DCRM Shoreline Profile Monitoring Data Report

Tinian and Rota

August 2021

Bureau of Environmental Coastal Quality - Division of Coastal Resources Management

Introduction

This report summarizes four years (March 2017–April 2021) of data collection under DCRM's Shoreline Profile Monitoring Program for Tinian and Rota. This is the first Shoreline Profile Monitoring Data Report covering these islands. Tinian and Rota were surveyed by DCRM staff opportunistically each year.

Shorelines are dynamic in nature. Morphology is driven by many factors, especially seasonal trade winds, the shifting of tides, and movement of sediment along the water. This includes regional changes in weather patterns such as typhoons and tropical disturbances that can greatly influence the accumulation of sand deposits on beach strands. If the area is losing more sediment than it is naturally receives, then data-driven shoreline interventions may be necessary to protect adjacent land, people, and infrastructure. Long-term shoreline monitoring is the current approach to identifying erosion hotspots by measuring the contour of a beach to compare over time. Data about beach width, vegetation cover, morphology, slope, and other features are collected along a transect, a straight "study line," running perpendicular to the shoreline from an identified semi-permanent landward point to the submerged beach toe or low water mark. By returning to the same place (known as the head stake) and comparing observations at regular intervals, one can visualize how much a certain beach site may be eroding (sand loss) or accreting (sand gain). Data records exhibit the shoreline length and profile change based on the tides and seasonal trade wind conditions. Each beach site has between two and four established transects. This current methodology, called the "Berger Level Method", results in beach profiles. Containing details of the 2D cross sectional contour at that time in place, beach profile records are currently qualitatively compared to report the general trend of a transect from the beginning of the program to April 2021 data. This four-year period is insufficient to determine long-term change. ***Thus it is important to note that the reported trends may not actually reflect long-term change but change during this short four-year period.*** The highly dynamic nature of shoreline morphology makes a solid determination of the status challenging, but data analysis can supplement observations. DCRM is still working on adopting an analysis method for the beach profile data to provide quantifiable results with high confidence that could inform erosion-based setbacks.

A general study of sediment transport of nearshore waters (similar to the *Hydrodynamic Study of Saipan's Western Lagoon*) may improve understanding of whether Tinian and Rota beaches are chronically eroding or accreting. Although areas have been identified as vulnerable to sea level rise through observations, shoreline change data should not serve as evidence for sea level rise at its contemporary state. As explained, the program needs more decades of data to see sea level rise impacts and compute long-term shoreline change rates. It is understood that increased sediment transport or excessive hydraulic action occurs high energy events (often induced by storms). Predicted sea level rise will decrease the amount of dry nearshore area and inhibit erosion processes, further resulting in beach loss. The *Climate Vulnerability Assessment for the Islands of Rota & Tinian, CNMI* (2015) identified **high** vulnerabilities to coastal erosion and storm surge due to sea level rise and increased storm intensity. Due to its applicability, this vulnerability assessment will be referenced throughout the report.

As monitoring data and institutional memory progresses, so will the program's determination of the long-term shoreline change trend. The data could also inform an updated vulnerability assessment. This report aims to guide coastal managers and stakeholders in making informed, effective, and adaptive decisions regarding our dynamic shoreline.

The Shoreline Monitoring program is led by the DCRM's Planning Section, with the direction of the Coastal Planner I and valued assistance from DCRM staff volunteers, dedicated summer interns, and student interns. Interns have greatly contributed numerous hours to data collection and field work and are the basis of the program's consistency. Any questions or comments about the program or this report may be directed to shorelines@dcrm.gov.mp.

Photo Cover: Tachonga Beach facing Taga Beach, Tinian

Financial assistance provided by the Coastal Zone Management Act of 1972, as amended, administered by the Office for Coastal Management, National Oceanic and Atmospheric Administration.

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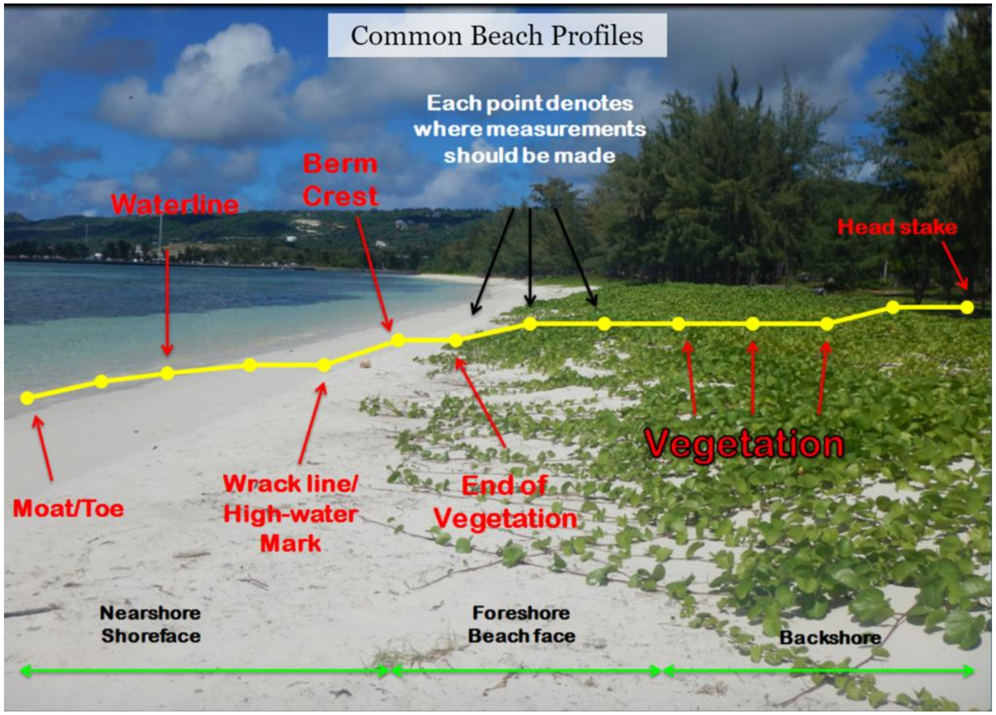
Methods

Beach contours are measured using simple survey equipment to conduct the Berger Level method. Elevation measurements along a transect are taken at distances of every 10 feet interval and at significant features such as vegetation boundaries, berms, wrack lines, water lines, etc. See the "Shoreline Features in a Common Beach Profile" figure below.

As this effort is growing, sampling methods are expected to undergo improvements for better accuracy. Sources of error may stem from the misalignment or loss of transect starting points and error in operating the equipment.

Rich S. and Art. C. laying out the transect during high tide and surf conditions at Tachonga South 1. On the right is the Berger Level on the tripod.



Shoreline Features in a Common Beach Profile

Shoreline features are recorded since they aid in understanding the stability of the shoreline. Most of the transect runs through the foreshore, or the portion of the shoreline that lies between high and low water mark during mean tide.

- Headstake – identified object serving as the starting point of the transect located at the backshore. The backshore usually consists of important infrastructure and relies on the foreshore to handle wave energy.
- Vegetation area – shoreline plants in the foreshore stabilizing the sand. The foreshore is capable of receiving wave run up.
- Berm – the nearly horizontal portion of the beach or backshore formed by the deposit of materials by wave action, or the vertical drop of a beach located on the nearshore. The nearshore is the beach toe to seaward, and is also important for the stabilization of the shoreline.
- Waterline – a line that marks the surface of the sea on land located within the nearshore.
- Moat/toe – point of a beach that juts out past the waterline located on the nearshore. It is exposed during low tide.

Monitoring Locations

DCRM's Shoreline Monitoring Program encompasses sandy beaches on Saipan, Mañagaha, Tinian, and Rota. Unlike Saipan, Tinian and Rota do not have a vast lagoon, setting their unique geographically-influenced shoreline morphology. However, monitoring beaches on these islands will help inform DCRM Planning and Permitting in guiding future development.

Refer to our interactive Shoreline Monitoring Program Story Map for better resolution on the DCRM Shoreline Monitoring Program page.

Tinian Sites

Tachonga		
Tachonga South 1 Lat. Degrees N: 14.95369 Long. Degrees E: 145.63148 Compass direction:	Tachonga South 2 Lat. Degrees N: 14.95397 Long. Degrees E: 145.63130 Compass direction:	Tachonga South 3 Lat. Degrees N: 14.95461 Long. Degrees E: 145.63083 Compass direction:
Tachonga North 1 Lat. Degrees N: 14.95493 Long. Degrees E: 145.63052 Compass direction:	Tachonga North 2 Lat. Degrees N: 14.95522 Long. Degrees E: 145.63043 Compass direction:	Tachonga 3 Lat. Degrees N: 14.95565 Long. Degrees E: 145.63039 Compass direction:

Jones		
Jones 1 Lat. Degrees N: 14.96455 Long. Degrees E: 145.62601 Compass direction:	Jones 2 Lat. Degrees N: 14.96523 Long. Degrees E: 145.62529 Compass direction:	Jones 3 Lat. Degrees N: 14.96586 Long. Degrees E: 145.62410 Compass direction:

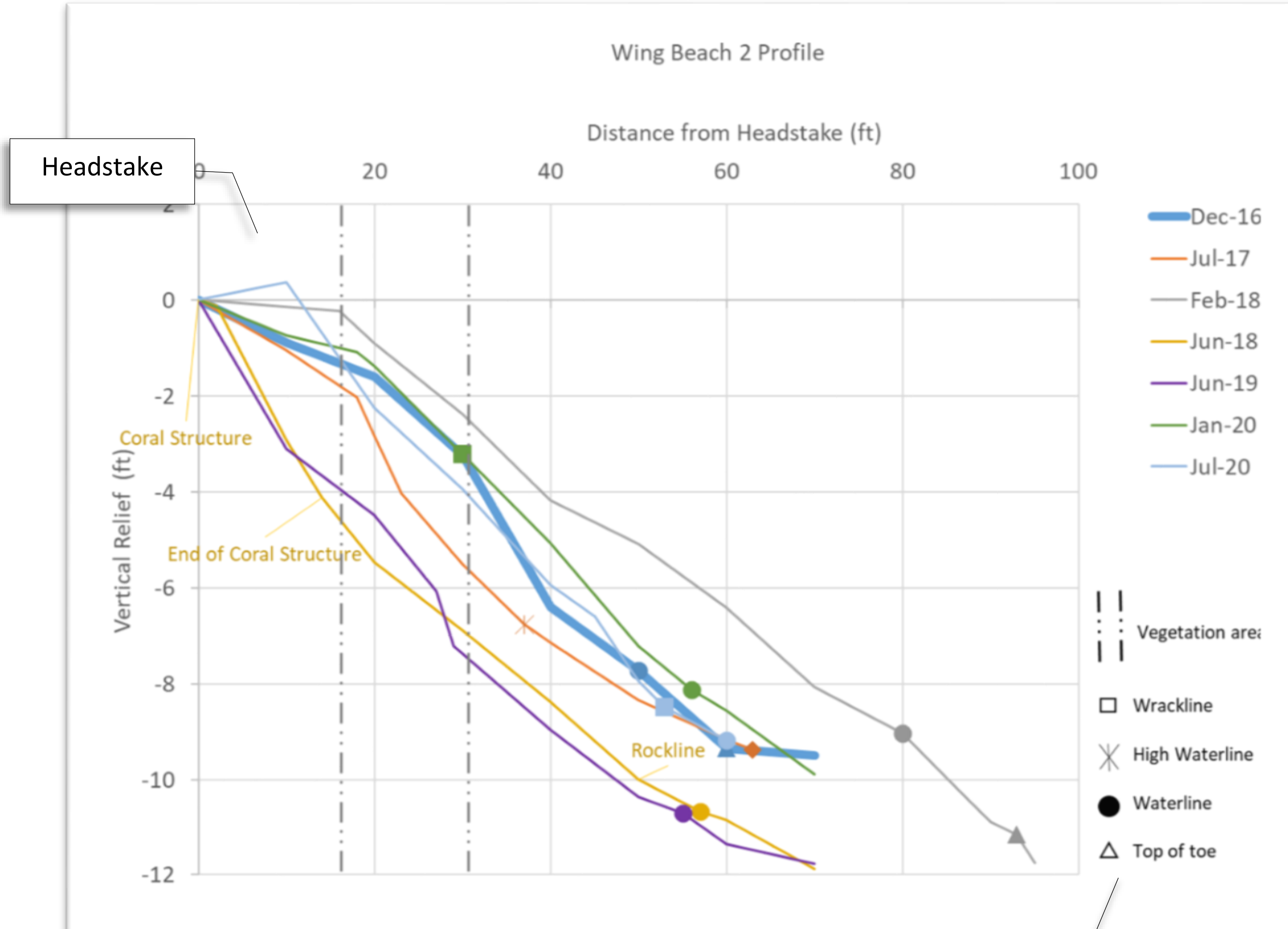
Rota Sites

Guata		
Guata 1 Lat. Degrees N: 14.17356 Long. Degrees E: 145.19360 Compass direction:	Guata 2 Lat. Degrees N: 14.17370 Long Degrees E: 145.19272 Compass direction:	Guata 3 Lat. Degrees N: 14.17370 Long Degrees E: 145.19191 Compass direction:

Teteto		
Teteto 1 Lat. Degrees N: 14.17207 Long. Degrees E: 145.18866 Compass direction:	Teteto 2 Lat. Degrees N: 14.17234 Long Degrees E: 145.18913 Compass direction:	Teteto 3 Lat. Degrees N: 14.17318 Long. Degrees E: 145.19034 Compass direction:
Teteto 4 Lat. Degrees N: 14.17358 Long. Degrees E: 145.19113 Compass direction:		

Sasanlagu		
Sasanlagu 1 Lat. Degrees N: 14.17361 Long. Degrees E: 145.19363 Compass direction:	Sasanlagu 2 Lat. Degrees N: 15.15025 Long Degrees E: 145.70032 Elevation: 18.118422 Compass direction: 248 °W	Sasanlagu 3 Lat. Degrees N: 15.15126 Long. Degrees E: 145.69997 Elevation: Compass direction: 263 °W

How to Read the Beach Profile



Symbology is used to indicate points where particular beach features have been detected along the transect. These beach features have been selected as importance and common indicators of shoreline profile change. The color matches the date/time of the transect taken. The symbol matches the beach feature. Vegetation area has two lines. The left indicates Start of Vegetation while the right indicates the End of Vegetation. Wrackline, high waterline, waterline, and top of toe are generally detected as one point. Note that not all beach features may be detected in a shoreline transect.

The next section will cover beach profiles for each transect lines.

The beach profile, shown on the left, captures the contour of the shoreline from the headstake (starting point inland) to the bottom of the moat/toe.

Distance from the headstake is shown vertically in relation to the elevation difference from the headstake.

Each different colored line is a data entry at a different time. For instance, a transect survey taken on Dec-16 is shown in thick blue.

Time is an important factor for shoreline monitoring because shoreline contours taken at different times will be compared to understand shoreline change.

Tinian

Tinian's shoreline area comprises mostly of limestone cliff terraces with isolated sandy beaches protected by fringing reef. The 2015 Vulnerability assessment states that Tinian could be the least vulnerable island to coastal erosion given its protected geological character. Headlands north and south of pocket beaches may also be a contributing sand source.

Tachonga and Jones Beach are among the few sandy shoreline sites selected for monitoring due to their proximity to the densely populated San Jose village and economically important Tinian Harbor. The harbor and its breakwater may influence the ongoing longshore transport, which remains unknown at this time. They exhibit high vulnerability to short-term erosion and storm surge during south, southwest, or west wave conditions. Sea level rise is anticipated to bring an additional 2 – 3 feet, which would threaten the shoreline and recreational areas around Tinian Seaport and Taga Beach. Current development of a casino and hotel on the Tinian Harbor area are at risk and will need guidance in addressing these coastal hazards[1].

Figure 1- Map of Tinian with the Lagoon and Reef APC (yellow) and the Shoreline APC (cyan blue).

[1] "Event Class: Coastal Erosion" from BECQ's *Climate Vulnerability Assessment for the Islands of Rota and Tinian, Commonwealth of the Northern Mariana Islands* pg 49 – 52

Tachonga Beach

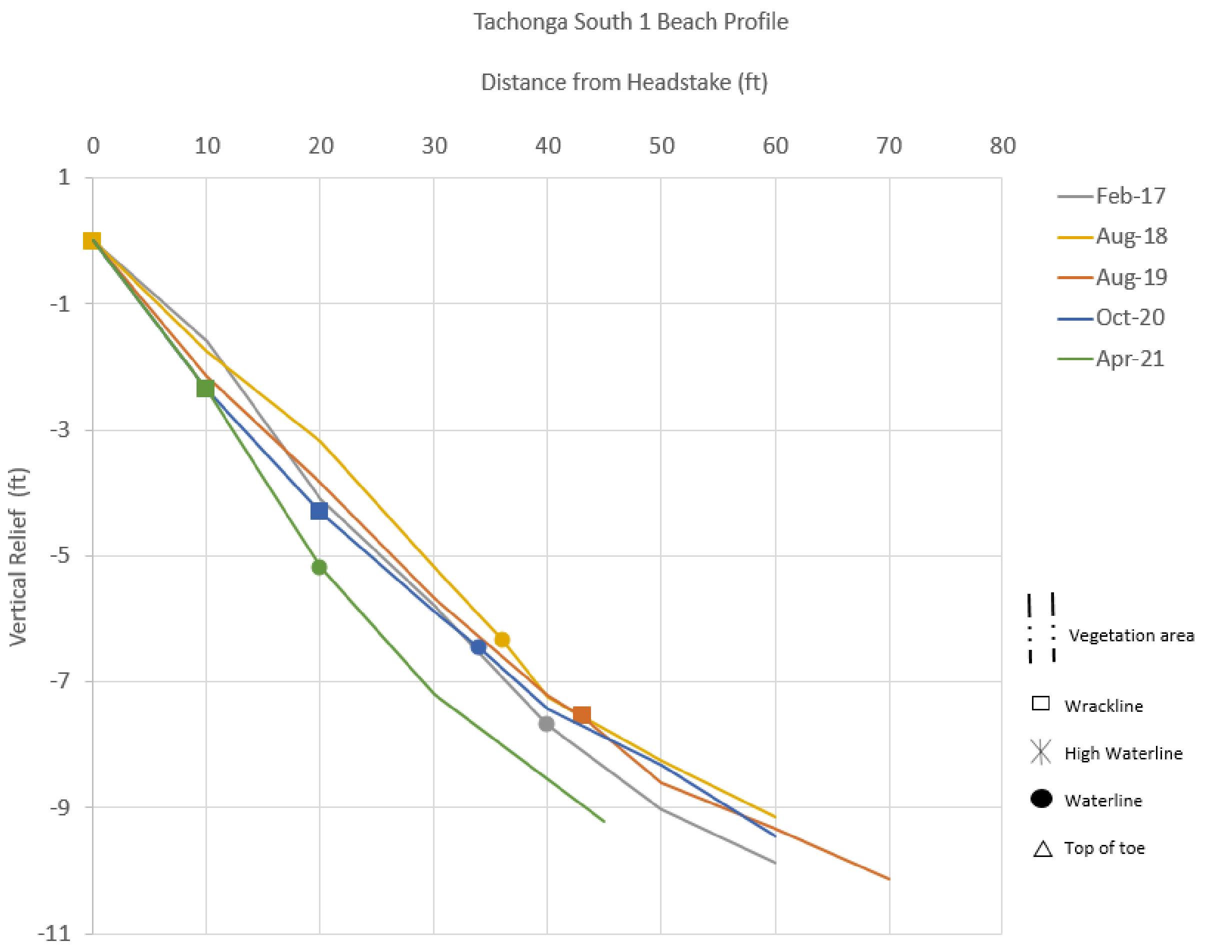
Average length: 54.5 ft

Average elevation: 7.33 ft

Tachonga Beach is important to Tinian's recreation and tourism as it is grounds for BBQs and marine sports. The southern part of the beach has a higher density of nearshore salt-tolerant vegetation, which acts as a sand stabilizer and buffer from waves for the backshore. Meanwhile, the northern section of the shoreline is more exposed since this area is more cleared and disturbed by recreational use. This area has historically been at risk of storm surge and tsunami events[2]. Apr-21 records for transects in this site presents the impact of storm surge and high surf on the shoreline.

[2] Ed Hofschneider, personal communication, April 22, 2021

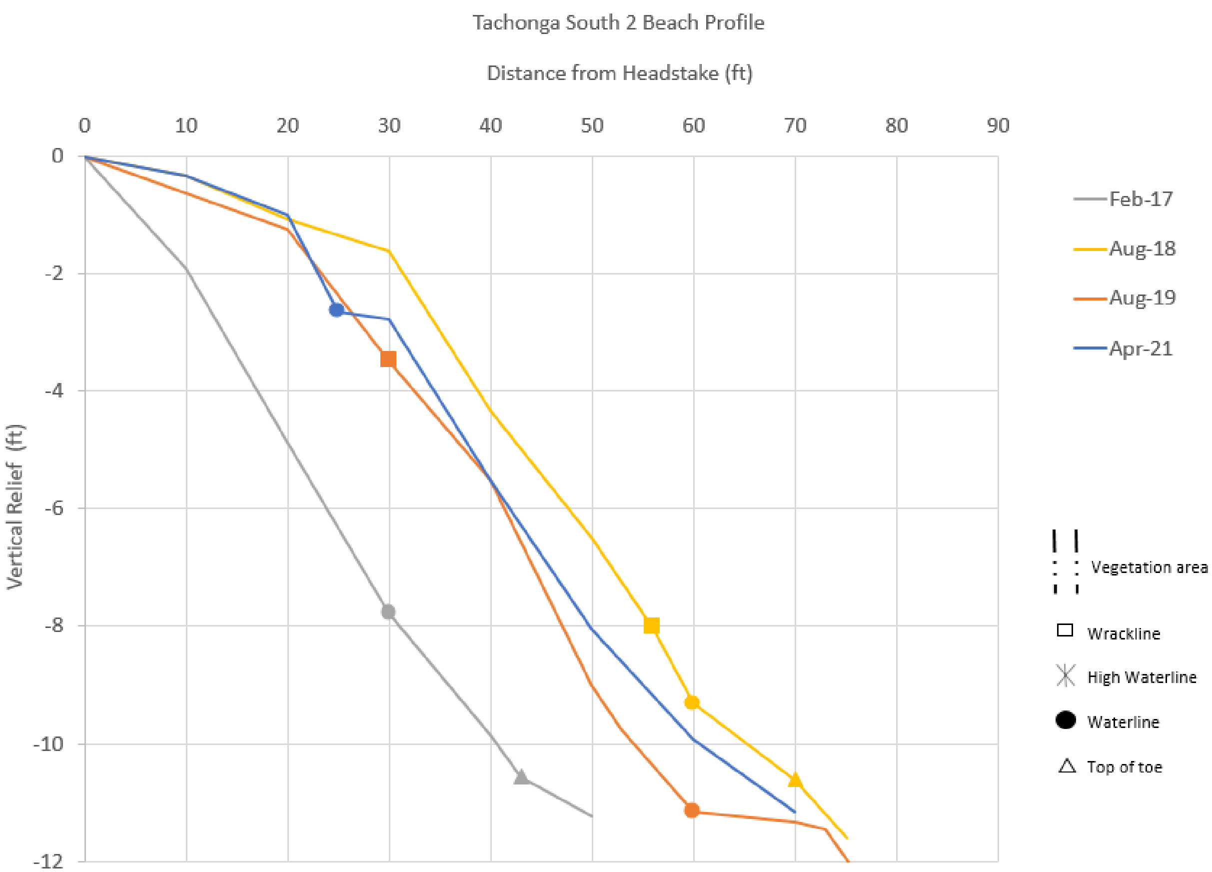
Tachonga South 1



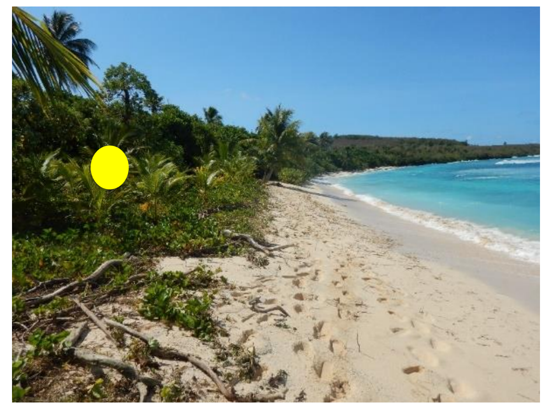
Day Recorded	Tide	Shoreline Length
Feb 16, 2017	1.46 ft	40 ft
Aug 30, 2018	1.59 ft	36 ft
Aug 27, 2019	0.6 ft	Not recorded
Oct 20, 2021	1.45 ft	34 ft
Apr 22, 2021	1.31 ft	20 ft
Average		32.5 ft

Tachonga South 1 appears to be generally eroding. The wrackline ranges from the headstake to 40 ft away. This area is on the southern end of the beach, which suggests its large wrackline range.

Tachonga South 2



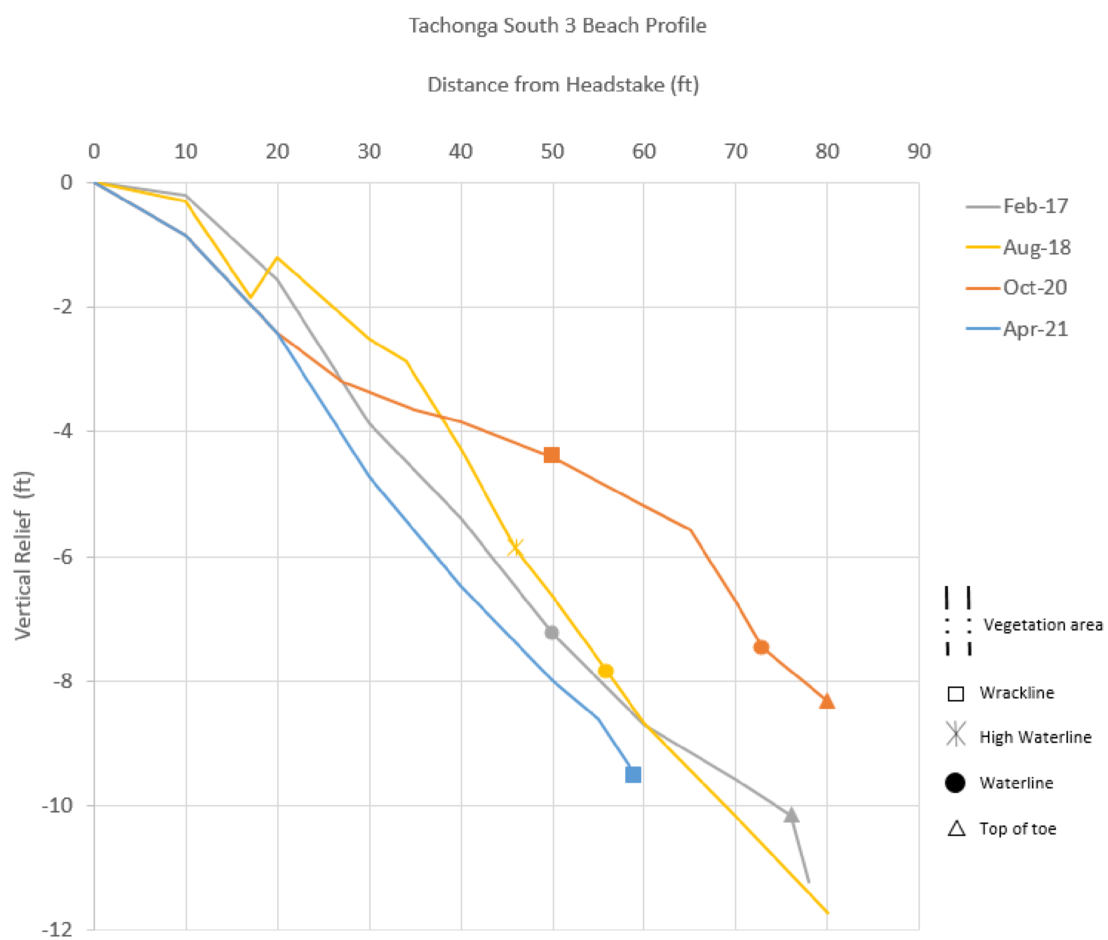
Day Recorded	Tide	Shoreline Length
Feb 16, 2017	1.51 ft	30 ft
Aug 30, 2018	1.52 ft	60 ft
Aug 27, 2019	-0.05 ft	60 ft
Apr 21, 2021	1.29 ft	25 ft
Average		43.75 ft



Tachonga South 2 appears to be eroding. Feb 2017 is an outlier with the misidentification of the headstake (a backshore plant). The wrackline ranges from 30 to 56 ft. The elevation difference from the headstake to the farthest top of toe is about 11 ft.

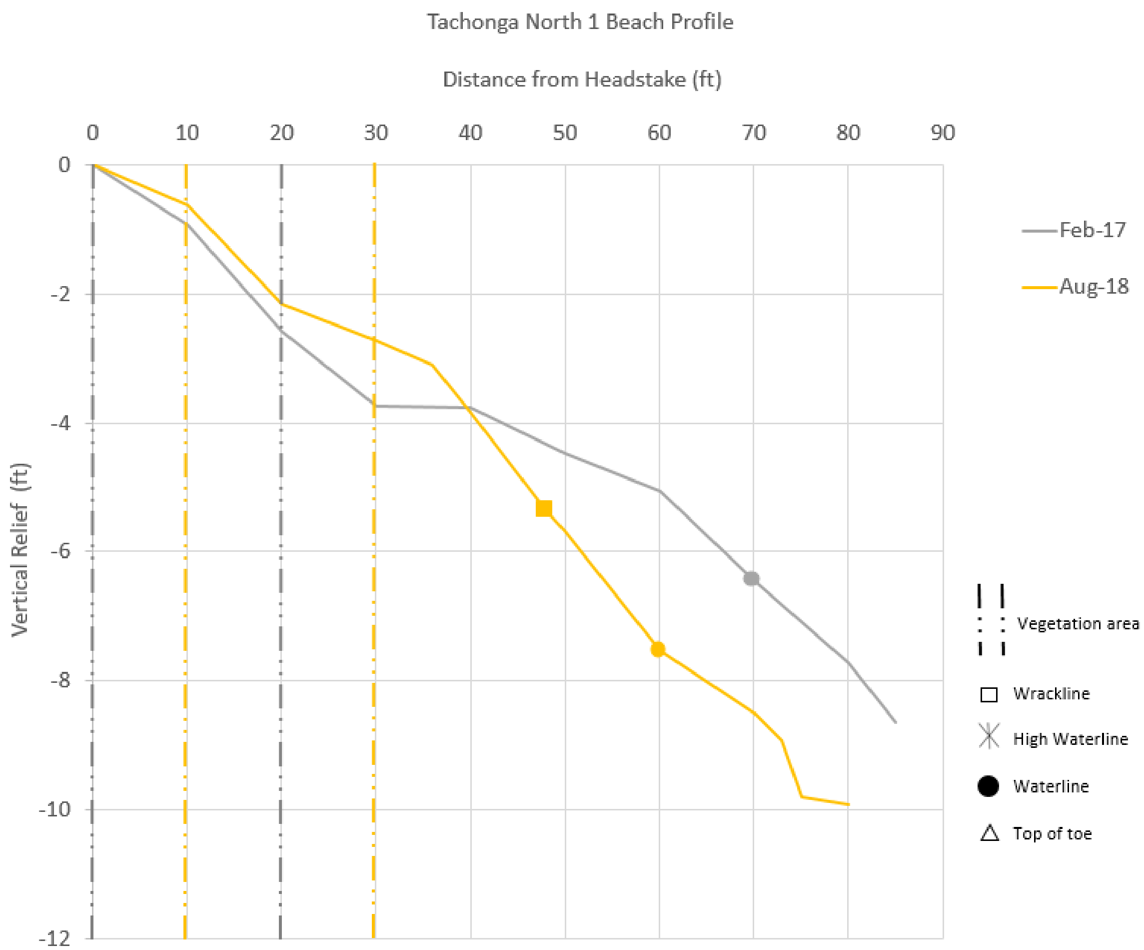
Tachonga South 3

Day Recorded	Tide	Length
Feb 16, 2017	1.57	50 ft
Aug 30, 2018	1.41	56 ft
Oct 8, 2020	1.61	73 ft
Apr 21, 2020	1.31	Not recorded
Average		59.67 ft



Tachonga South 3 is eroding given the loss of the berm. Oct-20 shows accretion with a longer shoreline length, but the high surf event of Apr-21 chipped away at that accumulated sand. The wrackline ranges from 50 ft to 59 ft. The elevation difference from the headstake to the farthest top of toe is about 10 ft.

Tachonga North 1

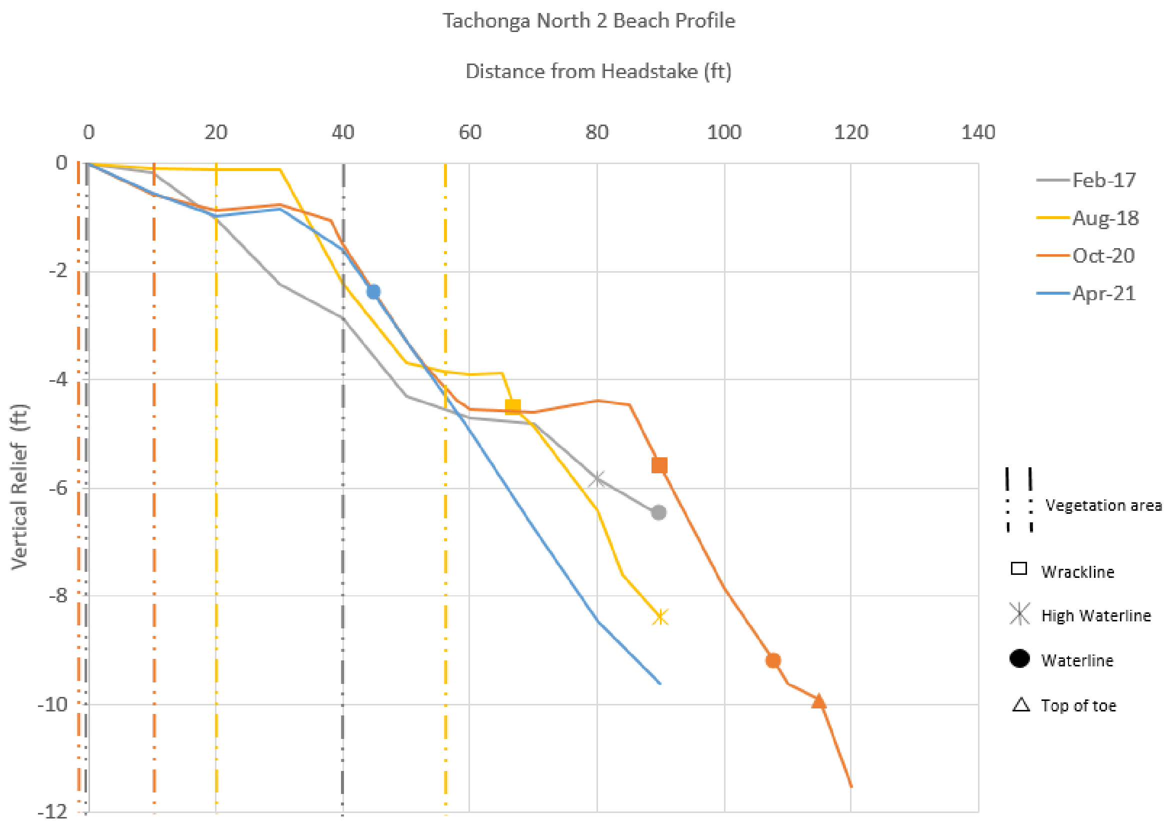


Day Recorded	Tide	Shoreline Length
Feb 16, 2017	Not recorded	70 ft
Aug 30, 2018	1.32 ft	60 ft
Average		65 ft

Note: No picture of the headstake was taken for this transect.

Tachonga North 1 is discontinued due to its difficulty in identifying the headstake. This headstake was in the vinicity of the beach parking lot and backshore meeting area. The shoreline from Feb-17 and Aug-18 appears to indicate erosion for this profile.

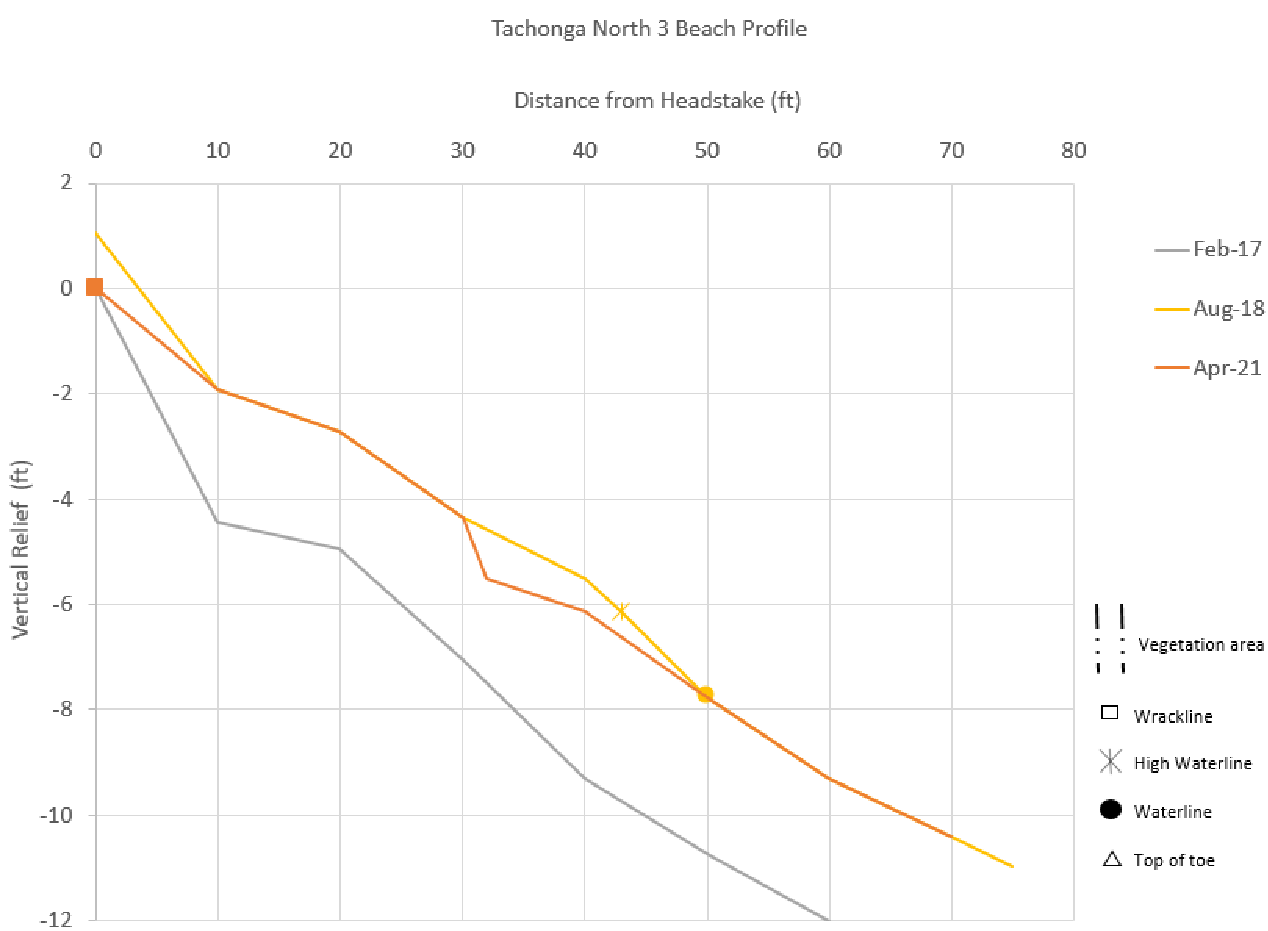
Tachonga North 2



Day Recorded	Tide	Shoreline Length
Feb 16, 2016	Not recorded	90 ft
Aug 30, 2018	1.27 ft	Not recorded
Oct 8, 2020	1.58 ft	108 ft
Apr 21, 2021	1.36 ft	45 ft
Average		81 ft

Tachonga North 2 appears to have generally eroded. Oct-20 indicated that the shoreline could be longer under regular conditions. Apr-21 indicates the shoreline erosion during high tide and high surf conditions. The vegetation line was not captured during that time because they were damaged by wave conditions. The wrackline ranges from 67 to 90 ft during regular surf conditions.

Tachonga North 3



Day Recorded	Tide	Shoreline Length
Feb 16, 2017	1.78 ft	40 ft
Aug 30, 2018	1.17 ft	50 ft
Apr 21, 2021	1.38 ft	Not recorded
Average		45 ft

Tachonga North 3 appears have slightly eroded. According to surveyor and residential observations, high surf has pushed up new sand into the shoreline and this area is highly prone to wave run up. The wrackline reached the headstake in Apr-21.

Jones Beach

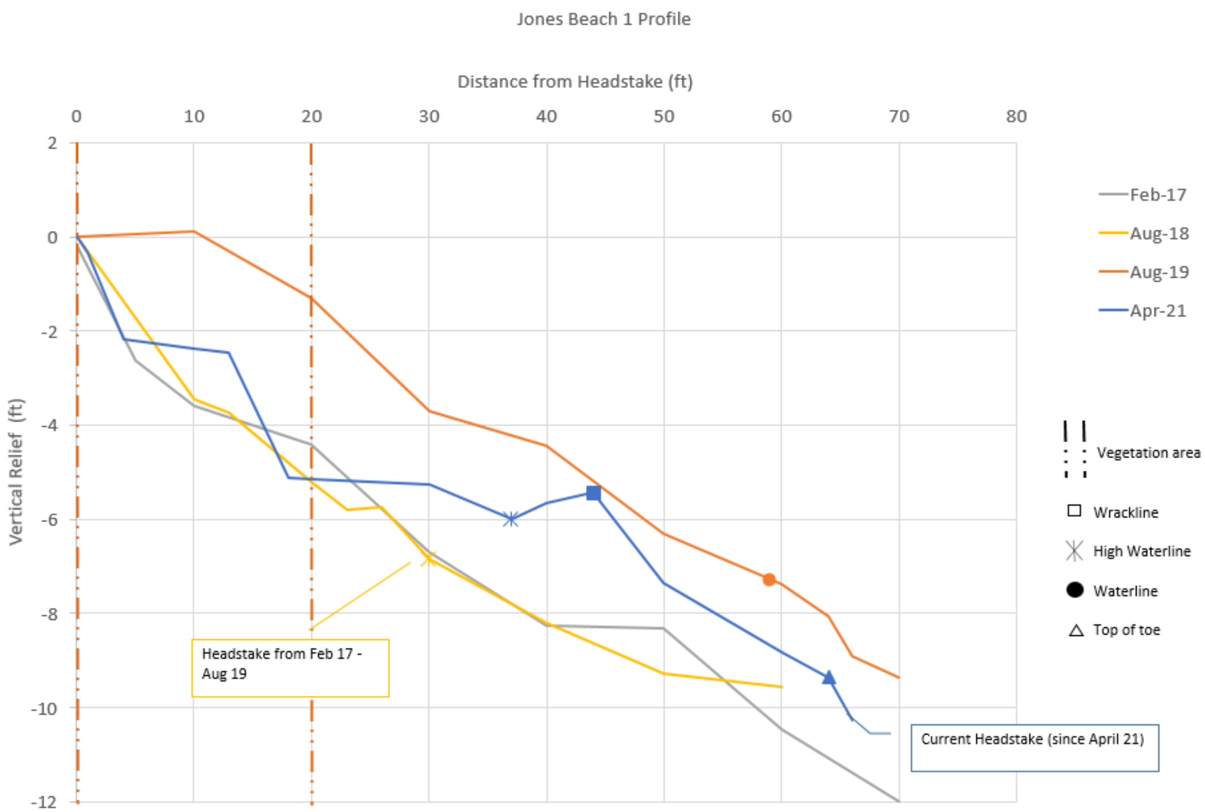
Trend: Stable

Average length: 46.3 ft

Average elevation: 6 ft

Formerly called “Kammer”, Jones Beach is a sandy beach park south of the Tinian Harbor. The northern portion of the shoreline which aligns with the boat harbor appears to have not as much coral and coastal protection. Jones Beach is closest to San Jose Village and the Tinian Harbor. The loss of this beach to sea level rise or erosion would push the risk of storm surge inland.

Jones 1

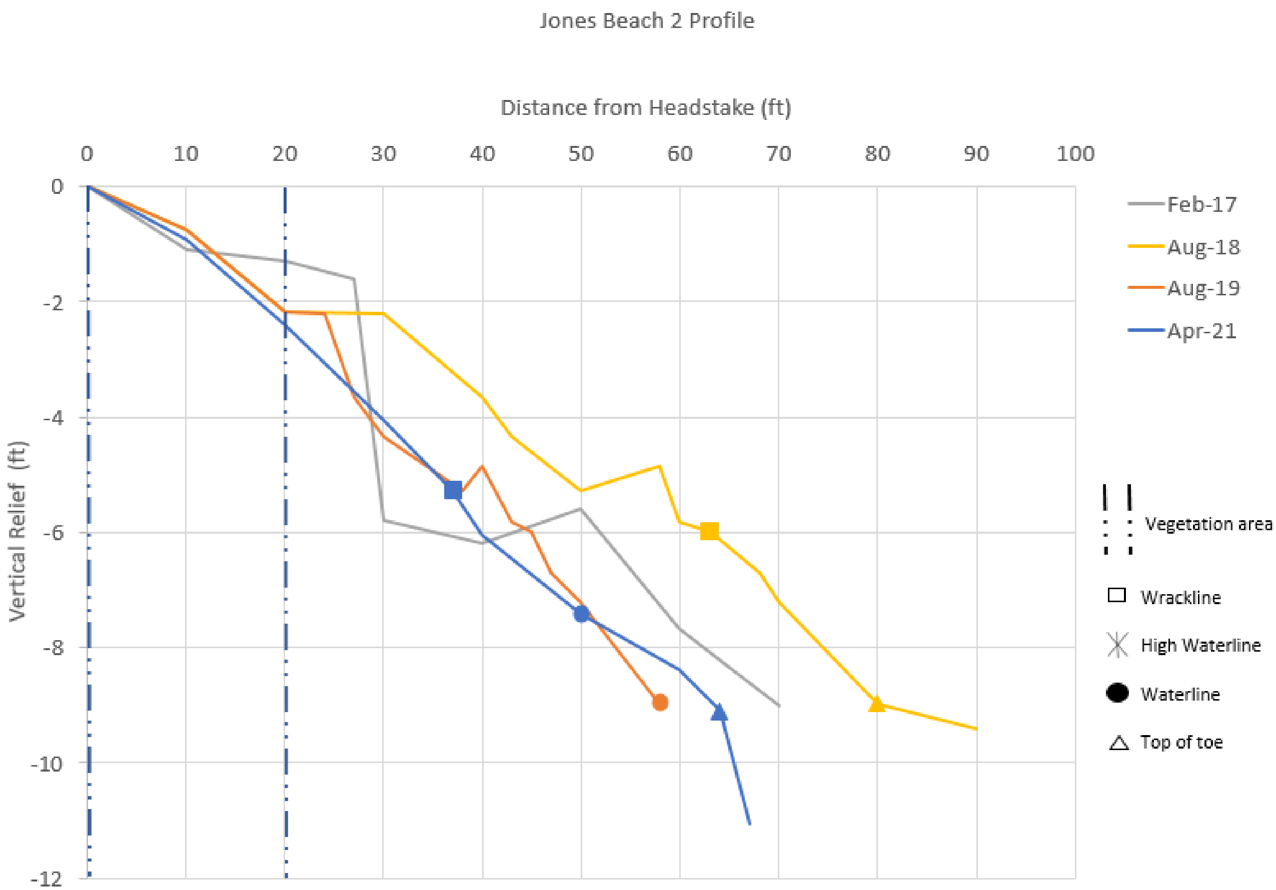


Day Recorded	Tide	Shoreline Length
Feb 16, 2017	1.07 ft	60 ft
Aug 30, 2018	0.55 ft	Not recorded
Aug 27, 2019	0.17 ft	59 ft
Apr 21, 2021	0.76 ft	Not recorded
Average		59.5 ft

Jones 1 is difficult to determine. The Aug-19 headstake was a tree that was growing larger in size, blocking the actual starting point and making the surveying difficult. The current headstake is new and is a coconut tree closer to the backshore the dirt closer to the pavilions. The elevation difference from the headstake to the farthest top of toe is about 9 ft.

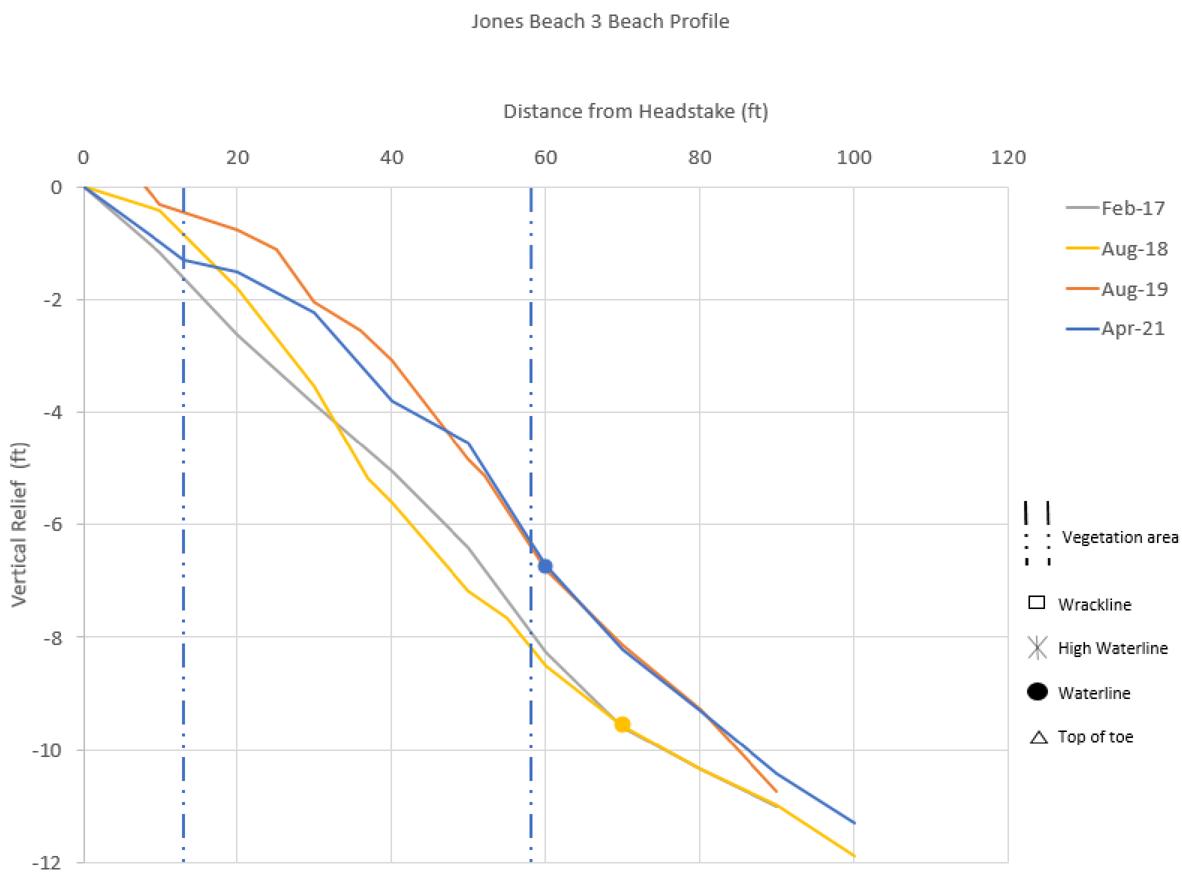
Jones 2

Day Recorded	Tide	Shoreline Length
Feb 16, 2017	1.21 ft	65 ft
Aug 30, 2018	0.69 ft	68 ft
Aug 27, 2019	1.4 ft	58 ft
Apr 21, 2021	1.21 ft	50 ft
Average		60.25 ft



Jones 2 is generally eroding. Aug 2018 appears to be an outlier. Through observation, it is speculated that storm surges from powerful storms may influence the shoreline vegetation dynamics. The elevation distance from the headstake to the furthest top of toe is 9 ft.

Jones 3



Day Recorded	Tide	Shoreline Length
Feb 16, 2017	1.35 ft	60 ft
Aug 30, 2018	0.82 ft	70 ft
Aug 27, 2019	-0.05 ft	Not recorded
Apr 21, 2021	0.52 ft	60 ft
Average		63.3 ft

Jones 3 appears to generally accreting. This transect is adjacent to the harbor. Future data collection would improve understanding of the shoreline and its effect by the harbor structure.

Rota

Rota has sandy shoreline that runs along parts of the island notably west of Songsong Village through the northwest roadway. According the 2015 vulnerability assessment, these areas have the highest reports of coastal erosion. Songsong residents have reported 55 years of beach loss and raised concerns of shoreline retreat and sea level rise to impact private property in the future[3]. Increased sea level rise and stronger storms may bring very high level of storm surge vulnerability for the low-lying Songsong village[4].

Teteto, Guata, and Sasanlagu shoreline are monitoring sites within this highly vulnerable area. Sasanlagu lines the western portion of Songsong Village. The nearby fringing reef provides coastal protection from the open ocean waters and appears to inhibit post-storm recovery of sandy beaches that have lost sediment[5]. The backshore areas generally contain thickets of beach strand plant species which provide an attenuation layer from potential wave run up for the road. For more exposed areas, powerful wave action have greatly abraded the narrowing road of West Harbor causeway at Esong.

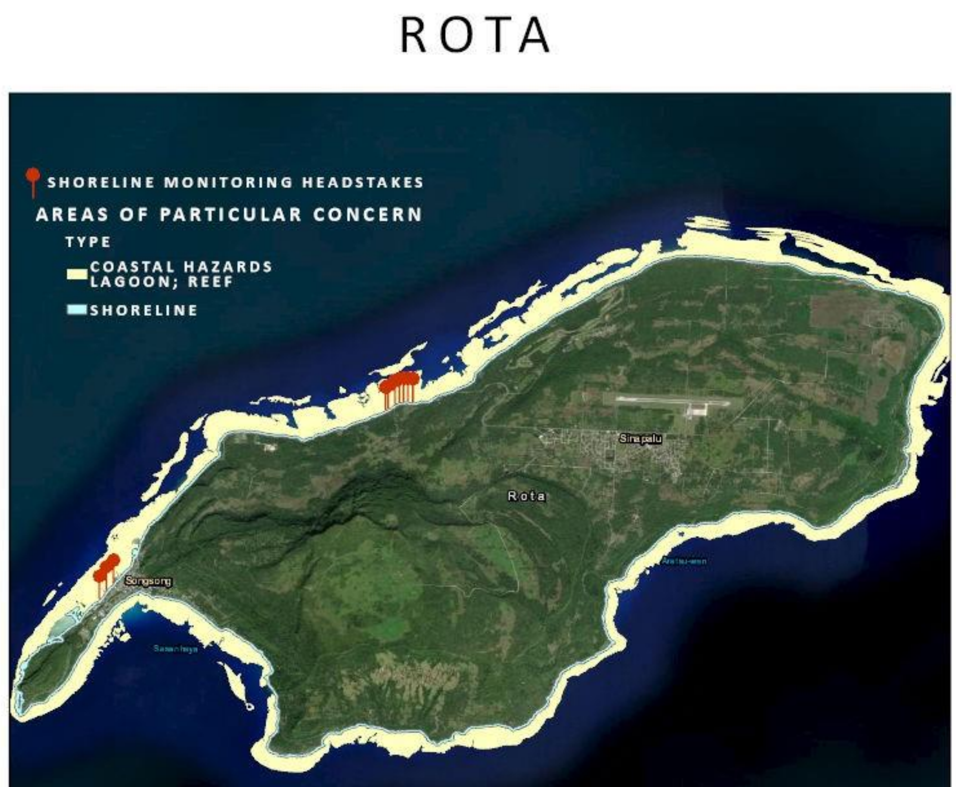


Figure 2 - Map of Rota with the Lagoon and Reef APC (yellow) and the Shoreline APC (cyan blue).

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[3] "Coastal Erosion at Teteto & Guata Shorelines" from BECQ's *Climate Vulnerability Assessment for the Islands of Rota and Tinian, Commonwealth of the Northern Mariana Islands* pg 31

[4] "Event Class: Surge" from BECQ's *Climate Vulnerability Assessment for the Islands of Rota and Tinian, Commonwealth of the Northern Mariana Islands* pg 32

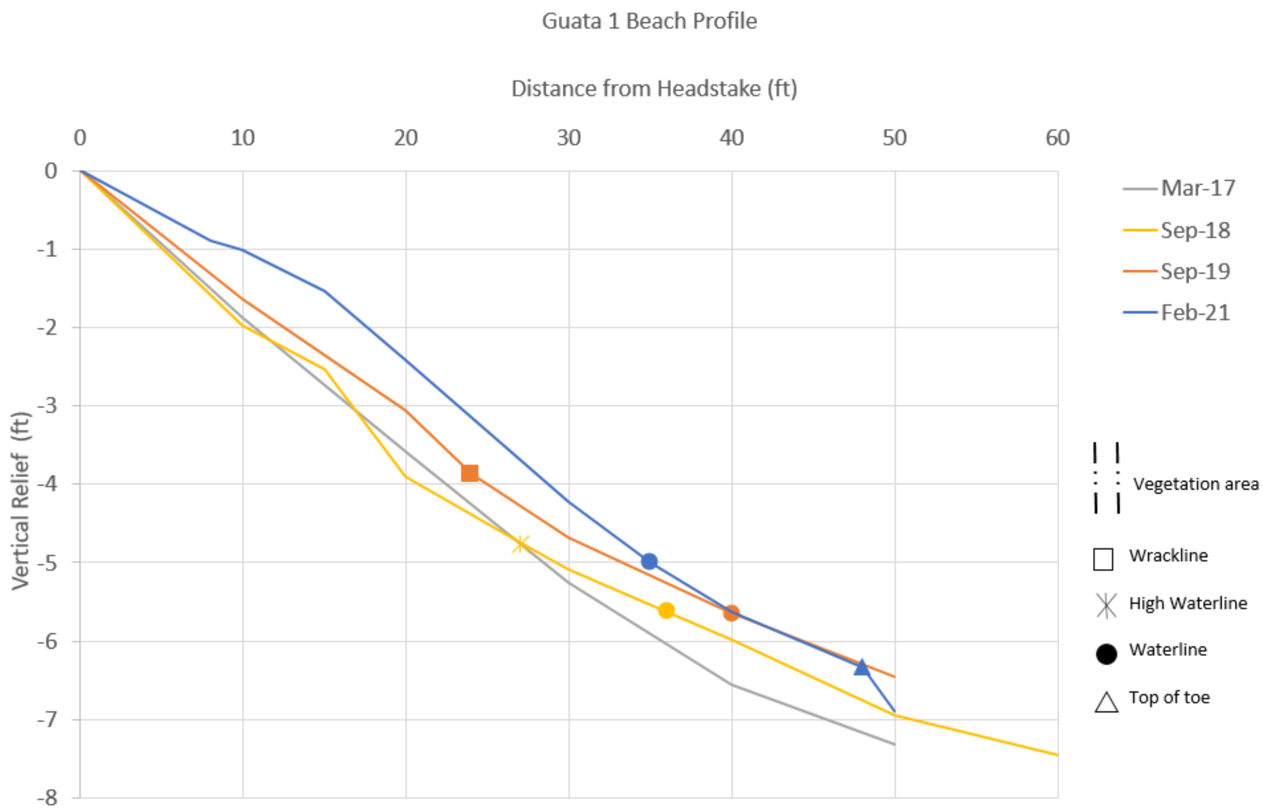
[5] William Pendergrass, personal communication, Feb 22, 2021

Guata Beach

Guata is the most northern monitoring site in Rota and a neighboring beach park to Teteto. This beach has high backshore vegetation density and provides excellent habitat for shoreline plant and animal species. The reef is at close proximity to shoreline. Inland, there are also multiple picnic palapalas, a playground, and restroom and shower facilities. The park and shoreline are also adjacent to the only road on the island headed for the airport[6]. Since the road lacks proper drainage, stormwater runoff contributes to accelerated beach erosion. Projected 50 and 75-year sea level rise scenarios suggest that Guata will recede further[7].

[6] Public Shoreline Access Guide for Saipan, Tinian, and Rota 2015. BECQ-DCRM
[7] "Coastal Erosion at Teteto & Guata Shorelines (Event ID 25)" from BECQ's *Climate Vulnerability Assessment for the Islands of Rota and Tinian, Commonwealth of the Northern Mariana Islands* pg 31

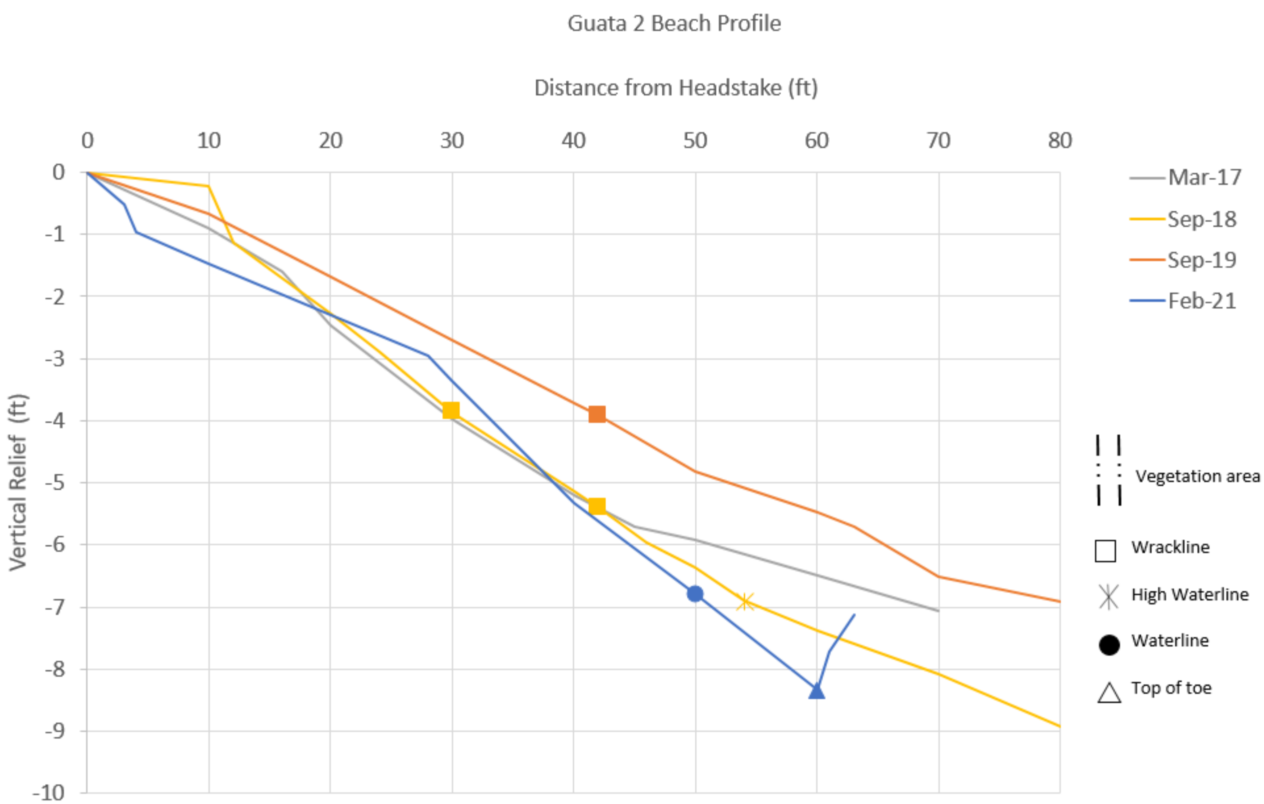
Guata 1



Day Recorded	Tide	Shoreline Length
Mar 14, 2017	1.35 ft	Not recorded
Sep 4, 2018	1.13 ft	36 ft
Sep 5, 2019	1.13 ft	40 ft
Feb 4, 2021	1.21 ft	35 ft

Guata 1 appears generally accreting. The elevation difference from the headstake to the top of the toe is approximately 6 ft.

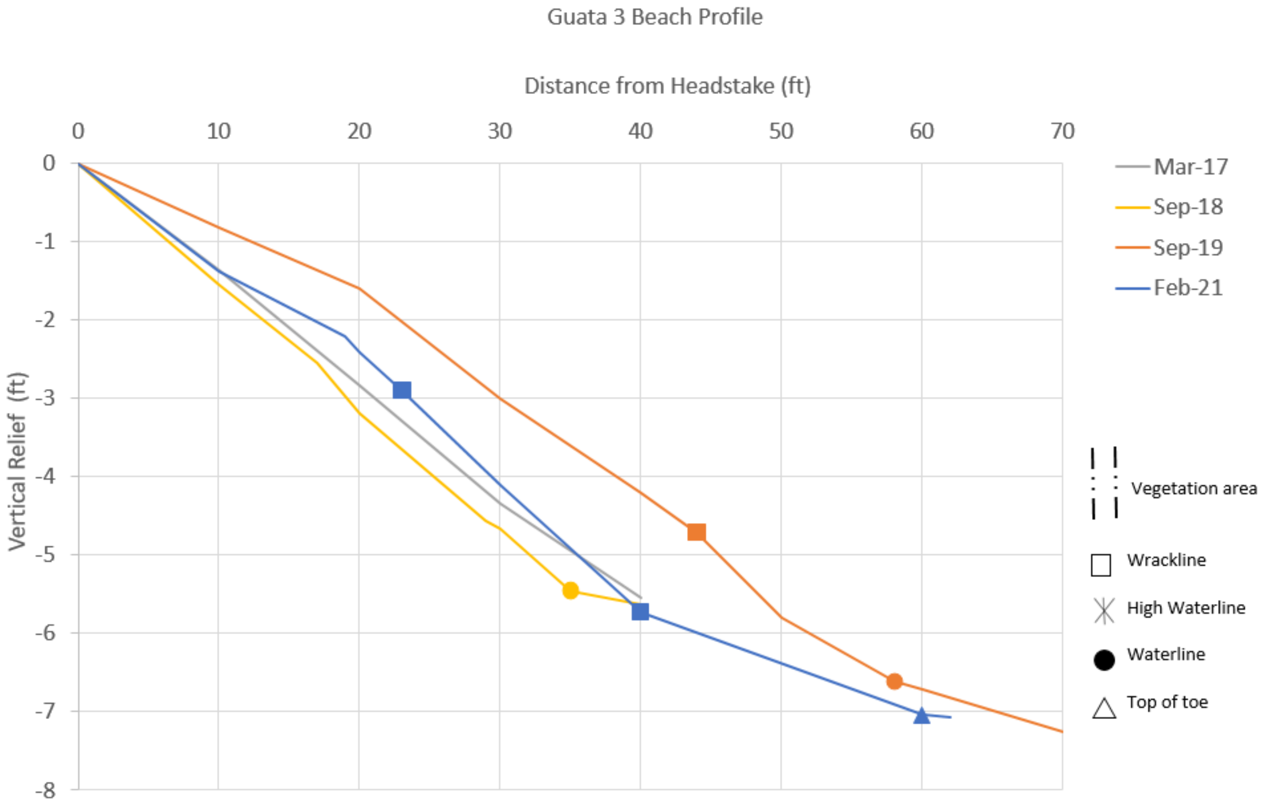
Guata 2



Day Recorded	Tide	Shoreline Length
Mar 14, 2017	1.58 ft	45 ft
Sep 4, 2018	1.25 ft	Not recorded
Sep 5, 2019	1.13 ft	63 ft
Feb 4, 2021	1.34 ft	50 ft

Guata 2 is eroding. The wrackline ranges from 30 ft to 42 ft. The elevation difference from the headstake to the top of the toe is approximately 8 ft.

Guata 3



Day Recorded	Tide	Shoreline Length
Mar 14, 2017	1.58 ft	30 ft
Sep 4, 2018	1.25 ft	35 ft
Sep 5, 2019	1.13 ft	58 ft
Feb 4, 2018	Not recorded	Not recorded
Average		41 ft

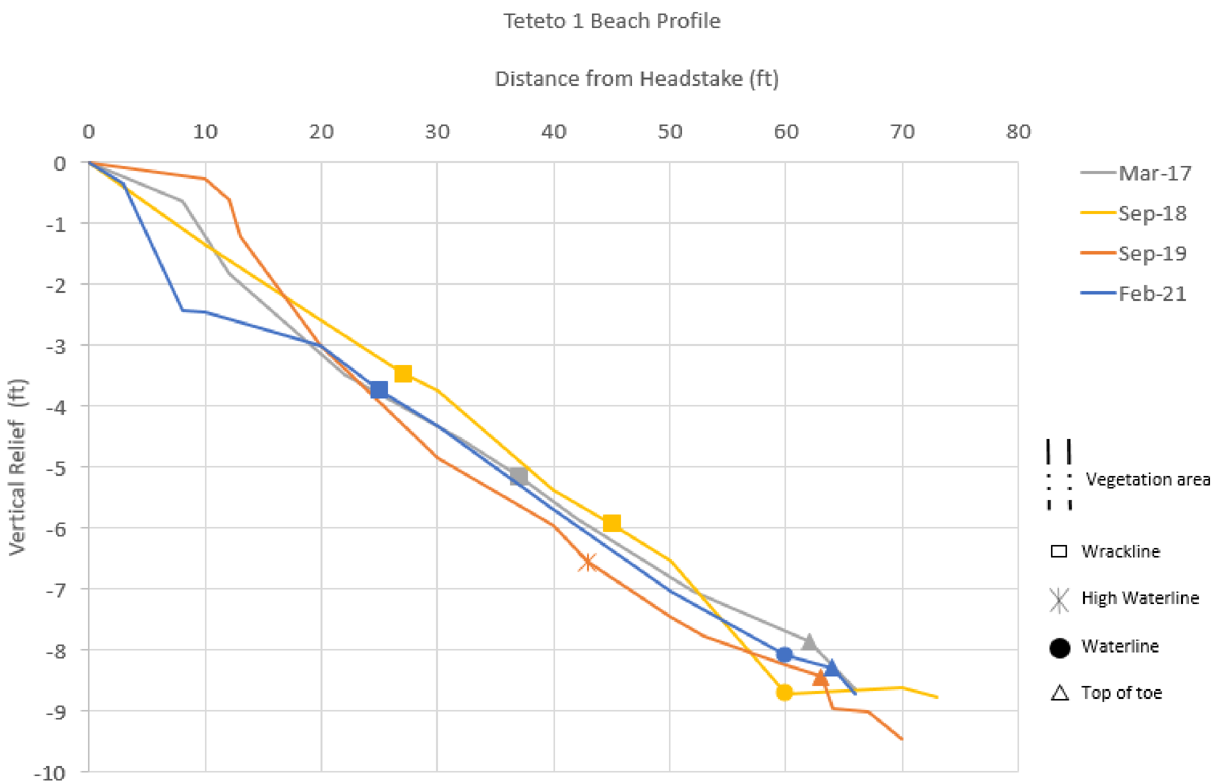
Guata 3 appears to be dynamic but it is slightly accreting. The wrackline ranges from 23 ft to 44 ft. The elevation difference from the headstake to the top of the toe is 7 ft.

Teteto

Teteto Beach Park contains picnicking areas and a parking area. The shoreline has higher foot traffic than Guata. Shoreline erosion is observed through the abrasion along the beach park.

Similarly to Guata beach, sea level rise projections suggest substantial loss of sand in the 50 and 75-year scenarios. The loss of beach as a buffer could damage the main road connecting Songsong to Sinapalo and inland areas during storm surge and high wave energy events.

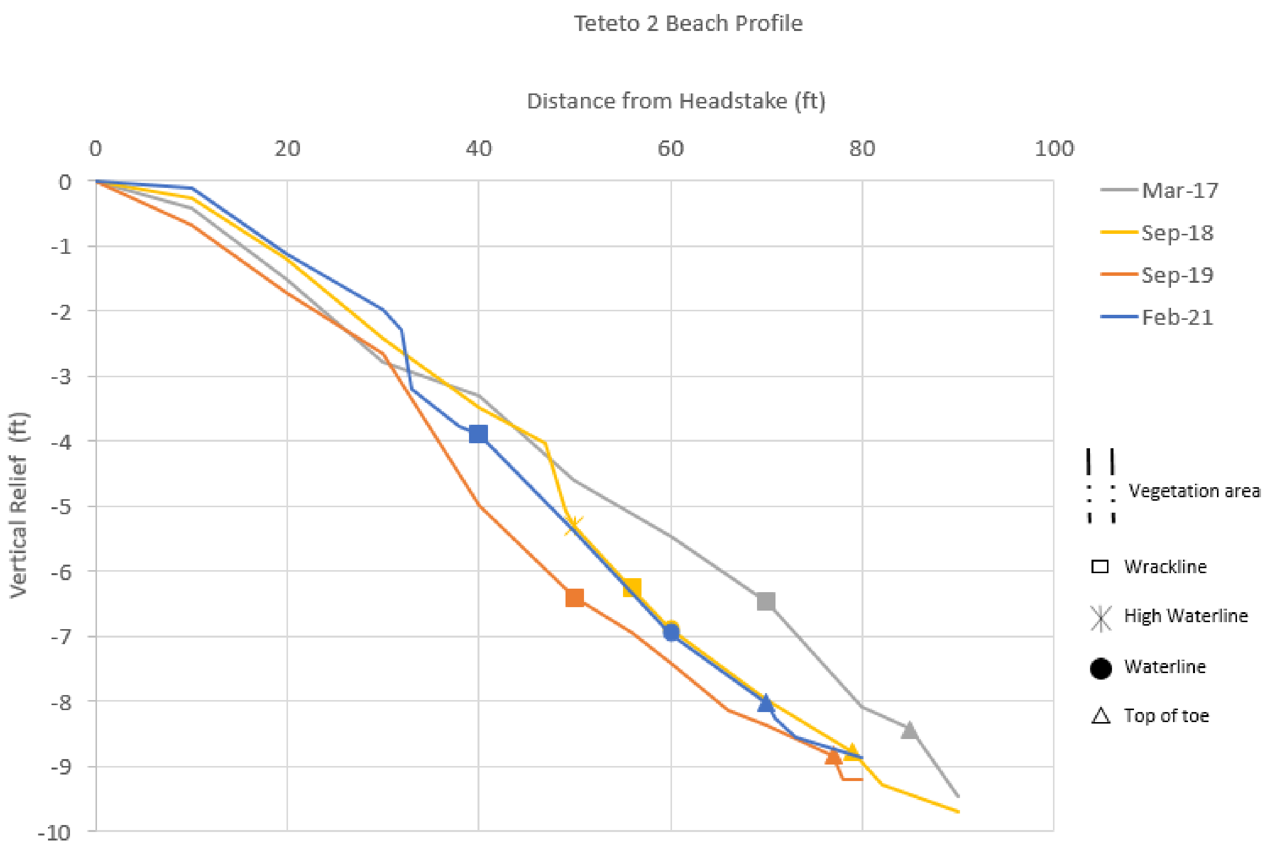
Teteto 1



Day Recorded	Tide	Shoreline Length
Mar 14, 2017	1.75 ft	Not recorded
Sep 4, 2018	0.9 ft	60 ft
Sep 5, 2019	Not recorded	53 ft
Feb 4, 2021	1.44 ft	60 ft
Average		57.67 ft

Teteto 1 appears to be generally eroding. The berm appears to be abraded. The wrackline ranges from 25 to 45 ft. The elevation from the headstake to the top of the toe around 8.5 ft.

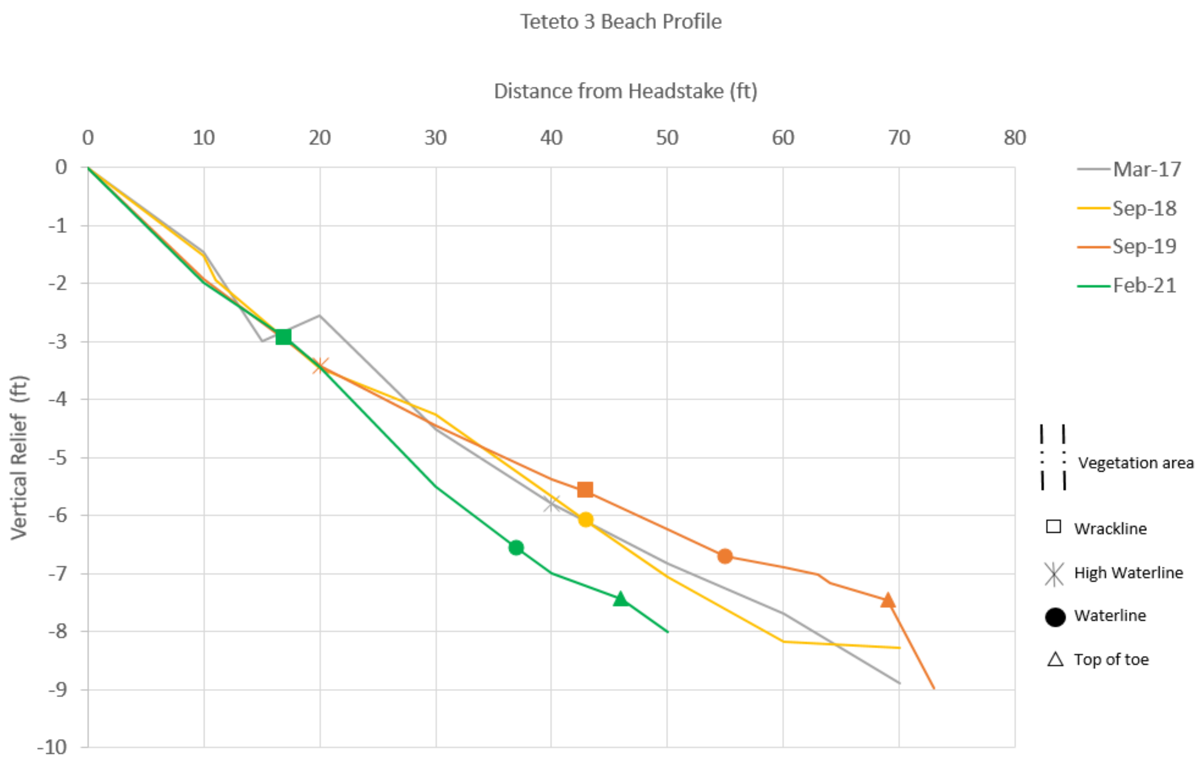
Teteto 2



Day Recorded	Tide	Shoreline Length
Mar 14, 2017	1.74 ft	Not recorded
Sep 4, 2018	0.97 ft	60 ft
Sep 5, 2019	Not recorded	70 ft
Feb 4, 2021	1.5 ft	60 ft
Average		63.3 ft

Teteto 2 is generally eroding, but future trends could determine the long term shoreline change. Sep-19 to Feb-21 indicates accretion but compared to the baseline record, Mar-17, erosion has occurred at this stretch. The wrackline ranges from 40 to 70 ft. A small scarp was observed in the most recent field work. The elevation from the headstake to the top of the toe around 8.5 ft.

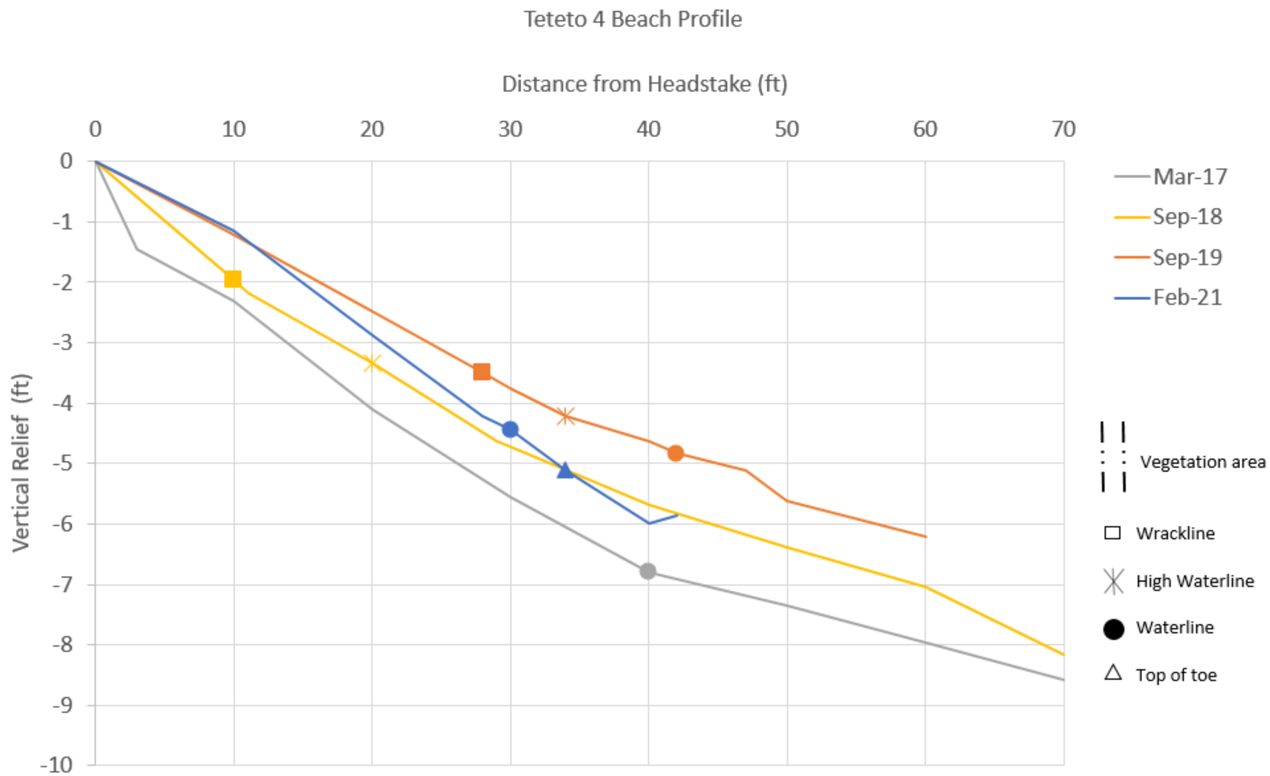
Teteto 3



Day Recorded	Tide	Shoreline Length
Mar 14, 2017	1.74 ft	Not recorded
Sep 4, 2018	1.04 ft	43 ft
Sep 5, 2019	1.27 ft	55 ft
Feb 4, 2021	1.13 ft	37 ft
Average		45 ft

Teteto 3 has eroded over time. The berm has lost and the length of the shoreline has decreased over time. The wrackline ranges from 17 ft to 43 ft. The elevation difference from the headstake to the top of the toe is approximately 7 ft.

Teteto 4



Day Recorded	Tide	Shoreline Length
Mar 14, 2017	1.74 ft	40 ft
Sep 4, 2018	Not recorded	Not recorded
Sep 5, 2019	1.13 ft	42 ft
Feb 4, 2021	1.15 ft	32 ft
Average		38 ft

Teteto 4 is generally accreting. The berm has grown since Sept-19. Further monitoring will better confirm the development of this berm or the shortening of the shoreline. The wrackline ranges from 10 ft to 28 ft.

Sansanlagu

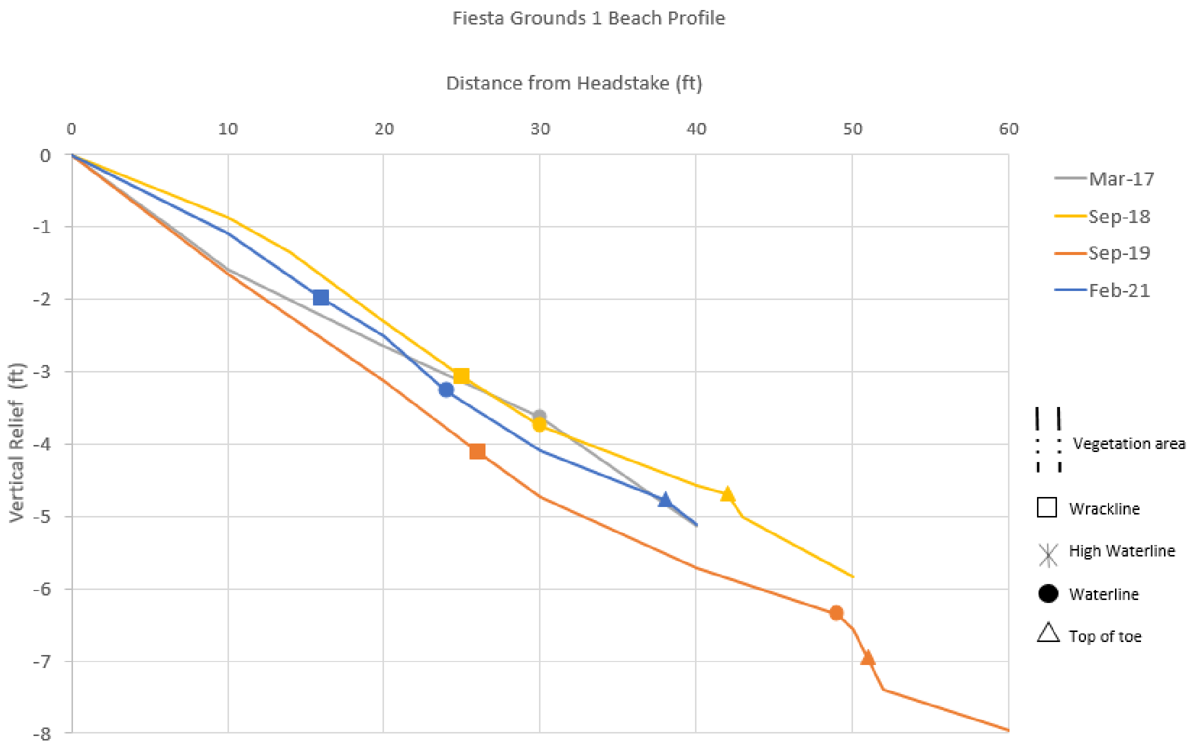
Sasanlagu monitoring site is also the popular Songsong beach park. The backshore are grounds for community events, shaded by rows of coconuts. Toward the West Harbor, the backshore vegetation density increases. Sections of the shoreline has been armored as indicated by concrete rubble scattered along with a concrete structure aligned with the line of coconut trees.

Typhoons and tropical disturbances have brought damaging storm surge to shoreline beach strands on the east and west sides of the peninsula boarding Songsong Village. In 2002, Typhoon Pongsona exhibited potential of an 18 to 22 feet surge according to the short proximity of the typhoon eye[8]. The loss of sandy beach to erosion will potentially increase the threat of future storm surge events.

Note that the beach profile titles hold the previous name 'Fiesta Grounds.'

[8] "Songsong Coastal Flood (Event ID 2)" from BECQ's *Climate Vulnerability Assessment for the Islands of Rota and Tinian, Commonwealth of the Northern Mariana Islands* pg 33

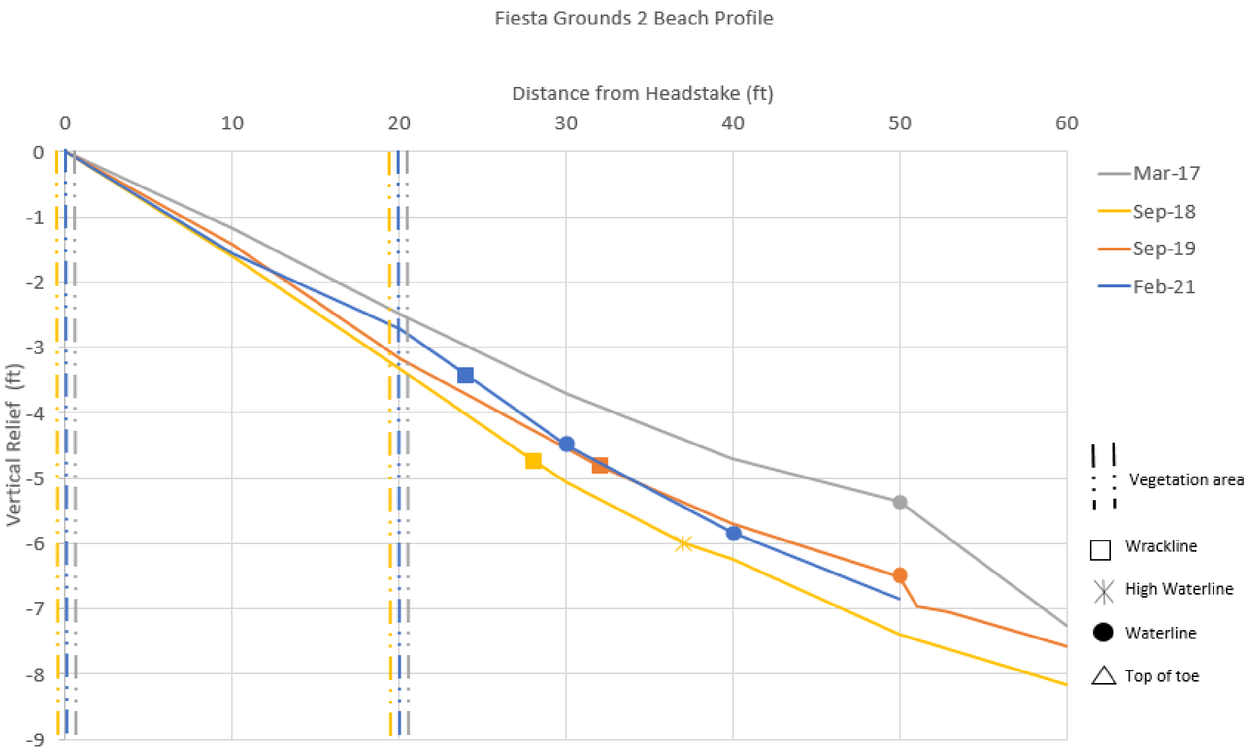
Sasanlagu 1



Day Recorded	Tide	Shoreline Length
Mar 14, 2017	0.59 ft	30 ft
Sep 4, 2018	1.28 ft	30 ft
Sep 5, 2019	1.13 ft	49 ft
Feb 4, 2021	Not recorded	24 ft
Average		33.25 ft

Sasanlagu 1 is generally accreting. The shoreline may have been longer in Sep-19 but the slope was steeper. The wrackline ranges from 16 ft to 26 ft. The elevation difference from the headstake to the top of the toe is 7 ft.

Sasanlagu 2



Day Recorded	Tide	Shoreline Length
Mar 14, 2017	0.58 ft	50 ft
Sep 4, 2018	1.58 ft	Not recorded
Sep 5, 2019	1.13 ft	Not recorded
Feb 4, 2021	1.93 ft	30 ft
Average		40 ft

Sasanlagu 2 is generally eroding. The wrackline ranges from 24 ft to 32 ft.

Sasanlagu 3

Day Recorded	Tide	Shoreline Length
Mar 13, 2017	0.56 ft	30 ft
Sep 4, 2018	1.58 ft	20 ft
Sep 5, 2019	1.13 ft	47 ft
Feb 4, 2021	1.93 ft	20 ft
Average		29.25 ft

Sasanlagu 3 is eroding but future monitoring could better inform the long term shoreline change rate. Sep-19 indicates accretion from Sep-18. Then erosion between Sep-19 and Feb-21. The wrackline ranges from 14 ft to 30 ft.

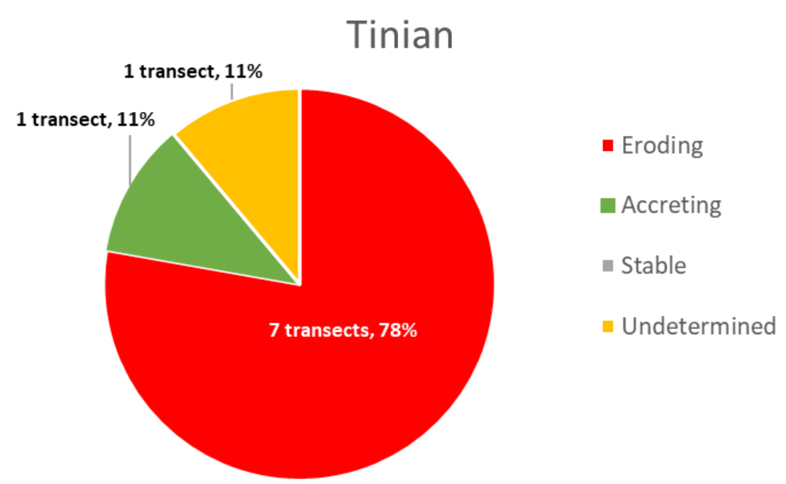
Summary

For the past four years, the DCRM Shoreline Monitoring team have monitored 9 transects within 2 Tinian beaches and 10 transects within 3 Rota beaches.

Based on the four-year period data collection:

78% of surveyed Tinian transects exhibited erosion while 11% are accreting and the remaining are undetermined.

40% of surveyed Rota transects exhibited accretion while the remaining 60% are eroding.



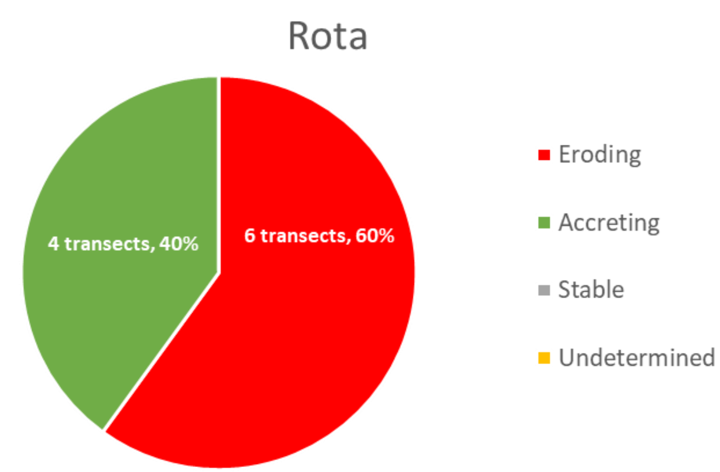


Figure 3 and 4 – More than 60% of Tinian and Rota transects are eroding while the rest are accreting and undetermined. A total of five transects for both islands are accreting.

These trends were determined by the current method of analyzing beach profile time records but data needs to mature to determine erosion hotspots. As shoreline monitoring data collection accrues over time, we may have clearer understanding of how long-term shoreline changes and patterns affect the beaches for Tinian and Rota. Throughout this report, we referenced the Rota and Tinian Climate Change Vulnerability Assessment because our shoreline monitoring data continues to support the findings of 2015. The adaptive response options in this vulnerability assessment remain relevant and can be implemented into management actions and development planning to address current and future impacts[10].

Anticipated improvements to the shoreline monitoring program are identified but not limited to: a) the integration of the total station and drone aerial imagery for accurate surveying, b) continued use of compass direction to reduce inaccuracies when laying the transect, and c) monitoring schedule devised for sites sensitive to seasonal variation.

The last identified improvement addresses questions posited at the Introduction section. Shoreline monitoring aims to be more consistent with tide seasonality for improved recording of the wrackline before or during high tide. An adopted shoreline change rate approach remains a priority for analysis and would further advance long-term shoreline change determination.

[10] See "Discussion: Steps Forward for Rota, Tinian, and CNMI" from BECQ's *Climate Vulnerability Assessment for the Islands of Rota and Tinian, Commonwealth of the Northern Mariana Islands* pg 58 – 65

Trends of Shoreline Monitoring Transects

(Mar 2017- Feb 2021)

Site	Transect	Accreting	Eroding	Stable	Undetermined
Tinian - Tachonga South	1		X		
	2		X		
	3		X		
Tinian - Tachonga North	1		X		
	2		X		
	3		X		
Tinian - Jones Beach	1				X
	2		X		
	3	X			
Rota - Guata Beach	1	X			
	2		X		
	3	X			
Rota - Teteto	1		X		
	2		X		
	3		X		
	4	X			
Rota - Sasanlagu	1	X			
	2		X		
	3		X		

Glossary of Terms

Accretion

The gradual addition of land by deposition of water-borne sediment.

Berm

The nearly horizontal portion of the beach or backshore formed by the deposit of materials by wave action. (In the CNMI, the berm is a vertical drop.)

Berger Level

Used to accurately measure the height of an inaccessible object. Takes cross sectional picture of a beach's contour.

Drop

The point at the bottom of the berm or changes in elevation.

Erosion

The wearing away of land and the removal of beach (or dune) sediments by wave action, tidal currents, drainage, or high winds.

Foreshore

The part of the shore that lies between high and low water mark at ordinary tide.

Headstake

The starting point of a transect. Usually marked on a tree in paint.

High Waterline

The level reached by the sea at high tide.

Level Rod

Used with a leveling instrument to determine the difference in height between points.

Measuring Rope

100 ft. rope measure is laid along the shore to be profiled.

Moat or Toe

The point of a beach that juts out past the waterline. Often this is sand that is covered by water but may be exposed during low tides.

Transect

A straight line or narrow section across the earth's surface along which observations are made or measurements are taken.

Tripod

Supports or holds the Berger Level.

Vegetation Line

The first line of stable and natural vegetation, separate from grass. Also the boundary between the sand beaches.

Waterline

A line that marks the surface of the sea on land.

Wrackline

The line of debris that is left by high tide. Usually made up of eelgrass, pebbles, and litter.

Other terms

- Abrasion – the process of scraping or wearing away
- Beach Profile – cross-sectional trace of the beach from the headstake to the water
- Dynamic – constantly changing
- Elevation difference – the height difference of the headstake to the beach toe
- Hydrodynamics – science revolving around the motion of fluids acting on solid bodies. For this report, it is the motion of waters surrounding the west coast of Saipan acting on corals and other physical objects in the water during wave conditions.
- Incidental erosion – a reversible process after cross-shore processes attack the shoreline during extreme events
- Outlier – observation that is at an abnormal distance from other values in a random sample from the population
- Risk – chance that something or someone will experience negative impacts from a coastal hazard
- Scarp – a drop formed by erosive forces

- Shoreline change – change in the shoreline contour by loss or gain of sand volume
- Stable/stability – a state in which the shoreline appears to return to its original condition over time even when disturbed
- Sediment transport – hydrogeological process in which waves currents push sediment into or away from coastal spaces
- Storm surge – the abnormal rise of water generated by winds from a storm. The amplitude of the storm surge at any given location depends on the coastline orientation and bathymetry coupled with the storm track, intensity, size, speed.
- Wave run up – maximum vertical extent of wave uprush on a beach above the still water level

References

CNMI Bureau of Environmental and Coastal Quality –Division of Coastal Resources Management. (2015). Climate Vulnerability Assessment for the Islands of Rota and Tinian, Commonwealth of the Northern Mariana Islands. Prepared for the CNMI Division of Coastal Resources Management –CNMI Office of the Governor.

CNMI Bureau of Environmental and Coastal Quality –Division of Coastal Resources Management. (2015). Public Shoreline Access Guide for Saipan, Tinian, and Rota. Prepared for the CNMI Division of Coastal Resources Management –CNMI Office of the Governor.