APPENDIX C

TIDE STATIONS

U.S. DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
National Ocean Service

Station ID: 1630000 PUBLICATION DATE: 08/30/2000
Name: GUAM, APRA HARBOR
0
NOAA Chart: 81054 Latitude: 13ø 26.5' N
USGS Quad: APRA HARBOR Longitude: 144ø 39.2' E

To reach the tidal bench marks, from the Guam airport travel east on Chalan Passajeros (Route 10A) for 2.9 km (1.8 mi) where it dead ends at Marine Drive (Route 1), turn left and proceed on Marine Drive for approximately 19 km (12 mi) until you reach the main gate of the Naval Station Guam. Obtain a visitor's pass and continue on Marine Drive for 2.9 km (1.8 mi) until you reach San Luis Road, turn right (east) and follow to the boat channel on your right to its entrance. The bench marks are located between Small Boat Channel and Fleet Landing Channel. The tide house is located on the east corner of the entrance to the Sunny Cove Marina boat harbor.

T I D A L B E N C H M A R K S

PRIMARY BENCH MARK STAMPING: NO 4 1949
DESIGNATION: 163 0000 TIDAL 4

MONUMENTATION: Tidal Station disk VM#: 1684
AGENCY: US Coast and Geodetic Survey (USC&GS) PID#: TW0041
SETTING CLASSIFICATION: Concrete valve box

The primary bench mark is a disk set in the NW side of a 2 m x 4 m (6 ft x 12 ft) concrete valve box with steel plates projecting 0.15 m (0.5 ft) in the center of road between remains of Fleet Post Office Building and Fleet Landing Channel, 81 m (266 ft) south of the NE corner of the remains of the building, 24.17 m (79.3 ft) NW of the last light pole along the SE bulkhead, and 7.92 m (26.0 ft) NW of the SE bulkhead of the old Fleet Landing Channel. Note: A white square is painted around mark.

BENCH MARK STAMPING: NO 5 1949
DESIGNATION: 163 0000 TIDAL 5

MONUMENTATION: Tidal Station disk VM#: 1685
AGENCY: US Coast and Geodetic Survey (USC&GS) PID#: TW0042
SETTING CLASSIFICATION: Concrete bulkhead

The bench mark is a disk set inside a 6-inch diameter iron pipe handhold at the

end of Small Boat Channel, about 29 m (95 ft) west of Fleet Landing Channel bulkhead, 1.98 m (6.5 ft) SW of east corner of boat channel, and 0.21 m (0.7 ft) below level of concrete bulkhead.

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T I D A L B E N C H M A R K S

BENCH MARK STAMPING: NO 6 1949
DESIGNATION: 163 0000 TIDAL 6

MONUMENTATION: Tidal Station disk VM#: 1686
AGENCY: US Coast and Geodetic Survey (USC&GS) PID#: TW0043
SETTING CLASSIFICATION: Concrete culvert headwall

The bench mark is a disk set in top of the south end of a concrete culvert headwall on the south side of San Luis Road, 95.40 m (313.0 ft) south of bench mark NO 5 1949, 82.30 m (270.0 ft) east of the centerline of Marine Drive, 12.19 m (40.0 ft) south of the centerline of San Luis Road, and 9.14 m (30.0 ft) north of telephone pole 2-H-22-6-19-2.

BENCH MARK STAMPING: NO 11 1964
DESIGNATION: 163 0000 NO 11

MONUMENTATION: Tidal Station disk VM#: 1688
AGENCY: US Coast and Geodetic Survey (USC&GS) PID#: AA4394
SETTING CLASSIFICATION: Concrete foundation

The bench mark is a disk set in concrete foundation which used to support a - now destroyed - walkway to tide house, 12.80 m (42.0 ft) south of the NE end of Pier K, 4.03 m (13.2 ft) east of SE corner of tidehouse, 0.91 m (3.0 ft) west of the steel piling bulkhead on the west side of Fleet Landing Channel, and 0.29 m (1.0 ft) SE of the SE corner of the concrete step that used to lead to the - now destroyed - walkway.

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T I D A L B E N C H M A R K S

BENCH MARK STAMPING: NO 12 1974
DESIGNATION: 163 0000 NO 12

MONUMENTATION: Tidal Station disk VM#: 1689
AGENCY: National Ocean Survey (NOS) PID:
SETTING CLASSIFICATION: Concrete patio slab

The bench mark is a disk set flush in SW corner of the elevated 9 m x 6 m (28 ft x 21 ft) concrete patio supporting a yellow flammable storage house of the U.S. Naval Sea Cadets Headquarters, 57 m (187 ft) west of the west side of the Fleet Landing Channel, 18.75 m (61.5 ft) east of the east side of the small boat channel, and 7.32 m (24.0 ft) south of a flagpole.

BENCH MARK STAMPING: TIDAL BM 13 1975
DESIGNATION: 163 0000 TIDAL BM 13

MONUMENTATION: Tidal Station disk VM#: 1690
AGENCY: National Ocean Survey (NOS) PID:
SETTING CLASSIFICATION: Concrete apron slab

The bench mark is a disk set in the concrete apron fronting the double door entrance to the Communication Security Material Issuing office, 70 m (230 ft) NW of the centerline of the intersection of San Luis Road and Marine Drive, 42 m (139 ft) west of a fire hydrant, 7 m (24 ft) north of the south wall of the office, and 0.85 m (2.8 ft) east of the office.

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T I D A L B E N C H M A R K S

BENCH MARK STAMPING: 0000 K TIDAL BM 1978
DESIGNATION: 163 0000 TIDAL BM K

MONUMENTATION: Tidal Station disk VM#: 1691
AGENCY: National Ocean Survey (NOS) PID:
SETTING CLASSIFICATION: Concrete base of a flagpole

The bench mark is a disk set in the NW corner of the concrete base of a flagpole at the Sumay Cove Marina, 61 m (200 ft) east of bench mark NO 6 1949, 19.96 m (65.5 ft) east of the SE corner of the Marina Building (#1985), 14.02 m (46.0 ft) east of east edge of a 6 m x 18 m (20 ft x 60 ft) old concrete foundation used for drydocking small boats, 6.10 m (20.0 ft) west of the eastern-most edge of a wooden plank deck along west side of Sunny Cove, and 3.05 m (10.0 ft) south of a small concrete floored picnic shelter.

BENCH MARK STAMPING: USN BM 1
DESIGNATION: 163 0000 USN BM 1
ALIAS: 14

MONUMENTATION: Bench Mark disk VM#: 1692
AGENCY: U.S. Department of Defense (DOD) PID:
SETTING CLASSIFICATION: Concrete bulkhead

The bench mark is a disk set inside a 6-inch diameter iron pipe handhold at end of Small Boat Channel, 38.10 m (125.0 ft) west of the Fleet Landing Channel bulkhead, 11.77 m (38.6 ft) SW of the inside east corner of the Small Boat Channel, 10.00 m (32.8 ft) SW of bench mark NO 5 1949, and 0.21 m (0.7 ft) below the level of concrete bulkhead.

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T I D A L B E N C H M A R K S

BENCH MARK STAMPING:
DESIGNATION: 163 0000 TIDAL 7
ALIAS: TIDAL 7 PIE

MONUMENTATION: Bolt VM#: 1693
AGENCY: Unknown PID#: TW0044
SETTING CLASSIFICATION: Concrete culvert headwall

The bench mark is a bolt set flush in the north end of a concrete culvert headwall at the SW corner of the intersection of Marine Drive and San Luis Road, 21.34 m (70.0 ft) south of the centerline of San Luis Road, 10.97 m (36.0 ft) west of the centerline of Marine Drive, and about 4 m (12 ft) north of a protruding concrete post labeled "Buried Cable".

BENCH MARK STAMPING: 0000 N 1994
DESIGNATION: 163 0000 N

MONUMENTATION: Tidal Station disk VM#: 12702
AGENCY: National Ocean Service (NOS) PID:
SETTING CLASSIFICATION: Concrete slab

The bench mark is a disk set flush in the SE corner of a 5 m x 8 m x 1 m (16 ft x 26 ft x 3 ft) utility access pad, 0.2 km (0.1 mi) west of the intersection of Marine Drive and San Luis Road, 30 m (98 ft) east of the Trans-Pacific Cable Station sign, 14.50 m (47.6 ft) SE of a 2.5 m x 2 m x 1 m (8 ft x 7 ft x 3 ft) concrete bunker, 11.75 m (38.5 ft) SW of utility pole "JB-61-9", 10.85 m (35.6 ft) north of the centerline of San Luis, and 1.24 m (4.1 ft) above the natural grade of the hill.

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T I D A L D A T U M S

Tidal datums at GUAM, APRA HARBOR based on:

LENGTH OF SERIES: 19 YEARS
TIME PERIOD: January 1960 - December 1978
TIDAL EPOCH: 1960-1978
CONTROL TIDE STATION:

Elevations of tidal datums referred to Mean Lower Low Water (MLLW), in METERS:

HIGHEST OBSERVED WATER LEVEL (08/28/1992)	= 1.338
MEAN HIGHER HIGH WATER (MHHW)	= 0.732
MEAN HIGH WATER (MHW)	= 0.695
MEAN TIDE LEVEL (MTL)	= 0.442
MEAN SEA LEVEL (MSL)	= 0.430
MEAN LOW WATER (MLW)	= 0.186
MEAN LOWER LOW WATER (MLLW)	= 0.000
LOWEST OBSERVED WATER LEVEL (12/21/1968)	= -0.683

Bench Mark Elevation Information In METERS above:

Stamping or Designation	MLLW	MHW
NO 4 1949	2.618	1.923
NO 5 1949	1.032	0.337
NO 6 1949	1.987	1.292
NO 11 1964	2.447	1.752
NO 12 1974	2.641	1.946
TIDAL BM 13 1975	3.295	2.600
0000 K TIDAL BM 1978	2.156	1.461
USN BM 1	0.988	0.293
163 0000 TIDAL 7	2.715	2.020
0000 N 1994	13.369	12.674

Station ID: 1630000 PUBLICATION DATE: 08/30/2000
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D E F I N I T I O N S

Mean Sea Level (MSL) is a tidal datum determined over a 19-year National Tidal Datum Epoch. It pertains to local mean sea level and should not be confused with the fixed datums of North American Vertical Datum of 1988 (NAVD 88).

NGVD 29 is a fixed datum adopted as a national standard geodetic reference for heights but is now considered superseded. NGVD 29 is sometimes referred to as Sea Level Datum of 1929 or as Mean Sea Level on some early issues of Geological Survey Topographic Quads. NGVD 29 was originally derived from a general adjustment of the first-order leveling networks of the U.S. and Canada after holding mean sea level observed at 26 long term tide stations as fixed. Numerous local and wide-spread adjustments have been made since establishment in 1929. Bench mark elevations relative to NGVD 29 are available from the National Geodetic Survey (NGS) data base via the World Wide Web at
National Geodetic Survey.

NAVD 88 is a fixed datum derived from a simultaneous, least squares, minimum constraint adjustment of Canadian/Mexican/United States leveling observations. Local mean sea level observed at Father Point/Rimouski, Canada was held fixed as the single initial constraint. NAVD 88 replaces NGVD 29 as the national standard geodetic reference for heights. Bench mark elevations relative to NAVD 88 are available from NGS through the World Wide Web at
National Geodetic Survey.

NGVD 29 and NAVD 88 are fixed geodetic datums whose elevation relationships to local MSL and other tidal datums may not be consistent from one location to another.

The Vertical Mark Number (VM#) and PID# shown on the bench mark sheet are unique identifiers for bench marks in the tidal and geodetic databases, respectively. Each bench mark in either database has a single, unique VM# and/or PID# assigned.
Where both VM# and PID# are indicated, both tidal and geodetic elevations are available for the bench mark listed.

The NAVD 88 elevation is shown on the Elevations of Tidal Datums Table Referred to MLLW only when two or more of the bench marks listed have NAVD 88 elevations. The NAVD 88 elevation relationship shown in the table is derived from an average of several bench mark elevations relative to tide station datum. As a result of this averaging, NAVD 88 bench mark elevations computed indirectly from the tidal datums elevation table may differ slightly from NAVD 88 elevations listed for each bench mark in the NGS database.

Station ID: 1633227 PUBLICATION DATE: 04/09/2001
Name: TANAPAG HBR, SAIPAN, N MARIANAS ISLAND 0
NOAA Chart: 81067 Latitude: 15ø 13.6' N
USGS Quad: ISLAND OF SAIPAN Longitude: 145ø 44.2' E

To reach tidal bench marks from Saipan International Airport, proceed north 3.4 km (2.1 mi) along an unnamed road. As the road terminates, turn left (west) onto Cross Island Road (Note: there are no road signs in Saipan). Turn right (north) on Middle Road (first large intersection with traffic light) and proceed for 8 km (5 mi). Turn left (west) immediately after the WESTPAC building (located on the west side of Middle Road). The unnamed road will bend to the south, turn right (west) just past the Port of Saipan Building (two story concrete building painted beige). Proceed through the parking toll booth and turn right toward the NNE side of the port facility. The bench marks were located on the Port of Saipan facility. The tide gauge was located where east parking lot meets with the east face of Delta Dock.

T I D A L B E N C H M A R K S

PRIMARY BENCH MARK STAMPING:
DESIGNATION: 163 3227 UH-2C

MONUMENTATION: Bolt VM#: 16316
AGENCY: University of Hawaii (UH) PID:
SETTING CLASSIFICATION: Concrete deck

The primary bench mark is a 9/16" SS hex head bolt set in the concrete deck where the east face of Delta Dock (Delta -3) meets the east face of the parking lot (CPA-2) fronting the port building, located at the Commonwealth Port Authority (CPA) facility in Saipan Harbor (aka Tanapag Harbor), 2.83 m (9.3 ft) SSE of the SE corner of a diesel containment wall, 2.56 m (8.4 ft) NNE of utility pole #7, and 1.13 m (3.7 ft) west of the east pier face (CPA-2).

BENCH MARK STAMPING:
DESIGNATION: 163 3227 CPA-1

MONUMENTATION: Bench Mark disk VM#: 16317
AGENCY: U.S. Geological Survey (USGS) PID:
SETTING CLASSIFICATION: Concrete deck

The bench mark is a disk set flush in the concrete deck in the extreme NW corner of the port, located at the Commonwealth Port Authority (CPA) facility in Saipan Harbor (aka Tanapag Harbor), 70.01 m (229.7 ft) north of the south end of Able Dock, 0.58 m (1.9 ft) south from the north edge of Baker Dock, and 0.55 m (1.8 ft) east of the west edge of Able Dock.

Station ID: 1633227 PUBLICATION DATE: 04/09/2001
Name: TANAPAG HBR, SAIPAN, N MARIANAS ISLAND 0
NOAA Chart: 81067 Latitude: 15ø 13.6' N
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T I D A L B E N C H M A R K S

BENCH MARK STAMPING:
DESIGNATION: 163 3227 CPA-2

MONUMENTATION: Bench Mark disk VM#: 16318
AGENCY: U.S. Geological Survey (USGS) PID:
SETTING CLASSIFICATION: Concrete bullrail

The bench mark is a disk set flush in the concrete bull rail in the extreme WSW corner of the port, located at the Commonwealth Port Authority (CPA) facility in Saipan Harbor (aka Tanapag Harbor), 70.01 m (229.7 ft) south of the north edge of Baker Dock, 1.60 m (5.2 ft) east of the west end of bull rail, 0.19 m (0.6 ft) north of the south end of bull rail, and 0.33 m (1.1 ft) above the pier deck.

BENCH MARK STAMPING:
DESIGNATION: 163 3227 UH-1

MONUMENTATION: Bolt VM#: 16319
AGENCY: University of Hawaii (UH) PID:
SETTING CLASSIFICATION: Concrete deck

The bench mark is a disk embedded in the NE corner of Delta Dock, located at the Commonwealth Port Authority (CPA) facility in Saipan Harbor (aka Tanapag Harbor), 18.71 m (61.4 ft) east of the NW corner Delta Dock, 0.47 m (1.5 ft) west of the east pier face (Delta-3) of Delta Dock, and 0.42 m (1.4 ft) south of the north pier face (Delta-2) of Delta Dock.

U.S. DEPARTMENT OF COMMERCE
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Station ID: 1633227 PUBLICATION DATE: 04/09/2001
Name: TANAPAG HBR, SAIPAN, N MARIANAS ISLAND 0
NOAA Chart: 81067 Latitude: 15ø 13.6' N
USGS Quad: ISLAND OF SAIPAN Longitude: 145ø 44.2' E

T I D A L B E N C H M A R K S

BENCH MARK STAMPING:
DESIGNATION: 163 3227 UH-3B

MONUMENTATION: Bolt VM#: 16320
AGENCY: University of Hawaii (UH) PID:
SETTING CLASSIFICATION: Concrete deck

The bench mark is a 1/4" SS square headed pin marker set in the concrete deck, located at the Commonwealth Port Authority (CPA) facility in Saipan Harbor (aka Tanapag Harbor), below the Mobile Gas sign, near the SW corner of Delta Deck, where the west face of Delta Dock (Delta-1) meets the north face of the parking lot (CPA-1) fronting the port building.

BENCH MARK STAMPING:
DESIGNATION: 163 3227 UH-4B

MONUMENTATION: Bolt VM#: 16321
AGENCY: University of Hawaii (UH) PID:
SETTING CLASSIFICATION: Concrete foundation for flagpole

The bench mark is a 9/16" SS hex head bolt set in the flag pole base north of the port building, located at the Commonwealth Port Authority (CPA) facility in Saipan Harbor (aka Tanapag Harbor), 46.53 m (152.7 ft) west of the east pier face (CPA-2), 42.21 m (138.5 ft) south of the north pier face (CPA-1), and 0.67 m (2.2 ft) north of the center flag pole.

Station ID: 1633227 PUBLICATION DATE: 04/09/2001
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T I D A L B E N C H M A R K S

BENCH MARK STAMPING:
DESIGNATION: 163 3227 UH-5B

MONUMENTATION: Bolt VM#: 16322
AGENCY: University of Hawaii (UH) PID:
SETTING CLASSIFICATION: Concrete deck

The bench mark is a 1-1/4" SS square headed pin marker set in the concrete deck near the SE corner of Charlie Dock where the east face of Charlie Dock (Charlie-2) meets the north face of the parking lot (CPA-1) fronting the port building, located at the Commonwealth Port Authority (CPA) facility in Saipan Harbor (aka Tanapag Harbor), 20.56 m (67.5 ft) south of the SE most large bollard on Charlie dock, 5.35 m (17.6 ft) north of Charlie-2 and CPA-1 corner, and 0.19 m (0.6 ft) west of the east face (Charlie-2) of Charlie Dock.

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T I D A L D A T U M S

Tidal datums at TANAPAG HBR, SAIPAN, N MARIANAS ISLAND based on:

LENGTH OF SERIES:	5 MONTHS
TIME PERIOD:	October 2000 - February 2001
TIDAL EPOCH:	1960-1978
CONTROL TIDE STATION:	1630000 GUAM, APRA HARBOR

Elevations of tidal datums referred to Mean Lower Low Water (MLLW), in METERS:

MEAN HIGHER HIGH WATER (MHHW)	= 0.683
MEAN HIGH WATER (MHW)	= 0.644
MEAN TIDE LEVEL (MTL)	= 0.414
MEAN SEA LEVEL (MSL)	= 0.400
MEAN LOW WATER (MLW)	= 0.184
MEAN LOWER LOW WATER (MLLW)	= 0.000

Bench Mark Elevation Information In METERS above:

Stamping or Designation	MLLW	MHW
163 3227 UH-2C	2.075	1.431
163 3227 CPA-1	2.373	1.729
163 3227 CPA-2	2.621	1.977
163 3227 UH-1	2.122	1.478
163 3227 UH-3B	2.010	1.366
163 3227 UH-4B	2.390	1.746
163 3227 UH-5B	1.854	1.210

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