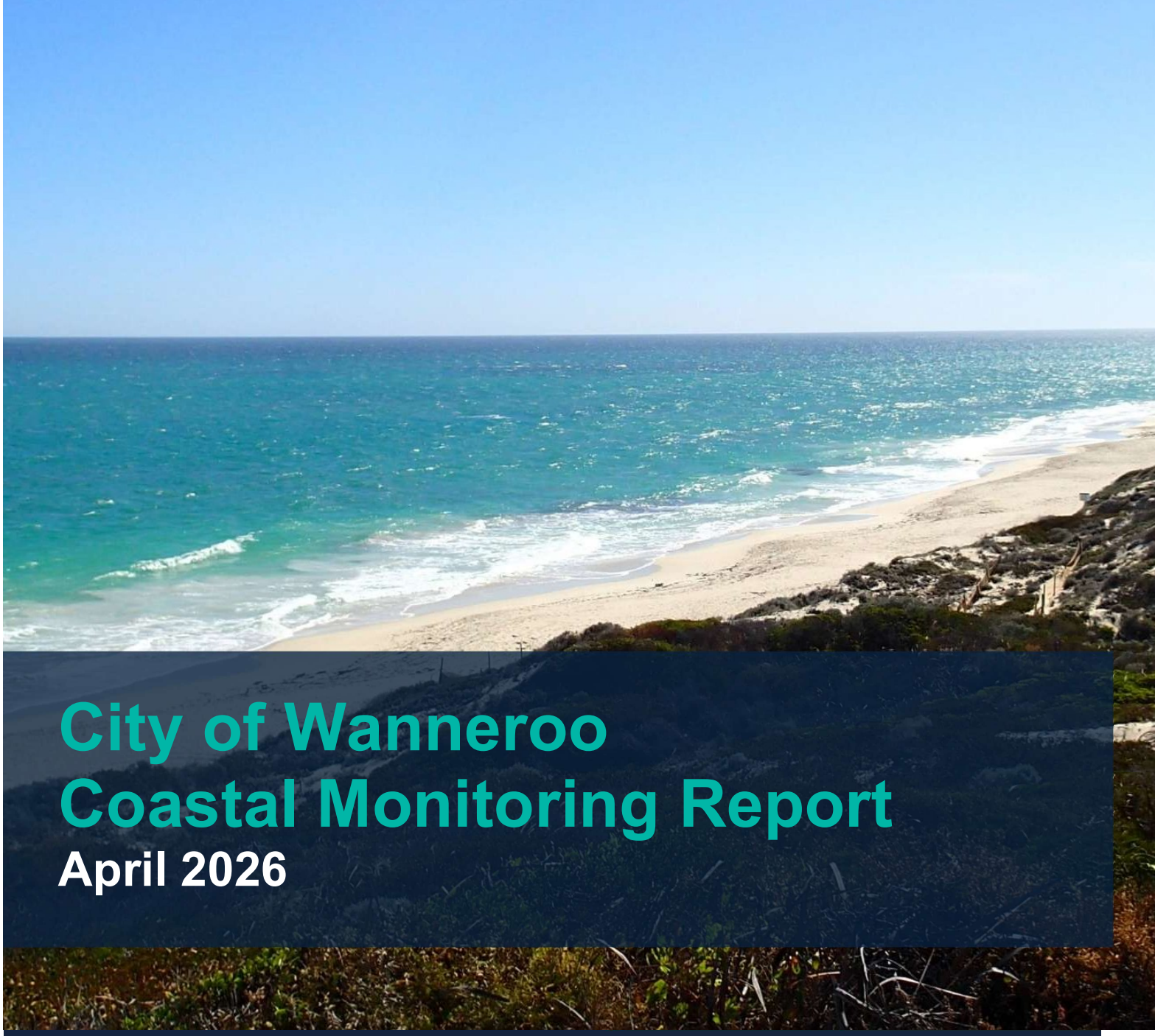


City of Wanneroo
Coastal Monitoring Report
April 2026

City of Wanneroo

Document Control

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Executive Summary

The City of Wanneroo Coastal Monitoring Program provides ongoing assessment of coastal processes and shoreline change along the City's coastline through the collection and analysis of meteorological, oceanographic, photographic and survey data. This report presents the findings of the April 2026 monitoring campaign and evaluates seasonal and longer-term coastal trends observed between April 2025 and April 2026.

The 2025/26 monitoring period was characterised by relatively mild winter conditions followed by a summer dominated by persistent southerly sea breezes. These conditions resulted in the expected seasonal sediment transport patterns along the coast, with beaches generally experiencing erosion during winter and recovery during summer. Across most monitored locations, summer accretion offset a significant proportion of the winter erosion, resulting in largely stable annual beach conditions.
Areas of more pronounced seasonal erosion were identified at Two Rocks and Yanchep, where localised reductions in beach width, increased beach gradients and erosion scarps were observed. However, in most cases dune systems remained stable and continued to provide protection to adjacent assets. Long-term photographic assessments showed predominantly minor erosion or accretion trends across the monitoring network, with no locations exhibiting major long-term erosion. Significant mid-term erosion was observed at Mindarie sites (B01 and B02), while Yanchep site (B13) displayed notable long-term accretion.

LiDAR and ground-based survey data confirmed the strong seasonal variability of beach volumes. Most monitored beaches experienced net erosion during the winter period, followed by substantial recovery during summer. The largest seasonal gains were recorded at Claytons Beach, Yanchep and several Quinns Rocks sections, reflecting the influence of summer sediment transport and beach rebuilding processes.

Overall, the monitoring results indicate that the City of Wanneroo coastline remains generally stable, with observed changes largely reflecting natural seasonal variability. While several localised erosion hotspots continue to warrant ongoing observation and management, there is no evidence of widespread coastal recession during the reporting period. Continued implementation of the Coastal Monitoring Program will provide critical information to support coastal planning, identify emerging risks, and guide future coastal management and adaptation initiatives.

1 Introduction

1.1 Coastal Foreshore Monitoring

A long-term coastal monitoring program has been undertaken by the City of Wanneroo (CoW) since 2014. The purpose of the program is to evaluate the seasonal, annual and long-term trends in erosion and accretion along the City's coastline. This helps to better inform future coastal management measures, identify key areas requiring future management and to provide data for future coastal hazard studies.

At present, the coastal monitoring program involves the acquisition and assessment of the following data sets.

- Biannual manual images taken at 51 beach monitoring sites;
- Hourly automatic photographic monitoring taken at five sites along Quinns Beach and Yanchep;
- 6 monthly LiDAR aerial surveys undertaken across all vulnerable areas;
- Aerial imagery taken across the entire CoW coastline;
- Metocean conditions including:
    - Half-hourly wave data from the City's three local wave buoys situated off the coast of Yanchep and Quinns Rocks;
    - Half-hourly wave data from the Department of Transport's (DoT's) Rottnest Island Wave Station; and
    - 5-minute water level data from the DoT's Fremantle Fishing Boat Harbour Tide Station.

This document outlines the methodology and results obtained from the seasonal and long-term assessments of coastline changes at priority locations along the City's coastline.

1.2 Coastal Structures Monitoring

The City's coastal monitoring program also includes 6 monthly monitoring of coastal structures and includes photographic monitoring of coastal infrastructure assets within the City's vulnerable coastal locations. This is used to capture a photographic record of the assets, identify and address any public safety and minor maintenance requirements and to flag any major structural concerns that may require further detailed investigation.

1.3 Condition Assessments

Each year the City also undertakes detailed condition assessments of each of its nine coastal protection structures. This is undertaken in October each year following the seasonal winter period to identify any structural issues that may have developed over the year. The latest condition assessments were undertaken in October 2025 and results are detailed in the City's October 2025 Coastal Monitoring Report.

Additional detailed condition assessments for all other coastal structural assets are undertaken every 5 years by an external structural engineering consultant.

2 Metocean Conditions

Metocean and wind conditions including wave and water level data are assessed as part of the coastal monitoring program. Data is obtained from the following instrumentation managed by the City, the Department of Transport (DoT) and the Bureau of Meteorology (BoM).

- Half-hourly wave data from the City's three local wave buoys situated off the coast of Yanchep and Quinns Rocks;
- Half-hourly wave data from the DoT Rottnest Island Wave Station;
- 5-minute water level data from the DoT Fremantle Fishing Boat Harbour Tide Station; and
- Half-hourly wind data from the Hillary's Boast Harbour Weather Station (Ocean Reef Weather Station decommissioned on the 13th of October 2025).

Locations of these instruments are presented in Figure 2-1.

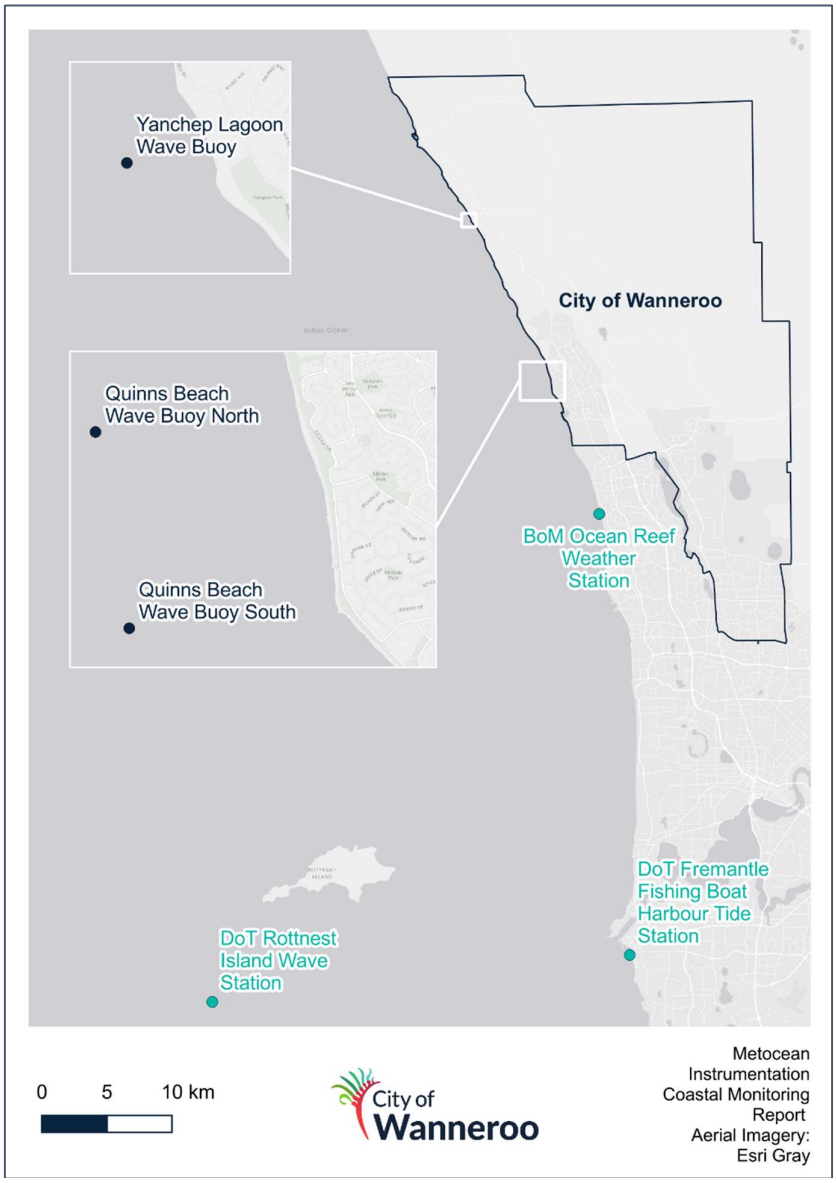


Figure 2-1 Location of Instruments

2.1 Assessment Methodology

The City's local wave buoys were deployed in November 2023 and the University of Western Australia (UWA) have been engaged by the City to service these instruments and provide a wave data set every six (6) months. This data is quality assured and controlled by UWA following best practice guidelines in line with the *Quality Assurance/Quality Control of Real Time Oceanographic Data* (QARTOD) standards for in situ wave data.

The data from the DoT and BoM is obtained for the annual monitoring period through data requests. The data is assessed using time series and rose plots to analyse trends and major weather events.

The metocean conditions at the time of manual photographic monitoring is noted and used to interpret qualitative observations from visual assessments of photo comparison (both seasonal and long term).

2.2 Results

2.2.1 Local Wave Data

Time series plots of the significant wave height calculated from the total wave spectrum (Hs) for the Yanchep Lagoon Wave Buoy, Quinns Beach Wave Buoy North and Quinns Beach Wave Buoy South is presented below in Figure 2-2, Figure 2-3 and Figure 2-4. These wave buoys were deployed on the 22 October 2025 and data was recovered on the 29 April 2026.

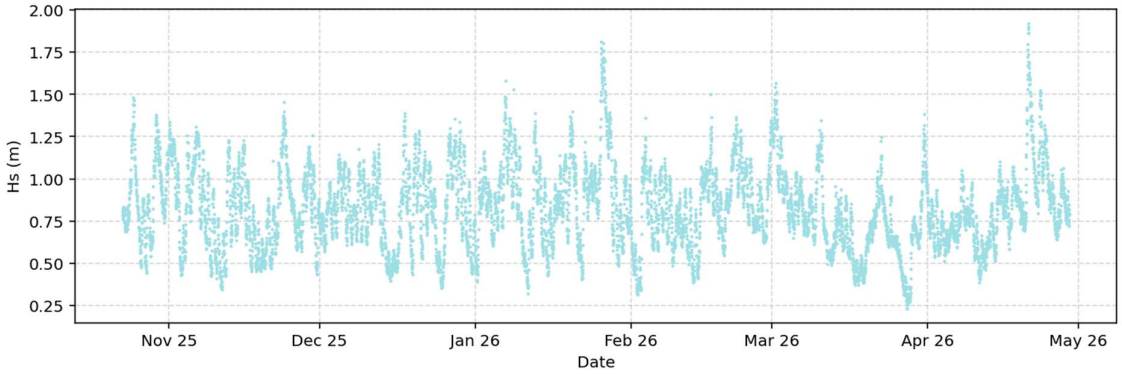


Figure 2-2 Total Significant Wave Height (Hs) recorded at the Yanchep Lagoon Wave Buoy from October 2025 to April 2026.

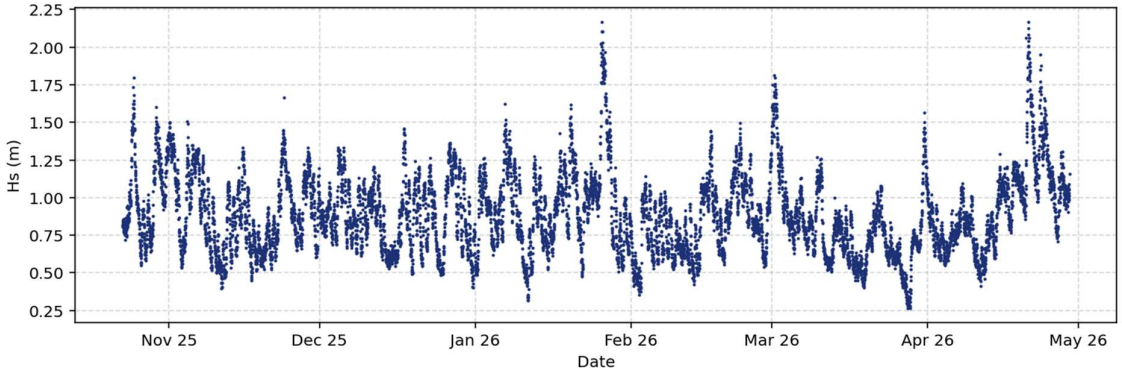


Figure 2-3 Total Significant Wave Height (Hs) recorded at the Quinns Beach Wave Buoy North from October 2025 to April 2026.

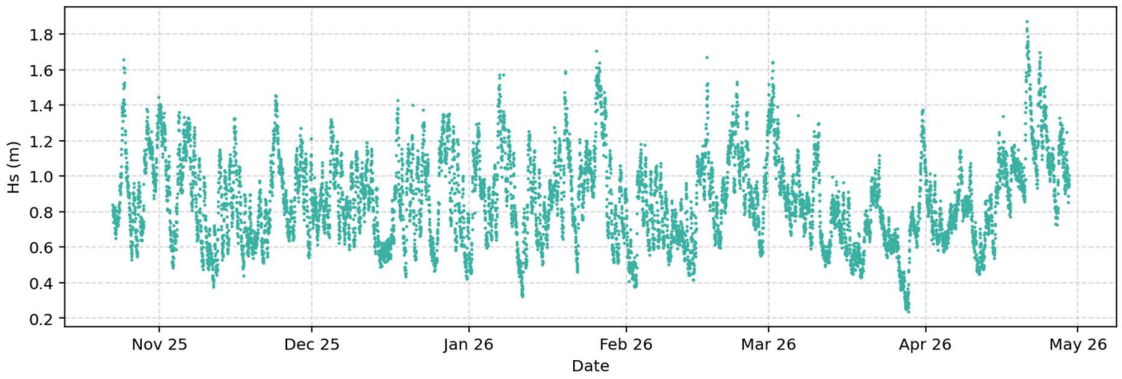


Figure 2-4 Total Significant Wave Height (Hs) recorded at the Quinns Beach Wave Buoy South from October 2025 to April 2026.

The total significant wave height does appear to be quite similar across all three monitoring instruments, with Quinns Beach Wave Buoy North recording slightly higher readings than Quinns Beach Wave Buoy South or Yanchep Lagoon Wave Buoy. The plots show typical summer conditions for the region during calm conditions. The largest significant wave heights recorded over the year at each site were: 2.17m on 26 January 2026 and 2.17m on 21 April 2026 by Quinns Rocks Beach Wave Buoy North, 1.87m on 21 April 2026 by Quinns Rocks Beach Wave Buoy South, and 1.92m on 21 April 2026 by Yanchep Lagoon Wave Buoy.

2.2.2 Study Period

A time series plot of the total significant wave height (Hs) recorded at the Rottnest Island Wave Station from April 2025 to April 2026 is presented below in Figure 2-5.

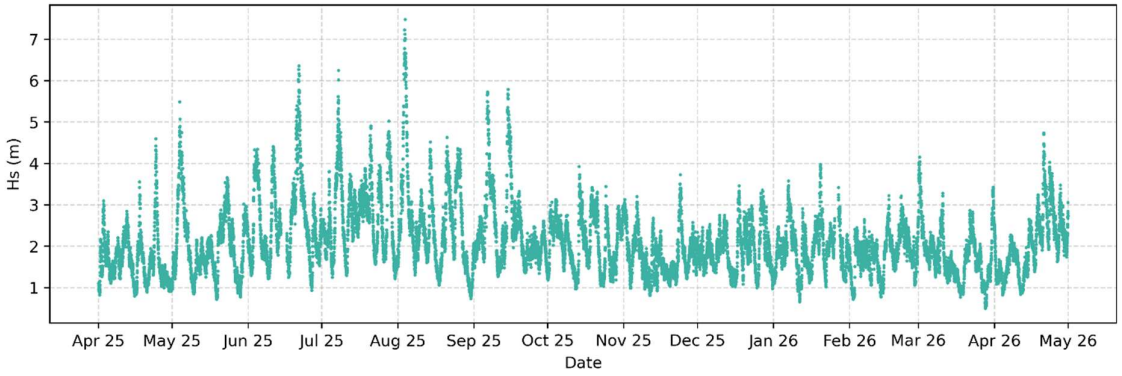


Figure 2-5 Total Significant Wave Height (Hs) recorded at the Rottnest Island Wave Station from April 2025 to April 2026.

The most notable observations from Figure 2-5 are the storm events that were recorded on the 21st of June 2025, 7th of July 2025 and 3rd of August 2025. These storm events recorded peak significant wave heights of 6,36m, 6.25m and 7.48m respectively. There were more storm events this year compared to 2024, which was a relatively calm year. The 2025 winter period was still calmer than 2022 and 2021. Comparatively, the largest storms during the 2021 and 2022 winter periods had peak significant wave heights of 7.84m and 8.67m, respectively. The calmer winter conditions resulted in minimal storm damage and limited coastal erosion as outlined in Section 3, 4 and 5.

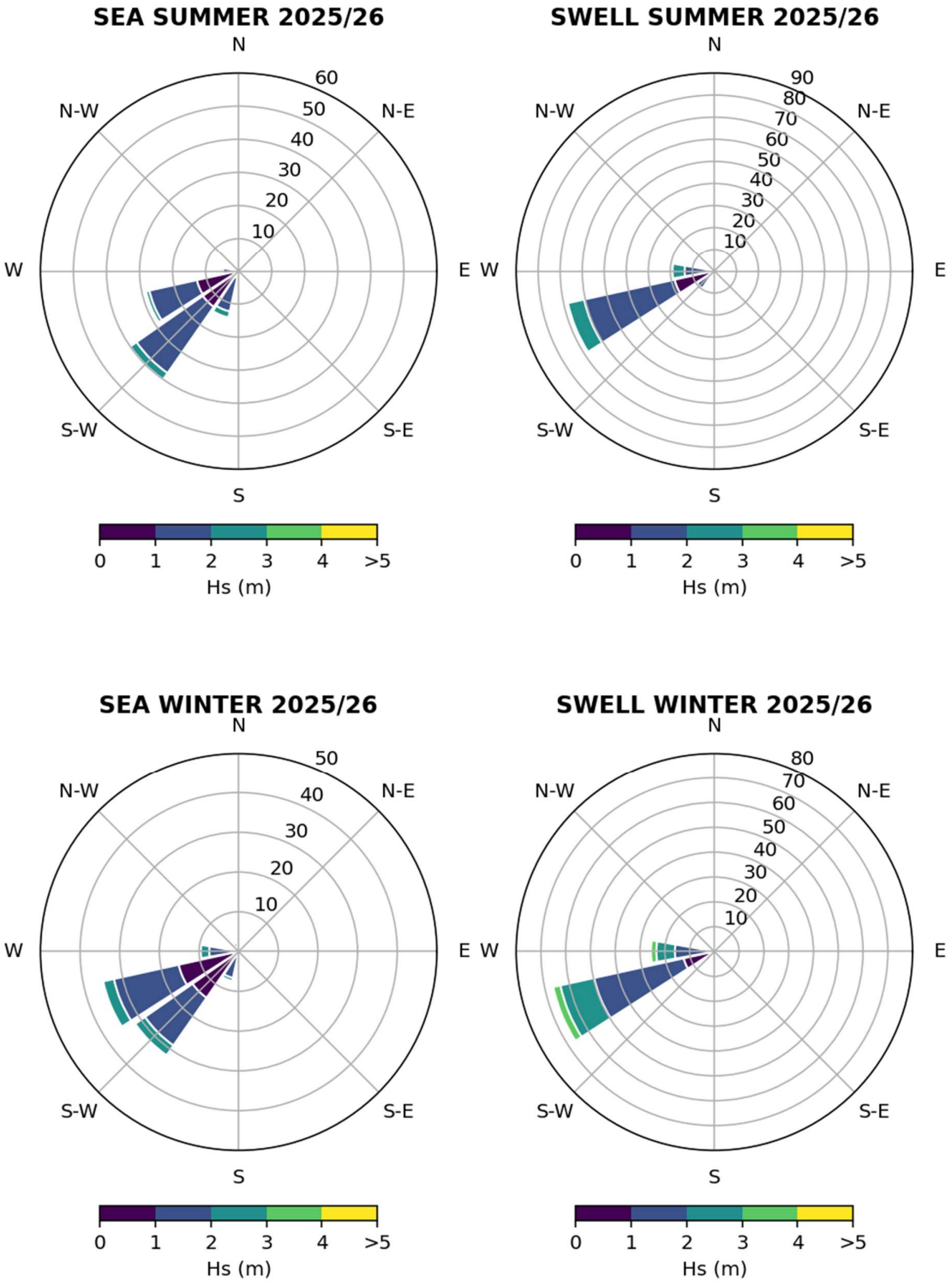


Figure 2-6 *Wave rose plots of sea and swell significant wave heights from the summer season (October 2025 to March 2026) and the winter Season (April to September 2025)*

As seen in Figure 2-6, the wave climate for both the summer and winter periods is characterised by west south westerly waves and as expected, there is an increase in swell height during the winter

period. Notably, for this study period, wave direction remained consistent for most of the year, with 10- 20% of readings captured outside of the consistent west south westerly direction.

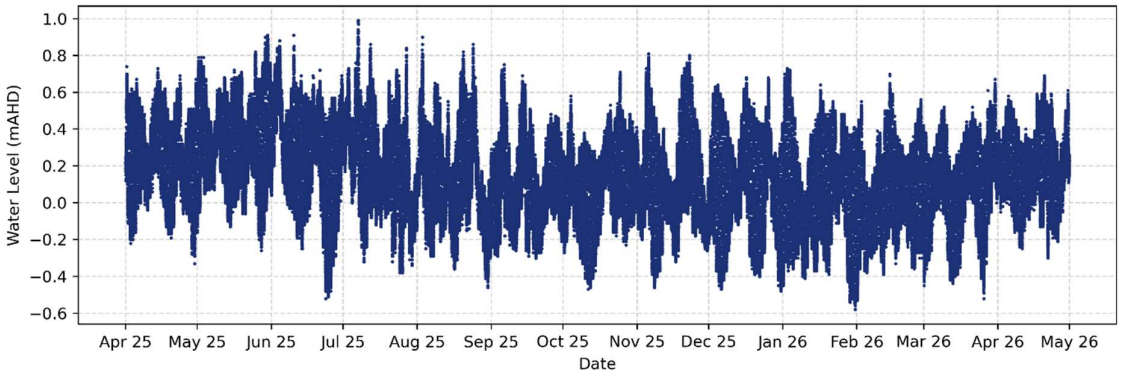


Figure 2-7 Water level (mAHD) recorded at the Fremantle Fishing Harbour Tide Station from April 2025 to April 2026.

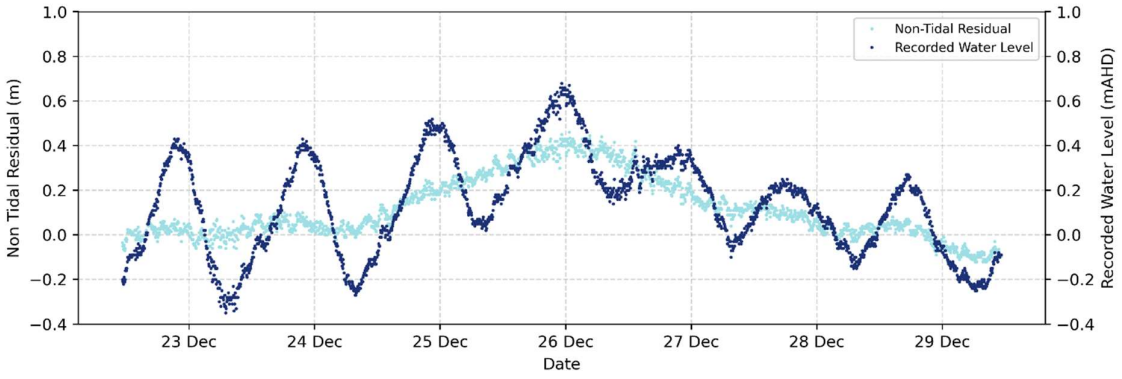


Figure 2-8 Largest non-tidal residual recorded water level at the Fremantle Fishing Harbour Tide Station between April 2025 to April 2026 was 25th December 2025.

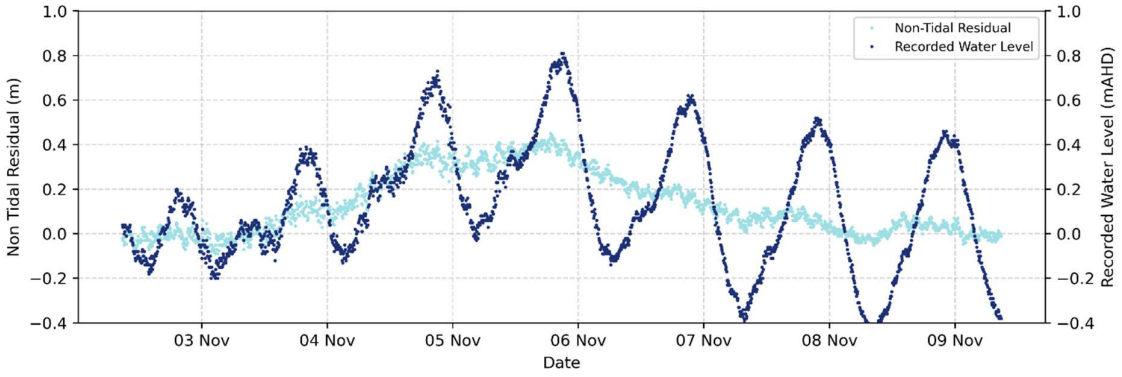


Figure 2-9 Non tidal residual recorded water level at the Fremantle Fishing Harbour Tide Station during the 5th November 2025 storm event.

Total recorded water level at the Fremantle Tide Station from, April 2025 to April 2026, is presented in Figure 2-7. The highest water level recorded was 0.99 mAHD recorded at 07:50AM on 7 July, during a storm which had a corresponding maximum offshore wave height of 6.25m. The largest non-tidal residual for the monitoring period (last 6 months), 0.46m, was observed on 26th December 2025 at 00:40 AM (Figure 2-8) with a corresponding maximum offshore wave height of 1.88m. The second largest non-tidal residual (Figure 2-9), 0.45m, was observed on 5th November 2025 at 6:40PM with a

corresponding maximum offshore wave height of 2.11m. These elevated residuals are attributed to low-pressure systems sitting offshore of the West Australian coast.
As outlined above, conditions during the 2025 winter period were mild and storm events caused very little damage to infrastructure. Further assessment on the impacts of the mild winter period is outlined in Sections 4, 5 and 6.

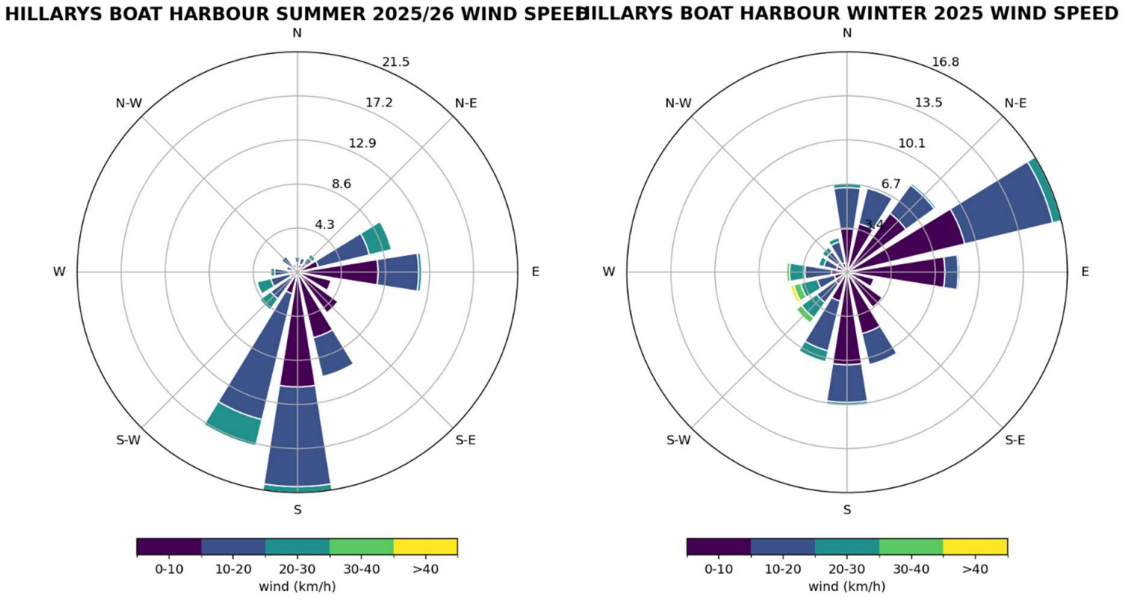


Figure 2-10 Rose plots showing wind speeds recorded during the summer season (October 2025 to March 2026) and the winter season (April to October 2025) at the Hillarys Boat Harbour Weather Station

Figure 2-10 indicates that the summer of 2025/26 was dominated by southerly to south-south-westerly winds, consistent with the prevailing summer wind regime along the Western Australian coastline. A secondary component of easterly winds was also observed. Compared with summer 2024/25, the overall wind direction distribution was very similar, with southerly winds remaining the dominant feature. Wind speeds during summer 2025/26 were generally comparable to those recorded in summer 2024/25; however, no wind speeds exceeding 40 km/h were recorded in 2025/26, representing a slight reduction in the occurrence of stronger wind events relative to the previous summer.

Winter 2025 was characterised by a predominance of east-north-easterly to north-easterly winds, with southerly winds forming a secondary directional component. Compared with winter 2024, winter 2025 exhibited a greater frequency of southerly winds, whereas winter 2024 showed a stronger easterly influence. Both winters were also characterised by occasional strong westerly to south-westerly wind events associated with the passage of frontal systems. The distribution of wind speeds during winter 2025 was broadly comparable to winter 2024, with both periods recording similar frequencies of moderate to strong wind events.

2.2.3 During Monitoring

Manual imagery and aerial surveys for this monitoring period were undertaken between 16 April 2026 and 22 April 2026. The water levels during these monitoring periods are presented below in Figure 2-11.

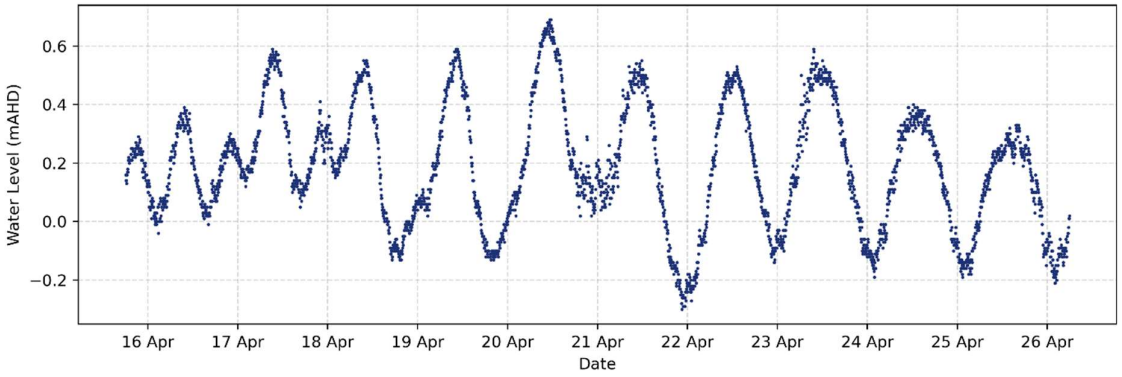


Figure 2-11 Recorded water level during April 2026 monitoring activities.

It is important to note when assessing manual imagery that most images were captured at a water level between 0.3 and 0.55 mAHD.

3 Storm Damage

As outlined above in Section 2 the 2025 winter period was relatively calm with only three notable storm events experienced within the study period. With the maximum offshore wave height for the year recorded as 7.48m, the storm damage along the City's coastline was minimal.

4 Manual Imagery

There are a total of 51 manual imagery beach monitoring sites located in key vulnerable coastal areas along the CoW coastline. The positions of these sites are presented in Figure 4-1 to Figure 4-6. Images are taken 6 monthly in April and October each year to assess seasonal and long-term changes to beach morphology. The April 2026 images are taken by JB Pacific's Coastal Engineer and are taken at the same location and with same field of view as previous years. A detailed description of the methodology for obtaining manual images is outlined in the Coastal Monitoring Inspection Manual.

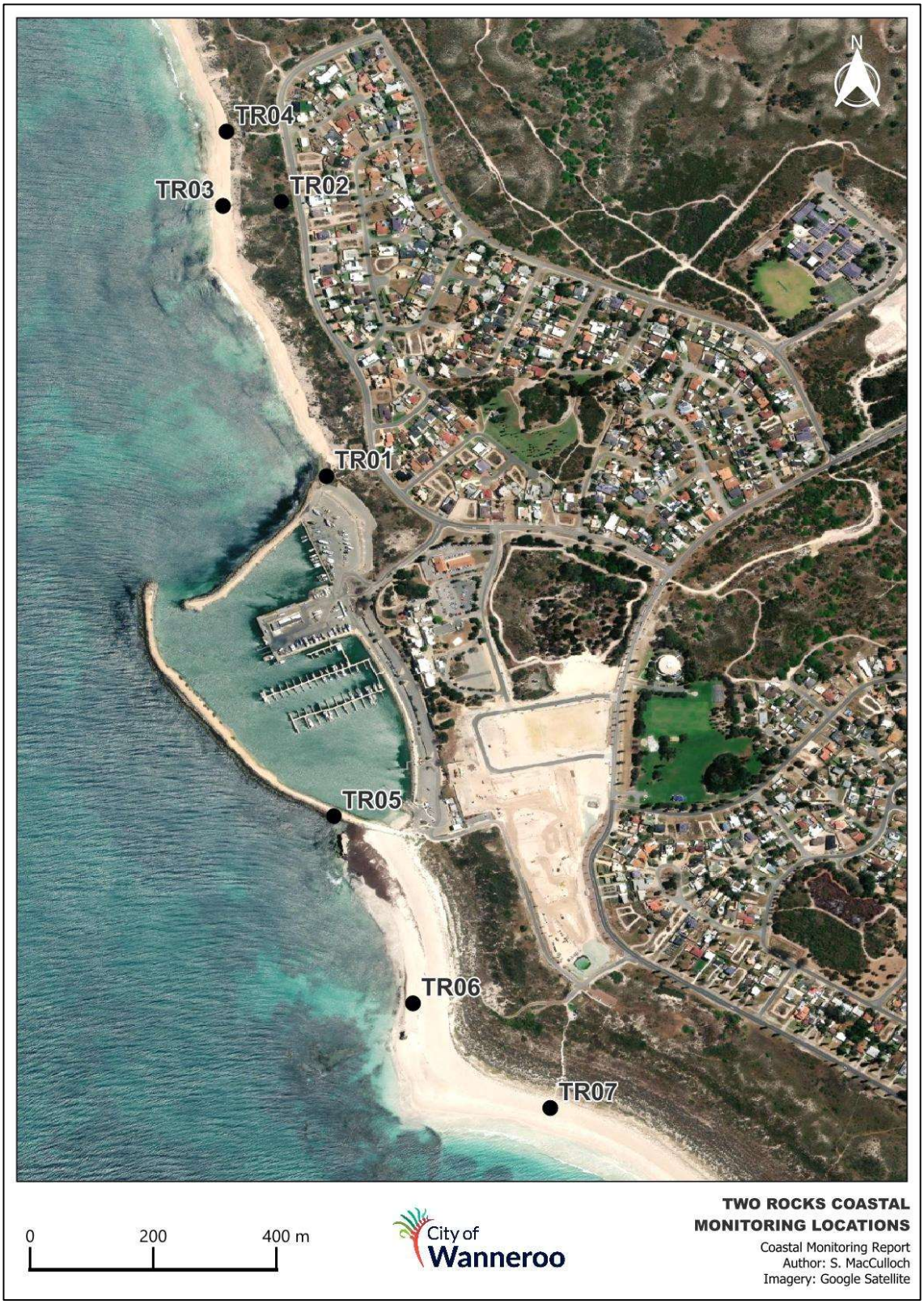


Figure 4-1 Two Rocks Coastal Monitoring Locations

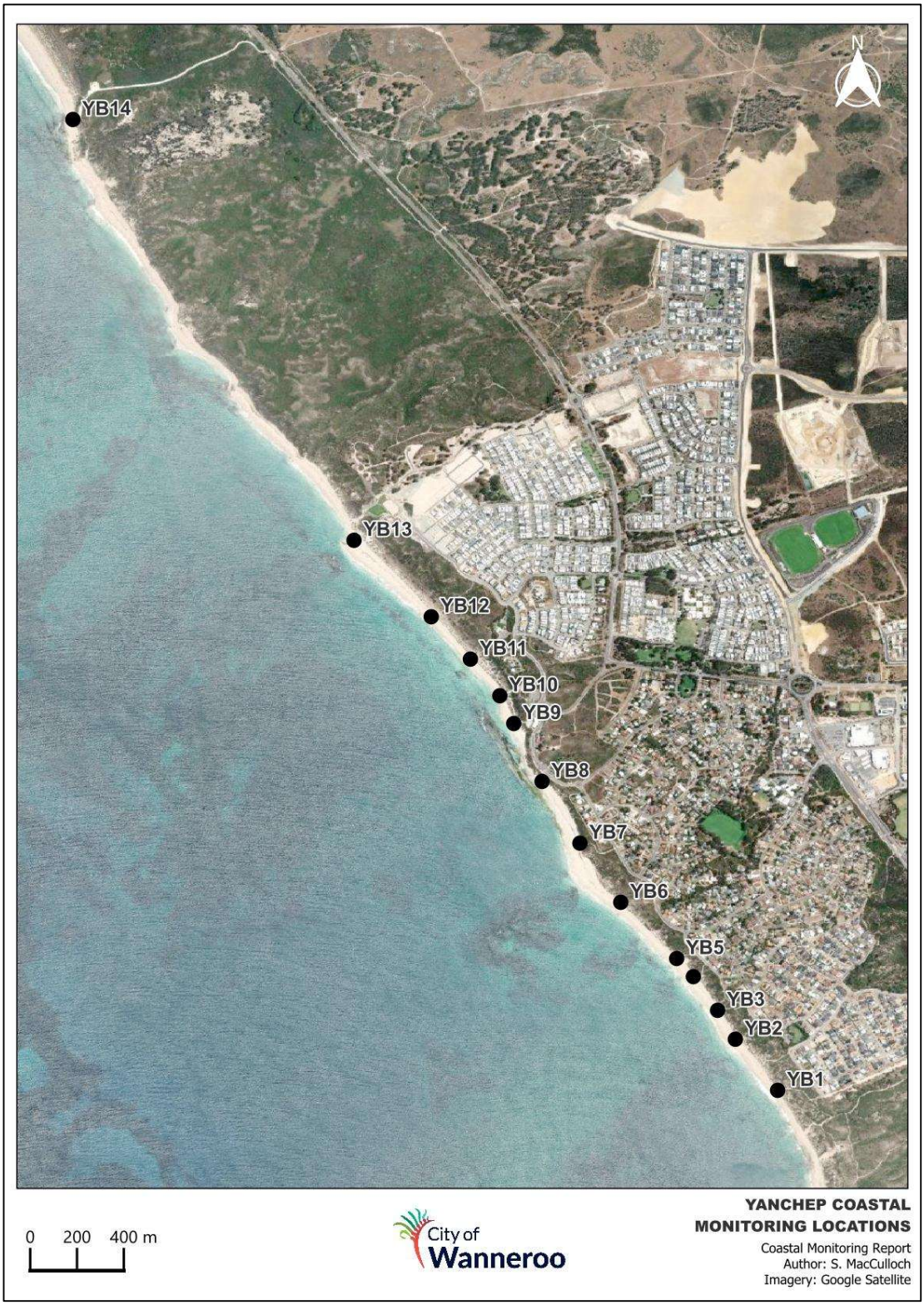


Figure 4-2 Yanchep Coastal Monitoring Locations

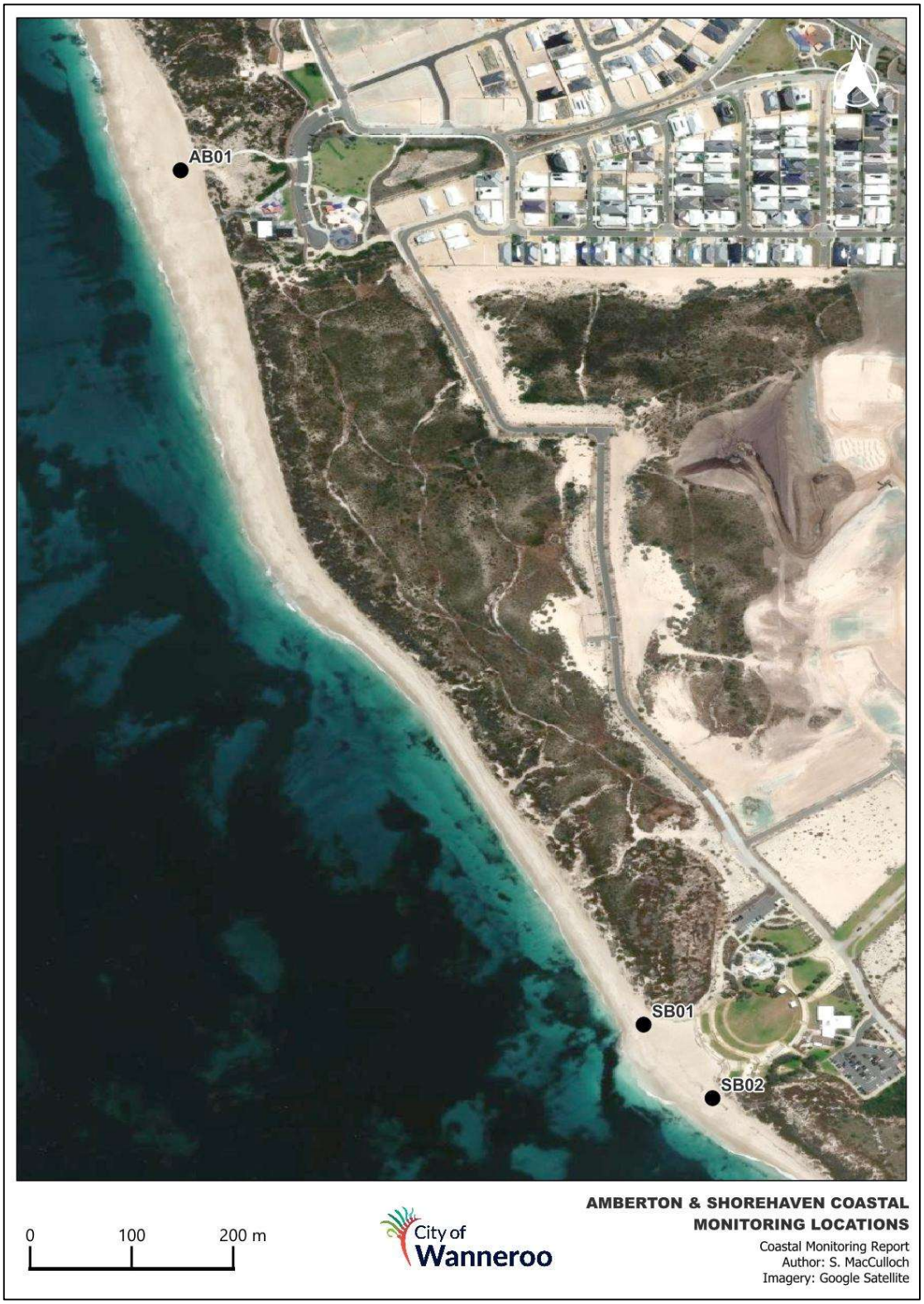


Figure 4-3 Amberton and Shorehaven Coastal Monitoring Locations

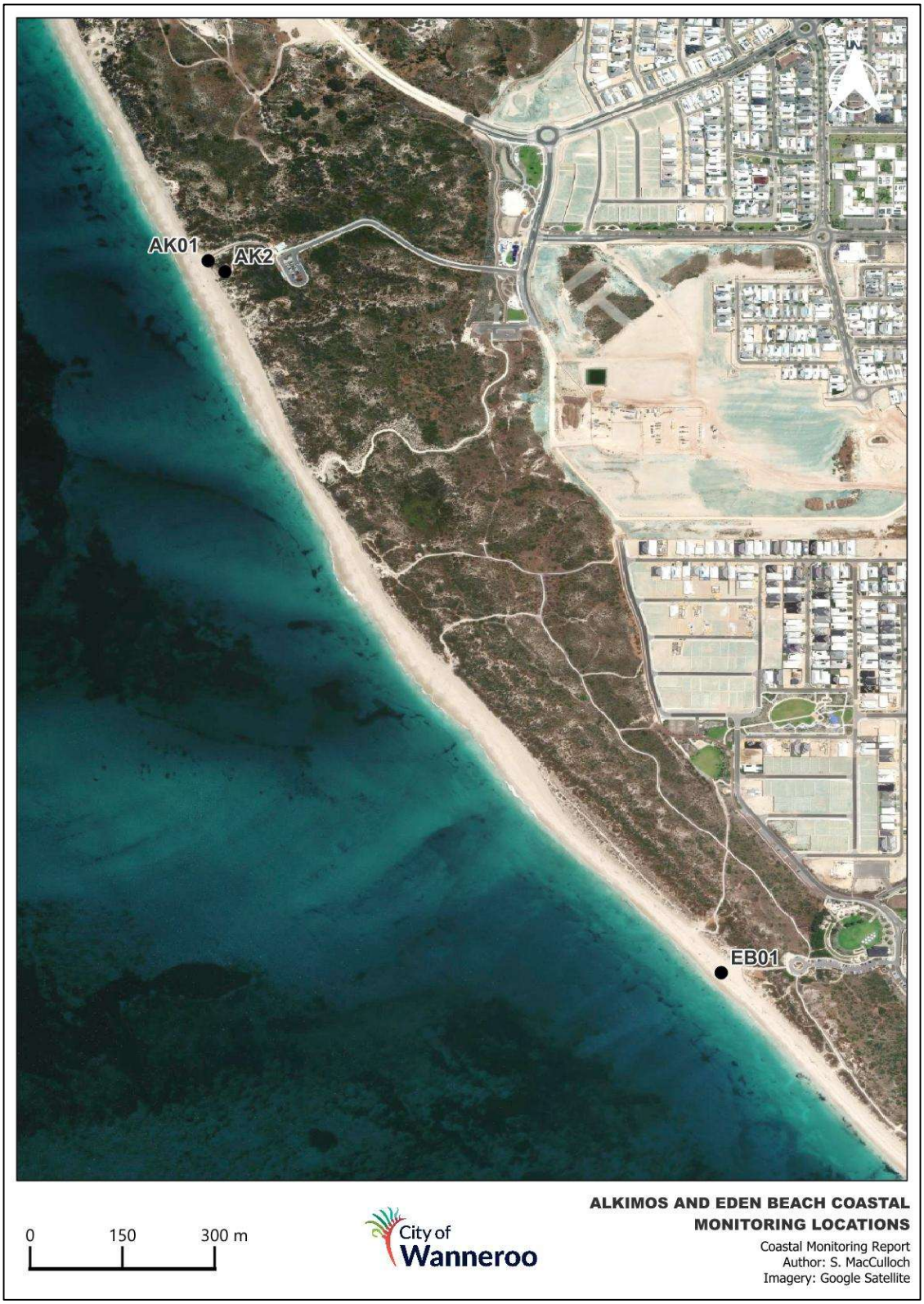


Figure 4-4 Alkimos and Eden Beach Coastal Monitoring Locations

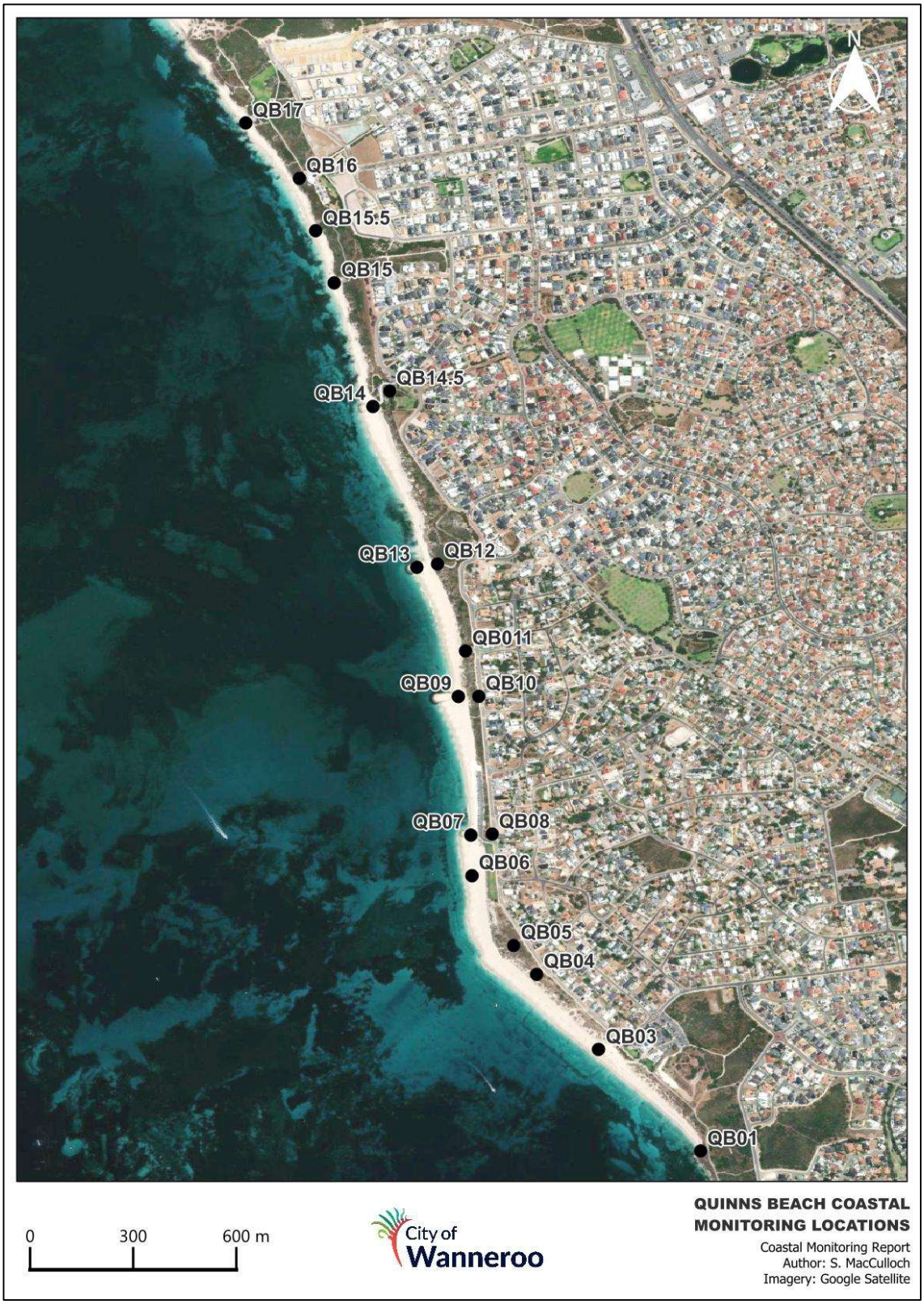


Figure 4-5 Quinns Beach Coastal Monitoring Locations

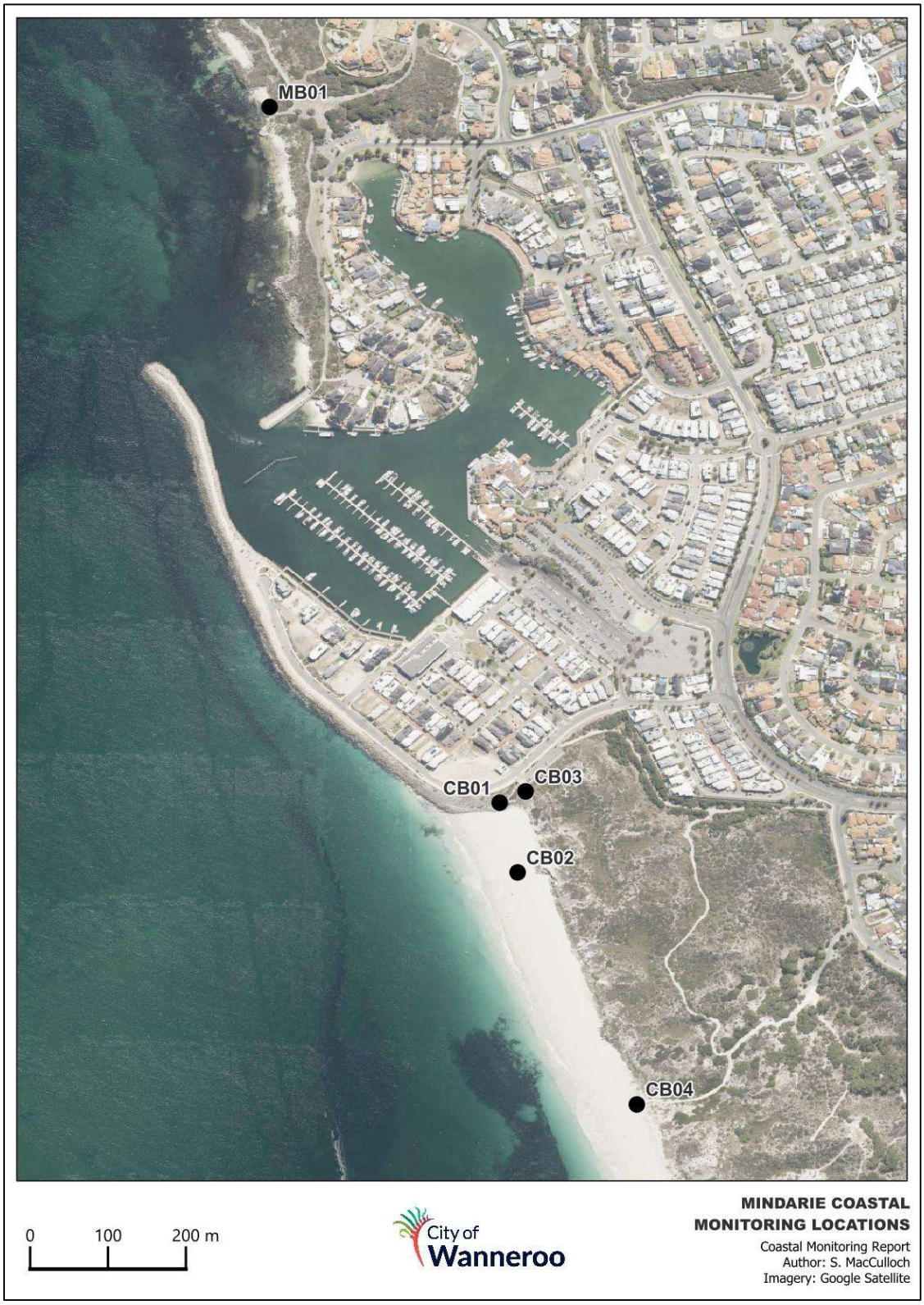


Figure 4-6 Mindarie Coastal Monitoring Locations

4.1 Assessment Methodology

Manual imagery is assessed via visual comparison. Images, once taken, are filed individually for each monitoring site allowing for an effective analysis of long-term and seasonal beach changes.

Seasonal changes are assessed by comparing the images taken in April (current year) with October (previous year) and October (previous year) with April (previous year). Annual changes are assessed by comparing current images with images from 12 months earlier. Long-term changes are assessed by comparing current images with the earliest images taken at the same time of year for each monitoring location.

Comments are made on the severity of beach changes observed at each monitoring site following the visual assessment. The severity of beach change is based upon the definitions as defined in Table 4-1.

Table 4-1 Severity of Beach Change Definitions

Accretion	• Increase in beach width; • Notable sand build up; or • Improvement in dune condition.
No change	• No identifiable change in beach width, slope or dune condition.
Minor Erosion	• Slight or minor decrease in beach width; • Slight or nil impact to dune condition; and • Remaining beach is sufficient to protect the dunes or infrastructure that lie landward of the beach.
Major Erosion	• Major decrease in beach width; • Some impact to dune condition; and • Remaining beach is not sufficient to protect dunes or infrastructure landward of the beach in the event of erosion.

4.2 Results

The severity of beach change and comments are presented in Table 4-2, to Table 4-9.

Table 4-2 Visual observations of beach changes at manual imagery monitoring sites in Two Rocks

Photo Monitoring Site	Summer Seasonal Changes (October 2025 to April 2026)		Winter Seasonal Changes (April 2025 to October 2025)		Long-term Changes (March 2015 to April 2026)		Long-term Changes (October 2014 to October 2025)	
	Severity of Beach Change	Beach Change Comments	Severity of Beach Change	Beach Change Comments	Severity of Beach Change	Beach Change Comments	Severity of Beach Change	Beach Change Comments
Two Rocks								
B01	Minor erosion	Slight decrease in beach width with exposed bed rock at certain locations	Accretion	Improvement in beach gradient and volume. Notable increase in beach width.	Minor erosion	Slight reduction in beach width and visible bedrock suggests minor reduction in beach volume	Minor erosion	Minor erosion scarp at the base of the dune.
B02 UP-COAST	Minor erosion	Slight reduction in beach width.	Minor erosion	Visible bedrock suggests minor reduction in beach volume	Minor erosion	Slight reduction in beach width.	Minor erosion	Bedrock visible in 2025 suggests a reduction in beach volume however beach width and dune condition appear largely unchanged.
B03 UP-COAST	Minor erosion	Slight decrease in beach width and erosion scarp at shoreline. No observable impact to dune condition.	Accretion	Slight increase in beach width	Minor erosion	Slight decrease in beach width and erosion scarp at shoreline. However, dune condition appears to have improved	Minor erosion	Minor erosion at the base of the dunes.
B03 DOWN-COAST	Minor erosion	Noticeable decrease in beach width and erosion scarp at shoreline. No observable change to the dune condition.	Minor erosion	Visible bedrock suggests minor reduction in beach volume	Minor erosion	Slight decrease in beach width and erosion scarp at shoreline. No observable impact to dune condition.	Minor erosion	Visible bedrock suggests minor reduction in beach volume
B04 UP-COAST_a	Minor erosion	Noticeable decrease in beach width. No observable impact to dune condition.	Accretion	Notable increase in beach width	No change	Location of monitoring has changed due to the relocation of the beach access staircase however beach condition appears unchanged and the dune condition appears to have improved.	No change	Location of monitoring has changed due to the relocation of the beach access staircase however beach condition appears unchanged and the dune condition appears to have improved
B04 UP-COAST_b	Minor erosion	Noticeable decrease in beach width and erosion scarp at shoreline. No observable impact to dune condition.	Accretion	Notable increase in beach width despite visible bedrock suggests minor reduction in beach volume	No change	Location of monitoring has changed due to the relocation of the beach access staircase however beach condition appears unchanged and the dune condition appears to have improved.	No change	Location of monitoring has changed due to the relocation of the beach access staircase however beach condition appears unchanged, and the dune condition appears to have improved.
B04 DOWN-COAST_b	Minor erosion	Noticeable decrease in beach width and erosion scarp at shoreline suggest reduction in beach volume.	Accretion	Notable increase in beach width and build-up of sand on beach	No change	Location of monitoring has changed due to the relocation of the beach access staircase however beach condition appears unchanged, and the dune condition appears to have improved.	No change	Location of monitoring has changed due to the relocation of the beach access staircase however beach condition appears unchanged, and the dune condition appears to have improved.
B05	Minor erosion	Slight decrease in beach width.	Major erosion	Significant reduction in beach width	Minor erosion*	Noticeable decrease in beach width.	Accretion*	Major increase in beach width.
B06 UP-COAST	Accretion	Increase in beach width.	Major erosion	Significant reduction in beach width	Minor erosion**	Minor decrease in beach width.	Minor erosion**	Minor decrease in beach width.
B06 DOWN-COAST	Minor erosion	Slight decrease in beach width.	Minor erosion	Notable reduction in beach width	Minor erosion**	Notable decrease in beach width.	Minor erosion**	Minor decrease in beach heigth.
B07 UP-COAST	Minor erosion	Slight decrease in beach width.	Minor erosion	Slight reduction in beach width, however, dune is in good condition with grown vegetation	Minor erosion*	Slight reduction in beach width; however, dune is in good condition with grown vegetation	Accretion*	Slight increase in beach width and improvement in dune condition with build up at the base of dune
B07 DOWN-COAST	Minor erosion	Slight decrease in beach width.	Minor erosion	Notable reduction in beach width, however, dune is in good condition with grown vegetation	Minor erosion*	Slight reduction in beach width.	No change *	Beach condition appears unchanged but improvement in dune condition with build up at the base of dune

**Long-term changes have been assessed through images taken in October 2019 and March 2020.*
**Long-term changes have been assessed through images taken in September /October 2021 and April 2021.*

Table 4-3 Visual observations of beach changes at manual imagery monitoring sites in Yanchep

Photo Monitoring Site	Summer Seasonal Changes (October 2025 to April 2026)		Winter Seasonal Changes (April 2025 to October 2025)		Mid-term Changes (April 2019 to April 2026)		Mid-term Changes (October 2018 to October 2025)	
	Severity of Beach Change	Beach Change Comments	Severity of Beach Change	Beach Change Comments	Severity of Beach Change	Beach Change Comments	Severity of Beach Change	Beach Change Comments
Yanchep								
B01 UP-COAST	Minor erosion	Slight decrease in beach width but base of the dunes is in good condition.	Accretion	Notable increase in beach width and build up in beach volume. Dune is in good condition	Minor erosion	Slight decrease in beach width but no observable impacts on dune condition.	Minor erosion	Minor erosion at the base of dune.
B01 DOWN-COAST	Minor erosion	Slight decrease in beach width.	Accretion	Notable increase in beach width and build up in beach volume. Dune is in good condition	Minor erosion	Slight decrease in beach width and erosion scarp at toe of dune.	Accretion	Improvement in dune condition with grown vegetation.
B02 UP-COAST	Minor erosion	Slight reduction in beach width.	Accretion	Notable increase in beach width and build up in beach volume. Dune is in good condition	Minor erosion	Slight reduction in beach width.	No change	Beach condition appears unchanged but improvement in dune condition with build up at the base of dune.
B02 DOWN-COAST	Minor erosion	Slight reduction in beach width.	Accretion	Notable increase in beach width and build up in beach volume. Dune is in good condition	Accretion	Slight improvement in beach and dune condition.	Minor erosion	Loss of dune vegetation at the base of the dunes.
B03 UP-COAST	Minor erosion	Slight reduction in beach width and increase in beach gradient.	Accretion	Minor accretion in beach width and erosion scarp at dune	No change	No notable change in beach width or dune condition.	Minor erosion	Notable reduction in beach width and erosion scarp at dune.
B03 DOWN-COAST	Minor erosion	Slight reduction in beach width and increase in beach gradient.	Minor erosion	Slight reduction in beach width. Dune remains in good condition	Minor erosion	Slight decrease in beach width.	Minor erosion	Slight reduction in beach width
B04 UP-COAST	Minor erosion	Slight reduction in beach width.	No change	No notable change in beach width but slight improvement in beach and dune condition.	No change	No notable change in beach width.	Minor erosion	Loss of dune vegetation at the base of the dunes.
B04 DOWN-COAST	Minor erosion	Slight reduction in beach width.	No change	No notable change in beach width, dune remains in good condition with grown vegetation	Minor erosion	Slight reduction in beach width.	Minor erosion	Slight reduction in beach width
B05 UP-COAST	No change	No notable change in beach width or dune condition.	Minor erosion	Minor reduction in beach width and erosion scarp at dune. Visible bedrock suggests a reduction in beach volume	No change	No notable change in beach width or dune condition.	Minor erosion	Minor reduction in beach width and erosion scarp at the base of dune.
B05 DOWN-COAST	Minor erosion	Slight reduction in beach width.	Accretion	Slight increase in beach width. Improvement in dune condition with grown vegetation.	Minor erosion	Slight reduction in beach width.	Minor erosion	Minor reduction in beach width and loss of vegetation at the base of dune
B06 UP-COAST	Minor erosion	Minor reduction in beach width: however, dune is in still good condition	Accretion	Slight increase in beach width. Improvement in dune condition with grown vegetation.	Minor erosion	Notable loss of foredune.	Minor erosion	Notable loss of foredune.
B06 DOWN-COAST	Minor erosion	Minor reduction in beach width.	Accretion	Notable increase in beach width and build up in beach volume. Dune is in good condition	Minor erosion	Slight decrease in beach width. Loss of vegetation is evident at the dune toe.	No change	No notable change in beach or dune condition.
B07 UP-COAST	Accretion	Significant increase in beach width. The cliff visible in October 2025 is no more visible, which suggests a massive increase in beach volume and height.	Accretion	Notable increase in beach width and build up in beach volume. Dune is in good condition	Accretion	Significant increase in beach width. The top of the cliff visible in April 2019 is no more visible, which suggests an increase in beach volume and height. However, slight decrease in beach width noted.	Accretion	Slight increase in beach height and volume
B07 DOWN-COAST	Accretion	Significant increase in beach width. The cliff visible in October 2025 is no more visible, which suggests a	Major erosion	Significant reduction in beach width. A visible bedrock suggests massive reduction in beach volume and height	Accretion	Slight increase in beach volume and height.	Accretion	Slight increase in beach height and volume

Photo Monitoring Site	Summer Seasonal Changes (October 2025 to April 2026)		Winter Seasonal Changes (April 2025 to October 2025)		Mid-term Changes (April 2019 to April 2026)		Mid-term Changes (October 2018 to October 2025)	
	Severity of Beach Change	Beach Change Comments	Severity of Beach Change	Beach Change Comments	Severity of Beach Change	Beach Change Comments	Severity of Beach Change	Beach Change Comments
Yanchep								
		massive increase in beach volume and height.						
B08 UP-COAST	Accretion	Significant increase in beach width. Only the top of the bedrock visible in October 2025 is now visible, which suggests an increase in beach volume and height.	Major erosion	Significant reduction in beach width. A visible bedrock suggests massive reduction in beach volume and height	Minor erosion	Slight decrease in beach width and visible bedrock in April 2026 suggest reduction in beach height.	Accretion	Slight increase in beach height
B08 DOWN-COAST	Minor erosion	Minor erosion	Major erosion	Significant reduction in beach width and volume.	Minor erosion	Slight decrease in beach width; but there is improved condition at toe of dune	Accretion	Slight increase in beach height
B09 UP-COAST	Minor erosion	Slight decrease in beach width and erosion scarp at toe of dune.	Accretion	Slight increase in beach width	Minor erosion	Slight decrease in beach width and erosion scarp at toe of dune. Nourishment has been undertaken at this site on numerous occasions between 2018 and 2023.	No change	No notable change in beach width or dune condition. Improvement in beach gradient. Nourishment has been undertaken at this site on numerous occasions between 2018 and 2023.
B09 DOWN-COAST	Accretion	Improvement in beach gradient and slight increase in beach width at the headland.	Minor erosion	Notable reduction in beach width	Accretion	Improvement in beach gradient and increase in beach width at the headland. Nourishment has been undertaken at this site on numerous occasions between 2018 and 2023.	No change	No notable change in beach width or dune condition. Improvement in beach gradient. Nourishment has been undertaken at this site on numerous occasions between 2018 and 2023.
B10 UP-COAST	Minor erosion	Noticeable decrease in beach width and erosion scarp at the toe of dune.	Accretion	Notable increase in beach width and improvement in beach gradient.	Minor erosion	Slight decrease in beach width and erosion scarp at the toe of dune.	No change	No notable change in beach width or dune condition.
B10 DOWN-COAST	Minor erosion	Noticeable decrease in beach width and erosion scarp at the toe of dune.	Accretion	Notable increase in beach width and improvement in beach gradient.	Minor erosion	Slight decrease in beach width and erosion scarp at the toe of dune.	No change	No notable change in beach width or dune condition.
B11 UP-COAST	Minor erosion	Slight decrease in beach width and minor erosion scarp at toe of dune	Accretion	Notable increase in beach width and improvement in dune condition.	No change	No notable change in beach width or dune condition.	No change	No notable change in beach width or dune condition.
B11 DOWN-COAST	Minor erosion	Noticeable decrease in beach width and erosion scarp at the toe of dune.	Accretion	Notable increase in beach width and improvement in dune condition.	Minor erosion	Erosion scarp at toe of dune.	Minor erosion	Minor reduction in beach width
B12 UP-COAST	No change	No notable difference in beach or dune condition.	No change	No notable difference in beach or dune condition.	No change	No notable change in beach width or dune condition.	Minor erosion	Minor reduction in beach width; however, dune is in still good condition
B12 DOWN-COAST	Minor erosion	Minor erosion; however, slight increase in beach height at the back of the beach.	No change	No notable difference in beach or dune condition.	Accretion	Slight improvement in beach condition.	Minor erosion	Notable reduction in beach width; however, dune is in still good condition
B13 UP-COAST	Accretion	Slight reduction in beach width	Accretion	Notable increase in beach width	Accretion	Slight increase in beach width.	No change	No notable difference in beach or dune condition.
B13 DOWN-COAST	Accretion	Slight increase in beach width; however, loss of vegetation on dune is visible	Major Erosion	Significant reduction in beach width, dune remains in good condition	Accretion	No notable difference in beach width; however, dune is in good condition with grown vegetation.	Minor erosion	Minor reduction in beach width

Table 4-4 Visual observations of beach changes at manual imagery monitoring sites in Amberton

Photo Monitoring Site	Summer Seasonal Changes (October 2025 to April 2026)		Winter Seasonal Changes (April 2025 to October 2025)		Mid-term Changes (April 2021 to April 2026)		Mid-term Changes (October 2021 to October 2025)	
	Severity of Beach Change	Beach Change Comments	Severity of Beach Change	Beach Change Comments	Severity of Beach Change	Beach Change Comments	Severity of Beach Change	Beach Change Comments
Amberton								
B01 UP-COAST	Accretion	Notable increase in beach width and volume, with bedrock visible in October 2025 now covered by sand.	Major erosion	Significant reduction in beach width, Minor erosion scarp, visible bedrock suggests reduction in beach volume	Minor erosion	Slight reduction in beach width.	Minor erosion	Slight reduction in beach width.
B01 DOWN-COAST	Accretion	Notable increase in beach width with some build up at the base of the dunes.	Major erosion	Significant reduction in beach width.	Minor erosion	Slight reduction in beach width.	Minor erosion	Slight reduction in beach width.

Table 4-5 Visual observations of beach changes at manual imagery monitoring sites in Shorehaven

Photo Monitoring Site	Summer Seasonal Changes (October 2025 to April 2026)		Winter Seasonal Changes (April 2025 to October 2025)		Mid-term Changes (March 2020 to April 2026)		Mid-term Changes (October 2019 to October 2025)	
	Severity of Beach Change	Beach Change Comments	Severity of Beach Change	Beach Change Comments	Severity of Beach Change	Beach Change Comments	Severity of Beach Change	Beach Change Comments
Shorehaven								
B01 UP-COAST	Minor erosion	Slight reduction in beach width.	Accretion	Notable increase in beach width and improvement in dune vegetation.	Minor erosion	Slight reduction in beach width.	Accretion	Slight increase in beach width and improvement in beach condition
B01 DOWN-COAST	Minor erosion	Slight reduction in beach width.	No change	No notable change in beach width or dune condition.	Minor erosion	Slight reduction in beach width.	No change	No notable change in beach width or dune condition.
B02 UP-COAST	No change	No notable change in beach width or dune condition.	No change	No notable change in beach width or dune condition.	Accretion	Slight improvement in beach condition.	No change	No notable change in beach width or dune condition. It is important to note that beach scraping was undertaken, adding a sediment buffer to the dunes in October 2022 not in 2021.
B02 DOWN-COAST	Minor erosion	Slight reduction in beach width.	No change	No notable change in beach width or dune condition.	Minor erosion	Slight reduction in beach width.	Minor erosion	Minor reduction in beach width

Table 4-6 Visual observations of beach changes at manual imagery monitoring sites in Alkimos

Photo Monitoring Site	Summer Seasonal Changes (October 2025 to April 2026)		Winter Seasonal Changes (April 2025 to October 2025)		Long-term Changes		Long-term Changes	
	Severity of Beach Change	Beach Change Comments	Severity of Beach Change	Beach Change Comments	Severity of Beach Change	Beach Change Comments	Severity of Beach Change	Beach Change Comments
Alkimos								
B01 UP-COAST	Accretion	Slight increase in beach width	Minor erosion	Slight reduction in beach width, but dunes are in good condition	*Unable to assess – photo monitoring began in April 2023.*			
B01 DOWN-COAST	Accretion	Slight increase in beach width	Minor erosion	Notable reduction in beach width, but dunes are in good condition				

Table 4-7 Visual observations of beach changes at manual imagery monitoring sites in Eden

Photo Monitoring Site	Summer Seasonal Changes (October 2025 to April 2026)		Winter Seasonal Changes (April 2025 to October 2025)		Mid-term Changes (April 2022 to April 2026)		Mid-term Changes (October 2021 to October 2025)	
	Severity of Beach Change	Beach Change Comments	Severity of Beach Change	Beach Change Comments	Severity of Beach Change	Beach Change Comments	Severity of Beach Change	Beach Change Comments
Eden								
B01 UP-COAST	Minor erosion	Very slight reduction in beach width.	Minor erosion	Significant reduction in beach width.	Minor erosion	Significant reduction in beach width.	Minor erosion	Minor reduction in beach width.
B01 DOWN-COAST	Minor erosion	Very slight reduction in beach width.	Minor erosion	Significant reduction in beach width.	Minor erosion	Minor reduction in beach width.	Minor erosion	Significant reduction in beach width.

Table 4-8 Visual observations of beach changes at manual imagery monitoring sites in Quinns Rocks

Photo Monitoring Site	Summer Seasonal Changes (October 2025 to April 2026)		Winter Seasonal Changes (April 2025 to October 2025)		Long-term Changes (April 2014 to April 2026)		Long-term Changes (September 2014 to October 2025)	
	Severity of Beach Change	Beach Change Comments	Severity of Beach Change	Beach Change Comments	Severity of Beach Change	Beach Change Comments	Severity of Beach Change	Beach Change Comments
Quinns Beach								
B01	Major erosion	Significant reduction in beach width and volume, with notable erosion scarp near dune.	Accretion	Notable increase in beach width and improvement in dune condition with increased vegetation density.	Minor erosion	Slight reduction in beach width and erosion scarp near dune.	No change	No discernible change in beach width. Dunes remain in similar condition.
B03 UP-COAST	Minor erosion	Slight reduction in beach width	No change	No discernible change in beach width. Dunes remain in similar condition.	Minor erosion	Minor reduction in beach width.	No change	No discernible change in beach condition, dunes remain in good condition.
B03 DOWN-COAST	Minor erosion	Noticeable reduction in beach width.	No change	No discernible change in beach width. Dunes remain in similar condition.	Minor erosion	Slight reduction in beach width.	No change	No discernible change in beach condition, dunes remain in good condition.
B04 UP-COAST	Accretion	Slight increase in beach width.	Minor erosion	Minor reduction in beach height. Dunes remain in similar condition.	No change	No discernible change in beach condition, dunes remain in similar condition.	Minor erosion	Slight reduction in beach width and height. Minor erosion at the dune toe.
B04 DOWN-COAST	Accretion	Slight increase in beach width.	Accretion	Minor accretion in beach width. Dunes remain in similar condition.	Accretion	Slight increase in beach width	Accretion	Slight increase in beach width.
B06 UP-COAST	Accretion	Slight increase in beach width and height.	Minor erosion	Notable reduction in beach width; however, increase in beach height near sandbags. The reduction in beach volume near the groyne is also noted.	Accretion	Slightly wider beach is evident in 2024 however the GSC Revetment was under construction in 2014 which makes visual assessment difficult.	Accretion	Increase in beach width and height in 2025 compared to last year; however, the GSC Revetment was under construction in 2014 which makes visual assessment difficult.
B06 DOWN-COAST	Accretion	Slight increase in beach width.	Minor erosion	Notable reduction in beach width.	Accretion	Slightly wider beach is evident in 2024 however the GSC Revetment was under construction in 2014 which makes visual assessment difficult.	Accretion	Slight increase in beach height in 2025 compared to last year; however, the GSC Revetment was under construction in 2014 which makes visual assessment difficult.
B07 UP-COAST	Minor erosion	Slight reduction in beach gradient as visible bedrocks at the back of the beach; however notably wide beach width.	Accretion	Slight increase in gradient. Notable build-up of sand towards the car park. Sand nourishment was undertaken in May 2025 following manual imagery.	Accretion	Slight improvement in beach condition. It is important to note that ~75,000 m^3 of nourishment has been undertaken at this site since 2013.	Accretion	Significant improvement in beach condition and gradient. It is important to note that ~75,000 m3 of nourishment has been undertaken at this site since 2013.

Photo Monitoring Site	Summer Seasonal Changes (October 2025 to April 2026)		Winter Seasonal Changes (April 2025 to October 2025)		Long-term Changes (April 2014 to April 2026)		Long-term Changes (September 2014 to October 2025)	
	Severity of Beach Change	Beach Change Comments	Severity of Beach Change	Beach Change Comments	Severity of Beach Change	Beach Change Comments	Severity of Beach Change	Beach Change Comments
Quinns Beach								
B07 DOWN-COAST	Accretion	Noticeable increase in beach width and height.	Minor erosion	Notable reduction in beach width; however, notable build-up of sand near sandbags.	Accretion	Slightly wider beach is evident in 2024 however the GSC Revetment was under construction in 2014 which makes visual assessment difficult.	Accretion	Slight improvement in beach condition and major improvement compared to last year, however the GSC Revetment was under construction in 2014 which makes visual assessment difficult.
B09 UP-COAST	Minor erosion	Slight reduction in beach width and erosion scarp at toe of dune.	Minor erosion	Extremely minor reduction beach width and slight erosion scarp at dunes. Dune vegetation remains in good condition.	Minor erosion	Slight reduction in beach width; however, dune remains in good condition.	Minor erosion	Minor reduction in beach width
B09 DOWN-COAST	Accretion	Slight increase in beach width	Minor erosion	Notable reduction in beach width and slight erosion scarp at dunes; however, dunes vegetation remains in good condition	Minor erosion	Extremely minor reduction in beach width; however, dunes vegetation remains in good condition	Accretion	Slight increase in beach width and improvement in dune condition with build-up of sand at base of dune
B11 UP-COAST	No change	No discernible change to beach width or dune condition.	No change	No discernible change to beach width. Dunes remain in good condition.	No change	No discernible change in beach condition, dunes remain in similar condition.	No change	No discernible change to beach width or dune condition.
B11 DOWN-COAST	No change	No discernible change to beach width or dune condition.	No change	No discernible change to beach width or dune condition.	No change	No discernible change in beach condition, dunes remain in similar condition.	No change	No discernible change to beach width or dune condition.
B13 UP-COAST	Minor erosion	Slight reduction in beach width and noticeable reduction in beach volume with visible bedrock. The erosion scarp is also visible at toes of dune.	Accretion	Notable increase in beach width and height. Not visible bedrocks compared to April 2025 suggests increase in beach volume. Sand nourishment was undertaken in May 2025 following manual imagery.	Minor erosion	Slight reduction in beach width and noticeable reduction in beach volume with visible bedrock. The erosion scarp is also visible at toes of dune. It is important to note that ~25,000m^3 of nourishment has been undertaken at this site since 2016, including nourishment that was undertaken in April 2023.	Accretion	Notable improvement in dune condition with increased density of dune vegetation. It is important to note that ~34,000m^3 of nourishment has been undertaken at this site since 2016.
B13 DOWN-COAST	No Change	No discernible change in beach condition. Dunes remain in good condition.	No change	No discernible change in beach condition. Dunes remain in good condition.	Minor erosion	Noticeable reduction in beach width	Minor erosion	Minor reduction in beach width; however, improvement in dune condition with grown vegetation.
B14 UP-COAST	Minor erosion	Slight reduction in beach width.	Accretion	Notable increase in beach width and less visible bedrocks compared to April 2025 suggests increase in beach volume. Sand nourishment was undertaken in May 2025 following manual imagery.	Minor erosion	Notable reduction in beach width.	Accretion	Slight increase in beach width. It is important to note that ~18,000m^3 of nourishment has been undertaken at this site since 2018.
B14 DOWN-COAST	Minor erosion	Slight reduction in beach width	Minor erosion	Notable reduction in beach width and visible bedrocks suggests reduction in beach volume	Minor erosion	Slight reduction in beach width. It is important to note that beach scraping was undertaken, adding a sediment buffer to the dunes in December 2023.	Minor erosion	Notable reduction in beach width and visible bedrocks suggests reduction in beach volume; however, it is important to note that beach scraping was undertaken, adding a sediment buffer to the dunes in December 2023.
B15 UP-COAST	Minor erosion	Notable reduction in beach height. The bedrock is more visible than October 2025.	Minor erosion	Notable reduction in beach height towards base of the dune. Less visible bedrocks compared to April 2025 near the sea suggests increase in beach volume towards the sea.	Minor erosion *	Notable reduction in beach height. The bedrock is more visible than June 2014.	Minor erosion	Minor reduction in beach width.
B15 DOWN-COAST	Minor erosion	Notable reduction in beach width and height.	Accretion	Increase in beach width. Dunes remain in similar condition.	Minor erosion *	Notable reduction in beach width and height.	Minor erosion	Minor reduction in beach width.
B16 UP-COAST	Accretion	No discernible change in beach width. However, slight increase	Major erosion	Notable reduction in beach width. Visible bedrocks suggest notable reduction in beach volume	No Change*	No discernible change in beach condition.	Accretion	Slight increase in beach width and beach volume

Photo Monitoring Site	Summer Seasonal Changes (October 2025 to April 2026)		Winter Seasonal Changes (April 2025 to October 2025)		Long-term Changes (April 2014 to April 2026)		Long-term Changes (September 2014 to October 2025)	
	Severity of Beach Change	Beach Change Comments	Severity of Beach Change	Beach Change Comments	Severity of Beach Change	Beach Change Comments	Severity of Beach Change	Beach Change Comments
Quinns Beach								
		in beach height. Dunes remain in good condition.						
B16 DOWN-COAST	Minor erosion	Slight reduction in beach width and height. Dunes remain in good condition.	Minor erosion	Notable reduction in beach width. Visible bedrocks suggest reduction in beach height.	Minor erosion*	Slight reduction in beach width.	Accretion	Slight increase in beach width and beach volume
B17 UP-COAST	Accretion	Slight increase in beach width. Visible bedrocks in October 2025 are not visible anymore, which suggest increase in beach height. Dunes remain in similar condition.	Major erosion	Minor reduction in beach width. Visible bedrocks suggest notable reduction in beach volume.	Minor erosion	Slight reduction in beach width and noticeable reduction in beach volume with visible bedrock	Minor erosion	Minor reduction in beach width. However, there is an improvement in the dune condition
B17 DOWN-COAST	Accretion	Slight increase in beach width. Visible bedrocks in October 2025 are not visible anymore, which suggest increase in beach height. However, there is visible erosion scarp at the toe of dune shows minor erosion.	Major erosion	Notable reduction in beach width. Visible bedrocks suggest notable reduction in beach volume.	Minor erosion	Slight reduction in beach width and beach volume. The erosion scarp visible near shoreline	Minor erosion	Minor reduction in beach width.

**Long-term changes have been assessed through images taken in 2015.*
***Long-term changes have been assessed through images taken in 2014.*

Table 4-9 Visual observations of beach changes at manual imagery monitoring sites in Mindarie

Photo Monitoring Site	Summer Seasonal Changes (October 2025 to April 2026)		Winter Seasonal Changes (April 2025 to October 2025)		Long-term Changes (March 2020 to April 2026)		Long-term Changes (October 2018 to October 2025)	
	Severity of Beach Change	Beach Change Comments	Severity of Beach Change	Beach Change Comments	Severity of Beach Change	Beach Change Comments	Severity of Beach Change	Beach Change Comments
Mindarie								
B01	Accretion	Significant increase in beach width and height.	Major erosion	Significant decrease in beach width, and bedrock visible suggests the reduction in beach volume	Minor erosion	Notable reduction in beach width.	Accretion	Significant increase in beach width and height.
B02 UP-COAST	Accretion	Significant increase in beach width and height.	Major erosion	Significant decrease in beach width with dunes remaining in good condition. Remaining beach is sufficient to protect dunes and infrastructure	Minor erosion	Significant decrease in beach height.	Accretion	Increase in beach width. Visible bedrocks in October 2018 are not visible anymore, which suggest increase in beach height.
B02 DOWN-COAST	Accretion	Significant increase in beach width and height.	Major erosion	Significant decrease in beach width and possible bedrock visible suggests the reduction in beach volume.	Minor erosion	Notable reduction in beach width.	No change	No discernible change in beach condition. Dunes remain in good condition, slightly improved in gradient.
B03	Accretion	Significant increase in beach width and height.	Major erosion	Significant decrease in beach width and possible bedrock visible suggests the reduction in beach volume	Minor erosion	Slight reduction in beach width.	Accretion	Increase in beach width. Visible bedrocks in October 2018 are not visible anymore, which suggest increase in beach height.
B04	Minor erosion	Slight decrease in beach height.	Minor erosion	No notable changes in beach width. More exposed bedrock visible suggests the reduction in beach volume.	Minor erosion *	Visible bedrocks suggest reduction in beach volume; however, significant improvement in dune conditions.	Minor erosion **	Visible bedrocks suggest reduction in beach volume

**Long-term changes have been assessed through images taken in 2022.*
***Long-term changes have been assessed through images taken in 2021.*

4.2.1 Areas Experiencing Major Seasonal Erosion

While assessing seasonal changes, four areas were identified as having experienced major erosion over the summer months (October 2025 to April 2026). Images of the identified areas experiencing major seasonal erosion are shown below.



Yanchep B03 Down-Coast – October 2025	Yanchep B03 Down-Coast – April 2026

Figure 4-7 Seasonal erosion between October 2025 and April 2026 at Yanchep B03 Down-Coast.

The beach captured in the photographs taken Down-Coast at the Yanchep monitoring location B03. The seasonal erosion during summer months resulted in the reduction in the beach width and steeper beach profile showing the loss of sediment along the shoreline.



Two Rocks B03 Down-Coast – October 2025	Two Rocks B03 Down-Coast – April 2026

Figure 4-8 Seasonal erosion between October 2025 and April 2026 at Two Rocks B03 Down-Coast.

The beach captured in the photographs taken Down-Coast at the Two Rocks monitoring location B03 shows evidence of significant seasonal erosion. Northward sediment transport during the summer months has resulted in a noticeable reduction in beach width and overall beach volume. An erosion scarp near shoreline reflects the loss of sediment from the beach. Despite these erosion impacts, the dune remains in good condition.



Two Rocks B04b Up-Coast – October 2025



Two Rocks B04b Up-Coast – April 2026



Two Rocks B04b Down-Coast – October 2025



Two Rocks B04b Down-Coast – April 2026

Figure 4-9 Seasonal erosion between October 2025 and April 2026 at Two Rocks B04b.

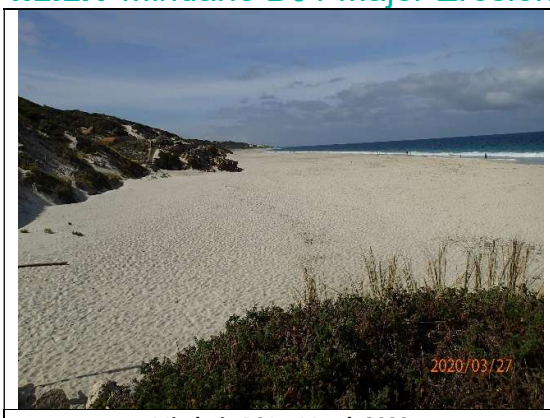
The beach captured in the photographs taken Up-Coast and Down-Coast at the Two Rocks monitoring location B04b shows evident of significant erosion resulting from northward sediment movement. This process has reduced both the width and elevation of the beach, indicating a loss of sediment from the shoreline. An erosion scarp is clearly evident from the photographs.

4.2.2 Areas Experiencing Major Long-Term Change

Mid-term and long-term trends of erosion and accretion were assessed by analysing photographs taken during the same time period, five years apart. Most long-term trends assessed were of minor erosion or accretion at the site. There were no manual imagery sites identified as having experienced major long-term erosion. It can be difficult to identify long-term erosion and accretion from visual assessment of manual imagery alone and, it is therefore recommended that long-term morphological changes be assessed and identified through the analysis of various data sources.

From the manual imagery it is evident that Mindarie sites B01 and B02 has seen a reduction in beach widths in the mid-term, whereas major accretion was observed at Yanchep site B13 over the same time period.

4.2.2.1 Mindarie B01 Major Erosion – Mid-Term Erosion



Mindarie B01 – March 2020



Mindarie B01 – April 2026

Figure 4-10 Mid-term erosion between 2020 and 2026 at Mindarie B01.



Mindarie B02 Down-Coast – March 2020



Mindarie B02 Down-Coast – April 2026

Figure 4-11 Mid-term erosion between 2020 and 2026 at Mindarie B02 Down-Coast

The Mid-term assessment at Mindarie monitoring sites B01 and B02 Down-Coast show significant erosion. Both sites exhibit a noticeable reduction in beach width compared to April 2020.

4.2.2.2 Yanchep B13 Down-Coast – Mid-Term Accretion



Yanchep B13 Down-Coast - April 2019



Yanchep B13 Down-Coast – April 2026

Figure 4-12 Mid-term accretion between 2019 and 2026 at Yanchep B13 Down-Coast.

Yanchep site B13 Down-Coast show major long-term accretion with notable increase in beach width. Significant erosion occurred in this location in 2018 which prompted the inclusion of Yanchep in the coastal monitoring program. Long term and seasonal change in Yanchep are currently being investigated as part of the Yanchep Coastal Management Study.

5 LIDAR and Ground Based Transect Surveys

Both LiDAR aerial surveys and nearshore ground based transect surveys are undertaken by MNG Surveyors including all post processing and analysis. LiDAR surveys are completed along the entire CoW coastal corridor and detailed analysis is undertaken for the following areas:

- Two Rocks Beach;
- Yanchep Beach;
- Quinns Rocks Beach; and
- Claytons Beach, Mindarie.

LiDAR Aerial Surveys can only capture areas above the waterline and when the shoreline has receded, the area of analysis is limited. Therefore, the City engaged MNG to capture an additional 129 nearshore ground based transect surveys to supplement the LiDAR data capture. These surveys are captured at the same time as the LiDAR aerial surveys and extend into the nearshore area, to a maximum water depth of one metre, to collect the data within the nearshore area that is otherwise missed.

These surveys are undertaken six (6) monthly in April and October each year, in line with the timing of manual photographic monitoring.

5.1 Assessment Methodology

14 discrete study areas within the overall survey area are analysed for changes in beach volume. A detailed description of the survey study areas is shown in Appendix A - QWF-JBAP-00-00-TN-C-0004-S3-P01-MNG Survey study areas.
Note that for this survey technique, analysis is limited to dry areas landward of the waterline. Seasonal changes (October 2025 to April 2026) and annual changes (April 2025 to April 2026) to beach volume are assessed for each discrete area via difference plots of the two survey surfaces.

Previously, MNG Surveyors provided statistics for two areas, ‘A’ and ‘B’, with 'A' representing the onshore component and 'B' serving as an interpolated estimate of the underwater component based on the field transect data. During post-survey discussions following the April 2025 survey, there were considerations regarding the determination of volume locations, as the coastal dune area encompasses a significant expanse. The accumulation of minor anomalies in the challenging, undulating dune areas may distort the results of the beach area that is of primary interest. To assist in understanding the change trends, they have divided the onshore component into two components: the dune areas, referred to as ‘A - Land’, and the beach area, referred to as ‘B - near-shore’, with the underwater component now designated as ‘C – Underwater’. The line of separation between areas A and B has been determined by offsetting the vegetation line east by 20m along areas of sandy coastline to ensure that area B (nearshore) captures any significant erosion of the dune face from wave action. In areas protected by hard structures (such as seawalls, known rocky cliffs etc.) the line of separation was positioned along the structure crest.
The data from ground-based survey transects has been interpolated to estimate changes in beach volume for the nearshore area below the waterline which is illustrated in the elevation difference plots. It is important to note that these volume changes are estimates only.

129 beach cross sections are extracted from the LiDAR surfaces within each of the study areas. These cross sections are combined with the nearshore ground-based survey transects and compared to earlier cross sections at the same location to further interrogate seasonal and long term changes to the beach profile.

5.2 Elevation Difference Plots

5.2.1 Seasonal Changes

Plots depicting the difference in elevation between the October 2025 surveys and April 2026 surveys are output by MNG. The change in beach volume between October 2025 and April 2026 is calculated for each of the 14 discrete study areas (Refer to Appendix A - QWF-JBAP-00-00-TN-C-0004-S3-P01-MNG Survey study areas), the results of which are presented below in Table 5-1.

Table 5-1 Seasonal Net Volume Change of Beach Sections October 2025 – April 2026.

Beach Section	Section Description	Winter Net Volume Change (m^3) April 2025 to October 2025	Summer Net Volume Change (m^3) October 2025 to April 2026
Clayton's Beach Section 1A+1B	Clayton's Beach above the waterline	-31,580	37,582
Clayton's Beach Section 1A	Clayton's Beach dune area	509	8,529
Clayton's Beach Section 1B	Clayton's Beach beach area	-32,089	29,053
Clayton's Beach Section 1C*	Clayton's Beach below the waterline	-35,608	35,183
Quinns Rocks Section 1A+1B	Quinns Rocks Main Beach - South of Artificial Headland above the waterline	1,578	3,221
Quinns Rocks Section 1A	Quinns Main Beach - South of Artificial Headland dune area	115	1,489
Quinns Rocks Section 1B	Quinns Main Beach - South of Artificial Headland beach area	1463	1,732
Quinns Rocks Section 1C*	Quinns Rocks Main Beach – South of Artificial Headland below the waterline	2,782	-8,049
Quinns Rocks Section 2A+2B	Frederick Stubbs Park and GSC Revetment above the waterline	-6,364	6,701
Quinns Rocks Section 2A	Frederick Stubbs Park and GSC Revetment dune area	298	671
Quinns Rocks Section 2B	Frederick Stubbs Park and GSC Revetment beach area	-6,662	6,030
Quinns Rocks Section 2C*	Frederick Stubbs Park and GSC Revetment below the waterline	-7,171	8,399
Quinns Rocks Section 3A+3B	Frederick Stubbs Carpark, South of Groyne 2 above the waterline	-1,555	3,974
Quinns Rocks Section 3A	Frederick Stubbs Carpark, South of Groyne 2 dune area	463	-23
Quinns Rocks Section 3B	Frederick Stubbs Carpark, South of Groyne 2 beach area	-2,018	3,997
Quinns Rocks Section 3C*	Frederick Stubbs Carpark, South of Groyne 2 below the waterline	-2,663	7,647
Quinns Rocks Section 4A+4B	North of Groyne 2, South of Groyne 3 above the waterline	-2,035	2,364
Quinns Rocks Section 4A	North of Groyne 2, South of Groyne 3 dune area	315	746
Quinns Rocks Section 4B	North of Groyne 2, South of Groyne 3 beach area	-2,350	1,618
Quinns Rocks Section 4C*	North of Groyne 2, South of Groyne 3 below the waterline	-1,044	634

Beach Section	Section Description	Winter Net Volume Change (m^3) April 2025 to October 2025	Summer Net Volume Change (m^3) October 2025 to April 2026
Quinns Rocks Section 5A+5B	North of Groyne 3, South of Groyne 4 above the waterline	-4,545	5,202
Quinns Rocks Section 5A	North of Groyne 3, South of Groyne 4 dune area	609	2,652
Quinns Rocks Section 5B	North of Groyne 3, South of Groyne 4 beach area	-5,154	2,550
Quinns Rocks Section 5C*	North of Groyne 3, South of Groyne 4 below the waterline	1,799	-2,971
Quinns Rocks Section 6A+6B	North of Groyne 4, Jindalee above the waterline	-4,767	5,440
Quinns Rocks Section 6A	North of Groyne 4, Jindalee dune area	1,254	2,295
Quinns Rocks Section 6B	North of Groyne 4, Jindalee beach area	-6,021	3,145
Quinns Rocks Section 6C*	North of Groyne 4, Jindalee below the waterline	2,090	-1,736
Yanchep Section 1A+1B	South of Fisherman's Hollow Beach Access above the waterline	-4,174	8,422
Yanchep Section 1A	South of Fisherman's Hollow Beach Access dune area	535	2,449
Yanchep Section 1B	South of Fisherman's Hollow Beach Access beach area	-4,709	5,973
Yanchep Section 1C*	South of Fisherman's Hollow Beach Access below the waterline	-1,675	-3,048
Yanchep Section 2A+2B	South of Headland, North of Fisherman's Hollow Beach Access above the waterline	-6,091	7,079
Yanchep Section 2A	South of Headland, North of Fisherman's Hollow Beach Access dune area	284	692
Yanchep Section 2B	South of Headland, North of Fisherman's Hollow Beach Access beach area	-6,375	6,387
Yanchep Section 2C*	South of Headland, North of Fisherman's Hollow Beach Access below the waterline	-24,787	26,451
Yanchep Section 3A+3B	Yanchep Lagoon above the waterline	1,900	108
Yanchep Section 3A	Yanchep Lagoon dune area	293	-105
Yanchep Section 3B	Yanchep Lagoon beach area	1,607	213
Yanchep Section 3C*	Yanchep Lagoon below the waterline	2,483	-3,254
Yanchep Section 4A+4B	South of Capricorn Groyne above the waterline	-5,284	9,419
Yanchep Section 4A	South of Capricorn Groyne dune area	41	1,856
Yanchep Section 4B	South of Capricorn Groyne beach area	-5,325	7,563
Yanchep Section 4C*	South of Capricorn Groyne below the waterline	567	2,053
Yanchep Section 5A+5B	North of Capricorn Groyne above the waterline	1,596	2,112
Yanchep Section 5A	North of Capricorn Groyne dune area	1,109	807

Beach Section	Section Description	Winter Net Volume Change (m^3) April 2025 to October 2025	Summer Net Volume Change (m^3) October 2025 to April 2026
Yanchep Section 5B	North of Capricorn Groyne beach area	487	1,305
Yanchep Section 5C*	North of Capricorn Groyne below the waterline	3,264	-2,180
Two Rocks Section 1A+1B	South of Two Rocks Marina above the waterline	-15,963	19,517
Two Rocks Section 1A	South of Two Rocks Marina dune area	826	2,229
Two Rocks Section 1B	South of Two Rocks Marina beach area	-16,789	17,288
Two Rocks Section 1C*	South of Two Rocks Marina below the waterline	-36,486	43,864
Two Rocks Section 2A+2B	North of Two Rocks Marina above the waterline	-5,343	6,125
Two Rocks Section 2A	North of Two Rocks Marina dune area	2,482	218
Two Rocks Section 2B	North of Two Rocks Marina beach area	-7,825	5,907
Two Rocks Section 2C*	North of Two Rocks Marina below the waterline	1,963	-6,578

**These values are interpolated from the results of the ground based transects and are an estimate of the volume changes below the waterline. The volume changes above the waterline are calculated from LiDAR surveys that have a resolution of +10 points per square meter however volume changes below the waterline are calculated from ground based transects that have 100m separation.*

Overall, there was an increase in beach volume across the 2025/26 summer period. The combined net volume changes of the Mindarie, Quinns, Yanchep and Two Rocks foreshore areas are as follows:

- The one beach section that is assessed within the Mindarie (Clayton's Beach) foreshore area had an estimated net beach volume gain of 72,765 m^3 between October 2025 and April 2026;
- The six beach sections along the Quinns foreshore area had an estimated combined net beach volume gain of 30,826 m^3 between October 2025 and April 2026;
- The five beach sections along the Yanchep foreshore area had an estimated combined net beach volume gain of 47,162 m^3 between October 2025 and April 2026; and
- The two beach sections along the Two Rocks foreshore area had an estimated combined net beach volume gain of 62,928 m^3 between October 2025 and April 2026.

These results represent a significant gain in beach volume over the 2025/26 summer period, particularly along Clayton's Beach and Two Rocks Beach South which are both situated immediately south of large breakwater structures. The net gain in beach volume at both Claytons and Two Rocks Beach South is of a similar order of magnitude to the seasonal net beach volume gain experienced at these sites each year which can be attributed to the strong summer southerly wind conditions transporting sand northward which is then interrupted by the breakwater structures. The extent of beach volume gain is similar to previous summer period. As outlined in Table 5-1, there is also significant seasonal beach volume loss at these sites each winter period. As outlined in Section 2, the 2025 winter period was considered to be a mild winter, with offshore wave heights not exceeding 7.48m and a wave climate characterised by WSW waves. This likely contributed to the significant gains in beach volume along the City's coastline.

Areas with significant seasonal changes in beach volume were consistent with manual imagery observations. It is important to note that the areas below the waterline are an estimate however the data does provide an improved understanding of how sediment is transported locally within these beach segments.

5.2.2 Annual Changes – April 2025 to April 2026

Volume change plots depicting the difference in surface elevation between the April 2026 surveys and April 2025 surveys are output by MNG. The change in beach volume over the year is calculated for each of the 14 discrete study areas, the results of which are presented below in Table 5-2.

Table 5-2 Annual Net Volume Change of Beach Sections April 2026 – April 2025.

Beach Section	Section Description	Net Volume Change (m^3) April 2026 – April 2025
Clayton's Beach Section 1A+1B	Clayton's Beach above the waterline	11,133
Clayton's Beach Section 1A	Clayton's Beach dune area	9,622
Clayton's Beach Section 1B	Clayton's Beach beach area	1,511
Clayton's Beach Section 1C*	Clayton's Beach below the waterline	637
Quinns Rocks Section 1A +1B	Quinns Rocks Main Beach - South of Artificial Headland above the waterline	1,291
Quinns Rocks Section 1A	Quinns Main Beach - South of Artificial Headland dune area	2,091
Quinns Rocks Section 1B	Quinns Main Beach - South of Artificial Headland beach area	-800
Quinns Rocks Section 1C*	Quinns Rocks Main Beach – South of Artificial Headland below the waterline	-3,954
Quinns Rocks Section 2A+2B	Frederick Stubbs Park and GSC Revetment above the waterline	514
Quinns Rocks Section 2A	Frederick Stubbs Park and GSC Revetment dune area	1,012
Quinns Rocks Section 2B	Frederick Stubbs Park and GSC Revetment beach area	-498
Quinns Rocks Section 2C*	Frederick Stubbs Park and GSC Revetment below the waterline	266
Quinns Rocks Section 3A+3B	Frederick Stubbs Carpark, South of Groyne 2 above the waterline	2,293
Quinns Rocks Section 3A	Frederick Stubbs Carpark, South of Groyne 2 dune area	1,128
Quinns Rocks Section 3B	Frederick Stubbs Carpark, South of Groyne 2 beach area	1,165
Quinns Rocks Section 3C*	Frederick Stubbs Carpark, South of Groyne 2 below the waterline	3,442
Quinns Rocks Section 4A+4B	North of Groyne 2, South of Groyne 3 above the waterline	1,230
Quinns Rocks Section 4A	North of Groyne 2, South of Groyne 3 dune area	1,281
Quinns Rocks Section 4B	North of Groyne 2, South of Groyne 3 beach area	-51
Quinns Rocks Section 4C*	North of Groyne 2, South of Groyne 3 below the waterline	-1,313
Quinns Rocks Section 5A+5B	North of Groyne 3, South of Groyne 4 above the waterline	1,002
Quinns Rocks Section 5A	North of Groyne 3, South of Groyne 4 dune area	1,462
Quinns Rocks Section 5B	North of Groyne 3, South of Groyne 4 beach area	-460
Quinns Rocks Section 5C*	North of Groyne 3, South of Groyne 4 below the waterline	-2,064
Quinns Rocks Section 6A+6B	North of Groyne 4, Jindalee above the waterline	3,240
Quinns Rocks Section 6A	North of Groyne 4, Jindalee dune area	2,977

Beach Section	Section Description	Net Volume Change (m^3) April 2026 – April 2025
Quinns Rocks Section 6B	North of Groyne 4, Jindalee beach area	263
Quinns Rocks Section 6C*	North of Groyne 4, Jindalee below the waterline	-1,007
Yanchep Section 1A+1B	South of Fisherman's Hollow Beach Access above the waterline	1,551
Yanchep Section 1A	South of Fisherman's Hollow Beach Access dune area	2,785
Yanchep Section 1B	South of Fisherman's Hollow Beach Access beach area	-1,234
Yanchep Section 1C*	South of Fisherman's Hollow Beach Access below the waterline	-1,219
Yanchep Section 2A+2B	South of Headland, North of Fisherman's Hollow Beach Access above the waterline	1,165
Yanchep Section 2A	South of Headland, North of Fisherman's Hollow Beach Access dune area	1,286
Yanchep Section 2B	South of Headland, North of Fisherman's Hollow Beach Access beach area	-121
Yanchep Section 2C*	South of Headland, North of Fisherman's Hollow Beach Access below the waterline	5,188
Yanchep Section 3A+3B	Yanchep Lagoon above the waterline	-179
Yanchep Section 3A	Yanchep Lagoon dune area	297
Yanchep Section 3B	Yanchep Lagoon beach area	-476
Yanchep Section 3C*	Yanchep Lagoon below the waterline	-912
Yanchep Section 4A+4B	South of Capricorn Groyne above the waterline	2,610
Yanchep Section 4A	South of Capricorn Groyne dune area	4,214
Yanchep Section 4B	South of Capricorn Groyne beach area	-1,604
Yanchep Section 4C*	South of Capricorn Groyne below the waterline	-1,697
Yanchep Section 5A+5B	North of Capricorn Groyne above the waterline	1,268
Yanchep Section 5A	North of Capricorn Groyne dune area	550
Yanchep Section 5B	North of Capricorn Groyne beach area	718
Yanchep Section 5C*	North of Capricorn Groyne below the waterline	1,378
Two Rocks Section 1A+1B	South of Two Rocks Marina above the waterline	4,209
Two Rocks Section 1A	South of Two Rocks Marina dune area	4,428
Two Rocks Section 1B	South of Two Rocks Marina beach area	-219
Two Rocks Section 1C*	South of Two Rocks Marina below the waterline	5,852
Two Rocks Section 2A+2B	North of Two Rocks Marina above the waterline	727
Two Rocks Section 2A	North of Two Rocks Marina dune area	1,703
Two Rocks Section 2B	North of Two Rocks Marina beach area	-976

Beach Section	Section Description	Net Volume Change (m^3) April 2026 – April 2025
Two Rocks Section 2C*	North of Two Rocks Marina below the waterline	-5,823

**These values are interpolated from the results of the ground based transects and are an estimate of the volume changes below the waterline. The volume changes above the waterline are calculated from LiDAR surveys that have a resolution of +10 points per square meter however volume changes below the waterline are calculated from ground based transects that have 100m separation.*

It is important to note that as part of the annual beach renourishment program, 8,500 tonnes (~6,500 m^3) of sand was imported in May 2025 for renourishment at Quinns Rocks Sections 3A, 5A, and 6A.

The beach volume change maps developed by MNG show that, while there was net volume gain for almost all the Sections above the waterline in the dune area (Sections A), there was a net volume loss for almost all the Sections in the beach area (Sections B) and the Sections below the waterline (Sections C). Sediment from below the waterline was likely transported above the waterline and towards the dunes across the summer season, as a result of cross shore sediment transport.

Overall, there was an accretion in beach volume across the Yanchep coastline for the year with the net beach volume gain within beach section 1A, 2A and 4A being particularly notable. Due to the mild winter and strong sea breeze conditions there was a slight net accretion in beach volume within the beach compartment south of the headland, known as Fisherman's Hollow. This section of beach is bound by two rocky headlands to the north and south and a nearshore fringing reef. Sediment transport along the Yanchep coastline will be assessed in more detail as part of the Yanchep Coastal Management Study.

Notably, there was also a significant net beach volume gain in Two Rocks Section 1A and Clayton's Beach Section 1A. Theses sections are bound by the Two Rocks Marina and the Mindarie Marina Breakwater to the north respectively, which interrupt longshore sediment transport trapping sand within the above Sections. Similarly to Quinns Sections 1A, sediment was likely transported to this area across the summer season as a result of strong summer sea breezes driving northward sediment transport.

5.2.3 Long Term Trends

Annual changes in beach volumes have been assessed by the City since 2020. To identify any long-term trends in annual beach volume change, net beach volume change per year, relative to length of coastline, was plotted for each beach section. As nearshore transects were only captured from April 2022 and later, long-term analysis could not be assessed for the nearshore area and therefore it is important to note that these plots only depict annual beach volume change above the waterline. These plots are presented in Figure 5-1, Figure 5-2, Figure 5-3 and Figure 5-4 below.

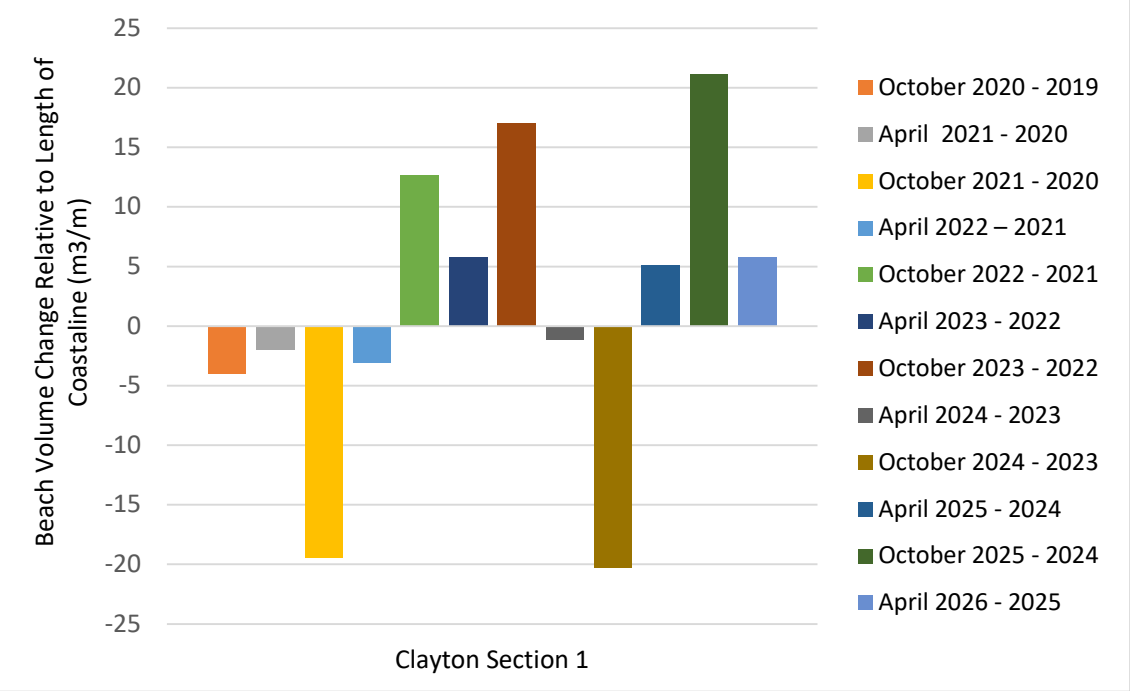


Figure 5-1 Annual net beach volume changes for Claytons Section 1.

The Clayton's Beach Section 1 is situated immediately south of the Mindarie Marina Breakwater, which interrupts the northward longshore sediment transport, trapping sand within the beach section defined by Clayton's Beach Section 1. Figure 5-1 shows that the increase in beach volume along Clayton's Beach observed between October 2021 and October 2023 has been followed by significant erosion over the 2024 period. The net beach volume gain observed during the study periods October 2021 to 2022, April 2022 to 2023 and October 2022 to 2023 is likely attributed to strong sea breezes observed throughout the seasonal summer period.

Over the 2025/2026 period there has been an increase in annual net beach volume of 11,133 m^3 (Clayton's Beach Section 1A+1B), as presented in Table 5-2, very similar to the previous April 2025-2024 year. With strong summer sea breezes we expect to see a net northward flow of sand during the summer monitoring period and, as the Mindarie Breakwater interrupts this northward flow, we expect to see a build-up of sand to the south of the structure, which is what has been observed.

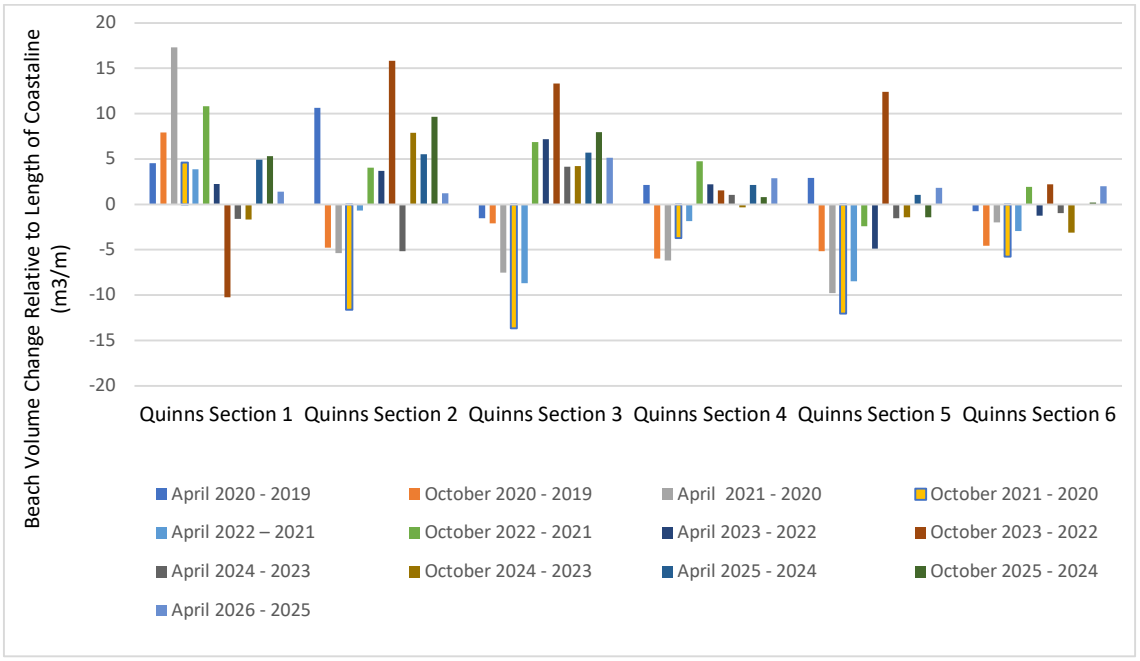


Figure 5-2 Annual net beach volume changes for Quinns Section 1, 2, 3, 4, 5 and 6.

Beach volumes exhibited a net accretionary trend during the summer monitoring period, although the extent of accretion was limited relative to previous years. As illustrated in Figure 2-13, this is likely associated with less persistent and/or weaker summer sea breeze conditions than those recorded in preceding summers.

Over the past year, nourishment works were undertaken within Quinns Rocks Section 3 (3,000 tonnes), Quinns Rocks Section 5 (1,500 tonnes), and Quinns Rocks Section 6 (4,000 tonnes). Figure 5-2 shows a continual reduction in beach volume within Quinns Rocks Section 5, except for a slight accretion during the monitoring period, even with the renourishment works. The City has placed approximately 34,000 m^3 of sand within this beach section since 2016 as part of the City's ongoing Beach Renourishment Program and has recently started to undertake regular nearshore beach scraping at this site since 2023 of approximately 1,000 to 2,000 m^3 moved annually in Summer from swash zone to base of dune/dune face. It is recommended that this site continue to be closely monitored as Ocean Drive, associated public infrastructure and residential housing is located less than 100m from the base of the dune and could be impacted by continued coastal erosion.

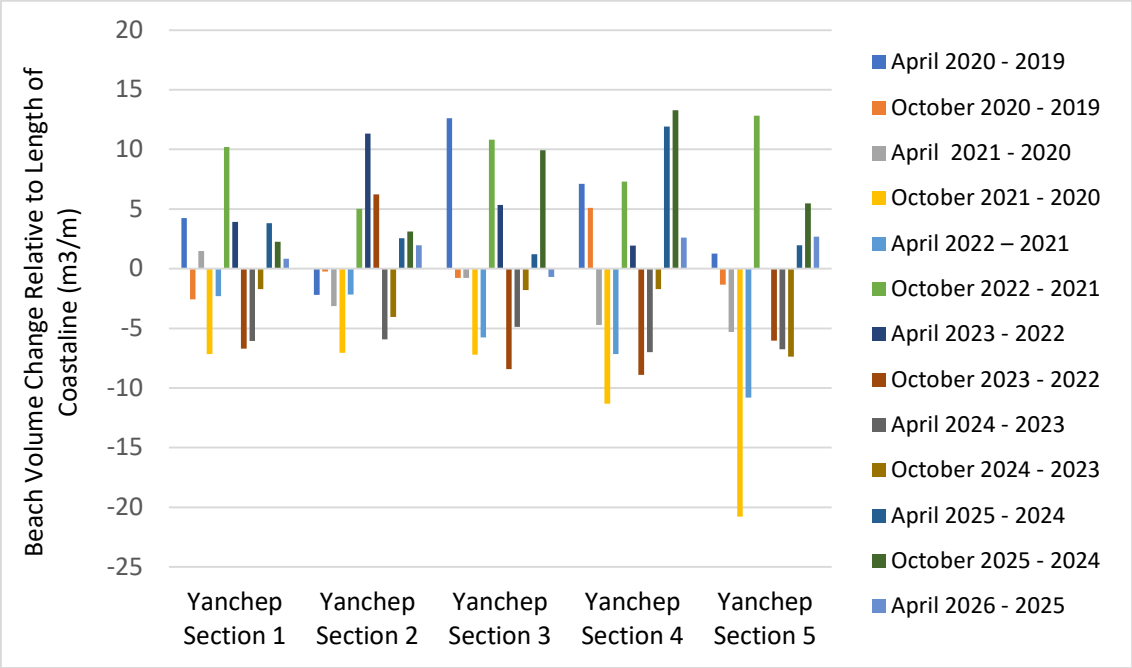


Figure 5-3 *Annual net beach volume changes for Yanchep Section 1, 2, 3, 4 and 5.*

Figure 5-3 shows the annual net beach volume changes along the Yanchep coastline. Consistent with the trends observed between April 2024 and April 2025, there was a general increase in beach volume between October 2024 and April 2026, indicating net accretion across much of the coastline.

The magnitude of accretion was generally lower than that recorded in previous years. This may be attributable to weaker summer sea breeze conditions, which typically drive northward sediment transport and promote sediment retention within individual beach compartments. However, further analysis is required to better understand the sediment transport processes operating along the Yanchep coastline. It is anticipated that additional data collection and the numerical sediment transport modelling being undertaken as part of the Yanchep Coastal Management Study will improve our understanding of sediment transport pathways and coastal processes within the study area.

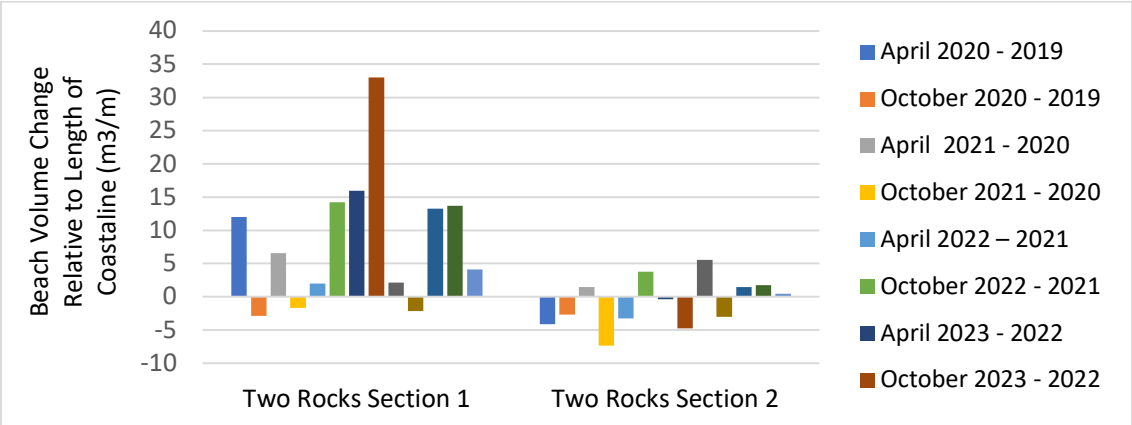


Figure 5-4 *Annual net beach volume changes for Two Rocks Section 1 and 2.*

Similarly to observations made for Claytons Beach (Figure 5-1), a continuous increase in beach volume was recorded from April 2025 and April 2026 at Two Rocks Section 1. However, the magnitude of

accretion was lower than that observed in previous years, likely for the same reasons discussed for the other beaches.

Under relatively calm winter conditions and the influence of strong summer sea breezes, there is typically a net northward transport of sediment over the annual monitoring period. As the Two Rocks Marina breakwater interrupts this northward sediment transport pathway, significant accumulation of sand is expected on the southern side of the structure. The observed increase in beach volume at Section 1 is consistent with this process.

A similar trend was observed at Section 2, although the magnitude of volume change was smaller. This is likely because Section 2 is located further south of the marina and is therefore less directly influenced by sediment trapping associated with the Two Rocks Marina breakwater.

5.3 Beach Cross Section Results

5.3.1 Transects with Significant Elevation Difference

The following sites were identified as having significant elevation difference (greater than 2.0m) between surveys. These areas may not have been identified in manual imagery observations but represent areas of major erosion or accretion and are important to identify as part of the coastal monitoring program.

5.3.1.1 Mindarie

Cross Section 16 – Manual Imagery Site B05 Up-Coast

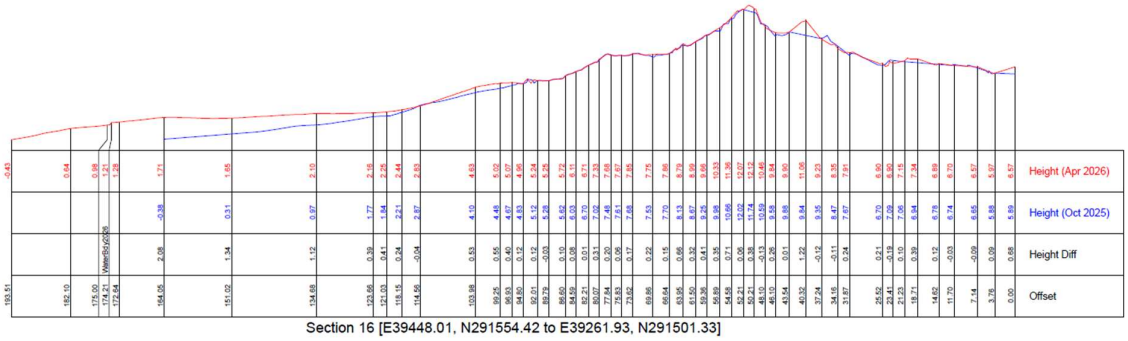


Figure 5-5 Cross section 16 at Clayton's Beach which shows an increase in beach height of up to 2.08m between October 2025 and April 2026.

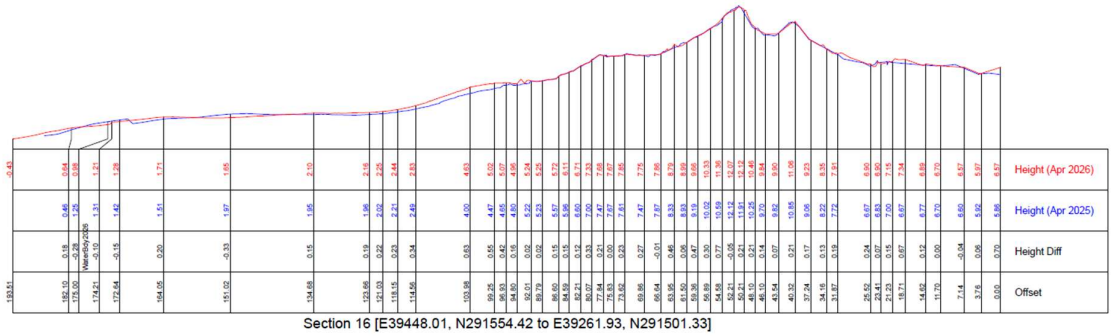


Figure 5-6 Cross section 16 at Clayton's Beach which shows an increase in beach height of up to 0.63m between April 2025 and April 2026.

Clayton's beach cross-section 16 is situated within the field of view of manual imagery point Mindarie B05 Up-Coast. The cross-sectional surveys show a maximum increase in elevation of 2.08m between October 2025 and April 2026. This is consistent with manual imagery observations.



Mindarie B04 Up-Coast, October 2025



Mindarie B04 Up-Coast, April 2026

Figure 5-7 Manual imagery taken at Mindarie B04 Up-Coast in October 2025 and April 2026

Cross Section 19 and 20 – Manual Imagery Site B02 Up-Coast and Down-Coast

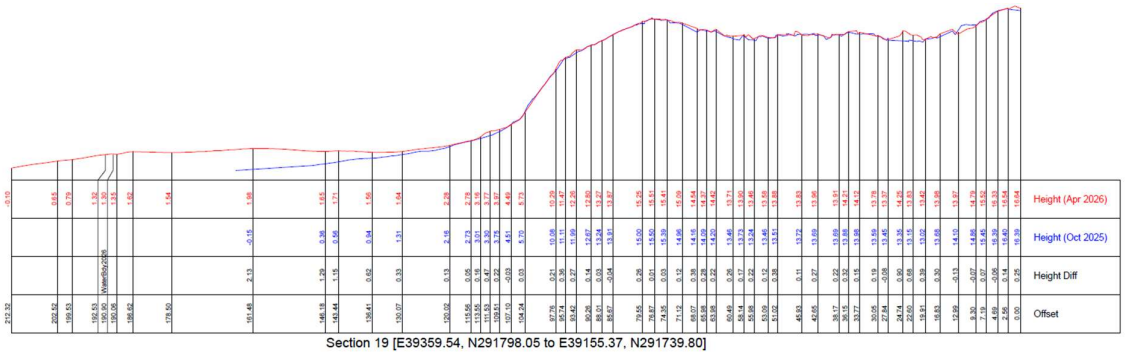


Figure 5-8 Cross section 19 at Clayton's Beach which shows an increase in beach height of up to 2.13m between October 2025 and April 2026.

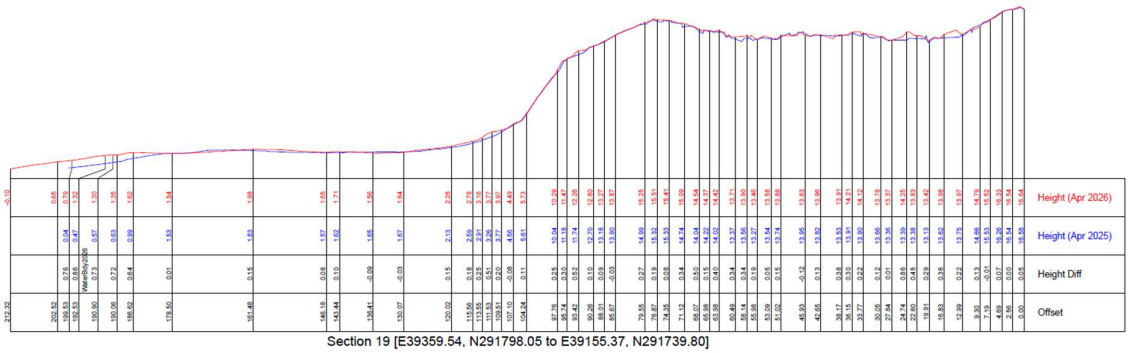


Figure 5-9 Cross section 19 at Clayton's Beach which shows an increase in beach height of up to 0.86m between April 2025 and April 2026.

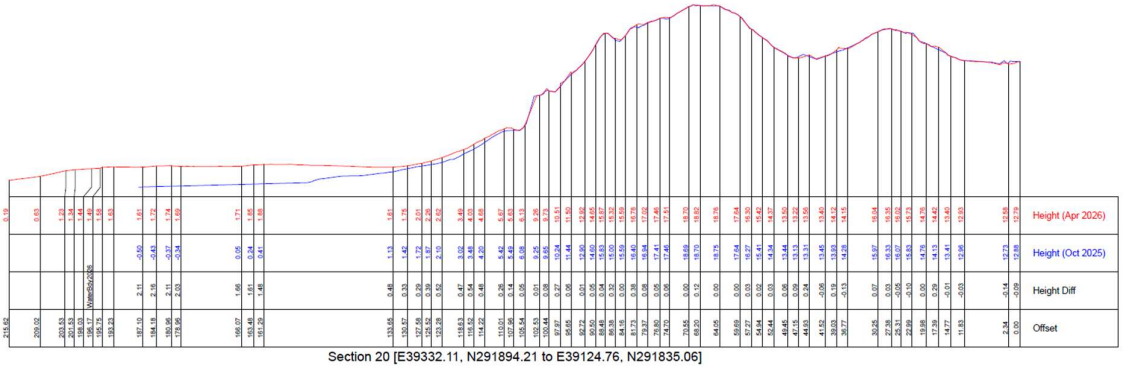


Figure 5-10 Cross section 20 at Clayton's Beach which shows an increase in beach height of up to 2.16m between October 2025 and April 2026.

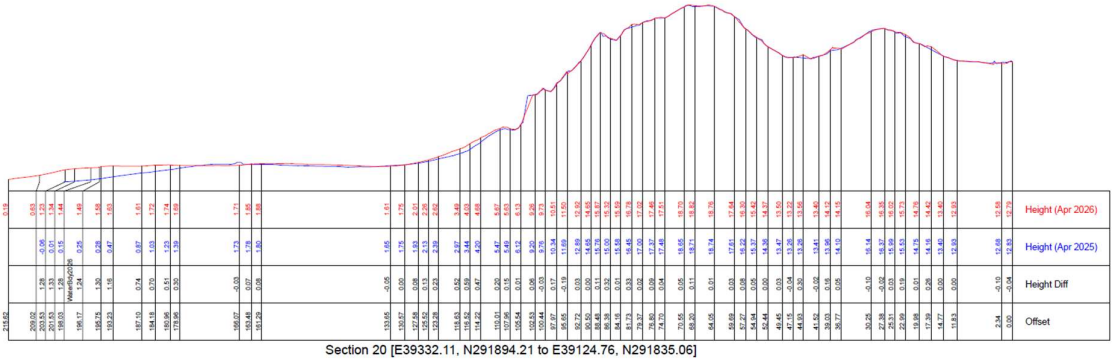


Figure 5-11 Cross section 20 at Clayton's Beach which shows an increase in beach height of up to 1.33m between April 2025 and April 2026.

At cross sections 19 and 20, the surveys show an increase in beach profile elevation of up to 2.16m between October 2025 and April 2026. This is consistent with manual imagery observations. The site is located south of Mindarie breakwater and significant accretion is expected during the summer months. Annual beach profiles show minimal beach elevation changes, indicating winter erosion has been balanced by summer accretion.

	
Mindarie B02 Up-Coast, October 2025	**Mindarie B02 Up-Coast, April 2026**



Mindarie B02 Down-Coast, October 2025



Mindarie B02 Down-Coast, April 2026

Figure 5-12 Manual imagery taken at Mindarie B02 Up-Coast and Down-Coast in October 2025 and April 2026

5.3.1.2 Quinns Rocks

Cross Section 1 - 2 - 3 – Section 1 – Manual Imagery Site B01 Up-Coast

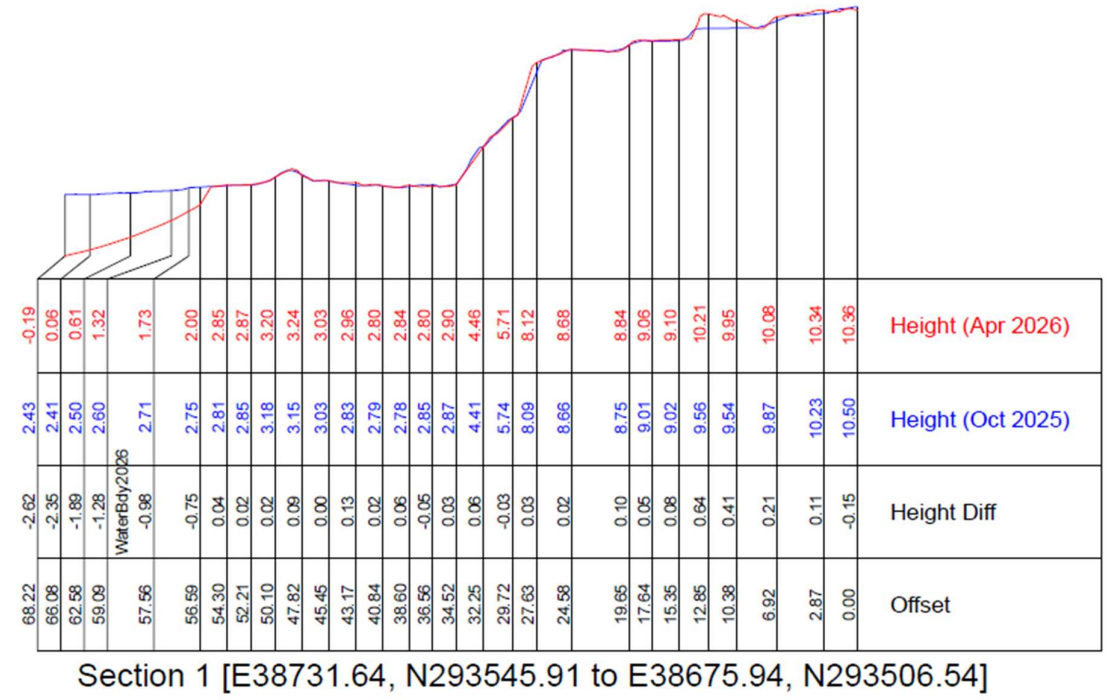


Figure 5-13 Cross section 1 at Quinns Beach which shows a reduction in beach height of up to 2.62m just below the waterline between October 2025 and April 2026.

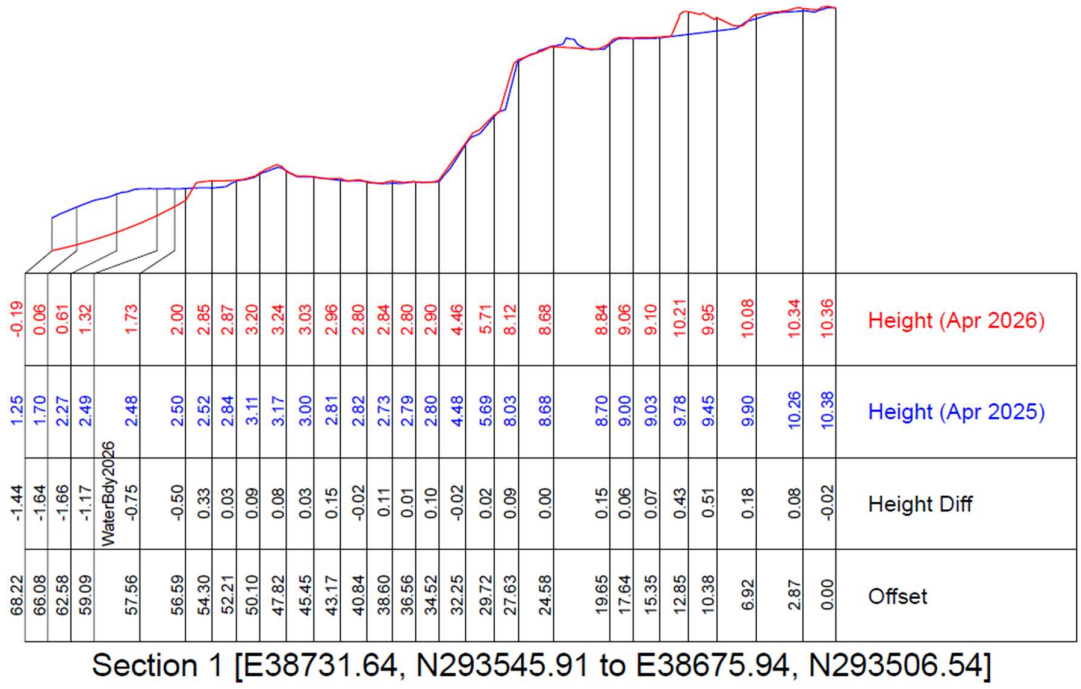


Figure 5-14 *Cross section 1 at Quinns Beach which shows a reduction in beach height of up to 1.66m just below the waterline between April 2024 and April 2025.*

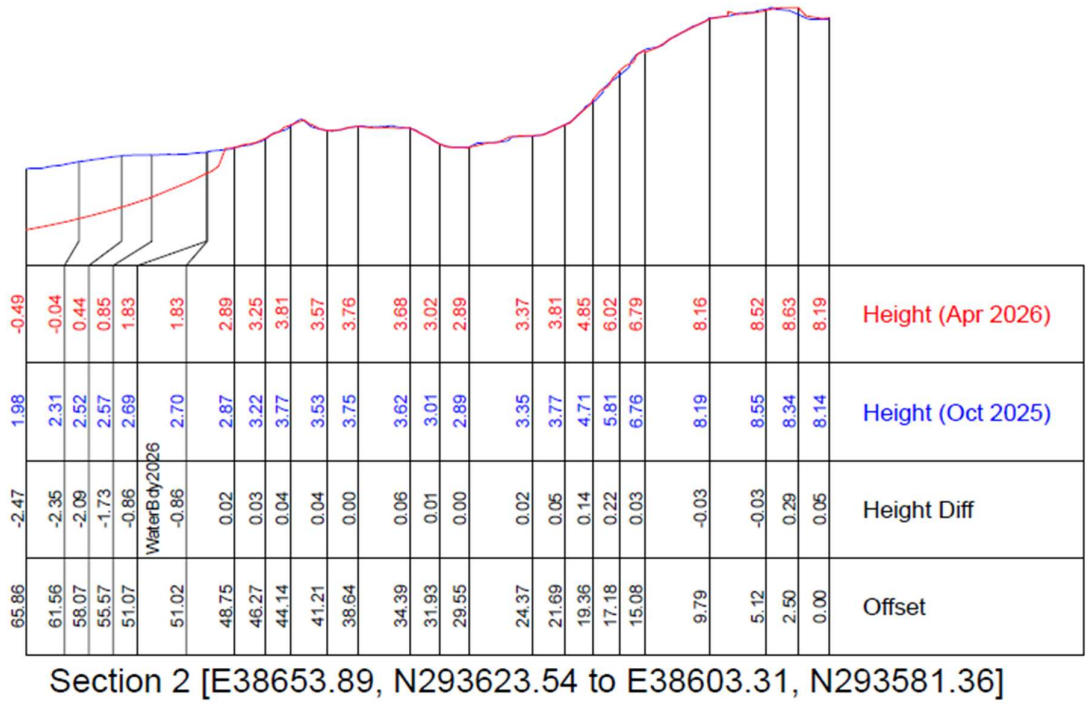


Figure 5-15 *Cross section 2 at Quinns Beach which shows a reduction in beach height of up to 2.47m just below the waterline between October 2025 and April 2026.*

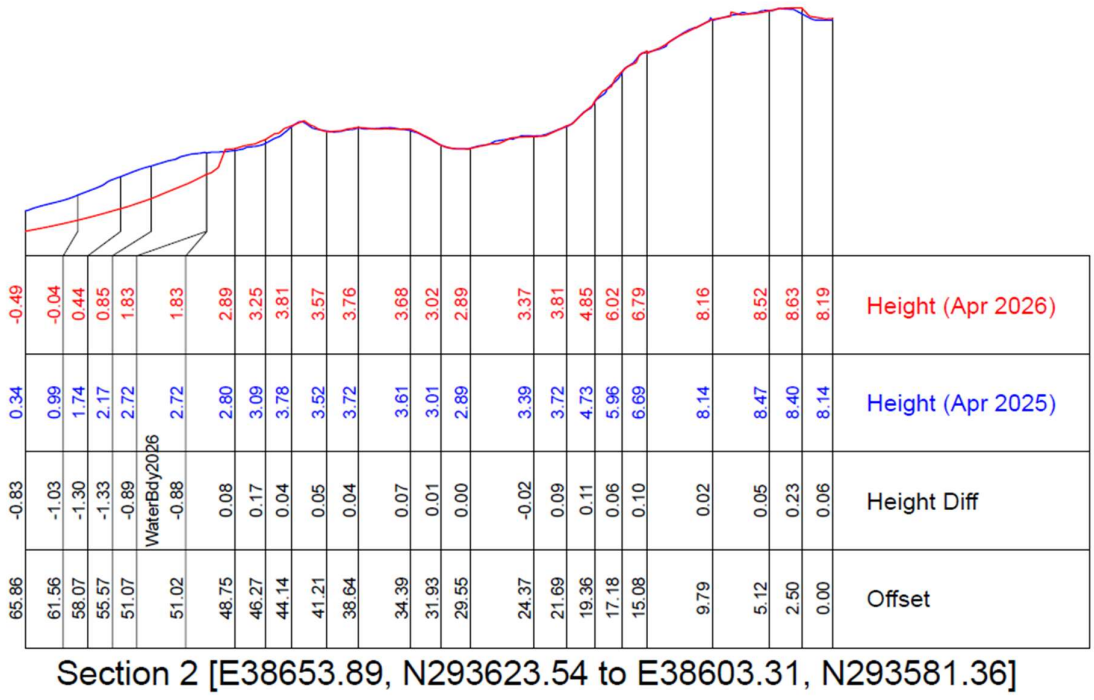


Figure 5-16 *Cross section 2 at Quinns Beach which shows a reduction in beach height of up to 1.33m just below the waterline between April 2024 and April 2025.*

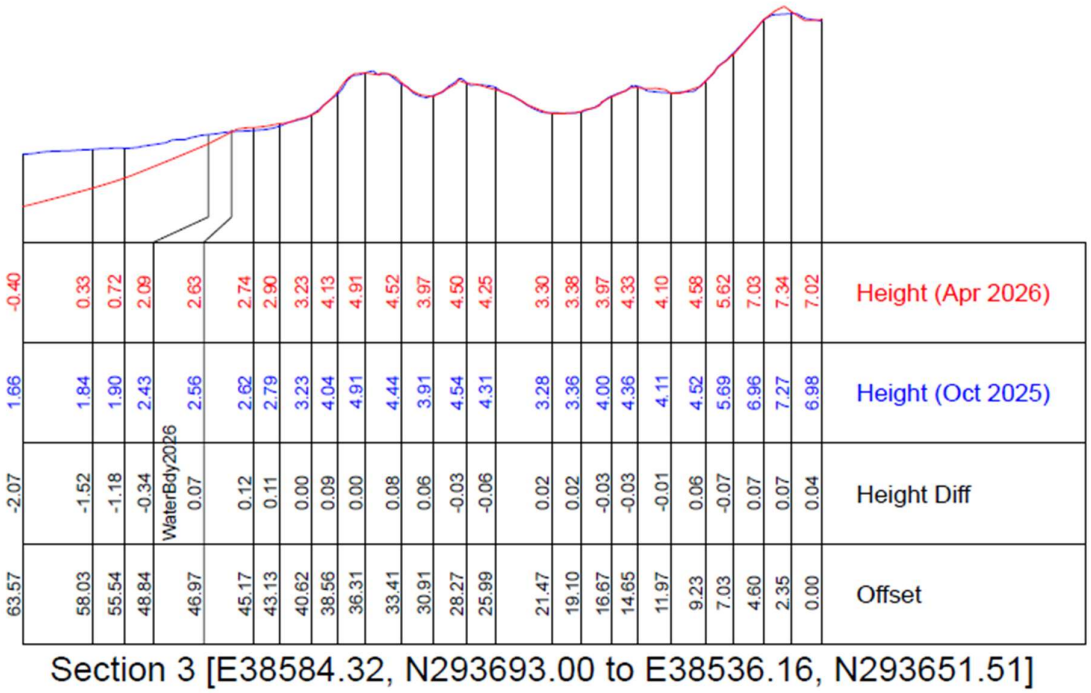


Figure 5-17 *Cross section 3 at Quinns Beach which shows a reduction in beach height of up to 2.07m just below the waterline between October 2025 and April 2026.*

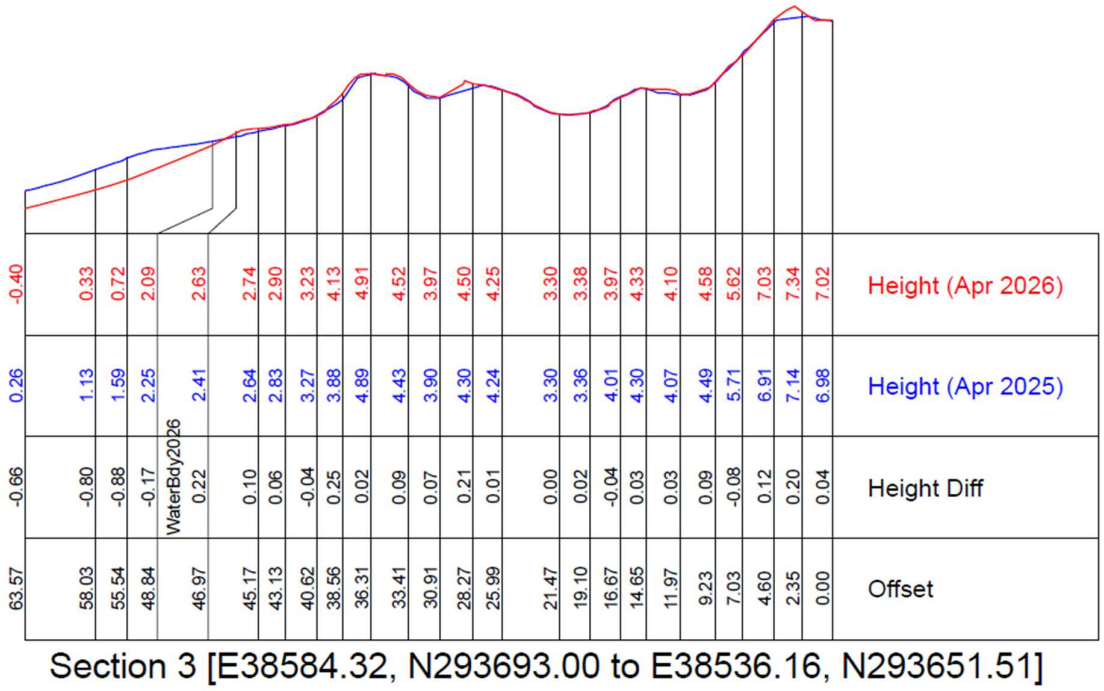


Figure 5-18 *Cross section 3 at Quinns Beach which shows a reduction in beach height of up to 0.88m just below the waterline between April 2024 and April 2025.*

The seasonal beach profile comparisons for Quinns Beach cross section 1 show a seasonal reduction in beach elevation of up to 2.62m between the October 2025 and April 2026 survey, which represents significant erosion along this section of coastline in the nearshore. Annual survey shows the beach is in a more eroded state than April 2025. Erosion at this site is likely a result strong summer sea breeze conditions which transport sand northward. This site is bound by a rocky headland and significant fringing reef system to the south.



Quinns Rocks B01 Up-Coast, October 2025	Quinns Rocks B01 Up-Coast, April 2026

Figure 5-19 *Manual imagery taken at Quinns B01 Up-Coast in October 2024 and April 2025.*

Cross Section 32 – Section 5 – Manual Imagery Site B14 Down-Coast

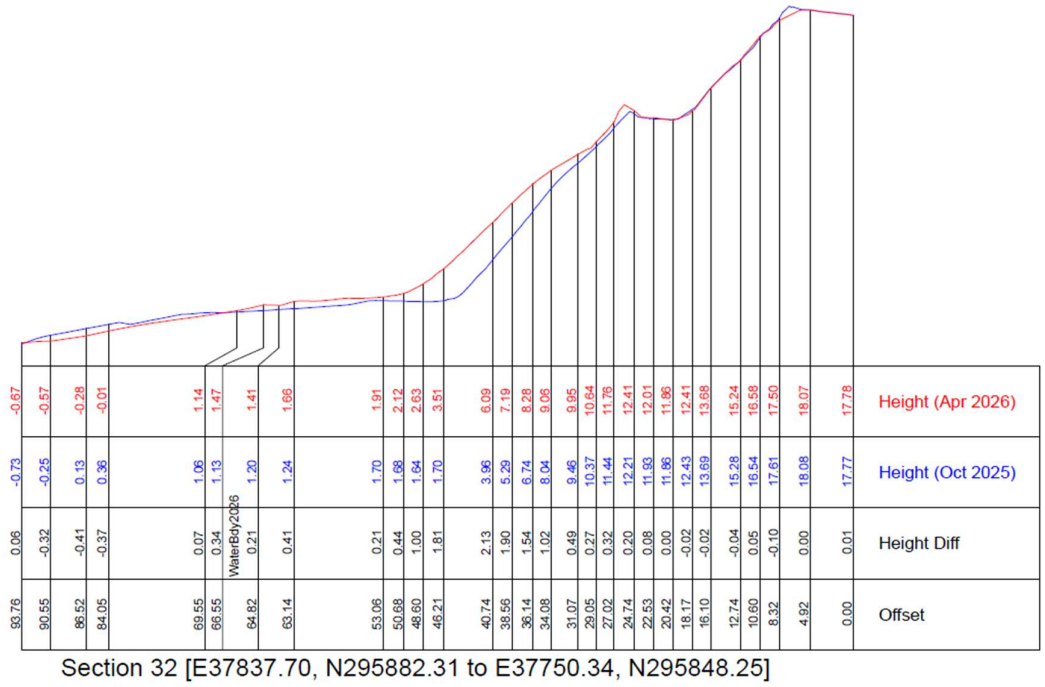


Figure 5-20 *Cross section 32 at Quinns Beach which shows an increase in beach height of up to 2.13m in the dune area between October 2025 and April 2026.*

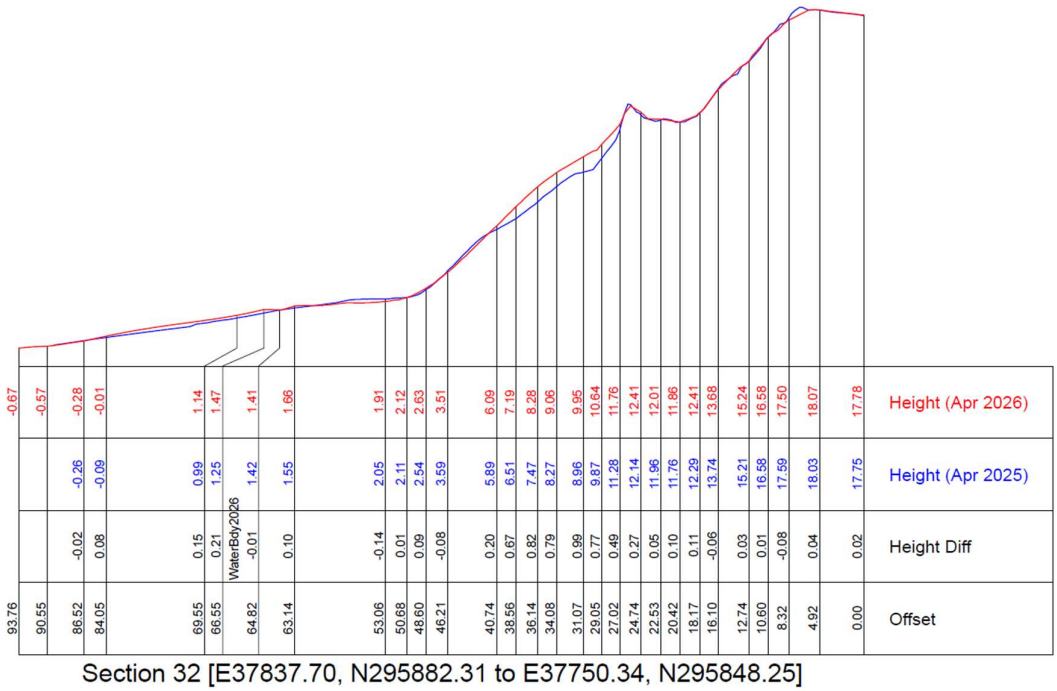


Figure 5-21 *Cross section 32 at Quinns Beach which shows an increase in beach height of up to 0.99m in the dune area between April 2025 and April 2026.*

Quinns Rocks beach cross-section 32 is situated within the field of view of manual imagery point Quinns Rocks B14. The seasonal cross-sectional survey shows a maximum increase in elevation of 2.13m between October 2025 and April 2026, with minimal change in the annual profile. This is consistent with manual imagery observations which show a significant increase in elevation in the dune area at this site and at Quinns Rocks B14 Down-Coast over the summer period.



Quinns Rocks B14 Down-Coast, October 2025	Quinns Rocks B14 Down-Coast, April 2026

Figure 5-22 Manual imagery taken at Quinns B14 Up-Coast and Down-Coast October 2025 and April 2026.

5.3.1.3 Yanchep

Cross Section 21 to 24 – Section 2 – Manual Imagery Site B07 Up-Coast and Down-Coast and Site B08 Down-Coast

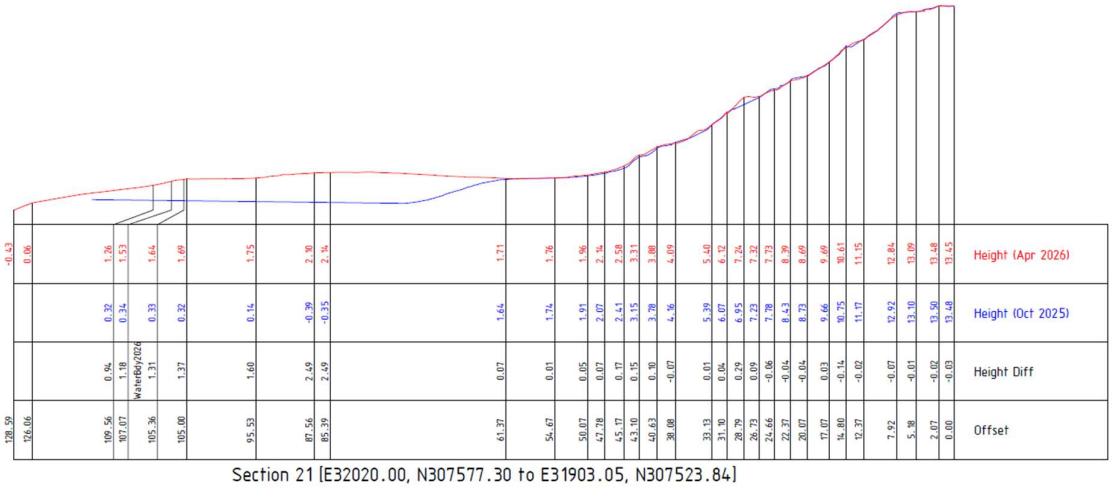


Figure 5-23 Cross section 21 at Yanchep Beach which shows an increase in beach height of up to 2.49m between October 20254 and April 2026.

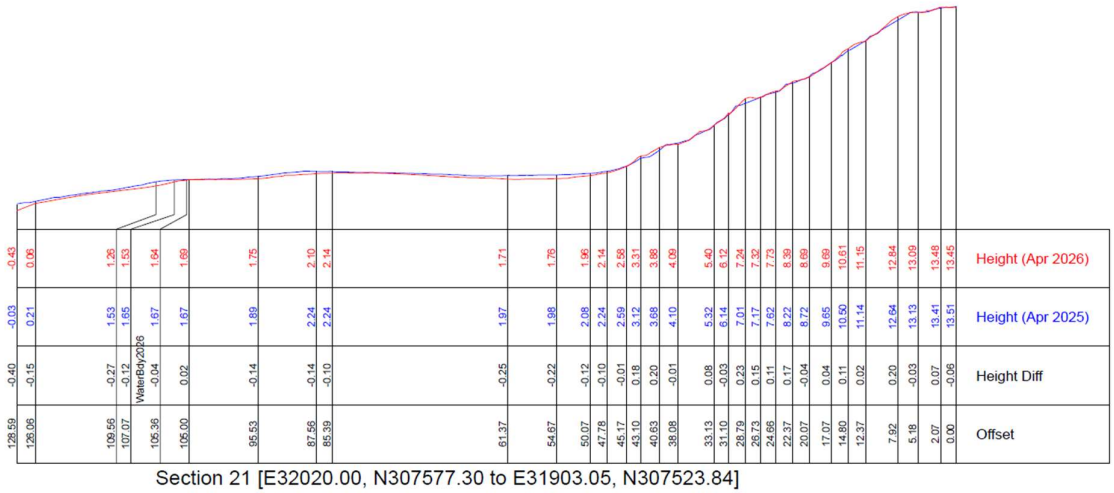


Figure 5-24 Cross section 21 at Yanchep Beach which shows a decrease in beach height of up to 0.4m between April 2025 and April 2026.

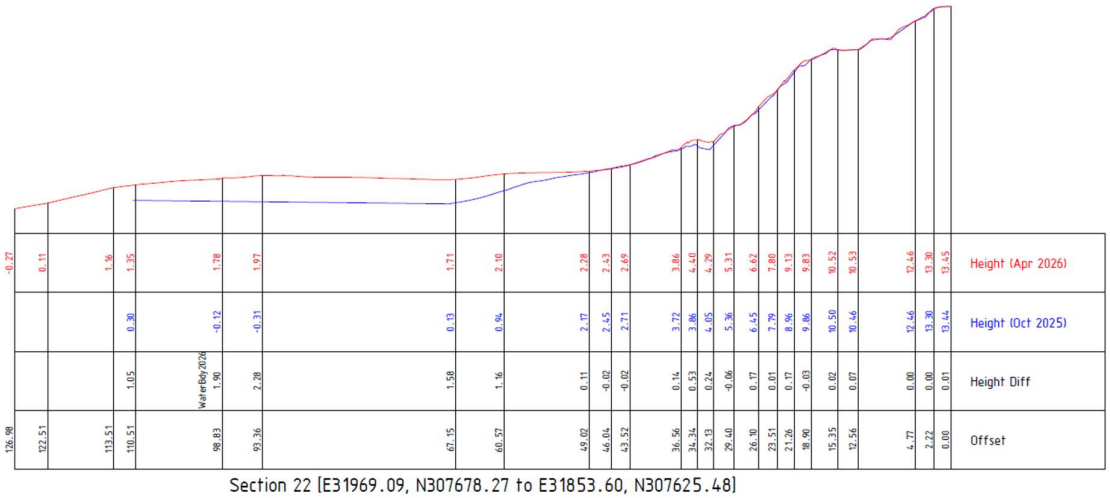


Figure 5-25 Cross section 22 at Yanchep Beach which shows an increase in beach height of up to 2.28m between October 2025 and April 2026.

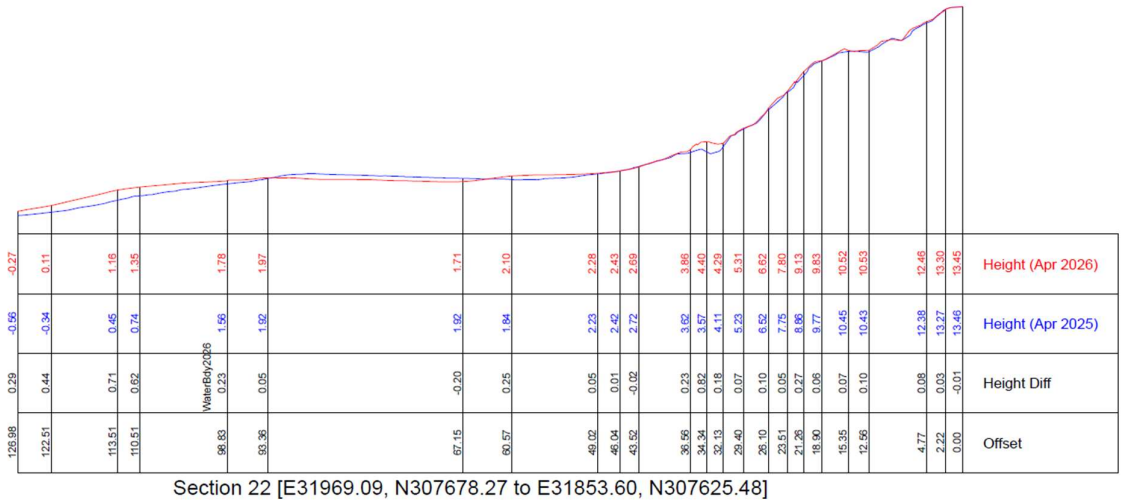


Figure 5-26 Cross section 22 at Yanchep Beach which shows an increase in beach height of up to 0.71m between April 2025 and April 2026

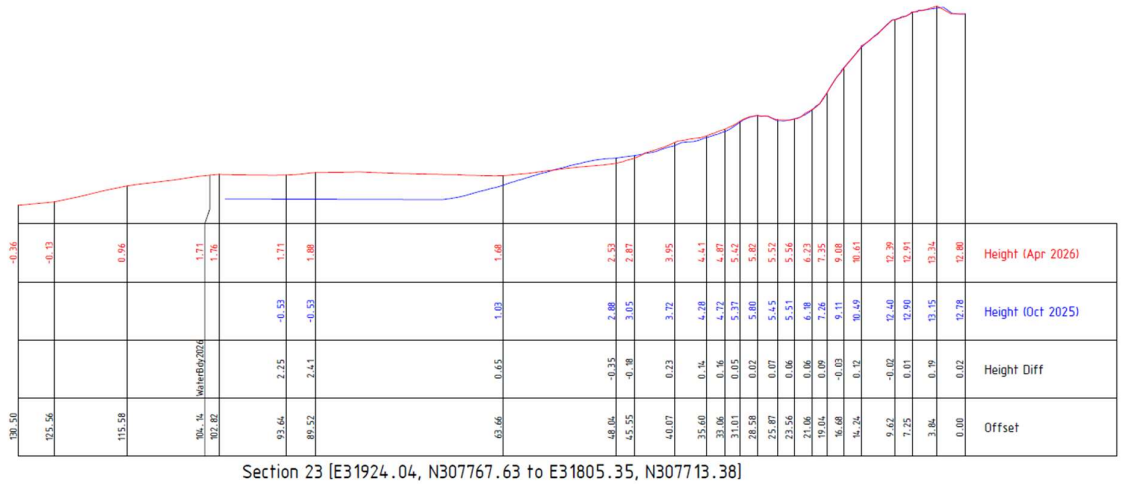


Figure 5-27 Cross section 23 at Yanchep Beach which shows an increase in beach height of up to 2.41m between October 2025 and April 2026.

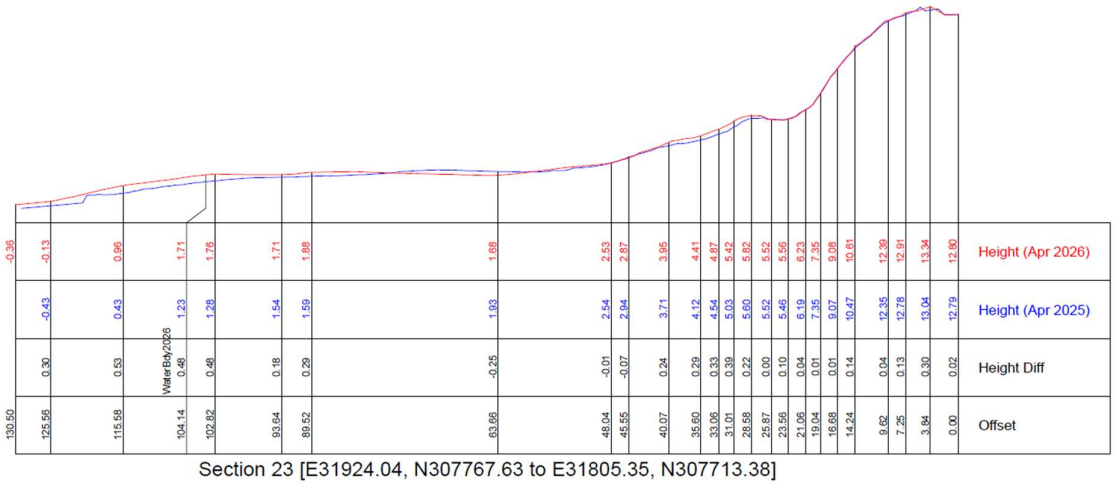


Figure 5-28 Cross section 23 at Yanchep Beach which shows an increase in beach height of up to 0.53m between April 2025 and April 2026.

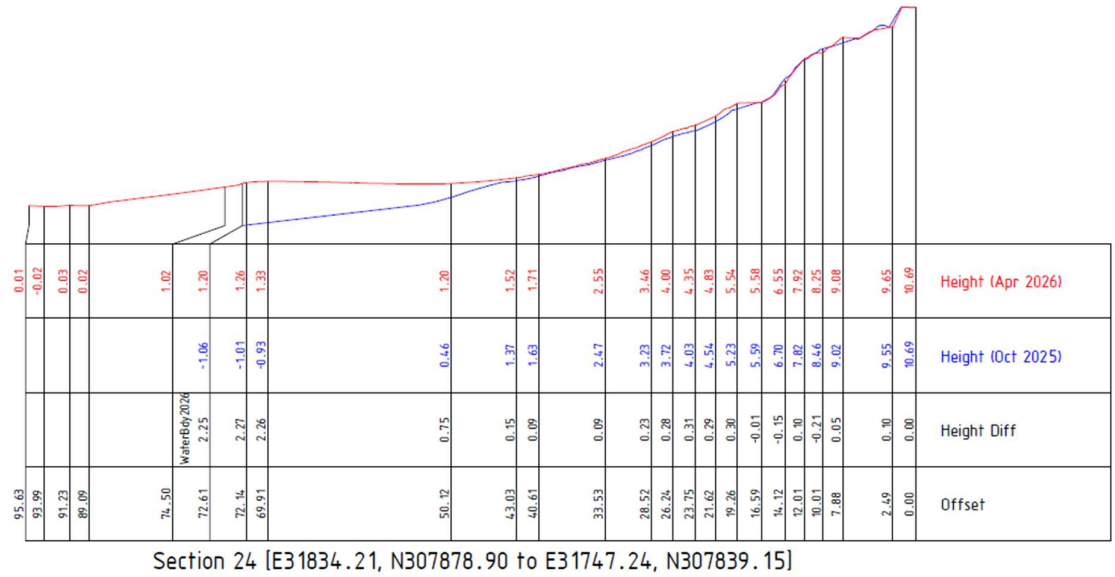


Figure 5-29 Cross section 24 at Yanchep Beach which shows an increase in beach height of up to 2.27m between October 2025 and April 2026.

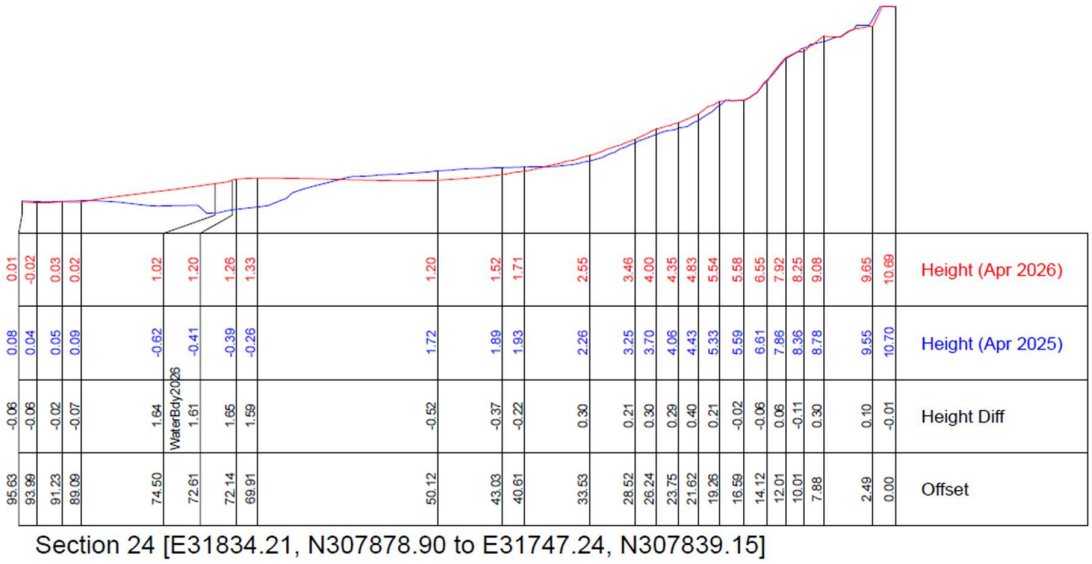


Figure 5-30 Cross section 24 at Yanchep Beach which shows an increase in beach height of up to 1.65m between April 2025 and April 2026.

Yanchep beach cross-sections 20 to 24 are situated within the field of view of manual imagery point Yanchep B07 Up-Coast and Down-Coast and Yanchep B08 Down-Coast. The seasonal cross-sectional surveys show a significant increase in elevation of more than 2m, and up to 2.49m at cross section 21, between October 2025 and April 2026. This is consistent with manual imagery observations which show a significant increase in elevation at this site. The annual beach profiles show more minor changes with an increase in beach elevation of up to 1.65m from April 2025.



Yanchep B07 Up-Coast, October 2025



Yanchep B07 Up-Coast, April 2026



Yanchep B07 Down-Coast, October 2025



Yanchep B07 Down-Coast, April 2026



Yanchep B08 Down-Coast, October 2025



Yanchep B08 Down-Coast, April 2026

Figure 5-31 Manual imagery taken at Yanchep B07 Up-Coast and Down-Coast and Yanchep B08 Down-Coast in October 2025 and April 2026.

Cross Section 31 and 32 – Section 3 and Section 4 – Manual Imagery Site B9 Up-Coast and B10 Up-Coast and Down-Coast

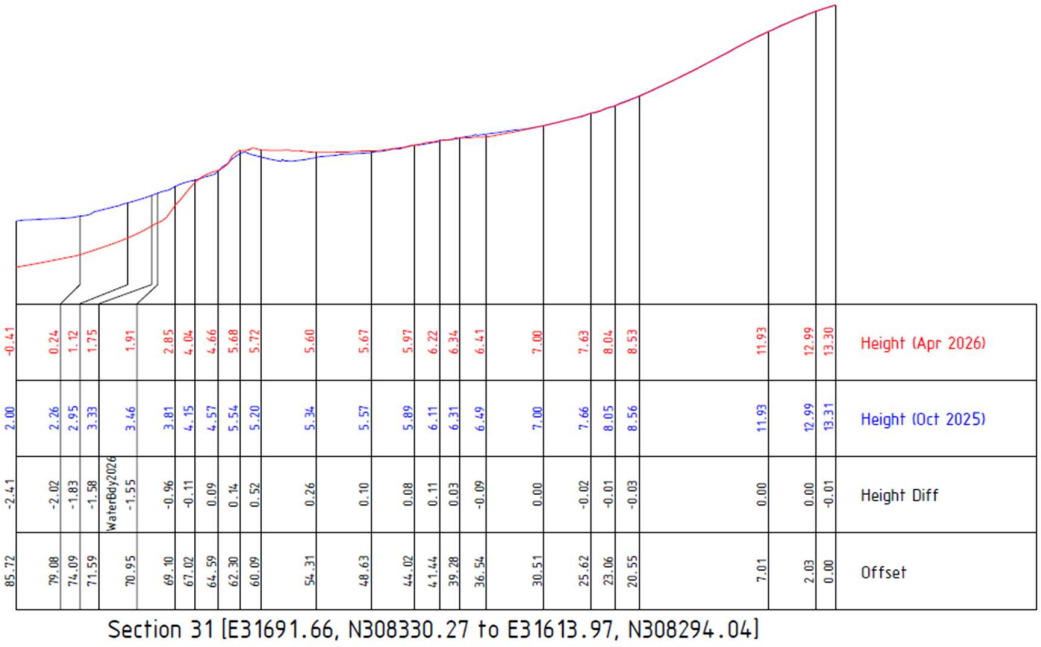


Figure 5-32 Cross section 31 at Yanchep Beach which shows a decrease in beach height of up to 2.41m between October 2025 and April 2026.

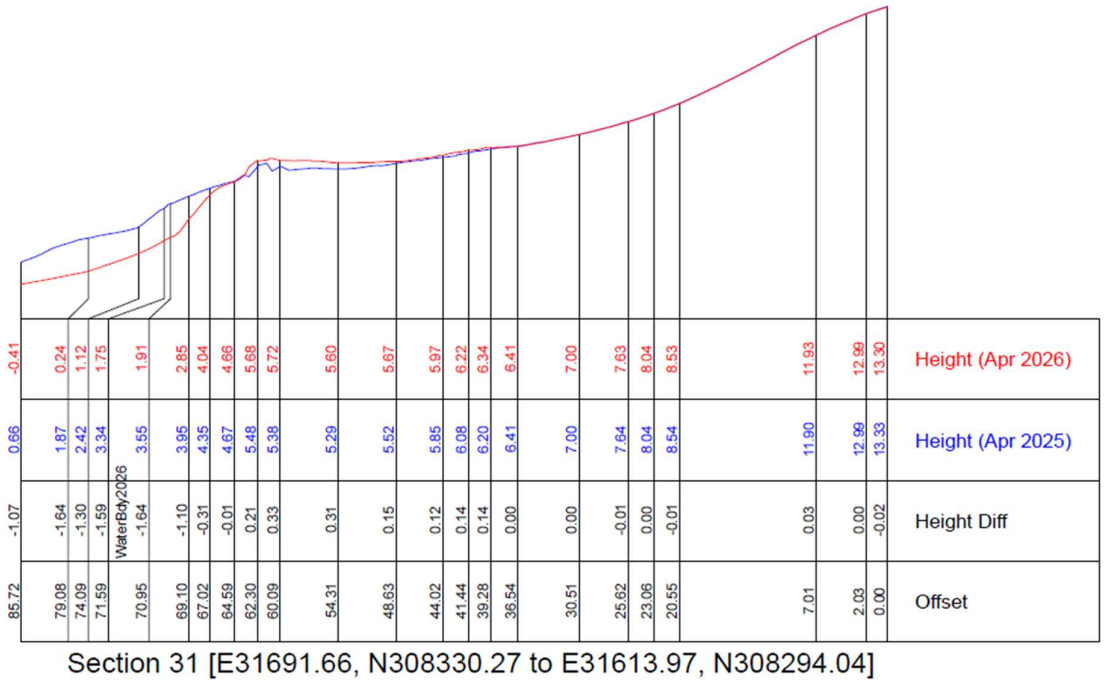


Figure 5-33 Cross section 31 at Yanchep Beach which shows a decrease in beach height of up to 1.64m between April 2025 and April 2026.

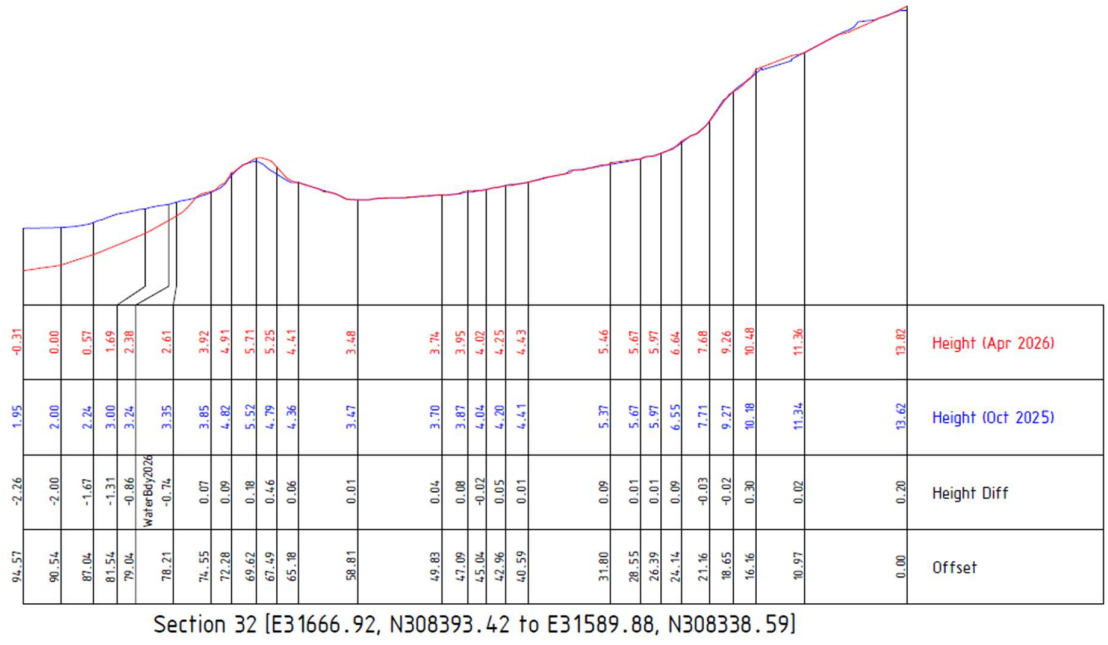


Figure 5-34 Cross section 32 at Yanchep Beach which shows a decrease in beach height of up to 2.26m between October 2025 and April 2026.

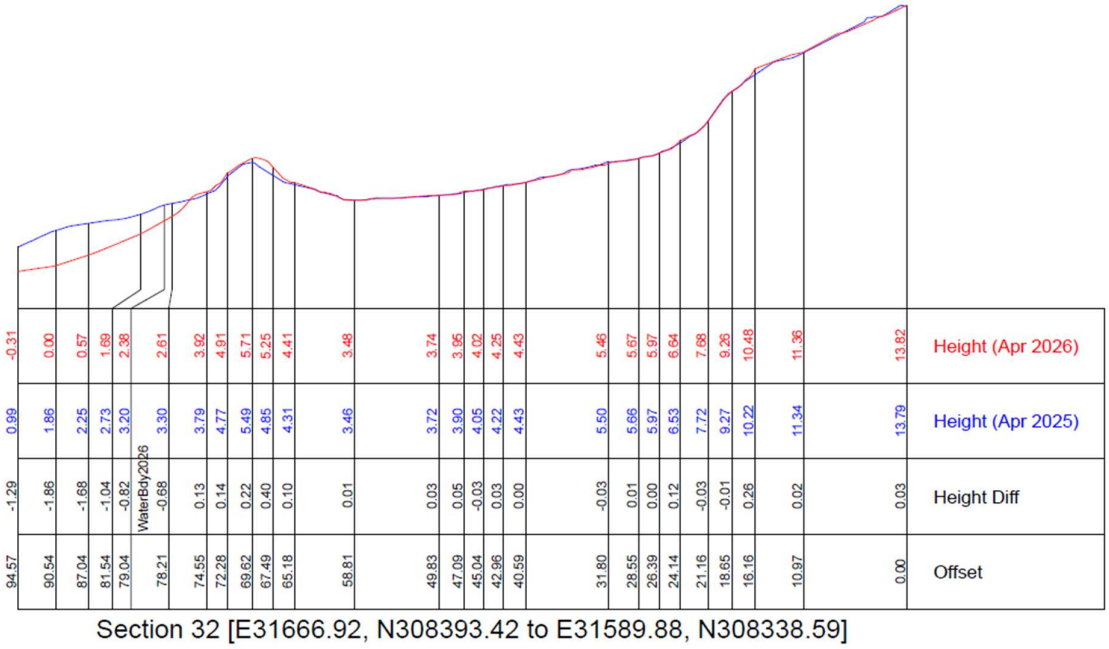


Figure 5-35 Cross section 32 at Yanchep Beach which shows a decrease in beach height of up to 1.86m between April 2025 and April 2026.

Yanchep beach cross-sections 31 and 32 are situated within the field of view of manual imagery point Yanchep B9 Up-Coast and B10 Up-Coast and Down-Coast. The cross-sectional surveys show a maximum decrease in elevation of 2.41m between October 2025 and April 2026. This is consistent with manual imagery observation which shows a significant increase in beach width. Annual surveys show a net decrease in beach elevation of up to 1.86m from April 2025.

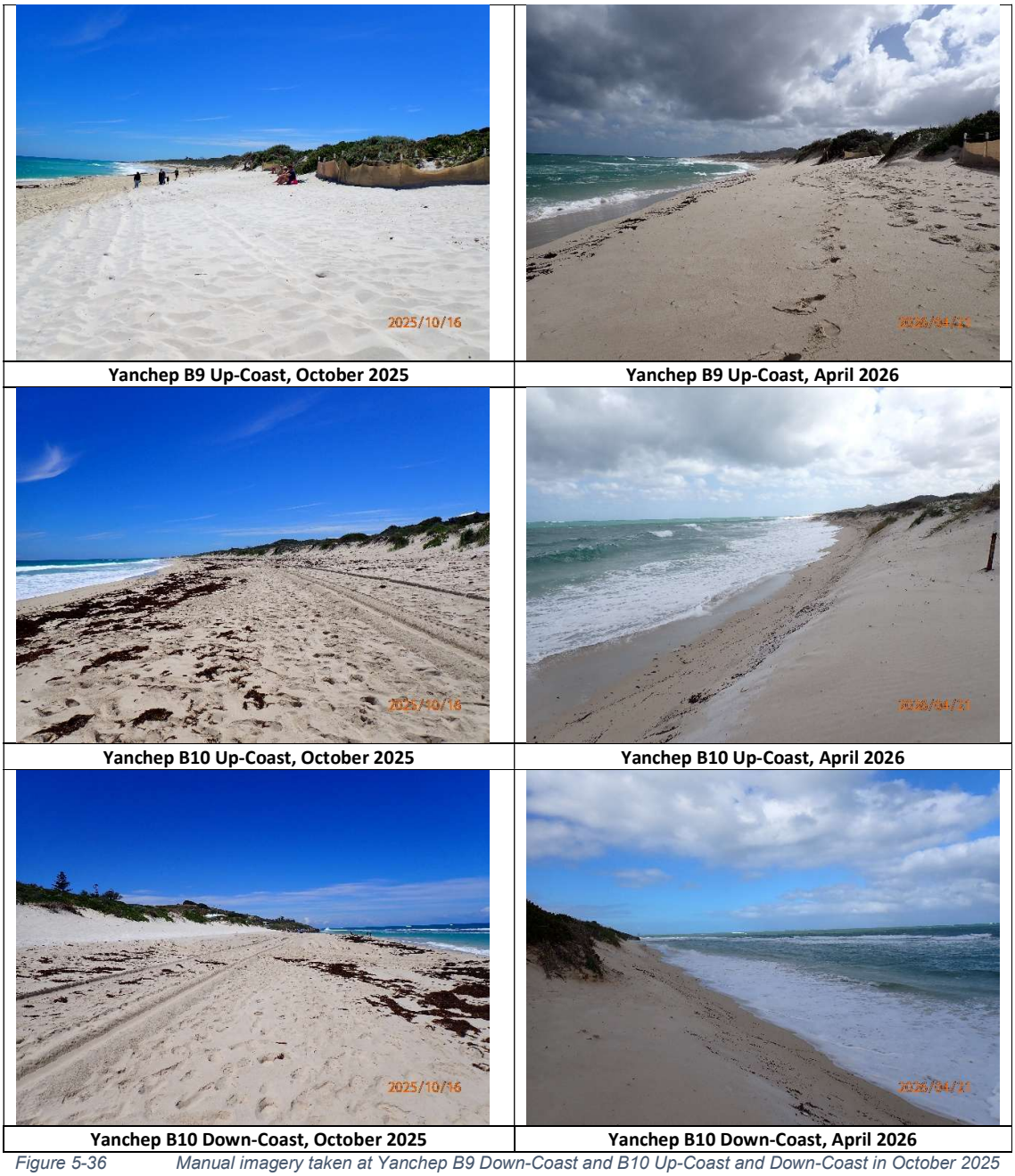


Figure 5-36 Manual imagery taken at Yanchep B9 Down-Coast and B10 Up-Coast and Down-Coast in October 2025 and April 2026.

5.3.1.4 Two Rocks

Cross Section 05 – Section 1 - Manual Imagery Site B07 Up-Coast and Down-Coast

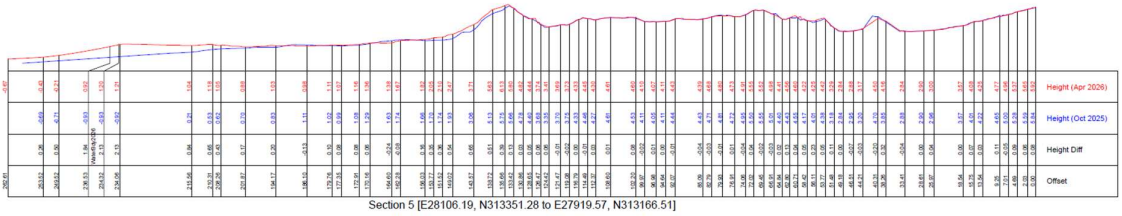


Figure 5-37 Cross section 5 at Two Rocks Beach which shows an increase in beach height of up to 2.13m between October 2025 and April 2026.

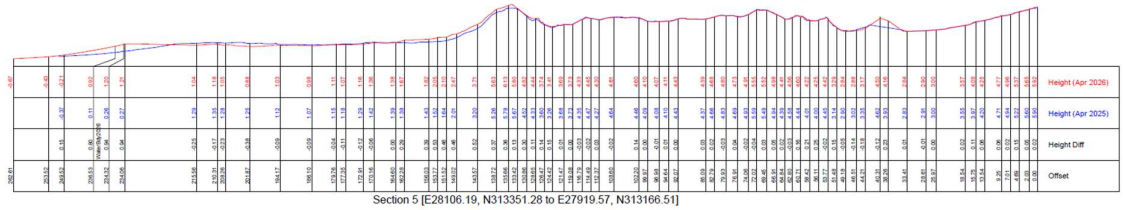


Figure 5-38 Cross section 5 at Two Rocks Beach which shows an increase in beach height of up to 0.94m between April 2025 and April 2026.

The cross-sectional surveys show an increase with 2.13m height difference between October 2025 and April 2026 at this site. The manual imagery appears to show an opposing trend; however, this is due to differences in tidal conditions, with the October 2025 image captured at low tide and the April 2026 image captured at high tide. Annual surveys show minimal changes, indicating that the summer accretion has been balanced by winter erosion.

	
Two Rocks B07 Up-Coast, October 2025	**Two Rocks B07 Up-Coast, April 2026**



Two Rocks B07 Down-Coast, October 2025



Two Rocks B07 Down-Coast, April 2026

Figure 5-39 Manual imagery taken at Two Rocks B07 Up-Coast and Down-Coast in October 2025 and April 2026.

Cross Section 16-17-18 – Section 2 - Manual Imagery Site B04 Up-Coast and Down-Coast

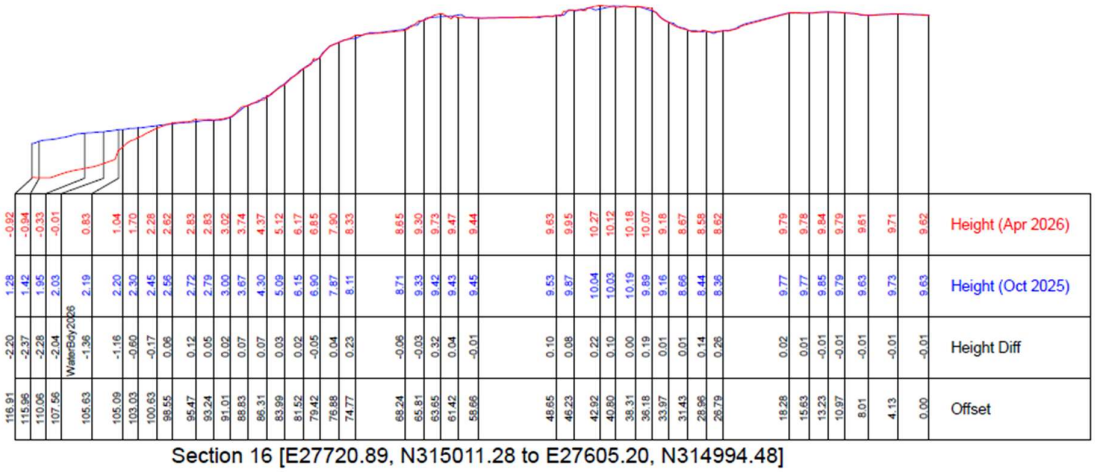


Figure 5-40 Cross section 16 at Two Rocks Beach which shows a decrease in beach height of up to 2.37m between October 2025 and April 2026.

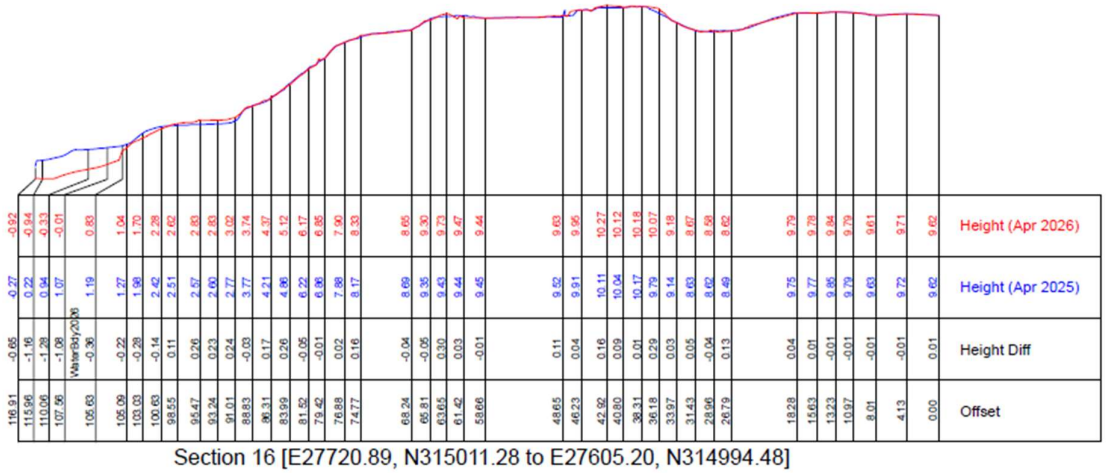


Figure 5-41 Cross section 16 at Two Rocks Beach which shows a decrease in beach height of up to 1.28m between April 2025 and April 2026.

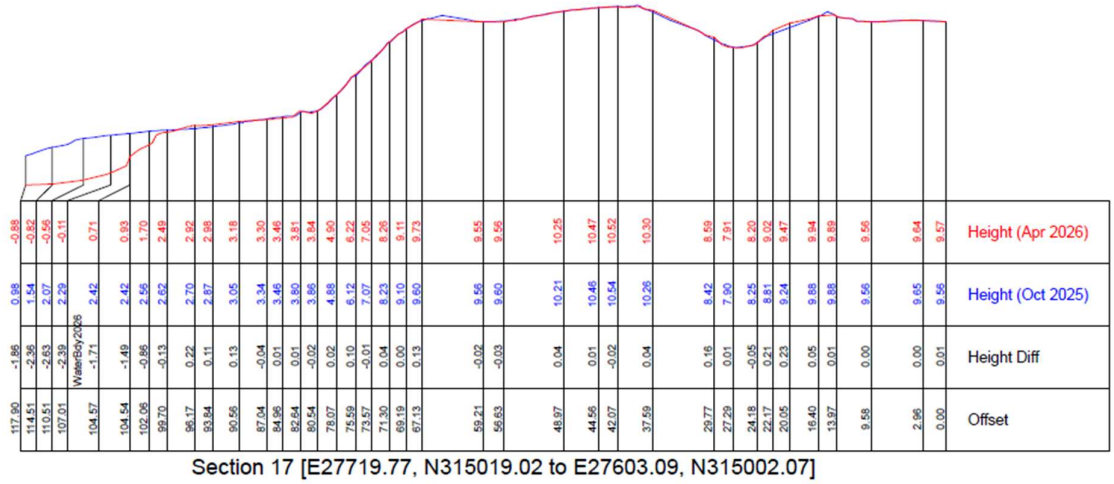


Figure 5-42 Cross section 17 at Two Rocks Beach which shows a decrease in beach height of up to 2.63m between October 2025 and April 2026.

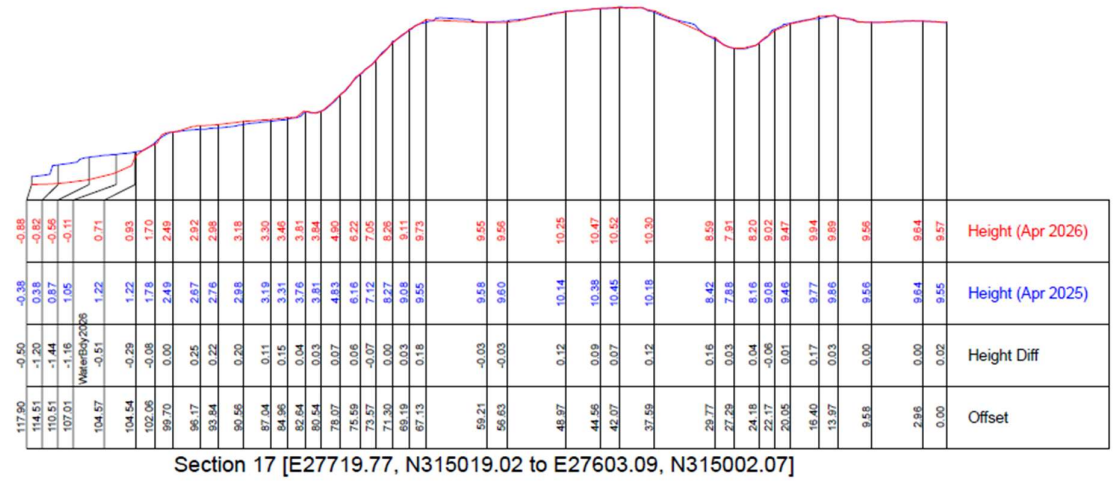


Figure 5-43 Cross section 17 at Two Rocks Beach which shows a decrease in beach height of up to 1.44m between April 2025 and April 2026.

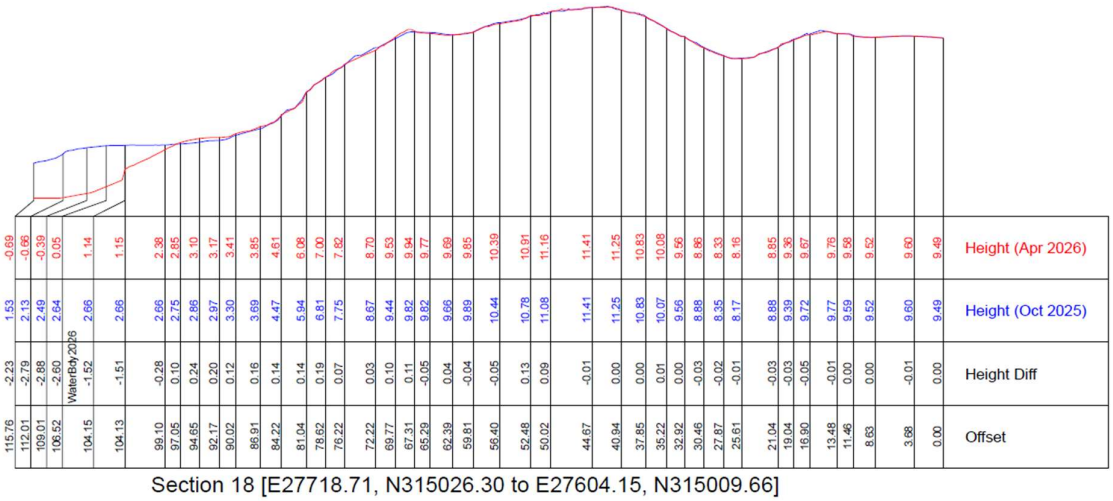


Figure 5-44 Cross section 18 at Two Rocks Beach which shows a decrease in beach height of up to 2.88m between October 2025 and April 2026.

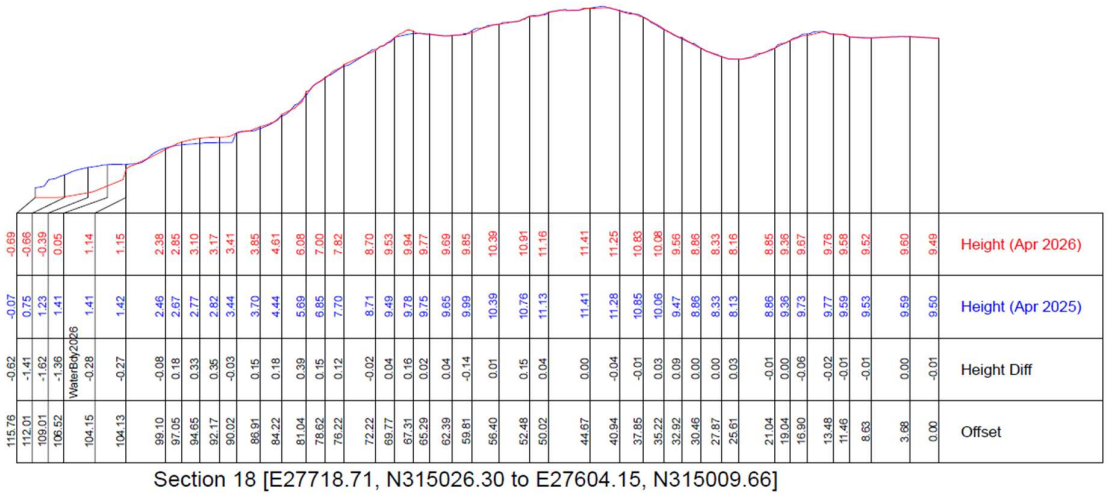


Figure 5-45 Cross section 18 at Two Rocks Beach which shows a decrease in beach height of up to 1.62m between April 2025 and April 2026.

Two Rocks beach cross-sections 16 to 18 are situated within the field of view of manual imagery point Two Rocks B04 Up-Coast and Down-Coast. The cross-sectional surveys show a maximum decrease in elevation of 2.88m difference between October 2025 and April 2026 at this site. This is consistent with manual imagery observations which show a decrease in elevation. Annual surveys show a net decrease in beach elevation of up to 1.62m from April 2025.



Two Rocks B04 Up-Coast, October 2025



Two Rocks B04 Up-Coast, April 2026

	
Two Rocks B04 Down-Coast, October 2025	**Two Rocks B04 Down-Coast, April 2026**

Figure 5-46 Manual imagery taken at Two Rocks B04 Up-Coast and Down-Coast in October 2025 and April 2026.

6 Remote Monitoring

Five remote monitoring cameras were installed along Quinns and Yanchep Beach in November 2021. The location and field of view of the cameras was selected to monitor vulnerable sections of the City's coastline, these locations are presented below in Figure 6-1 and Figure 6-2. The cameras take photographs on the following schedule:

- Camera 1: 6:00 and 19:00 hrs
- Camera 2: 5:00 and 19:00 hrs
- Camera 3: 5:00 and 19:00 hrs
- Camera 4: 6:00 and 19:00 hrs
- Camera 5: 7:00 and 18:00 hrs.

Timelapse videos were created for each camera to assess morphological changes to the coastline between April 2025 to April 2026.

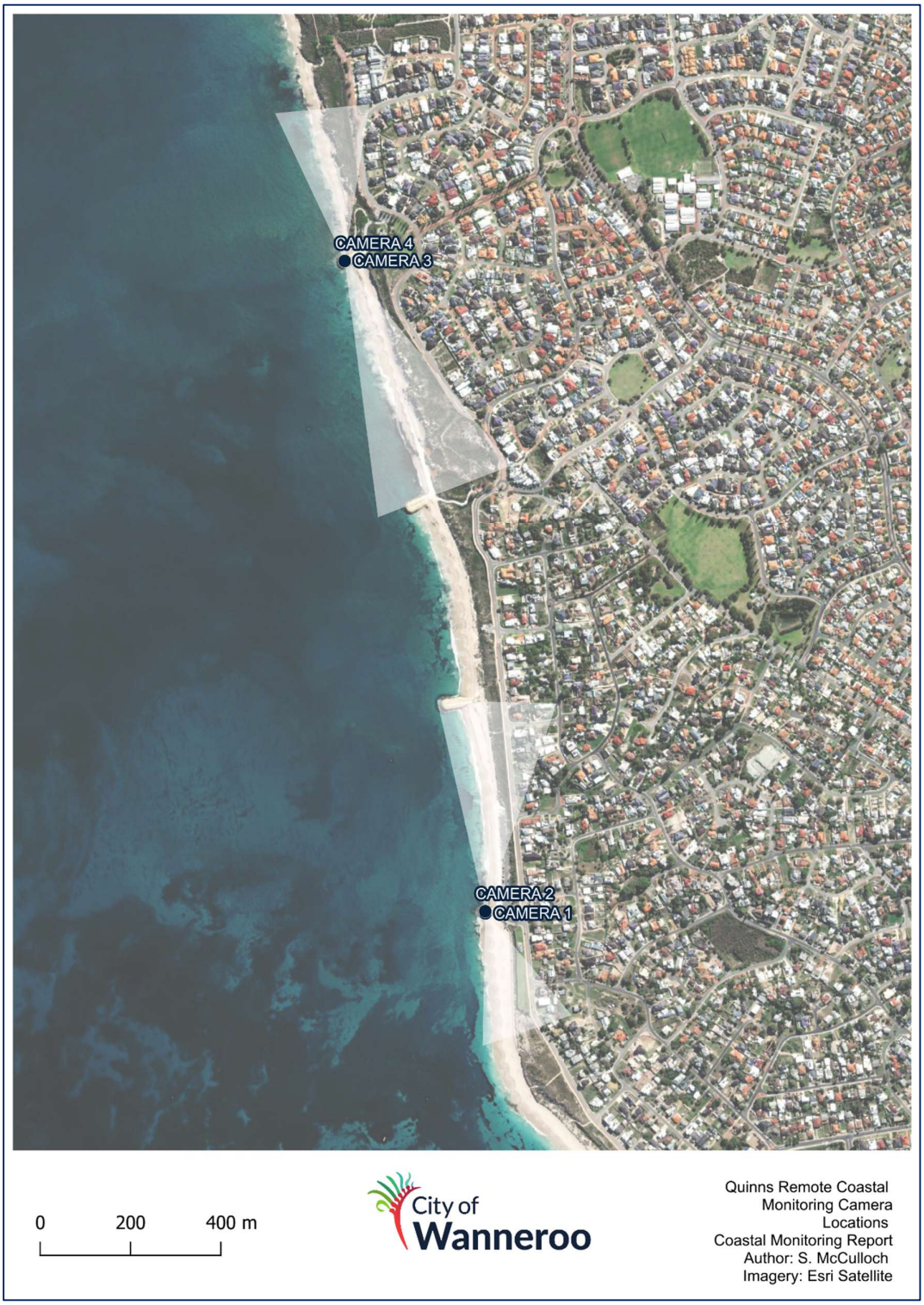


Figure 6-1 Quinns Rocks Remote Coastal Monitoring Camera Locations.

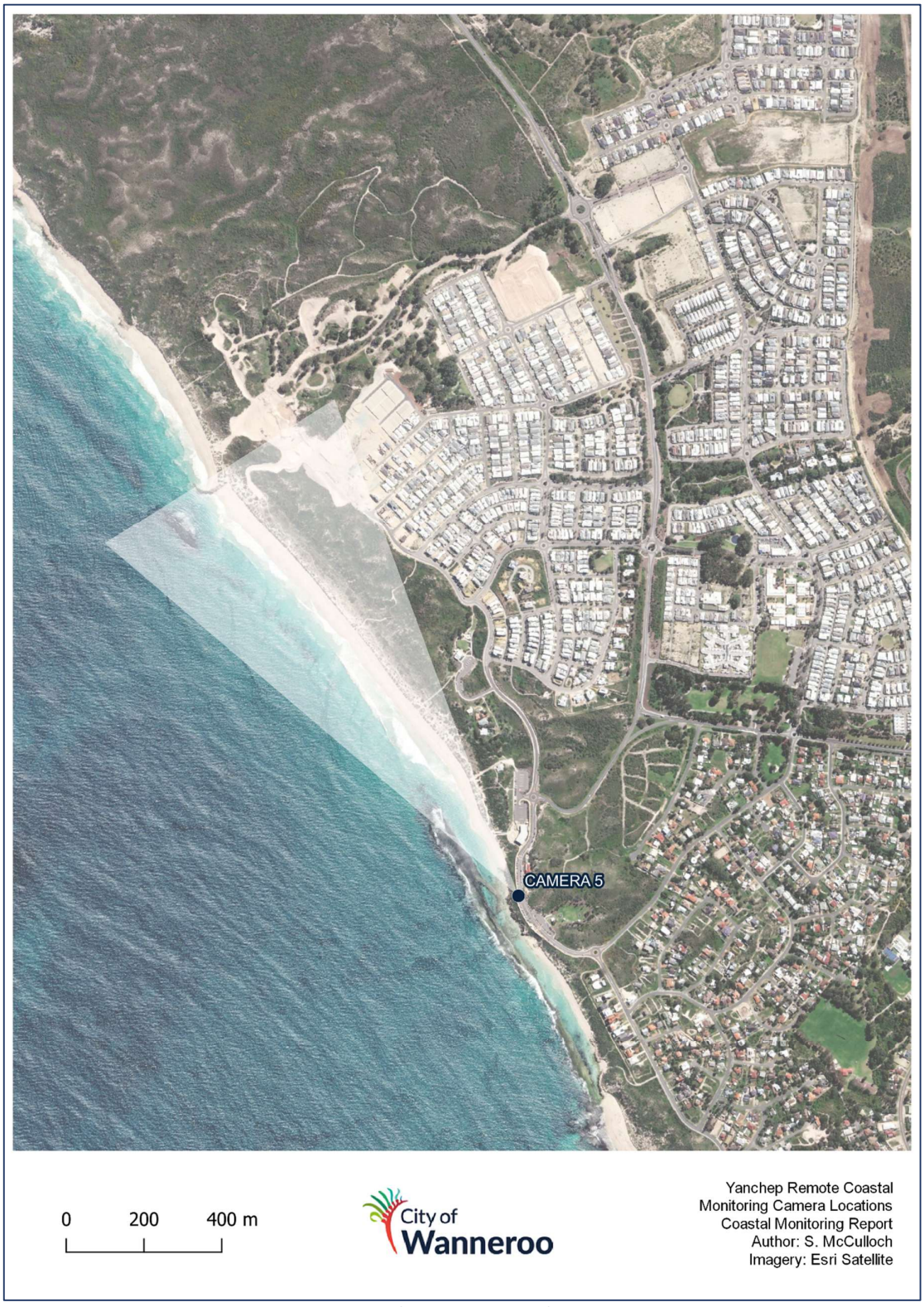
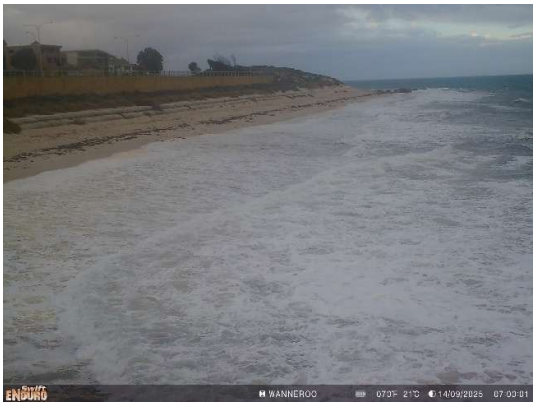


Figure 6-2 Yanchep Remote Coastal Monitoring Location.

6.1 Quinns Camera 1

Quinns Rocks Camera One (1) captures the beach immediately south of Groyne One (1), adjacent to the GSC Revetment. Images are taken every hour between 6am and 7pm. In the last monitoring period, there were two gaps in the timeseries data with no imagery collected between 2pm 15 May 2025 to 8am 7 June 2025 and between 8pm 12 November 2025 to 10:12am 21 January 2026.

The time series of images taken from Quinns Camera 1 between April 2025 and April 2026 show the beach eroding between May until September 2025 as winter storms mobilise sediment away from the beach face and transport sediment southward, to Quinns Main Beach. Hourly imagery then shows this beach section building up again as sea breezes transport sediment to the north where it builds up to the south of Groyne 1, reaching its most accreted position by the middle of February 2026. Imagery from Camera 2 (Section 6.2) shows sediment bypassing Groyne 1 and feeding the beach to the north of the Groyne after October 2025 until the end of the monitoring period in April 2026.



Most receded position – 14 September 2025

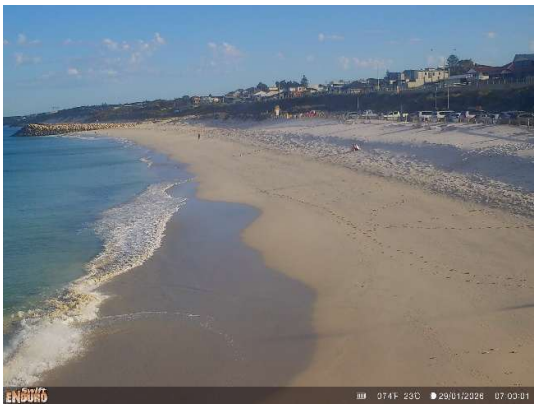


Most accreted position – 18 February 2026

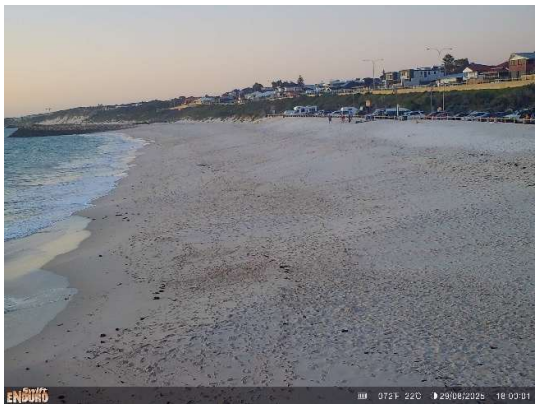
Figure 6-3 Most receded and most accreted shoreline position to the south of Quinns Groyne 1 during the study period.

6.2 Quinns Camera 2

Quinns Rocks Camera Two (2) captures the beach immediately north of Groyne One (1), adjacent to the Frederick Stubbs Carpark. Hourly images from the camera show the beach eroding over December 2025 throughout January. Accretion of the beach in the summer period is not expected, as prevailing southerly to south-westerly winds generally transport sand north where it is deposited to the south of the Groyne Two (2). It is believed that the build up to the south of Groyne One (1) has resulted in bypassing of sand around Groyne One (1) and onto the beach, adjacent to the carpark. The city undertook nourishment in front of the carpark in May 2025, where 3000 tonnes of sand was placed at the beach to provide a buffer against the impact of winter storm events and create a safe and accessible beach for the public.



Most receded position – 15 January 2026



Most accreted position – 29 August 2025

Figure 6-4 Most receded and most accreted shoreline position to the north of Quinns Groyne 1 during the study period.

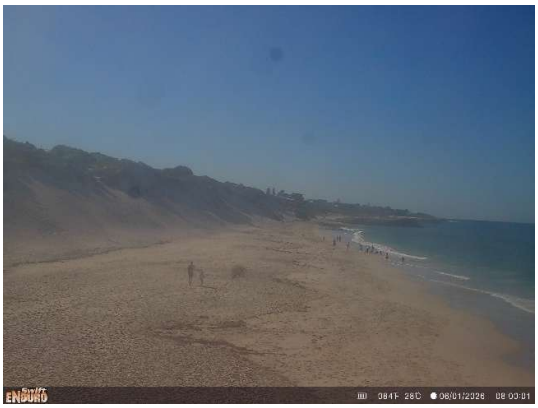
6.3 Quinns Camera 3

Quinns Rocks Camera Three (3) monitors the beach and dunes to the south of Quinns Rocks Groyne Four (4). At the start of the monitoring period, in April 2025, there is a wide beach and the dunes are in good condition. During the winter period, winter storm events appear to have mobilised sand away from the dry beach face resulting in exposure of limestone bedrock on the beach (beginning at the end of May 2025) and a narrow beach with a notable erosion scarp at the base of the dune by June 2025 (Figure 6-5). The most receded shoreline position was observed in August 2025, following a storm event, which resulted in exposure of limestone bedrock on the beach.

As summer sea breezes commence in October 2025, the beach area immediately south of Groyne 4 builds up as sediment is transported away from Groyne 3 to the south of Groyne 4. The City completed beach scraping at this site in late November 2025 where sand that had built up to the south of Groyne 4 was taken from the nearshore and placed along the base of the dune system. The beach to the south of Groyne 4 continues to build up until January 2026. From February 2026, the beach immediately south of Groyne 4 begins to erode. This is possibly due to sand bypassing Groyne 4 to the north, limiting sand availability within the compartment between Groyne 3 and Groyne 4. Another beach scraping was undertaken at this site in mid-February 2026. Over the 2025/2026 Summer period, a total of ~1,000 to 2,000m3 of sand was utilised in beach scraping activities to assist in addressing erosion south of Groyne 4.



Most receded position – 24 August 2025



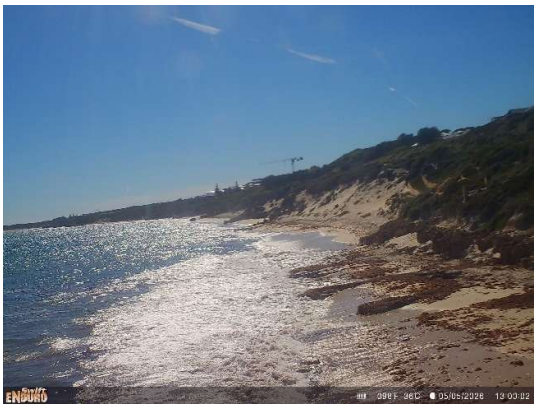
Most accreted position – 4 January 2026

Figure 6-5 Most receded and most accreted shoreline position to the south of Quinns Groyne 4 during the study period.

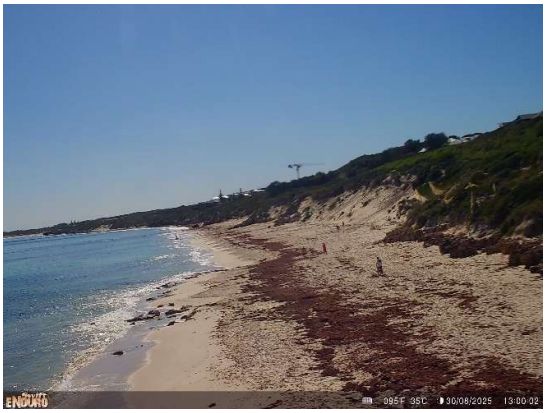
6.4 Quinns Camera 4

Quinns Camera 4 captures hourly imagery of the beach to the north of Quinns Groyne 4, along the northern Quinns Dog Beach. In the last monitoring period, there was a gap in the timeseries data with no imagery collected between 15:00pm 18 February 2025 to 17:23pm 13 May 2025.

Seasonal erosion over the summer months is expected in this area as prevailing southerly winds generally transport sand to the north, away from the Groyne. A review of hourly imagery shows the beach building up across the 2025 winter period as north-westerly storm events transport sand southward where it builds up against the Groyne. The beach then appears to erode across the 2025/26 summer months until the end of the monitoring period. The city undertook nourishment north of Groyne 4 in May 2025, where 4000 tonnes of sand was placed at the beach to provide a buffer against the impact of winter storm events and create a safe and accessible beach for the public. This beach section continued accreting until the last recorded date before the gap on the 23rd of October.



Most receded position – 5 May 2026



Most accreted position – 30 August 2025

Figure 6-6 Most receded and most accreted shoreline position to the north of Quinns Groyne 4 during the study period.

6.5 Yanchep Camera 5

The Yanchep Camera captures hourly images of Yanchep Lagoon Beach, which is bound by a rocky headland to the south and a small rock groyne to the north with a fringing reef system in the nearshore. At the start of the monitoring period, the beach is wide and accessible, particularly to the south, however throughout the winter period the beach to the south is eroded by winter storm events that mobilise sediment away from the beach face. The July 2025 storm events resulted in significant erosion at this site leaving the beach with a steep beach face and significant erosion scarp as per Figure 6-7.

Following the July storm events, the southern beach section begins to build out across the remainder of the 2025 winter period.
Throughout the early summer period, between November and January, the beach width appears to remain consistent until sediment appears to bypass the southern rocky headland and feed the southern section of Yanchep Lagoon Beach, leaving the beach in its most accreted position by the end of the monitoring period.

	
Most receded position – 21 July 2025	Most accreted position – 30 April 2026

Figure 6-7 Most receded and most accreted shoreline position at Yanchep Lagoon Beach.

7 Aerial Imagery

Aerial imagery obtained from Nearmap and captured during the six-monthly LiDAR surveys is used to assess changes to the CoW coastline.

The improved temporal resolution of aerial imagery allows us to assess the condition of the coastline throughout the year, unlike manual imagery, where we are limited to only two snapshots in time. Analysis of aerial imagery is limited to the visual assessment of changes to the coastline, which, in this instance, is defined as the shoreline.

During the study period, from April 2025 to April 2026, a total of 8 aerial images of the sites were available.

Table 7-1 Date of Aerial Images

Imagery Date	Imagery Time	Source	Water Level at Time of Monitoring (Fremantle Tide Gauge – mAHD)	Wave Height at Time of Monitoring (Rottnest Island Wave Station – m)
10 May 2025	1:17 PM to 3:04 PM	Nearmap	0.32 to 0.2	1.24 to 1.3
5 July 2025	1.26 PM to 2.29 PM	Nearmap	0.19 to 0.09	1.79 to 1.81
13 July 2025	12:41 PM	Nearmap	0.56	2.13 to 2.29
26 July 2025	10:07 AM to 10:45 AM	Nearmap	0.41 to 0.46	1.77 to 1.93
30 August 2025	10:05 AM to 12:13 AM	Nearmap	-0.24 to -0.38	0.8 to 0.97
29 November 2025	12:55 PM to 2:47 PM	Nearmap	-0.17 to -0.23	1.56 to 1.78
31 January 2026	7:58AM to 10:02AM	Nearmap	-0.21 to -0.43	1.6 to 1.76
3 April 2026	9:09AM to 11:05AM	Nearmap	0.35 to 0.41	1.42 to 1.54

7.1 Assessment Methodology

Similar to the analysis of remote imagery, aerial and satellite imagery is assessed through visual assessment.

Visual assessment allows for the identification of major erosion or accretion periods and is used to determine the most advanced and receded shoreline position during the observation period. Visual assessment also allows for the identification of additional vulnerable coastline areas that may require more detailed assessment in future coastal monitoring reports. Images obtained throughout the observation period are all loaded into QGIS software, georeferenced and assessed individually.

7.2 Results

For assessment purposes, the coastline has been divided into fourteen discrete areas as outlined in Table 7-2. The most advanced and most receded shoreline position was identified for each discrete area.

Table 7-2 Most advanced and receded shoreline positions as identified through aerial imagery review.

Area	Most Receded Shoreline Position	Most Advanced Shoreline Position
Clayton's Beach	26 July 2025	3 April 2026
Quinns Main Beach	30 August 2025	31 January 2026
Quinns – GSC Revetment	5 July 2025	31 January 2026
Quinns – Groyne 1 to Groyne 2	5 July 2025	3 April 2026
Quinns – Groyne 2 to Groyne 3	5 July 2025	31 January 2026
Quinns – Groyne 3 to Groyne 4	26 July 2025	31 January 2026
Jindalee	5 July 2025	31 January 2026
Eden Beach	5 July 2025	31 January 2026
Shorehaven	5 July 2025	31 January 2026
Eglinton Beach	5 July 2025	31 January 2026
South Yanchep	3 April 2026	31 January 2026
North Yanchep	5 July 2025	31 January 2026
South of Two Rocks Marina	30 August 2025	3 April 2026
North of Two Rocks Marina	30 August 2025	31 January 2026

The most receded shoreline position along several beaches was observed after the storms of July 2025 Sediment deficit is expected at these sites during the winter months.
Conversely, many of the sites had advanced shoreline positions at the end of the monitoring period, or at end of January 2026 where sediment was transported southward, building up against any natural rocky headlands or hard infrastructure to the south.
Some areas experienced the most receded and advanced shoreline positions outside of the survey periods (April and October). This indicates that while seasonal assessment of beach volume changes as detailed in Section 5 are indicative, they do not necessarily capture the total seasonal beach volume change for each area. Further assessment of satellite, aerial and remote imagery allows for the identification of the most appropriate time for surveys to capture the most accurate seasonal changes in beach volumes.

8 Particle Size Distribution Campaign

In April 2026, the City undertook a coastline-wide sand sampling campaign to establish baseline beach sediment conditions and support future beach nourishment planning. Sand samples were collected from 30 locations across the City's coastline, with samples obtained from the dune, beach face and swash zone at each site.

The assessment examined sand grain size, colour and mineral composition. Detailed methodology and results are provided in the *Particle Size Distribution Campaign Memorandum* (Appendix B)

8.1 Key Findings

The investigation found that beach sediments are generally consistent across much of the City's coastline and are predominantly medium-grained sand (Figure 8-1). While some local variation occurs, particularly in the sourthern part of the coastline (Vlamingh Sediment Cells 29a and 29c), sediment characteristics were broadly similar between most locations.

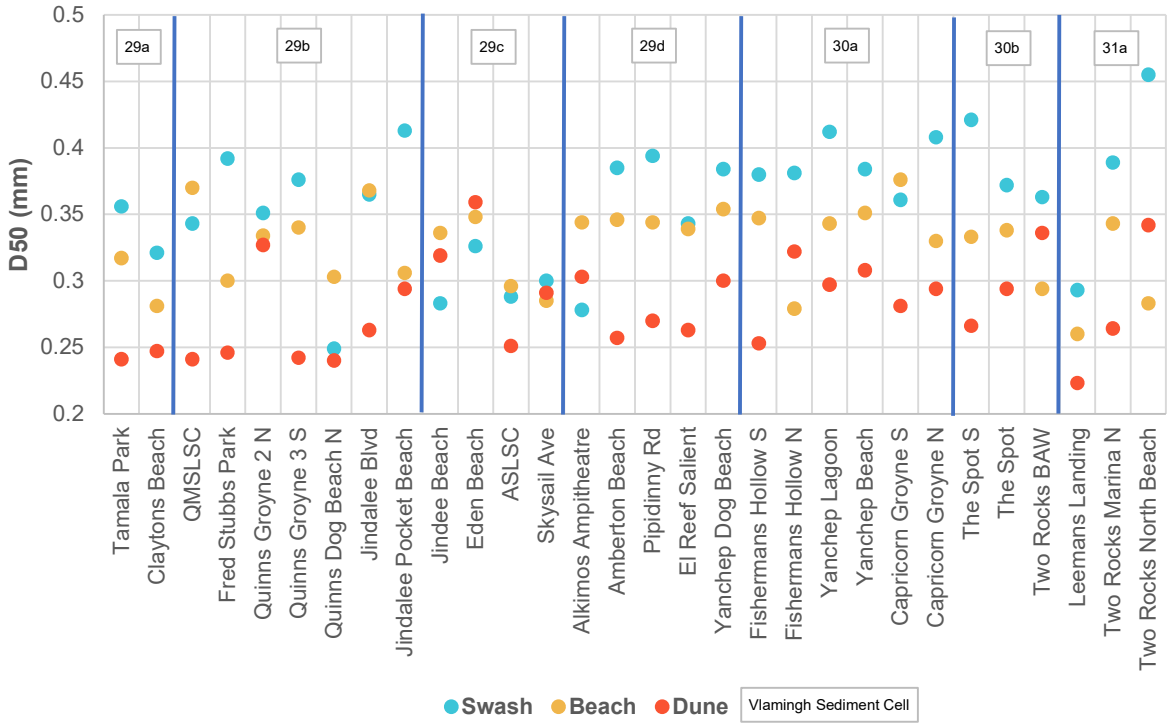


Figure 8-1 Median grain size (D50) along the City's coastline (ordered from north to south and grouped by Vlamingh Sediment Cell).

Analysis of grain size distribution identified two distinct nourishment areas (Figure 8-2). Sediments within Vlamingh Sediment Cells 29a and 29c were generally finer than those found elsewhere along the coast.

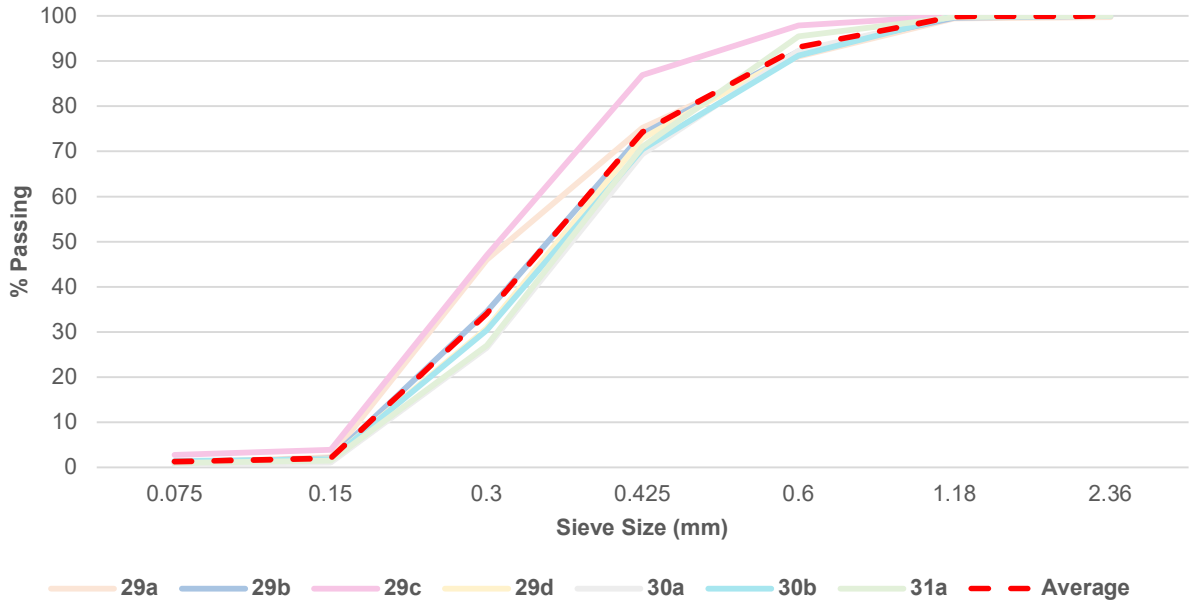


Figure 8-2 Average grain size distribution for each sediment cell and overall average.

Sand colour was predominantly light coloured across the coastline, with darker sands generally occurring in the swash zone where sediment remains regularly wetted by wave action (therefore lower exposure to sunlight and reduced ultraviolet bleaching compared with beach and dune environments). The Quinns Beach area exhibited uniformly white beach and dune sand compared with much of the remaining coastline. This trend is believed to reflect the influence of ongoing beach nourishment activities, which have placed over 179,000 tonnes of imported sand since 2014.

Mineralogical analysis confirmed that the City's beaches are primarily composed of mixtures of quartz and carbonate sands (Figure 8-3). The elevated quartz content at Quinns Beach is likely linked to historical nourishment activities using sand sourced from inland Spearwood Dune System quarries, which are characteristically quartz-rich. This is to be confirmed by testing a quarry sample from a recent nourishment campaign.

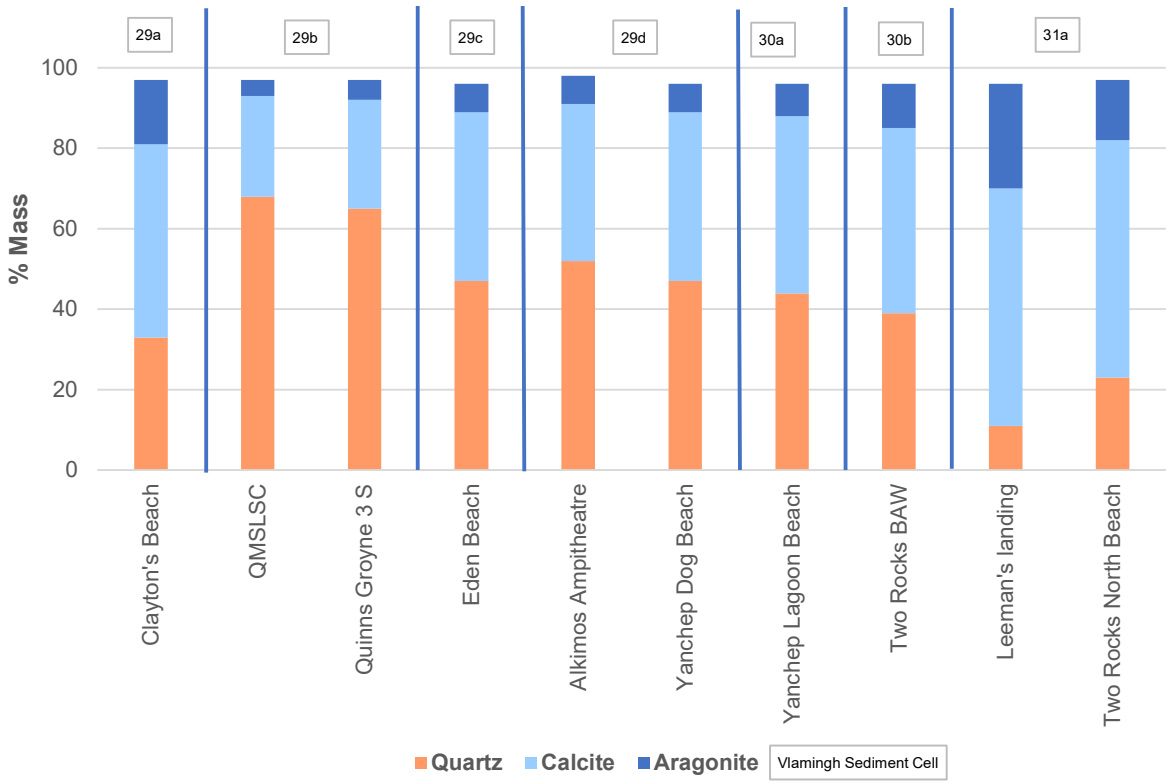


Figure 8-3 Mineral composition of sand samples.

This investigation has provided a comprehensive baseline dataset describing sediment characteristics along the entire coastline. The results will assist the City in sourcing compatible sand for future beach nourishment projects and provide a benchmark for future monitoring of coastal change.

Refer to Appendix B for detailed methodology, results and recommended nourishment sediment specifications.

9 Results and Recommendations

9.1 Seasonal Changes

Areas that experienced major seasonal changes were identified via manual imagery and then further assessed via the analysis of beach cross-sections. These areas are as follows.

1. **Fisherman's Hollow Beach:** Fisherman's Hollow Beach, south of Yanchep Lagoon, experienced major accretion between October 2025 and April 2026 but less than previous years. Seasonal survey cross-section comparisons show an increase in elevation just before the water line of 2.49m in 2025/2026 summer. It also experienced a summer net volume change between October 2025 to April 2026 of 26,451 m^3 below the waterline. This area is subject to large seasonal changes including erosion during the winter period. While the dunes appear always to be in good condition, residential houses and road infrastructure are in close proximity to the site and could, in future, be susceptible to the effects of coastal erosion. It is recommended that this area is closely monitored moving forward.

2. **Yanchep Lagoon:** between Yanchep Lagoon and south of Capricorn Groyne, experienced major erosion between October 2025 and April 2026. Seasonal survey cross-section comparisons show a maximum reduction in elevation just before the water line of 2.41m in 2025/2026 summer.

3. **South of Two Rocks Marina:** The area immediately south of the Two Rocks Marina experienced major accretion between October 2025 and April 2026. Manual imagery analysis could not pick this increase but beach cross section analysis noted a major increase up to 2.13m in beach elevation before the water line. It also experienced a summer net volume change between October 2025 to April 2026 of 61,152 m^3 between the beach area and below the waterline.

4. **North of Two Rocks Marina:** The area immediately north of the Two Rocks Marina experienced major erosion between October 2025 and April 2026. Manual imagery analysis and beach cross section analysis noted a major reduction in beach width, and a reduction of 2.88m in elevation just before the water line.

5. **South of Quinns Rocks Beach:** The southern most area of the beach experienced major erosion between October 2025 and April 2026. Manual imagery analysis and beach cross section analysis noted a major reduction in beach elevation. And a decrease of 2.62m in elevation after the water line. Erosion at this site is likely a result of strong sea breeze conditions which drive northward sediment transport. This site is bound by a rocky headland and significant fringing reef system to the south.

6. **Quinns Rocks Beach GSC Revetment South of Groyne One (1):** Major accretion over 2025/2026 summer period is evident through the manual imagery analysis of the beach immediately south of Quinns Rocks Groyne One (1). Seasonal beach cross sectional analysis also shows a maximum increase in elevation of 1.43m just before the water line. As this is an area that is known to experience significant accretion and erosion annually and has caused major maintenance issues in the past, both accretion and erosion at this location are not unexpected. The GSC Revetment was constructed in 2014 and prevents coastal erosion effects from impacting infrastructure.

7. **Quinns Rocks Beach South of Groyne Four (4):** A significant increase in beach width noted at Quinns Rocks Dog Beach immediately south of Groyne Four (4) in the April 2026 manual images.

Beach cross-section analysis noted an increase in elevation of 2.13 m in the dune area at this location.

8. **Clayton's Beach:** Clayton's Beach in Mindarie is bound by the Mindarie Breakwater to the north which interrupts longshore transport trapping sand within the beach leading to significant seasonal accretion over the summer months. Seasonal accretion is expected at this site each year, with a total beach volume gain of 72,765 m^3 reported for the 2025/2026 summer period. Major changes in width were clearly observed at this site via manual imagery. Furthermore, survey cross sections show an increase of 2.16m between the October 2025 and April 2026 surveys.

9.2 Annual Change

Changes in beach volumes between April 2025 and April 2026 were assessed via LiDAR survey elevation difference plots, volume change calculations and beach transect cross section comparisons produced by MNG Surveys. The beach volume change estimates developed by MNG (Table 5-2) show that, while there was net volume gain for all the Sections above the waterline, there was a net volume loss for almost all the Sections below the waterline. Sediment from below the waterline was likely transported above the waterline across the summer season from cross shore sediment transport.

Overall, there was an accretion in beach volume across the Yanchep coastline for the year with the net beach volume gain within beach section 1A, 2A and 4A being particularly notable. Due to the mild winter weather and strong summer sea breeze conditions, there was a slight net accretion in beach volume within the beach compartment south of the headland, known as Fisherman's Hollow. This section of beach is bound by two rocky headlands to the north and south and a nearshore fringing reef. Sediment transport along the Yanchep coastline will be assessed in more detail as part of the Yanchep Coastal Management Study.

Notably, there was also a significant net beach volume gain in Two Rocks Section 1A and Clayton's Beach Section 1A. Theses sections are bound by the Two Rocks Marina and the Mindarie Marina Breakwater to the north respectively, which interrupt longshore sediment transport trapping sand within the above Sections. Similarly to Quinns Sections 1A, sediment was likely transported to this area across the summer season as a result of strong summer sea breezes driving northward sediment transport.

9.3 Long-term Changes

From manual imagery

Long-term changes to the shoreline were assessed via manual imagery where, in Quinns Rocks and Two Rocks, April 2026 images were compared to images taken at the same location in April 2014, allowing for an assessment of long-term changes of the coastline from up to ten years prior. At Yanchep, the earliest recorded monitoring images were taken in October 2018 following significant coastal erosion events and therefore the long-term changes of the coastline can only be assessed from up to seven years prior.

There were no manual imagery sites identified as having experienced major long-term erosion. It can be difficult to identify long-term erosion from visual assessment of manual imagery alone and, it is therefore recommended that long-term morphological changes be assessed and identified through the analysis of various data sources including the assessment of long-term shoreline change.

From LIDAR and Ground Based Transect Surveys

Long-term trends in erosion and accretion were assessed by analysing historic surveyed net beach volume changes.

Clayton's Beach

There has been a notable increase in net beach volume immediately south of the Mindarie breakwater since October 2021 with the exception for October 2024. Strong sea breezes observed throughout the seasonal summer periods and mild winters have likely contributed to increased sand build up along this section of coastline.

Quinns Rocks Beach

Long-term trends for Quinns Rocks Beach show a significant increase in the beach sections north of the Quinns Rocks Artificial Headland since October 2025 relative to the same period in other years. Another notable observation is the overall reduction in beach volume observed within Quinns Section 5 in each study period since 2020 (with the exception of October 2022 and 2023), was reversed this study period. The City has placed approximately 34,000m^3 of sand within this beach section since 2020 as part of the City's ongoing Beach Renourishment Program and has recently started to undertake regular nearshore beach scraping at this site since 2023. It is recommended that this site continue to be closely monitored as Ocean Drive and associated public and private infrastructure is located less than 100m from the base of the dune and could be impacted by continued coastal erosion.

Yanchep

Consistent with the trends observed between April 2024 and October 2024, there was a general increase in beach volume between October 2024 and April 2026, indicating net accretion across much of the Yanchep coastline. The magnitude of accretion was generally lower than that recorded in previous years. This may be attributable to weaker summer sea breeze conditions, which typically drive northward sediment transport and promote sediment retention within individual beach compartments. However, further analysis is required to better understand the sediment transport processes operating along the Yanchep coastline. It is anticipated that additional data collection and the numerical sediment transport modelling being undertaken as part of the Yanchep Coastal Management Study will improve our understanding of sediment transport pathways and coastal processes within the study area.

Two Rocks

Similarly to observations made for Claytons Beach (Figure 5-1), a continuous increase in beach volume was recorded from April 2025 and April 2026 at Two Rocks Section 1. However, the magnitude of accretion was lower than that observed in previous years, likely for the same reasons discussed for the other beaches. Under relatively calm winter conditions and the influence of strong summer sea breezes, there is typically a net northward transport of sediment over the annual monitoring period. As the Two Rocks Marina breakwater interrupts this northward sediment transport pathway, significant accumulation of sand is expected on the southern side of the structure. The observed increase in beach volume at Section 1 is consistent with this process. A similar trend was observed at Section 2, although the magnitude of volume change was smaller. This is likely because Section 2 is located further south of the marina and is therefore less directly influenced by sediment trapping associated with the Two Rocks Marina breakwater.

9.4 Notable Erosion Events

Due to the relatively calm winter conditions, there were no significant acute erosion events across the 2025 winter period. The most notable winter storm events were observed on the 21st of June 2025, 7th of July 2025 and 3rd of August 2025 which recorded peak significant wave heights of 6.36m, 6.25m and 7.48m respectively. While there was some erosion observed across the study period, these storm events did not significantly impact any of the City's coastal assets or dune systems.

9.5 Sand Management

The location, date and quantity of sand management along the coastline within the past 12 months is outlined in the tables below.

Table 9-1 Renourishment locations and quantities within the study period.

Date	Renourishment Location	Renourishment Quantity
May 2025	Quinns Rocks Beach, Frederick Stubbs Carpark	3,000 tonnes
May 2025	Quins Dog Beach, North Groyne 3	1,500 tonnes
May 2025	Quinns Rocks Dog Beach, North Groyne 4	4,000 tonnes

Table 9-2 Sand scraping locations and approximate quantities within the study period.

Date	Sand Scraping Location	Scraping Quantity
December 2025	Quinns Rocks Dog Beach, South Groyne 4	Approx. 1,000 m^3
February 2026	Quinns Dog Beach, South Groyne 4	Approx. 1,000 m^3

9.6 Recommendations

10.6.1 Automatic Tracking of Shorelines

Five remote monitoring cameras were installed at Quinns Rocks and Yanchep in November 2021. Remote monitoring cameras allow for the continuous assessment of the coastline, particularly in areas where continued coastal erosion is experienced. It is recommended that the methodology for automatic shoreline tracking be finalised for 2026 so that hourly data can be quantified.

10.6.2 Automatic Vegetation Line Tracking in Aerial Imagery

The City is in the process of developing a methodology for the automatic detection of vegetation lines in satellite and aerial imagery It is recommended that this methodology be finalised in 2026/27 as it will facilitate quantitative analysis of satellite and aerial imagery. This will allow for the long-term analysis of coastline changes as historic Aerial Imagery of the City's coastline has been captured since 1965.

10.6.3 Inclusion of an Executive Summary Document

It is recommended that future coastal monitoring reports include an executive summary document to promote easy distribution and interpretation by community groups, schools, and other stakeholders.

10.6.4 Recommendations for Nearshore Bathymetry Data

It is recommended to establish a methodology for capturing nearshore bathymetry data. This should consider the extent and frequency of data collection, particularly in areas that may be nourished by offshore dredging. Such data will enhance understanding of coastal dynamics and inform future monitoring efforts. Initial guidance is provided below which can be used to develop the methodology.

1. *Extent of data collection*

The extent should cover the nearshore zone, extending from the high-water mark where detailed survey and LiDAR are available to a point beyond the depth of closure; considered below –10 m AHD (Cardno 2018). This cross-shore extent will capture key nearshore processes including dune/surf zone/bar dynamics.

Along the Wanneroo coastline coastal processes are locally influenced by the presence of limestone reef systems that modify wave transformation and sediment transport pathways. Because of this, the surveys should have a continuous 2D coverage (i.e. digital elevation model) to be created with a target horizontal resolution of 10 m, which is consistent with AusSeabed Australian Multibeam Guidelines and DTMI hydrographic survey practice.

2. *Frequency of Data Collection*

Regular data collection should be conducted at least annually, with increased frequency (biannual or quarterly) in areas experiencing rapid changes or ongoing coastal nourishment projects.

Surveys should also occur before and after any new intervention. For example, prior to nourishment, at least one to two baseline surveys should be undertaken, and after nourishment surveys should be undertaken biannually (e.g., post-summer and post-winter) for the first 1–2 years to capture rapid morphological adjustment.

10.6.5 Inclusion of Quantitative Trigger Levels for Management

It is recommended that the city investigates defining quantitative trigger levels for beach management actions (e.g. renourishment) using routinely collected monitoring data, for example:

- Beach width measurements derived from fixed remote monitoring cameras (high-frequency, short-term indicator), and
- Beach volume estimates derived from six-monthly LiDAR surveys (lower-frequency, high-confidence indicator).

Examples of how triggers can be presented are shown below.

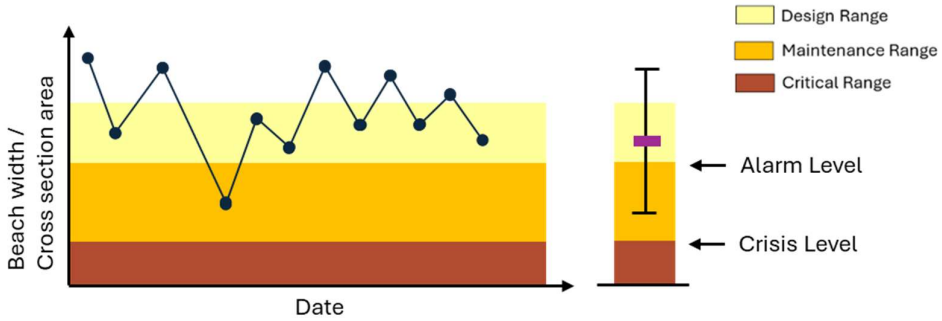


Figure 9-1 Overview of the state of a beach profile in relation to a set of defined triggers. The box and whisker plot on the right shows the lowest and highest the beach has ever been and its current state (purple bar).

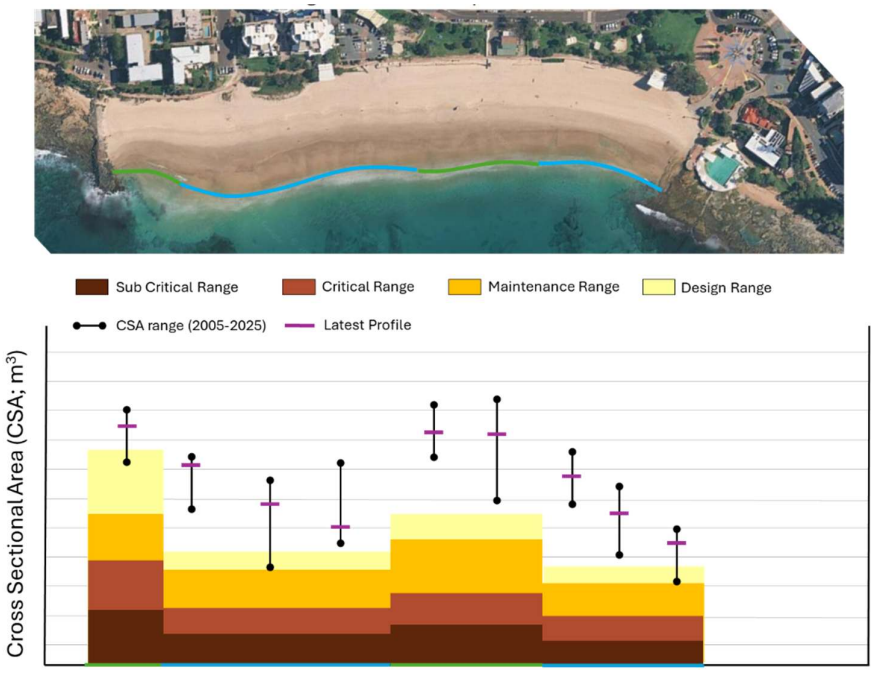


Figure 9-2 Overview of the state of a beach frontage in relation to a set of defined triggers with the temporal element reduced to the maximum, minimum and latest values.

10.6.6 Yanchep Study to Inform Coastal Management

It is recommended that the Yanchep Coastal Management Study be completed. This study aims to inform the future long-term management practices for Yanchep Beach and address ongoing erosion and accessibility issues at Yanchep. Additionally, it should address the condition issues and long term functionality of the Capricorn groyne.

10.6.7 Two Rocks Local Wave Buoys

Ahead of the potential Two Rocks Coastal Management Study local metocean data has been reviewed. The City has received historical wave data from DTMI including deployment dates and locations. The DTMI records indicate:

- There have been seven deployments at or near Two Rocks between 2013 and 2019.

These records span between 50 days to 3.6 years.

Whilst having available wave and current data at Two Rocks is beneficial to any future projects, it remains campaign-based, meaning the datasets are discontinuous. For the upcoming detailed coastal management study, a more recent, continuous, multi-year dataset located within the study area would offer additional project benefits than relying on historical deployments. Specifically this would be used for:

- Model calibration and validation
- Extreme value analysis
- Interannual variability assessment
- Long-term sediment transport modelling

Following the QA/QC process undertaken by UWA in April, the Southern Quinns Rock wave buoy was relocated to Two Rocks, near to a historic DTMI monitoring location.

The calibration process would benefit from two buoys being deployed. The second deployed in the outer nearshore zone (15-20 m depth), northwest of Two Rocks Marina and outside reef sheltering zones, to help separate offshore variability from local transformation. This second buoy would also allow a comparison of hindcast model accuracy (ECMWF, WW3, etc.), and would be used to force the new coastal model during the calibration period. CoW has applied for a CAP grant with DTMI to support the deployment of a second buoy; however, deployment will only proceed if the grant application is successful.

It is also advisable to collect data over several winter seasons, as individual winters may experience limited storm activity, and a multi-year record will ensure a more robust representation of local wave conditions.

10.6.8 Continued Beach Renourishment

It is recommended that beach renourishment continues to be undertaken in vulnerable areas to minimise the impacts of erosion on coastal infrastructure and the City's dune systems. It is recommended that the results from this report be used to identify areas that require reactive and ongoing scheduled renourishment works.

As outlined in Section 5.2.3 there has been considerable accretion along the coastline to the south of the Two Rocks Marina Southern Breakwater since October 2021. Based on the particle size distribution (PSD) analysis undertaken at this location (refer to Section 8.1), the sediment characteristics are considered suitable for beach nourishment purposes. Accordingly, this location is recommended as a potential future sand source for nourishment activities.

10.6.9 Continued Beach Scraping

It is recommended that beach scraping be undertaken annually along Quinns Dog Beach, to the south of Groyne Four (4), during periods of significant accretion. This will continue to improve the condition of the dune system at this location and provide a buffer against the impact of winter storms.

Clayton's beach experiences significant changes in beach volumes near the breakwater throughout the year. Based on the recent survey data and aerial images, beach scraping is not generally a viable option for the site. However, if conditions are right, i.e. October 2023, accretion at the southern end of the Clayton's Beach could be used to reprofile the eroded northern end of Clayton's Beach. It is recommended to continue with ongoing Claytons Beach scraping during suitable conditions.

10.6.10 Renewal of the Two Rocks Marina Northern Breakwater

The dune system immediately north of the Two Rocks Marina Northern Breakwater has been subject to significant ongoing erosion since the construction of the Marina. Over this period, the condition of the Northern Breakwater has deteriorated considerably. It is recommended that the condition of this Breakwater be formally assessed and the structure be renewed/repaired where required. While the structure is under the management of the Department of Transport and Major Infrastructure (DTMI), the City will work with the DTMI to manage this process.

10.6.11 Review of Quinns Beach Coastal Management Study

It is recommended that Quinns Artificial Headland be included in any future review of coastal management measures at Quinns Beach. The detached rock headland was constructed in 1977 with a primary aim to reduce erosion. Investigations should address structure condition and long-term functionality.

10.6.12 Monitoring and Plan for repairs/upgrade to Mindarie Breakwater Segment 3

It is recommended to continue monitoring segment 3 of the Mindarie Breakwater following large storms to assess vulnerabilities and determine the need for repairs. Although the segment condition has been assessed as poor, there is little evidence of movement over the past few years suggesting the segment can be monitored for now. Plans for repairs should be put in place, such that if the condition of this segment worsens, remedial action can take place with minimal delay.

10.6.13 Installation of Automatic Camera at Fisherman's Hollow

It is recommended that a new automatic camera be installed at Fisherman's Hollow, which is known to undergo significant seasonal beach volume changes. Continuous visual monitoring will assist in quantifying seasonal variability, detecting erosion and recovery patterns, and supporting future coastal management assessments.

10.6.14 AI analysis of camera imagery

It is recommended to implement advanced monitoring techniques, particularly the integration of AI analysis of camera imagery, supported by infrastructure and technology upgrades. This approach aims to capture critical information related to shoreline changes, monitor people counts, assess wave and current conditions, and provide insights into infrared bathymetry and surf zone dynamics.

10.6.15 Inclusion of Alkimos in photographic Monitoring

A review of the Digital Earth Australia (DEA) Coastlines dataset indicates sections of the Alkimos coastline have experienced a long-term erosion trend since 1988 (Figure 9-3). In areas where coastal development and structural beach access are proposed and there is an erosional trend, inclusion of new photographic monitoring sites is recommended. Red circles in Figure 9-3 mark existing photo monitoring sites, and white arrows indicate proposed future monitoring locations. It would also be

beneficial to include Alkimos shoreline in LiDAR and Ground Based Transect Surveys, for future beach volume change analysis.
When analysing the shoreline it will be useful to segment the beach into discrete zones (see green areas in Figure 9-3), which can be split based on the current erosion and accretion patterns.

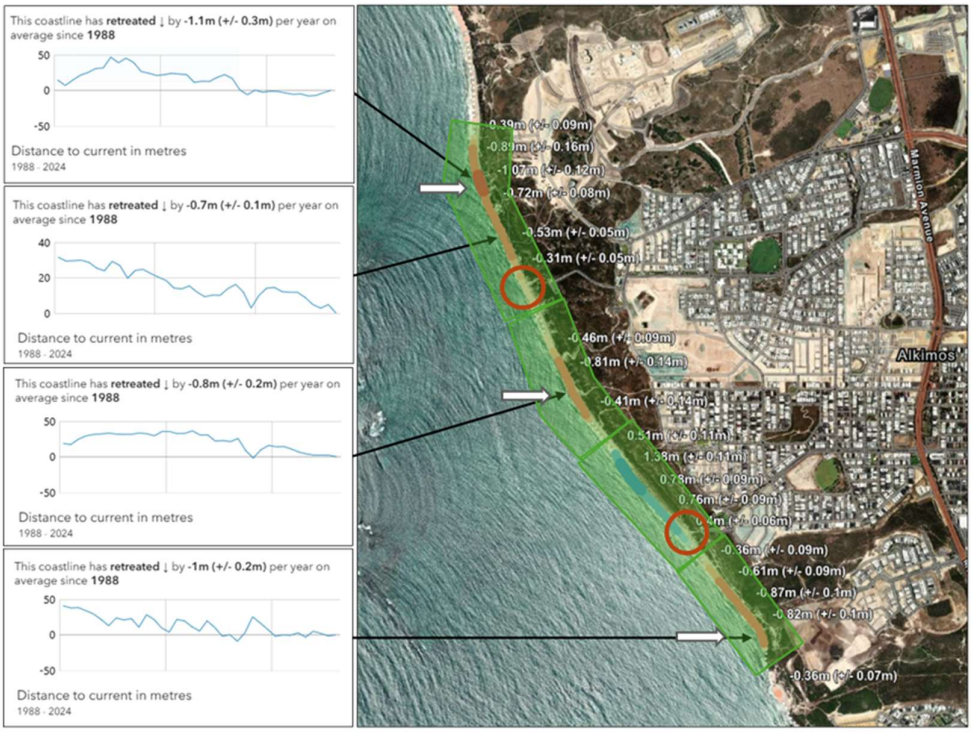


Figure 9-3 Annual shoreline change from Digital Earth Australia (DEA) Coastlines, Geoscience Australia. Red circles mark existing photo monitoring sites, and white arrows indicate proposed future monitoring locations. Suggested segments are shown in green areas.

10.6.16 Inclusion of Amberton and Shorehaven in Photographic Monitoring

Using a similar review of erosion trends a new beach photo location is recommended between the existing locations at Amberton and Shorehaven. This is shown in Figure 9-4.



Figure 9-4 Annual shoreline change from Digital Earth Australia (DEA) Coastlines, Geoscience Australia. Red circles mark existing photo monitoring sites, and white arrows indicate proposed future monitoring location.

10 Appendix A – MNG Survey study areas

(attached separately)

11 Appendix B – Particle Size Distribution Campaign

(attached separately)

NOTE TO FILE

JBP Project Code	2025s1444
Contract	Wanneroo Coastal Monitoring Program
Client	City of Wanneroo
Day, Date and Time	11 March 2026
Author	M V Mastronardi
Reviewer / Sign off	
Subject	MNG Survey study areas

1 Introduction

This note to file summarised the 14 discrete study areas within the overall survey area assessed for changes in beach volume.

2 Background

LiDAR Aerial Surveys can only capture areas above the waterline and when the shoreline has receded, the area of analysis is limited. Therefore, the City engaged MNG to capture an additional 129 nearshore ground based transect surveys to supplement the LiDAR data capture. These surveys are captured at the same time as the LiDAR aerial surveys and extend into the nearshore area, to a maximum water depth of one metre, to collect the data within the nearshore area that is otherwise missed.

These surveys are undertaken six (6) monthly in April and October each year, in line with the timing of manual photographic monitoring.

3 Study areas

14 discrete study areas within the overall survey area are then assessed for changes in beach volume.

To assist in understanding the change trends, MNG Surveyors have divided the onshore component into two components: the dune areas, referred to as ‘A - Land’, and the beach area, referred to as ‘B - near-shore’, with the underwater component now designated as ‘C – Underwater’. The line of separation between areas A and B has been determined by offsetting the vegetation line east by 20m along areas of sandy coastline to ensure that area B (nearshore) captures any significant erosion of the dune face from wave action. In areas protected by hard structures (such as seawalls, known rocky cliffs etc.) the line of separation was positioned along the structure crest.

The data from ground-based survey transects has been interpolated to estimate changes in beach volume for the nearshore area below the waterline which is illustrated in the elevation difference plots. It is important to note that these volumes are estimates only.

3.1 Clayton Beach

Clayton Beach has been considered as 1 section.

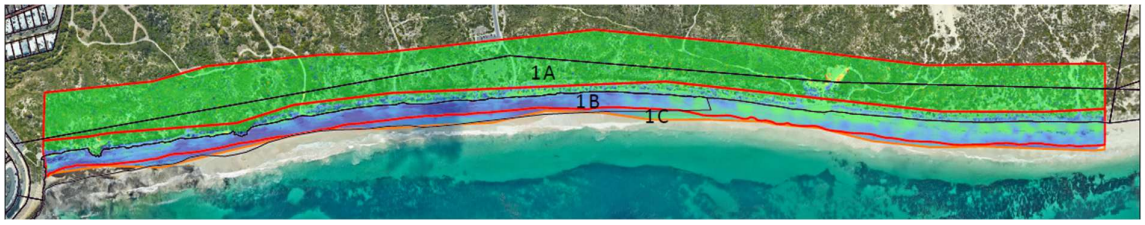


Figure 1 Clayton Beach – Section 1

3.2 Quinns Rocks

Quinns Rocks has been divided into 6 sections.

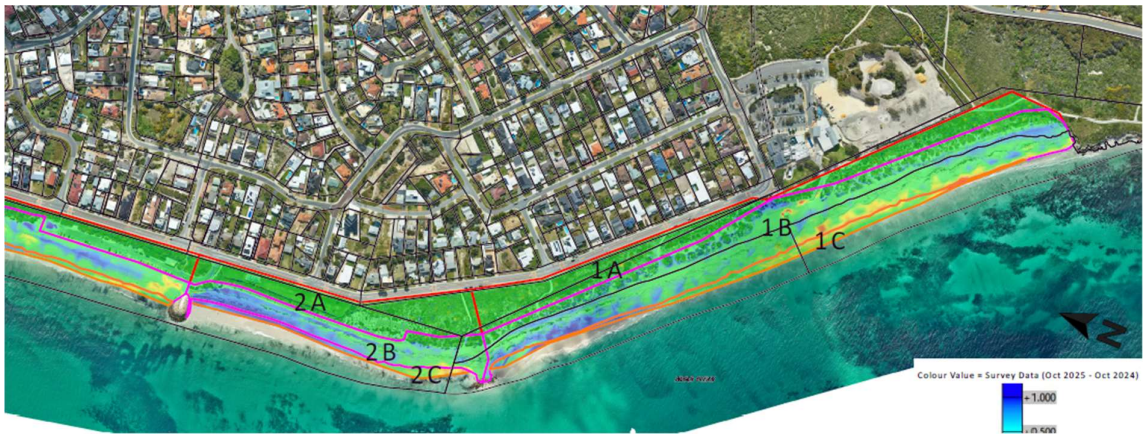


Figure 2 Quinns Rocks – Section 1 and Section 2

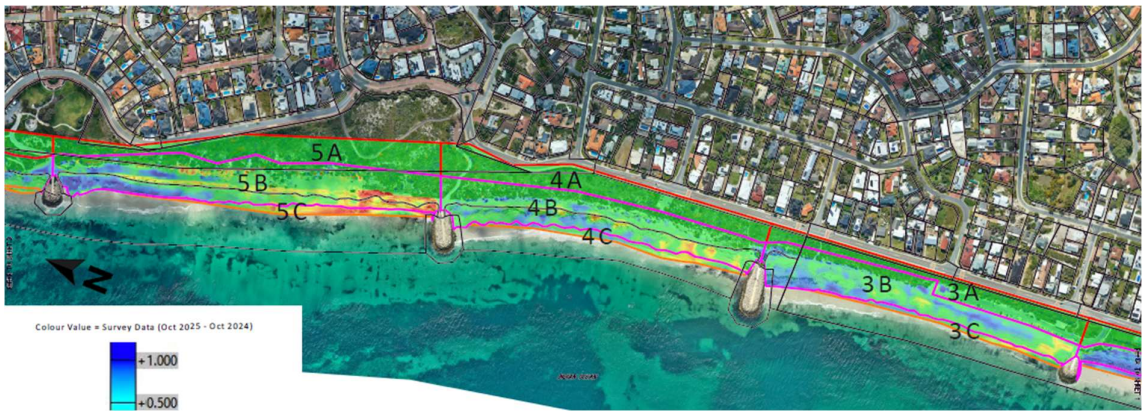


Figure 3 Quinns Rocks – Section 3, Section 4 and Section 5



Figure 4 Quinns Rocks – Section 6

3.3 Yanchep

Yanchep has been divided into 5 sections.



Figure 5 Yanchep – Section 1



Figure 6 Yanchep – Section 2 and Section 3

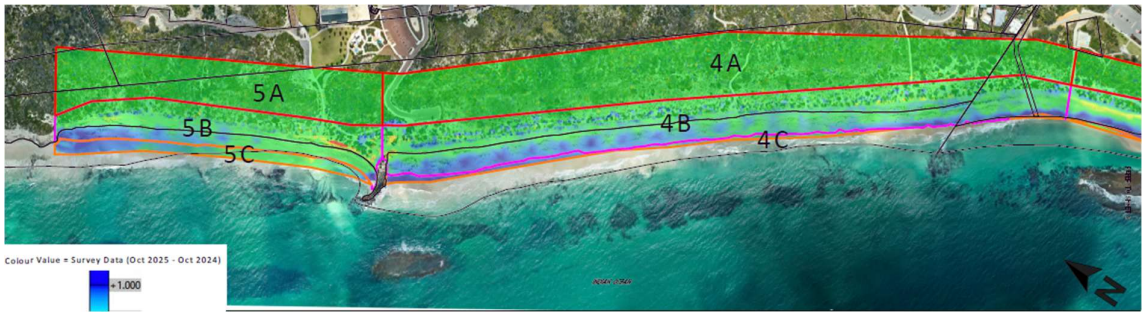


Figure 7 Yanchep – Section 4 and Section 5

3.4 Two Rocks

Two Rocks has been divided into 2 sections.



Figure 8 Two Rocks – Section 1

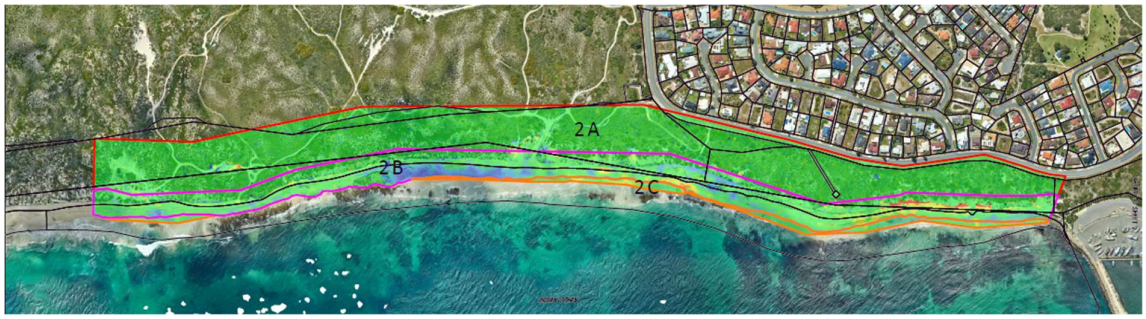


Figure 9 Two Rocks – Section 2

Memorandum

TO:	Z. Lindenberg, R. Ellyard
FROM:	I. Upson
FILE REF:	
DATE:	6/07/2026
SUBJECT:	**Beach Sand Analysis – April 2026 Campaign**

BACKGROUND

The City of Wanneroo (the City) manages 32km of coastline with varying sedimentology. In the past, the City has primarily taken beach sand samples on an adhoc basis in response to project demand. Previous campaigns have primarily focused on developed areas such as Quinns Rocks, Yanchep and Two Rocks. As the coastal suburbs continue to develop, pressure will increase on the coastal environment and nourishment at beaches fronting new developments may be required in the future.

In April 2026, the City undertook an extensive sand sample campaign including 30 sites distributed across developed and underdeveloped areas to provide insights into current sediment characteristics. Each site had a sample taken from the dune, the beach and the swash to account for cross-shore sediment variations. Three tests were undertaken on the samples to characterise grain size, colour and sample minerology. This Memorandum outlines the method utilised to analyse the 90 sand samples and discusses the results.

METHODOLGY

The 30 alongshore locations were selected considering the following criteria:

- Where appropriate, samples are to be collected updrift and downdrift of major coastal features such as marinas and headlands.
- Any sample locations sheltered by reefs should have an adjacent exposed beach location sampled.
- The most natural location to take samples along Quinns Beach is within the compartment between Groyne 2 & 3 where no nourishment has been placed. In saying that, it is expected that nourishment material is likely to have drifted into the compartment and will affect the results.
- Current and future usage and development expectations.
- Current accessibility.

Sand sampling location was verified onsite utilising the GPS Coordinates App. A map of all sampling locations is provided in Figure 1. The beach face and dune samples at each location were collected from approximately 200mm below the surface to avoid collecting recent windblown sand. The swash zone samples were taken in knee-deep water. Photos of the down-coast and up-coast beach state were taken at each sample location.

All samples were tested for Particle Size Distribution (PSD) and Munsell Colour. The Munsell Colour identification was performed after completely drying and re-wetting each sample. X-Ray Diffraction (XRD) analysis was undertaken on 10 of the samples from the beach face to quantify beach sand minerology. There was at least one location selected from each tertiary Vlamingh Sediment Cell for this analysis to ensure the entire coastline was equally represented. The following locations were tested via XRD analysis:

- Claytons Beach
- QMSLSC
- Quinns Groyne 3 South
- Eden Beach
- Alkimos Amphitheatre
- Yanchep Dog Beach
- Yanchep Lagoon
- Two Rocks BAW
- Leemans Landing
- Two Rocks North Beach

To estimate the appropriate sand specifications for beach nourishment, the sediment data was grouped into their respective Sediment Cell and screened for any outliers. A range of values and averages were obtained for each cell to specify acceptable median grain size for nourishment sand. Additionally, the average PSD for each Vlamingh Sediment Cell was determined by averaging the percentage passing for each sieve size in the respective sediment cell. An overall average PSD for all samples was determined by averaging the representative PSD determined for each sediment cell. These analyses informed sand specifications for the City's next sand supply contract (currently out for tender). As the City is currently focuses on beach nourishment, all dune samples were removed from these analyses.



Figure 1: Sample Locations for the April 2026 PSD campaign undertaken by the City.

RESULTS

Median Particle Size

The median particle size (D50) of all samples ranged between 0.24mm and 0.46mm. The swash, beach and dune samples had an average D50 of 0.36mm, 0.33mm and 0.28mm, respectively. For about 60% of the sites, the dune samples were the finest and the swash samples were the coarsest, with beach face samples somewhere in-between. Sites where this was not the case were:

- Jindee Beach, Eden Beach and Alkimos Amphitheatre (swash zone sand was the finest sample. At Eden Beach the dune was the coarsest sample)
- QMSLSC, Quinns Dog Beach North, Jindalee Boulevard, ASLSC and Capricorn Groyne South (beach sand was more course than in the swash zone)
- Skysail Avenue, Fisherman's Hollow North, Two Rocks BAW and Two Rocks North Beach (dune sand more coarse than beach sand)

A distribution plot of the medium grain size for each cross-shore sample at all 30 locations is provided below with the locations grouped by their tertiary Vlamingh Sediment Cell in Figure 2. Leeman's Landing is a significant outlier as its three samples are considerably smaller than the rest of the samples across all sites.

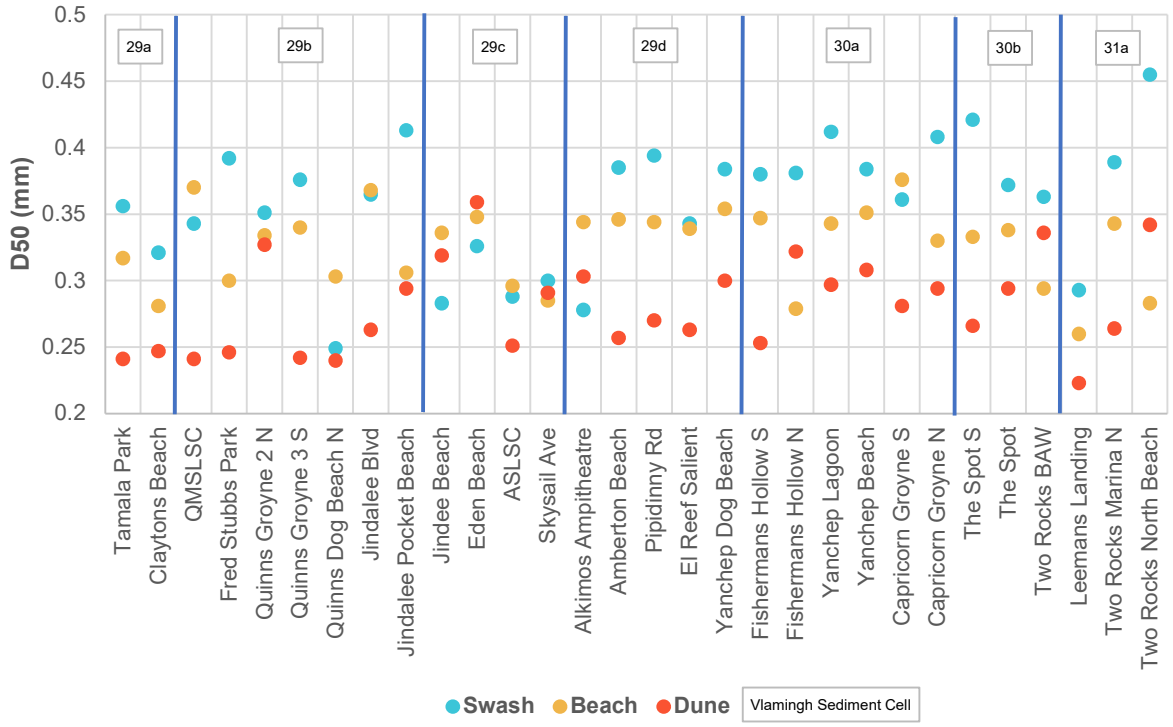


Figure 2: D50 of all swash, beach and dune samples ordered from north to south and grouped by Vlamingh Sediment Cell

To assess acceptable sand for beach nourishment in each cell the following outliers were removed due to their measured D50 being significantly smaller than the other samples taken in the same Vlamingh Cell:

- Quinns Dog Beach North (Swash)
- Alkimos Amphitheatre (Swash)
- Fisherman's Hollow North (Beach)
- Leeman's Landing (Beach and Swash)
- Two Rocks BAW (Beach)

The D50 range and average for the beach and swash samples for each sediment cell are plotted in Figure 3. The overall average D50 for all sediment cells is approximately 0.35mm. 29b and 29d to 31a have similar average D50s while 29a and 29c both have smaller D50s compared to the larger dataset.

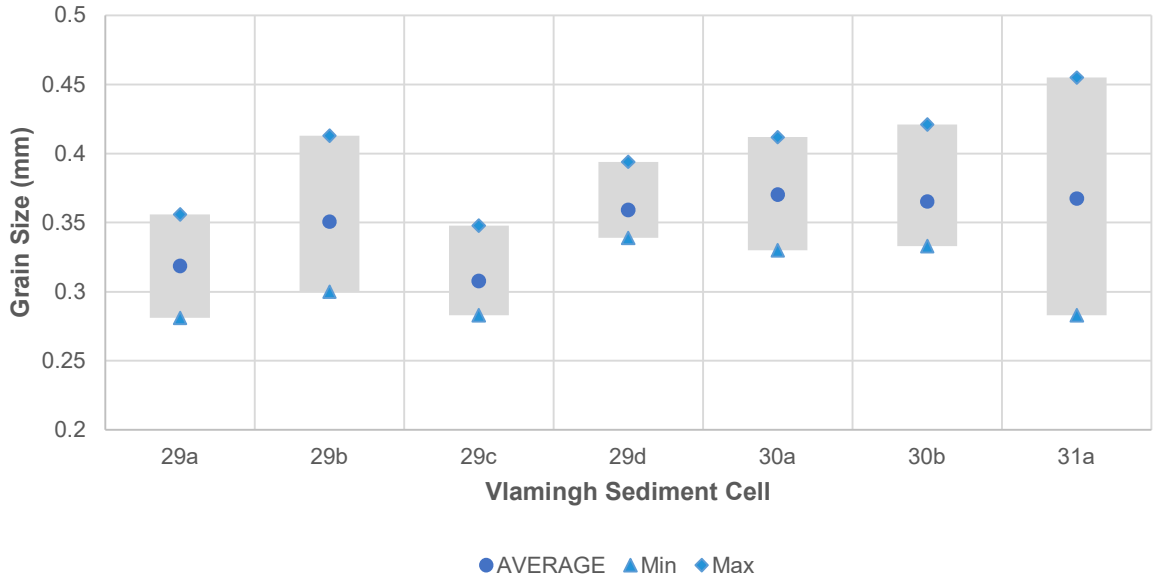


Figure 3: Range of acceptable D50 for nourishment in each Vlamingh Sediment Cell

Particle Size Distribution (PSD)

The average PSD for each Vlamingh Sediment Cell is plotted in Figure 4. Most of the PSDs follow a similar gradient as compared to the overall average. The finer D50s at 29a and 29c are apparent. 29a has a large percentage of particles pass at smaller sieve sizes but has a similar-to-average percentage of particles pass at the larger sieve sizes.

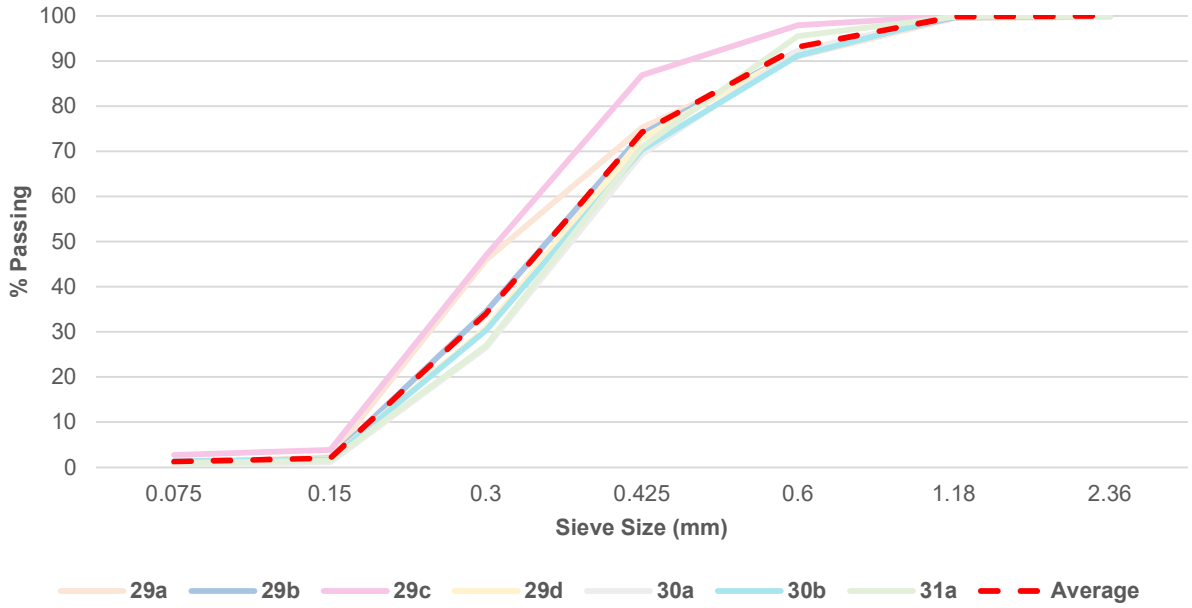


Figure 4: Average PSD for each sediment cell vs an overall average PSD

-Munsell Colour

The most common sand colour was white with 32% of all the samples being one of the following Munsell Colour variants:

- 10YR 8/1
- 2.5Y 8/1
- 5Y 8/1
- 7.5YR 8/1

White was the most common colour for the beach and dune zones and light grey was the most common colour for the swash zone. There were no white swash samples. Figure 5 shows the cross-shore variation in sand sample colour from the northern to southern sites. The dune and beach samples at Quinns Beach are consistently white in comparison to the rest of the coastline. All swash samples are darker or similar in colour to their respective beach samples despite all samples being dried and wetted during the testing process. The Two Rocks North Beach, Jindalee Pocket Beach and Jindalee Boulevard dune samples were significantly darker than all other dune samples.

	Swash	Beach	Dune
Two Rocks North Beach	10YR 7/3	10YR 8/2	10YR 6/2
Two Rocks Marina North	10YR 7/3	10YR 8/3	10YR 8/2
Leemans Landing	10YR 7/1	5Y 8/1	2.5Y 8/1
Two Rocks New BAW	2.5Y 6/2	2.5Y 7/2	2.5Y 8/1
The Spot	2.5Y 7/3	2.5Y 7/2	2.5Y 8/1
The Spot South	2.5Y 6/2	2.5Y 8/3	2.5Y 8/3
Capricorn Groyne North	2.5Y 7/2	2.5Y 8/2	2.5Y 8/2
Capricorn Groyne South	10YR 7/3	10YR 8/2	10YR 8/3
Yanchep Beach	10YR 7/3	10YR 8/2	2.5Y 8/2
Yanchep Lagoon	2.5Y 7/2	2.5Y 8/2	2.5Y 8/1
Fisherman's Hollow North	10YR 7/2	10YR 8/1	2.5Y 8/1
Fisherman's Hollow South	2.5Y 7/3	2.5Y 8/2	2.5Y 8/2
Yanchep Dog Beach	2.5Y 7/3	2.5Y 7/2	2.5Y 8/2
El Reef Sallient	2.5Y 7/3	2.5Y 7/2	2.5Y 8/1
Pipidinny Road	2.5Y 7/2	2.5Y 7/2	2.5Y 8/1
Amberton Beach	2.5Y 7/2	2.5Y 8/2	2.5Y 8/1
Alkimos Ampitheartre	2.5Y 7/2	2.5Y 8/2	5Y 8/1
Skysail Ave	2.5Y 7/3	2.5Y 7/2	2.5Y 8/1
Alkimos SLSC	2.5Y 7/2	2.5Y 8/2	2.5Y 8/1
Eden Beach	2.5Y 6/2	2.5Y 8/2	2.5Y 8/1
Jindee Beach	2.5Y 7/2	2.5Y 8/1	10YR 8/2
Jindalee Pocket Beach	10YR 7/2	10YR 8/1	10YR 6/2
Jindalee Blvd	10YR 7/2	10YR 7/1	10YR 6/2
Quinns Dog Beach North	10YR 7/1	10YR 8/1	10YR 8/1
Quinns Groyne 3 South	10YR 7/2	7.5YR 8/1	7.5YR 8/1
Quinns Groyne 2 North	10YR 7/3	10YR 8/1	10YR 8/1
Fred Stubs Park	10YR 7/2	10YR 8/1	10YR 8/1
QMSLSC	10YR 7/1	2.5Y 8/1	5Y 8/1
Claytons Beach	2.5Y 7/1	2.5Y 8/1	2.5Y 8/1
Tamala Park	2.5Y 7/2	2.5Y 7/1	2.5Y 8/1



Figure 5: Spatial distribution of sediment color (Munsell)

Minerology

The most common minerals in all samples were quartz, calcite and aragonite. Calcite and aragonite are chemically identical calcium carbonate ($CaCO_3$) minerals with different internal structures while quartz is composed of silicon dioxide (SiO_2). The mineral composition of each sample is displayed in Figure 6. The Quinns Beach samples are comprised of a high percentage of quartz in comparison to all other samples. The Claytons Beach, Leeman's Landing and Two Rocks North Beach samples are comprised of substantially more calcium carbonate than all other samples. The samples from Sediment Cell 29c to 30a are equally comprised of both quartz and the calcium carbonates.

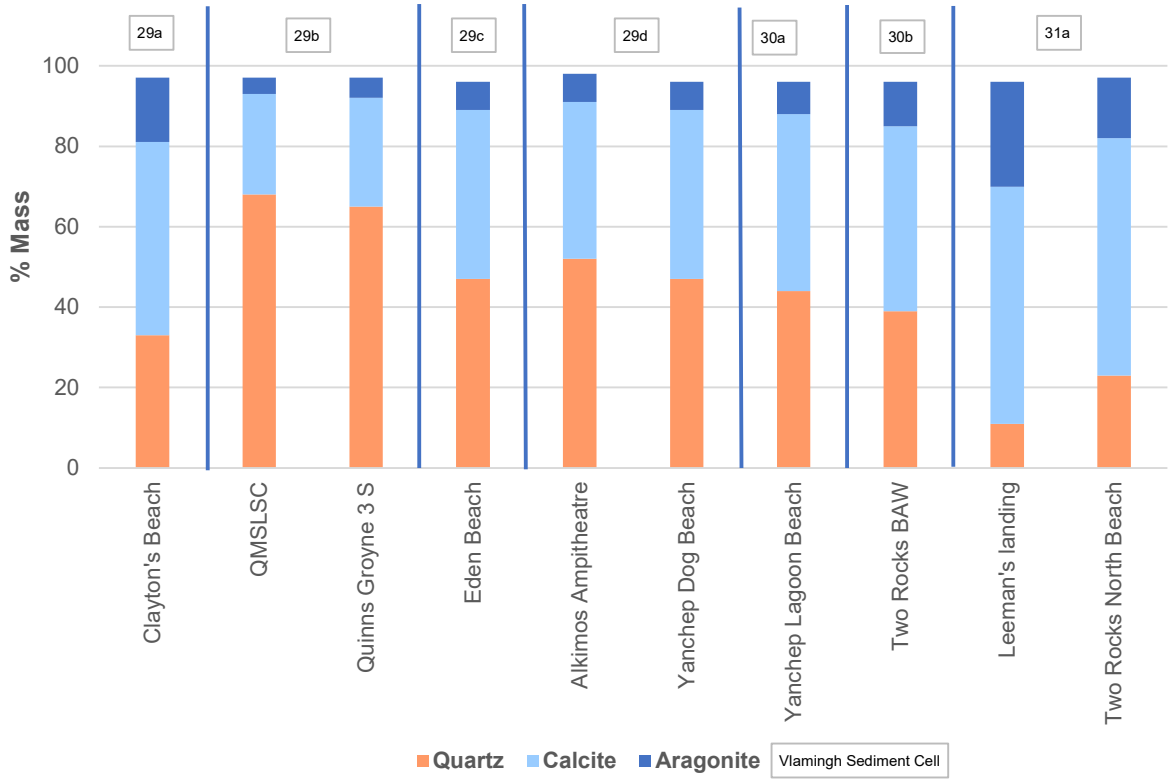


Figure 6: Mineral composition for all sites in XRD Analysis

DISCUSSION

Trends

The expected trend of the swash and dune zones consisting of the largest and smallest grain sizes, respectively, was generally observed in the average D50 results. Dunes are formed along coastlines via aeolian (i.e. windborne) transport, resulting in finer grain sizes which are moderate to well sorted. Finer particles in the swash zone are more easily suspended and carried offshore, while coarser particles are more likely to resist backwash and settle, hence the swash zone most likely to be made up of the larger sand grains.

A significant trend observed in the results from this analysis is the swash zone being uniformly darker in colour than the beach and dune samples. This trend is likely attributed to the beach and dune zones experiencing more UV exposure than the sand in the swash zone, causing natural bleaching.

The City's coastline consists primarily of the Quindalup Dune system. This dune system is made up of unconsolidated calcareous sands that consist of mainly calcium carbonate ($CaCO_3$) with some quartz sands (SiO_2). This explains the presence of quartz as well as the high composition of aragonite and calcite in some of the samples, specifically Two Rocks North, Leemans Landing and Clayton's Beach.

Outliers

The area South of Two Rocks marina has accreted significantly since construction. The sample location in the middle of the wide beach at Leemans Landing (Figure 7) displays characteristics similar to dunes at other sites, indicating the beach has built up over time from aeolian transport. The swash and dune samples were also finer than other sites. The sampling was undertaken at high tide, so it is likely the finer beach material was mixed in with the swash zone. The relatively finer dune size is likely a result of the wide beach and associated ridges, which encourage heavier material to deposit before the dune face.



DOWN-COAST	UP-COAST

Figure 7: Up-coast and down-coast image of Leeman's Landing site taken on day of sample collection

Annual beach nourishment has been undertaken at Quinns Beach since 2014. Over 179,000 tonnes of notably white sand has been imported to Quinns Beach throughout this time (see Figure 8). The consistently whiter Munsell Colour for the Quinns dune and beach zones is likely attributed to these nourishment activities.

The nourishment sand has also likely affected the minerology results. Nourishment sand is imported from inland quarries that extract sand from the Spearwood Dune System, which is mainly comprised of quartz sands. This may explain why the higher percentage of quartz by mass for the Quinns Beach samples as compared to other sample locations. A quarry sample from recent nourishment works is currently with the lab for testing to confirm this hypothesis.



Figure 8: Quinns Beach nourishment May 2026

The three dune samples with significantly darker Munsell Colour results were likely affected by a large presence of organic material in the sand. The three sites, Two Rocks North Beach, Jindalee Pocket Beach and Jindalee Boulevard, had dunes with abundant vegetation cover (see Figure 9). Samples were collected next to or from underneath vegetation, leading to the sand being high in brownish grey coloured organic material.



Two Rocks North Beach	Jindalee Pocket Beach	Jindalee Boulevard

Figure 9: Images taking at time of sampling of the dunes with darker Munsell Colour results.

Beach Nourishment Specifications

For the purpose of nourishment, the following sediment cells were grouped based on their sediment characteristics (particularly Figure 3):

- Area A – 29a and 29c
- Area B – 29b, 29d, 30a, 30b and 31a

The areas are spatially defined below in Figure 10.

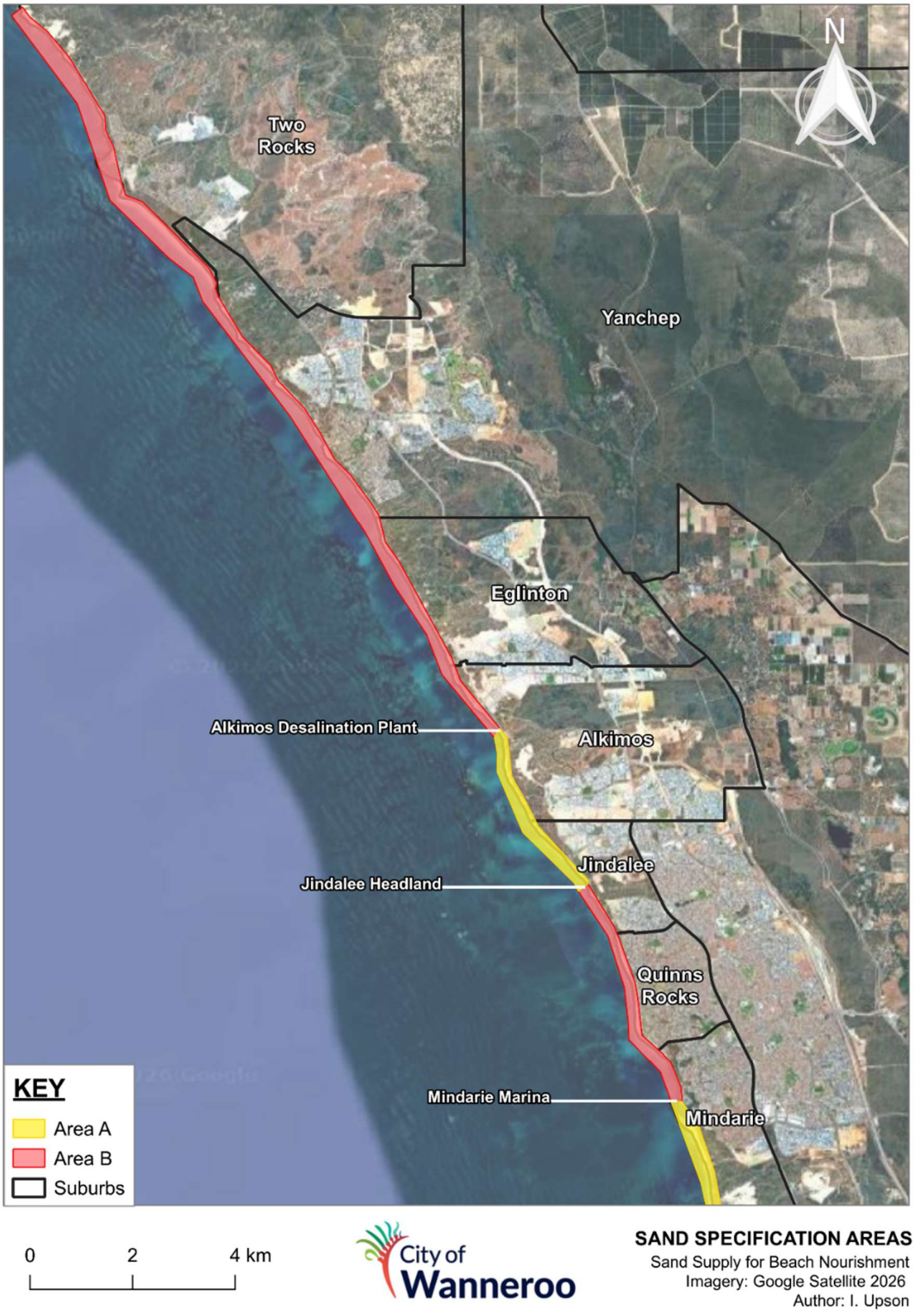


Figure 10: Sand specification areas for beach nourishment guidelines

Area A includes the two tertiary Vlamingh Cells with the lowest D50 results and Area B includes the remaining tertiary Vlamingh Cells that have similar-to-average D50 results. For the sand to be placed in Area B, both the average D50 and average PSD curve obtained from this analysis were used as

the sand specifications. For the sand to be placed in Area A, an average D50 of approximately 0.32mm was specified. This is slightly coarser than the averages of the two Vlamingh Cells included in this area to ensure that the nourishment sand is not too fine and easily mobilised. The ideal PSD specified in the contract for Area A maintained relatively the same gradient as the overall average PSD, transformed to corresponded to a D50 of 0.32mm (see Figure 11).

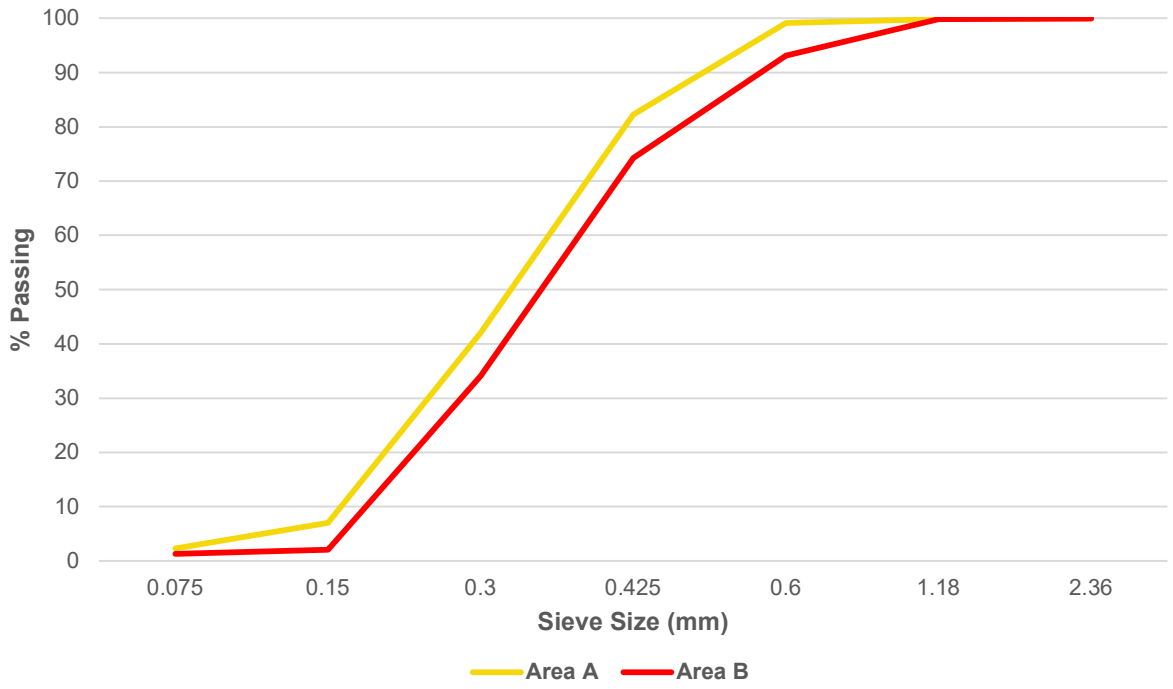


Figure 11: PSD sand specifications for nourishment sand in Area A and Area B