

W00209

NOAA FORM 76-35A

U.S. DEPARTMENT OF COMMERCE
NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION
NATIONAL OCEAN SERVICE

DESCRIPTIVE REPORT

Type of Survey Hydrographic Survey

Field No. N/A

Registry No. W00209

LOCALITY

State Commonwealth of the Northern Mariana Islands

General Locality Tinian Island

Sublocality Tinian Harbor

2009

CHIEF OF PARTY

Charles A. Baptiste, Hydrographer in Charge


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DATE

NOAA FORM 77-28 (11-72) U.S. DEPARTMENT OF COMMERCE NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION HYDROGRAPHIC TITLE SHEET	REGISTRY No W00209
INSTRUCTIONS — The Hydrographic Sheet should be accompanied by this form, filled in as completely as possible, when the sheet is forwarded to the Office.	FIELD No
State <u>Commonwealth of the Northern Mariana Islands</u> General Locality <u>Tinian Island</u> Sub-Locality <u>Tinian Harbor</u> Scale <u>1:10,000</u> Date of Survey <u>18-Jun-09</u> Instructions dated _____ Project No. _____ Vessel <u>FST Vessel, Swamp Fox</u> Chief of party <u>Charles A. Baptiste, Hydrographer in Charge</u> Surveyed by <u>U.S. Naval Oceanographic Office</u> Soundings by echo sounder, hand lead, pole <u>Reson Multibeam 7125</u> Graphic record scaled by <u>Fleet Survey Team</u> Graphic record checked by <u>Fleet Survey Team</u> Automated Plot <u>N/A</u> Verification by <u>Annie Raymond</u> Evaluation By <u>Annie Raymond</u> Soundings in <u>Fathoms and Feet</u> at <u>MLLW</u>	
REMARKS: <u>Revisions and annotations appearing as endotes were generated during office processing.</u> <u>As a result, page numbering may be interrupted or non-sequential.</u> <u>All depths listed in this report are referenced to mean lower low water unless otherwise noted. UTM Zone 55N</u> 	

November 12, 2009

MEMORANDUM TO: Gary Nelson
Chief, Pacific Hydrographic Branch

FROM:  Annemieke Raymond
Physical Scientist, Pacific Hydrographic Branch
2009.11.12 15:35:59 -08'00'

SUBJECT: Review of Outside Source Data Surveys W00209
U.S. Naval Oceanographic Office (NAVOCEANO)
Tinian Harbor, Commonwealth of the Northern Mariana
Islands

I have reviewed outside source hydrographic surveys W00209 with regard to data integrity and completeness of the data submission package, survey field procedures, data processing and quality assurance methods, and overall data accuracy and data quality. Survey W00209 complies with specifications and requirements set forth in the NOS Hydrographic Surveys Specifications and Deliverables Manual.


Only minor deficiencies, regarding limited documentation for certain deliverables and procedures, were encountered during the survey acceptance review.

Refer to the Chart Comparison section of the Outside Source Data Quality Assurance Checklist for specific charting recommendations.

Final Recommendations:

- The bathymetry data should supersede charted depths in the survey area. Because the CUBE BASE surfaces do not honor the least depths of a number of the coral heads and rocks prevalent in the critical under-keel-clearance areas, the source of bathymetry for chart compilation should be the shoal layer of the uncertainty BASE surfaces, not the depth layer of the CUBE BASE surfaces.
- The charted shoreline should be updated per current NGS shoreline.

Reviewed and approved:


Crescent Moegling
Hydrographic Team Leader, PHB

Digitally signed by Crescent
Moegling
Reason: Reviewed and Approved
Date: 2009.11.12 13:49:12 -08'00'

Date: _____



Pacific Hydrographic Branch

Document #:

PHB-QA-03

Rev.:

1

Title:

HYDROGRAPHIC SURVEY OUTSIDE SOURCE DATA QUALITY ASSURANCE CHECKLIST

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Registry No: W00209

State: Commonwealth of the Northern Mariana Islands

General Locality: Tinian Island

Sub Locality: Tinian Harbor

Dates of Survey: 06/18/09

OSD Supplier: NAVO

OSD Project No: 09CQ02

Reviewer: Raymond

Review Date: 11/2/2009



I. DATA INVENTORY

A. Reports

Report Type	Format	Document Title	Date
Descriptive Report or equivalent	PDF	Tinian_ROS_ALL.pdf	June 2009
Data Acquisition and Processing Report or equivalent			
Horizontal and Vertical Control Report or equivalent			
System Certification Report or Equivalent			
Other			

B. Data

Data Type	Format	Description (Raw, Processed)
Smooth Sheet Sounding Plots	.des	Caris GIS files
XYZ ASCII Files	.txt	no header
Multibeam	HDCS	Processed
Side Scan Sonar	CFS	Processed
LIDAR	n/a	
Single Beam	HDCS	y



Title:

**HYDROGRAPHIC SURVEY OUTSIDE SOURCE DATA QUALITY ASSURANCE
CHECKLIST**

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Data Type	Format	Description (Raw, Processed)
Detached Position Point Feature	.pdf	listing of positioned AtoNs in survey report
Kinematic / Static GPS		
Sound Velocity	.svp	
Water Levels	.tid	predicted and observed
AWOIS	n/a	
DtoN	n/a	
Shoreline	.des	uncertain source
Bottom Sample	n/a	

 y All data open correctly and without error (MBES lines, SSS lines, VBES, Crosslines, Fieldsheets, Smooth Sheets, Sessions, DTM's, BASE grids, Mosaics, and DP's).

C. Sensors

List all sensor(s) that were used to acquire data.

Sensor	Manufacturer	System	Model	Vessel / Platform
Side Scan	Klein	3000		FST Swamp Fox
Singlebeam	Echotrac			FST Swamp Fox
Multibeam	Reson		7125	FST Swamp Fox
Motion	Applanix Corporation	POS/MV	320 v 4	FST Swamp Fox
CTD	Sea Bird	SBE	19 CT	
Positioning	NAVCOM	GPS	204	

 note 1 Are all sensors listed above capable of meeting NOAA HSSDM accuracy and object detection requirements? Provide information in the comments section.

Title:

HYDROGRAPHIC SURVEY OUTSIDE SOURCE DATA QUALITY ASSURANCE CHECKLIST

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II. DATA ACQUISITION AND PROCESSING

A. System Calibrations and/or Certifications

^y A sensor offset and alignment survey was conducted to NOAA HSSDM requirements

^y Offset values provided

^y Patch tests were conducted for shallow-water multibeam systems

^y Alignment bias and latency values provided

y Draft measurements were conducted

Static Draft ✓ Dynamic Draft Loading

y Draft values were provided

^y Sensors were calibrated in accordance with manufacturer requirements and NOAA specifications

some Calibration reports were provided.

B. Sound Velocity Corrections

^y Sound velocity sampling regimen is in accordance with NOAA HSSDM requirements

y Sound velocity profiles were supplied

^y All profiles appear valid

C. Water Levels

note 2 Water level measuring equipment and methods are consistent with NOAA equipment and methods and are capable of meeting specifications

Equipment / method used: In-Situ Mini Troll

y Tide corrector files were supplied


y All tide correctors appear valid

y Water level correctors applied to sounding data

Verified ☒ Observed Predicted NOAA Zoning Other zoning

ⁿ Water level error estimate provided by CO-OPS

Water level / zoning error estimate:

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E. Survey Methodology

- y The surveyor has conducted adequate quality control of horizontal positioning data
- note 3 DTM, BASE surface, and/or mosaics indicate that seafloor coverage requirements (per NOAA HSSDM) were met and no significant coverage holidays exist.
- y All least depths over shoals, wrecks, rocks, obstructions, and other features have been determined note 4
- y The Hydrographer has conducted the required quantity of cross lines, or acquired sufficient redundant data, in accordance with the HSSDM, to assess internal data consistency.

F. Data Processing and Quality Control

- note 5 An adequate description of data processing and quality control methods is provided in documentation.

Processing software used: See Report of Survey Appendix I
- y Data processing methodology is robust enough and adequate to provide a dataset suitable for charting.
- y Data have been reviewed and are cleaned appropriately with no noise, fliers, or systematic errors noted.
- y Crossline agreement or redundant data overlap has been visually inspected by the hydrographer
- n Disagreements have been noted
- y A Chart comparison was conducted by the hydrographer
- y Disagreements have been noted.
see note 7

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III. DATA QUALITY AND RESULTS

A. Internal Data Consistency


- y Full resolution data was provided in order to gauge the adequacy of cleaning and/or processing of the data.
- y A review of the data reveals no positioning errors exceeding NOAA specifications
- y Crossline agreement or redundant data overlap shows no disagreements exceeding NOAA HSSDM tolerances.
- n Anomalous data (fliers, noise, etc) were apparent in the BASE surface, DTM, and/or selected sounding set.
- n Are there any tide errors exceeding NOAA HSSDM requirements observable in the data
- n Are there any observable SV errors exceeding NOAA HSSDM accuracy standards.
- see note 4 All shoals are valid (no fliers) and the proper least depth has been retained.
- y Where multiple systems, platforms, and/or sensors were used, junctioning or overlapping data agree within NOAA HSSDM tolerance between platforms.
- y Any statistical assessment of the data (e.g. BASE standard deviation, QC reports, etc) indicate that data agree within NOAA HSSDM tolerances.

B. Error Budget Analysis

- y An error budget analysis was provided by the surveyor
- y The error budget analysis indicates that data are capable of meeting NOAA HSSDM standards
- y The evaluator concurs with the provided error budget analysis
- y The evaluator has conducted an error budget analysis
- y The error budget analysis indicates that data are capable of meeting NOAA HSSDM standards

D. Automated Wreck and Obstruction Information System (AWOIS) Items

- n/a AWOIS Items are located within the limits of the survey.
- AWOIS Items can be sufficiently confirmed or disproved using data from this survey (Attach AWOIS pages to the certification memorandum.).

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E. Dangers to Navigation


Dangers to Navigation (DTONs) were selected and submitted by the surveyor / data provider
 DTONs have been verified by the office evaluator.
 Additional DTONs were noted during office evaluation and submitted

F. Aids to Navigation

Aids to Navigation (ATONs) were positioned during this survey
 New ATONS were positioned during this survey
 Survey positions match charted positions
 The surveyor / data provider issued DTONs or notified the USCG for any ATON discrepancies
 ATON discrepancies were noted during office evaluation and submitted as DTONs.

G. Shoreline and Bottom Samples

The shoreline (MHW and/or MLLW lines) were included as part of this survey
 Surveyed shoreline matches charted shoreline
 Surveyed shoreline compares with NGS/RSD source data
 Surveyed shoreline should be used to revise nautical charts
 Shoreline features were positioned during this survey
 Surveyed features match charted shoreline
 Surveyed features compares with NGS/RSD source data
 Surveyed features should be used to revise nautical charts
 Bottom samples were acquired during this survey
 Bottom sample spacing was in accordance with NOAA HSSDM requirements
 Bottom samples should be used to update NOAA charts

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IV. COMMENTS

1. Primarily evaluated submitted Reson 7125 data capable of meeting NOAA HSSDM accuracy and object detection requirements. Full list of equipment used proved in the Report of Survey Appendix H
2. The data were submitted with NAVO-produced observed tides applied. These will be accepted as final tides. There are no significant tide errors observed in the data.
3. A linear holiday appears in the data near 14-57-48.37N 145-37-25.92E measuring 104m in length and 8m wide at largest point. Holiday is likely due to line spacing and outerbeam filtering. Review of the side scan data did not reveal any significant features in the area of the holiday.

In addition, the survey limits do not fully cover the charted harbor area or the channel. No explanation was given as to why this is the case. Due to the fact that the survey does not fully cover the harbor or channel, reviewer recommends retaining the May 2007 date on the harbor and channel depth notes.

4. MBES least depths were achieved, but the CUBE BASEs resulting from standard gridding specifications do not honor the least depths of a number of the rocks and coral heads prevalent in this survey area. Reviewer began designated soundings but after discussion it was determined that rather than using the depth layer from a CUBE BASE, the shoal layer from the uncertainty should be used as the bathymetry source for chart compilation. The multibeam data were very well cleaned by FST.


5. The Report of survey does not thoroughly describe data processing techniques, but the processing log does convey the processing workflow. Side scan data were acquired, but the side scan processing techniques were not documented in the ROS.

6. All the coordinates listed for Floating ATON's in Appendix D have a typo with regards to the degree of latitude. Positions should correctly read 14° N not 15° N.

7. A portion of shoreline was surveyed with NAVCOM 2040G GPS receiver. The surveyed shoreline and a larger portion of shoreline digitized and submitted with the survey are consistent with the multibeam data submitted and in agreement with shoreline downloaded from NOAA's Shoreline Data Explorer. The shoreline depicted on the ENC and RNC however are not in agreement with each other nor the shoreline files submitted with this survey and shoreline downloaded from NOAA's Shoreline Data Explorer.

Additional Notes:

The shoal layer of the following surface should be used for compilation: Q:\W00209\09CQ02_Tinian\caris_hips\fieldsheets\09CQ02\Tinian_MB\Office_uncertainty

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V. CHART COMPARISON

The majority of the survey falls within the channel and harbor limits depicted on the raster charts.

Affected charts

Chart	Scale	Edition	Date
81071	1:20,000	7	12/01/2004
US4SP05M		1	06/16/2008

Smooth Sheet Soundings

The surveyed area does not fully extend to the charted limits of the channel or harbor. Due to this, reviewer recommends retaining the May 2007 date for reported harbor and channel depths. Smooth sheet soundings generally agree with the charted controlling depths of 27 ft for the channel and 24 ft for the harbor with the exception of some shoaling present in the NW corner of the channel and SE portion of the harbor. Smooth sheet soundings in the NW corner of the channel generally agree with the currently charted soundings depicting the shoaling and reviewer recommends retaining soundings as charted. Within the harbor reviewer recommends removing the charted soundings greater than controlling depth of 24 feet (4 fathoms) with in the surveyed area and updating the soundings in the SE corner as depicted in the HCell.

Reported Obstructions

No new reported obstructions.

Charted Features

The shoreline depicted on the ENC and RNC are not in agreement with each other nor the shoreline files submitted with this survey and shoreline downloaded from NOAA's Shoreline Data Explorer (NGS). Multibeam data submitted is consistent with the shoreline files submitted and NGS shoreline. Recommend chart is updated with current shoreline from NGS.

New Features

No new features reported

REPORT OF SURVEY
TINIAN HARBOR AND CHANNEL
TINIAN ISLAND
COMMONWEALTH OF THE NORTHERN MARIANA ISLANDS
ARCHIVE # 09CQ02
MAY THROUGH JUNE 2009

Charles A. Baptiste
Hydrographer in Charge

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FLEET SURVEY TEAM
STENNIS SPACE CENTER, MISSISSIPPI

REPORT OF SURVEY
ARCHIVE # 09CQ02

Country:	Commonwealth of the Northern Mariana Islands
Area:	Tinian Harbor, Tinian Island
Date of Survey:	18 June
Archive #:	09CQ02
Chart:	NOAA 81071
Sailing Directions:	NGA PUB 126 Pacific Islands
World Port Index:	Unknown
Light List:	PUB 111
Horizontal Datum:	WGS 84
Projection:	Transverse Mercator
GRID:	Universal Transverse Mercator Central Meridian = 147°E UTM Zone 55N
Sounding Datum:	Mean Lower Low Water (MLLW)
Vertical Datum:	Mean Sea Level (MSL)

MEMORANDUM

From: Charles A. Baptiste, Hydrographer in Charge

To: Commanding Officer Fleet Survey Team

Via: Plans Department

SUBJ: INTERNATIONAL HYDROGRAPHIC ORGANIZATION SURVEY ORDER
RECOMMENDATION FOR SURVEY 09CQ02

1. Recommend that survey 09CQ02 be accepted as meeting International Hydrographic Organization (IHO) Order 1a survey standards in accordance with IHO Special Publication 44, 5th Edition dated February 2008. All data as noted in the following report meets or exceeds the requirements for IHO Order 1a Survey.



Charles A. Baptiste
Hydrographer in Charge

2. After reviewing survey 09CQ02, Fleet Survey Team Plans Department Quality Review Team concurs with above recommendation.



Mr. I. A. Fergusson
Plans Department Head

3. Concur with recommendation.



CDR R. R. DELGADO
Commanding Officer
Fleet Survey Team

Survey Team

Name	Qualification	Dates	Position
Charles A. Baptiste	Hydrographer M1	22 May – 30 June	Hydrographer in Charge
Jessica Burt	Hydrographer M1	22 May – 01 July	Hydrographer in Charge U/I
Barry Sysak	Hydrographer M2	7 June – 27 June	Hydro Lead
LT Kyle Baden	Hydrographer M2	7 June – 24 July	Hydrographer
AG3 Daniel Brashear	Hydrographer M2	7 June – 24 July	Hydrographer
AG3 Jason Herron	Hydrographer M2	7 June – 18 July	Hydrographer
Henry Stout	Electronic Technician	7 June – 27 June	Electronic Technician

STATISTICS

PRIMARY DATA COLLECTION	MILEAGE	REMARKS
Multibeam	14.6nm	
Singlebeam	14.6nm	
Side Scan	3.2nm	

DATA TYPE	GOOD	BAD	TOTAL	REMARKS
XBT Drops	0	0	0	
Bottom Samples	0	0	0	
CTD	3	0	3	
OPTICS	0	0	0	
WATER SAMPLES	0	0	0	
ADCP Points	0	0	0	
TIDAL DATA Stations	1	0	15 Days	

DATA DELIVERED	NUMBER	SCALE	REMARKS
Fully edited and validated multibeam dataset BASE surface	1	N/A	Delivered to NOAA for update of official chart

Action	NUMBER	REMARKS
Bathymetric Data Collection Days	1	On water days collecting data
Ancillary Data Collection Days	16	Tide Gauge Install, Collection, Removal
Days Lost to Bad Weather	0	Days when Bathy Data was not collected
Pre Collection / Post Collection Setup	0	
Total Days On Site	1	

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G	Vessel Setup and Calibration
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L	Crosscheck Analysis and Previous Survey Comparison
M	General Shoreline Photography
N	Weekly Narrative and Operational Timeline
O	Water Clarity Observations via Secchi Disk

1. **General**

1.1. **Requirements**: A detachment of the Fleet Survey Team (FST) conducted a hydrographic survey of Tinian Harbor and Channel to support a validated requirement approved by Commander, U.S. Seventh Fleet (C7F) and tasked by the Naval Meteorology and Oceanography Command.

1.2. **Survey Area and Objectives**: The area surveyed is within the territorial waters of the Commonwealth of the Northern Mariana Islands (CNMI). The survey main objective was to collect high-resolution, high-density multibeam and side scan sonar data that meet or exceed International Hydrographic Organization (IHO) Order 1a standards as defined in SP-44, 5th Edition, 2008. See ***Appendix A*** for coordinates, area graphic and a 3D coverage depiction.

1.3. **Elements Affecting Survey Operations**:

1.3.1. Weather: Weather conditions had negligible impact on survey operations. Warm temperatures, in the mid 80s, and moderate winds resulted in seas 1-3 feet for the one-day survey.

1.3.2. Local Elements: Port of Tinian has low shipping activity, resulting in minimal survey disruption.

1.3.3. Marine Elements: Marine elements did not influence operations.

2. **Datums and Geodetic Control**

2.1. **Datums**:

2.1.1. Horizontal Datum: World Geodetic System 1984 (WGS84).

2.1.2. Projection Grid: Universal Transverse Mercator (UTM) Zone 55 – North.

2.1.3. Vertical Datum: Mean Sea Level.

2.1.4. Sounding Datum: Mean Lower Low Water (MLLW).

2.2. **Geodetic Control**: This survey utilized a GPS system that received differential corrections via satellite. No geodetic control point was established or observed in Tinian.

2.3. **Station Description**: Not Applicable.

2.4. **Shoreline**: The team utilized a NAVCOM SF-2040G GPS receiver to position shoreline areas formed by fabricated construction, but areas of natural

shoreline and rock breakwaters were not surveyed. See *Appendix M* for a graphical depiction of surveyed area as compared to the DNC shoreline.

3. **Digital Surveying System**

3.1. Data Collection and Processing Systems: No significant hardware problems were encountered. *Appendix H* lists equipment utilized for this project.

3.2. Data Collection and Processing Software: No significant software problems were encountered. *Appendix I* list software utilized for this project.

3.3. Performance: On several occasions, the team suspended survey operations due to suspected heat-related problems with the collection computer or Reson computer.

4. **Side Scan Sonar**

4.1. Equipment: Klein 3000.

4.2. Confidence Check: No confidence check was performed to determine the sonars' ability to detect 2-meter cube objects.

4.3. Line Orientation and Spacing: Survey lines were oriented parallel to the channel and harbor boundaries, respectfully, and were spaced 60 meters. Sonar range scale was set to 75 meters.

5. **Calibrations**

5.1. Horizontal Positioning: The horizontal positioning system utilized on the vessel was a NAVCOM SF-2050M GPS system. To test static accuracy, the system was set up over geodetic point FST-TPG for seven hours. Results indicate an accuracy of 0.1m at 95% confidence. See *Appendix J* for additional information.

5.2. Motion Sensor: This survey employed a POS/MV 320 motion sensor system that is equipped with a GPS Azimuth Measurement Subsystem (GAMS) feature and Kalman filter. The GAMS feature improves heading data accuracies from a manufacturer-stated 0.25° RMS to 0.02° RMS after calibrations, which the team completed prior to commencement of data collection.

5.3. Multibeam Echosounder: Prior to sounding data collection, the team performed multibeam echosounder calibrations, which involved a patch test to determine position latency, roll bias, pitch bias and yaw bias values. Patch test results are provided in *Appendix G*. Additionally, the team performed lead line measurements to compare with nadir depth readings.

5.4. Survey Platform: Survey operations were performed onboard a 9-meter RHIB equipped with dual outboard motors capable of propelling the RHIB in excess of 30kts; however, vessel speed was limited between 3kts and 7kts for data collection operations. To account for transducer draft changes resulting from surveying at different speeds, the team performed a squat and settlement test utilizing a leveling instrument and a level rod which was placed next to the transducer mount. A shore team member read and recorded the level rod value with the vessel stationary and at various speeds. For each reading, another team member read the tide staff to account for tidal influences. The resulting draft corrections were entered into the draft section of the vessel configuration file that is part of the CARIS HIPS program. Results are provided in **Appendix G** as well as sensor offset measurements.

6. Bathymetry

6.1. Sounding Development:

6.1.1. Harbor: Development survey lines were oriented 90°/270° and spaced 15m. HYPACK 2008 data collection software was set to record all information received from each device. Multibeam sonar was set to output every ping; motion data output was limited to 20 times per second; gyro data output was limited to 10 times per second; and navigation data output was limited to 15 times per second. These settings were used for the duration of survey operations.

6.1.2. Channel: Development survey lines were oriented parallel to the channel boundary and spaced 15m. HYPACK 2008 was set to record data at the same settings established for collection of harbor data.

6.2. Sounding Selection: Sounding selection was performed with CARIS HIPS version 6.1, SP2. The program selected shoalest soundings based on a user-defined bin size of 1 meter and exported the selected soundings along with user-selected designated soundings into a CARIS map where additional suppression was performed through CARIS GIS 4.4a, SP5. Through each iteration of suppression, the program retained shoalest soundings while masking the other soundings. Rounding rule was set to the NOAA option for GIS and HIPS. Note: This routine utilized only for internal FST QC procedure as full resolution dataset provided to NOAA.

6.3. Crosscheck Lines:

6.3.1. Harbor: One crosscheck line was run in the harbor and was compared against a 50cm-resolution base surface. Results indicate that the data passes IHO Special Order and Order 1a standards for depth accuracy. See **Appendix L** for additional information.

6.3.2. Channel: Two crosscheck lines were run in the channel area and were compared against a 50cm-resolution. Results indicate that the data passes IHO Special Order and Order 1a standards for depth accuracy. See *Appendix L* for additional information.

6.4. Agreement with Existing Charts: NOAA Chart 81071 was referenced for data comparison. The chart indicates that the area surveyed had a minimal depth of 27 feet as of March 2001. Current survey data has the channel minimal depth at 29 feet and 27 feet for the harbor.

6.5. Agreement with Prior Surveys: The team does not have prior survey data to compare with current survey data.

6.6. Reports of Dangers/Hydrographic Notes: NOAA Chart 81071 shows that the channel is cleared to a depth of 28 feet and the harbor to 27 feet. 09CQ02 data supports this information.

7. Oceanography

7.1. CTD Stations: Three velocity profiles were taken in the survey area using a Sea Bird SBE 19 CTD. Locations varied spatially and temporally. From a spatial perspective, casts were taken in proximity of multibeam data collection areas for that day. Temporally, the casts were taken at the beginning, middle and end of the survey period for that day. See *Appendix K* for a graphical representation of cast locations and a plot of the sound velocity profiles recorded.

7.2. Oceanographic Parameters: No additional oceanographic parameters were collected.

7.3. ADCP: No system was deployed.

8. Sailing Directions and Nomenclature

8.1. Sailing Direction Changes: No changes to the current information published in NGA Pub. 126 or NOAA Coast Pilot 7 were required.

8.2. Prominent Features: Prominent features descriptions in Coast Pilot 7 are accurate.

8.3. Warnings and Cautions: Warnings and cautions stated on NOAA Chart 81071 and in Coast Pilot 7 remain applicable.

8.4. Anchorage Area: The team did not confer with Tinian Port Authority officials concerning anchorage areas.

8.5. Photography: An aerial photograph of Tinian Harbor found on the internet and buoy pictures that include coastline in the background can be seen in *Appendix M*.

9. **Tides, Tide Gauges and Sounding Datum**

9.1. Tide Gauge Location: The tide gauge was installed on a small pier located in the inner portion of the harbor where small boats are docked. See *Appendix F* for locations and photographs.

9.2. Tide Gauge Comparison: The team did not observe tide staff readings.

9.3. Tide Gauge Type: In-Situ Mini Troll.

9.4. Tide Gauge Malfunctions: The tide gauge remained operational for the entire collection period.

9.5. Standard Port: Guam.

10. **Tidal Streams and Currents**

10.1. Tidal Streams and Currents: Tidal streams and currents were not observed.

11. **Seabed Topography and Texture**

11.1. Seabed Topography and Texture: No bottom samples were collected in Tinian.

11.2. Sonar Trace Interpretation: All data was collected digitally.

11.3. Dredging Activities: No dredging activity was noted during the survey period.

11.4. Previous Survey Comparison: Not applicable.

12. **Charted and Uncharted Wrecks and Obstructions**

12.1. Charted Wrecks and Obstructions: Chart 81071 does not depict any wrecks or obstructions within the area surveyed.

12.2. Uncharted Wrecks and Obstructions: Side scan operations was conducted in the channel and harbor areas and identified numerous rock, pinnacle and coral head contacts. However, these contacts do not rise above the controlling channel depth of 27 feet stated on NOAA Chart 81071, with the exception of the channel fringes.

12.3. Wrecks and Obstructions Least Depth: Least depth for all obstructions was determined from multibeam data. See *Appendix C* for more information.

13. **Charted and Uncharted Lights, NAVAIDs, Buoys and Piers**

13.1. Light Characteristics: Light characteristics were not verified. See *Appendix D*.

13.2. Uncharted/New Lights: No new lights were observed.

13.3. Fixed NAVAIDs: Fixed NAVAIDs on land and delineated shoreline were positioned with the NAVCOM SF-2040G GPS receiver. The mobile antenna was placed as close as possible to the center of each NAVAID before observing its position. Characteristics of each NAVAID, such as type of structure, color, color of light, type of light, period of light, height, etc. were collected. For piers, wharves and other shoreline areas, the mobile antenna was moved to the corners of man-made structures. See *Appendix D* for fixed NAVAID positions, descriptions and photos.

13.4. Floating NAVAIDs: Floating NAVAIDs located in water deep enough for the survey launch were positioned with the NAVCOM SF-2050M GPS Receiver. The boat maneuvered alongside each buoy and recorded each position using HYPACK software. The NAVCOM SF-2040G GPS receiver was also used for positioning floating NAVAIDs. The mobile antenna was placed as close as possible to the center of each NAVAID before recording its position. Characteristics of the floating NAVAIDs were also logged. See *Appendix D* for floating NAVAID positions, descriptions and photos.

13.5. Charted NAVAIDs: All of the Charted NAVAIDs in the Tinian Harbor Channel area on NOAA Chart 81071 were accurate. However, the light characteristics could not be verified. The Tinian Harbor survey was done in the daytime after a 1.5 hour transit from Tanapag Harbor on Saipan Island. Due to safety concerns of transiting at night the survey team began their return to Saipan before sunset and the lights were not observed. See *Appendix D* for NAVAID positions, descriptions and photos.

13.6. Uncharted NAVAIDs: There were no new uncharted NAVAIDS observed in the Tinian Harbor and channel area.

14. **Coastline, Topography, and Conspicuous Objects**

14.1. Coastline Positioning: The team used the NAVCOM SF-2040G GPS receiver to position manmade harbor inflection points. Neither areas of natural shoreline nor breakwater areas were positioned. See *Appendix M* for a graphical representation of areas positioned.

14.2. Conspicuous Objects: There were no objects to report.

15. **Ancillary Observations**

15.1. Water Clarity Observations: No water clarity observations performed.

15.2. Biological Observations: No scientific observations were conducted.

16. **Accuracy of Soundings**

16.1 Total Vertical Uncertainty: CARIS HIPs 6.1 SP2 was used to generate an uncertainty surface from the final 09CQ02 multibeam dataset. Total Propagated Error (TPE) values from the manufacturers' technical specifications for the various devices were entered into the vessel configuration file and the "Compute TPE" function was utilized. The minimum uncertainty was 0.183 meter and the maximum uncertainty was 0.258 meter. The allowable vertical uncertainty to meet IHO order 1a in this depth of water is 0.52 meter.

17. **Positional Accuracy**

17.1. Vessel Reference Point and Offsets: All offsets are referenced to the IMU, which is located near the vessel's center of gravity. Offset measurements were made using a steel tape. See *Appendix G* for additional information.

17.2. Establishment of Reference Point: From the manufacturer's vessel drawings and center of gravity marks located on either side of the vessel cabin, the IMU was placed in close proximity to vessel centerline and inline with the center of gravity marks.

17.3. Positional Accuracy: A NAVCOM SF-2050M GPS system was utilized as the positioning system on the RHIB throughout this survey. A static test was performed to evaluate system accuracy. Results indicated an accuracy of 0.1 meter at the 95% confidence level.

18. **Weekly Summary**

18.1 Weekly Summary: Excluding the tide gauge installation on 03 June, 09CQ02 was a one-day survey, 18 June. The team leveled-out and removed the tide gauge prior to departing Tinian and positioned NAVAIDS in the channel but did not observe NAVAIDS' light characteristics.

19. **Summary/Closing Remarks**

The main purposes of SURVOP 09CQ02 were to collect high-resolution, high-density multibeam and side scan sonar data in the vicinity of Tinian Port, Tinian. These objectives were accomplished in the boundary limits as defined on NOAA Chart 81071 for the channel and harbor areas. Survey data depth accuracy meets IHO Special Order requirements for the harbor and channel areas.

The survey team would like to thank the Port Authority of the Commonwealth of the Northern Mariana Islands for its outstanding support during this SURVOP and especially Ms. MaryAnn Lizama for her assistance with our efforts.

09CQ02

Tinian Harbor, Tinian Island

Appendix A:

Survey Area Coordinates and Graphics

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DISTRIBUTION STATEMENT A:

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Tinian Harbor and Channel, Tinian Island	
Latitude	Longitude
14-57-11 N	145-37-25 E
14-57-27 N	145-37-35 E
14-57-47 N	145-37-28 E
14-57-58 N	145-37-07 E
14-57-59 N	145-37-03 E
14-57-48 N	145-37-01 E
14-57-42 N	145-37-22 E
14-57-31 N	145-37-27 E
14-57-16 N	145-41-17 E

Table A-1: Coordinates of Survey Area.

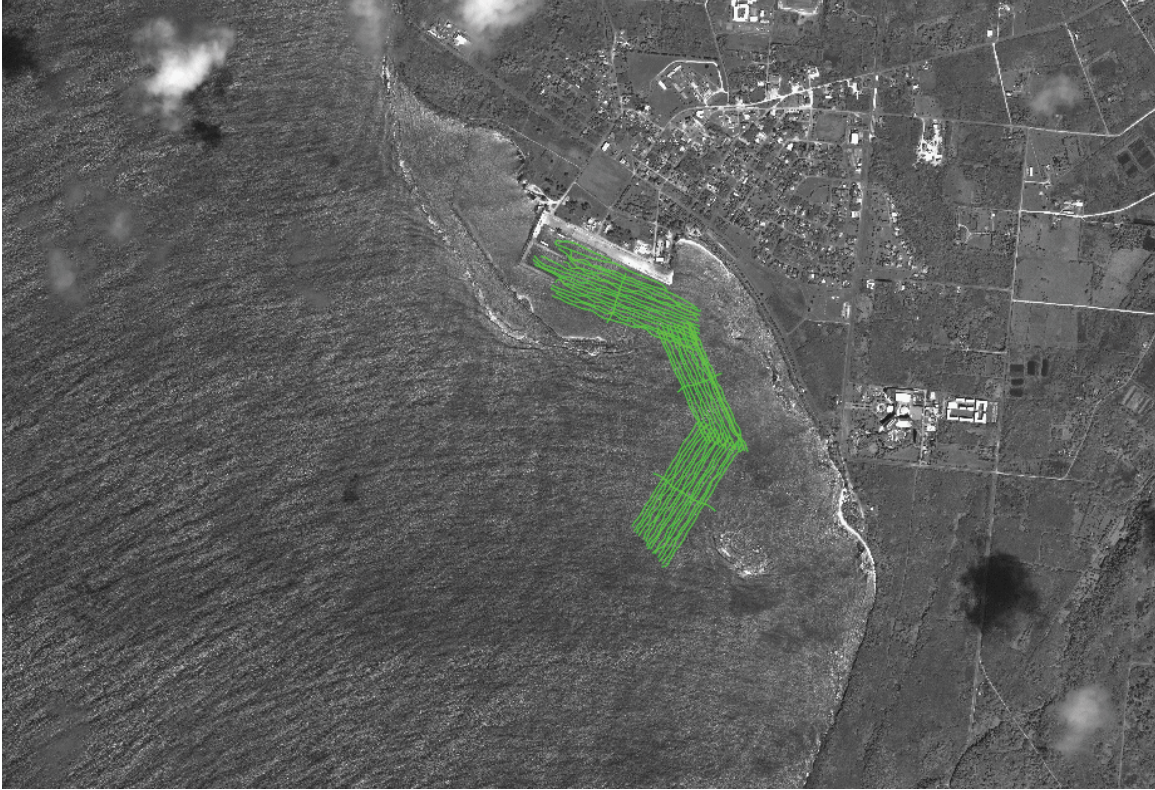


Figure A-1: Survey lines

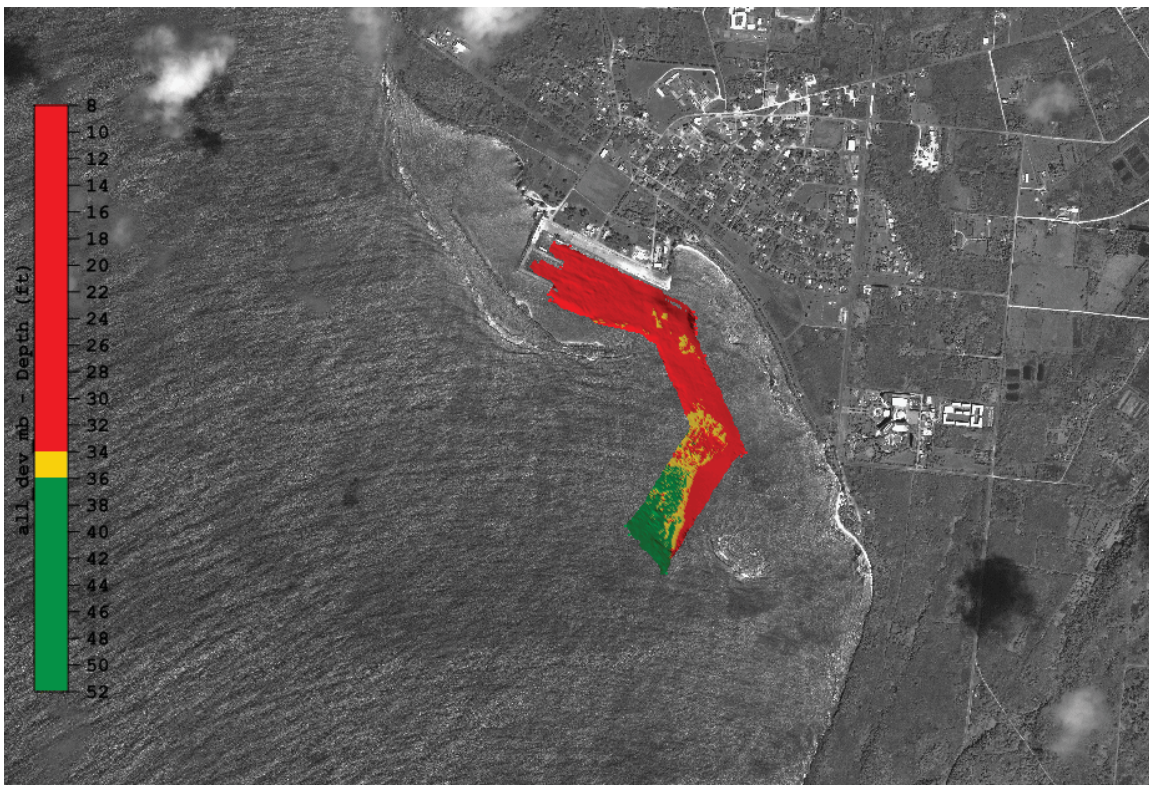


Figure A-2: Image of Actual Data Collected.

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Tinian Harbor, Tinian Island

Appendix B:

Daily Weather Log

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DISTRIBUTION STATEMENT A:

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WEATHER													
MONTH	DAY	SKY	WEATHER	VISIBILITY NM	PRESSURE		TEMPERATURE		RELATIVE HUMIDITY		WIND		SEAS FT
					LOW	HIGH	LOW	HIGH	HIGH	LOW	DIRECTION	SPEED	
					INCHES	INCHES	° F	° F	%	%		KNOTS	
	18	Partly Cloudy	Few	10	29.68	29.74	79	86	90	65	E	11	2

09CQ02

Tinian Harbor, Tinian Island

Appendix C:

Contacts

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DISTRIBUTION STATEMENT A:

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No contacts shoaler than the charted controlling depths of 27 feet for the harbor and 28 feet for the channel were found.

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Tinian Harbor, Tinian Island

Appendix D:

Navigation Aids Log and Photographs

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DISTRIBUTION STATEMENT A:

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REPORT OF SURVEY, APPENDIX D

09CQ02

FIXED AIDS TO NAVIGATION											
NGA Publication 111 - List of Lights - 2008						Observed					
Light No.		Name & Location		Position		GPS Position		Remarks			
				Latitude	Longitude	Latitude	Longitude				
10962 F 8370		Sunharon Roads Channel Light No. '5', corner of pier		14° 57.9' N	145° 37.5' E			Column, Green Triangular Daymark		Not Observed	Not Observed
								4 NM	12 ft 4 m	Fl. G. period 4s	Green Light Fixture on Pole with Green Triangular Daymark marked '5', located on South corner of wharf

Red = Change from NOAA Chart 81071, NGA DNC 12 and/or NGA List of Lights

FLOATING AIDS TO NAVIGATION								
Buoy Type	Marked with	GPS Position		Color	Light Characteristic	Topmark	Photo #	Remarks
		Latitude	Longitude					
Pillar Buoy	'1'	15° 57' 14.056" N	145° 37' 23.840" E	Green	Not Observed	None	2782	Light Characteristics Not Observed due to 1 day survey conducted during daytime, no opportunity for night operations
Pillar Buoy	'2'	15° 57' 24.405" N	145° 37' 21.793" E	Red	Not Observed	None	2787	"
Spherical Buoy	-	Not Positioned	Not Positioned	Orange	None	None	2781	Buoy lies southward of line between buoys '1' and '3' on the South side of channel marking a reef
Pillar Buoy	'3'	15° 57' 29.025" N	145° 37' 34.380" E	Green	Not Observed	None	2778	Light Characteristics Not Observed due to 1 day survey conducted during daytime, no opportunity for night operations
Pillar Buoy	'4'	15° 57' 32.899" N	145° 37' 27.384" E	Red	Not Observed	None	2774	"
Can Buoy	'6'	15° 57' 41.292" N	145° 37' 22.949" E	Red	None	None	2772	N/A

Red = Change from NOAA Chart 81071 and/or NGA DNC 12



Photo D-1: Pillar Buoy '1'

Location: 15° 57' 14.056" N 145° 37' 23.840" E

Color: Green

Light: Not Observed

Topmark: None



Photo D-2: Pillar Buoy '2'

Location: 15° 57' 24.405" N 145° 37' 21.793" E

Color: Red

Light: Not Observed

Topmark: None



Photo D-3: Pillar Buoy '3'

Location: 15° 57' 29.025" N 145° 37' 34.380" E

Color: Green

Light: Not Observed

Topmark: None



Photo D-4: Pillar Buoy '4'

Location: 15° 57' 32.899" N 145° 37' 27.384" E

Color: Red

Light: Not Observed

Topmark: None



Photo D-5: Light '5'

Location: Not observed

Color: Green

Light: Not Observed

Daymark: Green Triangle marked '5'



Photo D-6: Can Buoy '6'

Location: 15° 57' 41.292" N 145° 37' 22.949" E

Color: Red

Light: None

Topmark: None



Photo D-7: Spherical Buoy
Location: Not Observed
Color: Orange
Light: None
Topmark: None

09CQ02

Tinian Harbor, Tinian Island

Appendix E:

Bottom Sample Locations, Station Sheet and Analysis Results

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DISTRIBUTION STATEMENT A:

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No bottom samples were collected.

09CQ02

Tinian Harbor, Tinian

Appendix F:

Tide Station Descriptive Report

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DISTRIBUTION STATEMENT A:

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FLEET SURVEY TEAM**TIDE STATION - DESCRIPTION
INSTALLATION - LEVELING RECORD**

Country: Commonwealth of the Northern Mariana Islands, USA
Tinian Island

Specific Location: Tinian Harbor

Vessel: FST Swamp Fox

HIC: Charles A. Baptiste

Date: _____

Station Number: Tinian Harbor Tide Gauge

09CQ02

ARCHIVE NUMBER

0691-LL-000-3605

NAVOCEANO 3140/68 (07-00)

BENCH MARK LABELING

Bench mark disks should be stamped with steel dies, using a ten-digit IHO Identification Number, the Year of Installation and a Bench mark number BM1, BM2, etc. The IHO Number is constructed as follows:

Q	LATITUDE	LONGITUDE
#	DDMM	DDMM

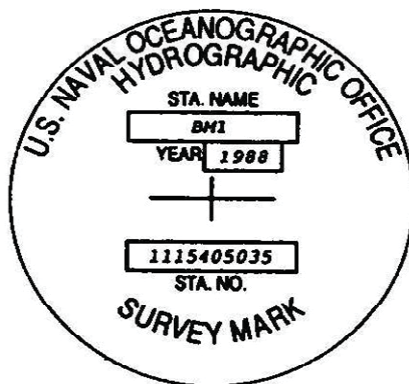
Where Q is the quadrant of the world,

- 1 for North-East
- 2 for North-West
- 3 for South-West
- 4 for South-East

LATITUDE in degrees-minutes
LONGITUDE in degrees-minutes

The values of minutes of a degree should be rounded to the nearest minute. Marks without disks should have their Identification Numbers etched in concrete while it is still wet.

EXAMPLE BENCH MARK DISK



NOTE: "1115405035 1988 BM1"
WOULD BE STAMPED IN THE FIELD
FOR N11°54' E050°35'

"C" CHECK INSTRUCTIONS

Place rods approximately 100m apart with the instrument setups about 10m from each point. Record rod readings to three decimal points for all three wires, if the difference is greater than 0.003m, reobserve. Determine the mean centerwire reading to four decimal places and sum the intervals for each observation. Multiply the sum interval for each foresight times 100 (stadia interval factor) to determine the shot length in meters. Use this distance to find the rod corrections in Table 1 for each foresight. Use the formula below to calculate the value of "C" to four decimals. Values greater than ± 0.004 require instrument adjustment.

$$\text{"C"} = \frac{(\text{sum of BS means} - \text{sum of corrected FS means})}{(\text{sum of FS intervals} - \text{sum of BS intervals})}$$

DISTANCE METERS	CORRECTION TO ROD IN METERS
0 to 27	0.0000
28 to 47	-0.0001
48 to 60	-0.0002
61 to 72	-0.0003
73 to 81	-0.0004
82 to 90	-0.0005
91 to 98	-0.0006
99 to 105	-0.0007

TABLE 1

LEVELING INSTRUCTIONS

- 1) Make all entries in ball point pen.
- 2) Record wire readings to three decimal places.
- 3) Always start a level run with the tide staff as the first backsight.
- 4) Pace all distances between rod placements before setting up the instrument. Balance all foresight and backsight distances (shots). Keep the total foresight and backsight distances within 10 meters. The maximum shot distance should not exceed 90 meters. The same person should pace all the distances for a level run and know the length of his/her pace before starting.
- 5) Individual unbalanced shots can be corrected by algebraically adding the collimation and curvature corrections to the observed height difference between turning points.
 - a) The collimation correction is determined using the formula:
 Coll. Corr. = "C"(Sum F.S. Intervals - Sum B.S. Intervals)
 For a lengthened foresight where:
 C = "C" Check value (Instrument collimation error)
 - b) Curvature corrections ® are computed using the formula:

$$r = -(\Delta s^2/d)$$

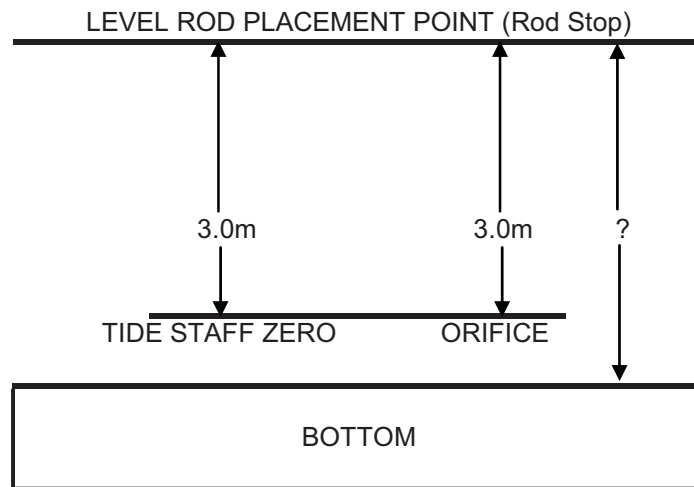
Where: Δs = The distance of the shot imbalance in meters

$d = 12,756,000\text{m}$ the diameter of the earth.

- 6) Subtract the total elevation difference for the forward run from the reverse run to determine the error of closure (E.C.). Calculate the allowable error (A.E.) with the following formula:

$$\text{A.E.} = \pm 0.012\text{m} \sqrt{k} \text{ where } k \text{ is the distance in kilometers of the shortest leg of the transit.}$$

TIDE STATION REPORT			
STATION NAME: Tinian Harbor		STATION #: N/A	
STATION LOCATION: Tinian Harbor, Tinian Island, CNMI	LATITUDE: 14° 58' 02" N	LONGITUDE: 145° 37' 05" E	TIME ZONE: UTC +10hr
INSTALLED BY: Naval Oceanographic Office / Fleet Survey Team (FST) Charles A. Baptiste, Jessica Burt		TIME:	DATE: 04 Jun 2009
GAUGE TYPE/MANUFACTURER: Mini-Troll / In-Situ	SERIAL # 08814	RANGE/SCALE: 3.5m	
BRIEF DESCRIPTION OF GAUGE SHELTER/SECUREMENT: The gauge was secured to the 2" x 10" wooden plank tide staff with 2 rubber insulated stainless steel clamps. Zip ties secured the gauge cable approximately every 0.5m to the plank. Three 1m graduated plates were screwed onto the board. The board was then bolted to the concrete pier with 2 anchor bolts.		POSTED NOTICE (Y / N) N	
TIDE STAFF, PRECISE LOCATION, METHOD OF SECUREMENT, TYPE OF STAFF DESCRIPTION OF ROD STOP AND ADDITIONAL REMARKS: The Tide Gauge/Staff was located in the Northwest corner of the Tinian Harbor facility. It was secured directly across from the floating dock at the small craft harbor on a small concrete pier extending out from a concrete wharf.			
LIMITS OF STAFF GRADUATIONS 0.0m - 3.0m Staff, 1cm graduations		POSITION OF RODSTOP Screw set into 2" x 10" wooden plank Tide Staff 3.0m above the Orifice of the Tide Gauge	
DATE OF LEVELS TO TIDE STAFF Leveled In, 03 Jun 2009 Leveled Out 24, Jun 2009		CONNECTED TO LOCAL DATUM (Y / N) Y	
NO. OF MARKS CONNECTED 3		NO. OF MARKS ESTABLISHED 1 Rod Stop on Staff, 2 Bench Marks (BM's 2 & 3)	
NO. OF MARKS RECOVERED Steel Bolt on flagpole brace used for 3rd Bench Mark (BM3)		DATES OF OTHER LEVEL RUNS N/A	
REMARKS ON LEVELING 3 BM's were used to tie in the Tide Gauge Orifice			
ADDITIONAL INFORMATION			

MEASUREMENTS**INSTALLATION SKETCH**

DESCRIPTION OF BENCH MARK - BM1

- 1. B.M. No.:** BM1
- 2. Established by:** Fleet Survey Team (FST)
- Date:** 03 Jun 2009
- 3. Recovered by:** N/A
- 4. Type of mark:** Round Head Stainless Steel Bolt, 15mm (9/16") in diameter epoxy glued into the concrete wharf deck.
- 5. How stamped:** No Stamp, Round Stainless Steel Bolt Head Only. However, there are markings in the concrete surface relating to another mark beside the FST Bench Mark. The etchings are: F. P. A. & P. I. B. and 8 - 6 - 07
- 6. Location and Detailed Description:** BM1 is located in the Northwest corner of the main wharf at the small craft harbor and is set almost flush near the edge of the wharf deck. See graphic.

Photos



DESCRIPTION OF BENCH MARK - BM2

1. **B.M. No.:** BM2
2. **Established by:** Fleet Survey Team (FST)
Date: 03 Jun 2009
3. **Recovered by:** N/A
4. **Type of mark:** Round Head Stainless Steel Bolt, 15mm (9/16") in diameter epoxy glued into a fence post concrete base.
5. **How Stamped:** There are no markings on the bolt or concrete, Round Head Stainless Steel Bolt Only.
6. **Location and Detailed Description:** BM2 is located in the concrete base of the 6th chain link fence post from the gate that enters into the Saipan Express Ferry berth / commercial port. Start counting from the post that holds the gate and move Northwest towards the small craft harbor on the outside of the fence. See graphic.

PICTURES

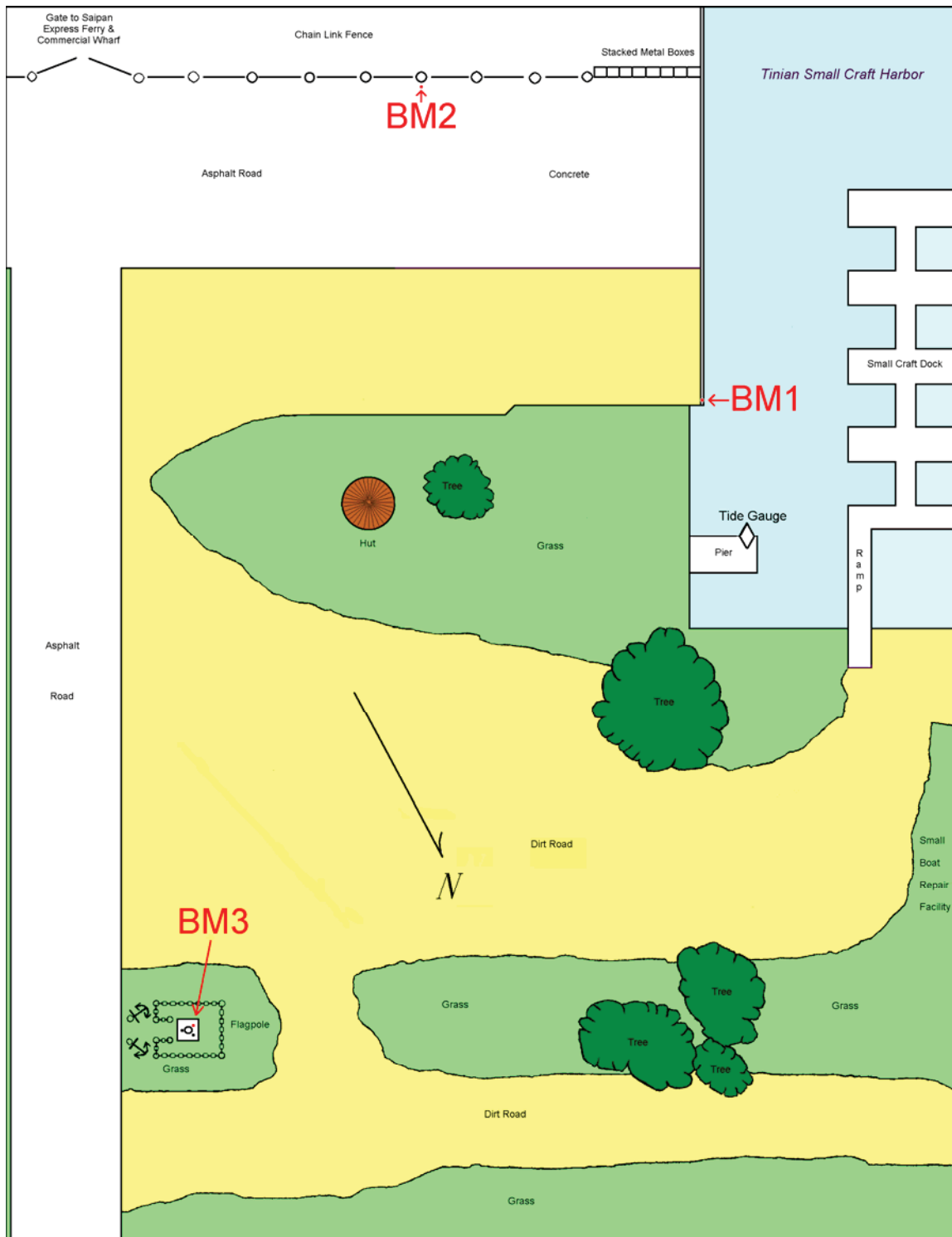


DESCRIPTION OF BENCH MARK - BM3

1. **B.M. No.:** BM3
2. **Established by:** Fleet Survey Team (FST)
Date: 03 Jun 2009
3. **Recovered by:** N/A
4. **Type of Mark:** Inverted (threads up) Steel Bolt painted Red securing flagpole brace.
There are 3 red Bolts on the red bracket securing the flagpole to the concrete base, BM3 is
the Bolt closest to the chain link fence that surrounds the ferry berth / commercial harbor
area.
5. **How Stamped:** The Bolt is not stamped, 'FST BM' with an arrow pointing to the Bolt is
written in indelible ink on the aluminum flagpole above BM3.
6. **Location and Detailed Description:** The flagpole and BM3 are located approximately
55 meters Northeast of BM2 in a small memorial surrounded by a heavy metal chain. There
are 2 large anchors in front of the chains and the monument is in a grassy patch with small
palm trees between dirt roads. See graphic.

PICTURES





Graphic F-1: Bench mark locations in Tinian Harbor, Tinian.

Level-In, C-Check

Tinian Harbor, Tinian Island, Commonwealth of the Northern Mariana Islands (CNMI)

"C" CHECK										"C" CHECK				
TOPCON 486357		Date:		5/22/09 UTC, 5/23/09 Local		Observer:		J. Burt		Recorder:		J. Burt		
Partly Cloudy		Time:		23:00 UTC, 09:00 Local		Rodman:		C. Baptiste		Int. X 100		Distance in meters		
	BACKSIGHT	MEAN	INTERVAL	SUM OF INT	REMARKS	FORESIGHT	MEAN	INTERVAL	SUM OF INT	DISTANCE	CORR.			
	1.570		0.050			2.085		0.450						
A	1.520	1.5200		0.100		1.635	1.6350		0.900	90.000	-0.0005			
	1.470		0.050			1.185		0.450						
	1.484		0.051			1.770		0.445						
B	1.433	1.4330		0.102		1.325	1.3233		0.895	89.500	-0.0005			
	1.382		0.051			0.875		0.450						
A =		2.9530		B =		0.202		C =		2.9583		D =		
										1.795		E =		
												-0.001		

$$"C" = \frac{A - (C + E)}{D - B}$$

"C" MUST BE LESS THAN ± 0.004 0.002720234 < 0.004 PASS

"C" = -0.00272023

Level-Out

THREE WIRE LEVELING					THREE WIRE LEVELING				
Project:	09CQ02	Location:	Tinian Hbr, Tinian Is.	Observer:	Barry Sysak	Recorder:	Jessica Burt		
Date:	6/18/2009	Time:	1200 L 0200 UTC	Rodman:	Charles Baptiste	Instr #:	Topcon 486357		
From:	Rod Stop	To:	BM3	Weather:	Hot, Humid, Scattered Clouds				
STATION		BACKSIGHT	MEAN	INTERVAL	SUM OF INT	MEAN	INTERVAL	SUM OF INT	REMARKS
Rod Stop		1.294		0.038			0.032		
TO		1.256	1.2560		0.076	0.7767		0.065	
BM1		1.218		0.038			0.033		
			1.2560		0.076	0.7767		0.065	
BM1		1.299							
TO		1.242	1.2420	0.057			0.067		
BM2		1.185		0.057	0.114	1.6273	0.066	0.133	
			2.4980		0.190	2.4040		0.198	
BM2		1.479		0.114			0.133		
TO		1.365	1.3650		0.228	1.1070		0.266	
BM3		1.251		0.114			0.133		
			3.8630		0.418	3.5110		0.464	
B.S. MEAN		3.8630							F.S. INTERVAL
-F.S. MEAN		3.5110							B.S. INTERVAL
Δ ELEVATION		0.3520	= FDE			F DIST. (Meters)		88.200	100=TRANSIT LENGTH
FOR FORWARD RUN						F DIST (Km)		0.0882	
			FDE =	0.3520					
			BDE =	-0.3523		A.E.	0.003564	PASS	
			EC =	0.0003					

09CQ02

Tinian Harbor, Tinian Island

Appendix G:

Vessel Setup and Calibration

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DISTRIBUTION STATEMENT A:

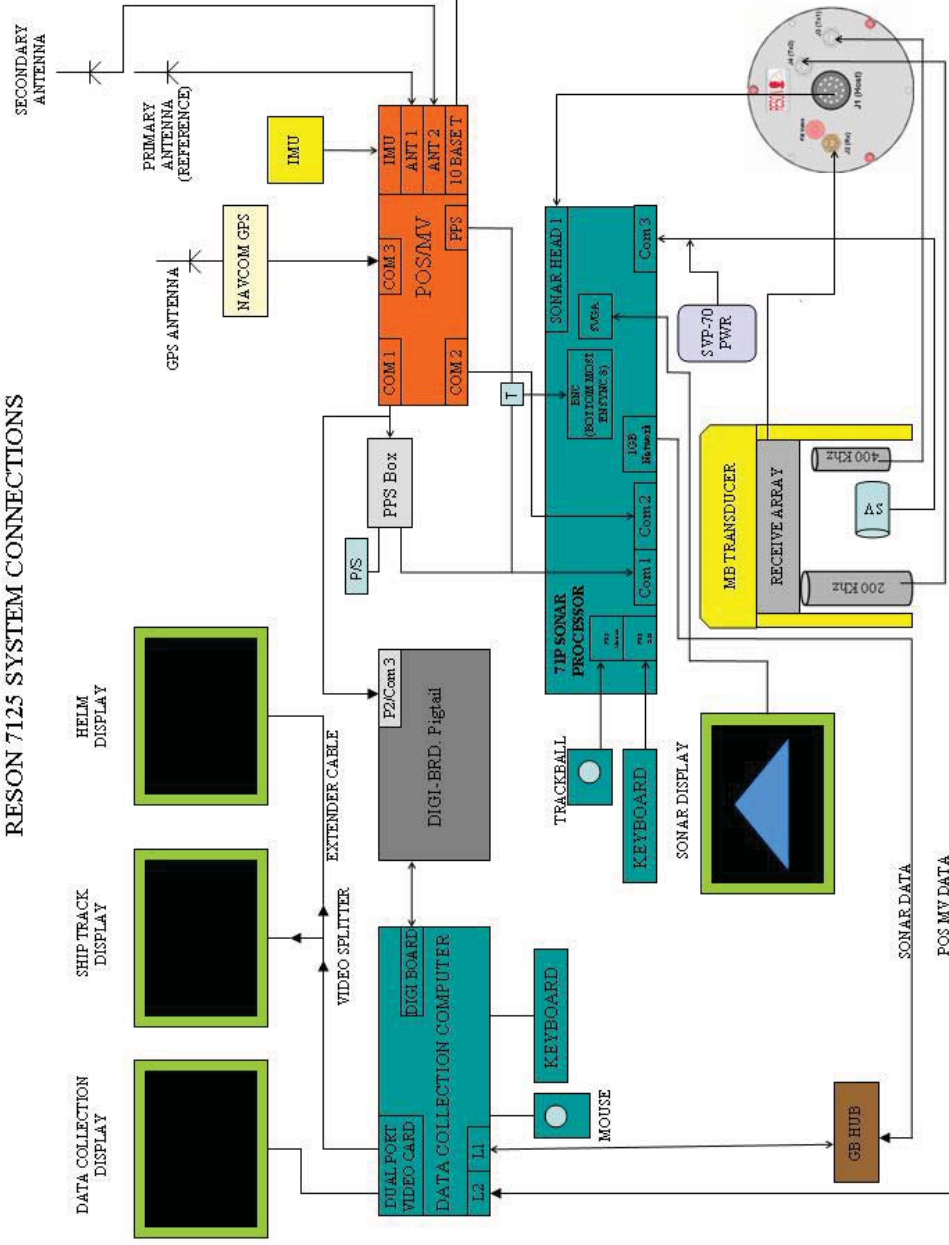
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VESSEL OFFSETS			
Field Unit: FST Vessel, Swamp Fox (fst001)			
Offset Reference Point (0,0,0): IMU			
Offset Calculation Method: Manual with Tape Measure			
Tabulated Data			
Position	Offset		
	X	Y	Z
POSMV Configuration	+ forward	+ starboard	+ down
Ref. to IMU Lever Arm	0.000	0.000	0.000
Ref. to Primary (Port) GPS Lever Arm	-0.153	-1.069	-2.681
Ref. to Aux. 1 GPS Lever Arm	-0.153	-0.063	-2.689
Vessel Configuration - Caris	+ starboard	+ forward	+ down
Transducer Acoustic Center	-1.722	-0.615	1.095
Note: All distance units are in meters (m).			
Graphic			

PATCH TEST ANALYSIS 19 JUNE 2009							
Field Unit:		FST Vessel, Swamp Fox					
Software Used:		Caris HIPS & SIPS version 6.1					
Patch Test Conducted By:				Jessica Burt, HIC/UI			
Patch Test Reviewed By:				Charles A. Baptiste, HIC			
Latency							
Line		Speed	Heading	Calibration Offsets		Average	Standard
Set	File	(KTS)	(Deg)	(Seconds)			Deviation
1-1	006_0800	3.0	145	-0.04		-0.04	N/A
1-2	006_0804	7.0	145				
Pitch							
Line		Speed	Heading	Calibration Offsets		Average	Standard
Set	File	(KTS)	(Deg)	(Degrees)			Deviation
1-1	006_0803	7.0	325	1.5		1.50	N/A
1-2	006_0804	7.0	145				
Roll							
Line		Speed	Heading	Calibration Offsets		Average	Standard
Set	File	(KTS)	(Deg)	(Degrees)			Deviation
1-1	006_0803	7.0	325	-1.35		-1.35	N/A
1-2	006_0804	7.0	145				
Yaw							
Line		Speed	Heading	Calibration Offsets		Average	Standard
Set	File	(KTS)	(Deg)	(Degrees)			Deviation
1-1	006_0746	3.0	325	0.5	---	0.50	N/A
1-2	005_0740	3.0	145				

DYNAMIC DRAFT DATA							
Field Unit:		FST Vessel, Swamp Fox					
Tabulated Data							
Vessel Speed		Level Reading	Tide Reading	Corrected Level	Difference of Levels	Avg. Vessel Speed	
kts	m/s					m/s	Level
0.0	0.000	3.30	0.57	3.300	---	0.0	3.300
4.0	2.058	3.32	0.56	3.310	0.000	2.058	3.310
4.0	2.058	3.32	0.56	3.310			
6.0	3.087	3.33	0.56	3.320	0.010	3.087	3.330
6.0	3.087	3.34	0.56	3.330			
8.0	4.116	3.39	0.54	3.360	0.020	4.116	3.370
8.0	4.116	3.42	0.53	3.380			
0.0	0.000	3.35	0.53	3.310	---	0.0	3.310
Note: All Level measurements are in Meters.							

RESON 7125 SYSTEM CONNECTIONS



Vessel Name: Swamp_Fox_7125_MB.hvf
Vessel created: July 07, 2009

Depth Sensor:

Sensor Class: Swath
Time Stamp: 2009-169 00:00

Transducer #1:

Pitch Offset: 1.500
Roll Offset: -1.350
Azimuth Offset: 0.500

DeltaX: -1.722
DeltaY: -0.615
DeltaZ: 1.095

Manufacturer:
Model: sb7125d
Serial Number:

Navigation Sensor:

Time Stamp: 2009-169 00:00

Comments

Latency -0.040

DeltaX: 0.000
DeltaY: 0.000
DeltaZ: 0.000

Manufacturer:
Model:
Serial Number:

Gyro Sensor:

Time Stamp: 2009-161 00:00

Comments

Latency 0.000

Heave Sensor:

Time Stamp: 2009-161 00:00

Comments

Apply Yes

Latency 0.000

DeltaX: 0.000

DeltaY: 0.000

DeltaZ: 0.000

Offset: 0.000

Manufacturer: (null)

Model: (null)

Serial Number: (null)

Pitch Sensor:

Time Stamp: 2009-161 00:00

Comments

Apply Yes

Latency 0.000

Pitch offset: 0.000

Manufacturer: (null)

Model: (null)

Serial Number: (null)

Roll Sensor:

Time Stamp: 2009-161 00:00

Comments

Apply Yes

Latency 0.000

Roll offset: 0.000

Manufacturer: (null)

Model: (null)

Serial Number: (null)

Draft Sensor:

Time Stamp: 2009-161 00:00

Apply Yes

Comments (null)

Entry 1) Draft: 3.300 Speed: 0.000

Entry 2) Draft: 3.310 Speed: 4.000

Entry 3) Draft: 3.320 Speed: 6.000

Entry 4) Draft: 3.370 Speed: 8.000

TPE

Time Stamp: 2009-161 00:00

Comments

Offsets

Motion sensing unit to the transducer 1

X Head 1 -1.722

Y Head 1 -0.615

Z Head 1 1.095

Motion sensing unit to the transducer 2

X Head 2 0.000

Y Head 2 0.000

Z Head 2 0.000

Navigation antenna to the transducer 1

X Head 1 -1.659

Y Head 1 -0.462

Z Head 1 3.784

Navigation antenna to the transducer 2

X Head 2 0.000

Y Head 2 0.000

Z Head 2 0.000

Roll offset of transducer number 1 0.000

Roll offset of transducer number 2 0.000

Heave Error: 0.020 or 5.000" of heave amplitude.

Measurement errors: 0.010

Motion sensing unit alignment errors

Gyro:0.100 Pitch:0.100 Roll:0.100

Gyro measurement error: 0.020

Roll measurement error: 0.100

Pitch measurement error: 0.100

Navigation measurement error: 0.100

Transducer timing error: 0.010
 Navigation timing error: 0.020
 Gyro timing error: 0.020
 Heave timing error: 0.020
 PitchTimingStdDev: 0.020
 Roll timing error: 0.020
 Sound Velocity speed measurement error: 0.000
 Surface sound speed measurement error: 0.000
 Tide measurement error: 0.000
 Tide zoning error: 0.000
 Speed over ground measurement error: 0.514
 Dynamic loading measurement error: 0.050
 Static draft measurement error: 0.050
 Delta draft measurement error: 0.050
 StDev Comment: 0>,,J ↑ †J@3†Jp4†J 1†J0 ...J .†J0^,,J` }€J°← †Ja

Svp Sensor:

Time Stamp: 2009-169 00:00

Comments

Svp #1:

Pitch Offset: 0.000
 Roll Offset: 0.000
 Azimuth Offset: 0.000

DeltaX: -1.722
 DeltaY: -0.615
 DeltaZ: 1.095

SVP #2:

Pitch Offset: 0.000
 Roll Offset: 0.000
 Azimuth Offset: 0.000

DeltaX: 0.000
 DeltaY: 0.000
 DeltaZ: 0.000

WaterLine:

Time Stamp: 2009-169 02:20

Comments
Apply Yes
WaterLine 0.045

Time Stamp: 2009-169 08:10

Comments
Apply Yes
WaterLine 0.045

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Tinian Harbor, Tinian Island

Appendix H:
List of Equipment

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DISTRIBUTION STATEMENT A:

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LIST OF EQUIPMENT		
Equipment Name	DPAS or Serial No.	Remarks
9m Safeboat "Swamp Fox" Survey Platform	---	1
Digibar Pro	70616	1
TPU, Klein	74096	1
Echotrac CV	77410	1
Computer, processing	66397	1
Processor, multibeam	70588	1
Reson Multibeam 7125	78589	1
Towfish, Klein 3000	70531	1
Navcom 2050M	77104	1
CTD, SBE 19	3144	1
Monitor, 20" VG2030	QCC082182473, 76, 81	3
Monitor, VG800	FST#0133	1
Processor, 4125	78900	1
Towfish, Edgetech 4125	78901	1
Computer, Laptop	78899	1
Computer, processing	79488 & 79500	2
Navcom 2040G	79091	1
Applanix POS MV 320 Version 4 Position and Orientation System	78589	1
TOPCON Level	486357	1
In-Situ Tide Gauge	8814	1
Ponar Bottom Grab	N/A	1

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Appendix I:

List of Software

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DISTRIBUTION STATEMENT A:

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LIST OF SOFTWARE	
Software and Version	Remarks
HYPACK© Version 2008	
Hysweep 2008	
CARIS HIPS and SIPS Version 6.1 SP2	
CARIS HIPS and SIPS Hotfix 1 through 8	
CARIS GIS Version 4.4a SP 5	
CARIS GIS Hotfix 1 through 38	
CARIS DOM Version 3.2	
Fledermaus Version 6.7	
SBE SeaTerm Version 1.59	
Sea-Bird SBE Data Processing Version 5.37e	
Sea-Bird Seasave Version 5.39c	
CTD HTML Processing Script	~ii c sea-bird ctd_sbe-19_script-processing.html
Sound Velocity Profile Generator Version 4.100	
Sonar Pro 11.2	
Sonar Wiz Map 4 Version 4.04.0015	
SA Watch Version 3.80.269	
Star Utilities Version 100.2.1	
In-Situ Win-Situ 4 Version 4.57.0.0	
NAVOTAS Version 2.3.5	
POS MV Controller Software Version 3 2.1	
Adobe Acrobat Professional 8.0	
Microsoft Office 2003	

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Appendix J:

Geodetic Station Descriptive Report, Calculations and Results

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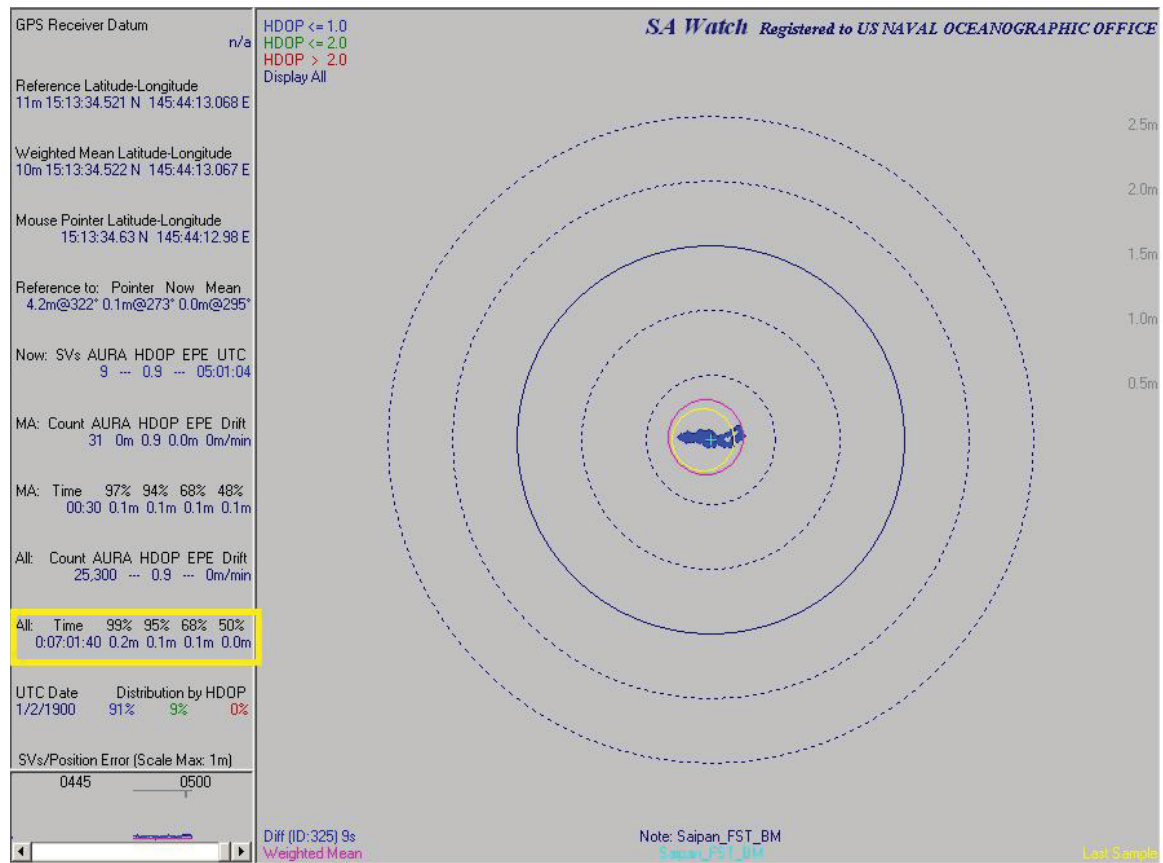


Figure J-1: Static Test of NAVCOM 2050M -- 0.1m @ 95% confidence level

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Appendix K:

CTD Locations, Station Sheets and Plot

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Figure K-1: CTD site locations.

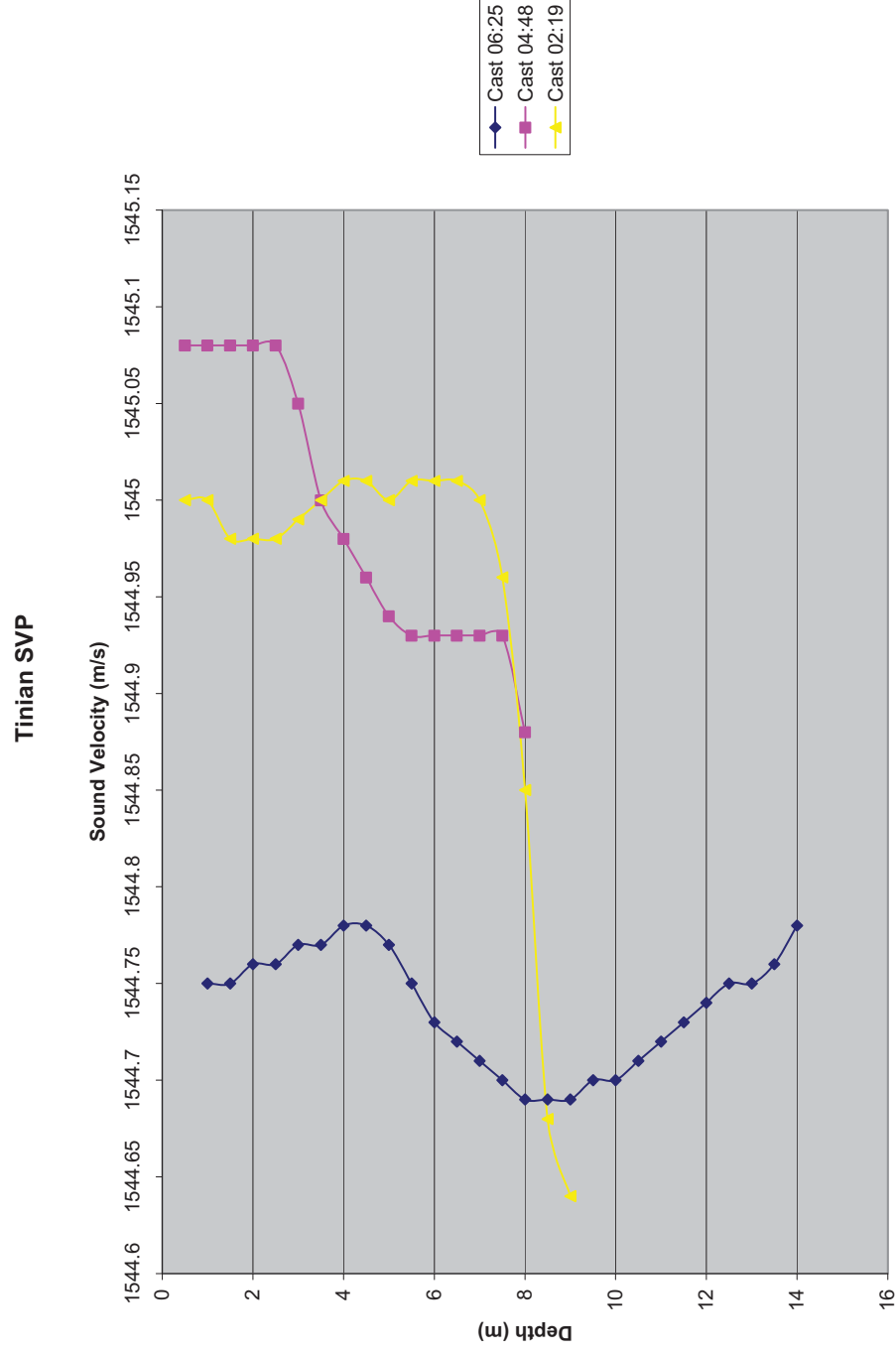


Figure K-2: Plot of sound velocity profiles generated from CTD casts.

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Appendix L:

Crosscheck Analysis and Previous Survey Comparisons

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Cross Check Analysis

Soundings from crosscheck lines were compared to a base surface generated from development lines. The resolution of the base surface is 50 centimeters. The QC Report process analyzed the data by beam number assigning a percentage of passable counts per beam. The results generated from the CARIS QC Report process found that all beams, 1-512, meet IHO Order 1a and IHO Special Order. The results of the CARIS QC Report process for crosscheck analysis is graphed below.

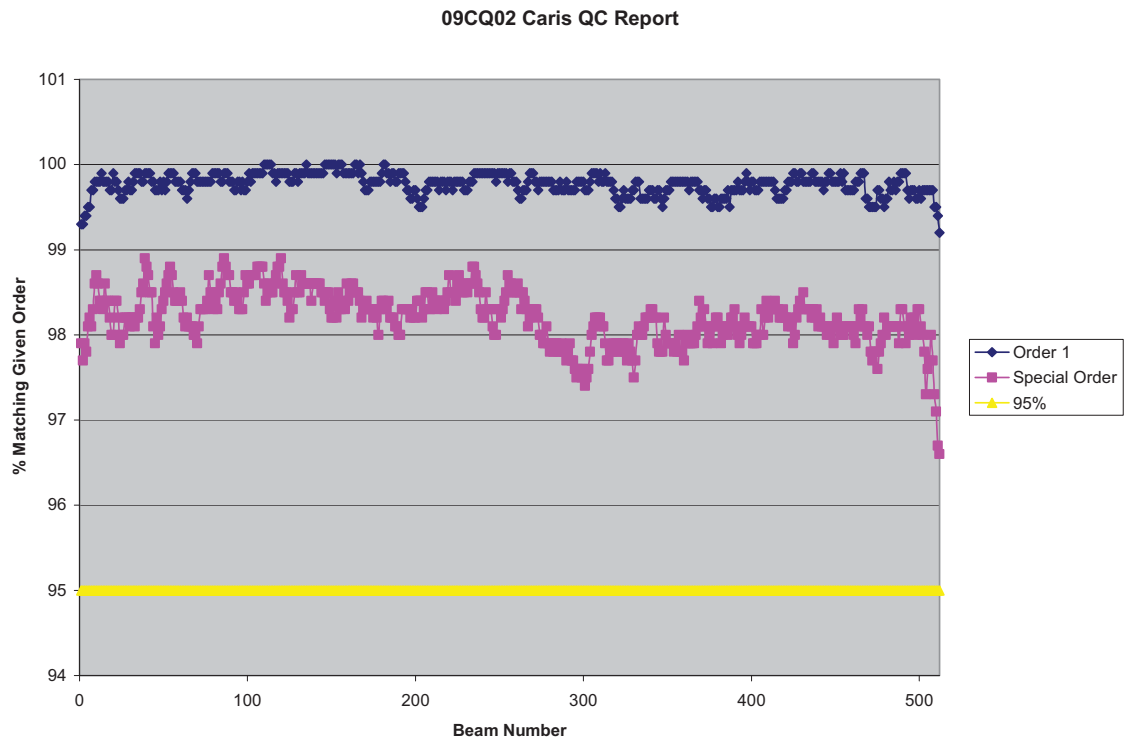


Figure L-1: CARIS HIPS 6.1 QC Report results for crosscheck analysis of the entire survey area.

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Tinian Harbor, Tinian Island

Appendix M:

General Shoreline Photography

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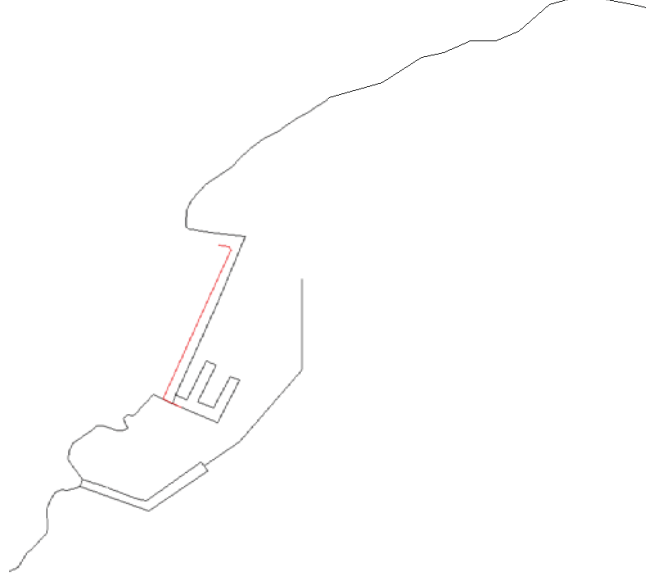


Figure M-1: The red line indicates shoreline surveyed with NAVCOM 2040G GPS receiver; the black line indicates shoreline extracted from the DNC.

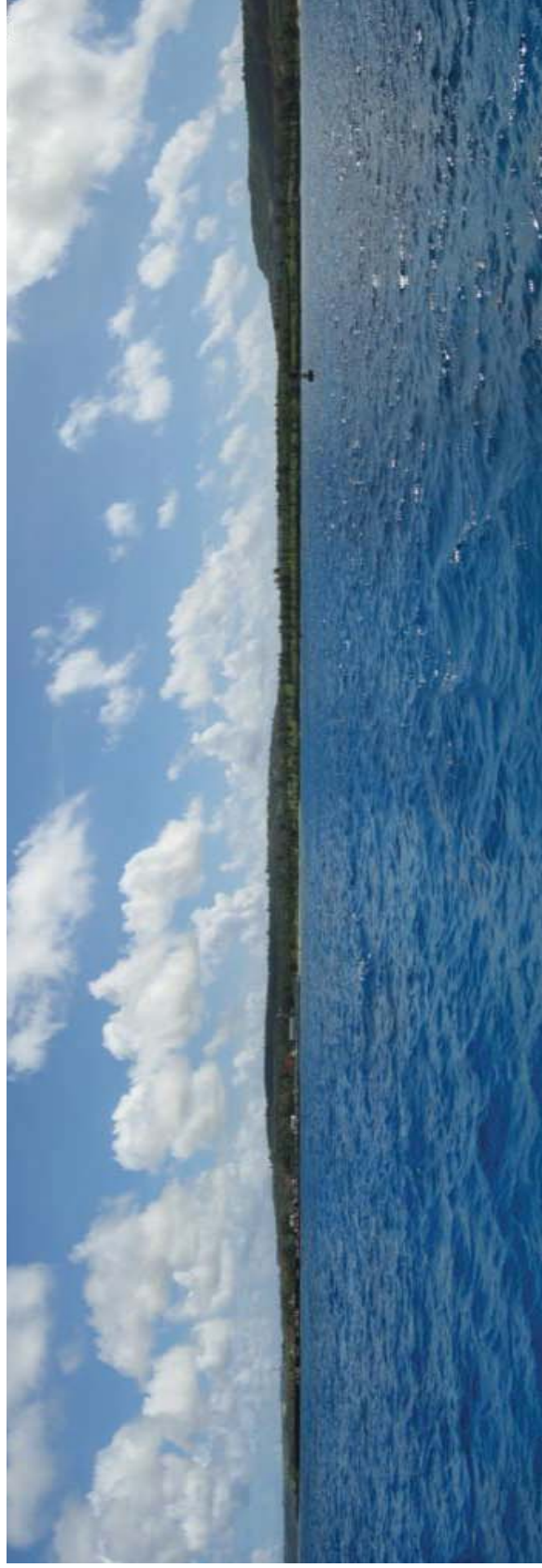


Photo M-1: Coast line of Tinian Harbor.



Photo M-2: Coast line to the south-east of Tinian Harbor.

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Appendix N:

Weekly Narrative and Operational Timeline

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No weekly narrative is available since 09CQ02 was a one day survey.

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Appendix O:

Water Clarity Observations via Secchi Disk

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No Secchi disk observations were made.

W00209 HCell Report
Annie, Raymond, Physical Scientist
Pacific Hydrographic Branch

Introduction

The primary purpose of the HCell is to provide new survey information in International Hydrographic Organization (IHO) format S-57 to update the largest ENC and RNC in the region: NOAA ENC US4SP05M and NOAA RNC 81071.

HCell compilation of survey W00209 utilized Office of Coast Survey HCell Specifications Version 3.1, with approved modifications to better align with PHB's HCell process and to meet MCD needs.

1. Compilation Scale

Depths for HCell W00209 were compiled to the largest scale chart in the region, 81071, 1:20,000.

2. Soundings

A survey-scale sounding (SOUNDG) feature object layer was built from the Shoal layer of a half-meter uncertainly gridded surface in order to retain the shoalest depth on the numerous coral heads and rocks prevalent in the critical under-keel-clearance areas. A shoal-biased selection was made at 1:10,000 survey scale using a Radius Table file with values shown in the table, below. The resultant sounding layer contains 2,507 depths ranging from 0 to 15.8 meters.

Upper limit (m)	Lower limit (m)	Radius (mm)
0	10	3
10	20	4
20	50	4.5
50	500	5

In CARIS BASE Editor soundings were manually selected from the high density sounding layers and imported into a new layer created to accommodate chart density depths. Manual selection was used to accomplish a density and distribution that closely represents the seafloor morphology.

3. Depth Areas and Depth Contours

3.1 Depth Areas

The extents of the highest resolution BASE Surface together with the extents of the soundings layer were used to digitize the hydrographic extents, which were then used to create the single, all encompassing depth area (DEPARE).

3.2 Depth Contours

Depth contours at the intervals on the largest scale chart are included in the W00209_SS HCell for MCD raster charting division to use for guidance in creating chart contours. The generalized metric and fathom equivalent contour values are shown in the table below.

Chart Contours in Fathoms	Metric Equivalent of Chart Contours	Metric Equivalent of Chart Contours Generalized	Actual Value of Chart Contours
0	0	0.2286	0
1	1.8288	2.0574	1.125
3	5.4864	5.715	3.125
5	9.144	9.3726	5.125
10	18.288	18.5166	10.125
20	36.576	184.2516	20.125

Contours delivered in the W00209_SS file have not been deconflicted against soundings and hydrography.

4. Meta Areas

The following Meta object areas are included in HCell W00209:

M_QUAL
M_COVR

Meta area objects were constructed on the basis of the limits of the hydrography. (See 3.1 *Depth Areas*.)

5. Features

No features are included in the HCell for W00209

6. S-57 Objects and Attributes

The *_CS HCell contains the following Objects:

\$CSYMB	Blue Notes
DEPARE	The all-encompassing depth area
M_COVR	Data coverage Meta object
M_QUAL	Data quality Meta object
SOUNDG	Soundings at the chart scale density

The *_SS HCell contains the following Objects:

DEPCNT	Generalized contours at chart scale intervals
SOUNDG	Soundings at the survey scale density

7. Blue Notes

Notes to the RNC and ENC chart compilers are included in the HCell as \$CSYMB features with the Blue Note information located in the INFORM field. By agreement with MCD, the NINFOM field is populated with an abbreviated version of the Blue Note (30 characters or less), describing the chart disposition, to be used by MCD in generating their Chart History spreadsheet.

8. Spatial Framework

8.1 Coordinate System

All spatial map and base cell file deliverables are in an LLDG geographic coordinate system, with WGS84 horizontal, MHW vertical, and MLLW (1983-2001 NTDE) sounding datums.

8.2 Horizontal and Vertical Units

DUNI, HUNI and PUNI are used to define units for depth, height and horizontal position in the chart units HCell, as shown below.

Chart Unit Base Cell Units:

Depth Units (DUNI):	Fathoms and feet
Height Units (HUNI):	Feet
Positional Units (PUNI):	Meters

During creation of the HCell in CARIS BASE Editor and CARIS S-57 Composer, all soundings and features are maintained in metric units with as high precision as possible. Depth units for soundings measured with sonar maintain millimeter precision.

BASE Editor and S-57 Composer Units:

Sounding Units:	Meters rounded to the nearest millimeter
Spot Height Units:	Meters rounded to the nearest decimeter

Conversion to charting units and application of NOAA rounding is completed in the same step, at the end of the HCell compilation process.

Conversion to fathoms and feet charting units with NOAA rounding ensures that:

- All depths deeper or equal to 11 fathoms display as whole fathoms.
- All depth units between 0 fathoms (MLLW) and 11 fathoms display as fathoms and whole feet.
- All depth units skyward of 0 fathoms (MLLW) to 2.0 feet above MHW display in feet for values that round to 5 feet or less, and in fathoms and feet skyward of that.
- All height units (HUNI) which have been converted to charting units, and that are 2.00 feet above MHW and greater, are shown in feet.

In an ENC viewer fathoms and feet depth units (DUNI) display in the format X.YZZZ, where X is fathoms, Y is feet, and ZZZ is decimals of the foot. In an ENC viewer, heights (HUNI) display as whole feet.

9. Data Processing Notes

9.1 Junction with H11508

No junctions.

9.2 Conflicts between Shoreline and Hydrography

The shoreline depicted on the ENC and RNC are not in agreement with each other or the shoreline downloaded from NOAA's Shoreline Data Explorer (NGS). Multibeam data submitted is consistent with NGS shoreline. Recommend updated raster and ENC with current shoreline from NGS.

10. QA/QC and ENC Validation Checks

W00209 was subjected to QA checks in S-57 Composer prior to exporting to the HCell base cell (000) file. The millimeter precision metric S-57 HCell was converted to a chart units and NOAA rounding applied. dKart Inspector was then used to further check the data set for conformity with the S-58 ver. 2 standard (formerly Appendix B.1 Annex C of the S-57 standard). All tests were run and warnings and errors investigated and corrected unless they are MCD approved as inherent to and acceptable for HCells.

11. Products

11.1 HSD, MCD and CGTP Deliverables

- W00209 Base Cell File, Chart Units, Soundings and features compiled to 1:20,000.
- W00209 Base Cell File, Chart Units, Soundings compiled to 1:10,000.
- W00209 Descriptive Report including Survey Acceptance Review, the HCell Report, and supplemental items.
- W00209 Survey outline to populate the SURDEX.

11.2 File Naming Conventions

- Chart units base cell file, chart scale soundings W00209_CS.000
- Chart units base cell file, survey scale sounding set W00209_SS.000
- Descriptive Report package W00209_DR.pdf
- Survey outline W00209_Outline.gml & *.xsd

11.3 Software

CARIS HIPS Ver. 6.1	Inspection of Combined BASE Surfaces
CARIS BASE Editor Ver. 2.2	Creation of soundings and bathy-derived features, creation of the depth area, meta area objects, and Blue Notes; Survey evaluation and verification; Initial HCell assembly.
CARIS S-57 Composer Ver. 2.1	Final compilation of the HCell, correct geometry and build topology, apply final attributes, export the HCell, and QA.

CARIS GIS 4.4a	Setting the sounding rounding variable for conversion of the metric HCell to NOAA charting units with NOAA rounding.
CARIS HOM Ver. 3.3	Perform conversion of the metric HCell to NOAA charting units with NOAA rounding.
HydroService AS, dKart Inspector Ver. 5.1	Validation of the base cell file.

12. Contacts

Inquiries regarding this HCell content or construction should be directed to:

Annie Raymond, Physical Scientist, PHB, Seattle, WA; 206-526-6849;
annemieke.raymond@noaa.gov.

APPROVAL SHEET
W00209

Initial Approvals:

The survey evaluation and verification has been conducted according to branch processing procedures and the H-Cell compiled per the latest OCS H-Cell Specifications.



Annemieke Raymond
2009.11.16 13:00:09 -08'00'

The survey and associated records have been inspected with regard to survey coverage, delineation of the depth curves, development of critical depths, S-57 classification and attribution of soundings and features, cartographic characterization, and verification or disproval of charted data within the survey limits. The survey records and digital data comply with OCS requirements except where noted in the Descriptive Report and are adequate to supersede prior surveys and nautical charts in the common area.

I have reviewed the H-Cell, accompanying data, and reports. This survey and accompanying digital data meet or exceed OCS requirements and standards for products in support of nautical charting except where noted in the Descriptive Report.