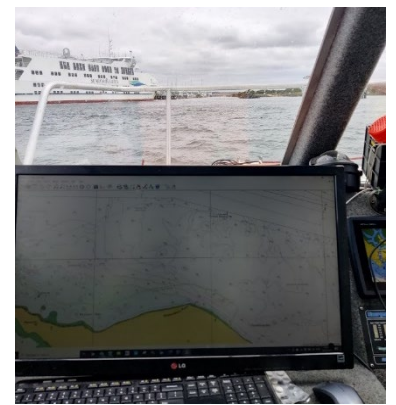
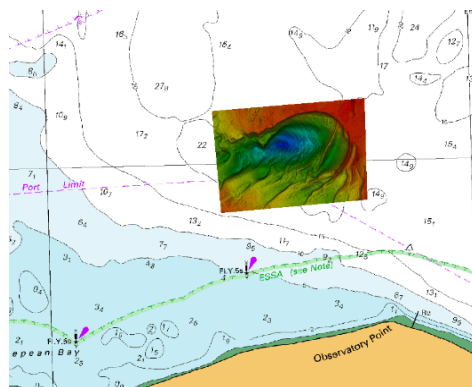
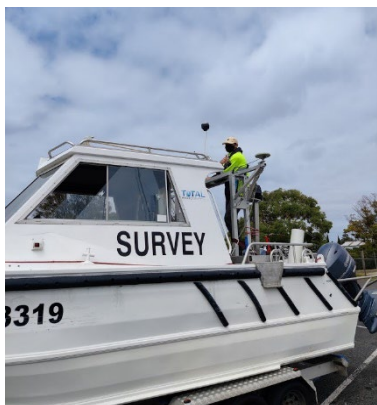




# VFA KingFish Reef Phase 1 Proposed Locations

## Report of Survey

Report compiled by: T.KAYE  
Date: 3/03/2021



## Purpose of the Survey

Hydrographic survey of the proposed VFA Kingfish Reef locations.

## General

Survey and ID		Project Locality	
VFA0001		Portsea, VIC	
Survey Authority/Client		Client Contact	
Vicorian Fisheries Association (VFA)		Brent Womersley	
Hydrographic Surveyor ( Supervising)		Certification or Qualification	
Tim Williams		AHSCP CPHS - Level 2	
Hydrographic Surveyor (Assisting)		Certification or Qualification	
Louis Bennett		Bachelor of Marine Geography	
Start date of Survey	14/02/2021	End Date of Survey	14/02/2021
Number of field days	1	Class of Survey	N/A
Survey Platform/Vessel Name		Survey Platform/Vessel Name	
Total 1 - 6.3m Catamaran		-	
Survey Report Completed By		Tom Kaye	
Date of Survey Report Completion		3/03/2021	

## Details of Survey Execution

The following positioning systems were used:

Positioning System 1	POS MV INS
Positioning System 2	Leica GS14
Base station (if applicable)	-

The following sounding systems were used:

	Model/System Details	Frequency (kHz)
Echosounder 1	R2Sonic 2020	400kHz
Sub Bottom Profiler	Innomar SES 2000 Compact	
Motion reference unit	Applanix WaveMaster POSMV	-
Towed Side Scan Sonar	-	-
Hull mounted Side Scan Sonar	-	-

Logging and processing systems used, and Versions:

Logging	Hypack 2020
Processing	Hypack 2020
Survey Plan line spacing	SBP: 20m across all extents & 10m across proposed reef
Has data been thinned from that collected	Yes
Data - thinning	1m Median Surface Export
Survey Plan - thinning method and bin size	10m Shoal Bias Thinning

## Horizontal Control

Soundings are on the following datum	
Datum	GDA94
Spheroid	GRS80
Projection and Zone	MGA Zone 55
How was the positioning system validated	RTK GNSS Validation against PSM/ Static Position
<b>THU - Total Horizontal Uncertainty. Estimated Accuracy of soundings at 2.45 Sigma (95%) confidence level</b>	<b>2.00m</b>

## Vertical Control

Tides Applied	RTK GNSS Tides
Sounding datum	Chart Datum (Queenscliff)
Geoid details if using GNSS tides	AusGeoid09
AHD Separation Value	0.625m below AHD
Tide Board/Gauge 1	N/A
Tide Board/Gauge 2	N/A
Survey Mark used for datum connection	PAYWIT PM 148
Survey Mark used for datum connection	-
Survey Mark used for datum connection	-
Method for Sound Velocity correction	Sound Velocity Profile
Temperature and Salinity values used	N/A

### Tide Model comments (if applicable)

The following table contains the Survey Control marks used and their associated coordinate uncertainties

Survey Mark	Easting	Northing	Orthometric Height
PAYWIT PM 148	295826.983	5762221.391	1.266
Uncertainty	0.017		0.026

<b>TVU - Total vertical uncertainty. Estimated vertical accuracy of soundings at 1.96 Sigma (95%) confidence level</b>	<b>0.25m</b>
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## Document Issuer

**Tim Williams** | Principal Hydrographer  
 Certified Professional Hydrographic Surveyor – Level 2 (CPHS2)

**Address:** 14/75 Endeavour Way, Sunshine West Victoria 3020, Australia  
**Telephone** 0467 055 005  
**Email** [tim@totalhydrographic.com.au](mailto:tim@totalhydrographic.com.au)  
**Website** [www.totalhydrographic.com.au](http://www.totalhydrographic.com.au)

## Document Revision

Revision	Issue Purpose	Prepared / Checked	Date
1.0	Report of Survey	Tim Williams	3/03/2021

## List of Acronyms

<b>AHD</b>	Australian Height Datum
<b>MGA</b>	Map Grid of Australia
<b>GDA</b>	Geocentric Datum of Australia
<b>CD</b>	Chart Datum
<b>THU</b>	Total Horizontal Uncertainty
<b>TVU</b>	Total Vertical Uncertainty
<b>SBES</b>	Single Beam Echosounder
<b>MBES</b>	Multibeam Echosounder
<b>GNSS</b>	Global Navigational Satellite System
<b>RTK</b>	Real Time Kinematic
<b>WGS</b>	World Geodetic System



Nine figure	338001480	Status	OK	Type	SCN (GDA), Adj. AHD		
Easting	295826.983	Northing	5762221.391	AHD height	1.266	Zone	55
Latitude	-38° 15' 53.5025"	Longitude	144° 39' 58.4240"	Ellipsoid height	3.713	CSF	1.0001132
Hx uncertainty	0.017	Hx order	3	Vt uncertainty	0.026	Vt order	3
Datum	GDA94	Plan ref	OP 122328				

3

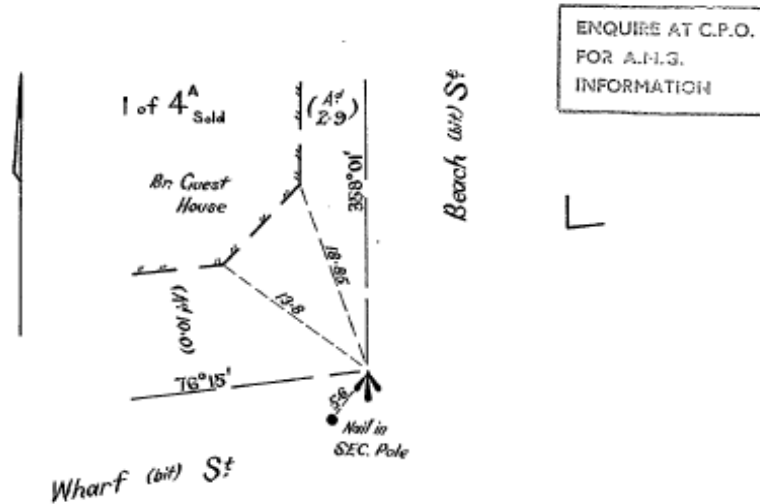
SEC. 6 (1) (c) SURVEY CO-ORDINATION ACT 1958

**PERMANENT MARK SKETCH PLAN**

Township Queenscliff Parish Paywit

- NOTE:— Not necessarily to Scale
- (1) Measurements to be shown from the Permanent Mark to as many near-by survey marks, buildings, fence posts, hydrants, trees, &c., as practicable. Up to six such measurements are desirable.
  - (2) Except where verified by a Licensed Surveyor in this survey, all boundaries in this sketch plan are to be shown by broken lines. The symbols for fences, buildings, &c., to be shown on the broken lines.
  - (3) Description of Permanent Mark and, where possible, Crown Abutments are to be shown.

MEASUREMENTS ARE IN links



ENQUIRE AT C.P.O.  
FOR A.H.G.  
INFORMATION

Established in connection with\* Cadastral Ref. No. COS.4949  
\*Type of Survey of Works

IF LEVELLED:— Reduced level of Mark \_\_\_\_\_ to Datum \_\_\_\_\_  
T.e.g. Railways, Board of Works, Sewerage Authority, &c., or Arbitrary.

I certify that the Permanent Marks shown in this sketch have been established on the ground by me in accordance with the Regulations under the Survey Co-ordination Act 1958 and that the information shown hereon is correct.

Department or Authority Crown Lands & Survey Signature William LS Date 26-2-71

CP. 77676

If a Licensed Surveyor the letters L.S. to be added

TO BE FILLED IN BY THE CENTRAL PLAN OFFICE

BOOK	SHEET	SUBDIVISION	Same Datum R.L.	Number
Surveys connected to this PM:			R.L.	<b>148</b>
OP 101622	OP. 102802	O.P. 105379	Copied from	
O.P. 107886	<b>108159</b>			
CP 112297	CP 111459			
CP 112691	CP 111587			

See also SUPPLEMENTARY Sketch

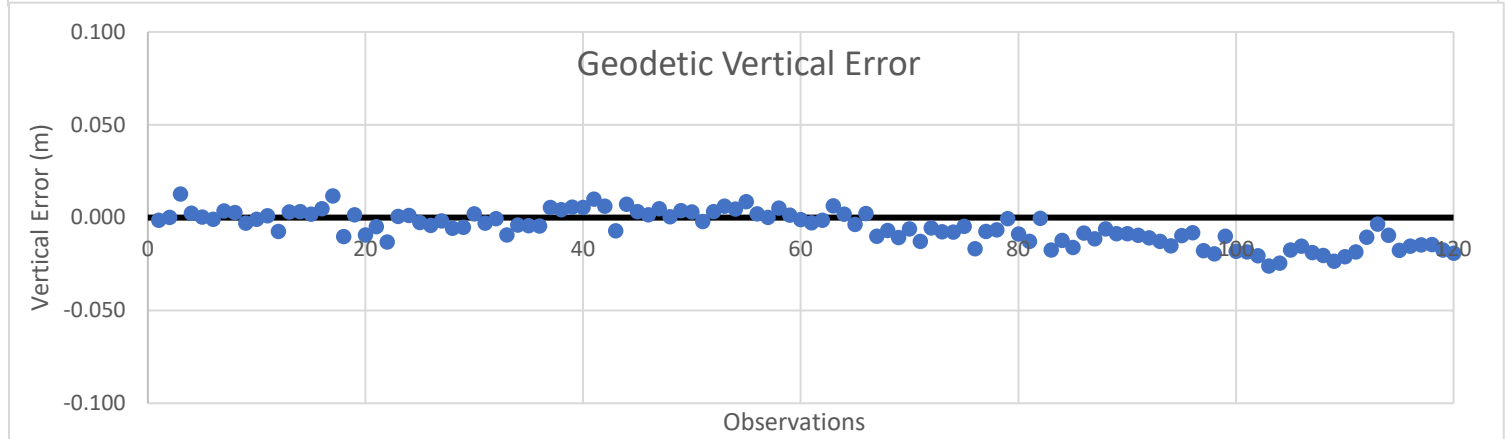
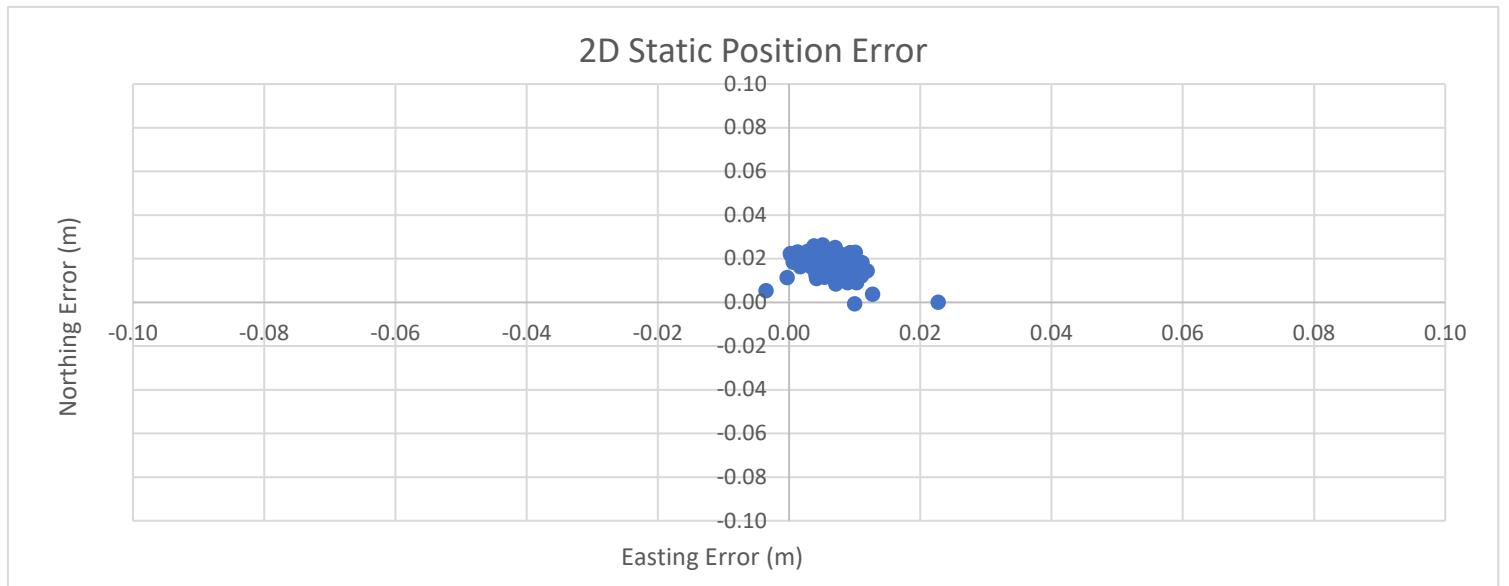
Noted on Record Plan Q 36 11-5-71 CO 1010000-71

- 6 MAY 1971

T.O. Borough of Queenscliff S.R. & W.S.C.

Date	14/02/2021	Time: (AEST)	15:15
Project Locality	Portsea, VIC	Control Vertical Datum	AHD
Horizontal Datum	GDA94	Map Projection	MGA Zone 55
Survey Mark	PAYWIT PM 148	Survey Mark Locality	Queenscliff, VIC
GNSS Device	GS14	Surveyor	Tim Williams
Correction	SNA MAC RTCM 3.1 (94)	Duration of RTK Observations	120s
# Observations	122	# Baseline Distance	N/A

Results			
	Easting	Northing	Orthometric Height
Survey Mark	295826.983	5762221.391	1.266
Survey Mark Uncertainty	0.017		0.026
GNSS Observation	295826.977	5762221.374	1.272
Standard Deviation	0.003	0.005	0.009
GNSS Uncertainty	0.008		0.017
Variation	0.006	0.017	-0.006



**Final Comments:**

Date	14/02/2021	Time: (AEST)	N/A
Project Locality	Portsea, VIC	Control Vertical Datum	AHD
Horizontal Datum	GDA94	Map Projection	MGA Zone 55

Geodetic Control Observation #1			
Survey Mark (SM)	PAYWIT PM 148	Survey Mark Locality	Queenscliff, VIC
GNSS Device	Leica GS14	Correction	SNA MAC RTCM 3.1 (94)
Time: (AEST)	0:00	Surveyor	Tim Williams
Survey Mark XY Uncertainty	0.017	Survey Mark Z Uncertainty	0.026
GNSS XY Uncertainty	0.008	GNSS Z Uncertainty	0.017
	Easting	Northing	Orthometric Height
Survey Mark (SM)	295826.983	5762221.391	1.266
GNSS Observation	295826.977	5762221.374	1.272
<b>Variation</b>	<b>0.006</b>	<b>0.017</b>	<b>-0.006</b>

Results			
	Easting	Northing	Orthometric Height
Average Variations	0.006	0.017	-0.006
RMS of GNSS observations	0.008		0.017
RMS of PSM Uncertainties	0.017		0.026
<b>Survey Datum Uncertainty, 95% confidence (1.96σ)</b>	<b>0.019</b>		<b>0.031</b>

Final Comment:

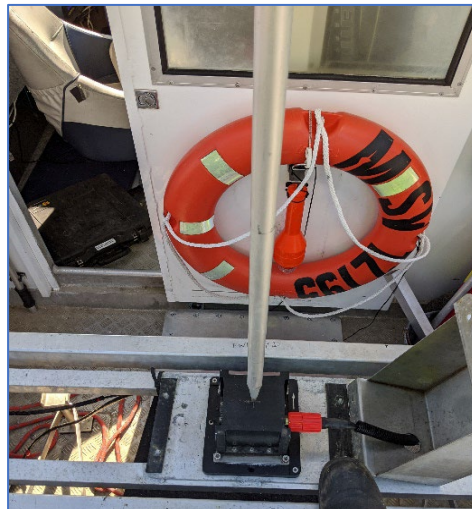
To validate the positioning system onboard Total Hydrographic's Survey vessel Total 1, a Static Position validation was performed whilst the vessel was ashore. This was carried out using an independent and validated RTK GNSS Rover to compare the survey system IMU Z observation to that from the RTK GNSS.



Survey vessel Total 1 stationary and ashore for static position validation



RTK GNSS observation taken on the IMU Z reference point



RTK GNSS and POS MV observations are taken simultaneously whilst the vessel is stationary and stable

The survey vessel is positioned on a flat, level area with an open sky view. Observations were taken simultaneously by both Applanix POSMV INS and Emlid RTK GNSS Rover for 120 seconds.

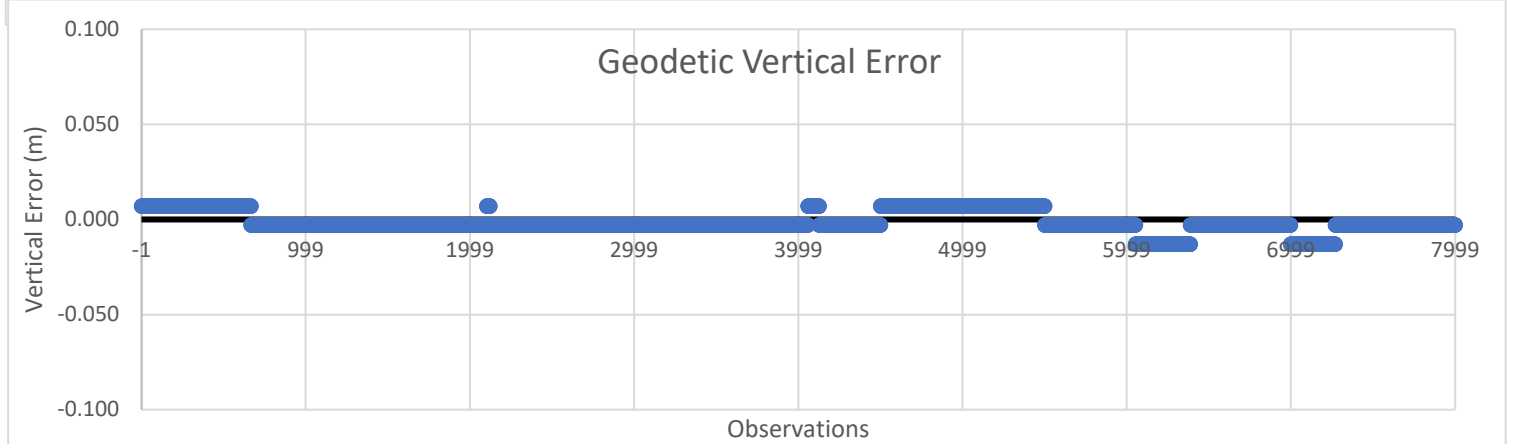
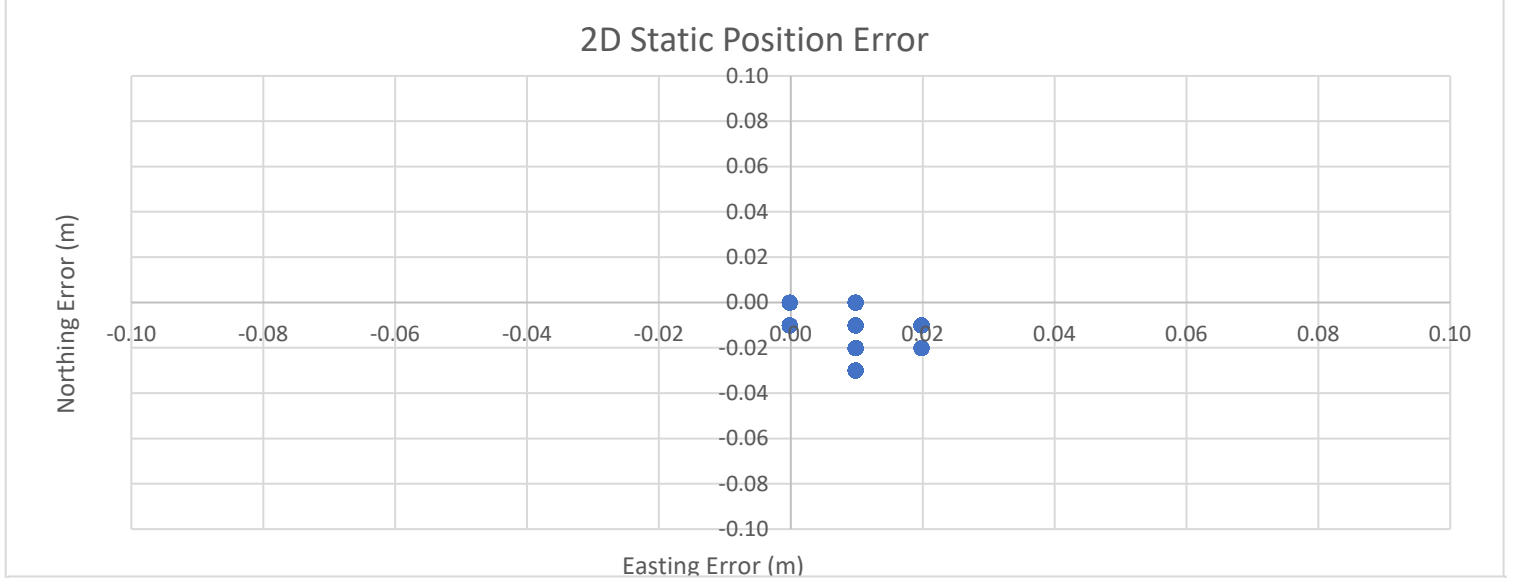


# STATIC POSITION VALIDATION RESULTS

Date	14/02/2021	Project	VFA0001
Time: (AEST)	15:00	Project Locality	Portsea, VIC
Vertical Datum	Chart Datum	AHD Separation	0.625m below AHD
Horizontal Datum	GDA94	Map Projection	MGA Zone 55

Static Position Node	POSMV IMU Origin	Validation Location	Queenscliff Boat Ramp
GNSS Device	Leica GS14	Surveyor	Louis Bennett
Correction	SNA MAC RTCM 3.1 (94)	Duration of RTK Observations	120s
# IMU Z Observations	8370	# Baseline Distance	N/A

Results			
	Easting	Northing	Orthometric Height
<b>IMU Z (RTK GNSS)</b>	295637.370	5762362.490	2.878
RTK Rover Uncertainty	0.005		0.006
<b>POSMV Observation</b>	295637.359	5762362.500	2.879
Standard Deviation	0.004	0.006	0.005
POSMV Uncertainty at 95%	0.018		0.010
<b>Variation</b>	<b>0.011</b>	<b>-0.010</b>	<b>-0.001</b>

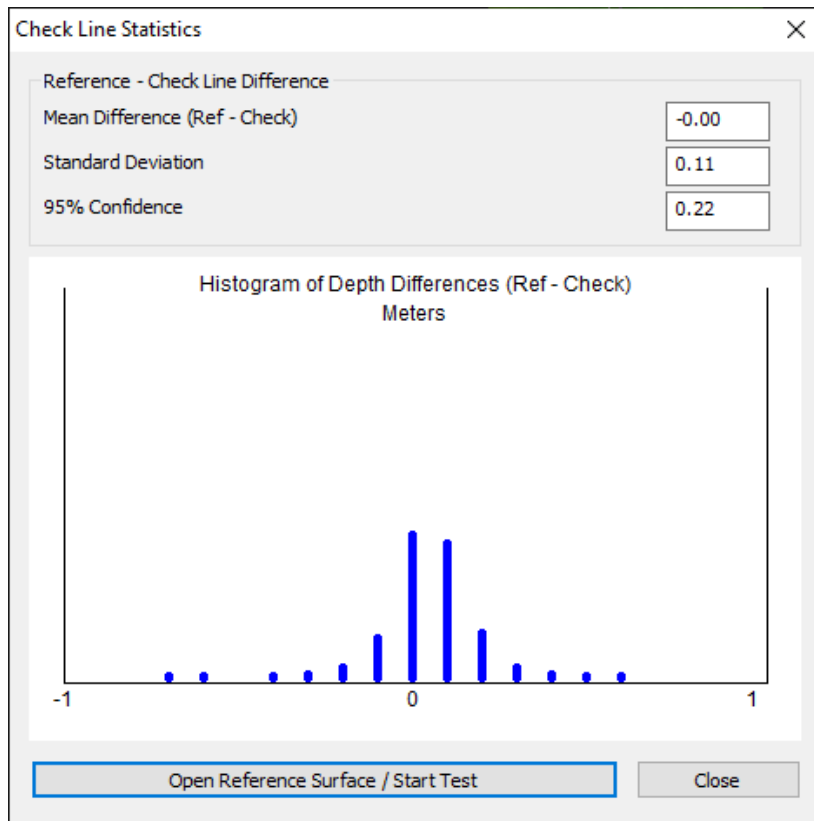


**Final Comments:** Static Pos observations reduced to AHD for comparison

Date	14/02/2021	Project Locality	Portsea, VIC
Project	VFA0001	AHD Separation	0.625m below AHD
Vertical Datum	Chart Datum	Map Projection	MGA Zone 55
Horizontal Datum	GDA94	Number of Cross Lines	1

Cross Line Statistics Results			
	Mean Difference (m)	Standard Deviation	95% Confidence (1.96σ)
Crossline 1	0.000	0.110	0.220
Crossline 2	-		
Crossline 3	-		
RTK GNSS / SBES	-		
Average	0.000	-	-
RMS	-	<b>0.110</b>	<b>0.220</b>

**SCREEN GRABS OF CROSS LINE STATISTICS APPLICATION**



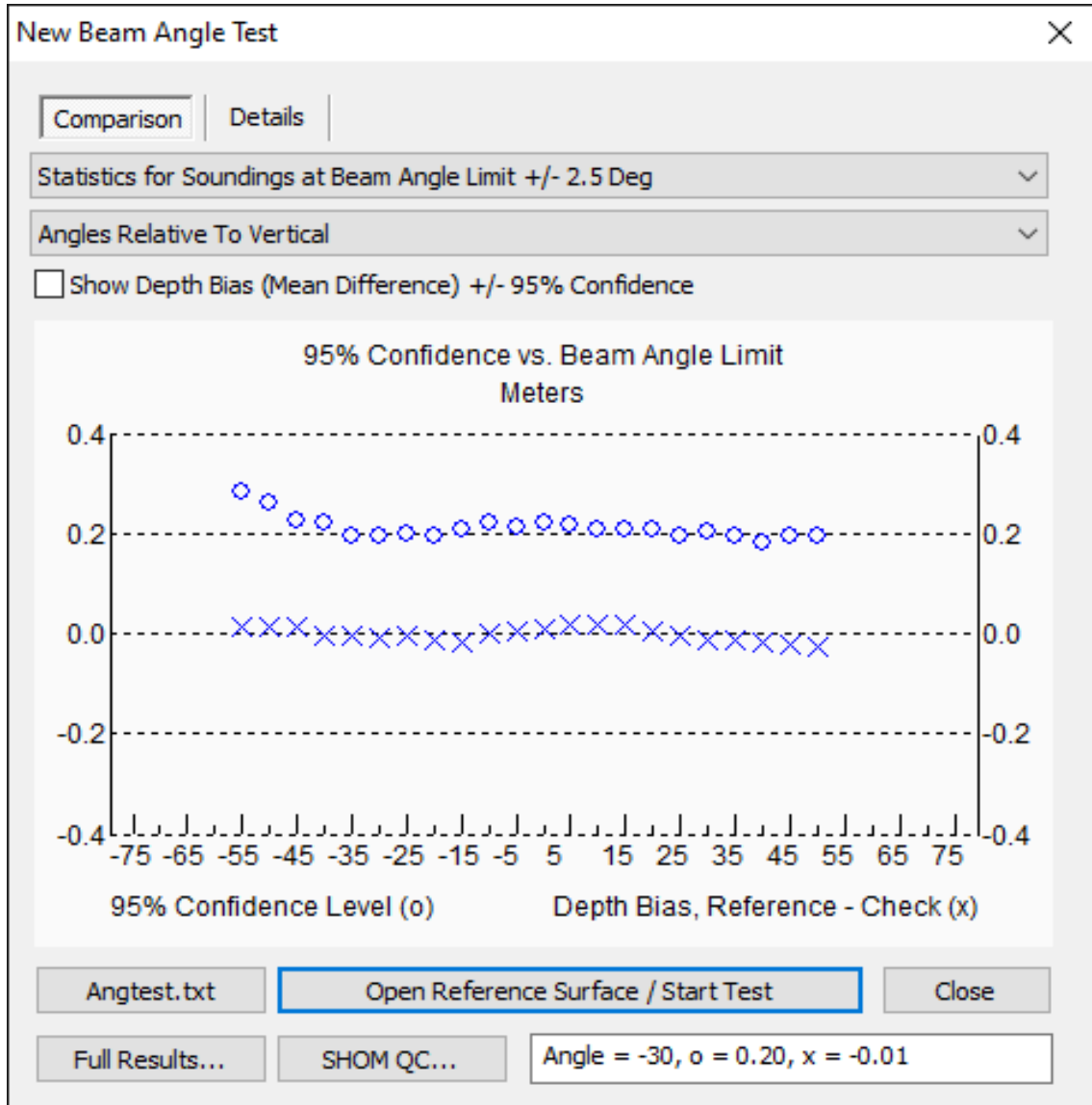
**Discussion:**

95% confidence of MBES soundings has been factored into the survey's final Total Vertical Uncertainty (TVU) assessment

Date	14/02/2021	Project Locality	Portsea, VIC
Project	VFA0001	AHD Separation	0.625m below AHD
Vertical Datum	Chart Datum	Map Projection	MGA Zone 55
Horizontal Datum	GDA94	Number of Cross Lines	1

A beam angle test was undertaken to assess the performance of the MBES system across the entire 256 beams per sonar head. Each beam/beam angle was analysed in Hypack 2020 to assess how the MBES system performs relative to its most reliable beams at Nadir. The beam angle test uses the same cross lines in the cross line statistics.

**BEAM ANGLE TEST RESULTS (GRAPHICAL)**

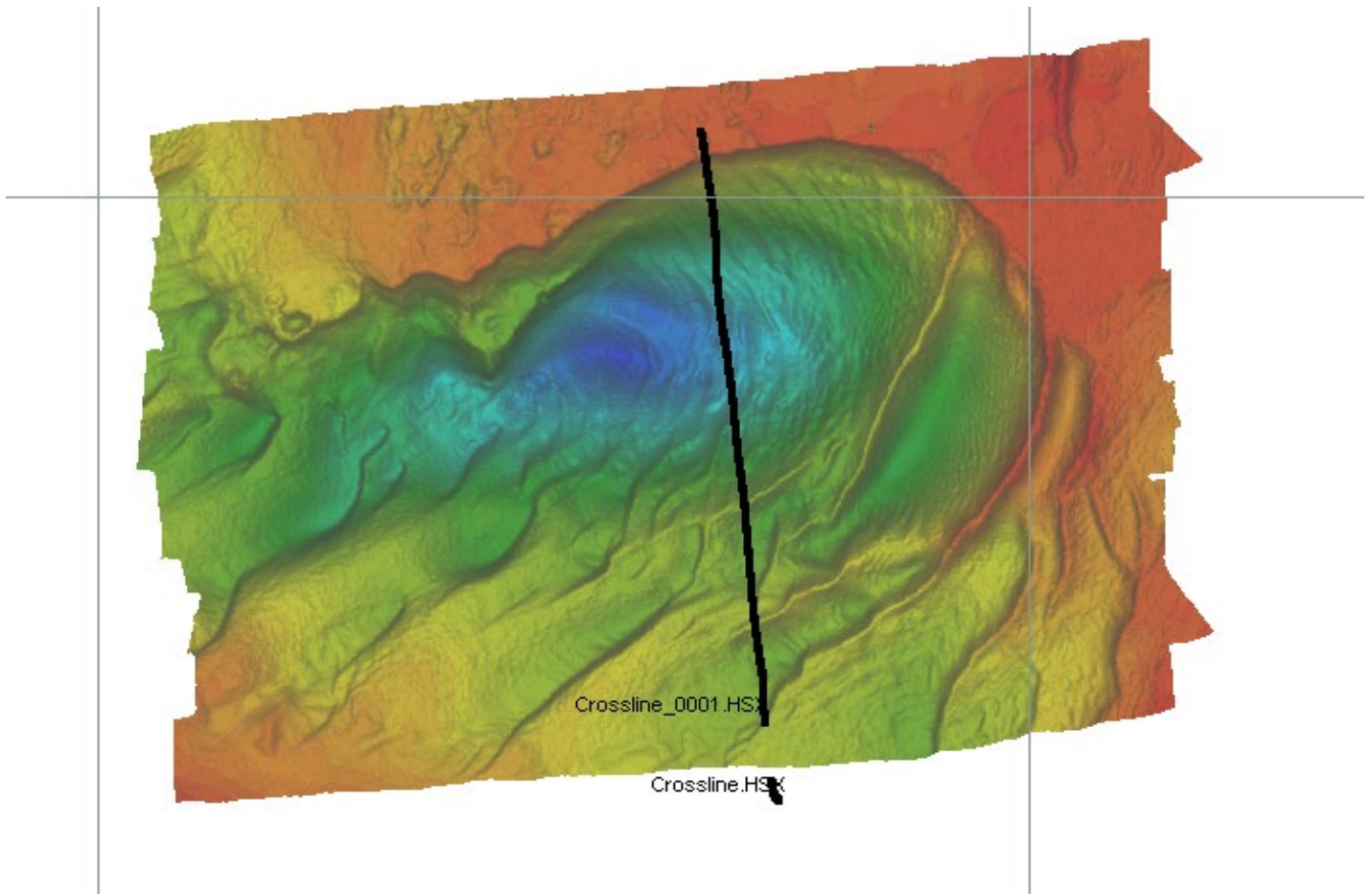


**Beam Angle Result #1**

## BEAM ANGLE TEST RESULTS

The beam angle test results show that the data has a uniform 95% confidence of approximately 0.20m across the MBES swath. Some signs of accuracy degradation can be seen on the port outer beams (-55,-60 degrees) which is likely due to the crossline passing over the deep hole in the extents. This validates the system is performing optimally across the entire MBES swath.

### Further Discussion



**Crossline over contours #1**

Date	14/02/2021	Project	VFA0001
Vertical Datum	Chart Datum	Project Locality	Portsea, VIC
Horizontal Datum	GDA94	AHD Separation	0.625m below AHD
Survey System	R2Sonic 2020	Map Projection	MGA Zone 55

Total Horizontal Uncertainty has been calculated using all of the following observations. All of these observation values are at a 95% confidence interval. SMES Uncertainties for PSM's have been supplied at the 95% horizontal confidence interval.

The propagation of error sources was computed to give an A Posteriori assessment of Total Horizontal Uncertainty

$$\sigma_z = \sqrt{(\sigma_x)^2 + (\sigma_y)^2}$$

### Summary of Horizontal Components of Survey Accuracy

Absolute Accuracy Sources of Error	Validation	95% Confidence (m)
Geodetic Control to Datum	Geodetic Control	0.019
POSMV Positional Uncertainty	Static Position Validation	0.018
POSMV Uncertainty to Datum	<i>Propagation of above</i>	0.026
Final Sounding Accuracy to Datum	Ground Truth	N/A
<b>Absolute Accuracy</b>	<b>Calculated Value</b>	<b>0.026</b>

Relative Accuracy Sources of Error	Validation	95% Confidence (m)
-		N/A
<b>Relative Accuracy</b>	<b>Calculated Value</b>	

### Propagation of Errors

Error Source	95% Confidence Value
Absolute Accuracy	0.026
Relative Accuracy	-
<b>Sounding Accuracy</b>	<b>Absolute &amp; Relative</b>
	<b>N/A</b>

The A Posteriori assessment of Total Horizontal Uncertainty unable to be calculated without a relative accuracy assessment. An estimated THU of 2.0m has been assigned to the survey

<b>Total Horizontal Uncertainty (THU)</b>	2.00m
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### Comments:

Limited ability to quantifiably assess system relative horizontal accuracy. Due to water depth and complex bathymetry of the survey extents, an estimated THU of 2.0m has been assigned to this survey

Date	14/02/2021	Project	VFA0001
Vertical Datum	Chart Datum	Project Locality	Portsea, VIC
Horizontal Datum	GDA94	AHD Separation	0.625m below AHD
Survey System	R2Sonic 2020	Map Projection	MGA Zone 55

Total Vertical Uncertainty has been calculated using all of the following observations. All of these observation values are at a 95% confidence interval. SMES Uncertainties for PSM's have been supplied at the 95% confidence interval.

The propagation of error sources was computed to give an A Posteriori assessment of Total Vertical Uncertainty

$$\sigma_z = \sqrt{(\sigma_x)^2 + (\sigma_y)^2}$$

### Summary of Vertical Components of Accuracy

Absolute Accuracy Sources of Error	Validation	95% Confidence (m)
Geodetic Control to Datum	Geodetic Control	0.031
POSMV Positional Uncertainty	Static Position Validation	0.010
POSMV Uncertainty to Datum	<i>Propagation of above errors</i>	0.033
Bar check	Bar Check Calibration*	0.04
Final Sounding Accuracy to Datum	Ground Truth	N/A
<b>Absolute Accuracy</b>	<b>Calculated Value</b>	<b>0.052</b>

Relative Accuracy Sources of Error	Validation	95% Confidence (m)
Relative system repeatability - Entire Swath	Cross Line Statistics	0.220
<b>Relative Accuracy</b>	<b>Calculated Value</b>	<b>0.220</b>

### Propagation of Errors

Error Source	95% Confidence Value
Absolute Accuracy	0.052
Relative Accuracy	0.220
<b>Sounding Accuracy</b>	<b>Absolute &amp; Relative</b>
	<b>0.226</b>

The A Posteriori assessment of Total Vertical Uncertainty was rounded up to give a final TVU of 0.25m

<b>Total Vertical Uncertainty (TVU)</b>	0.25m
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### Comments:

\*Bar check error taken from most recent bar check validation on 22/02/2021

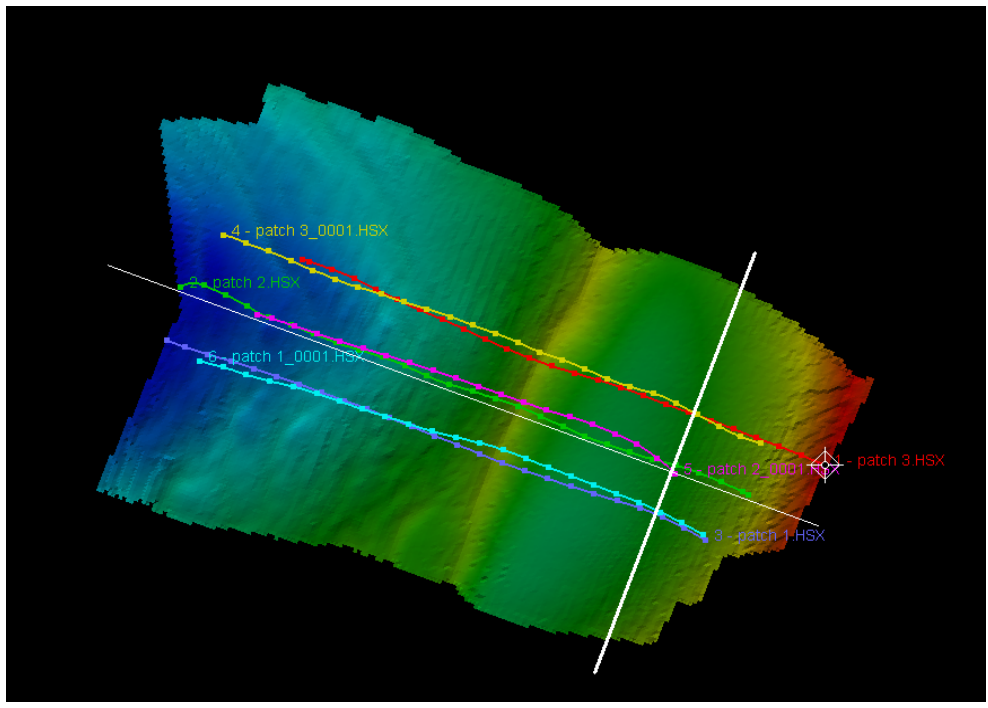
Date	14/02/2021	Project	VFA0001
Time: (AEST)	9:39	Project Locality	Portsea, VIC
Survey System	R2Sonic 2020	Positioning System	POS MV INS

Surveyors	Tim Williams, Louis Bennett	Vessel Speed (knots)	5kts
Water Depth (m)	15 - 20m	Swath Width	120°
Feature	Sand wave within survey extents		
Files	N/A		

Calibration of the MBES system was conducted at a typical patch test site throughout the duration of the project. The calibration procedure enables the system’s reference angle errors to be identified and corrected within the system. After the initial calibration as part of the system mobilisation the same procedure was undertaken as a system validation of the pre-determined parameters.

PATCH TEST RESULTS SUMMARY			
	Calibration Value	Validation Result	Status
Port Roll	20.35	20.35	OK
Starboard Roll	-29.95	-29.95	OK
Port Pitch	-0.20	-0.20	OK
Starboard Pitch	0.70	0.20	OK
Port Yaw	-2.00	-2.00	OK
Starboard Yaw	-1.50	0.50	CHECK

## PATCH TEST LINE CONFIGURATION OVERVIEW

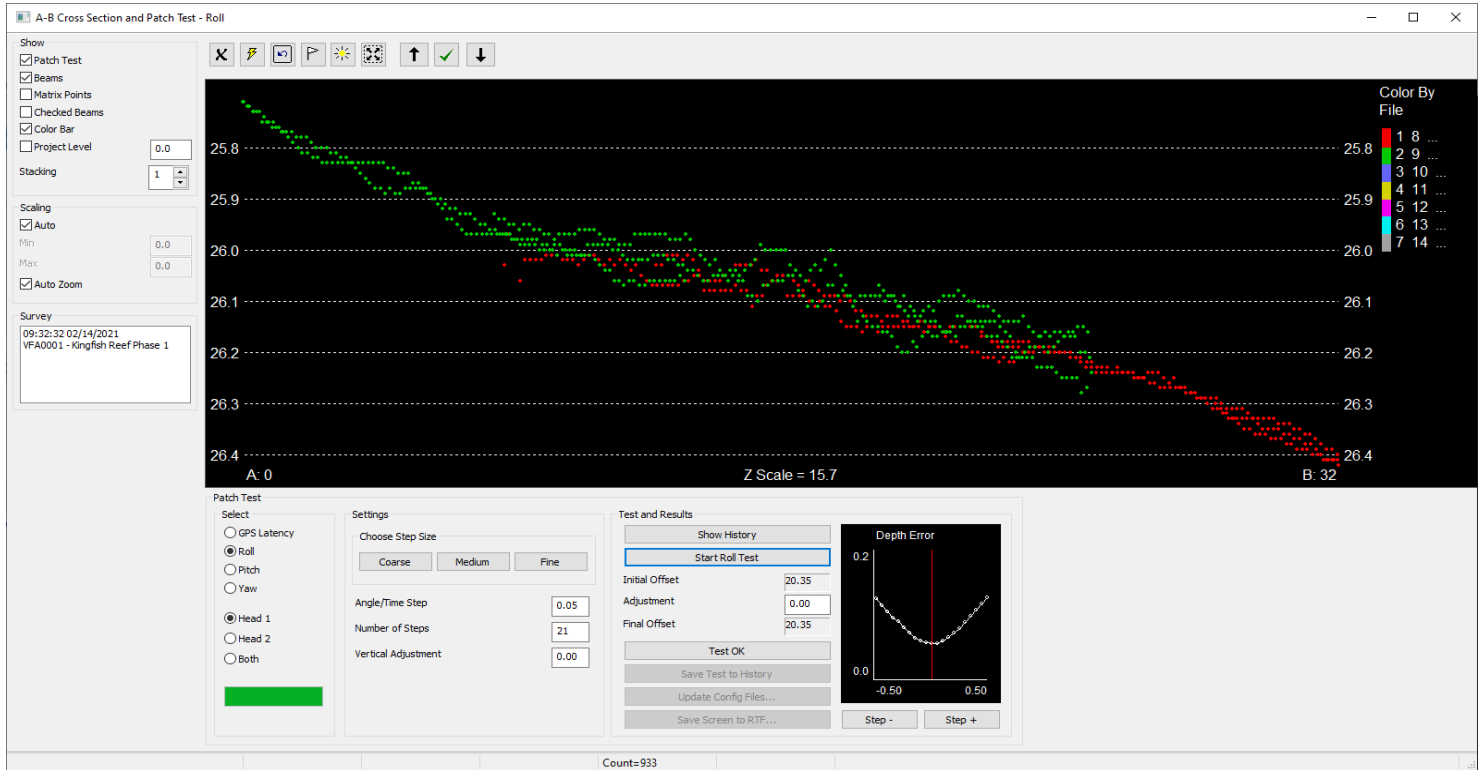


### Final Comments:

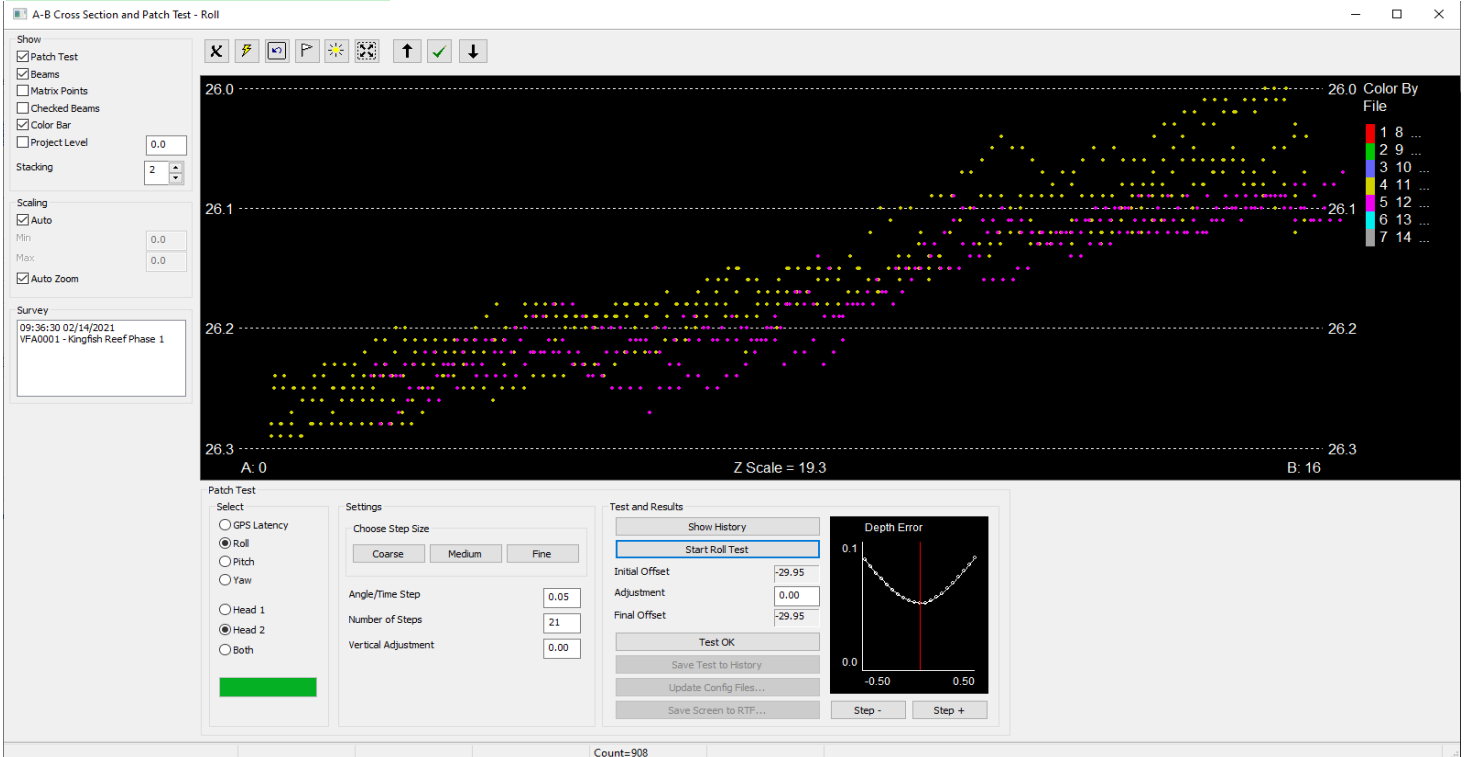
Larger than expected **starboard yaw**. A strong convergence was observed in the Hypack patch test tool, therefore the new value was adopted. This validation result was observed in two patch tests for starboard yaw.

**SCREEN GRABS OF ROLL VALIDATION**

**PORT SONAR HEAD**



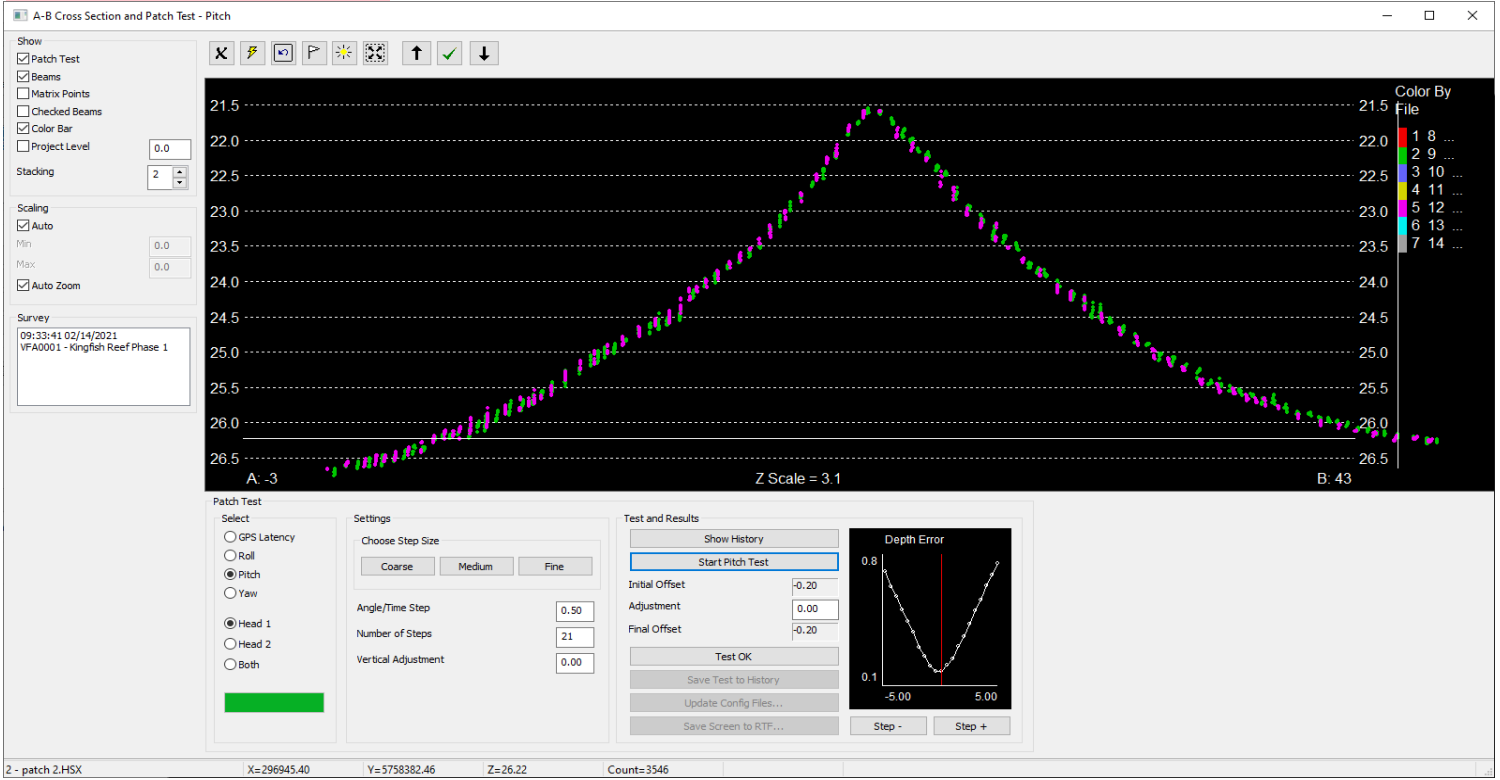
**STARBOARD SONAR HEAD**



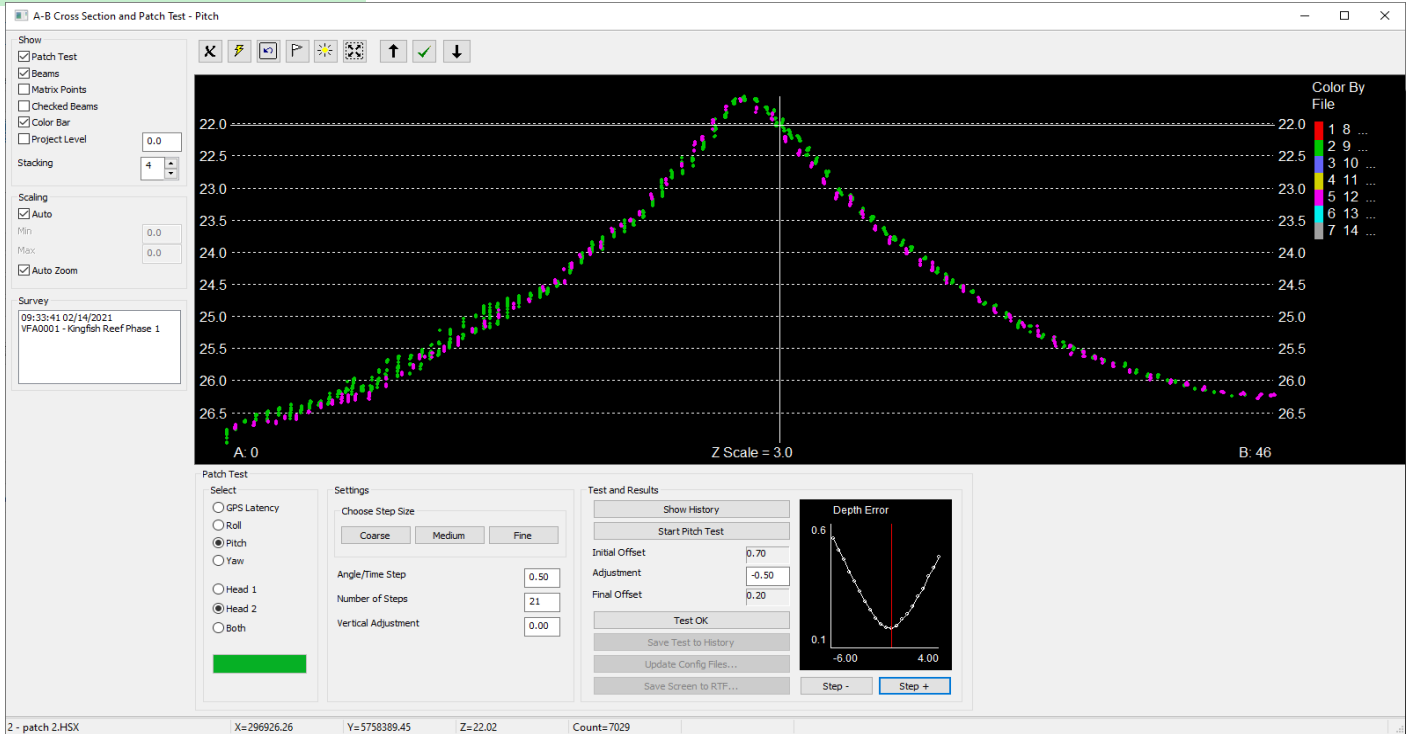


## SCREEN GRABS OF PITCH VALIDATION

### PORT SONAR HEAD

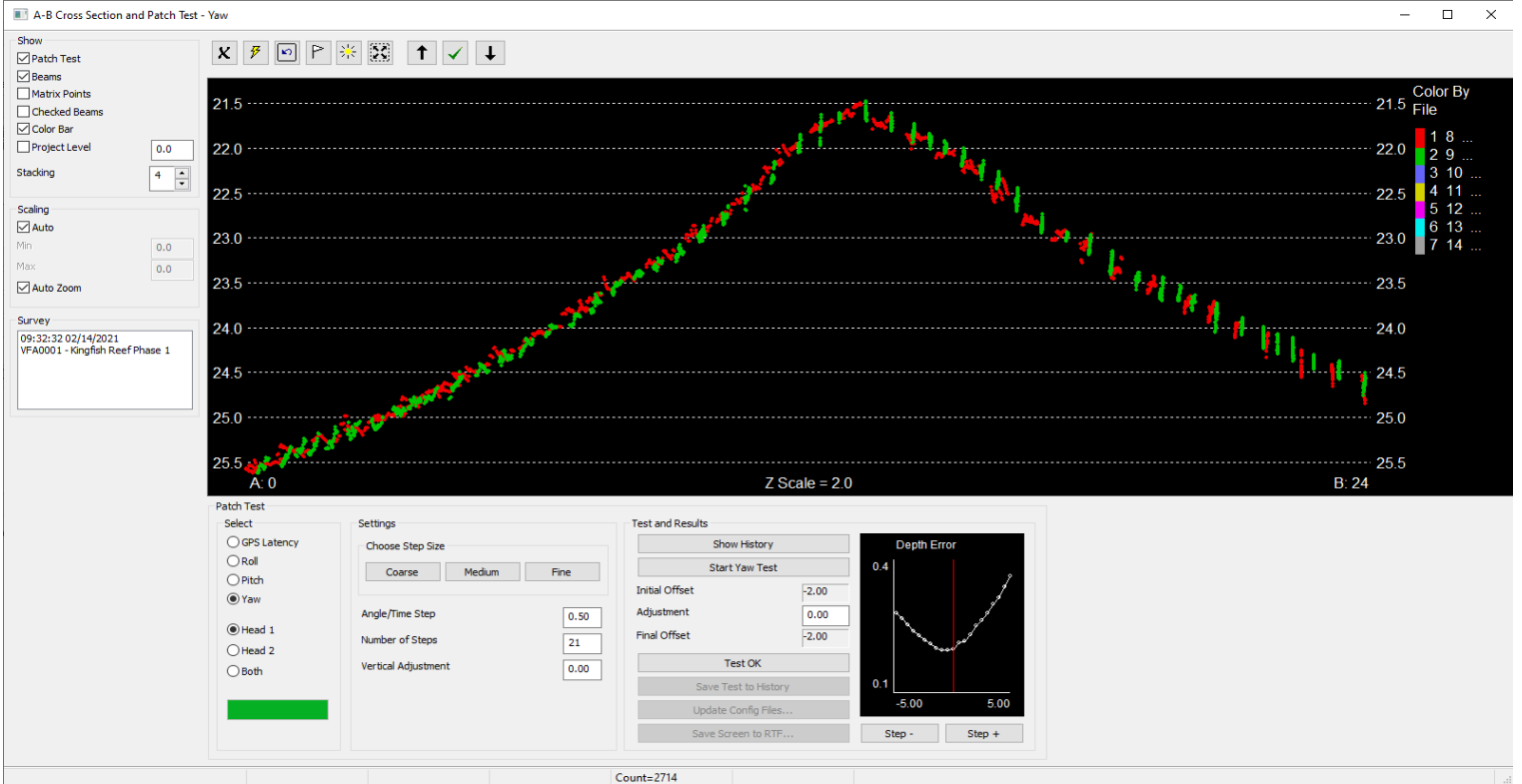


### STARBOARD SONAR HEAD

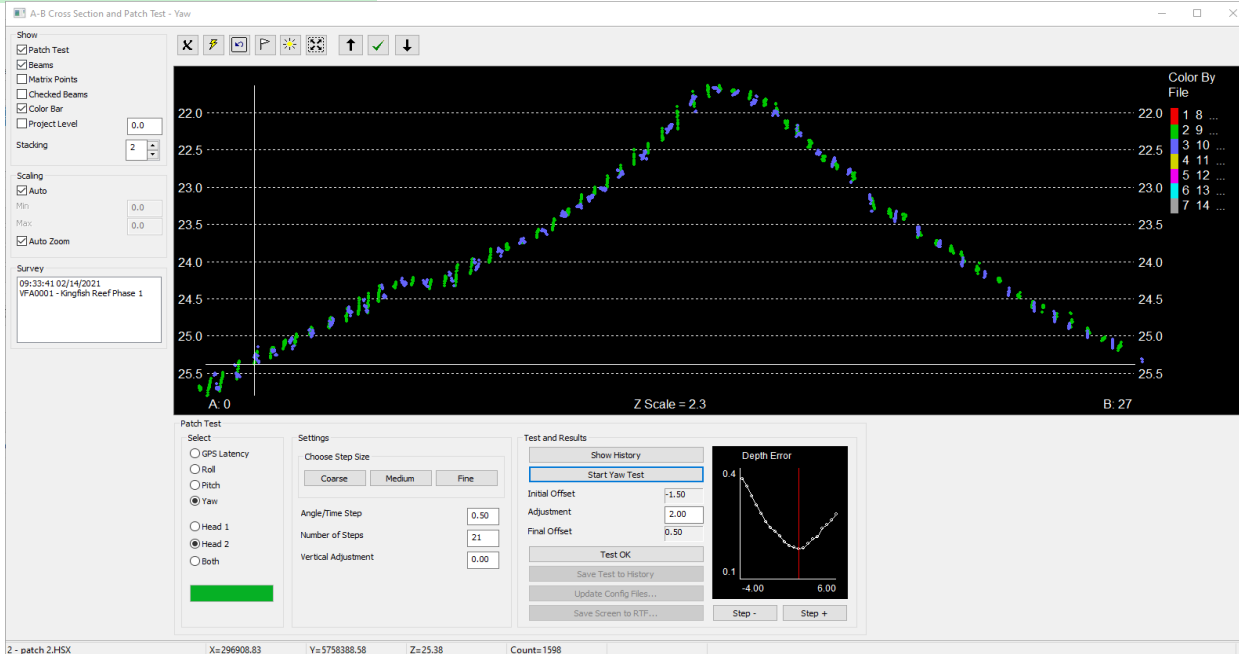


**SCREEN GRABS OF YAW VALIDATION**

**PORT SONAR HEAD**



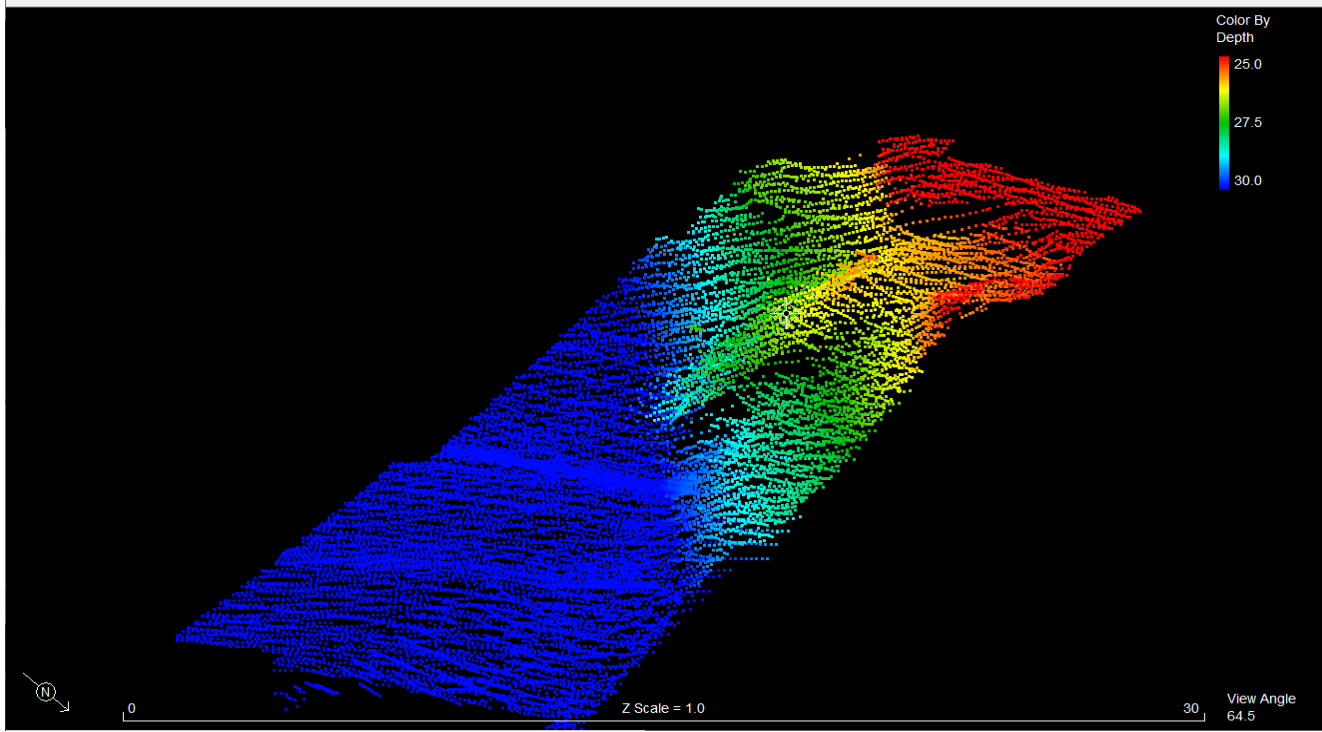
**STARBOARD SONAR HEAD**



**Feature**

A feature was identified on north-west edge of the hole, atop a the shelf at the following coordinates:

**E: 296743, N: 5758439      Approximate Depth 26 - 29m      Length = 7m      Width = 3m**



**Aspect/Slope Outputs**

Aspect and Slope outputs were derived from the final delivered bathymetric dataset. Data was gridded to 2m and imported into QGIS to generate the derived surfaces using QGIS's Raster Slope and Raster Aspect analysis tools.

**Deliverables**

- VFA0001 MGA94 Z55 Chart Datum 1m Median.xyz
- Report of Survey.pdf
- 5 x Survey Plans - Soft Copy

Sheet Number	File Name	Chart Scale / Sheet Size	Sounding Radius
1	VFA0001 - Bathymetry	1:1000 A1	10m Shoal Bias
2	VFA0001 - SBP Contours	1:1000 A1	N/A
3	VFA0001 - Backscatter	1:1000 A1	N/A
4	VFA0001 - Slope	1:1000 A1	N/A
5	VFA0001 - Aspect	1:1000 A1	N/A

*Tim Williams*

**Tim Williams** | Principal Hydrographer  
Certified Professional Hydrographic Surveyor – Level 2 (CPHS2)

