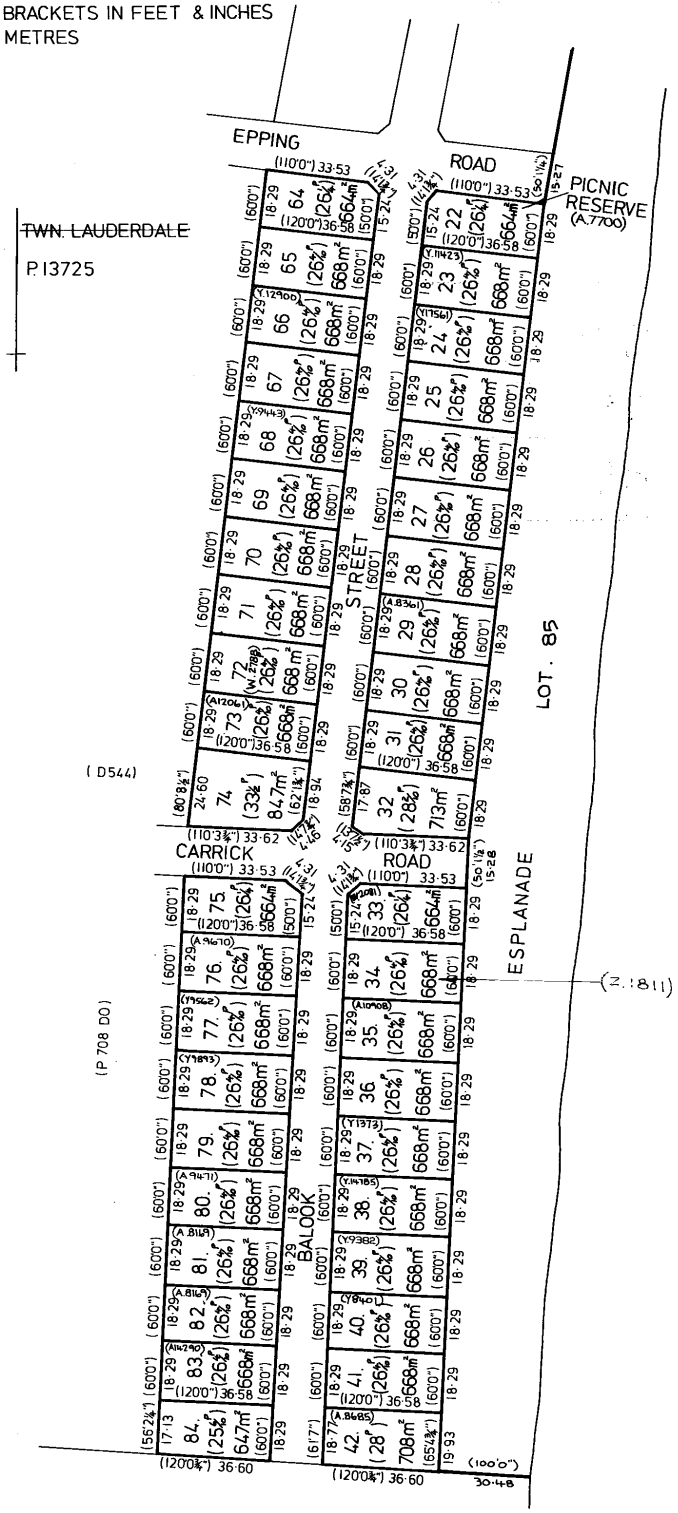
SKETCH BY WAY OF ILLUSTRATION ONLY

INDEX PLAN

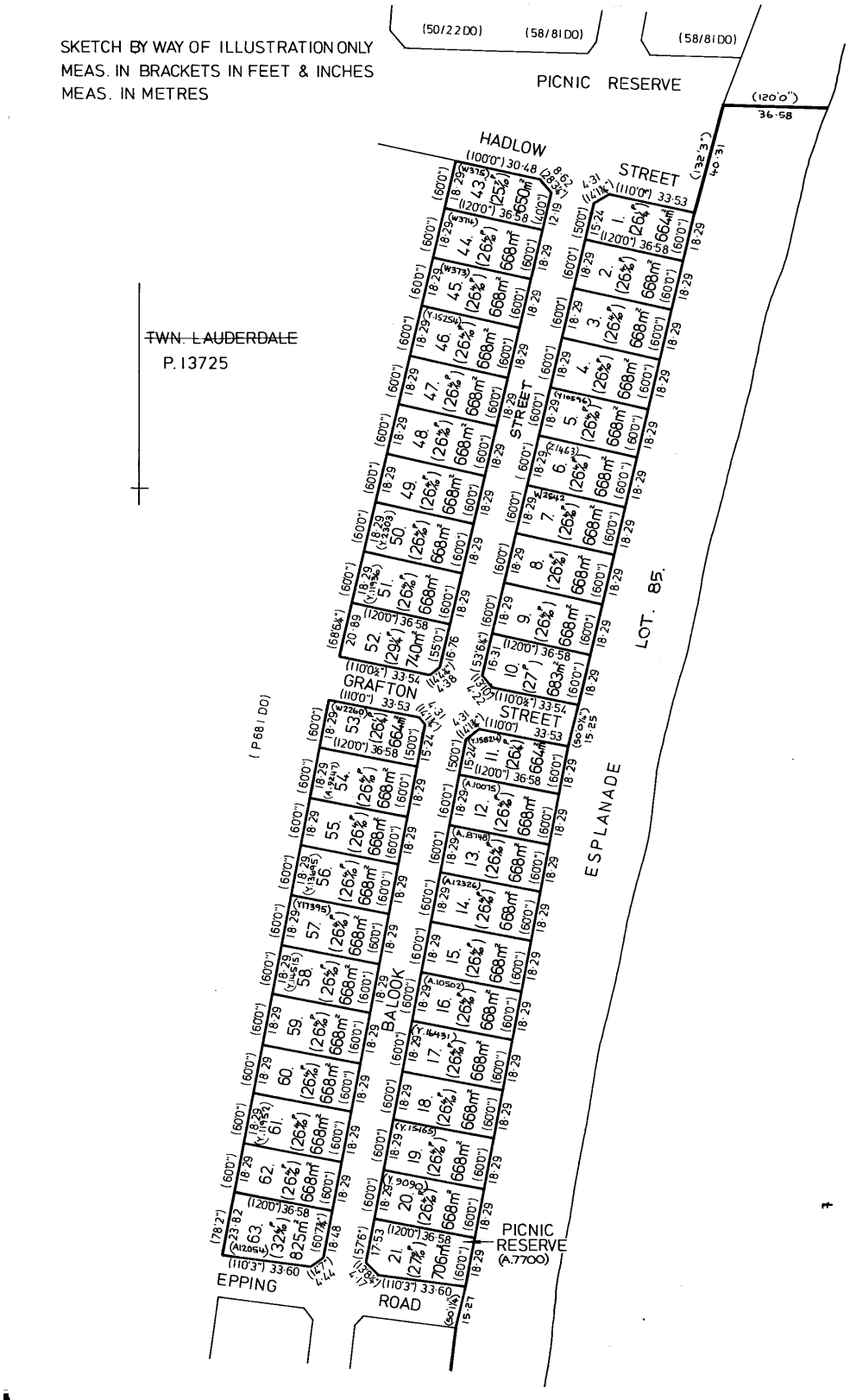


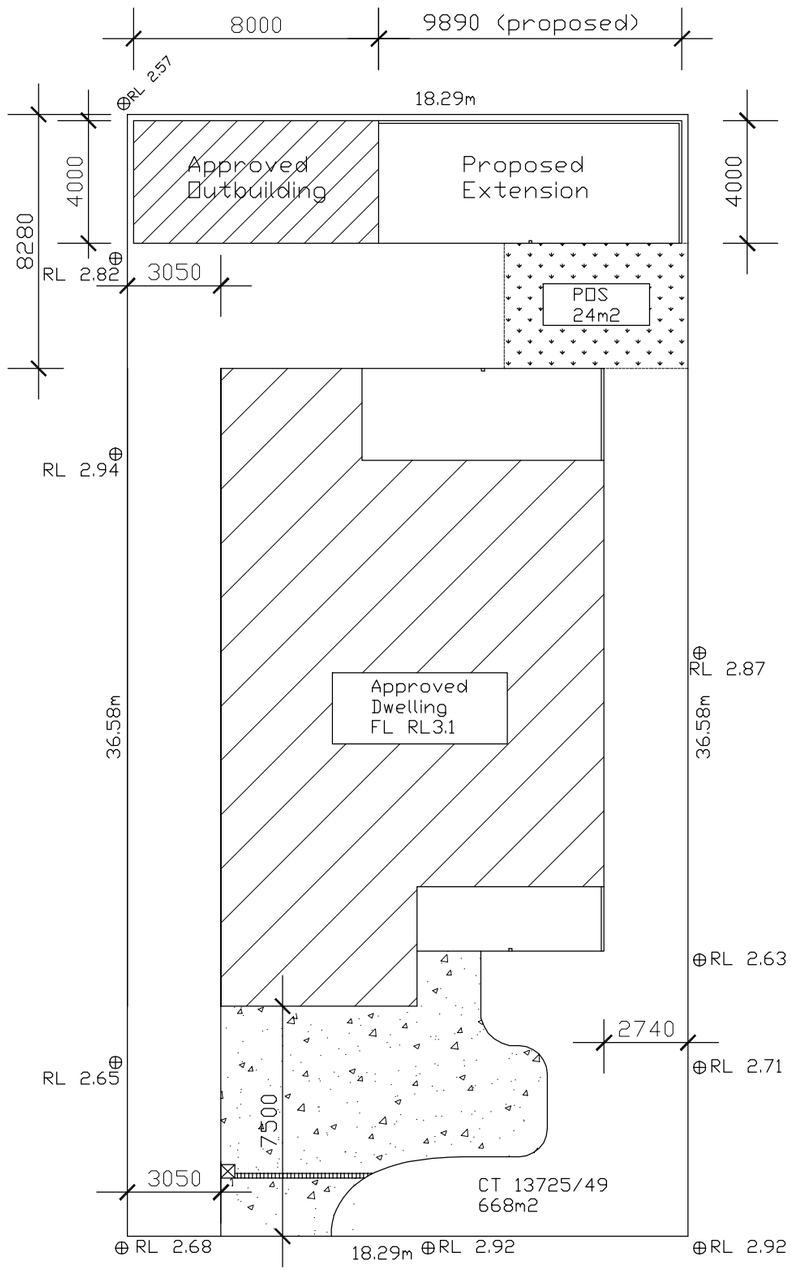
ANNEXURE SHEET No. 1 (of 2 annexures) to plan by Surveyor	This sheet contains detailed drawings of parcels shown on the index plan to which it is attached, which plan is verified by my certificate dated and that certificate extends to the detail shown on this sheet.	Registered Number: P. 13725
Signed for the purposes of identification	Surveyor	
Council Clerk	Owner: DECEASED PERSONS ESTATE Title Reference: Z. 493	NOT TO SCALE

SKETCH BY WAY OF ILLUSTRATION ONLY
MEAS. IN BRACKETS IN FEET & INCHES
MEAS. IN METRES



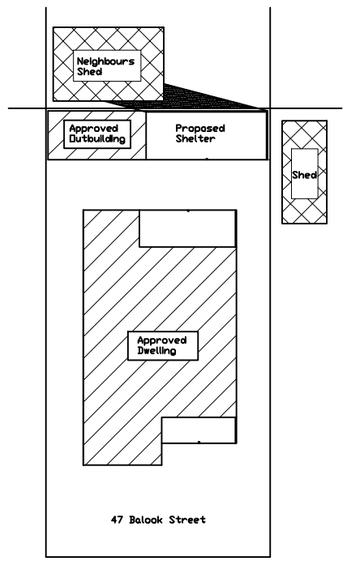
ANNEXURE SHEET No. 2 (of 2 annexures) to plan by Surveyor	This sheet contains detailed drawings of parcels shown on the index plan to which it is attached, which plan is verified by my certificate dated and that certificate extends to the detail shown on this sheet.	Registered Number: P.13725
Signed for the purposes of identification	Surveyor	
Council Clerk	Owner: DECEASED PERSONS ESTATE Title Reference: Z 493	NOT TO SCALE



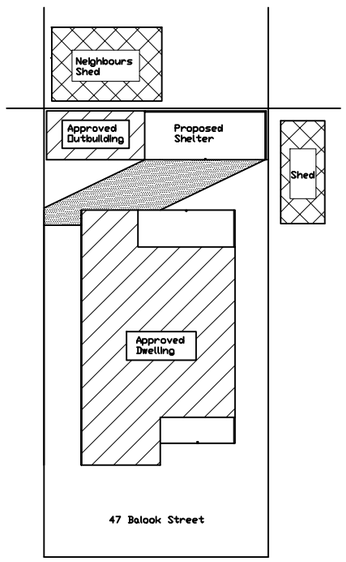


Revised Site Plan 1:200

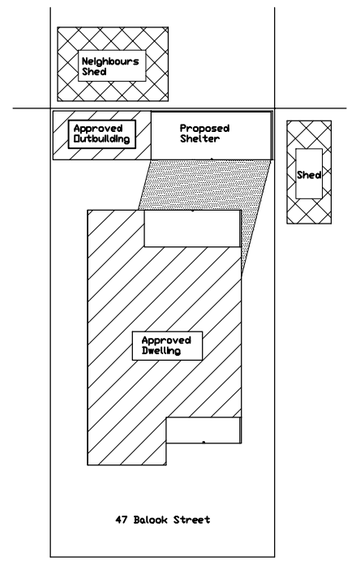
Total site coverage 46%



Shadow Diagram 9am 21 June
40° East of North, 17° altitude.



Shadow Diagram 12 noon 21 June
0° East of North, 27° altitude.



Shadow Diagram 3pm 21 June
40° West of North, 17° altitude.

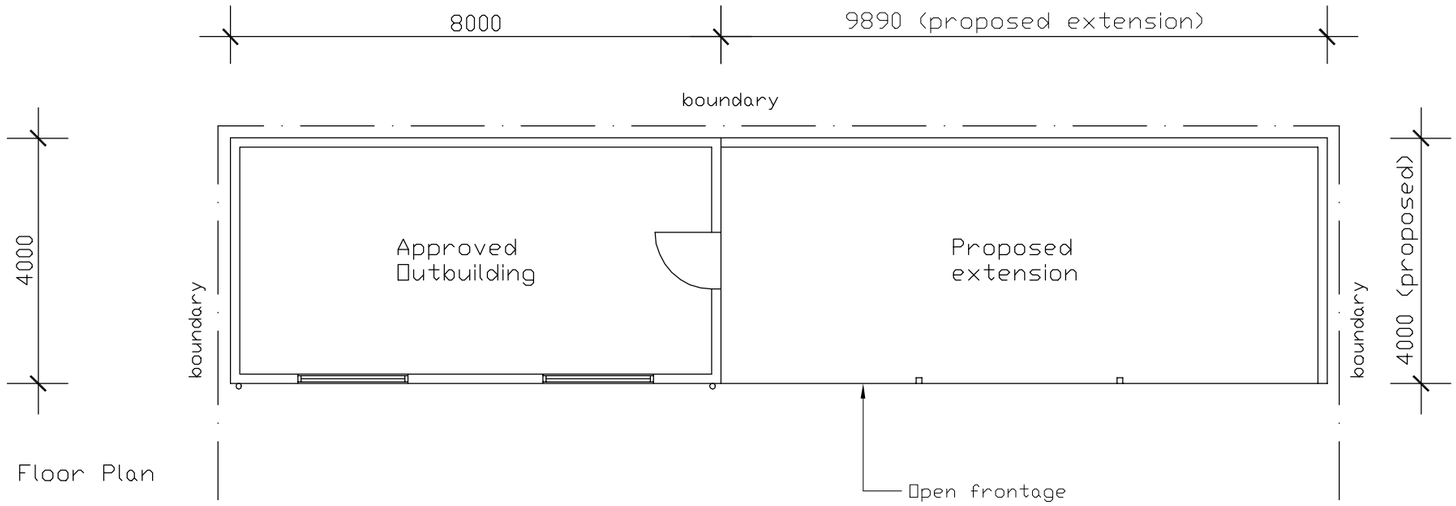
NOTE: Adjoining building information was obtained from LISTmap.

Shadow diagrams 1:500

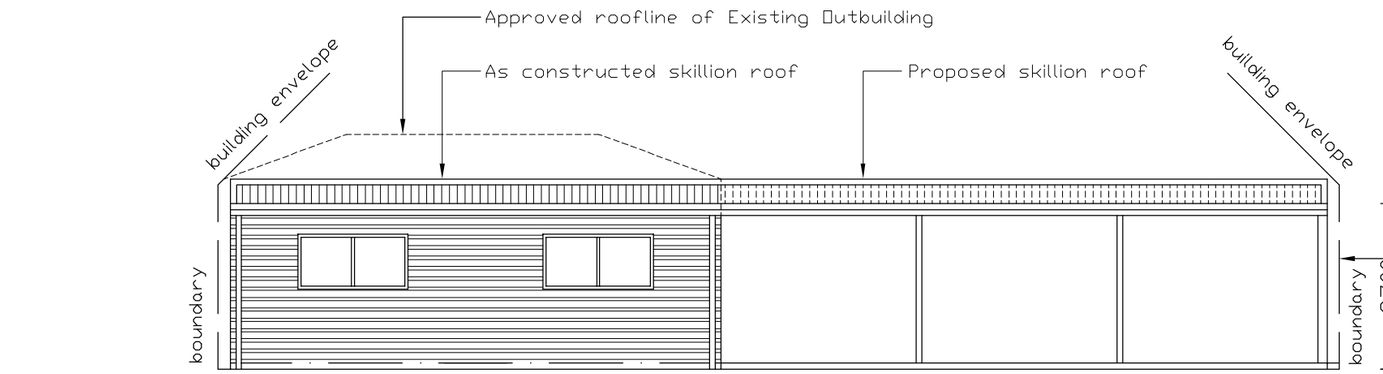
Proposed Extension to Existing Outbuilding
47 Balook Street, Lauderdale
For Amron Holdings

Site Plan and Shadow Diagrams	1:200,500	12/5/24	1 of 2

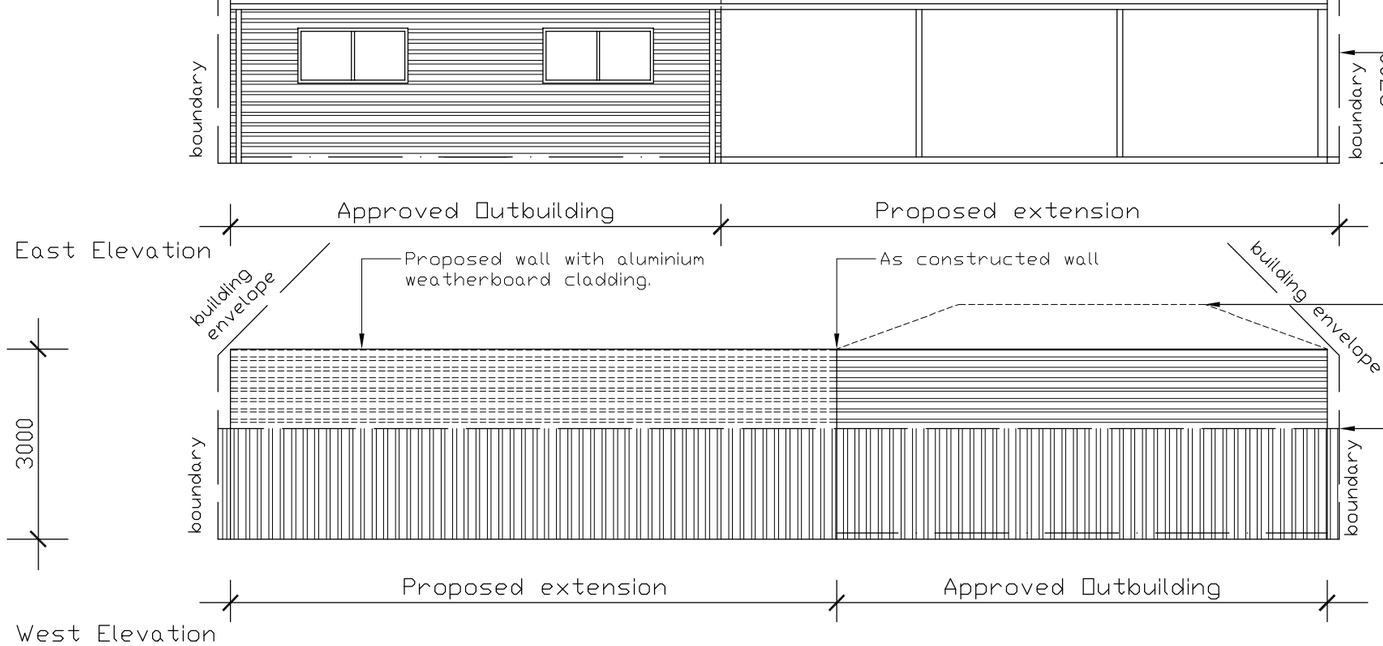
TONY MATHERS
Accredited Designer CC1345F
0408448448



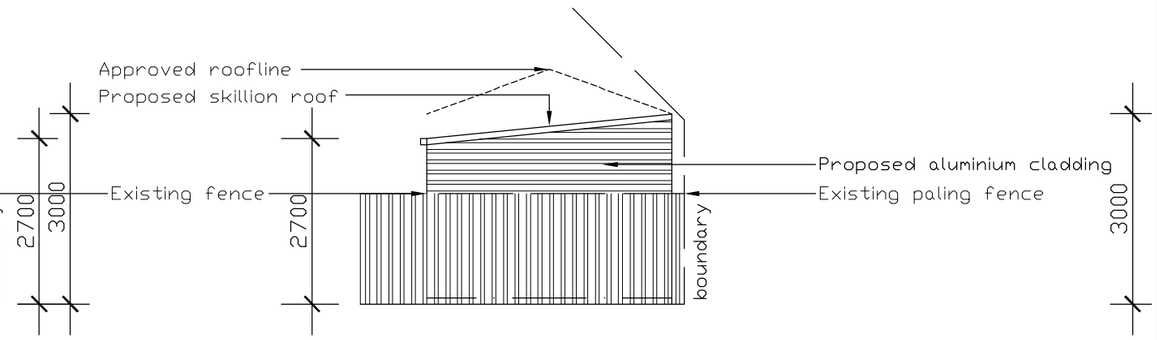
Floor Plan



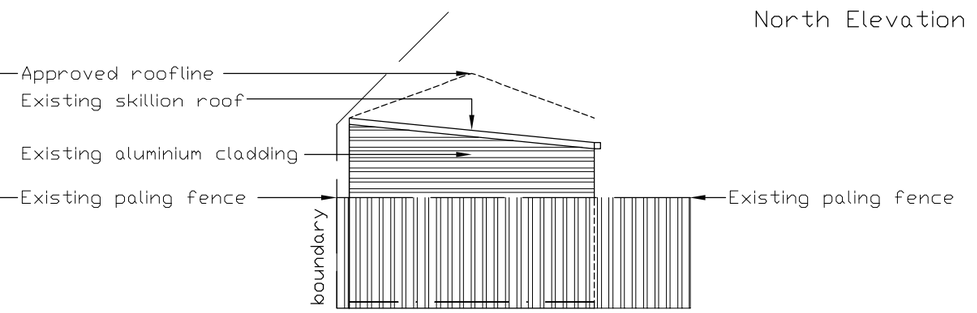
East Elevation



West Elevation



North Elevation



South Elevation

NOTE: the Existing Outbuilding has been modified from the Approved Documents. The overall height of the roof has been lowered. The hipped roof has been replaced with a skillion falling back into 47 Balook Street.

Proposed Extension to Existing Outbuilding
47 Balook Street, Lauderdale
For Amron Holdings

Outbuilding (Revised)	1:100	12/5/24	2 of 2

TONY MATHERS
Accredited Designer CC1345F
0408448448

enviro•tech
CONSULTANTS
Geotechnical & Environmental Services

COASTAL EROSION AND INUNDATION ASSESSMENT

PROPOSED DWELLING
47 BALOOK STREET - LAUDERDALE

Client: Amron Holdings

Certificate of Title: 13725/49

Investigation Date: Tuesday, 27 September 2022

Refer to this Report As

Enviro-Tech Consultants Pty. Ltd. 2022. Site Coastal Erosion and Inundation Assessment Report for a Proposed Dwelling, 47 Balook Street - Lauderdale. Unpublished report for Amron Holdings by Enviro-Tech Consultants Pty. Ltd., 25 November 2022.

Report Distribution:
This report has been prepared by Enviro-Tech Consultants Pty. Ltd. for the use by parties involved in the proposed residential development of the property named above. It is to be used only to assist in managing any existing or potential erosion hazards relating to the Site and its development.

Permission is hereby given by Enviro-Tech Consultants Pty. Ltd., and the client, for this report to be copied and distributed to interested parties, but only if it is reproduced in colour, and only distributed in full. No responsibility is otherwise taken for the contents.

Reporting Declaration – Tasmanian Planning Scheme Coastal Erosion & Coastal Inundation

This Hazard Assessment Report includes a Geotechnical Site Investigation which has been prepared in accordance with AS1726 and the Tasmanian Planning Scheme and the Director's Determination by a geotechnical practitioner with experience and competence in the preparation of coastal vulnerability assessment reports (see **Attachment 10** for signed Geotechnical Declaration & Verification).

Limitations of this report

In some cases, variations in actual Site conditions may exist between subsurface investigation boreholes. This report only applies to the tested parts of the Site, and if not specifically stated otherwise, results should not be interpreted beyond the tested areas.

The Site investigation is based on the observed and tested soil conditions relevant to the inspection date. Subsurface conditions may change laterally and vertically between test Sites, so discrepancies may occur between what is described in the reports and what is exposed by subsequent excavations. No responsibility is therefore accepted for any difference in what is reported, and actual Site and soil conditions for parts of the investigation Site which were not assessed at the time of inspection.

No responsibility is accepted for subsequent activities onsite by owners and/or climate variability including but not limited to placement of fill, uncontrolled earthworks, altered drainage conditions or changes in groundwater levels.

The pages that form the last six pages of this report are an integral part of this report. The notes contain advice and recommendations for all stakeholders in this project (i.e. the structural engineer, builder, owner and future owners) and should be read and followed by all concerned.

This report has been prepared based on provided plans detailed herein. Should there be any significant changes to these plans, then this report should not be used without further consultation. This report should not be applied to any project other than indicated herein.

Executive Summary

Enviro-Tech Consultants Pty. Ltd. (Envirotech) were contracted by Amron Holdings on behalf of Tony Mathers to prepare a Coastal Erosion and Coastal Inundation Assessment for a proposed dwelling located at 47 Balook Street Lauderdale which is herein defined as the Site.

The development comprises the development of a two-storey building with a garage with a finished floor level to be advised herein.

The proposed development is exempt from planning but requires both a coastal inundation and flood prone areas inundation assessment as well as a coastal erosion hazard assessment to address the respective director's determination.

Coastal erosion modelling has been prepared with a range of 32 to 35 m of horizontal erosion projected at the Site within the building design life (2073). This allows for storm erosion, underlying recession, and recession from sea level rise. The resulting stable foundation zone resides 30 m outside of the Site boundary, and therefore the proposed building works are projected to remain within the stable foundation zone.

It is projected that the frontal dune will be fully eroded within the next 20 to 30 years, with wave runup projected to encroach towards the Site.

Envirotech has prepared inundation modelling to assess 1% AEP inundation levels throughout the building design life (up to 2073). The resulting wave runup following projected erosion of the frontal dune is modelled at 2.7 m AHD, allowing for wave runup attenuation.

Given the site has an elevation of 2.6 to 3.0 m AHD, within the building design life, there is a low risk that the Site will be impacted by wave runup from the modelled 1% AEP swell wave from the south (the largest of the modelled waves).

The defined Site inundation level is determined at 2.8 m AHD which is based on Clarence City Council 1% AEP flood prone areas mapping. Local provisions for Roches Beach have a defined site inundation level at 2.7 m AHD. It is therefore a requirement that finished floor levels are constructed at 3.1 m AHD.

It is concluded that:

- The proposed building and work are unlikely to cause or contribute to coastal erosion or inundation on the land or on adjacent land
- The proposed work can achieve and maintain a tolerable risk for the intended life of the building
- Coastal protection works are not required at the Site.
- The site is not located on a mobile landform.
- Building foundations are designated CLASS P.

1 Introduction

1.1 *Background*

Enviro-Tech Consultants Pty. Ltd. (Envirotech) were contracted by Amron Holdings on behalf of Tony Mathers to prepare a Coastal Erosion and Coastal Inundation Assessment for a proposed dwelling located at 47 Balook Street Lauderdale which is herein defined as the Site.

The Project Area encompasses the Site, the frontal dune, and areas between the frontal dune and the Site. This coastal vulnerability assessment is based on Site specific testing and local information applicable to the Project Area.

Envirotech have assessed risks based on the identified hazards and the supplied Site plans for the proposed development.

1.2 *Scope*

The scope of the Site investigation is to:

- Identify which overlay codes apply to the Site in terms of coastal vulnerability and determine planning scheme exemptions and acceptable solutions.
- Prepare a report analysing Project Area hazards for any relevant performance criteria codes and directors' determination.
- Prepare a desktop review of relevant geological, geomorphologic, and hydrological information relevant to the Project Area and proposed development.
- Conduct an invasive Site investigation with soil bores and geotechnical testing.
- Using available geographic information system (GIS) data, construct a geotechnical model for the Project Area to interpret present and future Site conditions and how conditions may impact on the proposed development.
- Conduct a Site risk assessment for the proposed development in terms of inundation and erosion hazards ensuring relevant performance criteria, building regulations and directors determination are addressed; and
- Where applicable, provide recommendations on methods and design approach to reduce Site hazards.

1.3 *Cadastral Title*

The land studied in this report is defined by the title 13725/49

1.4 *Project Area Setting*

The Project Area and Site location plans are presented in Attachment 1 (Map 1 & Map 2). The Project Area is located on a coastal plain which was historically inland sea and beach barrier complex. The Site is set back approximately 90 m from the coast and in the future may be subject to coastal processes acting within Frederick Henry Bay.

2 Assessment

Planning code overlay mapping is presented in mapping presented in Attachment 1.

2.1 *Proposed Development*

Table 1 summarises the provided design documents from which this assessment is based with plans presented in Attachment 2 and proposed building envelopes presented in Map 3.

Table 1 Project Design Drawings

Drafted By	Project ID	Date Generated	Pages
Tony Mathers	47 Balook Street, Lauderdale	20/09/2022	19

The development comprises the development of a two-storey building with a garage with a finished floor level to be advised herein.

2.2 *Planning*

Planning code overlay descriptions, objectives, acceptable solutions and performance criteria are addressed in Attachment 3.

2.2.1 Coastal Erosion Assessment

Coastal erosion hazard overlay mapping are presented in Map 4 and coastal erosion reporting requirements are summarised in Attachment 3.

Although the proposed building and works fall within a coastal erosion overlay, given the proposed development requires authorisation under the Building Act 2016 (TPS C10.4.1) and does not trigger high risk planning criteria, the proposed development is exempt from planning Code C10.0 (Coastal Erosion Hazard Code).

2.2.2 Coastal Inundation Hazard Code

Coastal inundation hazard overlay mapping are presented in Map 5 and coastal inundation reporting requirements are summarised in Attachment 3.

Although the proposed building and works fall within a coastal inundation overlay, given the proposed development requires authorisation under the Building Act 2016 (TPS C10.4.1) and does not trigger high risk planning criteria, the proposed development is exempt from planning Code C11.0 (Coastal Inundation Hazard Code).

2.2.3 Flood Prone Areas Hazard Code

Coastal inundation hazard overlay mapping are presented in Map 6. The Flood Prone Areas Hazard Code does not need to be addressed on the basis that the building and works is within the coastal inundation hazard overlay.

2.3 *Building*

2.3.1 Coastal Erosion Hazard Overlay

An assessment is to be made on whether proposed work can achieve and maintain a tolerable risk from coastal erosion for the ***intended life of the building*** (2073) without requiring any specific coastal erosion protection measures.

The director's determination provisions are to be addressed which includes classification of the Site as Class P (problem Site which requires engineering design), provision of an accompanying geotechnical site investigation written by a geotechnical practitioner[1].

[1] Geotechnical practitioner: a person holding a building services license issued under the Occupational Licensing Act 2005 in the class of engineer-civil; a geotechnical engineer acting within their area of competence; or an engineering geologist acting within their area of competence.

2.3.2 Coastal Inundation Hazard Overlay

An assessment is to be made on whether proposed work can achieve and maintain a tolerable risk from coastal inundation for the ***intended life of the building*** (2073) without requiring any specific coastal inundation protection measures.

The director's determination provisions are to be addressed which includes ensuring habitable rooms in the proposed development are located 300 mm above the 2100 storm surge inundation level (outside of the low hazard band within the Tasmanian Planning Scheme local provisions schedule) with finished floor levels to be located at:

3.0 m AHD for Lauderdale - Roches Beach-Mays Beach

2.3.3 Flood Prone Areas (Riverine) Hazard Overlay

Given the pluvial nature of the flooding, a single inundation level applied to the Site. The defined riverine inundation level for the Site (based on 1% annual exceedance probability of inundation) is 2.8 m AHD with the following finished floor levels:

3.1 m AHD for all habitable rooms

3 Desktop Summary

3.1 *Topography*

The Site ranges in elevation from approximately 2.6 m AHD through to 3.0 m AHD. The western side of Site is located on a dune ridge and the central part is located on a dune swale (Map 7).

3.2 *Published Geology*

According to the 1:25,000 engineering geology series geological mapping by Mineral Resources Tasmania (MRT), as presented in Map 8, the geology comprises:

- Inferred undifferentiated marine and coastal barrier complex deposits (Qii).

4 Soil Investigation

4.1 *Site Geology*

Soil testing locations are presented in Map 8. Findings from the Soil assessment are presented in Attachment 4, with engineering logs presented in Attachment 5 and soil core photographs presented in Attachment 6.

SAND was encountered from surface to 3.2 m depth in BH02 and BH03. Sandy GRAVEL FILL is present to 0.3 m depth in BH01. The soil profile comprises predominantly medium grained SAND. The soil layers have variable colouration indicating considerable changes to the local environment during the depositional phases.

4.2 *Geotechnical Testing Summary*

The sand density will not have an influence on erosion rates but will influence the internal friction angles and angle of repose of the dune following storm erosion. An internal friction angle of 35° is applied to the sand at the Site for geotechnical modelling.

4.3 *Geological and Geotechnical Model*

A preliminary geotechnical model has not been prepared for the Site as there is very little relief or change in geology. Geotechnical erosion modelling has been prepared.

5 Coastal Processes

5.1 *Coastal Inundation Hazard Assessment*

The coastal hydrodynamic assessment is presented in Attachment 7 with radials used in the local wind wave analysis assessment presented in Map 10.

Defined flood levels for the Site are stipulated in the local provision schedule are to be used for determining the design finished floor level of habitable rooms.

Site specific inundation levels presented in Table 2 are used for risk assessment purposes.

Table 2 Project area inundation level modelling

Parameter	2073 Building Design Life (m AHD)
1% AEP Stillwater level	**2.0**
1% AEP Wave Setup (easterly wind wave)	**2.3**
1% AEP Attenuated Wave Runup (southerly swell wave)	**2.7**

5.2 *Coastal Erosion Hazard Assessment*

The coastal erosion assessment is presented in Attachment 8. Coastline recession is modelled for the Project Area based on coastline erosion relationships with sea level rise which are forward projected to the building design life. Procedures include:

- Analysing recession trends in historical aerial images
- Using wave modelling to project erosion potential
- Determining storm erosion demand based on beach typology and historic observations

Storm erosion potential is modelled independently of coastline recession and is determine based on the beach typology and observed beach storm bite (erosion) and recovery (accretion) cycles. Findings are presented in Table 3. The Site landform is vegetated and is therefore not considered actively mobile.

Table 3 Project area coastal erosion modelling

Parameter	2073 Building Design Life
Underlying Recession (m horizontal)	12
Sea level rise induced recession – wave analysis (m horizontal)	13
Sea level rise induced recession – aerial image analysis (m horizontal)	10
Storm Erosion Demand (m^3/m)	11
Storm Erosion Demand (m horizontal)	10
Projected Total Erosion (m horizontal)	32 to 35

6 Risk Assessment

Qualitative risk evaluation criteria have been created to determine fundamental risks that may occur due to development in areas that are vulnerable to erosion or inundation hazards.

This qualitative risk assessment technique is based on AS/NZS ISO 31000:2009 and relies on descriptive or comparative characterisation of consequence, likelihood, and the level of risk comparative (rather than using absolute numerical measures).

A risk consequence/likelihood matrix has been selected which is consistent with AS/NZS ISO 31000:2009 guidelines.

Consequence/likelihood criteria have assisted in determining if any risk management measures are required at the Site to mitigate any potential hazards. Adopted consequence/likelihood criteria are presented in Attachment 9.

6.1 *Building*

The director's determination form proposed building works is addressed in Attachment 10.

6.1.1 Inundation Assessment

The finished floor level of habitable rooms is limited by the flood prone area inundation mapping. The Clarence City Council have instated 1% AEP flood models for the municipality which are used for planning and building regulation purposes and are adopted as the defined flood level for the Site. Given a defined inundation level of 2.8 m at the Site, it is a requirement that finished floor level of habitable rooms are constructed at 3.1 m AHD.

Modelling has been conducted for building purposes to assess whether proposed work can achieve and maintain a tolerable risk to coastal inundation for the ***intended life of the building*** without requiring any specific coastal inundation protection measures.

The following is concluded based on 1% AEP inundation modelling prepared for the Site for 2073 (the building design life):

- Envirotech have modelled a wave runup level of 2.7 m AHD for the Project Area with a low risk or wave runup impacting proposed building structures.
- With finished floor levels at 3.1 m AHD, risks to inhabitants within the proposed development are considered tolerable based on the building design life.

6.1.2 Erosion Assessment

Modelling has been conducted for building purposes to assess whether proposed work can achieve and maintain a tolerable risk to erosion hazards for the ***intended life of the building*** without requiring any specific coastal erosion protection measures.

Coastal erosion risks associated with the proposed development are tolerable, as the Site is projected to remain within the stable foundation zone given sea level rise modelling for 2073 (the building design life).

7 Recommendations

7.1 *Finished Floor Levels*

Given a defined inundation level of 2.8 m at the Site, finished floor level of habitable rooms are to be constructed at:

- 3.1 m AHD.

7.2 *Inundation Protection Works*

No coastal inundation protection works are recommended at the Site. Site 1% AEP inundation levels for the building design life are tolerable.

7.3 *Building Foundations*

Given the development is within a coastal erosion overlay, the site is designated CLASS P and will require a structural engineer to assess and approve foundation works.

7.4 *Stable Foundation Zone*

The proposed development is outside of the modelled 2073 coastal erosion zone (resides within the stable foundation zone based on Nielsen et. al., 1992) and does not require any measures to mitigate coastal erosion hazards.

7.5 *Erosion Protection Works*

No coastal erosion protection works are recommended at the Site. Site 1% AEP inundation levels for the building design life are tolerable.

Kris J Taylor BSc (Hons) | Environmental & Engineering Geologist

Director

Enviro-Tech Consultants Pty. Ltd.

8 References

ABCB 2015. Landslide Hazards. Handbook. Non-Mandatory Document. Second Edition. Australian Building Code Board

AGS (2007e). The Australian Geoguides for Slope Management and Maintenance. Australian Geomechanics Vol 42 No 1 March 2007

AS1289 (2000). Australian Standard. Various methods as Prepared by Committee CE/9, Testing of Soils for Engineering Purposes. Approved on behalf of the Council of Standards Australia on 3 December 1999 and published on 28 February 2000.

AS1726 (2017). Australian Standard. Geotechnical Site Investigations. Approved on behalf of the Council of Standards Australia on 7 April 2017 and published on 2nd May 2017.

Ball, J. et al., 2019. Australian Rainfall and Runoff (AR&R): A guide to Flood Estimation. [Online] Available at: http://book.arr.org.au.s3-website-ap-southeast-2.amazonaws.com/ [Accessed 12 07 2022].

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Dean R.G., and Dalrymple R.A., (2012). Coastal Processes with Engineering Applications. Cambridge University Press.

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Attachment 1 Maps

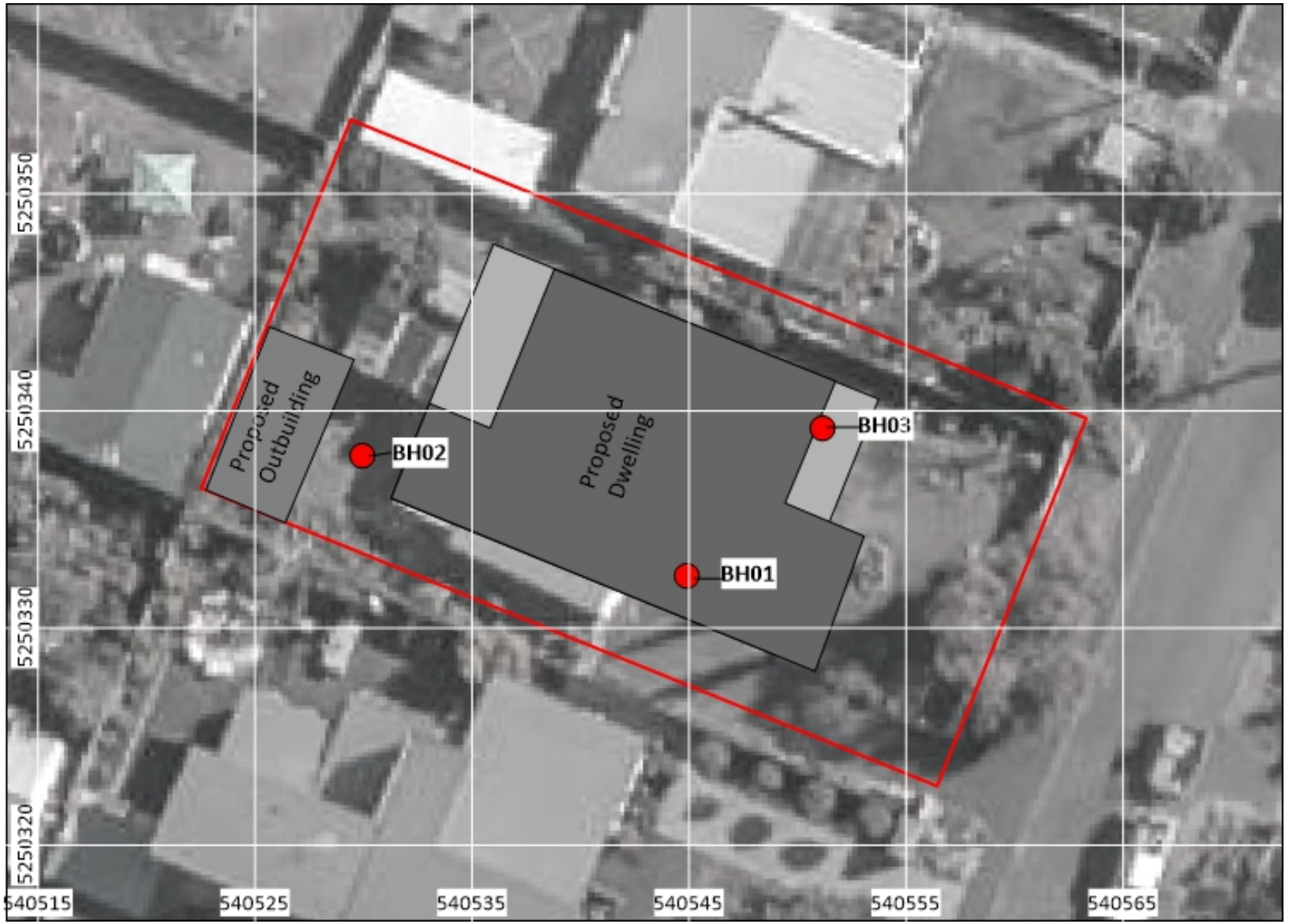
Map 1

Map 1 Site regional setting (The LIST)

Map 2

Map 2 Site and Project Area local setting

Map 3



Map 3 Site layout

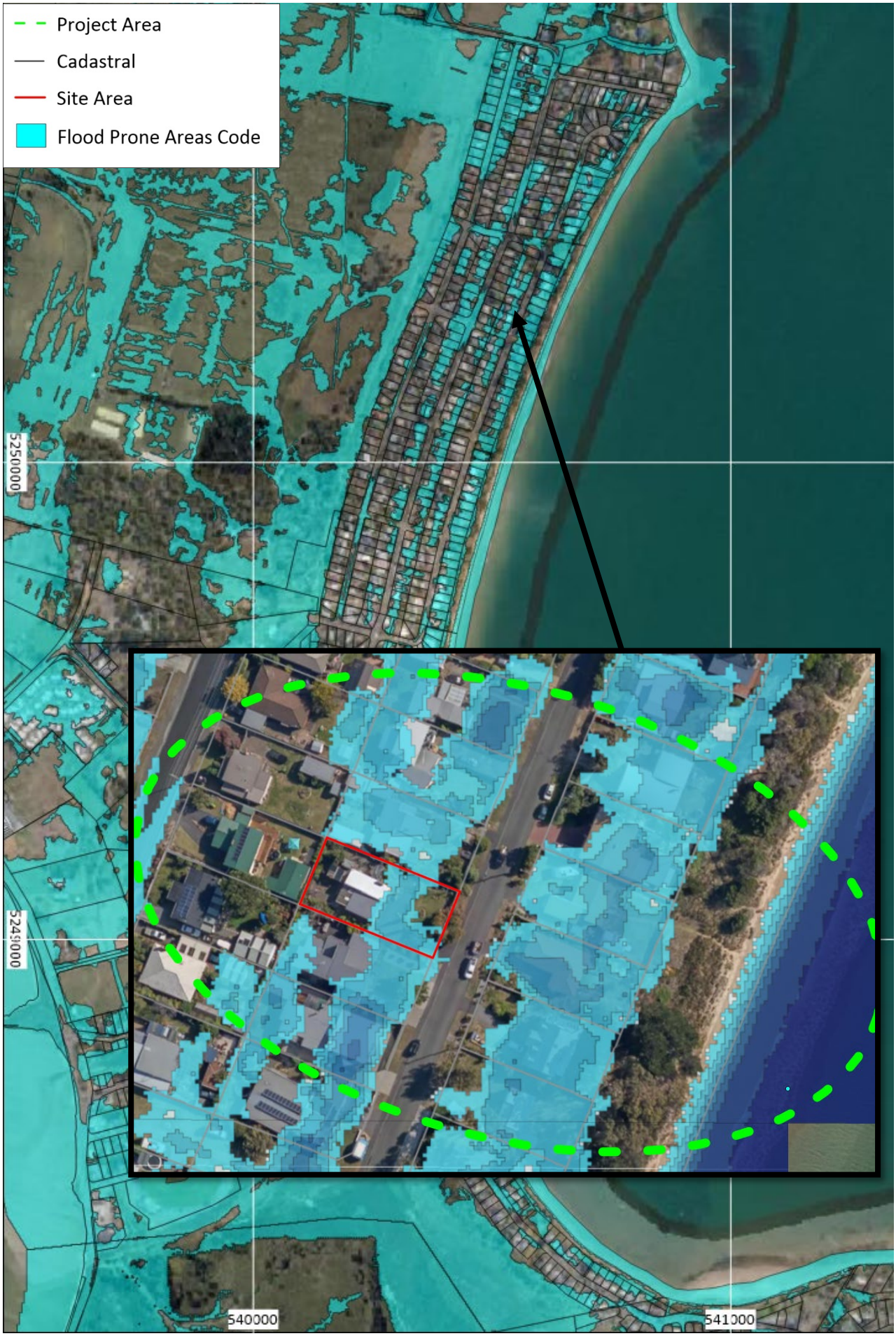
Map 4

Map 4 Coastal erosion overlay

Map 5

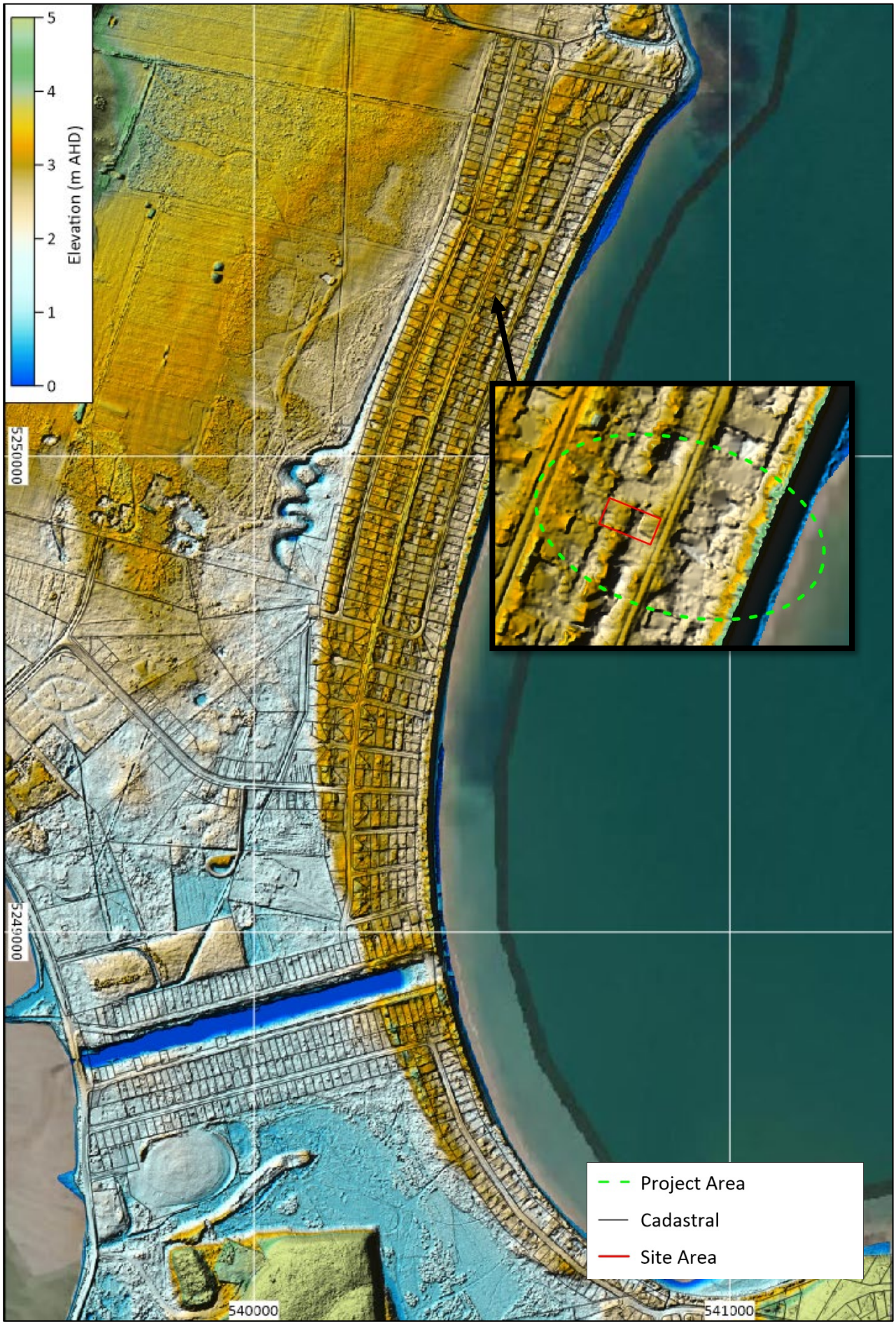
Map 5 Coastal inundation overlay

Map 6



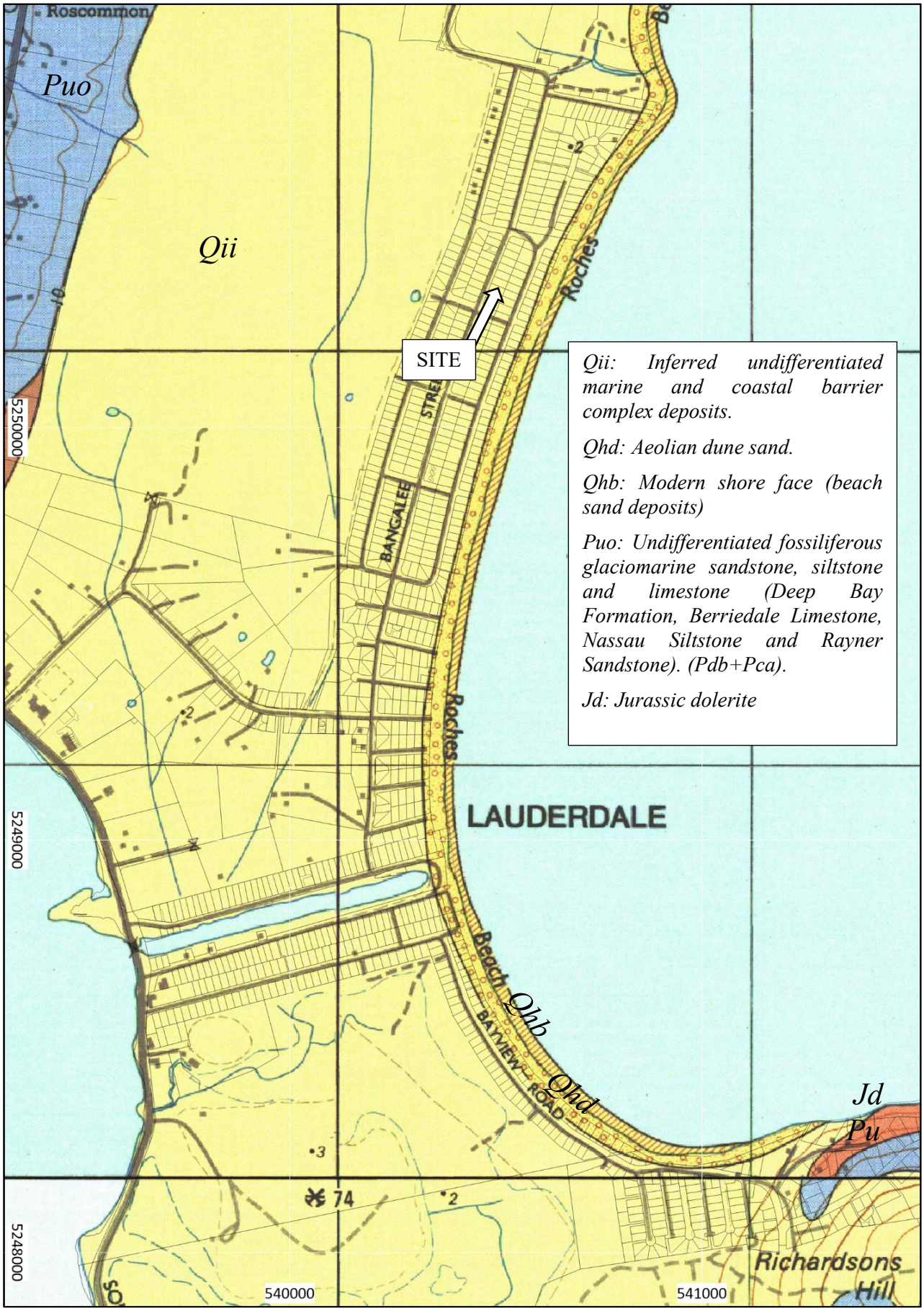
Map 6 Flood prone areas overlay – 1% AEP inundation mapping

Map 7



Map 7 Regional digital elevation model based on 2013 LIDAR

Map 8

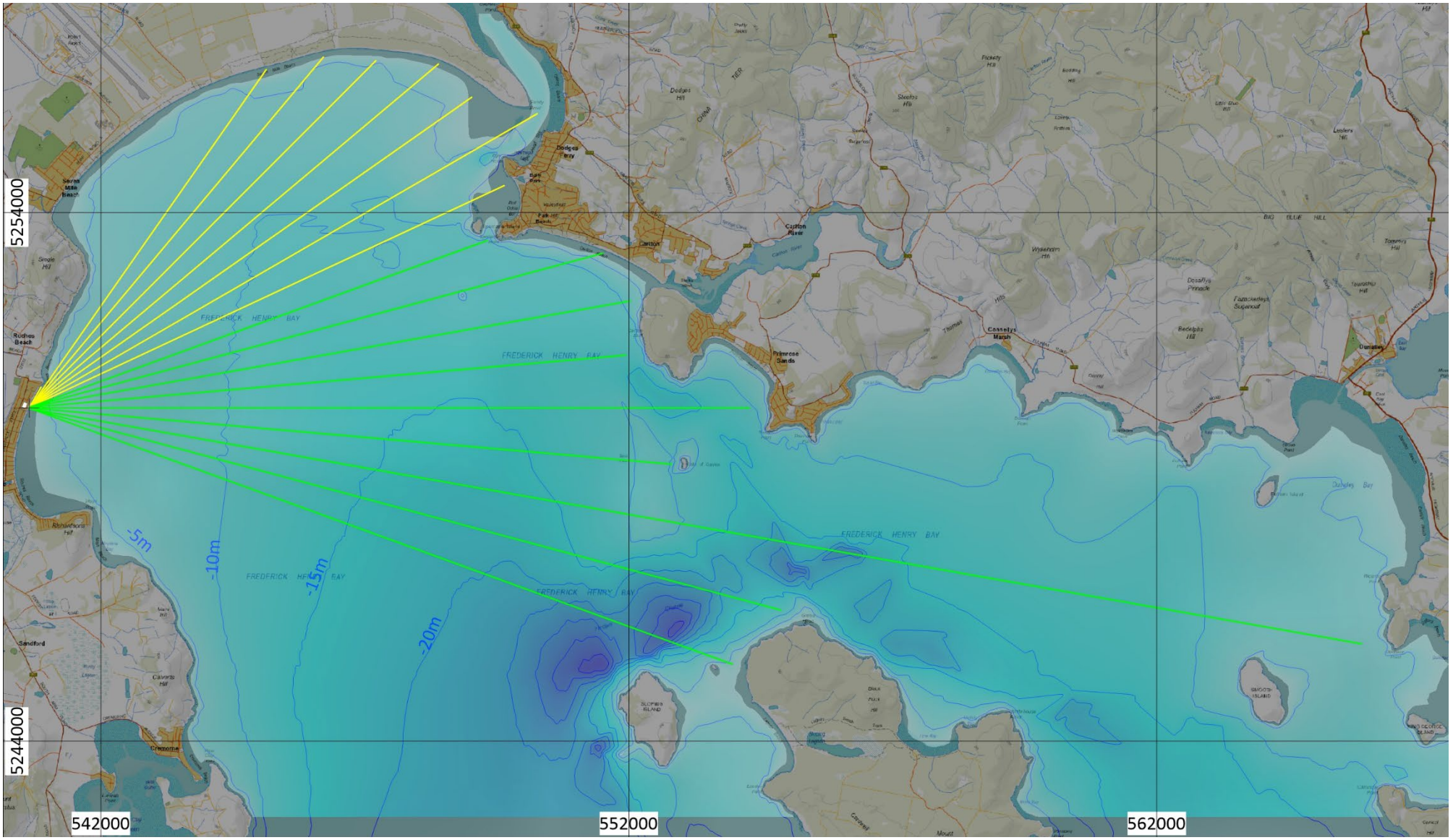


Map 8 1:25,000 Scale Mineral Resources Tasmania geology mapping

Map 9

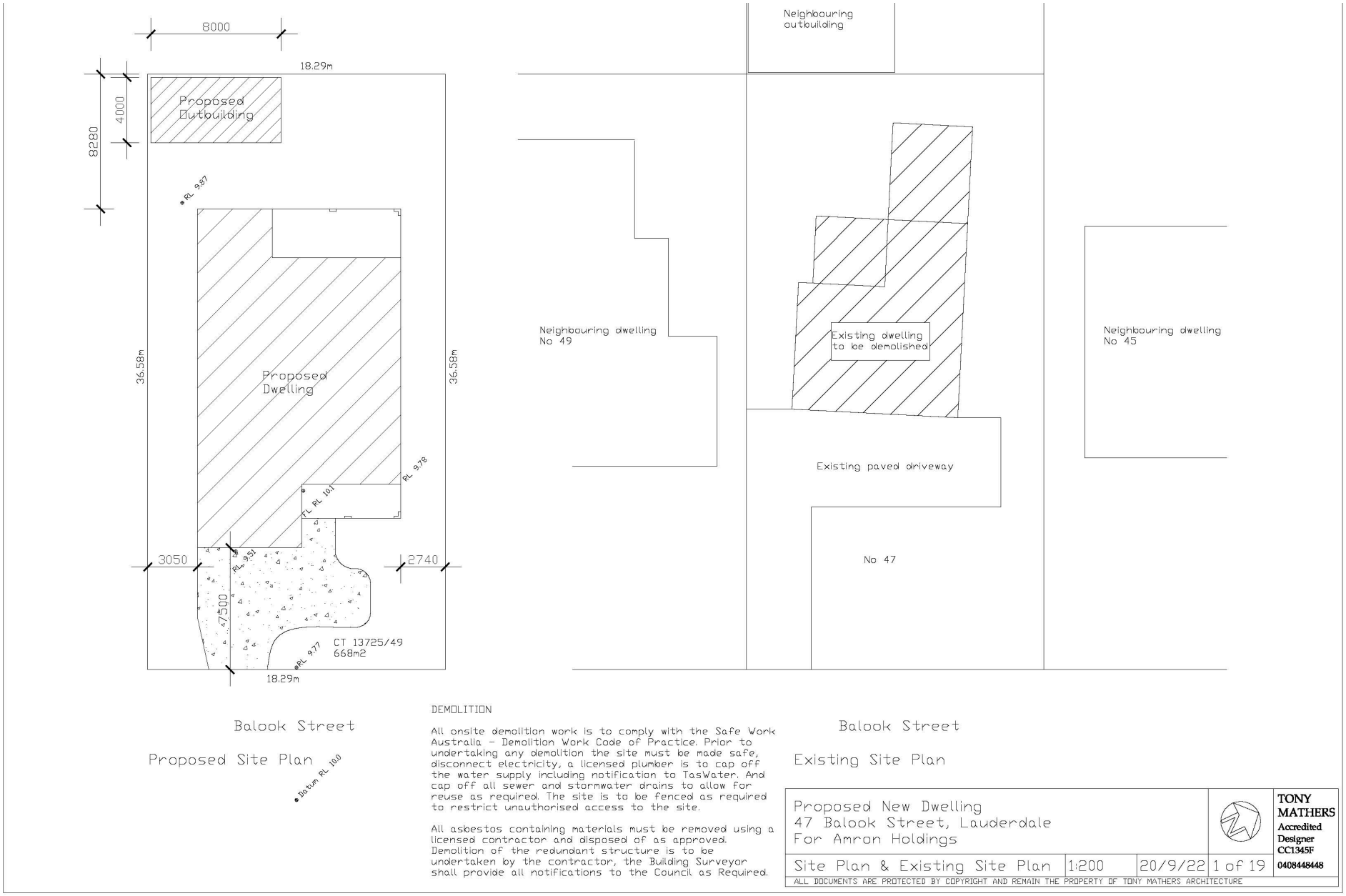
Map 9 Soil testing, cross section and erosion modelling location

Map 10



Map 10 Radials used to generate the wind wave model for the Site with the north easterly wave projected to have the greatest influence of site inundation levels from wave runup and wave setup.

Attachment 2 Preliminary Design Concept Plans



Attachment 3 Planning and Building Regulations

Coastal Erosion Hazard Overlay

The proposed building and works fall within The LIST Coastal Erosion Hazard Overlay (low and medium hazard band) as presented in Map 4.

Code Overlay Reporting Requirements

The proposed development reporting requirements are summarised in Table 4 with the following to be addressed:

- Directors Determination – Coastal Erosion Hazard Areas.
- Part 5 (Work in Hazardous Areas) of the Building Regulations 2016; Division 5 – Coastal Erosion

The proposed development is exempt from C10 Coastal Erosion Hazard Code planning on the basis that the use or development requires authorisation under the Building Act 2016 (TPS C10.4.1).

Table 4 Coastal Erosion Hazard Reporting Requirements Framework

Council	Clarence
Planning scheme code	Tasmanian Planning Scheme
Coastal erosion hazard band	Low
Actively mobile landform?	No
Critical use, hazardous use, or vulnerable use	No
Proposed coastal protection works	No
High coastal erosion hazard band	No
In a coastal erosion investigation area	No
Located in a non-urban zone	No
Exemption from code	Yes, on the basis that the use or development requires authorisation under the Building Act 2016 (TPS C10.4.1)
Coastal erosion code to be addressed	NA (exempt from planning)
Directors' determination applicable and requires coastal erosion hazard reporting	YES
Coastal erosion reporting requirements	Coastal Erosion Hazard Assessment & Geotechnical Site Investigation in accordance with directors determination
Development building design life	Modelled to a 50 Year Building Design Life
Site classification requirements	Class P
Coastal erosion investigation area report required	No

Directors Determination

Although a coastal erosion hazard assessment report may not be required for planning purposes, according to the director's determination, a coastal erosion hazard assessment report must be prepared for building. In determining an application for a Certificate of Likely Compliance, the building surveyor must:

(a) take into account the coastal erosion hazard report and any relevant coastal erosion management plan; and

(b) be satisfied that the proposed work will not cause or contribute to coastal erosion on the site or on adjacent land; and

(c) be satisfied that the proposed work can achieve and maintain a tolerable risk for the intended life of the building without requiring any specific coastal erosion protection measures; and

(d) be satisfied that the proposed work will not be located on actively mobile landforms, except where the work relates to protection measures or remediation works to protect land, property or human life.

Coastal Inundation Hazard Overlay

The proposed building and works fall within The LIST Coastal Inundation Hazard Overlay (low hazard band) as presented in Map 4.

Code Overlay Reporting Requirements

The proposed development reporting requirements are summarised in Table 5 with the following to be addressed:

- Part 5 (Work in Hazardous Areas) of the Building Regulations 2016; Division 5 – Coastal Inundation
- Directors Determination – Coastal Inundation Hazard Areas.

The proposed development is exempt from C11 Coastal Inundation Hazard Code planning on the basis that the use or development requires authorisation under the Building Act 2016 (TPS C10.4.1).

Table 5 Coastal Inundation Hazard Reporting Requirements Framework

Council	Clarence
Planning Scheme	Tasmanian Planning Scheme
Coastal Inundation Hazard Band	Medium
Critical use, hazardous use, or vulnerable use	No
Located within a non-urban zone and within a medium coastal inundation hazard band	No
Requires coastal protection works	No
Exemption from code	Yes, on the basis that the use or development requires authorisation under the Building Act 2016 (TPS C10.4.1)
Coastal inundation code to be addressed	NA (exempt from planning)
Directors' determination requires coastal inundation hazard reporting for building	Yes
Defined inundation level	1% AEP 2100 (Local Provisions Schedule)
In a coastal inundation investigation area	No
Coastal inundation investigation area report required	No
Located within a flood-prone area hazard code overlay	Yes
Flood-prone area hazard code overlay to be addressed	No, on the basis that the building and works is within the coastal inundation hazard overlay

Directors Determination - Coastal Inundation Hazard Areas

Although a coastal inundation hazard assessment report may not be required for planning purposes, according to the director's determination, a coastal inundation hazard report must be prepared for building. In determining an application for a Certificate of Likely Compliance, the building surveyor must:

(a) take into account the coastal inundation hazard report and any relevant coastal inundation management plan; and

(b) be satisfied that the proposed work will not cause or contribute to coastal inundation on the Site, on adjacent land or of public infrastructure; and

(c) be satisfied that the proposed work can achieve and maintain a tolerable risk for the intended life of the building without requiring any specific coastal inundation protection measures.

Defined Coastal Flood Level

Based on the Directors Determination – Coastal Inundation Hazard Areas and regulation 56(3) of the Building Regulations 2016, the defined flood level is the level above the 0 metres Australian Height Datum with a one per cent probability of being exceeded in a storm surge flooding event in the year 2100, as specified in the Local Provisions Schedule of the Tasmanian Planning Scheme.

Site Defined Coastal Flood Level

The defined inundation level for the Site is based on TPS Table C11.1 Coastal Inundation Hazard Bands AHD Levels for 2100 with the following 1% annual exceedance probability of inundation:

- **2.7 m AHD for Lauderdale - Roches Beach-Mays Beach**

Tasmanian Building Regulations 2016

Finished Floor Levels

The floor level of each habitable room[2] of the building, being erected, re-erected or added as part of the work, is at least 300 millimetres above the defined flood level for the land. The following finished floor level is required for all habitable rooms within habitable building at the site:

- **3.0 m AHD for Lauderdale - Roches Beach-Mays Beach**

C12.0 Flood-Prone Area Hazard Code

The site is located within the Clarence Council mapped 1% Annual Exceedance Probability (AEP) inland flooding hazard area (Map 6).

Code Overlay Reporting Requirements

The following are to be addressed:

- Part 5 (Work in Hazardous Areas) of the Building Regulations 2016; Division 2 – Riverine Inundation
- Directors Determination – Riverine Inundation Hazard Areas

The proposed development is exempt from C12.0 Flood-Prone Area Hazard Code planning on the basis that the code does not apply to land subject to the Coastal Inundation Hazard Code (C12.2.5).

Directors Determination - Riverine Inundation Hazard Areas

Although a coastal inundation hazard assessment report may not be required for planning purposes, according to the director's determination, a coastal inundation hazard report must be prepared for building.

Riverine inundation

For the purposes of the Tasmanian Building Act 2016, land that has previously been flooded, or land that has been assessed by the council of the relevant municipal area as having a reasonable probability of flooding, is land that is – (a) subject to riverine inundation (b) a hazardous area for the purposes of the definition of hazardous area in section 4(1) of the Act.

A person must not perform building work on a building on land that is subject to riverine inundation unless the floor level of each habitable room of the building being erected, re-erected or added as part of the work, is at least 300 millimetres above the defined flood level for the land.

Defined Riverine Flood Level

For the Clarence Council, and for the purposes of regulation 54(2) of the Building Regulations 2016, the defined flood levels are relation to the floodplains of any other watercourses, the level which has a 1% probability of being exceeded in any year according to a report adopted by the relevant council for the municipal area in which the land is located.

[2] habitable room - means any room of a habitable building other than a room used, or intended to be used, for a bathroom, laundry, toilet, pantry, walk-in wardrobe, corridor, stair, hallway, lobby, clothes drying room, service or utility room, or other space of a specialised nature occupied neither frequently nor for extended periods.

Site Defined Riverine Flood Level

The defined riverine flood level for the Site[3] is based on Clarence Council 1% AEP flood modelling (as written in the determination, the level which has a 1% probability of being exceeded in any year according to a report adopted by the relevant council for the municipal area in which the land is located).

The defined riverine inundation level for the Site is based on 1% annual exceedance probability of inundation is:

- **2.8 m AHD**

Finished Floor Levels

The floor level of each habitable room[4] of the building, being erected, re-erected or added as part of the work, is at least 300 millimetres above the defined flood level for the land. The following finished floor level is required for all habitable rooms within habitable building at the site:

- **3.1 m AHD**

[3] In coastal areas where the coastal and riverine overlay overlap, in terms of building regulations, the Site defined flood level is controlled by both the 1% AEP flood prone areas modelling and the local provisions schedule levels for the location (or whichever is limiting).

[4] habitable room - means any room of a habitable building other than a room used, or intended to be used, for a bathroom, laundry, toilet, pantry, walk-in wardrobe, corridor, stair, hallway, lobby, clothes drying room, service or utility room, or other space of a specialised nature occupied neither frequently nor for extended periods.

Attachment 4 Soil Assessment Findings

Soil bore logs are presented in Attachment 5 and core photographs are presented in Attachment 6. Soil bores BH01 to BH03 were used to characterise soil profiles at the Site which are summarised in Table 6.

The Soil is consistent with the 1:25,000 geological mapping and comprises marine and coastal barrier complex deposits.

The complex layered sand deposits encountered at the Site are susceptible to erosion.

Table 6 Summary of soil logging

#	Layer	Details	USCS	BH01	BH02	BH03
1	Sandy GRAVEL	FILL: Sandy GRAVEL trace leaf litter, dark brown/grey, well sorted, medium grained sand	GW	0-0.3		
2	SAND	TOPSOIL: SAND with clay, trace roots, trace silt, dark brown/grey, well sorted, fine grained sand, L	SC		0-0.2	0-0.4
3	SAND	SAND with gravel, pale brown/grey, well sorted, medium to coarse grained sand, VL-MD	SW	0.3-1		
4	SAND	SAND, pale brown, well sorted, fine to medium grained sand, VL-L	SW		0.2-1.4	0.4-1.3
5	SAND	SAND trace gravel, dark brown, well sorted, medium grained sand, MD-D	SW	1-1.8		1.3-1.5
6	SAND	SAND, pale brown, well sorted, medium grained sand, VL-VD	SW	1.8-3.2	1.4-3.2	

Consistency	**VS** Very soft; **S** Soft; **F** Firm; **St** Stiff; **Vst** Very Stiff; **H** Hard;
Density	**VL** Very loose; **L** Loose; **MD** Medium dense; **D** Dense; **VD** Very Dense
PV	Pocket Shear Vane Tested on U50 Core
FV	Field vane shear test
U50	Undisturbed 48mm diameter core sample collected for laboratory testing
REF	Borehole refusal

Attachment 5 Engineering Logs

enviro·tech CONSULTANTS

ASSESSMENT: Geotechnical Site Investigation
STRUCTURE: Dwelling
EASTING: 540545
NORTHING: 5250332

HOLE ID NO.: BH01
DATE TESTED: 27/09/2022
LOGGED BY: M. Scalisi
ELEVATION: 2.9

LOCATION: 47 Balook Street - Lauderdale
CLIENT: Amron Holdings

EQUIPMENT: Direct Push Soil Corer
RELATIVE NATURAL SURFACE (RL): 0.3

DEPTH (m)	GRAPHIC	DESCRIPTION	DENSITY CONSIST-ENCY	MOISTURE	ELEVATION (mAHD)	SAMPLES	Cu (kPa)	UCS (kPa)	BLOW COUNT	DCP blows/100mm
0.0	GW	FILL: Sandy GRAVEL trace leaf litter, dark brown/grey, well sorted, medium grained sand, gravel 50%, medium to coarse grained, sub-rounded		wet	2.8				0.5	
					2.6				0.5	
									0.2	
0.5	SW	SAND with gravel, pale brown/grey, well sorted, medium to coarse grained sand, gravel 20%, medium to coarse grained, sub-rounded	very loose to medium dense	wet	2.4	U50			0.2	
					2.2				0.2	
					2.0				0.2	
1.0									0.2	
									5.0	
					1.8				5.0	
						U50			7.0	
	SW	SAND trace gravel, dark brown, well sorted, medium grained sand	medium dense to dense	wet	1.6				6.0	
									5.0	
1.5					1.4				4.0	
						FV40	217		3.0	
					1.2				6.0	
									8.0	
									4.0	
2.0					1.0				10.0	
									13.0	
					0.8				24.0	
									26.0	
					0.6				REF	
2.5	SW	SAND, pale brown, well sorted, medium grained sand	dense to very dense	wet	0.4					
					0.2					
					0.0					
3.0					-0.2					
		Borehole Ended At Target Depth End of borehole at 3.2m depth.			-0.4					

GROUNDWATER: Not Encountered
TESTING: Penetrometer: AS 1289.6.3.2

PAGE 1 of 1

Where blows per 100mm are less than 1, distance travelled per penetrometer blow is measured and converted back to blows per 100mm.

enviro·tech CONSULTANTS

ASSESSMENT: Geotechnical Site Investigation
STRUCTURE: Dwelling
EASTING: 540530
NORTHING: 5250338

HOLE ID NO.: BH02
DATE TESTED: 27/09/2022
LOGGED BY: M. Scalisi
ELEVATION: 2.9

LOCATION: 47 Balook Street - Lauderdale
CLIENT: Amron Holdings

EQUIPMENT: Direct Push Soil Corer
RELATIVE NATURAL SURFACE (RL): 0

DEPTH (m)	GRAPHIC	DESCRIPTION	DENSITY CONSIST-ENCY	MOISTURE	ELEVATION (mAHD)	SAMPLES	Cu (kPa)	UCS (kPa)	BLOW COUNT
0.0	SC	TOPSOIL: SAND with clay, trace roots, trace silt, dark brown/grey, well sorted, fine grained sand	loose	wet	2.8				2.0
					2.6				2.0
									1.0
0.5					2.4				1.0
									1.0
	SW	SAND, pale brown, well sorted, fine to medium grained sand	very loose to loose	wet	2.2				1.0
									2.0
1.0					2.0				2.0
									2.0
					1.8				2.0
									2.0
					1.6				2.0
									2.0
1.5					1.4				1.0
									1.0
					1.2				1.0
									1.0
					1.0				1.0
									1.0
2.0					0.8				1.0
									2.0
	SW	SAND, pale brown, well sorted, medium grained sand	very loose to very dense	wet	0.6				2.0
									3.0
2.5					0.4				3.0
									5.0
					0.2				7.0
									11.0
					0.0				17.0
									15.0
3.0					-0.2				18.0
									22.0
		Borehole Ended At Target Depth End of borehole at 3.2m depth.			-0.4				

DCP blows/100mm (0, 5, 10, 15, 20)

GROUNDWATER: Not Encountered
TESTING: Penetrometer: AS 1289.6.3.2

PAGE 1 of 1

Where blows per 100mm are less than 1, distance travelled per penetrometer blow is measured and converted back to blows per 100mm.

enviro·tech CONSULTANTS

ASSESSMENT: Geotechnical Site Investigation
STRUCTURE: Dwelling
EASTING: 540551
NORTHING: 5250339

HOLE ID NO.: BH03
DATE TESTED: 27/09/2022
LOGGED BY: M. Scalisi
ELEVATION: 2.9

LOCATION: 47 Balook Street - Lauderdale
CLIENT: Amron Holdings

EQUIPMENT: Direct Push Soil Corer
RELATIVE NATURAL SURFACE (RL): 0

DEPTH (m)	GRAPHIC	DESCRIPTION	DENSITY CONSIST-ENCY	MOISTURE	ELEVATION (mAHD)	SAMPLES	Cu (kPa)	UCS (kPa)	BLOW COUNT	blows/100mm 0 5 10 15 20
0.0	SC	TOPSOIL: SAND with clay, trace roots, trace silt, dark brown/grey, well sorted, fine grained sand	loose	wet	2.8					
0.5	SW	SAND, pale brown, well sorted, fine to medium grained sand	very loose to loose	wet	2.6					
1.0	SW	SAND trace gravel, dark brown, well sorted, medium grained sand	medium dense to dense	wet	2.4					
1.5		Refusal in medium dense to dense, dark brown SAND trace gravel End of borehole at 1.5m depth.			2.2					
					2.0					
					1.8					
					1.6					
					1.4					

GROUNDWATER: Not Encountered
TESTING:

PAGE 1 of 1

Where blows per 100mm are less than 1, distance travelled per penetrometer blow is measured and converted back to blows per 100mm.

Attachment 6 Core, Test Pit and Cut Photos

BH01

BH02

Dynamic Cone Penetrometer (DCP)

Dynamic Cone Penetrometer (DCP) testing results are summarised in Attachment 5. Inferred SAND internal friction angles are presented in Table 7.

Testing was conducted to 3.2 m in BH01 and BH02 and 1.5 m in BH03 for the permeameter test. No hard substrate was hound at the Site. Sand has a highly variable density ranging from very loose to very dense, gradually increased in density with depth to very dense.

Table 7 Inferred SAND internal friction angles

Test Hole	Depth From (m)	Depth To (m)	Description	Density/ Consistency	Internal Friction Angle
BH01	0.3	1	Pale Brown/Grey; SAND with gravel	Very Loose To Medium Dense	24
BH01	1	1.8	Dark Brown; SAND trace gravel	Medium Dense To Dense	35 to 41
BH01	1.8	3.2	Pale Brown; SAND	Dense To Very Dense	42 to 48
BH02	0	0.2	Dark Brown/Grey; TOPSOIL: SAND with clay, trace roots, trace silt	Loose	33
BH02	0.2	1.4	Pale Brown; SAND	Very Loose To Loose	30 to 33
BH02	1.4	3.2	Pale Brown; SAND	Very Loose To Very Dense	30 to 47
BH03	0	0.4	Dark Brown/Grey; TOPSOIL: SAND with clay, trace roots, trace silt	Loose	33
BH03	0.4	1.3	Pale Brown; SAND	Very Loose To Loose	30 to 33
BH03	1.3	1.5	Dark Brown; SAND trace gravel	Medium Dense To Dense	35 to 41

Attachment 7 Coastal Hydrodynamics

Stillwater Levels

Assessment Method

Stillwater levels influencing coastal processes within the Project Area are calculated from the combination of the following factors:

- **Storm Tide** - Present day astronomical tides combined with barometric low-pressure influence (coined storm tide). Storm tide inundation levels are adopted from 1% annual exceedance probability (AEP) modelling (McInnes O'Grady 2016).
- **Sea Levels** - are projected based on IPCC RCP8.5 scenarios which have been locally modelled for local government area (DPAC 2016) based on McInnes et. al. (2016). An allowance has been made for present sea level heights relative to Australian Height Datum (AHD). Projections are based on 2050 and 2100 scenarios which are all compiled from a 2010 baseline. The 50-year building design life (2073) scenario is extrapolated from the projection curve.
- **Wind Setup** – are calculated based on procedures outlined in Kamphuis (2000) with 100-year ARI wind data adapted from AS1170 based on a 0.2 s wind gust of 41 m/s with 0.85 to 1.00 directional multipliers.

Findings

Project Area stillwater levels are presented in Table 8. The following is concluded:

Building: **1% AEP stillwater inundation level of 2.05 m AHD for 2073 (building design life)**

Table 8 Project Area 1% AEP Stillwater Levels

Parameter	Units	Scenario			
		2022	2050	2073	2100
Sea Levels	m AHD	0.13	0.23	0.55	0.93
Local 1% AEP Storm Tide	m	1.28	1.28	1.28	1.28
Wind Setup	m	0.22	0.22	0.22	0.21
Total	m AHD	1.63	1.73	2.05	2.42

Wave Forecast Modelling

Assessment Method

Wave processes within the Project Area are used to calculate both coastal inundation levels (in addition to stillwater levels) and coastline recession rates based on the following:

- **Offshore Swell Waves** – 31 years of data from Wavewatch III models are applied to determine 1% AEP significant wave height and period for the relevant wave direction influencing the Project Area.
- **Localised 'Wind' Waves –** Are modelled for the Project Area based on methods outlined in the Coastal Engineering Manual (2002). TAFI (<40 m depth) and Geoscience Australia deep-water bathymetry contours (>40 m depth), and coastal LIDAR are used to develop an accurate 3D bathymetry model. 100-year ARI wind data adapted from AS1170 based on a 0.2 s wind gust of 41 m/s with 0.85 to 1.00 directional multipliers. Wind speeds were calculated using the methods of the Shore Protection Manual (CERC, 1984) are used in wave propagation model for primary wave direction as illustrated in the radial map (Attachment 1- Map 10.
- **Nearshore Waves** – A combination of SWAN and CEM (2002) attenuation models are adopted in determining nearshore wave heights.

Breaker Zone Modelling

Assessment Method

Wave processes within the breaker zone are used to calculate coastal inundation levels which are specific to the Project Area (Figure 1) based on the following:

- **Wave Setup** – Wave setup is the increase of water level within the surf zone during wave-breaking. It is calculated from significant wave height, period, water depth and bathymetry gradient at the breaking point.
- **Wave Runup -** is the maximum onshore elevation reached by waves, relative to the shoreline position in the absence of waves. In this case, the wave runup is calculated from:
    - The scenario assessed for present day scenario is based on smooth beach wave runup on the existing frontal dune.
    - Given the frontal dune is projected to be eroded within the building design life, wave runup is calculated using Van Der Meer (1992) and reductions factors for grassy surfaces between the erosion zone and the Site.

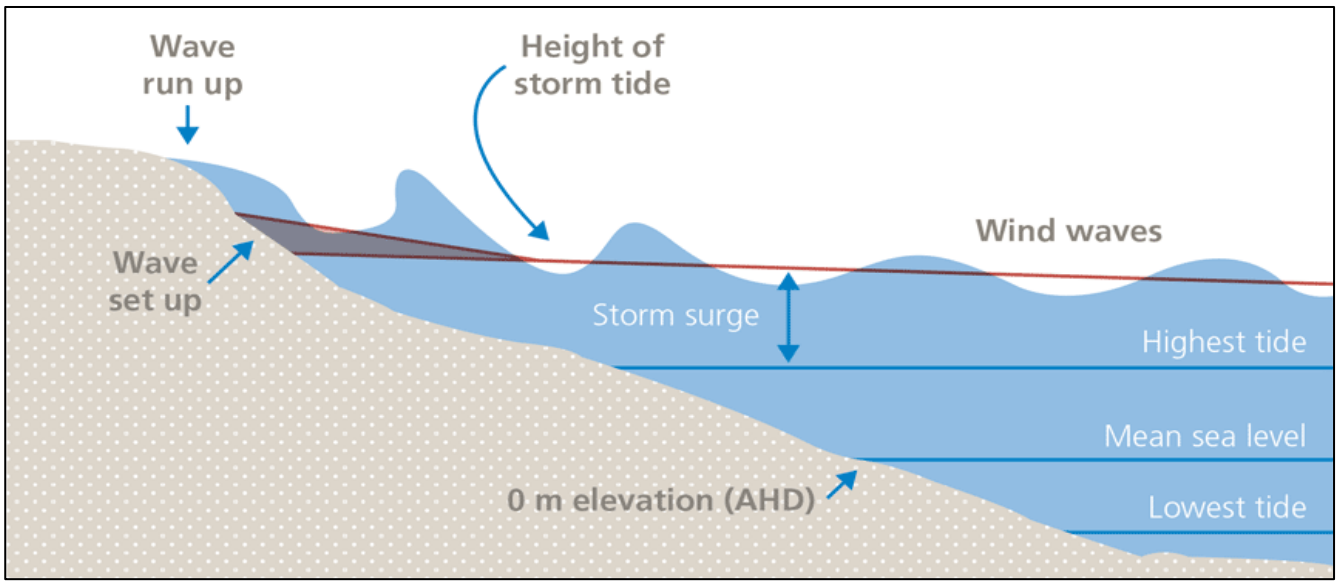


Figure 1 Schematic of coastal processes

Findings

Modelled wave runup and wave setup inundation levels are presented in Table 9. Wave runup levels are projected to reach higher elevations in present day conditions due to the steepened dune face. With projected erosion of the frontal dune and allowing for wave attenuation over low gradient grassy surfaces, the wave runup levels for 2073 are projected to be lower than present runup scenarios.

Table 9 Summary of inundation levels within the Project Area[5]

Parameter	Units	Scenario		
		2022	2050	2073
1% AEP Stillwater Levels	m AHD	1.6	1.7	2.0
Wave Setup (easterly wind)	m AHD	1.9	2.0	2.3
Wave Runup (southerly swell)	m AHD	2.9	NA	2.7

[5] These levels modelled by Envirotech are for Site risk assessment purposes only and are not defined flood levels for determining habitable room finished floor levels.

Coastal Inundation Hazard Modelling

Building - Directors Determination - Coastal Inundation Hazard Areas

Envirotech have conducted Site specific modelling to address directors' determination (Division 2.2.6.c). This modelling is conducted to assess whether the proposed work can achieve and maintain a tolerable risk for the intended life of the building without requiring any specific coastal inundation protection measures.

Envirotech have modelled the following Site inundation level to determine Site tolerable risks for building purposes:

2.7 m AHD based on a 1% AEP storm tide and southerly swell runup event for 2073

Resulting water depths under these extreme conditions at the end of the building life will be lower than the Site ground levels, and therefore coastal inundation is not projected at the Site within the building design life.

Attachment 8 Coastline Recession & Storm Erosion

Bruun Recession Model

Assessment Method

Where applicable, the Bruun Rule model (Figure 2) is applied to the Project Area. In more complex settings where there is the influence of longshore drift, headlands and tidal movements, this model cannot be applied. The method involves determining the closure depth and distance (sand deposition extent) dune heights, sea level rise. The closure depth is calculated based on methods derived by Dean and Darymple (2002). Sea level rise projection for the local government area (McInnes et. al. 2016) has been applied for the building design life.

Shoreline modelling conducted using LANDSAT imagery has been used for the underlying recession/progradation trends which have been applied into the modelling.

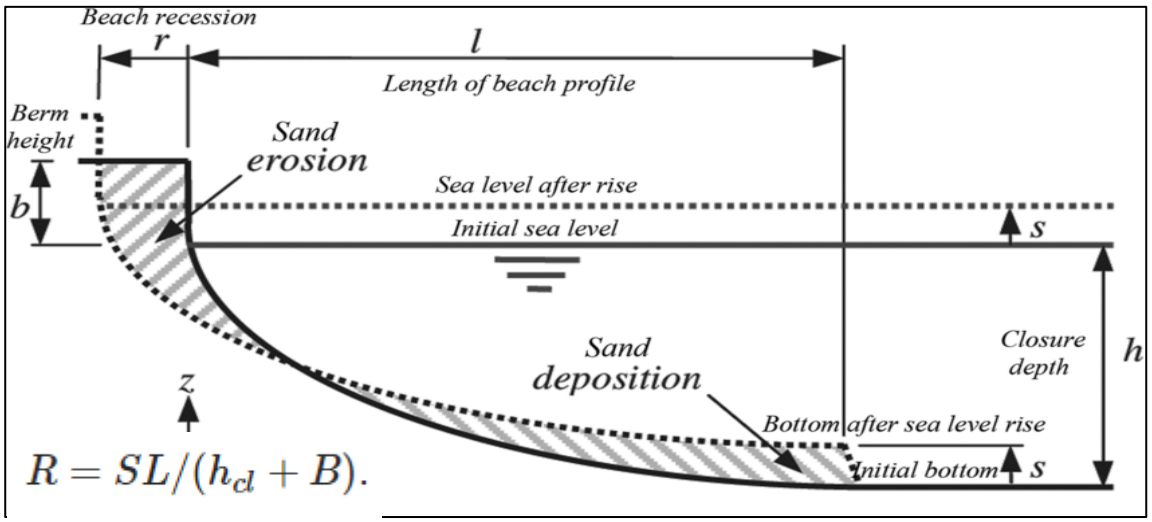


Figure 2 Bruun Rule concept for determining coastline recession relationship

Findings

Parameters adopted in the assessment are presented in

Table 10 with findings presented in Table 11. The findings are estimated:

27 m horizontal recession per metre sea level rise

0.24 m/year underlying recession

22 m horizontal coastline recession within the building design life

Table 10 Bruun parameters adopted for the assessment

Variable	Units	Symbol	Value
Profile Closure Depth	m	h	2.4
Length of Active Erosion Zone	m	L	125
Active Dune/Berm Height	m	D	2.2
Calculated Bruun Ratio	m/m		27

Table 11 Calculated coastline recession

Variable	Units	Symbol	Year 2073
Sea level	m	s	0.46
Sea level rise horizontal recession*	m	R	13
Underlying recession	m		12
Total recession	m		25

* Relative to 2019 LIDAR

Historical Recession Model

Assessment Method

An historical series of georeferenced aerial photographs and satellite imagery have been used in the analysis (Table 12). The margin of error of the image georeferencing is estimated to be in the order of 0.5 m.

Table 12 Details of aerial images used in the analysis

Photographic Measurements	Temporal Data
Photography Range (Years)	1948 to 2021
Number of Temporal Measurements	11

A relationship between sea level rise and coastline recession has been determined for the Project Area based on historical sea level rise curves (Church and White 2011) and sea level rise projections between 2010 and present for the local government area (McInnes et. al. 2016).

Given the Bruun relationship, a ratio of sea level rise vs horizontal recession is developed for the Site. Sea level rise projections adopted from local government area models are applied to the Bruun ratio to derive a coastline recession rate for the building design life.

Findings

Findings from the assessment are charted in Figure 3 illustrating the coastline position (m) relative to sea levels (m AHD) for various temporal points.

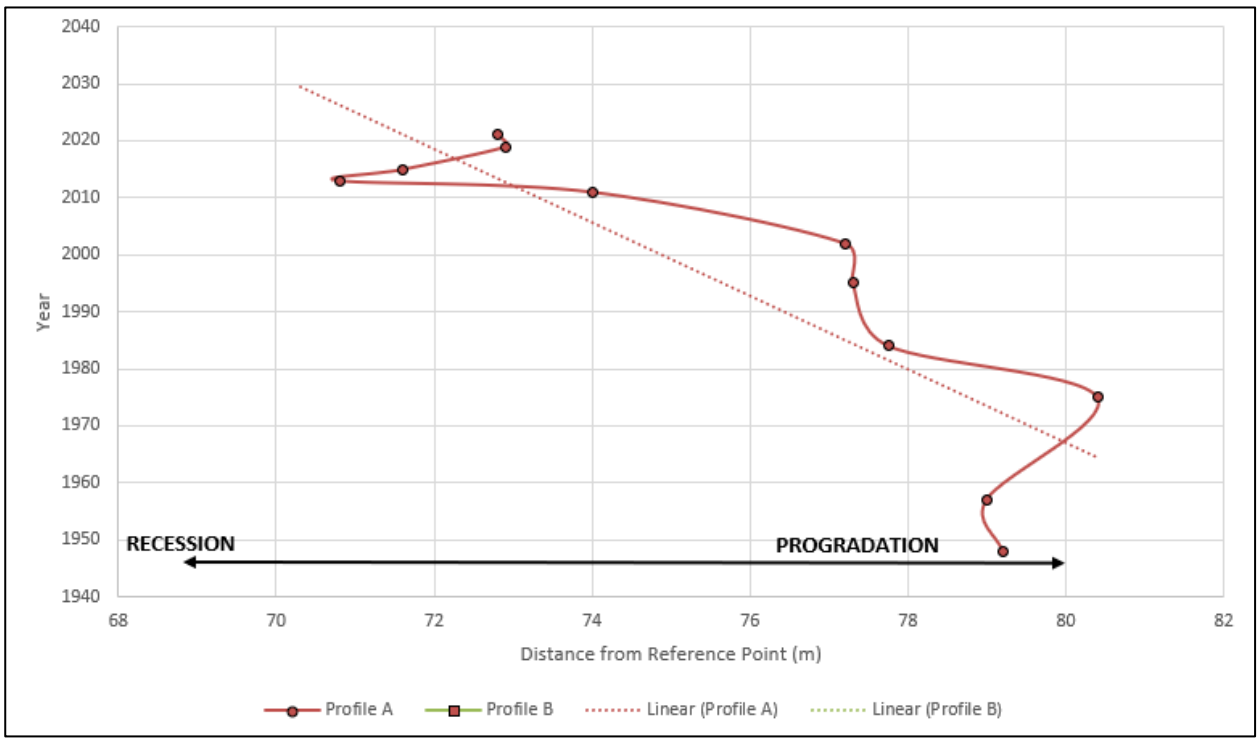


Figure 3 Measured coastline recession as distance of vegetation line relative to a fixed reference point

The following is summarised from the analysis presented in Table 12:

- An underlying recession trend of 0.24 m per year is applied to the Site model
- Sea level rise induced recession is calculated at 13 m horizontal for the building design life
- A total recession of 25 m horizontal is modelled for the Site.

Table 13 Forecast building design life recession/progradation based on historical shoreline modelling

Year	Underlying Recession (m)	Sea Level Rise Recession (m)	Total Recession (m)
2073	12	10	22

Storm Erosion Assessment

Assessment Method

The short-term deviation in coastline recession and progradation relative to the trendline illustrated Figure 3 are used to determine the storm erosion demand at the site.

This relationship is used to determine the total storm erosion demand cycles within the Project Area, which is determine by the sum deviation relative to the beach profile height to derive m^3/m storm erosion demand.

As the time series is less than what would ordinarily be required to determine design 1 in 100-year storm erosion demand or consecutive 1 in 100-year storm erosion demand for the Project Area, adjustments need to be made to the model.

Mariani et. al (2012) developed a broad model to assess storm erosion demand for various beach types around Australia, with 10 models developed for Tasmania. These models are used to derive 100-year average recurrence interval (ARI) values extrapolated from the measured the period.

Findings

Making allowance for the current phase in the storm erosion/accretion cycle observed at the Site (Table 14), the following is estimated:

Consecutive (2x) 100-year ARI storm erosion events are calculated at 27 m^3/m

Table 14 Project Area storm erosion demand estimates

Storm Erosion Parameter	Units	Calculated Value
Profile		47 Balook Street
Temporal Observation Range	Years	73
Profile Height Within Erosion Zone	m	2.2
Measured Deviation (m horizonal)	m	5.2
Observed Storm Erosion Demand	m^3/m	11
Beach Typology		Wave Dominated- Low Tide Terrace
Projected Beach 100 Year ARI	m^3/m	12
Projected Beach 2 x 100 Year ARI	m^3/m	18
Projected 2 x 100 Year ARI Considering Present Cycle	**m^3/m**	**11**

Stable Foundation Zone Analysis

Process

A stable foundation zone analysis has been prepared for the Site based on methods outlined by Nielsen et. al., 1992. The theory takes into consideration for slope instability within the face of the sand deposits. Slope instability scenarios are identified which need to be considered in any building design:

- **Wave Runup Erosion Zone** - The beach escarpment is often left with a vertical profile following storm erosion events. The profile will eventually collapse to the angle of repose as the sand desiccates.
- **Retrogressive Landslip -** This process is triggered by individual storm erosion events, with the net migration of surface layers of sand towards the coast. Geotechnical instability is often initiated by loss of toe support, with subsequent retrogressive slope instability transferring towards the crest of the escarpment. This can occur through a series of slumps which can be exacerbated by human and animal traffic across the dune face, animal burrowing and wind action.
- **Top of swash zone** – Due to the very low dune profile within the Project Area, following the projected erosion of the frontal dune, storm erosion occurs within the top of swash zone only which is defined by a 1:10 gradient between sea level and 2.0 m above sea level at the time.

Findings - Zone of Slope Adjustment

The following horizontal erosion is projected within the "Zone of Slope Adjustment" following loss of the calculated storm erosion demand:

10 m horizontal from storm erosion demand

Findings – Stable Foundation Zone

The Site resides within the 2073 Stable Foundation Zone, with the Stable Foundation Zone located approximately 30 m outside of the Site boundary.

Foundations

All structures must be piered or piled into the stable foundation zone as presented in Figure 4.

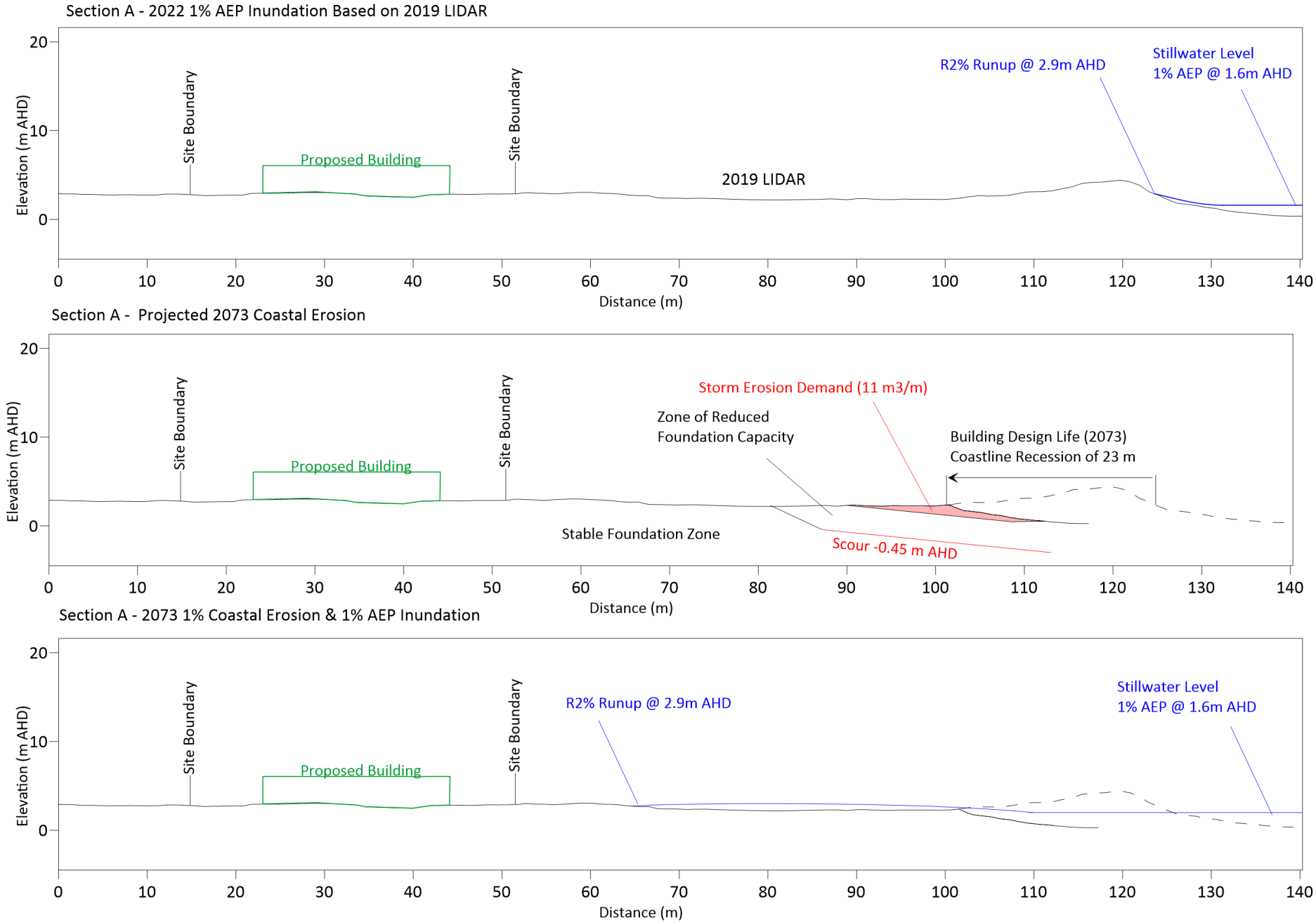


Figure 4 Coastal recession, storm erosion and inundation model for 2073 based on 1% AEP scenarios

Landform Mobility

Dune mobility at the site has not been classified (Figure 5). The LIST mapping, dune mobility classification is based on vegetation cover. Using the same system, the dune landform at the Site is identified as having 70 to 100% vegetation coverage and is therefore defined at being 'transitory' according to Mowling (2006). As the site comprises greater than 10% vegetation, the dune mobility is not classified as being mobile.

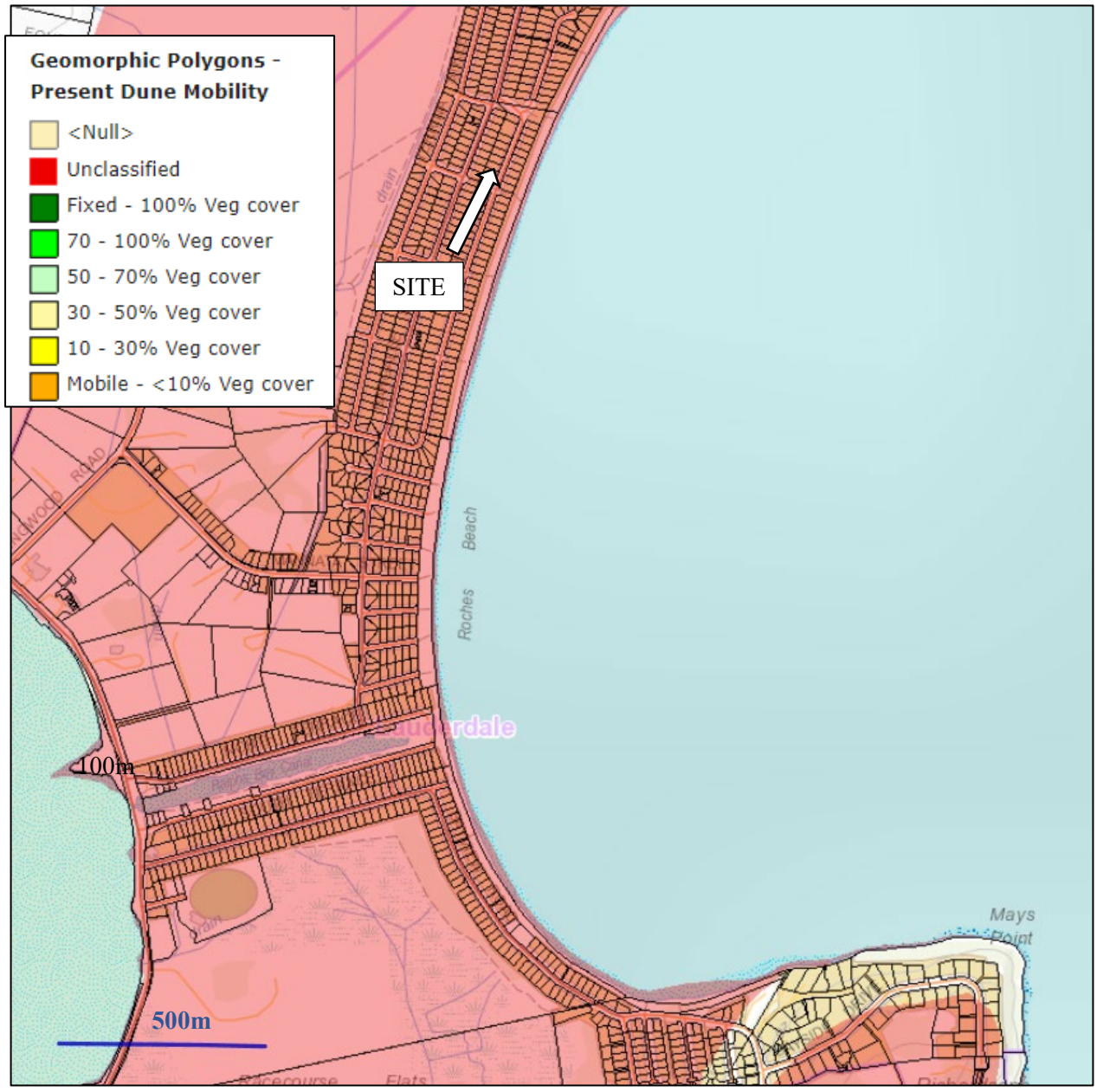


Figure 5 Present dune mobility classification (The LIST)

Coastal Erosion Protection Works

Directors Determination

To satisfy the directors determination, the proposed development must achieve and maintain a tolerable risk for the intended life of the building without requiring any specific coastal erosion protection measures.

Site Modelling

Envirotech have prepared Project Area erosion modelling with the following considerations:

- Modelling has identified that the proposed works will not require coastal erosion protection works given the erosion is not projected to encroach onto the Site within the building design life.

Attachment 9 Qualitative Terminology

almost certain	Is expected to occur in most circumstances; and/or there is a high level of recorded incidents; and/or strong anecdotal evidence; and/or a strong likelihood the event will recur; and/ or great opportunity, reason, or means to occur; may occur once every year or more
Likely	Will probably occur in most circumstances; and/or regular recorded incidents and strong anecdotal evidence; and/or considerable opportunity, reason or means to occur; may occur once every five years
Possible	May occur at some time; and/or few, infrequent or randomly recorded incidents or little anecdotal evidence; and/or very few incidents in associated or comparable organisations, facilities or communities; and/or some opportunity, reason or means to occur; may occur once every 20 years
Unlikely	Is not expected to occur; and/or no recorded incidents or anecdotal evidence; and/or no recent incidents in associated organisations, facilities or communities; and/or little opportunity, reason or means to occur; may occur once every 100 years
Rare	May occur only in exceptional circumstances; may occur once every 500 or more years

Source: Commonwealth of Australia, 2004: Emergency Management Australia – Emergency Risk Management Applications Guide Manual 5

Consequence Rating	***Public Safety***	***Local growth and economy***	***Community and Lifestyle***	***Environment & sustainability***	***Public administration***
Catastrophic	Large numbers of serious injuries or loss of lives	Local decline leading to business failure, loss of employment, local hardship	Local area seen as very unattractive, significant decline, and unable to support community	Major widespread loss of environmental amenity and progressive irrecoverable environmental damage	Public Administration would fail and cease to be effective
Major	Isolated instances of serious injuries or loss of lives	Local stagnation such that businesses unable to thrive and imbalance between employment and local population growth	Severe and widespread decline in services and quality of life within community	Severe loss of environmental amenity and a danger of continuing environmental damage	Public administration would struggle to remain effective and would be perceived as being in danger of failing completely
Moderate	Small number of injuries	Significant general reduction in economic performance relative to current forecasts	General appreciable decline in services	Isolated significant instances of environmental damage that might be reversed with intensive efforts	Public administration would be under significant pressure on numerous fronts
Minor	Serious near misses or minor injuries	Individually significant but isolated areas of reduction in economic performance relative to current forecasts	Isolated but noticeable examples of decline in services	Minor instances of environmental damage that could be reversed	Isolated instances of Public administration being under significant pressure
Insignificant	Appearance of threat by no actual harm	Minor shortfall relative to current forecasts	There would be minor areas in which the region was unable to maintain is current services	No environmental damage	There would be some minor instances of public administration being under more than usual stress but it could be managed

Likelihood (L)	**Consequences (C)**				
	Insignificant	**Minor**	**Moderate**	**Major**	**Catastrophic**
Almost certain	MEDIUM	medium	high	extreme	extreme
Likely	low	medium	high	high	extreme
Possible	low	medium	medium	high	high
Unlikely	low	low	medium	medium	medium
Rare	low	low	low	low	medium

Adapted from DCC 2006, 40.

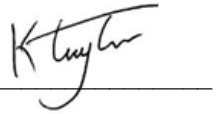
Attachment 10 Director's Determination Declaration

Coastal Inundation Hazard Reporting	Application			
whether the development is likely to cause or contribute to coastal inundation on the Site or on adjacent land.	There is a low likelihood that the proposed building and works will contribute to coastal inundation on the site or adjacent land.			
whether the proposed work can achieve and maintain a *tolerable risk*[6] for the intended life of the building having regard to:	**Application/Management**	**Consequence**	**Likelihood**	**Risk**
nature, intensity and duration of the use	Risks are considered tolerable considering the nature, intensity and duration of the use within a 50-year building design life duration (1% AEP modelling).	Minor	Unlikely	Low
type, form and duration of the development	With raised finished floor levels above the floodwaters, risks are considered tolerable considering the type, form, and duration of the development	Minor	Unlikely	Low
change in risk across the intended life of the building	This risk assessment is based on worst case scenario climate modelling for 2073. There is a low chance that a tolerable risk cannot be maintained throughout the duration of the building design life until 2073.	Minor	Unlikely	Low
adaptation to any potential changes in risk	Given the setbacks, there is ample opportunity to adapt to changing inundation conditions within the Project Area.	Minor	Unlikely	Low
ability to maintain access to utilities and services	It is probable that services can be maintained throughout the life of the proposed development with occasional disruption caused by floodwater events.	Minor	Unlikely	Low
the need for specific coastal inundation hazard reduction or protection measures on the Site;	No need for specific coastal inundation hazard reduction or protection measures are recommended for the Site	Minor	Unlikely	Low
the need for coastal inundation hazard reduction or protection measures beyond the boundary of the Site; and	No need for coastal inundation hazard reduction or protection measures beyond the boundary of the Site	Minor	Unlikely	Low
any coastal inundation management plan in place for the Site and/or adjacent land.	An assessment needs to be made by the building surveyor to determine if a coastal inundation management plan is required on a case-by-case scenario.			
hazardous chemical used, handled, generated, or stored on the Site,	General household chemicals being stored are typically in low volumes and in sealed containers.	Minor	Unlikely	Low
Details of the person who prepared or verified this report:	This coastal inundation hazard report has been prepared in accordance with a methodology specified in the Director's Determination - Coastal Inundation Hazard Area by a suitably qualified practitioner with relevant qualifications, experience and competence in the preparation of coastal inundation hazard reports.			
Qualifications	Bachelor of Science with first honours in geology			
Expertise	Kris Taylor has over 10 years of experience in coastal inundation modelling with several reports externally reviewed by parties including the University of New South Wales Water Research Lab. Reports written include Crown Land pilot studies, several reports for councils, and numerous costal inundation assessments for planning and building			
Level of current indemnity insurance	Current indemnity insurance of $2,000,000 ($4,000,000) Underwriters at Lloyd's covers coastal geomorphology, natural hazard, hydrology and environmental coastal inundation hazard assessments.			

Kris Taylor Signed 

[6] Tolerable risk means the lowest level of likely risk from coastal inundation to secure the benefits of a use or development in a coastal inundation hazard area, and which can be managed through routine regulatory measures or by specific hazard management measures for the intended life of each use or development.

Coastal Erosion Hazard Reporting	Application			
Geotechnical Site investigation undertaken consistent with AS 1726	This Geotechnical Site Investigation has been written in accordance with AS 1726 by a geotechnical practitioner with 14 years' experience, 4 years in house geotechnical engineer training and first-class honours in geology (Section 5.3.2)			
whether the work is likely to cause or contribute to coastal erosion on the land or on adjacent land;	Based on the provided plans and the coastal erosion hazard modelling, the works is unlikely to cause or contribute to coastal erosion on the land or on adjacent land;			
whether work is proposed on actively mobile landforms;	The Site landform comprises historic sheet sand deposits which are vegetated and not considered a mobile landform.			
whether the proposed work can achieve and maintain a *tolerable risk*[7] for the intended life of the building having regard to:	**Application/Management: Within the building design life and modelled based on a storm event by 2073**	**Consequence**	**Likelihood**	**Risk**
nature, intensity and duration of the use	No hazard management measures are recommended as the building is seated within the stable foundation zone.	Minor	Unlikely	Low
type, form and duration of the development	The building is suitably set back outside of the modelled erosion zone for the building design life.	Minor	Unlikely	Low
the likely change in the risk across the intended life of the building	The likelihood of a change in risk is considered low, and the building is well outside of the modelled erosion zone.	Minor	Unlikely	Low
the ability to adapt to a change in the risk	Risks are considered low based on a storm event by 2073. There is considerable buffer in the assessment which will allow for adaption.	Minor	Unlikely	Low
The ability to maintain access to utilities and services	Access to services and utilities can be maintained.	Minor	Unlikely	Low
the need for specific coastal erosion hazard reduction or protection measures on the site	No coastal erosion protection measures are required at the Site.	Minor	Unlikely	Low
the need for coastal erosion hazard reduction or protection measures beyond the boundary of the site; and	No coastal erosion protection measures are required beyond the boundary of the Site.	Minor	Unlikely	Low
any coastal erosion management plan in place for the site and/or adjacent land.	No coastal erosion management plan is recommended.	Minor	Unlikely	Low
hazardous chemical used, handled, generated, or stored on the site,	General household chemicals being stored are typically in low volumes and in sealed containers.	Minor	Unlikely	Low
Details of the person who prepared or verified this report:	This coastal inundation hazard report has been prepared in accordance with methodology specified in the Director's Determination - Coastal Erosion Hazard Area (version 1.2) by a suitably qualified geotechnical practitioner with relevant qualifications, experience, and competence in the preparation of Coastal erosion hazard reports.			
Qualifications (Certificates by Qualified Persons for an Assessable Item Determination)	Bachelor of Science with first honours in geology			
Expertise - Geo-technical reports	Kris Taylor has 14 years of experience in coastal erosion modelling with several reports externally reviewed by parties including the University of New South Wales Water Research Lab. Reports written include Crown Land pilot studies, several reports for councils, and over 200 costal erosion assessment reports for planning and building			
Level of current indemnity insurance	Current indemnity insurance of $2,000,000 ($4,000,000) Underwriters at Lloyd's covers soil and rock mechanics, erosion, coastal geomorphology, natural hazard, soil and rock testing, hydrology and environmental coastal inundation and erosion hazard assessments.			

Kris Taylor Signed 

[7] * Tolerable risk means the lowest level of likely risk from coastal erosion to secure the benefits of a use or development in a coastal erosion hazard area, and which can be managed through routine regulatory measures or by specific hazard management measures for the intended life of each use or development.

enviro•tech
CONSULTANTS
Geotechnical & Environmental Services

Proposed Dwelling
47 Balook Street - Lauderdale

STORMWATER DETENTION MANAGEMENT

Client: Amron Holdings

Certificate of Title: 13725/49

Investigation Date: Monday, 28 November 2022

Refer to this Report As

Enviro-Tech Consultants Pty. Ltd. 2022. Site Stormwater Detention & Management Report for a Proposed Dwelling, 47 Balook Street - Lauderdale. Unpublished report for Amron Holdings by Enviro-Tech Consultants Pty. Ltd., 28 November 2022.

Report Distribution:

This report has been prepared by Enviro-Tech Consultants Pty. Ltd. for the use by parties involved in the proposed residential development of the property named above. It is to be used only to assist in managing any existing or potential erosion hazards relating to the Site and its development.

Limitations of this report

The data displayed within this document has been prepared using open-source scientific documents and data. Envirotech have used this local and regional data to estimate present and future hazards at the site. The data is by its nature approximate and may contain errors introduced by the data provider(s).

Building plumbing plans are to incorporate information contained within this document. This report contains information for determining trench geometry only and may not contain complete information for hydraulic plumbing design.

1 Introduction

1.1 *Background*

Enviro-Tech Consultants Pty. Ltd. (Envirotech) were contracted by Amron Holdings to prepare a stormwater detention management assessment for a proposed dwelling at 47 Balook Street - Lauderdale (Attachment 1 Map 1).

This assessment report has been prepared by an environmental and engineering geologist with hydrology and hydrogeology training and experience.

1.2 *Cadastral Title*

The land studied in this report is defined by the title 13725/49

2 Stormwater Management

2.1 *Proposed Development*

Table 1 summarises the provided design documents from which this assessment is based.

Table 1 Project Design Drawings

Drafted By	Project Number	Date Generated	Drawings
Maters Architecture	CC1345F	20/09/22	01 to 19

2.2 *Water Table*

Given the proposed development is in a low-lying area which is potential subject to inundation from groundwater, the proposed stormwater trench will need to be designed to discharge from above the water table. Details of the groundwater analysis are presented in Attachment 3. The trench will need to be less than 1.1 m depth.

2.3 *Soil Properties*

Soil at the site comprises SAND (Category 1) and has an estimated hydraulic conductivity of 9.30E-01 m/day with details presented in Attachment 4.

2.4 *Trench Sizing*

The sizing of the trench is summarised in Table 2. Trench sizing calculations are presented in Attachment 5.

Table 2 Trench Sizing

Dimension	Units	Value
Depth	m	1.1
Width	m	1.0
Length	m	27

3 Risk Assessment

Qualitative risk evaluation criteria have been created to determine fundamental risks that may occur due to development in areas that are vulnerable to erosion or inundation hazards.

This qualitative risk assessment technique is based on AS/NZS ISO 31000:2009 and relies on descriptive or comparative characterisation of consequence, likelihood, and the level of risk comparative (rather than using absolute numerical measures).

A risk consequence/likelihood matrix has been selected which is consistent with AS/NZS ISO 31000:2009 guidelines.

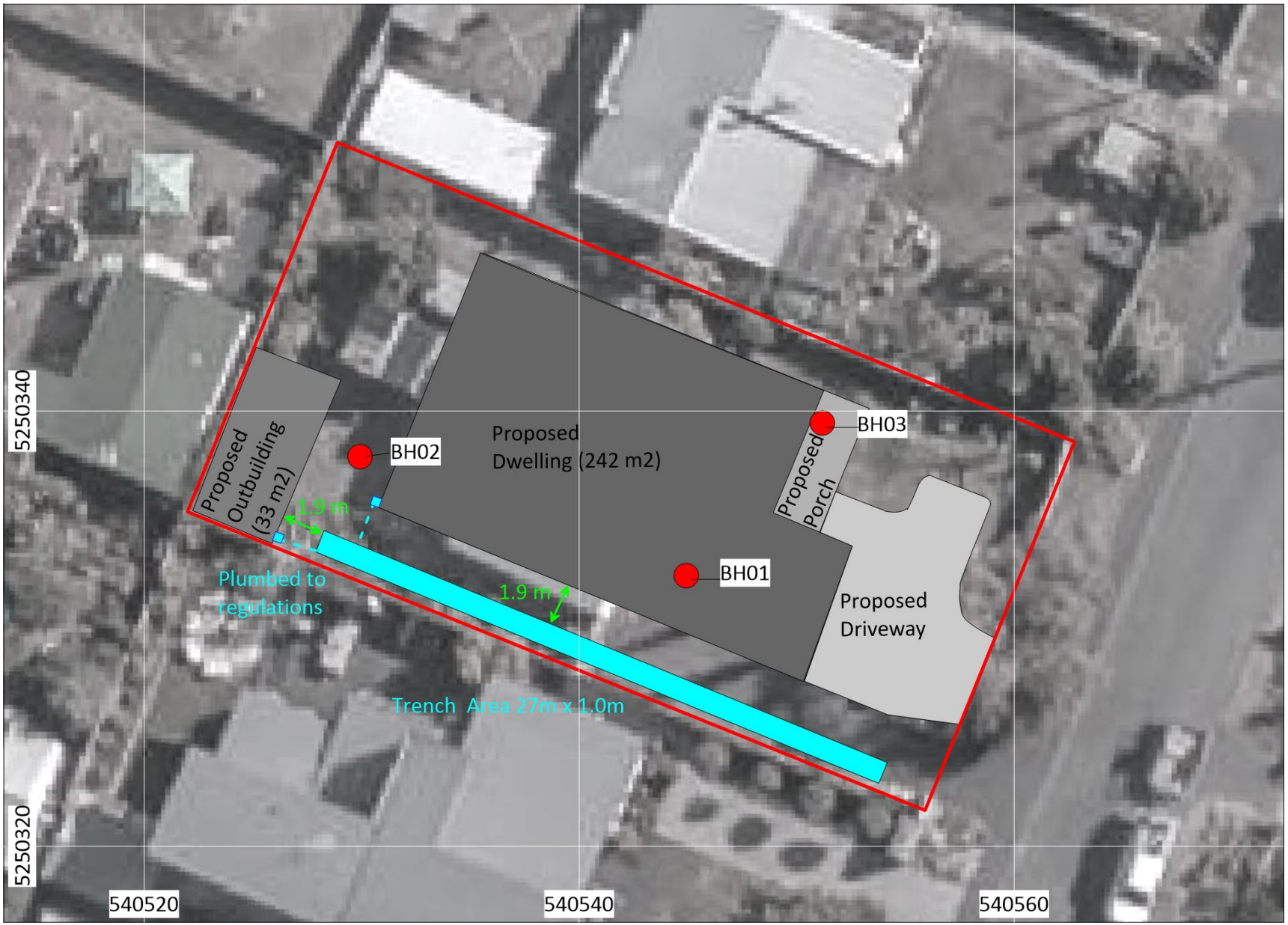
Consequence/likelihood criteria have assisted in determining if any risk management measures are required at the Site to mitigate any potential hazards. Adopted consequence/likelihood criteria are presented in Attachment 6.

Kris J Taylor BSc (Hons) | Environmental & Engineering Geologist

Director

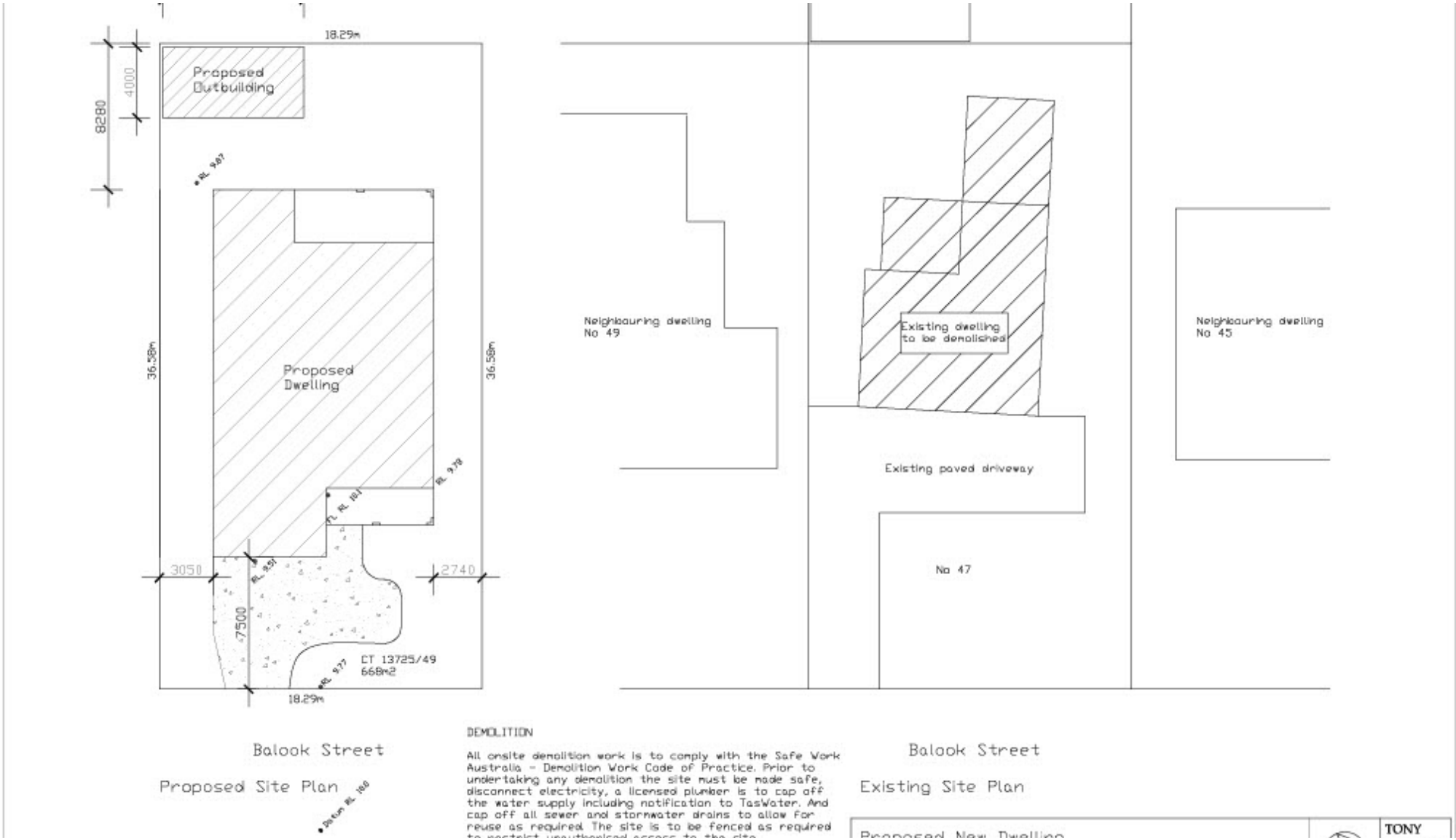
Enviro-Tech Consultants Pty. Ltd.

Attachment 1 Mapping



Map 1 Stormwater retention pit dimensions – refer to Attachment 2 for plumbing

Attachment 2 Preliminary Design Concept Plans



Attachment 3 Groundwater Levels

The site is identified in a location which is susceptible to fluctuating water table level from seasonal and climatic variation. The effects of sea level rise on groundwater levels need to be assessed at the Site to ensure serviceability of the trenching system.

Groundwater levels at the Site are derived from Geotechnical Assessment conducted by Rock Solid Geotechnics PTY LTD on 20/04/2022:

Peak groundwater levels from 2022 have been used as a baseline for assessing sea level rise variations. Table 3 presents a summary of groundwater levels at the Site recommended for drainage trench design.

Table 3 Groundwater depth calculations allowing for climate change

Parameter	Units	Value
Groundwater depths at the time of investigation (Autumn 2022)	m	1.6
Projected Groundwater for Winter	m	1.4
Additional Groundwater for El Nino and La Nina cycles	m	0
Projected Groundwater Depth 2057 (35 years)	m	1.1
Design Groundwater Depth	**m**	**1.1**

Attachment 4 Soil Assessment Findings

Soil Bore Logs

Soil descriptions summarised in Table 4 are derived from Enviro-Tech soil testing.

Table 4 Site soil profiles used to determine trench construction

#	Layer	Details	USCS	BH01	BH02	BH03
1	Sandy GRAVEL	FILL: Sandy GRAVEL trace leaf litter, dark brown/grey, well sorted, medium grained sand	GW	0-0.3		
2	SAND	TOPSOIL: SAND with clay, trace roots, trace silt, dark brown/grey, well sorted, fine grained sand, L	SC		0-0.2	0-0.4
3	SAND	SAND with gravel, pale brown/grey, well sorted, medium to coarse grained sand, VL-MD	SW	0.3-1		
4	SAND	SAND, pale brown, well sorted, fine to medium grained sand, VL-L	SW		0.2-1.4	0.4-1.3
5	SAND	SAND trace gravel, dark brown, well sorted, medium grained sand, MD-D	SW	1-1.8		1.3-1.5
6	SAND	SAND, pale brown, well sorted, medium grained sand, VL-VD	SW	1.8-3.2	1.4-3.2	

Soil Infiltration Capacity

Based on the permeameter testing conducted by Envirotech, the Sandy soil at the site has a saturated hydraulic conductivity of ~1 m/day as presented in Table 5.

Table 5 Permeameter Testing Results

Hole ID	Hole Depth (m)	Hole Diameter (mm)	Test Duration (mins)	Flow Rate (cm3/min)	K/sat (m/day)
BH03	1.4	60	1.3	240581	9.3E-01

Attachment 5 Stormwater Retention Management

Proposed Development Footprint

The proposed development plan is presented in Appendix A. The total surface areas for drainage calculations are presented in Table 6. Water from the main dwelling along with the water from the outbuilding are to be diverted directly into a stormwater detention and absorption trench.

Table 6 Site Drainage Surfaces

Proposed Development or Works	Surfacing	Runoff Coefficient	Drainage Surface Area (m^2)
Dwelling	Zinc/Colourbond	0.95	242
Outbuilding	Zinc/Colourbond	0.95	33

Rainfall Depths

The design runoff is based on an Average Recurrence Interval (ARI) of 20 years (5% Annual Exceedance Probability) precipitation event with cumulative values for 1 minute to 168-hour stormflow durations.

This information is obtained from the Bureau of Meteorology (BOM) Design Rainfall Data System with Intensity Duration Frequency (IDF) Design Rainfall Depths specific to the Site.

Data sheets are presented in Figure 1 with rainfall depths (in mm) used in the analysis.

Stormwater Volumes

This analysis is based on total stormwater volumes and not peak flow rates. Stormwater discharge volumes (input into the system given the AEP event) is calculated from the following formula:

V = CAI

Where:

V = volume accumulated (m3)

C = runoff coefficient

A = area of catchment (metres square)

I = rainfall depth (metres)

Potential Trench Discharge Volumes

Potential trench discharge volumes are calculated from the hydraulic conductivity of the underlying Sand units and the surface area of the base of the trench (transmissivity) for the duration of the hypothetical 5% AEP storm flow event.

Groundwater Transmissivity

Absorption trenches are designed based on vertical hydraulic gradients alone, recharging directly into the underlying Sand observed at the testing location.

Hydraulic Conductivity

A hydraulic conductivity of 1 m per day is based on permeameter testing of the fine to medium grained sandy soils at the site.

Trench Peak Water Volume

The trench peak water volume is calculated from the stormwater volume minus the potential discharge volume to determine the peak net volume stored for the given period.

Stormwater Retention – Total Runoff

Stormwater calculations are presented in Appendix C. Based on a 5% AEP stormflow event, stormwater will fill a 27m^2 trench to 0.9 m height above the base in 9 hours.

Stormwater Retention – Trench Geometry

The above calculations are based on a 1.1 m deep and 1.0 m wide trench with 350mm x 1200mm arches. Trench location and geometry are included in Map 1 & Figure 2

Label:47 Balook Street, Lauderdale
Requested coordinate Easting: 540540.0000 Northing: 5250337.0000 Zone: 55
Nearest grid cell Latitude: 42.8875 (S) Longitude: 147.4875 (E)

IFD Design Rainfall Depth (mm)

Issued: 28 November 2022

Rainfall depth in millimetres for Durations, Exceedance per Year (EY), and Annual Exceedance Probabilities (AEP).

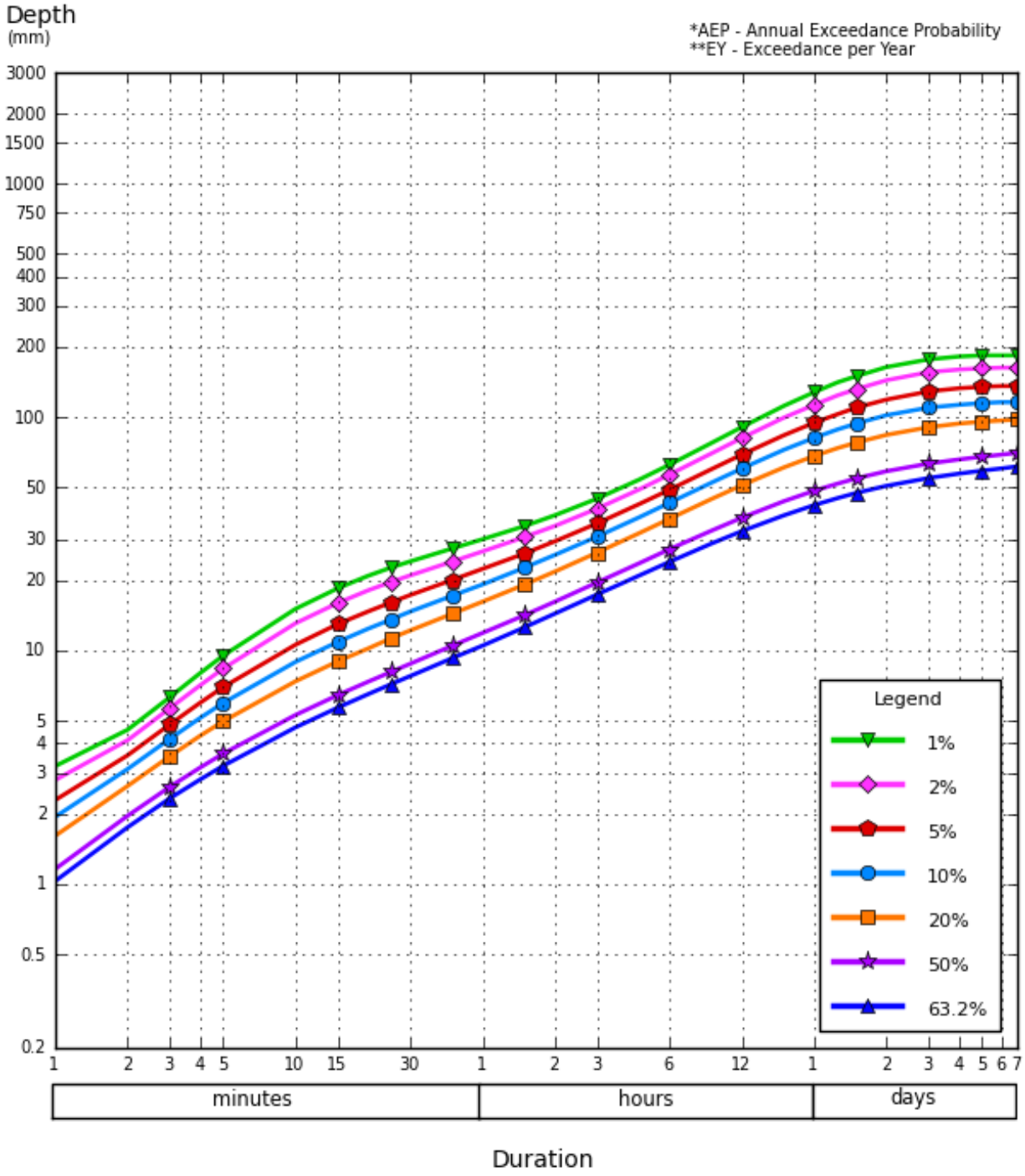


Figure 1 Site Australian rainfall and runoff design rainfall - chart

Table 7 Site Australian rainfall and runoff design rainfall - Table

	Annual Exceedance Probability (AEP)						
Duration	**63.2%**	**50%#**	**20%***	**10%**	**5%**	**2%**	**1%**
1 min	1.03	1.16	1.61	1.94	2.29	2.79	3.20
2 min	1.75	1.96	2.63	3.11	3.56	4.13	4.58
3 min	2.33	2.61	3.53	4.19	4.83	5.67	6.32
4 min	2.80	3.15	4.31	5.14	5.97	7.09	8.00
5 min	3.21	3.62	4.98	5.97	6.98	8.38	9.52
10 min	4.69	5.30	7.39	8.95	10.6	13.1	15.1
15 min	5.70	6.45	9.00	10.9	13.0	16.0	18.5
20 min	6.50	7.35	10.2	12.4	14.7	18.1	20.9
25 min	7.18	8.11	11.3	13.6	16.1	19.7	22.7
30 min	7.78	8.78	12.2	14.7	17.3	21.0	24.1
45 min	9.29	10.5	14.4	17.2	20.1	24.1	27.4
1 hour	10.5	11.9	16.2	19.2	22.4	26.6	30.0
1.5 hour	12.6	14.2	19.2	22.7	26.1	30.7	34.2
2 hour	14.4	16.2	21.8	25.7	29.4	34.2	38.0
3 hour	17.4	19.6	26.3	30.8	35.1	40.6	44.8
4.5 hour	21.0	23.7	31.9	37.3	42.5	49.1	54.1
6 hour	24.0	27.2	36.7	43.0	48.9	56.8	62.6
9 hour	28.8	32.7	44.7	52.5	60.0	70.1	77.7
12 hour	32.5	37.1	51.1	60.3	69.2	81.5	90.7
18 hour	38.0	43.7	61.0	72.6	83.8	99.7	112
24 hour	42.0	48.4	68.2	81.6	94.7	113	128
30 hour	45.0	51.9	73.7	88.6	103	124	141
36 hour	47.4	54.7	77.9	94.0	110	132	150
48 hour	50.8	58.7	84.0	102	119	144	164
72 hour	54.9	63.3	90.6	110	129	156	177
96 hour	57.3	65.9	93.9	113	133	160	182
120 hour	59.0	67.7	95.7	115	135	162	184
144 hour	60.3	69.1	96.8	116	136	163	184
168 hour	61.5	70.4	97.8	116	136	163	184

Table 8 Stormwater calculations Scenario 1

Stormwater Balance Calculations - Dwelling Roof Runoff					
AEP	1%		Trench Area Adopted (m2)	23.00	
Runoff Scenario	Dwelling Roof				
Moderating Factor	0.50		Trench Length (m)	23.0	
Dwelling Roof Runoff Coeficient	95%		Trench Width (m)	1.00	
Dwelling Roof Area (m2)	241		Trench Depth (m)	1.10	
Transmissive Unit	SAND		Topsoil Thickness - Mounded (m)	0.25	
Hydraulic Conductivity (m/day)	0.9		Drainage Rock Thickness (m)	0.90	
Infiltration Rate (mm/min)	0.6				
			Total Arch Volume (m3)	4.5	
Drainage Rock Porosity	0.35		Est. Volume of Drainage Rock (m3)	16.2	
			Volume of Topsoil In Place (m3)	5.8	
Arch Sizing (mm)	350				
Number of Arches (100 overlap)	20		Trench Peak Water Volume (m3)	10.1	
Arch Width (mm)	584		Trench Peak Water Level (m)	0.9	
Arch Volume (L)	227		Trench Peak Water Level (hours)	12 hour	

Rainfall Duration	Duration in min	1% ARI mm	Dwelling Roof Stormwater Volume (m3)	Potential Trench Discharge (m3)	Net Volume Stored In Trench (m3)
1 min	1	3.2	0.7	0.0	0.7
2 min	2	4.6	1.0	0.0	1.0
3 min	3	6.3	1.4	0.0	1.4
4 min	4	8.0	1.8	0.1	1.8
5 min	5	9.5	2.2	0.1	2.1
10 min	10	15.1	3.5	0.1	3.3
15 min	15	18.5	4.2	0.2	4.0
20 min	20	20.9	4.8	0.3	4.5
25 min	25	22.7	5.2	0.4	4.8
30 min	30	24.1	5.5	0.4	5.1
45 min	45	27.4	6.3	0.7	5.6
1 hour	60	30.0	6.9	0.9	6.0
1.5 hour	90	34.2	7.8	1.3	6.5
2 hour	120	38.0	8.7	1.8	6.9
3 hour	180	44.8	10.3	2.7	7.6
4.5 hour	270	54.1	12.4	4.0	8.4
6 hour	360	62.6	14.3	5.3	9.0
9 hour	540	77.7	17.8	8.0	9.8
12 hour	720	90.7	20.8	10.7	10.1
18 hour	1080	112.0	25.6	16.0	9.6
24 hour	1440	128.0	29.3	21.4	7.9
30 hour	1800	141.0	32.3	26.7	5.5
36 hour	2160	150.0	34.3	32.1	2.3
48 hour	2880	164.0	37.5	42.8	0.0
72 hour	4320	177.0	40.5	64.2	0.0
96 hour	5760	182.0	41.7	85.6	0.0
120 hour	7200	184.0	42.1	107.0	0.0
144 hour	8640	184.0	42.1	128.3	0.0
168 hour	10080	184.0	42.1	149.7	0.0

Table 9 Stormwater calculations Scenario 2

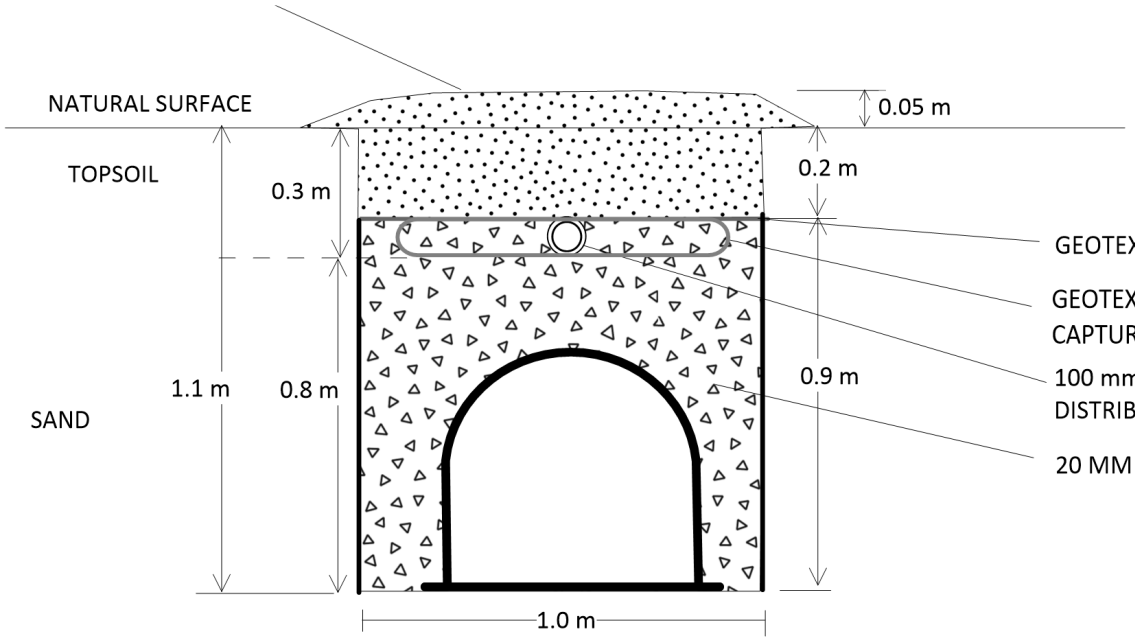
Stormwater Balance Calculations - Outbuilding Runoff					
AEP	1%		Trench Area Adopted (m2)		4.00
Runoff Scenario	Outbuilding				
			Trench Length (m)		4.0
Outbuilding Runoff Coeficient	95%		Trench Width (m)		1.00
Outbuilding Area (m2)	33		Trench Depth (m)		1.10
Transmissive Unit	SAND		Topsoil Thickness - Mounded (m)		0.25
Hydraulic Conductivity (m/day)	0.9		Drainage Rock Thickness (m)		0.90
Infiltration Rate (mm/min)	0.65				
			Total Arch Volume (m3)		0.7
Drainage Rock Porosity	0.35		Est. Volume of Drainage Rock (m3)		2.9
			Volume of Topsoil In Place (m3)		1.0
Arch Sizing (mm)	350				
Number of Arches (100 overlap)	3		Trench Peak Water Volume (m3)		1.0
Arch Width (mm)	584		Trench Peak Water Level (m)		0.4
Arch Volume (L)	227		Trench Peak Water Level (hours)		9 hour

Rainfall Duration	Duration in min	1% ARI mm	Outbuilding Stormwater Volume (m3)	Potential Trench Discharge (m3)	Net Volume Stored In Trench (m3)
1 min	1	3.2	0.1	0.0	0.1
2 min	2	4.6	0.1	0.0	0.1
3 min	3	6.3	0.2	0.0	0.2
4 min	4	8.0	0.3	0.0	0.2
5 min	5	9.5	0.3	0.0	0.3
10 min	10	15.1	0.5	0.0	0.4
15 min	15	18.5	0.6	0.0	0.5
20 min	20	20.9	0.7	0.1	0.6
25 min	25	22.7	0.7	0.1	0.6
30 min	30	24.1	0.8	0.1	0.7
45 min	45	27.4	0.9	0.1	0.7
1 hour	60	30.0	0.9	0.2	0.8
1.5 hour	90	34.2	1.1	0.2	0.8
2 hour	120	38.0	1.2	0.3	0.9
3 hour	180	44.8	1.4	0.5	0.9
4.5 hour	270	54.1	1.7	0.7	1.0
6 hour	360	62.6	2.0	0.9	1.0
9 hour	540	77.7	2.4	1.4	1.0
12 hour	720	90.7	2.8	1.9	1.0
18 hour	1080	112.0	3.5	2.8	0.7
24 hour	1440	128.0	4.0	3.7	0.3
30 hour	1800	141.0	4.4	4.7	0.0
36 hour	2160	150.0	4.7	5.6	0.0
48 hour	2880	164.0	5.1	7.4	0.0
72 hour	4320	177.0	5.5	11.2	0.0
96 hour	5760	182.0	5.7	14.9	0.0
120 hour	7200	184.0	5.8	18.6	0.0
144 hour	8640	184.0	5.8	22.3	0.0
168 hour	10080	184.0	5.8	26.0	0.0

Figure 2 Trench Design – Site Specific for Soil Conditions

FINISHED SURFACE OF SANDY LOAM
50 mm MINIMUM ABOVE NATURAL UPSLOPE
AND 150 MINIMUM ABOVE AGGREGATE

STORMWATER TRENCH DETAIL NOT TO SCALE
SERVICING DRIVEWAY, CARPORT & DWELLING



Trench Depth (m)	1.1	1.1	1.10
Target Unit in Base of Trench			SAND
Trench Width (m)	1	1	1.00
Topsoil Depth (m)			0.25
Trench Dimensions	Dwelling Roof	Outbuilding	Trench 1
Trench Length (m)	23.0	4.0	27
Trench Area (m^2)	23.0	4.0	27.0
Number of Arches	20	3	23
Arch Length (mm)	1200	1200	1200
Arch Width (mm)	350	350	350
Arch Overlap (mm)	100	100	100
Estimated Topsoil Volume (bulked) m^3	7.2	1.3	8.4
Estimated Drainage Rock Volume m^3	16.2	2.9	19.1

NOTES:
Trench to be excavated level
Smearing and compaction of base and sides to be avoided
Slotted pipe to be placed in the top 100 mm of the aggregate
Geotextile filter to be placed over the arches
Geotextile placed beneath the stormwater distribution pipe
All works are to comply with AS3500 and Tasmanian Plumbing Code