COASTAL EROSION AND INUNDATION ASSESSMENT

PROPOSED VISITOR ACCOMMODATION
WHITEMARK WHARF- 16 ESPLANADE

Client:	**Jo Youl**
Certificate of Title:	**129006/1**
Investigation Date:	**Thursday, 25 May 2023**

Refer to this Report As

Enviro-Tech Consultants Pty. Ltd. 2023. Site Coastal Erosion and Inundation Assessment Report for a Proposed Visitor Accommodation, WHITEMARK WHARF- 16 Esplanade - Unpublished report for Jo Youl by Enviro-Tech Consultants Pty. Ltd., 25 May 2023.

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Reporting Declaration –Coastal Erosion

This Hazard Assessment Report includes a Geotechnical Site Investigation (GSI) 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 9 for signed declaration & verification).

Reporting Declaration – Coastal Inundation

This Hazard Assessment Report has been prepared in accordance with the Director's Determination – Coastal Inundation Hazard Areas by an environmental and engineering geologist with more than 10 years of experience and competence in coastal inundation modelling (see Attachment 9 for signed declaration & verification).

Executive Summary

Enviro-Tech Consultants Pty. Ltd. (Envirotech) were contracted by Jo Youl to prepare a Coastal Erosion, and Inundation Assessment for proposed visitor accommodation at Whitemark Wharf - 16 Esplanade – Flinders Island which is herein defined as the Site.

The proposal involves the conversion of the existing shed into visitor accommodation (habitable rooms above ~3.9 m AHD).

The proposed development is exempt from Tasmanian Planning Scheme (TPS) inundation planning code C11 but not exempt from TPS erosion planning code C10 on the basis that the proposed development falls within the coastal inundation high overlay. Coastal inundation within the Project Area is assessed through the director's determination. Although the director's determination also applies to coastal erosion, it is limited by TPS planning code which stipulates a 2100 modelling as opposed to the directors determination building design life modelling.

The following environmental modelling scenarios are assessed:

- Erosion modelling based on a 2100 erosion event (TPS)
- Coastal inundation modelling based on a storm surge event in 2100 (directors' determination)

A rocky substrate was mapped beneath the Project Area which would provide a suitable founding base for any new developments. Further analysis has identified that the substrate does not need to be relied upon for the proposed development.

Historical aerial imaging has been used to assessed overall coastal erosion and accretion trends. Although erosion has been distinguished outside of the Project Area, there is an unusual trend of coastline progradation (beach growth) occurring on the northern and southern sides of the jetty since 1972. Overall erosion risks to the proposed development are considered low.

The inundation assessment, which is based on the directors determination criteria, indicates that given a storm surge event by 2100, water levels have the potential to elevate to 2.4 m AHD within the Project Area. Defined inundation levels for Whitemark are tabulated at 2.7 m AHD within the local provisions schedule.

Given the above inundation constraints, risks associated with the proposed development are considered LOW with proposed finished floor levels at or above 3.3 m AHD.

Overall risks associated with the proposed development are considered acceptable considering the planning and determination constraints. Recommendations presented within the attached GSI report need to be applied for the proposed development works.

1 Introduction

1.1 *Background*

Enviro-Tech Consultants Pty. Ltd. (Envirotech) were contracted by Jo Youl to prepare a Coastal Erosion, and Inundation Assessment for proposed visitor accommodation at Whitemark Wharf - 16 Esplanade – Flinders Island which is herein defined as the Site (Map 1).

The Project Area encompasses the Site, the wharf area, frontal dune system and jetty fringing on Parrys Bay. 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 to determine development constraints including planning scheme exemptions, acceptable solutions, performance criteria as well as directors' determinations and building regulations specific to the identified hazards.
- Prepare a report encompassing the Project Area with modelling and hazard analysis to assess development risks, directors' determination and performance criteria codes based on building design life and where applicable planning to 2100.
- Prepare a desktop review of relevant geological, geotechnical, geomorphologic, and hydrological information relevant to the Project Area and proposed development.
- Conduct an invasive Site investigation with soil bores, in-situ and laboratory geotechnical testing.
- Using available geographic information system (GIS) data, construct a geotechnical, hydrodynamic, and coastal process 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 129006/1

1.4 *Project Area Setting*

The Project Area and Site location plans are presented in Map 2, Attachment 1. The Project Area is located on a coastal plain which was historically inland sea. The Site is set back approximately 20 m from the coast and in the future may be subject to coastal processes acting within Parrys Bay.

2 Assessment

2.1 *Proposed Development*

Table 1 summarises the provided design documents from which this assessment is based with plans presented in Attachment 2 with the Site outlay presented in Map 3.

Table 1 Project Design Drawings

Drafted By	Project ID	Date Generated	Pages
Adams Building design	010420	27/02/2024	03/28

The proposal involves the conversion of the existing shed into visitor accommodation (habitable rooms above ~3.9 m AHD) with works including but not limited to the development of hardstand (paved) areas for visitor and staff parking which includes information to facilitate the construction of earth drainage systems to manage stormwater runoff.

2.2 *Planning*

Planning code overlay mapping is presented in Attachment 1.

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 planning codes are addressed in more detail in Attachment 3 with the following codes addressed:

- **C10.5.1 A1** There are no acceptable solutions to use within a high coastal erosion hazard band, and therefore performance criteria are to be addressed:
    - **C10.5.1 P1.2** To address erosion hazards and tolerable risks from a coastal erosion event in 2100 and the potential need for hazard reduction or protection measures.
- **C10.6.1 A1** There are no acceptable solutions to building and works excluding coastal protection works within a coastal erosion hazard area, and therefore performance criteria are to be addressed:
    - **C10.6.1 P1.1** Addressed based on a risk matrix which assesses the identified hazards within the modelled timeframe and the proposed development building and works
    - **C10.6.1 P1.2** An assessment is to be made on whether the proposed building and works can achieve and maintain a tolerable risk from a coastal erosion event in 2100 for the intended life of the use without requiring any specific coastal erosion protection works.

2.2.2 Coastal Inundation Hazard Code

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). Building

2.2.3 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 addressed which includes classification of the Site as Class P (problem Site which requires engineering design) and provision of an accompanying geotechnical site investigation written by a geotechnical practitioner[1].

2.2.4 Coastal Inundation Hazard Overlay

An assessment is to be made on whether proposed work can achieve and maintain a tolerable risk given a ***1% AEP storm surge flooding event in the year 2100*** for the intended life of the building (2073) without requiring any specific coastal inundation protection measures. This includes an assessment of 1% AEP barometric low pressures, wind setup, wave runup and wave setup based on 2100 sea levels.

The director's determination provisions are to be addressed which includes ensuring risks are tolerable and that 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 Whitemark – Flinders Island

3 Desktop Summary

3.1 *Topography*

The Site ranges in elevation from approximately 0 m AHD through to 5.5 m AHD and has a relatively steep beach face (Map 6). The Site is in part protected from coastal processes from Jetty which acts as a groyne.

3.2 *Published Geology*

According to the 1:250,000 geological mapping by Mineral Resources Tasmania (MRT), as presented in Map 7, the geology of the Project Area comprises:

- Sand gravel and mud of alluvial, lacustrine and littoral origin (Qh)

4 Soil Investigation

4.1 *Site Geology*

Soil testing locations are presented in Map 7.

Findings from the Soil assessment, engineering logs, and soil core photographs presented in The Geotechnical Site Investigation (GSI) report attached to this report Attachment 10.

The Soil at the Site is characterised as comprising SAND with/trace gravel to depths of up to 4.5 m to the south of the existing shed and 6.0 m near the existing shed.

The SAND overlie bedrock inferred to comprise turbidic mudstone.

4.2 *Geotechnical Testing Summary*

Findings from the geotechnical assessment are presented in GSI report in Attachment 10.

Findings indicate the SAND is low density to depths of up to 2.0 m near the existing shed (PT06) and up to 1.2 m depth near BH02.

The sand densities are important from a foundation point of view but less important with respect to erosion hazards.

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[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.

5 Inundation Assessment

5.1 *Assessment Methods*

The coastal hydrodynamic assessment is presented in Attachment 5 with radials used in the assessment presented in Map 9.

Inundation levels are modelled by Envirotech based on Site-specific hydrodynamic and topographic/bathymetric conditions within the Project Area. The Site specified inundation levels and wave dynamics have critical implications for Site building works and in determining the need for coastal protection works.

To comply with the director's determination, an assessment has been made based on storm surge event by 2100.

5.2 *Findings*

Making allowance for factors such as wind setup, wave setup and wave runup as well as barometric low pressures findings presented in Table 2 indicate:

The 2100 storm surge inundation level for the Site is calculated at 2.4 m AHD.

Table 2 Site specific inundation level modelling

1% AEP Parameter	Units	2100
Storm Surge Levels	m AHD	1.9
Wave setup (westerly swell wave)	m AHD	2.3
Wave runup (westerly swell)	m AHD	2.4

6 Erosion Hazard Assessment

6.1 *Assessment Methods*

The coastal erosion assessment is presented in Attachment 6.

Coastline recession is modelled for the Project Area based on coastline erosion relationships with sea level rise which is forward projected to the building design life and 2100 scenarios. Procedures include:

6.1.1 Historical Aerial Images

Coastline recession been assessed by measuring coastal escarpment erosion rates in historical aerial images and comparing with historical sea levels. Future coastline recession is determined for the Project Area by forward projecting this historical relationship to the building design life and 2100 scenarios.

6.1.2 Storm Erosion

Storm erosion potential is modelled independently of coastline recession and is determine based on storm erosion cycles occurring either side of the normal recession (coastline loss) or propagation (coastline growth) trend observed at the Site often attributes to sea level rise. The storm erosion cycles are often short (such as seasonal) or longer term (such as southern oscillation). This is determined based on previous regional beach typology modelling and observed historical storm bite (erosion) and recovery (accretion) cycles. Findings are presented in Attachment 6.

6.2 *Findings*

Historical aerial imagery has been assessed at two locations including across the existing shed structure.

Both scenarios indicate an overall trend of coastline progradation within the Project Area. The accretion of can within the Project Area is most likely attributed to oversupply of sediment (sand) within the coastal setting, and longshore drift accumulation across the Jetty structure. The incidence of historical storm erosion events has been factored into this assessament:

> **Within the assessed 2100 timeframes, there is low risk of coastal erosion impact on the existing and proposed structures at the Site.**

7 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 7.

7.1 *Planning*

7.1.1 Inundation Assessment

The proposed development is exempt from inundation code C10.

7.1.2 Erosion Assessment

Modelling has been conducted for planning purposes to assess whether the proposed building and works can achieve and maintain a tolerable risk* from ***a coastal erosion event in 2100 for the intended life of the use*** without requiring any specific coastal inundation protection works.

It is concluded that overall risks to existing structures and proposed works are low given the coastal progradation observed at the Site.

7.2 *Building*

7.2.1 Coastal Inundation Assessment

Modelling has been conducted for directors' determination purposes to assess whether the proposed building and work can achieve and maintain a tolerable risk given a 1% AEP storm surge flooding event for the year 2100 without requiring any specific coastal inundation protection works.

With combined storm surge and 2100 sea levels at 2.4 m AHD, there is a **RARE** likelihood and **LOW** risk of inundation to habitable rooms within the existing building structure. Overall risks to the proposed development based on the directors' determination are considered low.

7.2.2 Erosion Assessment

Given the proposal is not exempt from planning, the risk assessment for the Site is limited by planning criteria for a 2100 erosion event alone rather than directors' determination given erosion during the building design life. Findings from the planning assessment are therefore applicable for building.

All proposed works are projected to resid outside of the modelled 2100 erosion area.

8 Recommendations

8.1 *Building Foundations*

The proposed building is to be constructed in accordance with recommendations presented in the attached geotechnical site investigation report. The existing building (shed) envelopes reside within the projected 2100 stable foundation zone.

8.2 *Site Classification*

The site is classicised as Class P with further information presented within the attached geotechnical site investigation report.

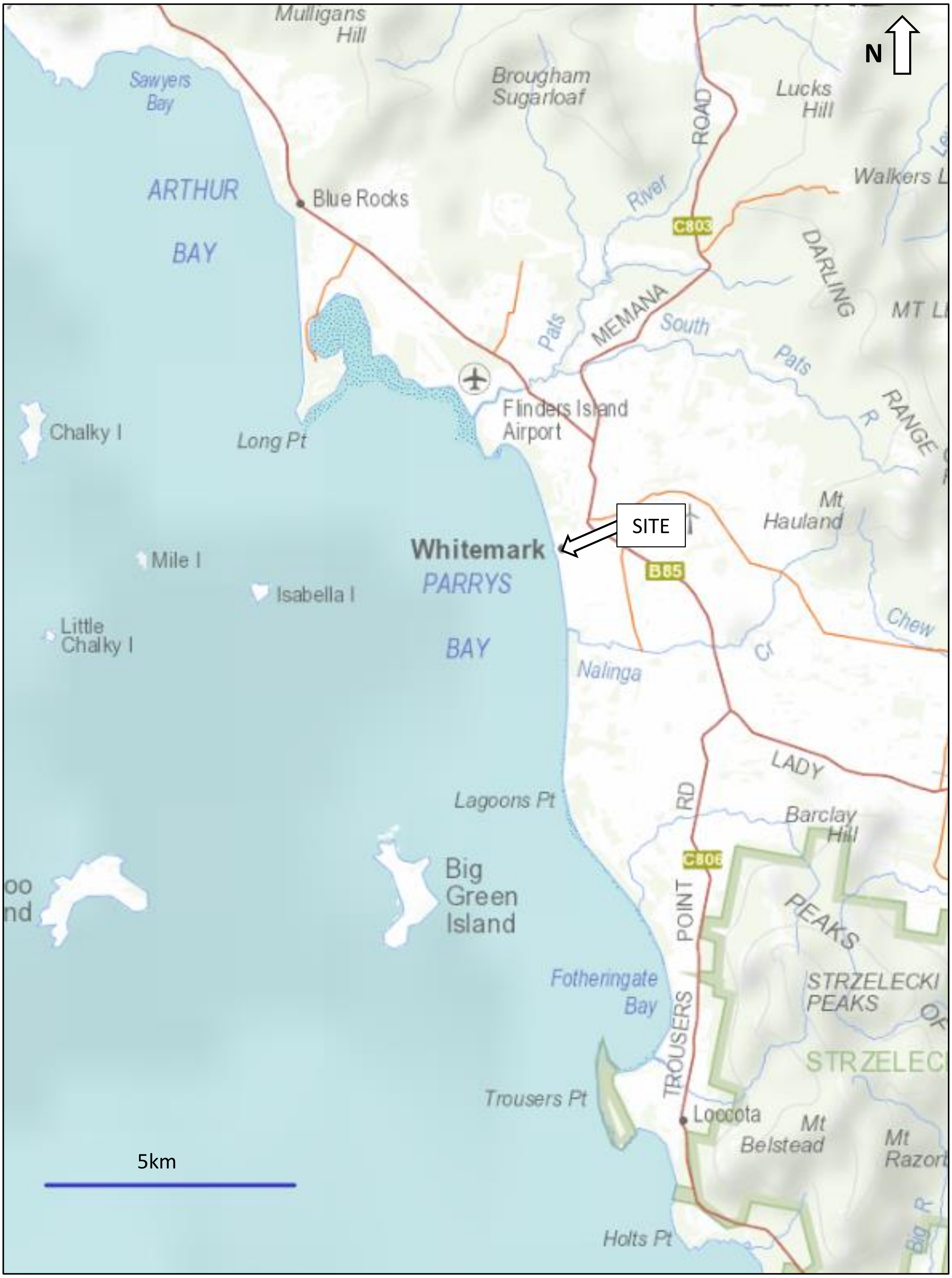
Kris J Taylor BSc (Hons) | Environmental & Engineering Geologist

Director

Enviro-Tech Consultants Pty. Ltd.

Attachment 1 Maps

Map 1

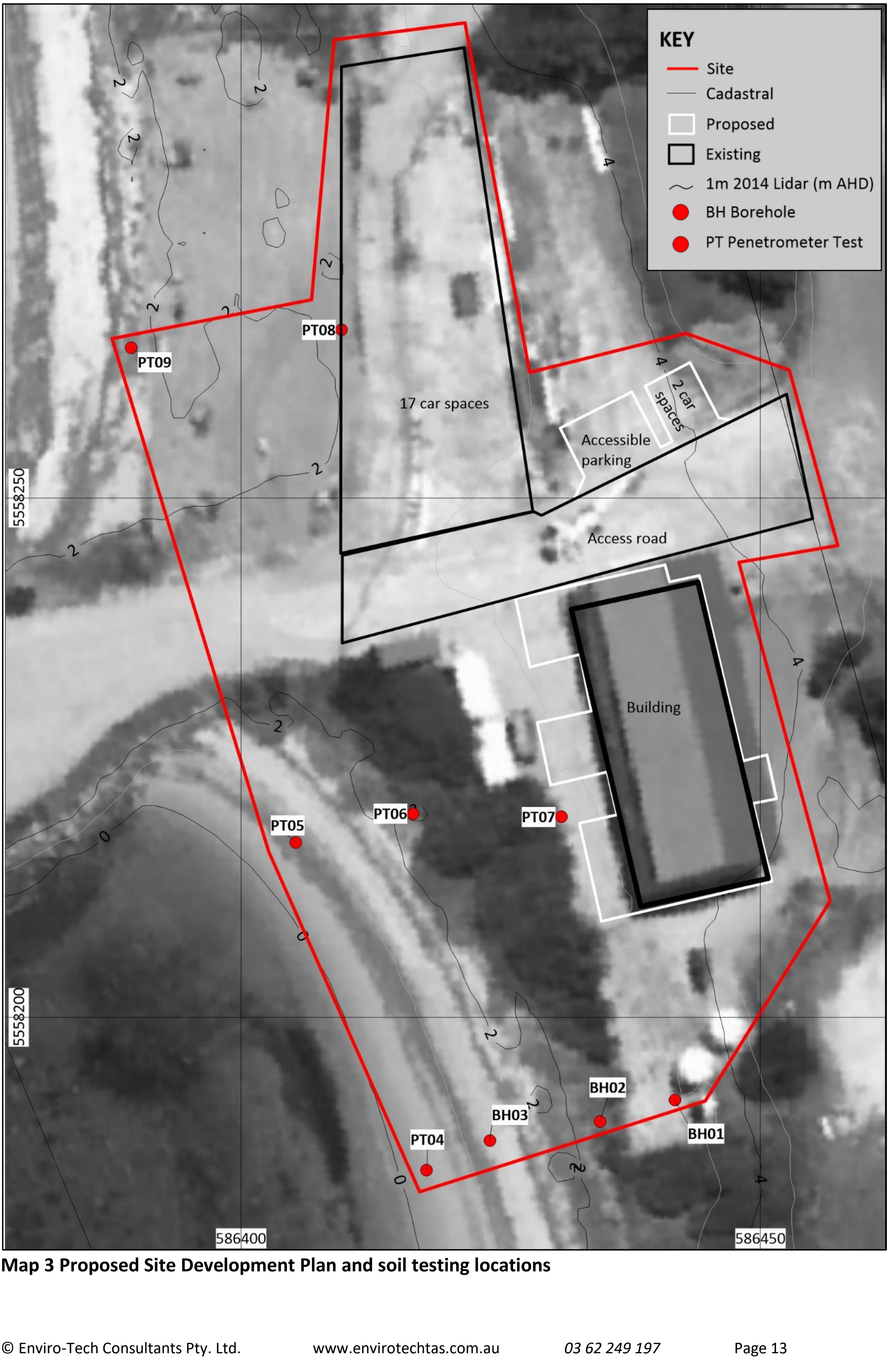


Map 1 Site regional setting (The LIST)

Map 2

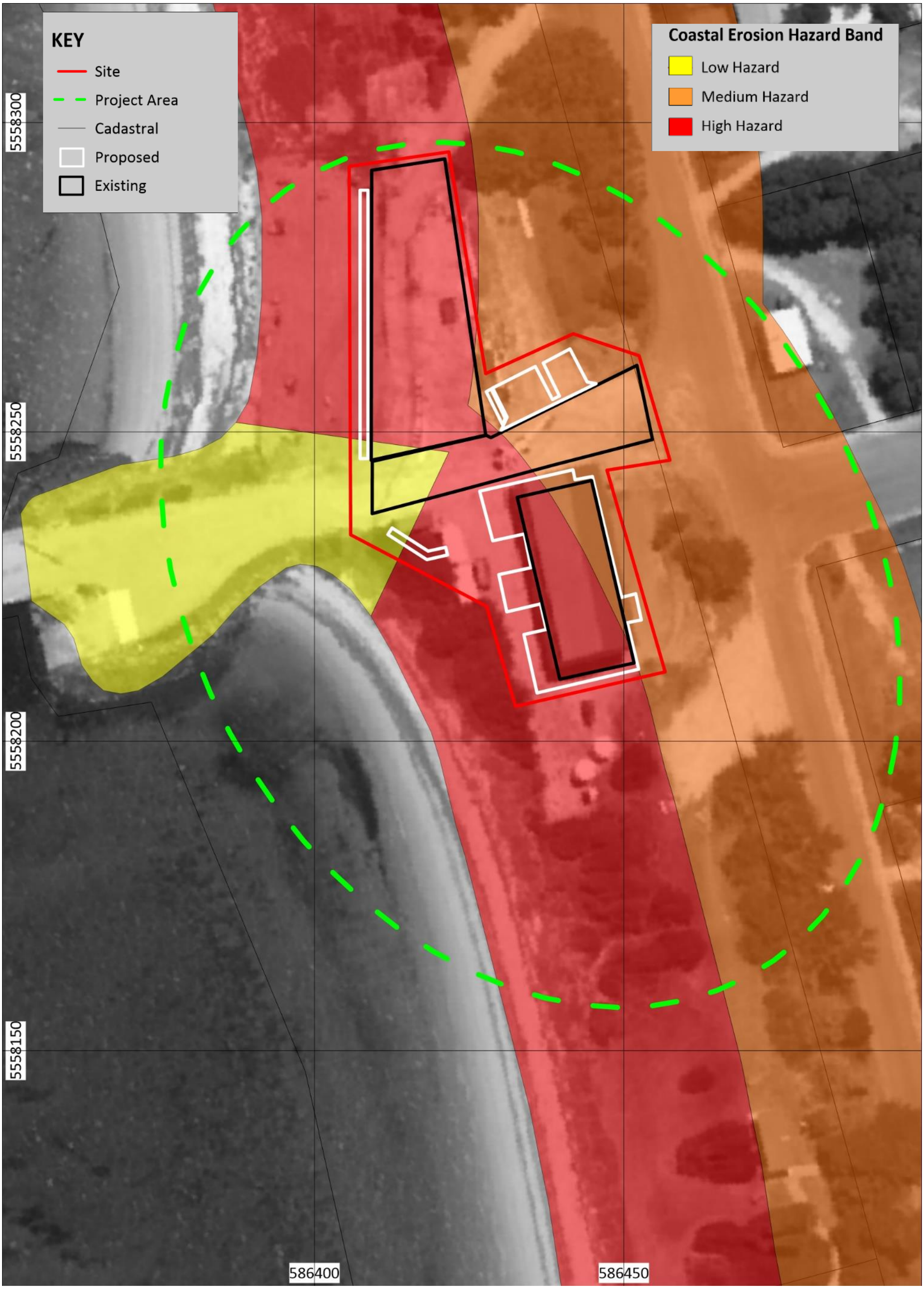
Map 2 Site and Project Area local setting

Map 3



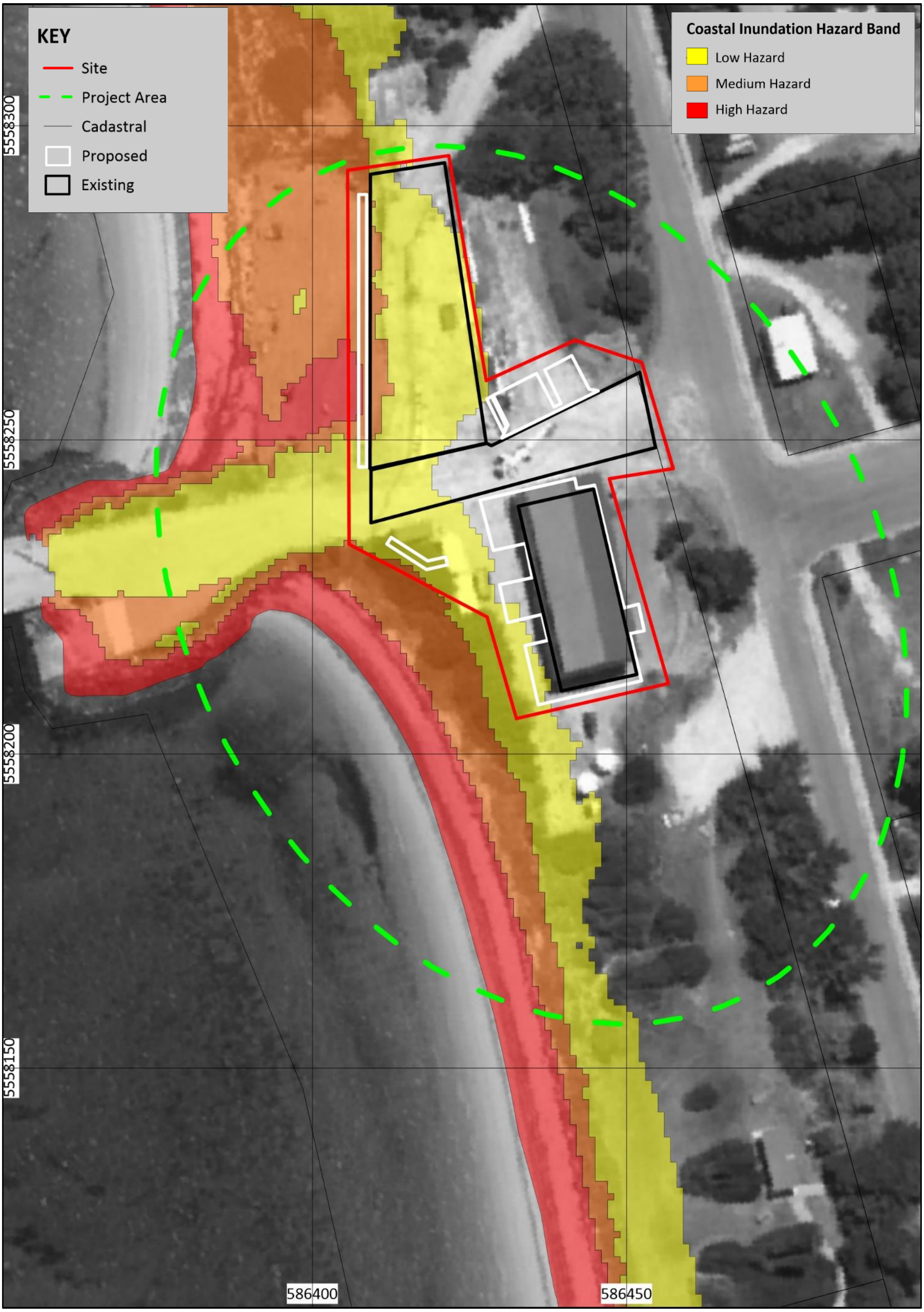
Map 3 Proposed Site Development Plan and soil testing locations

Map 4



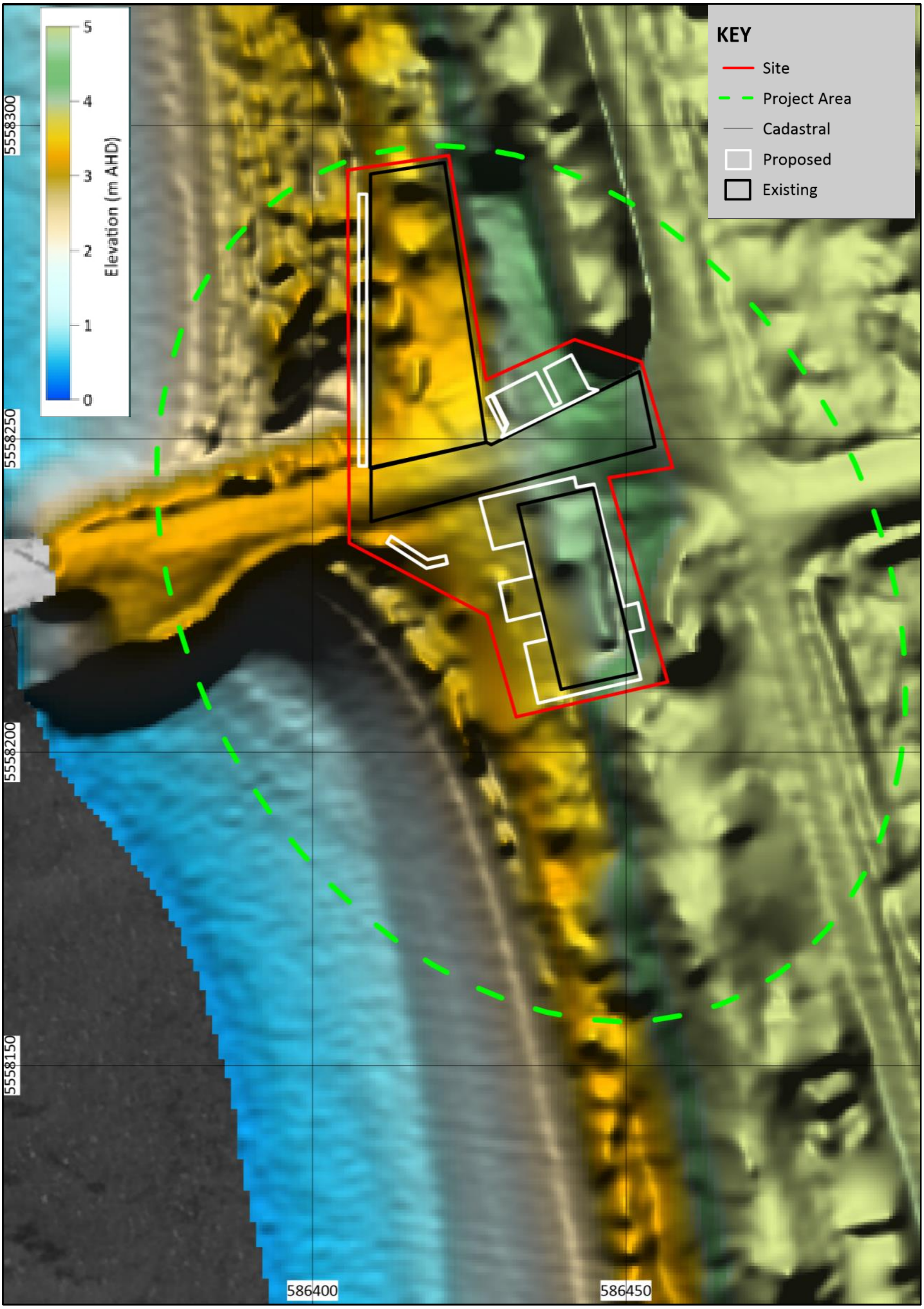
Map 4 Coastal erosion overlay

Map 5



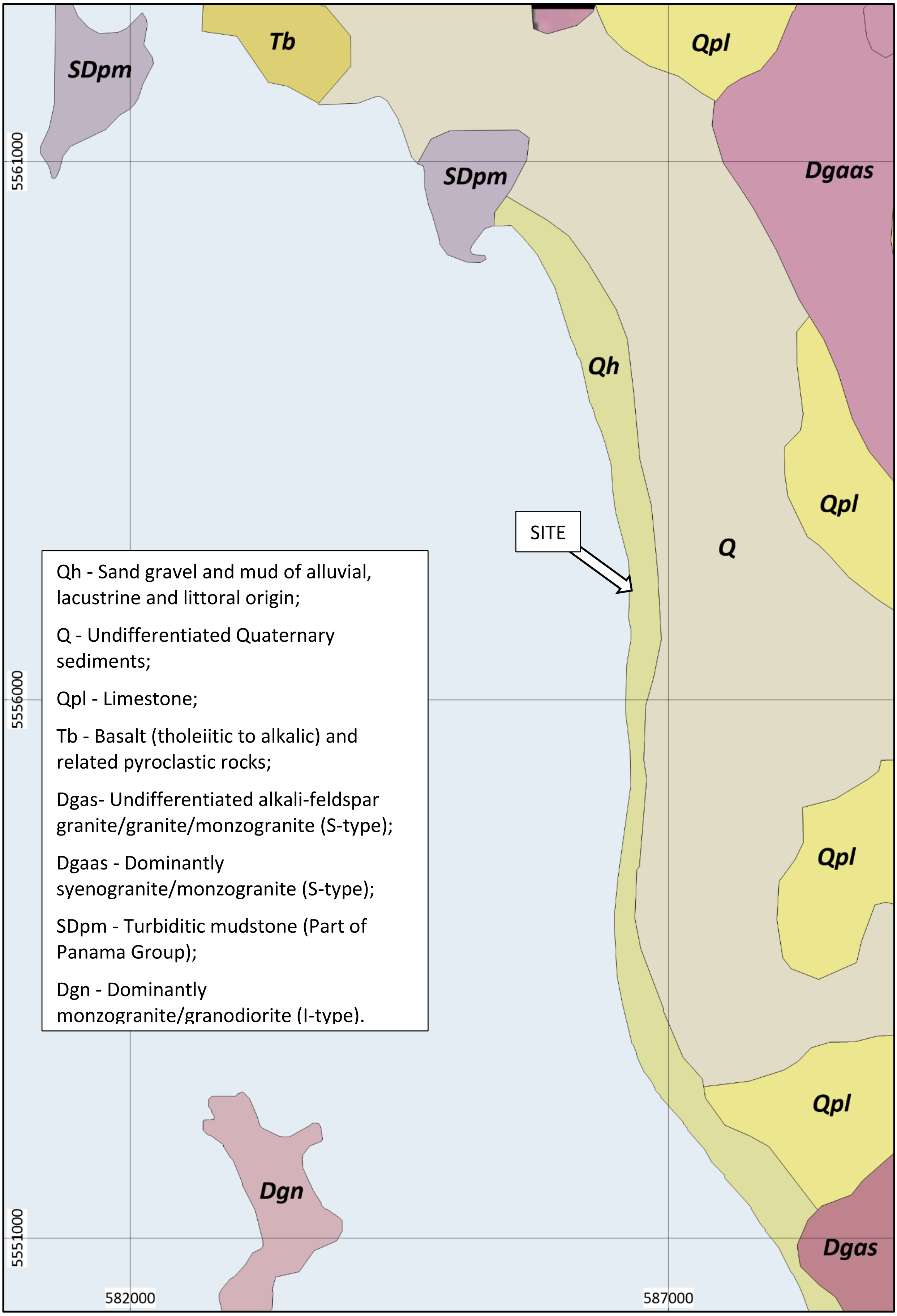
Map 5 Coastal inundation overlay

Map 6



Map 6 Local digital elevation model based on 2014 LIDAR

Map 7



Qh - Sand gravel and mud of alluvial, lacustrine and littoral origin;

Q - Undifferentiated Quaternary sediments;

Qpl - Limestone;

Tb - Basalt (tholeiitic to alkalic) and related pyroclastic rocks;

Dgas- Undifferentiated alkali-feldspar granite/granite/monzogranite (S-type);

Dgaas - Dominantly syenogranite/monzogranite (S-type);

SDpm - Turbiditic mudstone (Part of Panama Group);

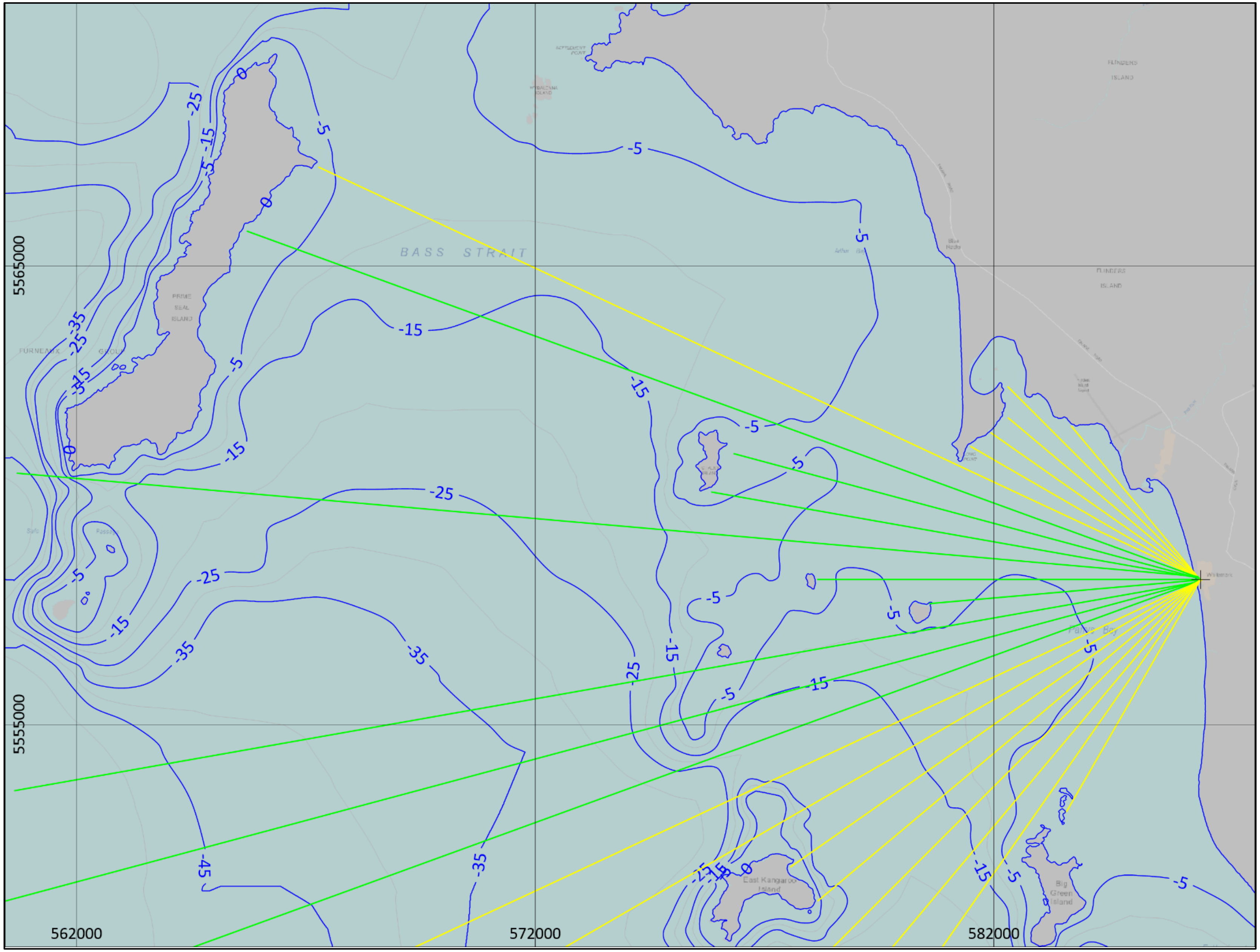
Dgn - Dominantly monzogranite/granodiorite (I-type).

Map 7 1:250,000 Scale Mineral Resources Tasmania geology mapping

Map 8

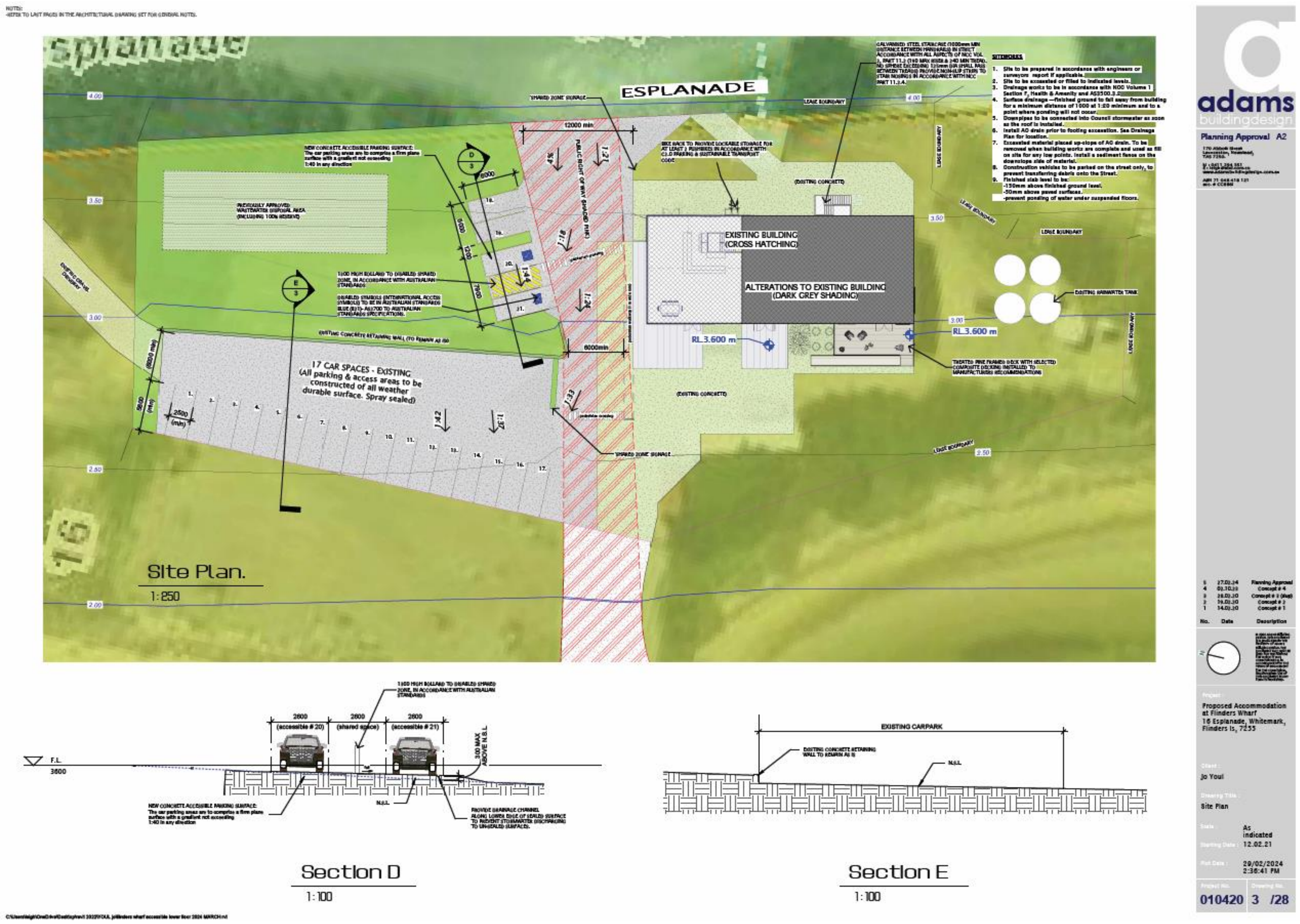
Map 8 Soil testing locations

Map 9



Map 9 Radials used to generate the wind wave model for the Site.

Attachment 2 Preliminary Design Concept Plans



Attachment 3 Planning and Building Regulations

C10.0 Coastal Erosion Hazard Overlay

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

Code Overlay Reporting Requirements

The proposed development reporting requirements are summarised in Table 3 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
- State Planning Provisions (the Tasmanian Planning Scheme) C10 Coastal Erosion Hazard Code

The proposed development is not exempt from C10 Coastal Erosion Hazard Code on the basis that the proposal will involve vulnerable use.

Table 3 Coastal Erosion Hazard Reporting Requirements Framework

Council	Flinders
Planning scheme code	Tasmanian Planning Scheme
Critical use, hazardous use, or vulnerable use	No
Low or medium coastal erosion hazard band	Medium
Parts of the Site are located within a High coastal erosion hazard band	Yes
Located in a non-urban zone	No
Actively mobile landform?	No
Proposed coastal protection works	No
Exemption from code	No, on the basis that the proposed development is located within a high coastal erosion hazard band
Coastal erosion reporting requirements	Coastal Erosion Hazard Assessment & Geotechnical Site Investigation in accordance with directors determination and C10.0 Codes
Coastal erosion code to be addressed	C10.5.1 Use within a high coastal erosion hazard band C10.6.1 Buildings and works, excluding coastal protection works, within a coastal erosion hazard area
Development building design life	Modelled to Year 2100
Site classification requirements	Class P
In a coastal erosion investigation area	No
Coastal erosion investigation area report required	No

Directors Determination

According to the director's determination, 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.

Tasmanian Planning Scheme

C10.5 Use Standards

C10.5.1 Use within a high coastal erosion hazard band

C10.5.1 Objective

That use within a high coastal erosion hazard band:

- is reliant on a coastal location; and
- can achieve and maintain a tolerable risk from coastal erosion.

C10.5.1 Acceptable Solutions

There are no acceptable solutions to use within a high coastal erosion hazard band, and therefore performance criteria are to be addressed.

C10.5.1 Performance Criteria P1.1

Performance criteria C10.5.1 is addressed in Attachment 8 as a risk assessment with regards to the existing and proposed change of use to the existing structure that relies upon its coastal location to fulfil its purpose.

In this case, the criterion is fulfilled given the proposed development is for a marine-related recreational facility (f):

a) the need to access a specific resource in a coastal location;
b) the need to operate a marine farming shore facility;
c) the need to access infrastructure available in a coastal location;
d) the need to service a marine or coastal related activity;
e) provision of an essential utility or marine infrastructure;
f) provision of open space or for marine-related educational, research or recreational facilities;
g) any advice from a State authority, regulated entity or a council; and
h) the advice obtained in a coastal erosion hazard report.

C10.5.1 Performance Criteria P1.2

Performance criteria C10.5.1 P1.2 is to be assessed by addressing erosion hazards and tolerable risks from a coastal erosion event in 2100 and the potential need for hazard reduction or protection measures.

C10.5.3 Critical use, hazardous use or vulnerable use

C10.5.3 Objective

That critical, hazardous and vulnerable uses located within a coastal erosion hazard band can achieve and maintain a tolerable risk from coastal erosion.

Although the development is for visitor use, the proposed development is not considered a critical use given the number of visitors at any one time will not exceed 12, and therefore this code is not applicable.

C10.6. Development Standards for Building and Works

C10.6.1 Buildings and Works, Excluding Coastal Protection Works, Within A Coastal Erosion Hazard Area

C10.6.1 Objective

The objective of Code C10.6.1 is to ensure that:

- building and works excluding coastal protection works within a coastal erosion hazard area, can achieve, and maintain a tolerable risk from coastal erosion; and
- buildings and works do not increase the risk from coastal erosion to adjacent land and public infrastructure.

C10.6.1 Acceptable Solutions

There are no acceptable solutions to building and works excluding coastal protection works within a coastal erosion hazard area, and therefore performance criteria are to be addressed.

C10.6.1 Performance Criteria

Performance criteria C10.6.1 is addressed based on a risk matrix which assesses the identified hazards within the modelled timeframe and the proposed development building and works (Attachment 8).

Coastal Erosion Risk Assessment

To comply with the determination and C10 performance codes, this report includes an assessment of whether the proposed work and use can achieve and maintain a ***tolerable risk***[2] from ***a coastal erosion event in 2100 for the intended life of the building*** without requiring any specific coastal erosion protection measures. In accordance with the determination and the Tasmanian Planning Scheme, this risk assessment has been prepared by a geotechnical practitioner[3] with experience and competence in the preparation of coastal erosion hazard reports. Coastal erosion processes considered within this report include an assessment of coastline recession based on 2100 sea levels as well as erosion from a single 1 in 100-year storm erosion event.

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[2] 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.

[3] Geotechnical practitioner means any of the following: (a) an engineer-civil; (b) a geotechnical engineer licensed as an engineer-civil acting within their area of competence; (c) an engineering geologist with the qualifications and expertise specified in the Certificates by Qualified Persons for an Assessable Item Determination made by the Director of Building Control as amended or substituted from time to time, acting within their area of competence.

C11.0 Coastal Inundation Hazard

The Site falls within The LIST Coastal Inundation Hazard Overlay (low and medium hazard band) as presented in Map 5.

Code Overlay Reporting Requirements

The proposed development reporting requirements are summarised in Table 4 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 4 Coastal Inundation Hazard Reporting Requirements Framework

Council	Flinders
Planning Scheme	Tasmanian Planning Scheme
Critical use, hazardous use, or vulnerable use	No
Low or medium coastal inundation hazard band	Low & Medium
Parts of the Site are located within a high coastal inundation hazard band	No
Located within a non-urban zone	No
Requires inundation protection works	No
Exemption from code	Yes, on the basis that the development requires authorisation under the Building Act 2016
Coastal inundation reporting requirements	Coastal Inundation Hazard Assessment in accordance with directors determination
Coastal inundation code to be addressed	NA (exempt from planning)
Defined inundation level	2.7m AHD. Based on 1% AEP for year 2100 - as per Tasmanian Planning Scheme Local Provisions Schedule Table C11.1 Whitemark - Flinders Island
Minimum habitable room finished floor level based on the defined inundation level plus 0.3m freeboard (Tasmanian Building Regulations 2016)	3m AHD
Risk assessment modelling criteria	Be satisfied that the proposed work can achieve and maintain a tolerable risk for the intended life of the building (50 years) based on inundation levels from a 2100 sea level storm surge event (includes wave setup, wave runup, wind setup, barometric low)
In a coastal inundation investigation area	No
Coastal inundation investigation area report required	No
Located within a flood-prone area hazard code overlay	No
Flood-prone area hazard code overlay to be addressed	No

Directors Determination

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. 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 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 Flood Level

The defined flood 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 Whitemark – Flinders Island**

Tasmanian Building Regulations 2016

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:

- **3.0 m AHD for Whitemark – Flinders Island**

Proposed Finished Floor Levels

Given the proposed finished floor levels of the habitable rooms within the existing structure are above ~ 3.9 m AHD (existing ground level), the proposed development finished floor level comply with the 2016 Tasmanian Building Regulation.

Storm Surge Risk Assessment

To comply with the determination, this report assesses whether the proposed work can achieve and maintain a ***tolerable risk***[5] given a ***defined flood event***[6] for the intended life of the building without requiring any specific coastal inundation protection measures. This risk assessment is therefore based on the defined flood level and includes an assessment of risks associated with a ***1% AEP storm surge flooding event in the year 2100***. 1% AEP storm surge processes for 2100 include 1% AEP barometric low pressures, wind setup, wave runup and wave setup based on 2100 sea levels. An assessment of tides is not specified within the Directors Determination.

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[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.

5 Tolerable risk means the lowest level of likely risk from coastal inundation from a defined flood event 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

6 Defined flood event means a flood event that causes flooding to the defined flood level;

Attachment 4 Project Area Photos

Plate 1 North view of the Site shoreline.

Attachment 5 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 Surge** - Barometric low-pressure influence on coastal 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 5. The following is concluded:

- **1% AEP storm surge inundation level of 1.93 AHD for 2100**

Table 5 Project Area 1% AEP Stillwater Levels

Parameter	Units	Scenario		
		2023	2050	2100
Sea Levels	m AHD	0.12	0.23	1.00
Local 1% AEP Storm Surge	m	0.43	0.43	0.43
Wind Setup	m	0.49	0.49	0.49
Total	m AHD	1.05	1.15	1.93

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 9.
- **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:
  - Mase (1989) for smooth beach profiles (no wave runup attenuation applied)
  - The scenario assessed for present day scenario is based on smooth beach wave runup on the existing frontal dune;

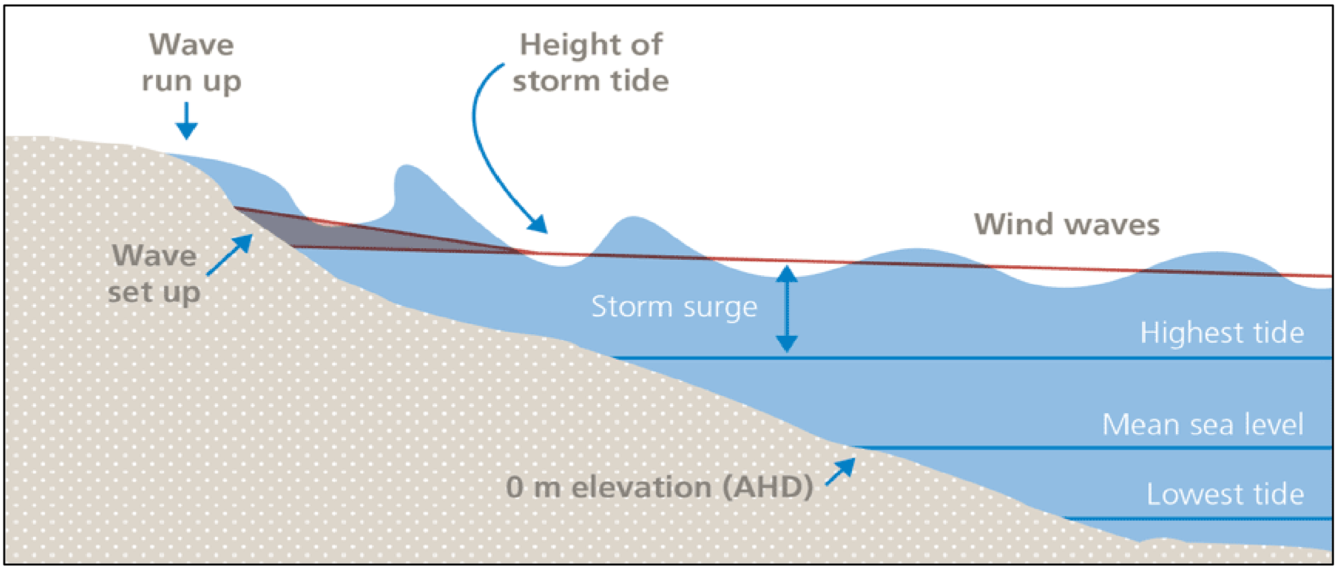

Figure 1 Schematic of coastal processes

Findings

Modelled wave runup and wave setup inundation levels are presented in Table 6 with the following findings:

- *A defined flood level of 2.4 m AHD is calculated for 2100*
- *This level is approximately 300 mm less than the defined flood level stipulated in the local provisions schedule for Whitemark.*
- *Given the storm surge event, wave runup is projected not reach the existing building structure which is proposed to have a change of use.*

Table 6 Summary of inundation modelling for the Project Area[7]

1% AEP Parameter	Units	2100
Storm Surge Levels	m AHD	1.9
Wave setup (westerly swell wave)	m AHD	2.3
Wave runup (westerly swell)	m AHD	2.4

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[7] 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.

Attachment 6 Coastline Recession & Storm Erosion

Historical Recession Model

Assessment Method

An historical series of georeferenced aerial photographs and satellite imagery have been used in the analysis (Table 7). The margin of error of the image georeferencing is estimated to be in the order of 0.5 m.

Table 7 Details of aerial images used in the analysis

Photographic Measurements	Temporal Data
Photography Range (Years)	1973 to 2021
Number of Temporal Measurements	10

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.

Correlations are approximate due to interference from factors such as:

- Changing active erosion profile thickness,
- Underlying recession rates and
- Erosion/accretion interference from manmade structures such as sea walls, jetties or groynes etc.

All the above influences were observed at the Site which are considered in the model interpretation.

Findings

Findings from the assessment are charted in Figure 2 illustrating the coastline position (m) relative to sea levels (m AHD) for various temporal points.

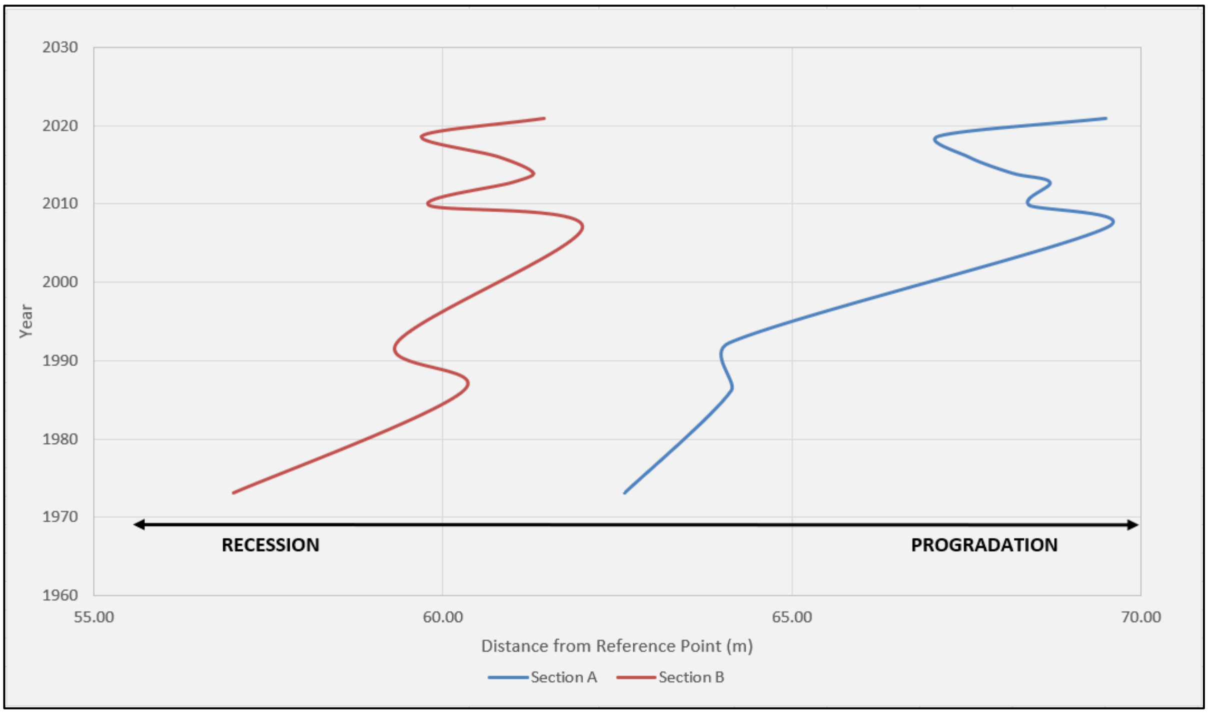


Figure 2 Measured coastline recession as distance of vegetation line relative to a fixed reference point

At both Section A and Section B sites, there is documented evidence of historic coastline progradation since 1973. It is apparent that prior to 1973 that within the Project Area there has been coastal erosion on the southern side of the jetty and accretion on the norther side of the jetty from north to south directed longshore drift.

The observed trend of sand accretion (progradation) within the Project Area which is inconsistent with local/regional trends. Previous reporting (GES 2020) has identified active erosion 200 metres to the north and 300 metres to the south of the Project Area.

It is apparent that there may be an increase in sediment supply within the nearshore zone which is causing localised accretion. As observed at many other locations across the State, oversupply of sediment is resulting in the leeward entrapment of sediments within embayment's where it would not ordinarily been entrapped before onset of sea levels rise. Therefore, the groyne affects historically observed at the Site is probably becoming less pronounced more recently due to abundant sediment supply within the system.

The spit forming 1.5 km to the South of the Site provides an indication that longshore drift has shifted to the north within the last decade.

Storm Erosion Assessment

Assessment Method

The short-term deviation in coastline recession and progradation relative to the trendline illustrated Figure 2 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

It is estimated that the 100-year ARI storm erosion demand for the beach within the Project Area is 8 to 10 m3/m (Table 8). Making allowance for the current phase in the storm erosion/accretion cycle observed within the Project Area, the following is estimated:

100-year ARI storm erosion demand for the Project Area is calculated at 4 to 5 m^3/m

Table 8 Project Area storm erosion demand estimates

Storm Erosion Parameter	Units	Section A	Section A
Temporal Observation Range	Years	48	48
Profile Height Within Erosion Zone	m	2.3	2.5
Measured Deviation (m horizonal)	m	4.3	3.2
Observed Storm Erosion Demand	m^3/m	10	8
Beach Typology		Tide-Modified Beach-Ultra dissipative	Wave Dominated- Low Tide Terrace
Projected 100 Year ARI Storm Erosion	m^3/m	10.1	8.2
Projected 2 x 100 Year ARI Storm Erosion	m^3/m	12.2	9.9
Projected 100 Year ARI (Present Cycle)	**m^3/m**	5.1	4.1

Stable Foundation Zone Analysis

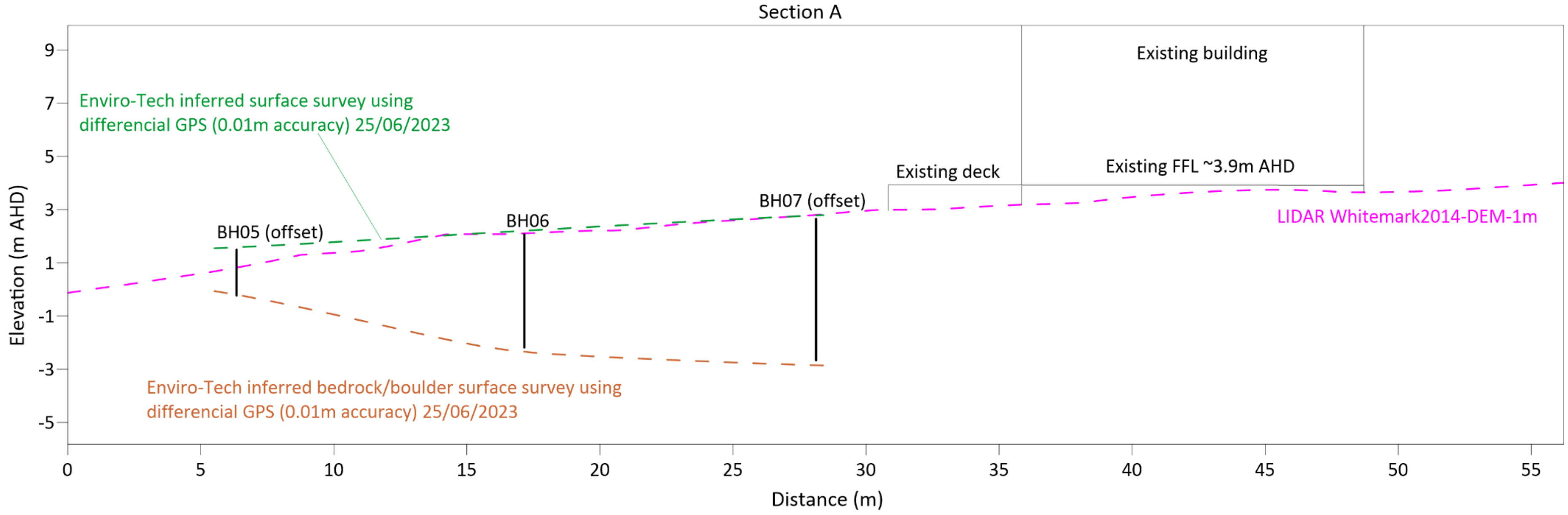
Bedrock Substrate

The bedrock substrate was surveyed beneath the Site in anticipation that active erosion processes will need to be managed deepened building foundations into the stable foundation zone. Ordinarily, where beach recession is observed, a stable foundation zone analysis is required. In this case, given the observed beach propagation within the Project Area, the sandy soils observed within the building envelope are modelled to remain stable by 2100. This assessment also factors in the observed 4 to 5 m^3/m storm erosion demand.

In the unlikely event that coastal progradation trends are to reverse, the two option may considered as a option for mitigation:

- Establishment of the proposed structure on blade(screw) piles which are founded onto the underlying bedrock.
- Relocation of the structure

Any proposed foundations for the development must comply with the AS2870 (foundation assessment)report attached to this document.



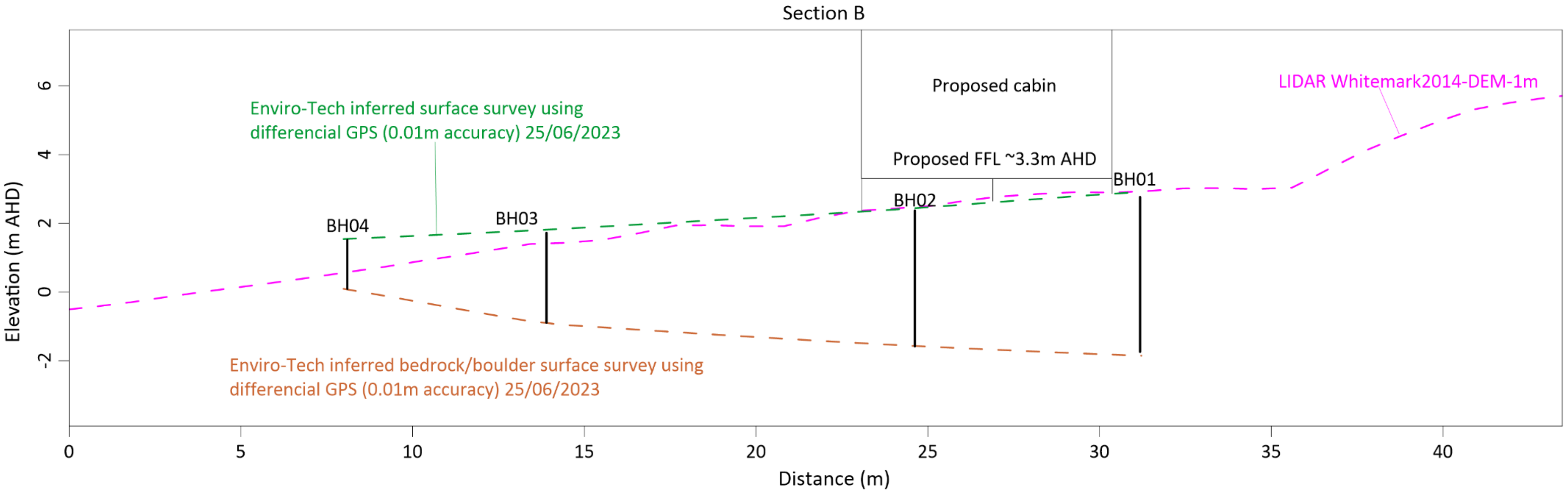


Figure 3 Coastal recession, storm erosion and inundation model for 2073 based on 1% AEP scenario

Landform Mobility

Dune mobility at the site has not been classified (Figure 4). In accordance with 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 are therefore defined at being 'transitory' according to Mowling (2006). As the Site comprises greater than 10% vegetation, the Site is not classified as being mobile.

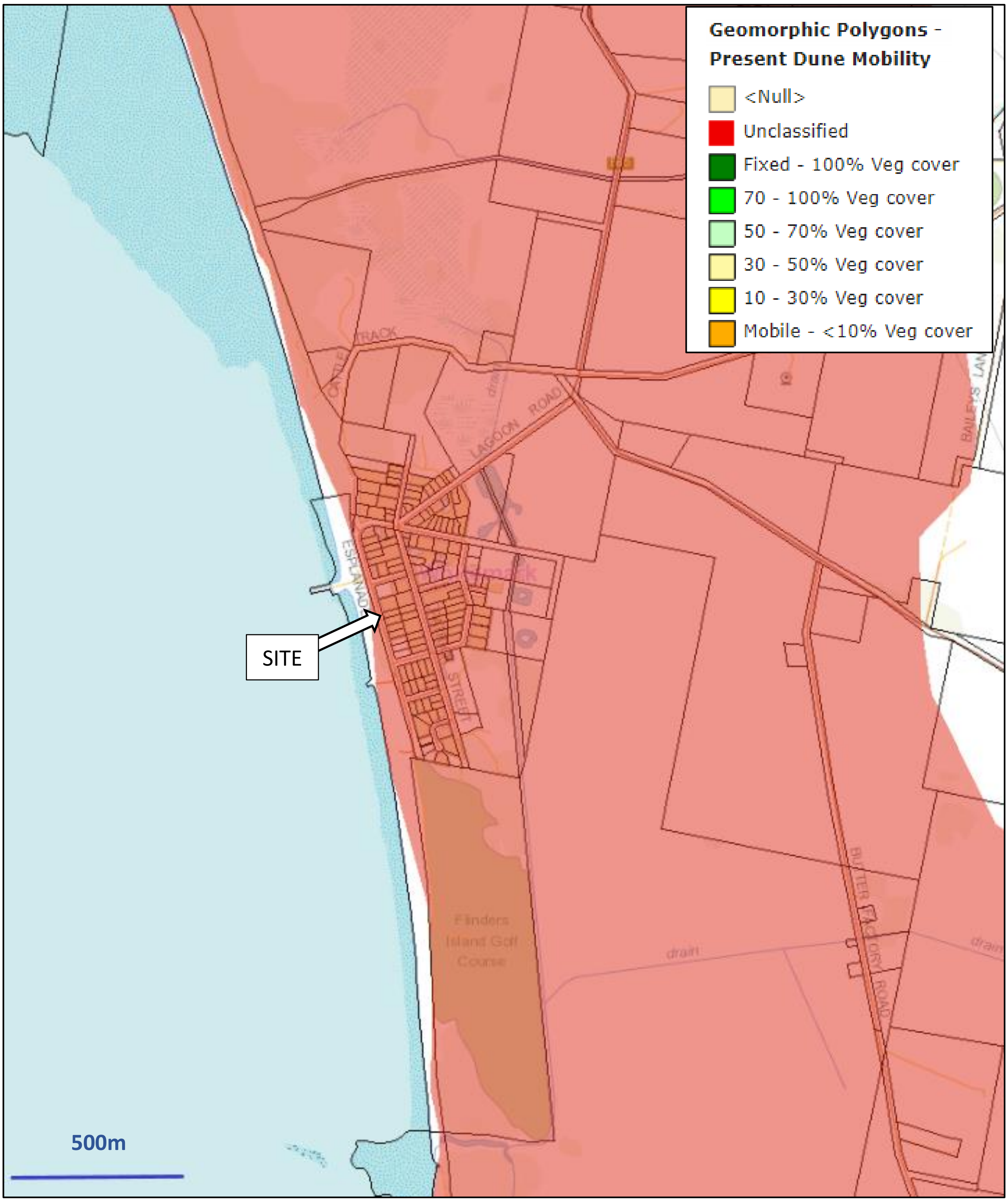


Figure 4 Dune mobility classification (The LIST)

Attachment 7 Risk Assessment Qualitative Terminology

DESCRIPTOR	QUALITATIVE MEASURES OF LIKELIHOOD
ALMOST CERTAIN	The event is expected to occur over the design life
LIKELY	The event will probably occur under adverse conditions over the design life
POSSIBLE	The event could occur under adverse conditions over the design life
UNLIKELY	The event is conceivable but only under exceptional circumstances over the building design life
RARE	The event is inconceivable or fanciful over the design life

DESCRIPTOR	QUALITATIVE MEASURES OF CONSEQUENCES TO PROPERTY
CATASTROPHIC	Structure(s) completely destroyed and/or large-scale damage requiring major engineering works for stabilisation. Could cause at least one adjacent property major consequence damage.
MAJOR	Extensive damage to most of structure, and/or extending beyond site boundaries requiring significant stabilisation works. Could cause at least one adjacent property medium consequence damage.
MEDIUM	Moderate damage to some of structure, and/or significant part of site requiring large stabilisation works. Could cause at least one adjacent property minor consequence damage.
MINOR	Limited damage to part of structure, and/or part of site requiring some reinstatement stabilisation works.
INSIGNIFICANT	Little damage. (Note for high probability event (Almost Certain), this category may be subdivided at a notional boundary of 0.1%. See Risk Matrix.)

LIKELIHOOD	CONSEQUENCES TO PROPERTY				
	CATASTROPHIC	MAJOR	MEDIUM	MINOR	INSIGNIFICANT
ALMOST CERTAIN	VH	VH	VH	H	**L**
LIKELY	VH	VH	H	M	**L**
POSSIBLE	VH	H	M	M	**VL**
UNLIKELY	H	M	**L**	**L**	**VL**
RARE	M	**L**	**L**	**VL**	**VL**
BARELY CREDIBLE	**L**	**VL**	**VL**	**VL**	**VL**

RISK LEVEL		EXAMPLE IMPLICATIONS
VH	VERY HIGH RISK	Unacceptable without treatment. Extensive detailed investigation and research, planning and implementation of treatment options essential to reduce risk to Low; may be too expensive and not practical. Work likely to cost more than value of the property.
H	HIGH RISK	Unacceptable without treatment. Detailed investigation, planning and implementation of treatment options required to reduce risk to Low.
M	MODERATE RISK	May be tolerated in certain circumstances (subject to regulator's approval) but requires investigation, planning and implementation of treatment options to reduce the risk to Low. Treatment options to reduce to Low risk should be implemented as soon as practicable.
L	LOW RISK	Usually acceptable to regulators. Where treatment has been required to reduce the risk to this level, ongoing management is required.
VL	VERY LOW RISK	Acceptable. Manage by management procedures.

Attachment 8 Performance Criteria - Coastal Erosion Hazards

C10.5.1 Use within a high coastal erosion hazard band P1.1

A use within a high coastal erosion hazard band must be for a use which relies upon a coastal location to fulfil its purpose, having regard to:	Relevance	Management Options	Risk Assessment Based on Treatment Recommendations			Further Assessment Required
			Consequence	Likelihood	Risk	
a) the need to access a specific resource in a coastal location;						
b) the need to operate a marine farming shore facility;						
c) the need to access infrastructure available in a coastal location;						
d) the need to service a marine or coastal related activity;						
e) provision of an essential utility or marine infrastructure;						
f) provision of open space or for marine-related educational, research or recreational facilities;	The proposed development relies upon a coastal location to fulfil its purpose through marine related recreational use.		Insignificant	Unlikely	Low	No
g) any advice from a State authority, regulated entity or a council; and						
h) the advice obtained in a coastal erosion hazard report.						

C10.5.1 Use within a high coastal erosion hazard band P1.2

A coastal erosion hazard report also demonstrates that:	Relevance	Management Options	Risk Assessment Based on Treatment Recommendations			Further Assessment Required
			Consequence	Likelihood	Risk	
a) any increase in the level of risk from coastal erosion does not require any specific hazard reduction or protection measures; or	Based on historical observations, there is not projected to be any increase in risk to existing structures or proposed works at the Site.	No hazard reduction or protection measures are required.	Insignificant	Unlikely	Low	No
b) the use can achieve and maintain a tolerable risk from a coastal erosion event in 2100 for the intended life of the use without requiring any specific hazard reduction or protection measures.	Tolerable risks can be achieved and maintained based on risk modelling from a coastal erosion event in 2100		Insignificant	Unlikely	Low	No

C10.6.1 Buildings and works, excluding coastal protection works, within a coastal erosion hazard area - Performance Criteria P1.1

Buildings and works, excluding coastal protection works, within a coastal erosion hazard area must have a tolerable risk, having regard to:	Relevance	Management Options	Preliminary Risk Assessment (where relevant)			Further Assessment Required
			Consequence	Likelihood	Risk	
(a) whether any increase in the level of risk from coastal erosion requires any specific hazard reduction or protection measures;	Based on historical observations, there is not projected to be any increase in risk to existing structures and proposed works at the Site.	No hazard reduction or protection measures are required.	Insignificant	Unlikely	Low	No
(b) any advice from a State authority, regulated entity or a council; and						
(c) the advice contained in a coastal erosion hazard report.						

Attachment 9 Director’s Determination Declaration – Coastal Inundation & Erosion

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*[8] for the intended life of the building having regard to:	**Application/Management**
nature, intensity and duration of the use	Risks are considered tolerable considering the nature, intensity and duration of the use based on a 2100 storm surge inundation event and considering a 50-year building design life (1% AEP modelling).
type, form and duration of the development	With finished floor levels above the floodwaters, risks are considered tolerable considering the type, form, and duration of the development
change in risk across the intended life of the building	This risk assessment is based on storm surge modelling given 2100 sea level for the Project Area. There is a low chance that a tolerable risk cannot be maintained throughout the duration of the building design life until 2073.
adaptation to any potential changes in risk	Given forecasting and graduated sea level rise processes, there is ample opportunity to adapt to changing risk
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.
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
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
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.
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 class 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 over 200 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__________K Taylor__________

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[8] 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 (AS1726) and has been written by a geotechnical practitioner with appropriate training and qualifications and over 13 years of experience in formulating coastal erosion models.
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, it is barely credible that the proposed works will 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. The Site landform comprises residual soils which are not considered a mobile landform.
whether the proposed work can achieve and maintain a *tolerable risk*[9] for the intended life of the building having regard to:	**Application/Management:**
nature, intensity and duration of the use	Given the observed coastal progradation within the Project Area, the nature and intensity of the use will not influence risks within the building design life.
type, form and duration of the development	No particular management measures involving the type, form and duration of the development are required beyond which is indicated within the proposal.
the likely change in the risk across the intended life of the building	There is an unlikely change is risk beyond what is modelled.
the ability to adapt to a change in the risk	The proposed building structure should allow for adaption to a change risk based on the building design life including modular deconstruction etc.
The ability to maintain access to utilities and services	Given the projected erosion, access to services and utilities can be maintained.
the need for specific coastal erosion hazard reduction or protection measures on the site	Modelling is based on the absence of coastal erosion protection measures. Findings indicated that coastal protection measures are not required at the Site.
the need for coastal erosion hazard reduction or protection measures beyond the boundary of the site; and	Modelling is based on the absence of coastal erosion protection measures. Findings indicated that coastal protection measures are not required beyond the boundary of the Site.
any coastal erosion management plan in place for the site and/or adjacent land.	No coastal erosion management plan is recommended.
hazardous chemical used, handled, generated, or stored on the site,	General household chemicals being stored are typically in low volumes and in sealed containers.
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 class 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________________________

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[9] 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.

Attachment 10 Geotechnical Site Investigation

enviro•tech
CONSULTANTS
Geotechnical & Environmental Services

GEOTECHNICAL SITE INVESTIGATION AND WINDLOADING

PROPOSED VISITOR ACCOMMODATION
WHITEMARK WHARF - 16 ESPLANADE

Client:	**Jo Youl**
Certificate of Title:	**129006/1**
Investigation Date:	**Thursday, 25 May 2023**

Investigation Summary

Site Classification

In accordance with AS2870 – 2011 and after allowing due consideration to known details of the proposed building and works (herein referred to as the Site), the Site geology, soil conditions, soil properties and drainage, soil at the Site has been classified as:

CLASS P based on the following problematic ground conditions identified at the Site:

- The proposed building is located within a coastal erosion hazard overlay, and assumes a CLASS P in accordance with the Directors Determination - Coastal Erosion Hazards
- Loose soil was identified at the Site with DCP blow counts of less than 2.5 per 100mm travel at depths of up to 4.7 m in BH01; 3.9 m in BH02; 1 m in BH03; 2.3 m in BH04; 1 m in BH05; 1 m in BH06; 1 m in BH07; 1 m in BH09. Loose soil may be a problem where the soil is shallow and limited by allowable bearing capacities.
- Low bearing capacity soil was encountered with allowable bearing capacities of less than 100 kPa to a depth of up to 1.1 m in BH01; 2.1 m in BH02; 1 m in BH03; 1.5 m in BH04; 1.8 m in BH05; 1.6 m in BH06; 2 m in BH07; 1.1 m in BH08; 1.9 m in BH09. Low bearing capacity soil may be a problem in cases where the problematic soil is shallow and depends on the loads and the load distribution which is considered in tables herein.

Notwithstanding the problematic soil conditions observed at the Site, ordinarily the soil would be classified as Class A.

Foundations

Ideally, footings should be extended to depths of 2 m or greater to intercept suitable founding materials as presented in the bearing capacity table of this report.

Wind Load Classification

The AS 4055-2021 Wind loads for Housing classification is summarised.

Region:	A
Terrain category:	TC1
Shielding Classification:	NS
Topographic Classification:	T0
Wind Classification:	N3
Design Wind Gust Speed ($V_{h,u}$) m/s	50

I recommend that during construction that I and/or the design engineer be notified of any major variation to the foundation conditions as predicted in this report.

K Taylor

Kris Taylor BSc (hons)

Environmental & Engineering Geologist

Site Investigation

The Site investigation is summarised in Table 1.

Table 1 Summary of Site Investigation

Client	Jo Youl
Project Address	Whitemark Wharf - 16 Esplanade Whitemark
Council	Flinders
Planning Scheme	
Inundation, Erosion or Landslip Overlays	High Coastal Erosion Hazard Area; Low Coastal Inundation Hazard Area
Proposed	Visitor Accommodation
Investigation	Fieldwork was carried out by an Engineering Geologist on the 25/5/2023
Site Topography	The building site has a very gentle slope of approximately 3% (2°) to the west
Site Drainage	The site receives overland flow runoff directly from the east.
Soil Profiling	A total of 3 boreholes and 9 soil profiling DCP's were used to investigate at the Site.
Investigation Depths	The target excavation depth was estimated at 3.0 m. Borehole logs and photos are presented in Appendix B & C.
Soil moisture and groundwater	All recovered soil at the site ranged from dry to slightly moist. Groundwater was not encountered.
Geology	According to 1:250,000 Mineral Resources Tasmania geological mapping (accessed through The LIST), the geology comprises: Quaternary Sand gravel and mud of alluvial, lacustrine and littoral origin.

Soil Profiles

The geology of the Site has been logged and described in accordance with Unified Soil Classification System (AS1726). Soil is summarised in Table 2.

Table 2 Soil Summary Table

#	Layer	Details	USCS	BH01	BH02	BH03	BH04	BH05	BH06	BH07	BH08	BH09
1	SAND	SAND, pale grey/yellow, well sorted, coarse grained sand, trace roots, VL	SW	0-0.1 DS@0.0	0-0.1							
2	SAND	SAND, dark brown, well sorted, coarse grained sand, trace roots, trace silt, VL-MD	SW	0.1-0.3 DS@0.1								
3	SAND	SAND, pale brown, well sorted, coarse grained sand, L-MD	SW	0.3-1.8 DS@0.7								
4	SAND	SAND trace gravel, pale brown/yellow, well sorted, coarse grained sand, VL-VD	SW	1.8-2.5 DS@2.1	0.1-1	0-1.5 1.5-3.9 INF	0-2.7 INF	0-2.6 INF	0-5.4 INF	0-5.9 INF	0-4.9 INF	0-3.9 INF
5	SAND	INFERRED SAND with gravel, VL-D	SW	2.5-4.8 INF	1-4.5 INF							

Consistency[1]	**VS** Very soft; **S** Soft; **F** Firm; **St** Stiff; **Vst** Very Stiff; **H** Hard.
Density[2]	**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

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[1] Soil consistencies are derived from a combination of field index, DCP and shear vane readings.

[2] Soil density descriptions presented in engineering logs are derived from the DCP testing

Soil Testing Results

Dynamic Cone Penetrometer (DCP)

Dynamic Cone Penetrometer (DCP)[3] testing was conducted in accordance with AS 1289.6.3.2 with the results presented in Appendix B.

Particle Size Analysis

Soil particle sizes distribution was assessed with results presented in Table 3.

Table 3 Soil Particle Size Analysis

Bore	***From***	***To***	***Gravel %***	***Sand***				***Silt & Clay %***
				Coarse %	***Medium %***	***Fine %***	**Total %**	
	m	***m***	***>2.36 mm***	***0.6 mm***	***0.18 mm***	***0.075 mm***	**0.075 to 2.36 mm**	***<0.075***
BH01	0.1	0.2	11	55	31	2	89	1
BH01	0.2	0.3	13	39	38	4	82	5
BH01	0.7	0.8	2	53	43	1	98	0
BH01	2.1	2.2	14	85	1	0	86	0

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[3] DCP values are a measure of soil strength and are logged as the number of 9 kg sliding hammer drops (from 510 mm height) required to drive a 20mm diameter cone tipped rod at 100mm intervals.

Geotechnical Interpretation

Bearing Capacities

Soil bearing capacity was calculated from correlations with DCP blow counts and soil undrained shear strength obtained from vane shear testing. Interpretive values are presented in Table 4.

Table 4 Soil bearing capacities and problematic ground conditions.

Allowable Bearing Capacity (kPa)									
Depth from (m)	**BH01**	**BH02**	**BH03**	**BH04**	**BH05**	**BH06**	**BH07**	**BH08**	**BH09**
0	40~	20~	10~	10~	10~	10~	40~	140*	10~
0.1	80~	20~	10~	10~	10~	10~	50~	150	10~
0.2	110*	30~	10~	10~	10~	10~	80~	190	10~
0.3	150	30~	20~	10~	20~	10~	110	190	10~
0.4	130	50~	20~	50~	30~	10~	110	190	50~
0.5	150	70~	30~	80~	50~	20~	80~	170	70~
0.6	160	90~	50~	130	70~	30~	50~	160	80~
0.7	160	80~	70~	120	80~	40~	50~	160	70~
0.8	130	80~	90~	90~	80~	50~	70~	150	70~
0.9	90~	70~	90~	80~	70~	80~	70~	170	70~
1	90~	90~	110*	110*	70~	110	50~	160	70~
1.1	110	90~	110	150	50~	130	50~	150	70~
1.2	120	110*	120	250	70~	130	70~	120	80~
1.3	120	110	160	>400	80~	150	80~	110	90~
1.4	120	120	240	>400	110*	130	90~	110~	120*
1.5	120	150	290	>400	120	120	110*	130	150
1.6	120	170	290	>400	120	80~	120	160	130
1.7	120	200	290	330	110	50~	110	160	120~
1.8	130	200	290	190	80~	50~	110~	120	110
1.9	130	230	280	120~	70~	90~	120	90~	130
2	170	170	230	90~	70~	130*	210	70~	150
2.1	170	130~	230	80~	90~	200	310	80~	190
2.2	280	90~	230	70~	120	250	350	130	210
2.3	350	130	290	40~	190	390	310	230	250
2.4	>400	160	390	40~	370	390	230	270	240
2.5	280	170	>400	160~	>400	370	200	270	270
2.6	160~	150	>400	220	REF	230	170	320	270
2.7	80~	130~	390	REF		240	170	>400	240
2.8	110~	120	310			360	240	>400	170
2.9	130	160	250			>400	270	>400	150
3	190	200	210			>400	280	>400	190
3.1	230	200	160			>400	230	370	230
3.2	270	160	160			>400	210	330	230
3.3	280	110~	160			270	230	390	190
3.4	280	90~	160			150	230	>400	130
3.5	310	90~	210			90~	250	>400	80~
3.6	360	110~	350			80~	270	>400	50~
3.7	>400	90~	>400			120	270	360	40~
3.8	370	110~	>400			150	240	280	40~
3.9	290	130	REF			160	210	200	REF
4	230	170				200	190	160	
4.1	200	200				270	170	120~	
4.2	170	210				350	120	80~	

Allowable Bearing Capacity (kPa)									
Depth from (m)	**BH01**	**BH02**	**BH03**	**BH04**	**BH05**	**BH06**	**BH07**	**BH08**	**BH09**
4.3	**120**	**190**				**>400**	**80~**	**80~**	
4.4	**90~**	**180**				**>400**	**50~**	**80~**	
4.5	**80~**	**REF**				**>400**	**50~**	**70~**	
4.6	**80~**					**>400**	**90~**	**70~**	
4.7	**80~**					**>400**	**120**	**170~**	
4.8	**REF**					**390**	**200**	**240**	
4.9						**360**	**160**	**REF**	
5						**310**	**120~**		
5.1						**320**	**70~**		
5.2						**360**	**110**		
5.3						**380**	**170**		
5.4						**REF**	**190**		
5.5							**190**		
5.6							**170**		
5.7							**230**		
5.8							**260**		
5.9							**REF**		

Correlations drawn from DCP and vane shear testing with 300 mm interval averaging applied.

REF - Penetrometer Refusal

~Problematic soil layers: Soil is either loose, soft or the bearing capacity is less than 100 kPa. In accordance with AS2870, 'The design bearing capacity at foundation level should be no less than 100 kPa for strip and pad footings and under the edge footing of footing slabs used without tie bars between the edge footing and slab. The design bearing capacity at foundation level shall be no less than 50kPa under all beams and slab panels and support thickenings for slab construction.'

***Soil type expected at the base of problematic soil layers (where present):**

BH01: Medium dense, dark brown SAND at 0.2 m depth
BH02: Loose, pale brown/yellow SAND at 1.2 m depth
BH03: Loose, pale brown/yellow SAND at 1 m depth
BH04: Medium dense, pale brown/yellow SAND at 1 m depth
BH05: Medium dense, pale brown/yellow SAND at 1.4 m depth
BH06: Medium dense, pale brown/yellow SAND at 2 m depth
BH07: Medium dense, pale brown/yellow SAND at 1.5 m depth
BH08: Medium dense, pale brown/yellow SAND at 0 m depth
BH09: Medium dense, pale brown/yellow SAND at 1.4 m depth

Recommendations – Design Considerations

General

For Class P Sites, the designer should be a qualified engineer experienced in the design of footing systems for buildings.

Site Drainage Design

As part of the building design plan, swale drains are recommended upslope of the proposed building Site and above batters and earth retaining structures to capture Site stormwater flow.

Surface drainage shall be considered in the design of the footing system and necessary modification shall be included in the design documentation. Surface drainage of the Site shall be controlled from the start of Site preparation and construction. The drainage system shall be completed by the finish of construction of the building.

Ideally, areas around the building footprint should be graded or drained such that water cannot pond against or near the building. As soon as footing construction has been completed, ground immediately adjacent to the building should be graded to a uniform fall of 50mm minimum away from the building over the first metre. Final provision of paving to the edge of the building can greatly limit soil moisture variations due to seasonal wetting and drying.

Foundation Type – Wave Forcing, Coastal Erosion, Soil Collapse in Cobbles

It is recommended that either bored piers, driven piles or screw piles are used at the Site. Consideration needs to be given to lateral earth pressures acting on the foundations given erosion and wave runup forcing (see coastal erosion assessment for more detail). If bored piers are selected, consideration needs to be given to potential collapse and infilling with groundwater at approximately 0.5 m AHD. Consideration given to saltwater corrosion resistance of all foundation types.

Due to the presence of the groundwater, screw (blade) or driven piles may me more effective in this type of setting.

Recommendations – Earthworks

Building Pad Preparation

Any organic matter or other deleterious materials will need to be removed from the building envelope.

Unless otherwise stated in an engineering report, fill material or loose, soft, low bearing capacity soil should either be removed from the building pad, or otherwise footings should ideally be established to the base of this material.

Earthworks should be carried out in accordance with AS3798 ‘Earthworks for Residential and Commercial Developments’. Unsuitable materials in structural fill are listed in AS2870 Section 4.3.

Pad Preparation - Compaction

It is recommended that any sands or granular materials across the building pad and bases of footing excavations are compacted with several passes using a medium weight (~80 kg) plate compactor. Soil to 1.0 m depth may be improved to meet the desired allowable bearing capacity through testing with a DCP tool.

Foundation Maintenance

Details on appropriate Site and foundation maintenance practices from CSIRO Information Sheet BTF 18 Foundation Maintenance and Footing Performance: A Homeowner's Guide are presented in Appendix D of this report.

K Taylor

Kris Taylor BSc (hons)

Environmental & Engineering Geologist

Notes About Your Assessment

The Site classification provided, and footing recommendations including foundation depths are assessed based on the subsurface profile conditions present at the time of fieldwork and may vary according to any subsequent *Site works* carried out. *Site works* may include changes to the existing soil profile by cutting exceeding 0.4 m and filling exceeding 0.4 to 0.8 m depending on the material type and footing design. All footings must be founded through fill material *other than* sand not exceeding 0.4 m depth or sand not exceeding 0.8 m depth, or otherwise a Class P applies (AS2870 Clauses 2.5.2 and 2.5.3).

For reference, borehole investigation depths relative to natural soil surface levels are stated in borehole logs where applicable.

In some cases, variations in actual Site conditions may exist between subsurface investigation boreholes. At the time of construction, if conditions exist which differ from those described in this report, it is recommended that the base of all footing excavations be inspected to ensure that the founding medium meets that requirement referenced herein or stipulated by an engineer before any footings are poured.

The Site classification assumes that the performance requirements as set out in Appendix B of AS 2870 are acceptable and that Site foundation maintenance is undertaken to avoid extremes of wetting and drying.

It is up to the homeowner to ensure that the soil conditions are maintained and that abnormal moisture conditions do not develop around the building. The following are examples of poor practices which may result in abnormal soil conditions:

- The effect of trees too close to a footing.
- Excessive or irregular watering of gardens adjacent to the building.
- Failure to maintain Site drainage.
- Failure to repair plumbing leaks.
- Loss of vegetation from near the building.

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.

References

AS 1289.6.3.2-2003 Soil strength and consolidation tests—Determination of the penetration resistance of a soil—9 kg dynamic cone penetrometer test, Standards Australia, Sydney, Retrieved from SAI Global

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AS 1726-2017, Geotechnical Site investigations, Standards Australia, Sydney, Retrieved from SAI Global

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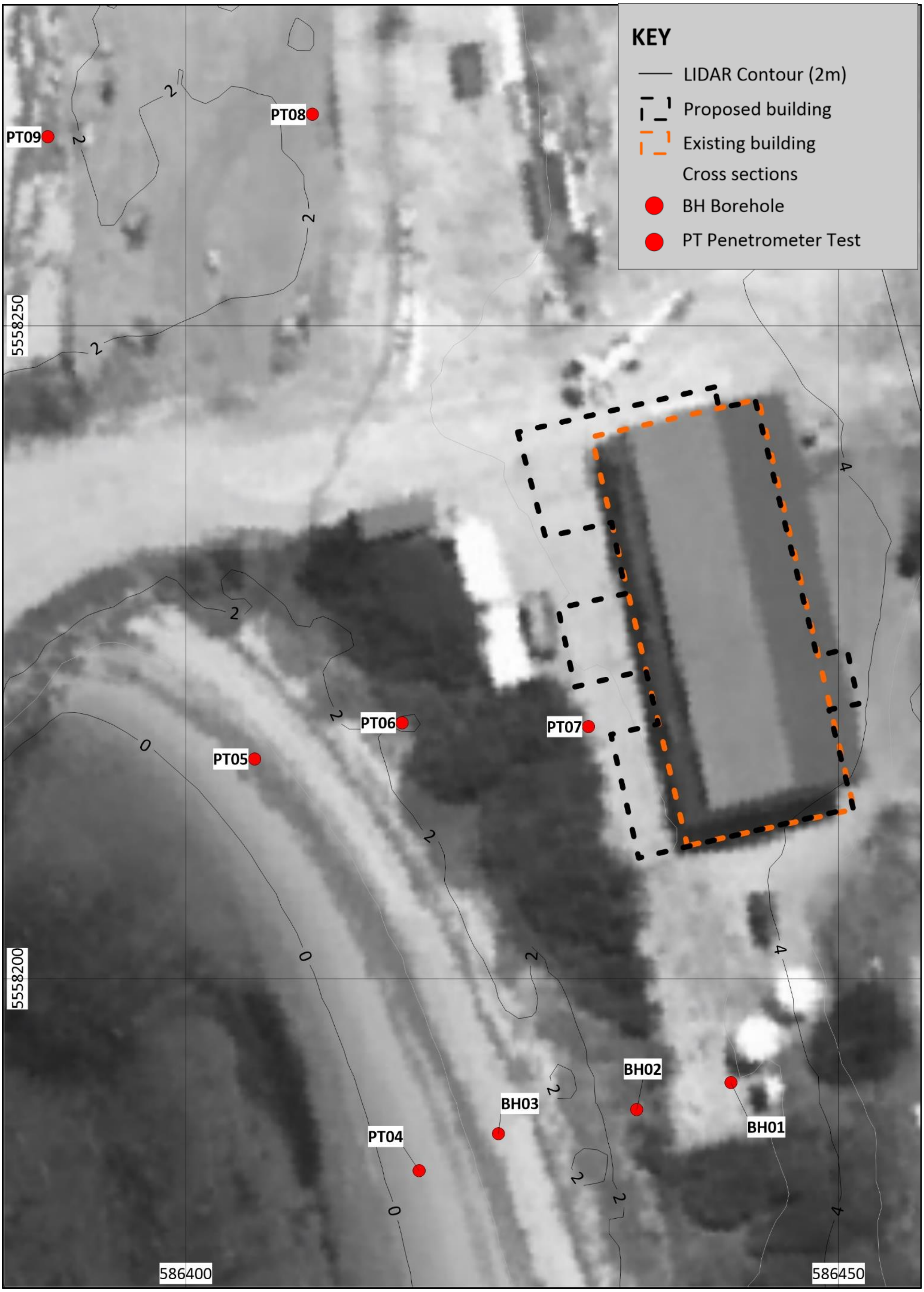
AS4055 (2021). Australian Standard. Prepared by Committee BD-099, Wind Loads for Housing. Approved on behalf of the Council of Standards Australia on 1st June 2021 and published on 25th June 2021.

DPIPWE 2009. Dispersive Soils and their Management. Technical Reference Manual. Sustainable Land Use Department of Primary Industries Water and Environment.

Appendix A Borehole Locations



Appendix B Borehole Logs

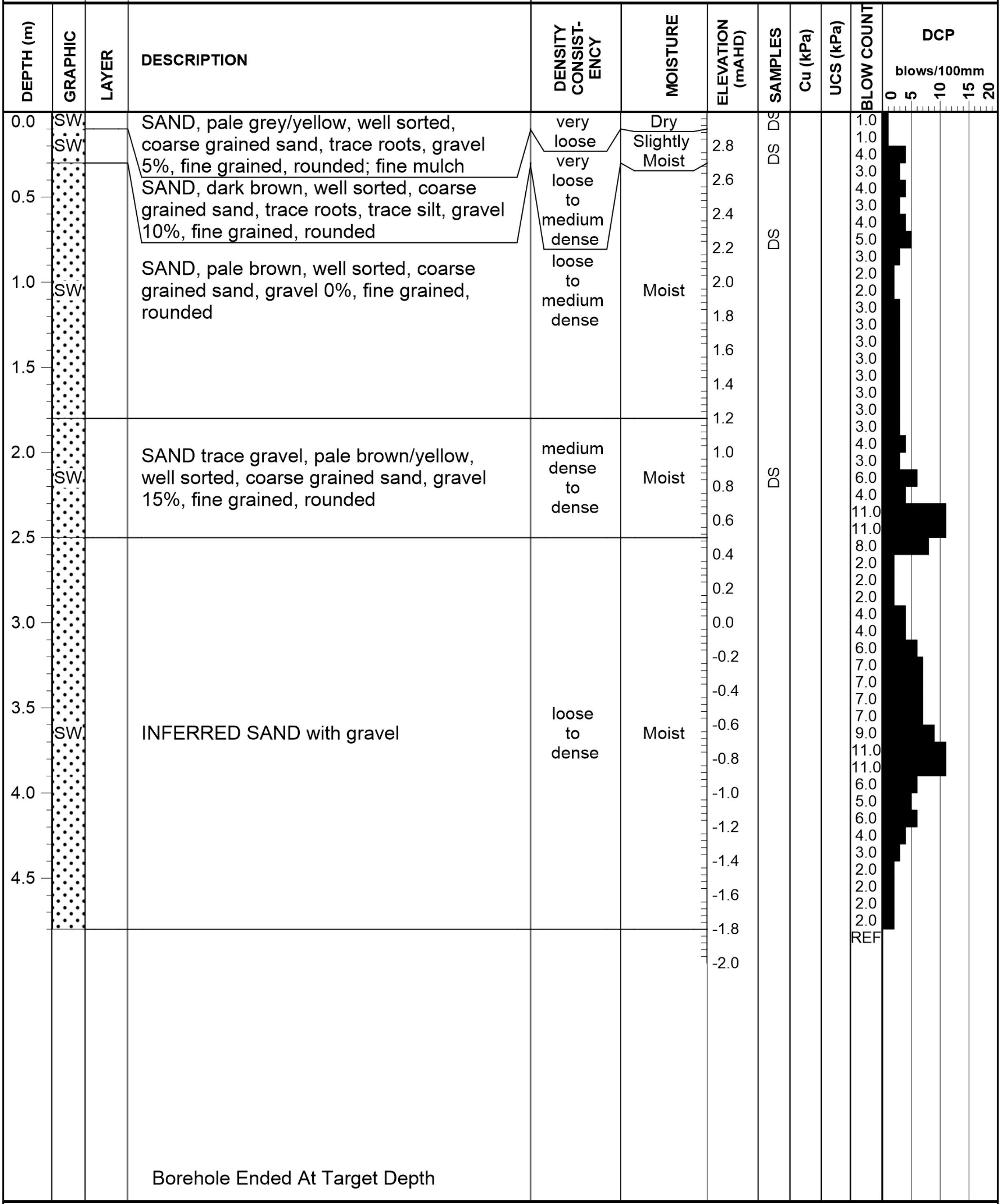
enviro·tech CONSULTANTS

ASSESSMENT: Geotechnical Site Investigation
STRUCTURE: Visitor Accommodation
EASTING: 586441.8
NORTHING: 5558192

HOLE ID NO.: BH01
DATE TESTED: 25/05/2023
LOGGED BY: M. Scalisi
ELEVATION: 3

LOCATION: WHITEMARK WHARF- 16 Esplanade -
CLIENT: Jo Youl

EQUIPMENT: Power auger
RELATIVE NATURAL SURFACE (RL): 0



GRAPHIC	DESCRIPTION	DENSITY CONSIST-ENCY	MOISTURE	SAMPLES
SW	SAND, pale grey/yellow, well sorted, coarse grained sand, trace roots, gravel 5%, fine grained, rounded; fine mulch	very loose	Dry	DS
SW	SAND, dark brown, well sorted, coarse grained sand, trace roots, trace silt, gravel 10%, fine grained, rounded	very loose to medium dense	Slightly Moist	DS
SW	SAND, pale brown, well sorted, coarse grained sand, gravel 0%, fine grained, rounded	loose to medium dense	Moist	DS
SW	SAND trace gravel, pale brown/yellow, well sorted, coarse grained sand, gravel 15%, fine grained, rounded	medium dense to dense	Moist	DS
SW	INFERRED SAND with gravel	loose to dense	Moist	

Borehole Ended At Target Depth

BLOW COUNT
1.0
1.0
4.0
3.0
4.0
3.0
4.0
5.0
3.0
2.0
2.0
3.0
3.0
3.0
3.0
3.0
3.0
3.0
3.0
4.0
3.0
6.0
4.0
11.0
11.0
8.0
2.0
2.0
2.0
4.0
4.0
6.0
7.0
7.0
7.0
7.0
9.0
11.0
11.0
6.0
5.0
6.0
4.0
3.0
2.0
2.0
2.0
2.0
REF

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.

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CONSULTANTS

ASSESSMENT: Geotechnical Site Investigation
STRUCTURE: Visitor Accommodation
EASTING: 586434.5
NORTHING: 5558190

HOLE ID NO.: BH02
DATE TESTED: 25/05/2023
LOGGED BY: M. Scalisi
ELEVATION: 2.4

LOCATION: WHITEMARK WHARF- 16 Esplanade -
CLIENT: Jo Youl

EQUIPMENT: Power auger
RELATIVE NATURAL SURFACE (RL): 0

GRAPHIC	LAYER	DESCRIPTION	DENSITY CONSIST-ENCY	MOISTURE	SAMPLES	Cu (kPa)	UCS (kPa)
SW		SAND, pale grey/yellow, well sorted, coarse grained sand, trace roots, gravel 5%, fine grained, rounded; fine mulch	very loose	Dry			
SW		SAND trace gravel, pale brown/yellow, well sorted, coarse grained sand, gravel 15%, fine grained, rounded	very loose to medium dense	Dry			
SW		INFERRED INFERRED SAND with gravel	very loose to medium dense				

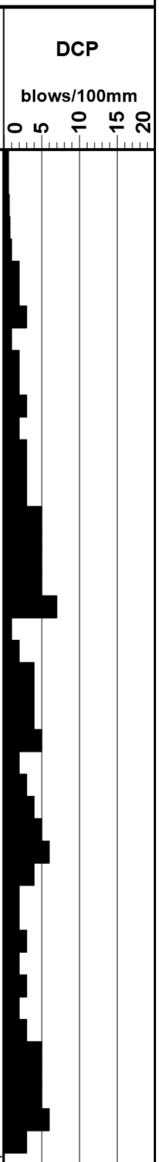
Borehole Ended At Target Depth

DEPTH (m): 0.0, 0.5, 1.0, 1.5, 2.0, 2.5, 3.0, 3.5, 4.0, 4.5

ELEVATION (mAHD): 2.4, 2.2, 2.0, 1.8, 1.6, 1.4, 1.2, 1.0, 0.8, 0.6, 0.4, 0.2, 0.0, -0.2, -0.4, -0.6, -0.8, -1.0, -1.2, -1.4, -1.6, -1.8, -2.0, -2.2, -2.4

BLOW COUNT
0.6
0.6
0.7
0.8
1.0
2.0
2.0
3.0
1.0
2.0
2.0
3.0
2.0
3.0
3.0
3.0
5.0
5.0
5.0
5.0
7.0
1.0
2.0
4.0
4.0
4.0
5.0
2.0
3.0
4.0
5.0
6.0
4.0
2.0
2.0
3.0
2.0
3.0
2.0
3.0
5.0
5.0
5.0
6.0
3.0
REF

DCP



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.

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ASSESSMENT: Geotechnical Site Investigation
STRUCTURE: Visitor Accommodation
EASTING: 586423.9
NORTHING: 5558188.1

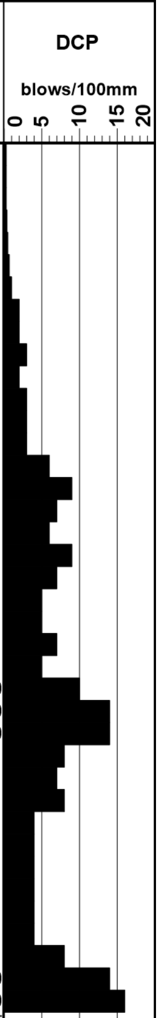
HOLE ID NO.: BH03
DATE TESTED: 25/05/2023
LOGGED BY: M. Scalisi
ELEVATION: 1.8

LOCATION: WHITEMARK WHARF- 16 Esplanade -
CLIENT: Jo Youl

EQUIPMENT: Power auger
RELATIVE NATURAL SURFACE (RL): 0

DEPTH (m)	GRAPHIC	LAYER	DESCRIPTION	DENSITY CONSIST-ENCY	MOISTURE	ELEVATION (mAHD)	SAMPLES	Cu (kPa)	UCS (kPa)
0.0 0.5 1.0	SW		SAND trace gravel, pale brown/yellow, well sorted, coarse grained sand, gravel 15%, fine grained, rounded	very loose to medium dense	Moist	1.8 1.6 1.4 1.2 1.0 0.8 0.6 0.4			
1.5 2.0 2.5 3.0 3.5	SW		INFERRED SAND trace gravel, pale brown/yellow, well sorted, coarse grained sand, gravel 15%, fine grained, rounded	medium dense to very dense	Moist	0.2 0.0 -0.2 -0.4 -0.6 -0.8 -1.0 -1.2 -1.4 -1.6 -1.8 -2.0			
4.0			Borehole Ended At Target Depth			-2.2			

BLOW COUNT
0.3
0.3
0.3
0.4
0.5
0.7
1.0
2.0
2.0
3.0
2.0
3.0
3.0
3.0
6.0
9.0
7.0
6.0
9.0
7.0
5.0
5.0
7.0
5.0
10.0
14.0
14.0
8.0
7.0
8.0
4.0
4.0
4.0
4.0
4.0
4.0
8.0
14.0
16.0
REF



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.

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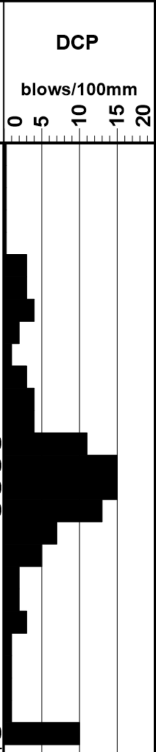
CONSULTANTS

ASSESSMENT: Geotechnical Site Investigation
STRUCTURE: Visitor Accommodation
EASTING: 586417.9
NORTHING: 5558185.3

HOLE ID NO.: PT04
DATE TESTED: 25/05/2023
LOGGED BY: M. Scalisi
ELEVATION: 1.5

LOCATION: WHITEMARK WHARF- 16 Esplanade -
CLIENT: Jo Youl

EQUIPMENT: Power auger
RELATIVE NATURAL SURFACE (RL): 0

DEPTH (m)	GRAPHIC	LAYER	DESCRIPTION	DENSITY CONSISTENCY	MOISTURE	ELEVATION (mAHD)	SAMPLES	Cu (kPa)	UCS (kPa)	BLOW COUNT	DCP blows/100mm
0.0 0.5 1.0 1.5 2.0 2.5	SW		INFERRED SAND trace gravel, pale brown/yellow, well sorted, coarse grained sand, gravel 15%, fine grained, rounded	very loose to dense	Moist	1.4 1.2 1.0 0.8 0.6 0.4 0.2 0.0 -0.2 -0.4 -0.6 -0.8 -1.0 -1.2				0.3 0.3 0.3 0.3 0.3 3.0 3.0 4.0 2.0 1.0 3.0 4.0 4.0 11.0 15.0 15.0 13.0 7.0 5.0 2.0 2.0 3.0 1.0 1.0 1.0 1.0 10.0 REF	

DCP Terminated at 2.7 m Depth

GROUNDWATER: NA

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.

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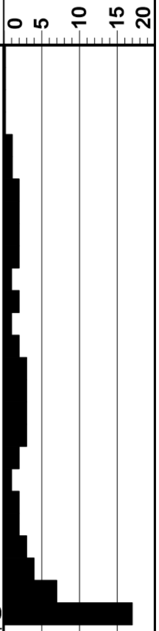
CONSULTANTS

ASSESSMENT: Geotechnical Site Investigation
STRUCTURE: Visitor Accommodation
EASTING: 586405.3
NORTHING: 5558216.85

HOLE ID NO.: PT05
DATE TESTED: 25/05/2023
LOGGED BY: M. Scalisi
ELEVATION: 1.45

LOCATION: WHITEMARK WHARF- 16 Esplanade -
CLIENT: Jo Youl

EQUIPMENT: Power auger
RELATIVE NATURAL SURFACE (RL): 0

DEPTH (m)	GRAPHIC	LAYER	DESCRIPTION	DENSITY CONSIST-ENCY	MOISTURE	ELEVATION (mAHD)	SAMPLES	Cu (kPa)	UCS (kPa)	BLOW COUNT	DCP blows/100mm
0.0 0.5 1.0 1.5 2.0 2.5	SW		INFERRED SAND trace gravel, pale brown/yellow, well sorted, coarse grained sand, gravel 15%, fine grained, rounded	very loose to very dense	Moist	1.4 1.2 1.0 0.8 0.6 0.4 0.2 0.0 -0.2 -0.4 -0.6 -0.8 -1.0 -1.2				0.2 0.2 0.2 0.2 1.1 1.1 2.0 2.0 2.0 2.0 1.0 2.0 1.0 2.0 3.0 3.0 3.0 3.0 2.0 1.0 2.0 2.0 3.0 4.0 7.0 17.0 REF	

DCP Terminated at 2.6 m Depth

GROUNDWATER: NA
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.

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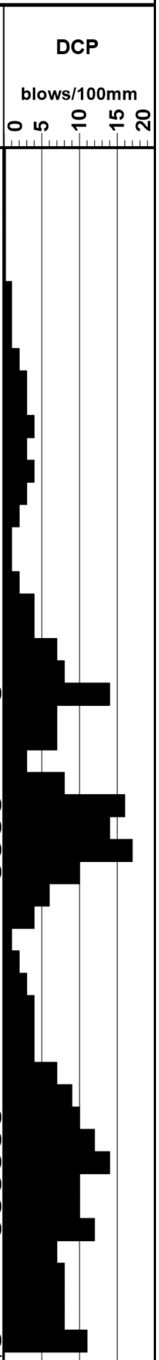
ASSESSMENT: Geotechnical Site Investigation
STRUCTURE: Visitor Accommodation
EASTING: 586416.55
NORTHING: 5558219.6

HOLE ID NO.: PT06
DATE TESTED: 25/05/2023
LOGGED BY: M. Scalisi
ELEVATION: 2.15

LOCATION: WHITEMARK WHARF- 16 Esplanade -
CLIENT: Jo Youl

EQUIPMENT: Power auger
RELATIVE NATURAL SURFACE (RL): 0

DEPTH (m)	GRAPHIC	LAYER	DESCRIPTION	DENSITY CONSIST-ENCY	MOISTURE	ELEVATION (mAHD)	SAMPLES	Cu (kPa)	UCS (kPa)	BLOW COUNT	DCP blows/100mm 0 5 10 15 20
0.0 0.5 1.0 1.5 2.0 2.5 3.0 3.5 4.0 4.5 5.0 5.5	SW		INFERRED SAND trace gravel, pale brown/yellow, well sorted, coarse grained sand, gravel 15%, fine grained, rounded	very loose to very dense	Moist	2.0 1.8 1.6 1.4 1.2 1.0 0.8 0.6 0.4 0.2 0.0 -0.2 -0.4 -0.6 -0.8 -1.0 -1.2 -1.4 -1.6 -1.8 -2.0 -2.2 -2.4 -2.6 -2.8 -3.0 -3.2 -3.4 -3.6				0.2 0.2 0.2 0.2 0.2 0.2 1.0 1.0 1.0 2.0 3.0 3.0 4.0 3.0 4.0 3.0 2.0 1.0 1.0 2.0 4.0 4.0 7.0 8.0 14.0 7.0 7.0 3.0 8.0 16.0 14.0 17.0 10.0 6.0 4.0 1.0 2.0 3.0 4.0 4.0 4.0 7.0 9.0 10.0 12.0 14.0 10.0 10.0 12.0 7.0 8.0 8.0 8.0 11.0 REF	
			DCP Terminated at 5.4 m Depth								

GROUNDWATER: Not Encountered

PAGE 1 of 1

TESTING: Penetrometer: AS 1289.6.3.2

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

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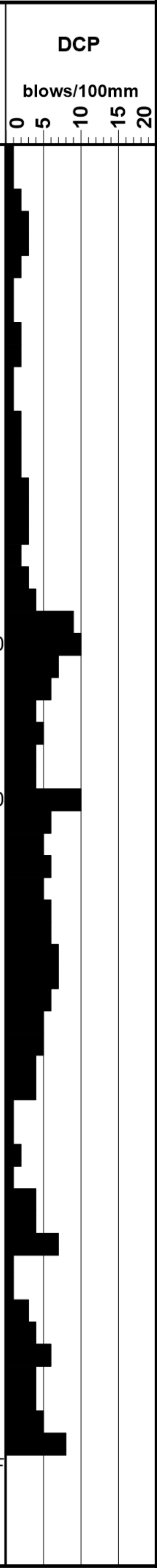
ASSESSMENT: Geotechnical Site Investigation
STRUCTURE: Visitor Accommodation
EASTING: 586430.9
NORTHING: 5558219.3

HOLE ID NO.: PT07
DATE TESTED: 25/05/2023
LOGGED BY: M. Scalisi
ELEVATION: 2.9

LOCATION: WHITEMARK WHARF- 16 Esplanade -
CLIENT: Jo Youl

EQUIPMENT: Power auger
RELATIVE NATURAL SURFACE (RL): 0

DEPTH (m)	GRAPHIC	LAYER	DESCRIPTION	DENSITY CONSIST-ENCY	MOISTURE	ELEVATION (mAHD)	SAMPLES	Cu (kPa)	UCS (kPa)	BLOW COUNT
0.0 0.5 1.0 1.5 2.0 2.5 3.0 3.5 4.0 4.5 5.0 5.5	SW		INFERRED SAND trace gravel, pale brown/yellow, well sorted, coarse grained sand, gravel 15%, fine grained, rounded	very loose to dense	Moist	2.8 2.6 2.4 2.2 2.0 1.8 1.6 1.4 1.2 1.0 0.8 0.6 0.4 0.2 0.0 -0.2 -0.4 -0.6 -0.8 -1.0 -1.2 -1.4 -1.6 -1.8 -2.0 -2.2 -2.4 -2.6 -2.8				1.0 1.0 2.0 3.0 3.0 2.0 1.0 1.0 2.0 2.0 1.0 1.0 2.0 2.0 2.0 3.0 3.0 3.0 2.0 3.0 4.0 9.0 10.0 7.0 6.0 4.0 5.0 4.0 4.0 10.0 6.0 5.0 6.0 5.0 6.0 6.0 7.0 7.0 6.0 5.0 5.0 4.0 4.0 1.0 1.0 2.0 1.0 4.0 4.0 7.0 1.0 1.0 3.0 4.0 6.0 4.0 4.0 5.0 8.0
6.0			DCP Terminated at 5.9 m Depth			-3.0 -3.2				REF



GROUNDWATER: NA

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.

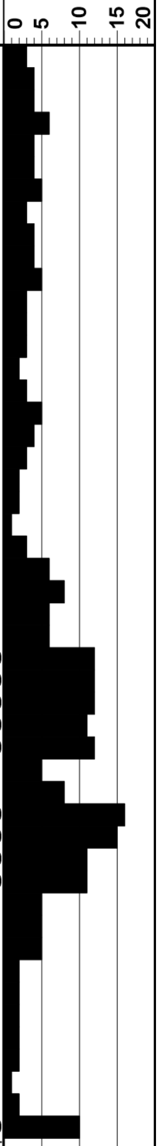
enviro·tech
CONSULTANTS

ASSESSMENT: Geotechnical Site Investigation
STRUCTURE: Visitor Accommodation
EASTING: 586409.7
NORTHING: 5558266.2

HOLE ID NO.: PT08
DATE TESTED: 25/05/2023
LOGGED BY: M. Scalisi
ELEVATION: 2.9

LOCATION: WHITEMARK WHARF- 16 Esplanade -
CLIENT: Jo Youl

EQUIPMENT: Power auger
RELATIVE NATURAL SURFACE (RL): 0

DEPTH (m)	GRAPHIC	LAYER	DESCRIPTION	DENSITY CONSIST-ENCY	MOISTURE	ELEVATION (mAHD)	SAMPLES	Cu (kPa)	UCS (kPa)	BLOW COUNT	DCP blows/100mm
0.0 0.5 1.0 1.5 2.0 2.5 3.0 3.5 4.0 4.5 5.0	SW		INFERRED SAND trace gravel, pale brown/yellow, well sorted, coarse grained sand, gravel 15%, fine grained, rounded	very loose to very dense	Moist	2.8 2.6 2.4 2.2 2.0 1.8 1.6 1.4 1.2 1.0 0.8 0.6 0.4 0.2 0.0 -0.2 -0.4 -0.6 -0.8 -1.0 -1.2 -1.4 -1.6 -1.8 -2.0				3.0 4.0 4.0 6.0 4.0 4.0 5.0 3.0 4.0 4.0 5.0 3.0 3.0 3.0 2.0 3.0 5.0 4.0 3.0 2.0 2.0 1.0 3.0 6.0 8.0 6.0 6.0 12.0 12.0 12.0 11.0 12.0 5.0 8.0 16.0 15.0 11.0 11.0 5.0 5.0 5.0 2.0 2.0 2.0 2.0 2.0 1.0 2.0 10.0 REF	
			DCP Terminated at 4.9 m Depth								

GROUNDWATER: NA
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

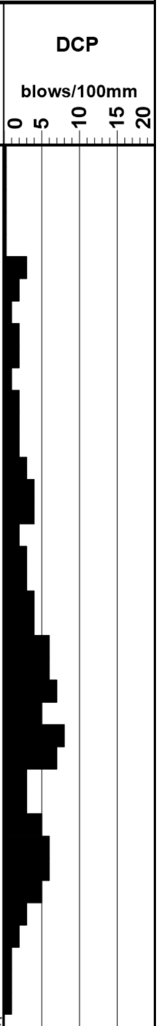
ASSESSMENT: Geotechnical Site Investigation
STRUCTURE: Visitor Accommodation
EASTING: 586389.4
NORTHING: 5558264.45

HOLE ID NO.: PT09
DATE TESTED: 25/05/2023
LOGGED BY: M. Scalisi
ELEVATION: 2.1

LOCATION: WHITEMARK WHARF- 16 Esplanade -
CLIENT: Jo Youl

EQUIPMENT: Power auger
RELATIVE NATURAL SURFACE (RL): 0

DEPTH (m)	GRAPHIC	LAYER	DESCRIPTION	DENSITY CONSIST-ENCY	MOISTURE	ELEVATION (mAHD)	SAMPLES	Cu (kPa)	UCS (kPa)	BLOW COUNT
0.0 0.5 1.0 1.5 2.0 2.5 3.0 3.5 4.0	SW		INFERRED SAND trace gravel, pale brown/yellow, well sorted, coarse grained sand, gravel 15%, fine grained, rounded	very loose to dense	Moist	2.0 1.8 1.6 1.4 1.2 1.0 0.8 0.6 0.4 0.2 0.0 -0.2 -0.4 -0.6 -0.8 -1.0 -1.2 -1.4 -1.6 -1.8 -2.0				0.3 0.3 0.3 0.3 0.3 3.0 2.0 1.0 2.0 2.0 1.0 2.0 2.0 2.0 3.0 4.0 4.0 2.0 3.0 3.0 4.0 4.0 6.0 6.0 7.0 5.0 8.0 7.0 3.0 3.0 5.0 6.0 6.0 5.0 3.0 2.0 1.0 1.0 1.0 REF



DCP Terminated at 3.9 m Depth

GROUNDWATER: NA
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.

Appendix C Core Photographs

BH01

BH02

BH03

*** 1 metre core tray length**

Foundation Maintenance and Footing Performance:

A Homeowner's Guide

CSIRO

BTF 18
replaces
Information
Sheet 10/91

Buildings can and often do move. This movement can be up, down, lateral or rotational. The fundamental cause of movement in buildings can usually be related to one or more problems in the foundation soil. It is important for the homeowner to identify the soil type in order to ascertain the measures that should be put in place in order to ensure that problems in the foundation soil can be prevented, thus protecting against building movement.

This Building Technology File is designed to identify causes of soil-related building movement, and to suggest methods of prevention of resultant cracking in buildings.

Soil Types

The types of soils usually present under the topsoil in land zoned for residential buildings can be split into two approximate groups – granular and clay. Quite often, foundation soil is a mixture of both types. The general problems associated with soils having granular content are usually caused by erosion. Clay soils are subject to saturation and swell/shrink problems.

Classifications for a given area can generally be obtained by application to the local authority, but these are sometimes unreliable and if there is doubt, a geotechnical report should be commissioned. As most buildings suffering movement problems are founded on clay soils, there is an emphasis on classification of soils according to the amount of swell and shrinkage they experience with variations of water content. The table below is Table 2.1 from AS 2870, the Residential Slab and Footing Code.

Causes of Movement

Settlement due to construction

There are two types of settlement that occur as a result of construction:

- Immediate settlement occurs when a building is first placed on its foundation soil, as a result of compaction of the soil under the weight of the structure. The cohesive quality of clay soil mitigates against this, but granular (particularly sandy) soil is susceptible.
- Consolidation settlement is a feature of clay soil and may take place because of the expulsion of moisture from the soil or because of the soil's lack of resistance to local compressive or shear stresses. This will usually take place during the first few months after construction, but has been known to take many years in exceptional cases.

These problems are the province of the builder and should be taken into consideration as part of the preparation of the site for construction. Building Technology File 19 (BTF 19) deals with these problems.

Erosion

All soils are prone to erosion, but sandy soil is particularly susceptible to being washed away. Even clay with a sand component of say 10% or more can suffer from erosion.

Saturation

This is particularly a problem in clay soils. Saturation creates a bog-like suspension of the soil that causes it to lose virtually all of its bearing capacity. To a lesser degree, sand is affected by saturation because saturated sand may undergo a reduction in volume – particularly imported sand fill for bedding and blinding layers. However, this usually occurs as immediate settlement and should normally be the province of the builder.

Seasonal swelling and shrinkage of soil

All clays react to the presence of water by slowly absorbing it, making the soil increase in volume (see table below). The degree of increase varies considerably between different clays, as does the degree of decrease during the subsequent drying out caused by fair weather periods. Because of the low absorption and expulsion rate, this phenomenon will not usually be noticeable unless there are prolonged rainy or dry periods, usually of weeks or months, depending on the land and soil characteristics.

The swelling of soil creates an upward force on the footings of the building, and shrinkage creates subsidence that takes away the support needed by the footing to retain equilibrium.

Shear failure

This phenomenon occurs when the foundation soil does not have sufficient strength to support the weight of the footing. There are two major post-construction causes:

- Significant load increase.
- Reduction of lateral support of the soil under the footing due to erosion or excavation.
- In clay soil, shear failure can be caused by saturation of the soil adjacent to or under the footing.

GENERAL DEFINITIONS OF SITE CLASSES

Class	Foundation
A	Most sand and rock sites with little or no ground movement from moisture changes
S	Slightly reactive clay sites with only slight ground movement from moisture changes
M	Moderately reactive clay or silt sites, which can experience moderate ground movement from moisture changes
H	Highly reactive clay sites, which can experience high ground movement from moisture changes
E	Extremely reactive sites, which can experience extreme ground movement from moisture changes
A to P	Filled sites
P	Sites which include soft soils, such as soft clay or silt or loose sands; landslip; mine subsidence; collapsing soils; soils subject to erosion; reactive sites subject to abnormal moisture conditions or sites which cannot be classified otherwise

Tree root growth

Trees and shrubs that are allowed to grow in the vicinity of footings can cause foundation soil movement in two ways:

- Roots that grow under footings may increase in cross-sectional size, exerting upward pressure on footings.
- Roots in the vicinity of footings will absorb much of the moisture in the foundation soil, causing shrinkage or subsidence.

Unevenness of Movement

The types of ground movement described above usually occur unevenly throughout the building's foundation soil. Settlement due to construction tends to be uneven because of:

- Differing compaction of foundation soil prior to construction.
- Differing moisture content of foundation soil prior to construction.

Movement due to non-construction causes is usually more uneven still. Erosion can undermine a footing that traverses the flow or can create the conditions for shear failure by eroding soil adjacent to a footing that runs in the same direction as the flow.

Saturation of clay foundation soil may occur where subfloor walls create a dam that makes water pond. It can also occur wherever there is a source of water near footings in clay soil. This leads to a severe reduction in the strength of the soil which may create local shear failure.

Seasonal swelling and shrinkage of clay soil affects the perimeter of the building first, then gradually spreads to the interior. The swelling process will usually begin at the uphill extreme of the building, or on the weather side where the land is flat. Swelling gradually reaches the interior soil as absorption continues. Shrinkage usually begins where the sun's heat is greatest.

Effects of Uneven Soil Movement on Structures

Erosion and saturation

Erosion removes the support from under footings, tending to create subsidence of the part of the structure under which it occurs. Brickwork walls will resist the stress created by this removal of support by bridging the gap or cantilevering until the bricks or the mortar bedding fail. Older masonry has little resistance. Evidence of failure varies according to circumstances and symptoms may include:

- Step cracking in the mortar beds in the body of the wall or above/below openings such as doors or windows.
- Vertical cracking in the bricks (usually but not necessarily in line with the vertical beds or perpends).

Isolated piers affected by erosion or saturation of foundations will eventually lose contact with the bearers they support and may tilt or fall over. The floors that have lost this support will become bouncy, sometimes rattling ornaments etc.

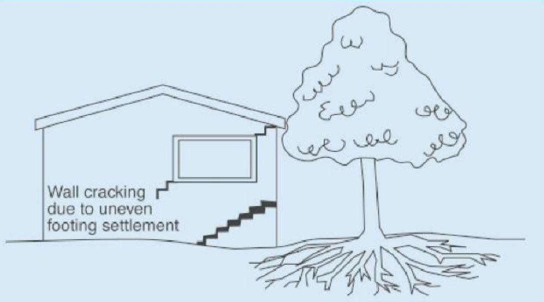
Seasonal swelling/shrinkage in clay

Swelling foundation soil due to rainy periods first lifts the most exposed extremities of the footing system, then the remainder of the perimeter footings while gradually permeating inside the building footprint to lift internal footings. This swelling first tends to create a dish effect, because the external footings are pushed higher than the internal ones.

The first noticeable symptom may be that the floor appears slightly dished. This is often accompanied by some doors binding on the floor or the door head, together with some cracking of cornice mitres. In buildings with timber flooring supported by bearers and joists, the floor can be bouncy. Externally there may be visible dishing of the hip or ridge lines.

As the moisture absorption process completes its journey to the innermost areas of the building, the internal footings will rise. If the spread of moisture is roughly even, it may be that the symptoms will temporarily disappear, but it is more likely that swelling will be uneven, creating a difference rather than a disappearance in symptoms. In buildings with timber flooring supported by bearers and joists, the isolated piers will rise more easily than the strip footings or piers under walls, creating noticeable doming of flooring.

Trees can cause shrinkage and damage



As the weather pattern changes and the soil begins to dry out, the external footings will be first affected, beginning with the locations where the sun's effect is strongest. This has the effect of lowering the external footings. The doming is accentuated and cracking reduces or disappears where it occurred because of dishing, but other cracks open up. The roof lines may become convex.

Doming and dishing are also affected by weather in other ways. In areas where warm, wet summers and cooler dry winters prevail, water migration tends to be toward the interior and doming will be accentuated, whereas where summers are dry and winters are cold and wet, migration tends to be toward the exterior and the underlying propensity is toward dishing.

Movement caused by tree roots

In general, growing roots will exert an upward pressure on footings, whereas soil subject to drying because of tree or shrub roots will tend to remove support from under footings by inducing shrinkage.

Complications caused by the structure itself

Most forces that the soil causes to be exerted on structures are vertical – i.e. either up or down. However, because these forces are seldom spread evenly around the footings, and because the building resists uneven movement because of its rigidity, forces are exerted from one part of the building to another. The net result of all these forces is usually rotational. This resultant force often complicates the diagnosis because the visible symptoms do not simply reflect the original cause. A common symptom is binding of doors on the vertical member of the frame.

Effects on full masonry structures

Brickwork will resist cracking where it can. It will attempt to span areas that lose support because of subsided foundations or raised points. It is therefore usual to see cracking at weak points, such as openings for windows or doors.

In the event of construction settlement, cracking will usually remain unchanged after the process of settlement has ceased.

With local shear or erosion, cracking will usually continue to develop until the original cause has been remedied, or until the subsidence has completely neutralised the affected portion of footing and the structure has stabilised on other footings that remain effective.

In the case of swell/shrink effects, the brickwork will in some cases return to its original position after completion of a cycle, however it is more likely that the rotational effect will not be exactly reversed, and it is also usual that brickwork will settle in its new position and will resist the forces trying to return it to its original position. This means that in a case where swelling takes place after construction and cracking occurs, the cracking is likely to at least partly remain after the shrink segment of the cycle is complete. Thus, each time the cycle is repeated, the likelihood is that the cracking will become wider until the sections of brickwork become virtually independent.

With repeated cycles, once the cracking is established, if there is no other complication, it is normal for the incidence of cracking to stabilise, as the building has the articulation it needs to cope with the problem. This is by no means always the case, however, and monitoring of cracks in walls and floors should always be treated seriously.

Upheaval caused by growth of tree roots under footings is not a simple vertical shear stress. There is a tendency for the root to also exert lateral forces that attempt to separate sections of brickwork after initial cracking has occurred.

The normal structural arrangement is that the inner leaf of brickwork in the external walls and at least some of the internal walls (depending on the roof type) comprise the load-bearing structure on which any upper floors, ceilings and the roof are supported. In these cases, it is internally visible cracking that should be the main focus of attention, however there are a few examples of dwellings whose external leaf of masonry plays some supporting role, so this should be checked if there is any doubt. In any case, externally visible cracking is important as a guide to stresses on the structure generally, and it should also be remembered that the external walls must be capable of supporting themselves.

Effects on framed structures
Timber or steel framed buildings are less likely to exhibit cracking due to swell/shrink than masonry buildings because of their flexibility. Also, the doming/dishing effects tend to be lower because of the lighter weight of walls. The main risks to framed buildings are encountered because of the isolated pier footings used under walls. Where erosion or saturation cause a footing to fall away, this can double the span which a wall must bridge. This additional stress can create cracking in wall linings, particularly where there is a weak point in the structure caused by a door or window opening. It is, however, unlikely that framed structures will be so stressed as to suffer serious damage without first exhibiting some or all of the above symptoms for a considerable period. The same warning period should apply in the case of upheaval. It should be noted, however, that where framed buildings are supported by strip footings there is only one leaf of brickwork and therefore the externally visible walls are the supporting structure for the building. In this case, the subfloor masonry walls can be expected to behave as full brickwork walls.

Effects on brick veneer structures
Because the load-bearing structure of a brick veneer building is the frame that makes up the interior leaf of the external walls plus perhaps the internal walls, depending on the type of roof, the building can be expected to behave as a framed structure, except that the external masonry will behave in a similar way to the external leaf of a full masonry structure.

Water Service and Drainage

Where a water service pipe, a sewer or stormwater drainage pipe is in the vicinity of a building, a water leak can cause erosion, swelling or saturation of susceptible soil. Even a minuscule leak can be enough to saturate a clay foundation. A leaking tap near a building can have the same effect. In addition, trenches containing pipes can become watercourses even though backfilled, particularly where broken rubble is used as fill. Water that runs along these trenches can be responsible for serious erosion, interstrata seepage into subfloor areas and saturation.

Pipe leakage and trench water flows also encourage tree and shrub roots to the source of water, complicating and exacerbating the problem.
Poor roof plumbing can result in large volumes of rainwater being concentrated in a small area of soil:

- Incorrect falls in roof guttering may result in overflows, as may gutters blocked with leaves etc.
- Corroded guttering or downpipes can spill water to ground.
- Downpipes not positively connected to a proper stormwater collection system will direct a concentration of water to soil that is directly adjacent to footings, sometimes causing large-scale problems such as erosion, saturation and migration of water under the building.

Seriousness of Cracking

In general, most cracking found in masonry walls is a cosmetic nuisance only and can be kept in repair or even ignored. The table below is a reproduction of Table C1 of AS 2870.

AS 2870 also publishes figures relating to cracking in concrete floors, however because wall cracking will usually reach the critical point significantly earlier than cracking in slabs, this table is not reproduced here.

Prevention/Cure

Plumbing
Where building movement is caused by water service, roof plumbing, sewer or stormwater failure, the remedy is to repair the problem. It is prudent, however, to consider also rerouting pipes away from the building where possible, and relocating taps to positions where any leakage will not direct water to the building vicinity. Even where gully traps are present, there is sometimes sufficient spill to create erosion or saturation, particularly in modern installations using smaller diameter PVC fixtures. Indeed, some gully traps are not situated directly under the taps that are installed to charge them, with the result that water from the tap may enter the backfilled trench that houses the sewer piping. If the trench has been poorly backfilled, the water will either pond or flow along the bottom of the trench. As these trenches usually run alongside the footings and can be at a similar depth, it is not hard to see how any water that is thus directed into a trench can easily affect the foundation's ability to support footings or even gain entry to the subfloor area.

Ground drainage
In all soils there is the capacity for water to travel on the surface and below it. Surface water flows can be established by inspection during and after heavy or prolonged rain. If necessary, a grated drain system connected to the stormwater collection system is usually an easy solution.

It is, however, sometimes necessary when attempting to prevent water migration that testing be carried out to establish watertable height and subsoil water flows. This subject is referred to in BTF 19 and may properly be regarded as an area for an expert consultant.

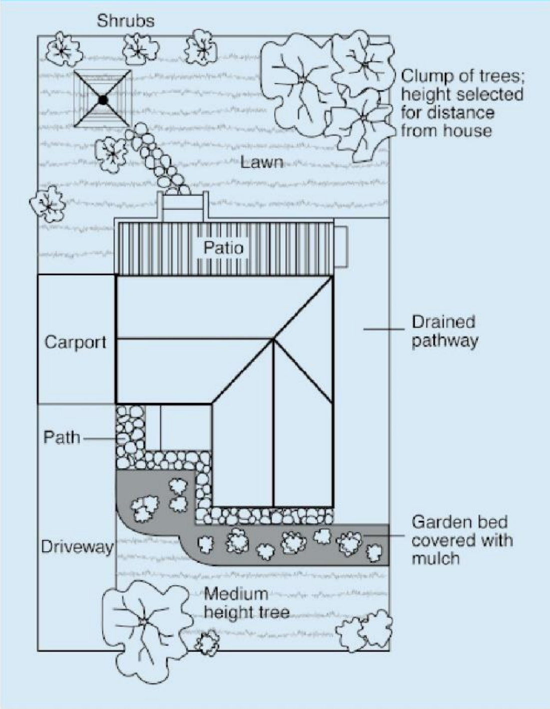
Protection of the building perimeter
It is essential to remember that the soil that affects footings extends well beyond the actual building line. Watering of garden plants, shrubs and trees causes some of the most serious water problems.

For this reason, particularly where problems exist or are likely to occur, it is recommended that an apron of paving be installed around as much of the building perimeter as necessary. This paving

CLASSIFICATION OF DAMAGE WITH REFERENCE TO WALLS

Description of typical damage and required repair	Approximate crack width limit (see Note 3)	Damage category
Hairline cracks	<0.1 mm	0
Fine cracks which do not need repair	<1 mm	1
Cracks noticeable but easily filled. Doors and windows stick slightly	<5 mm	2
Cracks can be repaired and possibly a small amount of wall will need to be replaced. Doors and windows stick. Service pipes can fracture. Weathertightness often impaired	5–15 mm (or a number of cracks 3 mm or more in one group)	3
Extensive repair work involving breaking-out and replacing sections of walls, especially over doors and windows. Window and door frames distort. Walls lean or bulge noticeably, some loss of bearing in beams. Service pipes disrupted	15–25 mm but also depend on number of cracks	4

Gardens for a reactive site



should extend outwards a minimum of 900 mm (more in highly reactive soil) and should have a minimum fall away from the building of 1:60. The finished paving should be no less than 100 mm below brick vent bases.

It is prudent to relocate drainage pipes away from this paving, if possible, to avoid complications from future leakage. If this is not practical, earthenware pipes should be replaced by PVC and backfilling should be of the same soil type as the surrounding soil and compacted to the same density.

Except in areas where freezing of water is an issue, it is wise to remove taps in the building area and relocate them well away from the building – preferably not uphill from it (see BTF 19).

It may be desirable to install a grated drain at the outside edge of the paving on the uphill side of the building. If subsoil drainage is needed this can be installed under the surface drain.

Condensation

In buildings with a subfloor void such as where bearers and joists support flooring, insufficient ventilation creates ideal conditions for condensation, particularly where there is little clearance between the floor and the ground. Condensation adds to the moisture already present in the subfloor and significantly slows the process of drying out. Installation of an adequate subfloor ventilation system, either natural or mechanical, is desirable.

Warning: Although this Building Technology File deals with cracking in buildings, it should be said that subfloor moisture can result in the development of other problems, notably:

- Water that is transmitted into masonry, metal or timber building elements causes damage and/or decay to those elements.
- High subfloor humidity and moisture content create an ideal environment for various pests, including termites and spiders.
- Where high moisture levels are transmitted to the flooring and walls, an increase in the dust mite count can ensue within the living areas. Dust mites, as well as dampness in general, can be a health hazard to inhabitants, particularly those who are abnormally susceptible to respiratory ailments.

The garden

The ideal vegetation layout is to have lawn or plants that require only light watering immediately adjacent to the drainage or paving edge, then more demanding plants, shrubs and trees spread out in that order.

Overwatering due to misuse of automatic watering systems is a common cause of saturation and water migration under footings. If it is necessary to use these systems, it is important to remove garden beds to a completely safe distance from buildings.

Existing trees

Where a tree is causing a problem of soil drying or there is the existence or threat of upheaval of footings, if the offending roots are subsidiary and their removal will not significantly damage the tree, they should be severed and a concrete or metal barrier placed vertically in the soil to prevent future root growth in the direction of the building. If it is not possible to remove the relevant roots without damage to the tree, an application to remove the tree should be made to the local authority. A prudent plan is to transplant likely offenders before they become a problem.

Information on trees, plants and shrubs

State departments overseeing agriculture can give information regarding root patterns, volume of water needed and safe distance from buildings of most species. Botanic gardens are also sources of information. For information on plant roots and drains, see Building Technology File 17.

Excavation

Excavation around footings must be properly engineered. Soil supporting footings can only be safely excavated at an angle that allows the soil under the footing to remain stable. This angle is called the angle of repose (or friction) and varies significantly between soil types and conditions. Removal of soil within the angle of repose will cause subsidence.

Remediation

Where erosion has occurred that has washed away soil adjacent to footings, soil of the same classification should be introduced and compacted to the same density. Where footings have been undermined, augmentation or other specialist work may be required. Remediation of footings and foundations is generally the realm of a specialist consultant.

Where isolated footings rise and fall because of swell/shrink effect, the homeowner may be tempted to alleviate floor bounce by filling the gap that has appeared between the bearer and the pier with blocking. The danger here is that when the next swell segment of the cycle occurs, the extra blocking will push the floor up into an accentuated dome and may also cause local shear failure in the soil. If it is necessary to use blocking, it should be by a pair of fine wedges and monitoring should be carried out fortnightly.

This BTF was prepared by John Lewer FAIB, MIAMA, Partner, Construction Diagnosis.

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CERTIFICATE OF QUALIFIED PERSON – ASSESSABLE ITEM

Section 321

Form 55

To: Jo Youl — *Owner /Agent*
16 ESPLANADE — *Address*
WHITEMARK 7255 — *Suburb/postcode*

Qualified person details:

Qualified person: Kris Taylor
Address: 162 Macquarie Street
Hobart 7000
Phone No: 036224 9197
Fax No:
Licence No: NA
Email address: office@envirotechtas.com.au

Qualifications and Insurance details: Bachelor of Science with Honours in Geology. Loyd's Underwriters $2,000,000: Coastal geomorphology and coastal erosion hazard assessments

(description from Column 3 of the Director's Determination - Certificates by Qualified Persons for Assessable Items

Speciality area of expertise: Geo-technical Reports

(description from Column 4 of the Director's Determination - Certificates by Qualified Persons for Assessable Items)

Details of work: Coastal Erosion Hazard Report

Address: WHITEMARK WHARF- 16- Esplanade
Lot No: 1
Certificate of title No: 129006/1

The assessable item related to this certificate: Coastal Erosion Hazard Report prepared by a geotechnical practitioner with experience and competence in the preparation of coastal erosion hazard reports

(description of the assessable item being certified)
Assessable item includes –
- *a material;*
- *a design*
- *a form of construction*
- *a document*
- *testing of a component, building system or plumbing system*
- *an inspection, or assessment, performed*

Certificate details:

Certificate type: Geotechnical

(description from Column 1 of Schedule 1 of the Director's Determination - Certificates by Qualified Persons for Assessable Items n)

This certificate is in relation to the above assessable items, at any stage, as part of – *(tick one)*

● building work, plumbing work or plumbing installation or demolition work

OR

○ a building, temporary structure or plumbing installation

In issuing this certificate the following matters are relevant –

Documents: Enviro-Tech Consultants Pty. Ltd. 2023. Geotechnical Site Investigation Report for a Proposed Carpark, WHITEMARK WHARF- 16 - Esplanade. Unpublished report for JoYoul by Enviro-Tech Consultants Pty. Ltd., 25/05/2023

Relevant calculations:

References:

Directors Determination - Coastal Erosion Hazard Areas Determination
-Tasmanian Planning Scheme - State Planning Provisions 2023
- Part 5 (Work in Hazardous Areas) of the Building Regulations 2016; Division 5 - Coastal Erosion

Substance of Certificate: (what it is that is being certified)

- An assessment building or demolition work in coastal erosion hazard areas in accordance with the Directors Determination
- To ensure that use or development subject to risk from coastal erosion is appropriately located and managed (TPS)

Scope and/or Limitations

Where exempt from planning, includes an assessment of tolerable risks for the intended life of the building without requiring any specific coastal erosion protection measures.

Where not exempt from planning, includes an assessment of tolerable risk from a coastal erosion event in 2100 for the intended life of the building without requiring any specific coastal erosion protection measures.

I certify the matters described in this certificate.

	Signed:	*Certificate No:*	*Date:*
Qualified person:			25/05/2023

CERTIFICATE OF QUALIFIED PERSON – ASSESSABLE ITEM

Section 321

Form **55**

To: Jo Youl *Owner /Agent*

16 ESPLANADE *Address*

WHITEMARK 7255 *Suburb/postcode*

Qualified person details:

Qualified person: Kris Taylor

Address: 162 Macquarie Street

Hobart 7000

Phone No: 036224 9197

Fax No:

Licence No: NA

Email address: office@envirotechtas.com.au

Qualifications and Insurance details: Bachelor of Science with Honours in Geology. Lloyd's Underwriters: soil and rock mechanics, soil and rock testing

(description from Column 3 of the Director's Determination - Certificates by Qualified Persons for Assessable Items

Speciality area of expertise: Geo-technical Reports

(description from Column 4 of the Director's Determination - Certificates by Qualified Persons for Assessable Items)

Details of work: Geotechnical Site Investigation

Address: WHITEMARK WHARF- 16- Esplanade

Lot No: 1

Certificate of title No: 129006/1

The assessable item related to this certificate: Geotechnical Site Investigation written in accordance with AS1726 by a geotechncial practitioner with appropriate experience, training and qualifications.

(description of the assessable item being certified)
Assessable item includes –
- *a material;*
- *a design*
- *a form of construction*
- *a document*
- *testing of a component, building system or plumbing system*
- *an inspection, or assessment, performed*

Certificate details:

Certificate type: Geotechnical including landslide risk assessment in accordance with "Practice Note Guidelines for Landslide Risk Management 2007" published by the Australian Geomechanics Society.

(description from Column 1 of Schedule 1 of the Director's Determination - Certificates by Qualified Persons for Assessable Items n)

This certificate is in relation to the above assessable items, at any stage, as part of – *(tick one)*

● building work, plumbing work or plumbing installation or demolition work

OR

○ a building, temporary structure or plumbing installation

In issuing this certificate the following matters are relevant –

Documents:

Enviro-Tech Consultants Pty. Ltd. 2023. Geotechnical Site Investigation Report for a Proposed Carpark, WHITEMARK WHARF- 16 -Esplanade . Unpublished report for Jo Youl by Enviro-Tech Consultants Pty. Ltd.,25/05/2023

Relevant calculations:

References:

- AS1726-2017 Geotechnical Site Investigations

Substance of Certificate: (what it is that is being certified)

- An assessment of:
- Foundations for proposed building structures.

Scope and/or Limitations

The Geotechnical Site Investigation applies to the Site and Project Area as inspected and does not account for future alteration to foundation conditions as a result of earth works, drainage condition changes or variations in site maintenance which are not included within the provided plans.

I certify the matters described in this certificate.

	Signed:	*Certificate No:*	*Date:*
Qualified person:			25/05/2023