

# ESTABLISHMENT OF BEACH PROFILES FOR NAURU

9-28 March 2000

Chaoxiong He  
*SOPAC Secretariat*

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SOPAC Preliminary Report 132



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## **SUMMARY**

A Japanese-funded boat harbor is under construction in Anibare on Nauru. A post-construction evaluation and assistance for monitoring of possible environmental effects was proposed. The government of Nauru therefore requested SOPAC to conduct the project, entitled Coastal Erosion Monitoring and Advise on Response Strategies. This project's objectives are to examine and identify coastal erosion around the Nauru coast and collect information on countermeasures to be proposed at state level, and to establish a shoreline monitoring system for long-term observation as one part of a baseline data set.

The field reconnaissance survey for this project was conducted from 9 to 28 March 2000. During this period, the coastal landforms around Nauru were examined, and 17 beach profiles around the coast was put in place for long-term beach-change monitoring. These beach profiles were coordinated with the local datum and tied to permanent fixtures. Each site was documented photographically and the control points were created and plotted on a MapInfo GIS format aerial photography.

This report presents the basic results of only the beach profiling of this project. A detailed discussion and data analysis will be provided in SOPAC Technical Report 323.

## **ACKNOWLEDGEMENTS**

The funding for this project was provided by the Government of the People's Republic of China.

The work was carried out in collaboration with the Nauru Government. Particular assistance was received from both Department of Island Development & Industry (IDI) of Nauru Government and Nauru Fisheries and Marine Resources Authority (NFMRA).

The coordination assistance and arrangement of logistic support during the field-work period by Tyrone Deiye, A/Director of Projects Department of Industry & Economic Development, Republic of Nauru, is highly appreciated.

Special thanks go to Peter Jacob, Acting Chief Executive Office of MFMRA, for his introductory trip around Nauru.

Land Survey Department of NPC provided benchmark information.

Permission to use the wind and tide data by the National Tidal Facility (NTF) is acknowledged;

Review and comments on the draft of this report were given by Robert Smith, Marine Geophysicist of SOPAC; and Quan Chung from SOPAC and Mr Pene Agadio, Environment Officer from IDI, provided the field assistance.

## INTRODUCTION

Located in the central Pacific Ocean at 0°32'S, 166°56'E, Nauru is a small island with a land area of 22 km<sup>2</sup> (Figure 1), and it has the highest population density in the South Pacific. Its coast is under a high degree of erosion brought about by both natural and human processes. Some new development construction has produced higher erosion on the coast, such as the airport runway extension and the small boat harbor construction in Anibare. The government of Nauru requested SOPAC to conduct the project entitled Coastal Erosion Monitoring and Advise on Response Strategies. This project's objectives are to examine and identify coastal erosion around Nauru's coast and collect information on countermeasures to be proposed at state level, and to establish a shoreline monitoring system on Nauru for long-term observation.

The field reconnaissance survey for this project was conducted from 9 to 28 March 2000. During this period, the coastal landforms around Nauru Island were examined, and 17 beach profiles around the coast were put in place. These beach profiles were coordinated to the local datum and tied to local permanent fixtures. Each site was documented photographically.

The beach profiles were surveyed using the Sokkia set 2C Total Station. A hand-held Global Positioning System (GPS) unit was used to record the latitude and longitude of the control point of each beach profile.

In developing a coast GIS for Nauru, the 1992 aerial photography was converted into MapInfo GIS format and all control points were geo-coded and plotted on the MapInfo GIS format aerial photography (Figure 2). These data are stored in digital format in SOPAC database.

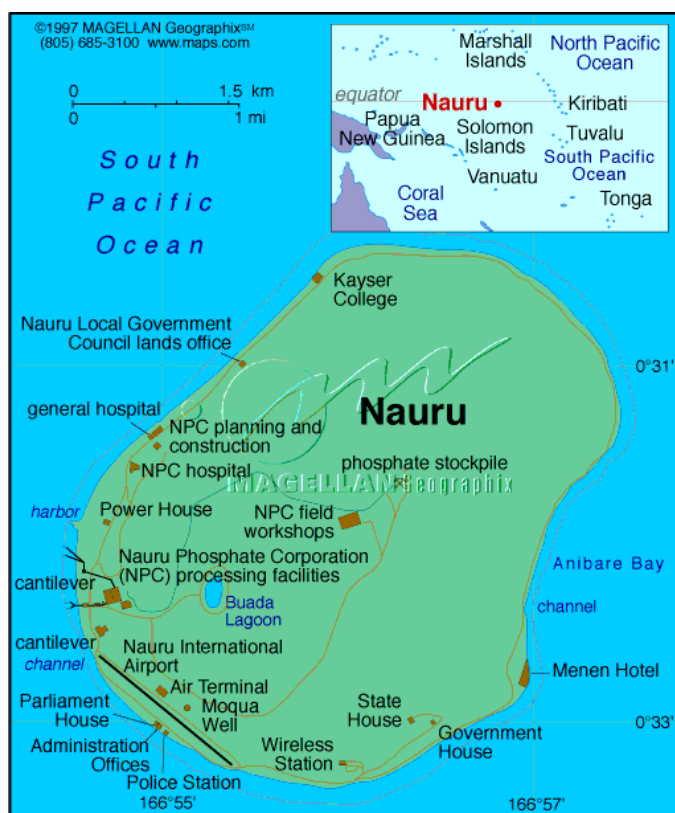


Figure 1. Map of Nauru.



Figure 2. The MapInfo GIS format aerial photography of Nauru, showing the locations of beach profiles.

#### PERSONNEL INVOLVED

Chaoxiong He  
Quan Chung  
Pene Agadio

SOPAC, Coastal Geologist  
SOPAC, Field Assistant  
Department of Island Development & Industry, Republic of Nauru

#### PRELIMINARY RESULTS

See appendix.



## **CONCLUSIONS AND RECOMMENDATIONS**

- The factors responsible for shoreline erosion can be divided into two major categories, natural and human induced. The natural causes identified for significant and continuous erosion on Nauru are sea, wave and tide surges, which are controlled by the equatorial monsoon climate; the human-induced processes result from inappropriate man-made structures and sand mining on the beach.
- As a highly developed small island with the highest population density in the South Pacific, Nauru is under significant anthropological stress. Field reconnaissance showed severe erosion on the shoreline adjacent to the newly built harbor in Anibare; that the airport runway extension has resulted in erosion of a section of the shoreline close to the extension; that sand mining at Gabab Channel has contributed to shoreline erosion and recession at this site; and that a lot of seawalls around the whole island were undercut.
- It is still too early to assess quantitatively the environmental impact of the newly built harbor in Anibare on the adjacent shoreline; continued observation and monitoring is recommended. The site visit revealed that there has been sand lost from the adjacent beaches and exposure of base-rock. The newly built harbor will cause changes in the coastal circulation around Anibare Bay. How the changes will effect the coastal system is still unknown.
- The sediment distribution and movement on the Nauru coast is dominated mainly by the coastal hydrodynamic regime driven by easterly tradewinds which prevail during the period March to October. Better-sorted, finer sands are deposited in the western sections of Nauru coast which is leeward of the easterly tradewinds, while other sections of the Nauru coast are characterized by deposits of coarser sand and coral rubble.
- More attention needs to be given by the government sectors and local communities to coastal erosion issues in Nauru. Immediate measures are required to be taken to react to the problems identified in this report. Among the problem sites mentioned in this report, except for Anibare Bay, a continuous beach observation and monitoring program is required, and repair works need to be considered for other areas to mitigate further damage.
- On a small island with high population stress, even a small change on the coast can be significant. A code of practice for coastal structure design and engineering is needed to emphasize environmental impact assessment (EIA) which should precede any construction activity. Every EIA should include all boundary conditions, such as meteorology, oceanography, sedimentation, coastal dynamics, and bio-ecology, as well as possible anthropological effects.
- Sand mining on beaches should be immediately controlled or phased out to avoid further beach erosion and recession.
- According to the IPCC projection, the sea level will rise 0.3 m to 0.95 m, with a best-guess scenario of 0.5 m, by the year 2100. As almost all of its residents and infrastructure are located in a narrow coastal strip with an elevation between 1.5 and 5.5 m above mean sea level (3 to 7 m above chart datum), or 0.5 m to 4.5 m above HHWL, Nauru is vulnerable to the future sea-level rise. Recent SOPAC studies have indicated that land will be lost and some infrastructures will be under threat by overtopping and inundation during extreme events at present sea level. An assessment of vulnerability to accelerated sea-level rise, even to climate change, is necessary for Nauru.

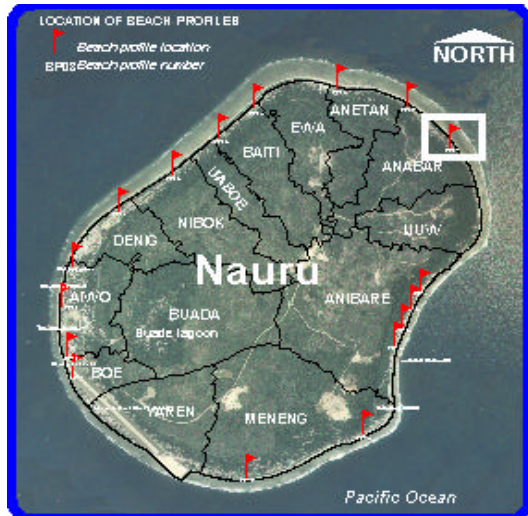
- For long-term monitoring of shoreline stability, beach profiles established around Nauru Island should be re-surveyed periodically, at least on a yearly basis, if not more often and immediately after extreme events.

## **REFERENCE**

He C. 2000. Coastal Erosion Monitoring and Advise on Response Strategies Nauru. *SOPAC Technical Report 285*.

## APPENDIX : PRELIMINARY RESULTS

### BEACH PROFILE INFORMATION **BP01**



Location of BP01

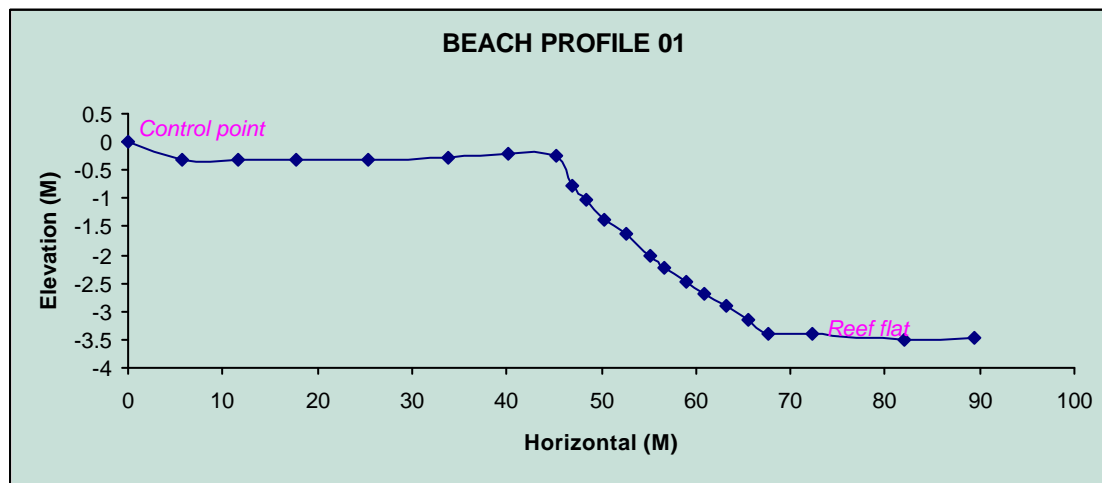


Control point of BP01

Location: Anabar, Nauru Island  
 Control Point: Basement of Power pole 102  
 Position: 00°30'04"S 166°57'15.5E  
 Bearing: 42°

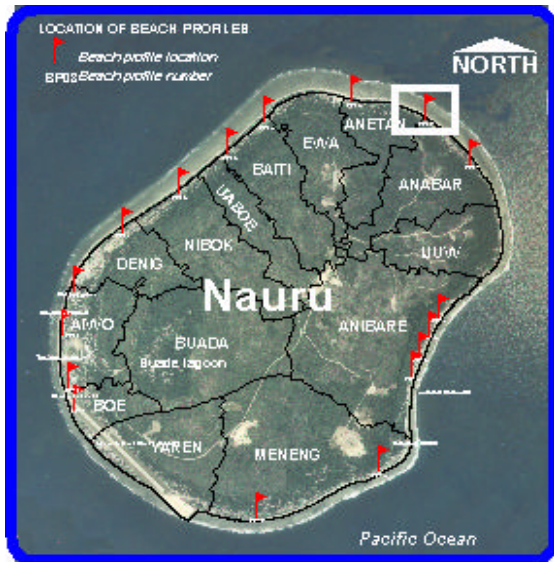
Horizontal	Elevation
0	0.001
5.771	-0.304
11.642	-0.329
17.729	-0.326
25.4	-0.328
33.905	-0.265
40.071	-0.212
45.156	-0.245
46.876	-0.77
48.454	-1.009
50.333	-1.39
52.72	-1.622
55.207	-2.002
56.66	-2.23
59.037	-2.468
60.874	-2.600
63.11	-2.903
65.527	-3.166
67.598	-3.41
72.377	-3.381
82.061	-3.518
89.443	-3.473

Beach slope: 7.4 °





## BEACH PROFILE INFORMATION **BP02**



*Location of BP02*

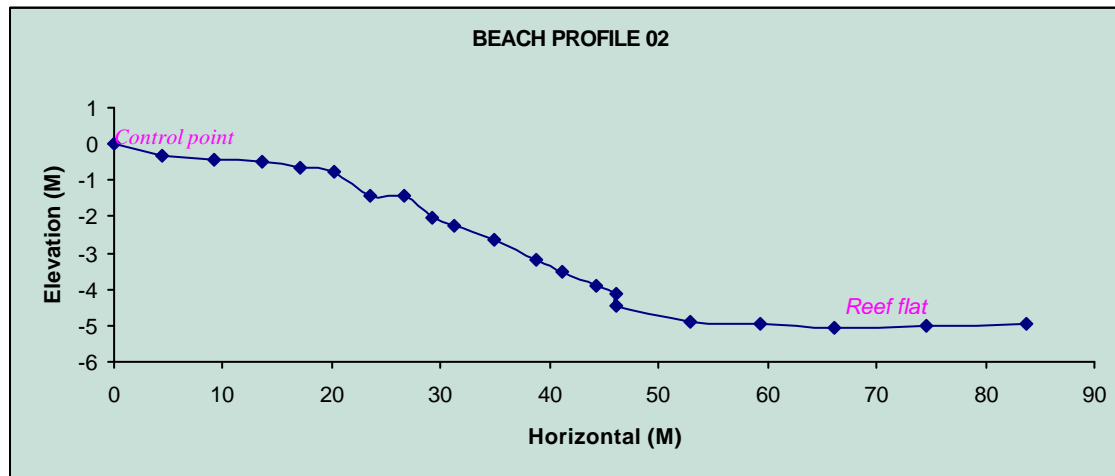


Control point of BP02

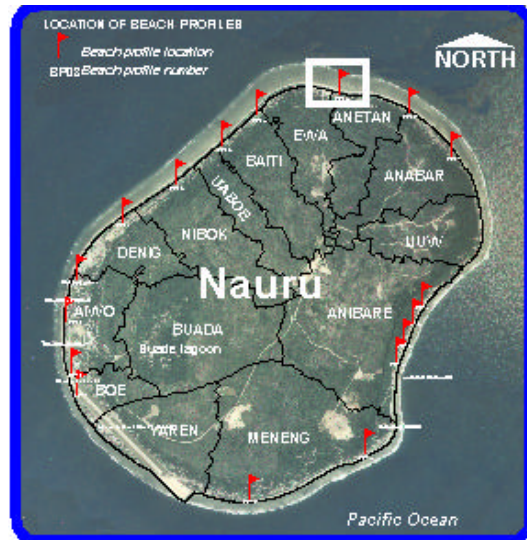
**Location:** Anabar, Nauru Island  
**Control Point:** Basement of Power pole 122  
**Position:** 00°30'17.3"S 166°56'54.9E  
**Bearing:** 26°

Horizontal	Elevation
0.001	0.003
4.357	-0.329
9.195	-0.436
13.648	-0.498
17.007	-0.661
20.286	-0.737
23.484	-1.434
26.607	-1.438
29.147	-2.054
31.171	-2.249
34.872	-2.663
38.747	-3.179
41.067	-3.541
44.348	-3.898
46.149	-4.136
46.187	-4.459
52.937	-4.895
59.364	-4.945
66.138	-5.052
74.621	-5.001
83.757	-4.939

Beach slope:  $8.2^{\circ}$



# BEACH PROFILE INFORMATION **BP03**



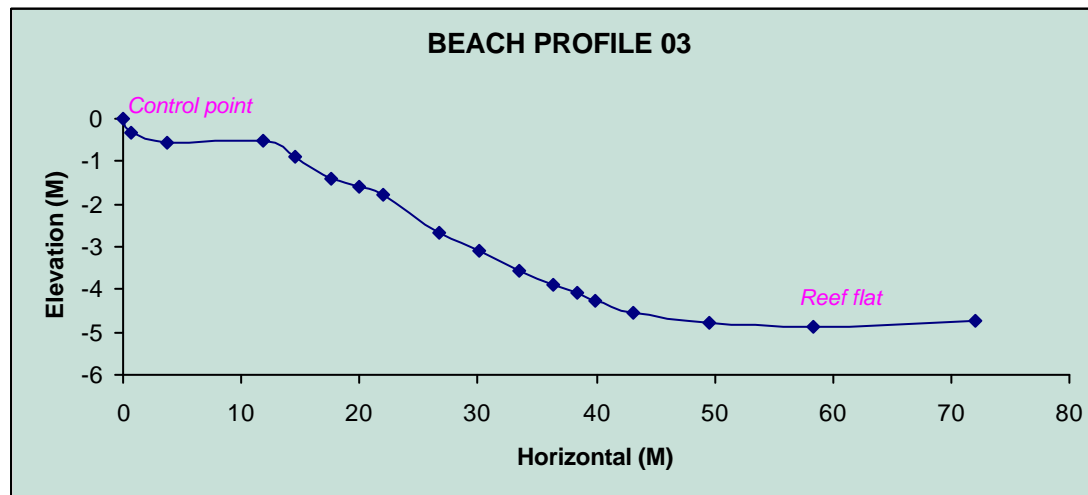
Location of BP03



Control point of BP03

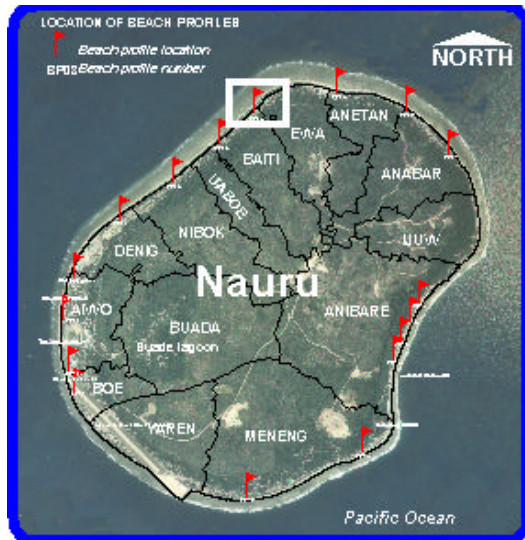
**Location:** Anetan, Nauru Island  
**Control Point:** Basement of Power pole 122  
**Position:** 00°30'12.0"S 166°56'24.8E  
**Bearing:** 358°

Horizontal	Elevation
0.001	0
0.647	-0.347
3.653	-0.585
11.755	-0.539
14.564	-0.9
17.559	-1.384
20	-1.588
22.055	-1.773
26.647	-2.684
30.179	-3.092
33.561	-3.563
36.411	-3.903
38.408	-4.098
39.934	-4.289
43.083	-4.57
49.532	-4.783
58.365	-4.852
72.106	-4.739



Beach slope: 7.3 °

# BEACH PROFILE INFORMATION **BP04**



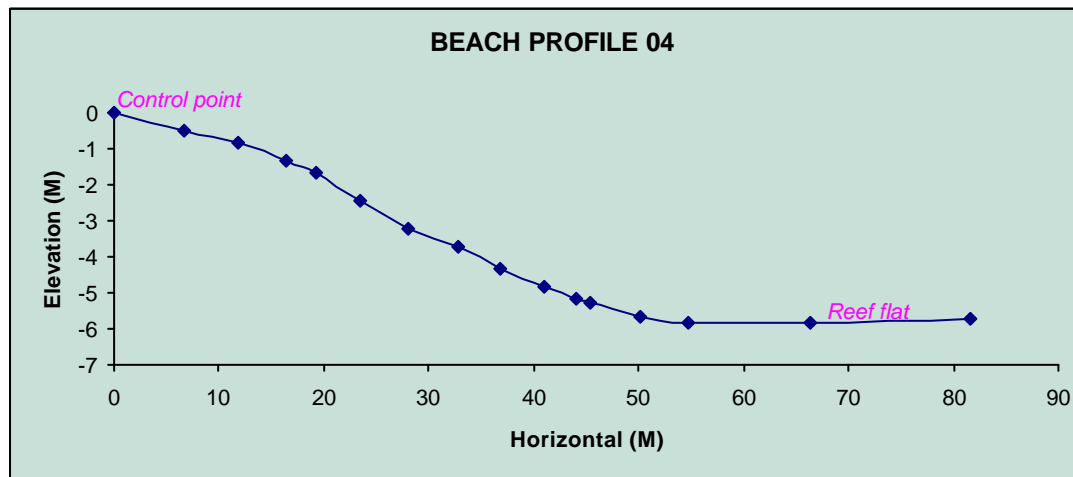
Location of BP04



Control point of BP04

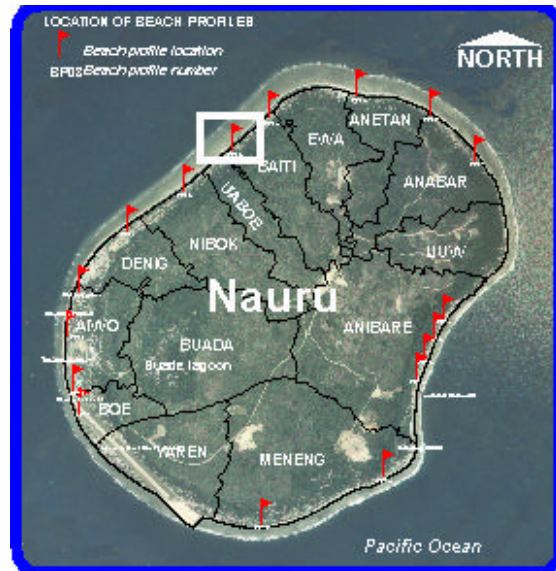
**Location:** Bairi, Nauru Island  
**Control Point:** Western corner of RAD Restaurant  
**Position:** 00°30'24.3"S 166°55'50.0E  
**Bearing:** 292°

Horizontal	Elevation
0.001	0
6.712	-0.479
11.917	-0.833
16.42	-1.316
19.204	-1.673
23.397	-2.431
28.073	-3.233
32.84	-3.736
36.772	-4.313
40.973	-4.816
43.954	-5.147
45.437	-5.257
50.064	-5.658
54.747	-5.812
66.388	-5.842
81.595	-5.706



Beach slope: 7.4 °

# BEACH PROFILE INFORMATION **BP05**



Location of BP05

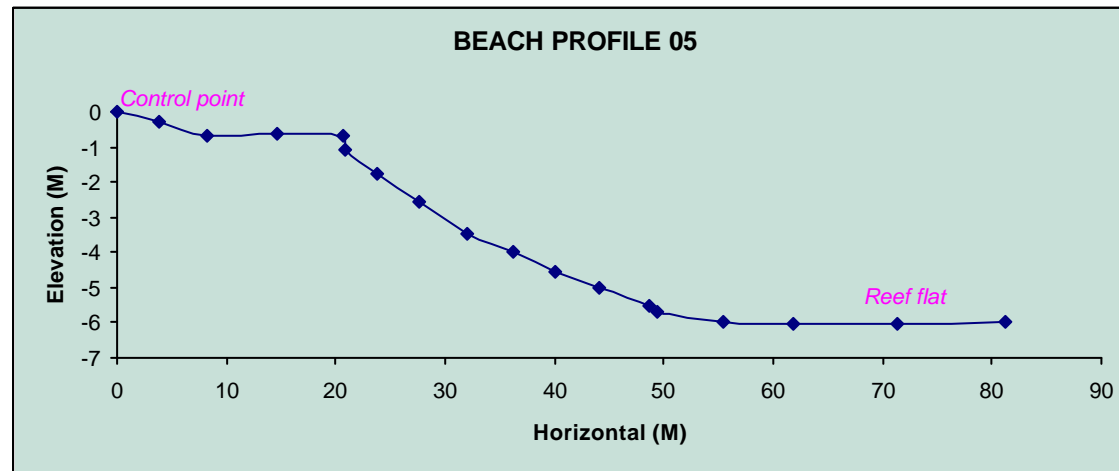


Control point of BP05

**Location:** Baiti, Nauru Island  
**Control Point:** Western corner of Mr Jezza Dowiyogo's property  
**Position:** 00°30'38.7"S 166°55'36.6E  
**Bearing:** 300°

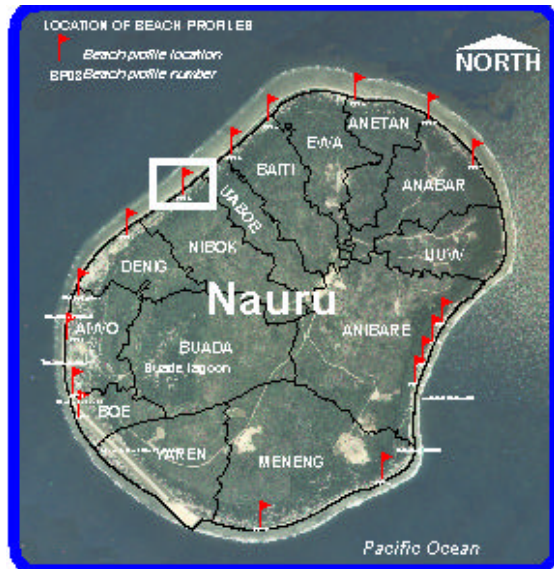
Horizontal	Elevation
0	0
3.902	-0.26
8.3	-0.669
14.549	-0.606
20.737	-0.666
20.779	-1.079
23.741	-1.777
27.674	-2.572
32.09	-3.484
36.17	-3.994
40.103	-4.561
44.036	-5.014
48.673	-5.534
49.422	-5.687
55.467	-5.994
61.852	-6.015
71.304	-6.04
81.284	-5.977

Beach slope: 9.1 °





# BEACH PROFILE INFORMATION **BP06**



Location of BP06

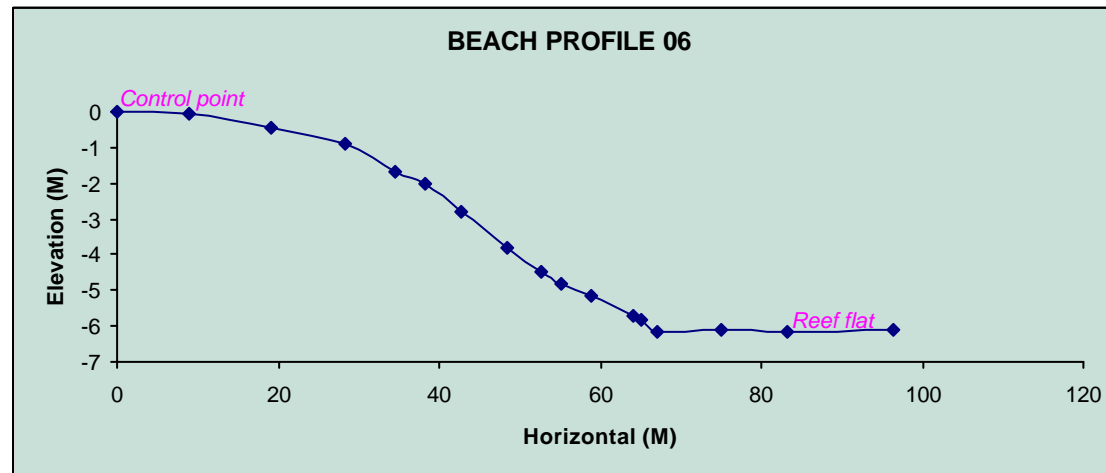


Control point of BP06

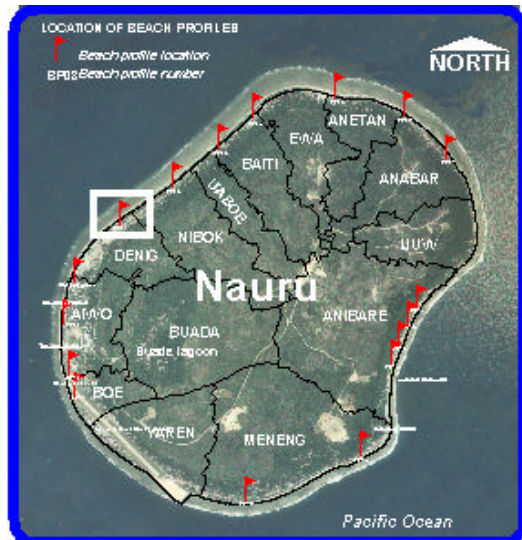
**Location:** Nibok, Nauru Island  
**Control Point:** Southwest corner of Mr Frank Reppaa's proerty  
**Position:** 00°30'58"S 166°55'18.5E  
**Bearing:** 317°

Horizontal	Elevation
0.005	0
9.009	-0.042
19.207	-0.449
28.393	-0.913
34.558	-1.663
38.369	-2.022
42.849	-2.823
48.392	-3.817
52.781	-4.471
55.265	-4.799
58.947	-5.175
64.037	-5.714
65.017	-5.845
67.157	-6.158
75.121	-6.078
83.324	-6.152
96.49	-6.121

Beach slope: 7.7 °



# BEACH PROFILE INFORMATION **BP07**



Location of BP07

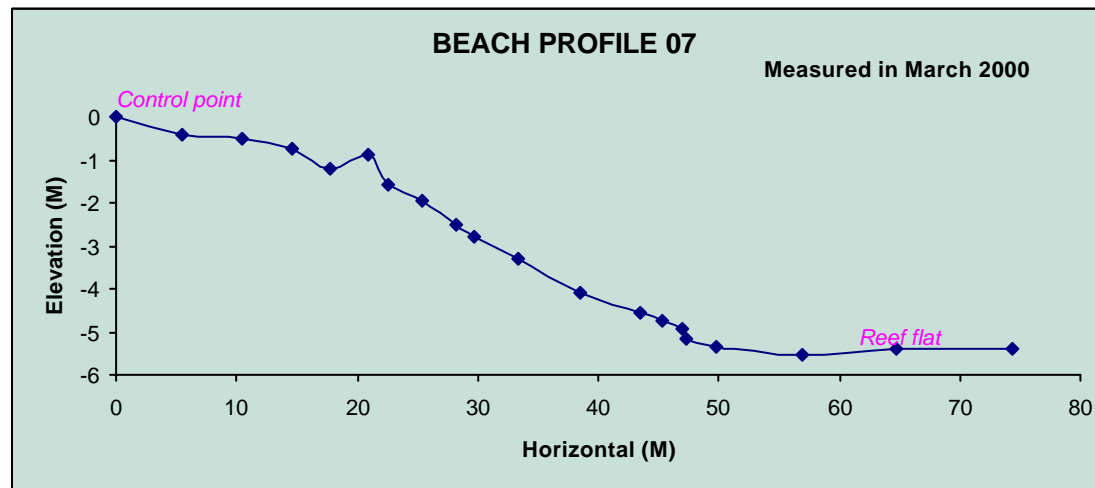


Control point of BP07

**Location:** Denig, Nauru Island  
**Control Point:** Western corner of CNF building  
**Position:** 00°31'17.1"S 166°54'56.0E  
**Bearing:** 304°

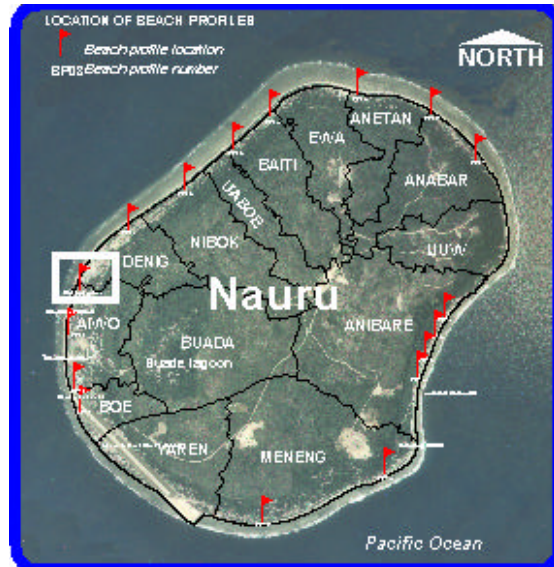
Horizontal	Elevation
0	0
5.425	-0.435
10.413	-0.503
14.577	-0.754
17.805	-1.231
20.934	-0.883
22.603	-1.602
25.339	-1.969
28.167	-2.52
29.719	-2.78
33.283	-3.284
38.528	-4.101
43.548	-4.581
45.317	-4.733
46.92	-4.936
47.241	-5.153
49.798	-5.355
56.864	-5.516
64.749	-5.374
74.281	-5.414

Beach slope: 7.8 °





# BEACH PROFILE INFORMATION **BP08**



Location of BP08

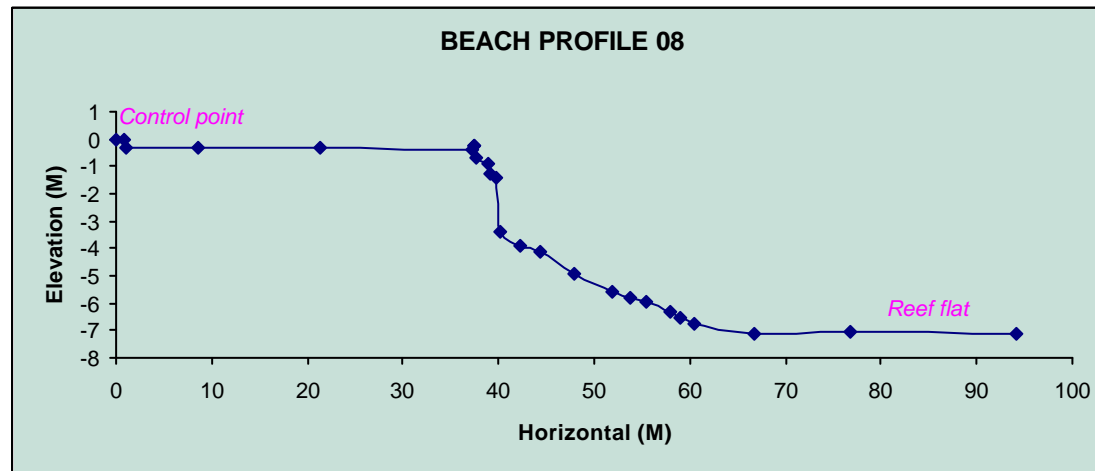


Control point of BP08

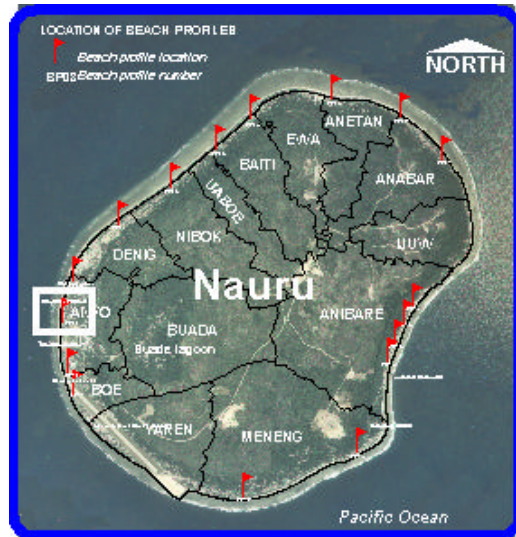
**Location:** Aiwo, Nauru Island  
**Control Point:** Southwest corner of Immigration & Custom Building  
**Position:** 00°31'41.2"S 166°54'38.5"E  
**Bearing:** 273°

Horizontal	Elevation
0.001	0
0.905	0.005
0.964	-0.3
8.515	-0.282
21.405	-0.283
37.337	-0.425
37.348	-0.245
37.518	-0.218
37.616	-0.695
38.972	-0.938
39.135	-1.274
39.797	-1.419
40.247	-3.383
42.327	-3.906
44.389	-4.154
47.976	-4.927
51.885	-5.581
53.8	-5.831
55.411	-5.954
58.014	-6.331
58.936	-6.518
60.366	-6.733
66.762	-7.107
76.787	-7.076
94.222	-7.15

Beach slope: 9.5 °



# BEACH PROFILE INFORMATION **BP09**



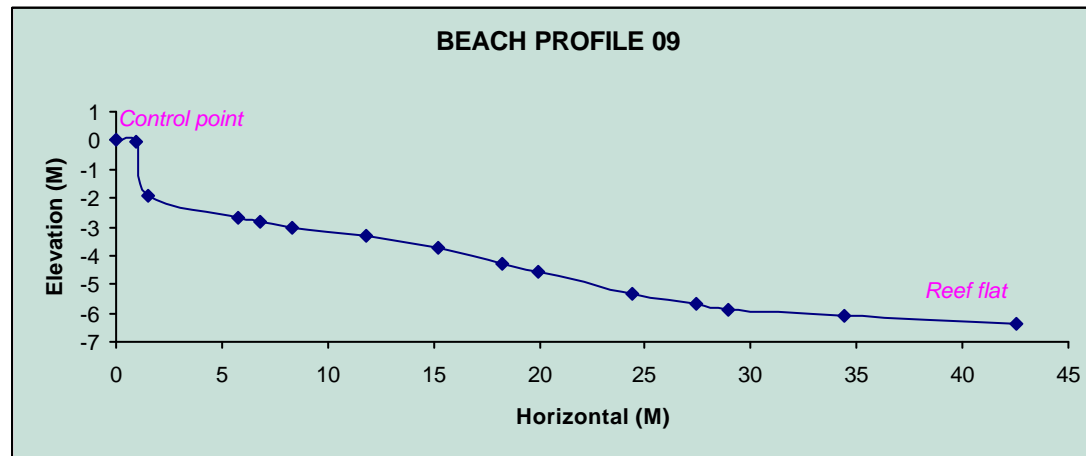
Location of BP09



Control point of BP09

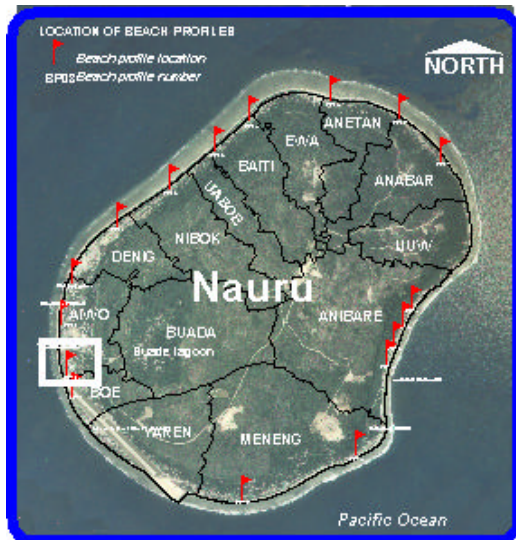
Location: Aiwo, Nauru Island  
Control Point: South end of NPC Club wall  
Position: 00°32'00.0"S 166°54'37.4E  
Bearing: 257°

Horizontal	Elevation
0	0
0.931	-0.042
1.488	-1.911
5.775	-2.7
6.767	-2.846
8.305	-3.029
11.852	-3.297
15.251	-3.722
18.2	-4.277
19.954	-4.587
24.348	-5.3
27.426	-5.7
28.96	-5.903
34.443	-6.126
42.577	-6.358



Beach slope: 7.4 °

# BEACH PROFILE INFORMATION **BP10**



Location of BP10

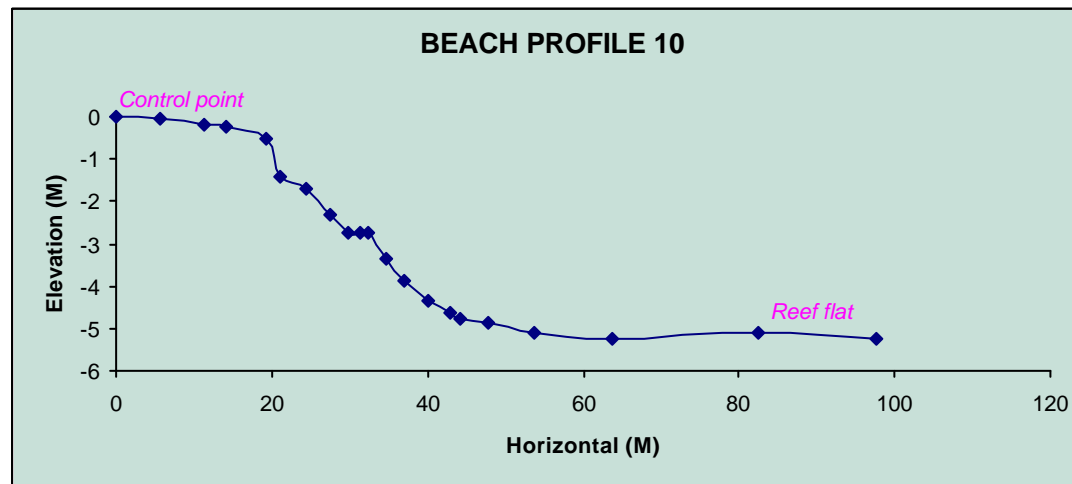


Control point of BP10

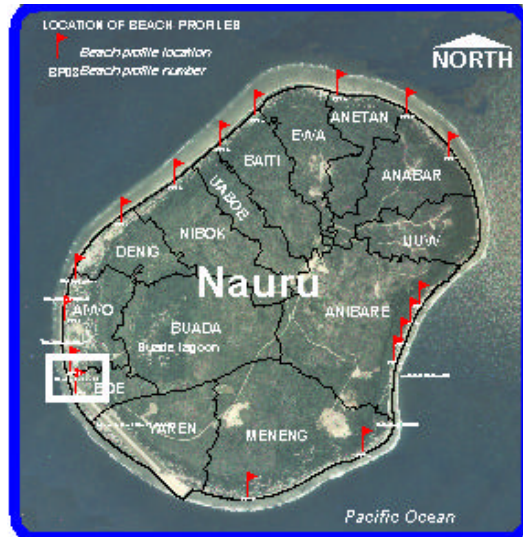
**Location:** Boe, Nauru Island  
**Control Point:** Northwest corner of Gabab Restaurant  
**Position:** 00°32'25.5"S 166°54'40.1"E  
**Bearing:** 232°

Horizontal	Elevation
0.002	0
5.672	-0.06
11.182	-0.2
14.031	-0.224
19.362	-0.528
20.961	-1.436
24.437	-1.706
27.464	-2.32
29.849	-2.762
31.383	-2.745
32.489	-2.75
34.8	-3.343
37.031	-3.854
40.11	-4.327
42.794	-4.627
44.108	-4.794
47.885	-4.85
53.789	-5.101
63.71	-5.236
82.554	-5.111
97.762	-5.267

Beach slope: 9.8°



# BEACH PROFILE INFORMATION **BP11**



Location of BP11

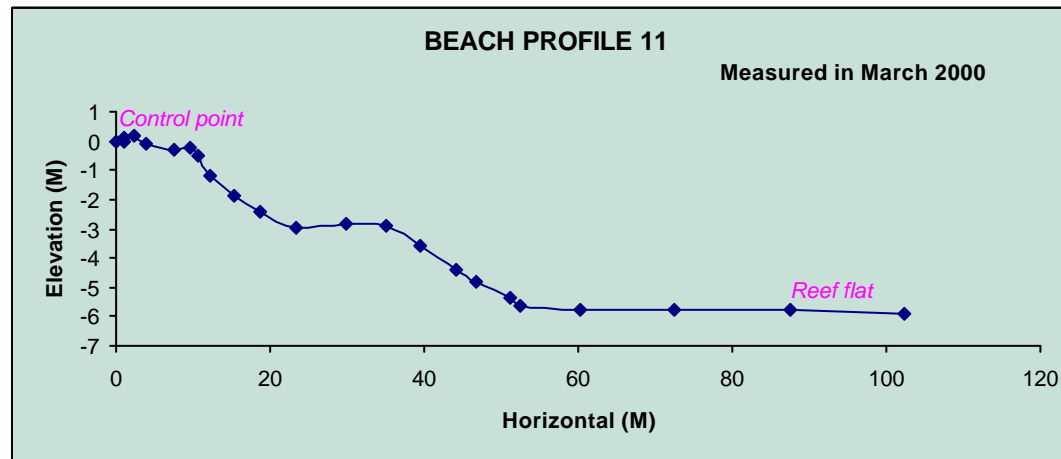


Control point of BP11

**Location:** Boe, Nauru Island  
**Control Point:** Benchmark on main road  
**Position:** 00°32'32.9"S 166°54'43.6E  
**Bearing:** 230°

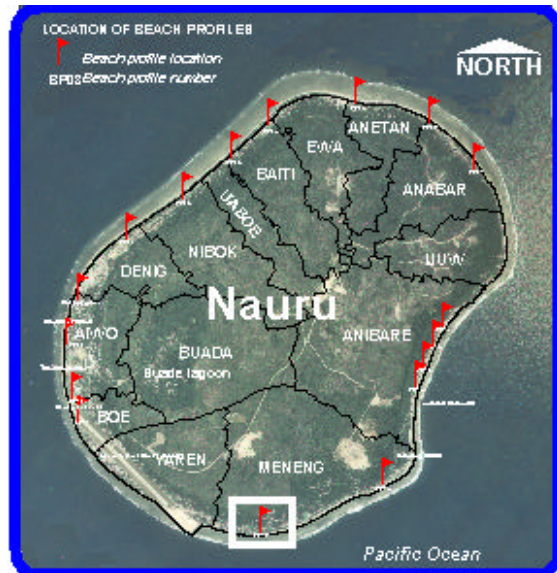
Horizontal	Elevation
0.004	-0.001
1.022	-0.016
1.055	0.124
2.419	0.149
3.97	-0.062
7.63	-0.266
9.58	-0.224
10.7	-0.504
12.269	-1.189
15.324	-1.857
18.786	-2.439
23.33	-2.939
29.773	-2.8
35.075	-2.88
39.513	-3.594
44.046	-4.368
46.78	-4.779
51.088	-5.373
52.525	-5.646
60.292	-5.759
72.37	-5.736
87.433	-5.79
102.255	-5.875

Beach slope: 9.0°





# BEACH PROFILE INFORMATION **BP12**



Location of BP12

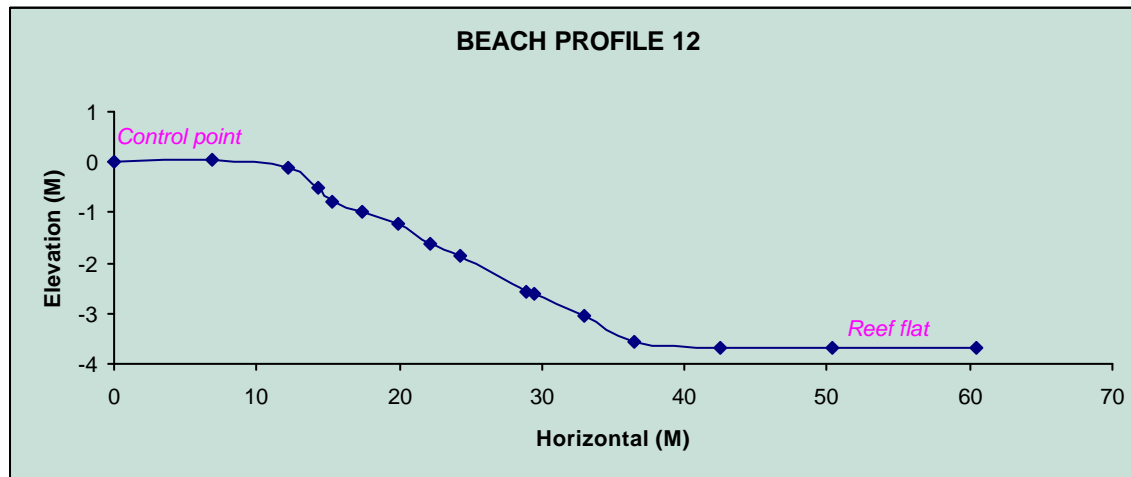


Control point of BP12

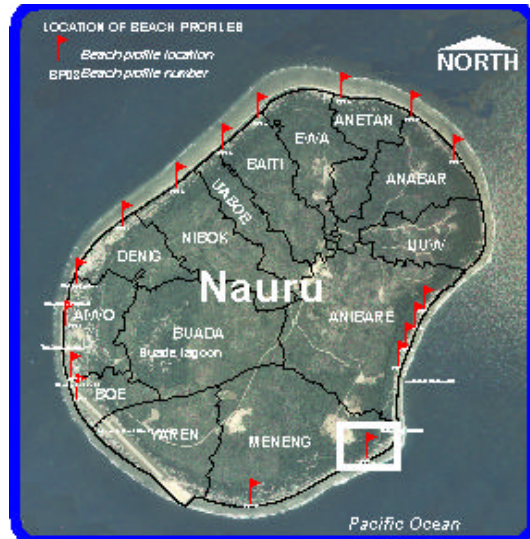
**Location:** Meneng, Nauru Island  
**Control Point:** Eastern corner of Mr. Hedmon Kam's house extension  
**Position:** 00°33'12.0"S 166°56'02.0E  
**Bearing:** 162°

Horizontal	Elevation
0	0
6.865	0.06
12.213	-0.117
14.377	-0.494
15.226	-0.793
17.455	-0.984
19.928	-1.212
22.167	-1.631
24.256	-1.87
28.847	-2.552
29.519	-2.597
32.974	-3.052
36.528	-3.579
42.478	-3.697
50.417	-3.7
60.433	-3.695

Beach slope: 8.1°



# BEACH PROFILE INFORMATION **BP13**



Location of BP13

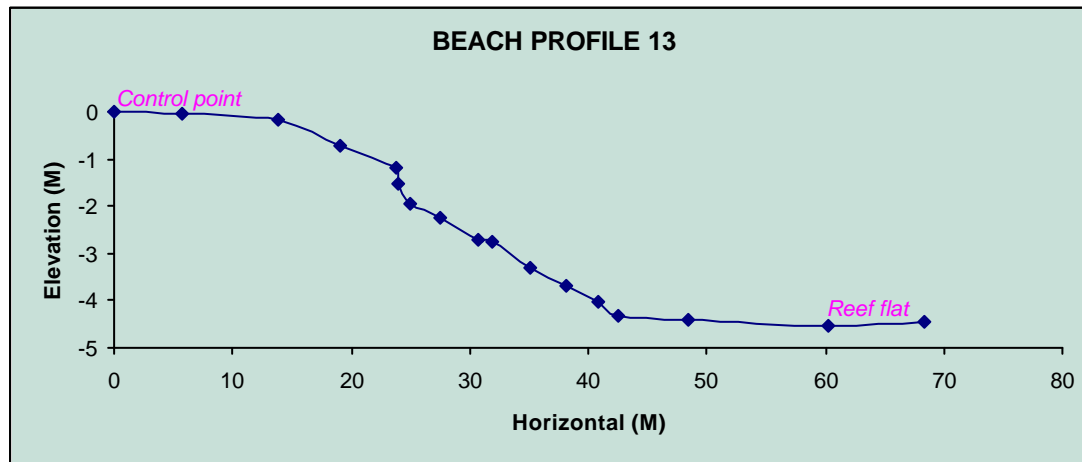


Control point of BP13

**Location:** Meneng, Nauru Island  
**Control Point:** Basement of Power pole 242  
**Position:** 00°32'46.6"S 166°56'48.9"E  
**Bearing:** 144°

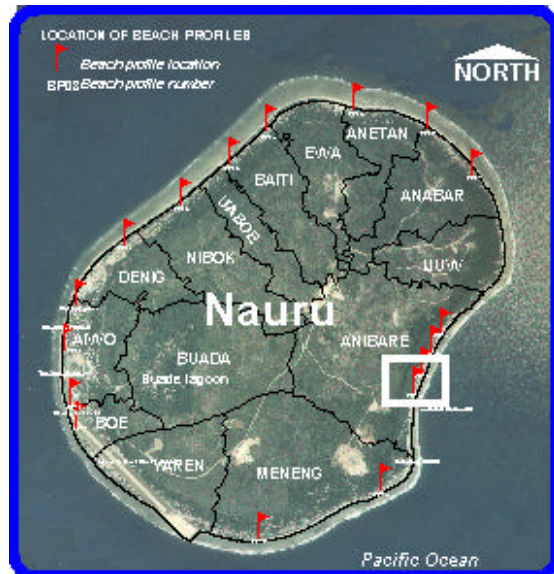
Horizontal	Elevation
0	0
5.742	-0.027
13.765	-0.181
19.129	-0.727
23.788	-1.194
23.888	-1.537
24.946	-1.934
27.545	-2.246
30.69	-2.72
31.927	-2.761
35.125	-3.284
38.107	-3.698
40.848	-4.043
42.513	-4.334
48.408	-4.407
60.197	-4.53
68.352	-4.469

Beach slope: 8.8°





# BEACH PROFILE INFORMATION **BP14**



Location of BP14

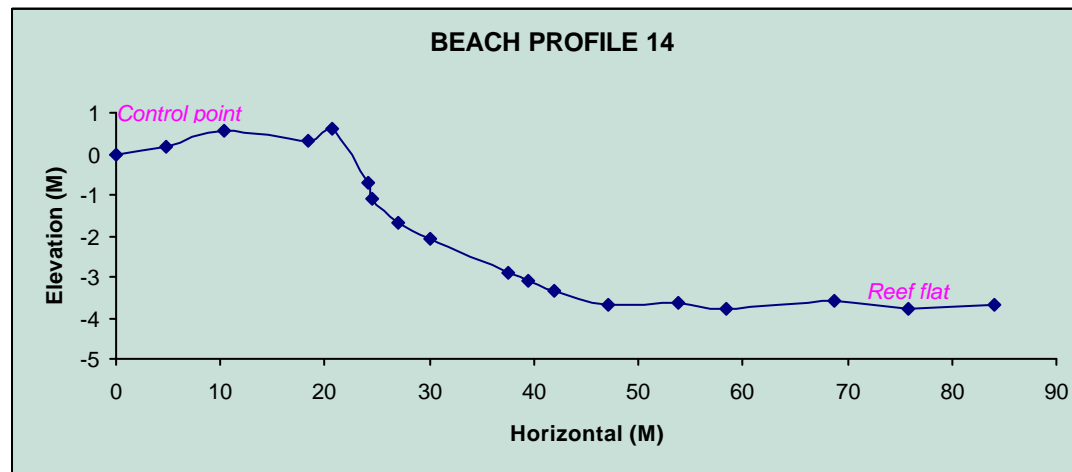


Control point of BP14

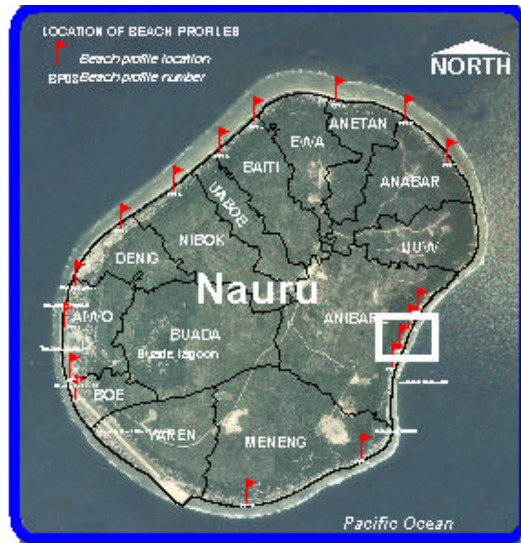
**Location:** Anibare, Nauru Island  
**Control Point:** Northeast corner of Mr. Robert Robidem's House  
**Position:** 00°32'06.9"S 166°57'0.00E  
**Bearing:** 93°

Horizontal	Elevation
0	0
4.78	0.149
10.375	0.555
18.418	0.324
20.716	0.63
24.06	-0.72
24.594	-1.113
27.047	-1.698
30.023	-2.096
37.468	-2.912
39.437	-3.109
41.863	-3.36
47.186	-3.7
53.782	-3.647
58.314	-3.793
68.824	-3.609
75.772	-3.777
84.139	-3.68

Beach slope: 5.7°



# BEACH PROFILE INFORMATION **BP15**



Location of BP15

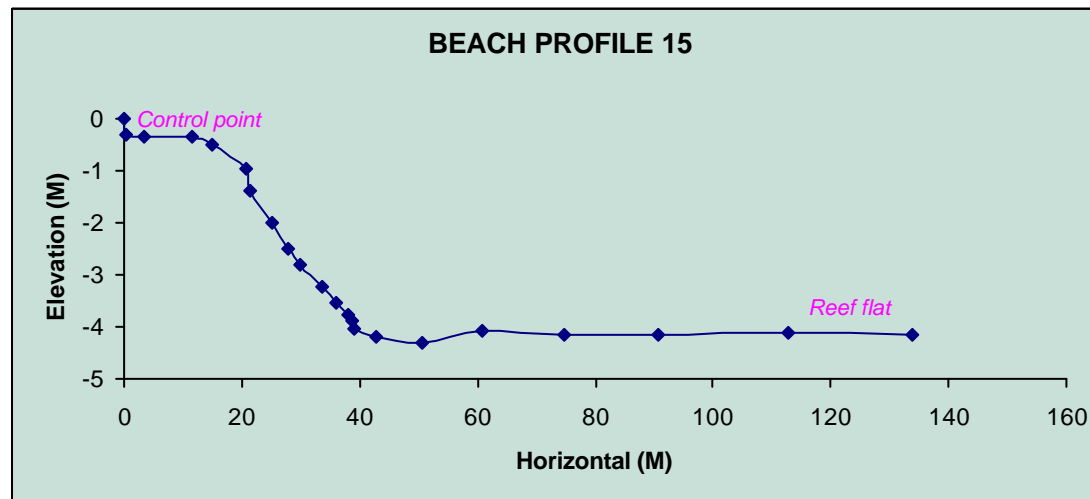


Control point of BP15

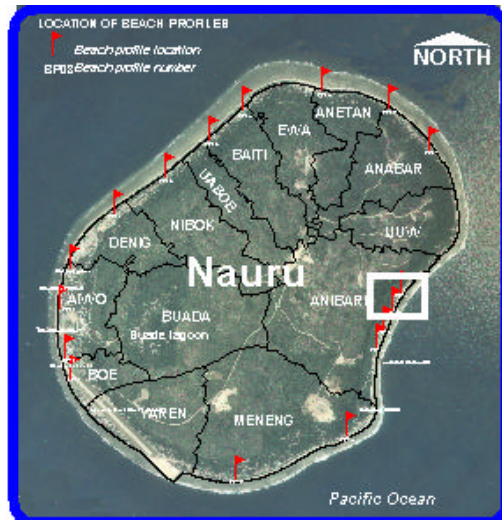
**Location:** Anibare, Nauru Island  
**Control Point:** Basement of Power pole 207  
**Position:** 00°31'59.24"S 166°57'03.1E  
**Bearing:** 98°

Horizontal	Elevation
0.001	0
0.335	-0.294
3.344	-0.341
11.382	-0.337
15.031	-0.509
20.642	-0.959
21.404	-1.372
25.061	-1.983
27.873	-2.509
29.956	-2.822
33.512	-3.248
35.995	-3.525
38.036	-3.771
38.624	-3.868
38.911	-4.042
42.824	-4.207
50.724	-4.312
60.961	-4.087
74.892	-4.151
90.569	-4.169
112.828	-4.106
133.778	-4.162

Beach slope: 8.3°



# BEACH PROFILE INFORMATION **BP16**



Location of BP16

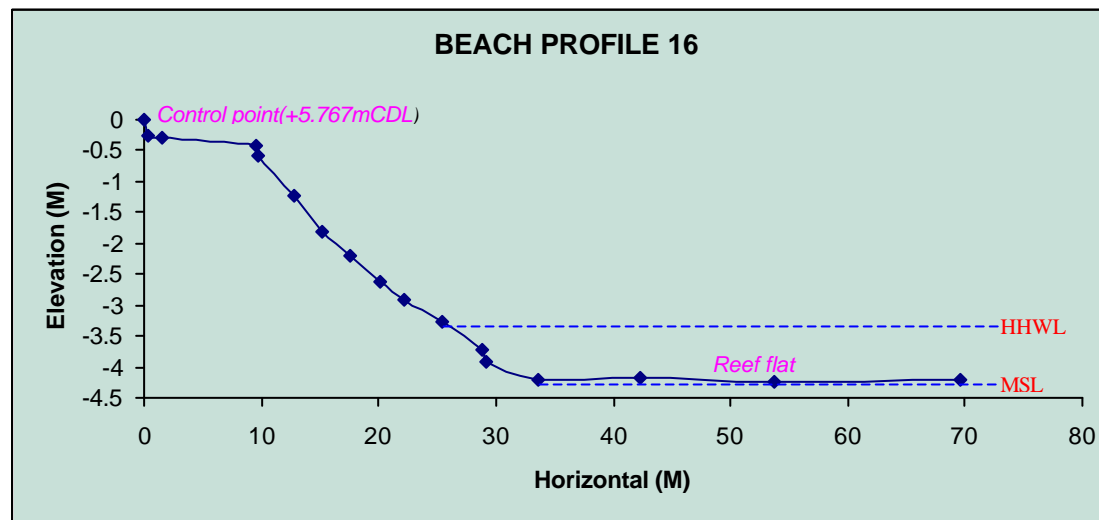


Control point of BP16

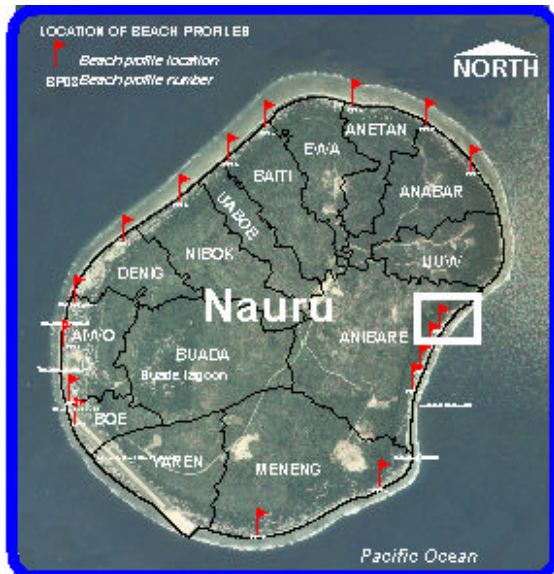
**Location:** Anibare, Nauru Island  
**Control Point:** Basement of Power pole 201  
**Position:** 00°31'49.9"S 166°57'05.2E  
**Bearing:** 104°

Horizontal	Elevation
0.001	0
0.259	-0.259
1.537	-0.287
9.569	-0.413
9.673	-0.579
12.752	-1.217
15.244	-1.805
17.603	-2.204
20.138	-2.609
22.141	-2.908
25.385	-3.277
28.807	-3.716
29.226	-3.91
33.569	-4.195
42.277	-4.175
53.672	-4.231
69.644	-4.196

Beach slope: 9.7°



# BEACH PROFILE INFORMATION **BP17**



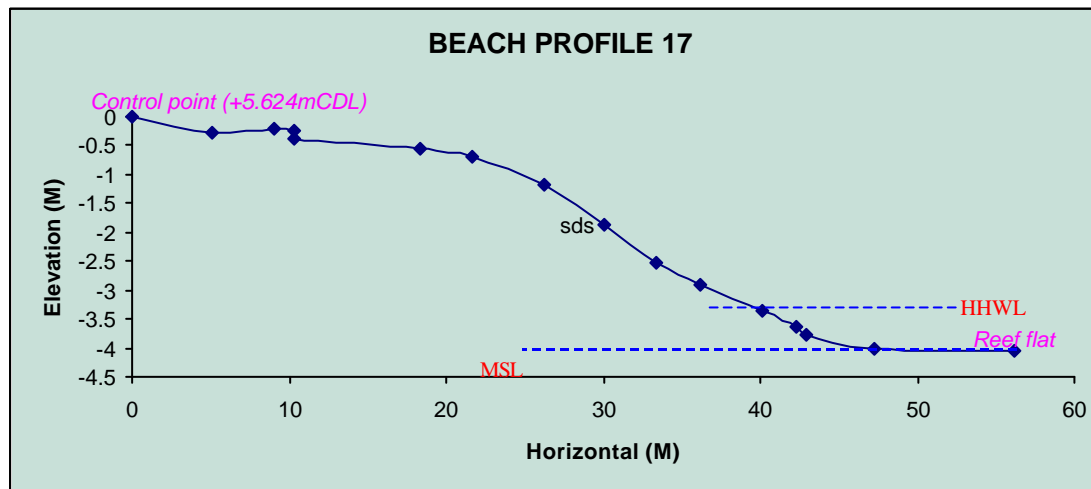
Location of BP17



Control point of BP17

**Location:** Anabare, Nauru Island  
**Control Point:** Northwest corner of Miss Etaleamon's Property  
**Position:** 00°31'42.5"S 166°57'08.9"E  
**Bearing:** 110°

Horizontal	Elevation
0.004	0
5.1	-0.284
9.034	-0.22
10.348	-0.232
10.376	-0.379
18.369	-0.542
21.706	-0.685
26.199	-1.162
30.056	-1.879
33.377	-2.515
36.15	-2.915
40.087	-3.35
42.252	-3.642
42.945	-3.79
47.282	-4.006
56.127	-4.049



Beach slope: 8.9°