PATEA BEACH
SAND MANAGEMENT REPORT

January 2021 to May 2022

A report prepared for the South Taranaki District Council

By Dr Roger D Shand

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TABLE OF CONTENTS

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1. BACKGROUND

Patea Rivermouth is controlled by stone jetties (moles) which were completed in 1921 and have resulted in shoreline accretion and dune formation along 900 m of the northern coast (see Figure 1). Because of the physical characteristics and processes operating in this area the potential for dune instability is very high. Some ongoing management will always be required if the beach settlement and other assets sited downwind are to avoid potential sand hazards (wind-blown sand nuisance and burial) as occurred in the mid-1950s and late 1980s. This history, including more recent management initiated by the South Taranaki District Council (STDC) is described in Appendix B. In recent years, green waste has been used extensively in sand stabilisation programs under Taranaki Regional Council (TRC) *resource consent 6088* (copy included as Appendix A1) which permits the STDC to discharge domestic green waste onto land on the northwestern side of the Patea Rivermouth for the purpose of sand stabilization. This consent was reviewed and reissued in June 2010 and June 2016. It expires in June this year and a renewal application has been submitted to the TRC. The STDC also issued a land use consent *RML 070115* which is still active - a copy is included as Appendix A2.

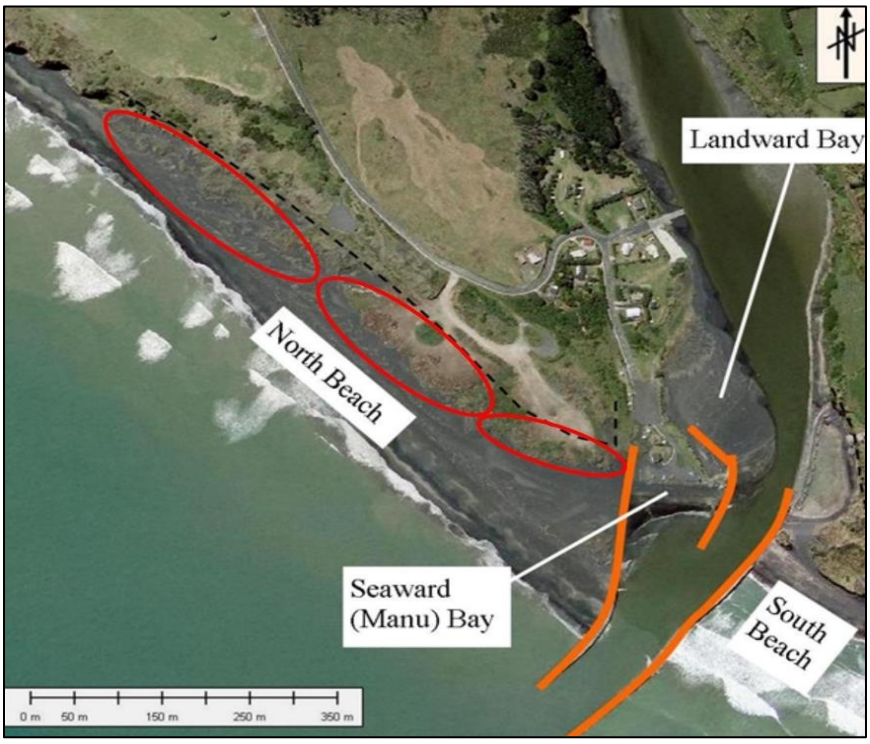

Figure 1 Location map depicting river control structures (moles and guidewall) in orange, the pre-colonial cliffline (dashed black line), and the red ellipses denote the three management sectors (north, central and south) which have required different sand stabilization approaches.

Annual reports were prepared on the sand stabilization on the northern coast between 2010 to 2019. A brief stabilisation report issued in July 2020 (see Appendix C). This current report covers 2021 to the present (May, 2022).

Section 2 describes the condition of the site, referred to at times as the "green waste site"; during the later 1990s and up until 2017 it was a free of charge green waste dump for Patea residents. Section 3 describes the revised monitoring plan along with results of recent monitoring carried out in December 2021 to February 2022.

Section 4 discusses management including green waste placement and drainage, while Section 5 discusses reviewing the 2007 Patea Beach Management Plan. Section 6 is a summary containing recommendations.

2 SITE CONDITION

Beginning in 2010-11, wave erosion had been impacting affecting the base of the (fore)dune and a sand cliff (scarp) characterized the topography. The annual monitoring record indicated this erosion episode was beginning to abate in 2019 and the photo comparison in Figure 2 (Oct 2019 with Dec 2021) shows vegetation on the scarp and a widening beach between the high tide line and the dune toe which is a further indication of shoreline stability returning. This is elaborated upon in the monitoring section (3).

However, while the base of the dune is stablising, wind erosion continues to affect the upper dune and this has led to severe erosion near the rivermouth lookout (at the eastern end of the green waste site and marked in Figure 4). Of particular significance is Site D (location in Figure 8), and monitoring had shown the erosion worsening over several years from 47 m^2 of bare sand in 2016 to 1559 m^2 in 2019. In May 2021 the area had reduced to 1314 following placement of 100 m^3 of green waste in the gut (blowout) at the crest of the dune in June 2020 (see Figure 4, Appendix C). The spatial reduction was also coupled with lesser winds from with a positive ENSO[1].

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1 Explaining/predicting weather regimes are assisted by the El Niño/La Niña cycle (collectively known as El Niño-Southern Oscillation or ENSO). At Patea, positive ENSO or La Nina conditions tend to have easterly quarter winds and higher rainfall, while negative ENSO or El Nino conditions have strong W-SW winds and low rainfall. It is noted that the present ENSO index range of 0 to 33.6 (mean 9.1), are the highest values since 2010. Such a positive index corresponds to lighter prevailing winds, so the more recent wind erosion on the upper dune is mild compared to what would have been the case under a negative index or even a neutral wind regime. This illustrates the controlling effect morphology can have an airflow dynamics and the need to respond to developing instabilities.

Figure 2 The continuous erosion scarp in late 2019 (upper photo) with the high tide intersecting the dune toe indicating a sand deficit on the beach and hence exposure of the dune to wave erosion. By comparison, in late 2022 (lower photo) vegetation mantles the scarp as the slope stabilises. Clumps of vegetation have slide downslope (rafted) as the slope adjusts toward the stable angle of repose. Note the debris between the high tide line and the base of the dune – indicating a recovery in the volume of beach sand and this protects the base of the dune from further wave erosion.

However, by the end of 2021 the area landward of the June 2020 placement had undergone significant erosion (Figure 3) and further placement of green waste was required. This placement was carried out in late April 2022 and is described in Section 4.2. In addition, the road accessway and stormwater drainage were impacted and this is described in Section 4.3.

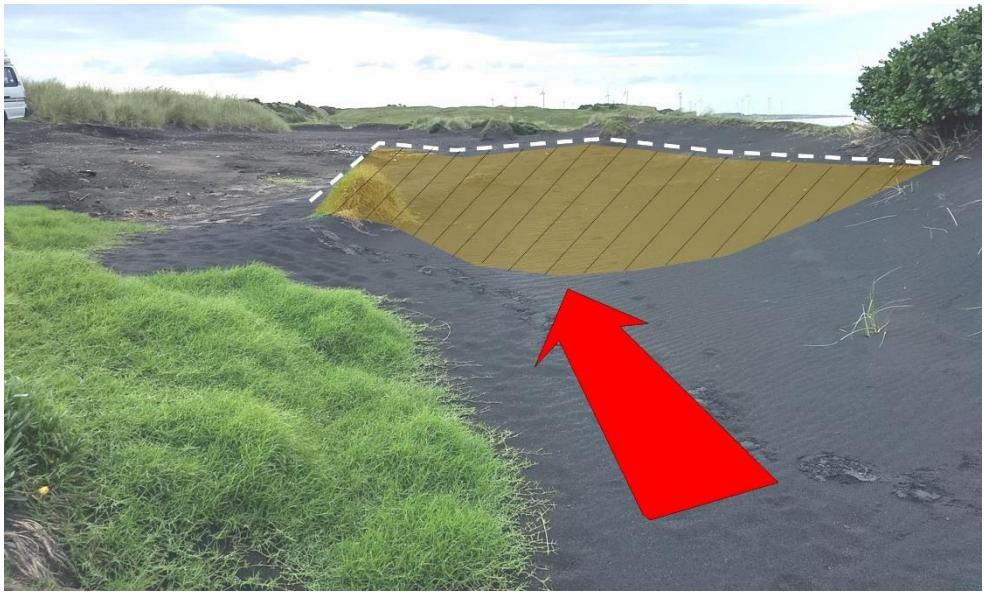

Figure 3 Erosion at Site D in December 2021 was undermining the rivermouth lookout car park (location marked in Figure 4), destroying the local stormwater drainage channel, and was about to impact the dune face just beyond right side of photo. Arrow denotes predominant wind direction while white dashed line and light yellow are denote the 2019 surface and vertical erosion extent (also see Figure 8).

3 MONITORING

3.1 Introduction

The following three types of monitoring are carried out as part of the TRC resource consent and 2007 Patea Beach Monitoring Plan (which the resource consent gives effect to):

Site inspections (undertaken by CSL) to define erosion/burial areas and thus the need for, and location of, future green waste placements, plantings and hazard mitigation measures;

Profile surveys: undertaken by surveyors Taylor Patrick Ltd (TPL) since 2007 to define shoreline and foredune erosion using a series of cross-shore profiles, and

Vertical aerial photography: Imagery of the entire site to define, in particular, upper-dune wind erosion and wind-drifting to landward. Originally this survey was undertaken by Laurie Cairns Aerial Photography Ltd using a fixed wing aircraft. However, since 2016, Taylor Patrick Ltd have operated a drone and this year LandPro used a fixed wing aircraft.

Section 2.4 and 2.5 of the Patea Beach Management Plan require profile surveys every 2 years and aerial imaging every 5 years. Nine transects (profiling lines) were monitored (numbered 1-9). However, the unprecedented erosion from 2010 until 2019 resulted in more frequent (yearly) monitoring and additional sites were established inside the inlet (#20-23) also one on the South Beach (#30) to better track the episode and to identify and if necessary manage, any impacts. With the erosion episode now passing the original two yearly profile monitoring and five yearly aerial/drone photography have resumed.

Last year the STDC districtwide coastal monitoring programme was reviewed[1] after the TRC required measurement-based monitoring be carried out for resource consentfor all the coastal structures at Patea. Consequently, profile line #1 on the north coast together with inlet profile lines 20-23 and South coast profile line 30 will now be monitored as part of the wider monitoring programme, and only 2 to 9 for the green waste/sand management programme/consent.

3.2 Site inspections undertaken by CSL

8 May, 2021	Assessed required stabilisation works and took aerial (drone) photos of Site D.
13 Dec 2021	General site inspection
4 Feb 2022	Met with STDC officer Mr Herbert Denton on site. Confirmed green waste placement urgently required. Report also required to include summary of site conditions since January 2021. Should also discuss the need for a Patea Beach Management Plan Review, green waste sourcing and future contractors. Also carried out full site inspection in preparation to green waste placement.
26 Apr 2022	Supervised McCole contractors placing green waste, and restoring drainage network

1. Coastal Monitoring Review. 2021. A report prepared by Coastal Systems Ltd for the STDC. CSL client report 2021-9.

3.3 Profile surveys undertaken by TPL

Profile surveys were carried out on 7/8 December 2021 and the 7 profiles surveyed (2, 3, 3A, 4, 6, 8, 9) are located in Figure 4. In future, profiles 3A, 6 and 9 will be excluded unless a significant episode of instability reoccurs. (These 3 were to be excluded from the December survey but were inadvertently included). Other profile lines within the inlet (7), along the south beach (3) and on the north beach near the mole (1) were also surveyed at the time, but these will be reported elsewhere as they are part of the Coastal Structure Monitoring programme.

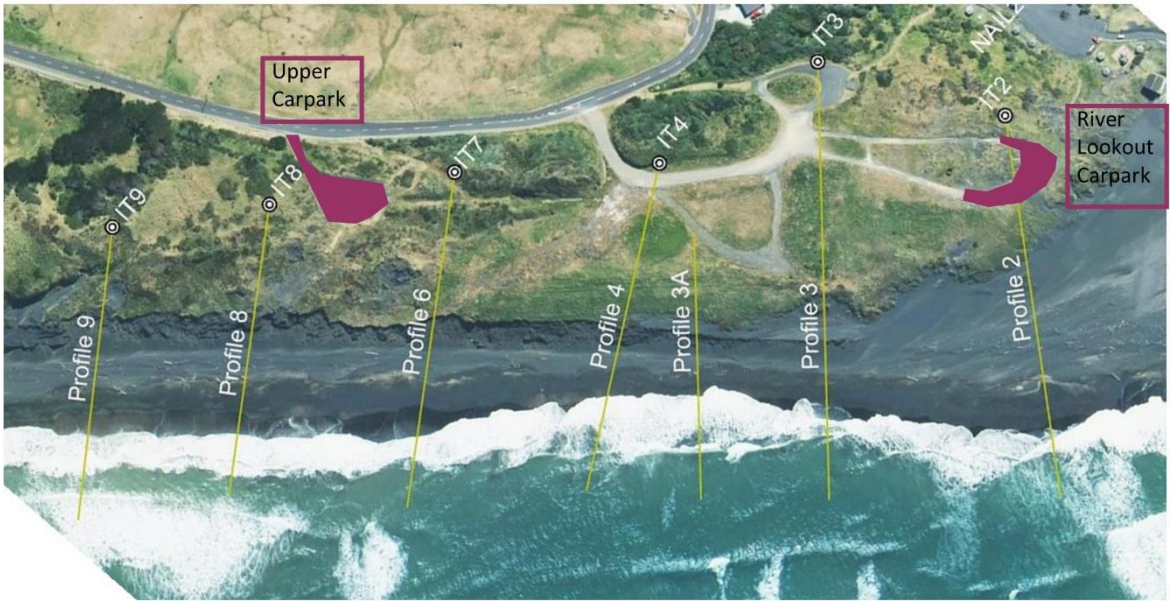

Figure 4 Profile line locations and finder benchmarks surveyed by TPL on 7/8 December 2021.

Time-series line graphs for the dune toe (MSL +4 m) and mid dune face (MSL +10 m) extending back to 2007 are depicted in Figure 5. The MSL +4m elevation has clearly moved seaward in the northern sector (lower graphs). The superimposed set for profile 9 is shown in Figure 6 and confirms the onset of accretion and accompanying buildout of the beach. Stability of the lower dune in the central section further supports an end of the decade long episode of erosion. In addition, the relative stability of the upper dune (MSL +10 m) indicates slope adjustment is progressing smoothly and this is considered further in the following section on aerial data. While recent data for the southern sector closer to the rivermouth (profile 2) shows erosion at the lower level (MSL +4m), which could be associated with the southern translation of the erosion episode, it may equally be associated with rivermouth behaviour which tends to be erratic.

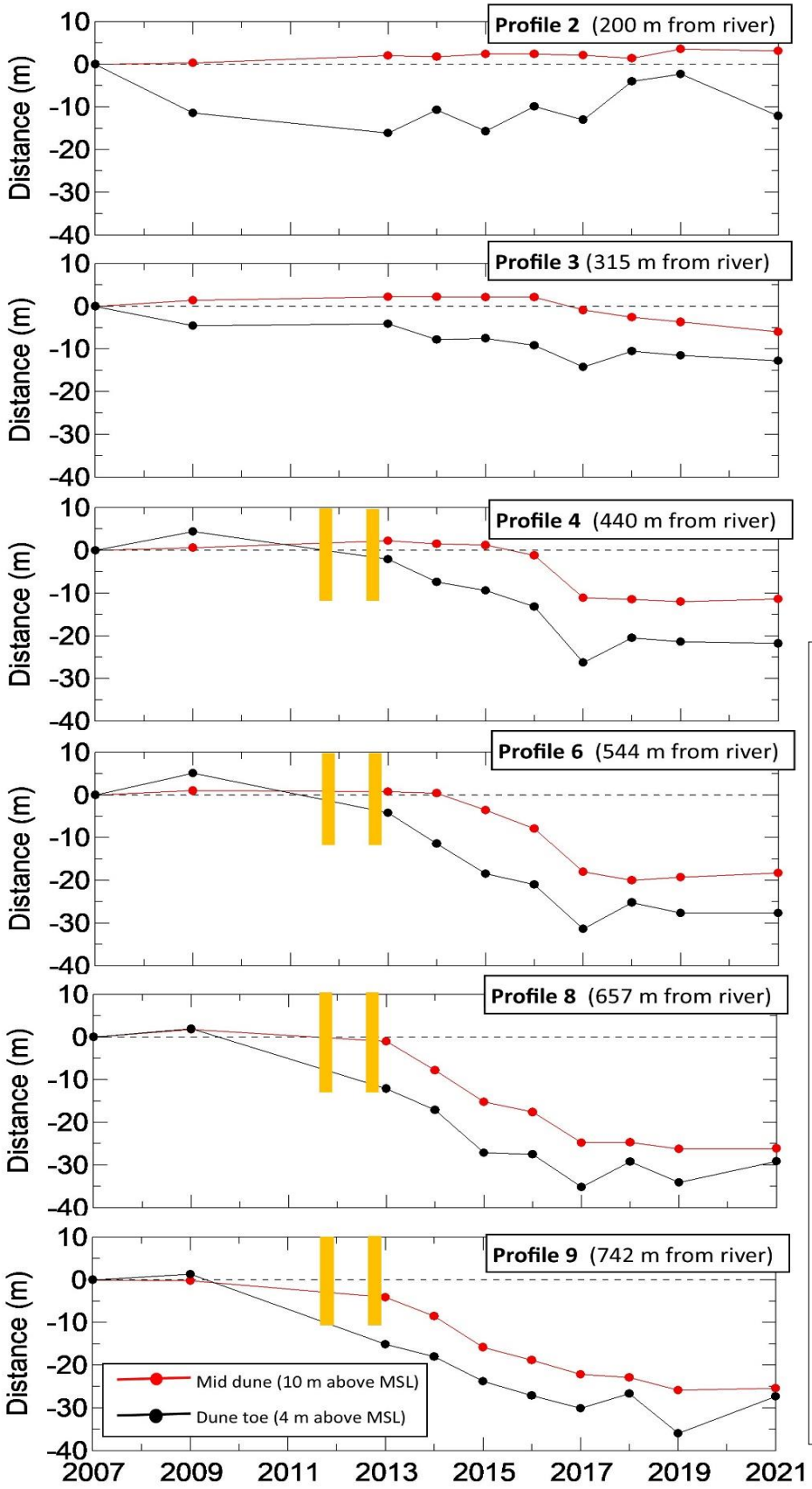

Figure 5

North Beach cross-shore change at the profile locations marked in Figure 4. Note that change is relative to the first survey in 2007.

Positive values=accretion

Negative values=erosion

The dune toe (MSL +4m) is represented by **black line** and mid/upper foredune face (MSL +10 m) by the **red line.**

The vertical **orange bars** mark initial observations of foredune erosion in October 2010 and June 2011.

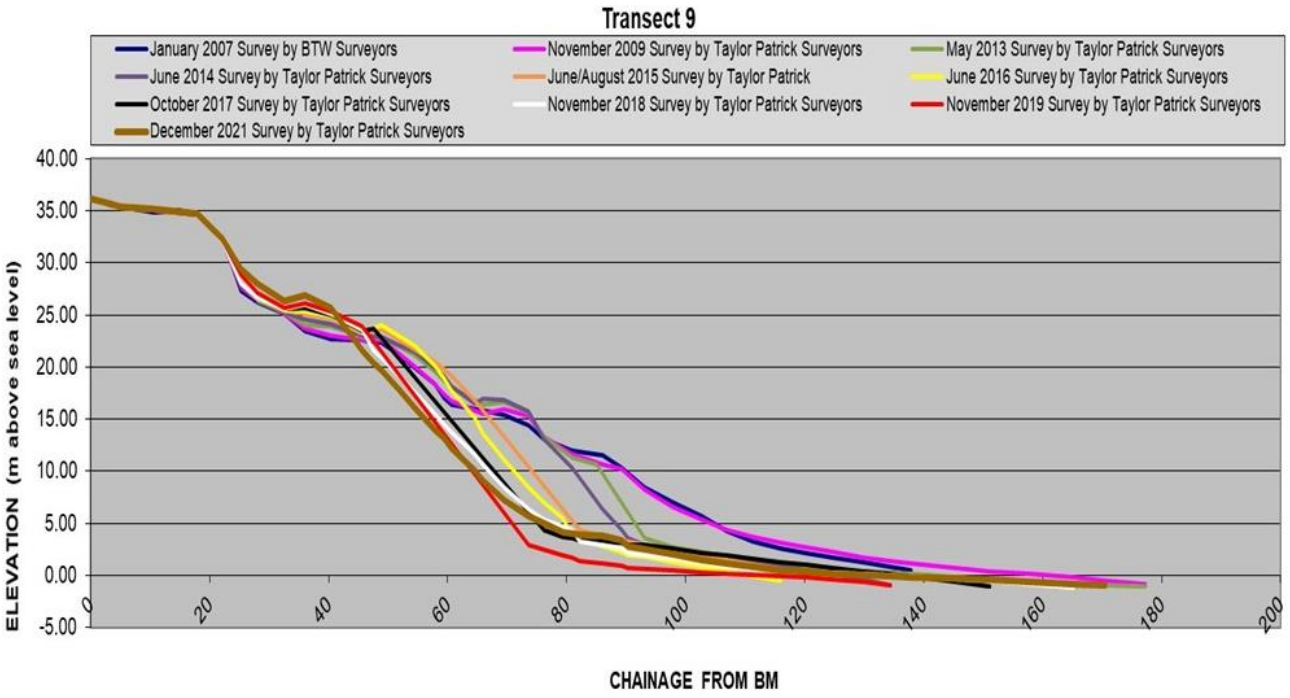

Figure 6 Superimposed profiles for the northernmost transect (9) with the most recent profile Dec 2021 brown line) showing significant infill at the dune base and buildout of the beach compared with the 2019. This figure also clearly illustrates the extent of the decade long erosion episode with, for example, the 5 m elevation (approximate dune toe) having retreated some 34 metres.

3.4 Aerial photography and LIDAR undertaken by Landpro Ltd

Aerial photography and LIDAR surveys were carried out on 14 January, 2022 using a fixed wing aircraft. The coast and inlet were captured at ~5 cm accuracy (vertical and horizontal). The aerial imagery is here used to define the vegetation/bare-sand boundary thus enabling erosion/deposition of the upper dune to be identified (see Figure 7). Three vegetation lines are marked in Figure 7: purple is the pre-erosion episode line, brown is the present 2022 line, and red is the previous aerial survey of 2019. For much of the northern and central coast the current sand-vegetation boundary is somewhat seaward of the 2019 boundary: this relates to down-slope movement of clumps of existing vegetation – this "rafting" process enables the original steep erosion scarp to attain a lesser and more stable angle. Of note is the vegetation boundary fronting the upper carpark (circled in Figure 7). This area is particularly unstable, possible due to continual disturbance by pedestrian traffic. It was successfully stabilised with green waste during the June 2020 placement, but has since been reactivated and further stabilisation may be required. There are also isolated locations further north (marked with asterisks in Figure 7) where wind erosion is destabilising the landward vegetation and these will require ongoing inspection.

The problematic Site D is infilled black in Figure 7. This 1260 m^2area of bare sand contains some erosion and some deposition. Comparing this value to 1559 m^2 in 2019 and 1314 in May 2021 indicates the instability is becoming less active. However, the reduction is associated more with benign weather (discussed earlier in Section 2) when vegetation is able to spread. In addition, an area of severe surface erosion has occurred landward of the placement made in June 2020 (and illustrated in Appendix C). This erosion is defined by long section and cross section comparisons depicted in Figure 8. Over 1 m of surface lowering has occurred and this process would result in destruction of the accessway/car park and the seaward dune face with wind-blown sand ramifications for the settlement beyond if not arrested. At the time of the February 2022 site inspection and decision to undertake a green waste placement, however, there was insufficient green waste available at the Transfer Station. This situation is described in the following section (4.2).

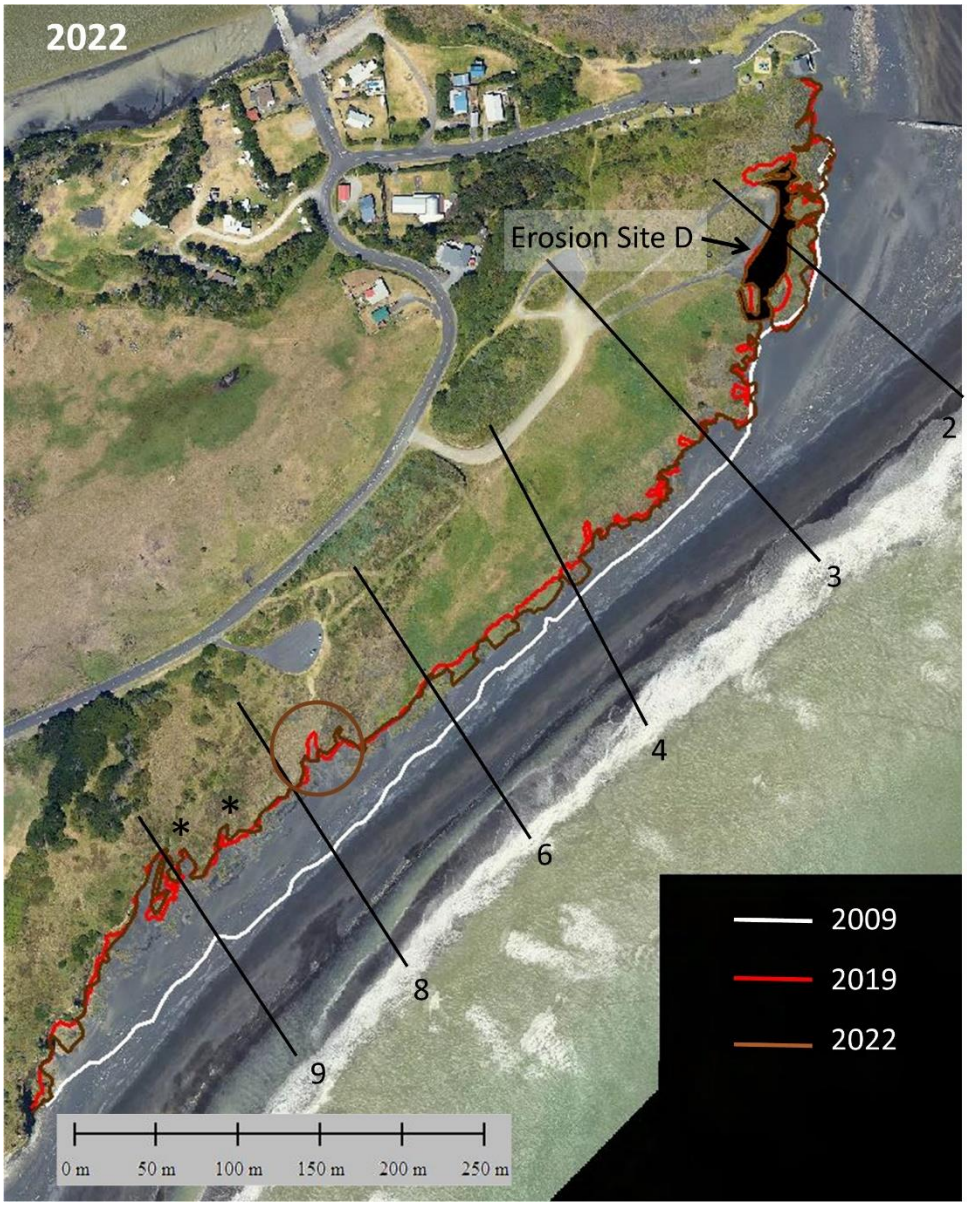

Figure 7 Vertical aerial photo taken on 14th January 2022 and overlain with vegetation-fronts from 2009 (before the erosion episode began), 2019 and 2022. Profile lines are marked 2 to 9. Brown circle locates instability fronting the upper car park which may need further treatment, and asterisks locate unstable areas further north which may need treatment in the future.

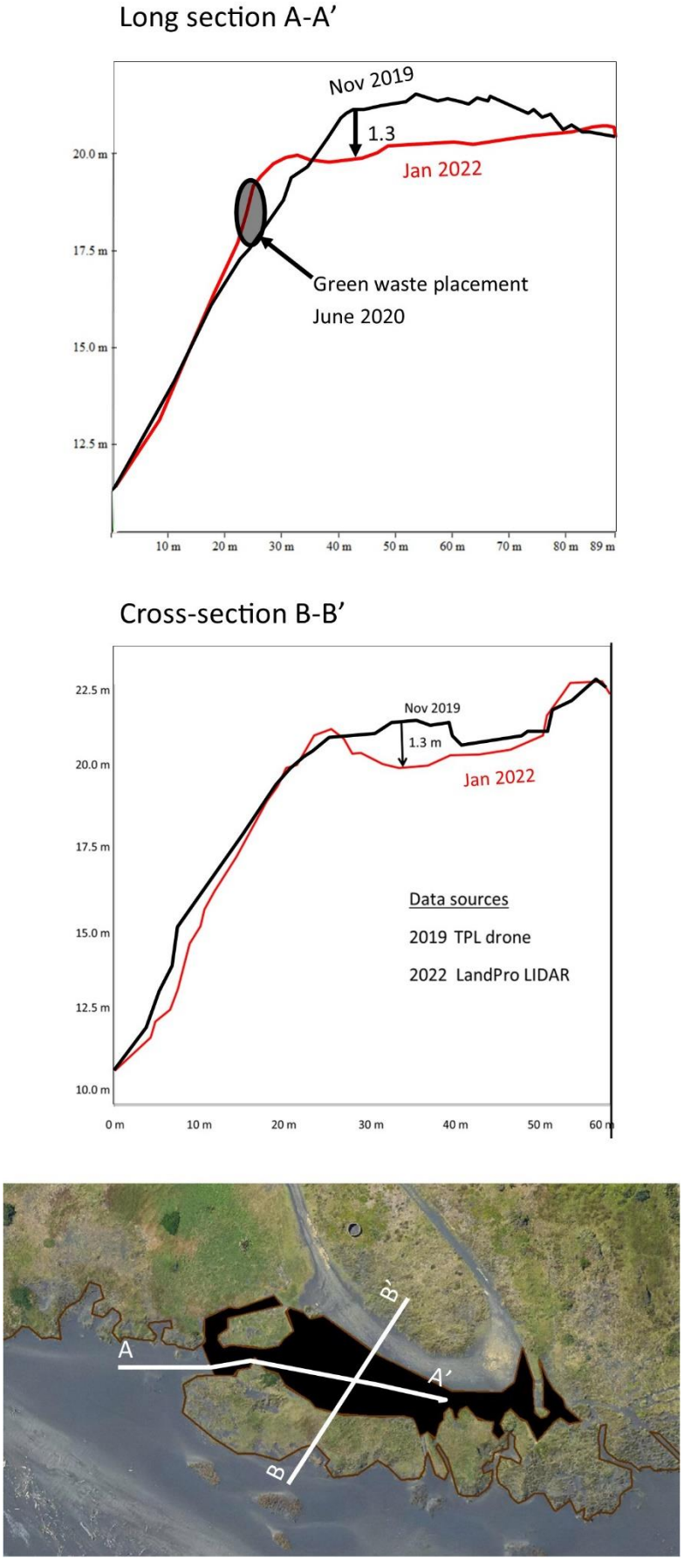

Figure 8 Erosion Site D surface behaviour between November 2019 and January 2022, thus incorporating the June 2020 green waste placement. Top figure depicts the long section (A-A') comparison with placement parked. Central figure depicts cross section at B-B'. Sources: TPL drone Digital Surface Model data (2019) and Landpro LIDAR (2022)

4. MANAGEMENT

4.1 Administration

In February 2017 the green waste dump site was closed with users directed to the nearby Patea Transfer Station. The council also resolved that green waste would be diverted to the Patea Beach dunes as required to maintain sand stability. However, residents have been reluctant to use the Transfer Station. For example, input between 17 June 2020 and 4 Feb 2022 was only 150 m^3, this equating to 0.25 m^3/day, compared with an average rate of 22 m^3 day at the dump site before its closure !

Earth works and green waste placement for the STDC at Patea Beach is carried out by Noel McColl of McColls Contracting Ltd. With Noel approaching retirement, his projects will likely be taken over by his grandson Hayden McColl who at present operates his own earthmoving company focusing on roading and forestry. He employs several staff. Haden carried out the April 2022 placement. My past experience with Hayden is that he is a competent and skilled operator, and will provide good and reliable future service at the site.

4.2 Green waste

While there was a growing need to place green waste at site D during 2021, there wasa lack of available material at the site upon inspection on 4 February 2022. It was decided that Mr Denton would try to have waste imported from other transfer station under emergency provisions to bypass resource consent restrictions. However, this was not required as a week later an extreme storm event hit and district and the council opened the transfer station for a week of free green waste drop-off. This resulted in an additional 350 m^3 boosting the stock pile to 500 m^3. Placement was carried out on 29 April 2022 , with the very satisfactory result shown in Figure 9. Once the waste settles, planting of marram may be required if the surrounding kikuyu is unable to provide ground cover fast enough.

It had been hoped to also deposit green waste in the dune fronting the car park on 29 April (location is circled in Figure 7 and referred to as Site I in the 2019 Annual Report as well as in earlier reporting). Foot traffic appears to contribute to the ongoing sand instability at this site. However, on 29 April all the waste was needed at Site D. Ongoing inspection will be made of the upper car park site (I).

Figure 9 Green waste placement made on 29-4-2022 at Site D. The top photo shows green waste filling the gut at the dune crest filled with green waste, while the lower photo shows green waste infilling the landward erosion area illustrated in Figure 3.

4.3 Vehicle Accessway and Stormwater Drainage

As noted earlier in Section 2, the Site D erosion had compromised the road access and surface stormwater drainage system. If left unchecked this situation could rapidly form guts on the dune face and significantly increase wind erosion, potentially becoming hazardous to the beach infrastructure, situations which had occurred in the past. Figure 10 shows the existing surface drainage regime. However, the bund close to the O (which happens to be an old water tank) had become ineffective and stormwater was reaching the Site D dune face. The other bunds, designed to intercept and disburse stormwater within well vegetated dune hollows, had subsided through vehicle compaction, and other arrowed exits were inoperable due infill by wind-blown sand.

Maintenance was therefore also carried out on the 29th April during the green waste placement. While this will avert the immanent risk of stormwater erosion, the accessway and bunds urgently needs replenishing with metal. Hayden McColl suggested "road digout" material could be trialed as this will bind together due to some bitumen being present. He also offered his time free of charge to place this material.

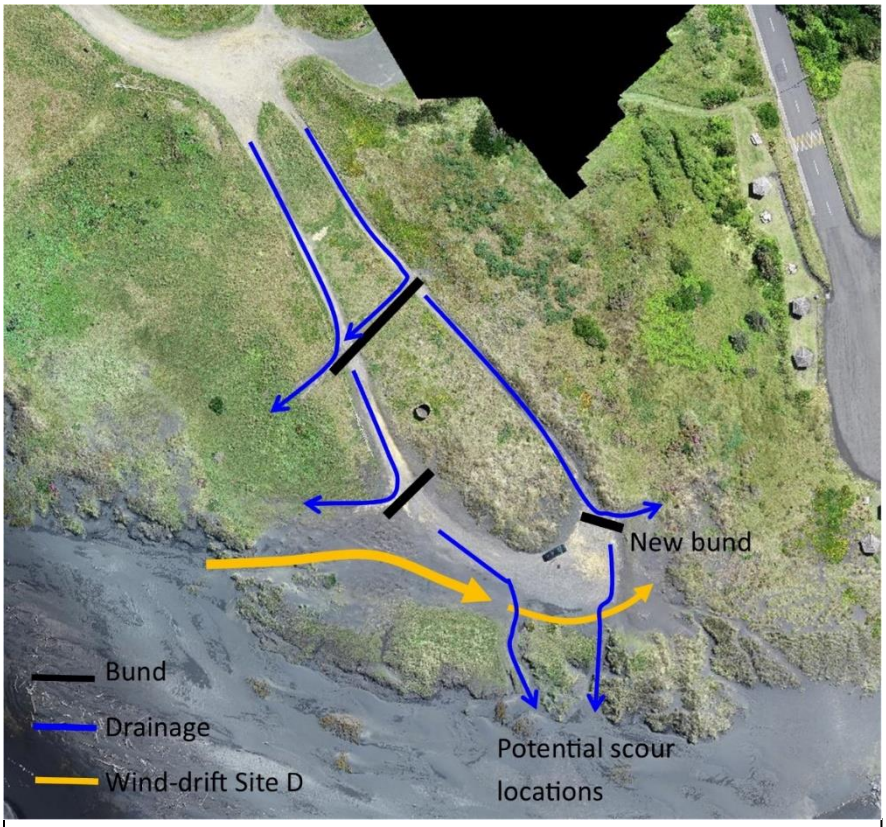

Figure 10 Drainage layout and traffic accessways (reproduced from the 2019 Annual Report) to the rivermouth lookout car park (location in Figure 4). The two seaward bunds were first established in 2011 , with the landward "New bund" being established in 2019 to trial the landward disbursal of stormwater.

However, the drainage system outlined in Figure 10 was only ever designed as a temporary fix and a more sustainable system was proposed in 2014[1]. The associated concept design is illustrated below as Figure 11. This design kept only one of the loop accessways with stormwater reaching the car park being redirected landward into the marked soakage areas with the possibility of connecting into the settlement's stormwater infrastructure or direct river exit if needbe. However, trialing since 2019 indicates that simple soakage areas in well-vegetated dune hollows may suffice.

Based on the 2022 LIDAR, an average infill of some 0.25 to 0.5 m would be required to reverse the fall across the rivemouth lookout car park.

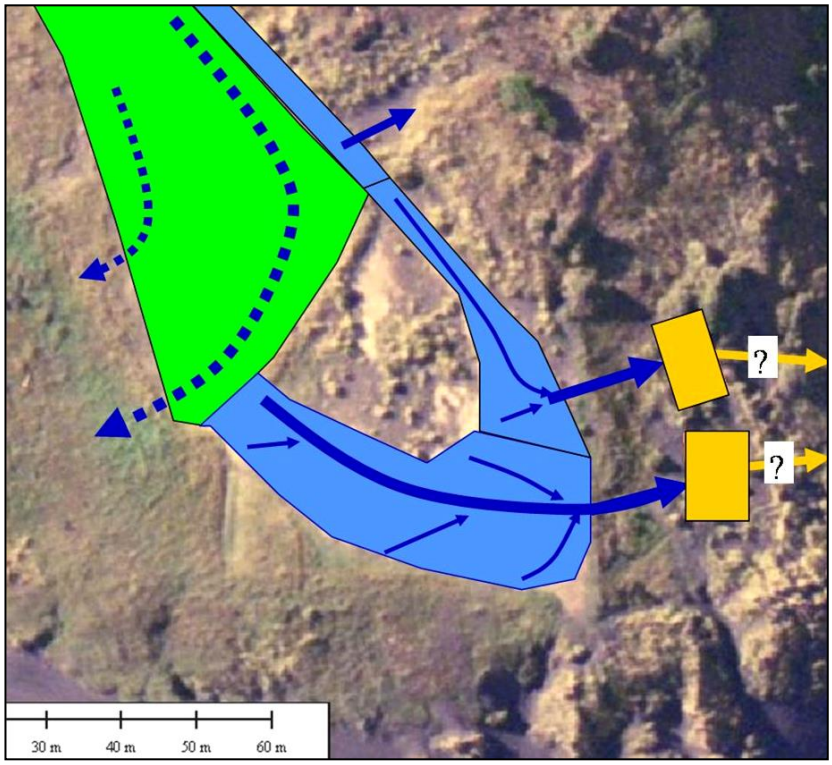

Figure 11 Concept design plan from the CSL 2014 draft Drainage Report[1]. The green area is retired from vehicle access and planted as required. The dashed blue lines on the green area indicate expected subsurface flow pattern. The blue area is re-contoured as required so drainage water flows landward to be collected in "soakage areas" (yellow) in which water is retained to enable infiltration/sediment deposition.

CSL (2014c) Drainage Management DRAFT Report. A report for the South Taranaki District Council. Client Report 2014/10.

4.4 Hazards

The ongoing dune instability fronting the upper car park is likely caused/agravated by pedestrian traffic accessing the beach. The sign warning against using this track has been removed. Given the dynamic and potentially hazardous nature of this location, warning signage should be replaced and a physical barrier (horizonal pole) erected across the beach access track at the lookout structure.

4.5 Complaints

CSL were not informed of any complaints relating to the sand management project.

5 PATEA BEACH MANAGEMENT PLAN REVIEW

The current beach management plan of 2007 states in Section 2.11 that,
"The Plan is an active document and does not purport to be without need for review. As more information is gathered through inspections and monitoring, improved methods may need to be incorporated into the Plan".

Since 2007, the coast has undergone a significant episode of erosion enabling a better understanding of processes, measurement-based monitoring is well established and has recently been revised, and the site was closed for free public dumping of green waste. Future sourcing of green waste is discussed above in Section 4.2.

The northern foredune is subject to ongoing instability and potential for drift sand to become hazardous. However, the present monitoring regime and stabilizing techniques should prevent this from occurring in the future.

Most of the original green waste dump site is now stable and vegetated (shown as the green area in Figure 11 and extending westward toward the upper car park (an area some 250 m long by 60 m wide). This area's potential usage could be included in the management Plan Review.

A review of the drainage configuration about the vehicle access to the rivermouth lookout car park could be included as background in the Management Plan Review.

In addition, extending the Patea Beach Management Plan to cover the wider environment could also be considered as monitoring has been increased to comprehensively cover the inlet and south coast.

6 SUMMARY and RECOMMENDATIONS

1. A revised and simplified profile and aerial monitoring regime is now in place.

2. The 2021-22 summer monitoring shows the episode of wave erosion affecting the foredune that began in 2010-11, now appears to have passed. Vegetation clumps are sliding down the scarp as the slope stabilizes. Some upper dune wind erosion is occurring.

3. Five hundred cubic metres of green waste has recently been placed at Site D near the rivermouth lookout carpark – as this site had been subject to severe wind erosion. Smaller instabilities fronting the upper carpark and closer to the western cliff need to be monitored during site inspections.

4. Sourcing green waste since the site was closed in 2017 has been problematic with public resistance to paying at the Transfer Station. An alternative may be to open the transfer station to free drop-off when green waste is needed. This worked well during the February post-storm cleanup and allows operators to inspect and approve/reject material.

5. Stormwater drainage at the eastern end of the dune platform has been reformed but metal is urgently required on the drainage bunds and accessway road surface. Contractor Haden McColl suggested using “road digout” material in the future as this contains some bitumen that will better withstand stormwater erosion and vehicle weight.

6. The temporary drainage configuration 2011 needs reviewing and a more permanent alternative proposed in 2014 could be reconsidered.

7. This may be an appropriate time to review and possibly expand the Patea Beach Management Plan as several significant changes have occurred since 2007 including tested and revised monitoring, green waste dump closure, much of the site is permanently stabilized, access and drainage need reviewing, and the wider environment is now being monitored.

COASTAL SYSTEMS LTD
Hazard, Management and Research Consultants

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Dr Roger Shand
Senior Coastal Scientist

APPENDIX A1 Taranaki Regional Council Consent 6088-3

Consent 6088-3

TARANAKI REGIONAL COUNCIL
CHIEF EXECUTIVE
PRIVATE BAG 713
47 CLOTEN ROAD
STRATFORD
NEW ZEALAND
PHONE: 06-765 7127
FAX: 06-765 5097
www.trc.govt.nz
Please quote our file number on all correspondence

Discharge Permit

Pursuant to the Resource Management Act 1991 a resource consent is hereby granted by the Taranaki Regional Council

Name of Consent Holder:	South Taranaki District Council Private Bag 902 HAWERA 4640
Consent Granted Date:	30 October 2007

Conditions of Consent

Consent Granted:	To discharge domestic green waste onto land for the purpose of stabilising sand dunes at or about 2637357E-6158276N
Expiry Date:	1 June 2022
Review Date(s):	June 2010, June 2016
Site Location:	Patea Beach, Beach Road, Patea
Legal Description:	Sec 137 SO 2680 SO 6641 Pt Lot 6 DP 648 Pt Sec 74 Blk VII Carlyle SD
Catchment:	Patea

For General, Standard and Special conditions pertaining to this consent please see reverse side of this document
www.trc.govt.nz

Doc# 370202-v1

Consent 6088-3

General conditions

a) On receipt of a requirement from the Chief Executive, Taranaki Regional Council the consent holder shall, within the time specified in the requirement, supply the information required relating to the exercise of this consent.

b) Unless it is otherwise specified in the conditions of this consent, compliance with any monitoring requirement imposed by this consent must be at the consent holder's own expense.

c) The consent holder shall pay to the Council all required administrative charges fixed by the Council pursuant to section 36 in relation to:

i) the administration, monitoring and supervision of this consent; and
ii) charges authorised by regulations.

Special conditions

1. The consent holder shall at all times adopt the best practicable option, as defined in section 2 of the Resource Management Act 1991, to prevent or minimise any adverse effects on the environment from the exercise of this consent.

2. The exercise of this consent shall be undertaken in accordance with the documentation submitted in support of application 4491. Specifically this includes *Patea Beach Management Plan, South Taranaki District Council (June 2007)*. If there is any contradiction between the documentation submitted in support of the application and the conditions of this consent, the conditions of this consent shall prevail.

3. Dumping of green waste by the public shall be limited to specific designated areas identified by signs. The consent holder shall regularly remove the green waste from the dumping area and deposit it in the quantities and at the locations necessary to achieve the purpose of this consent.

4. For the purposes of this consent, domestic green waste is defined as: leaves, grass clippings, hedge trimmings, sticks/branches/logs with a diameter no greater than 100 mm, and other similar material all in quantities consistent with maintenance of a residential garden. Specifically excluded from the definition are: sticks/branches/logs with a diameter greater than 100 mm; timber (treated or not); and any viable plant identified in the *Pest Management Strategy for Taranaki: Plants.*

5. The consent holder shall ensure that signs at the dumping points clearly describe the waste that may be dumped.

6. The consent holder shall remove any dumped material from the site that is not green waste (as defined in condition 4).

7. The consent holder shall comply with the requirements of the *Pest Management Strategy for Taranaki: Plants* at the site.

8. The consent holder shall ensure that no waste discharged to the site is placed at or below the mean high water springs mark.

Consent 6088-3

9. The discharge to land shall not result in any contaminant entering surface water.

10. The consent holder shall control and maintain all stormwater at the site to minimise erosion or scour of the adjacent foredune area to the satisfaction of the Chief Executive, Taranaki Regional Council.

11. This consent shall lapse on the expiry of five years after the date of issue of this consent, unless the consent is given effect to before the end of that period or the Taranaki Regional Council fixes a longer period pursuant to section 125(1)(b) of the Resource Management Act 1991.

12. In accordance with section 128 and section 129 of the Resource Management Act 1991, the Taranaki Regional Council may serve notice of its intention to review, amend, delete or add to the conditions of this resource consent by giving notice of review during the month of June 2010 and/or June 2016, for the purpose of ensuring that the conditions are adequate to deal with any adverse effects on the environment arising from the exercise of this resource consent, which were either not foreseen at the time the application was considered or which it was not appropriate to deal with at the time.

Signed at Stratford on 30 October 2007

For and on behalf of
Taranaki Regional Council

Director-Resource Management

APPENDIX A2 South Taranaki District Council Consent RML 0701515

RML070115

21 January 2008

Vivek Goel & Clive Margetts
Engineering Services Group
South Taranaki District Council
Albion Street
Hawera

Dear Vivek and Clive

Resource Consent Application – RML070115, Sand Dune Stabilisation Project, Patea Beach, Patea

Your application was considered by the Planning Manager under delegated authority on 16 January and she has resolved as follows:

THAT consent be granted to South Taranaki District Council to operate the Patea Greenwaste Disposal Facility along a section of the Patea Coastline (Part 6 Patea Suburban and Part 8 DP 648) pursuant to Sections 104 and 108 of the Resource Management Act 1991.

For the following reasons:

1. The applicant has provided the written approval from all affected parties.
2. The proposal would not give rise to any adverse environmental effects that are more than minor on the surrounding rural and coastal areas.
3. The proposal is supported by the District Plan's objectives and policies and is consistent with the purpose of the Resource Management Act 1991.

Subject to the following conditions:

1. That the activity be undertaken in accordance with the Management Plan submitted to the South Taranaki District Council and signed by the affected parties.
2. That the signs are positioned in accordance with the Management Plan submitted to the South Taranaki District Council and signed by the affected parties.
3. That in accordance with Section 128(1) of the Resource Management Act 1991, the South Taranaki District Council may review, amend, delete or add to the conditions of this consent by giving notice to the consent holder of such a review during the month of November 2010 and every 5 years thereafter if required, for the purpose of:
    a. Ensuring that the conditions adequately deal with the environmental effects resulting from the exercise of this resource consent, and

b. To avoid, remedy or mitigate any adverse effects on the environment.

4. That weekly monitoring of the site is undertaken to ensure that the site is free of non-vegetative material.

5. That the site is not used for the disposal of commercially sourced greenwaste.

6. That all monitoring information required under the Management Plan is made available to the South Taranaki District Council at any time upon request.

7. That the vehicle crossing serving the site is upgraded to meet the Council's Commercial Property Entrance specifications.

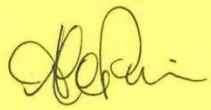
Advice Note:

1. *Subject to any legal requirements of the Police, Historic Places Act 1993, Antiques Act 1975 and any other governing legislation, should a Waahi Tapu or archaeological site be uncovered during earthworks or other construction work, work in the affected area shall stop immediately the consent holder shall seek advice from Tangata Whenua, the Historic Places Trust and/or the Police (as appropriate) to determine what further actions are appropriate to safeguard the site or its contents before work recommences.*

Attached is an invoice for the approval.

Council draws your attention to the rights of objection to which this Consent is subject, as set out in Section 357 of the Resource Management Act 1991.

Yours sincerely



Andrea Te Puni
Planner

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APPENDIX B Sand Stabilization History

Following rivermouth mole completion in the 1920s, accretion resulted in sand conservation schemes being being carried out in the 1950s and 1980s. Since the 1990s, sand stability has been maintained primarily using green waste. However, in the mid-2000s the Taranaki Regional Council required a management plan for such a process if green waste discharge consents were to be issued. The *Patea Beach Management Plan*[1] was subsequently prepared and in 2008 the TRC and STRC issued consents (see Appendix A). In 2008, the district council began the *Patea Beach Sand Management Project* and Coastal Systems Ltd was engaged to carry out inspections, co-ordinate monitoring surveys, supervise site operations and produce annual reports. In 2015 the project history and findings were described in a *Summary Report* that also included *Sand Management Guidelines*[2].

This green waste operation must meet conditions set out in the Taranaki Regional Council (TRC) *resource consent 6088* and Special Condition 2 of the requires that management be carried out in accordance with the *Patea Beach Management Plan.* This Plan sets out monitoring requirements and also requires the Plan be reviewed as more information becomes available regarding natural processes and management techniques.

In 2015, CSL also prepared a report for the council specifically addressing *Review Issues*[3] that would need to be considered during a management plan review. While this CSL assessment showed that the operation was broadly compliant, a consistent oversupply of green waste had resulted in partial compliance or non-compliance of some conditions. This report consequently proposed several management options including closing the dump and importing green waste as required for stabilization purposes. This option was adopted by the council and implemented in February 2017.

A further issue of significance for sand management was a drawn-out episode of wave induced foredune erosion that began in 2010 to 2011 at the northwestern end of the beach with the erosion focus systematically moving along the foredune toward the rivermouth.

In 2016, the TRC served an Abatement Notice when non-organic materials were found within the green waste and also some green waste had slid downslope and into the sea during particularly high energy (El Nino) storm conditions. The STDC modified

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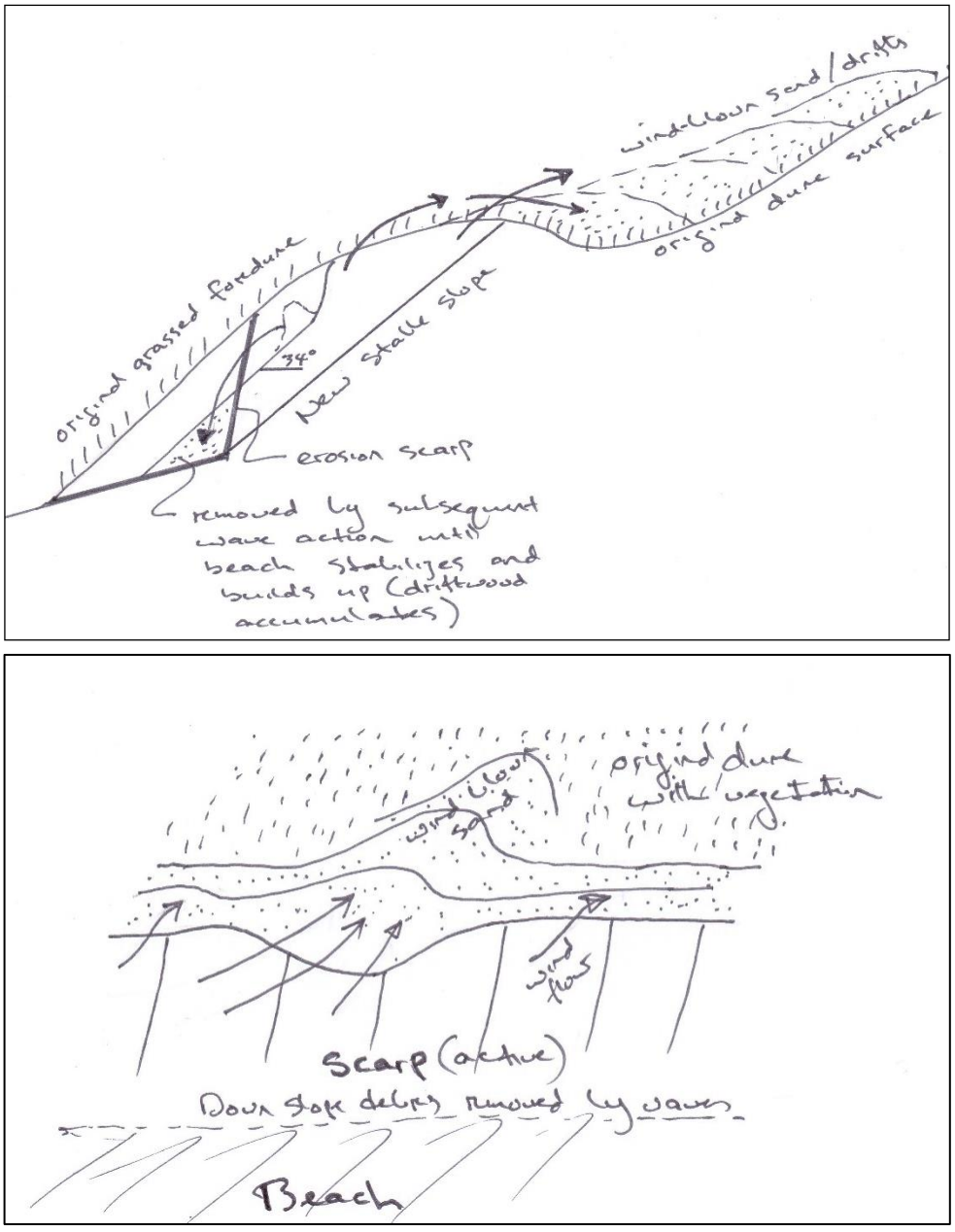
1. Patea Beach Management Plan. A report prepared by Environmental Insight Ltd. 2007.
2 Patea Beach Sand Management Project: Summary Report 2008 to 2015 including Sand Management Guidelines. A report prepared by Coastal Systems Ltd for the STDC. CSL client report 2015-02 CRep. October 2015.
3. Patea Beach Sand Management Project: Review Issues. A report prepared by Coastal Systems Ltd for the STDC. CSL client report 2015-14 CRep. October 2015.

management operations to stop green waste application close to the scarp edge. However, a consequence to cessation was the allowing of wind to affect the top of the scarp and more easily blow sand landward, burying vegetation and drifting landward to a greater extent than would have otherwise been the case. These post-scarp processes are diagrammatically illustrated in the Figures below and monitoring is required to locate such instabilities and treat with green waste.



The upper figure shows profile (cross-section) view of slope adjustment processes following foredune erosion by storm wave action. The new slope is achieved by downslope movement of sediment under gravity (by avalanching, sliding and rafting (block glides)). Upslope processes are driven by wind erosion and can result in burial of vegetation and wind drifts migrating inland.
The lower figure shows an oblique view of wind processes removing sand from the scarp face and depositing it landward. Wind-flow funnels through low points along the scarp crest line, and guts develop which can cause significant localized erosion and the landward deposition/burial of vegetation.

APPENDIX C FILE NOTE 1 July 2020: Stabilizing Site D

Sand instability Site D, see Figure 1 which is from the 2019 Annual Report: Patea Beach Sand Management Project, consists of a blowout (gut) though the dune crest and extensive wind drift to landward. The area is increasing in an exponential manner from 47 m^2 in 2016, to 140 m^2 in 2017, to 337 m^2 in 2018 and to 1260 m^2 in 2019 with sand now spilling down toward the beach utilities (Figure 2) . Such a nonlinear increase in area is common when sand dunes become unstable, for example see Figure 3.

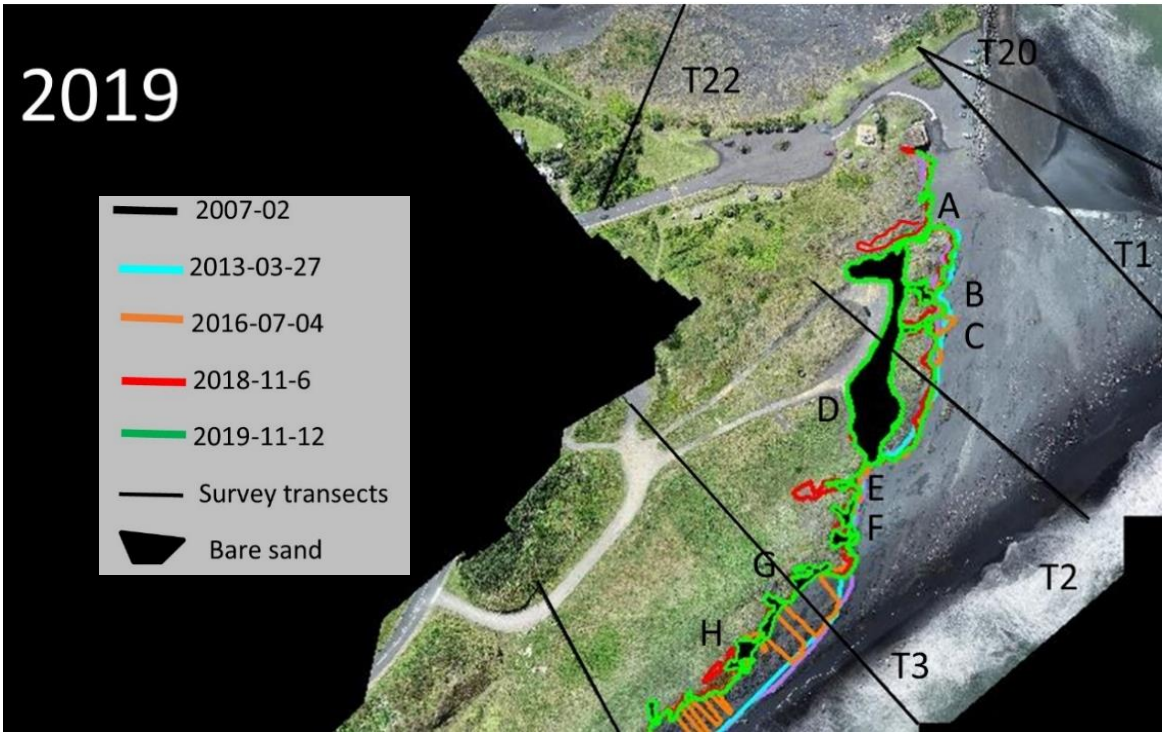


Figure 1 Areas of bare sand (black) and vegetation-fronts, from 2019 Annual Report

The 2019 Annual report recommended in the 2020 year that "green waste be placed at site D with planting carried out once it has settled".

About 100 m^3 of (loose) green waste recently become available at the Patea transfer station. This equates to ~6 of the contractors truckloads (a truck carries ~16 m^3).

On 17 June. McCole Contracting carted the green waste to the site and placed it within the gut. (see Figure 4 photos). The gut consumed the full amount of green waste leaving the bare sand of the landward wind drift still exposed. In addition, as illustrated in Figure 5, the excavator exposed further sand while transporting/placing the waste.

Figure 2 Gut (red), wind-drift direction arrows and extent on 17 June, 2020.

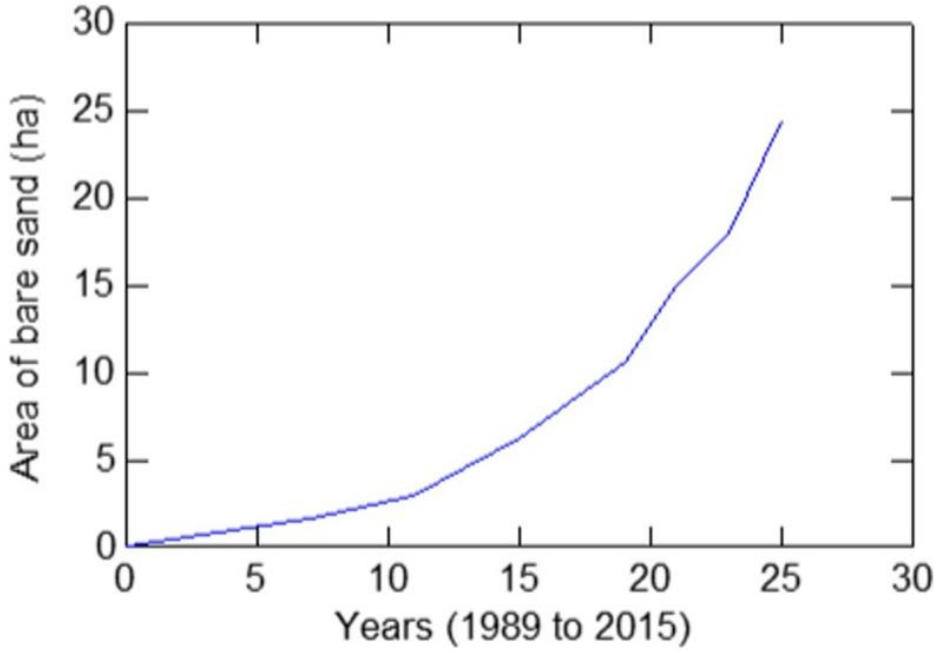


Figure 3 Example of exponential-type increase in bare sand area from frontal foredune erosion and landward wind-drifting on the Wanganui coast.

Figure 4 Gut before (upper photo) and after (lower photo) green waste infill.

While the infilled gut will reduce local windspeed and trap sand blowing up from the beach, the bare sand to landward will continue to move and advance downwind. During the remaining winter further green waste should be acquired and placed over the wind drift surface in anticipation of a dry, windy spring.

Figure 5 Surface disruption by digger during green waste placement.

The 2019 Annual Report noted in its recommendations that “Sourcing green waste for sand stabilization has been problematic and a sustainable solution is required. What is clear is that locals are not prepared to pay to drop off green waste at the transfer station. If the cost cannot be enticingly lowered, then importation is required and administration matters need to be resolved”.

That recommendation should urgently be actioned.

Dr Roger Shand
Principal Scientist