Australian Government

Geoscience Australia

South Pacific Sea Level and Climate Monitoring Project (SPSLCMP)

Survey Report

EDM Height Traversing
Levelling Survey

Nauru

February 2009

This project is sponsored by the Australian Agency for International Development (AusAID), managed by the Bureau of Meteorology (BOM) and supported by the National Geospatial Reference Systems Project, Geospatial Earth Monitoring Division, GEOSCIENCE AUSTRALIA.

Geocat # 69401

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Introduction

This report outlines the level survey completed during the visit to Nauru, between 1 – 8 February 2009.

Personnel: Steve Yates – Surveyor - **GEOSCIENCE AUSTRALIA**
Andrick Lal – Surveyor - **SOPAC**

This is the third EDM Height Traversing levelling survey of the deep driven bench mark array in Nauru. These surveys follow the nine previous surveys from 1993 to 2003, undertaken by the National Tidal Centre (NTC) using the Precise Differential Levelling technique.

The Survey

The EDM Height Traversing level survey was carried out between the 6 deep driven bench marks:

NAU1
NAU2
NAU36
NAU37
NAU38
NAU16

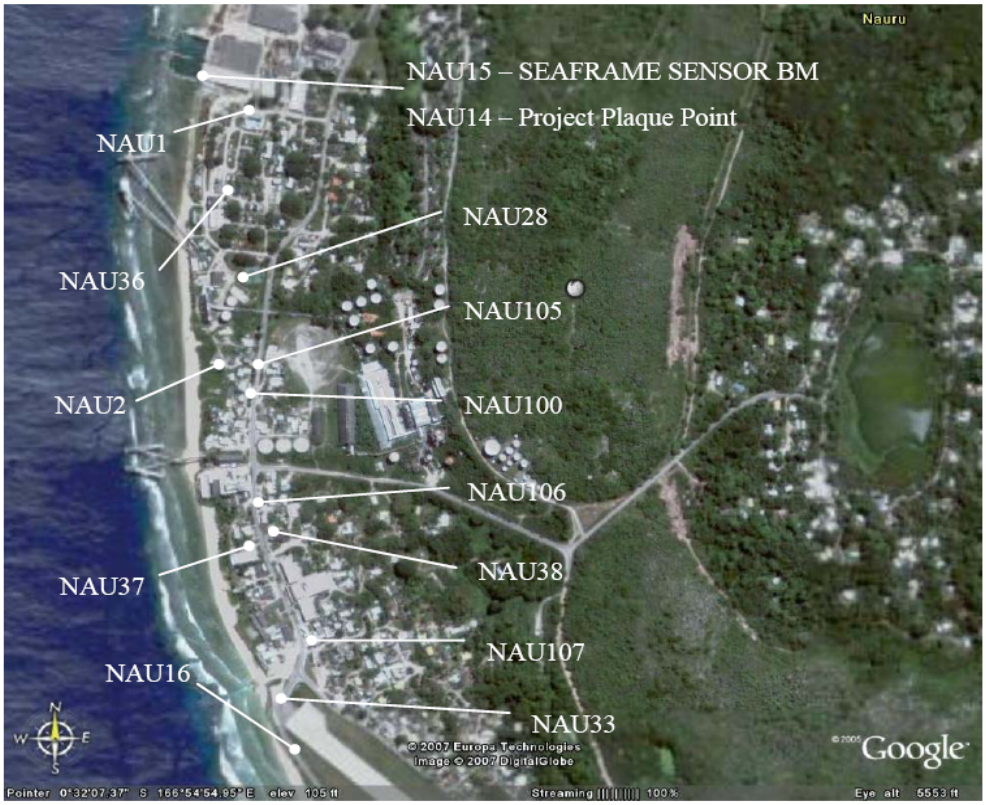
Included in the survey were the CGPS Station bench mark, **NAURBM** and the 3 CGPS Reference Marks **RM1, RM2** and **RM3,** the SEAFRAME Sensor Bench Mark **NAU15,** the Project Plaque Point **NAU14** at the Tide Gauge and Holding Marks **NAU28, NAU105, NAU100, NAU106, NAU107, NAU33, NAU108, NAU43, NAU44, NAU109, NAU47, NAU101, NAU102, NAU103, NAU104** and **NAU53**.

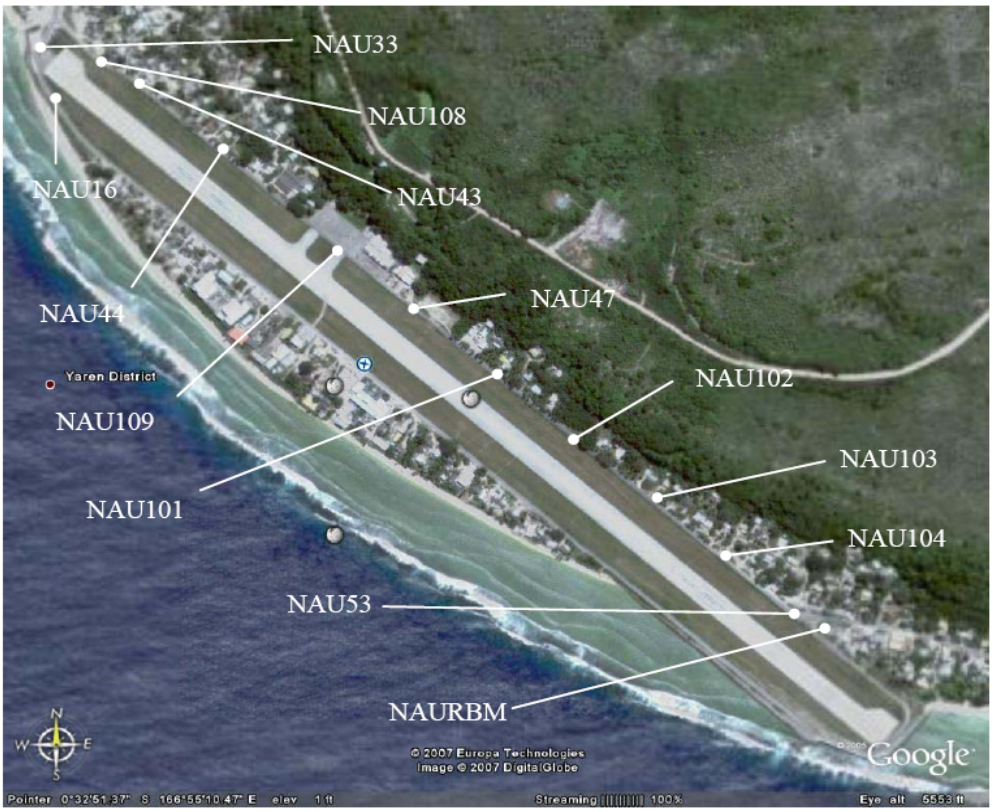
All the deep driven bench marks were located and found undisturbed and in good order. Five (5) new permanent holding marks were established during the 2009 survey visit, **NAU105 - 109**, and consist of domed stainless steel bolts drilled in concrete and glued in place with quality epoxy resin.

The EDM Height Traversing levelling technique was performed to the Class L2A, as per the Inter-Government Committee on Surveying and Mapping (ICSM), Standards and Practices for Control Surveys, SP1, Ver. 1.5, May 2002.

NAURU

Bench Mark Locality Map





After reduction an internal precision of **1mm** $\sqrt{K}$ or better was achieved, where K is levelled distance in kilometres. Project Specification for precision is **2mm** $\sqrt{K}$**.**

The Nauru Datum

The Datum for the levelling survey is the **Nauru Island Datum (NID).**
Reduction of the data has been calculated holding **NAU 1** fixed at 7.2930 metres NID, this value was determined by the NTC in 1993 by:

1993 Adopting the height of **UH 1** as 4.130 metres NID.
1994 Adopting the 1993 height of **UH 2B** as 3.8894 metres NID.
1995 Adopting the 1993 height of **UH 2B** as 3.8894 metres NID

Equipment

LEICA Total Station Model TCA2003 (S/N 440883).
LEICA Precision Prisms GPH1P (2).
LEICA Rigid Tripod.
Stainless Steel Target Poles supported by LEICA telescopic Bi-Poles (2).
LEICA Cast Iron Change Plates (2).
KESTRAL 4000 Pocket Weather Tracker

Method

"**Leap-Frog" EDM-Height-Traversing**: "Leap-Frog" EDM-Height-Traversing involves the one target remaining at a particular change point for both sightings. To avoid the possibility of the target being placed on a different point the target is not moved between the back-sight and foresight. Two target/reflectors are employed (on reflector rods with struts). As in spirit levelling, it is imperative that the electronic tacheometer (total station) is set up in the middle between the two reflectors. Recorded are the height differences (between the instrument's trunnion axis and the reflector) that are computed by the electronic tacheometers. In consequence, the ambient temperature and pressure must be input into the instrument since the slope distances must be corrected for temperature and pressure (first velocity correction) on-line. See Rüeger & Brunner (1982) and *The Canadian Surveyor*, 36(1): 69-87.

All observations were recorded digitally.

Reduction of the digital data was computed by the Geoscience Australia levelling program "leveling1.exe"

This program computes the height difference between the two reflectors at any one set-up. Results can also be gained with the EDM Height Traversing method by using a single set-up / single rod configuration. To achieve height differences when using this single rod configuration, a simple comment line is added, indicating this is the case before running the program.

This "single set-up / single rod" configuration is particularly useful when levelling between bench marks which are close together e.g. between the Project Plaque BM and the SEAFRAME Sensor BM.

All levelling bays started and finished with the same reflector and reflector rod, i.e. an even number of setups when the two reflector rod configuration was used – this eliminates any reflector rod zero error.

Atmospheric readings were obtained using a KESTRAL 4000 Pocket Weather Tracker. These atmospheric readings were recorded manually onto the Nauru Levelling Booking Sheets and entered into the Total Station prior to each level run and approximately every hour thereafter or when ever an obvious change in weather conditions was observed.

Survey Support

The Director of the Nauru Lands and Survey, Mr. Porthos Bop and Mr. Wess Tsitsi, Senior Surveyor, as always, provided the survey team with valuable support and willingness to help during our visit. The Lands and Survey Office also collected and provided secure storage for all our survey equipment prior to our arrival.

The survey team did not require any field assistance from the Lands and Survey Department during this visit.

No other personnel or authorities associated with the project were consulted during this visit.

Issues

No issues or concerns of any importance were encountered during the 2009 visit but a few points worth mentioning.

1. A point to note: Flight schedules to Nauru can be cancelled, delayed or brought forward at very short notice.
2. On the next scheduled visit it is recommended to establish an additional Deep Driven Bench Mark. The most suitable location is approximately midway along the airport road between Deep Driven BM, NAU 16 and the CGPS Bench Mark, NAURBM.
3. Also recommended is the replacement of the valve boxes (2) for the CGPS Reference Marks 2 and 3.

Description of Marks - NAURU

NAU 1 is the bench mark held fixed with an **RL = 7.29300 metres.**

The height of **NAU 1** was derived in 1993 by NTC as described in Section 3 on Page 6.

Bench Marks:
NAU 1, NAU 2, NAU 36, NAU 37, NAU 38 and NAU 16 are all Deep Driven BM's

Point:
NAU 15 is the SEAFRAME Sensor Bench Mark.

NAU 14 is the Project Plaque point.

NAURBM is the Reference Bench Mark for the CGPS Pillar.

RM1, RM2 and RM3 are the CGPS Pillar Reference Monitoring Marks.

NAU28, NAU105, NAU100, NAU106, NAU107, NAU33, NAU108, NAU43, NAU44, NAU109, NAU47, NAU101, NAU102, NAU103, NAU104 and NAU53 are all permanent holding marks and consist of stainless steel bolts drilled in concrete and glued in situ with epoxy resin.

Table of Results for 2009 and Comparisons between 2007 and 2009

NAURU 2009 - EDM Height Traversing Levelling Comparison 2007 - 2009 and Table of Results

NAU 1 - Adopted fixed height (NID) 7.29300

FROM	TO	Levelled Height Difference	Reduced Level 2009	Misclose (mm)	Distance (Km)	1mm√K	Reduced Level 2007	Difference (m) 2007 - 2009
NAU 1	NAU 14	-3.4451	3.84790	-0.13	0.102	0.32	3.84778	*-0.00012*
NAU 14	NAU 15	2.15943	6.00733	-0.10	0.014	0.12	6.00695	*-0.00038*
NAU 1	NAU 36	-0.07442	7.21858	0.00	0.184	0.43	7.21919	*0.00061*
NAU 36	NAU 28	0.58101	7.79958	-0.02	0.199	0.45	***See Note 1**	
NAU 28	NAU 2	-0.01485	7.78474	-0.15	0.166	0.41	7.78573	*0.00100*
NAU 2	NAU 105	-0.00212	7.78262	0.16	0.072	0.27	***See Note 2**	
NAU 105	NAU 100	0.42704	8.20966	-0.10	0.097	0.31	8.21058	*0.00092*
NAU 100	NAU 106	-0.16373	8.04593	-0.01	0.200	0.45	***See Note 2**	
NAU 106	NAU 37	-0.34676	7.69918	0.07	0.118	0.34	7.69984	*0.00066*
NAU 37	NAU 38	-0.12672	7.57245	-0.03	0.053	0.23	7.57308	*0.00063*
NAU 38	NAU 107	0.20787	7.78033	-0.35	0.200	0.45	***See Note 2**	
NAU 107	NAU 33	-0.37045	7.40987	-0.08	0.131	0.36	7.41073	*0.00086*
NAU 33	NAU 16	-0.71636	6.69351	0.08	0.127	0.36	6.69437	*0.00086*
NAU 33	NAU 108	-0.54703	6.86285	0.15	0.180	0.42	***See Note 2**	
NAU 108	NAU 43	-0.94293	5.91991	-0.07	0.177	0.42	5.92130	*0.00139*
NAU 43	NAU 44	0.57019	6.49010	-0.25	0.204	0.45	6.49199	*0.00189*
NAU 44	NAU 109	-0.77791	5.71220	-0.24	0.200	0.45	***See Note 2**	
NAU 109	NAU 47	0.13135	5.84355	0.01	0.200	0.45	5.84516	*0.00161*
NAU 47	NAU 101	0.47173	6.31528	-0.28	0.201	0.45	6.31612	*0.00084*
NAU 101	NAU 102	-0.01036	6.30492	0.06	0.202	0.45	6.30588	*0.00096*
NAU 102	NAU 103	-0.67962	5.62530	0.11	0.201	0.45	5.62587	*0.00057*
NAU 103	NAU 104	-0.42882	5.19648	-0.08	0.199	0.45	5.19718	*0.00070*
NAU 104	NAU 53	0.28879	5.48527	-0.29	0.192	0.44	5.48694	*0.00167*
NAU 53	NAURBM	-0.22486	5.26041	-0.06	0.075	0.27	5.26246	*0.00205*

Cont …

FROM	TO	Levelled Height Difference	Reduced Level 2009	Misclose (mm)	Distance (Km)	1mm√K	Reduced Level 2007	Difference (m) 2007 - 2009
NAURBM	NAUR	0.94851	6.20892	-0.08	0.020	0.14	6.21076	*0.00184*
NAURBM	RM 1	-0.71233	4.54808	0.00	0.010	0.10	4.54988	*0.00180*
RM 1	RM 2	-0.16264	4.38544	0.00	0.018	0.13	4.38742	*0.00198*
RM 2	RM 3	0.09797	4.48341	0.00	0.018	0.13	4.48537	*0.00196*

Allowable Misclose is 2√K

An internal precision of 1mm√K was achieved for all bays levelled - the Project Specification is 2mm√K

* ***Note 1 - Mark not included in 2007 survey***
* ***Note 2 - New mark established in 2009***

Combined Comparisons 1993 to 2009

NAURU - Comparison of the RL's for Precise Differential Levelling (1993 to 2005) and EDM Height Traversing (2005 to 2009)

YEAR	NAU1	NAU2	NAU36	NAU37	MARK NAU38	NAU16	NAURBM	NAU14	NAU15
1993	7.2930	7.7837						3.8459	6.0044
1994	7.2930	7.7849				6.6915		3.8462	6.0041
1995	7.2930	7.7849				6.6923		3.8459	6.0038
1996	7.2930	7.7836				6.6923		3.8469	6.0048
1997	7.2930	7.7849				6.6920		3.8462	6.0027
1999	7.2930	7.7835				6.6916		3.8462	6.0032
2000	7.2930	7.7841				6.6920		3.8465	6.0050
2002	7.2930	7.7838	7.2191	7.6977	7.5711	6.6920		3.8464	6.0046
2003	7.2930	7.7842	7.2191	7.6979	7.5714	6.6915	5.2570	3.8472	6.0046
2005	7.2930	7.7846	7.2193	7.6987	7.5722	6.6934		3.8478	6.0064
2005 EDM	7.2930	7.7851	7.2191	7.6994	7.5729	6.6939	5.2613	3.8476	6.0070
2007 EDM	7.2930	7.7857	7.2192	7.6998	7.5731	6.6944	5.2625	3.8479	6.0070
2009 EDM	7.2930	7.7847	7.2186	7.6992	7.5725	6.6935	5.2604	3.8479	6.0073

Nauru 2009 Reduced Levels

Date: 01 – 08 February 2009

Datum: Nauru Island Datum (NID)

POINT#	2009 levelled diff. ht.	2009 RL
NAU 1 (fixed)	***0.000000***	***7.29300 (fixed)***
NAU 14	-3.4451	3.84790
NAU 15	**+2.15943**	**6.00733**
NAU 1 (fixed)	**---**	***7.29300 (fixed)***
NAU 36	**-0.07442**	**7.21858**
NAU 28	+0.58101	7.79958
NAU 2	**-0.01485**	**7.78474**
NAU 105	-0.00212	7.78262
NAU 100	+0.42704	8.20966
NAU 106	-0.16373	8.04593
NAU 37	**-0.34676**	**7.69918**
NAU 38	**-0.12672**	**7.57245**
NAU 107	+0.20787	7.78033
NAU 33	-0.37045	7.40987
NAU 16	**-0.71636**	**6.69351**
NAU 33	---	7.40987
NAU 108	-0.54703	6.86285
NAU 43	-0.94293	5.91991
NAU 44	+0.57019	6.49010
NAU 109	-0.77791	5.71220
NAU 47	+0.13135	5.84355
NAU 101	+0.47173	6.31528
NAU 102	-0.01036	6.30492
NAU 103	-0.67962	5.62530
NAU 104	-0.42882	5.19648

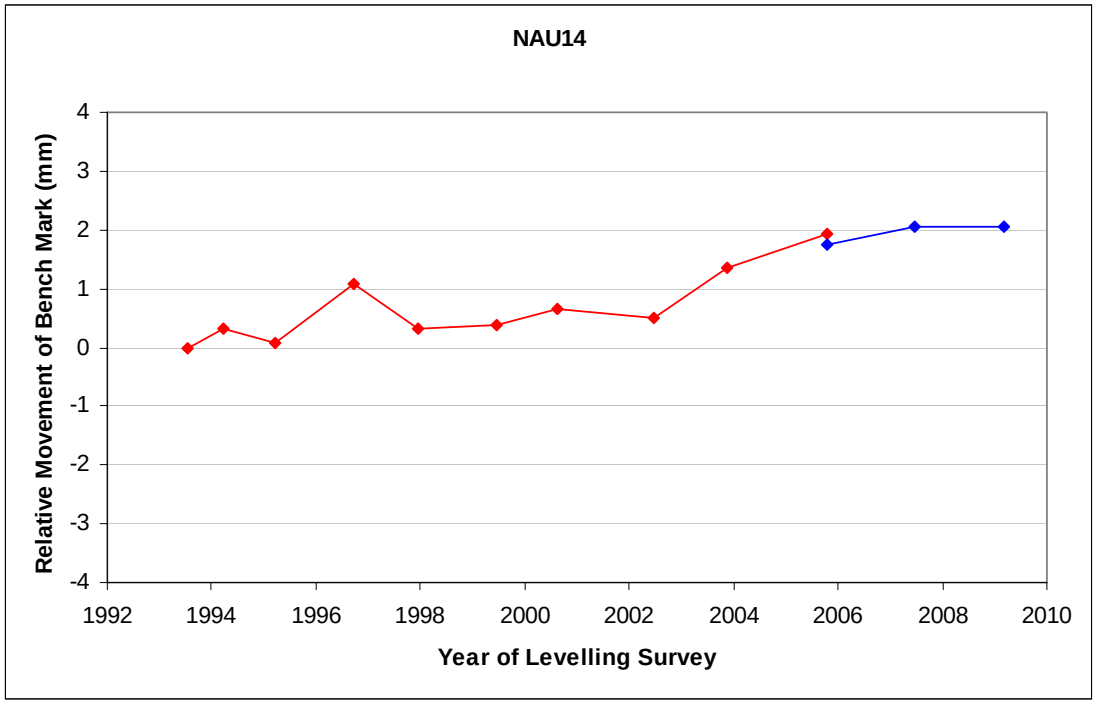
Cont…

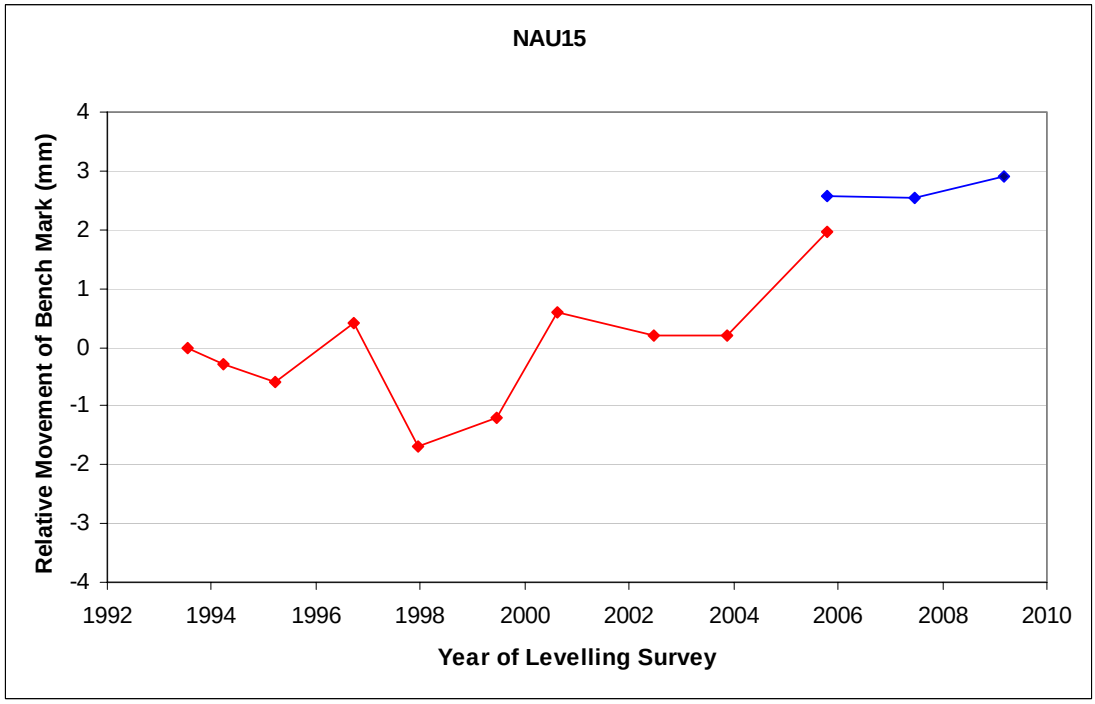
POINT#	2009 levelled diff. ht.	2009 RL
NAU 53	+0.28879	5.48527
NAURBM	**-0.22486**	**5.26041**
NAUR	**+0.94851**	**6.20892**
NAURBM	**---**	**5.26041**
RM 1	**-0.712328**	**4.54808**
RM 2	**-0.162638**	**4.38544**
RM 3	**+0.097972**	**4.48342**

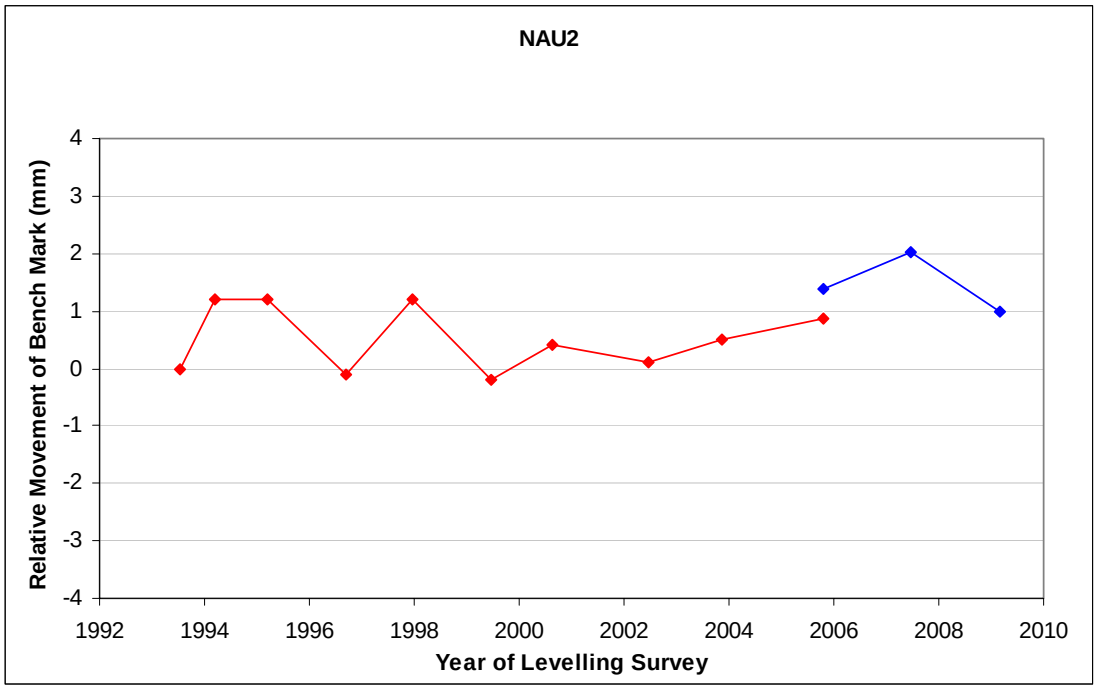
Time Series of Bench Mark movement relative to the Fixed Deep driven Bench Mark – NAU 1

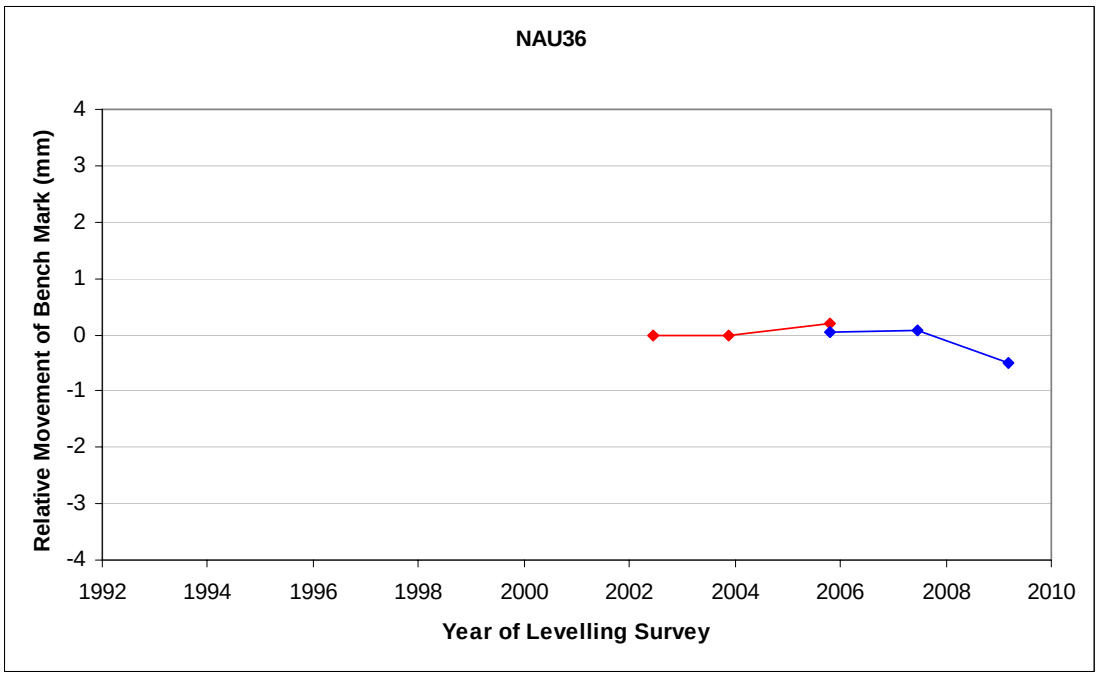
Precise Differential Levelling - 1993 to 2003 (2005)

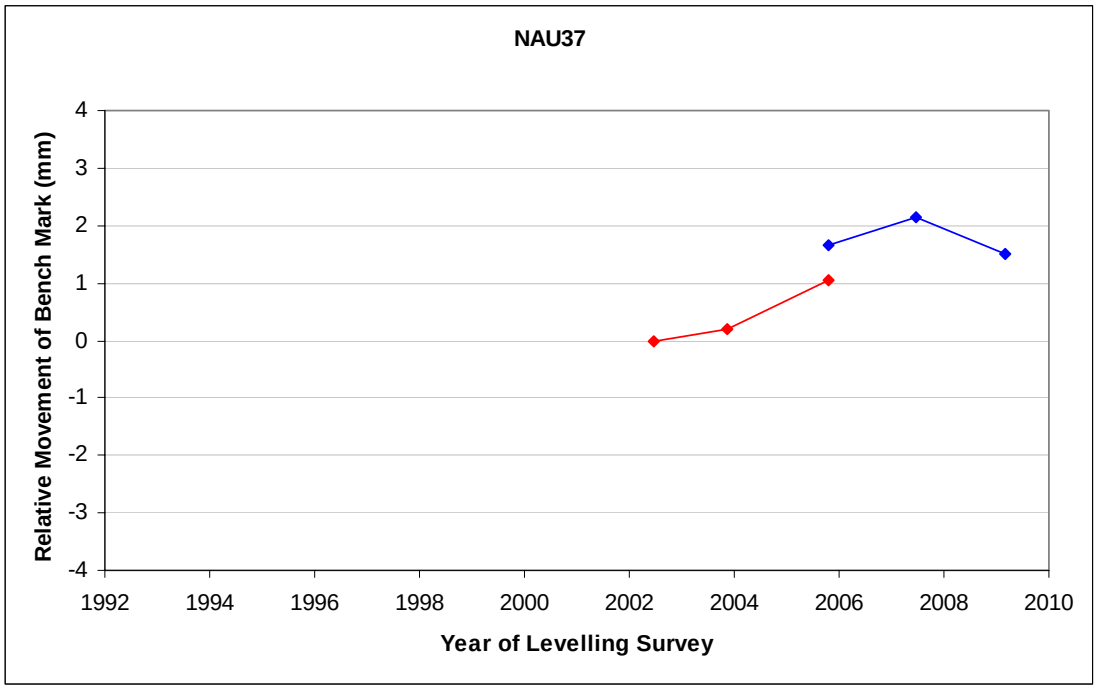
EDM Height Traversing - commenced 2005

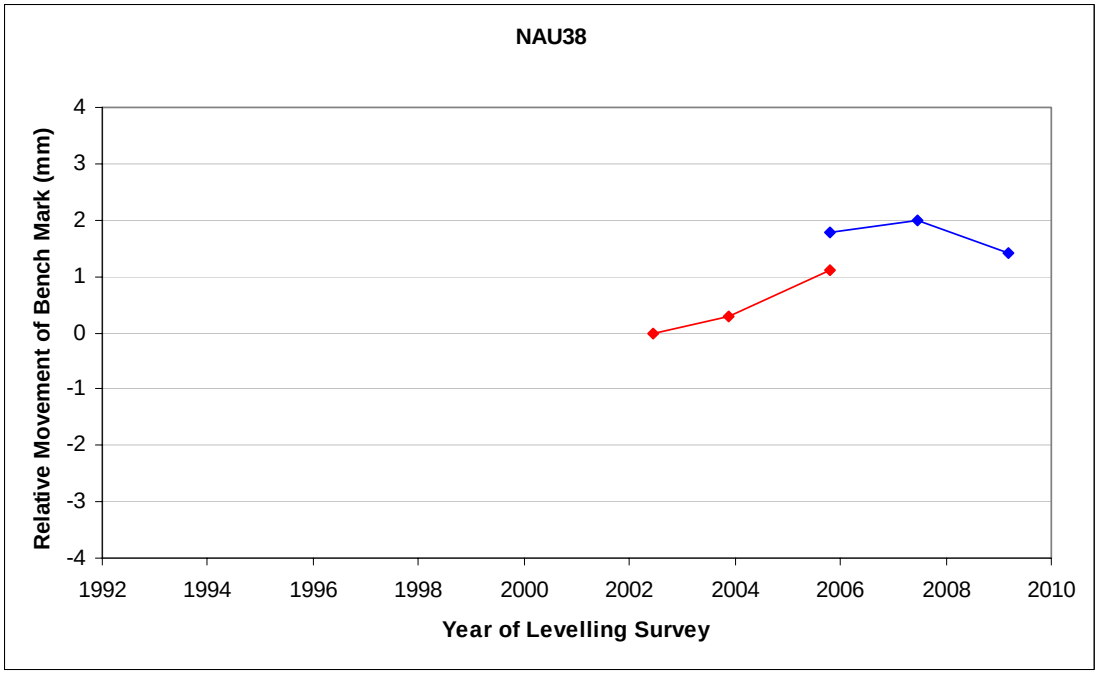


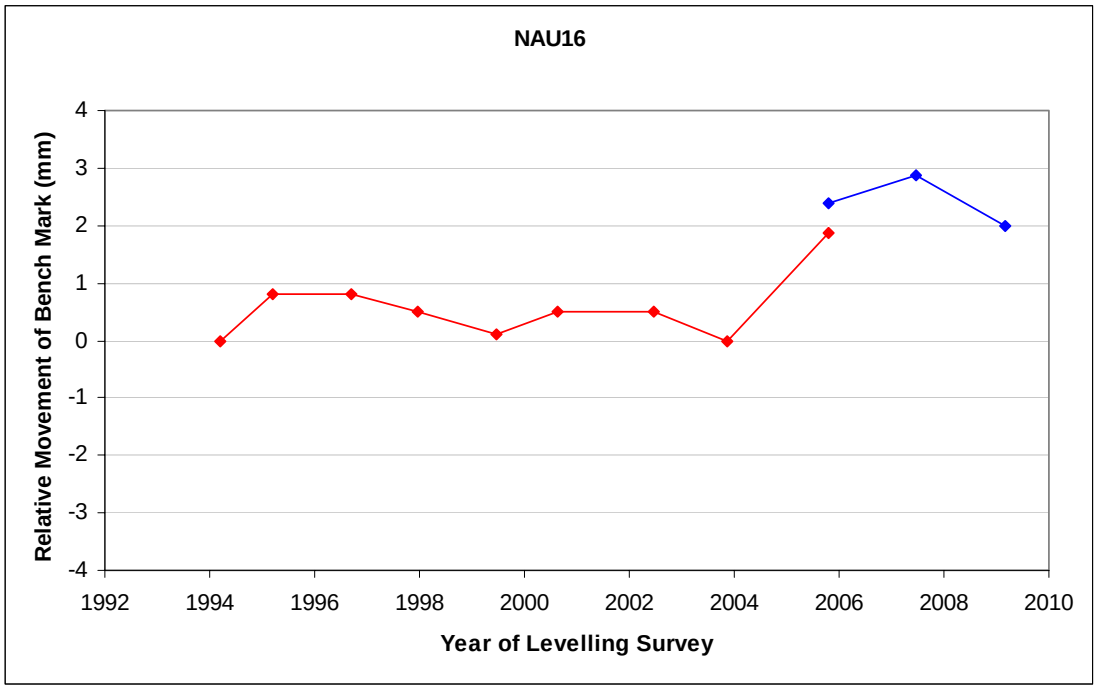


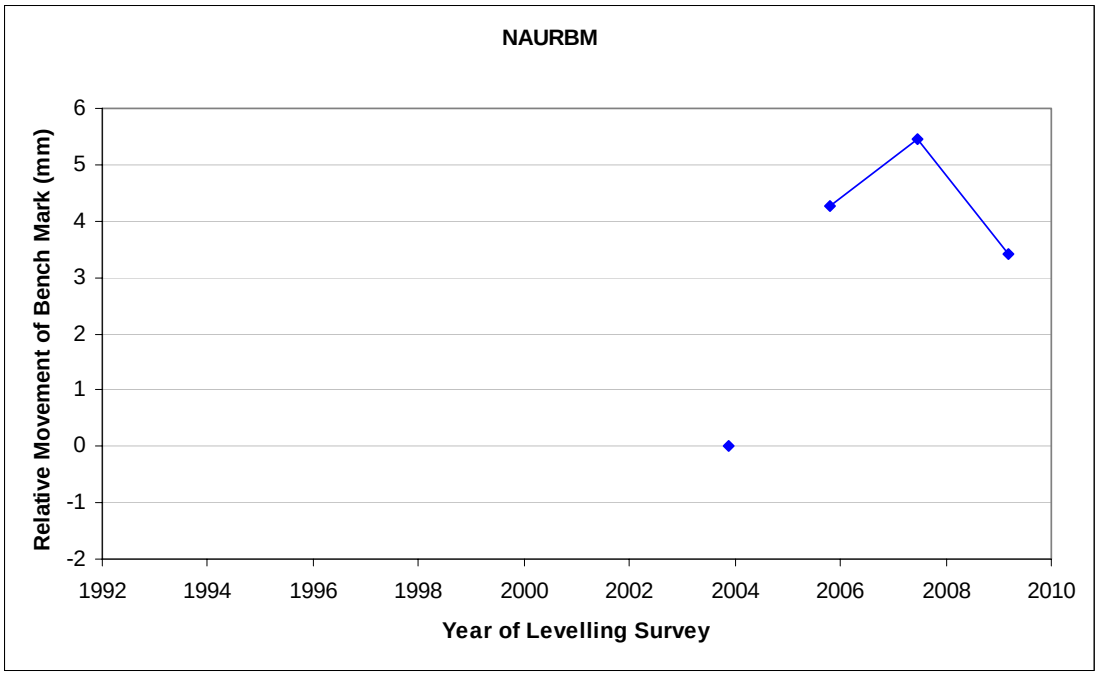












Deep driven Bench Mark Locality Diagrams

SOUTH PACIFIC SEA LEVEL
&
CLIMATE MONITORING PROJECT

Survey Bench Mark Record

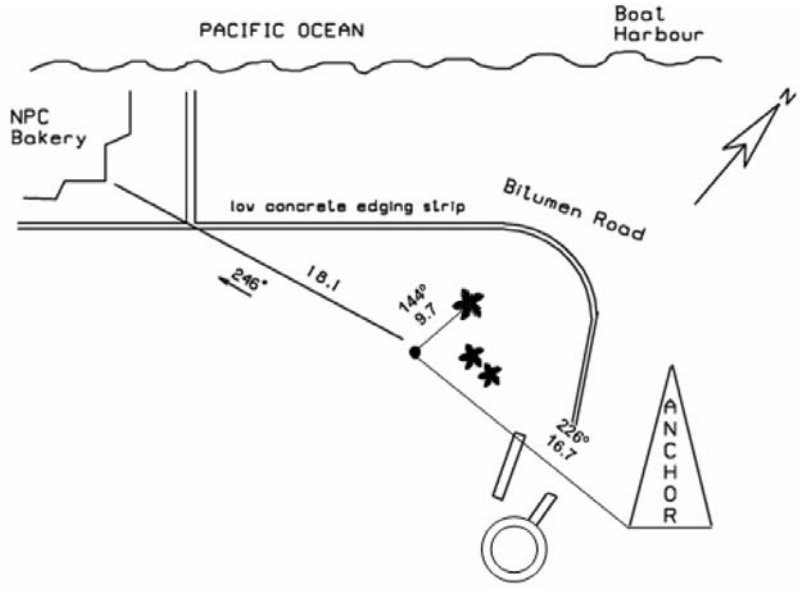
Bench Mark Number: NAU1

Original Bench Mark Established by: National Tidal Centre Australia, Oceanographic Services, Bureau of Meteorology, 25 College Rd, Kent Town, SA. — *Date*: 11-02-92
Existing Bench Mark Established by: — *Date*:
Notes / References: Deep Survey Benchmark This survey mark is in a good locality for GPS occupation.
Country: Nauru *Island*: Nauru — *Atoll: Nauru*

Marking and locality sketch

Bench Mark: 4.3m of 19mm diameter stainless steel capped rod driven to refusal. Rod sheathed with 50mm diameter PVC pipe, filled with bentonite, for 1.5m. Top of mark 0.2m below ground level.

Locality sketch: Mark approximately 100m from the tide gauge station.



Not to scale — Distances in Metres — Magnetic bearings

Approved by: Geoscience Australia / SOPAC — Date: November 2006

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SOUTH PACIFIC SEA LEVEL
&
CLIMATE MONITORING PROJECT

Survey Bench Mark Record

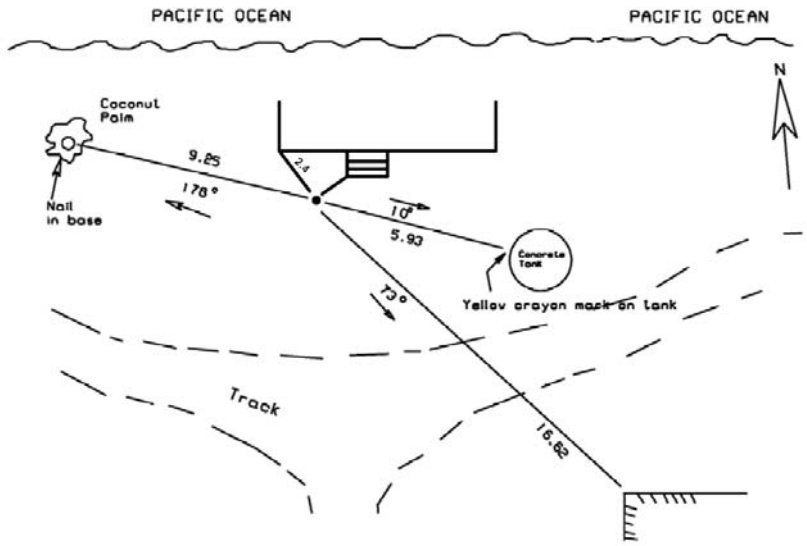
Bench Mark Number: NAU2

Original Bench Mark Established by: National Tidal Centre Australia, Oceanographic Services, Bureau of Meteorology, 25 College Rd, Kent Town, SA.	*Date*: 11-02-92
Existing Bench Mark Established by:	*Date*:
Notes / References: Deep Survey Benchmark This survey mark is in a good locality for GPS occupation.	
Country: Nauru *Island*: Nauru	*Atoll: Nauru*

Marking and locality sketch

Bench Mark: 4.8m of 19mm diameter stainless steel capped rod driven to refusal. Rod sheathed with 50mm diameter PVC pipe, filled with bentonite, for 1.8m. Top of mark 0.1m below ground level.

Locality sketch: Mark approximately 600m from the tide gauge station.



Not to scale | Distances in Metres | Magnetic bearings

Approved by: Geoscience Australia / SOPAC | Date: November 2006

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SOUTH PACIFIC SEA LEVEL
&
CLIMATE MONITORING PROJECT

Survey Bench Mark Record

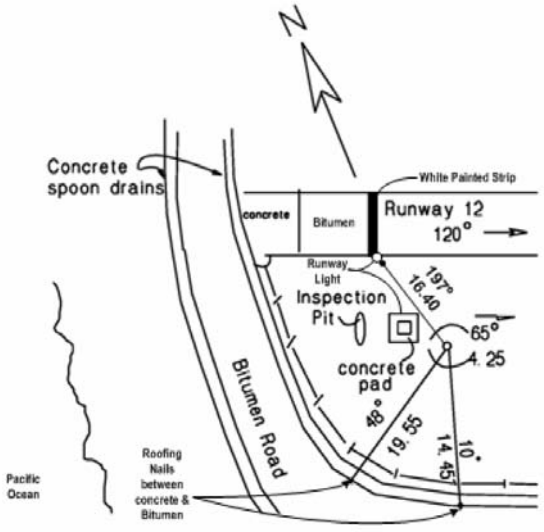
Bench Mark Number: NAU16

Original Bench Mark Established by: National Tidal Centre Australia, Oceanographic Services, Bureau of Meteorology, 25 College Rd, Kent Town, SA. — *Date*: 25-08-93
Existing Bench Mark Established by: — *Date*:
Notes / References: Deep Survey Benchmark This survey mark is not in a good locality for GPS occupation.
Country: Nauru *Island*: Nauru — *Atoll: Nauru*

Marking and locality sketch

Bench Mark: 4.3m of 19mm diameter stainless steel capped rod driven to refusal. Rod sheathed with 50mm diameter PVC pipe, filled with bentonite, for 0.5m. Top of mark 0.1m below ground level.

Locality sketch: Mark approximately 1500m from the tide gauge station.



Not to scale — Distances in Metres — Magnetic bearings

Approved by: Geoscience Australia / SOPAC — Date: November 2006

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SOUTH PACIFIC SEA LEVEL
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Survey Bench Mark Record

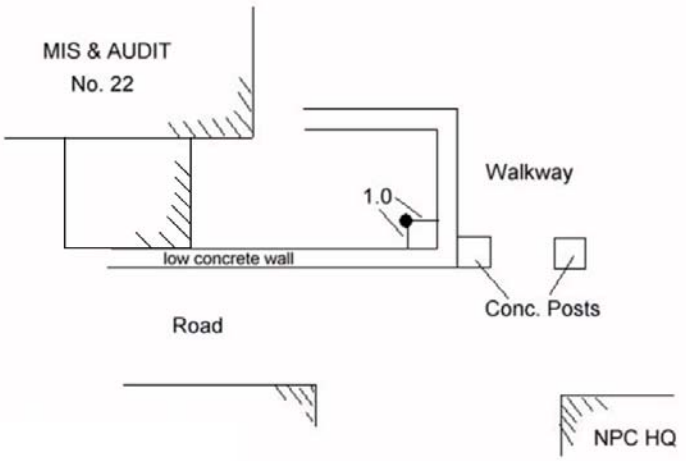
Bench Mark Number: NAU36

Original Bench Mark Established by: National Tidal Centre Australia, Oceanographic Services, Bureau of Meteorology, 25 College Rd, Kent Town, SA.	*Date*: 03-06-02
Existing Bench Mark Established by:	*Date*:
Notes / References: Deep Survey Benchmark This survey mark is not in a good locality for GPS occupation.	
Country: Nauru *Island*: Nauru	*Atoll: Nauru*

Marking and locality sketch

Bench Mark: 4.2m of 19mm diameter stainless steel capped rod driven to refusal. Rod sheathed with 50mm diameter PVC pipe, filled with bentonite, for 0.5m. Top of mark 0.1m below ground level.

Locality sketch: Mark approximately 600m from the tide gauge station.



Not to scale | Distances in Metres | Magnetic bearings

Approved by: Geoscience Australia / SOPAC | Date: November 2006

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SOUTH PACIFIC SEA LEVEL
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Survey Bench Mark Record

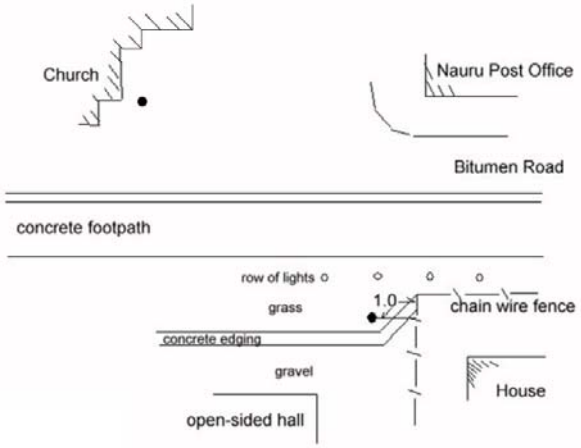
Bench Mark Number: NAU37

Original Bench Mark Established by: National Tidal Centre Australia, Oceanographic Services, Bureau of Meteorology, 25 College Rd, Kent Town, SA. — *Date*: 03-06-02
Existing Bench Mark Established by: — *Date*:
Notes / References: Deep Survey Benchmark This survey mark is not in a good locality for GPS occupation.
Country: Nauru *Island*: Nauru — *Atoll: Nauru*

Marking and locality sketch

Bench Mark: 3.3m of 19mm diameter stainless steel capped rod driven to refusal. Rod sheathed with 50mm diameter PVC pipe, filled with bentonite, for 0.5m. Top of mark 0.1m below ground level.

Locality sketch: Mark approximately 1200m from the tide gauge station.



Not to scale — Distances in Metres — Magnetic bearings

Approved by: Geoscience Australia / SOPAC — Date: November 2006

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SOUTH PACIFIC SEA LEVEL
&
CLIMATE MONITORING PROJECT

Survey Bench Mark Record

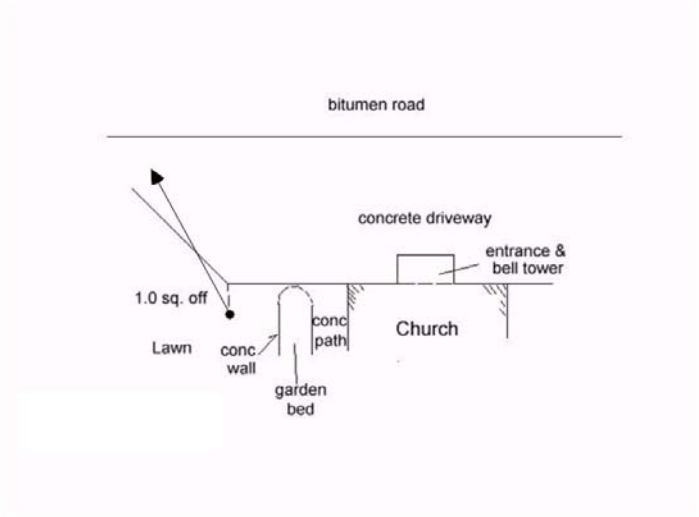
Bench Mark Number: NAU38

Original Bench Mark Established by: National Tidal Centre Australia, Oceanographic Services, Bureau of Meteorology, 25 College Rd, Kent Town, SA.	*Date*: 03-06-02
Existing Bench Mark Established by:	*Date*:
Notes / References: Deep Survey Benchmark This survey mark is not in a good locality for GPS occupation.	
Country: Nauru *Island*: Nauru	*Atoll: Nauru*

Marking and locality sketch

Bench Mark: 3.3m of 19mm diameter stainless steel capped rod driven to refusal. Rod sheathed with 50mm diameter PVC pipe, filled with bentonite, for 0.5m. Top of mark 0.1m below ground level.

Locality sketch: Mark approximately 1200m from the tide gauge station.



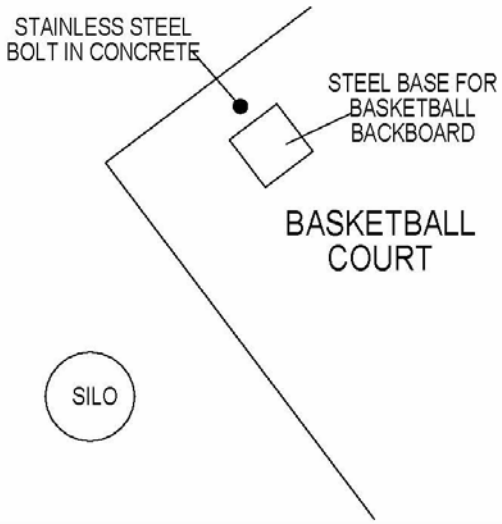
Not to scale | Distances in Metres | Magnetic bearings

Approved by: Geoscience Australia / SOPAC | Date: November 2006

c:\users\andrick\spslcmp\localitydiagrams\nauru

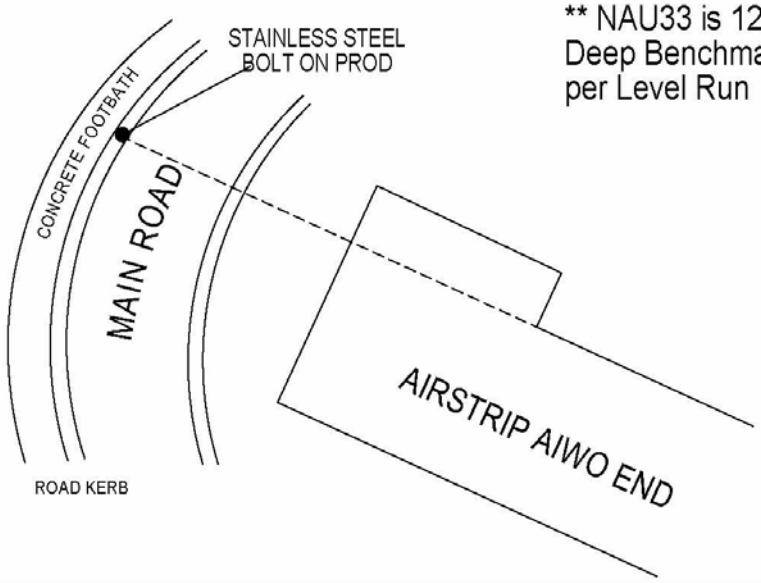
COUNTRY: Nauru	ISLAND: Nauru DISTRICT: Aiwo/Boe	L. D. P. 565 POINT NO. NAU 28
PROJECT: SPSLCMP	SURVEYOR: S. Turner	DATE: 31-05-02

** NAU28 is 197m away from Deep Benchmark; NAU36 as per Level Run

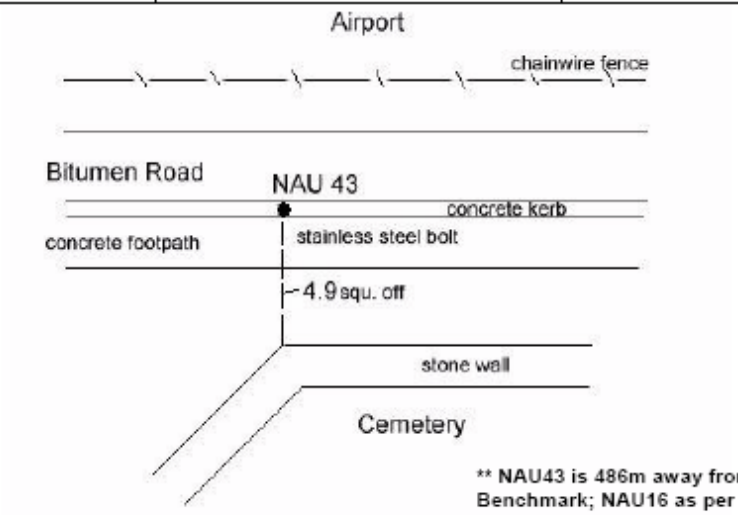


COUNTRY: Nauru	ISLAND: Nauru DISTRICT: Aiwo/Boe	L. D. P. 570 POINT NO. NAU 33
PROJECT: SPSLCMP	SURVEYOR: S. Turner	DATE: 31-05-02

** NAU33 is 129m away from Deep Benchmark; NAU16 as per Level Run

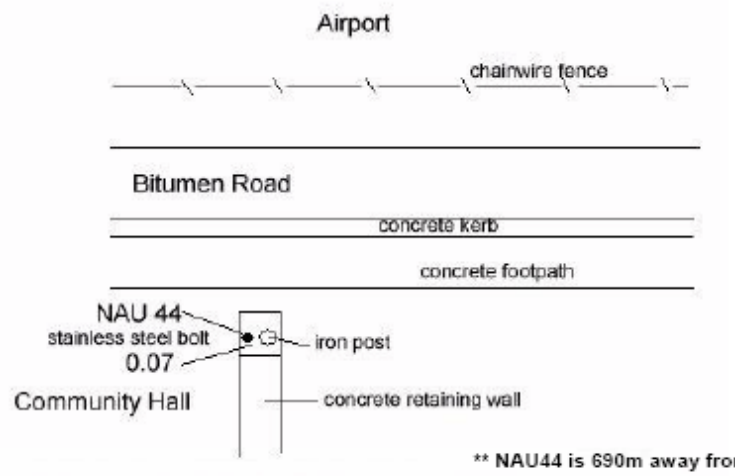


COUNTRY: Nauru	ISLAND: Nauru DISTRICT: Aiwo/ Boe	L. D. P. 752 POINT NO. NAU 43
PROJECT: SPSLCMP	SURVEYOR: S. Turner	DATE: 06-11-03



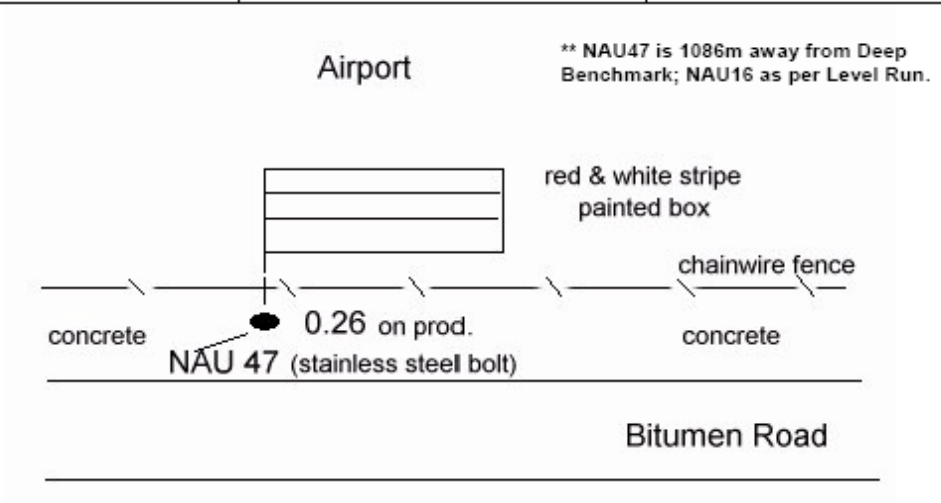
** NAU43 is 486m away from Deep Benchmark; NAU16 as per Level Run.

COUNTRY: Nauru	ISLAND: Nauru DISTRICT: Aiwo/ Boe	L. D. P. 753 POINT NO. NAU 44
PROJECT: SPSLCMP	SURVEYOR: S. Turner	DATE: 06-11-03

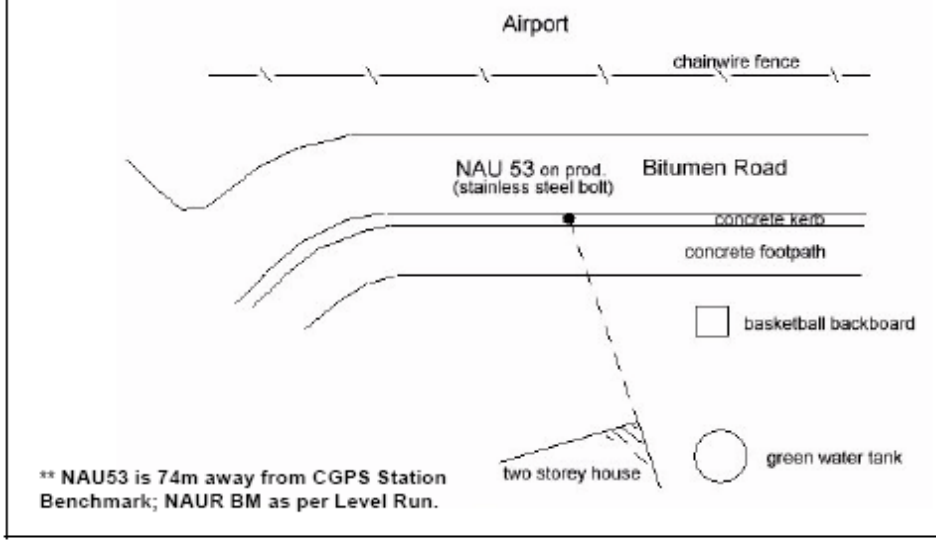


** NAU44 is 690m away from Deep Benchmark; NAU16 as per Level Run.

COUNTRY: Nauru	ISLAND: Nauru DISTRICT: Aiwo/ Boe	L. D. P. 756 POINT NO. NAU 47
PROJECT: SPSLCMP	SURVEYOR: S. Turner	DATE: 06-11-03

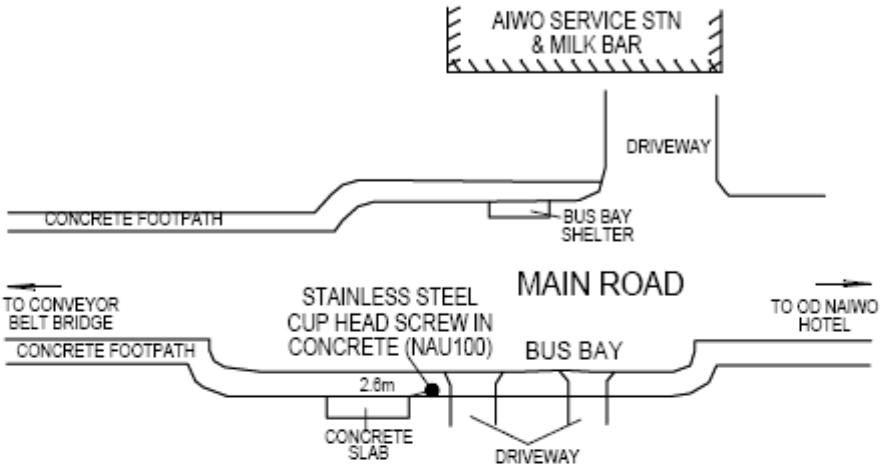


COUNTRY: Nauru	ISLAND: Nauru DISTRICT: Aiwo/ Boe	L. D. P. 762 POINT NO. NAU 53
PROJECT: SPSLCMP	SURVEYOR: S. Turner	DATE: 06-11-03

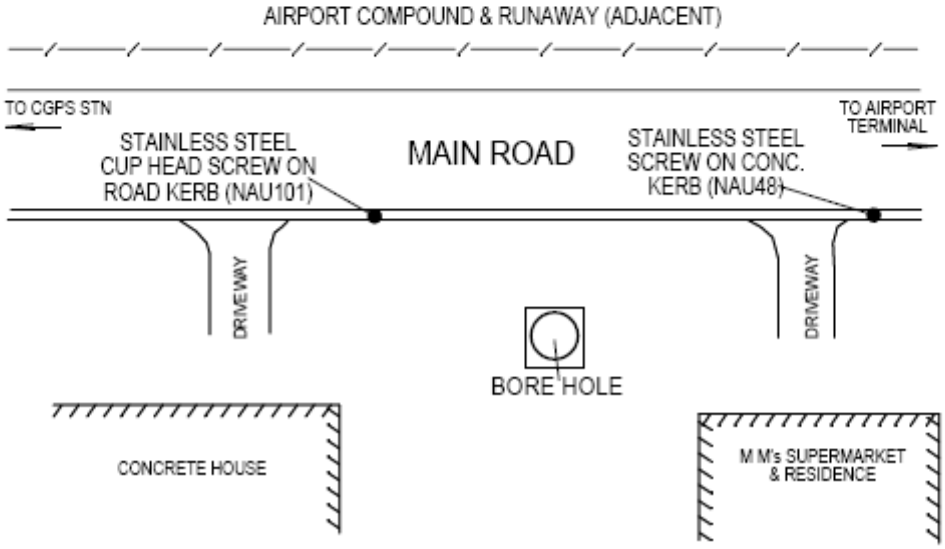


COUNTRY: Nauru	ISLAND: Nauru DISTRICT: Aiwo/Boe	L. D. P. 786 POINT NO. NAU 100
PROJECT: SPSLCMP	SURVEYOR: S. Yates & A Lal	DATE: 04-06-07

** NAU100 is 166m away from Deep Benchmark; NAU2 as per Level Run

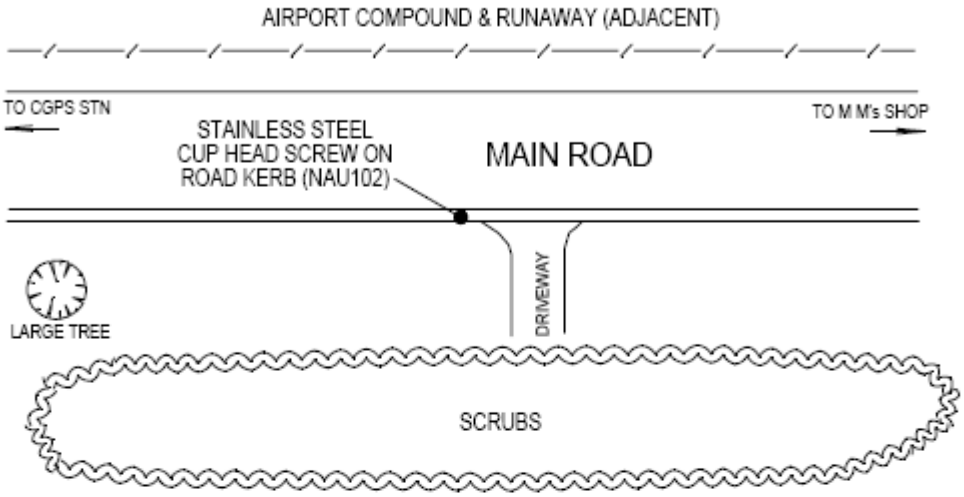


COUNTRY: Nauru	ISLAND: Nauru DISTRICT: Aiwo/Boe	L. D. P. 787 POINT NO. NAU 101
PROJECT: SPSLCMP	SURVEYOR: S. Yates & A Lal	DATE: 04-06-07



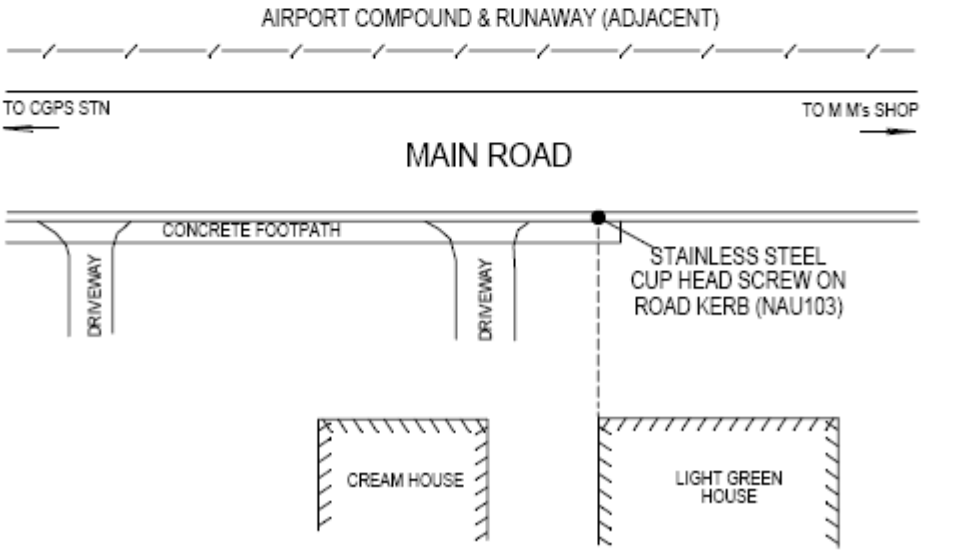
** NAU101 is 1287m away from Deep Benchmark; NAU16 as per Level Run

COUNTRY: Nauru	ISLAND: Nauru DISTRICT: Aiwo/Boe	L. D. P. 788 POINT NO. NAU 102
PROJECT: SPSLCMP	SURVEYOR: S. Yates & A Lal	DATE: 04-06-07



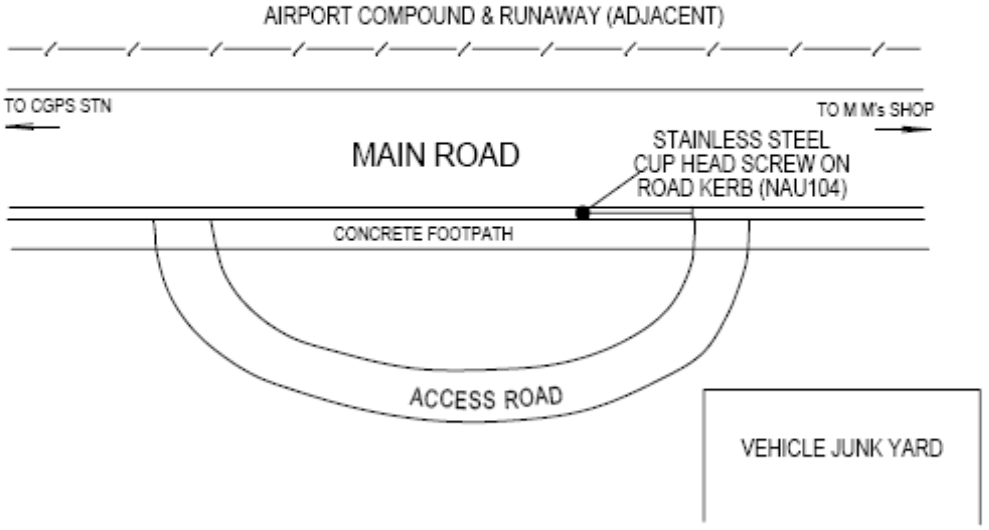
** NAU102 is 1486m away from Deep Benchmark; NAU16 as per Level Run

COUNTRY: Nauru	ISLAND: Nauru DISTRICT: Aiwo/Boe	L. D. P. 789 POINT NO. NAU 103
PROJECT: SPSLCMP	SURVEYOR: S. Yates & A Lal	DATE: 04-06-07



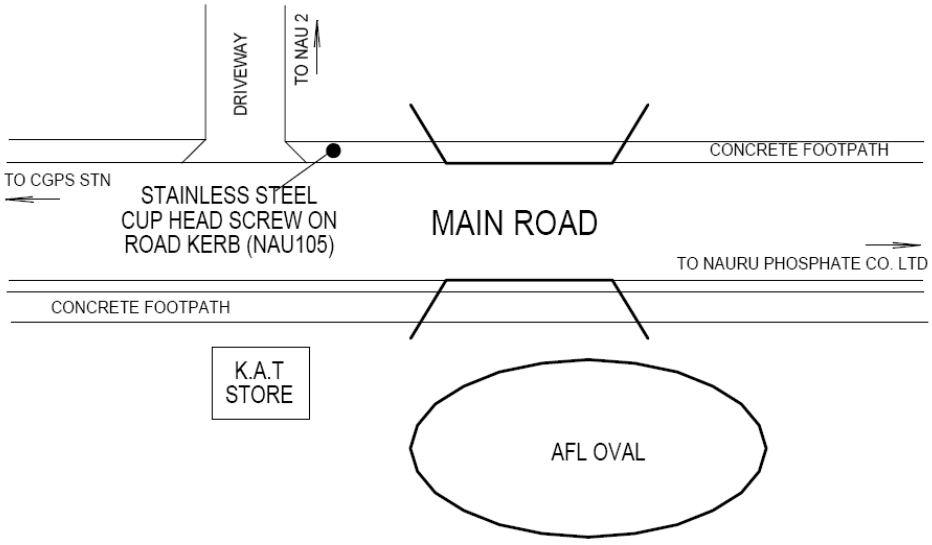
** NAU103 is 1686m away from Deep Benchmark; NAU16 as per Level Run

COUNTRY: Nauru	ISLAND: Nauru DISTRICT: Aiwo/Boe	L. D. P. 790 POINT NO. NAU 104
PROJECT: SPSLCMP	SURVEYOR: S. Yates & A Lal	DATE: 04-06-07

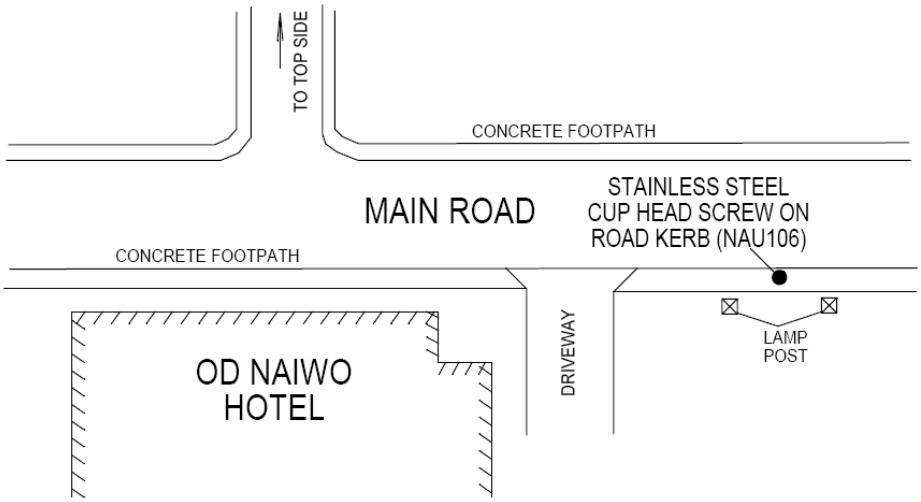


** NAU104 is 265m away from CGPS Benchmark; NAURBM as per Level Run

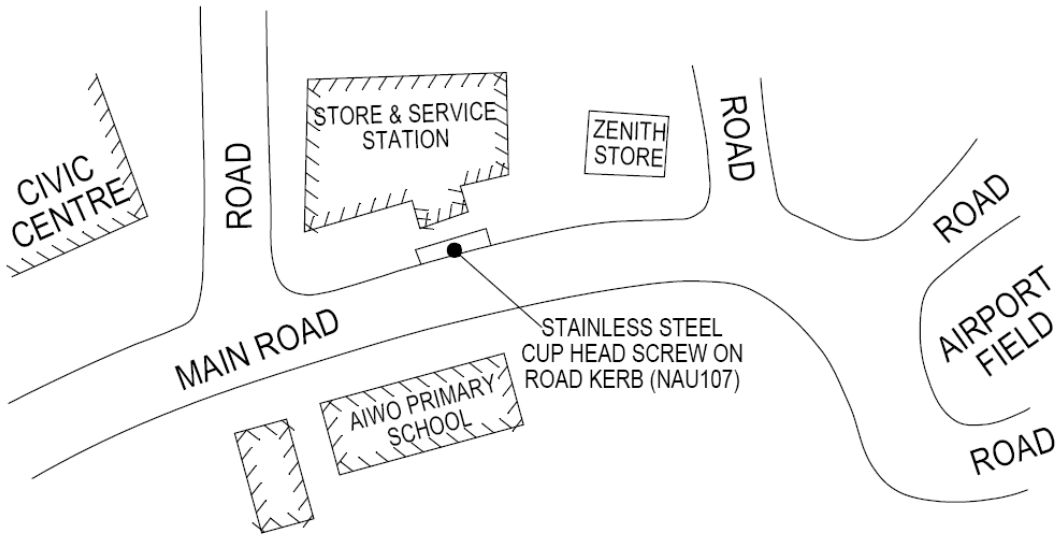
COUNTRY: Nauru	ISLAND: Nauru DISTRICT: Aiwo/Boe	L. D. P. 892 POINT NO. NAU 105
PROJECT: SPSLCMP	SURVEYOR: S. Yates & A Lal	DATE: 05-02-09



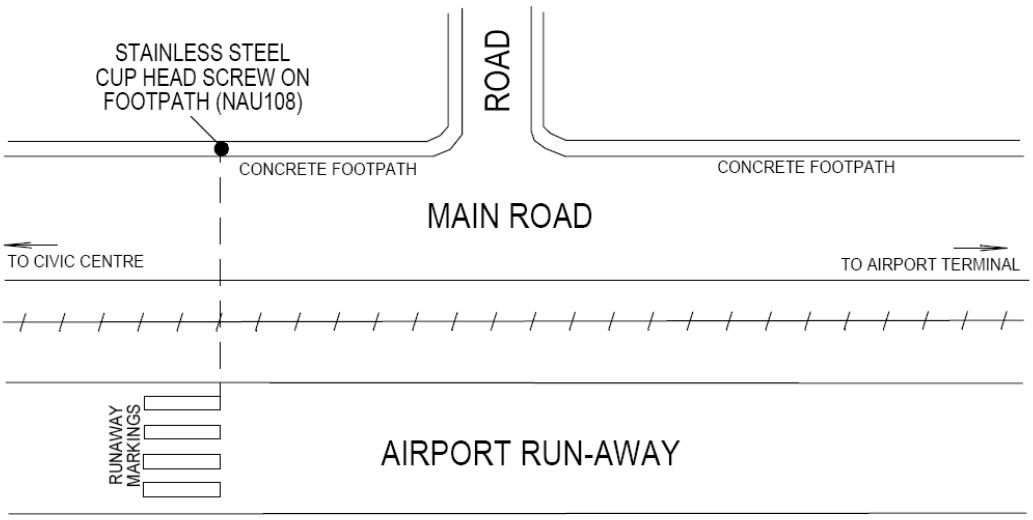
COUNTRY: Nauru	ISLAND: Nauru DISTRICT: Aiwo/Boe	L. D. P. 893 POINT NO. NAU 106
PROJECT: SPSLCMP	SURVEYOR: S. Yates & A Lal	DATE: 05-02-09



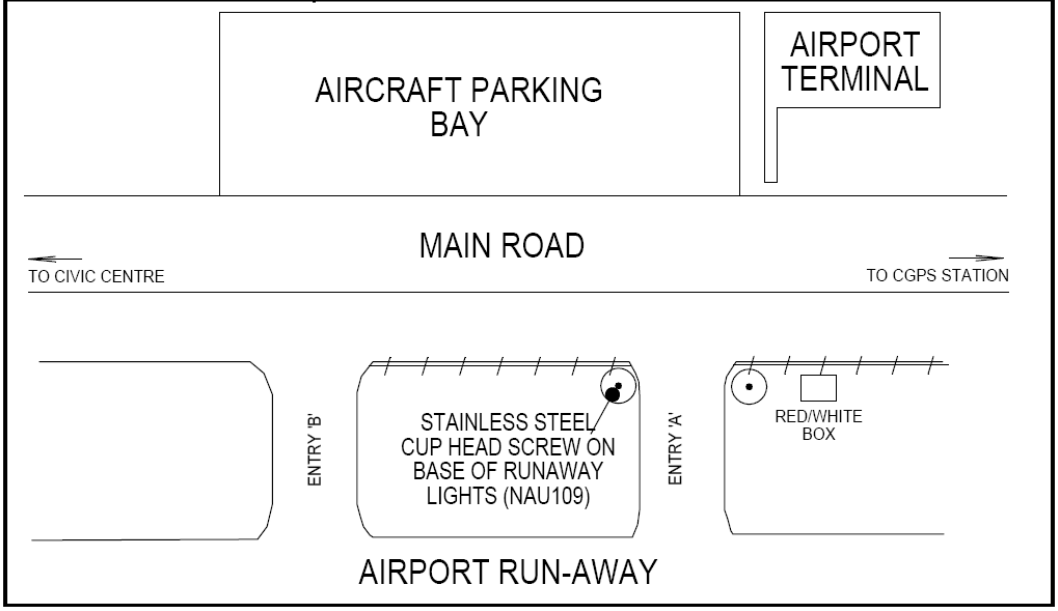
COUNTRY: Nauru	ISLAND: Nauru DISTRICT: Aiwo/Boe	L. D. P. 894 POINT NO. NAU 107
PROJECT: SPSLCMP	SURVEYOR: S. Yates & A Lal	DATE: 05-02-09



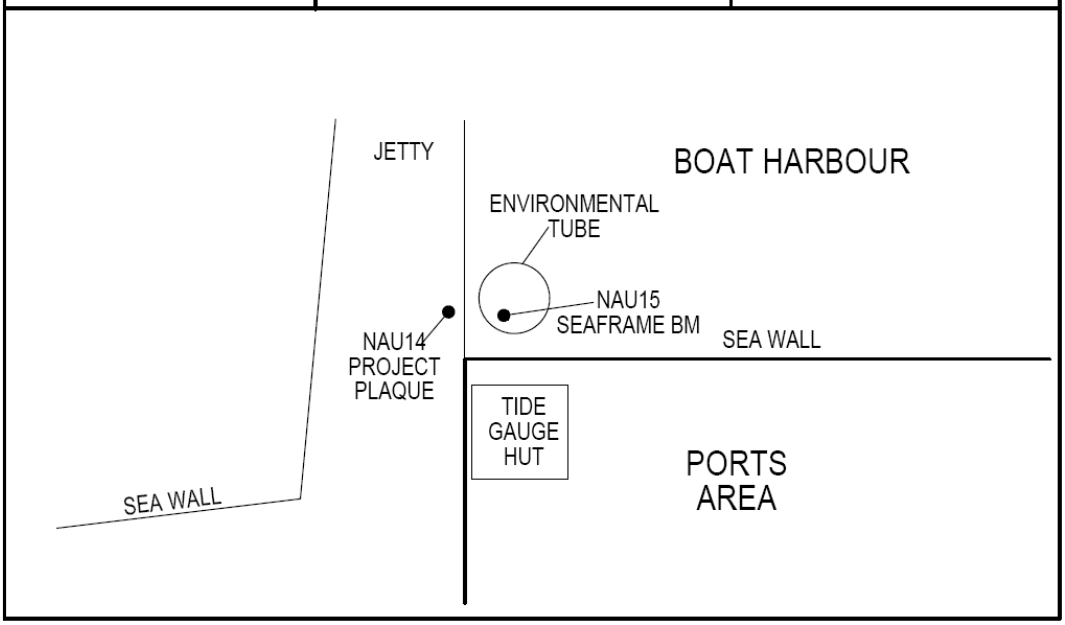
COUNTRY: Nauru	ISLAND: Nauru DISTRICT: Aiwo/Boe	L. D. P. 895 POINT NO. NAU 108
PROJECT: SPSLCMP	SURVEYOR: S. Yates & A Lal	DATE: 05-02-09



COUNTRY: Nauru	ISLAND: Nauru DISTRICT: Aiwo/Boe	L. D. P. 896 POINT NO. NAU 109
PROJECT: SPSLCMP	SURVEYOR: S. Yates & A Lal	DATE: 05-02-09



COUNTRY: Nauru	ISLAND: Nauru DISTRICT: Aiwo/Boe	L. D. P. 897 POINT NO. NAU 14 & 15
PROJECT: SPSLCMP	SURVEYOR: S. Yates & A Lal	DATE: 05-02-09

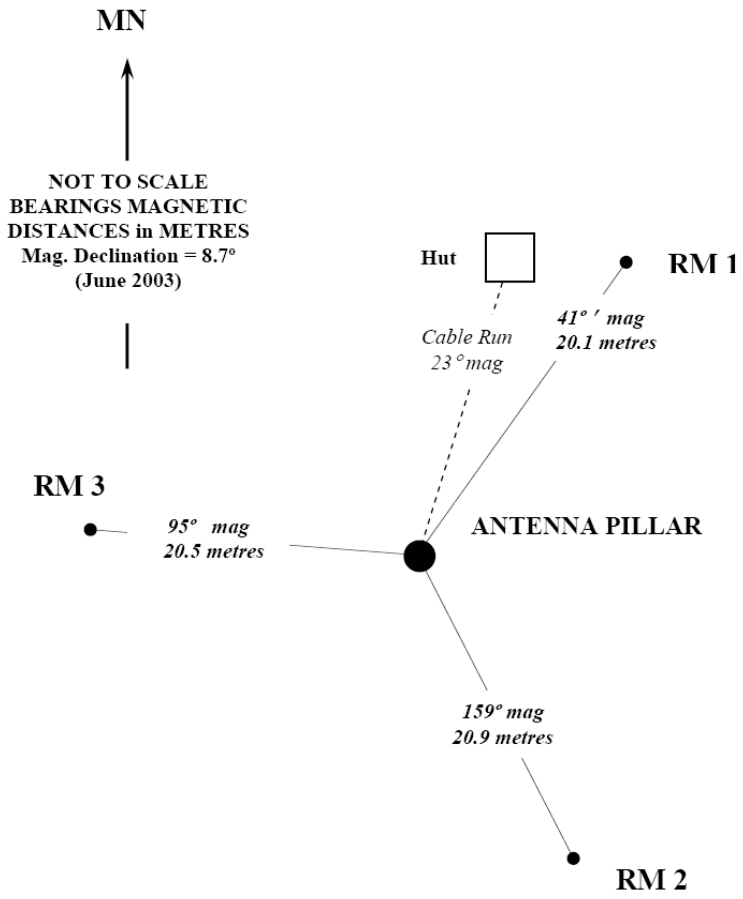


NAURBM and NAUR Reference Mark Locality Diagrams

NAURU CGPS Station, Yaren District. – Reference Marks

REFERENCE MARKS

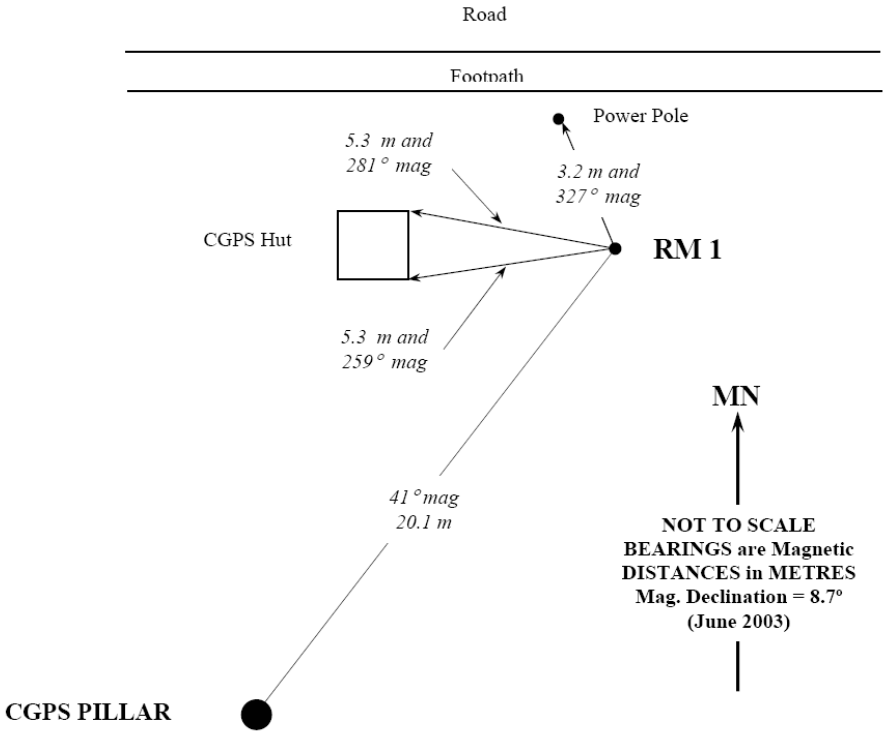
All RM's are capped 20 mm stainless steel rods driven to refusal and protected by 150 mm PVC pipe within circular poly carbonate valve boxes. The valve box lids are approximately 50mm below ground level.



NAURU CGPS Station, Yaren District. – RM 1

REFERENCE MARKS

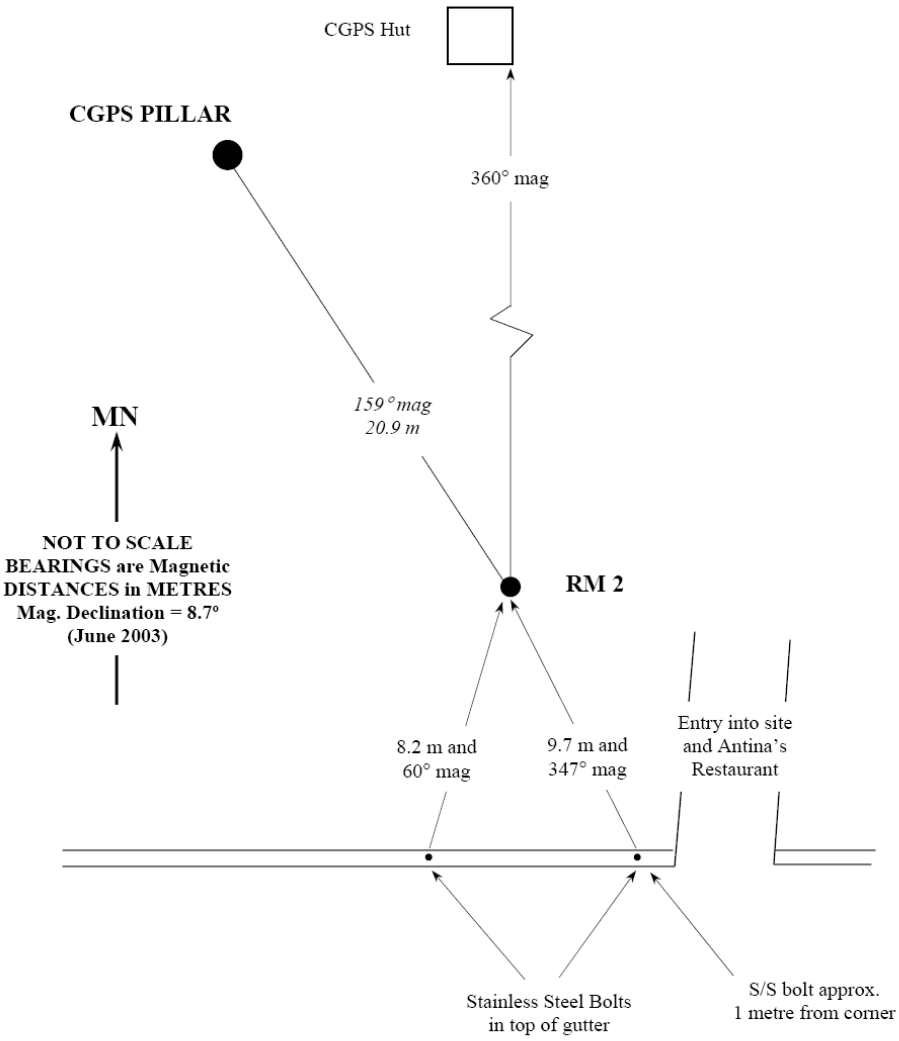
All RM's are capped 20 mm stainless steel rods driven to refusal and protected by 150 mm PVC pipe within circular poly carbonate valve boxes. The valve box lids are approximately 50mm below ground level.



NAURU CGPS Station, Yaren District. – RM 2

REFERENCE MARKS

All RM's are capped 20 mm stainless steel rods driven to refusal and protected by 150 mm PVC pipe within circular poly carbonate valve boxes. The valve box lids are approximately 50mm below ground level.



NAURU CGPS Station, Yaren District. – RM 3

REFERENCE MARKS

All RM's are capped 20 mm stainless steel rods driven to refusal and protected by 150 mm PVC pipe within circular poly carbonate valve boxes. The valve box lids are approximately 50mm below ground level.