# SURVEY REPORT
# FOR THE
# OCEAN BOUNTY RIG MOVE TO
# THE GEOGRAPHE NORTH-1 LOCATION

HY15597-34

| | | |
|---|---|---|
| Client | : | Woodside Energy Limited<br>1 Adelaide Terrace<br>PERTH WA 6000 |
| Date of Survey | : | 21st to 30th September 2001 |
| Date of Report | : | 4th October 2001 |
| Checked | : | |
| Authorised | : | _____ |

## TABLE OF CONTENTS

Contents (continued)

## FIGURES



## TABLES



## APPENDICES

## ABSTRACT

*Between 21st and 30th September 2001, Fugro Survey provided equipment and personnel for the MODU Ocean Bounty rig move to the Geographe North-1 location in exploration permit VIC/P43, in the Otway Basin, Australia.*

*Surface positioning was achieved utilising Fugro Survey's Multi-Reference Differential GPS and Starfix Seis Navigation Software.*

*The final position for the drill stem derived from DGPS observations at the Geographe North-1 location was:*

| **Location Name:** | **GEOGRAPHE NORTH-1** |
|---|---|
| Easting: | 665 736.2 m |
| Northing: | 5 672 832.3 m |
| Latitude: | 39° 04' 39.928" S |
| Longitude: | 142° 54' 57.647" E |
| Rig Heading: | 248.4° (T) |

*This position is 5.6 m on a bearing of 240.0º (G) from the proposed Geographe North-1 location. All coordinates in this report are quoted in AGD84 datum and UTM Zone 54 (CM 141º) projection unless otherwise stated.*

# 1.0 INTRODUCTION

Fugro Survey Pty Ltd (Fugro) was contracted by Woodside Energy Limited (Woodside) to provide positioning services for the mobile offshore drilling unit (MODU) Ocean Bounty move to the Geographe North-1 location in exploration permit VIC/P43 in the Otway Basin, Australia.

A general location diagram is shown as Figure 1.

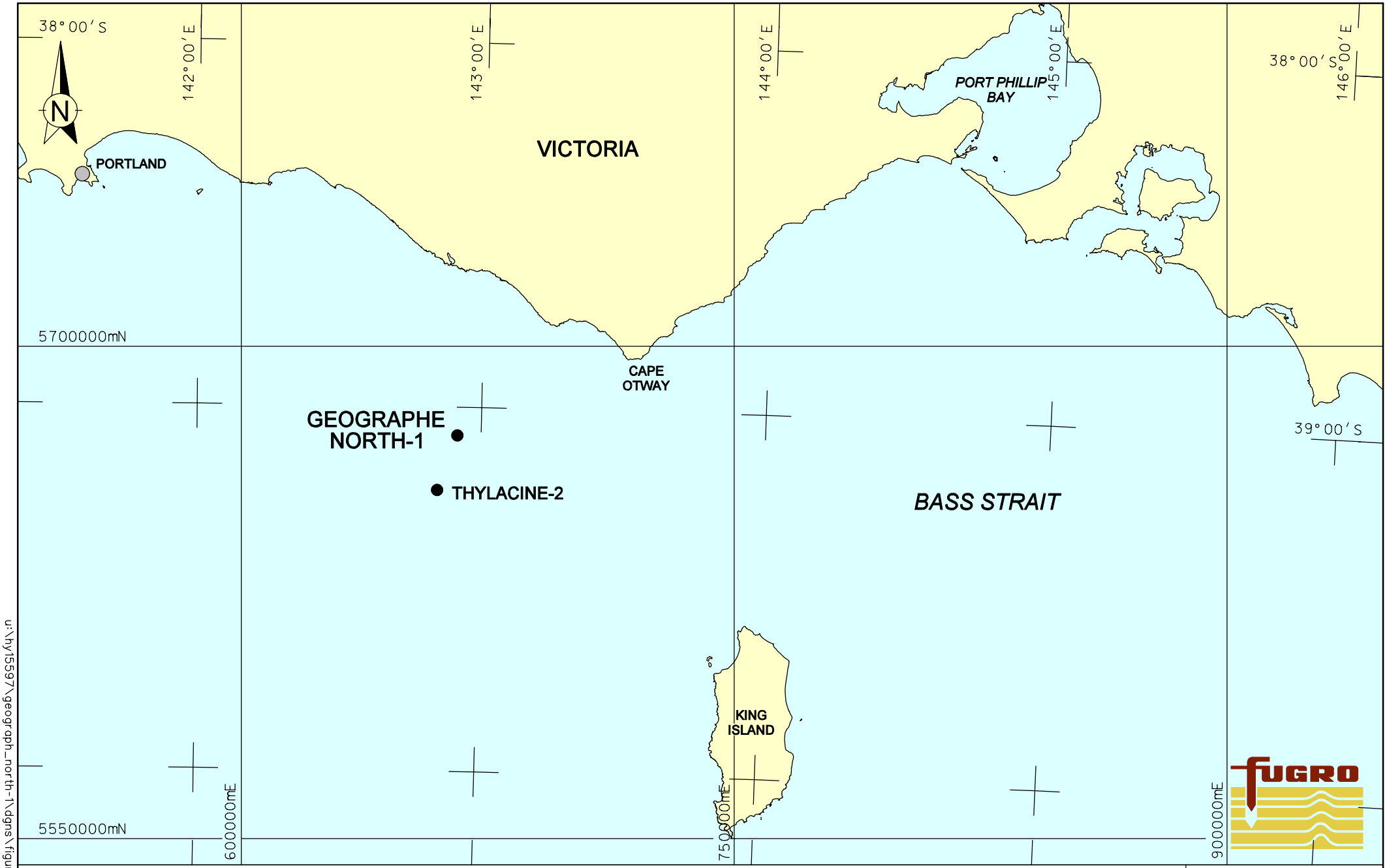
This report details equipment used, survey parameters adopted, procedures employed, and the results achieved. Safety is included in Section 7.0 of this report.

## 1.1 Scope of Work

Personnel and equipment were to be provided on a 24-hour per day basis for:

- Surface navigation for the Ocean Bounty using Fugro's Starfix Spot Differential GPS (Optus and Apsat satellites) and Multi Reference Differential Solution.
- Surface navigation for two AHV's and barge management system to send tow route and anchor locations from the survey computer to the AHV's.
- Final rig position calculation for the Geographe North-1 location using DGPS observations.
- Logging of GPS Phase data.

Woodside provided coordinates for the proposed Geographe North-1 location and Diamond Offshore supplied the proposed anchor pattern. These coordinates are located in Appendix B.




u:\hy15597\geograph_north-1\dgns\figure-1.dgn

GENERAL LOCATION DIAGRAM

FIGURE 1

## 1.2 Sequence of Events

| | |
|---|---|
| 21st September 2001 | Fugro personnel travel Perth to Melbourne. Standby in Airport Hilton for helicopter to rig. |
| 22nd September 2001 | Standby in Airport Hilton for helicopter to rig. |
| 23rd September 2001 | Helicopter to rig, anchored at Thylacine-2. Rig inductions. Power up survey equipment. |
| 24th September 2001 | Standby for anchor recovery operations. |
| 25th September 2001 | Standby for anchor recovery operations. Gyro and DGPS checks. Fire and abandon rig drills. Weekly safety meeting. |
| 26th September 2001 | Standby for anchor recovery operations. Pre rig move meeting. |
| 27th September 2001 | Commence anchor recovery operations at 1034 hrs. Tow bridle passed to Pacific Sentinel at 2236 hrs. |
| 28th September 2001 | Anchor recovery operations continuing. Last anchor off seabed at 0725 hrs. Rig towed to Geographe North-1 location. First anchor deployed by rig at 1637 hrs. Rig over location at 1703 hrs. Commence anchor deployment operations with AHV's. |

| | |
|---|---|
| 29th September 2001 | Complete anchor deployment at 0110 hrs. All anchor pre-tensioning complete and rig anchored over location at 0125 hrs. Demobilise survey equipment aboard Pacific Conqueror. Log data for final DGPS position. Demobilise survey equipment aboard rig and Pacific Sentinel. Log GPS phase data. Demobilisation complete at 2000 hrs. Standby for helicopter off rig. |
| 30th September 2001 | Fugro personnel transfer to Melbourne via helicopter, and return to Perth. |

Full details of Fugro involvement in the rig move are presented in the Daily Operations Reports included in Appendix A.

## 2.0 SURVEY PARAMETERS

All coordinates supplied in this report are referenced to the Australian Geodetic Datum 1984 (AGD84). The GPS is in reference to the World Geodetic System 1984 (WGS84).

### 2.1 Geodetic Parameters

| | | |
|---|---|---|
| **Datum** | **:** | **WGS84** |
| Reference Spheroid | : | World Geodetic Spheroid 1984 |
| Semi-major Axis | : | 6 378 137 m |
| Inverse flattening (1/f) | : | 298.257223563 |

The proposed drilling location and all project coordinates are quoted in the following coordinate system:

| | | |
|---|---|---|
| **Datum** | **:** | **AGD 1984** |
| Reference Spheroid | : | Australian National Spheroid (ANS) |
| Semi-major Axis | : | 6 378 160 m |
| Inverse flattening (1/f) | : | 298.25 |

| | | |
|---|---|---|
| **Projection** | **:** | **UTM** |
| False Easting | : | 500 000 m |
| False Northing | : | 10 000 000 m |
| Latitude of Origin | : | 0.0° |
| Central Meridian (CM) | : | 141° East |
| UTM Zone | : | 54 |
| Scale Factor on CM | : | 0.9996 |
| Units | : | International Metres |

**Datum Transformation**

The transformation parameters used for conversion from WGS84 co-ordinates, generated by the Differential GPS system, to AGD84 are listed below. Fugro follow the DMA convention for datum transformations.

| | | | | | |
|---|---|---|---|---|---|
| X Shift (metres) | = | +116.0000 | Rotation X (secs) | = | +0.2300 |
| Y Shift (metres) | = | +50.4700 | Rotation Y (secs) | = | +0.3900 |
| Z Shift (metres) | = | -141.6900 | Rotation Z (secs) | = | +0.3440 |
| Scale (ppm) | = | -0.0983 | | | |

## 2.2 Differential GPS Reference Stations

The reference stations listed in the table below were used in the computation of the Multi Reference DGPS position.

| Name | Site ID | Latitude | Longitude | Height (m) | Datum |
|---|---|---|---|---|---|
| Melbourne | 385 | 38°27'53.375" S | 144°54'46.909"E | 144.9 | WGS84 |
| Bathurst | 336 | 33°25'46.902"S | 149°34'01.960"E | 756.8 | WGS84 |
| Pt Augusta | 326 | 32°29'55.166"S | 137°46'31.459"E | 19.0 | WGS84 |

**TABLE 1 : DIFFERENTIAL GPS REFERENCE STATIONS**

## 2.3 Project Co-ordinates and Tolerances

Woodside supplied the proposed target coordinates for the Geographe North-1 location:

| GEOGRAPHE NORTH-1 | Easting | Northing |
|---|---|---|
| Proposed Wellhead | 665 741 m | 5 672 835 m |

**TABLE 2 : PROJECT COORDINATES**

Woodside specified the position tolerance for the rig's moon pool, at the sea surface, to be within ±25 m (radial) of the proposed location.

A rig heading of 250° was specified by Diamond Offshore.

Please refer to Appendix B for the full listing.

## 3.0 EQUIPMENT AND PERSONNEL

### 3.1 Equipment Listing

**Ocean Bounty**

2 x Starfix Seis navigation computers and monitors

2 x Starfix Spot (Optus) DGPS System c/w antennae, cabling and interfaces

2 x Starfix Spot (APsat) DGPS System c/w antennae, cabling and interfaces

2 x Trimble 4000 series GPS Receivers c/w antennae, cabling and interfaces

2 x Tokimec GM20/21 Gyro Compass

1 x PCTug computer and monitor (Spare)

2 x Remote Tug Tracking Telemetry Systems (radio/modem & antenna)

1 x Theodolite and tripod

1 x DeskJet Printer

**Pacific Conqueror and Pacific Sentinel (Anchor Handling Vessels)**

1 x PCTug navigation computer and monitor

1 x OmniSTAR*plus* Enhanced Differential System (EDS) unit c/w associated antenna, cabling and interfaces

1 x Remote Tug Tracking Telemetry System (radio/modem & antenna)

1 x Fluxgate Compass

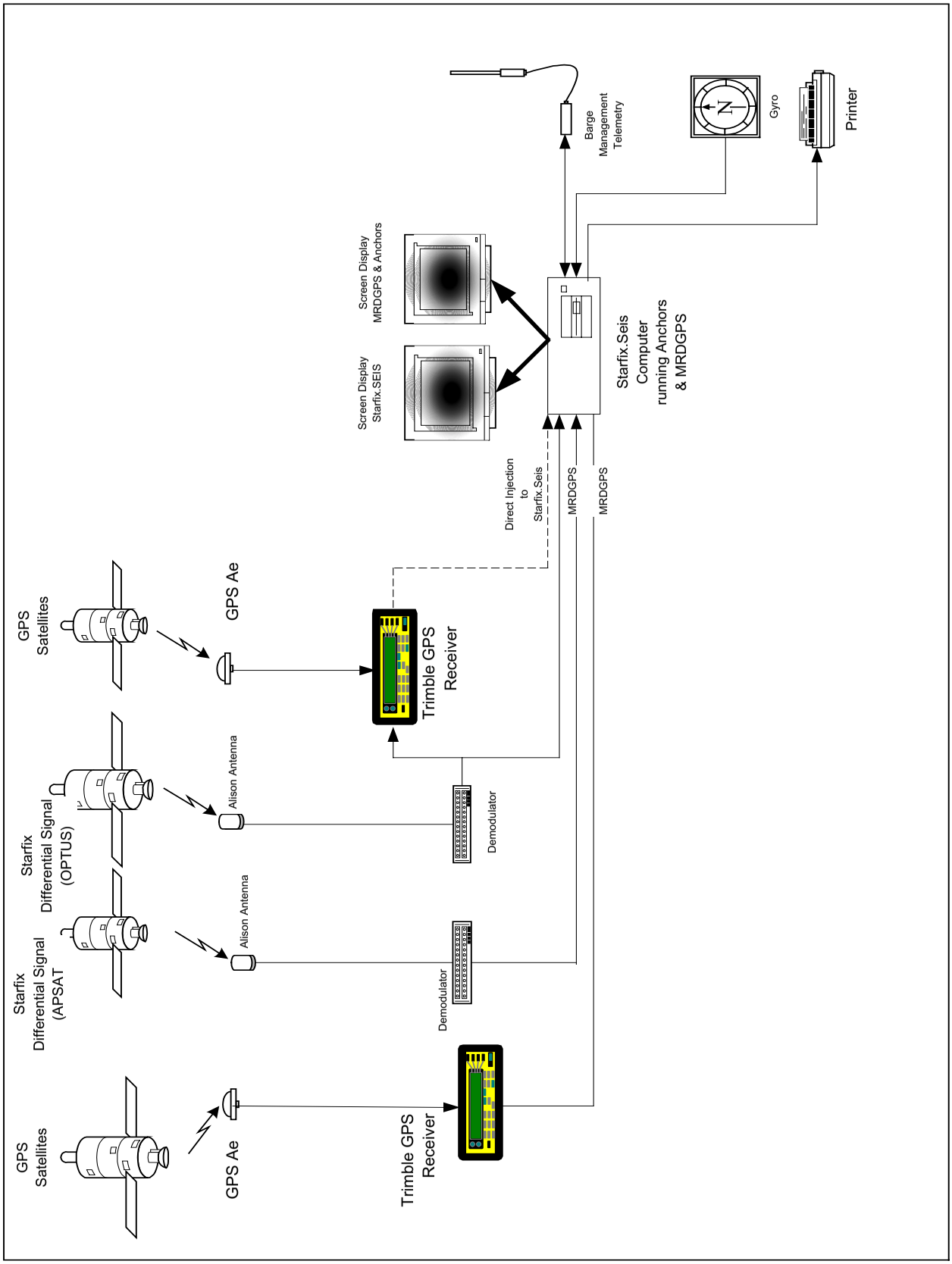
Please refer overleaf for equipment flow diagrams shown as Figures 2 and 3.

### 3.2 Vessels

The vessels used for anchor handling and towing of the Ocean Bounty were the Pacific Conqueror and Pacific Sentinel.

Refer to Figures 4, 5 and 6 for vessel offset diagrams.

## FIGURE 2 : EQUIPMENT FLOW DIAGRAM - OCEAN BOUNTY



## FIGURE 3 : EQUIPMENT FLOW DIAGRAM - AHV'S

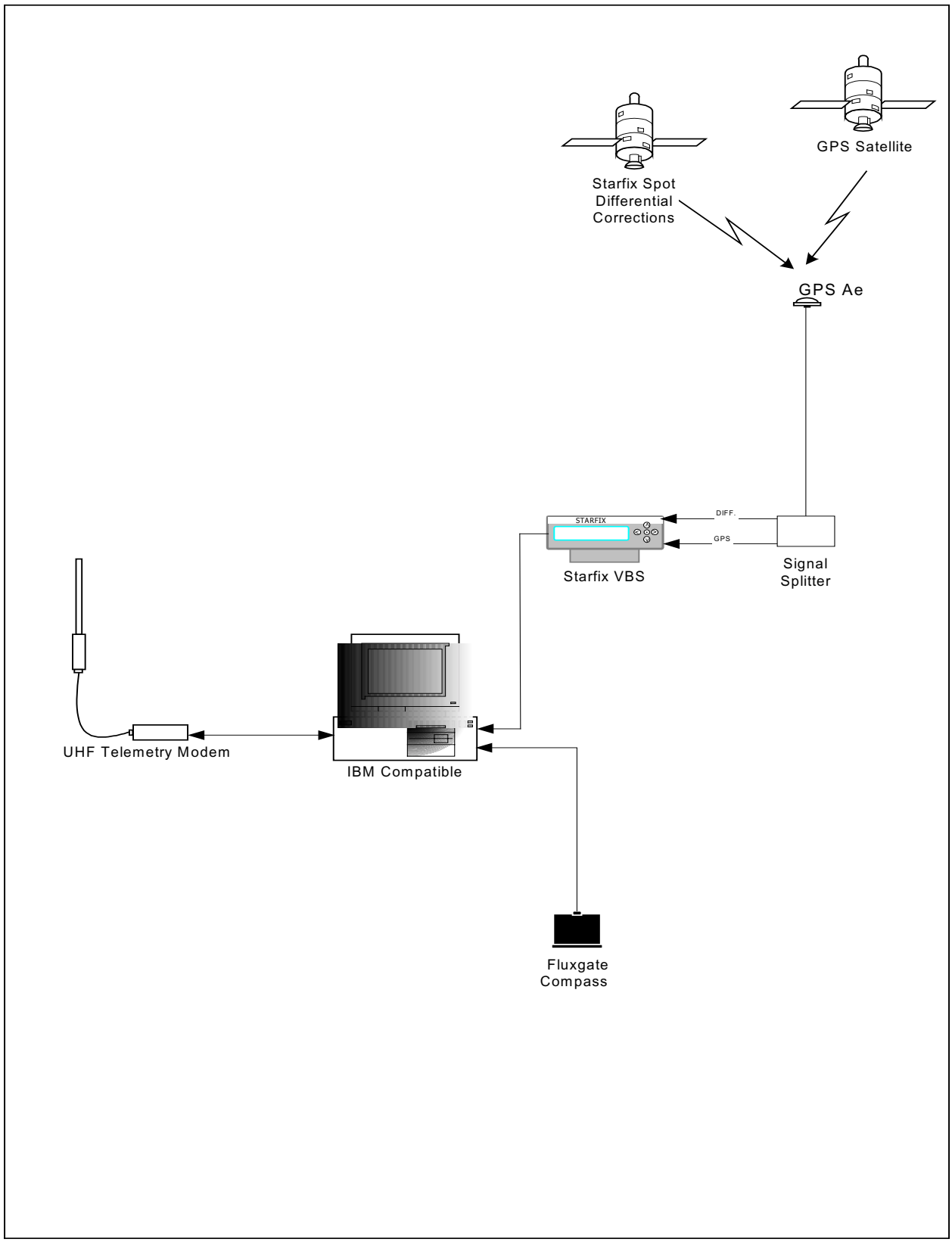


**FIGURE 4 : VESSEL OFFSET DIAGRAM - OCEAN BOUNTY**

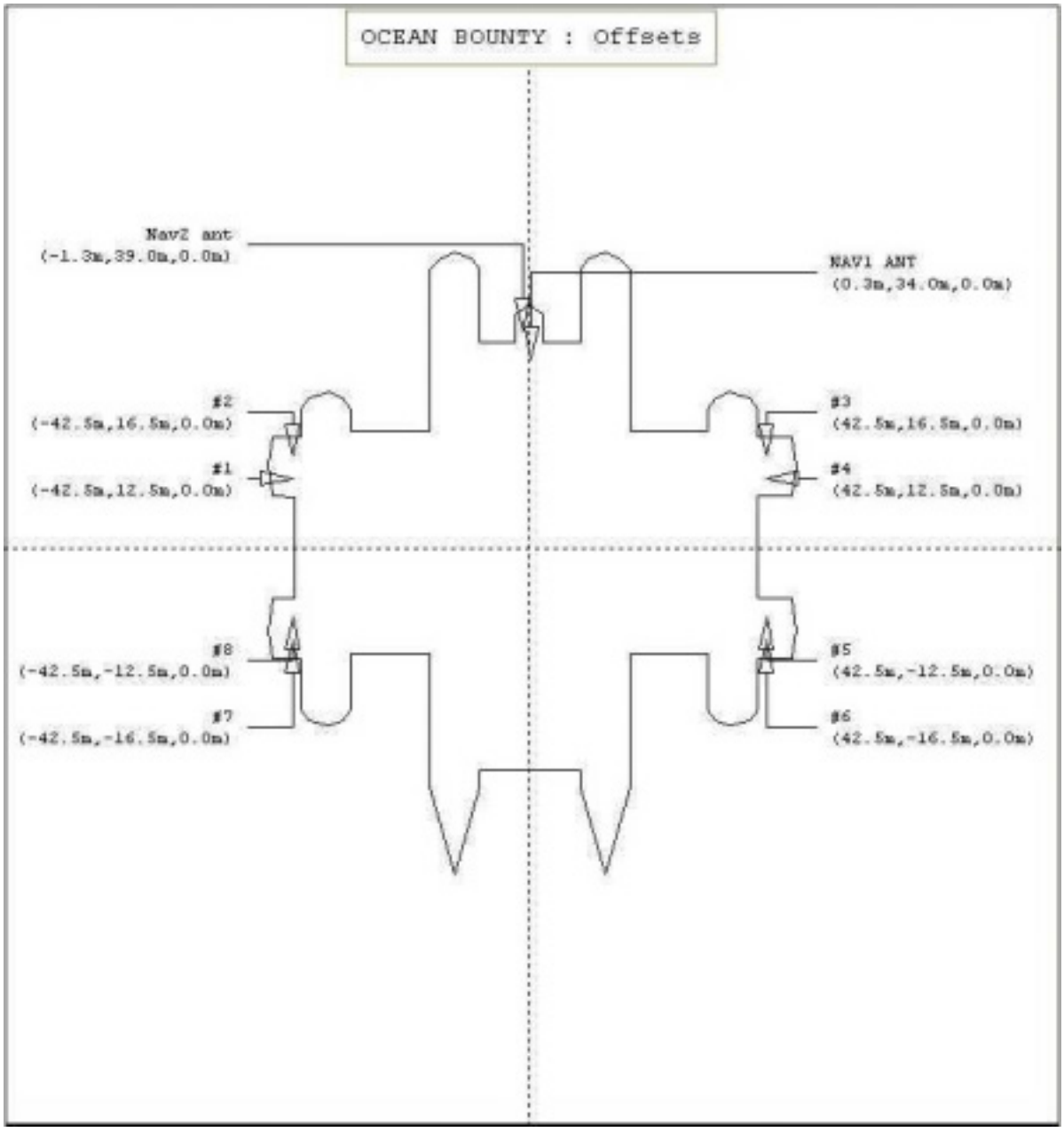


**FIGURE 5 : VESSEL OFFSET DIAGRAM - PACIFIC CONQUEROR**

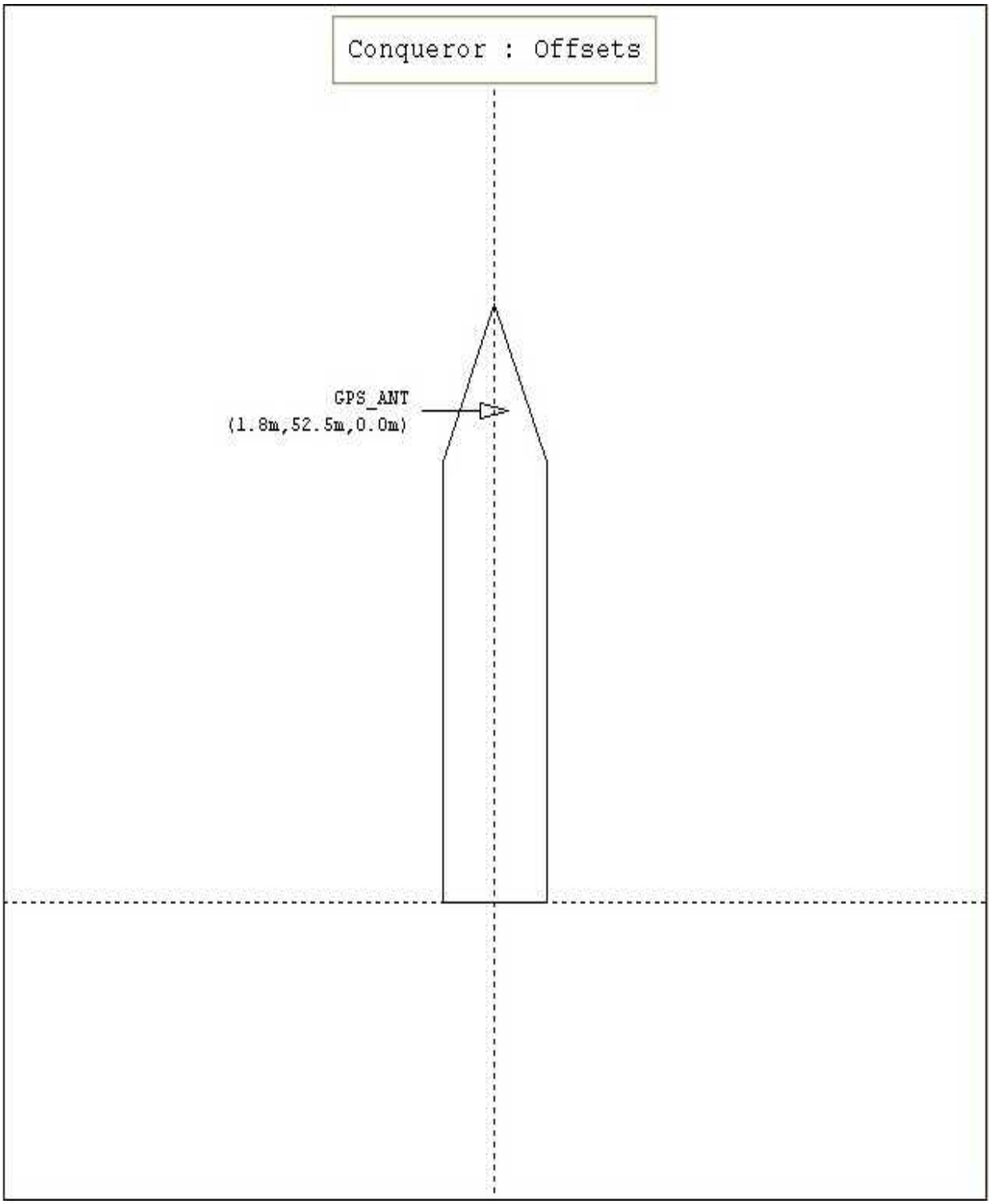
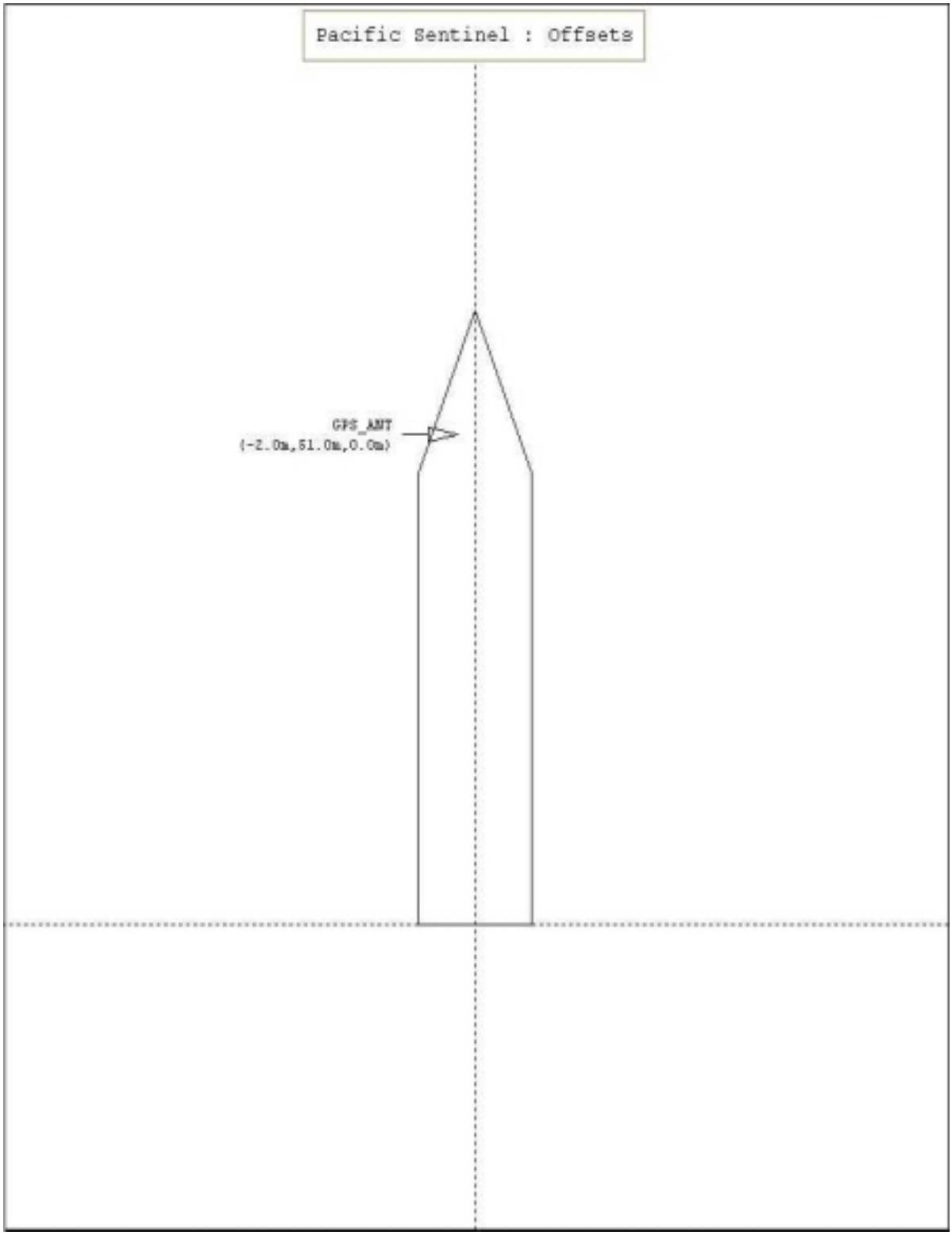


**FIGURE 6 : VESSEL OFFSET DIAGRAM - PACIFIC SENTINEL**



### 3.3 Personnel

Fugro personnel involved in this project were as follows:

| | | |
|---|---|---|
| J. McCawley | Party Chief/Surveyor | 21st to 30th September 2001 |
| P. Cronin | Technician/Surveyor | 21st to 30th September 2001 |

Woodside were represented during the rig move by:

| | | |
|---|---|---|
| A. Sellers | Survey Representative | 26th to 30th September 2001 |

## 4.0 EQUIPMENT CALIBRATIONS

### 4.1 DGPS Navigation Integrity Check

The primary navigation system comprised a Trimble GPS receiver and the Fugro Survey Multi Reference Differential GPS (MRDGPS) utilising reference stations at Melbourne, Bathurst and Pt Augusta. The secondary navigation system comprised a Trimble GPS receiver with single base station direct-injection RTCM corrections, from the reference station at Melbourne.

With the rig stationary and fully anchored over the Thylacine-2 location on 25th September 2001, the calculated datum position (drill stem) was logged for approximately thirty minutes. The calculated datum position from the primary and secondary positioning systems were then compared to each other. The two systems were found to be in good agreement. Refer to Tables 4 and 5.

| | Easting | Northing |
|---|---|---|
| Established Coordinates (Thylacine-2) | 659 564.5 m | 5 656 220.4 m |
| Observed Coordinates (Primary Navigation) | 659 567.6 m | 5 656 217.8 m |
| Differences (Established – Observed) | -3.1m | +2.6 m |

**TABLE 3 : COMPARISON TO ESTABLISHED POSITION**

| | Easting | Northing |
|---|---|---|
| Primary navigation (MRDGPS) | 659 567.6 m | 5 656 217.8 m |
| Secondary navigation (Direct Injection RTCM) | 659 566.3 m | 5 656 217.0 m |
| Differences | +1.3 m | +0.8 m |

**TABLE 4 : PRIMARY/SECONDARY SYSTEMS COMPARISON**

Please refer to Appendix C for details of the DGPS checks.

A positioning checklist was completed to ensure that correct antenna offsets, transformation parameters and UTM central meridian were being used in all calculations. The geodetic calculations were checked with both the online Starfix Seis navigation program and the offline GEO geodetic calculations program.

## 4.2 Gyro Compass Check

The calibration of the survey gyro compass was checked on 25th September 2001, while the rig was anchored at the Thylacine-2 location.
A series of observations were made to the sun, from which the rig heading was calculated. The calculated values were then compared to the observed gyro compass values logged in Starfix Seis. A mean C-O value of +3.72° was determined and added to the existing correction of +199.54°, giving a final correction of +203.26°. This value was applied as a correction in Starfix Seis.

Details of the observations, reductions and gyro calibration results are enclosed in Appendix C.

# 5.0 SURVEY PROCEDURES

## 5.1 Mobilisation

Fugro Survey personnel mobilised to Melbourne from Perth on 21st Septmber 2001. Fugro personnel transferred to the rig by helicopter on 23rd September whilst the rig was fully anchored at the Thylacine-2 location.

All survey systems had been installed for the move to the previous well. The rig's survey equipment was powered up on the 23rd September 2001 and all systems were confirmed as operational by 1900 hrs the same day. The survey equipment aboard the AHV's was confirmed as operational on the 24th September.

## 5.2 General Survey Procedures

Anchor recovery at Thylacine-2 location commenced on 27th September 2001, as drilling operations neared completion. The as-laid anchor positions were sent to each of the vessels, via the Starfix Seis system, to assist them in chasing out the PCCs along the chains and to recover the anchors. The last anchor was recovered at 0725 hrs on 28th September 2001 and the Ocean Bounty commenced the approximately 10 nautical mile tow to the Geographe North-1 location.

The rig deployed Anchor #7 from the fairlead as it was towed over the design location for the anchor, at 1637 hrs on the 28th September 2001. The AHV's continued to tow the rig until it was located over the proposed Geographe North-1 location and the required amount of chain had been paid out from winch #7. The Pacific Conqueror then rigged for anchor handling operations and proceeded to deploy Anchor #3.

For each anchor, the AHV's were given a waypoint with the corresponding runline through the PCTug system. The AHV's would then run out the anchor chain along this line until the desired amount of chain, as determined by the winch's cable counter, had been paid out from the rig. The anchor chain was then stretched out and the anchor lowered to the seabed with the vessel then stripping the chain chaser back to the rig.

After deployment of the anchor spread, anchors were storm tensioned and the rig's moon pool location was positioned over the proposed Geographe North-1 location. To facilitate positioning operations, the rig's drill stem position relative to the required location was displayed on the navigation monitor, which displayed the bearing and distance from the intended location both graphically and numerically.

The Ocean Bounty was positioned over the Geographe North-1 location and all anchoring and pre-tensioning completed by 0125 hrs on 29th September 2001. Final position data was logged between 0928 hrs and 1128 hrs on 29th September 2001. A field report was issued to the Woodside Survey Representative and the Woodside Wellsite Manager on 29th September 2001.

## 5.3 Demobilisation

All navigation systems onboard the Ocean Bounty, Pacific Conqueror and Pacific Sentinel were demobilised after positioning requirements had been completed. All survey equipment was boxed and packed in Fugro's shipping container for transport to Perth at 2000 hrs 29th September 2001.

Fugro personnel departed the rig on 30th September 2001 and returned to Perth the same day.

# 6.0 RESULTS

## 6.1 Final Position

The final position of the Ocean Bounty drill-stem was established by calculating the mean position from two hours of differential GPS data between 0928 hrs and 1128 hrs on 29th September 2001. During this period, calculated drill-stem coordinates from both the primary and secondary positioning systems were logged at one second intervals in Starfix Seis. Data from the primary positioning system was used for the final position calculation.

Differential corrections for the GPS positioning system were derived using a multi reference solution with base station data from Melbourne, Pt Augusta and Bathurst.

AGD84 geographical positions for the Geographe North-1 location are as follows:

| Position | Method | Latitude | Longitude |
|---|---|---|---|
| **Drill Stem @ Surface** | **DGPS** | **39° 04' 39.928" S** | **142° 54' 57.647" E** |
| Proposed Location | | 39° 04' 39.834" S | 142° 54' 57.844" E |

**TABLE 5 : AGD84 GEOGRAPHICAL POSITIONS FOR GEOGRAPHE NORTH-1**

AGD84 grid coordinates (CM 141° E) for the Geographe North-1 location are as follows:

| Position | Method | Easting | Northing | No. of Obs | Std. Dev. |
|---|---|---|---|---|---|
| **Drill Stem @ Surface** | **DGPS** | **665 736.2 m** | **5 672 832.2 m** | **7190** | **±0.60 m** |
| Proposed Location | | 665 741 m | 5 672 835 m | | |

**TABLE 6 : AGD84 GRID CO-ORDINATES FOR GEOGRAPHE**

**NORTH-1**

This position is **5.6m** at a bearing of **240.0°** (Grid) from the proposed Geographe North-1 location.

The rig position field report and final position fix data are enclosed in Appendix D.

## 6.2 Rig Heading

The heading of the Ocean Bounty was established by calculating the average heading from two hours of gyro compass data logged between 0928 hrs and 1128 hrs on 29th September 2001. During this period, gyro readings were logged at one second intervals in Starfix Seis.

The Ocean Bounty rig heading is as follows:

| Description | Method | Grid | No. Of Obs | S.Dev | |
|---|---|---|---|---|---|
| **Rig Heading** | **Gyro** | **248.4°** | **249.6°** | **7190** | **± 0.73°** |
| Proposed Heading | | 250° | | | |

**TABLE 7 : RIG HEADING**

## 6.3 Anchor Positions

The approximate locations of the Ocean Bounty anchors are shown below. These positions are derived from a position fix on the stern of the AHV at the time of anchor deployment on the seabed.

| Anchor | Easting | Northing | Bearing(T) | Deployed by |
|---|---|---|---|---|
| 1 | 665 479 m | 5 671 451 m | 189.8° | Pacific Conqueror |
| 2 | 664 855 m | 5 671 793 m | 220.3° | Pacific Conqueror |
| 3 | 664 301 m | 5 673 152 m | 280.3° | Pacific Conqueror |
| 4 | 664 619 m | 5 673 808 m | 309.6° | Pacific Conqueror |
| 5 | 666 037 m | 5 674 340 m | 010.5° | Pacific Sentinel |
| 6 | 666 630 m | 5 673 952 m | 038.6° | Pacific Sentinel |
| 7 | 667 106 m | 5 672 543 m | 099.6° | Ocean Bounty |
| 8 | 666 798 m | 5 671 880 m | 130.3° | Pacific Conqueror |

**TABLE 8 : ANCHOR POSITIONS**

## 7.0 SAFETY

All work undertaken by Fugro personnel during the project was conducted within the guidelines of Fugro Survey's Safety Policy as defined in Fugro Survey's Safety Manual (FSSM01) and Offshore Survey Safety Practices (FSSM06).

Fugro personnel worked within project safety guidelines and plans adopted by Diamond Offshore and Woodside.

Personal safety equipment was worn throughout the project as required.

No injuries involving Fugro personnel were reported during the project.

Fugro personnel participated in a fire and abandon rig drill on 25th September 2001. Fugro personnel also attended the rig's weekly safety meeting on the same day.

## 8.0 CONCLUSIONS

On reviewing the rig move operations undertaken by Fugro Survey for the Ocean Bounty, the following conclusions have been reached:

- The Ocean Bounty was successfully positioned on location within required tolerances.
- On demobilisation of the survey equipment, the antenna cables into the pilothouse were left in place due to the semi-permanent nature of the installation. For future rig moves involving Fugro Survey, the cable lengths and runs will be refined in consultation with Diamond Offshore to meet the rig's requirements.