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Coastal beach-dune dynamics and historical changes in the Victor Harbor to Kingston region, South Australia

January 2026

Patrick A. Hesp, Evan Corbett, Elijah Reiger; Adrian Werner and Graziela Miot da Silva

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Title page photo credit: Patrick Hesp. A parabolic dune which developed post-2017 at Godfreys Landing on the Younghusband Peninsula, SA.

Enquires should be addressed to: CLLMM Research Centre
Level 1, 92 Barrage Road
Goolwa, SA 5214
e-mail: info@cllmmresearchcentre.org

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Version

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Executive Summary

The historical foredune and beach topographic profile data gathered and made available by the Department of Environment and Water (DEW) for the Victor Harbor to Kingston region is examined. In addition, the LiDAR data for 2008 and 2018 is briefly examined. In particular, we assess (i) the magnitude of changes that have taken place at each profiling location, and (ii) attempt to quantify if there is any signal in the data that indicates a shoreline response to sea level rise. This study finds that beach-dune systems in the region show considerable variability in behaviour over time, with some accreting, some eroding and some essentially stable. A few beaches (Victor Harbor; Cape Jaffa) display consistent erosional tendencies, while very few beaches (e.g. Goolwa) display accretion. There is no consistent trend in beach-dune erosion associated with or able to be correlated with sea level rise over the past 40+ years of survey record. It is likely that the "noise" associated with regular or periodic erosion and subsequent accretion events driven by storm and calm wave periods respectively is significantly greater than any signal associated with sea level rise.

Acknowledgement

We acknowledge the cultural connections to the land and connected waters, as well as the cultural significance of waterbirds that exist between people of the Ngarrindjeri and Boandik Nations across the Coorong, Lower Lakes, and Murray Mouth region. We recognise that First Nations peoples' spiritual, social, cultural, and economic practices come from their lands and waters, and they continue to maintain their cultural heritage, economies, languages, and laws which are of ongoing importance. We are committed to fostering and nurturing ongoing relationships with First Nations community in the CLLMM region, as we continue to work together towards a diverse and thriving waterbird community.

This project was funded by the Goyder Institute for Water Research's CLLMM Research Centre, which is funded by the Australian Government. We thank the CLLMM Research Centre staff, and, in particular Nick Whiterod, for project initiation, support and management. We especially thank DEW and the survey staff for provision of data and support and advice. We thank the Goyder Institute for Water Research, Research Advisory Committee and Alison Turner (DEW) and Kia Ly (DEW) for reviews and constructive feedback on the report.

1. Introduction

Sandy beaches represent a third of the global coastline, and, apart from the Nullabor cliffs region, are very common across the South Australian coast. They are dynamic environments and may erode or accrete across tens to hundreds of metres over time due to seasonal changes, storms, (Luijendijk et al., 2018; Harley et al., 2017; D'Anna et al., 2021; Doyle et al., 2024), and climatic drivers such as, for example, El Nino-Southern Oscillation (ENSO) and Southern Annular Mode (SAM) (Perry et al, 2024a, 2024b). In some cases, beaches also shift from stable or accretional to erosional due to changing sediment budgets or changing nearshore-surfzone conditions (e.g. breakdown of nearshore reefs; loss of seagrass and associated seabed deepening); Davidson et al., 2021; Hesp et al., 2022; DaSilva et al., 2024).

In the past ~100 years sea level has been rising and will continue to rise, possibly at a greater rate than present. In the 1900's the global sea level rise rate averaged 1.5 (1.1–1.9) mm/year, but in the period 2006-2018 it has increased to around 3.7 ± 0.5 mm/yr (Scambos and Abdalati, 2022). Sea levels may reach between +0.75m (Intermediate scenario) and +1.0m (very high scenario) above the 1900 level by 2100 (IPCC, AR5, AR6; Lee and Romero, 20231) (Figure 1).

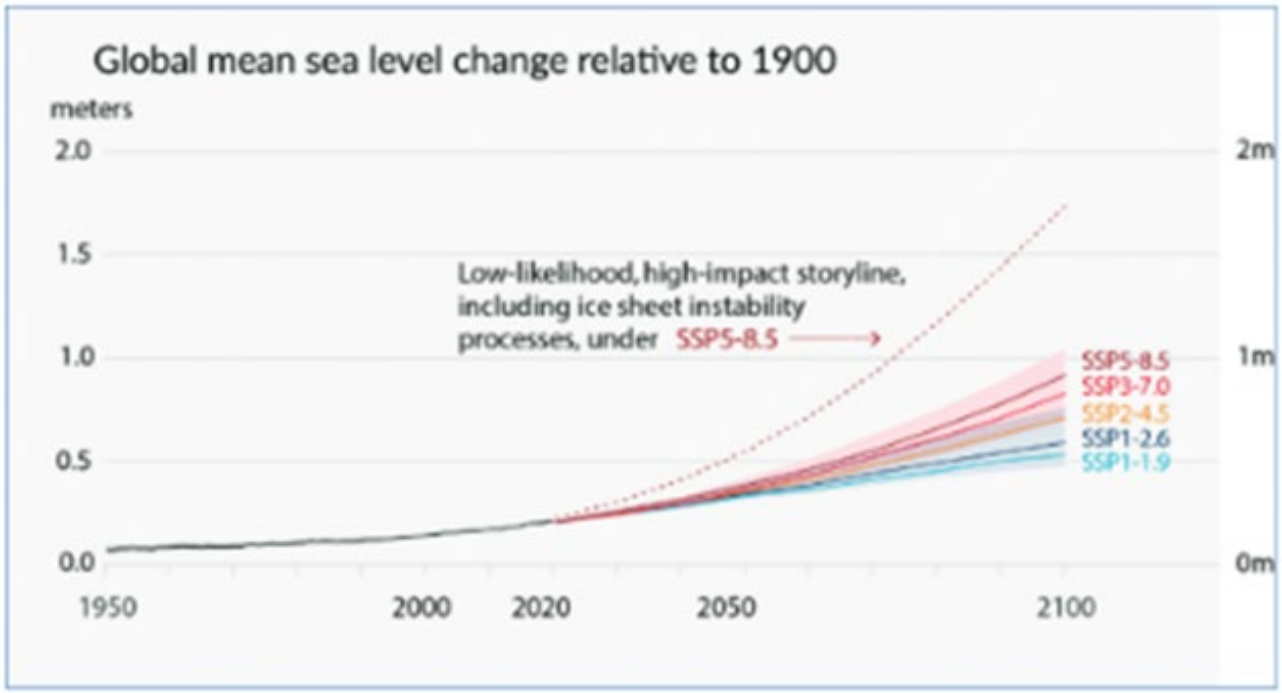


Figure 1. Historical sea level data from 1950 to 2020 and estimated future sea level rise. Projections and ranges are shown for the IPCC AR6 SSP1-2.6 (blue) and SSP3-7.0 (red) scenarios, with additional story-line (Source: Scambos and Abdalati, 2022).

The gradual increase in sea levels in Adelaide may also be observed in the tide record for Port Adelaide (Figure 2). In the period 1966 to 2022 sea level rose at an average rate of 2mm/year. However, the rate is increasing such that between 1993 and 2022 the rate was between 3mm/year and 5mm/year. Mean sea level at Victor Harbor has increased by 10-12cm between 1965-69 and 2017-22 (EPA, 2023).

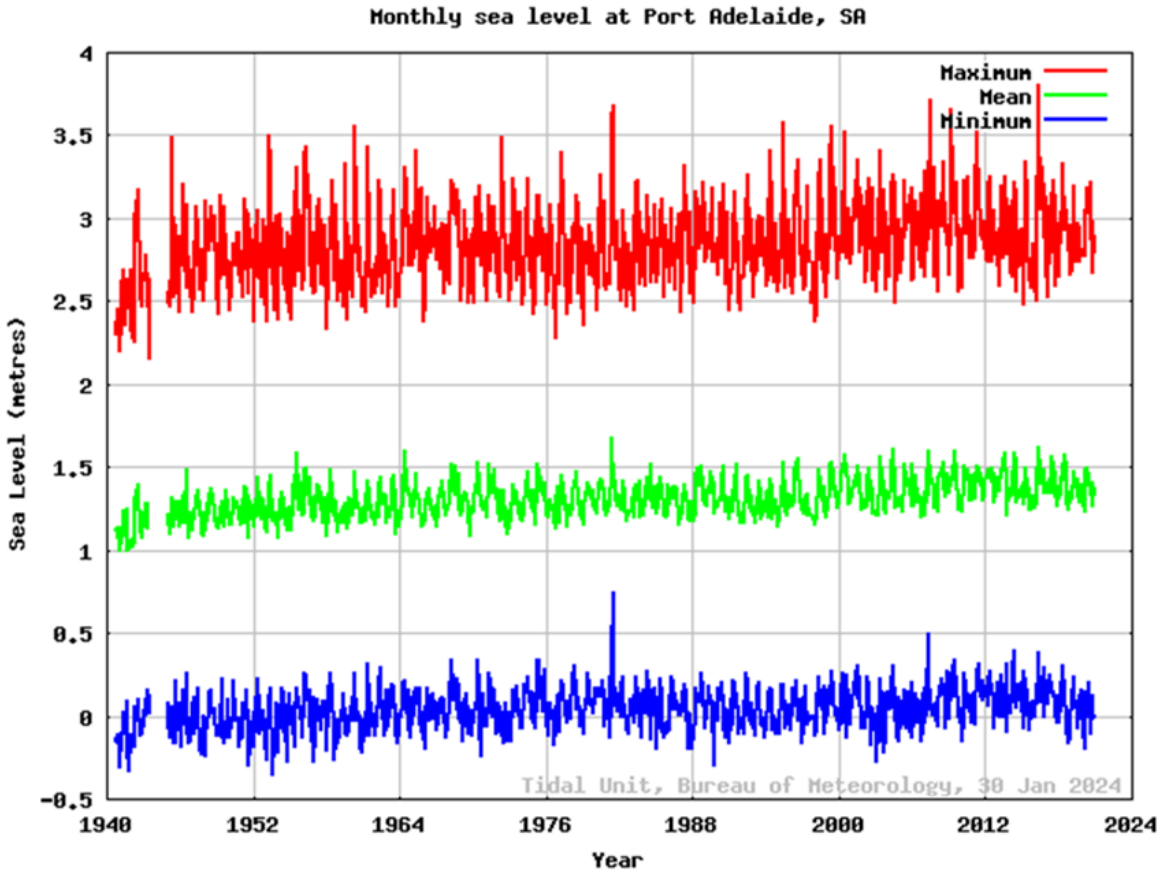


Figure 2. Monthly sea levels for Port Adelaide (Outer Harbor) for 1940-2022. Source: Bureau of Meteorology; http://www.bom.gov.au/ntc/IDO70000/IDO70000_61600_SLI.shtml

Climate change has already altered wave climate in South Australia. Hemer et al (2008) state that there has been a recent intensification of the Southern Ocean storm belt in the past few decades, and this equates to a decrease in the number of southern ocean systems but an increase in their intensity (i.e. larger storms). Young and Ribal (2019) show that oceanic wind speed and significant wave heights have increased in the Southern Ocean in the 1985-2018 period by approximately 0.3cm/year. This likely means that significant wave heights have gradually increased slightly by ~10cm in surfzones across the region since 1985. Storm frequency and intensity will likely also change into the future. Modelling indicates that it is likely there will be a poleward shift of storm tracks in the Southern Hemisphere, and the intensity of the most extreme extratropical cyclones will increase in the future (IPCC AR5; Christensen et al., 2013; Chang, 2017; Priestley and Catto, 2021; Lee and Romero, 2023). If storm intensities increase, coastal flooding will also increase and extreme wind events will be more common (Browning, 2004). In addition, Lee and Romero (2023) state that global surface temperature has increased faster since 1970 than in any other 50-year period over at least the last 2000 years. Precipitation intensities are predicted to increase as temperature rises (Visser et al., 2023) potentially leading to greater flooding. Increased temperatures, global warming and sea level rise are projected to change current 1-in-100 year extreme sea level events such that they will occur at least annually in more than half of all global tide gauge locations by 2100 (Lee and Romero, 2023).

Beaches and foredunes can respond to sea level rise by translating upwards and landwards as sea level rises (Ollerhead et al., 2013; Van Ijzendoorn et al., 2021; Davidson-Arnott et al.,

2024) but this can only occur if some sediment is returned to the beach following erosion events, and where there is space for the beach and dunes to do so. If infrastructure is emplaced on or near a foredune then it is unlikely we will allow translation to take place unless we are willing to retreat (which seldom occurs).

Understanding shoreline change in the future depends in part on understanding historical changes to beaches and dunes, so that trends, and, for example, any responses to sea level rise visible at present can be examined and considered. As the IPCC 2023 assessment notes "Adaptation options that are feasible and effective today will become constrained and less effective with increasing global warming." (Lee and Romero, 2023, p. 19). Thus, in the following, we examine the historical foredune (or backshore-landward landforms and beach topographic profile data gathered and made available by the Department of Environment and Water (DEW), undertaken on behalf of the SA Coast Protection Board, for the Victor Harbor to Kingston region. In particular, we examine (i) the magnitude of changes that have taken place at each profiling location, and (ii) attempt to assess if there is any signal in the data that indicates a shoreline response to sea level rise.

2. Methodology.

2.1 Victor Harbor to Kingston Region Methods

In the following the various methods utilised to analyse the DEW profile data are outlined.

The Government of South Australia's Coast Protection Board through the Department for Environment and Water (DEW) have been sporadically surveying coastal profiles in the region from Waitpinga to Cape Jaffa, with the earliest surveys being measured in 1977. These surveys provide dune and beach profile data that are surveyed at points of change in slope to accurately capture changes in surface gradient. The data are resampled to 0.5 m increments and provide insights into beach and dune change across profiles of interest over the past ~47 years. Not all profiles have surveys dating back to the late 1970's, with survey frequency and distance reflective of council/government interest and specific responses to storms or significant erosion at certain places and/or times. In general, the closer the profile to public and residential infrastructure, the greater the survey density. The profile data is separated into two groups, with SF referring to the Southern Fleurieu region, and SE to the Southeast region.

Note that differing methods have been utilised to conduct the surveys over time since the 1970's to the present. We have not filtered the survey data other than removing clear obvious errors (e.g. apparent benchmark shifts) in a few surveys.

The Middleton area is downwarping over time (Sprigg, 1952, p. 55; Bourman et al., 2000) and thus, that area is affected by neotectonic events. Bourman (1974) and Bourman et al. (2000) state that the oral history indicates erosion of as much as 400m since 1897, and a rate of 0.4m/year is indicated from surveys conducted between 1860 and 1974. This erosion due to downwarping should be considered when interpreting the survey data for the Middleton area.

In addition, we have analysed separately the SA State Government Light Detection and Ranging (LiDaR) data available for 2008 and 2018 along the Younghusband Peninsula in order to add additional data to the very few DEW surveys that been conducted.

2.1.1 Processing Topographic Profiles

Each survey measured is categorised with a classification relative to its accuracy or data type, and are as follows:

Accuracy classification:

A: +/- 5 cm

B: +/- 10 cm

C: +/- 15 cm

D: +/- 20 cm

E: >20 cm

X: Unclassified

The Data type is also classified as follows:

S: Seagrass specific

M: Extracted from a model survey

Note that DEW surveyors indicate that these classifications of accuracy need to be updated, with classification errors found in the data. With this in mind, and with a desire to include as many topographic surveys as possible, no surveys were removed from this research based upon their accuracy classification; however, accuracy information is indicated where appropriate.

This work possesses the following assumptions:

- 0 m AHD is the shoreline position and is approximately 0.0m, that is, mean sea level (msl).

- 3 m AHD is the top of the backshore position, and commonly the seaward toe of the foredune, where a foredune exists. Note that surveys conducted by the authors on various open ocean beaches around the SE region indicate that ~3m above AHD is typically the top of the backshore/toe of the foredune.

- The horizontal distance between these two points of 0 and 3 m AHD is the beach width

- The rate of change can be determined by the difference between two surveys measured along a profile

- Survey data is accurate and representative of the date listed (survey data from sections of a profile are not copied between years), unless they traverse terrain that is relatively unchanged; i.e. Esplanade Roads which back urbanised profile locations such as Victor Harbor where applicable and where they traverse stable clifftop environments (e.g. Middleton).

In some cases there are identical surveys with different dates. This occurs as DEW appear to occasionally mirror data when they add additional bathymetry (i.e. survey A and B identical down to -1m AHD and then survey A stops whereas B continues). In these cases the first survey date of the two was utilised.

2.1.2 Processing Volumetric Data, and Beach Widths.

The following steps were performed on each profile cleaned elevation data such that for each individual survey:

1. The Top of Backshore position is defined as the point where each survey intercepts the y-axis at 3 m AHD. Giving the Distance along the profile where the condition Elevation >= 3 is met.

2. The Shoreline position is defined as the point where each survey intercepts the y-axis at 0 m AHD. Giving the Distance along the profile where the condition Elevation <= 0 is met.

3. The Dune Volume (m^3) is calculated using the area under the curve formula for all survey data above the horizontal datum of 3 m AHD. The cross-sectional area value is then multiplied by a factor of 1 (i.e. a 1m wide strip) to obtain volume. Condition: Elevation >= 3. Any surveys that do not meet this condition (i.e. there is no cross-sectional area above the 3 m AHD datum) are converted from NA to 0, indicating that the survey possesses 0 m^3 of dune volume.

4. The Beach Volume (m^3) is calculated using the area under the curve formula for all survey data above the horizontal datum of 0 m AHD and below the horizontal datum of 3 m AHD. The cross-sectional area value is then multiplied by a factor of 1 to give volume. Condition: Elevation >= 0 & Elevation <= 3.

5. The Total Survey Volume (m3) is the sum of both the defined dune volume and the defined beach volume. Should beach volume be NA (i.e. no shoreline intercept) then the total survey volume will be NA.

6. The Beach Width (m) for each survey is calculated as the horizontal distance between the defined Top of Backshore position and the Shoreline position.

- Beach width is not calculated if the survey does not intercept both 0 m AHD and 3 m AHD.

7. The Top of Backshore Relative Distance (m) is calculated as the horizontal difference between the first surveys top of backshore position (0) and the position of all other surveys top of backshore position (0.5m resolution). The 'first survey' is more precisely the first survey that possesses a non-NA top of backshore position. Not calculated for "Younghusband" profiles due to lack of survey data.

8. The Shoreline Relative Distance (m) is calculated as the horizontal difference between the first surveys shoreline position (0) and the position of all other surveys shoreline position (0.5m resolution). The 'first survey' is more precisely the first survey that possesses a non-NA shoreline position. Not calculated for "Younghusband" profiles due to lack of survey data.

9. The Volumetric Change (%) between surveys is calculated by taking the volumetric difference between a defined volume (beach, dune, or total survey) and the previous non-NA volume survey. This difference is then divided by the previous surveys volume, with the result being multiplied by 100 to give a percentage.

For each profile:

10. The Mean Beach Width (m) is calculated simply as the mean of all survey beach widths computed.

- The number of beach widths calculated for each profile and therefore included in this calculation is stored in the variable nobs (number of observations).

11. The Beach Mobility is calculated as the standard deviation of all survey beach widths computed. The higher the value of beach mobility, the more mobile the beach is; i.e. the greater the amount of beach morphological change over time (Short & Hesp, 1982).

2.1.3 Rates of Change

1. The Rate of the Top of Backshore position change (m/yr) is calculated as the horizontal difference between the top of backshore position from the first 3m AHD intercepting survey to the last, divided by the number of years between the two surveys. The precise number of years between the two surveys is determined by the number of days between the two surveys divided by 365.25.

2. The Rate of Shoreline position change (m/yr) is calculated as the horizontal difference between the shoreline position from the first 0m AHD intercepting survey to the last, divided by the number of years between the two surveys. The precise number of years between the two surveys is determined by the number of days between the two surveys divided by 365.25.

3. The Rate of dune volume change (m^3/yr) is calculated as the volumetric difference between the dune volume of the first survey that intercepts 3m AHD and has an elevation value at 0m along the profiles and that of the last survey. This difference is then divided by the number of years between the two surveys, which is determined by calculating the number of days between them and dividing by 365.25. The requirement for both selected surveys to intercept the 3m AHD horizontal datum and have an elevation value at 0m along the profile ensures only 'complete' dune volumes are included in the calculation, and excluding 'incomplete' dune volume surveys which do not cover the entire distance from 0m to the top of the backshore.

4. The Rate of beach volume change (m3/yr) is calculated by taking the volumetric difference between the beach volume of the first survey that intercepts 0m AHD and has a beach volume value and that of the last survey. This difference is then divided by the number of years between the two surveys, which is determined by calculating the number of days between them and dividing by 365.25. The requirement for both selected surveys to intercept the 0m AHD horizontal datum ensures that surveys that stop above this datum are excluded, maintaining consistency in the volumes being represented. This prevents the rate of change being calculated between a 'complete' beach survey and an 'incomplete' beach survey.

5. The Rate of total survey volume change (m3/yr) is calculated by taking the volumetric difference between the total survey volume of the first survey that intercepts 0m AHD and that of the last survey. This difference is then divided by the number of years between the two surveys, which is determined by calculating the number of days between them and dividing by 365.25. The requirement for both selected surveys to intercept the 0m AHD horizontal datum ensures that surveys that stop above this datum are excluded, maintaining consistency in the volumes being represented.

2,1,4 Foredune/Dune Volumes

The defined 'dune volume' is the area above 3m AHD moving landward from the defined top of the backshore (seaward-most 3m AHD point) along a topographic transect. This volume is calculated to the landward extent of the survey NOT to a defined position such as the base of the foredune lee slope or some other landform unit or feature. This means that on occasion the landward boundary is entirely arbitrary and just indicates where the original and subsequent profile surveys were conducted from (Figure 3).

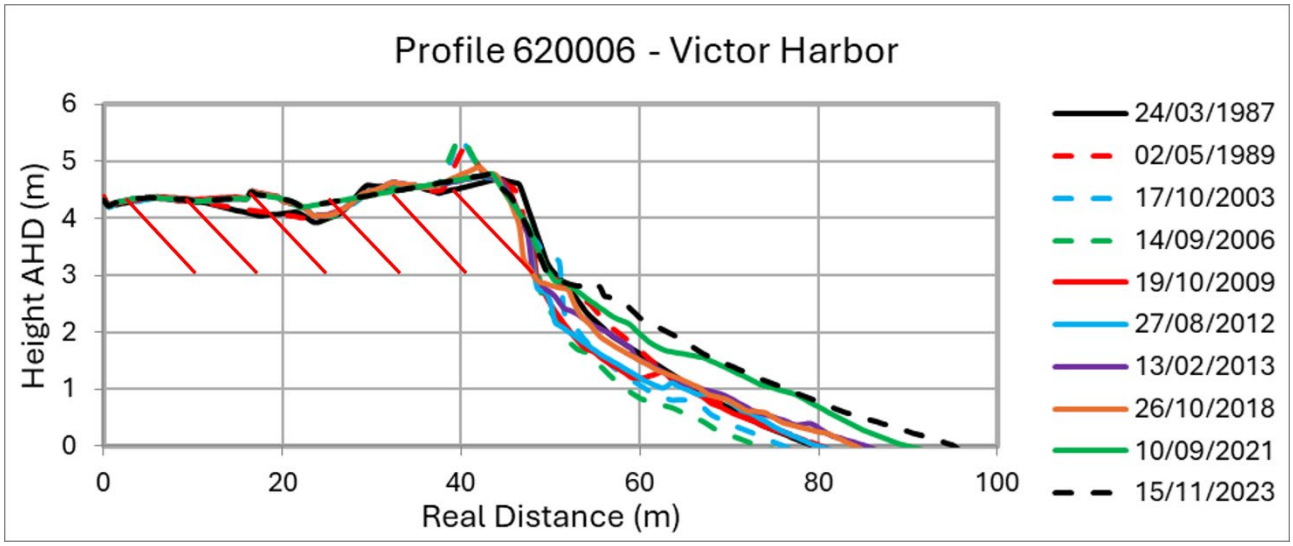


Figure 3. Illustration of the calculation of dune volume above 3m AHD for the Victor Harbor profile 620006. All the volume above +3m AHD and extending to the landward edge of the foredune or landform indicated by the red lines is included in the calculation.

Given the limitations of this method in calculating dune volumes, changes in the volumes themselves are not particularly useful, but the percentage change across surveys is a reasonable indicator of change (erosion, stability or accretion).

For transects along the Younghusband Peninsula, there is consistently one survey from 2009 spanning ~9km alongside limited older surveys <1km in length. For improved visualisation of change across the repeatedly surveyed profiles, and to facilitate the rate of volumetric change calculations, these Younghusband transects were 'sliced' to a distance seaward of the surveys' starting location. This distance is around 5000m, being unique to each Younghusband transect.

The distance is determined by the landward starting distance along the transect of the shorter surveys (i.e. 2005). The distance each transect was 'sliced' at is clear on each transect's topographic plot. An example is the attached topographic plot for the transect 720007 (Figure 4), where it was clearly 'sliced' at 4919m, as indicated by the starting value printed on the x-axis.

Importantly, incomplete surveys where the profile does not extend from the landward extent of the transect to the top of the backshore are excluded from dune volume calculations and are assigned NA. Note that with the y-axis on each topographic plot starting at 0m AHD and the x-axis starting at the landward extent of the dune volume calculation, the area under each survey line displayed on a topographic plot is the exact area represented by the 'Total Survey Volume' (dune volume + beach volume).

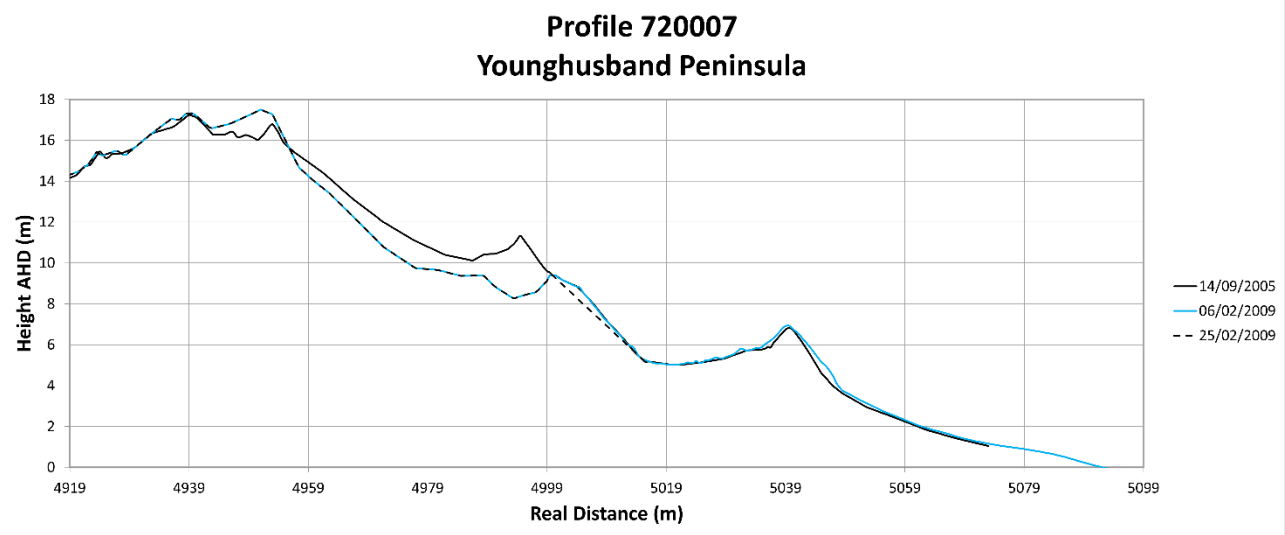


Figure 4: Calculation of Younghusband Peninsula volumes showing Profile 720007 as an example.

2.2 2008-2018 LiDAR Comparison and Data Errors

"The 2018 LiDAR precision elevation data and derived products was captured over the South East coast of South Australia and orthorectified 3 band RGB colour imagery was captured simultaneously at 12.5cm resolution. LiDAR data in LAS 1.2 format was acquired using a Trimble AX60 LiDAR sensor over the South East coastline of South Australia. Average Point Spacings: 3.87 pts per sqm. External ground control provided from Supplier surveyors who collected position information using permanent survey marks. Date of capture: 22 May - 24 August 2018. Derived products from the LiDAR data include: Digital Terrain Model / Bare Earth Elevation Model with 1m spacings, Digital Surface Model with 1m spacings, Canopy Height Model with 2m spacings, and intensity imagery at 1m spacings. Natural colour aerial imagery was also acquired simultaneously and orthorectified at 12.5cm resolution. Data captured by RPS Australia East Pty Ltd. Vertical accuracy: +/-15cm (95% confidence interval). Horizontal accuracy: +/-50cm (95% confidence interval). Vertical datum: AHD (Ausgeoid09)." Sourced from: https://location.sa.gov.au/LMS/Reports/ReportMetadata.aspx?p_no=2212

A study comparing consecutive LiDAR datasets from 2008 to 2014 in South Australia found discrepancies of around 0.3 meters between the Digital Surface Model (DSM) and Digital Terrain Model (DTM), potentially due to vegetation removal processes.

3. Waitpinga to Kingston DEW Topographic Profile Change Analyses

In the following, the historical surveys of beaches extending from Waitpinga Beach to Kingston conducted by DEW are reviewed. The surveys are collated into cells, with cell SF15 having one beach (Waitpinga; section 3.1), cell SF12 extending from the Inman River to Rosetta Harbour and including 2 beaches in the Victor Harbor region (Section 3.2), cell SF11 extending from the Hindmarsh River to the Inman River and including 5 beaches (Section 3.3), cell SF10 extending from Watson's Gap to the Hindmarsh River including one beach (Section 3.4), cell SF8 extending from Commodore Point to Freemans Knob comprising one profile at Port Elliot/Horseshoe Bay (section 3.5), cell SF7 comprising one profile at Bashams Beach (Section 3.6), cell SF5 comprising 3 adjacent beach profiles at Middleton (Section 3.7), cell SF3 comprising one profile at Goolwa (Section 3.8), cell SF2 comprising 2 profiles along the Sir Richard Peninsula (Section 3.9), cell SE17 comprising 4 profiles in the northern section of the Younghusband Peninsula (Section 3.10), cell SE16 comprising two profiles north of Parnka Point (Section 3.11), cell SE15 comprising 8 profiles extending from the central Younghusband Peninsula to ~28 Mile crossing (Section 3.12), and, cell SE13 extending from Kingston to Cape Jaffa and comprising 4 beach profiles (Section 3.13).

3.1 Cell SF15 Newland Head to Parsons Beach

Only one beach, Waitpinga Beach, has been surveyed in this cell (Figure 5).

Figure 5. Location of Profile line 62001 at Waitpinga Beach.

Waitpinga Beach changed little between 1977 and 1981, then subsequently built upwards and seawards by 1989 (Figure 6 and Table 1). By 2022, the foredune had eroded but built upwards by ~2m. In concert with this behaviour the top of the backshore/toe of the foredune has moved seawards and then landwards over time (Figure 7). Relative change in the position of the shoreline at 0.0m (or AHD) is shown in Figure 8, and displays considerable movement seawards and landwards as is typical of a high energy

intermediate, rip dominated beach. The foredune volume increased consistently post 1979 to 1989 and then declined by ~60m^3/m to 2022 (Figure 9). Beach volume has generally increased post-1979 (Figure 10).

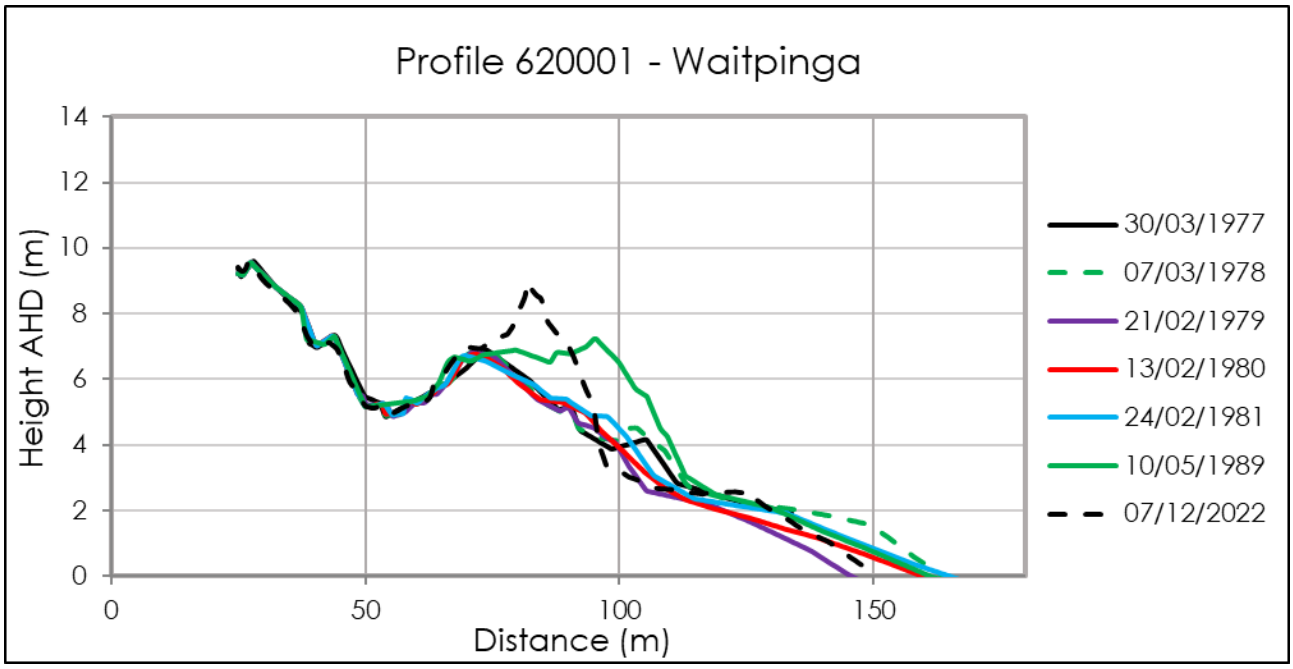


Figure 6. Topographic changes between 1977 and 2022 at Waitpinga Beach.

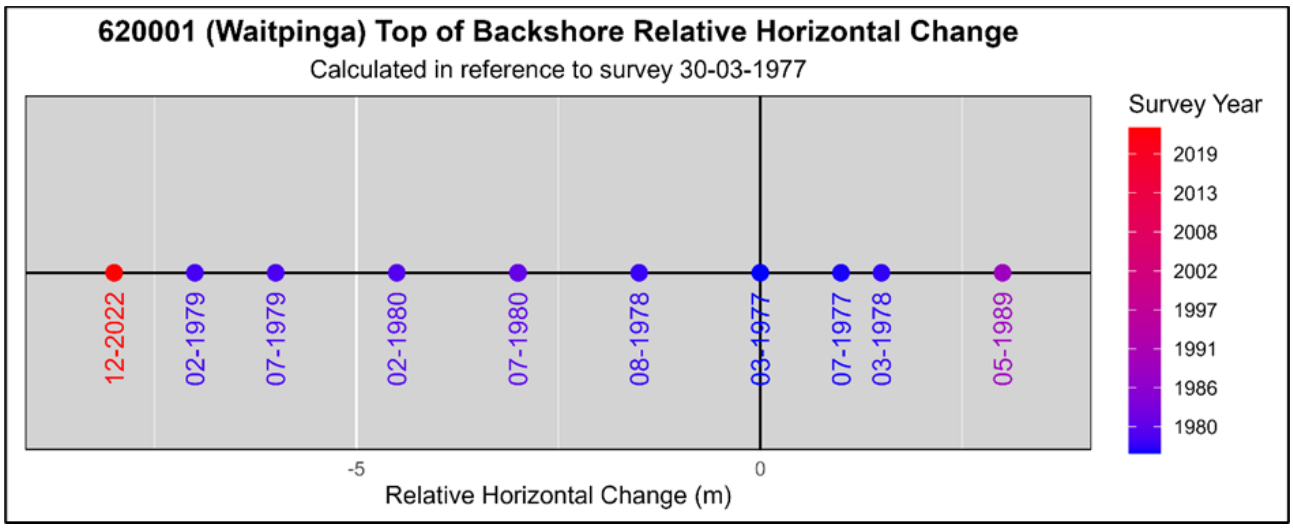


Figure 7. Horizontal movement over time of the top of the backshore position (located at 3m above AHD).

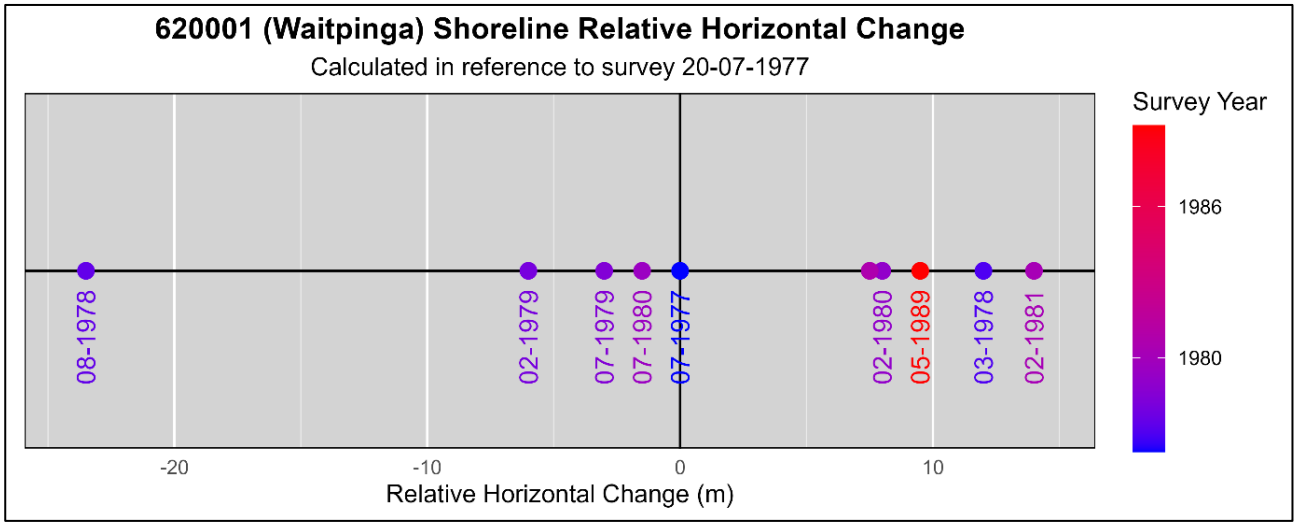


Figure 8. Relative change in the position of the shoreline at 0.0m (or AHD) seawards or landwards since 1977.

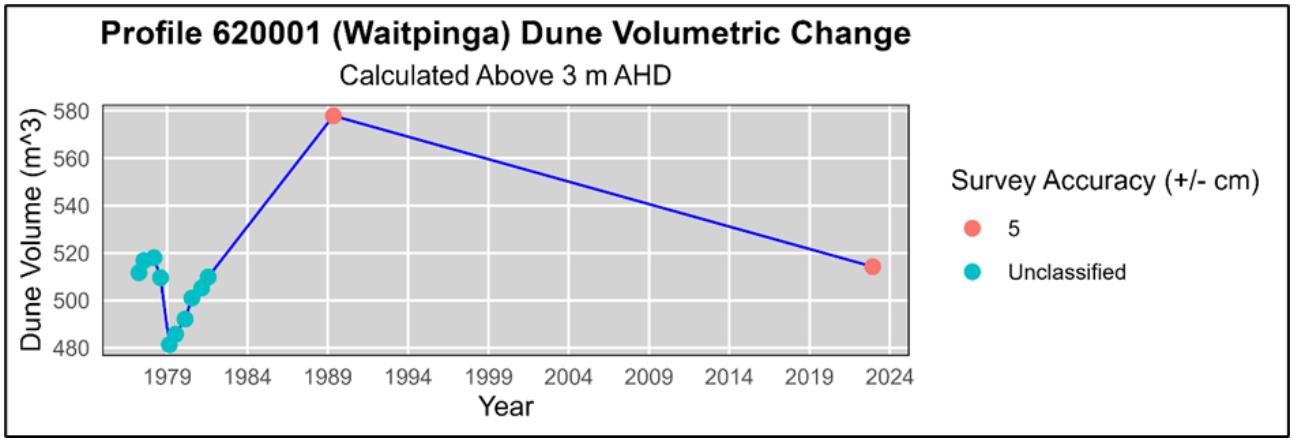


Figure 9. Volumetric change of the foredune over time post-1977. The toe of the foredune/top of the backshore is at 3m AHD.

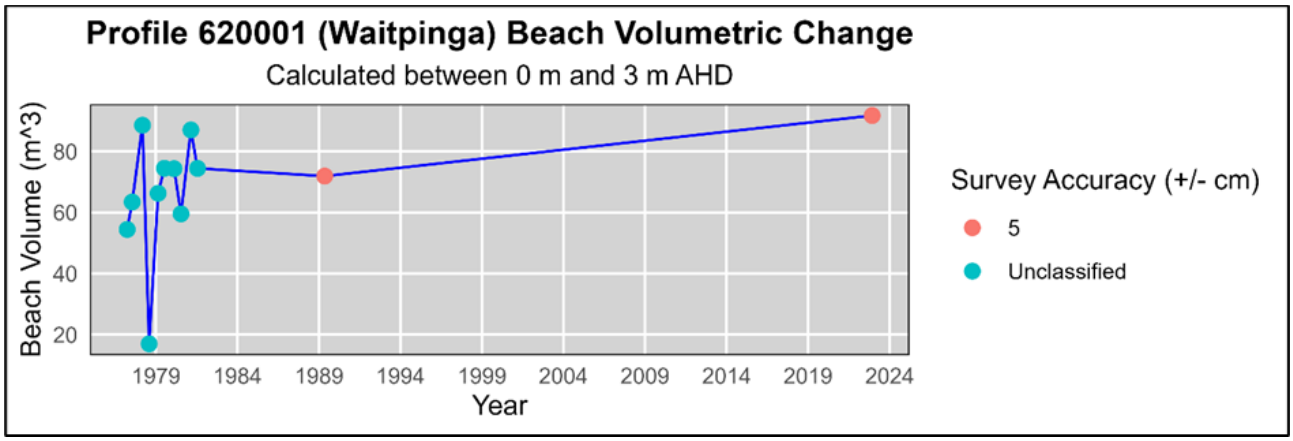


Figure 10. Beach volumetric change over time calculated between 0 and 3m AHD.

Table 1. Survey date, accuracy, beach width, dune volume, beach volume and total volume data for Waitpinga Beach, 1977-2022.

Survey	Survey Accuracy (+/- cm)	Beach Width (m)	Dune Volume (m^3)	Beach Volume (m^3)	Total Volume (m^3)
30/03/1977	Unclassified	NA	511.68	54.43	566.11
20/07/1977	Unclassified	40	516.81	63.42	580.23
7/03/1978	Unclassified	51.5	518.01	88.58	606.59
3/08/1978	Unclassified	19	509.58	16.97	526.55
21/02/1979	Unclassified	42	481.34	66.28	547.63
11/07/1979	Unclassified	44	485.73	74.46	560.19
13/02/1980	Unclassified	53.5	492.1	74.34	566.44
17/07/1980	Unclassified	42.5	501.01	59.54	560.55
24/02/1981	Unclassified	58	505.2	87.03	592.24
22/07/1981	Unclassified	51.5	509.85	74.44	584.29
10/05/1989	5	47.5	577.9	71.91	649.82
7/12/2022	5	NA	514.22	91.74	605.97
Mean Beach Width (m)	44.95				
nobs	10				
Beach Mobility	10.8				
Top of Backshore Relative Horizontal Change (m/yr)	-0.18				
Shoreline Relative Horizontal Change (m/yr)	0.8				
Dune Volume Change (m^3/yr)	0.06				
Beach Volume Change (m^3/yr)	0.72				
Total Volume Change (m^3/yr)	5.89				

3.2 Cell SF12 Inman River to Rosetta Harbour

This cell contains two profiled beaches, 62002 and 62007 (Figure 11).

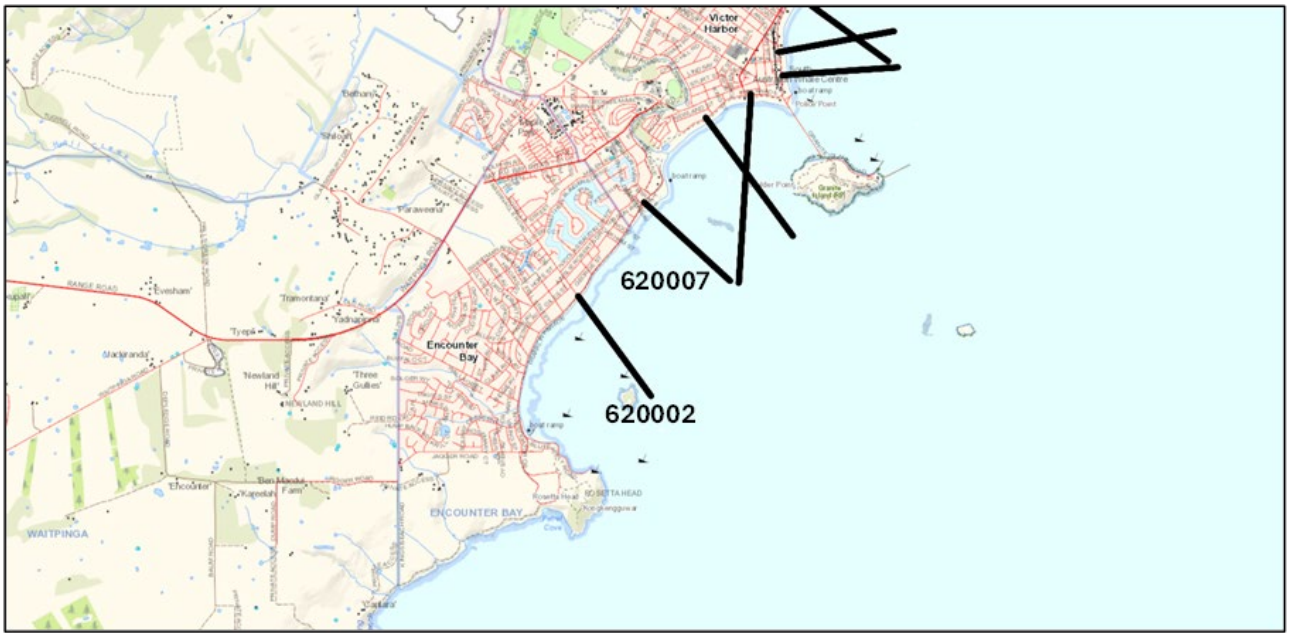


Figure 11. Surveyed beaches in the Victor Harbor region.

3.2.1 Profile 620002

Profile 620002 in Encounter Bay (Victor Harbor) indicates it built seawards from 1986 to 2018, although possible works post-1989 have taken place to assist in this process. The profile has since eroded landwards post-2018 (Figure 12 and Table 2), with considerable volumetric loss in both beach and dunes (Figures 13-16). The "dune" volumetric change actually includes human-made structures and is not a true reflection of change (Figures 15, 16).

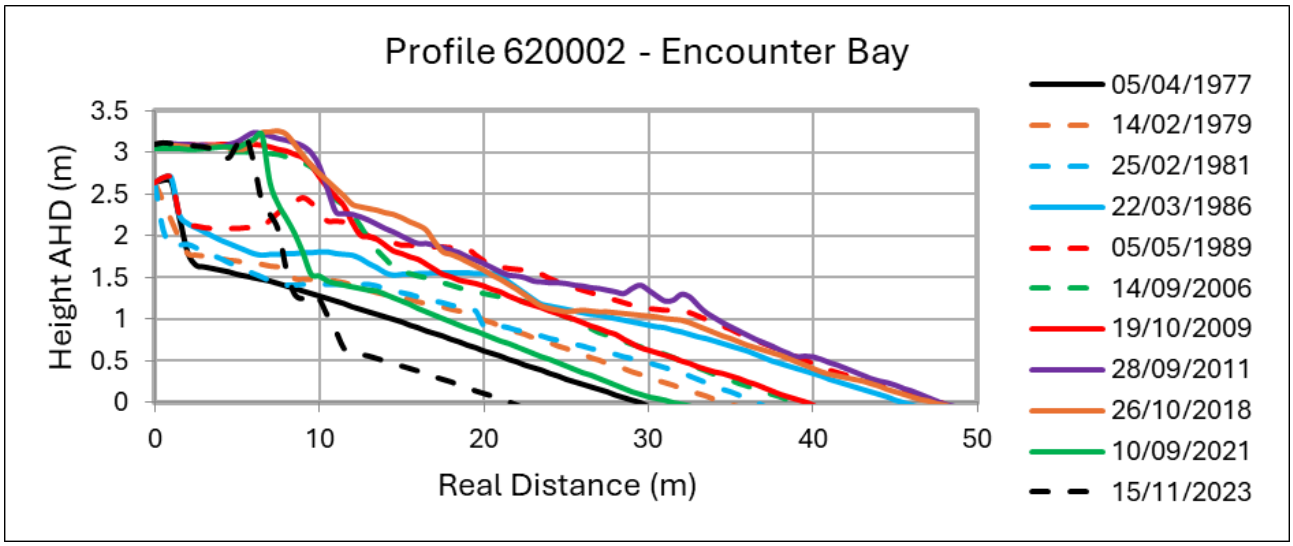


Figure12, Topographic changes in the period 1977 to 2023 at Profile 62002.

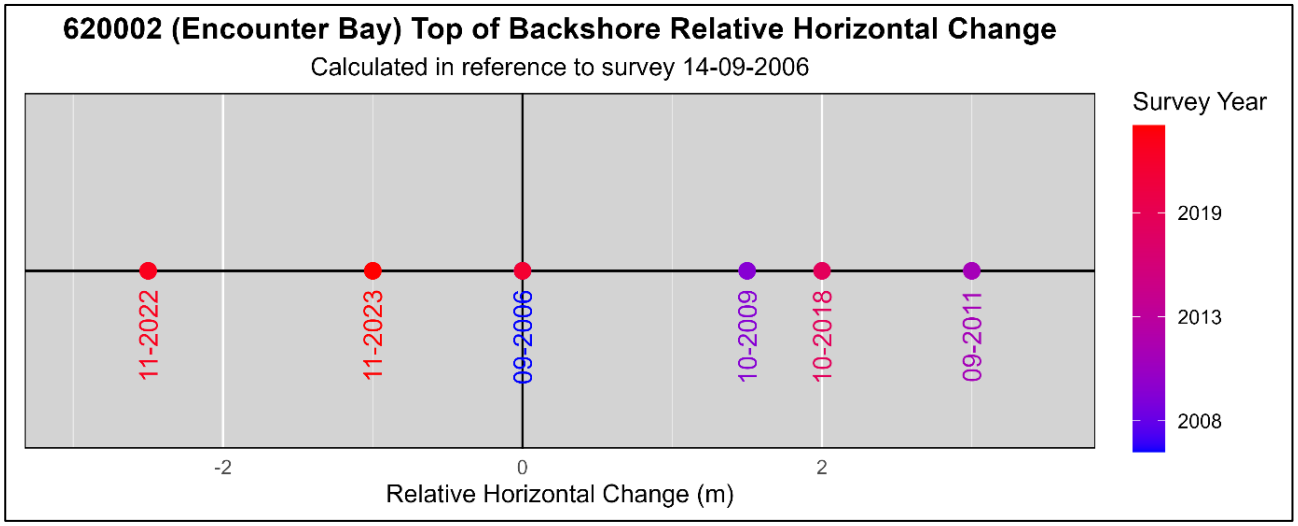


Figure 13. Relative horizontal change of the backshore at Profile 62002.

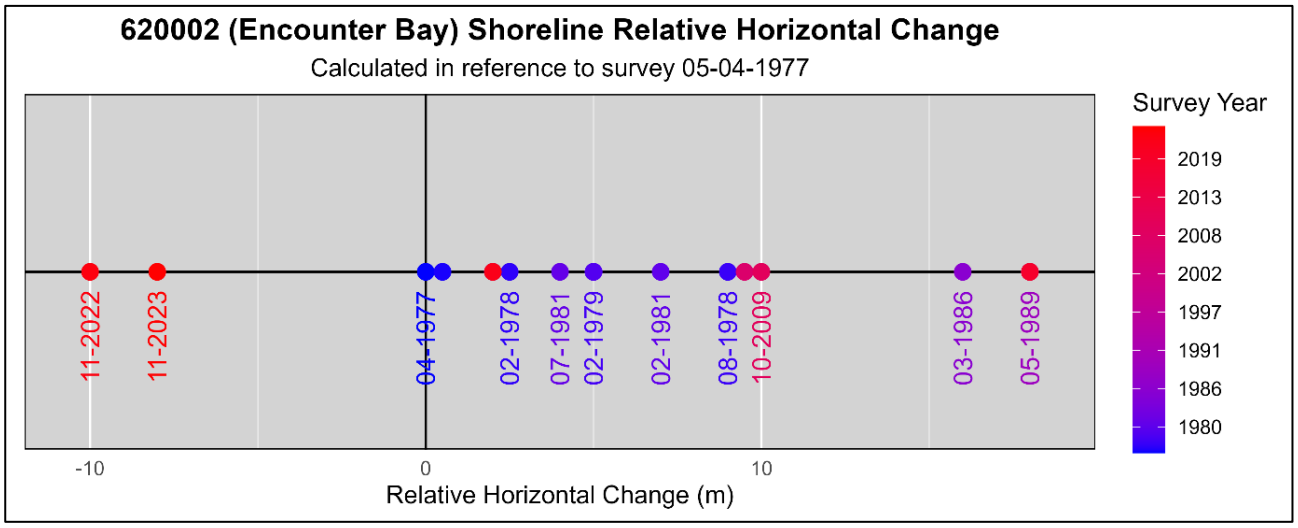


Figure 14. Relative change in the position of the shoreline at 0.0m (or AHD) seawards or landwards since 1980.

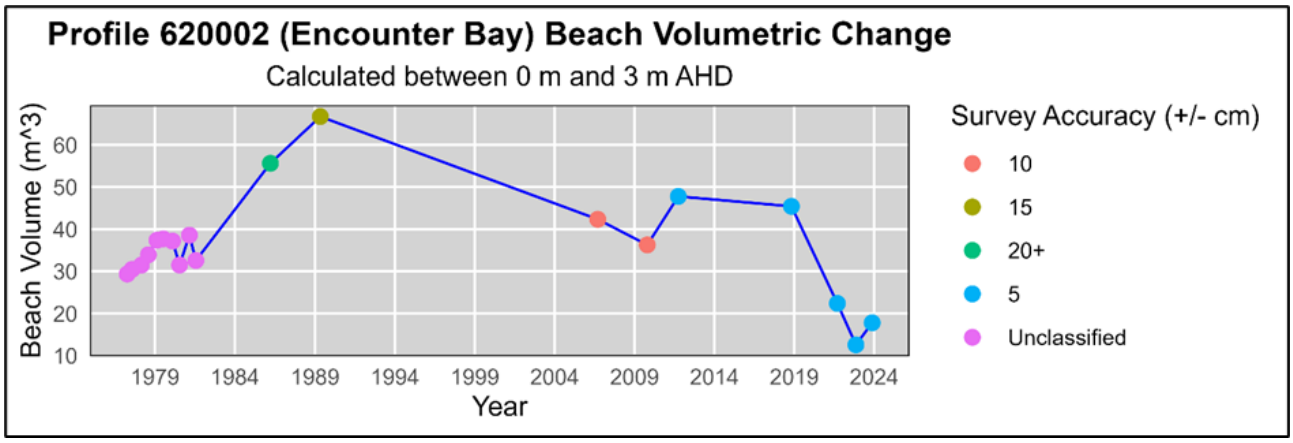


Figure 15. Beach volumetric change over time calculated between 0 and 3m AHD.

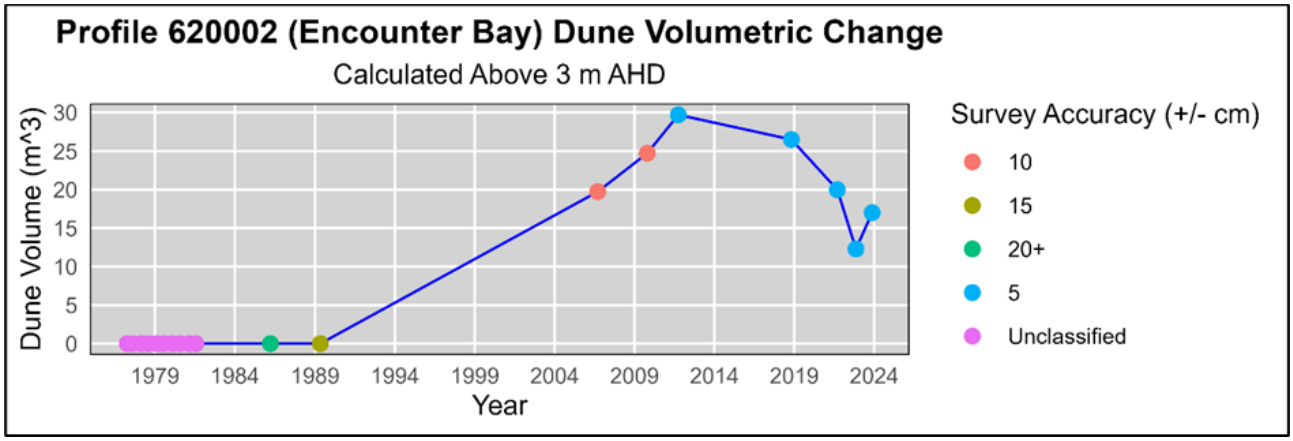


Figure 16. Volumetric change of the foredune/dune system/structures over time post-1979. The toe of the foredune/top of the backshore is at 3m AHD.

Table 2. Survey date, accuracy, beach width, dune volume, beach volume and total volume data for Profile 62002, 1977-2022.

Survey	Survey Accuracy (+/- cm)	Beach Width (m)	Dune Volume (m^3)	Beach Volume (m^3)	Total Volume (m^3)
5/04/1977	Unclassified	NA	0	29.35	29.35
26/07/1977	Unclassified	NA	0	30.46	30.46
24/02/1978	Unclassified	NA	0	31.47	31.47
1/08/1978	Unclassified	NA	0	33.93	33.93
14/02/1979	Unclassified	NA	0	37.37	37.37
9/07/1979	Unclassified	NA	0	37.69	37.69
5/02/1980	Unclassified	NA	0	37.16	37.16
15/07/1980	Unclassified	NA	0	31.48	31.48
25/02/1981	Unclassified	NA	0	38.57	38.57
22/07/1981	Unclassified	NA	0	32.56	32.56
22/03/1986	20+	NA	0	55.62	55.62
5/05/1989	15	NA	0	66.7	66.7
14/09/2006	10	32.5	19.73	42.33	62.06
19/10/2009	10	31.5	24.72	36.26	60.98
28/09/2011	5	38	29.71	47.77	77.47
26/10/2018	5	39	26.5	45.41	71.91
10/09/2021	5	25	19.98	22.38	42.36
9/11/2022	5	15.5	12.28	12.56	24.84
15/11/2023	5	16	17	17.78	34.79
Mean Beach Width (m)	28.21				
nobs	7				
Beach Mobility	9.68				
Top of Backshore Relative Horizontal Change (m/yr)	-0.06				
Shoreline Relative Horizontal Change (m/yr)	-0.17				
Dune Volume Change (m^3/yr)	-0.16				
Beach Volume Change (m^3/yr)	-0.25				
Total Volume Change (m^3/yr)	0.12				

Major shift in topography from 1989 to 2006, likely change to beach management during this period.

3.2.2 Profile 620007

Profile 620007 (Figure 17) has shown consistent erosion and retreat since 2013, with the top of the backshore retreating ~20m post-2009 (Figure 18 and Table 3), the beach retreating ~38m post-2006 (Figure 19), and dune and beach volumes reducing overtime respectively (Figures 20, 21).

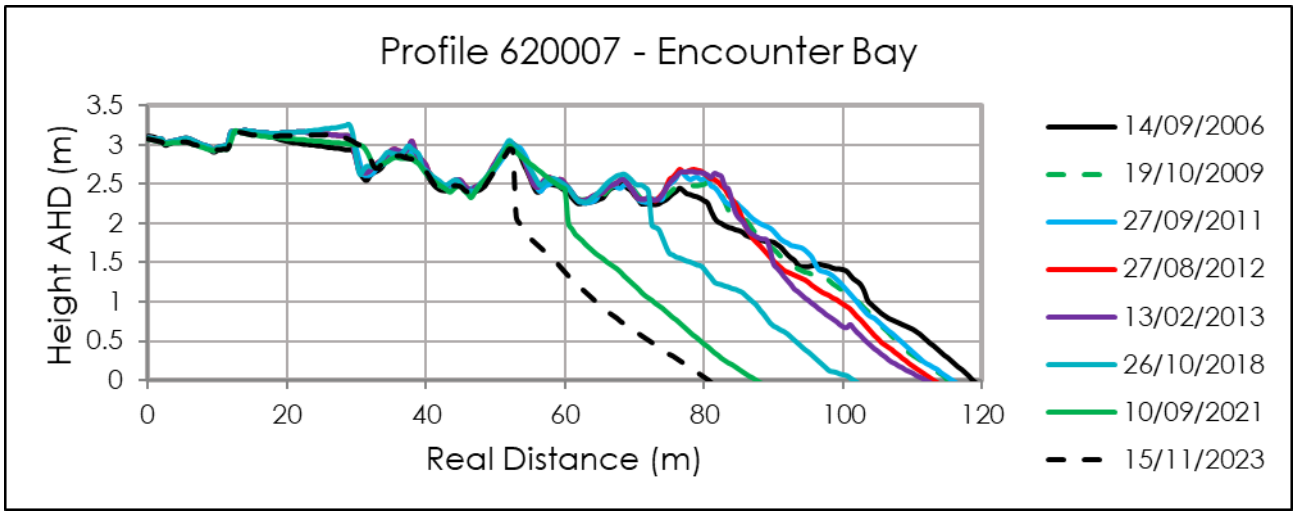


Figure 17. Topographic changes between 2006 and 2023 at Profile 620007.

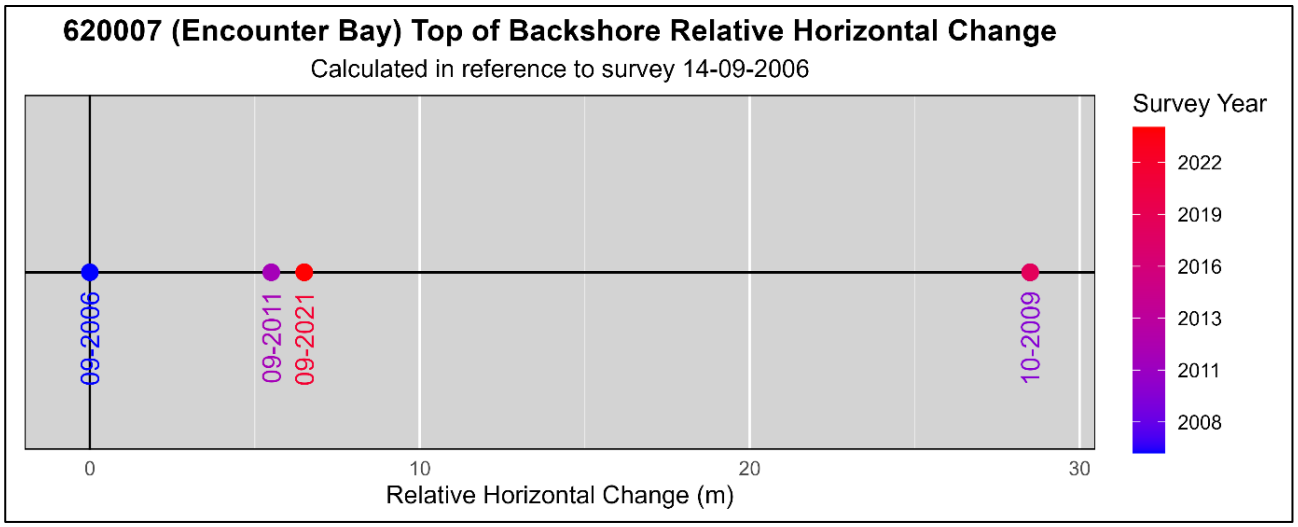


Figure 18. Horizontal movement over time of the top of the backshore position (located at 3m above AHD).

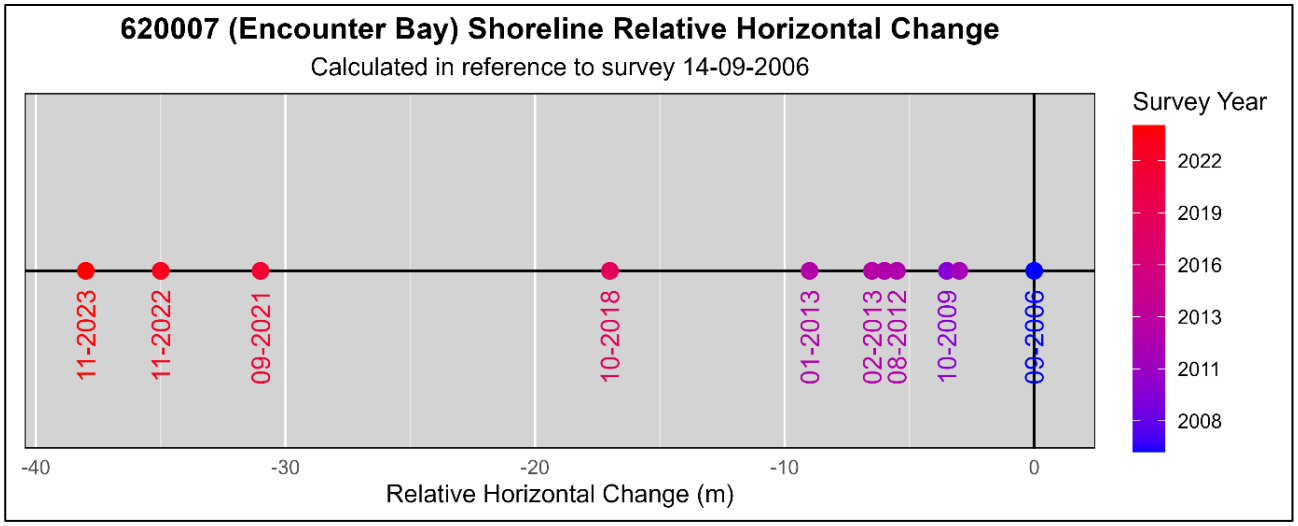


Figure 19. Relative change in the position of the shoreline at 0.0m (or AHD) seawards or landwards since 2008.

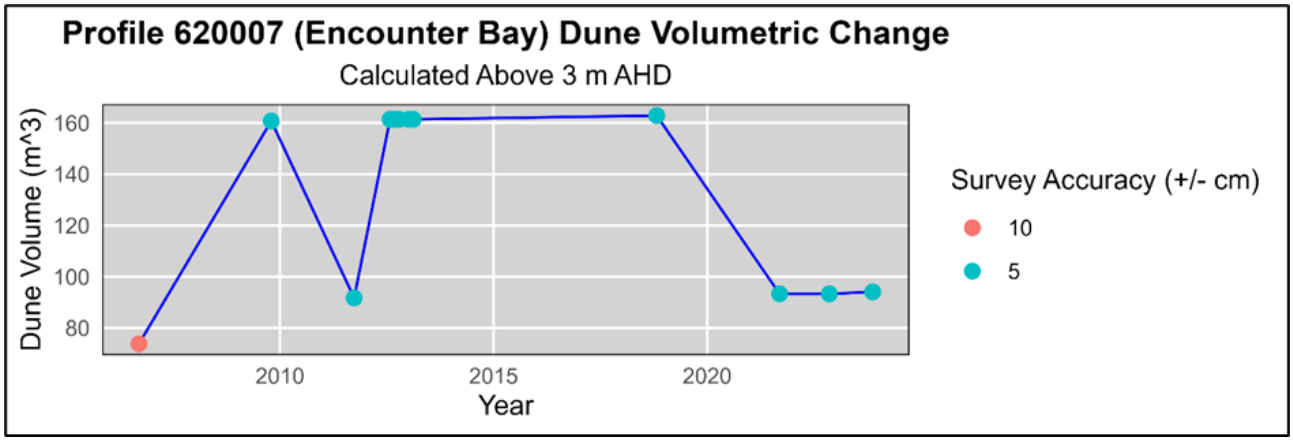


Figure 20. Volumetric change of the foredune over time. The toe of the foredune/top of the backshore is at 3m AHD.

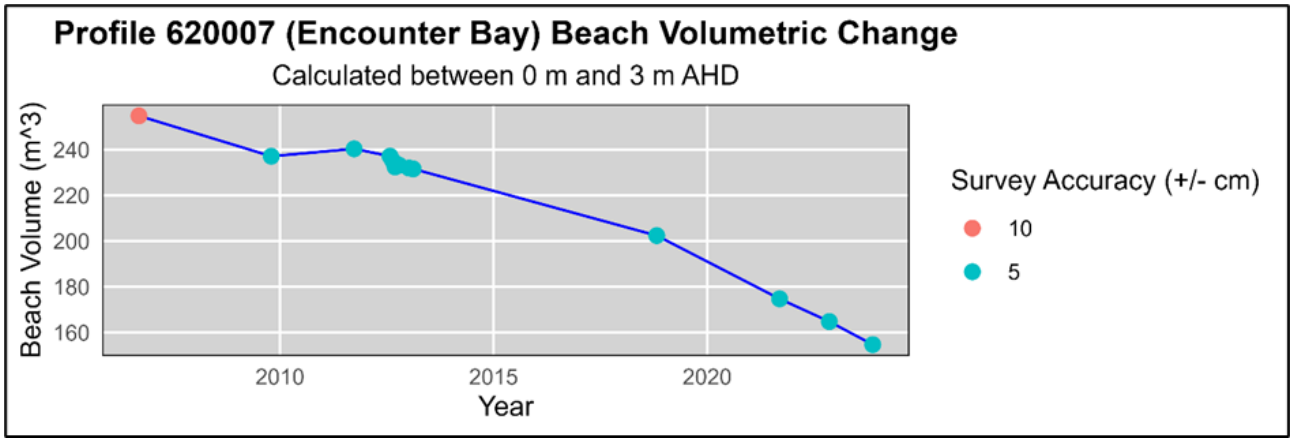


Figure 21. Beach volumetric change over time calculated between 0 and 3m AHD.

Table 3. Survey date, accuracy, beach width, dune volume, beach volume and total volume data for Profile 620007, 2006-2023.

Survey	Survey Accuracy (+/- cm)	Beach Width (m)	Dune Volume (m^3)	Beach Volume (m^3)	Total Volume (m^3)
14/09/2006	10	94.5	73.84	254.76	328.6
19/10/2009	5	62.5	160.72	237.08	397.8
27/09/2011	5	86	91.73	240.34	332.07
30/07/2012	5	NA	161.36	237.12	398.48
21/08/2012	5	60.5	161.36	235.18	396.55
11/09/2012	5	60	161.36	232.42	393.78
17/10/2012	5	60	161.36	233.14	394.5
9/01/2013	5	57	161.36	231.9	393.26
13/02/2013	5	59.5	161.36	231.55	392.91
26/10/2018	5	49	162.83	202.39	365.23
10/09/2021	5	57	93.31	174.75	268.06
9/11/2022	5	53	93.31	164.8	258.11
15/11/2023	5	50	94.08	154.73	248.81
Mean Beach Width (m)	62.42				
nobs	12				
Beach Mobility	13.79				
Top of Backshore Relative Horizontal Change (m/yr)	0.38				
Shoreline Relative Horizontal Change (m/yr)	-2.21				
Dune Volume Change (m^3/yr)	1.18				
Beach Volume Change (m^3/yr)	-5.83				
Total Volume Change (m^3/yr)	-4.65				

3.3 Cell SF11 Hindmarsh River to Inman River

Cell SF11 extends from the Hindmarsh River to the Inman River and includes five profiles (Figure 22).

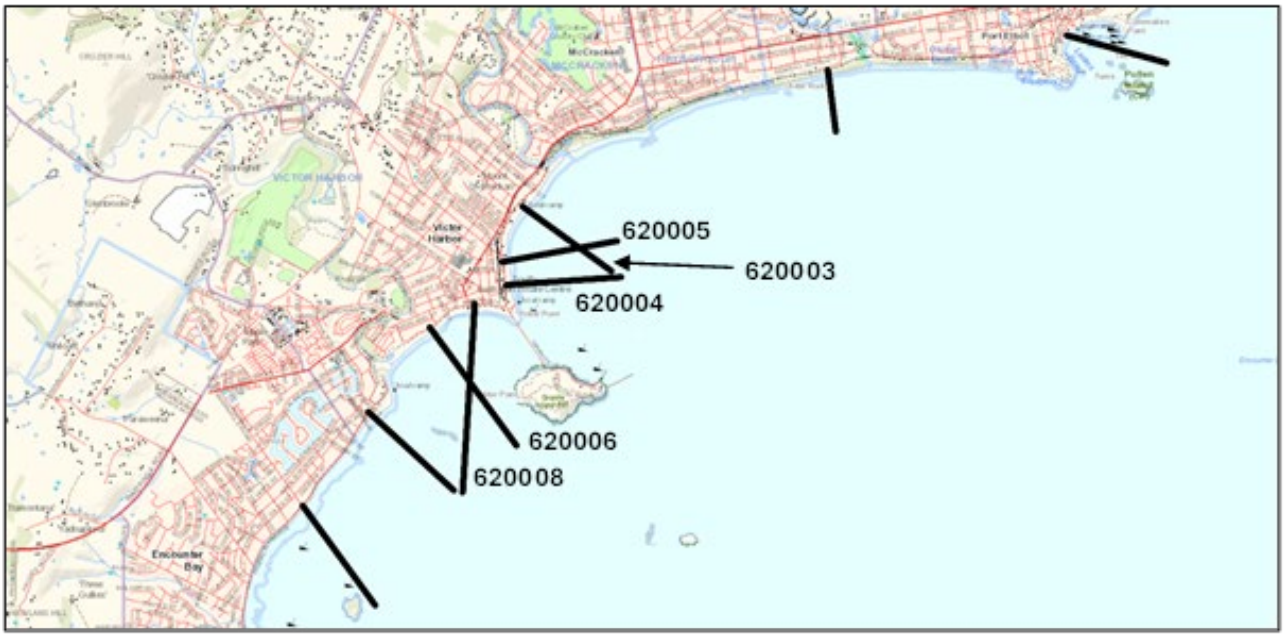


Figure 22. Location of Profile lines 62003 to 62008.

3.3.1 Profile 620006

Profile 620006 located south of the Causeway displays relatively small change overtime (Figure 23 and Table 4). The 1989-2006 surveys all have spikes on the top of the dune, likely indicating a structure positioned there over that period. The top of the backshore position has moved little (Figure 24) while the 0m AHD shoreline position has fluctuated back and forth through ~20m (Figure 25). Dune volumetric change is minimal (Figure 26), while the beach volume has increased by ~40m3/m post-2004 (Figure 27).

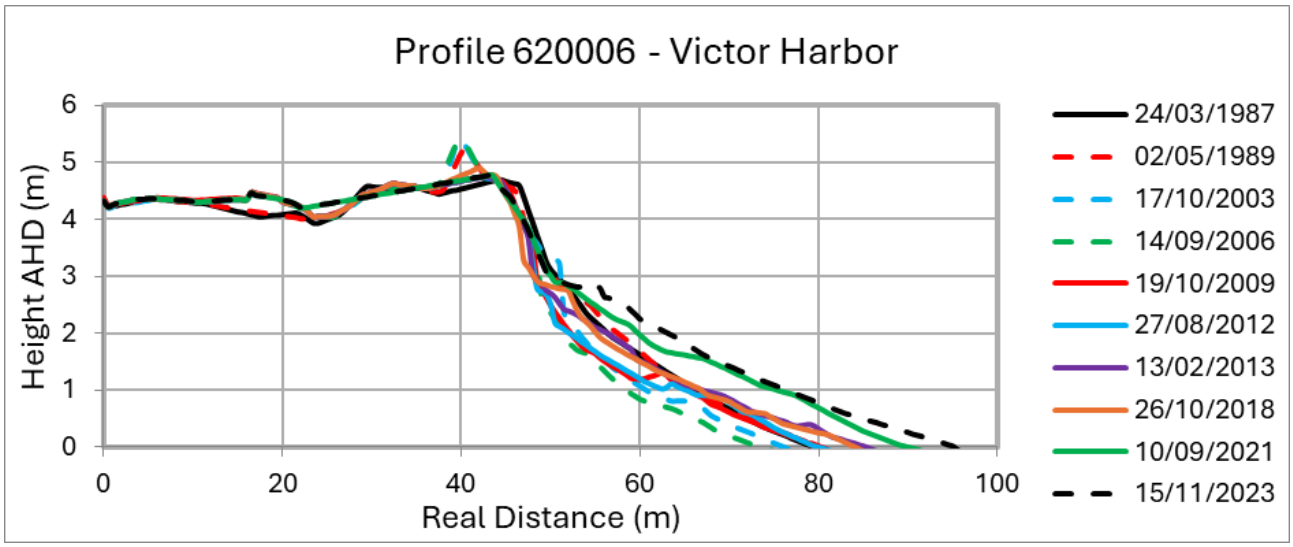


Figure 23. Topographic changes between 1987 and 2023 at Profile 620006.

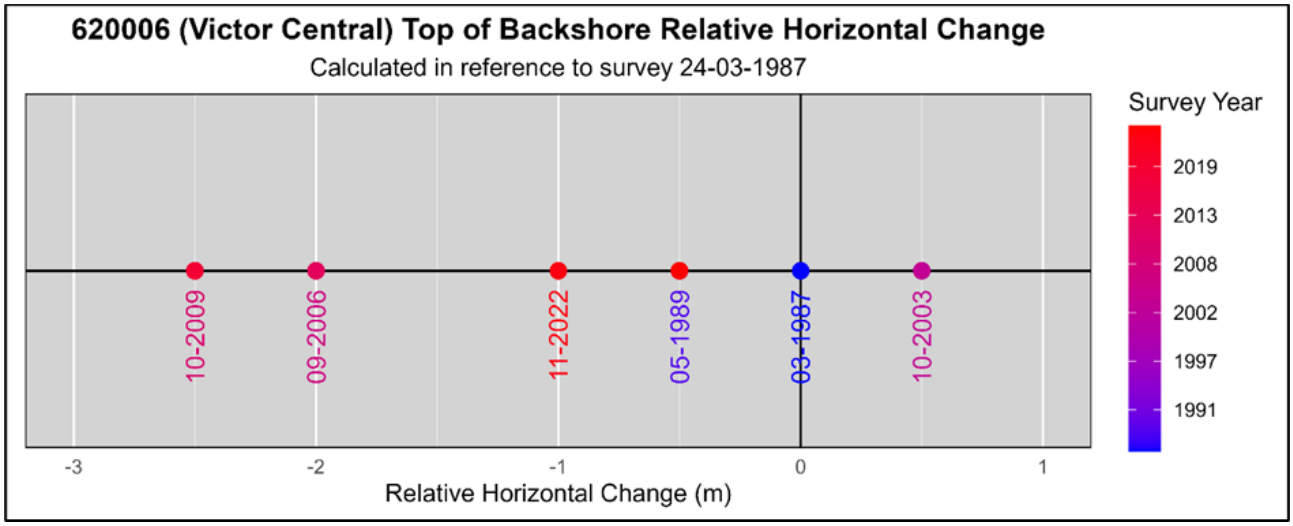


Figure 24. Horizontal movement over time of the top of the backshore position (located at 3m above AHD).

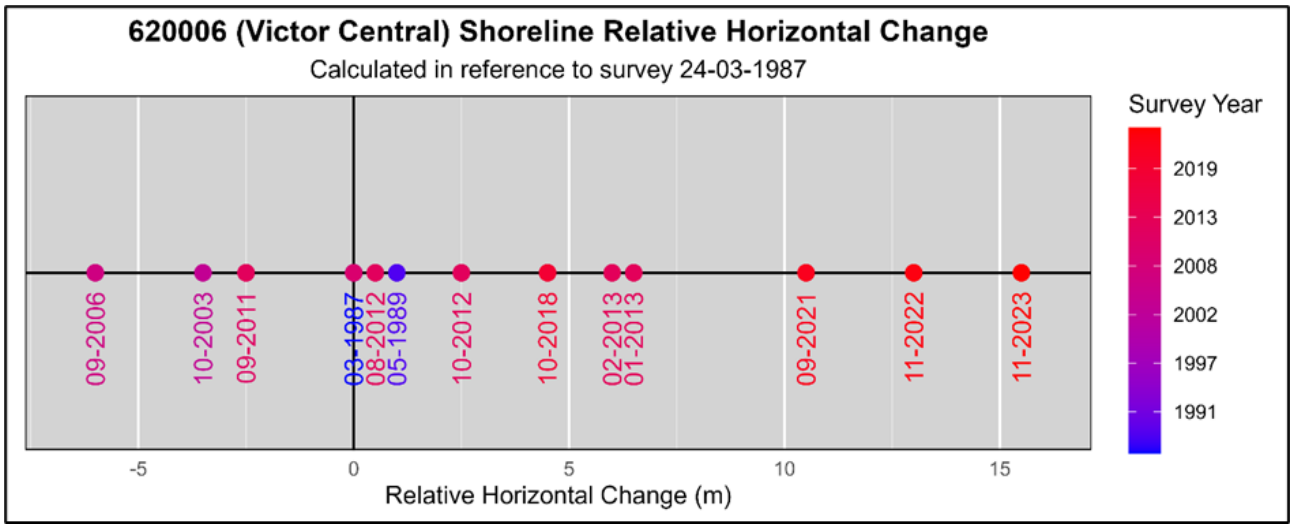


Figure 25. Relative change in the position of the shoreline at 0.0m (or AHD) seawards or landwards since 1991.

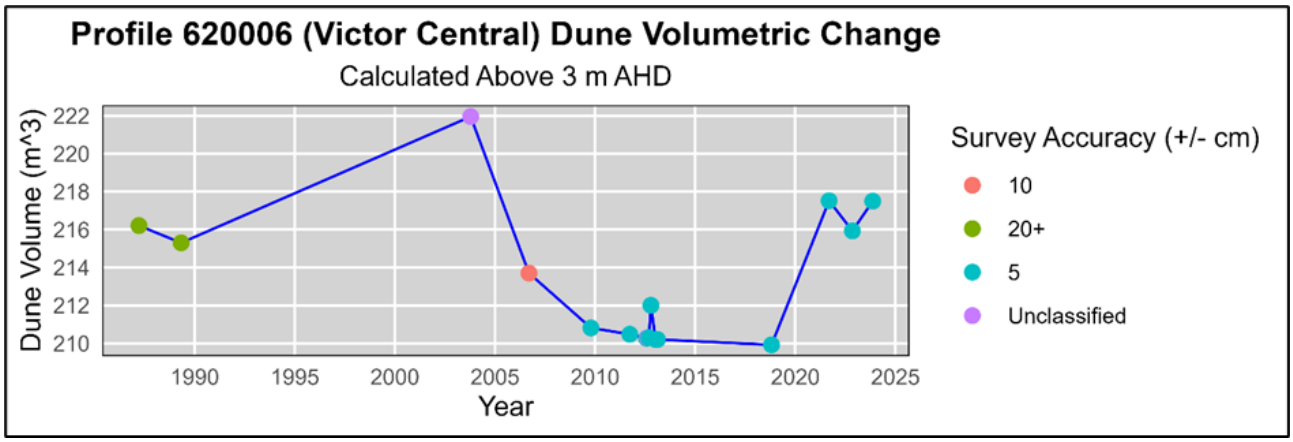


Figure 26. Volumetric change of the foredune over time. The toe of the foredune/top of the backshore is at 3m AHD.

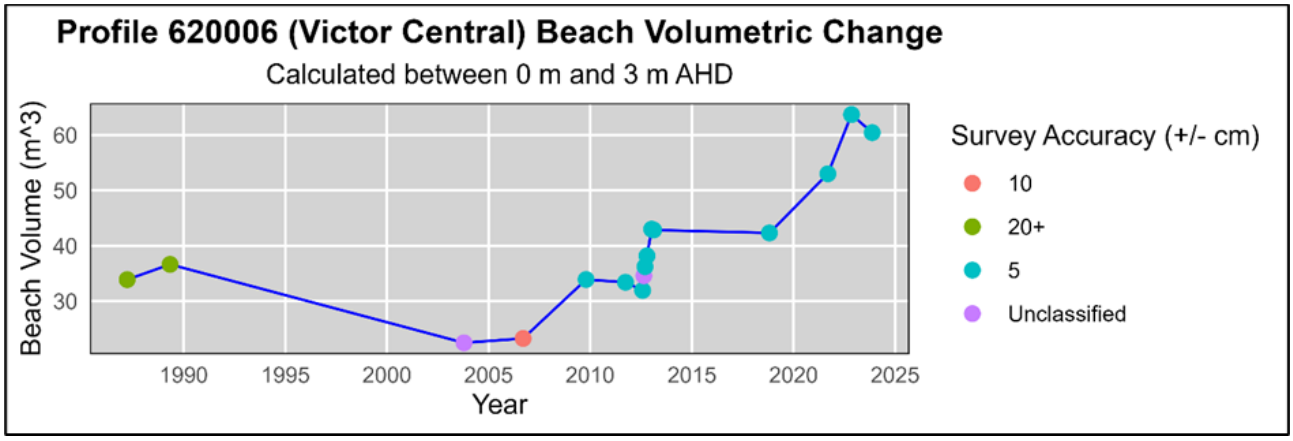


Figure 27. Beach volumetric change over time calculated between 0 and 3m AHD.

Table 4. Survey date, accuracy, beach width, dune volume, beach volume and total volume data for Profile 620006, 1987-2023.

Survey	Survey Accuracy (+/- cm)	Beach Width (m)	Dune Volume (m^3)	Beach Volume (m^3)	Total Volume (m^3)
24/03/1987	20+	29	216.21	33.89	250.1
2/05/1989	20+	30.5	215.3	36.64	251.94
17/10/2003	Unclassified	25	221.95	22.48	244.43
14/09/2006	10	25	213.7	23.26	236.96
19/10/2009	5	31.5	210.81	33.91	244.72
27/09/2011	5	29	210.48	33.41	243.88
30/07/2012	5	NA	210.27	31.93	242.2
21/08/2012	Unclassified	32	210.29	34.58	244.87
11/09/2012	5	29	210.29	36.22	246.51
17/10/2012	5	33.5	212	38.18	250.18
9/01/2013	5	38	210.2	43	253.21
13/02/2013	5	37.5	210.2	42.84	253.05
26/10/2018	5	36	209.92	42.32	252.24
10/09/2021	5	40	217.52	53	270.52
9/11/2022	5	43	215.93	63.69	279.62
15/11/2023	5	45	217.49	60.43	277.93
Mean Beach Width (m)	33.6				
nobs	15				
Beach Mobility	6.14				
Top of Backshore Relative Horizontal Change (m/yr)	-0.01				
Shoreline Relative Horizontal Change (m/yr)	0.42				
Dune Volume Change (m^3/yr)	0.04				
Beach Volume Change (m^3/yr)	0.72				
Total Volume Change (m^3/yr)	0.76				

3.3.2 Profile 620008

Profile 620008 is located immediately south of the Causeway in Victor Harbor (Figure 28). This profile displays a similar trend to the adjacent profile 620006 and has gradually accreted over time (Figures 29–32 and Table 5).

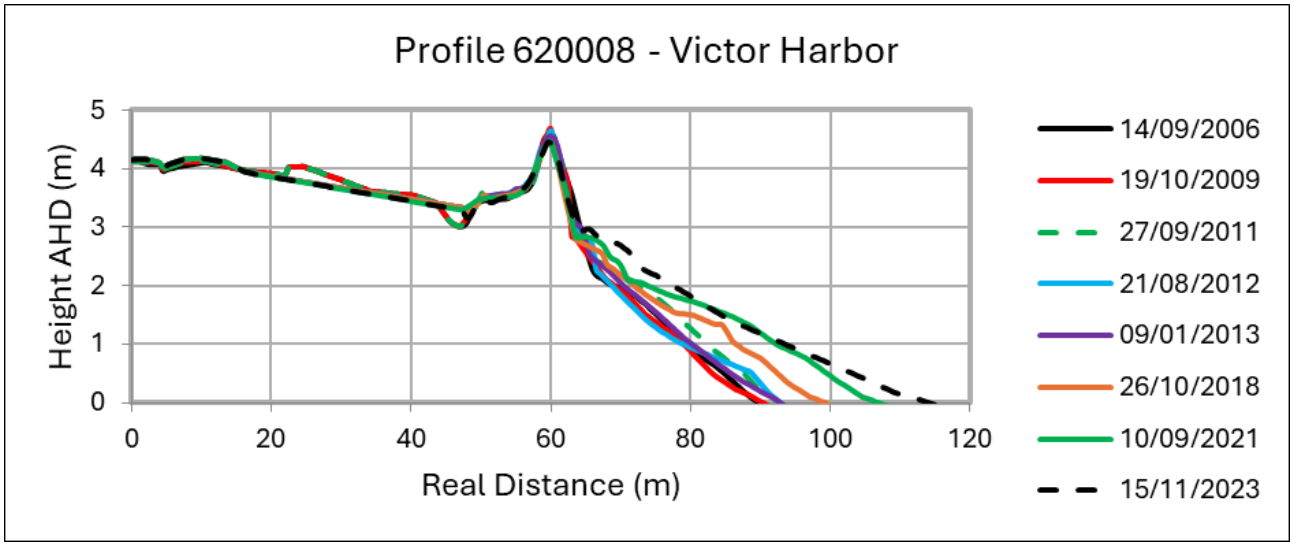


Figure 28. Topographic changes between 2006 and 2023 at Profile 620008.

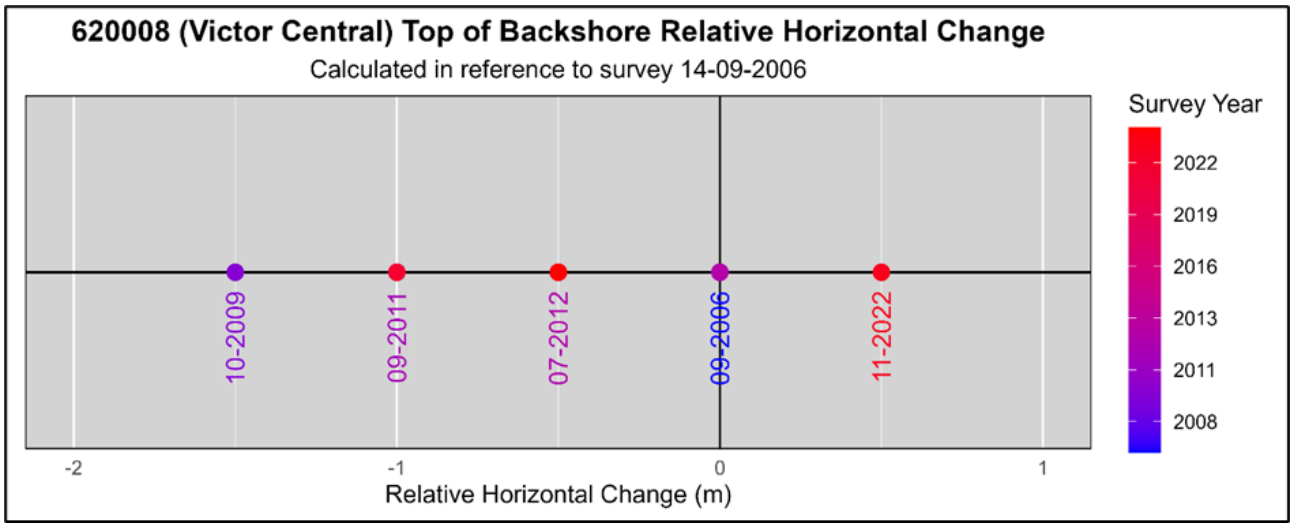


Figure 29. Horizontal movement over time of the top of the backshore position (located at 3m above AHD).

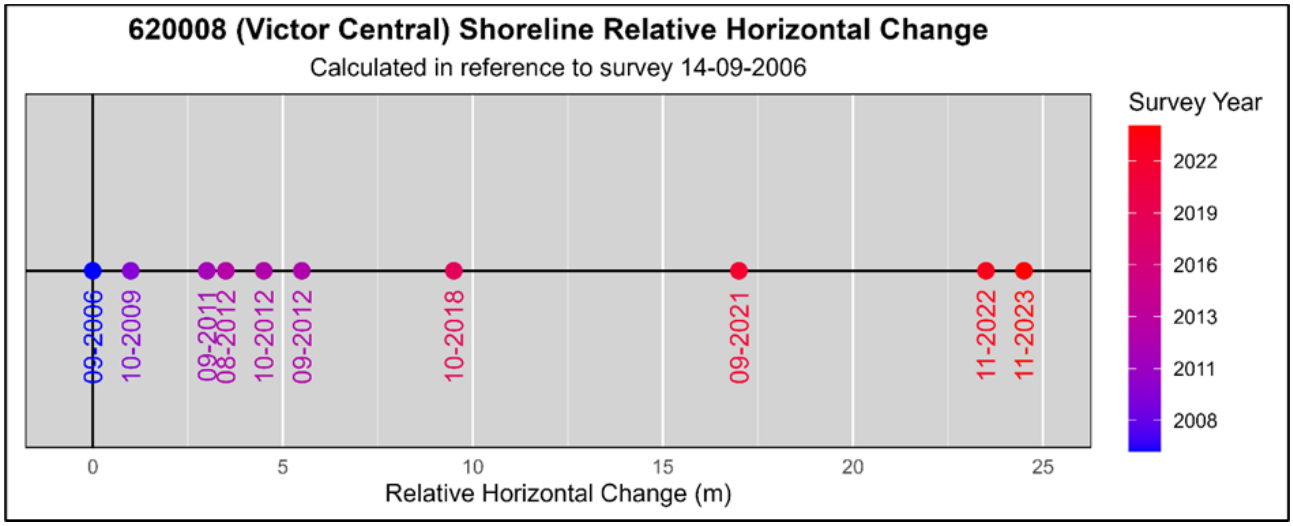


Figure 30. Relative change in the position of the shoreline at 0.0m (or AHD) seawards or landwards since 2008.

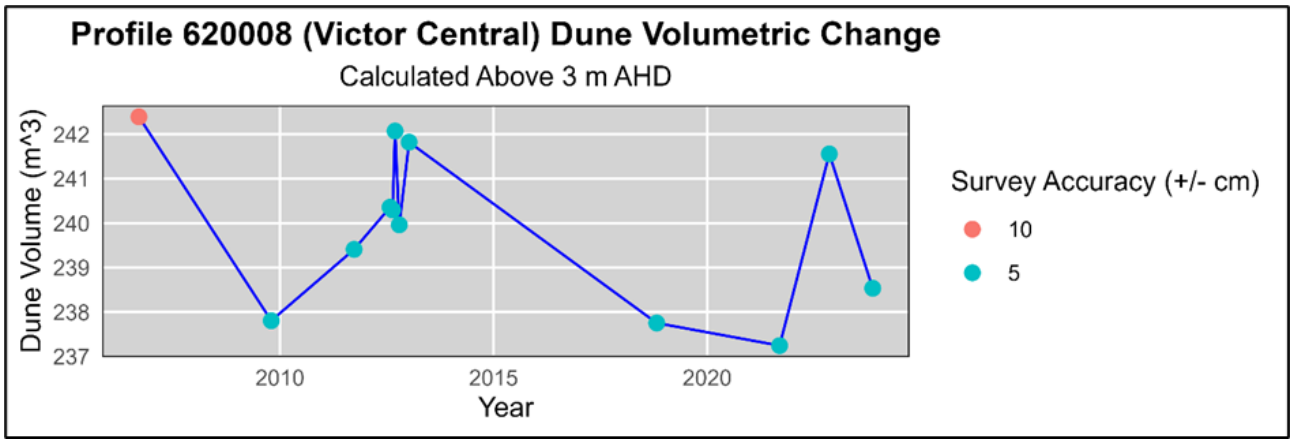


Figure 31. Volumetric change of the foredune over time. The toe of the foredune/top of the backshore is at 3m AHD.

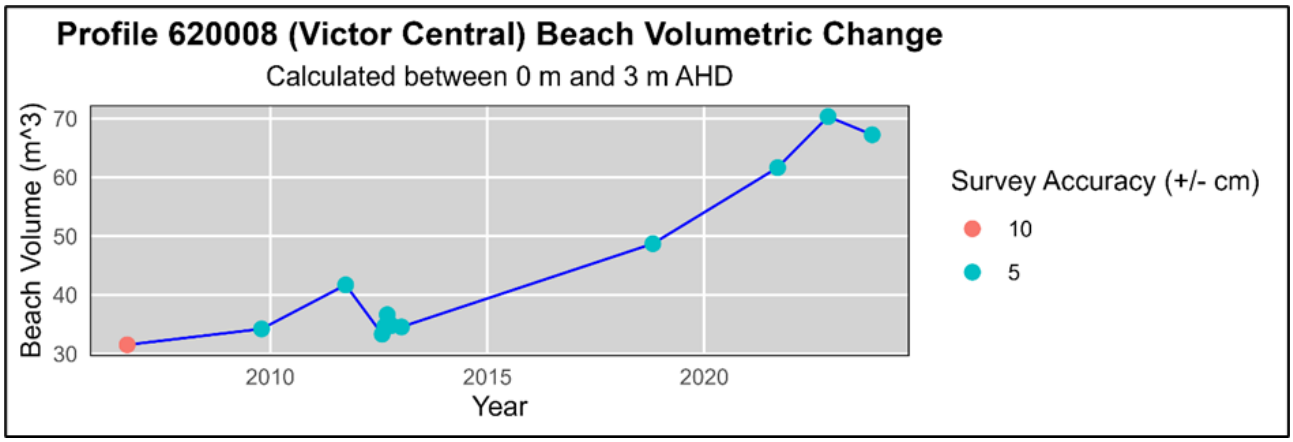


Figure 32. Beach volumetric change over time calculated between 0 and 3m AHD.

Table 5. Survey date, accuracy, beach width, dune volume, beach volume and total volume data for Profile 620008, 2006-2023.

Survey	Survey Accuracy (+/- cm)	Beach Width (m)	Dune Volume (m^3)	Beach Volume (m^3)	Total Volume (m^3)
14/09/2006	10	25.5	242.39	31.52	273.91
19/10/2009	5	28	237.81	34.22	272.03
27/09/2011	5	29.5	239.41	41.71	281.12
30/07/2012	5	NA	240.36	33.32	273.68
21/08/2012	5	29.5	240.3	34.66	274.95
11/09/2012	5	31	242.07	36.64	278.71
17/10/2012	5	30.5	239.96	34.79	274.75
9/01/2013	5	29	241.82	34.56	276.39
26/10/2018	5	36	237.75	48.72	286.47
10/09/2021	5	43.5	237.24	61.64	298.89
9/11/2022	5	48.5	241.56	70.32	311.88
15/11/2023	5	50.5	238.53	67.24	305.77
Mean Beach Width (m)	34.68				
nobs	11				
Beach Mobility	8.76				
Top of Backshore Relative Horizontal Change (m/yr)	-0.03				
Shoreline Relative Horizontal Change (m/yr)	1.43				
Dune Volume Change (m^3/yr)	-0.22				
Beach Volume Change (m^3/yr)	2.08				
Total Volume Change (m^3/yr)	1.86				

3.3.3 Profile 620004

Profile 620004 is located immediately north of the Causeway (Figure 33). It has been stable above 2m AHD due to the structures emplaced there, while the beach has varied seawards and landwards over ~20m over time (Figures 34–35 and Table 6).

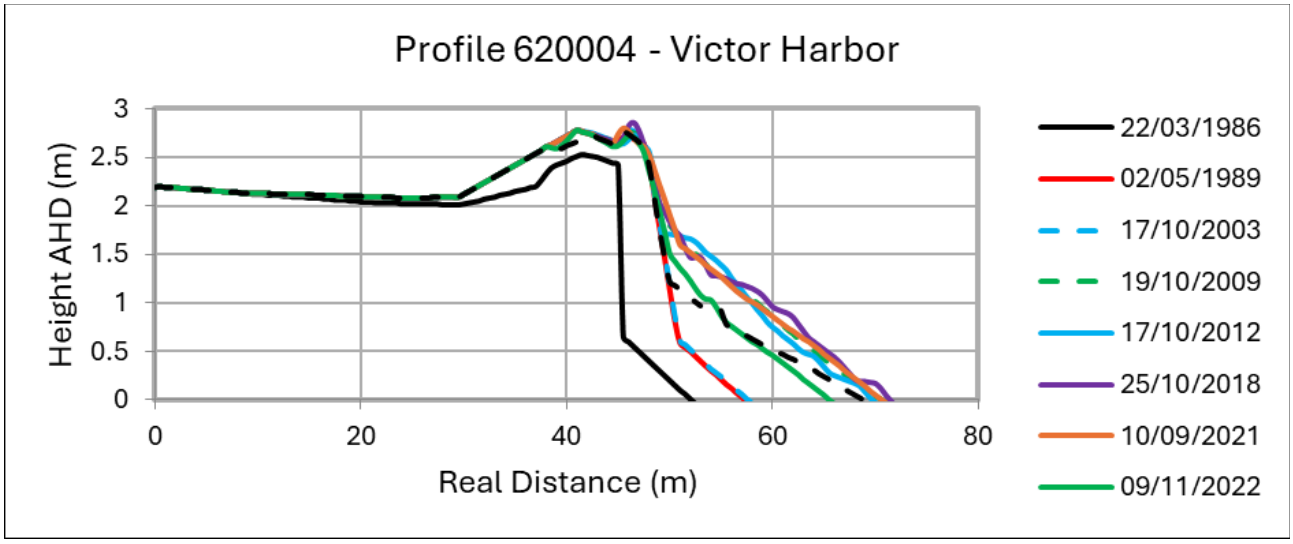


Figure 33. Topographic changes between 1986 and 2022 at Profile 620004.

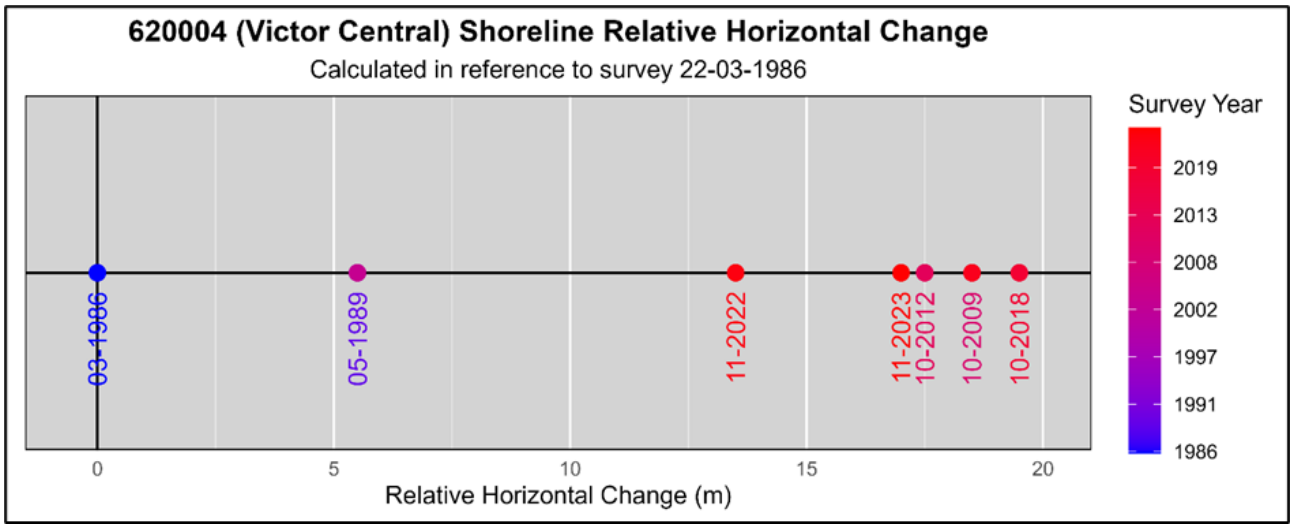


Figure 34. Relative change in the position of the shoreline at 0.0m (or AHD) seawards or landwards since 1977.

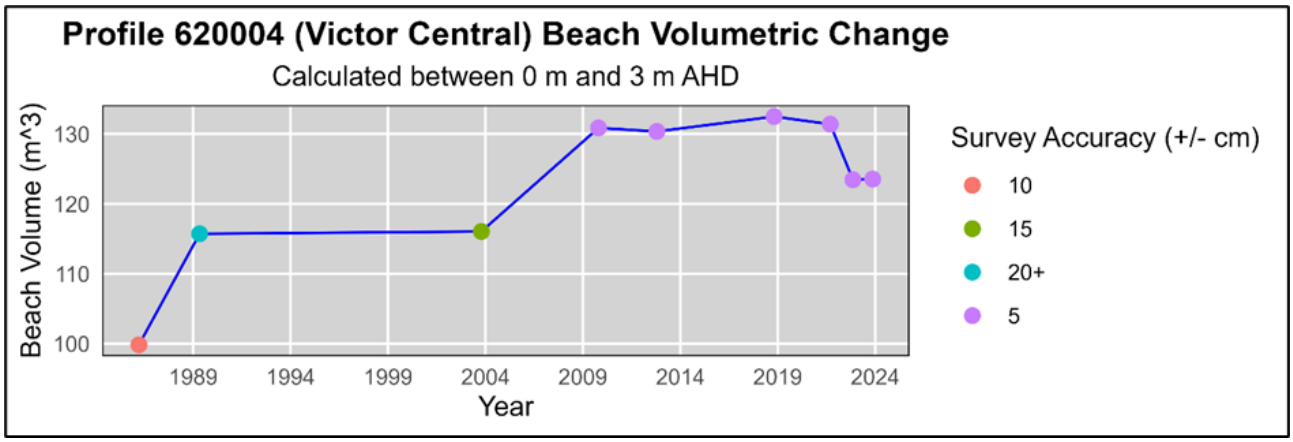


Figure 35. Beach volumetric change over time calculated between 0 and 3m AHD.

Table 6. Survey date, accuracy, beach width, dune volume, beach volume and total volume data for profile 620004, 1986-2023.

Survey	Survey Accuracy (+/- cm)	Beach Width (m)	Dune Volume (m^3)	Beach Volume (m^3)	Total Volume (m^3)
22/03/1986	10	NA	0	99.83	99.83
2/05/1989	20+	NA	0	115.71	115.71
17/10/2003	15	NA	0	116.05	116.05
19/10/2009	5	NA	0	130.86	130.86
17/10/2012	5	NA	0	130.36	130.36
25/10/2018	5	NA	0	132.49	132.49
10/09/2021	5	NA	0	131.39	131.39
9/11/2022	5	NA	0	123.45	123.45
15/11/2023	5	NA	0	123.55	123.55
Mean Beach Width (m)	NA				
nobs	0				
Beach Mobility	NA				
Top of Backshore Relative Horizontal Change (m/yr)	NA				
Shoreline Relative Horizontal Change (m/yr)	0.45				
Dune Volume Change (m^3/yr)	NA				
Beach Volume Change (m^3/yr)	0.63				
Total Volume Change (m^3/yr)	0.63				

3.3.4 Profile 620005

Profile 620005 is located opposite the central portion of Flinders Parade in Victor Harbor (Figure 36). It has a stabilised landward edge and the beach has fluctuated around 9m over the survey period (Figures 37 to 40 and Table 7).

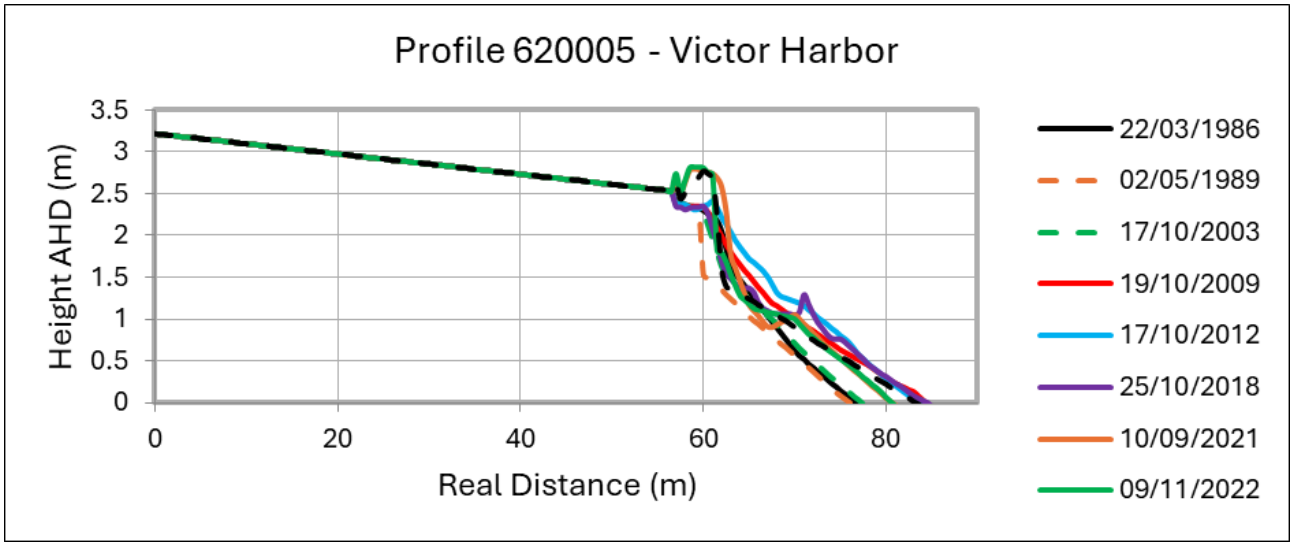


Figure 36. Topographic changes between 1986 and 2022 at Profile 620005.

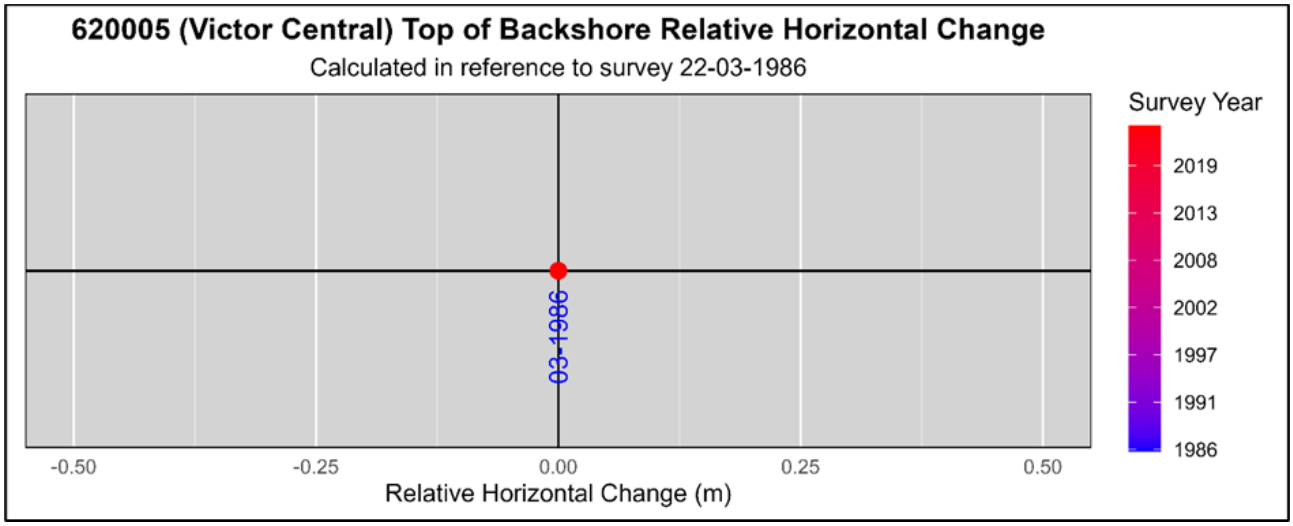


Figure 37. Horizontal movement over time of the top of the backshore position (located at 3m above AHD).

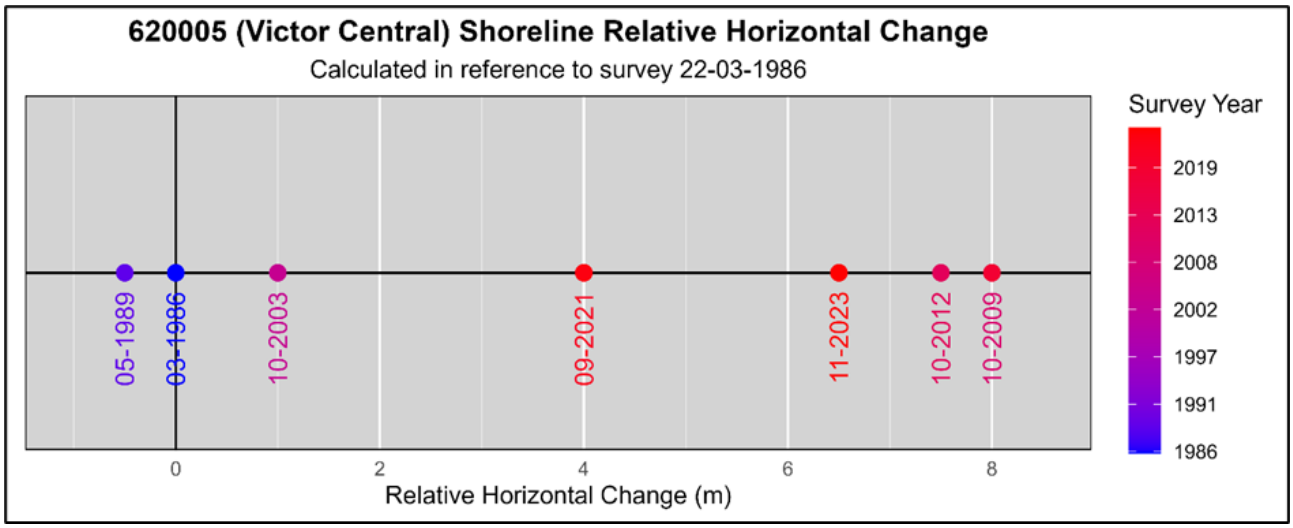


Figure 38. Relative change in the position of the shoreline at 0.0m (or AHD) seawards or landwards since 1977.

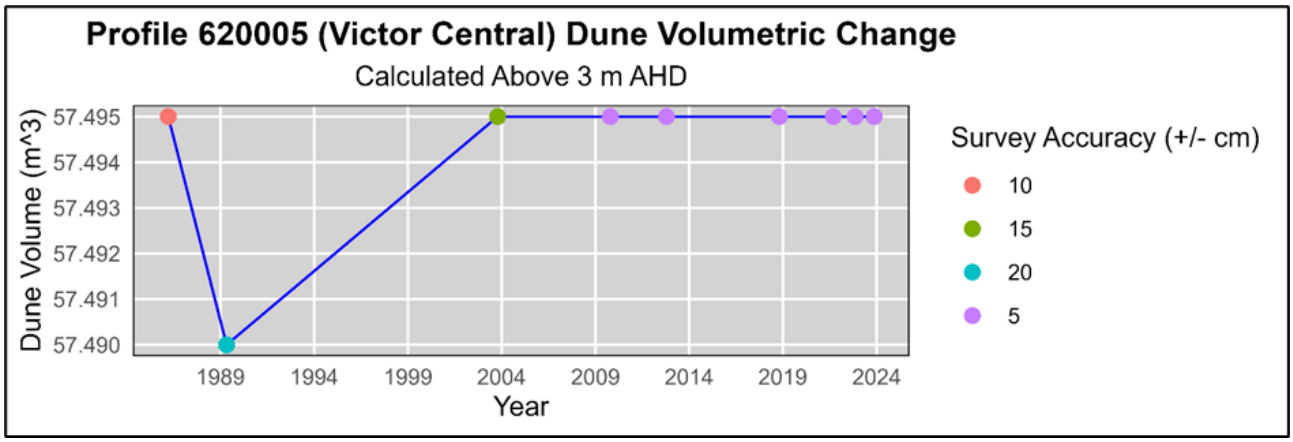


Figure 39. Volumetric change of the dune/infrastructure over time. The toe of the foredune/top of the backshore is at 3m AHD.

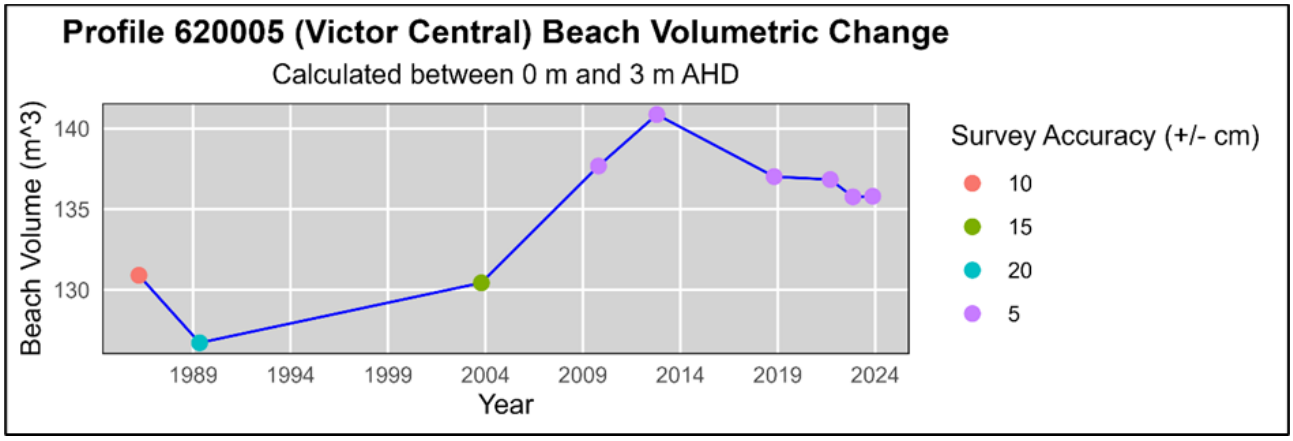


Figure 40. Beach volumetric change over time calculated between 0 and 3m AHD.

Table 7. Survey date, accuracy, beach width, dune volume, beach volume and total volume data for profile620005, 1986-2023.

Survey	Survey Accuracy (+/- cm)	Beach Width (m)	Dune Volume (m^3)	Beach Volume (m^3)	Total Volume (m^3)
22/03/1986	10	58	57.5	130.9	188.4
2/05/1989	20	57.5	57.49	126.72	184.21
17/10/2003	15	59	57.5	130.44	187.93
19/10/2009	5	66	57.5	137.68	195.17
17/10/2012	5	65.5	57.5	140.86	198.36
25/10/2018	5	66	57.5	137.02	194.52
10/09/2021	5	62	57.5	136.84	194.33
9/11/2022	5	62	57.5	135.77	193.26
15/11/2023	5	64.5	57.5	135.8	193.3
Mean Beach Width (m)	62.28				
nobs	9				
Beach Mobility	3.45				
Top of Backshore Relative Horizontal Change (m/yr)	0				
Shoreline Relative Horizontal Change (m/yr)	0.17				
Dune Volume Change (m^3/yr)	0				
Beach Volume Change (m^3/yr)	0.13				
Total Volume Change (m^3/yr)	0.13				

3.3.5 Profile 620003

Profile 620003 is located in the southern bay south of the Hindmarsh River entrance. The topographic changes shown in Figure 41 also indicate there is minimal sediment in this Victor Harbor region as indicated by the other Victor Harbor profiles. The top of the backshore and the 0m AHD position have only changed over a few metres (Figures 42 and 43 and Table 8). "dune"/landward landform volume change is very small (Figure 44), and beach changes are minimal (Figure 45).

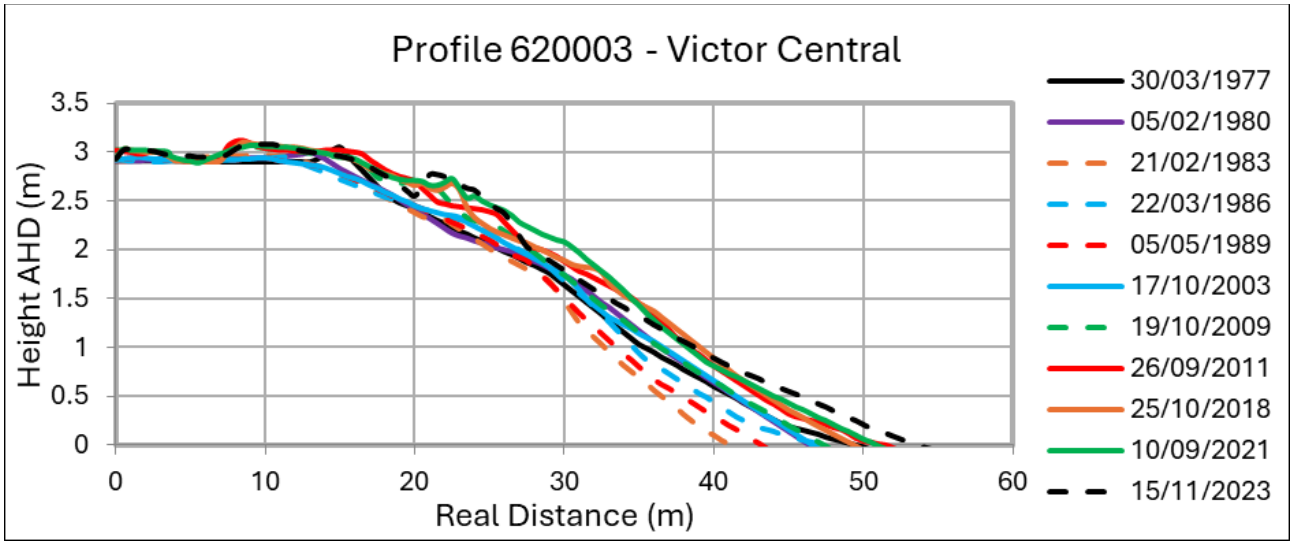


Figure 41. Topographic changes between 1977 and 2023 at Profile 620003.

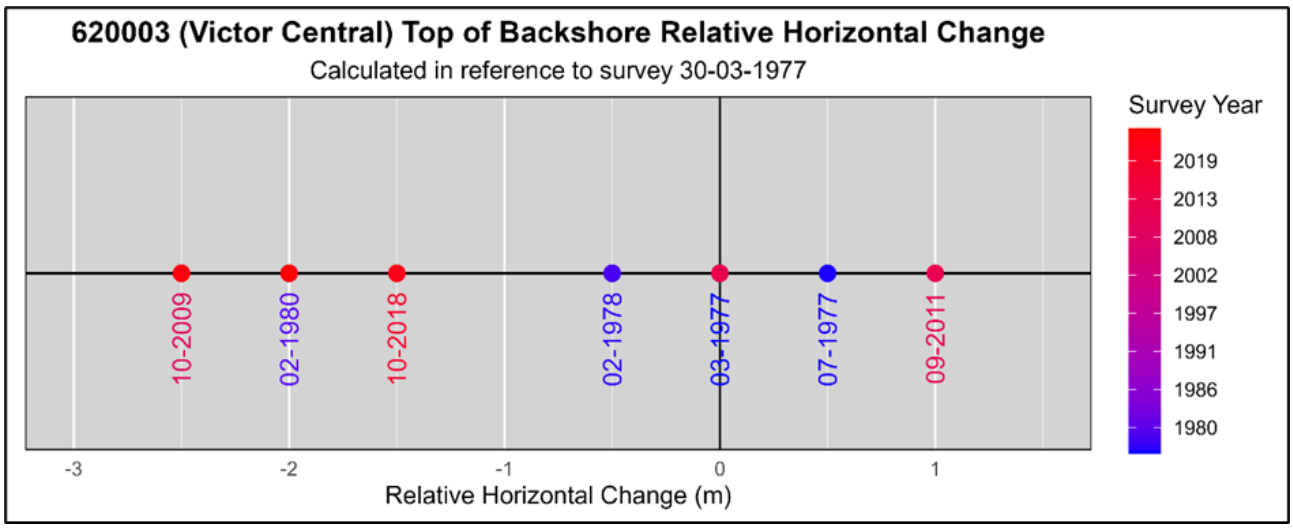


Figure 42. Horizontal movement over time of the top of the backshore position (located at 3m above AHD).

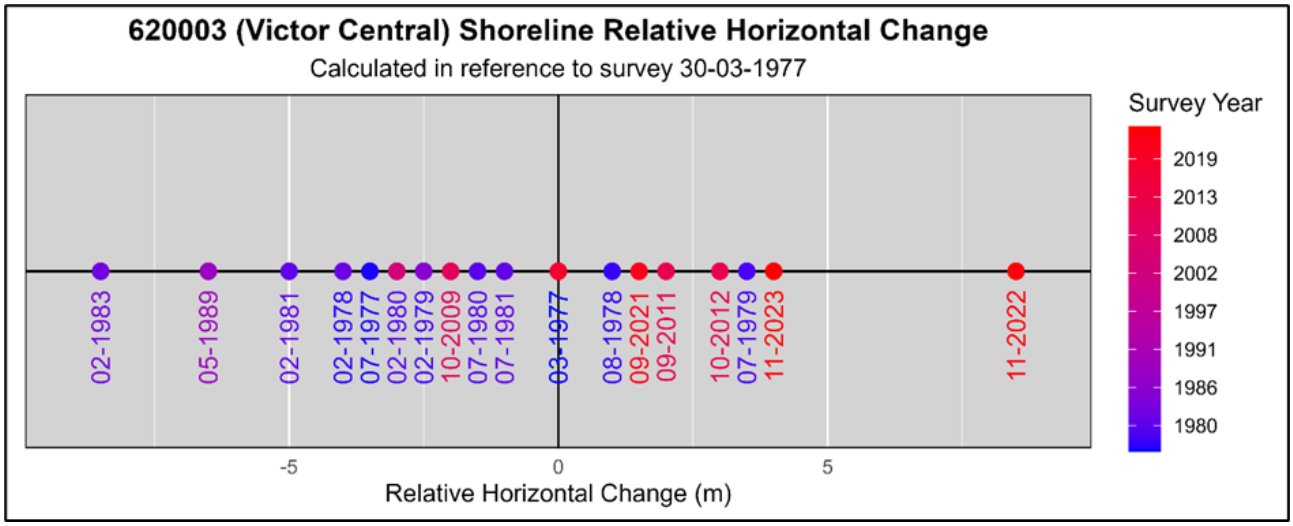


Figure 43. Relative change in the position of the shoreline at 0.0m (or AHD) seawards or landwards since 1980.

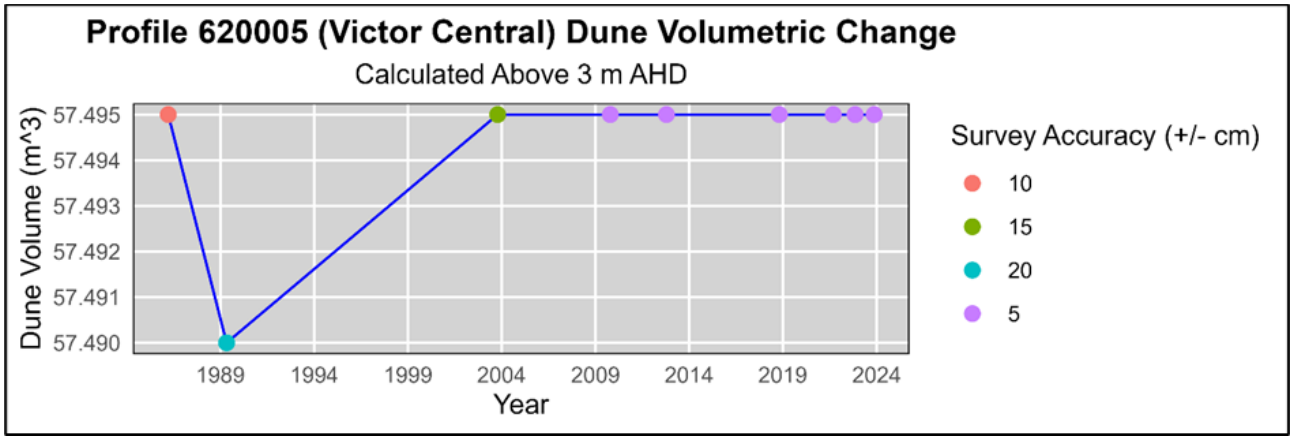


Figure 44. Volumetric change of the foredune/backing landform over time. The toe of the foredune/top of the backshore is at 3m AHD.

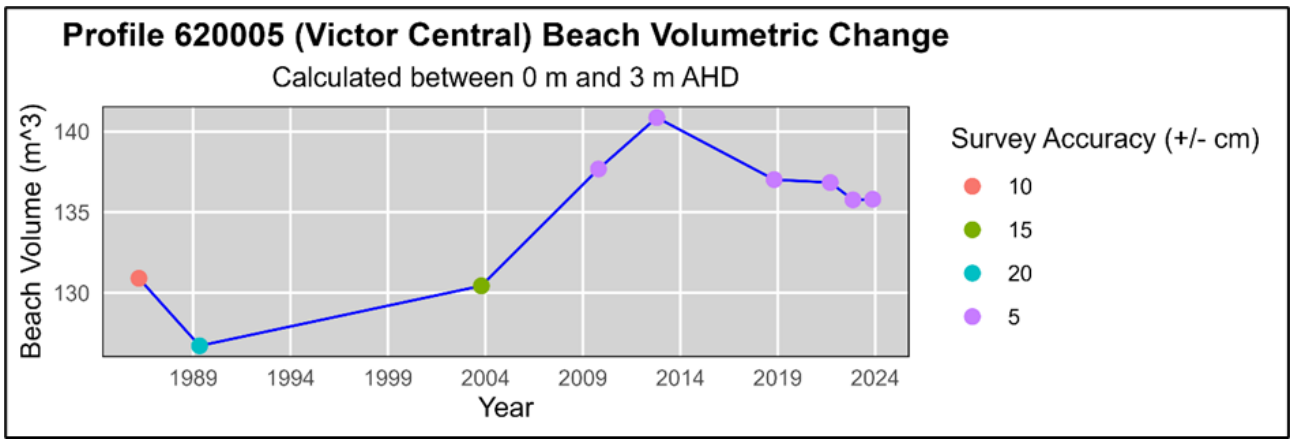


Figure 45. Beach volumetric change over time calculated between 0 and 3m AHD.

Table 8. Survey date, accuracy, beach width, dune volume, beach volume and total volume data for profile 620005, 1977-2024.

Survey	Survey Accuracy (+/- cm)	Beach Width (m)	Dune Volume (m^3)	Beach Volume (m^3)	Total Volume (m^3)
30/03/1977	Unclassified	34.5	1.52	90.69	92.21
27/07/1977	Unclassified	30.5	3.04	89.91	92.95
24/02/1978	Unclassified	31	3.06	89.32	92.37
1/08/1978	Unclassified	36	3.05	93.38	96.44
14/02/1979	Unclassified	32.5	4.52	89.18	93.7
9/07/1979	Unclassified	38.5	16.63	99.03	115.66
5/02/1980	Unclassified	33.5	0	91.5	91.5
14/07/1980	Unclassified	35	0	92.82	92.82
25/02/1981	Unclassified	NA	0	85.43	85.43
22/07/1981	Unclassified	NA	0	89.54	89.54
28/07/1982	Unclassified	NA	0	85.12	85.12
21/02/1983	Unclassified	NA	0	84.03	84.03
22/03/1986	10	NA	0	89.09	89.09
5/05/1989	15	NA	0	86.17	86.17
17/10/2003	10	NA	0	91.8	91.8

19/10/2009	5	35	37.77	90.37	128.13
26/09/2011	5	35.5	48.51	96.51	145.02
17/10/2012	5	37.5	45.58	99.33	144.91
25/10/2018	5	36	39.36	99.82	139.18
10/09/2021	5	37.5	39.33	101.74	141.07
9/11/2022	5	45.5	36.32	108.45	144.77
15/11/2023	5	40.5	37.92	101.47	139.39
Mean Beach Width (m)	35.93				
nobs	15				
Beach Mobility	3.77				
Top of Backshore Relative Horizontal Change (m/yr)	-0.04				
Shoreline Relative Horizontal Change (m/yr)	0.09				
Dune Volume Change (m^3/yr)	0.78				
Beach Volume Change (m^3/yr)	0.23				
Total Volume Change (m^3/yr)	1.01				

3.4 Cell SF10 Watson's Gap to the Hindmarsh River Profile 615001

Profile 615001 is located at Hayborough (Figure 46). Topographic change has been absolutely minimal over the survey period (Figures 47 to 51 and Table 9).

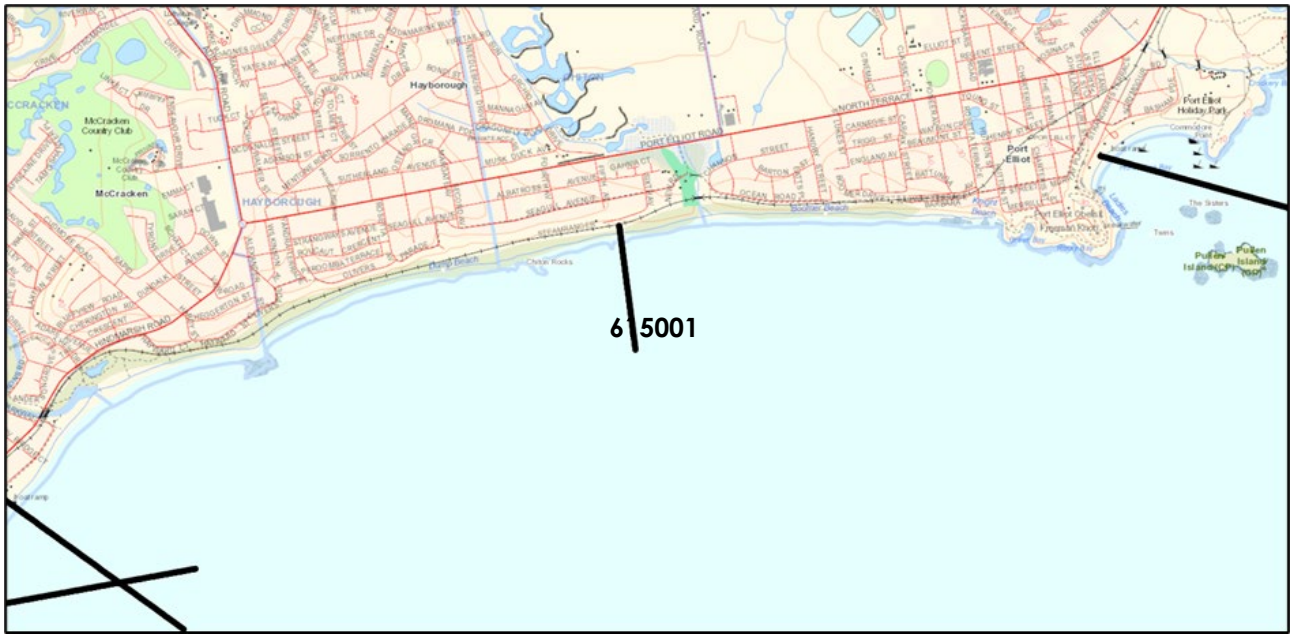


Figure 46. Location of Profile line 615001.

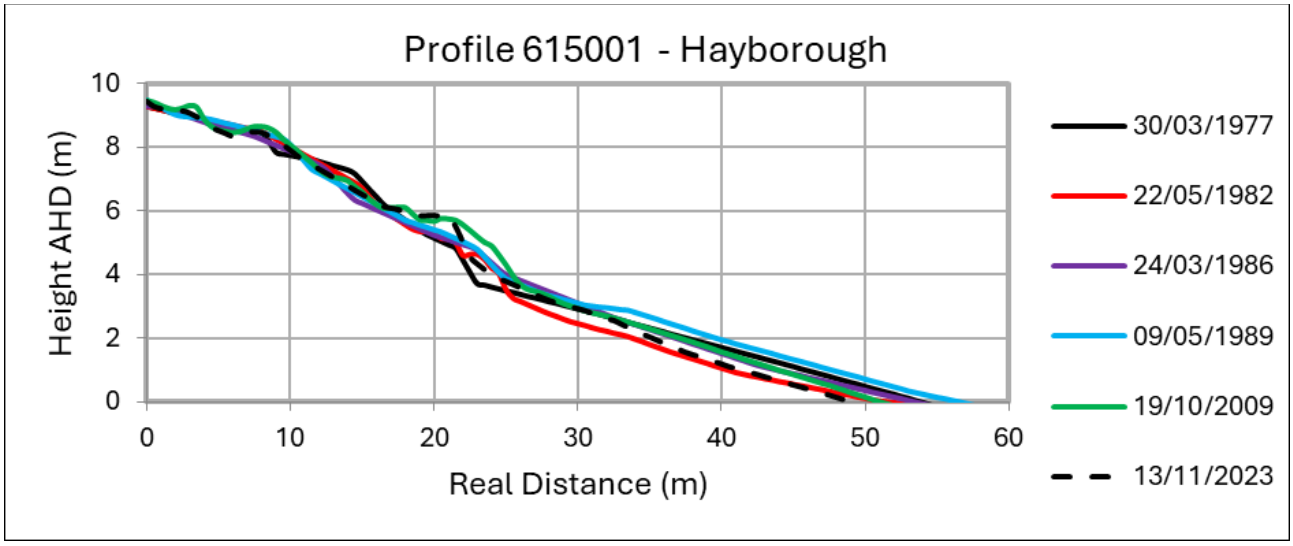


Figure 47. Topographic changes between 1977 and 2023 at Profile 615001.

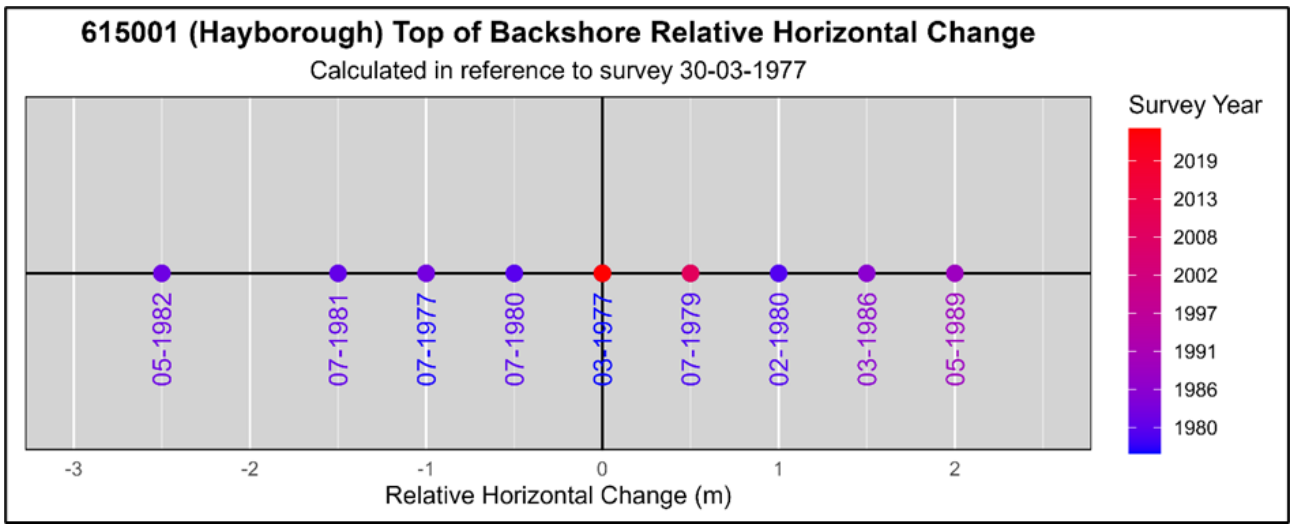


Figure 48. Horizontal movement over time of the top of the backshore position (located at 3m above AHD).

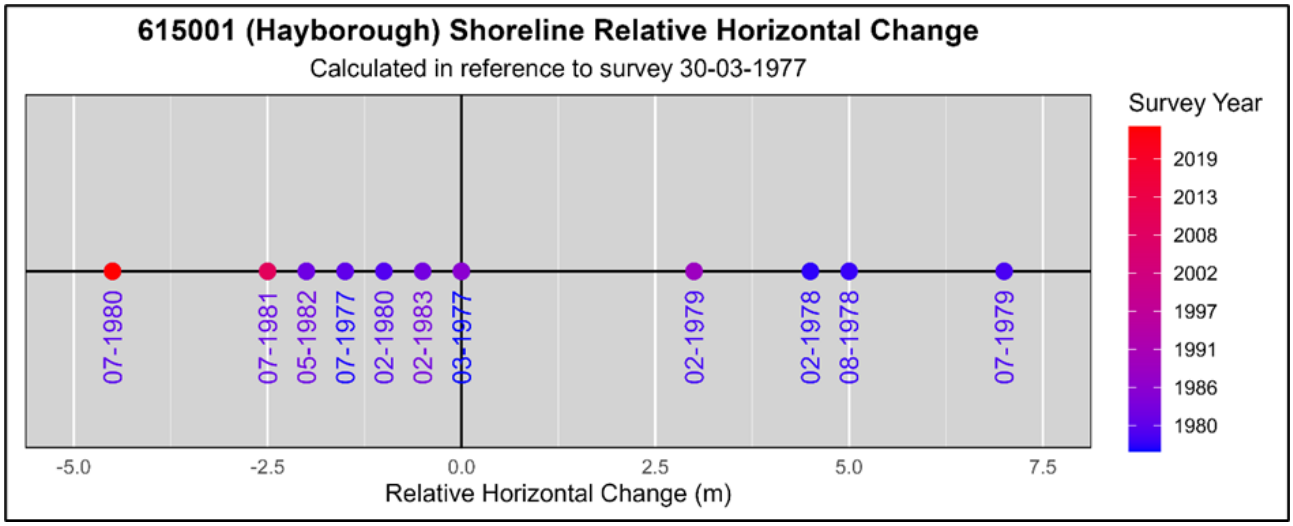


Figure 49. Relative change in the position of the shoreline at 0.0m (or AHD) seawards or landwards since 1980.

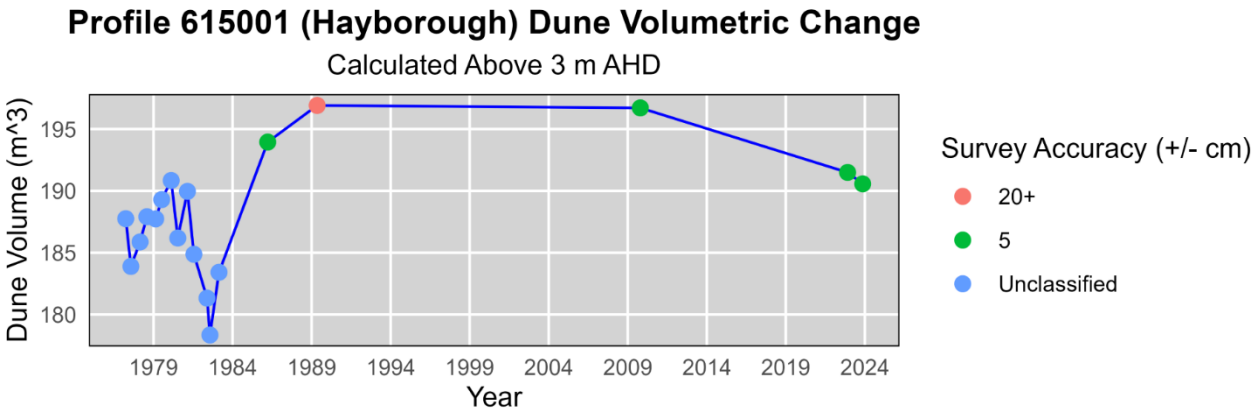


Figure 50. Volumetric change of the foredune/backing landform over time. The toe of the foredune/top of the backshore is at 3m AHD.

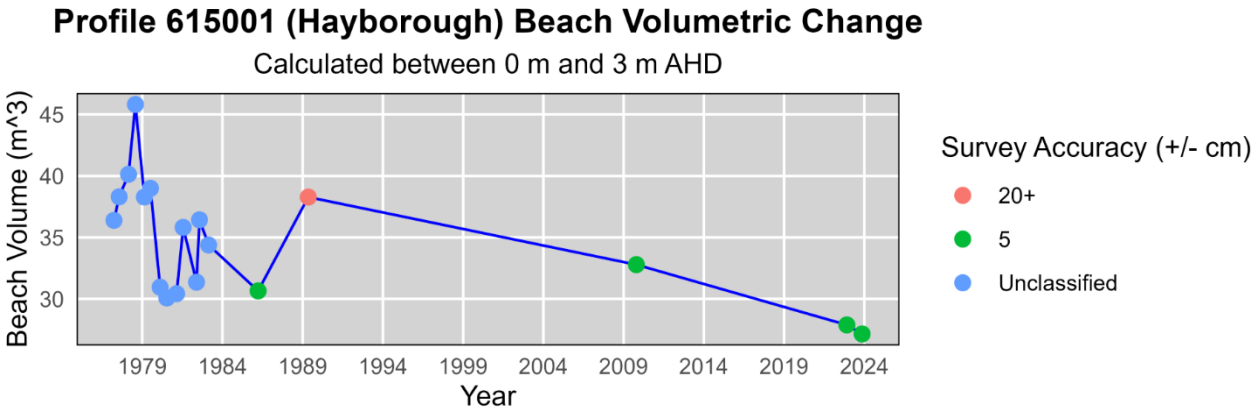


Figure 51. Beach volumetric change over time calculated between 0 and 3m AHD.

Table 9. Survey date, accuracy, beach width, dune volume, beach volume and total volume data for Profile 615001, 1977-2023.

Survey	Survey Accuracy (+/- cm)	Beach Width (m)	Dune Volume (m^3)	Beach Volume (m^3)	Total Volume (m^3)
30/03/1977	Unclassified	24.5	187.75	36.39	224.14
27/07/1977	Unclassified	24	183.89	38.3	222.2
24/02/1978	Unclassified	29	185.87	40.13	226.01
1/08/1978	Unclassified	29.5	187.91	45.81	233.72
20/02/1979	Unclassified	27.5	187.74	38.28	226.02
9/07/1979	Unclassified	31	189.3	38.99	228.29
13/02/1980	Unclassified	22.5	190.84	30.95	221.79
15/07/1980	Unclassified	20.5	186.19	30.07	216.26
23/02/1981	Unclassified	22.5	189.96	30.43	220.39
22/07/1981	Unclassified	23.5	184.88	35.82	220.69
22/05/1982	Unclassified	25	181.33	31.36	212.69
28/07/1982	Unclassified	25	178.35	36.43	214.78
22/02/1983	Unclassified	25	183.42	34.38	217.8
24/03/1986	5	23	193.95	30.65	224.6
9/05/1989	20+	25.5	196.91	38.28	235.19
19/10/2009	5	21.5	196.71	32.79	229.5
30/11/2022	5	NA	191.49	27.89	219.38
13/11/2023	5	20	190.57	27.15	217.72
Mean Beach Width (m)	24.68				
nobs	17				
Beach Mobility	3.11				
Top of Backshore Relative Horizontal Change (m/yr)	0				
Shoreline Relative Horizontal Change (m/yr)	-0.1				
Dune Volume Change (m^3/yr)	0.06				
Beach Volume Change (m^3/yr)	-0.2				
Total Volume Change (m^3/yr)	-0.14				

3.5 Cell SF8 Commodore Point to Freemans Knob: Horseshoe Bay

This Profile 615002 is located in Horseshoe Bay. The cliff at the rear of the beach comprises part dune and part fill (Figure 52). The beach has exhibited long term historical (post-early 1900's) erosion (Western et al., 2019) although the beach profiles shown in Figure 53 do not overly indicate this for the 1977-2023 period. The top of the backshore is relatively fixed through this period (Figure 54 and Table 10), while the 0m AHD position shows changes of ~16 metres (Figure 55). Dune volumes have changed little (Figure 56), and beach volumes have been relatively stable since 2009 (Figure 57).

Figure 52. Location of Profile line 615002, Horseshoe Bay, Port Eliott.

3.5.1 Profile 615002

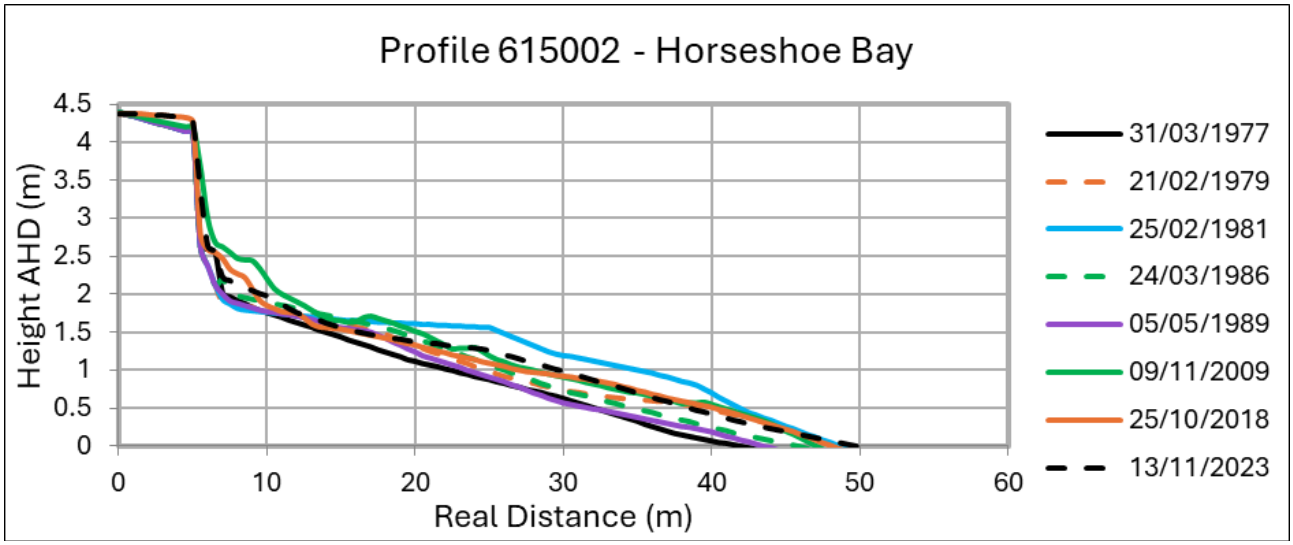


Figure 53. Topographic changes between 1977 and 2023 at Profile 615002.

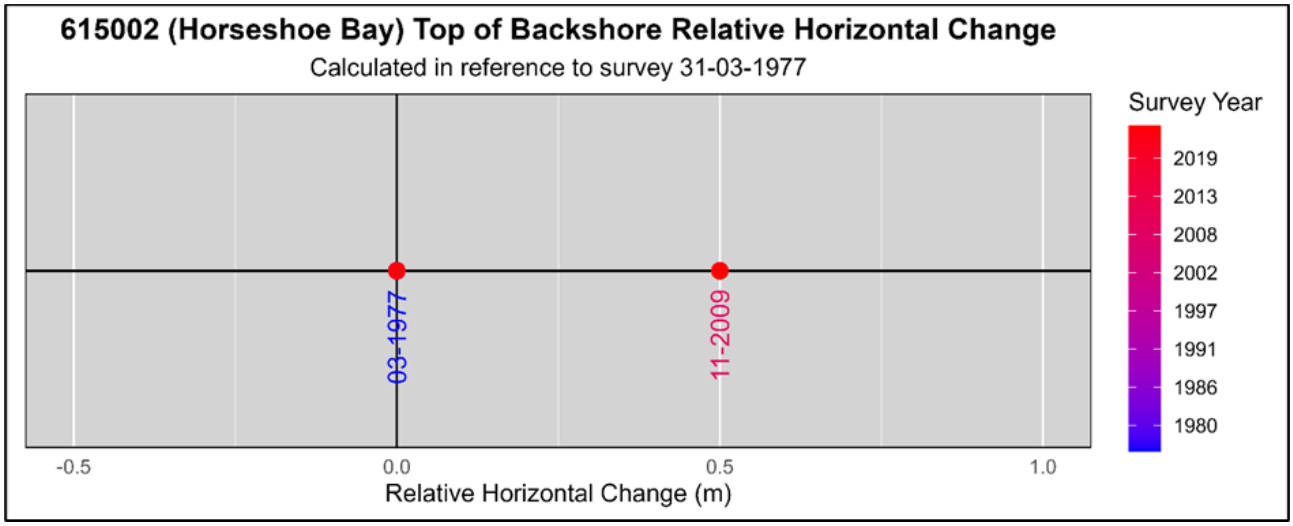


Figure 54. Horizontal movement over time of the top of the backshore position (located at 3m above AHD).

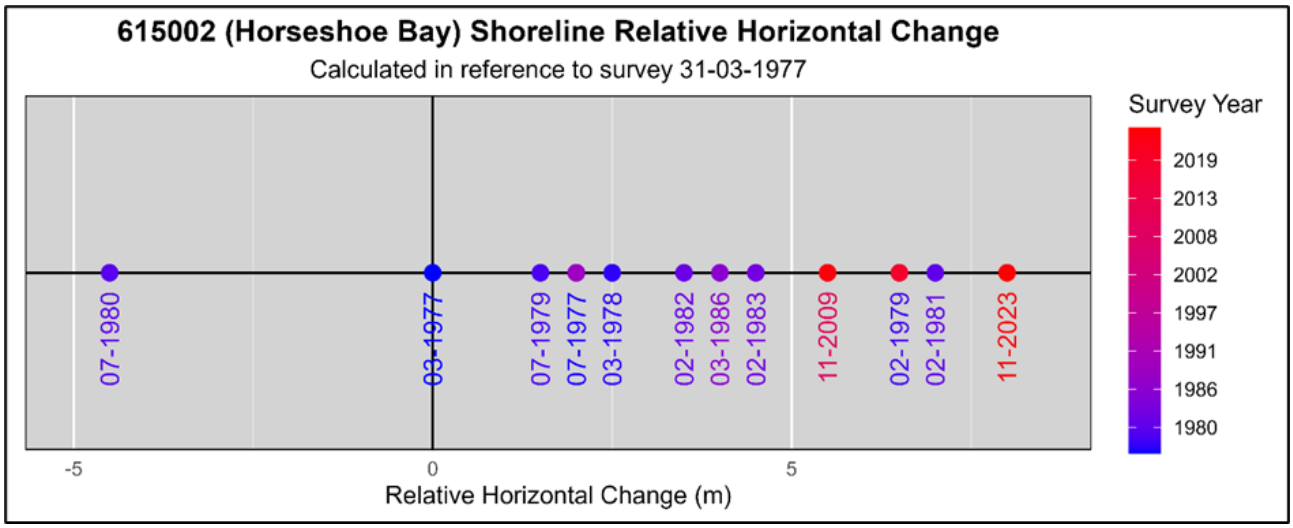


Figure 55. Relative change in the position of the shoreline at 0.0m (or AHD) seawards or landwards since 1980.

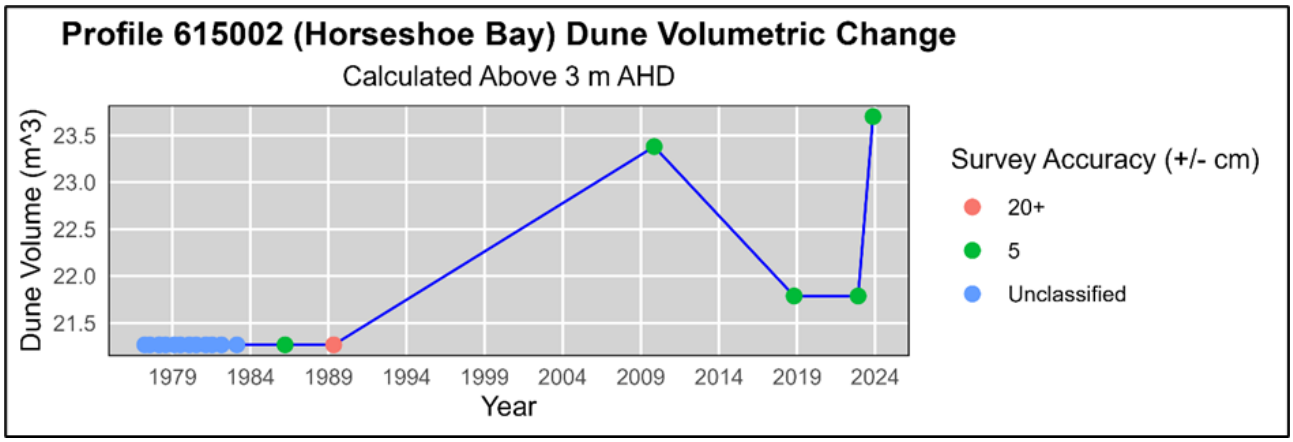


Figure 56. Volumetric change of the foredune over time. The toe of the foredune/top of the backshore is at 3m AHD.

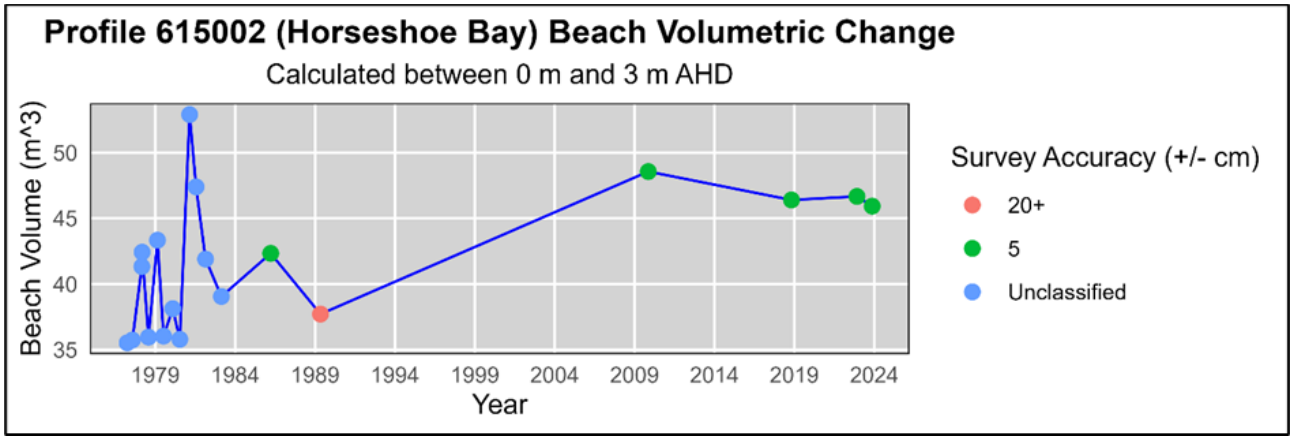


Figure 57. Beach volumetric change over time calculated between 0 and 3m AHD.

Table 10. Survey date, accuracy, beach width, dune volume, beach volume and total volume data for Horseshoe Bay, 1977-2023.

Survey	Survey Accuracy (+/- cm)	Beach Width (m)	Dune Volume (m^3)	Beach Volume (m^3)	Total Volume (m^3)
31/03/1977	Unclassified	36.5	21.27	35.52	56.79
27/07/1977	Unclassified	38.5	21.27	35.74	57
1/03/1978	Unclassified	39	21.27	41.33	62.59
7/03/1978	Unclassified	39	21.27	42.42	63.69
31/07/1978	Unclassified	38.5	21.27	35.96	57.22
21/02/1979	Unclassified	43	21.27	43.33	64.6
10/07/1979	Unclassified	38	21.27	36.03	57.3
5/02/1980	Unclassified	38.5	21.27	38.12	59.39
16/07/1980	Unclassified	32	21.27	35.79	57.06
25/02/1981	Unclassified	43.5	21.27	52.9	74.17
22/07/1981	Unclassified	38.5	21.27	47.39	68.66
24/02/1982	Unclassified	40	21.27	41.9	63.16
21/02/1983	Unclassified	41	21.27	39.05	60.32
24/03/1986	5	40.5	21.27	42.33	63.6
5/05/1989	20+	38.5	21.27	37.71	58.98
9/11/2009	5	41.5	23.38	48.56	71.94
25/10/2018	5	43	21.79	46.4	68.19
30/11/2022	5	42	21.79	46.67	68.45
13/11/2023	5	44	23.7	45.93	69.63
Mean Beach Width (m)	39.76				
nobs	19				
Beach Mobility	2.85				
Top of Backshore Relative Horizontal Change (m/yr)	0.01				
Shoreline Relative Horizontal Change (m/yr)	0.17				
Dune Volume Change (m^3/yr)	0.05				
Beach Volume Change (m^3/yr)	0.22				

Total Volume Change (m^3/yr)	0.28	[redacted]

3.6 Cell SF7 Basham's Regional Park, Bashams Beach, Profile 615003

Profile 615003 is located in the northern end of Bashams Beach (Figure 58). The central to southern portion of this beach has a tendency towards erosion. In the north, where profile 615003 is located, no profile has been formed seawards of the 1986 survey (Figure 59 and Table 11). The top of the backshore has accreted and eroded across ~7m (Figure 60), while the 0m AHD shoreline has eroded and accreted through 20m (Figure 601). Dune volume change is down since 2009, while beach volume change is relatively stable since 2009 (Figures 62 and 63).

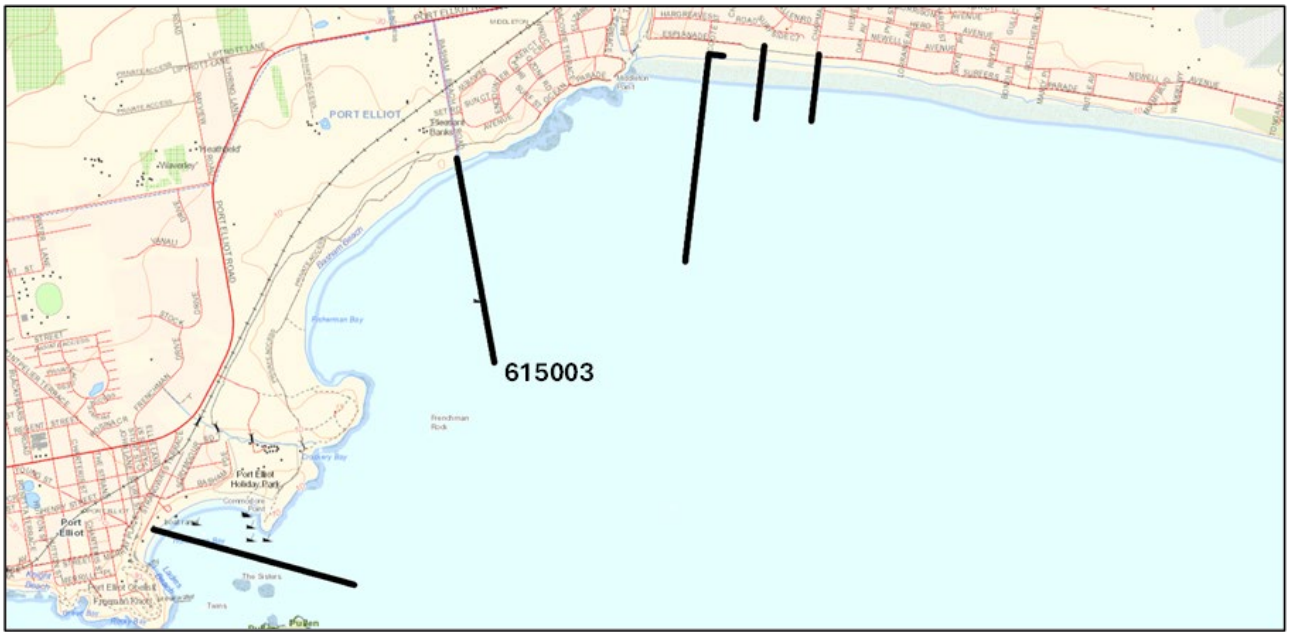


Figure 58. Location of Profile line 615003, Bashams Beach.

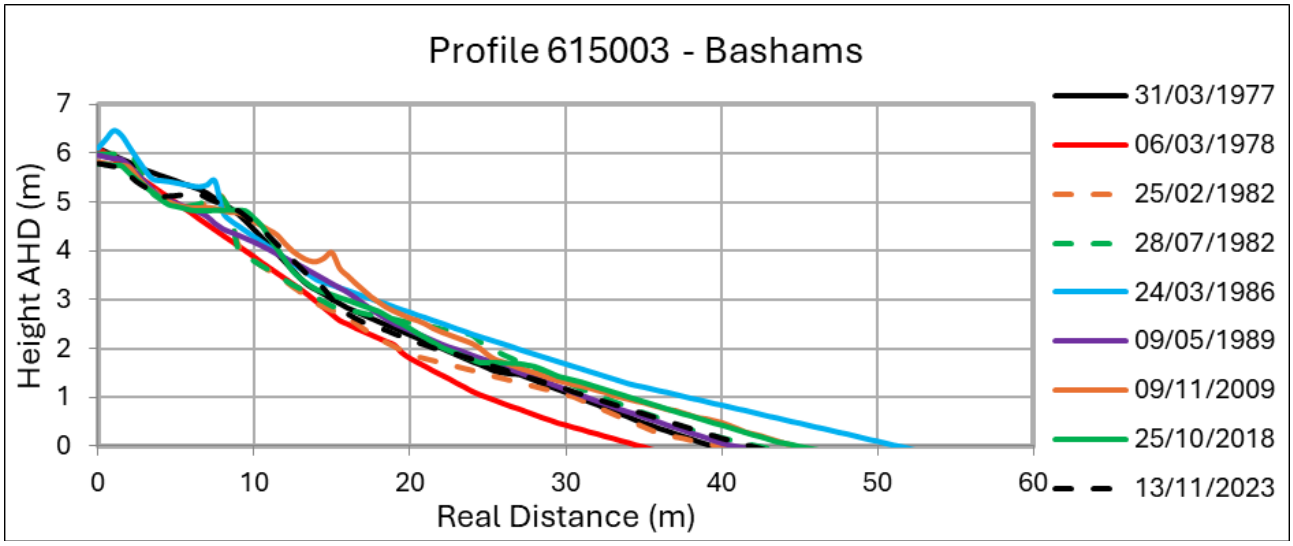


Figure 59. Topographic changes between 1977 and 2023 at Profile 615003.

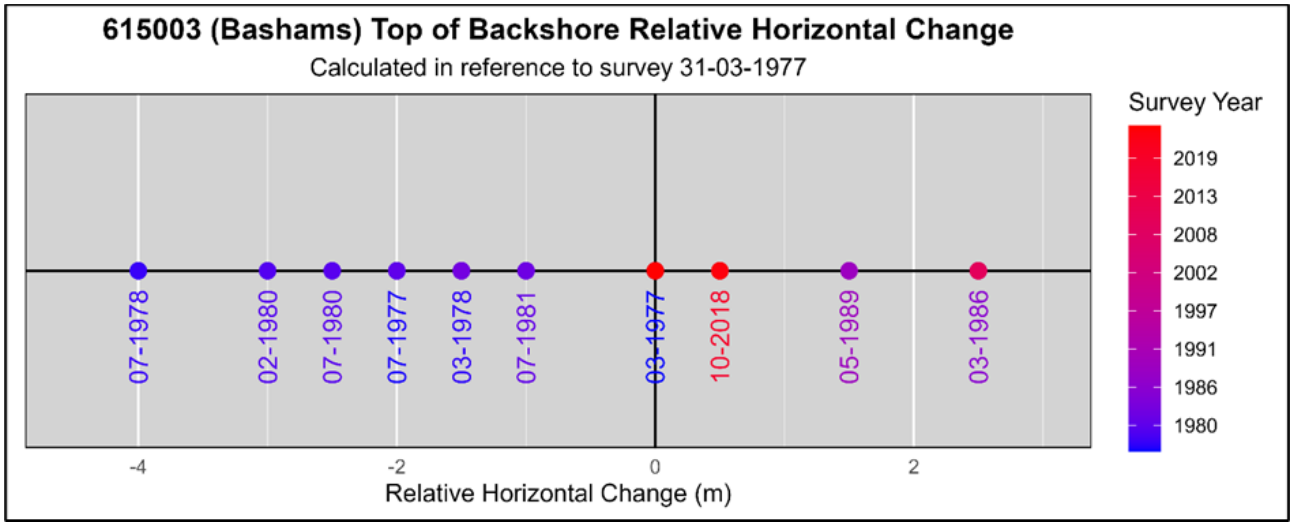


Figure 60. Horizontal movement over time of the top of the backshore position (located at 3m above AHD).

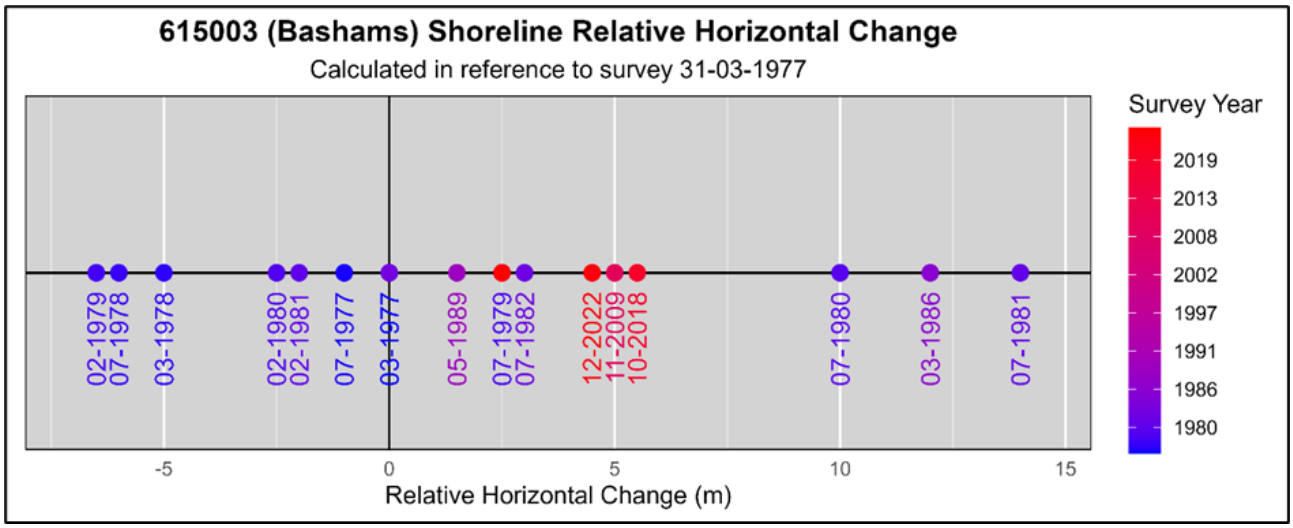


Figure 61. Relative change in the position of the shoreline at 0.0m (or AHD) seawards or landwards since 1980.

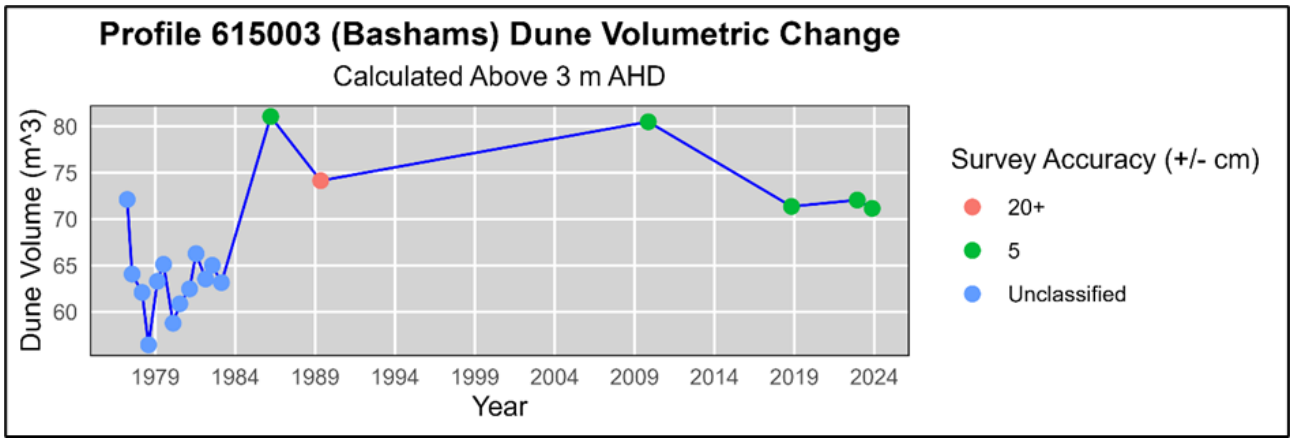


Figure 62. Volumetric change of the foredune over time. The toe of the foredune/top of the backshore is at 3m AHD.

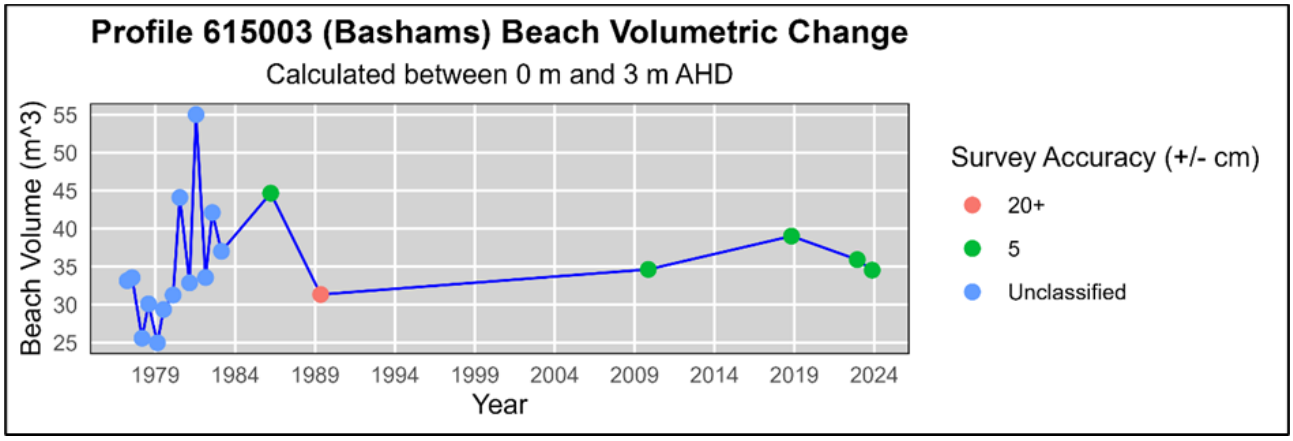


Figure 63. Beach volumetric change over time calculated between 0 and 3m AHD.

Table 11. Survey date, accuracy, beach width, dune volume, beach volume and total volume data for profile 615003, 1977-2023.

Survey	Survey Accuracy (+/- cm)	Beach Width (m)	Dune Volume (m^3)	Beach Volume (m^3)	Total Volume (m^3)
31/03/1977	Unclassified	24.5	72.11	33.15	105.26
21/07/1977	Unclassified	25.5	64.07	33.55	97.62
6/03/1978	Unclassified	21	62.08	25.59	87.67
31/07/1978	Unclassified	22.5	56.44	30.11	86.54
20/02/1979	Unclassified	20	63.28	24.98	88.27
10/07/1979	Unclassified	28.5	65.12	29.37	94.49
13/02/1980	Unclassified	25	58.76	31.26	90.02
16/07/1980	Unclassified	37	60.86	44.1	104.96
23/02/1981	Unclassified	24.5	62.47	32.87	95.33
22/07/1981	Unclassified	39.5	66.27	55.01	121.28
25/02/1982	Unclassified	26	63.54	33.57	97.11
28/07/1982	Unclassified	28.5	65.02	42.12	107.14
22/02/1983	Unclassified	26	63.14	37.02	100.16
24/03/1986	5	34	81.06	44.67	125.72
9/05/1989	20+	24.5	74.14	31.34	105.48
9/11/2009	5	27	80.49	34.64	115.13
25/10/2018	5	29.5	71.36	39.02	110.38
7/12/2022	5	28.5	72.05	35.92	107.98
13/11/2023	5	27	71.15	34.54	105.69
Mean Beach Width (m)	27.32				
nobs	19				
Beach Mobility	4.99				
Top of Backshore Relative Horizontal Change (m/yr)	0				
Shoreline Relative Horizontal Change (m/yr)	0.05				
Dune Volume Change (m^3/yr)	-0.02				
Beach Volume Change (m^3/yr)	0.03				

Total Volume Change (m^3/yr)	0.01	

3.7 Cell SF5 Middleton

Cell SF5 is located at Middleton and comprises three closely located profiles (615004, 615006, 615007) shown in Figure 64.

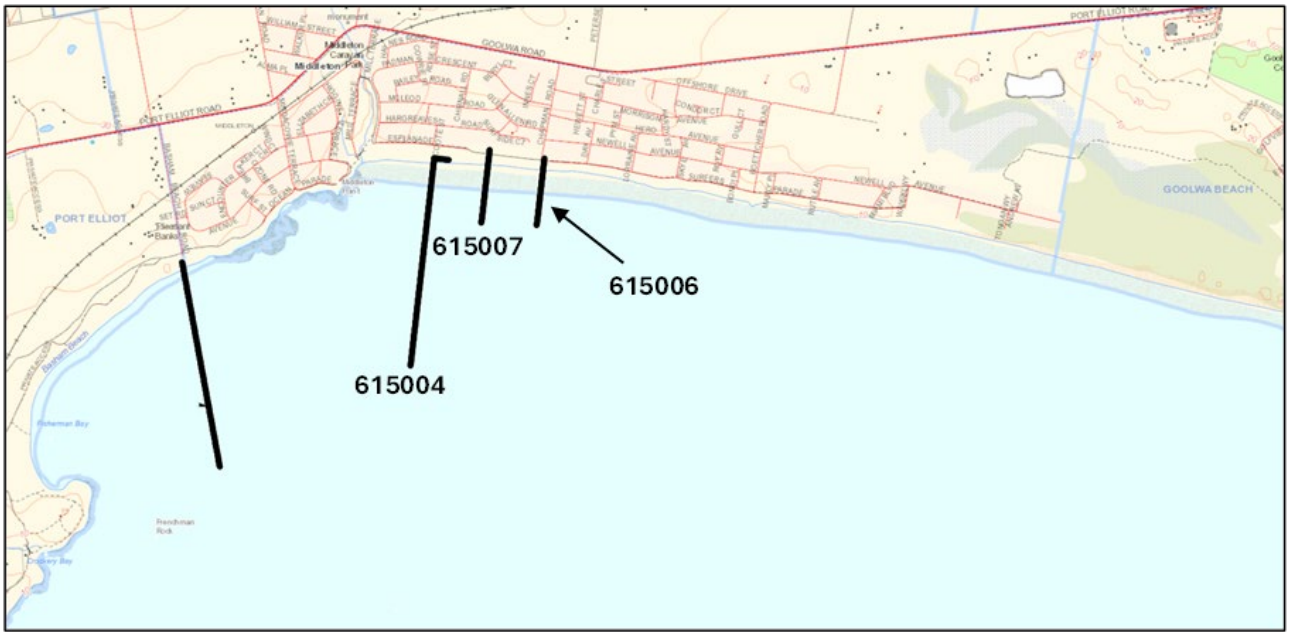


Figure 64. Location of Profile lines 615004 to 615007 in the Middleton Beach area.

3.7.1 Profile 615004

Profile 615004 has a cliffed backshore, and the beach shows variable erosion and accretion over time post-1977 (Figure 65 and Table 12). The top of the backshore varies through 22m (Figure 66), while the beach varies over ~ 52m (Figure 67). Dune volume increased by ~70m3/m (Figure 68). Beach volume change has varied though ~60m3/m (Figure 69).

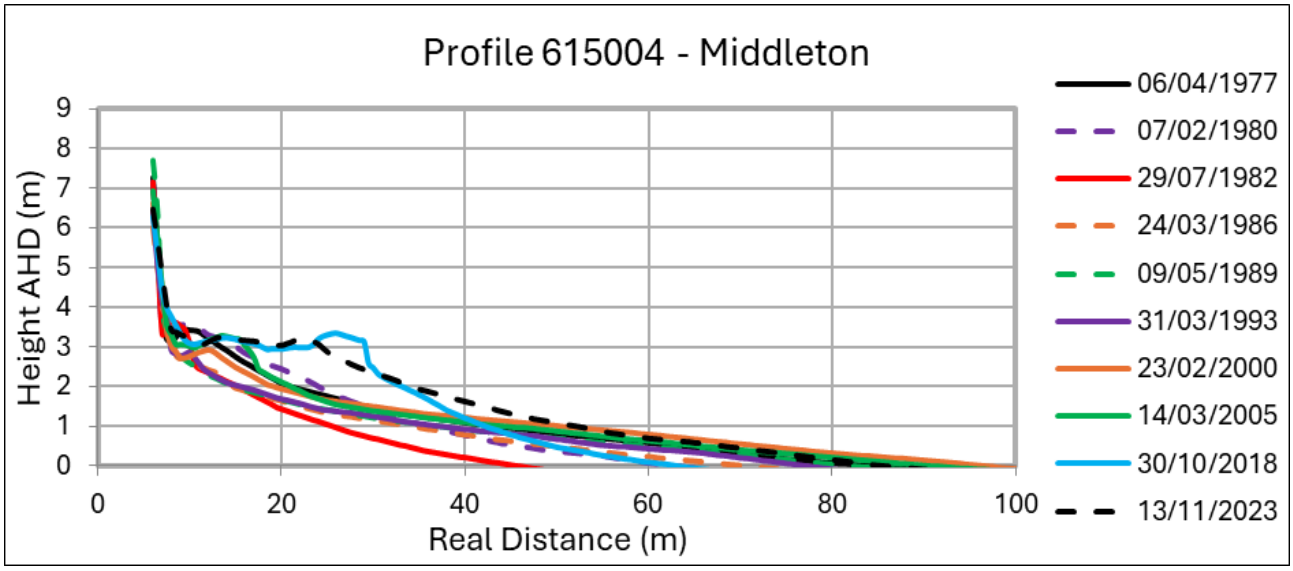


Figure 65. Topographic changes between 1977 and 2023 at Profile 615004.

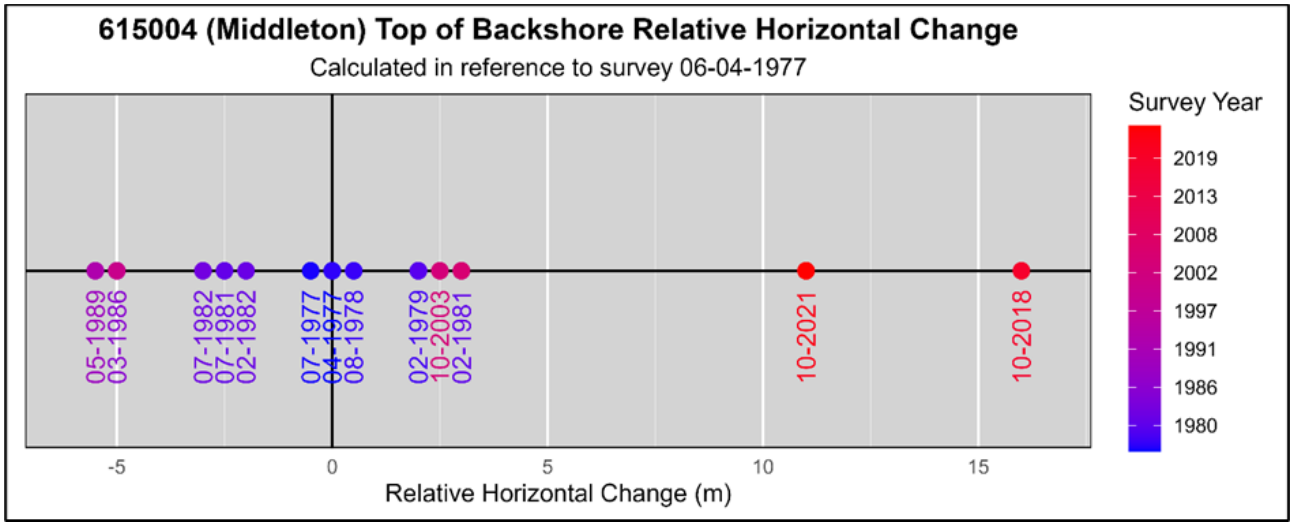


Figure 66. Horizontal movement over time of the top of the backshore position (located at 3m above AHD).

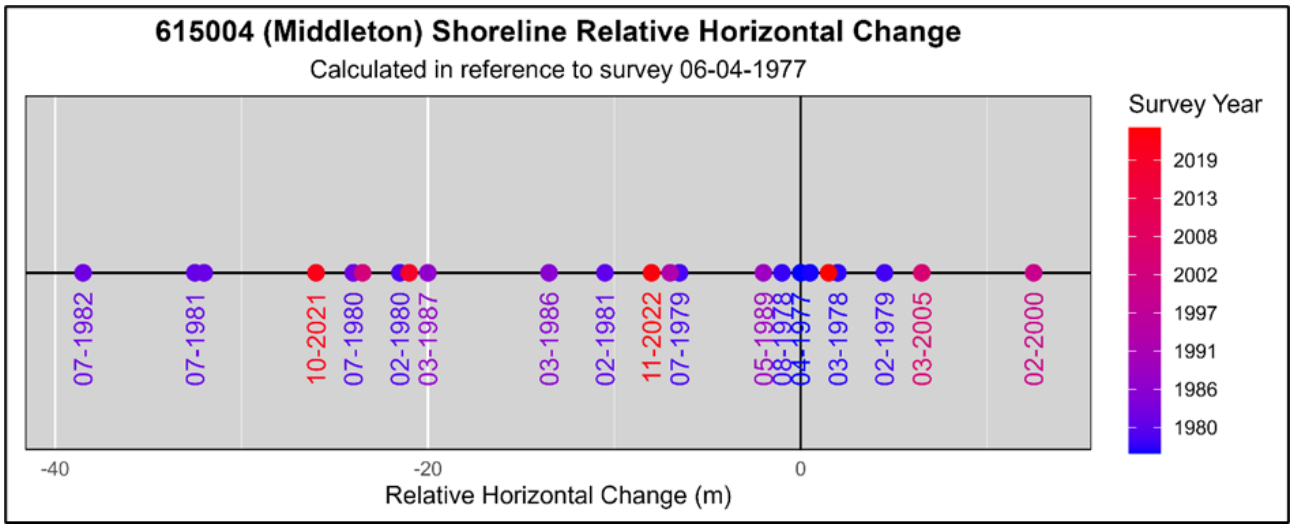


Figure 67. Relative change in the position of the shoreline at 0.0m (or AHD) seawards or landwards since 1980.

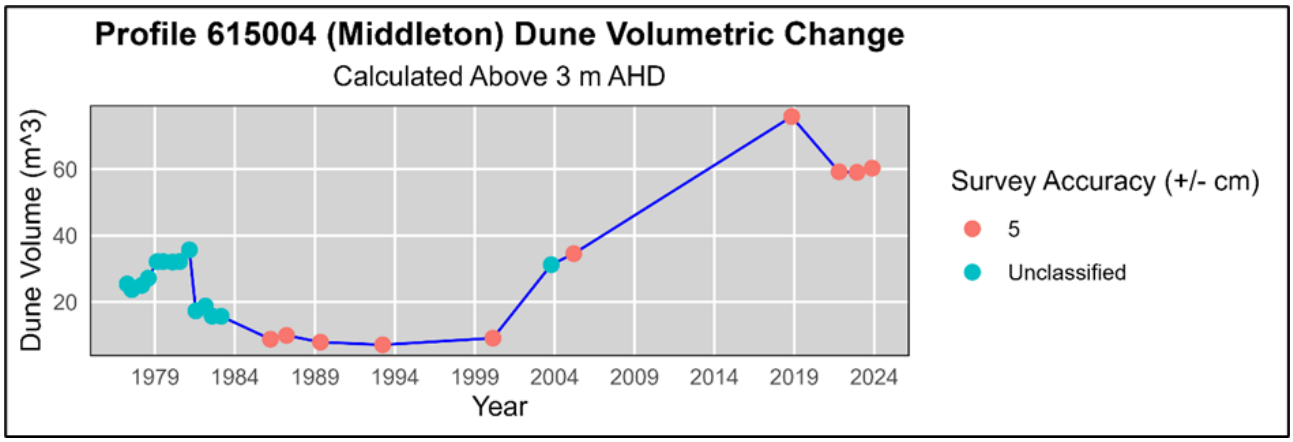


Figure 68. Volumetric change of the foredune/backing landform over time. The toe of the foredune/top of the backshore is at 3m AHD.

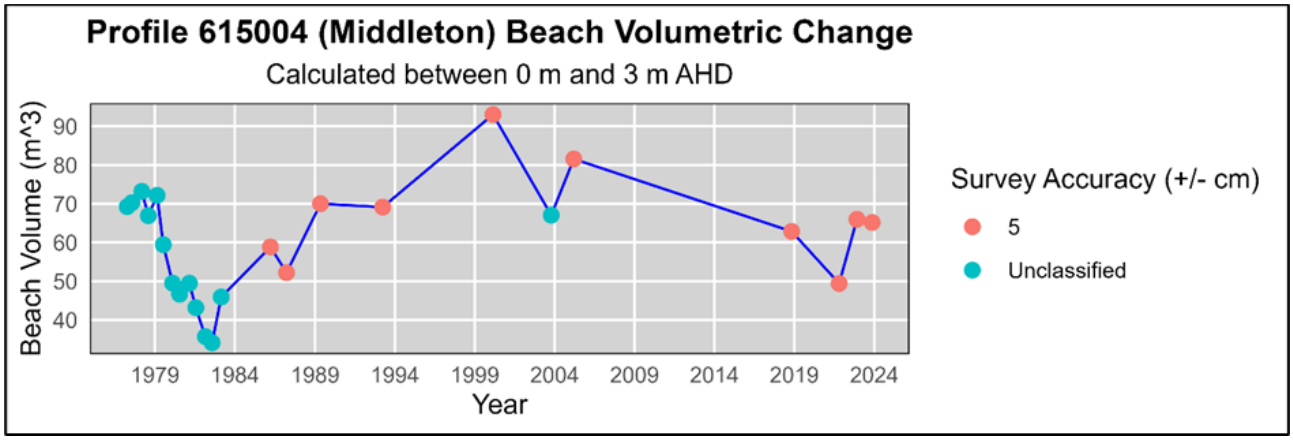


Figure 69. Beach volumetric change over time calculated between 0 and 3m AHD.

Table 12. Survey date, accuracy, beach width, dune volume, beach volume and total volume data for profile 615004, 1977-2023.

Survey	Survey Accuracy (+/- cm)	Beach Width (m)	Dune Volume (m^3)	Beach Volume (m^3)	Total Volume (m^3)
6/04/1977	Unclassified	71	25.42	69.25	94.67
21/07/1977	Unclassified	72	23.73	70.25	93.98
6/03/1978	Unclassified	73	25.02	73.2	98.22
1/08/1978	Unclassified	69.5	27.19	66.91	94.09
19/02/1979	Unclassified	73.5	32.13	72.16	104.29
9/07/1979	Unclassified	62.5	32.17	59.43	91.6
7/02/1980	Unclassified	47.5	32.04	49.48	81.52
16/07/1980	Unclassified	45	32.16	46.63	78.79
25/02/1981	Unclassified	57.5	35.7	49.47	85.17
22/07/1981	Unclassified	41	17.32	43.15	60.47
25/02/1982	Unclassified	41	18.78	35.67	54.45
29/07/1982	Unclassified	35.5	15.73	34.09	49.82
23/02/1983	Unclassified	50	15.68	45.91	61.6
24/03/1986	5	62.5	8.79	58.83	67.62
25/03/1987	5	56	9.93	52.19	62.12
9/05/1989	5	74.5	7.91	69.99	77.91
31/03/1993	5	69.5	7.11	69.12	76.23
23/02/2000	5	88.5	9.12	93.02	102.14
16/10/2003	Unclassified	45	31.23	67.03	98.26
14/03/2005	5	74.5	34.56	81.56	116.11
30/10/2018	5	34	75.82	62.84	138.66
19/10/2021	5	34	59.19	49.41	108.6
30/11/2022	5	52	59.02	65.96	124.98
13/11/2023	5	61.5	60.29	65.15	125.44
Mean Beach Width (m)	57.96				
nobs	24				
Beach Mobility	15.34				
Top of Backshore Relative Horizontal Change (m/yr)	0.24				

Shoreline Relative Horizontal Change (m/yr)	0.03	[redacted]
Dune Volume Change (m^3/yr)	0.75	
Beach Volume Change (m^3/yr)	-0.09	
Total Volume Change (m^3/yr)	0.66	

3.7.2 Profile 615007

Profile 615007 is also backed by a relatively stable cliff, and shows beach accretion and erosion over time (Figure 70). The top of the backshore is ~17m seawards of the 1993 backshore position (Figure 71). The beach varies over ~ 33m (Figure 72). Significant dune volume change took place in 2013 but has recovered (Figure 73). Beach volume levels have varied though ~50m^3/m post-2013 (Figure 734).

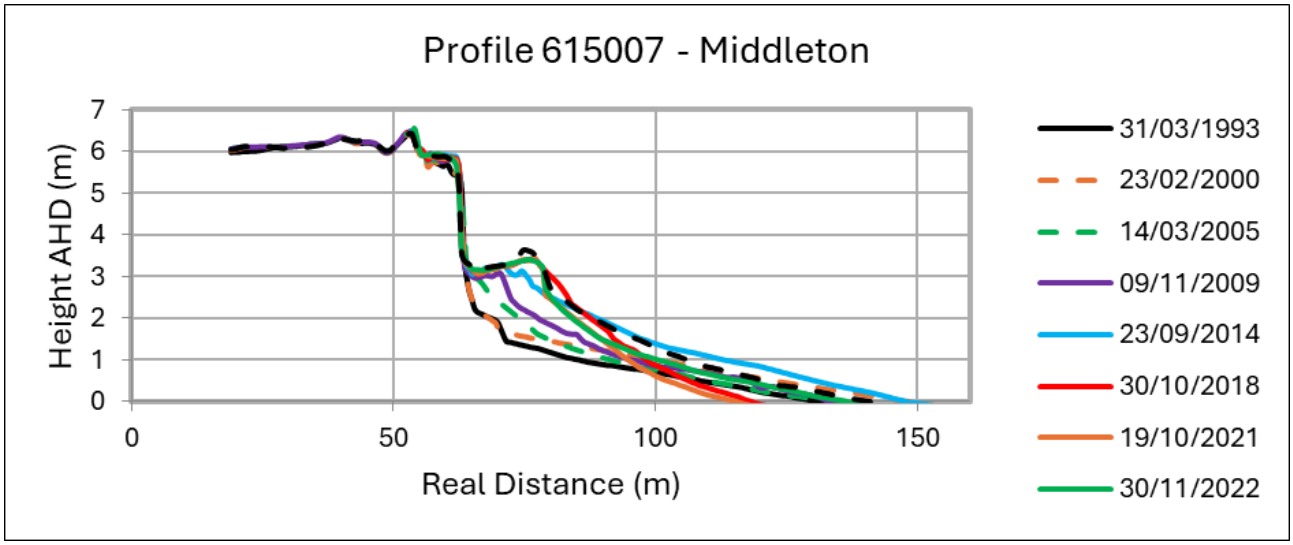


Figure 70. Topographic changes between 1993 and 2022 at Profile 615007.

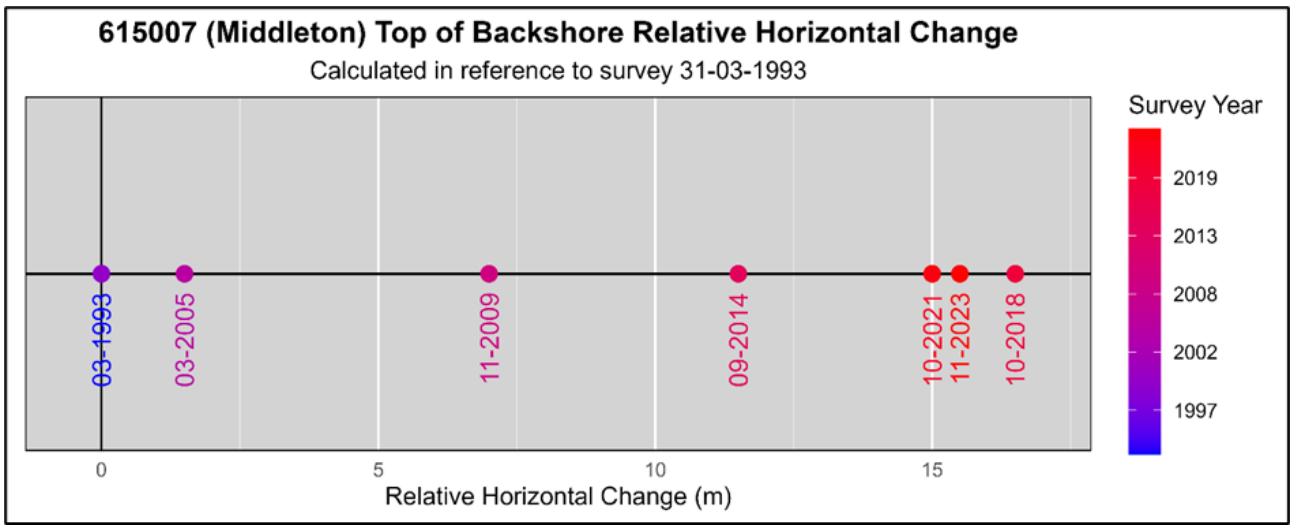


Figure 71. Horizontal movement over time of the top of the backshore position (located at 3m above AHD).

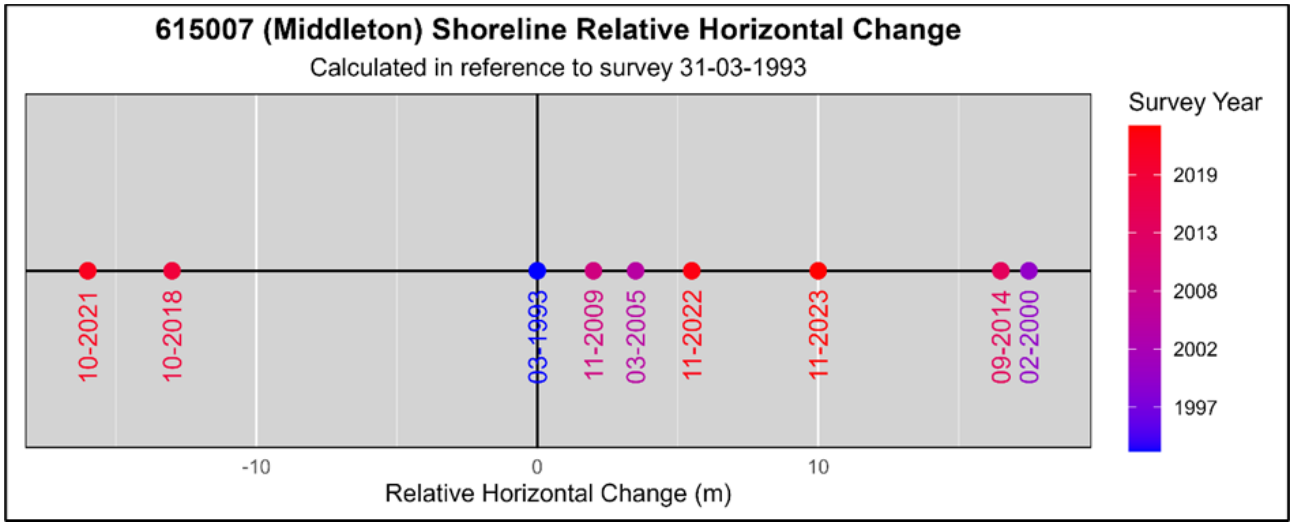


Figure 72. Relative change in the position of the shoreline at 0.0m (or AHD) seawards or landwards since 1997.

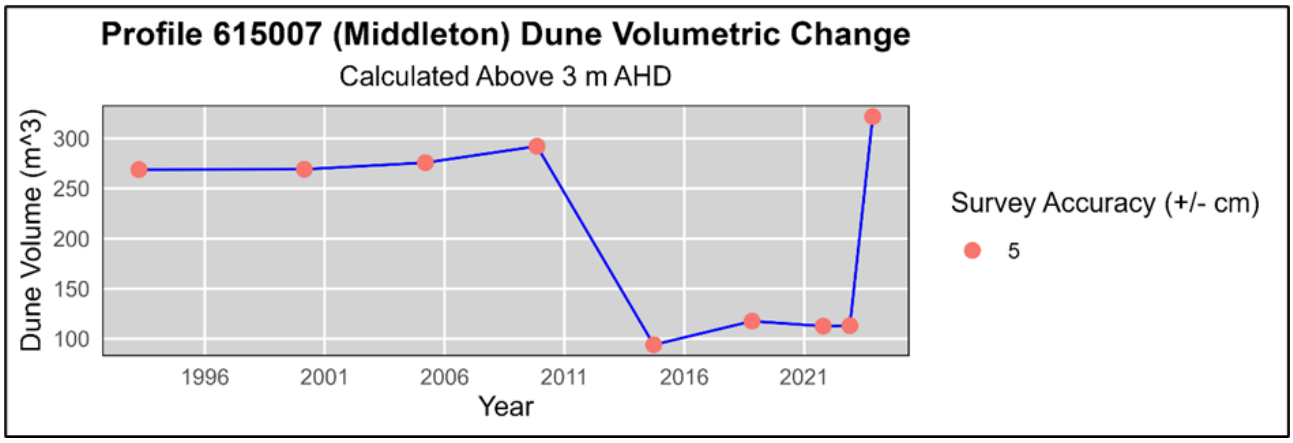


Figure 73. Volumetric change of the foredune/backing landform over time. The toe of the foredune/top of the backshore is at 3m AHD.

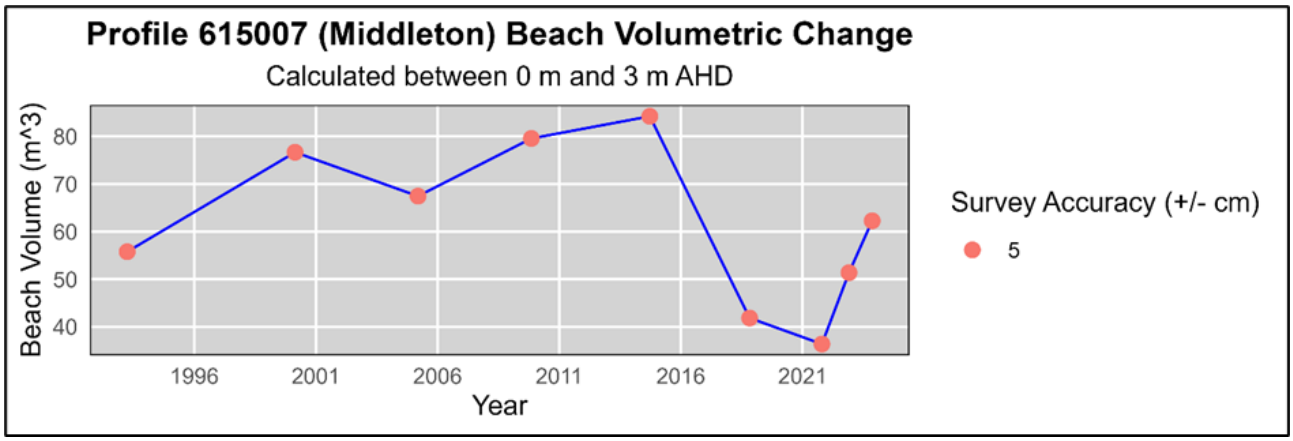


Figure 74. Beach volumetric change over time calculated between 0 and 3m AHD.

Table 13. Survey date, accuracy, beach width, dune volume, beach volume and total volume data for profile 615007, 1993 -2022.

Survey	Survey Accuracy (+/- cm)	Beach Width (m)	Dune Volume (m^3)	Beach Volume (m^3)	Total Volume (m^3)
31/03/1993	5	67.5	268.92	55.76	324.68
23/02/2000	5	85	269.24	76.65	345.9
14/03/2005	5	69.5	275.85	67.44	343.29
9/11/2009	5	62.5	292.22	79.56	371.77
23/09/2014	5	72.5	93.9	84.2	178.1
30/10/2018	5	38	117.53	41.84	159.37
19/10/2021	5	36.5	112.55	36.38	148.93
30/11/2022	5	58	113.06	51.38	164.43
13/11/2023	5	62	321.88	62.26	384.14
Mean Beach Width (m)	61.28				
nobs	9				
Beach Mobility	15.67				
Top of Backshore Relative Horizontal Change (m/yr)	0.51				
Shoreline Relative Horizontal Change (m/yr)	0.33				
Dune Volume Change (m^3/yr)	1.73				
Beach Volume Change (m^3/yr)	0.21				
Total Volume Change (m^3/yr)	1.94				

3.7.3 Profile 615006

Profile 615006 illustrates a typical response to a cliffed system undergoing occasional accretion (Figure 74 and Table 14). This is indicated by the dune building up and over the cliff crest post-2005. The profile has a landward spike in the topography which may be a survey error. The top of the backshore varies only 4m (Figure 75), while the beach varies over ~30 m (Figure 76). Significant dune volume change took place in 2013 but has otherwise been stable (Figure 77). Beach volume change has varied though ~40m^3/m (Figure 78). This reflects significant storm events both in November 2013 and two 1 in 100 year coastal storm events in 2016 that impacted the state's coastline.

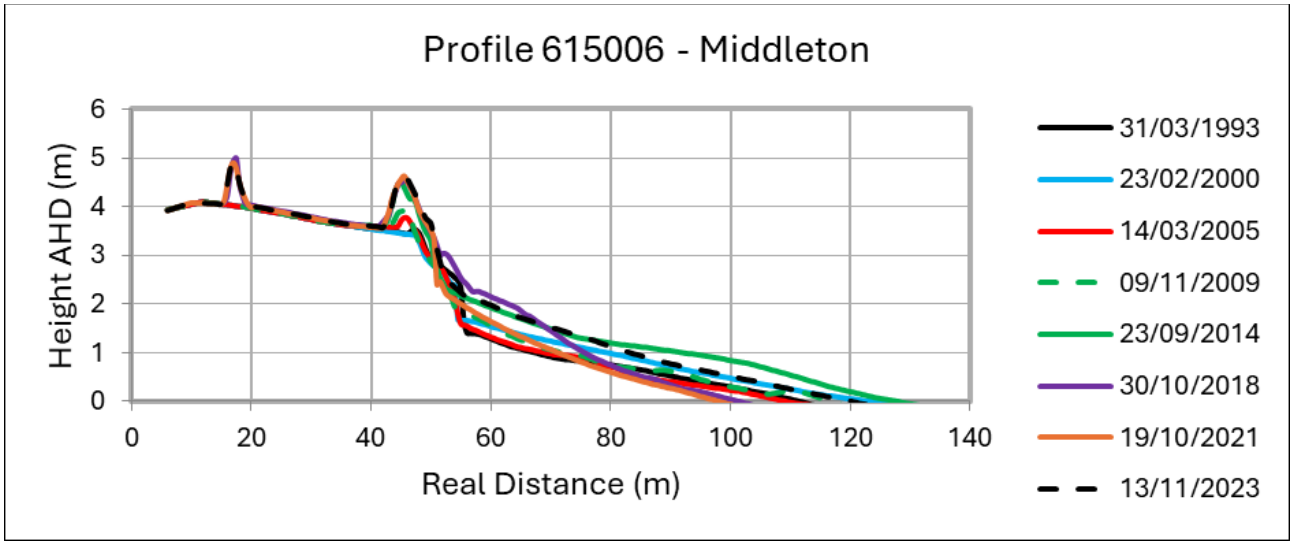


Figure 75. Topographic changes between 1993 and 2023 at Profile 615006.

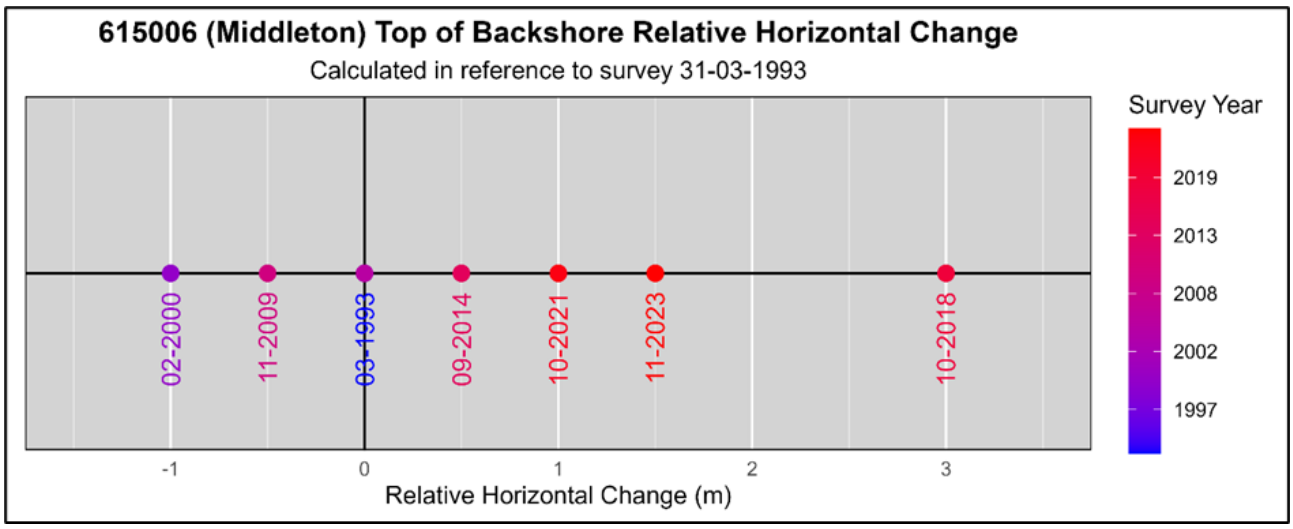


Figure 76. Horizontal movement over time of the top of the backshore position (located at 3m above AHD).

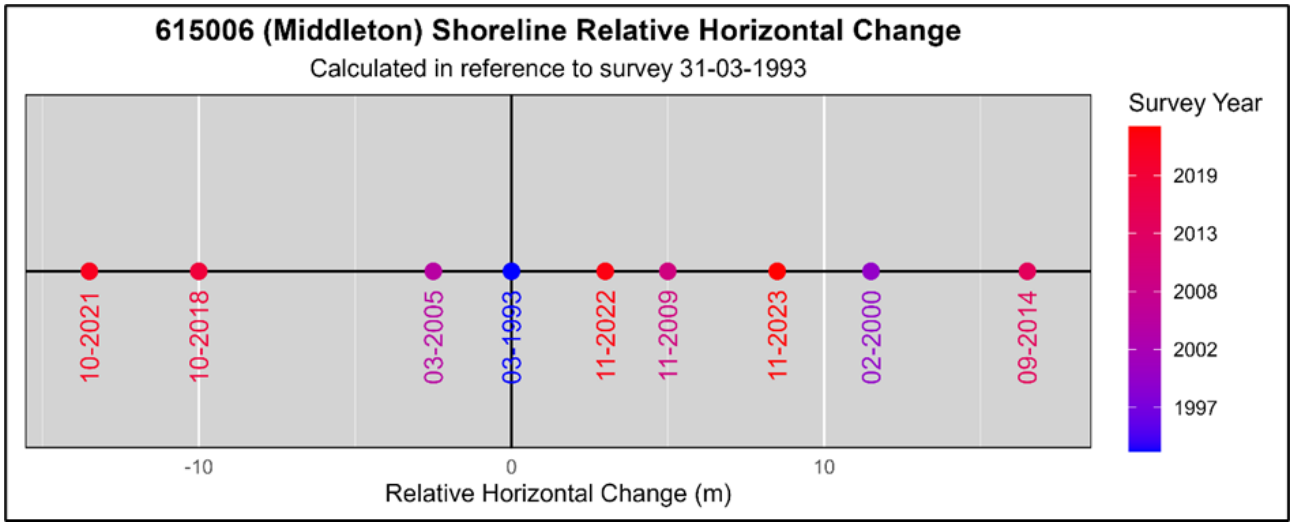


Figure 77. Relative change in the position of the shoreline at 0.0m (or AHD) seawards or landwards since 1997.

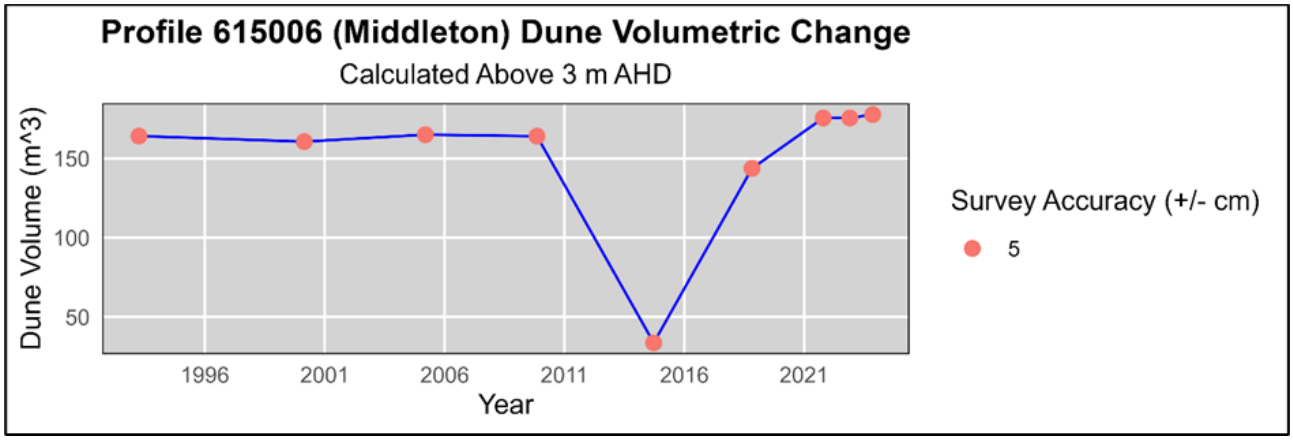


Figure 78. Volumetric change of the foredune over time. The toe of the foredune/top of the backshore is at 3m AHD.

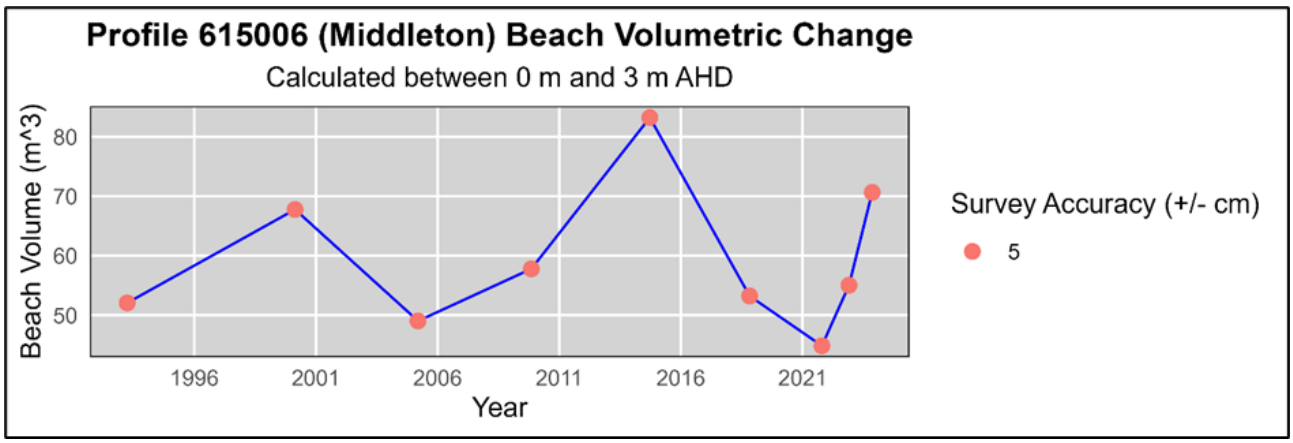


Figure 79. Beach volumetric change over time calculated between 0 and 3m AHD.

Table 14. Survey date, accuracy, beach width, dune volume, beach volume and total volume data for Profile 615006, 1993 - 2022.

Survey	Survey Accuracy (+/- cm)	Beach Width (m)	Dune Volume (m^3)	Beach Volume (m^3)	Total Volume (m^3)
31/03/1993	5	62	164.16	52.07	216.23
23/02/2000	5	74.5	160.62	67.78	228.4
14/03/2005	5	59.5	165.03	49.03	214.07
9/11/2009	5	67.5	164.07	57.8	221.87
23/09/2014	5	78	33.66	83.25	116.91
30/10/2018	5	49	143.7	53.23	196.93
19/10/2021	5	47.5	175.54	44.85	220.39
30/11/2022	5	64	175.53	55.03	230.57
13/11/2023	5	69	177.7	70.67	248.37
Mean Beach Width (m)	63.44				
nobs	9				
Beach Mobility	10.38				
Top of Backshore Relative Horizontal Change (m/yr)	0.05				
Shoreline Relative Horizontal Change (m/yr)	0.28				

Dune Volume Change (m^3/yr)	0.44	[redacted]
Beach Volume Change (m^3/yr)	0.61	
Total Volume Change (m^3/yr)	1.05	

It is important to note that there are tectonic/neotectonic factors at play in the Middleton to Mount Gambier region that will be affecting beach-dune profile changes now and into the future. There is ongoing tectonic uplift of the Victor Harbor coastline, and likely downwarping of the adjacent Middleton coast. The Last interglacial marine Glanville Formation (~125,000 years BP) comprises marine and estuarine deposits which occur at ~2 m above sea level on the Eyre Peninsula, but at Victor Harbor occur up to ~6m above sea level. This indicates an uplift rate of 0.05mm/year for the past 125,000 years (Bourman, 2021). In contrast, an 1897 earthquake located near Beachport resulted in subsidence of the nearby Middleton coast and caused >200m of shoreline erosion (Western et al., 2021).

3.8 Cell SF3 Goolwa Profile 615005

The Goolwa profile (Figure 80) has been prograding and accreting since around 1983 but particularly since 1989 (Figure 81 and Table 15). This may be because sediment is being delivered to this portion of the coast alongshore from Middleton or from the Murray mouth region or both. The period of accretion also corresponds with the invasion of *Thinopyrum* (sea wheat grass) into the region and the foredune is a monoculture of this grass with very little native *Spinifex* present. The beach has prograded ~42m (Figure 82), and the backshore prograded ~18m post-1983 (Figure 83). The dune volume has increased by 100m^3/m in the period 1984-2024 (Figure 84 and 85).

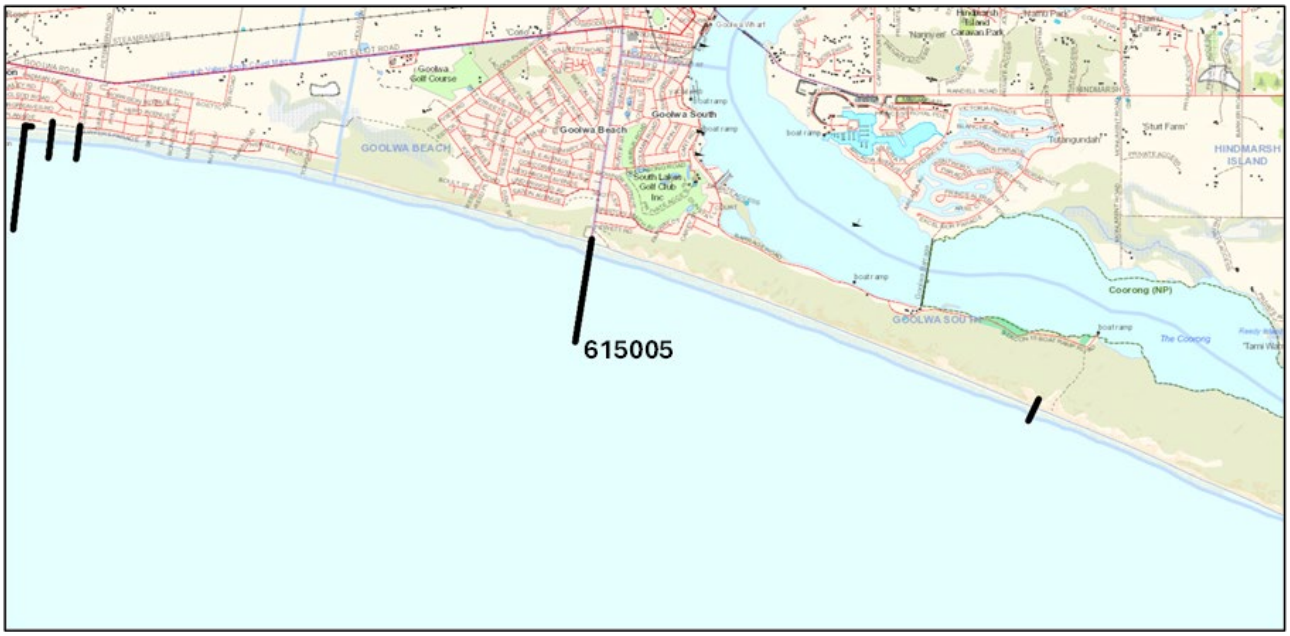


Figure 80. Location of Profile line 615005 at Goolwa.

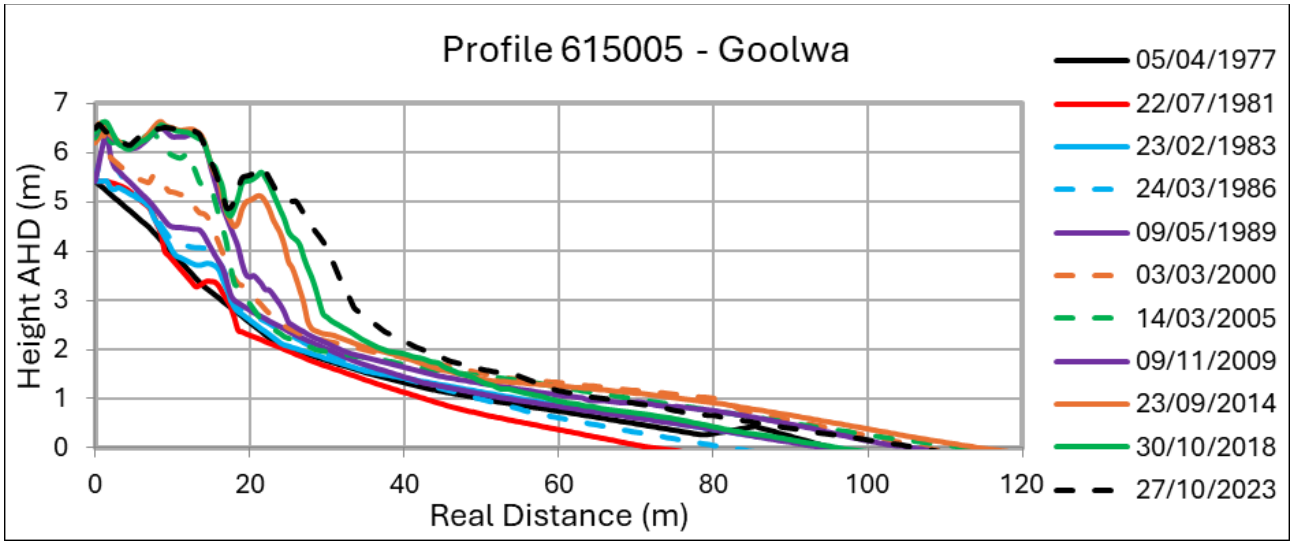


Figure 81. Topographic changes between 1977 and 2023 at Goolwa.

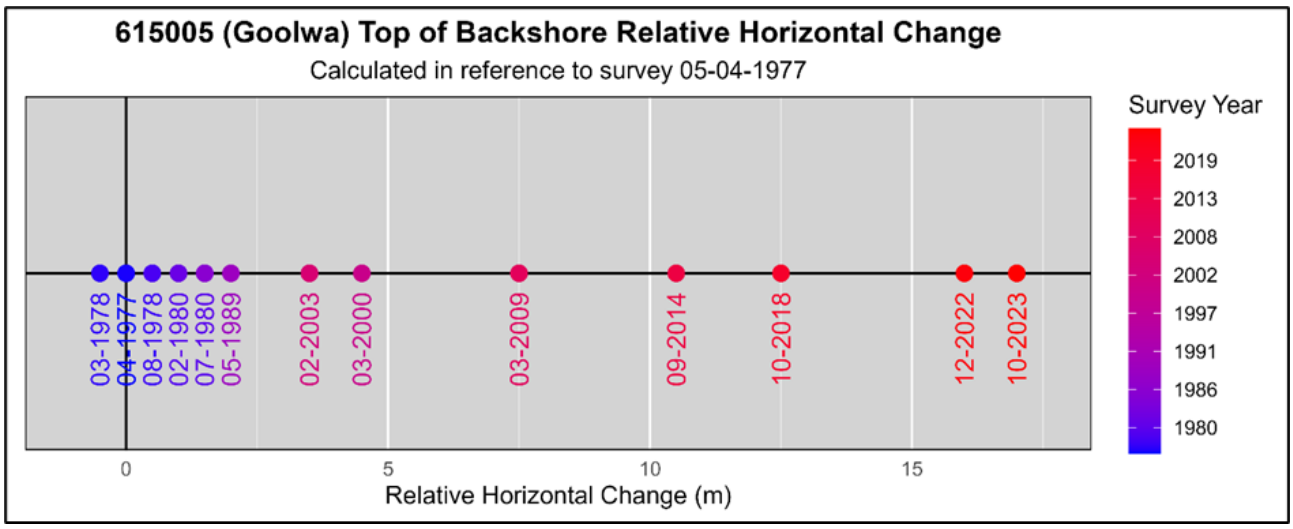


Figure 82. Horizontal movement over time of the top of the backshore position (located at 3m above AHD).

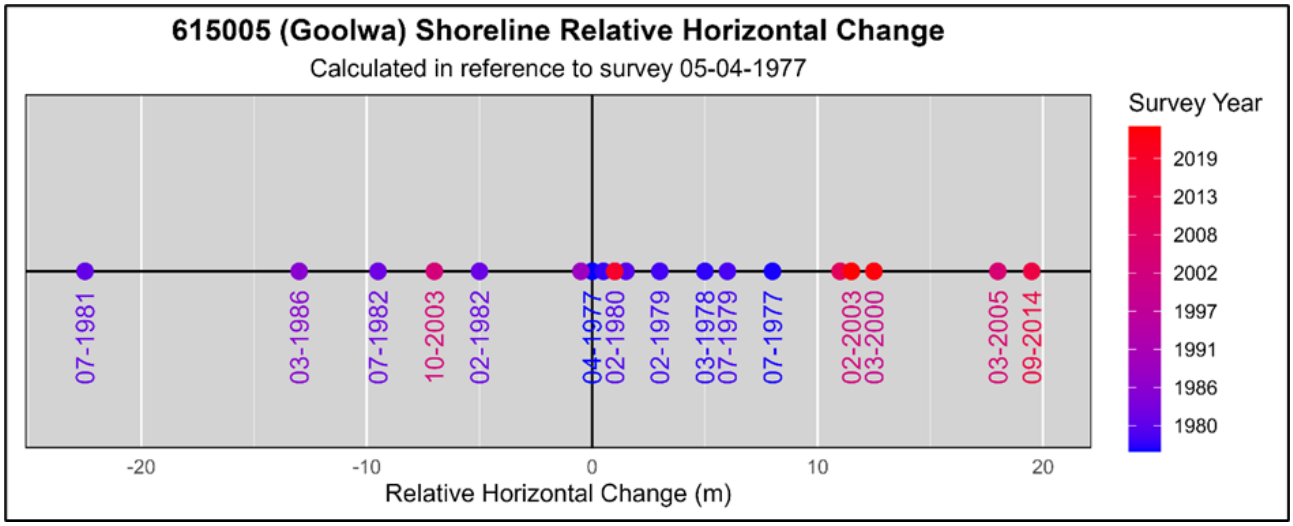


Figure 83. Relative change in the position of the shoreline at 0.0m (or AHD) seawards or landwards since 1980.

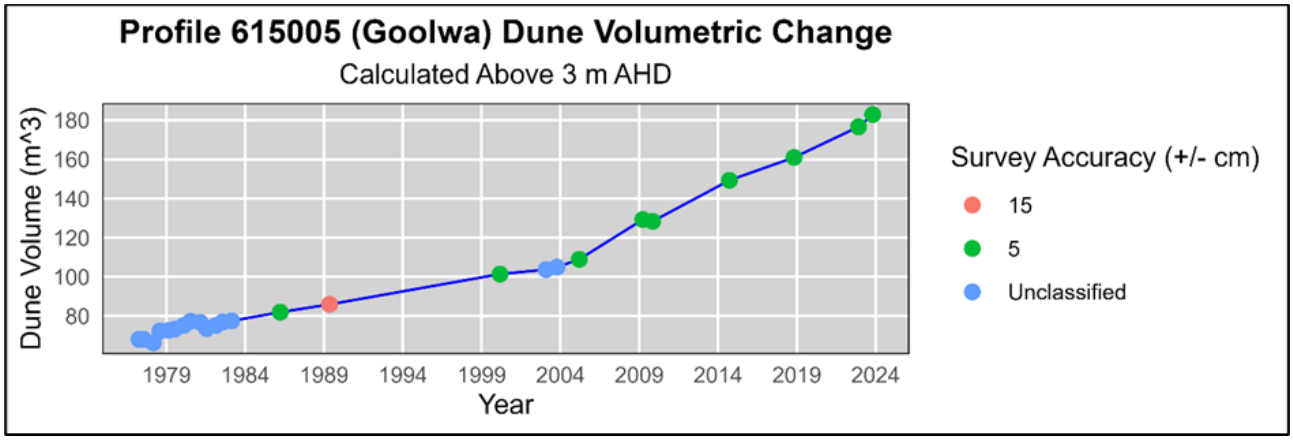


Figure 84. Volumetric change of the foredune over time. The toe of the foredune/top of the backshore is at 3m AHD.

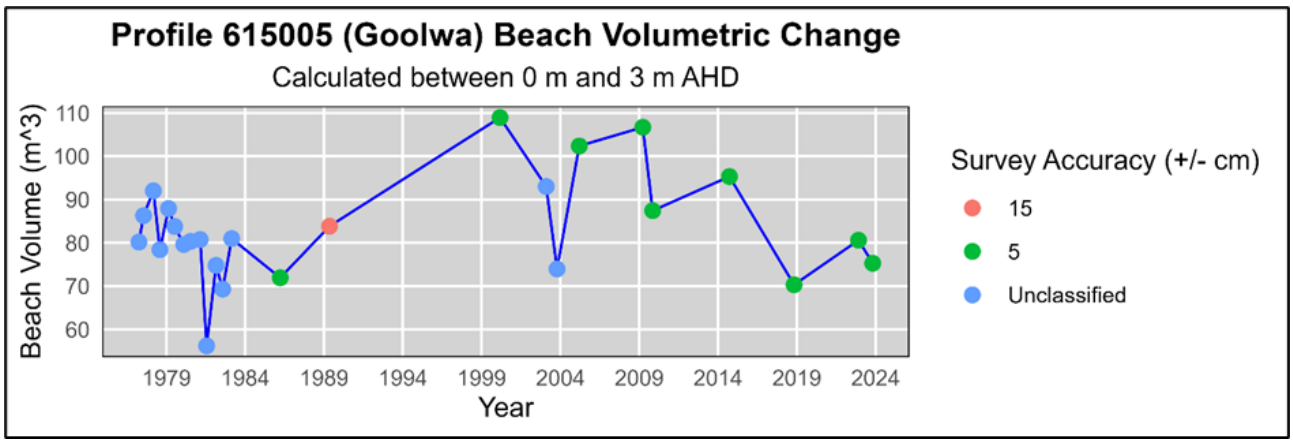


Figure 85. Beach volumetric change over time calculated between 0 and 3m AHD.

Table 15. Survey date, accuracy, beach width, dune volume, beach volume and total volume data for profile 615005, 1977-2022.

Survey	Survey Accuracy (+/- cm)	Beach Width (m)	Dune Volume (m^3)	Beach Volume (m^3)	Total Volume (m^3)
5/04/1977	Unclassified	79	68.15	80.17	148.32
21/07/1977	Unclassified	87	68.12	86.27	154.39
6/03/1978	Unclassified	84.5	66.31	92.01	158.32
4/08/1978	Unclassified	79	72.35	78.4	150.75
21/02/1979	Unclassified	81.5	72.62	87.92	160.54
12/07/1979	Unclassified	84.5	73.24	83.77	157
7/02/1980	Unclassified	79	75.16	79.62	154.78
16/07/1980	Unclassified	79	77.32	80.32	157.64
23/02/1981	Unclassified	78.5	76.75	80.76	157.51
22/07/1981	Unclassified	55.5	73.54	56.2	129.74
25/02/1982	Unclassified	73	75.23	74.78	150.01
29/07/1982	Unclassified	68	76.92	69.3	146.22
23/02/1983	Unclassified	78.5	77.51	80.97	158.48
24/03/1986	5	64.5	81.95	71.92	153.86
9/05/1989	15	76.5	85.91	83.83	169.74
3/03/2000	5	87	101.39	108.93	210.32

6/02/2003	Unclassified	87	103.7	93	196.7
16/10/2003	Unclassified	68.5	104.94	73.94	178.88
14/03/2005	5	93.5	108.95	102.37	211.33
25/03/2009	5	NA	129.25	106.69	235.94
9/11/2009	5	82.5	128.34	87.42	215.76
23/09/2014	5	88	149.29	95.31	244.6
30/10/2018	5	67.5	160.97	70.3	231.27
1/12/2022	5	75.5	176.6	80.6	257.2
27/10/2023	5	73.5	182.85	75.27	258.12
Mean Beach Width (m)	77.96				
nobs	24				
Beach Mobility	8.72				
Top of Backshore Relative Horizontal Change (m/yr)	0.37				
Shoreline Relative Horizontal Change (m/yr)	0.25				
Dune Volume Change (m^3/yr)	2.46				
Beach Volume Change (m^3/yr)	-0.11				
Total Volume Change (m^3/yr)	2.36				

3.9 Cell SF2 Sir Richards Peninsula

Profiles 615009 and 615010 are located on the Sir Richards Peninsula SE of the Goolwa profile. Both profiles show accretion over time (Figure 86 and Table 16 and Table 17) but the accretion is greater at the more SE profile (Figures 87 and 88) nearer to the Murray mouth (Profile 615010). This may be related to that area receiving more sediment due to placement of dredged sediment placed on the adjacent beach near the mouth. The top of the backshore on Profile 615009 retreated 6m in 2014 but had progaded to the -0.5m position by 2022 (Figure 89). The beach eroded ~4.5m post-2000 to 20 but then prograded ~11metres post-2005 to 2023 (Figures 89). The dune changes indicate that a blowout (wind eroded hollow) in the dune crest was infilled with wind blown aeolian sand and then the crest continued to build (Figure 87).

The top of the backshore on Profile 615010 has prograded 10m (2005-2023; Figure 88), while the beach prograded ~57m between 2003 and 2009, and since 2009 has retreated 55 metres to 2023 (Figure 91). This profile is still ~5m seawards of the 2003 shoreline position. Dune volume has consistently increased post-2002 (Figure 92). This profile is an example of how a dune responds to erosion and scarping after the storms of 2004-2005. The dune crest builds upwards vertically while also translating landwards.

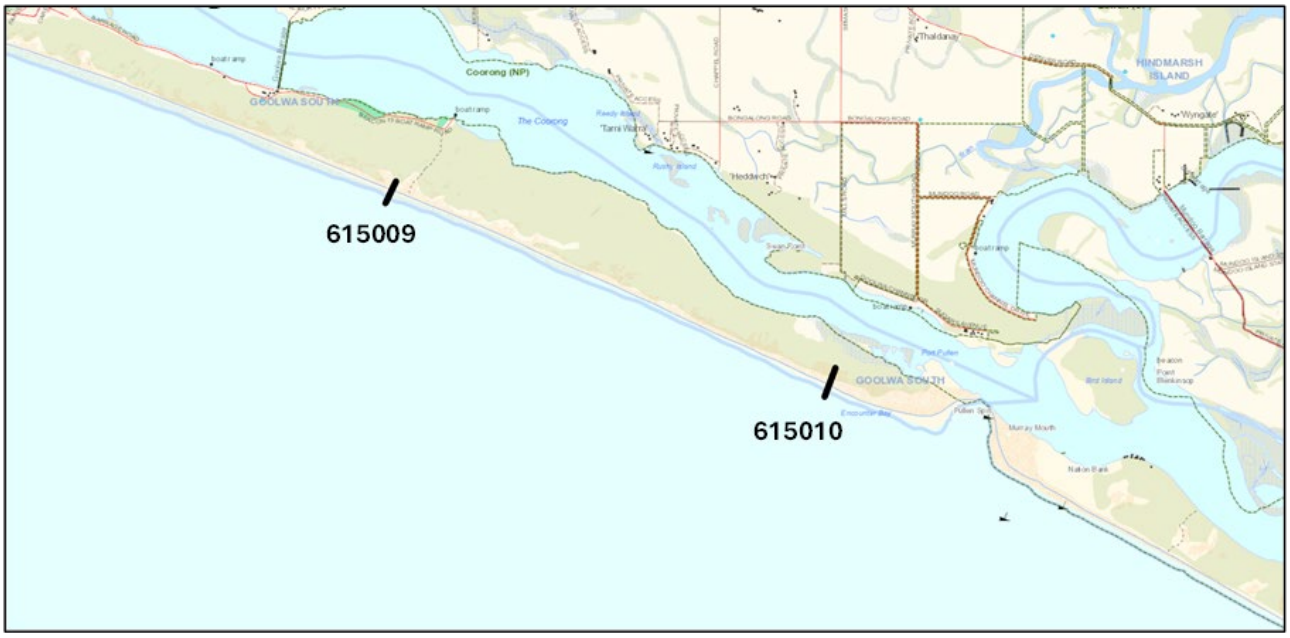


Figure 86. Location of Profile lines 615009 and 615010, along the Sir Richard Peninsula.

3.9.1 Profile 615009

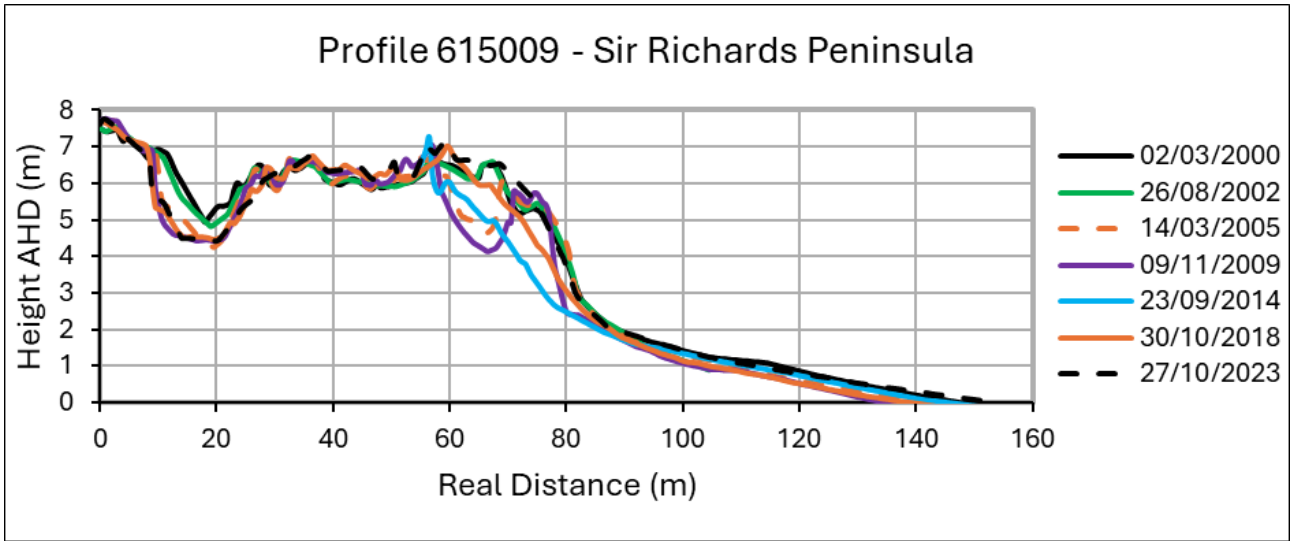


Figure 87. Topographic changes between 2000 and 2023 at Profile 615009.

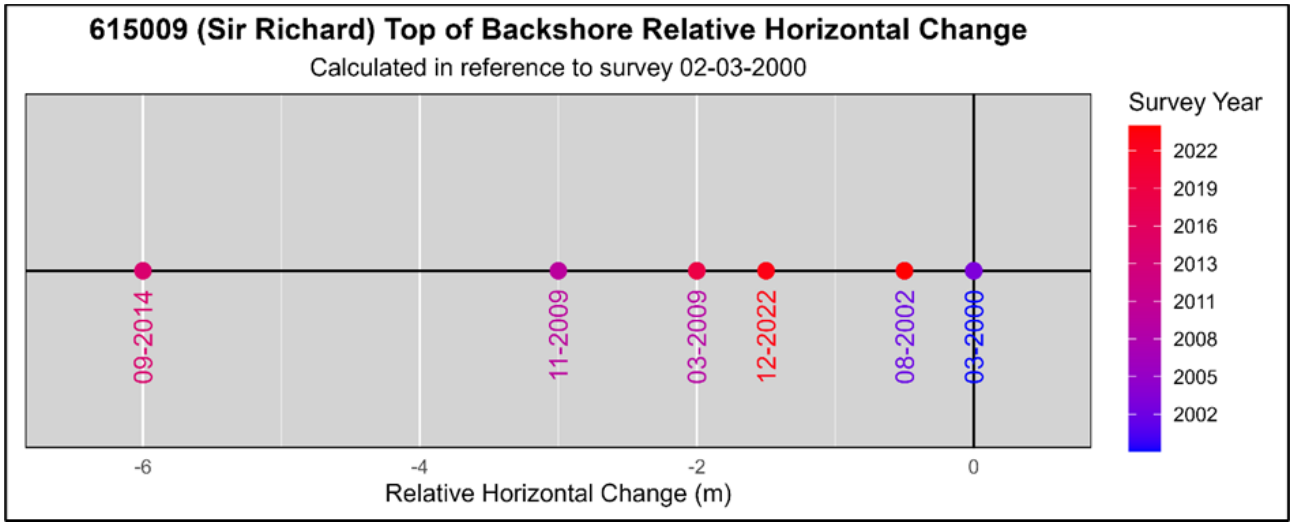


Figure 88. Horizontal movement over time of the top of the backshore position (located at 3m above AHD).

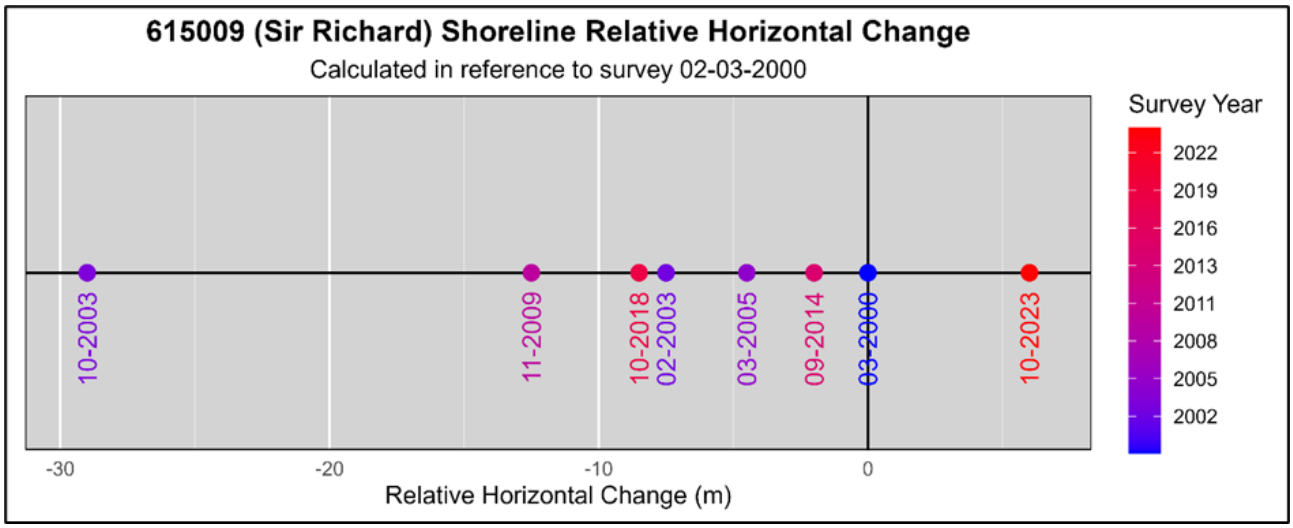


Figure 89. Relative change in the position of the shoreline at 0.0m (or AHD) seawards or landwards since 2002.

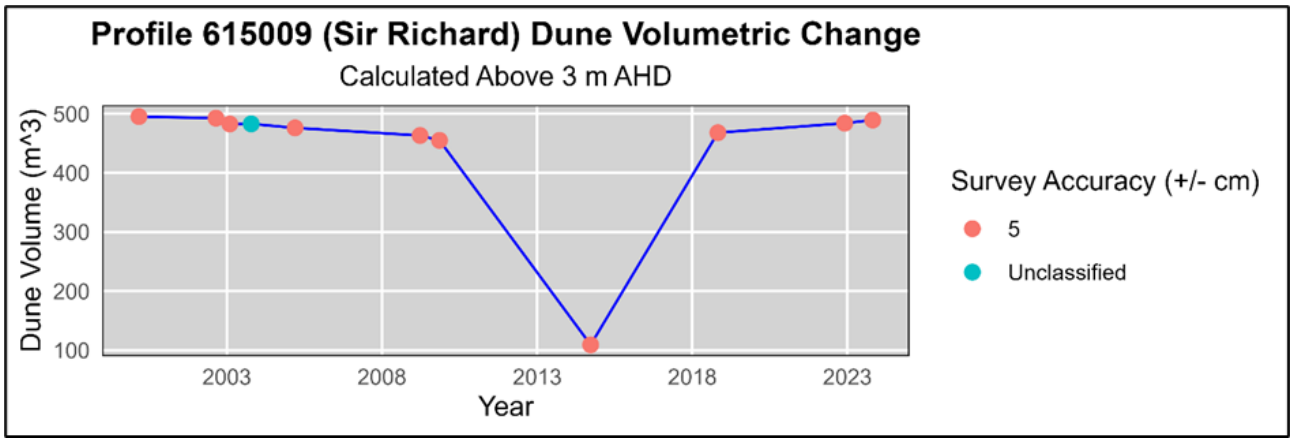


Figure 90. Volumetric change of the foredune over time. The toe of the foredune/top of the backshore is at 3m AHD.

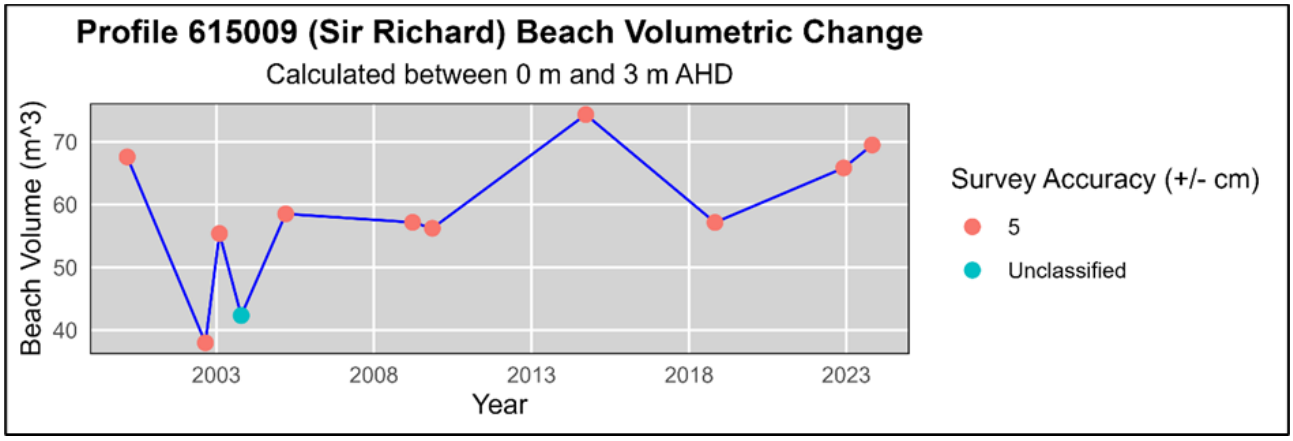


Figure 91. Beach volumetric change over time calculated between 0 and 3m AHD.

Table 16. Survey date, accuracy, beach width, dune volume, beach volume and total volume data for profile 615009, 2000 - 2023.

Survey	Survey Accuracy (+/- cm)	Beach Width (m)	Dune Volume (m^3)	Beach Volume (m^3)	Total Volume (m^3)
2/03/2000	5	65.5	495.07	67.59	562.66
26/08/2002	5	NA	492.39	37.98	530.37
5/02/2003	5	58	482.56	55.39	537.95
15/10/2003	Unclassified	36.5	482.71	42.32	525.04
14/03/2005	5	61.5	475.94	58.52	534.46
25/03/2009	5	NA	463.08	57.17	520.24
9/11/2009	5	56	454.79	56.23	511.02
23/09/2014	5	69.5	109.13	74.34	183.47
30/10/2018	5	59	467.86	57.15	525
1/12/2022	5	NA	483.88	65.84	549.72
27/10/2023	5	72	489.2	69.49	558.69
Mean Beach Width (m)	59.75				
nobs	8				
Beach Mobility	10.95				
Top of Backshore Relative Horizontal Change (m/yr)	-0.02				
Shoreline Relative Horizontal Change (m/yr)	0.25				
Dune Volume Change (m^3/yr)	-0.25				
Beach Volume Change (m^3/yr)	0.08				
Total Volume Change (m^3/yr)	-0.17				

3.9.2 Profile 615010

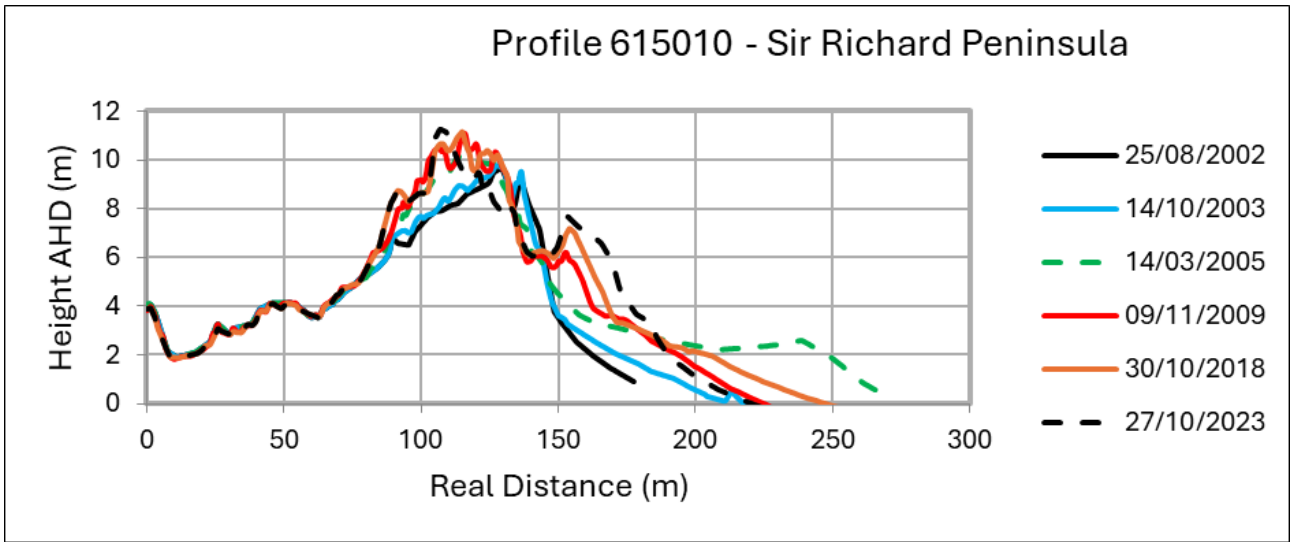


Figure 92. Topographic changes between 2002 and 2023 at Profile 615010.

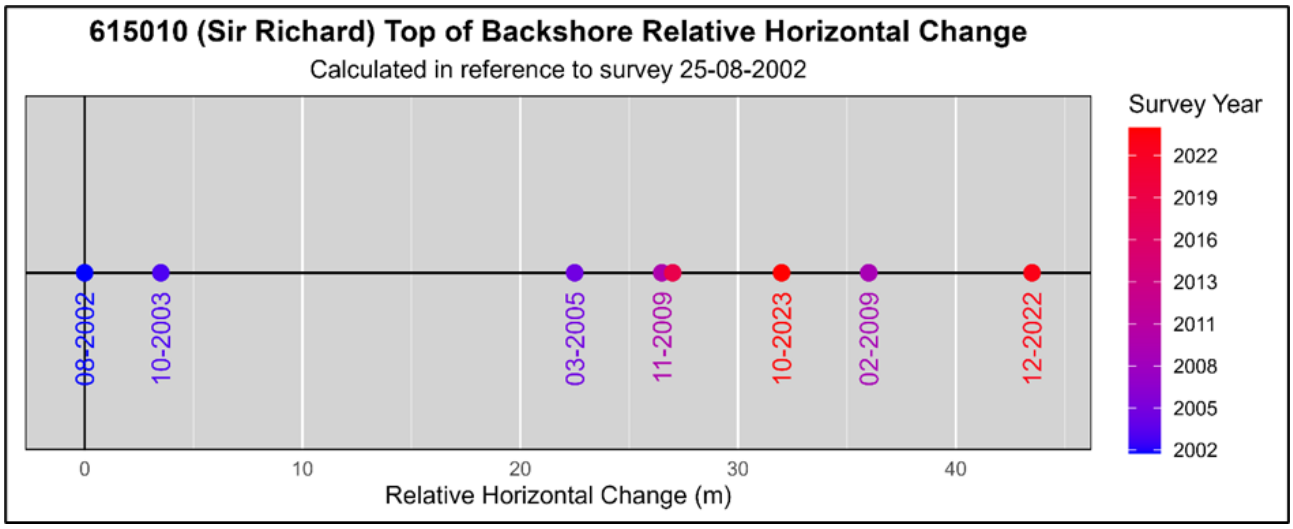


Figure 93. Horizontal movement over time of the top of the backshore position (located at 3m above AHD).

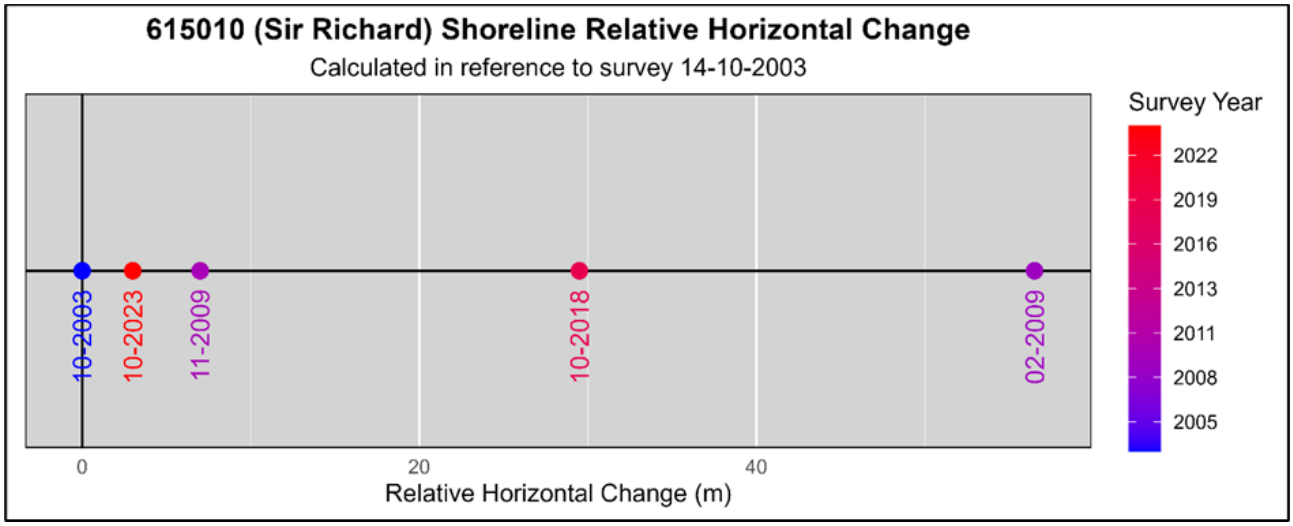


Figure 94. Relative change in the position of the shoreline at 0.0m (or AHD) seawards or landwards since 2005.

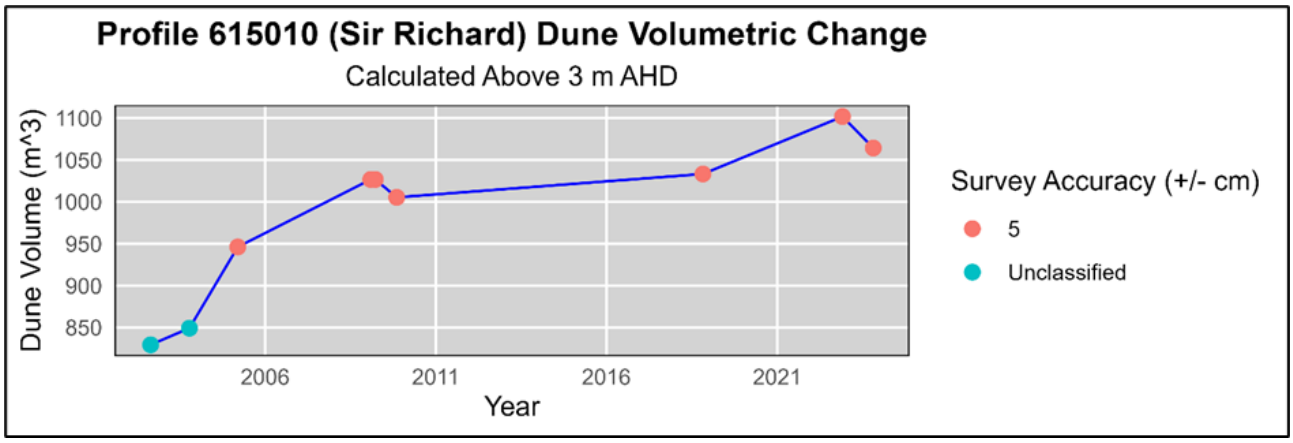


Figure 95. Volumetric change of the foredune over time. The toe of the foredune/top of the backshore is at 3m AHD.

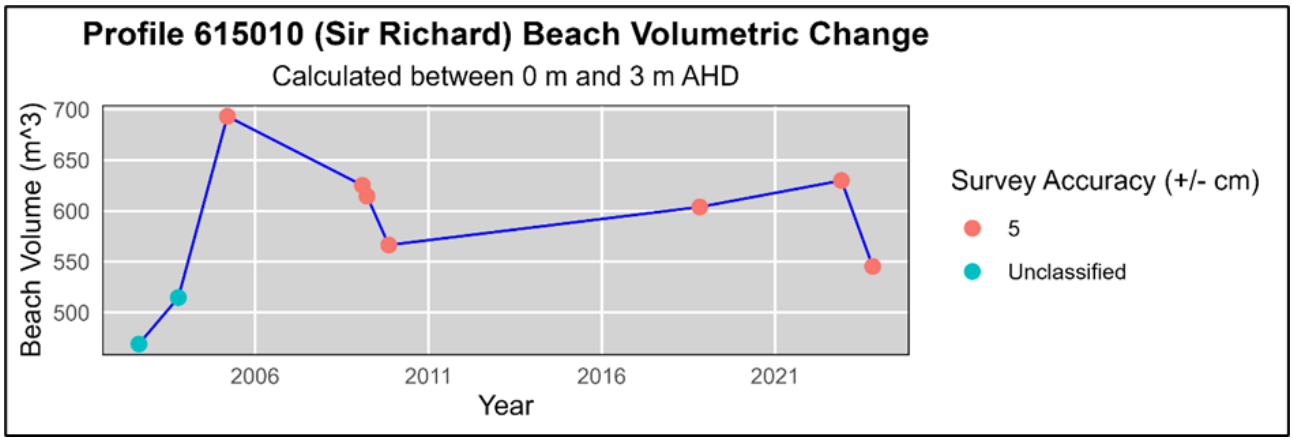


Figure 96. Beach volumetric change over time calculated between 0 and 3m AHD.

Table 17. Survey date, accuracy, beach width, dune volume, beach volume and total volume data for profile 615010, 2002 - 2023.

Survey	Survey Accuracy (+/- cm)	Beach Width (m)	Dune Volume (m^3)	Beach Volume (m^3)	Total Volume (m^3)
25/08/2002	Unclassified	NA	829.35	468.88	1298.23
14/10/2003	Unclassified	61	849.24	514.66	1363.9
14/03/2005	5	NA	946.17	693.25	1639.42
4/02/2009	5	85	1026.78	625.24	1652.02
25/03/2009	5	NA	1026.78	614.49	1641.27
9/11/2009	5	45	1005.42	566.43	1571.85
30/10/2018	5	67	1033.33	603.91	1637.24
1/12/2022	5	NA	1101.87	629.97	1731.84
27/10/2023	5	35.5	1064.36	545.3	1609.65
Mean Beach Width (m)	58.7				
nobs	5				
Beach Mobility	19.31				
Top of Backshore Relative Horizontal Change (m/yr)	1.51				
Shoreline Relative Horizontal Change (m/yr)	0.15				
Dune Volume Change (m^3/yr)	11.1				
Beach Volume Change (m^3/yr)	1.53				
Total Volume Change (m^3/yr)	12.27				

3.10 Cell SE17 Northern Younghusband Peninsula

Cell SF17 comprises four profiles, 720011 to 720008 (Figure 97). The profiles have only been surveyed completely twice, in 2005 and 2009. They either show approximate stability (profiles 720011, 720009; Figures 98 to 100; Table 18 and 20) or slight accretion and dune building (profile 720010; 720008; Figures 99 and 101, Table 19 and 21).

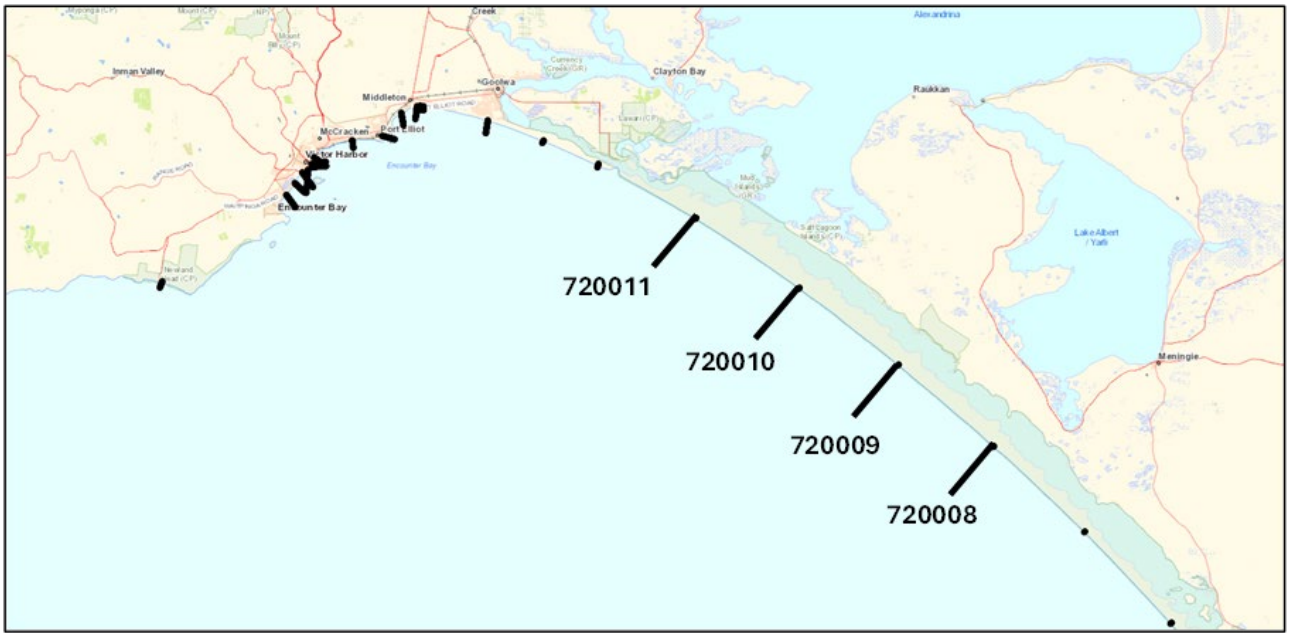


Figure 97. Location of Profile lines 720011 to 720008 in the northern portion of the Younghusband Peninsula.

3.10.1 Profile 720011

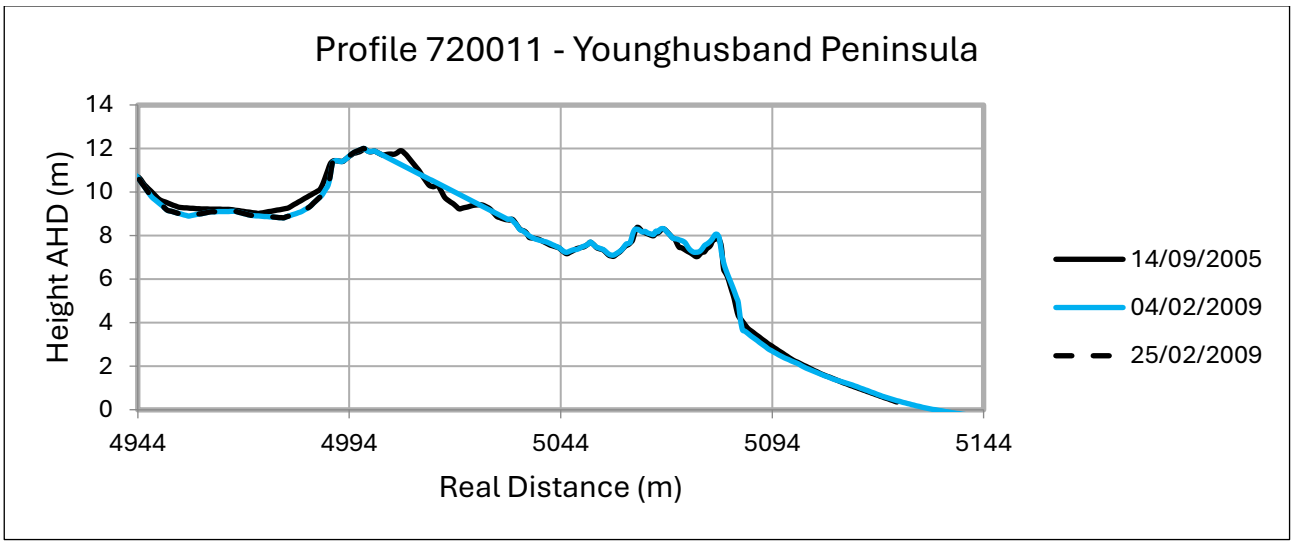


Figure 98. Topographic changes between 2005 and 2009 at Profile 720011.

Table 18. Survey date, accuracy, beach width, dune volume, beach volume and total volume data for profile 720011, 2005 - 2009.

Survey	Survey Accuracy (+/- cm)	Beach Width (m)	Dune Volume (m^3)	Beach Volume (m^3)	Total Volume (m^3)
14/09/2005	5	NA	1313.93	45.12	1359.05
4/02/2009	5	41	1301.76	50.43	1352.19
25/02/2009	5	NA	542.23	NA	NA
Mean Beach Width (m)	41				
nobs	1				
Beach Mobility	NA				
Top of Backshore Relative Horizontal Change (m/yr)	-26.96				
Shoreline Relative Horizontal Change (m/yr)	NA				
Dune Volume Change (m^3/yr)	-223.7				
Beach Volume Change (m^3/yr)	NaN				
Total Volume Change (m^3/yr)	NaN				

3.10.2 Profile 720010

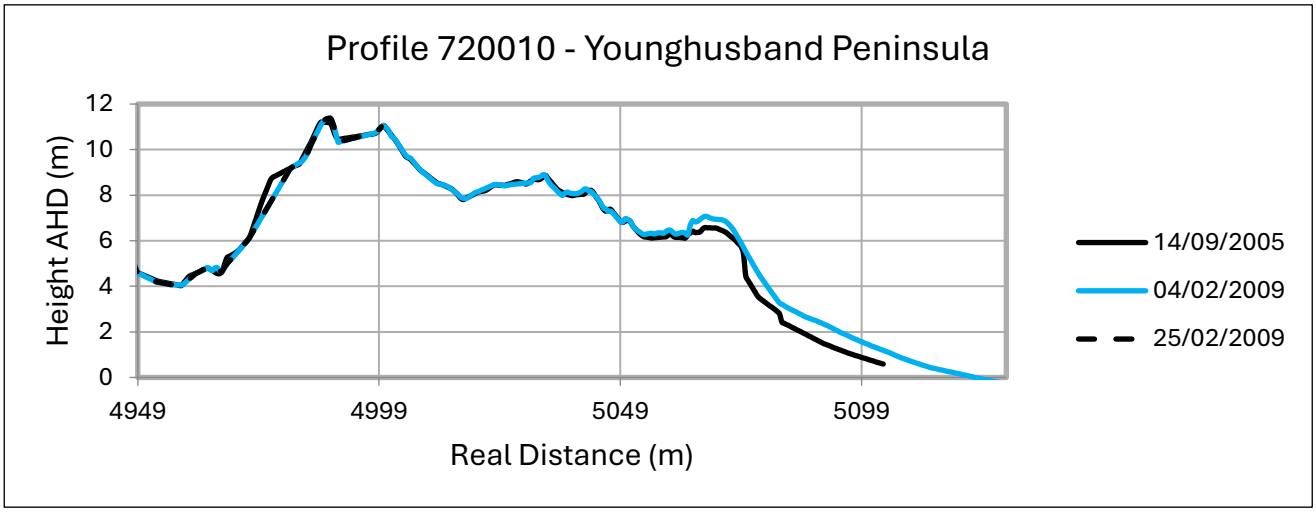


Figure 99. Topographic changes between 2005 and 2009 at Profile 720010.

Table 19. Survey date, accuracy, beach width, dune volume, beach volume and total volume data for profile 720010, 2005 - 2009.

Survey	Survey Accuracy (+/- cm)	Beach Width (m)	Dune Volume (m^3)	Beach Volume (m^3)	Total Volume (m^3)
14/09/2005	5	NA	981.51	33.65	1015.16
4/02/2009	5	38.5	999.82	48.8	1048.62
25/02/2009	5	NA	369.75	NA	NA
Mean Beach Width (m)	38.5				
nobs	1				
Beach Mobility	NA				
Top of Backshore Relative Horizontal Change (m/yr)	-23.48				
Shoreline Relative Horizontal Change (m/yr)	NA				
Dune Volume Change (m^3/yr)	-177.34				
Beach Volume Change (m^3/yr)	NaN				
Total Volume Change (m^3/yr)	NaN				

3.10.3 Profile 720009

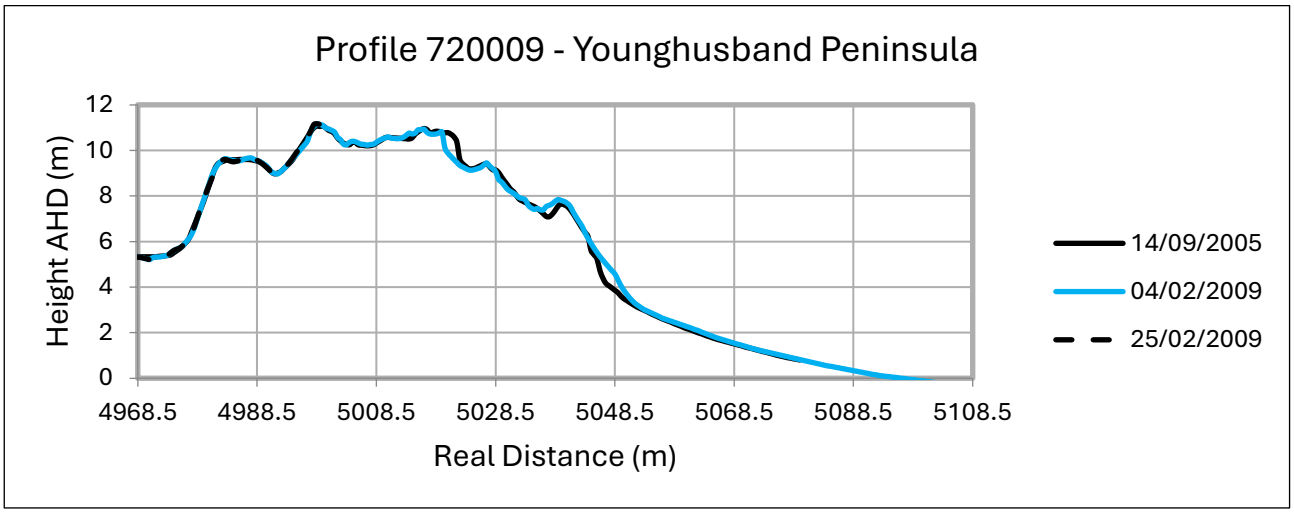


Figure 100. Topographic changes between 2005 and 2009 at Profile 720009.

Table 20. Survey date, accuracy, beach width, dune volume, beach volume and total volume data for profile 720009, 2005 - 2009.

Survey	Survey Accuracy (+/- cm)	Beach Width (m)	Dune Volume (m^3)	Beach Volume (m^3)	Total Volume (m^3)
14/09/2005	5	NA	708.87	44.96	753.84
4/02/2009	5	43	713.13	52.45	765.59
25/02/2009	5	NA	261.77	NA	NA
Mean Beach Width (m)	43				
nobs	1				
Beach Mobility	NA				
Top of Backshore Relative Horizontal Change (m/yr)	-15.36				
Shoreline Relative Horizontal Change (m/yr)	NA				
Dune Volume Change (m^3/yr)	-129.61				
Beach Volume Change (m^3/yr)	NaN				
Total Volume Change (m^3/yr)	NaN				

3.10.4 Profile 720008

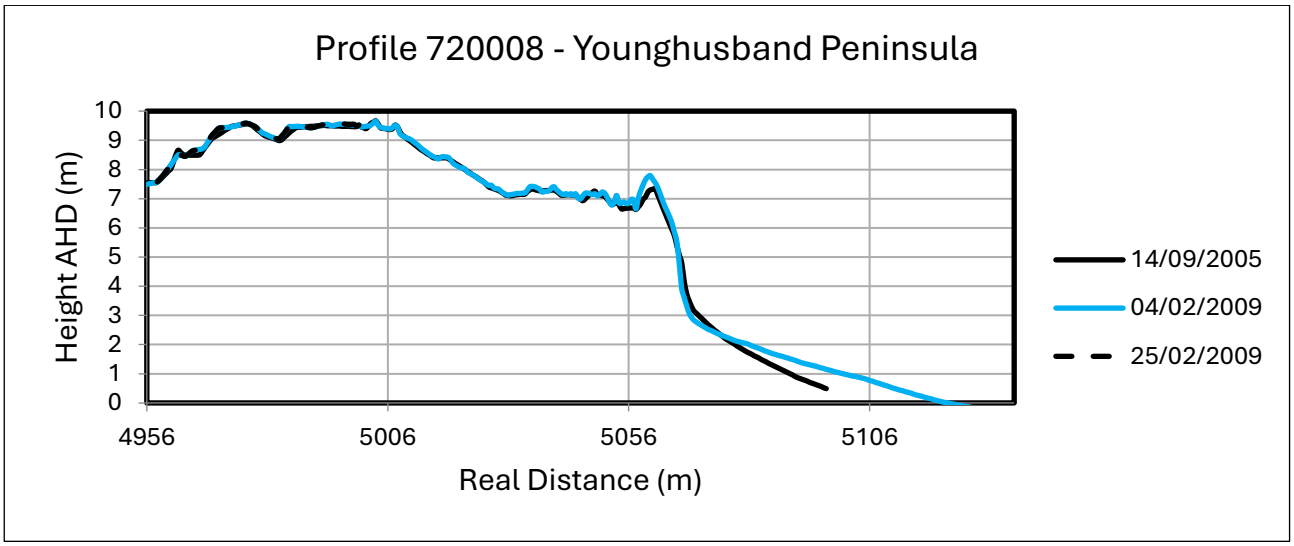


Figure 101. Topographic changes between 2005 and 2009 at Profile 720008.

Table 21. Survey date, accuracy, beach width, dune volume, beach volume and total volume data for profile 720008, 2005 - 2009.

Survey	Survey Accuracy (+/- cm)	Beach Width (m)	Dune Volume (m^3)	Beach Volume (m^3)	Total Volume (m^3)
14/09/2005	5	NA	923.01	40.96	963.97
4/02/2009	5	53.5	922.18	67.73	989.91
25/02/2009	5	NA	399.39	NA	NA
Mean Beach Width (m)	53.5				
nobs	1				
Beach Mobility	NA				
Top of Backshore Relative Horizontal Change (m/yr)	-20.44				
Shoreline Relative Horizontal Change (m/yr)	NA				
Dune Volume Change (m^3/yr)	-151.79				
Beach Volume Change (m^3/yr)	NaN				
Total Volume Change (m^3/yr)	NaN				

3.11 Cell SE16 Younghusband Peninsula (Adjacent to Robs Point to north of Parnka Point)

Cell SE16 comprises two profiles, 720007 and 720006 (Figure 102). These profiles have also only been surveyed in 2005 and twice in 2009. Profile 720007 shows deflation and wind erosion of the seaward facing slopes of the transgressive dunefield between 2005 and 2009 (Figure 103 and Table 22) with a dune volume loss of around 230m^3/m. In contrast, profile 720006 remained stable though this 4 year period (Figure 104 and Table 23).

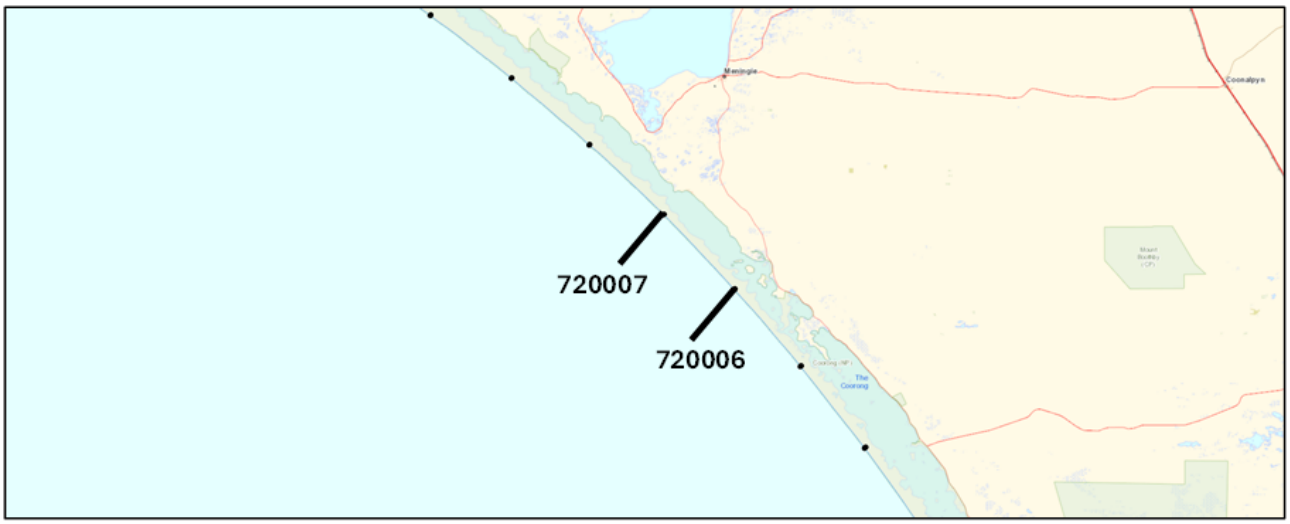


Figure 102. Location of Profile lines 720007 and 720006 on the Younghusband Peninsula.

3.11.1 Profile 720007

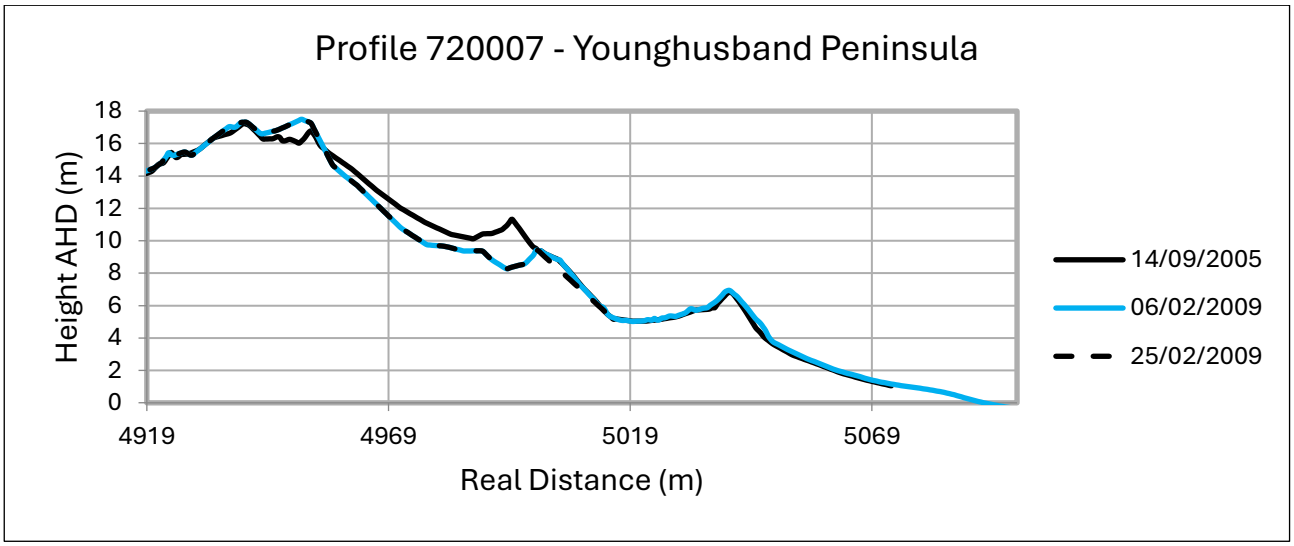


Figure 103. Topographic changes between 2005 and 2009 at Profile 720007.

Table 22. Survey date, accuracy, beach width, dune volume, beach volume and total volume data for profile 720007, 2005 - 2009.

Survey	Survey Accuracy (+/- cm)	Beach Width (m)	Dune Volume (m^3)	Beach Volume (m^3)	Total Volume (m^3)
14/09/2005	5	NA	1416.97	39.05	1456.02
6/02/2009	5	38.5	1387.29	49.1	1436.39
25/02/2009	5	NA	1184.05	NA	NA
Mean Beach Width (m)	38.5				
nobs	1				
Beach Mobility	NA				
Top of Backshore Relative Horizontal Change (m/yr)	-10.58				
Shoreline Relative Horizontal Change (m/yr)	NA				
Dune Volume Change (m^3/yr)	-67.52				
Beach Volume Change (m^3/yr)	NaN				
Total Volume Change (m^3/yr)	NaN				

3.11.2 Profile 720006

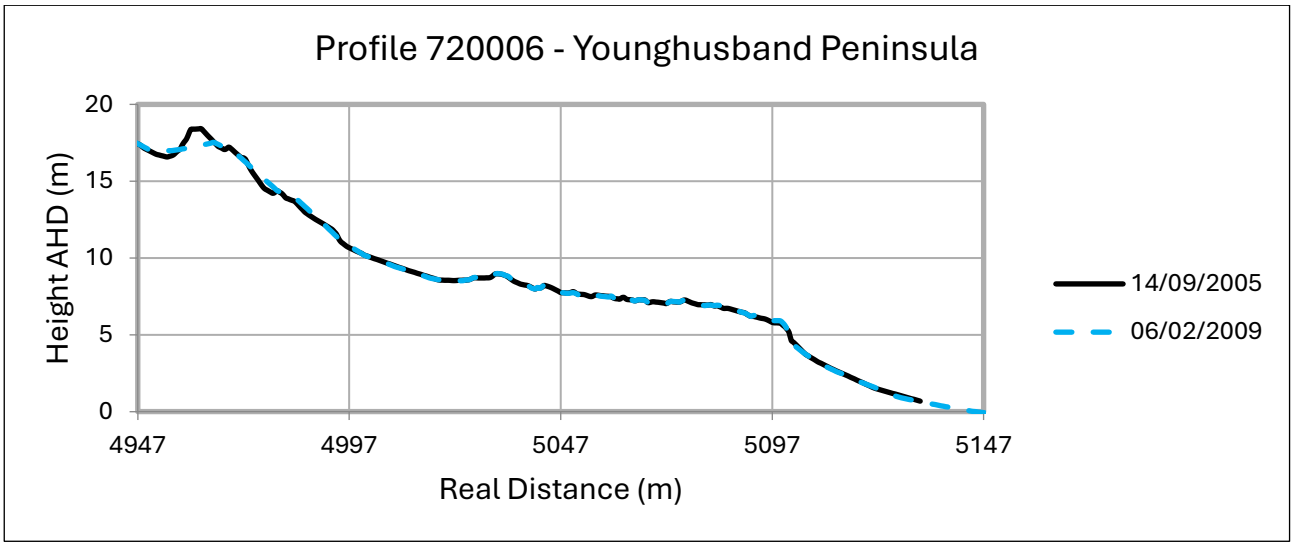


Figure 104. Topographic changes between 2005 and 2009 at Profile 720006.

Table 23. Survey date, accuracy, beach width, dune volume, beach volume and total volume data for profile 720006, 2005 - 2009.

Survey	Survey Accuracy (+/- cm)	Beach Width (m)	Dune Volume (m^3)	Beach Volume (m^3)	Total Volume (m^3)
14/09/2005	5	NA	1621.03	36.83	1657.86
6/02/2009	5	36	1619.64	41.36	1661
Mean Beach Width (m)	36				
nobs	1				
Beach Mobility	NA				
Top of Backshore Relative Horizontal Change (m/yr)	-0.15				
Shoreline Relative Horizontal Change (m/yr)	NA				
Dune Volume Change (m^3/yr)	-0.41				
Beach Volume Change (m^3/yr)	NaN				
Total Volume Change (m^3/yr)	NaN				

3.12 Cell SE15 Younghusband Peninsula, ~Parnka Point to ~28 Mile Crossing

Cell SE15 comprises 8 profiles extending from 750005 to 715007 (approximately located near 28 Mile Crossing) (Figure 105). The northern profiles (720005 to 720003) show little change or stability over the survey period of 4 years (Figure 106 and 107; Table 24 and 26). However, the more southern profiles (720002 to 715007; Table 27 to 31) are located in a zone of intensifying erosion post -1980's, and these all show erosion over the 2005–2009 period (Figure 108 to 113).

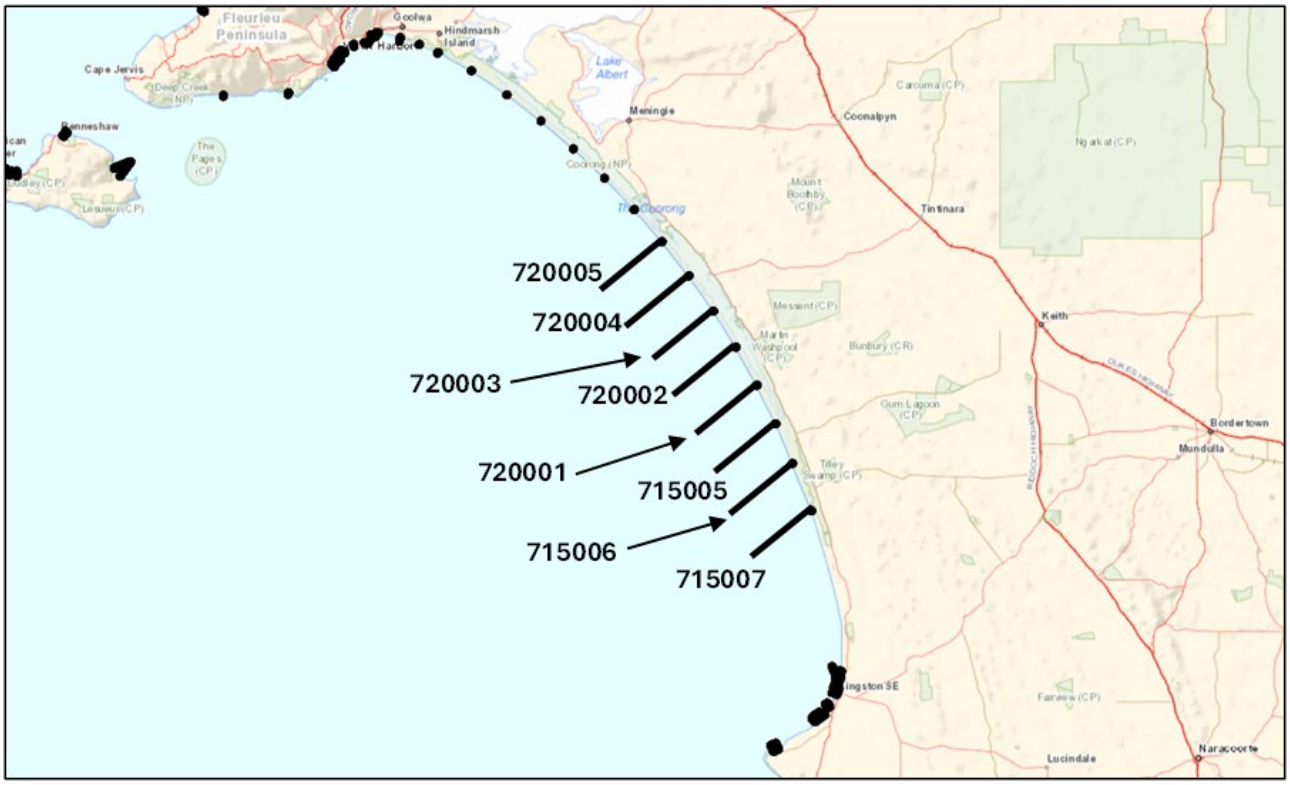


Figure 105. Location of Profile lines 720005 to 715007 in the southern portion of the Younghusband Peninsula.

3.12.1 Profile 720005

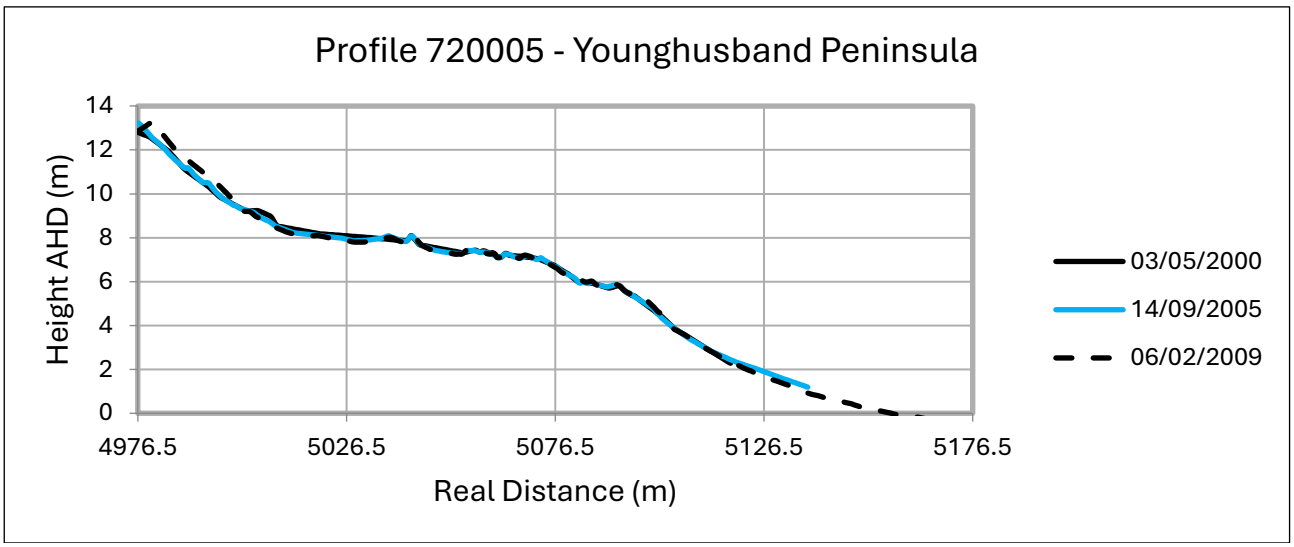


Figure 106. Topographic changes between 2000 and 2009 at Profile 720005.

Table 24. Survey date, accuracy, beach width, dune volume, beach volume and total volume data for profile 720005, 2000 - 2009.

Survey	Survey Accuracy (+/- cm)	Beach Width (m)	Dune Volume (m^3)	Beach Volume (m^3)	Total Volume (m^3)
3/05/2000	5	NA	1046.74	15.78	1062.51
14/09/2005	5	NA	1043.44	49.63	1093.07
6/02/2009	5	45	1051.62	54.37	1105.99
Mean Beach Width (m)	45				
nobs	1				
Beach Mobility	NA				
Top of Backshore Relative Horizontal Change (m/yr)	0				
Shoreline Relative Horizontal Change (m/yr)	NA				
Dune Volume Change (m^3/yr)	0.56				
Beach Volume Change (m^3/yr)	NaN				
Total Volume Change (m^3/yr)	NaN				

3.12.2 Profile 720004

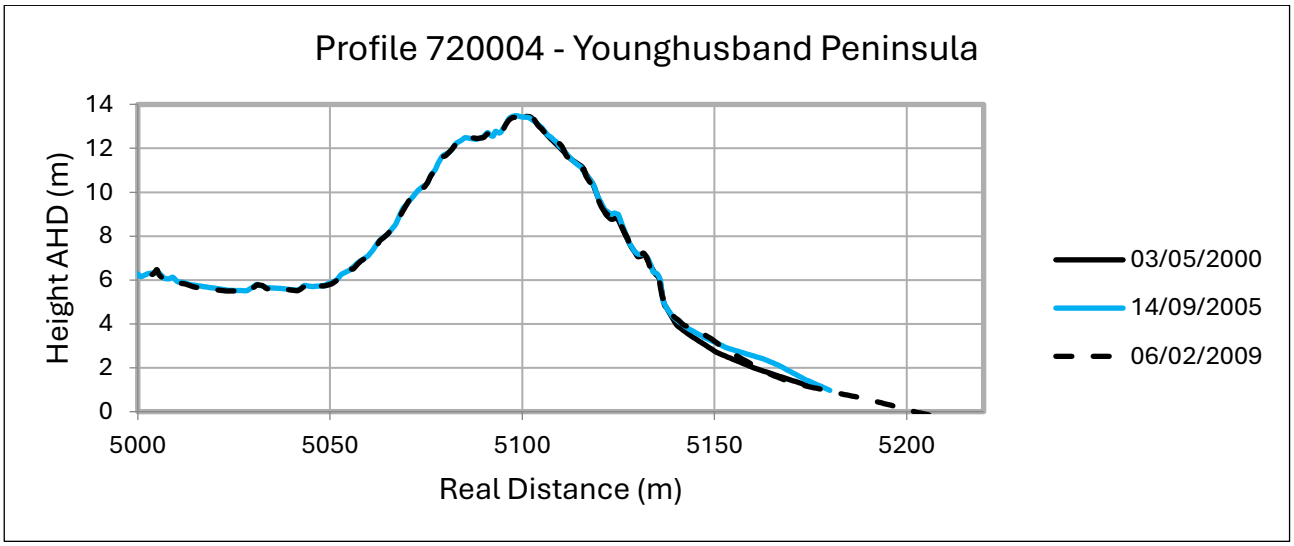


Figure 107. Topographic changes between 2000 and 2009 at Profile 720004.

Table 25. Survey date, accuracy, beach width, dune volume, beach volume and total volume data for profile 720004, 2000 - 2009.

Survey	Survey Accuracy (+/- cm)	Beach Width (m)	Dune Volume (m^3)	Beach Volume (m^3)	Total Volume (m^3)
3/05/2000	5	NA	394.87	51.98	446.84
14/09/2005	5	NA	1220.55	56.43	1276.99
6/02/2009	5	50.5	1215.29	59.14	1274.43
Mean Beach Width (m)	50.5				
nobs	1				
Beach Mobility	NA				
Top of Backshore Relative Horizontal Change (m/yr)	0.46				
Shoreline Relative Horizontal Change (m/yr)	NA				
Dune Volume Change (m^3/yr)	-1.55				
Beach Volume Change (m^3/yr)	NaN				
Total Volume Change (m^3/yr)	NaN				

3.12.3 Profile 720003

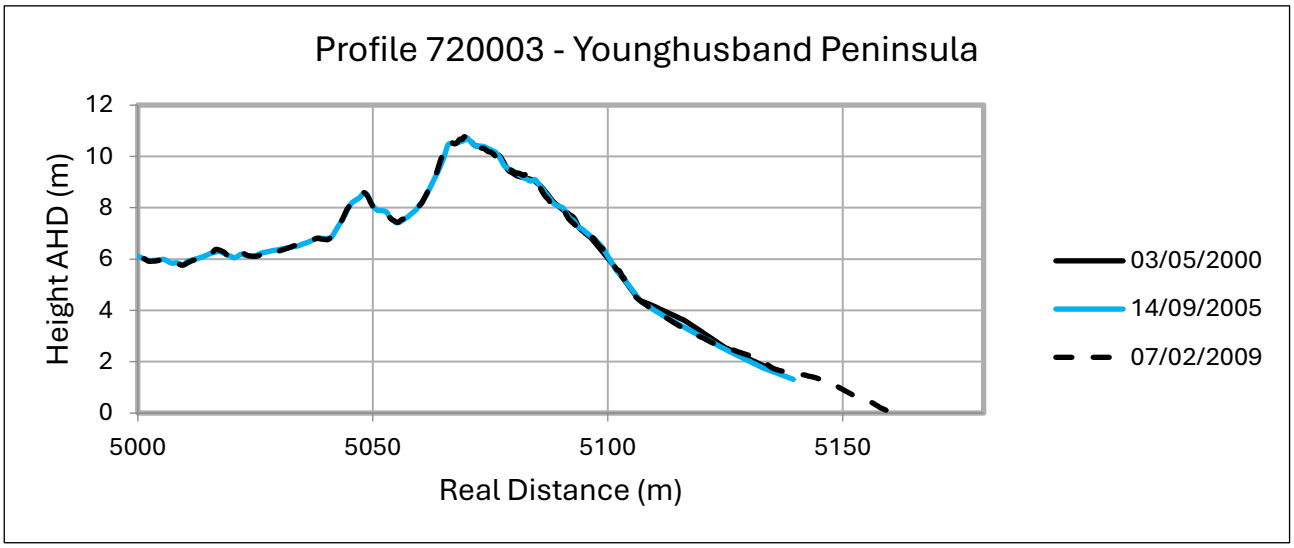


Figure 108. Topographic changes between 2000 and 2009 at Profile 720003.

Table 26. Survey date, accuracy, beach width, dune volume, beach volume and total volume data for profile 720003, 2000 - 2009.

Survey	Survey Accuracy (+/- cm)	Beach Width (m)	Dune Volume (m^3)	Beach Volume (m^3)	Total Volume (m^3)
3/05/2000	5	NA	338.56	32.49	371.06
14/09/2005	5	NA	843.55	40.62	884.17
7/02/2009	5	41.5	840.21	63.13	903.33
Mean Beach Width (m)	41.5				
nobs	1				
Beach Mobility	NA				
Top of Backshore Relative Horizontal Change (m/yr)	-0.23				
Shoreline Relative Horizontal Change (m/yr)	NA				
Dune Volume Change (m^3/yr)	-0.98				
Beach Volume Change (m^3/yr)	NaN				
Total Volume Change (m^3/yr)	NaN				

3.12.4 Profile 720002

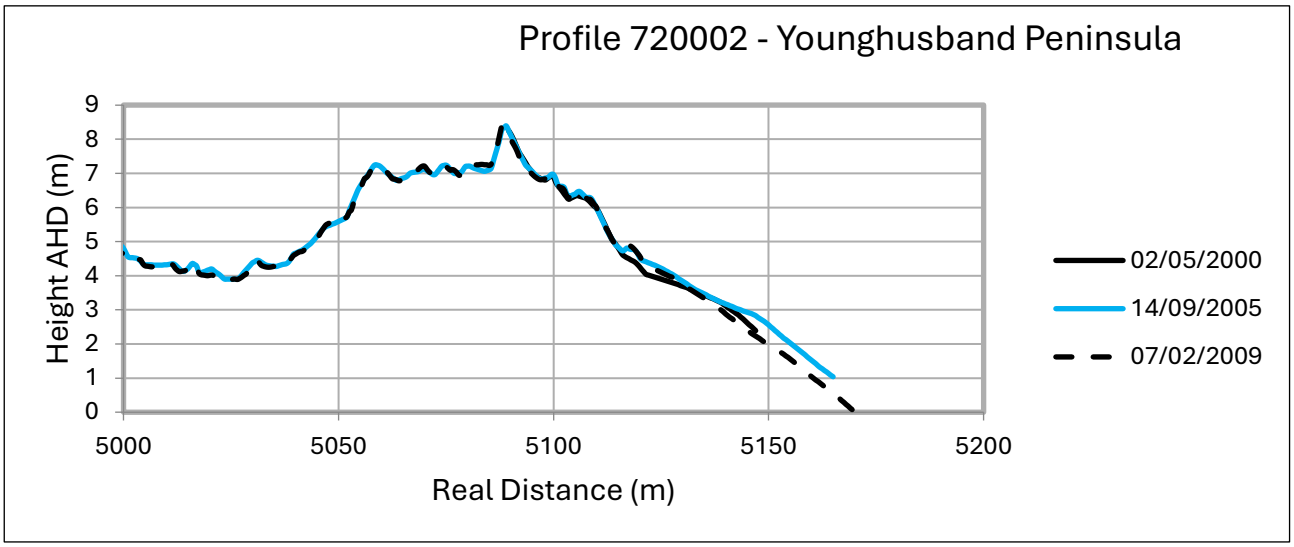


Figure 109. Topographic changes between 2000 and 2009 at Profile 720002.

Table 27. Survey date, accuracy, beach width, dune volume, beach volume and total volume data for profile 720002, 2000 - 2009.

Survey	Survey Accuracy (+/- cm)	Beach Width (m)	Dune Volume (m^3)	Beach Volume (m^3)	Total Volume (m^3)
2/05/2000	5	NA	265.45	14.86	280.3
14/09/2005	5	NA	777.12	44.99	822.11
7/02/2009	5	31.5	757.3	47.91	805.21
Mean Beach Width (m)	31.5				
nobs	1				
Beach Mobility	NA				
Top of Backshore Relative Horizontal Change (m/yr)	-0.29				
Shoreline Relative Horizontal Change (m/yr)	NA				
Dune Volume Change (m^3/yr)	-5.83				
Beach Volume Change (m^3/yr)	NaN				
Total Volume Change (m^3/yr)	NaN				

3.12.4 Profile 720001

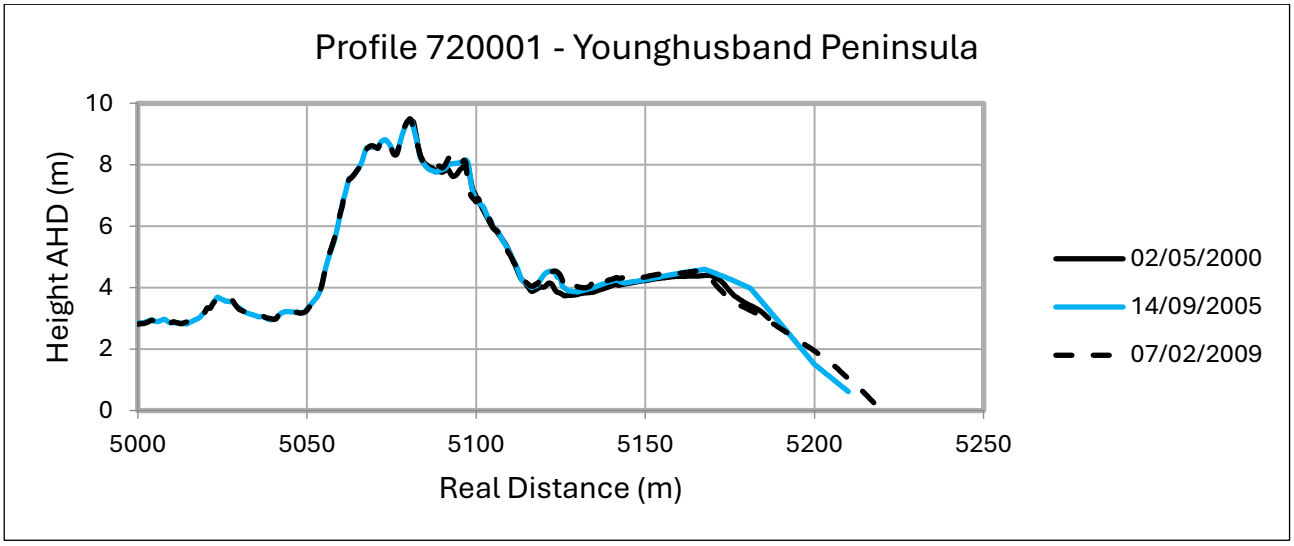


Figure 110. Topographic changes between 2000 and 2009 at Profile 720001.

Table 28. Survey date, accuracy, beach width, dune volume, beach volume and total volume data for profile 720001, 2000 - 2009.

Survey	Survey Accuracy (+/- cm)	Beach Width (m)	Dune Volume (m^3)	Beach Volume (m^3)	Total Volume (m^3)
2/05/2000	5	NA	520.32	0	520.32
14/09/2005	5	NA	867.31	594.52	1461.83
7/02/2009	5	35	851.75	609.97	1461.72
Mean Beach Width (m)	35				
nobs	1				
Beach Mobility	NA				
Top of Backshore Relative Horizontal Change (m/yr)	-0.17				
Shoreline Relative Horizontal Change (m/yr)	NA				
Dune Volume Change (m^3/yr)	-4.58				
Beach Volume Change (m^3/yr)	NaN				
Total Volume Change (m^3/yr)	NaN				

3.12.5 Profile 715005

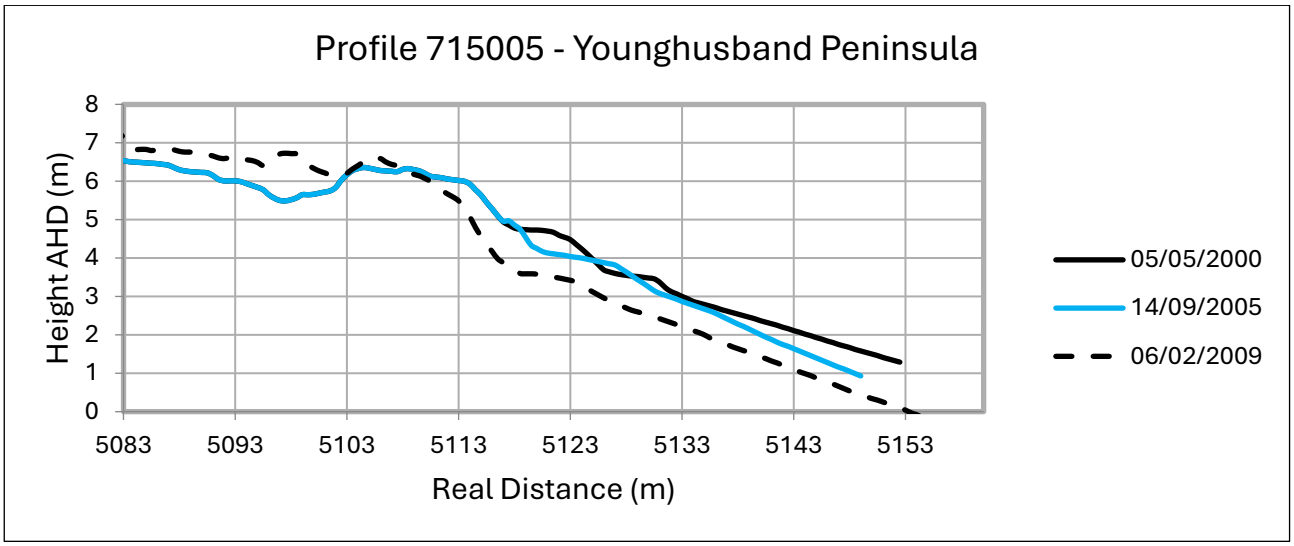


Figure 111. Topographic changes between 2000 and 2009 at Profile 715005.

Table 29. Survey date, accuracy, beach width, dune volume, beach volume and total volume data for profile 715005, 2000 - 2009.

Survey	Survey Accuracy (+/- cm)	Beach Width (m)	Dune Volume (m^3)	Beach Volume (m^3)	Total Volume (m^3)
5/05/2000	5	NA	269.66	41.5	311.16
14/09/2005	5	NA	262.55	33.37	295.92
6/02/2009	5	28	242.54	40.08	282.62
Mean Beach Width (m)	28				
nobs	1				
Beach Mobility	NA				
Top of Backshore Relative Horizontal Change (m/yr)	-0.86				
Shoreline Relative Horizontal Change (m/yr)	NA				
Dune Volume Change (m^3/yr)	-3.1				
Beach Volume Change (m^3/yr)	NaN				
Total Volume Change (m^3/yr)	NaN				

3.12.6 Profile 715006

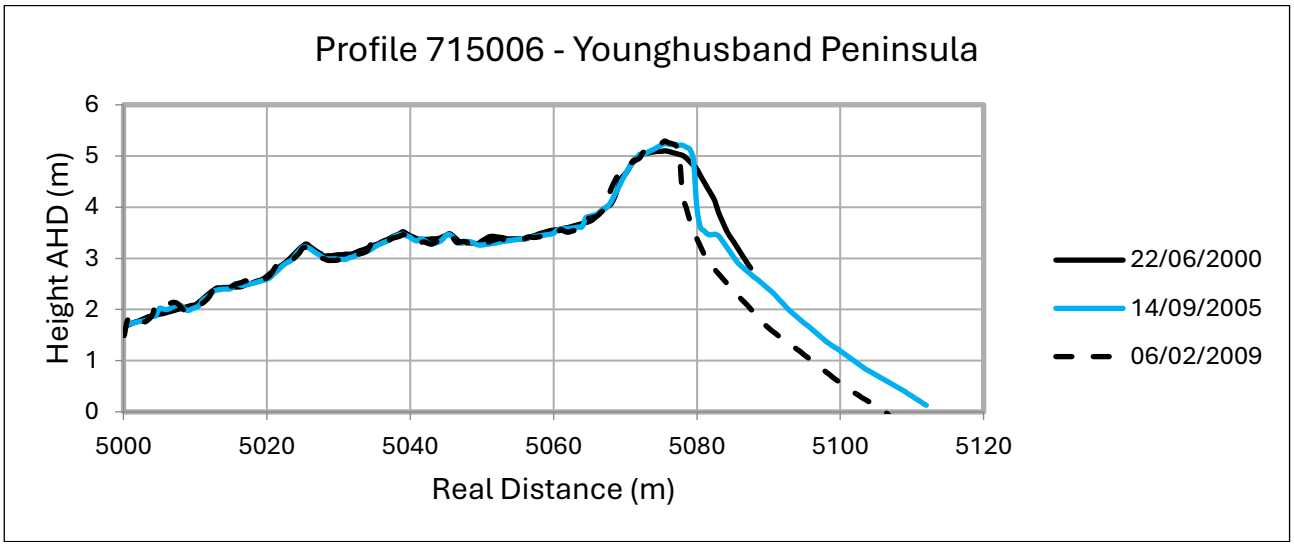


Figure 112. Topographic changes between 2000 and 2009 at Profile 715006.

Table 30. Survey date, accuracy, beach width, dune volume, beach volume and total volume data for profile 715006, 2000 - 2009.

Survey	Survey Accuracy (+/- cm)	Beach Width (m)	Dune Volume (m^3)	Beach Volume (m^3)	Total Volume (m^3)
22/06/2000	5	NA	234.47	241.17	475.64
14/09/2005	5	NA	224.18	274.09	498.27
6/02/2009	5	25	208.22	257.34	465.57
Mean Beach Width (m)	25				
nobs	1				
Beach Mobility	NA				
Top of Backshore Relative Horizontal Change (m/yr)	-0.64				
Shoreline Relative Horizontal Change (m/yr)	NA				
Dune Volume Change (m^3/yr)	-3.04				
Beach Volume Change (m^3/yr)	NaN				
Total Volume Change (m^3/yr)	NaN				

3.12.7 Profile 715007

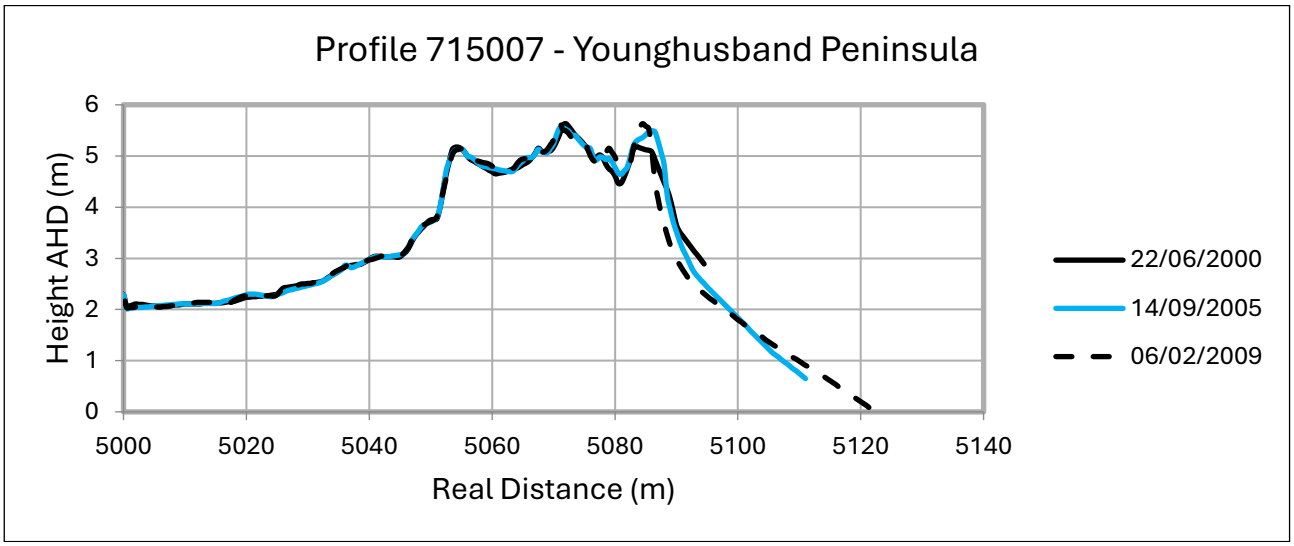


Figure 113. Topographic changes between 2000 and 2009 at Profile 715007.

Table 31. Survey date, accuracy, beach width, dune volume, beach volume and total volume data for profile 715007, 2000 - 2009.

Survey	Survey Accuracy (+/- cm)	Beach Width (m)	Dune Volume (m^3)	Beach Volume (m^3)	Total Volume (m^3)
22/06/2000	5	NA	237.06	255.18	492.24
14/09/2005	5	NA	232.79	278.73	511.52
6/02/2009	5	33	222.45	285.47	507.92
Mean Beach Width (m)	33				
nobs	1				
Beach Mobility	NA				
Top of Backshore Relative Horizontal Change (m/yr)	-0.46				
Shoreline Relative Horizontal Change (m/yr)	NA				
Dune Volume Change (m^3/yr)	-1.69				
Beach Volume Change (m^3/yr)	NaN				
Total Volume Change (m^3/yr)	NaN				

3.13 Cell SE13 Kingston to Cape Jaffa

Four profiles are located in cell SE13, profiles 715003, 715009, 715053, and 715049 (Figure 114).

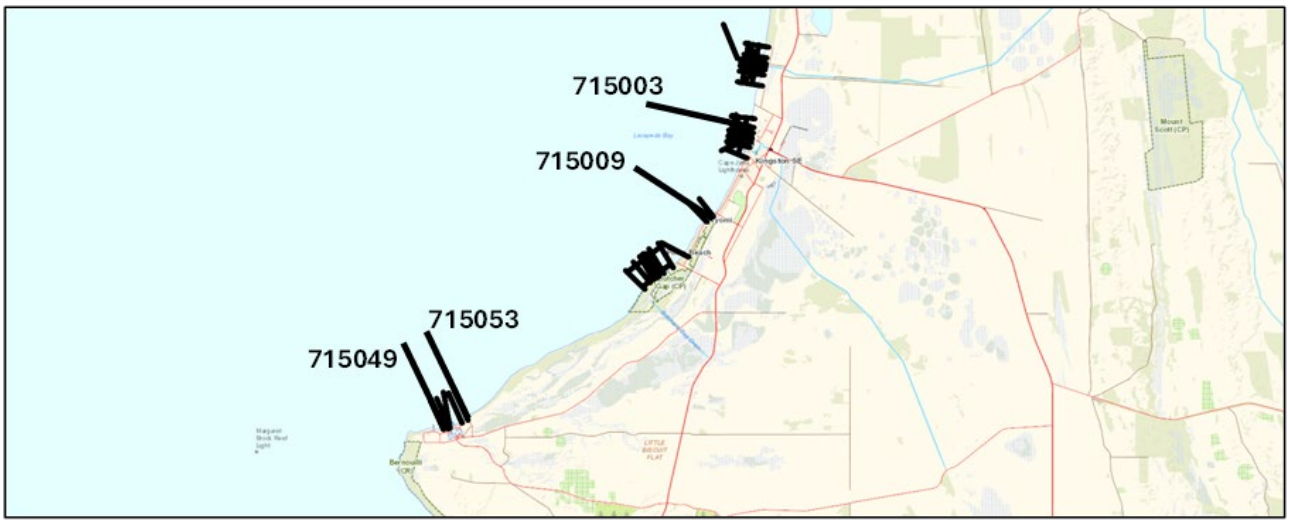


Figure 114. Location of Profile lines 715003 to 715049, Kingston to Cape Jaffa.

3.13.1 Profile 715003

Profile 715003 at Kingston shows long term accretion over time (Figure 115 and Table 32). This profile is located in a region of very low wave energy, high seagrass wrack production, and sits within a long term longshore drift accretion zone. The profile has mostly accreted vertically. While the top of the backshore has barely moved (Figure 116), the 0m AHD position has actually retreated some ~7m between 1986 and 2012 (Figure 117). However,

dune volume is negligible (Figure 118) but beach volume has increased by 200m3/m (Figure 119).

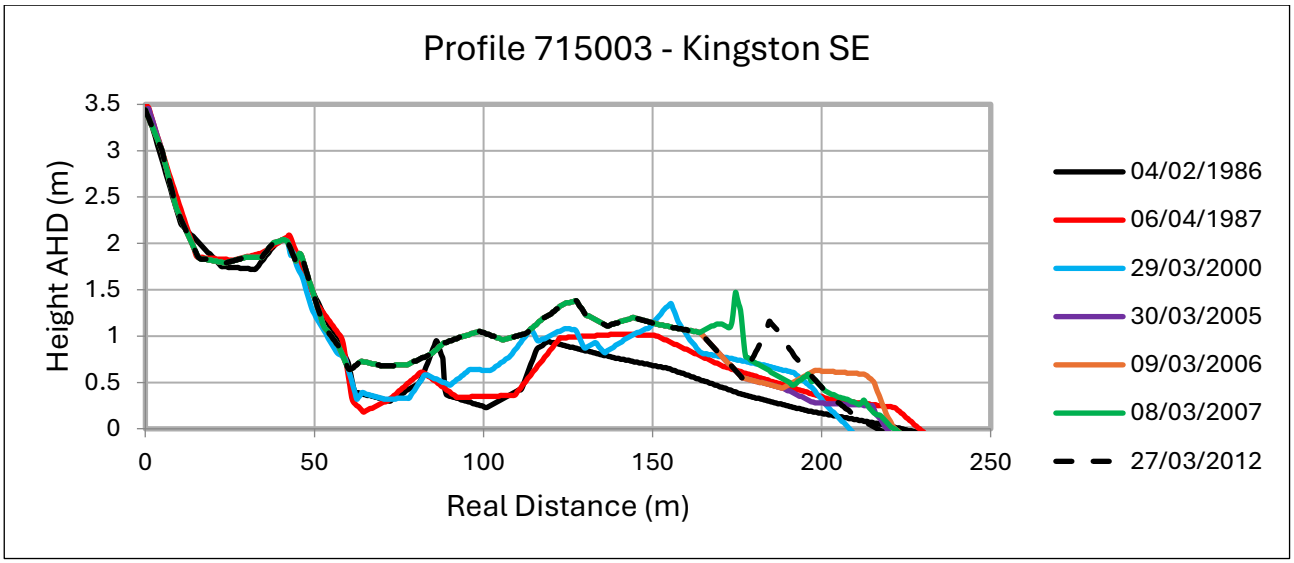


Figure 115. Topographic changes between 1986 and 2012 at Profile 715003.

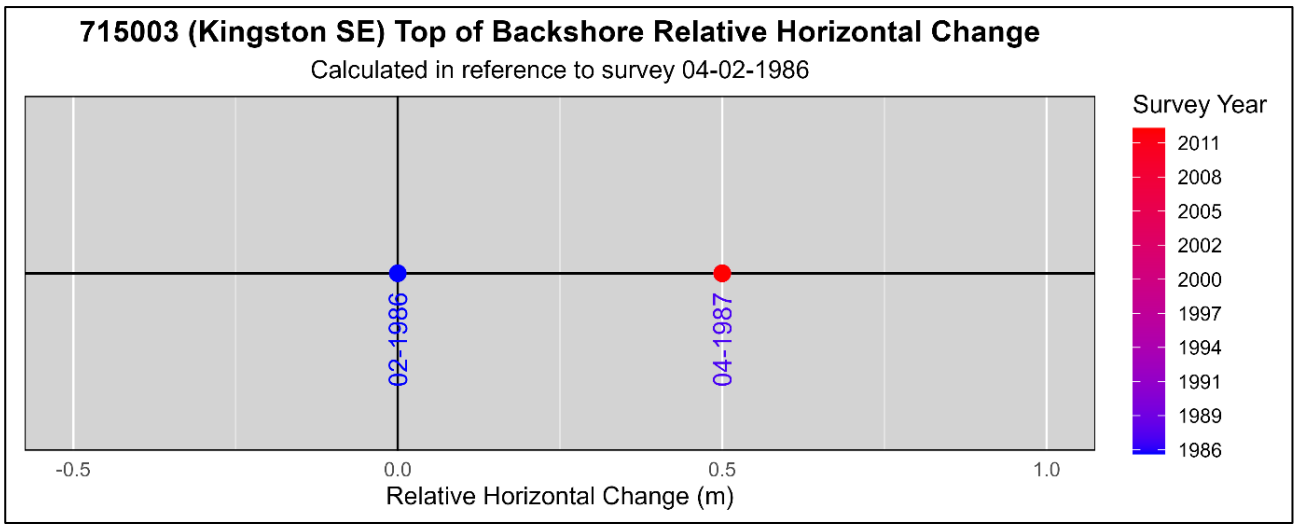


Figure 116. Horizontal movement over time of the top of the backshore position (located at 3m above AHD).

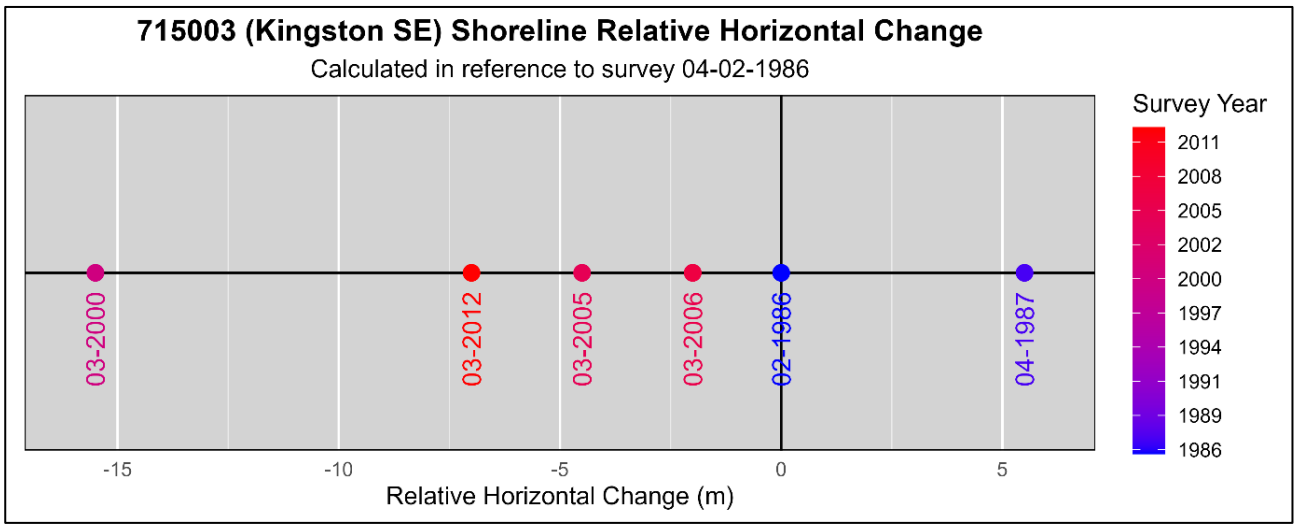


Figure 117. Relative change in the position of the shoreline at 0.0m (or AHD) seawards or landwards since 1986.

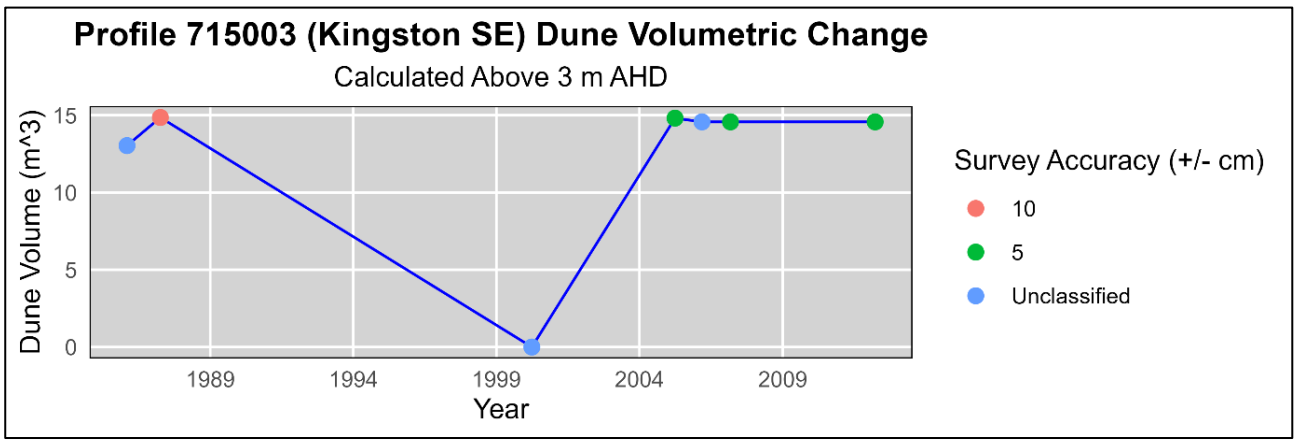


Figure 118. Volumetric change of the foredune over time. The toe of the foredune/top of the backshore is at 3m AHD.

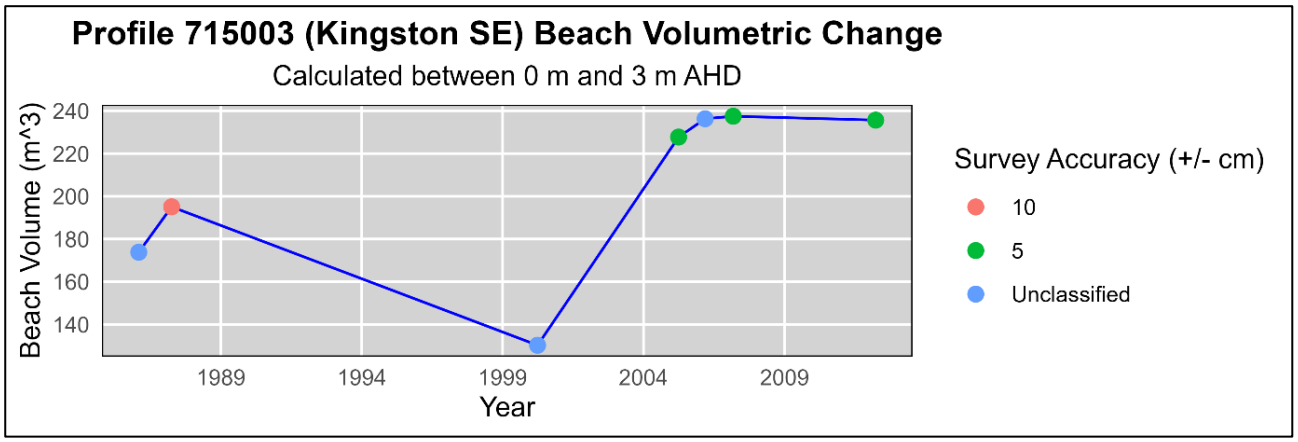


Figure 119. Beach volumetric change over time calculated between 0 and 3m AHD.

Table 32. Survey date, accuracy, beach width, dune volume, beach volume and total volume data for profile 715003, 1986 - 2012.

Survey	Survey Accuracy (+/- cm)	Beach Width (m)	Dune Volume (m^3)	Beach Volume (m^3)	Total Volume (m^3)
4/02/1986	Unclassified	219.5	13.04	173.82	186.86
6/04/1987	10	224.5	14.86	195.07	209.93
29/03/2000	Unclassified	NA	0	130.29	130.29
30/03/2005	5	214.5	14.81	227.73	242.54
9/03/2006	Unclassified	217	14.57	236.3	250.87
8/03/2007	5	217	14.57	237.48	252.05
27/03/2012	5	212	14.57	235.66	250.23
Mean Beach Width (m)	217.42				
nobs	6				
Beach Mobility	4.31				
Top of Backshore Relative Horizontal Change (m/yr)	0.02				
Shoreline Relative Horizontal Change (m/yr)	-0.27				
Dune Volume Change (m^3/yr)	0.06				
Beach Volume Change (m^3/yr)	2.37				
Total Volume Change (m^3/yr)	2.42				

3.13.2 Profile 715009

The Wyomi area is currently undergoing erosion and the beach has been nourished several times, and eroded in between nourishments (Figures 120–124; Table 33 and). A seawall has been emplaced also. Thus, little can be stated about the medium term, past 20 years natural behaviour of this beach. The relative position of the shoreline has retreated ~18m post- 2010 (Figure 122).

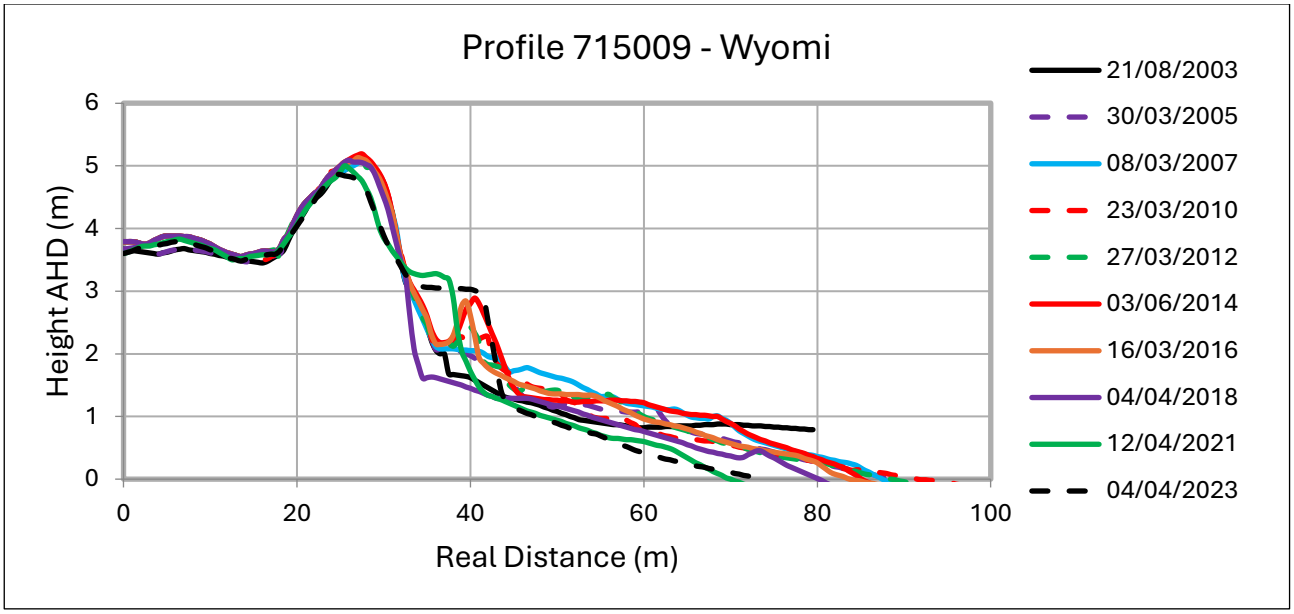


Figure 120. Topographic changes between 2003 and 2018 at Profile 715009.

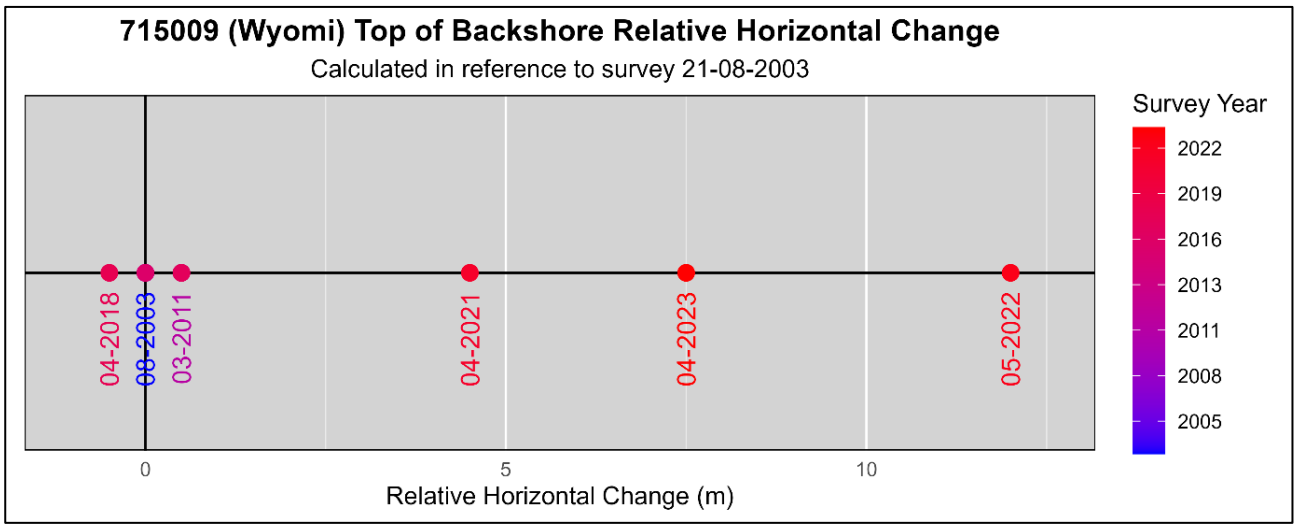


Figure 121. Horizontal movement over time of the top of the backshore position (located at 3m above AHD).

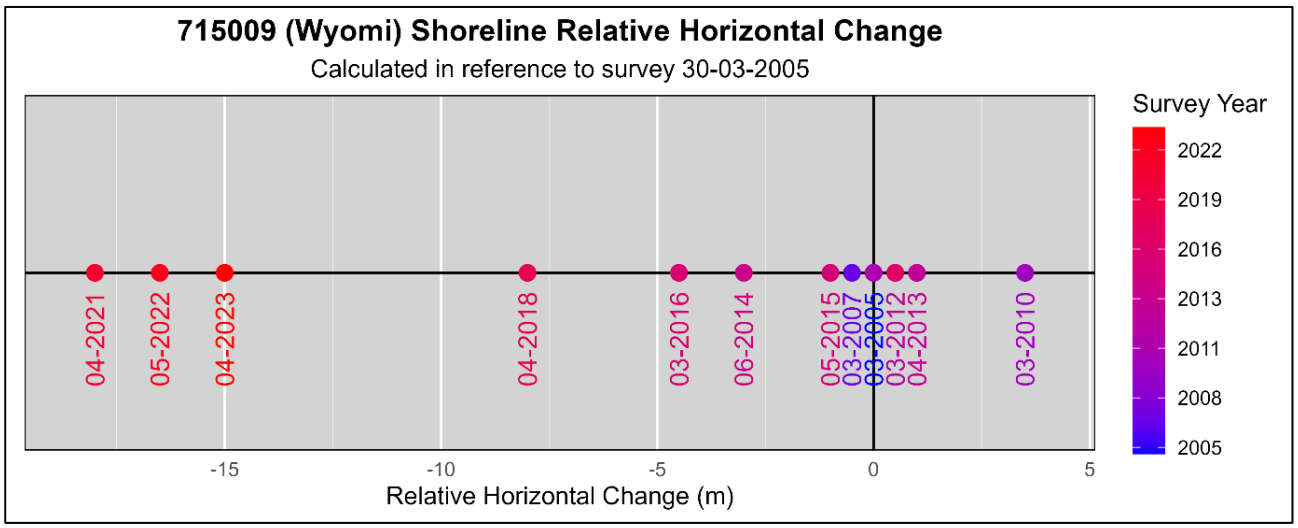


Figure 122. Relative change in the position of the shoreline at 0.0m (or AHD) seawards or landwards since 2005.

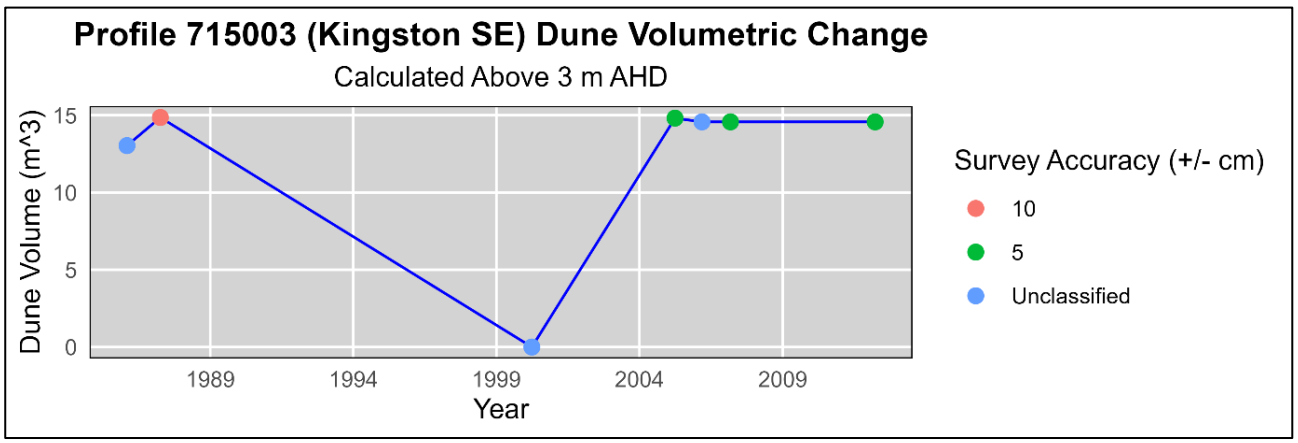


Figure 123. Volumetric change of the foredune over time. The toe of the foredune/top of the backshore is at 3m AHD.

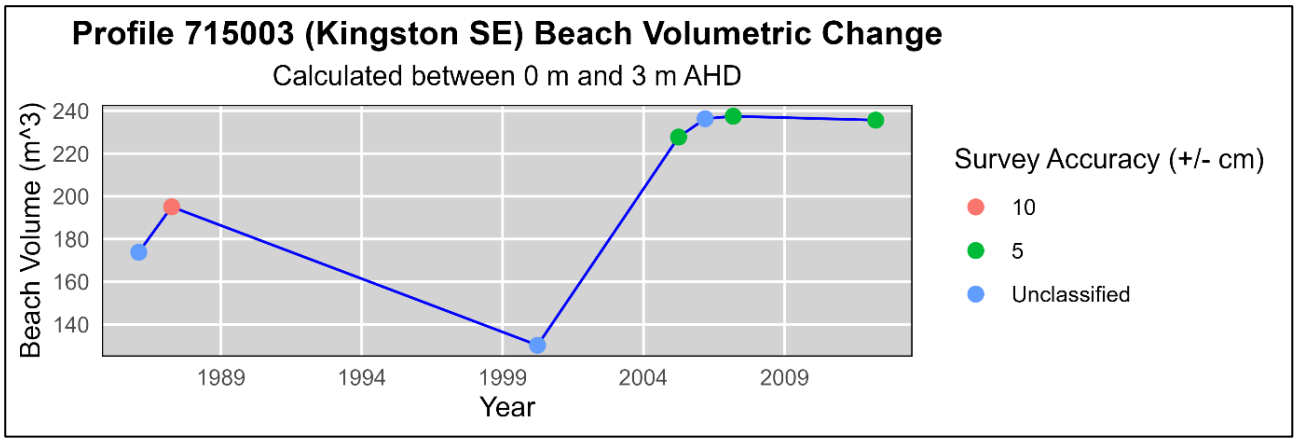


Figure 124. Beach volumetric change over time calculated between 0 and 3m AHD.

Table 33. Survey date, accuracy, beach width, dune volume, beach volume and total volume data for profile 715003, 2003 - 2023.

Survey	Survey Accuracy (+/- cm)	Beach Width (m)	Dune Volume (m^3)	Beach Volume (m^3)	Total Volume (m^3)
21/08/2003	5	NA	131.03	52.05	183.08
30/03/2005	5	55	131.73	55.2	186.93
8/03/2007	5	54.5	134.69	64.03	198.72
23/03/2010	5	58.5	134.83	55.01	189.84
28/03/2011	5	54.5	136.92	57.9	194.83
27/03/2012	5	55.5	134.74	57.17	191.91
15/04/2013	5	56	134.87	58.82	193.69
3/06/2014	5	51.5	136.86	62.29	199.15
25/05/2015	5	53.5	136.68	55.52	192.21
16/03/2016	5	50.5	134.93	57.26	192.19
15/05/2017	5	55	136.47	55.89	192.37
4/04/2018	5	47.5	132.78	42.4	175.18
12/04/2021	10	32.5	144.81	26.94	171.75
18/05/2022	5	26.5	167.53	20.55	188.08
4/04/2023	5	32.5	152.23	22.05	174.28
Mean Beach Width (m)	48.82				
nobs	14				
Beach Mobility	10.36				
Top of Backshore Relative Horizontal Change (m/yr)	0.38				
Shoreline Relative Horizontal Change (m/yr)	-0.83				
Dune Volume Change (m^3/yr)	1.08				
Beach Volume Change (m^3/yr)	-1.84				
Total Volume Change (m^3/yr)	-0.7				

3.13.3 Profile 715053

This profile is located on the downdrift side of the Cape Jaffa Marina and provides a classic example of continual erosion due to updrift trapping of alongshore sands by the marina training walls/breakwater walls. Very significant shoreline retreat of ~76m has occurred (Figures 125-129, Table 34). The dune volume has reduced from ~120 m^3 to near zero. Pumping of sediment from the mouth of the marina entrance and immediately updrift of the entrance has added some sediment to the profile as may be seen between the April 2023 and April 2024 surveys.

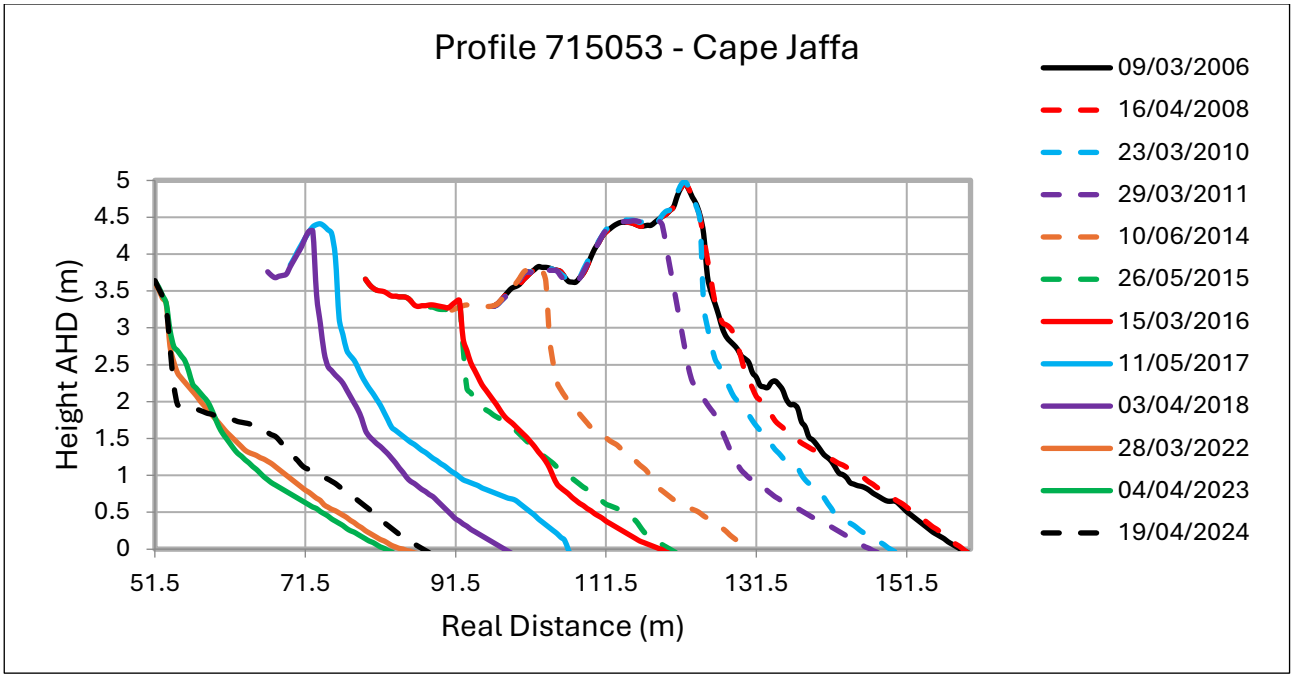


Figure 125. Topographic changes between 2006 and 2024 at Profile 715053.

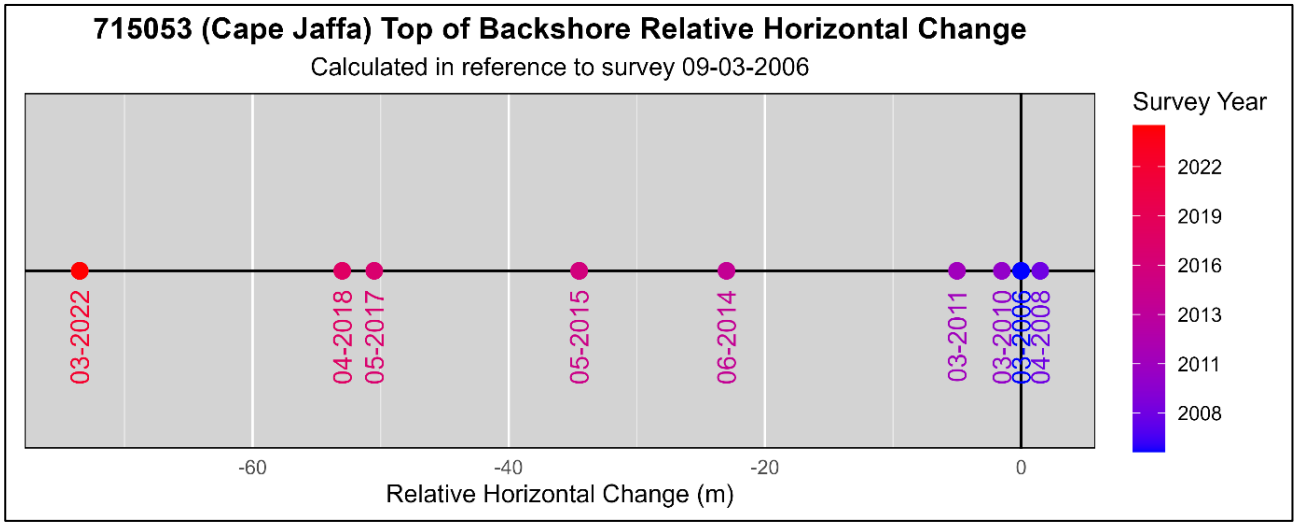


Figure 126. Horizontal movement over time of the top of the backshore position (located at 3m above AHD).

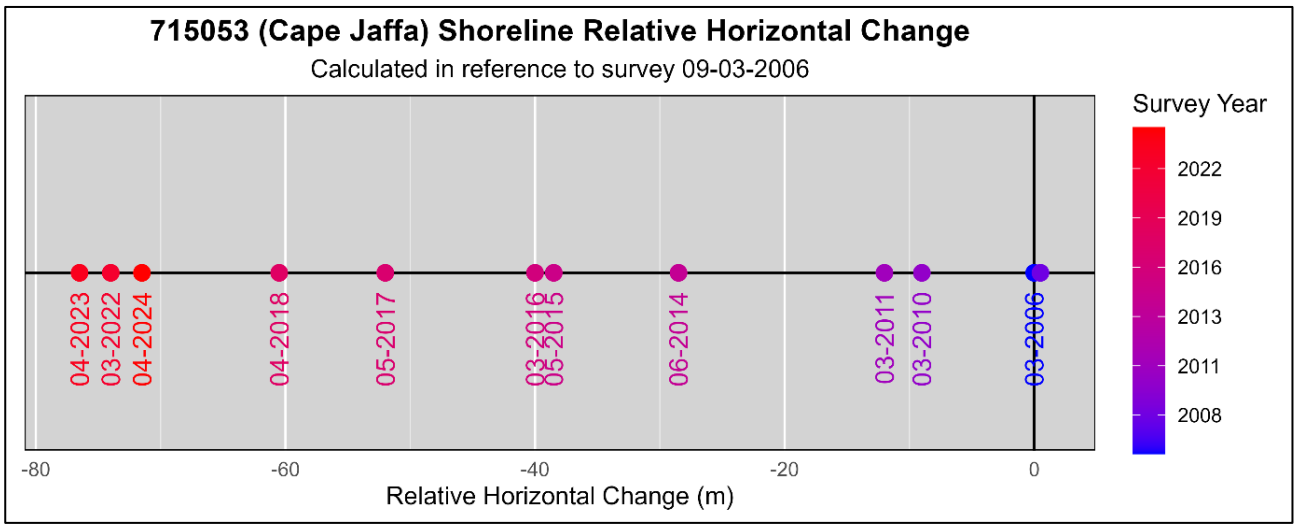


Figure 127. Relative change in the position of the shoreline at 0.0m (or AHD) seawards or landwards since 2008.

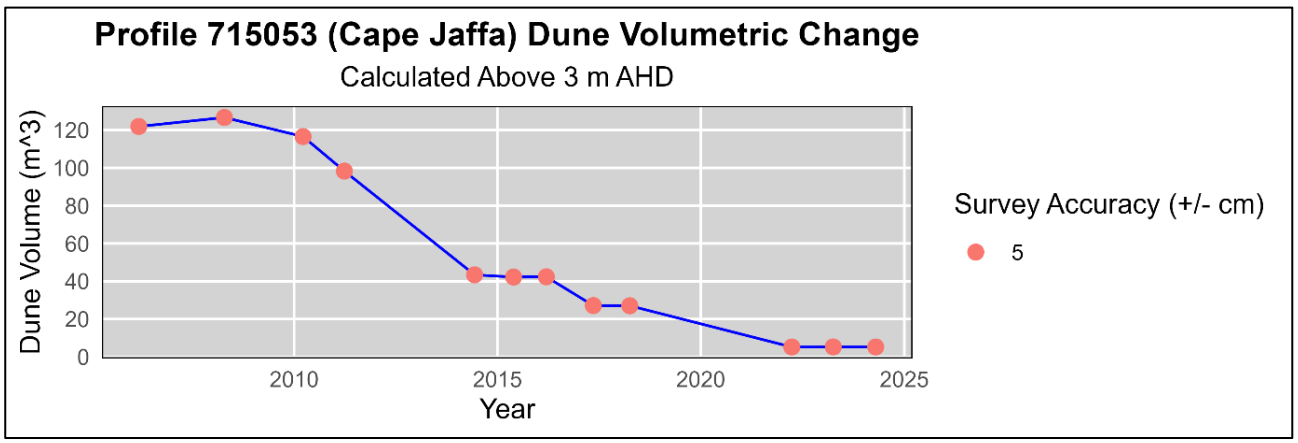


Figure 128. Volumetric change of the foredune over time. The toe of the foredune/top of the backshore is at 3m AHD.

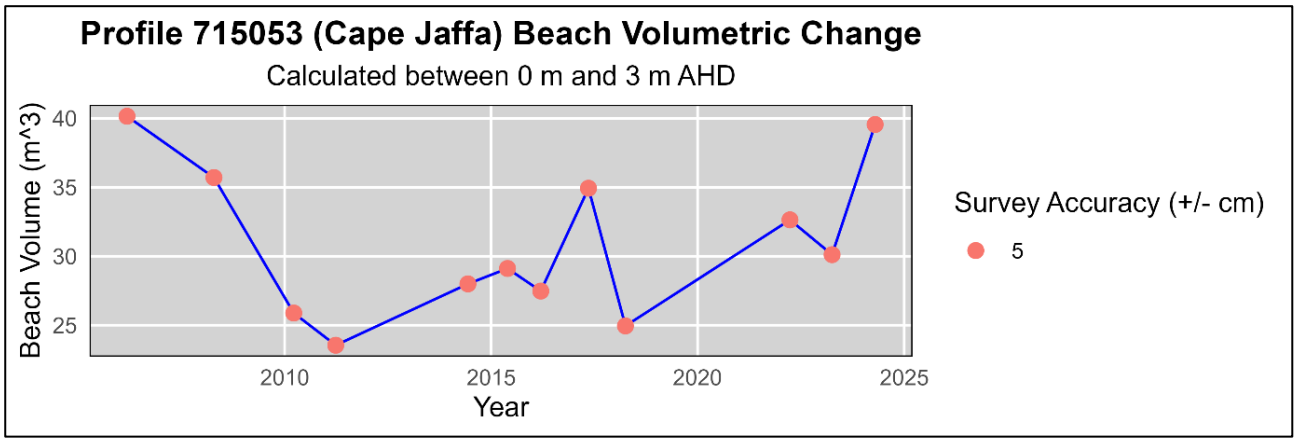


Figure 129. Beach volumetric change over time calculated between 0 and 3m AHD.

Table 34. Survey date, accuracy, beach width, dune volume, beach volume and total volume data for profile 715053, 2006 - 2024.

Survey	Survey Accuracy (+/- cm)	Beach Width (m)	Dune Volume (m^3)	Beach Volume (m^3)	Total Volume (m^3)
9/03/2006	5	32	121.91	40.15	162.06
16/04/2008	5	31	126.68	35.7	162.38
23/03/2010	5	24.5	116.58	25.88	142.46
29/03/2011	5	25	98.31	23.55	121.85
10/06/2014	5	26.5	43.4	28	71.39
26/05/2015	5	28	42.23	29.11	71.34
15/03/2016	5	26.5	42.35	27.48	69.83
11/05/2017	5	30.5	27.12	34.93	62.05
3/04/2018	5	24.5	27.04	24.95	51.99
28/03/2022	5	31.5	5.19	32.64	37.83
4/04/2023	5	29	5.23	30.11	35.35
19/04/2024	5	34	5.21	39.55	44.76
Mean Beach Width (m)	28.58				
nobs	12				
Beach Mobility	3.23				
Top of Backshore Relative Horizontal Change (m/yr)	-4.06				
Shoreline Relative Horizontal Change (m/yr)	-3.95				
Dune Volume Change (m^3/yr)	0.01				
Beach Volume Change (m^3/yr)	-0.03				
Total Volume Change (m^3/yr)	-6.48				

3.13.4 Profile 715049

Profile 715049 is located on the updrift side of the Cape Jaffa marina which has been trapping significant quantities of sediment being transported alongshore from the SE, but also very significant quantities of seagrass wrack which explains the somewhat bizarre profiles shown in Figure 130. The shoreline has prograded around 93m since 2006 (Figures 131 and 132; Table 35), and the volume changes are in the order of +160m^3 for dunes and 250m^3 for the beach (Figures 133 and 134).

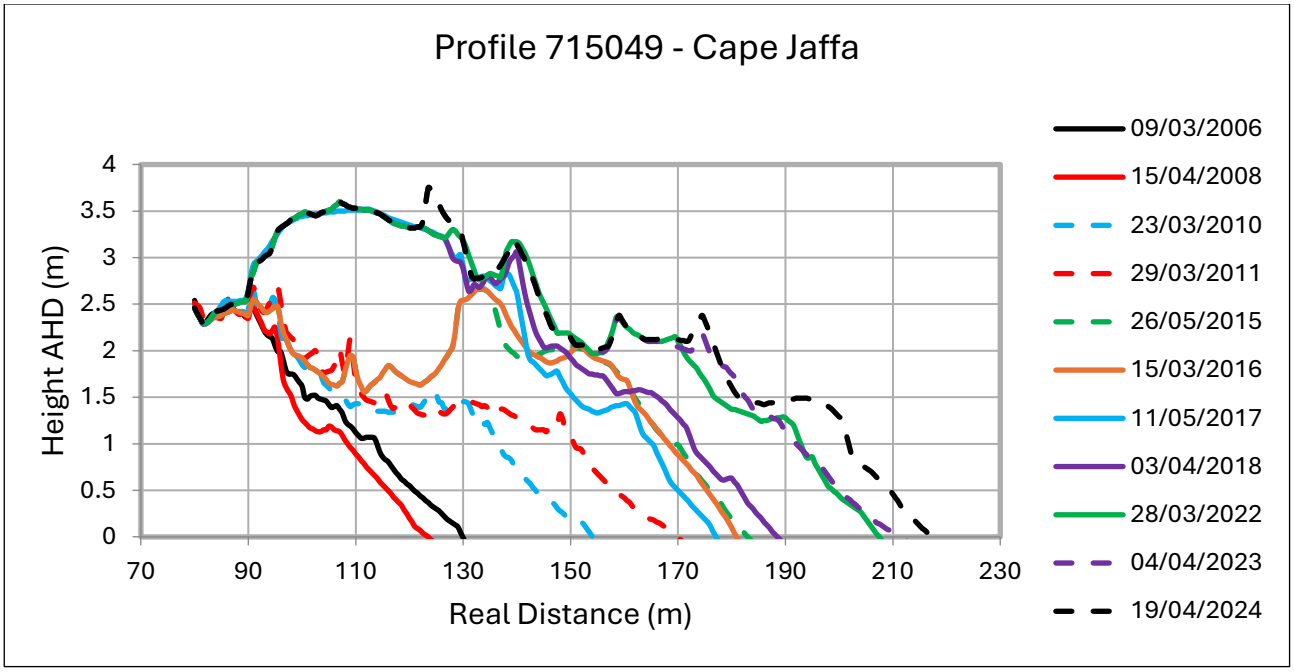


Figure 130. Topographic changes between 2006 and 2024 at Profile 715049.

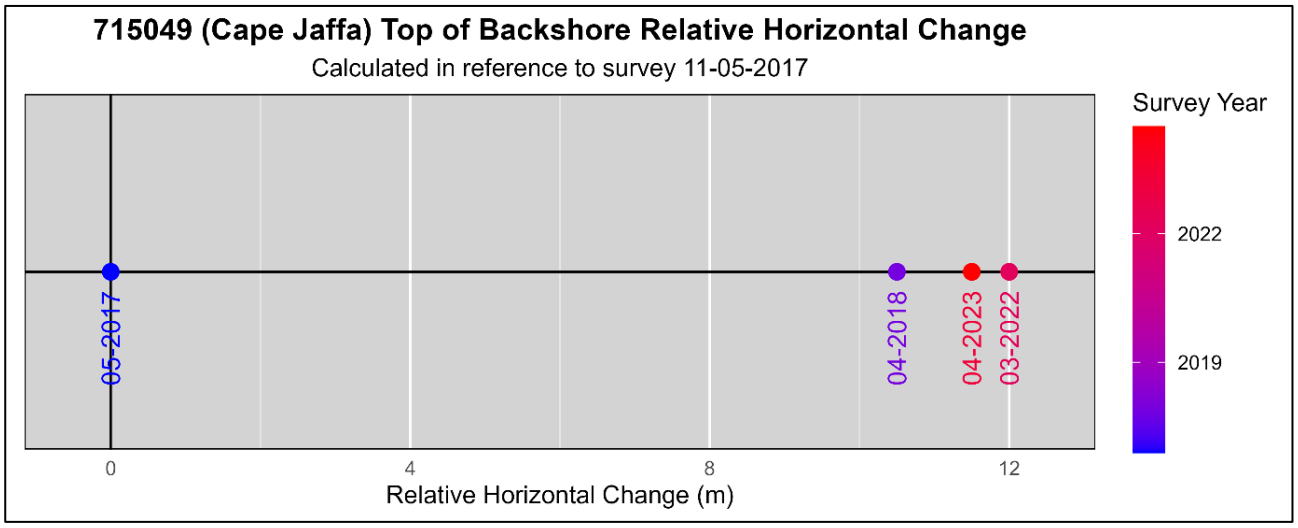


Figure 131. Horizontal movement over time of the top of the backshore position (located at 3m above AHD).

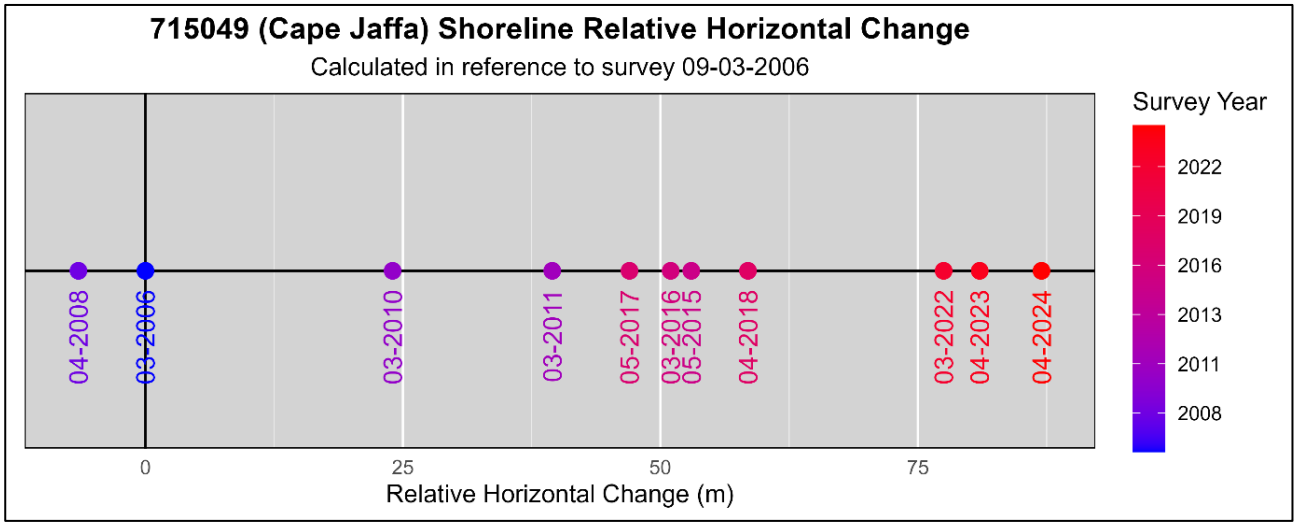


Figure 132. Relative change in the position of the shoreline at 0.0m (or AHD) seawards or landwards since 2008.

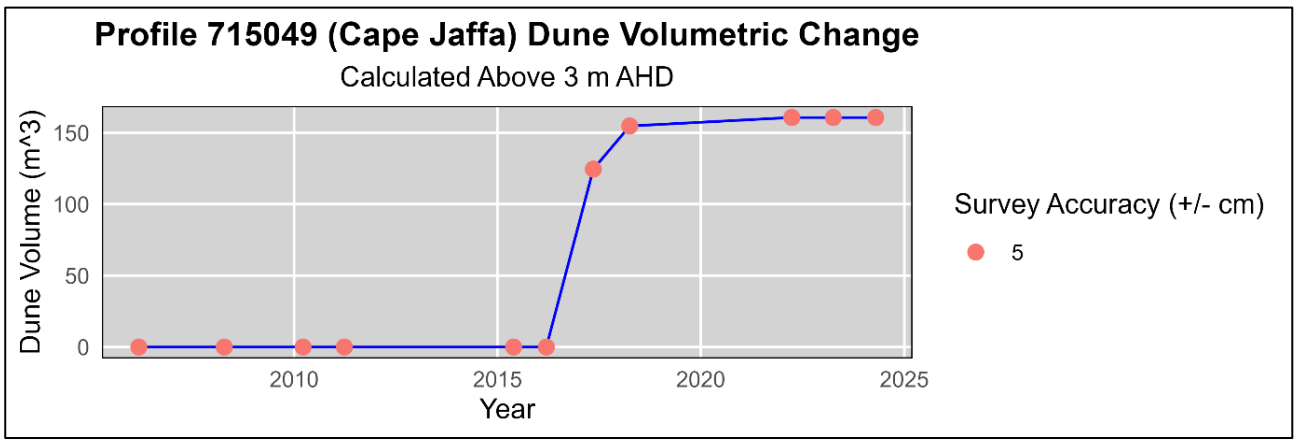


Figure 133. Volumetric change of the foredune over time. The toe of the foredune/top of the backshore is at 3m AHD.

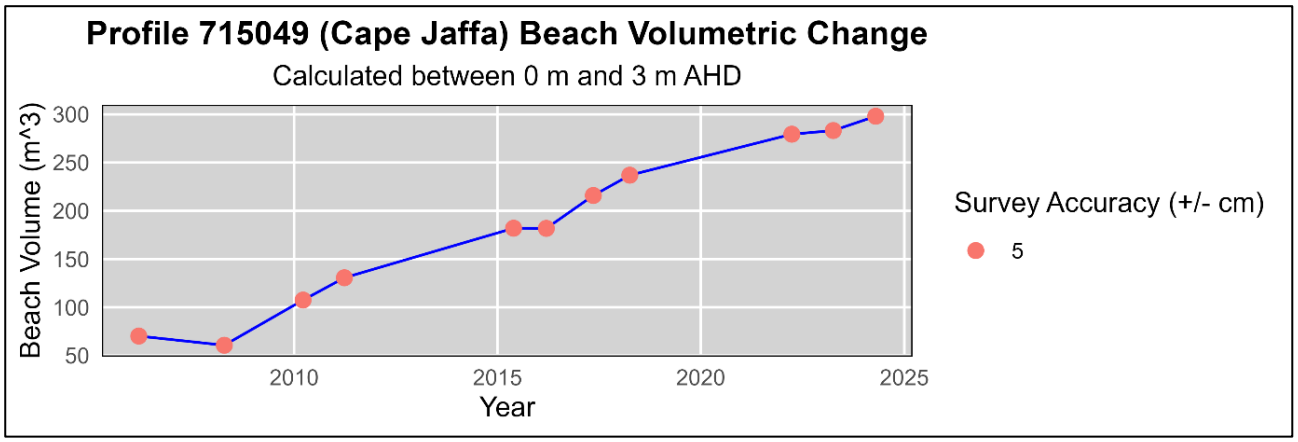


Figure 134. Beach volumetric change over time calculated between 0 and 3m AHD.

Table 35. Survey date, accuracy, beach width, dune volume, beach volume and total volume data for profile 715049, 2006 - 2024.

Survey	Survey Accuracy (+/- cm)	Beach Width (m)	Dune Volume (m^3)	Beach Volume (m^3)	Total Volume (m^3)
9/03/2006	5	NA	0	70.14	70.14
15/04/2008	5	NA	0	60.64	60.64
23/03/2010	5	NA	0	107.44	107.44
29/03/2011	5	NA	0	130.61	130.61
26/05/2015	5	NA	0	181.95	181.95
15/03/2016	5	NA	0	181.8	181.8
11/05/2017	5	47.5	124.56	215.9	340.46
3/04/2018	5	48.5	154.7	236.89	391.59
28/03/2022	5	66	160.67	279.4	440.06
4/04/2023	5	70	160.64	283.19	443.84
19/04/2024	5	76	160.64	298.04	458.68
Mean Beach Width (m)	61.6				
nobs	5				
Beach Mobility	12.92				
Top of Backshore Relative Horizontal Change (m/yr)	1.66				
Shoreline Relative Horizontal Change (m/yr)	4.8				
Dune Volume Change (m^3/yr)	5.2				
Beach Volume Change (m^3/yr)	12.58				
Total Volume Change (m^3/yr)	21.45				

4. 2008-2018 Lidar Analyses of Younghusband Peninsula beach-dune system

The South Australian Government has conducted Light Detection and Ranging (LiDAR) surveys twice along portions of the SA coast in 2008 and 2018. In the following we have also utilised this data to examine changes along the Younghusband Peninsula from near the Murray River mouth to down to 2km south of 28 Mile Crossing. Below or SE of this area, there are a larger number of DEW topographic profiles.

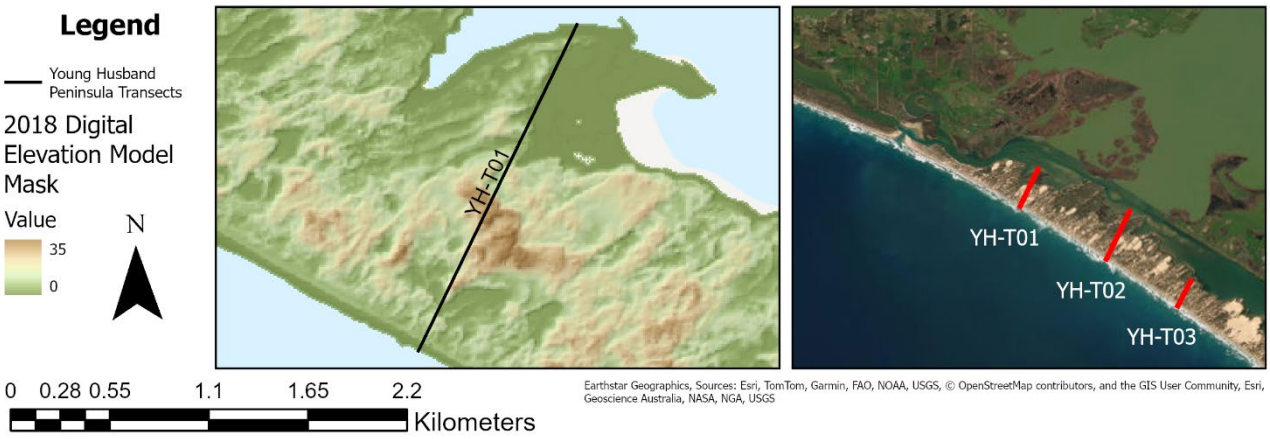
The Younghusband Peninsula is predominantly a transgressive dunefield coastal barrier for 140km of its 190km length. SE of ~Coxiella Lake or Dalkeith Road, the barrier switches to a mixed parabolic and relict foredune plain, and then ~2km north of The Granites it is a foredune plain (Hesp et al., 2022).

Figures 135 to 161 illustrate the survey locations, and the two surveys for every 5km position along the Younghusband Peninsula coastal barrier. Note that at times the quality of the 2008 data is less than the 2018 data, and so some differences in elevation at certain points or areas across the barrier are likely due to issues related to the presence of vegetation; that is, at times the vegetation is being incorrectly interpreted as the land surface.

In general, many of the profile comparisons show little change in the 10 year period (2008-2018). For example, profiles T01 to T14, and profiles T24 to T26 show minimal change in the first 500m landwards from the beach at this scale. As one approaches the 42 Mile region (around T22-T23, there has been increasing rates of erosion since the 1980's (Hesp et al., 2022), and thus, there is a clear difference in topography between the 2008 and 2018 surveys in that area (Figures 157 and 158). This erosion hot spot appears to be spreading both north and south along the barrier from the initial starting point of erosion around 41.5 Mile (i.e. just 0.5 miles south of the 42 Mile Crossing entrance). Profiles T15 to T19 appear to be mildly accreting in the 2008-1018 period (Figures 149 to 153).

Overall, there are variable changes alongshore on the Younghusband Peninsula, and the fact that there are only two survey periods makes it difficult to determine if sea level rise post-1900 has had any affect on the beach-dune system. As indicated by Hesp et al. (2022) and Da Silva et al. (2024), it may be that the 42 Mile area started eroding due to a combination of factors, namely, sea level rise, increasing wave energy over time in the past decade, and the breakdown of nearshore reefs leading to more wave energy reaching the shoreline. However, there is not universal erosion taking place along the entire Younghusband Peninsula, so these factors are either only operating locally around the 42 Mile region, or redistribution of the eroded sediment to the north and south results either in shoreline stability or accretion elsewhere.

4.1 Transect T01



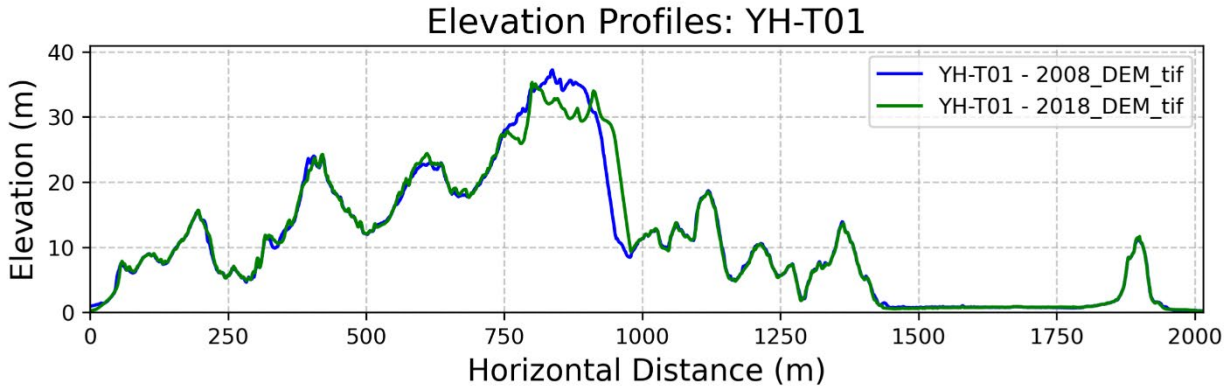
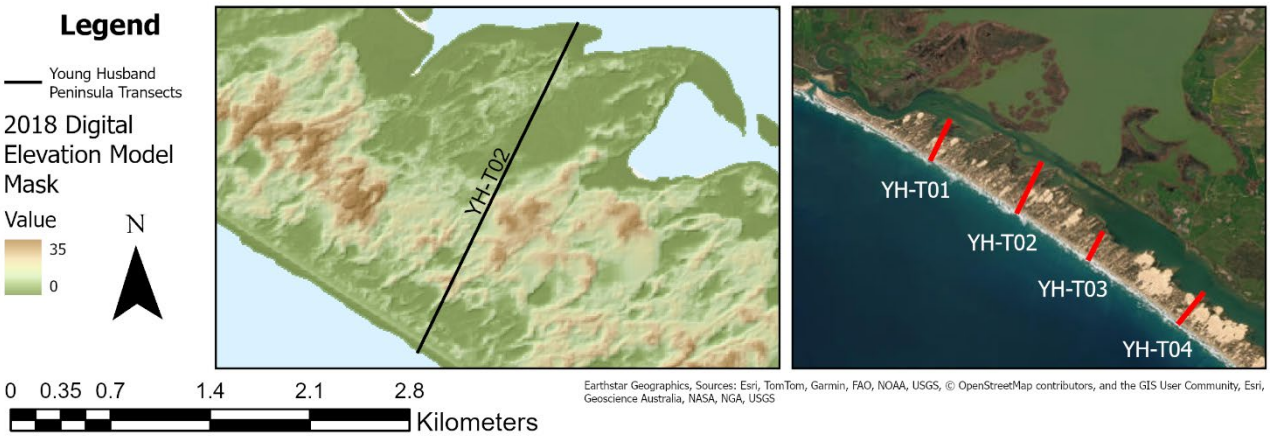


Figure 135. 2008 and 2018 LiDAR comparison at YH-T01. The transect line is indicated on the 2018 Digital elevation model (DEM), and the location of the transect and position relative to other transects is also indicated in the top right.

4.2 Transect T02



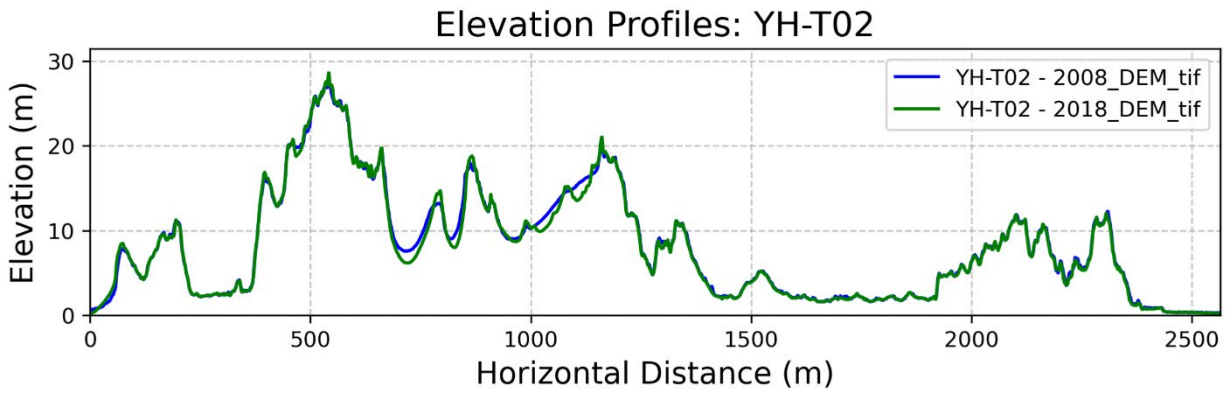
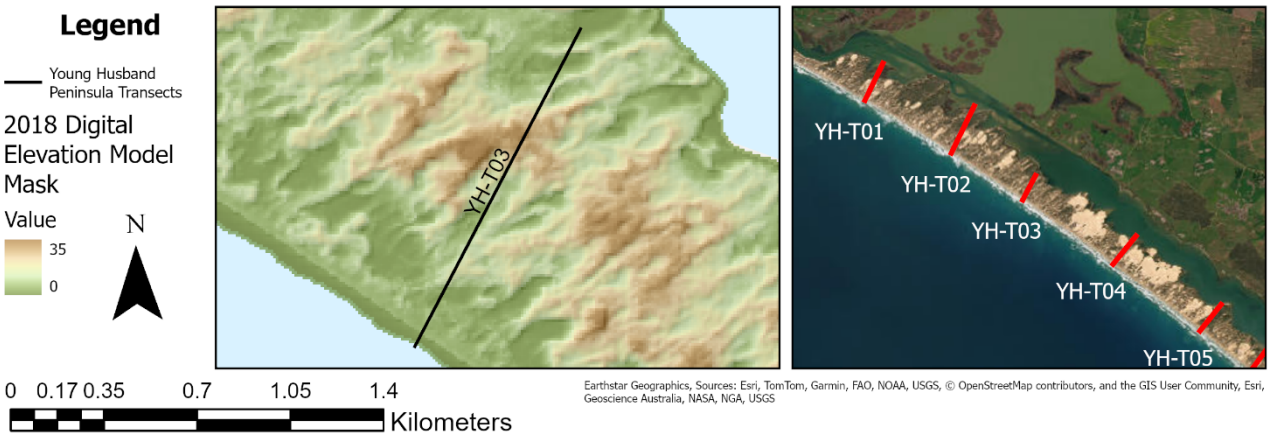


Figure 136. 2008 and 2018 LiDAR comparison at YH-T02. The transect line is indicated on the 2018 Digital elevation model (DEM), and the location of the transect and position relative to other transects is also indicated in the top right.

4.3 Transect T03



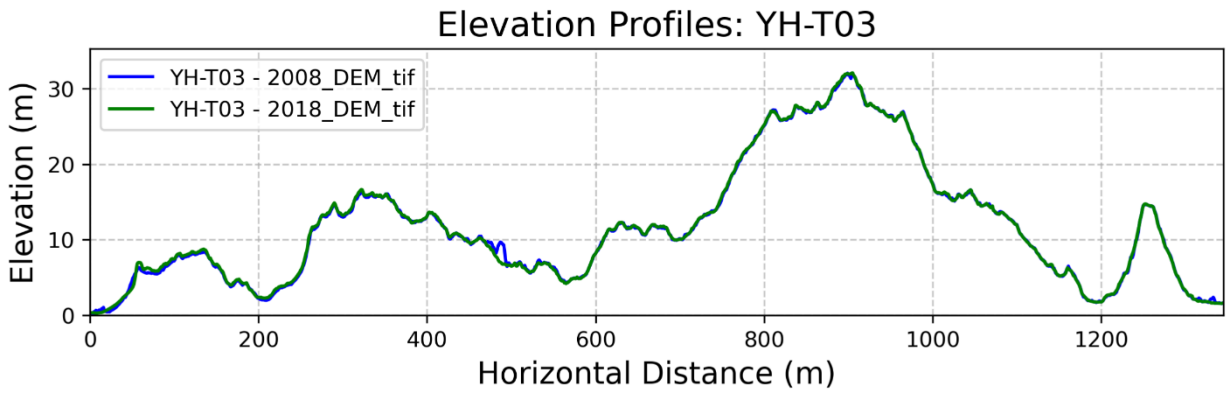


Figure 137. 2008 and 2018 LiDAR comparison at YH-T01. The transect line is indicated on the 2018 Digital elevation model (DEM), and the location of the transect and position relative to other transects is also indicated in the top right.

4.4 Transect T04

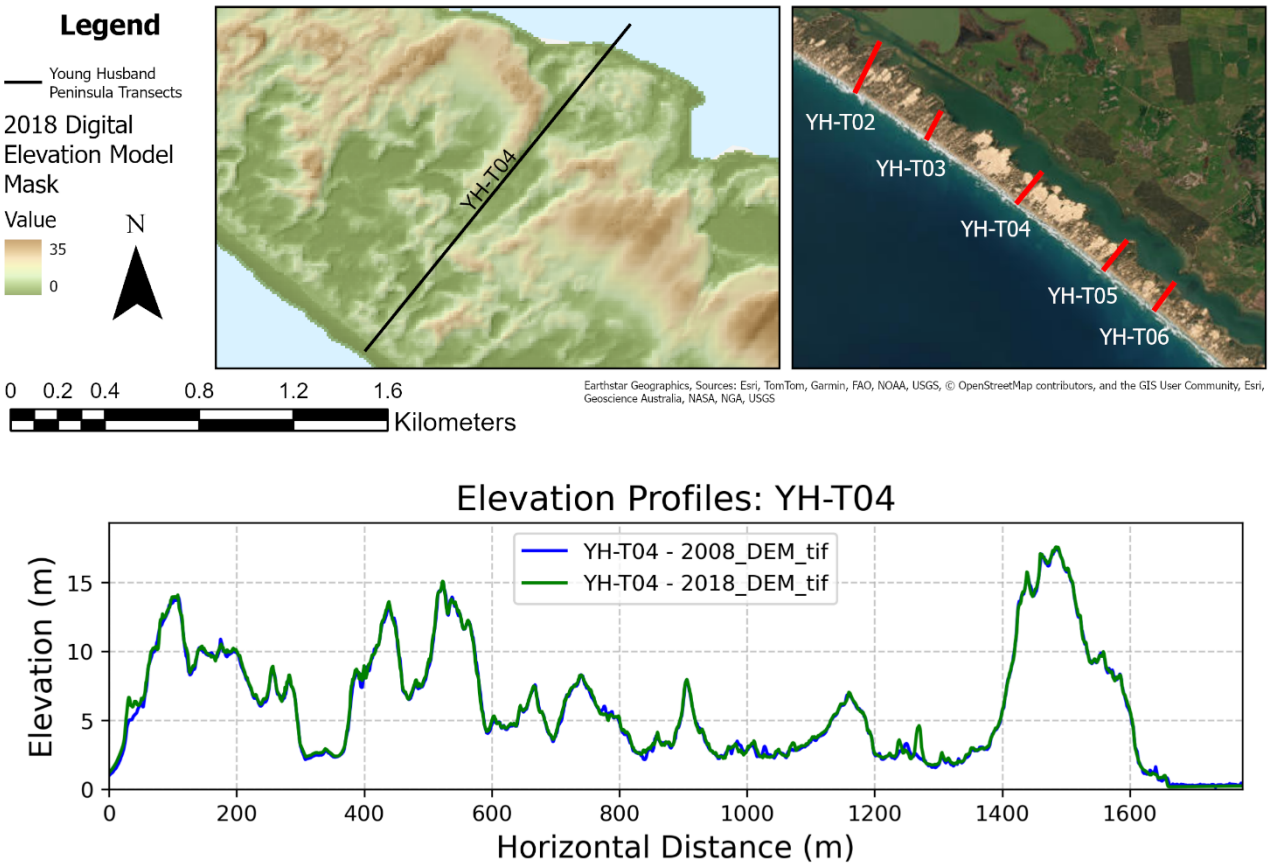
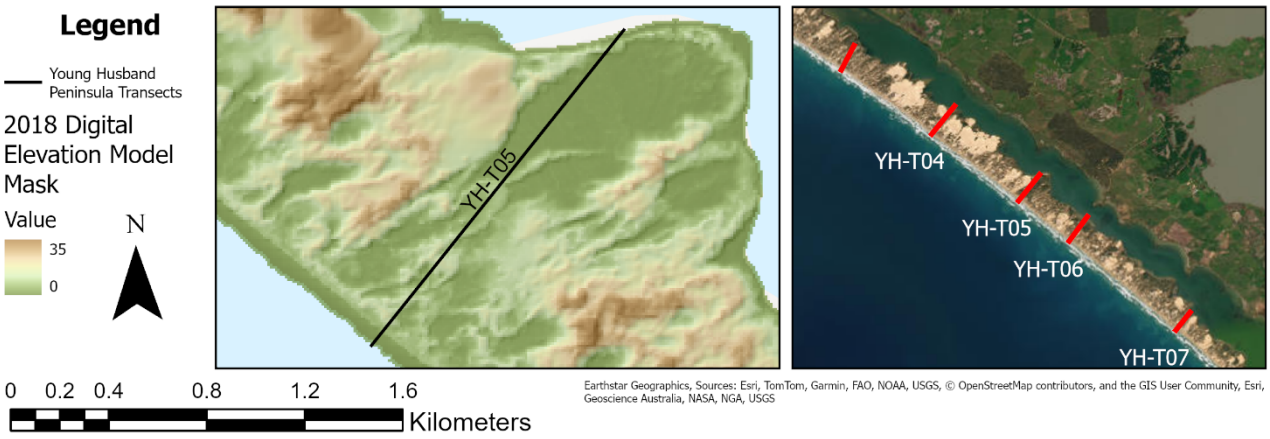


Figure 138. 2008 and 2018 LiDAR comparison at YH-T04. The transect line is indicated on the 2018 Digital elevation model (DEM), and the location of the transect and position relative to other transects is also indicated in the top right.

4.5 Transect T05



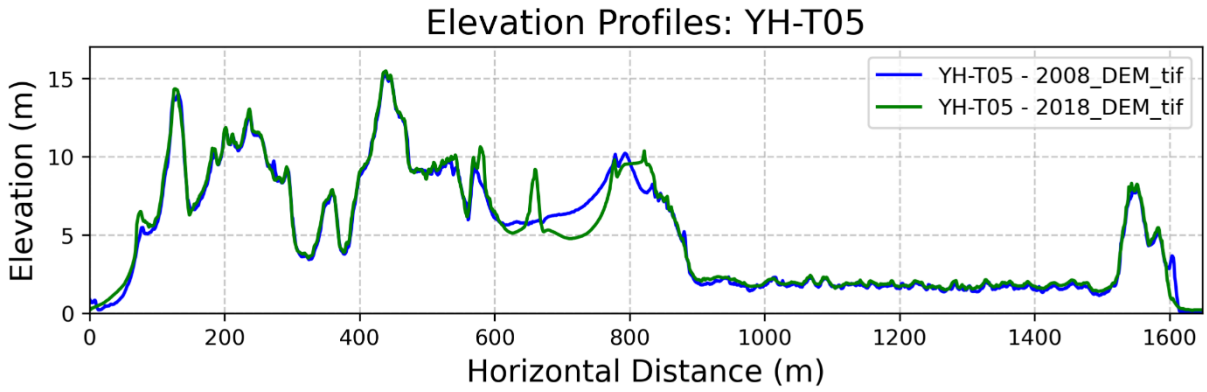
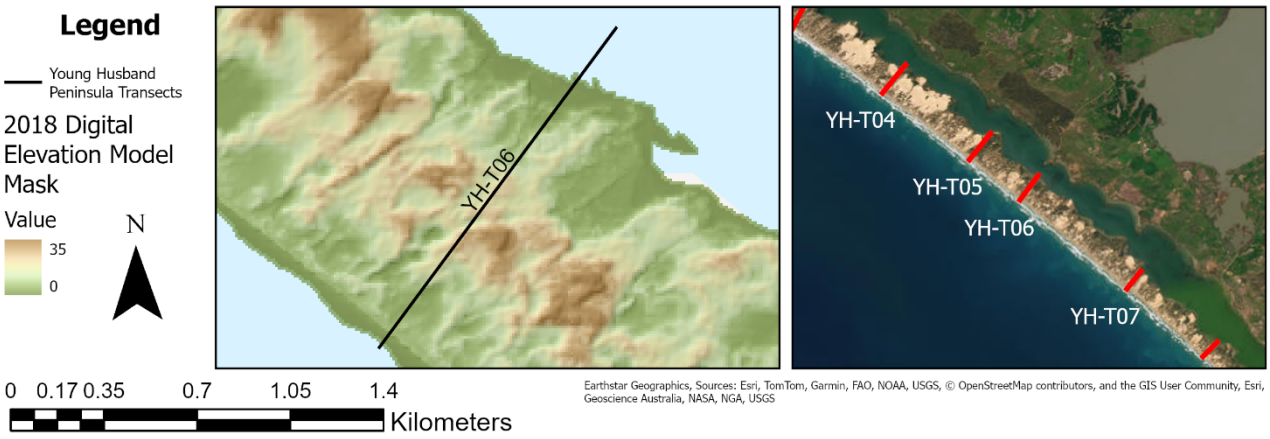


Figure 139. 2008 and 2018 LiDAR comparison at YH-T05. The transect line is indicated on the 2018 Digital elevation model (DEM), and the location of the transect and position relative to other transects is also indicated in the top right.

4.6 Transect T06



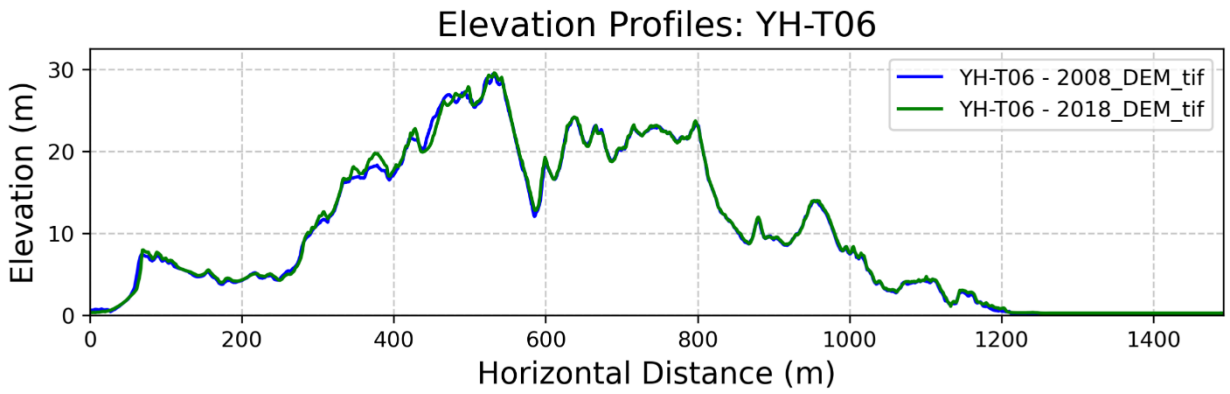
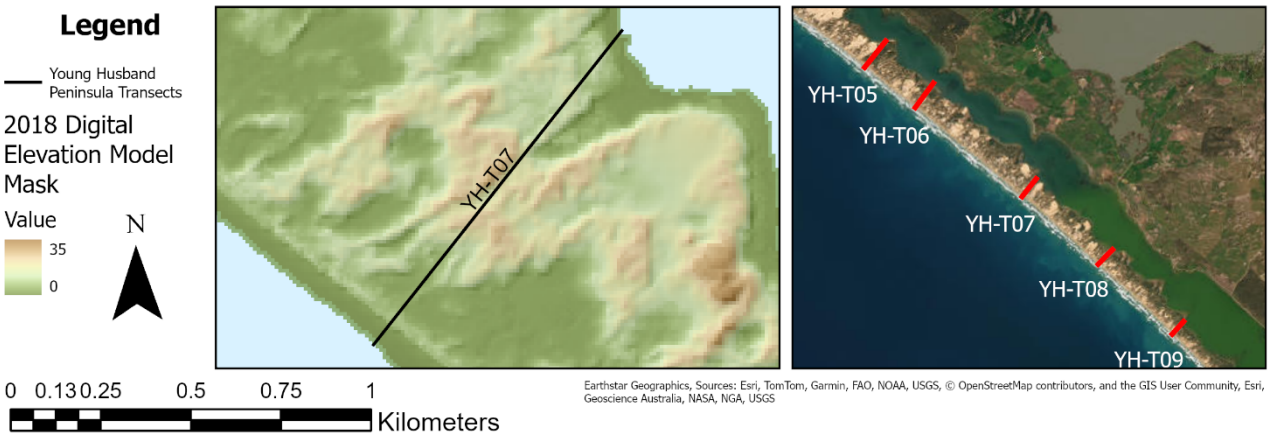


Figure 140. 2008 and 2018 LiDAR comparison at YH-T06. The transect line is indicated on the 2018 Digital elevation model (DEM), and the location of the transect and position relative to other transects is also indicated in the top right.

4.7 Transect T07



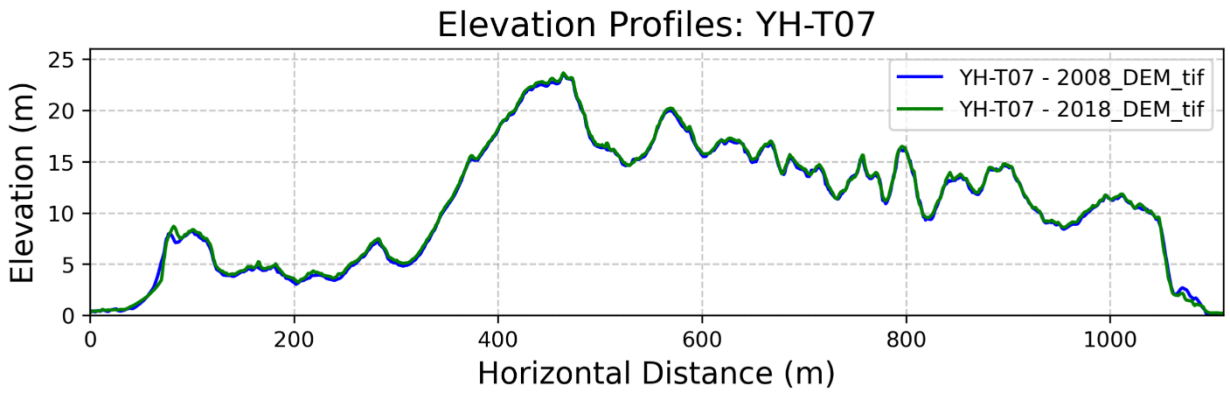


Figure 141. 2008 and 2018 LiDAR comparison at YH-T07. The transect line is indicated on the 2018 Digital elevation model (DEM), and the location of the transect and position relative to other transects is also indicated in the top right.

4.8 Transect T08

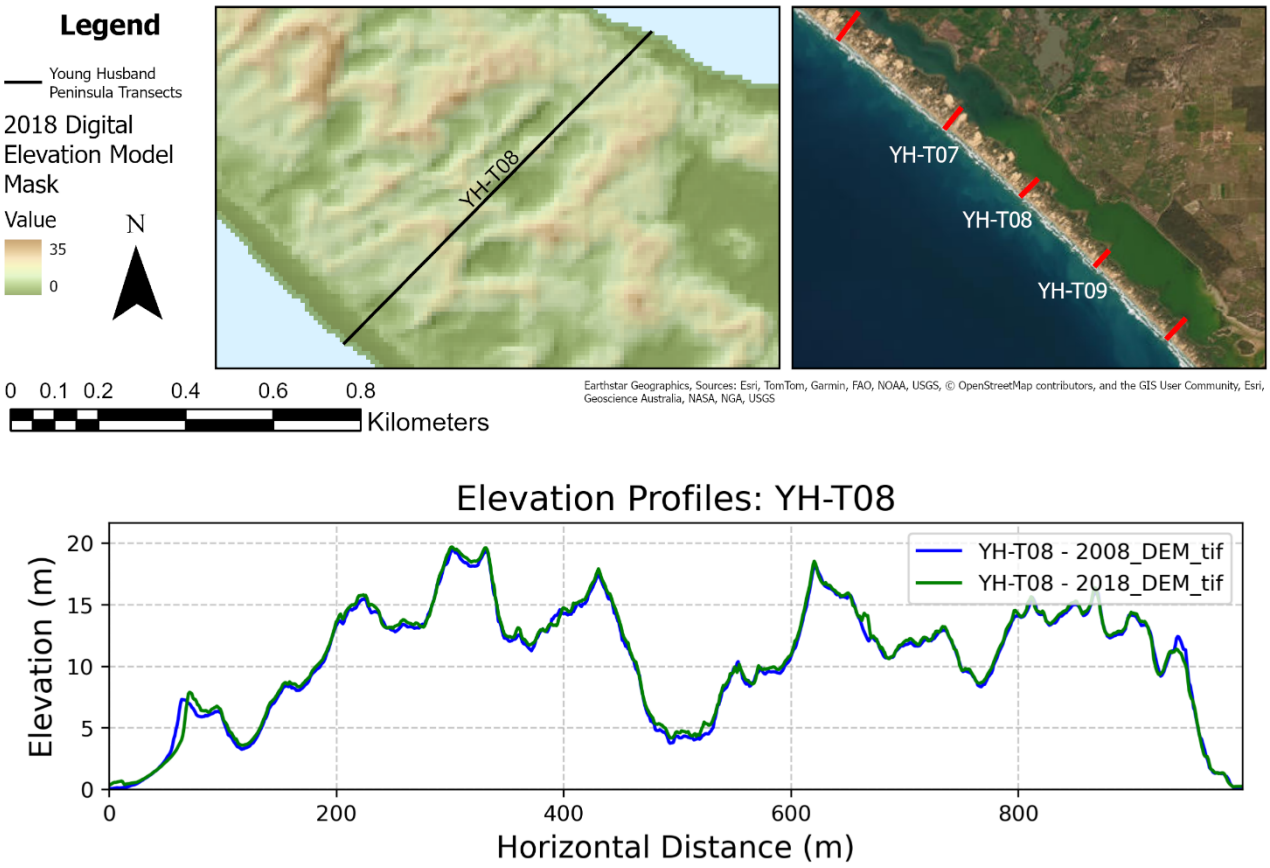
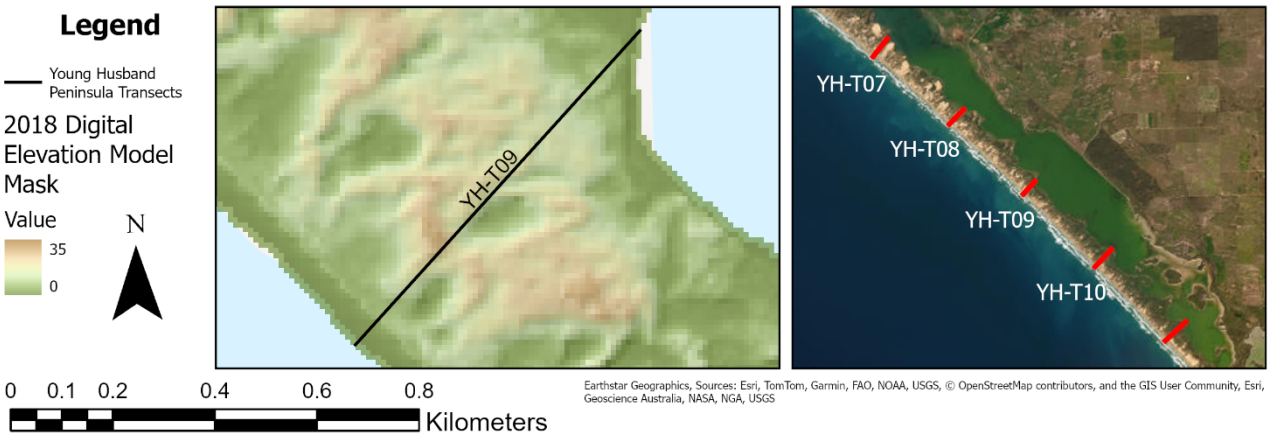


Figure 142. 2008 and 2018 LiDAR comparison at YH-T08. The transect line is indicated on the 2018 Digital elevation model (DEM), and the location of the transect and position relative to other transects is also indicated in the top right.

4.9 Transect T09



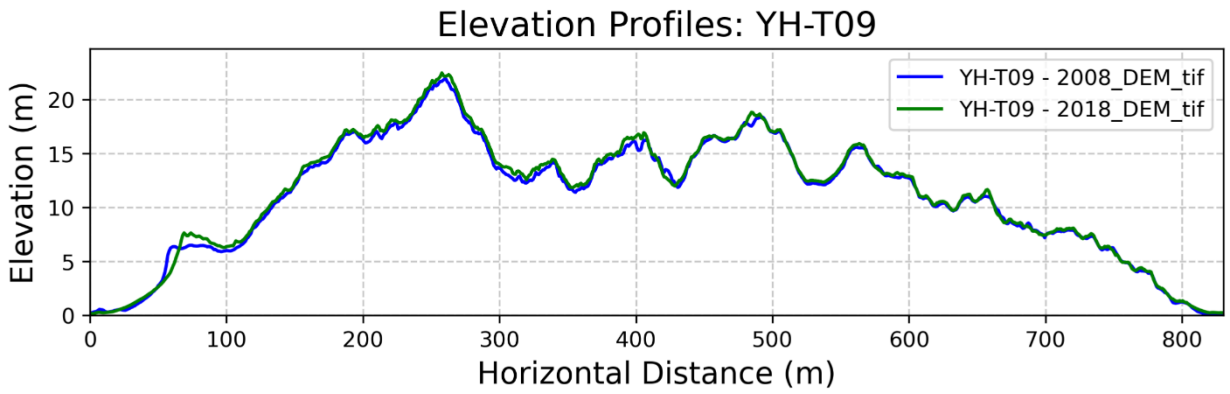


Figure 143. 2008 and 2018 LiDAR comparison at YH-T09. The transect line is indicated on the 2018 Digital elevation model (DEM), and the location of the transect and position relative to other transects is also indicated in the top right.

4.10 Transect T010

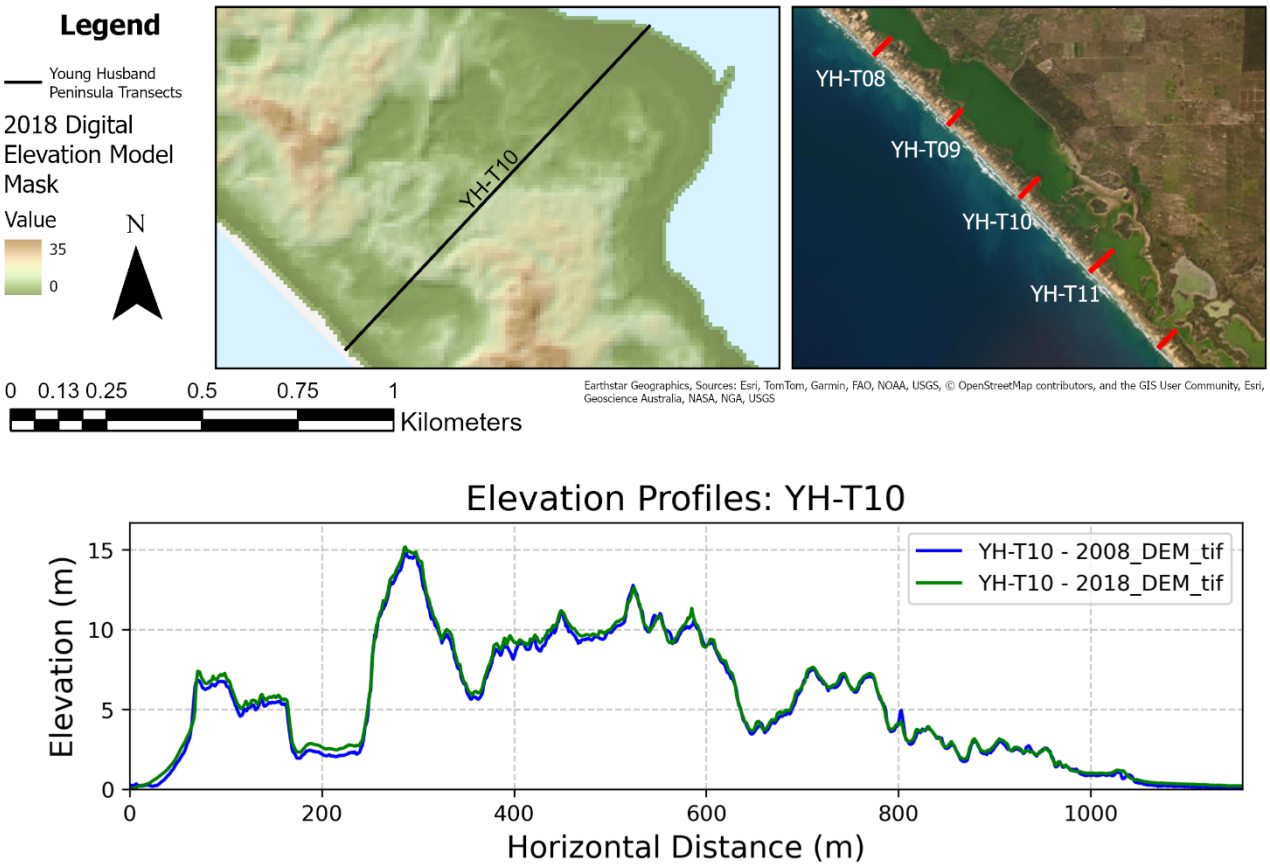
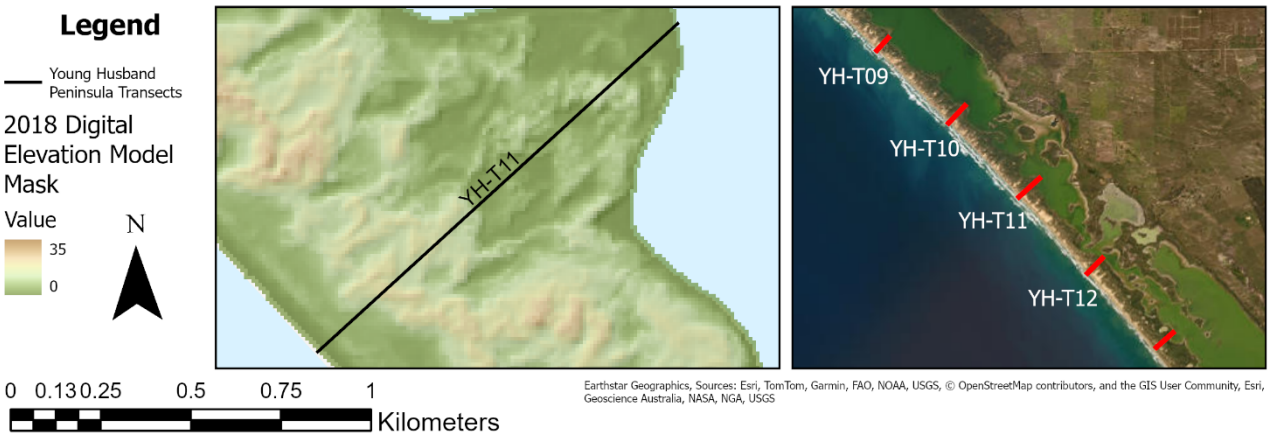


Figure 144. 2008 and 2018 LiDAR comparison at YH-T010. The transect line is indicated on the 2018 Digital elevation model (DEM), and the location of the transect and position relative to other transects is also indicated in the top right.

4.11 Transect T011



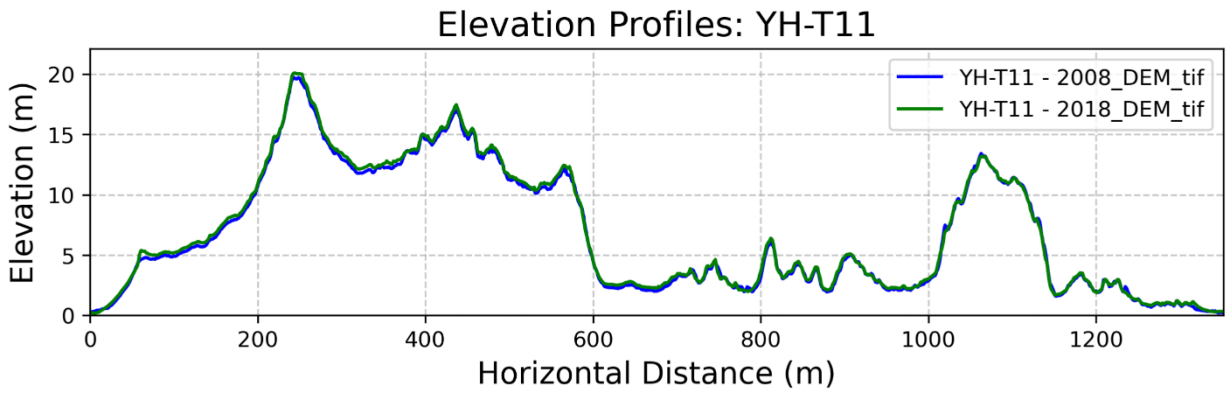
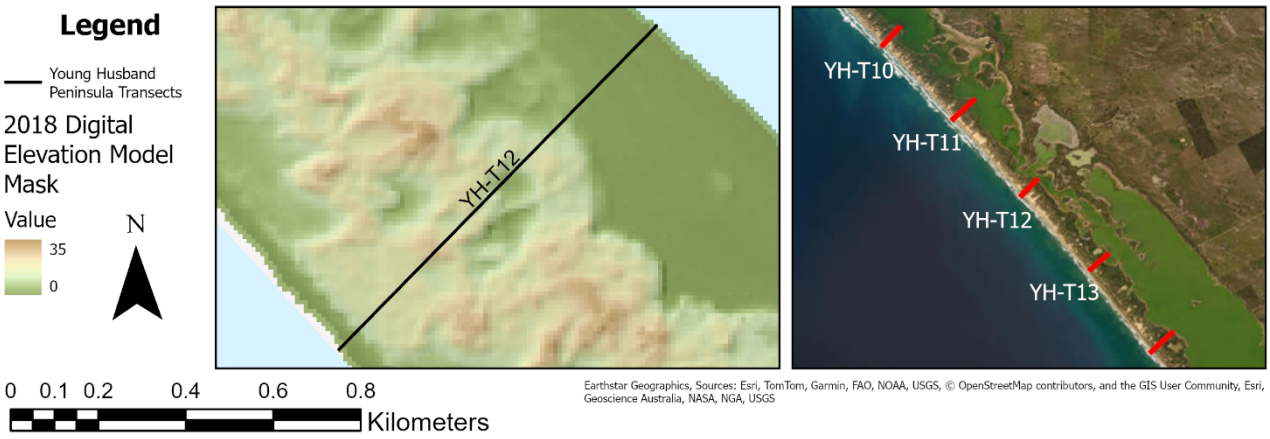


Figure 145. 2008 and 2018 LiDAR comparison at YH-T011. The transect line is indicated on the 2018 Digital elevation model (DEM), and the location of the transect and position relative to other transects is also indicated in the top right.

4.12 Transect T012



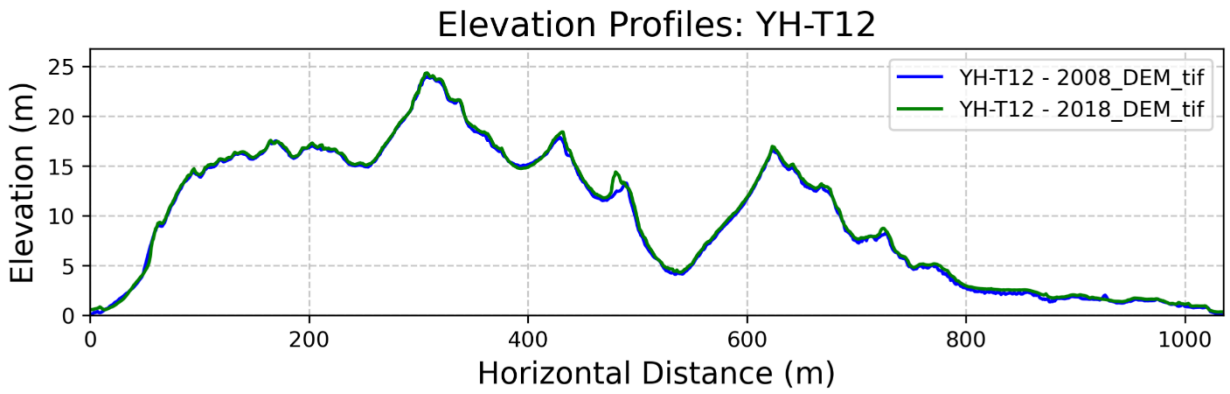
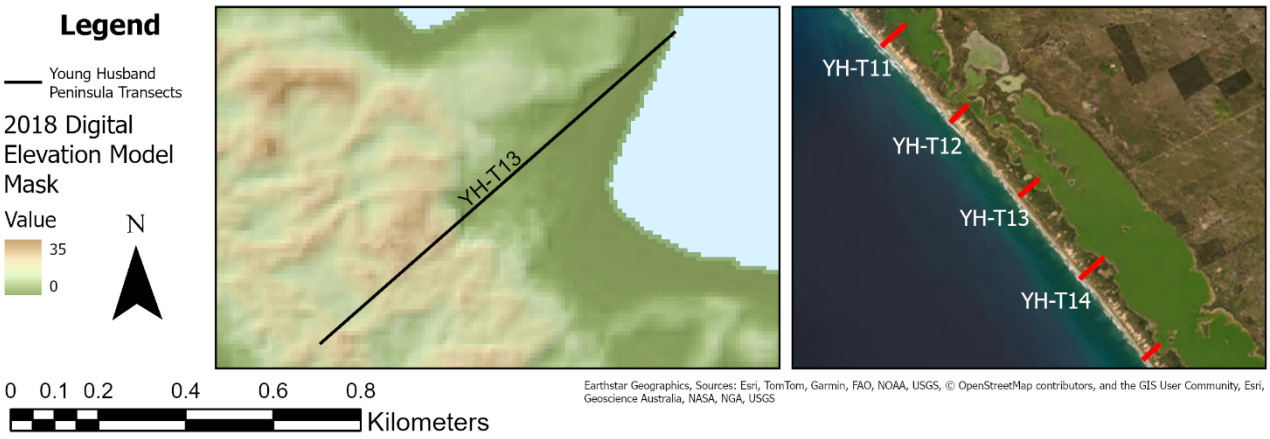


Figure 146. 2008 and 2018 LiDAR comparison at YH-T012. The transect line is indicated on the 2018 Digital elevation model (DEM), and the location of the transect and position relative to other transects is also indicated in the top right.

4.13 Transect T013



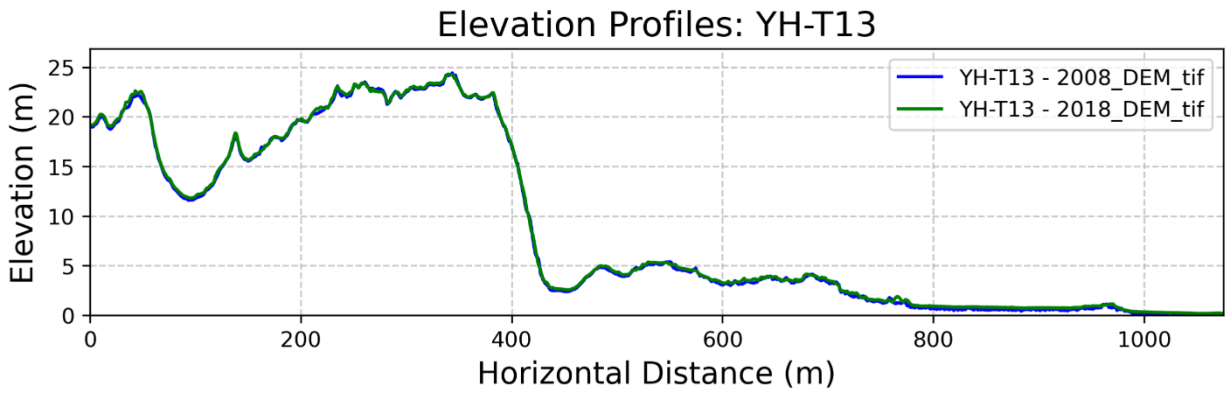
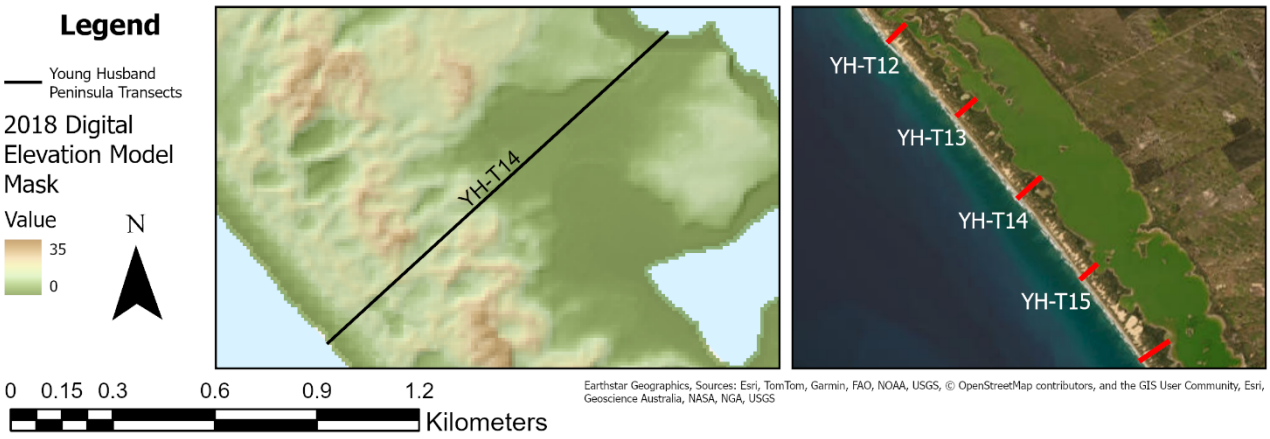


Figure 147. 2008 and 2018 LiDAR comparison at YH-T013. The transect line is indicated on the 2018 Digital elevation model (DEM), and the location of the transect and position relative to other transects is also indicated in the top right.

4.14 Transect T014



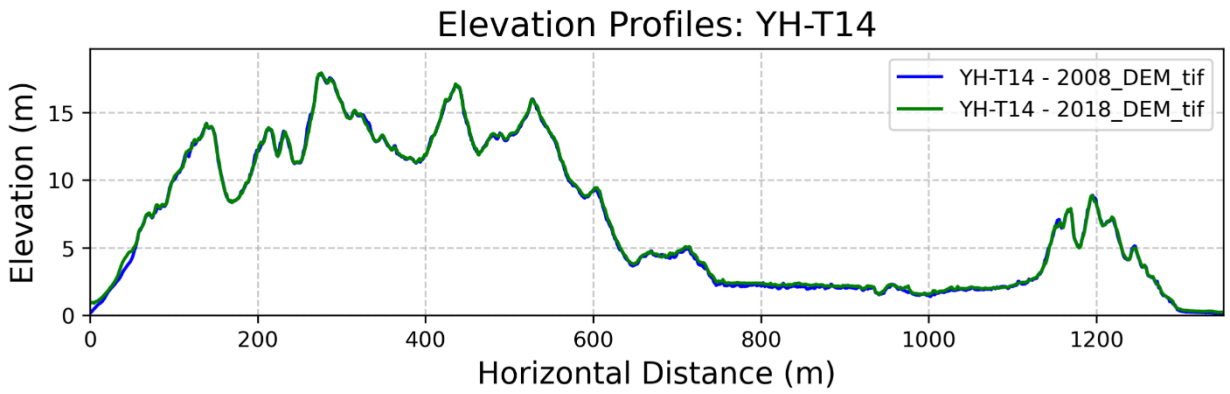


Figure 148. 2008 and 2018 LiDAR comparison at YH-T014. The transect line is indicated on the 2018 Digital elevation model (DEM), and the location of the transect and position relative to other transects is also indicated in the top right.

4.15 Transect T015

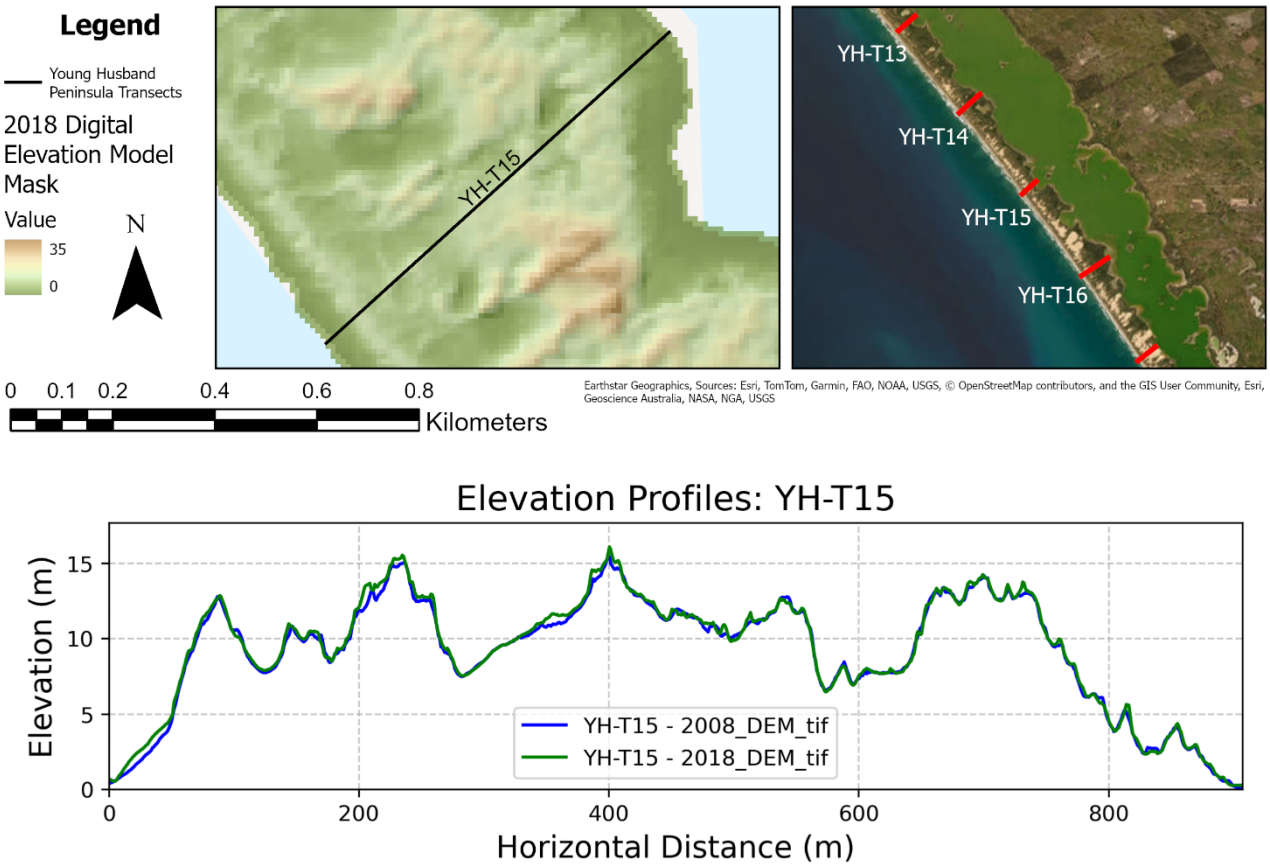
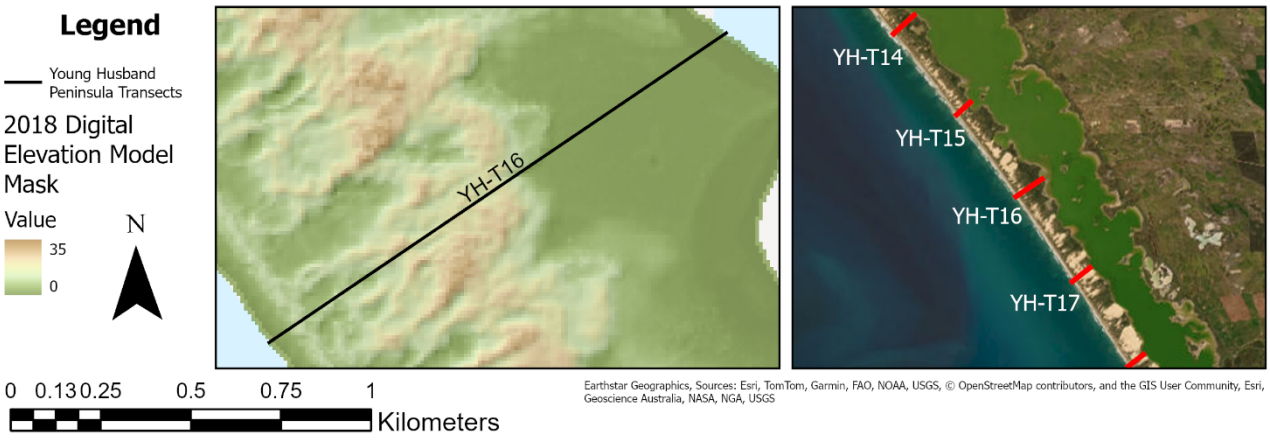


Figure 149. 2008 and 2018 LiDAR comparison at YH-T015. The transect line is indicated on the 2018 Digital elevation model (DEM), and the location of the transect and position relative to other transects is also indicated in the top right.

4.16 Transect T016



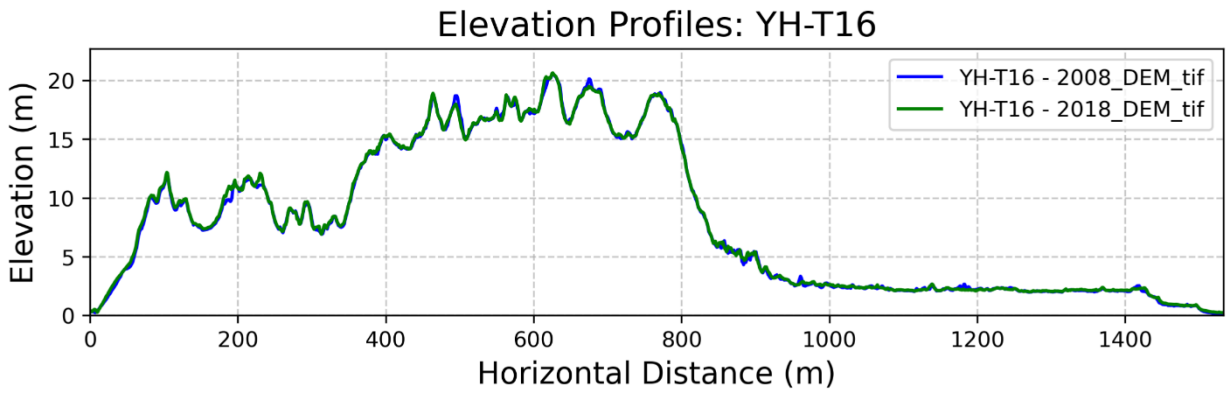


Figure 150. 2008 and 2018 LiDAR comparison at YH-T016. The transect line is indicated on the 2018 Digital elevation model (DEM), and the location of the transect and position relative to other transects is also indicated in the top right.

4.17 Transect T017

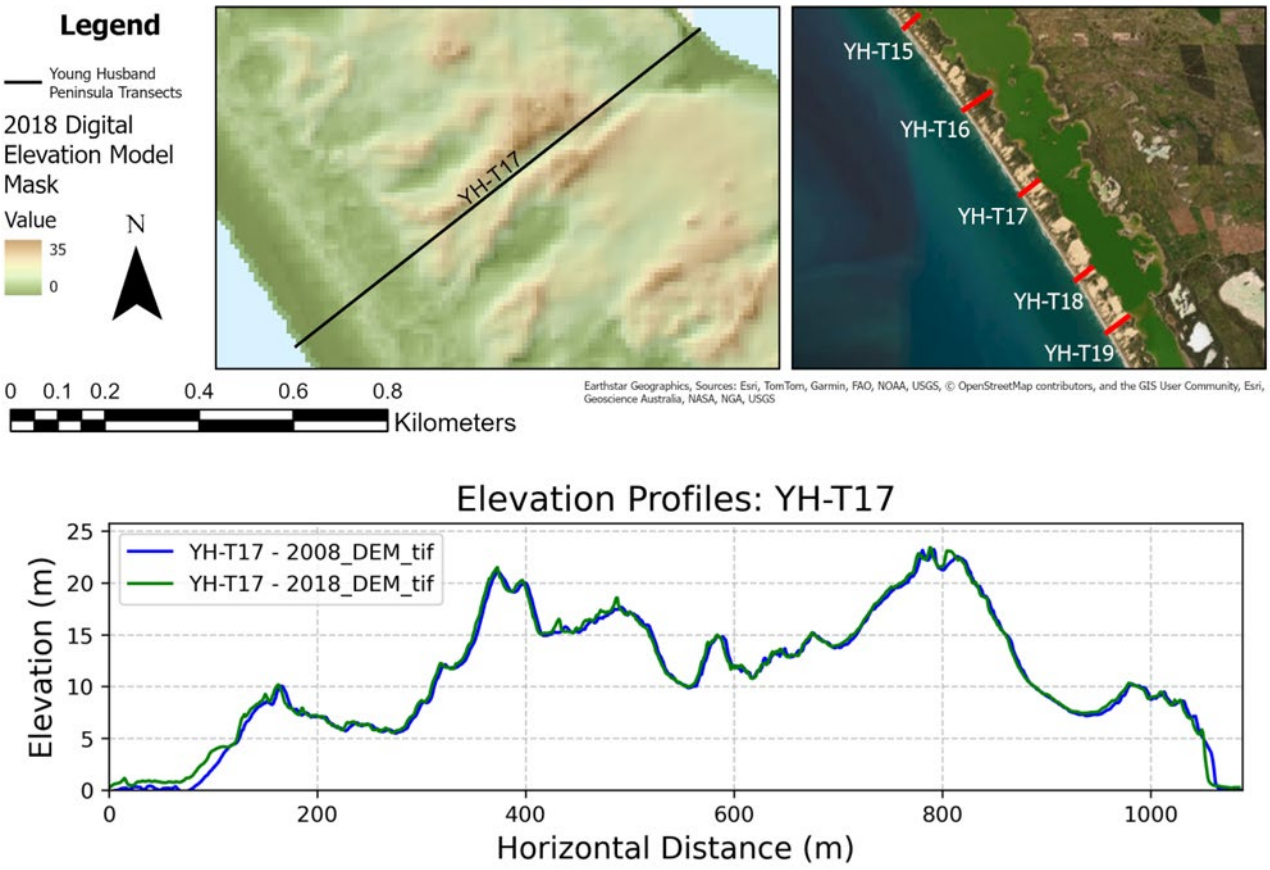


Figure 151. 2008 and 2018 LiDAR comparison at YH-T017. The transect line is indicated on the 2018 Digital elevation model (DEM), and the location of the transect and position relative to other transects is also indicated in the top right.

4.18 Transect T018

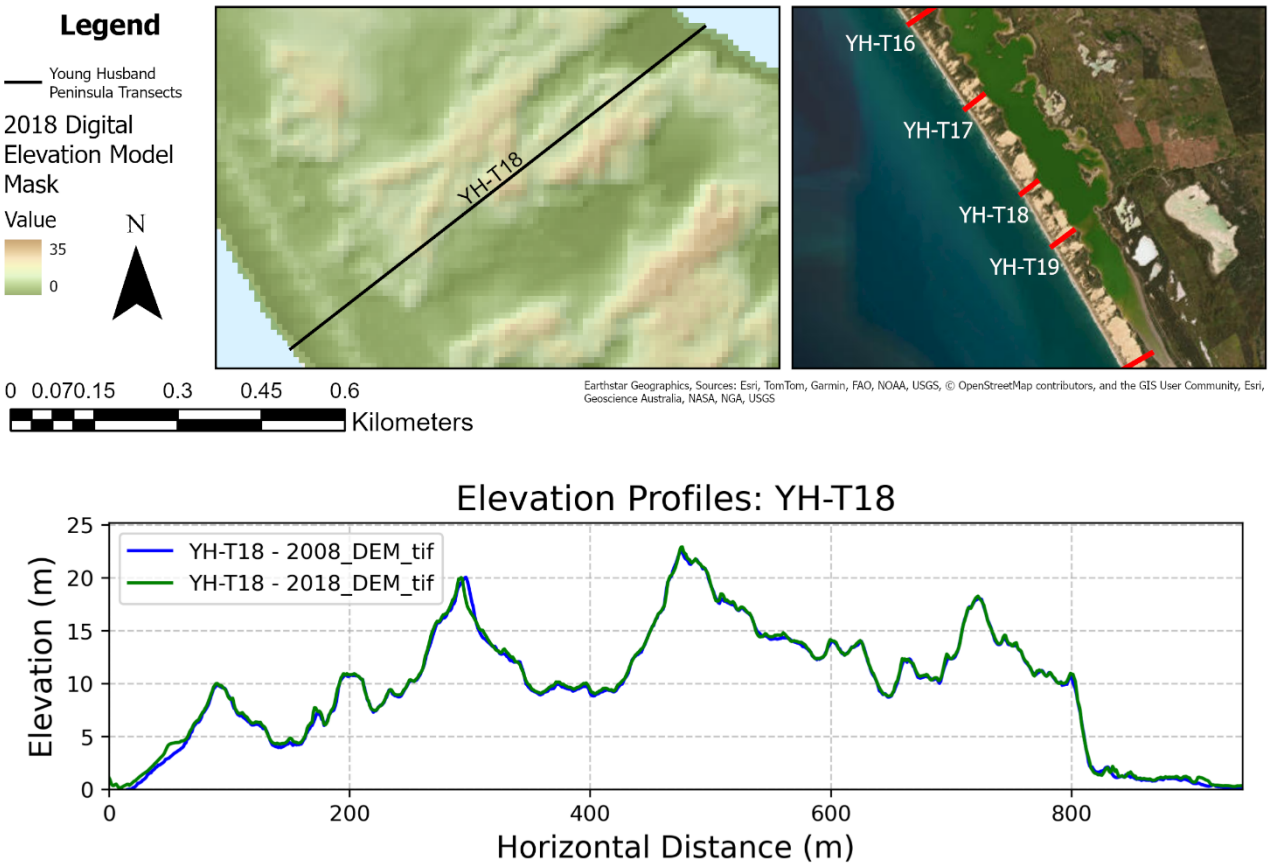
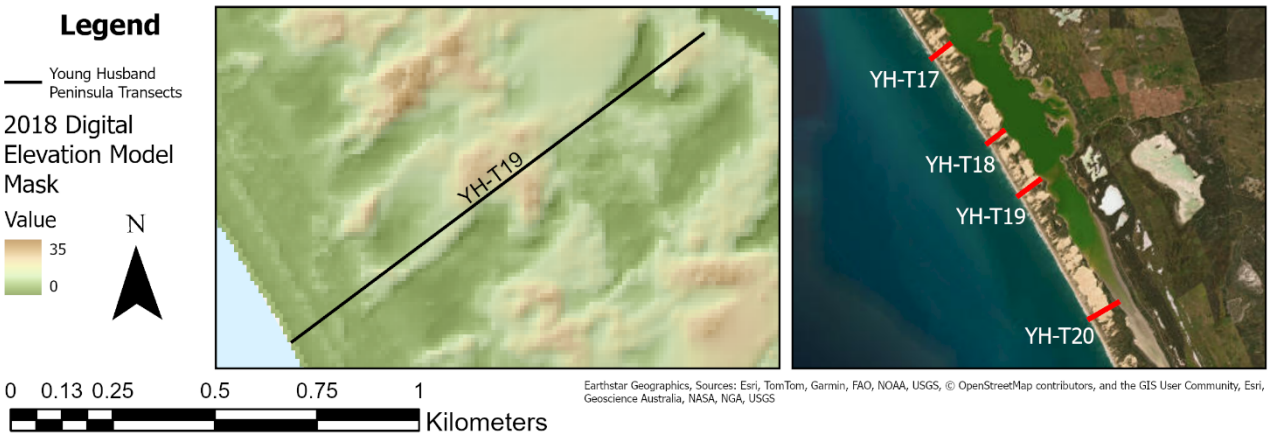


Figure 152. 2008 and 2018 LiDAR comparison at YH-T018. The transect line is indicated on the 2018 Digital elevation model (DEM), and the location of the transect and position relative to other transects is also indicated in the top right.

4.19 Transect T019



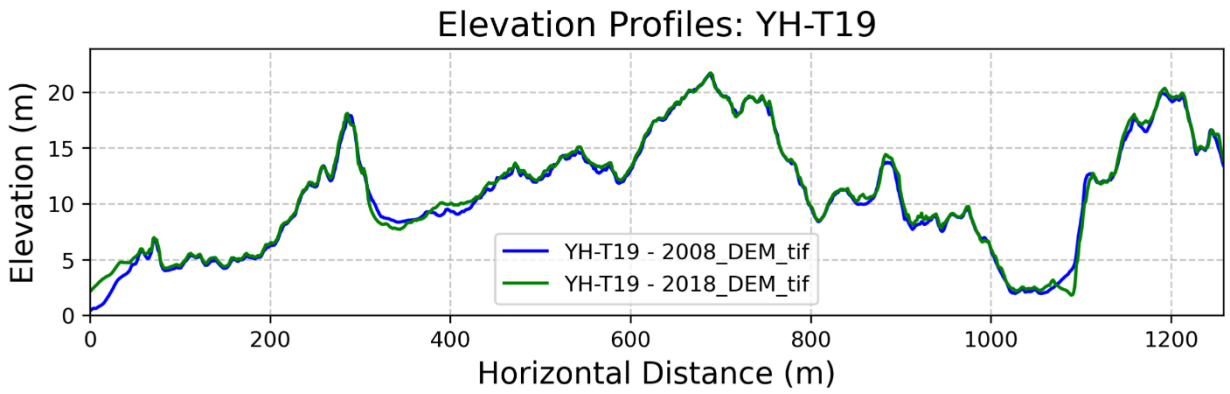
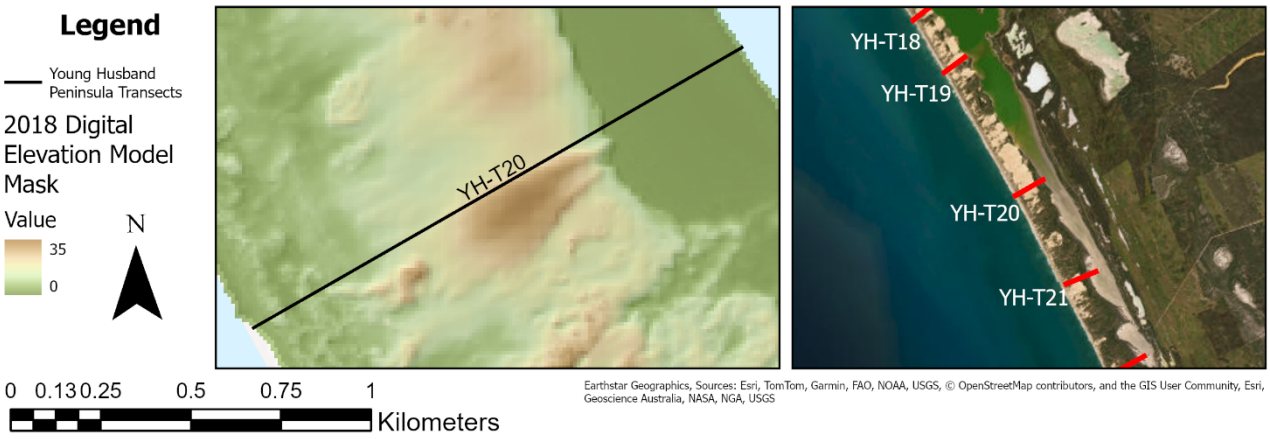


Figure 153. 2008 and 2018 LiDAR comparison at YH-T019. The transect line is indicated on the 2018 Digital elevation model (DEM), and the location of the transect and position relative to other transects is also indicated in the top right.

4.20 Transect T020



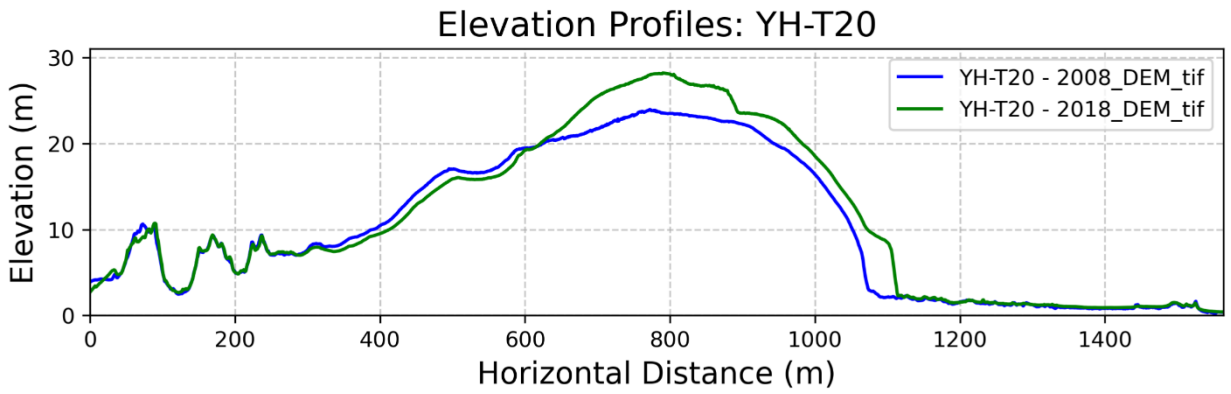
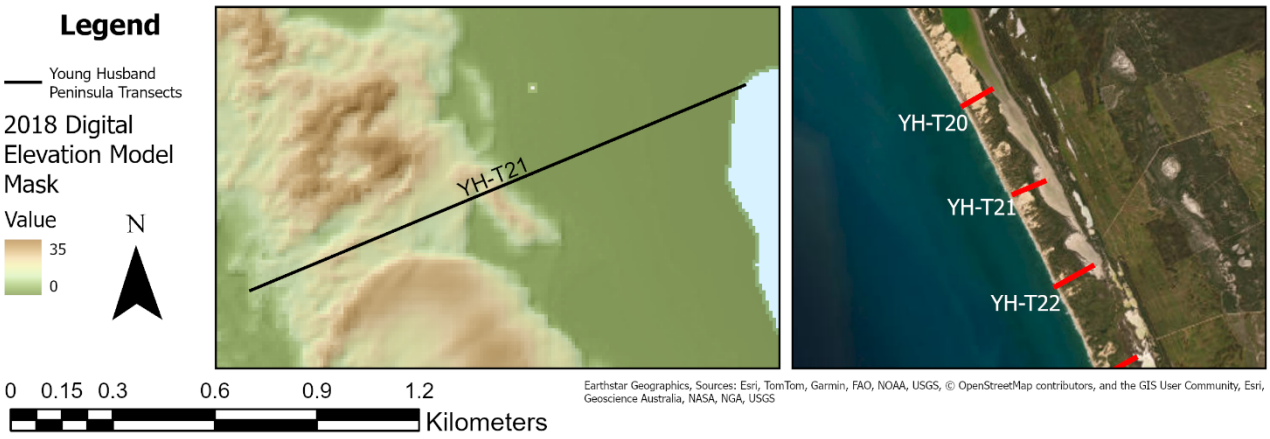


Figure 154. 2008 and 2018 LiDAR comparison at YH-T020. The transect line is indicated on the 2018 Digital elevation model (DEM), and the location of the transect and position relative to other transects is also indicated in the top right.

4.21 Transect T021



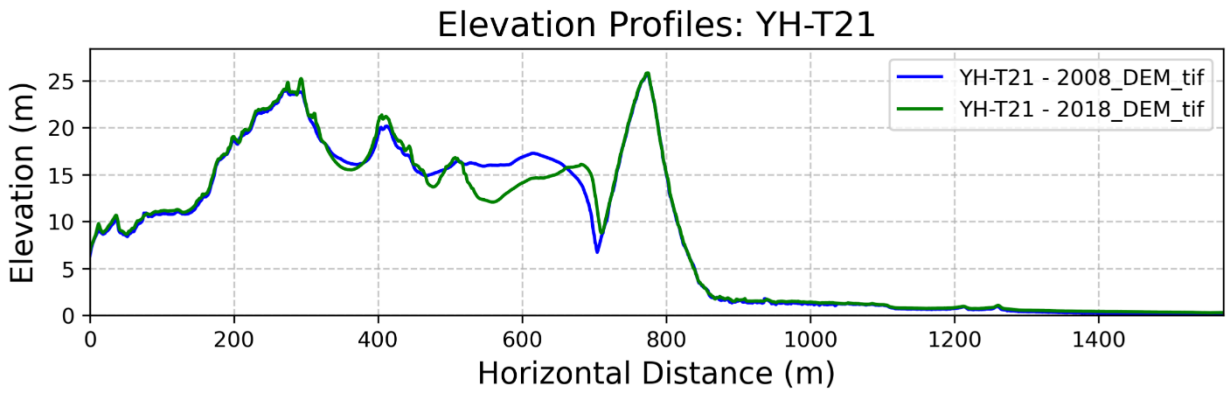
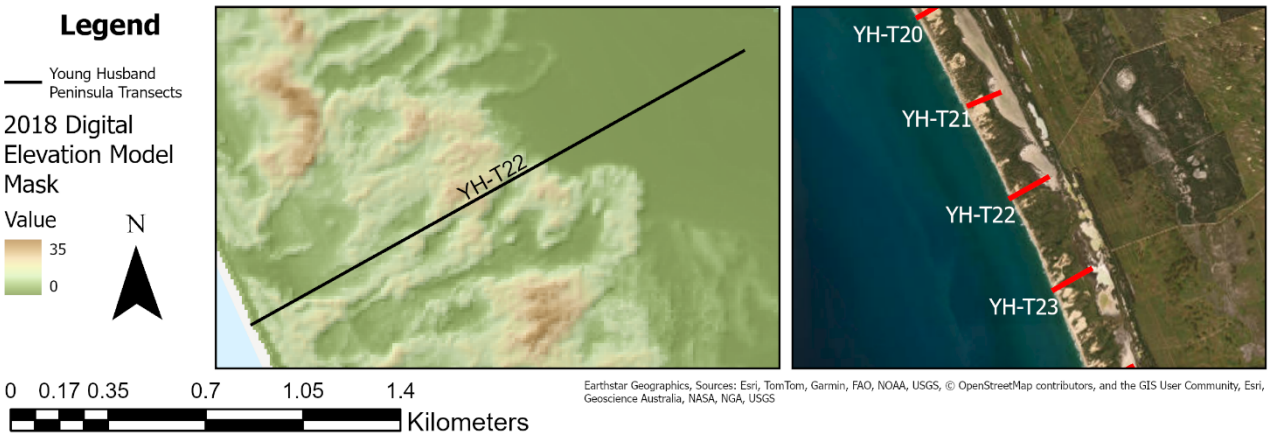


Figure 156. 2008 and 2018 LiDAR comparison at YH-T021. The transect line is indicated on the 2018 Digital elevation model (DEM), and the location of the transect and position relative to other transects is also indicated in the top right.

4.22 Transect T022 (near 42 Mile Crossing)



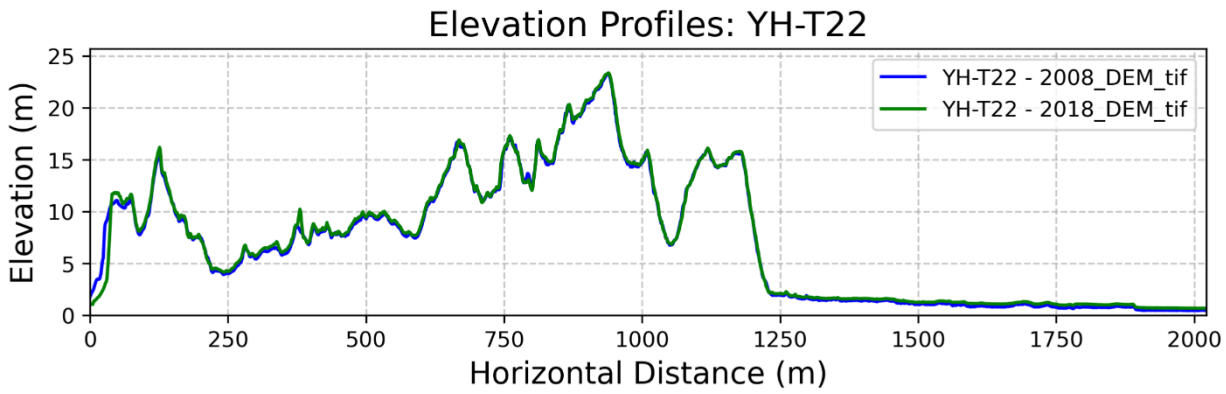
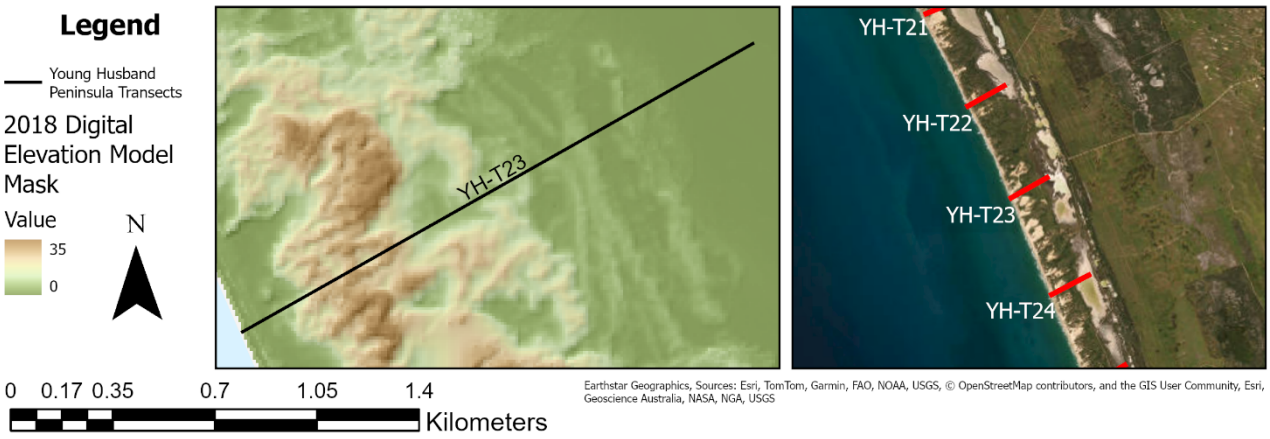


Figure 157. 2008 and 2018 LiDAR comparison at YH-T22. The transect line is indicated on the 2018 Digital elevation model (DEM), and the location of the transect and position relative to other transects is also indicated in the top right.

4.23 Transect T023



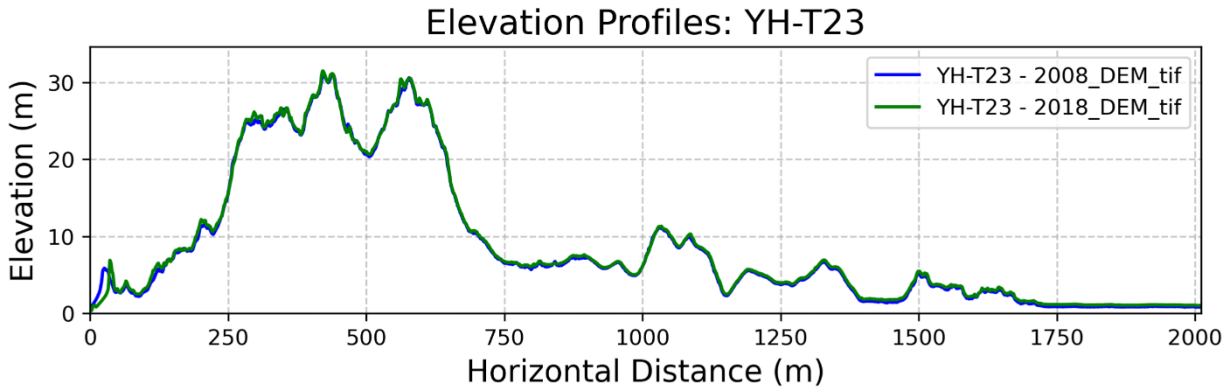
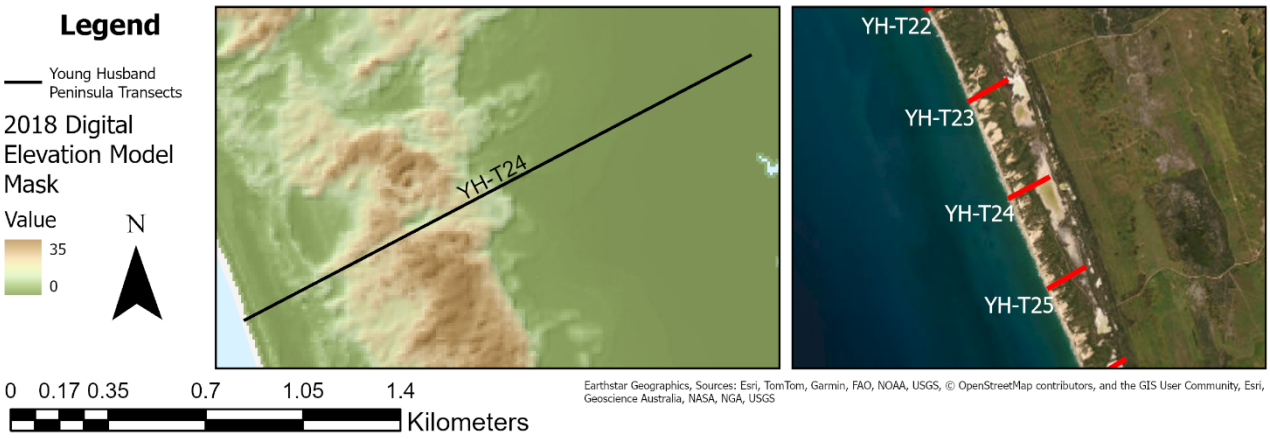


Figure 158. 2008 and 2018 LiDAR comparison at YH-T23. The transect line is indicated on the 2018 Digital elevation model (DEM), and the location of the transect and position relative to other transects is also indicated in the top right.

4.24 Transect T024



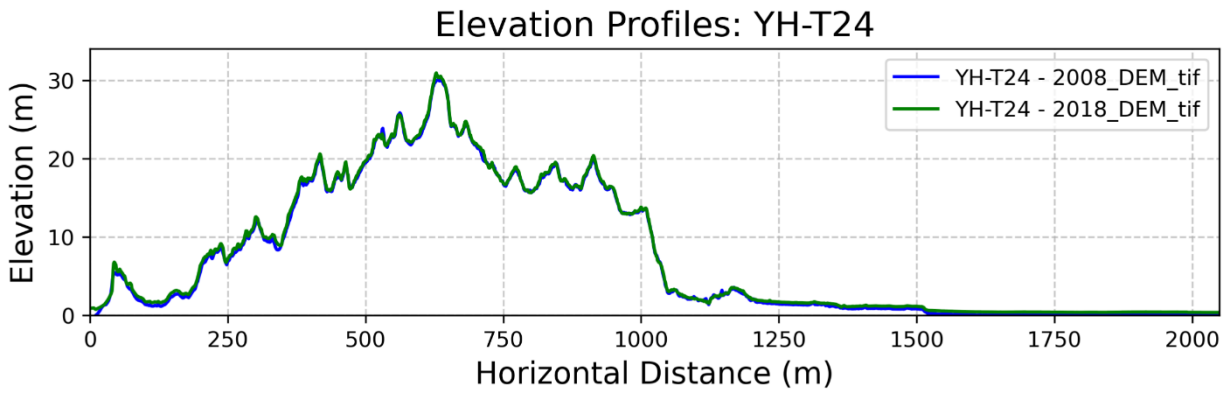
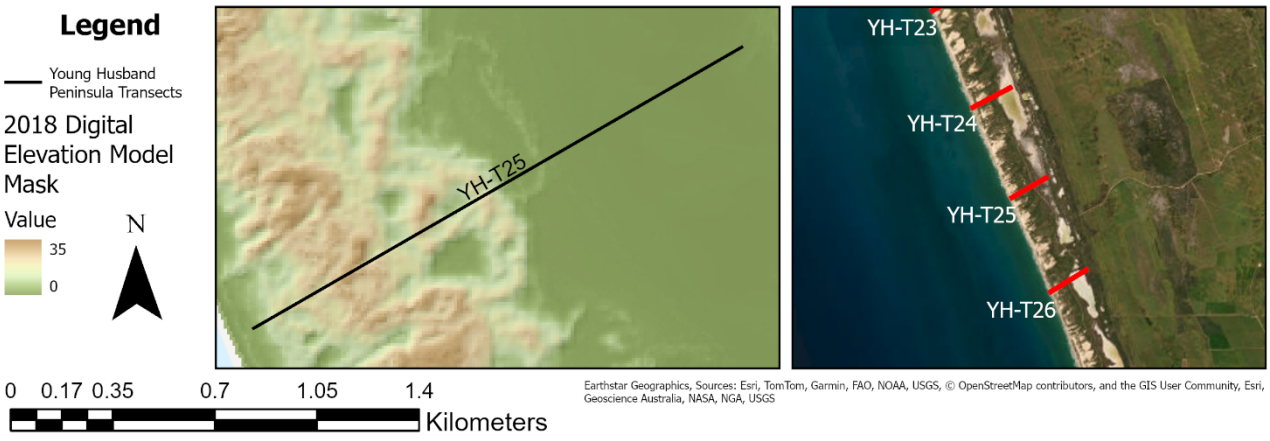


Figure 159. 2008 and 2018 LiDAR comparison at YH-T24. The transect line is indicated on the 2018 Digital elevation model (DEM), and the location of the transect and position relative to other transects is also indicated in the top right.

4.25 Transect T025



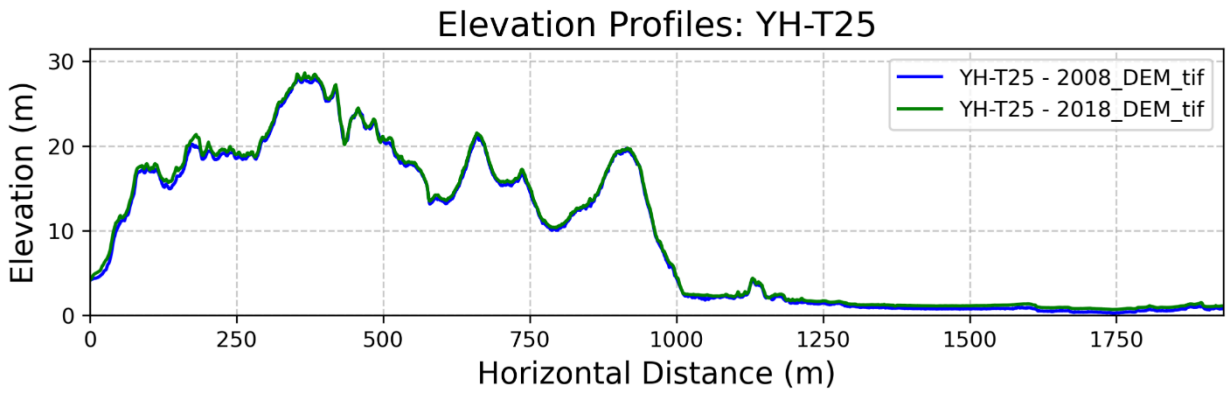
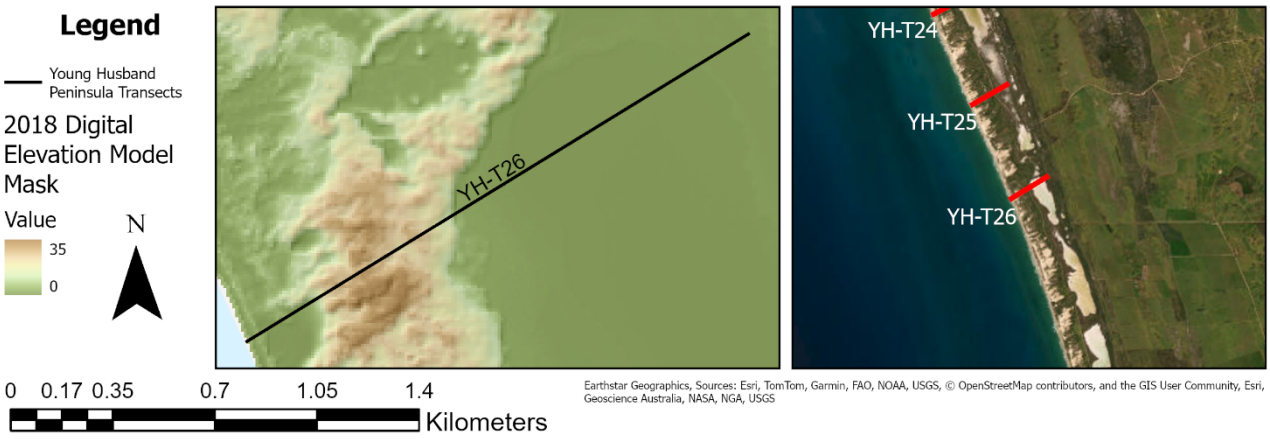


Figure 160. 2008 and 2018 LiDAR comparison at YH-T25. The transect line is indicated on the 2018 Digital elevation model (DEM), and the location of the transect and position relative to other transects is also indicated in the top right.

4.26 Transect T026



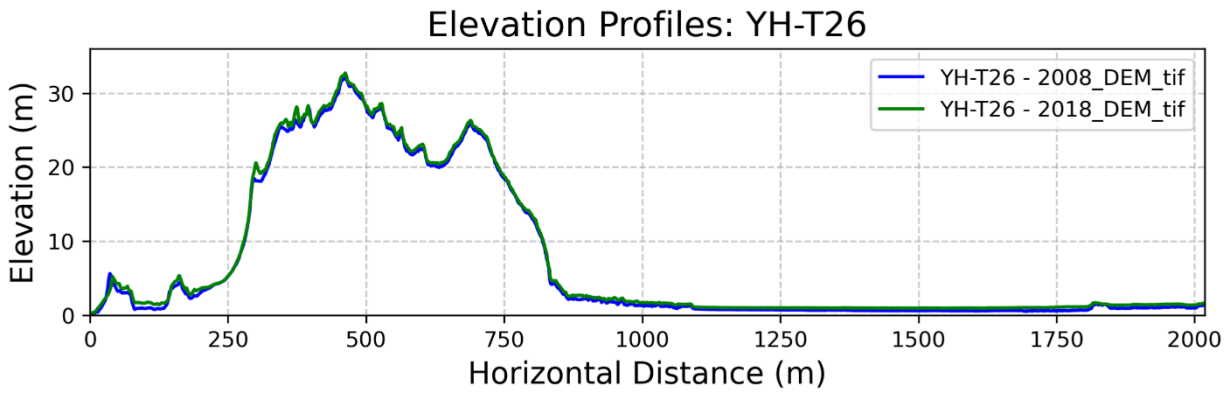


Figure 161. 2008 and 2018 LiDAR comparison at YH-T26. The transect line is indicated on the 2018 Digital elevation model (DEM), and the location of the transect and position relative to other transects is also indicated in the top right.

5. Summary of Beach-Dune Changes for the Region

Table 36. All profile locations examined, their abbreviations used in the figures, full name and their DEW profile numbers.

Abbreviation	Full Name	Profile
W	Waitpinga	620001 (Waitpinga)
EB1	Encounter Bay 1	620002 (Encounter Bay)
EB2	Encounter Bay 2	620007 (Encounter Bay)
V1	Victor Central 1	620006 (Victor Central)
V2	Victor Central 2	620008 (Victor Central)
V3	Victor Central 3	620004 (Victor Central)
V4	Victor Central 4	620005 (Victor Central)
V5	Victor Central 5	620003 (Victor Central)
H	Hayborough	615001 (Hayborough)
HB	Horseshoe Bay	615002 (Horseshoe Bay)
B	Bashams	615003 (Bashams)
M1	Middleton 1	615004 (Middleton)
M2	Middleton 2	615007 (Middleton)
M3	Middleton 3	615006 (Middleton)
G	Goolwa	615005 (Goolwa)
SR1	Sir Richard 1	615009 (Sir Richard)
SR2	Sir Richard 2	615010 (Sir Richard)
YH1	Younghusband 1	720011 (Younghusband)
YH2	Younghusband 2	720010 (Younghusband)
YH3	Younghusband 3	720009 (Younghusband)
YH4	Younghusband 4	720008 (Younghusband)
YH5	Younghusband 5	720007 (Younghusband)
YH6	Younghusband 6	720006 (Younghusband)
YH7	Younghusband 7	720005 (Younghusband)
YH8	Younghusband 8	720004 (Younghusband)
YH9	Younghusband 9	720003 (Younghusband)
YH10	Younghusband 10	720002 (Younghusband)
YH11	Younghusband 11	720001 (Younghusband)
YH12	Younghusband 12	715005 (Younghusband)
YH13	Younghusband 13	715006 (Younghusband)
YH14	Younghusband 14	715007 (Younghusband)
K	Kingston SE	715003 (Kingston SE)
Wy	Wyomi	715009 (Wyomi)
CJ1	Cape Jaffa 1	715053 (Cape Jaffa)
CJ2	Cape Jaffa 2	715049 (Cape Jaffa)

Figure 161 illustrates the mean beach width for each profile location for all topographic profiles conducted. The profiles have been grouped (colour coded) according to the number of times they have been surveyed (ranging from very few times – 2-5, to >16). All beaches bar one sit within the ~25 to 75m range with one beach (Kingston SE) being

significantly outside that range at 217m. The Kingston profile (715003) is located where significant beach accretion has taken place over time. The shortest beach profiles tend to correspond to low energy reflective beaches (e.g. profile 615002 at Horseshoe Bay; HB on Figure 161), and widest on the dissipative beaches such as Goolwa (G on Figure 161; profile 615005).

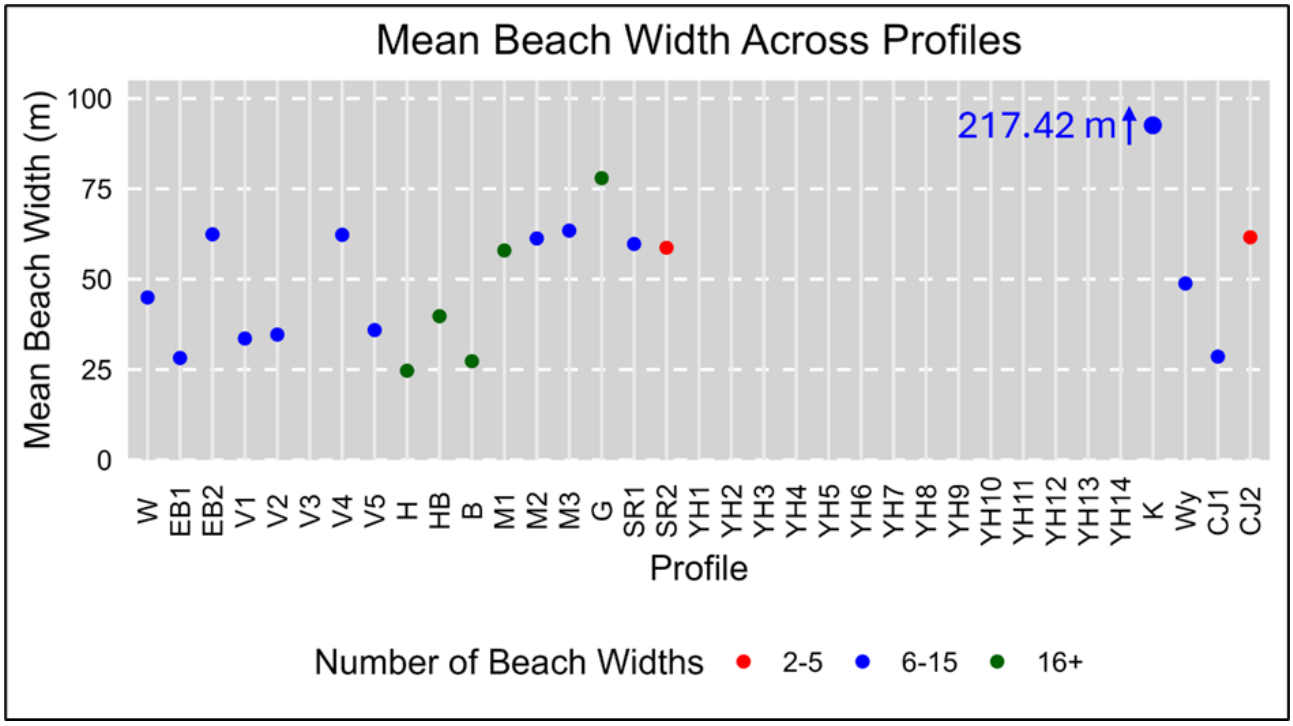


Figure 161. Mean beach widths for each profiling location across the region. Note that the number of times a profile was surveyed varies.

Figure 162 illustrates the degree of beach mobility of profiles across the region. Beach mobility is calculated as the standard deviation of all survey beach widths computed. The highest beach mobility occurs at Sir Richard 2 which is located ~800m NW the Murray River mouth and may be influenced by sediment dredged from the river mouth and being deposited on the beach nearby. The Middleton 1 and 2 profiles (Profiles 615004, 615007) are also highly mobile with significant changes in beach width over time. Beach mobility is also high at Cape Jaffa 2 (Profile 715049) due to continual accretion or progradation following the construction of the Cape Jaffa marina. The natural mobility of intermediate and dissipative beaches, or moderate to high energy beaches will mask changes that might have occurred due to sea level rise.

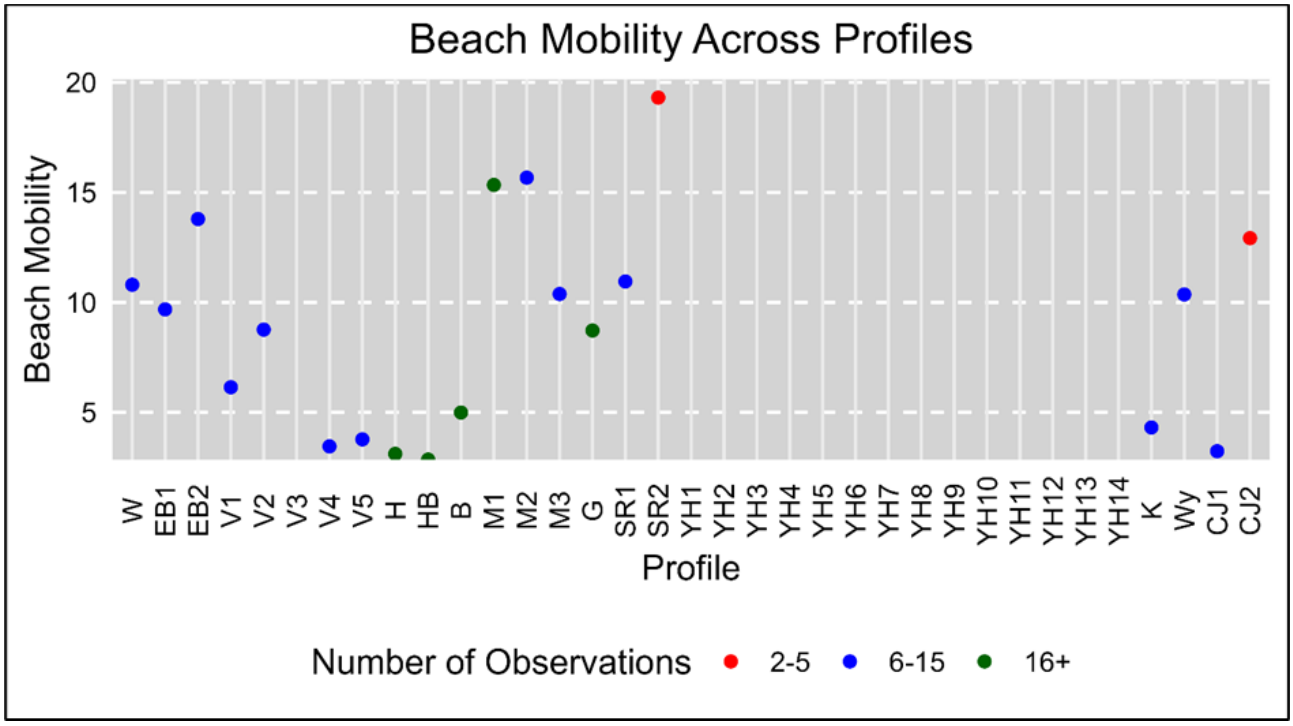


Figure 162. Beach mobility for all profiles across the region excluding several of the Younghusband Peninsula profiles. Higher mobility indicates a greater degree of topographic change (i.e. amount of erosion or accretion over time).

Figure 163 illustrates the relative changes in m/year in backshore position across all the profiles excluding some of the Younghusband Peninsula profiles for which there are very few surveys. It may be seen that there is relatively little change for many of the profiles with the outliers being those that are significantly eroding or accreting due to either human actions (e.g. construction of the Cape Jaffa marina breakwaters/training walls- CJ1 and CJ2 (Profiles 715053, 715049), or due to a natural long term erosion trend (e.g. Younghusband 12, 13, and 14; profiles 715005, 715006, 715007); see Hesp et al., 2022 and DaSilva et al., 2024). If there was a sea level rise signature in these data, one would likely expect to see a general erosion trend for most beaches excluding those clearly accreting in the historic survey period. Alternatively, it appears that the historic sea level rise of ~ 29cm since 1920 has not triggered widespread erosion of these surveyed beaches to date.

These data are likely more reliable to examine for potential longer term shoreline changes than the relative shoreline position changes shown in Figure 164. This is because the top of the backshore would possibly more likely indicate shoreline translation with sea level rise than the 0m AHD position. Figure 164 shows that EB2, profile 620007 in Victor Harbor is in a long term erosion phase.

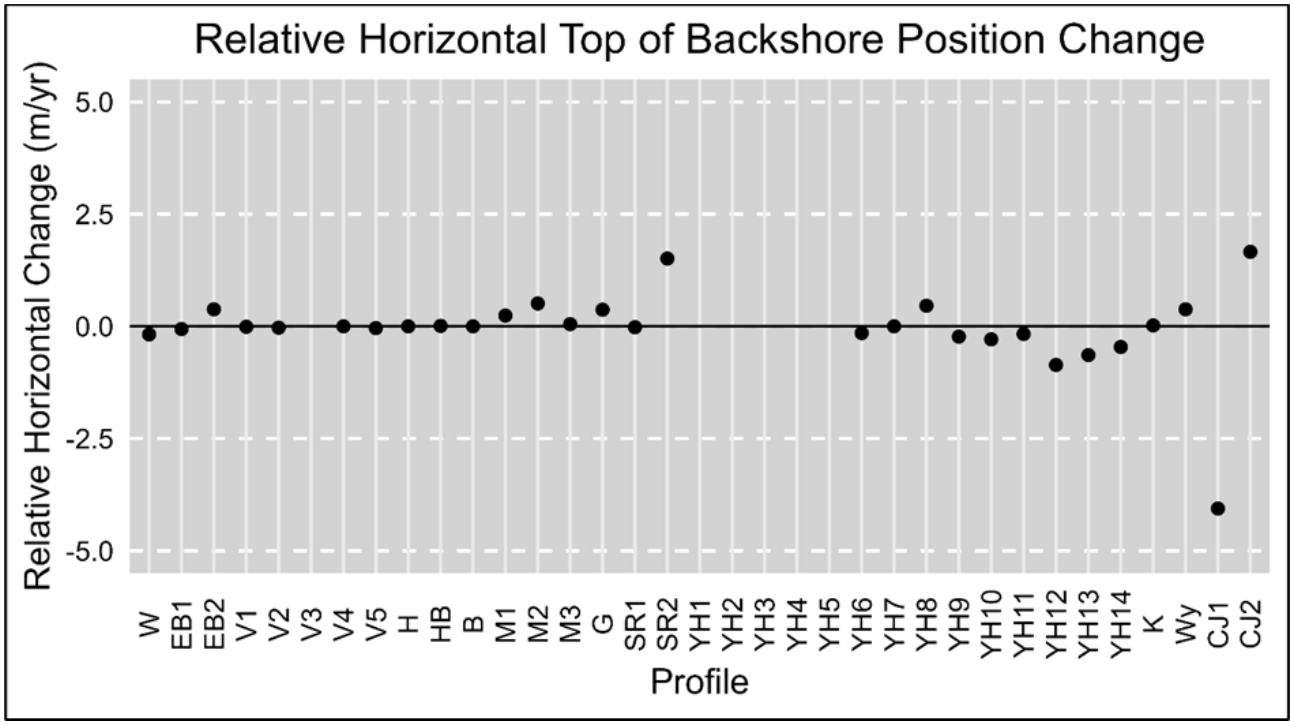


Figure 163. Relative horizontal position change of the backshore position for all profiles excluding several of the Younghusband Peninsula profiles.

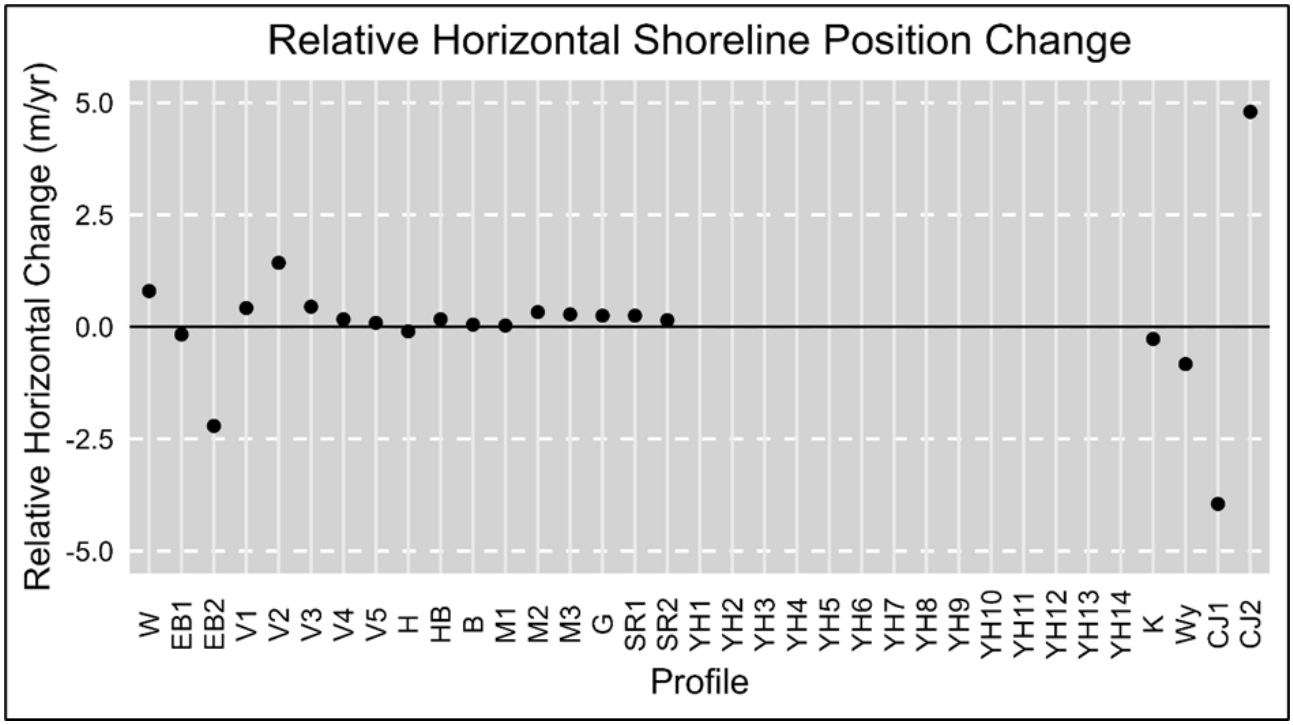


Figure 164. Relative shoreline position change across all profiles excluding several of the Younghusband Peninsula profiles.

Figure 165 illustrates the long term dune volume changes across all profiles and indicates similar trends seen in Figures 163 and 164. The highest dune volumes losses are in the eroding section of the Younghusband Peninsula, whilst the highest accreting beaches are at Goolwa, Sir Richard 2 near the Murray mouth, and at Cape Jaffa. Goolwa has been long term accreting, and a new foredune has been formed along that section of coast due to

invasion by the non-native species Thinopyrum junceiforme (sea wheat grass) (Hilton et al., 2006), and sediment supply. Thinopyrum grows further seawards than the native Spinifex pioneer grass, and also displaces Spinifex, so post-1980's it has formed a new incipient foredune all along the Goolwa-Sir Richard-Younghusband Peninsula (where erosion is not occurring), and where some sediment is being supplied to the coast. Beach volume changes are more muted compared to the dune/shoreward landforms volumetric changes but display similar trends (Figure 166). Total volume changes (beach and dune; Figure 167) also display similar trends.

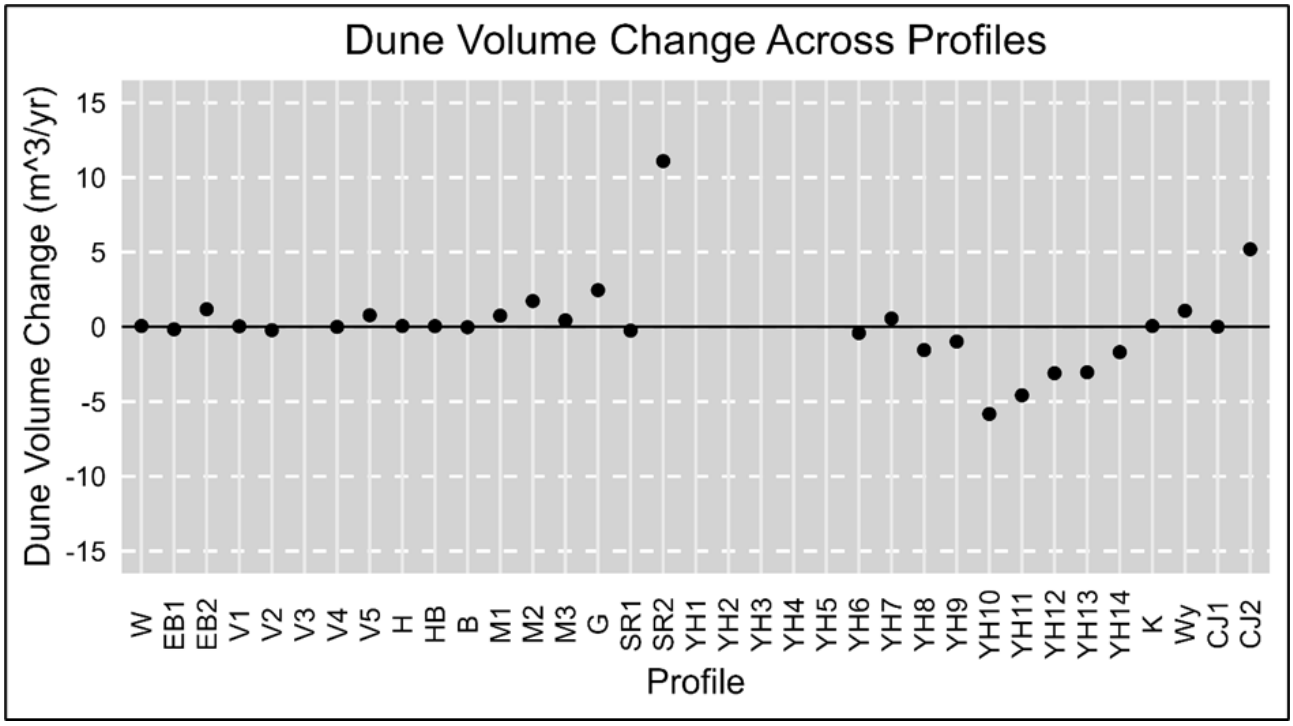


Figure 165. Dune/landform volumetric changes across all profiles in the region excluding several of the Younghusband profiles.

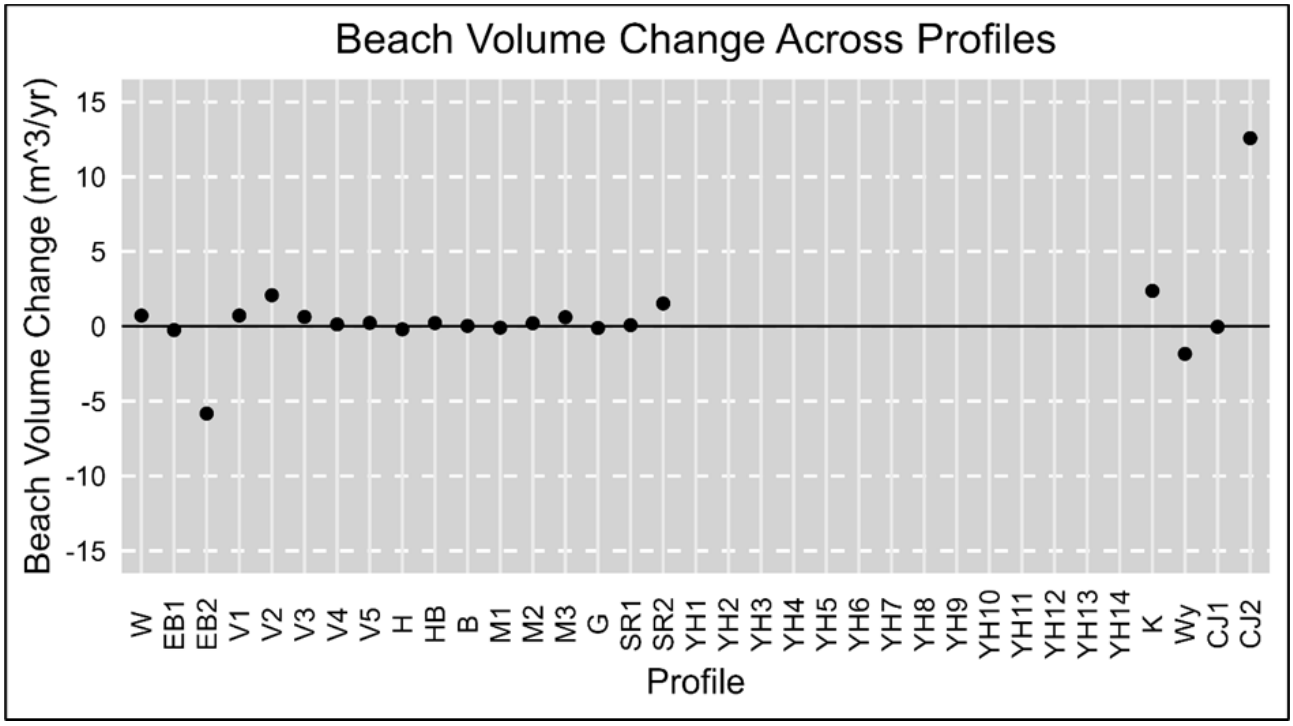


Figure 166. Beach volume changes across all profiles in the region excluding several of the Younghusband profiles.

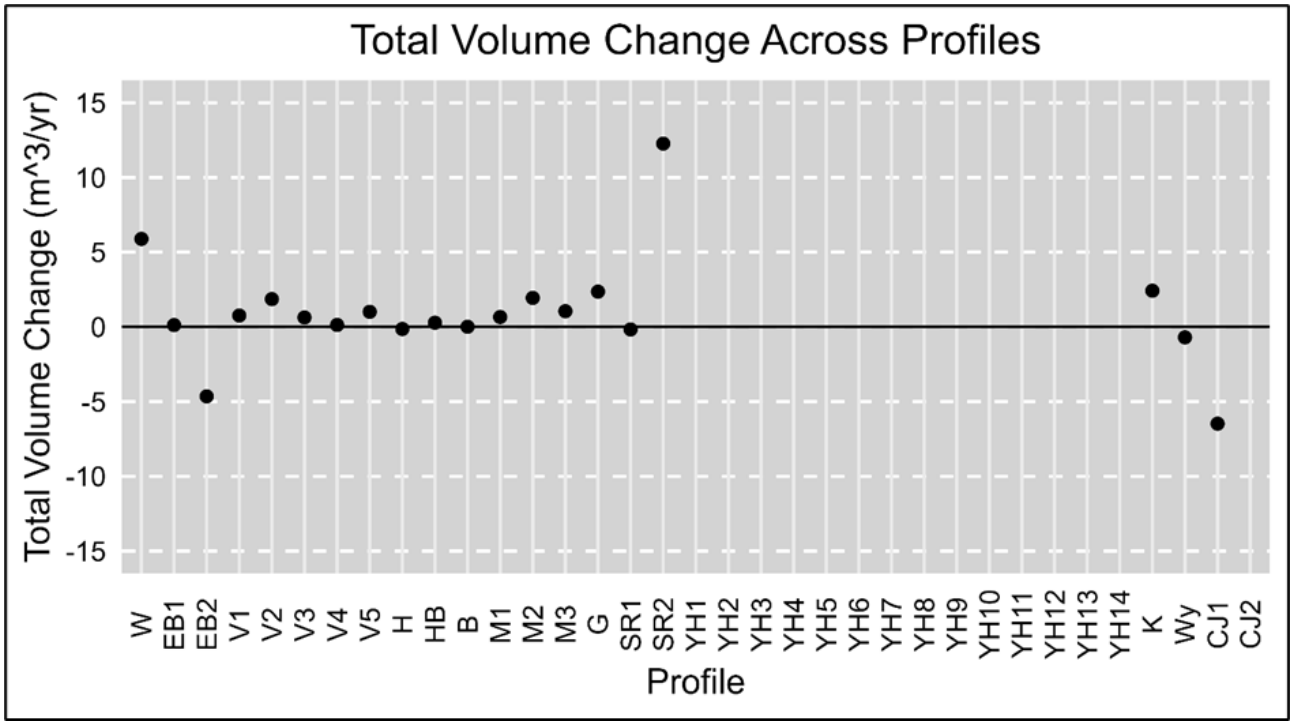


Figure 167. Total volume changes across all profiles excluding the Younghusband Peninsula.

6. Conclusion

In 2022, Short (2022) reviewed the past behaviour and present status of Australian beach systems and investigated if Australian beaches were currently responding to sea level rise.

He concluded that most Australian beaches are presently stable, and that a sea level tipping point is decades away.

The present study finds that beach-dune systems in the Victor Harbor to Kingston region show considerable variability in behaviour over time, with some accreting, some eroding and some essentially stable. There is no consistent trend in beach-dune erosion associated with or able to be correlated with sea level rise over the past 40+ years of survey record. It is likely that the "noise" associated with regular or periodic erosion and subsequent accretion events driven by storm and calm wave periods respectively is significantly greater than any signal associated with sea level rise. When one examines the beach-dune profiles in the Victor Harbor to Kingston region, and removing the profiles clearly influenced by human actions, it is not possible to see a gradual vertical translation of the 0m AHD position, or the +3m AHD top of the backshore/toe of the foredune or other landform in the data. If sea level rise takes place, a natural foredune and beach will translate upwards and landwards as shown by medium to long term surveys of beaches undergoing various levels of erosion (Ollerhead et al., 2013; van IJzendoorn et al., 2021; Davidson-Arnott et al; 2024). The topographic profiles examined in this study do not show any clear evidence of vertical and horizontal translation. Thus, it is impossible at the moment, to state with any certainty that beaches in the region have experienced erosion due to sea level rise. It is possible, perhaps even quite likely, that a sea level rise of ~24cm post-1900 (https://research.csiro.au/slrwavescoast/sea-level/sea-level-changes/) has contributed to beach-dune erosion along the coast, but a signal purely related to sea level rise is not yet apparent.

7. References

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