REPORT

Tonkin+Taylor

Beachlands South Wastewater Marine Outfall

Preliminary Geotechnical Desk Study

Prepared for
Beachlands South Limited Partnership
Prepared by
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Beachlands South Limited Partnership	1 electronic copy
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1 Intro

1.1 Background

Beachlands South Limited Partnership (BSLP) engaged Tonkin & Taylor Ltd (T+T) to undertake a preliminary geotechnical desktop study for the proposed Beachlands South Wastewater Marine Outfall.

This preliminary geotechnical desktop study letter report sets out to present a high-level review of the inferred ground conditions for the outfall. The report also addresses the design considerations provided by BSLP.

The inferred ground conditions presented in this report are based on a review of the available land-based ground investigation data, aerial photographs, survey and the findings presented in existing reports. There has been no targeted ground investigation for the outfall and no marine ground investigation along the proposed outfall alignment to confirm the ground conditions.

1.2 Location of proposed outfall options

BSLP have provided 5 options for the outfall routes, and these options are shown on Figure 1.1. The BSLP preferred route is Option 5[1].

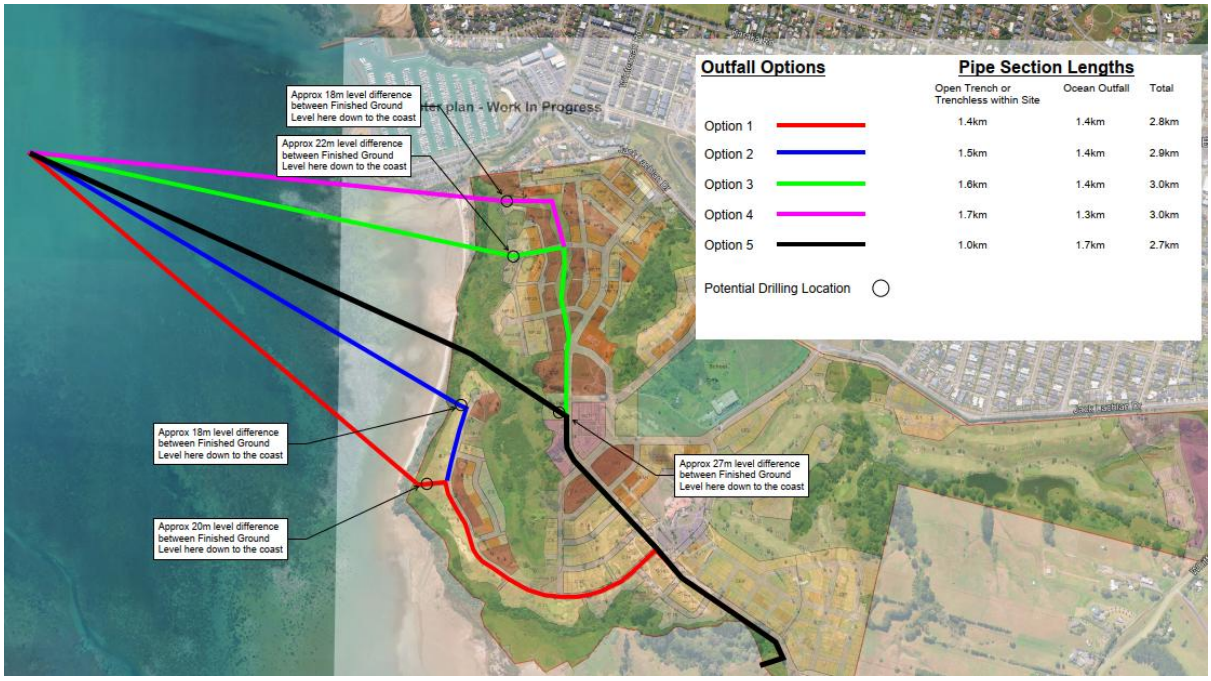

Figure 1.1: Proposed outfall options.

2 Source material

The ground investigation data, aerial photographs, survey and the data presented in existing reports reviewed in preparing this report included the following:

1 The 1:50,000 Geological Map (Earth Sciences New Zealand (ESNZ), previously GNS)

2 Historical aerial photographs (provided by Retrolens and dating back to 1939)

[1] Email titled 'Beachlands south ocean discharge outfall' from Graeme Harvey to T+T various, dated 28 April 2026

3 Google Earth images (various reference dates and particularly the December 2023 image, taken at low tide)

4 T+T aerial photographs (taken by T+T using drone footage from 2021)

5 Land based photographs (taken by T+T during various site visits)

6 Bathymetric LiDAR and bathymetric survey maps[2]

7 Recent and historic machine borehole, hand auger and cone penetrometer test ground investigations

8 Beachlands South Structure Plan Change. Water Quality & Sedimentation Modelling Report. Tonkin & Taylor Ltd. March 2022.

3 Geology

3.1 General

The ESNZ (formally GNS) 1:50,000 geological map shows the geology at the location of the proposed outfalls as East Coast Bays Formation with localised Holocene alluvial and littoral deposits on the shoreline and at the mouth of the two small streams that exit at the shoreline in the general vicinity of the proposed outfall location.

The geological map (ESNZ) shows the ECBF is overlain by Takaanini Formation north of Pine Harbour Marina.

The ECBF is exposed along the steep to moderately steep coastal cliffs on the shoreline and on the wave cut platforms extending up to 130 m in a seaward direction from the beach. This is highlighted on the drone photograph on Figure 3.1.

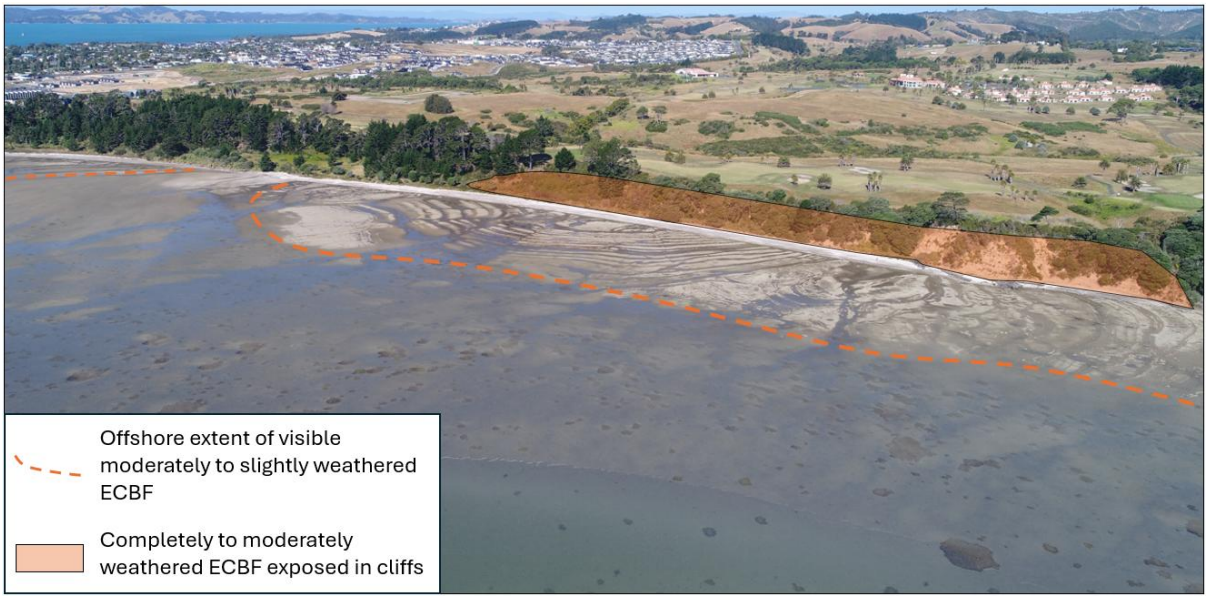

Figure 3.1: Drone photograph (T+T) of coastal exposure of ECBF.

3.2 Subsurface geology

The subsurface geology was assessed by reviewing the nearby 2025 Cone Penetrometer Tests (CPTs) and hand augers (HA). A borehole located at the north of the site (on Tui Brae cul-de-sac), drilled by Pattle Delamore Partners (pdp) in 2008, was also reviewed.

[2] Beachlands South Structure Plan Change. Water Quality & Sedimentation Modelling Report. Tonkin & Taylor March 2022

The hand augers were terminated at 5 m below ground level in residual soil and completely weathered ECBF. The residual soil is stiff to hard clay and silt, and the completely weathered ECBF is loose silty and clayey sand. Fill material consisting of reworked ECBF was also reported in the hand augers.

The ECBF rock consists of interbedded siltstone and sandstone, with bedding thickness varying from centimetres to meters. The depth to moderately to slightly weathered rock varies across the site due to variable weathering rates (due to geological structure) and earthworks associated with the development of the golf course.

The top of moderately to slightly weathered ECBF rock was inferred to be where the CPT Qc (CPT tip resistance) exceeded 20 MPa (or refusal), which can be roughly converted to a uniaxial compressive strength (UCS) of approximately 2 MPa (conservatively using Nk = 10 and not considering the impact of vertical stress). It should be emphasized, however, that CPT refusal at qc = 20 MPa may be misleading as an indicator of the top of rock, because weaker beds can occur at greater depth and may not be detected once refusal is reached.

The location of the CPTs and HA's and borehole BH2309 is show on Figure 3.2, along with the depth to inferred top of moderately to slightly weathered ECBF.

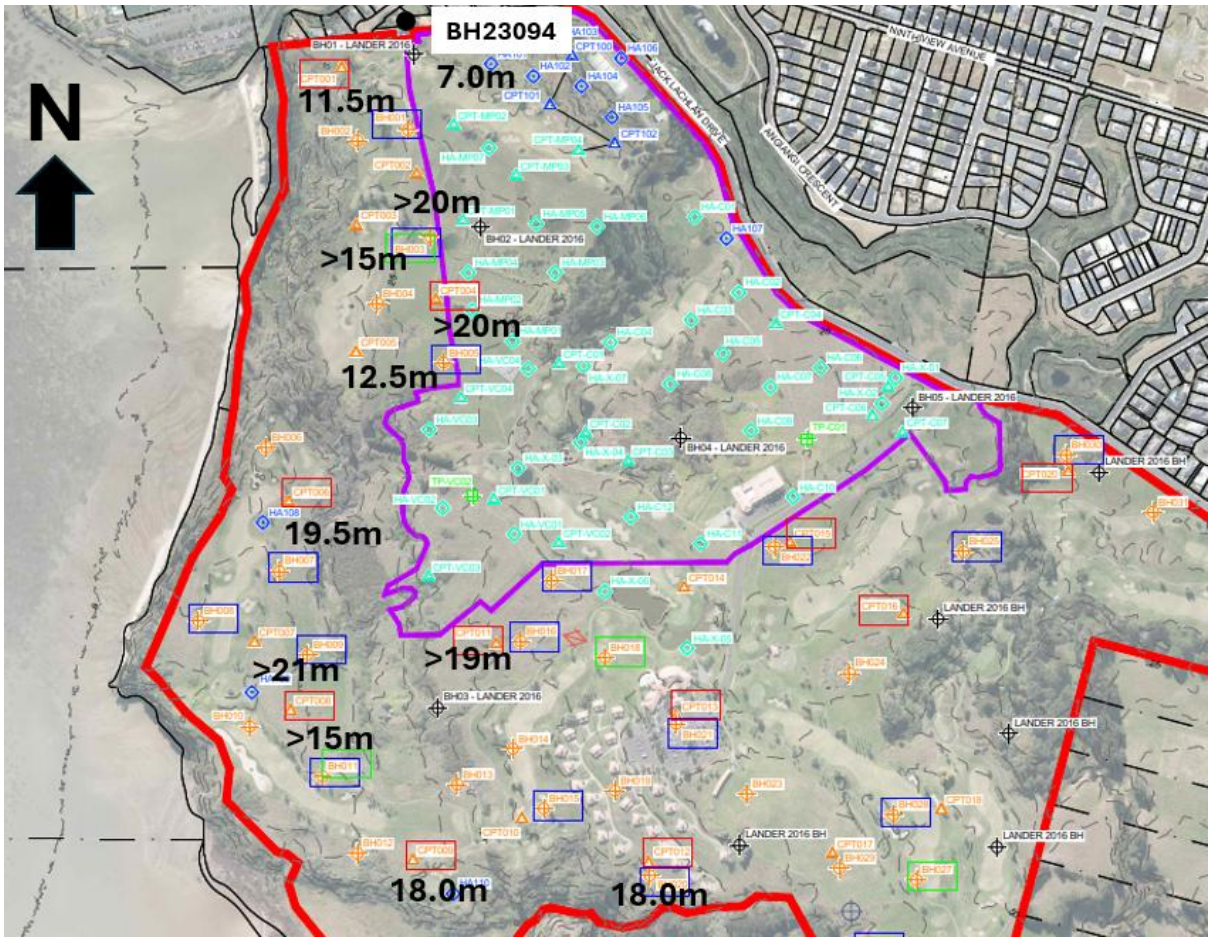

Figure 3.2: Ground investigation plan (May 2026) with depth below ground level (m) to top of moderately to slightly weathered ECBF using CPT interpretation (Qc = 20MPa) and borehole (BH23094).

The approximate New Zealand Vertical Datum (NZVD) elevation of the top of moderately to slightly weathered rock at the locations of the 9 No. CPTs and the borehole, and at the offshore edge of the wave-cut platform, is shown in Figure 3.3.

These NZVD elevation estimates are approximate, as the CPTs have not been correlated with boreholes, and the elevation of the wave-cut platform edge at low tide has been inferred solely from visual interpretation of the aerial and satellite imagery at low tide (low tide is inferred to be approximately -1.0 NZVD or 0.9 m CD).

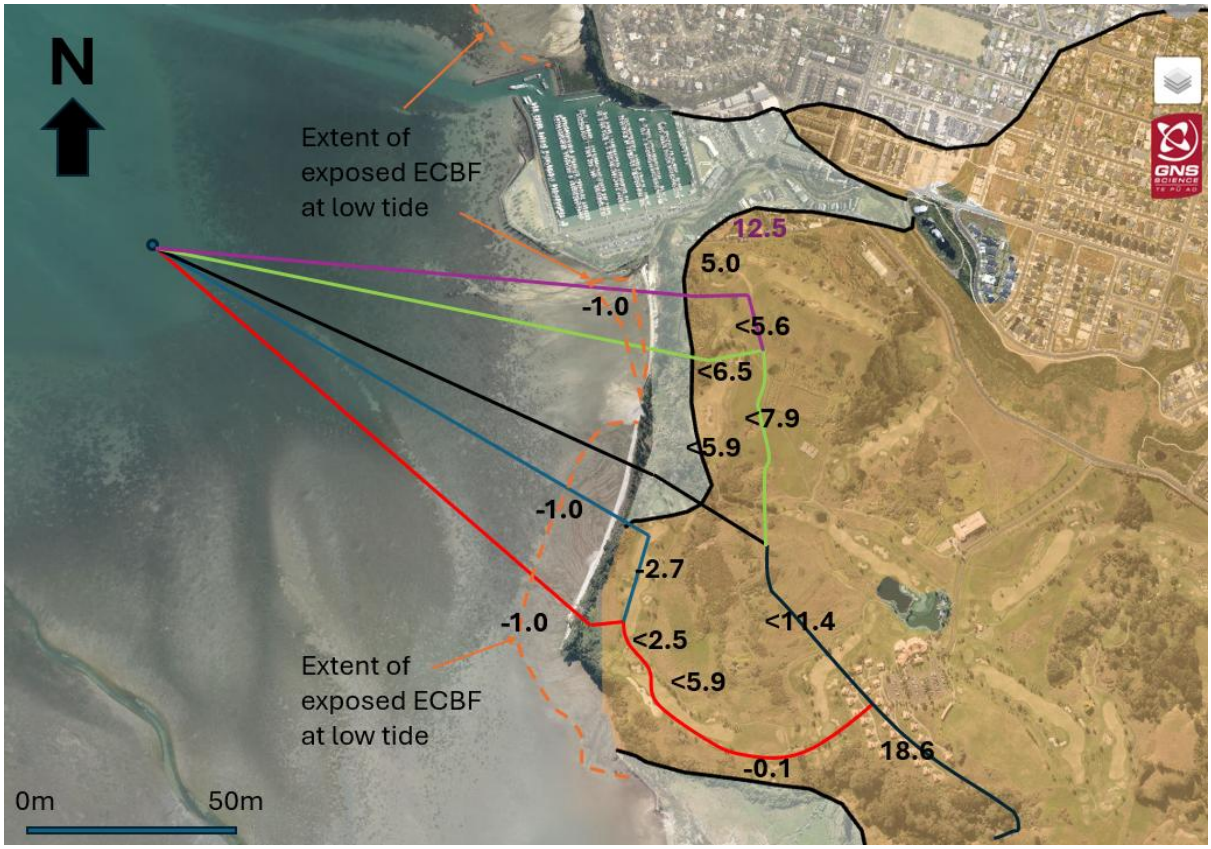

Figure 3.3: ESNZ (formely GNS) 1:50,000 geological map with coastal ECBF exposure and inferred top of moderately to slightly weathered rock elevations (NZGD16).

3.3 Seabed sediments

The likely distribution of seabed sediments along the proposed outfall options in terms of percentage silt and clay is show on Figure 3.4.

At the location of the diffuser (outfall exit) the percentage silt and clay content is between 15% to 25%, suggesting low energy soft seabed sediments. The thickness of these sediments is unknown and will require further investigation.

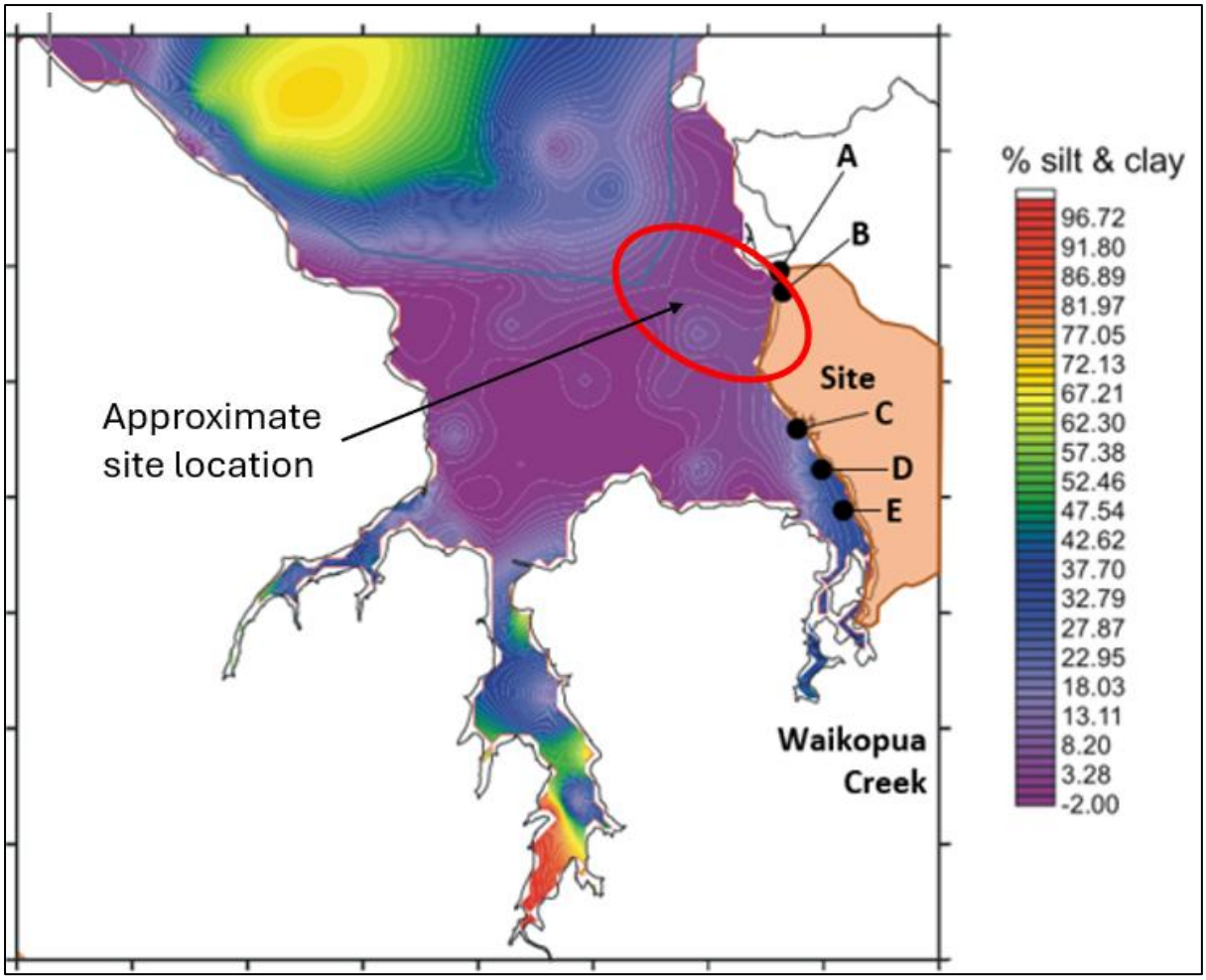

Figure 3.4: Characterised sediment types and spatial distribution (reproduced from Auckland Council, after Norkka et al, 2002).

4 Geotechnical design considerations

BSLP has indicated that Option 5 is the preferred outfall option. The inferred top of moderately to slightly weathered rock along Option 5 from the drilling location (inferred to be temporary shaft for direct pipe drive) to the edge of the ECBF wavecut platform is shown on the cross section on Figure 4.1.

At the proposed drilling location (inferred to be the temporary shaft for direct pipe drive location), the depth to moderately to slightly weathered rock is approximately 17 m. At this location, however, it would be feasible to install the thruster block by installing micro-piles, or similar, to generate sufficient resistance to drive the TBM within the residual soil / completely weathered materials (which are typically logged as stiff to hard in the nearby hand augers) at the required angle to ensure the alignment is in moderately to slightly weathered ECBF with sufficient cover at the existing shoreline. Noting, however, that the presence of small faults and persistent open joints within ECBF rock materials may result channelling drilling fluids to the surface, which may impact waterways.

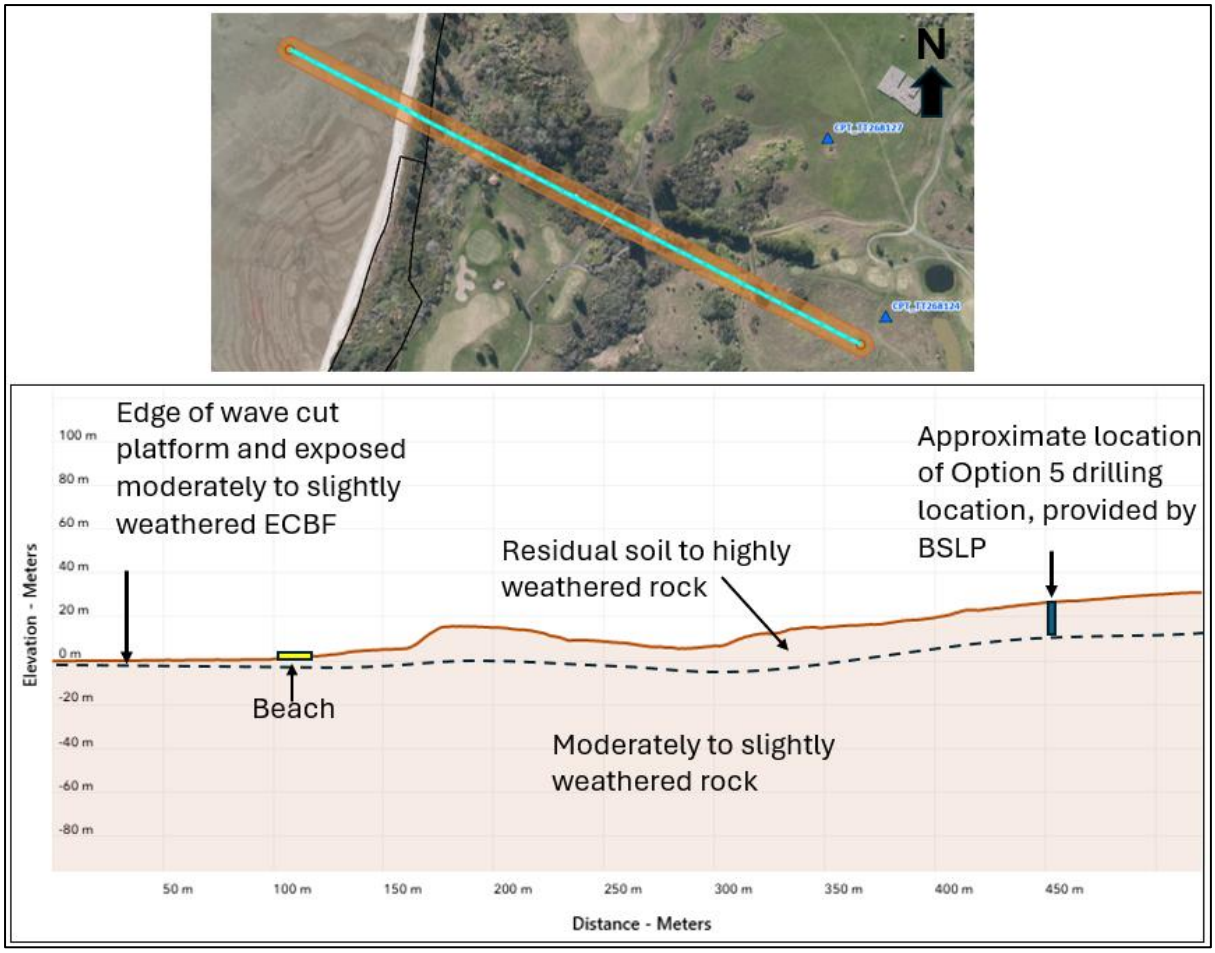

Figure 4.1: Inferred top of moderately to slightly weathered rock along Option 5, from drilling location to edge of wave cut platform.

We have not provided a cross section between the edge of the ECBF wave-cut platform and the outlet/diffuser due to insufficient ground investigation data.

4.1 Design methodology

The geotechnical design considerations have been developed on the basis that the outfall pipe option will be constructed using the following construction methodologies:

- Open trench methods on land, or
- Direct drive methods (microtunnelling using TBM) from the proposed drilling location (inferred to be temporary shaft for direct pipe drive);
- Excavation methodologies required to launch and extract the TBM; and
- Driven pile methodologies to secure the diffuser (the requirement for the stabilisation of the diffuser will be dependent on the stability of seabed materials).

A commentary of the design options is provided in Table 4.1.

The following table is based on the options provided by BSP and these options are shown on Figure 1.1.

Table 4.1: Commentary on the various design options provided by BSP

Outfall option	Surface elevation (m RL) at potential drilling location as shown on Figure 2.1	Pipe section lengths (km) – these lengths are inferred to be approximate			Approximate elevation of top of rock at drilling location (m RL)	Comments
		Landside	Ocean	Total		
1	20	1.4	1.4	2.8	Deeper than 2.5	1. The potential drilling locations are close to the coast and will require a deep shaft for TBM launch 2. Open trenching to the drilling location from the land side will require deep trenches in residual soil and completely to highly weathered ECBF, which will require considerable stabilisation and a potentially large excavation footprint
2	18	1.5	1.4	2.9	-2.7	
3	22	1.6	1.4	3.0	Deeper than 6.5	
4	18	1.7	1.3	3.0	3.0	
5	27	1.0 (+0.4)	1.7 (-0.4)	2.7	~10.0	1. The potential drilling location is in approximately 15 – 20 m of residual soil to highly weathered rock, overlying moderately to slightly weathered rock 2. It is considered feasible to install the thruster block within the residual soil / completely weathered materials and drive the TBM at the required angle to achieve sufficient elevation to be in moderately to slightly weathered at the existing coastline 3. Provides the shortest open trench 4. To the north of the proposed route on the landside there is a small stream which may be associated with poor ground. It may be preferred to realign the route towards the south and away from the stream

4.2 Further construction considerations

It is inferred that the majority of the construction works offshore will be through moderately to slightly weathered ECBF.

The following matters will need to be considered:

1 Risk of fluid frac-out (drilling fluid) from insufficient cover.

2 Risk of fluid frac-out from high angle discontinuities channelling drilling fluids to surface and into water channels or water courses.

3 Direct Pipe advancing through variable weathering profile within ECBF materials causing sudden changes in material characteristics and strength.

4 Uncertainty around the seabed surface material at the outlet / diffuser.

5 Uncertainty around the depth of rock near the outlet / diffuser.

5 Statement of qualifications and experience

My name is Mark Robertshaw Thomas. I am a Chartered Professional Geotechnical Engineer and Senior Principal at Tonkin & Taylor Limited (T+T), an environmental and engineering consultancy firm.

I have a BE (Hons) from the University of Auckland. I have 25 years post-graduate experience in geotechnical and civil engineering and am a member of Engineering New Zealand and the Geotechnical Society of New Zealand. Recent projects and services relevant to this engagement include:

i Geotechnical Design Manager for the Piritahi Auckland Housing Programme (more recently rebranded as “Lead Alliance”), covering residential redevelopment of large areas within Auckland City;

ii Lead Geotechnical Engineer for Commercial Bay and interfacing with the CRL tunnels that pass through it;

iii Geotechnical Project Director for large central urban developments (the proposed Mission Bay and Devonport redevelopments);

iv Geotechnical Expert and Project Director for several Watercare wastewater upgrades (Motions CC2, Kelmarna – Grey Lynn, Herne Bay, Avondale CC6, Hingaia);

v Geotechnical Project Director for the Hunua Quarry Expansion Fast Track application;

vi Geotechnical Project Director for the Beachlands South subdivision;

vii Geotechnical Design Manager for Waterview Connection surface works;

viii Project Director for 29 properties within the Kainga Ora Wellington Region Housing programme;

ix Design Manager and later Project Director for remediation of the large Rawene landslide in Birkenhead, Auckland;

x Project Director, civil and geotechnical works for Stages 1 and 2 of the St Ignatius of Loyola Catholic College in Drury; and

xi Geotechnical Project Director for Parklands Estate Area 4 subdivision, Napier.

I confirm that I have read the Code of Conduct for expert witnesses contained in the Environment Court of New Zealand Practice Note 2023 and that I have complied with it when preparing this report. Other than when I state I am relying on the advice of another person, this report is within my area of expertise. I have not omitted to consider material facts known to me that might alter or detract from the opinions that I express.

6 Applicability

This report has been prepared for the exclusive use of our client Beachlands South Ltd Partnership, with respect to the particular brief given to us and it may not be relied upon in other contexts or for any other purpose, or by any person other than our client, without our prior written agreement.

We understand and agree that our client will submit this report as part of an application under the Fast-track Approvals Act 2024 and that an Expert Panel as the consenting authority will use this report for the purpose of assessing that application. We understand and agree that this report will be used by the Expert Panel in undertaking its regulatory functions.

Tonkin & Taylor Ltd

Report prepared by:

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Willy Roberts
Principal Engineering Geologist

Authorised for Tonkin & Taylor Ltd by:

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Mark Thomas
Project Director

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