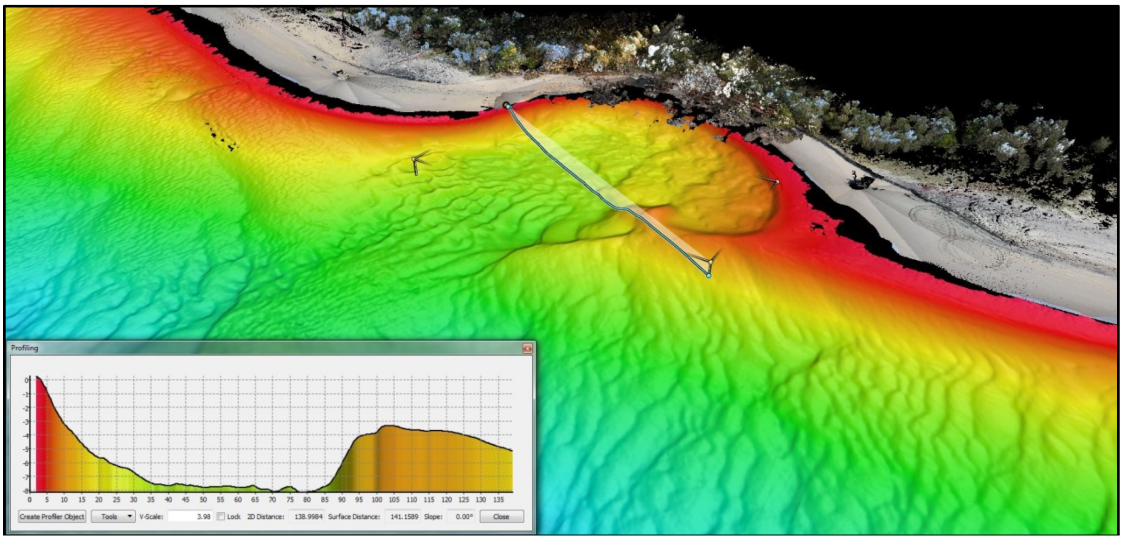
Port of Brisbane Pty Ltd

Combined High Resolution Multibeam and Vessel Mounted & Terrestrial Laser Survey of Inskip Point

Survey Report

Queensland Parks and Wildlife Service - October 2015



Port of Brisbane Pty Ltd. Hydrographic Solutions - Locked Bag 1818. Port of Brisbane QLD. Australia 4178. Phone +61 7 3258 4800. www.portbris.com.au

Blank Page

Contents

List of Appendices

1.0 Introduction

This document outlines the Survey Works performed by the Port of Brisbane Pty Ltd (PBPL) whilst carrying out a combined high resolution multibeam and vessel mounted & terrestrial laser survey of the northern side of Inskip Point on the Inskip Peninsula. The survey would be used to provide point data along the length of the northern side of the Inskip Spit. It includes approximately 200m of hydrographic data parallel to the shore line and topographic data filled in using a combination of vessel mounted terrestrial laser and stationary terrestrial laser techniques.

All hydrographic survey operations are prepared and executed in accordance with the Maritime Safety Queensland (MSQ) “Standards for Hydrographic Surveys within Queensland Waters”.

2.0 Personnel

Hydrographic surveys undertaken by PBPL are only to be performed by experienced and suitably trained employees. All hydrographic surveyors employed by the Port of Brisbane have Tertiary level survey degrees or Post Graduate degrees. In addition, hydrographers are either Certified Professionals (Level 1) from the Australasian Hydrographic Surveyors Certification Panel (AHSCP) or undergoing certification. A Certified Hydrographic Professional (Level 1) will supervise all field work, processing and reporting on this project. Personnel involved or providing support with this project were:

Manager Hydrographic Surveys

Giles Stimson - Certified Professional in Hydrographic Surveying (Level 1)

Project Manager

Robert Slater - Certified Professional in Hydrographic Surveying (Level 1)

Supervising Surveyor

Aaron Willcock - Certified Professional in Hydrographic Surveying (Level 1)

Field Surveyor

John Wylie - 10 years hydrographic experience

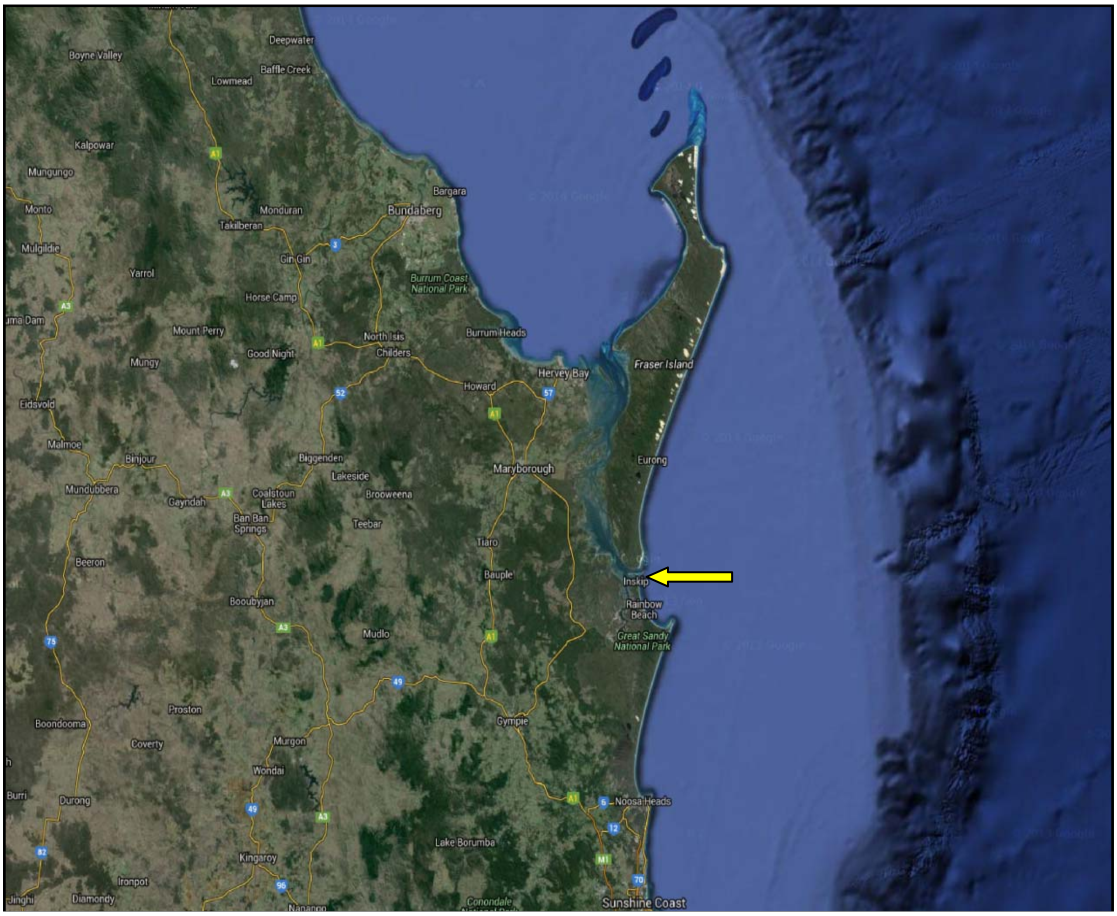
Only the people listed above performed survey operations in accordance with the scope of works previously supplied by PBPL. By signing the survey reports and plans, the Survey Manager, Project Manager and Supervising Surveyors declare that the survey meets the requirements for the declared survey class as defined in “Standards for Hydrographic Surveys within Queensland Waters"

3.0 Methodology

3.1 Site Conditions

The survey area is located in the Great Sandy National Park and is on Inskip Point. The location of the site is shown in Image No.1 below and is approximately 300km north from the Port of Brisbane's Operation Base.

The requirement was to detail the shoreline, including the recent sink hole that has formed to the north of the spit, and provide information to the client & consultant.



(Image No.1) Location of the Proposed Survey Area – Inskip Point

Image No.2 shows the approximate survey area (yellow line) which is approximately 2.8km along the point's beach line. The site is approximately 3 km from the Inskip boat ramp, which is to south of the site on the inner side of the spit.

(Image No.2) Extract of Inskip Point from Google Earth

3.2 Scope of Works

The brief on the project was to carry out a Class 'A' Shallow water Multibeam and Vessel mounted Terrestrial Laser survey of 2.8km of the Northern Shoreline of Inskip Point. The survey would extend out approximately 200m from the shoreline. PBPL would also conduct an additional Land Based Terrestrial Laser Survey with integrated photography.

3.3 PBPL Survey Vessel

The "Navigator" (7m) was the vessel used to undertake hydrographic survey work. It is fitted out with a RESON 8125 Hybrid shallow water multibeam system and an Applanix POSMV motion sensor.

(Image No.3) PBPL 7m Survey Vessel “The Navigator”

The multibeam sonar head is mounted in a purpose built moon pool and is permanently tilted at an angle of 15° towards starboard. The RESON 8125 Hybrid system is capable of horizontally steering the sonar ping electronically, enabling the surveyor to choose in real-time whether they want to survey directly below the vessel or to the side. The location of the moon pool is close to the centre of gravity of the vessel to enable maximum stability and accuracy of acoustic data collected. The precise positioning of all soundings is achieved by using an Applanix POSMV motion sensor system.

A Riegl VZ-2000 Laser Scanner was mounted to the roof of the Navigator at a 15° pitch to help pick up circular vertical objects like light posts and beacons. The VZ-2000 contains a Class 1 Laser with a maximum measurement range of up to 2000m. The laser has a measurement rate of up to 230,000 measurements per second at a range of 750m with a 100° Field of View. This provided an extremely high detail dataset of the Inskip coastline within the survey area.

(Image No.4) Laser mount configuration on the 'Navigator"

The "Navigator" was towed to Rainbow Beach with a PBPL 4WD. See Appendix A for the Navigator Node Locations and Appendix B for the QINSY Vessel Database (db) file.

3.4 Equipment Listing

Survey Vessel

- Multibeam Echosounder:
  - RESON 8125 Hybrid
- Laser Scanner
  - Riegl VZ-2000
- Positioning System :
  - Applanix POSMV 320 V5
- Seabird SBE-37 Sound Velocity Sensor
- Intuicom RTK Bridge for receiving SmartNet Corrections
- YSI Castaway CTD Sensor
- QINSy Acquisition software
- Applanix POSView

Data Processing

- QINSy Processing Manager and Qloud
- Hysurv Survey Software
- Bentley Microstation
- QINSy Fledermaus
- Applanix POSPAC
- Riegl RiScan

Land Survey

- Trimble R8 GNSS Receiver
- Laser Scanner
  - Riegl VZ-2000
  - Nikon D610 Camera

3.5 Survey Checks and Calibrations

3.5.1 Patch Test

To calculate the mounting angle corrections associated with the multibeam transducer/vessel mounted laser scanner with respect to the motion sensor, an industry standard patch test was conducted prior to the Inskip Point Beach survey.

The Port of Brisbane conducts regular patch tests on all its multibeam vessels over a well-known site in the Brisbane River, with the average calibration angles used. The roll angle was calculated with two lines run in opposite directions over the deeper flat seabed patch. For pitch to be calculated, two lines over the top of the rock high spot run in opposite directions were collected. For Yaw to be calculated, 2 lines run either side of the rock high spot in the same direction were collected. For the tilted head patch test, electronic steering in the echosounder was applied for the Yaw run-lines in order to be able have appropriate multibeam overlap over the rocky outcrop. See Table 2 below for the current Patch Test results for the Navigator Survey Vessel used for survey.

Navigator Patch Test Values	
RESON 8125 Hybrid	
Roll	-15.41°
Pitch	-1.13°
Yaw	+0.47°

(Table No. 1) Navigator Multibeam Patch Test Values

A similar process was conducted with the laser patch test with the exception of using terrestrial targets instead.

Navigator Patch Test Values	
Riegl VZ-2000 Laser	
Roll	+0.67°
Pitch	+15.60°
Yaw	-1.23°

(Table No. 2) Navigator Laser Patch Test Values

3.5.2 RTK GPS Corrections and Position Checks

The Port of Brisbane subscribes to the SmartNet DGNSS RTK CORS network for RTK corrections. For the Inskip Point Beach survey, Smartnet's Nearest Base Station corrections were utilised in Real-Time online and then the survey position results post-processed back in the office. To check the online positional accuracy of the Survey Vessel systems, position checks were conducted by logging GPS positions (using Smartnet corrections) on a permanent survey mark (PSM121815) located at the Inskip Point. Two other PSM's were investigated in the area but could not be found. See Appendix C for the PSM Information and the Permanent Mark checks conducted by PBPL.

3.5.3 Multibeam Bar Check

An industry standard bar check is conducted every time the multibeam transducer is removed from the mount. This was completed prior to conducting the Inskip Point Beach survey. A metal bar is lowered to 3m below the multibeam transducer. The multibeam is set to a range that zooms in enough to see the bar in the echosounder display. The power and gain settings are adjusted to remove as much of the noise artefacts and second returns as possible. In the multibeam echosounder display, the bar depth as well as the Beam Number that picks up the bar the best are noted. Using the Time Plot Display in QINSy, the system raw data and system results for that particular Beam number are averaged over approximately 1 minute or until the Standard Deviation of the measurements is as low as possible. The Raw multibeam value should match the echosounder display as a check. The Multibeam System Results show the Depth of the Bar that QINSy calculates (Reduced to Water Level).

The QINSy Mean Bar Height is calculated by:
Raw Multibeam Depth + Z Value of Transducer -Draft = QINSy Bar Depth
Note that a Positive Draft value in QINSy refers to the Centre of Gravity (COG) being above the water, where the COG is the IMU of the POSMV.

3.5.4 Squat Measurement

Squat is the amount the vessel moves vertically at the Centre of Gravity (COG) location, as the survey vessel changes speed through the water. On the PBPL survey vessels, the Applanix POSMV IMU is set as the COG in QINSy. Squat tests are performed yearly for each of the PBPL survey vessels and when major changes are made to that vessel that may affect the squat profile. Squat tests are performed using RTK GPS Heights and measuring the height of the COG (IMU) at different speeds. A squat profile for each multibeam vessel has been measured for each RPM value of the vessel. Squat is only applied when RTK Heights are not used for survey. The vessels RPM is noted for every survey line in the field book.

3.5.5 Draft Measurement

On every PBPL Survey vessel, a Draft measurement node is picked up when the node survey is conducted (see Appendix A). These Draft measurement nodes are always in the vessels moonpool as close to the transducer as possible. With a tape measure, the water level is measured before the vessel departs from the wharf and the measurement is subtracted or added from the Draft Node Z Height. This calculated Draft is then entered into the vessel Database (db) file before the commencement of the survey and noted in the fieldbook.

3.5.6 Motion Sensor Calibrations

An Applanix POS MV is permanently installed on-board the “Navigator” survey vessel. The POSMV requires a GPS Azimuth Measurement Subsystem (GAMS) calibration whenever the GPS antennas are removed. This involved putting the vessel through a series of dynamic manoeuvres, such as ‘figure of eights’ and varying the speed of the vessel to give the motion sensor system enough information to resolve the ambiguities and commence full system operation. The GAMS uses both the primary and secondary GPS antennas to determine a GPS-based heading that is accurate to ±0.02° and their separation represents the length of the baseline vector for the system. The calculated distances of the GAMS calibration was compared to the offset tape measurements and proved to be to be within the 5mm tolerance recommended by the manufacturers. With the baseline and offsets resolved, the system was fully operational according to manufacturer's specifications.

3.6 Field Operations

The survey team departed Fisherman Islands, Brisbane on the 14th October and arrived onsite before midday. The survey vessel "Navigator" was dropped at National Parks depot south of Rainbow Beach and the stationary stop go laser survey was commenced. The tide was ebbing so this was the most advantageous time to be performing laser operations as maximum coverage would be obtained at low tide.

On the 15th October the survey vessel was launched early in the morning at Rainbow Beach boat ramp. Travel time to Inskip point by water was about 30 minutes. Once on site a tide gauge system was deployed and all necessary checks were made to ensure a high standard of data quality. The hydrographic survey was started at 8:00 am to coincide with high tide which was at 9:04 am. This allowed a large portion of the intertidal zone along the 2.8 km beach to be surveyed. The hydrographic survey was completed for the day at 11:30 am and the vessel mounted laser survey was started. One run line in both directions along the survey area was performed. Once completed the equipment including the tide gauge were demobilised and the vessel returned to Rainbow Beach boat ramp.

In the afternoon the remainder of the stationary stop go laser survey was completed. Laser data was checked onsite to ensure that as much of the intertidal and sand-dune areas was captured.

On the 16th October the survey vessel was again launched early in the morning at Rainbow Beach boat ramp. The tide gauge was once again deployed and hydrographic survey operations were recommenced. This was mainly to fill in any gaps that were unsurveyed from the previous day's work and to utilise high tide which occurred at 9:30 am. The survey was completed by 11:00 am and the vessel was demobilised and trailered back to Brisbane in the afternoon.

3.7 Hydrographic Survey - Multibeam Component

As per the scope of works, the Port of Brisbane was responsible for providing an accurate Class 'A' multibeam survey of Inskip Point Beach area.

3.7.1 RESON 8125 Hybrid Technical Specifications

- Frequency = 455 kHz
- Ping Rate = Up to 50 pings/second
- Beam Density = 256 Beams
- Swath Width = 120°
- Along Track Transmit Beamwidth = 1.0°
- Across Track Receive Beamwidth = 0.5° (at nadir)
- Depth Resolution* = 6mm
- Pulse Length Used = 51 μsec

* Depth Resolution refers to the sensors measurement accuracy and not the absolute survey accuracy. Refer to the Survey Accuracy Section on page 20.

3.7.2 Sound Velocity

The multibeam system is calibrated using an industry standard Patch Test, in conjunction with regular water column sound velocity profiles at the survey site. A Seabird SBE37 sound velocity sensor is mounted at the transducer head, in order to measure instantaneous sound velocity, which is interfaced to the sonar processor for the integral 'beam-forming' process of the system to occur. The water column sound velocity profiles were measured with an YSI Castaway Sound Velocity profiler. Velocity profiles were conducted before and during survey operations. The sound velocity was monitored throughout the survey and new velocity profiles were conducted when noticeable differences in sound velocity occurred.

3.7.3 Seabed Coverage

During multibeam survey operations, adjacent multibeam lines were carried out in order to ensure that the minimum depth has been determined and to provide data redundancy enabling the detection of errors and inconsistencies. The survey vessel operated no faster than 5 knots while conducting multibeam surveying operations. Surveying was conducted at varies run line centres due to dynamic depth changes to ensure full esonification was achieved of the seabed structures within survey area.

3.7.4 Method to Compensate for Vessel Motion

When using the RESON 8125H Multibeam Echosounder, vessel position and motion compensation were provided by an Applanix POS MV 320. The motion sensor provides accurate attitude, heading, heave, position and velocity data to be interfaced with the other vessel sensors. This is calibrated during the patch test process, GAMS calibration and by analysis of overlapping data.

3.7.5 Horizontal Positioning

SmartNet Nearest BaseStation corrections were used to provide RTK positioning in conjunction with the motion sensors throughout the multibeam surveys. The Inertial Navigation System (INS) provides a positional accuracy better than ±0.10m (at 95% confidence interval).

Survey data was rejected at any time during the survey when any of the following conditions were experienced:

- Real Time Kinematic (RTK) correction age greater than 15 seconds
- Positional Dilution of Precision (PDOP) exceeded 6.0
- Less than 5 Healthy satellites were being tracked at elevations of no less than 13° from the horizontal.

3.7.6 Applanix POSMV 320 Technical Specifications

- Horizontal Position Accuracy* : RTK = ±0.008m + 1 ppm x baseline length
- Vertical Position Accuracy* : RTK = ±0.015m + 1 ppm x baseline length
- Roll & Pitch Accuracy : 0.01°
- Heave Accuracy : 2 cm (True Heave)

* Horizontal and Vertical Position accuracy refers to the sensors measurement accuracy and not the absolute survey accuracy. Refer to the Survey Accuracy Section on page 20.

3.7.7 Connection to Vertical Datum

Survey work was conducted using RTK corrections for the vertical datum connections. Regular checks were made and recorded against the PBPL measured tides throughout survey operations.

When using RTK GPS, the vertical component of the position solution may be used to connect soundings to the vertical datum. The AUSGeoid09 model was applied to the raw RTK GPS height to connect to the AHD vertical datum. The Lowest Astronomical Tide (LAT) datum is defined by MSQ as 1.12m below 0.0m AHD at Inskip Point.

3.8 Hydrographic Survey - Laser Scanning Component

The combination of surveying with sideward looking multibeam at high tide and laser scanning at low tide allows the entire intertidal surf zone slope to be surveyed.

The requirement was to pick up as much data of the Inskip Beach area, above and below water, as possible. The laser data was collected at lower tides to try to join with the multibeam data for both coverage and data integrity.

3.8.1 Riegl VZ-2000 Laser Scanner Technical Specifications

- Classification : Class 1 Laser Product according to IEC60825-1:2007
- Scan Angle Range : Total 100° (+60° / -40°)
- Scanning Mechanism : Rotating Multi-facet mirror
- Scan Speed : Up to 240 lines/second
- Effective Measurement Rate : Up to 396,000 measurements/second at 1MHz
- Angle Measurement Resolution : Better than 0.0015°
- Laser Wavelength : Near Infrared
- Beam Divergence = 0.3mrad
- Accuracy* = 8mm
- Precision = 5mm

* Accuracy refers to the sensors measurement accuracy and not the absolute survey accuracy. Refer to the Survey Accuracy Section below.

3.8.2 Scanning Coverage

At least two overlapping laser lines were carried out along the beach area in order to capture as much data in and around structures and to provide data redundancy which enables the detection of errors and inconsistencies. During survey operations, the survey vessel operated no faster than 5 knots. Run lines for the laser scanner surveys were generally conducted as close to the beach as safely possible.

3.8.3 Method to Compensate for Vessel Motion

When using the Riegl VZ-2000 Laser Scanner, vessel position and motion compensation were provided by an Applanix POS MV 320. The POSMV provides accurate attitude, heading, heave, position and velocity data to be interfaced with the other vessel sensors. This is calibrated during the patch test process, and by analysis of overlapping data.

3.8.4 Horizontal Positioning

Trimble RTK positioning was used in conjunction with an Applanix POSMV motion sensor throughout the laser scan surveys.

Survey data was rejected at any time during the survey any of the following conditions were experienced:

- Real Time Kinematic (RTK) correction age greater than 15 seconds
- Positional Dilution of Precision (PDOP) exceeded 6.0
- Less than 5 Healthy satellites were being tracked at elevations of no less than 13° from the horizontal.

3.8.5 Connection to Vertical Datum

The Laser Scan Survey work was conducted using only RTK corrections for the vertical datum connections. Regular checks were made and recorded against the local tides measured onsite when the vessel was surveying afloat.

When using RTK GPS, the vertical component of the position solution may be used to connect the laser data to the vertical datum. The AUSGeoid09 model in conjunction with the LAT to AHD differences for the survey area, as supplied by MSQ, were applied to the raw laser data from the laser scanner together with RTK GPS heights to give real time heights reduced to the vertical datum.

3.9 Terrestrial Laser Scanning Component

In conjunction with the hydrographic survey component, a Vehicle mounted laser scan was conducted to provide high accuracy laser data around the beach areas that could not be scanned from the vessel.

3.9.1 Vehicle Mounted Terrestrial Laser Survey Configuration

Image No.5 below shows a typical setup of the terrestrial laser mounted on a survey vehicle. The vehicle mounted configuration allows the beach line to be surveyed with the laser in the same geodetic reference as surveyed with the vessel system. A high resolution camera was also installed and interfaced to collect high resolution photography to be merged with the laser data.

(Image No.5) A typical laser mount configuration on a survey vehicle

3.9.2 Terrestrial Laser Survey Data Collection

The laser system was installed on a PBPL vehicle and the RTK "stop and go" method was undertaken along the beach shoreline using multiple setups. High Resolution photos were collected in conjunction with the laser data to be used in the processing procedure of colouring the laser points files with the actual colour.

The laser data was acquired using the RiSCAN software which is standard for Riegl terrestrial laser units. At each scan position, the laser and calibration target position was measured prior to scanning with an RTK GPS Position using the Smartnet Nearest Base Corrections. At each scan position along the beach, the laser would collect data from 30^0 to 130^0 in the vertical with a spacing 0.040 of a degree at the laser. The horizontal was scanned from 0^0 to 360^0 also with a spacing of 0.040 of a degree. This provides a representative 3D snapshot of all objects within the field of view the instrument at the time of acquisition. Using the software the reflective target positioned on the vehicle is located in the scanned image and a high resolution scan is conducted.

4.0 Project Configuration

4.1 Geodetic Parameters

All coordinates supplied in this report are referenced to the Geocentric Datum of Australia (GDA94), which is based on the global mathematical reference frame ITRF92 (fixed to a number of points in Australia). All surveys were referenced to GDA94 by connection to suitable benchmarks. The geodetic parameters are listed below:

Datum :	**WGS84**
Reference Spheroid :	World Geodetic Spheroid 1984
Semi-Major Axis :	6378137.000m
Inverse flattening (1/f) :	298.257223563

Datum :	**GDA94**
Reference Spheroid :	Geocentric Reference System 1980 (GRS80)
Semi-Major Axis (a) :	6378137.000m
Inverse flattening (1/f) :	298.257222101

Projection :	**Universal Transverse Mercator**
Grid :	Map Grid of Australia (MGA94)
Central Meridian (CM) :	153° East (UTM Zone 56)
Origin Latitude :	0°
Hemisphere :	South
False Easting :	500000m
False Northing :	10000000m
Scale Factor on CM :	0.999600
Units :	International Metres

4.2 Vertical Datum

Soundings are reduced to Lowest Astronomical Datum (LAT) using the AUSGeoid 2009 model. 0.0m LAT is 1.12m below 0.0m AHD (Australian Height Datum) as defined by MSQ.

5.0 Survey Data Processing Procedures

5.1 Bathymetry and Vessel Laser Processing

All bathymetric survey data collected was processed in QINSy Processing Manager and QLOUD. QINSy Processing Manager was used to conduct tide checks, squat comparisons and apply Post Processed GPS (SBET) tracks to the survey files. Survey data was then imported into QINSy's 3D editing package QLOUD. An IHO S44 Special Order (0 – 20m) filter – using a 3D surface spline algorithm, was then applied to the data. A sounding will be flagged as an outlier if it meets the criteria displayed in the equation below.

$$\text{A Sounding is Flagged if } x > \sqrt{a^2+(b*d)^2}$$

Where a = 0.25 and b = 0.0075 and d= water depth as set out in the S44 guidelines.

Once the filter finished cleaning the obvious artefacts out of the data, a visual inspection over the entire survey area was conducted to check that the survey data had no artefacts missed by the cleaning filter. This involves a combination of visualising the survey data in 3D, stepping through the data in profile view and also analysing the online sounding grids standard deviations. Once the data has been validated, a 50cm x 50cm MEAN Gridded Surface was exported out of QLOUD.

5.2 Terrestrial Laser and Photo Processing

The raw data is processed using the RiSCAN software. The GPS file for all scanner positions and reflective target positions are imported into the software and ten registered using these coordinates. The scans are then corrected using a multi-station adjustment (using least squares) to fit each scan as closely as possible. The scans are then cleaned, removing erroneous data. Once cleaned the scanned points are able to be coloured from the photos captured at the time of scanning giving a realistically coloured 3D point cloud. This data can then be incorporated with the bathymetry to produce a complete 3D model of the target area.

5.3 Data Presentation and Visualisation

Once the 50cm x 50cm MEAN Gridded surface had been created a subsequent 50cm x 50cm MEAN Depth point's file (PTS) was produced. The 50cm PTS file was used in PBPL's in house "Build Array" program to build 25m x 25m and 50m x 50m Minimum Depth Priority Sounding Arrays (ARR) and a 50cm x 50cm "Multibeam Model" (MBM).

5.3.1 Method Used for Sounding Selection

When using multibeam in all navigable waters PBPL has found that the best representation of the navigable seabed is to display the minimum of soundings from the 50cm x 50cm MEAN gridded surface. The minimum depth is displayed on the plans at an interval of 25m x 25m and 50m x 50m (depending on the plan scale) at the location of the minimum depth sounding.

5.3.2 Process for Rounding of Soundings

Soundings are rounded about the 0.05m. 0.050m and greater are rounded up and 0.049m and less are rounded down. For example, 10.949m will be displayed 10.9m, whereas 11.550m will be displayed as 11.6m.

5.3.3 Method of Surface (Model) Generation

Colour banded imagery was created based on the DTM of 50cm x 50cm MEAN gridded surface as a GEOTIFF. The software used to create the GEOTIFF was the QINSy Sounding Grid utility.

5.3.4 Contour Generation

Contours were created based on the 50cm x 50cm MEAN gridded surface detailed above. However to smooth the contours and to ensure only the significant structures are visualised, the 50cm x 50cm MEAN surface was reduced to a 4m x 4m MEAN gridded surface for contour generation. A minimum contour length of 100m was also applied. A contour interval of 0.25m was provided to the client in a 3D DXF file format and the 1m contours were shown on the survey plan.

5.3.5 3D Model Generation

The 3D model was created in a software package called Fledermaus Professional. PBPL format the data such that it can be used and viewed in 3D, in a free downloadable version of the software called iView 4D. This enables the user to “fly” through the survey area, zooming in and targeting areas of interest. The 3D viewer is very functional to use and is an extremely useful and powerful visualisation tool.

6.0 Data Quality and Retention

6.1 Survey Accuracies

The accuracy of the survey data is not just the sensors measurement accuracy but a combination of all the small measurement uncertainties within the system as a whole. The accuracies stated in the sensor technical specifications refer to each measurement collected by each sensor within the survey system.

However, for the creation of models, sounding grids and arrays, the soundings are exported to a 0.5m x 0.5m Mean Gridded DTM Grid. This surface has a larger error associated with it because it is a **MEAN** surface so there is an associated uncertainty in position and height on top of the absolute accuracies stated above.

Horizontal Accuracies for MEAN Gridded DTM Surfaces:

- 0.50m Grid = ±0.353m

To determine the vertical accuracy of the DTM surface, redundant data was collected by at least 1 line run perpendicular to the main survey lines. The average absolute difference between the mean depths of the main survey lines and check lines, in each 0.5m x 0.5m cell, were computed as well as the standard deviation.

The survey accuracies achieved for the Inskip Beach survey were:

- Horizontal Accuracy (at 95% Confidence) = Better Than ±0.50m
- Vertical Accuracy (at 95% Confidence) = ±0.15m

To meet "Class A" accuracy requirements, the accuracies must be better than:

- Horizontal Accuracy (at 95% Confidence) = ±0.50m
- Vertical Accuracy (at 95% Confidence) = ±0.15m

The Horizontal and Vertical Tolerances quoted on the PBPL plans state the accuracy requirements for "Class A" surveys as specified by Maritime Safety Queensland's document titled 'Standards for Hydrographic Surveys within Queensland Waters'. The Inskip Beach survey accuracies are **better than** these "Class A" requirements.

6.2 Data Summary

Survey Metadata Summary:

- Horizontal Datum : Geocentric Datum of Australia 1994 (GDA94)
- Vertical Datum : Lowest Astronomical Tide (LAT)
- Points File Coordinate System : Map Grid of Australia 1994 (MGA94)
- Survey Class : A

6.3 Data Archival Time Frames and Responsibility

Raw electronic hydrographic survey data will be stored by PBPL for at least 7 years. Sufficient data will be stored to enable independent reprocessing of survey data within this period. Electronic copies of final plans will also be stored by PBPL for at least 7 years.

Hardcopy hydrographic survey data and hardcopy final plans will be kept for 7 years by PBPL, before being archived and maintained off-site.

7.0 Data Deliverables

7.1 Survey PTS Files

Survey ASCII points files (PTS) were exported out of QINSy once the data processing procedures had been completed. The following PTS files were provided to the client:

- 50cm x 50cm MEAN Grid

All PTS files have the following characteristics:

- Horizontal Datum = Map Grid of Australia (MGA94)
- Vertical Datum = Lowest Astronomical Tide (LAT)
- Depths are negative numbers.

7.2 Survey Plans

Two survey plans were provided in PDF and DXF formats to the client to display the survey results. The following were provided to the client:

- 132361 – 1 : 1:1000 Scale Plan of The Near Shore Instability Area
- 132361 – 2 : 1:5000 Scale Overview Plan of Inskip Point

Bentley Microstation was used to create the final CAD drawings of the Survey Plan. See Appendix D for each Survey Plans.

7.3 GeoTIFF Imagery

The following GeoTIFF Images were provided to the client:

- Multibeam Sounding Imagery:
    - 50cm x 50 cm MEAN

7.4 Contours

A 3D DXF containing contours at an Interval of 25cm was provided to the client. A contour interval of 1m was used for the 1:1000 survey plan.

7.5 3D Model

A 3D Model presenting all the above deliverables was created in QPS Fledermaus. A Scene file was provided to the client to be viewed in the freely downloadable software package iView4D.

8.0 Certification

I certify that this Survey Report and the results described herein conform to the hydrographic survey meeting Survey Class A standard as defined by MSQ's 'Standards for Hydrographic Surveys within Queensland Waters'.

G Stimson   Giles Stimson   10-11-15
....
(Signature)   (Print Name)   (Date)

Manager of Port Surveys
Certified Professional in Hydrographic Surveying (Level 1)

[signature]   AARON WILLCOCK   10/11/2015
....
(Signature)   (Print Name)   (Date)

Supervising Surveyor
Certified Professional in Hydrographic Surveying (Level 1)

[signature]   ROBERT SLATER   10/11/15
....
(Signature)   (Print Name)   (Date)

Hydrographic Surveyor
Certified Professional in Hydrographic Surveying (Level 1)

Appendix A

Navigator Node Locations

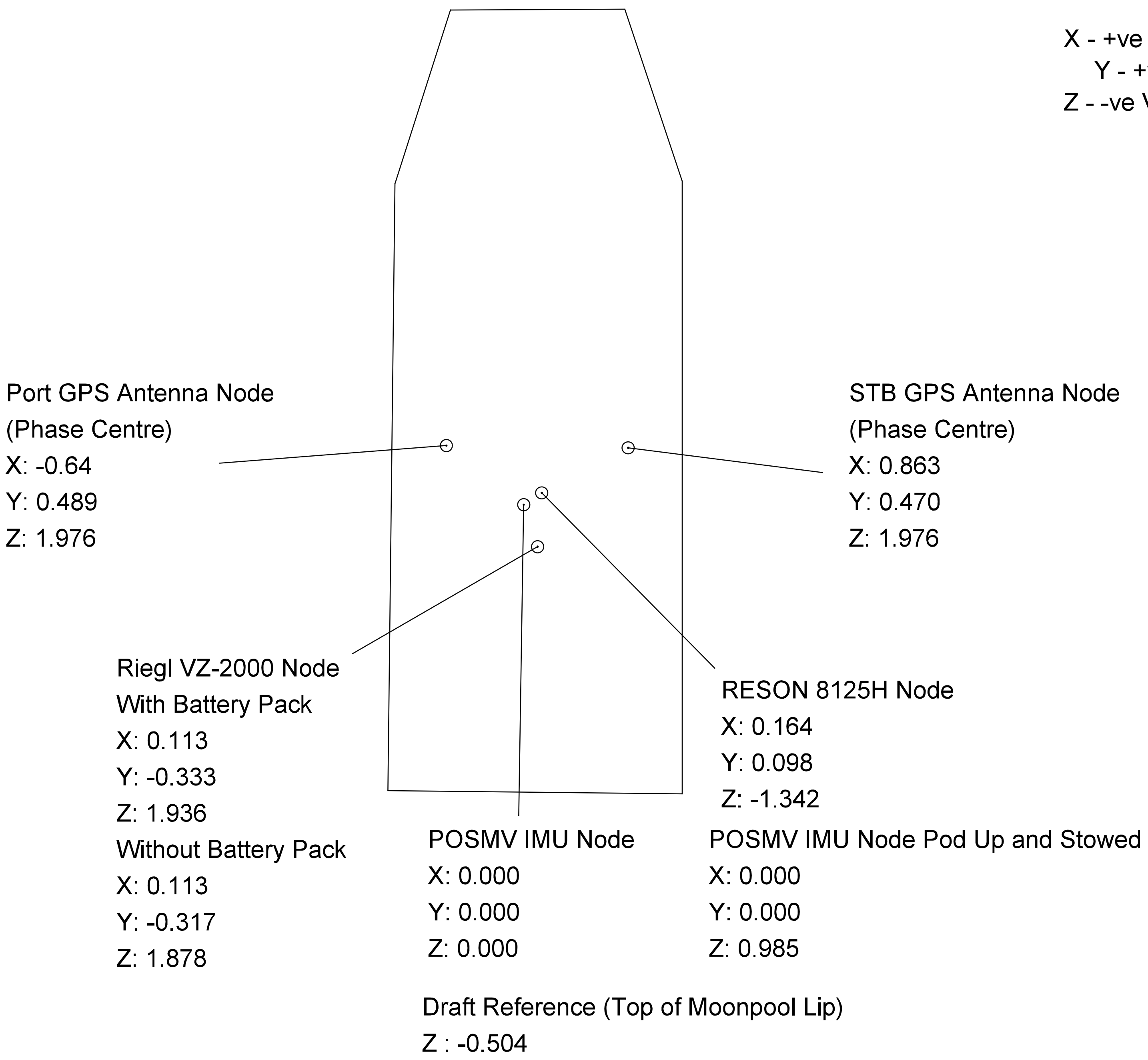
POS Coordinates

IMU to Centre of Rotation

X = 0.535
Y = 0.125
Z = 0.460

Sensor Layout on Navigator
Refers to the Reference Frame in QINSy

X - +ve Value to Starboard Direction
Y - +ve Value to Bow Direction
Z - -ve Value to Downward Direction



IMU to Centre of Rotation
(POS Coordinates)

X = 0.535
Y = 0.125
Z = 0.460

Surveyor: AW, RS, JW, DI
Field Book: 318 page 62-63
Vessel: Navigator
Data Type:
Data File:

DESIGN DIMENSIONS
Length: Depth:
Width: Ins. Depth:

VERTICAL MEASURMENTS
Equipment:
Calibration:
Tide Gauge:

HORIZONTAL POSITIONING
Equipment:
Mode:
Base Station:

SPECIFIED SYSTEM ACCURACY
Vertical Tolerance (95%): ± Typical Coverage:
Horizontal Tolerance (95%): ± Survey Class:

CLIENT:

PURPOSE OF SURVEY:
Calibration

Robert Slater
SURVEYED AND CHECKED

Aaron Willcock
SUPERVISING SURVEYOR (AHSCP LEVEL 1)

APPROVED DATE

Navigator
Node Survey 6/10/2015
RESON 8125H and Riegl VZ-2000

GDA

LEVEL DATUM: <V DATUM> AZIMUTH DATUM: <H DATUM> SCALE 1:<PLOT SCALE> (A3 sheet)

PORT OF BRISBANE PTY LTD 3 PORT CENTRAL AVENUE PORT OF BRISBANE QUEENSLAND 4178 Phone 07 32584888

PORT of BRISBANE
Here for the future

Dwg. No. 132324
Proj. File: <PROJECT FILE>

Appendix B

Navigator Vessel Database Setup

SURVEY DEFINITIONS

General Definitions

Line name	:	Inskip
Line sequence number	:	29
Line description	:	
UTC to GPS time correction	:	17.000 s
Survey unit name	:	Meters
Conversion factor to metres	:	1.000000000000000

Geodetic Definitions

Magnetic Variation Information

Undefined

Datum Definitions

Survey Datum	:	Australia GDA 1994
Spheroid name	:	GRS 1980
Prime meridian	:	Greenwich
Conversion factor to metres	:	1.0000000000000
Semi-major axis (a)	:	6378137.000 m
Semi-minor axis (b)	:	6356752.314 m
Inverse flattening (1/f)	:	298.25722210100
First eccentricity squared (e**2)	:	0.0066943800229
Second eccentricity squared (e'**2)	:	0.0067394967754
Additional Datum	:	WGS84
Spheroid name	:	WGS 1984
Prime meridian	:	Greenwich
Conversion factor to metres	:	1.0000000000000
Semi-major axis (a)	:	6378137.000 m
Semi-minor axis (b)	:	6356752.314 m
Inverse flattening (1/f)	:	298.25722356300
First eccentricity squared (e**2)	:	0.0066943799901
Second eccentricity squared (e'**2)	:	0.0067394967422

Datum Shift Definitions

WGS84 to Australia GDA 1994 — Helmert 7-Parameter Transformation
Position vector rotation — Arc Seconds

X shift	:	0.000 m	X rotation	:	0.000000 "
Y shift	:	0.000 m	Y rotation	:	0.000000 "
Z shift	:	0.000 m	Z rotation	:	0.000000 "
Scale correction	:	0.00000000 ppm			

Rotation center point	:	Not Defined
Reference epoch	:	Not Defined

Chart Datum / Vertical Datum Definition

Chart datum	:	AUSGeoid09 (Australia)
Height file	:	AUSGeoid09.BIN
Height level	:	No Level Correction
Height file	:	N/A
Height offset	:	-1.120 m
MWL model	:	AUSGeoid09 (Australia)
MWL file	:	AUSGeoid09.BIN
MWL level	:	No Level Correction
MWL file	:	N/A
MWL offset	:	-1.120 m
MWL st.dev.	:	0.013 m
DTM mode	:	Absolute DTM's
DTM datum	:	AUSGeoid09 (Australia)
DTM file	:	AUSGeoid09.BIN
DTM level	:	No Level Correction
DTM file	:	N/A
DTM offset	:	-1.120 m

Projection Definition

Projection type	:	0002
Projection name	:	Universal Transverse Mercator (South Oriented)
Conversion factor to metres	:	1.0000000000000
UTM zone number	:	56
UTM central meridian	:	153;00;00.00000 E
Latitude of grid origin	:	0;00;00.00000 N
Longitude of grid origin	:	153;00;00.00000 E
Grid Easting at grid origin	:	500000.000 m
Grid Northing at grid origin	:	10000000.000 m
Scale factor at longitude of origin	:	0.999600000000

Local Construction Grid Definition

Not Applicable

Offset Convention

Offset mode	:	Rectangular
Offset distances units	:	Meters
Offset angles units	:	Degrees

OBJECT DEFINITIONS

General Summary Information

Number of survey vessels or objects	:	1
Number of relay vessels or buoys	:	0
Number of external network nodes	:	0
Number of datums/ellipsoids defined	:	2

Vessel Definitions

Navigator

Streamers	:	0	Gun arrays	:	0
Buoys	:	0	Echosounders	:	0
Satellite receivers	:	0	USBL systems	:	0
Network nodes	:	5	Pitch/Roll/Heave sensors	:	Yes

Correction to GMT (UTC)	:	0.000 h
Correction to master vessel's time	:	0.000 s
Height above draft reference	:	0.584 m
Description of reference point	:	Navigator IMU

Point	X	Y	Z	Pen	Fill	Style
1	-1.200	-2.400	0.000	Up	On	Solid
2	-1.200	2.700	0.000	Down	On	Solid
3	-0.600	4.100	0.000	Down	On	Solid
4	0.840	4.100	0.000	Down	On	Solid
5	1.300	2.700	0.000	Down	On	Solid
6	1.300	-2.400	0.000	Down	On	Solid
7	-1.200	-2.400	0.000	Down	On	Solid

Gun Array Definitions

NETWORK DEFINITIONS

Fixed Node Definitions

Variable Node Definitions

Navigator IMU

Object location	:	Navigator
X (Stbd = Positive):	:	0.000 m
Y (Bow = Positive):	:	0.000 m
Z (Up = Positive):	:	0.000 m
A-priori SD	:	0.010 m

8125 Tx

Object location	:	Navigator
X (Stbd = Positive):	:	0.164 m
Y (Bow = Positive):	:	0.098 m
Z (Up = Positive):	:	-1.342 m
A-priori SD	:	0.010 m

Draft Reference

Object location	:	Navigator
X (Stbd = Positive):	:	0.000 m
Y (Bow = Positive):	:	0.000 m
Z (Up = Positive):	:	-0.504 m
A-priori SD	:	0.010 m

Riegl VZ-2000

Object location	:	Navigator
X (Stbd = Positive):	:	0.113 m
Y (Bow = Positive):	:	-0.346 m
Z (Up = Positive):	:	1.948 m
A-priori SD	:	0.010 m

Variable Node Definitions (continued)

Water Level		
Object location	:	Navigator
X (Stbd = Positive):	:	0.000 m
Y (Bow = Positive):	:	0.000 m
Z (Up = Positive):	:	-0.579 m
A-priori SD	:	0.010 m

Observation Definitions

POS MV Heading	:	Bearing (True)
'At' node	:	Navigator IMU
'To' node 1	:	Ship's axis
Measurement unit code	:	Degrees
System description	:	POS MV Heading
Propagation speed	:	0.0000000000 m/s
Lanewidth on baseline	:	0.0000000000 m/s
Scale factor	:	1.0000000000
Fixed system (C-O)	:	0.00000000 °
Variable (C-O)	:	0.000000 °
A-priori SD	:	0.05 °
Quality indicator	:	No quality info recorded

Realtime Heave	:	Generic
'At' node	:	Undefined
System description	:	True Heave
Propagation speed	:	0.0000000000 m/s
Lanewidth on baseline	:	0.0000000000 m/s
Scale factor	:	1.0000000000
Fixed system (C-O)	:	0.00000000 m
Variable (C-O)	:	0.000000 m
A-priori SD	:	1.00 m
Quality indicator	:	No quality info recorded

True Heave	:	Generic
'At' node	:	Undefined
System description	:	True Heave
Propagation speed	:	0.0000000000 m/s
Lanewidth on baseline	:	0.0000000000 m/s
Scale factor	:	1.0000000000
Fixed system (C-O)	:	0.00000000
Variable (C-O)	:	0.000000
A-priori SD	:	1.00
Quality indicator	:	No quality info recorded

Reference Station Definitions

ATT Node Definitions

SYSTEM DEFINITIONS

Gyro Compass

POS MV Heading

Interfacing

Type	:	Gyro Compass		
Driver	:	Network - POS MV V5 (Binary Groups 1/102/103)		
Executable and Cmdlir	:	DrvQPSCountedUDP.exe POSMV PPS		
Port	:	5602	Latency :	0.000 s

Acquired by	:	[Directly into QINSy] (No additional time tags)
Observation time from	:	N/A
Number of slots	:	1

Connected Observations

POS MV Heading : Bearing (True)

Slot 1 : 102

Connected Nodes

Navigator IMU : Navigator

Pitch Roll Heave Sensor

POS MV Motion

Interfacing

Type	: Pitch Roll Heave Sensor			
Driver	: Network - POS MV V5 (Binary Groups 1/102/103)			
Executable and Cmdlir	: DrvQPSCountedUDP.exe POSMV PPS			
Port	: 5602	Latency	:	0.000 s

Acquired by	: [Directly into QINSy] (No additional time tags)
Observation time from	: N/A

Number of slots	: 1

System Parameters

POS MV Motion

Object	: Navigator
Location on object (Lever arm)	: Navigator IMU
PRH sensor reference number	: 1
Rotation convention pitch	: Positive bow up
Rotation convention roll	: Positive heeling to starboard
Angular variable measured	: HPR (roll first)
Angular measurement units	: Degrees
Sign convention heave	: Positive downwards
Measurement units heave	: Meters
Conversion factor to degrees decimal	: 1.0000000000000
Conversion factor to metres	: 1.0000000000000
Quality indicator type pitch and roll	: No quality info recorded
Quality indicator type heave	: No quality info recorded
Description of quality indicator type	:
X (Stbd = Positive):	: 0.000 m
Y (Bow = Positive):	: 0.000 m
Z (Up = Positive):	: 0.000 m
A-priori SD	: 0.010 m
(C-O) pitch offset	: 0.000 °
(C-O) roll offset	: 0.000 °
(C-O) heave offset	: 0.000 m
Heave time delay	: 0.000 s
SD roll and pitch	: 0.020 °
SD heave (fixed)	: 0.050 m
SD heave (variable)	: 5.000 %
SD roll offset	: 0.050 °
SD pitch offset	: 0.050 °
SD heave offset	: 0.050 m

Description of pitch, roll and heave system
POS MV Motion
Slot
102

Position Navigation System

POS MV Position

Interfacing

Type	:	Position Navigation System		
Driver	:	Network - POS MV V5 (Binary Groups 1/102/103)		
Executable and Cmdlir	:	DrvQPSCountedUDP.exe POSMV PPS		
Port	:	5602	Latency :	0.000 s

Acquired by	:	[Directly into QINSy] (No additional time tags)
Observation time from	:	N/A

Number of slots	:	1

Satellite System Definition

Position datum	:	WGS84
Satellite system name	:	WGS84

Satellite Receiver Definition

Receiver number	:	102
Receiver description	:	
Node identifier	:	Navigator IMU
Object location	:	Navigator
X (Stbd = Positive):	:	0.000 m
Y (Bow = Positive):	:	0.000 m
Z (Up = Positive):	:	0.000 m
A-priori SD	:	0.010 m

SD latitude	:	0.050 m
SD longitude	:	0.050 m
SD height	:	0.100 m

Horizontal datum	:	WGS84	
Vertical datum	:	WGS84	N/A
Height level	:	No Level Correction	N/A
Height offset	:	0.000 m	

Connected Observations

Connected Nodes

Multibeam Echosounder

Seabat 8125H

Interfacing

Type	:	Multibeam Echosounder			
Driver	:	Reson Seabat 7K (TCP/Network)			
Executable and Cmdlir	:	DrvSeabat7K.exe			
IP address	:	11. 0. 11. 2			
Update rate	:	0.000 s			
Port	:	7000	Latency	:	0.000 s

Acquired by	:	[Directly into QINSy] (No additional time tags)
Observation time from	:	N/A
Number of slots	:	0

System Parameters

Node name	:	8125 Tx
X (Stbd = Positive):	:	0.164 m
Y (Bow = Positive):	:	0.098 m
Z (Up = Positive):	:	-1.342 m
A-priori SD	:	0.010 m
Description	:	Seabat 8125H
Object	:	Navigator
Number of transducers	:	Single
Transducer node TX	:	8125 Tx
Heading offset	:	0.470 °
Roll offset	:	-15.410 °
Pitch offset	:	-1.130 °
Unit is roll stabilized	:	No
Unit is pitch stabilized	:	No
Unit is heave compensated	:	No
Beam steering (flat transducer)	:	Yes
Beam angle width along	:	1.000 °
Beam angle width across	:	0.500 °
Maximum number of beams per ping	:	512
Use sound velocity from unit	:	Yes
Slot	:	1
SD type	:	Angle, Range
SD beam angle	:	0.030 °
SD beam range	:	0.010 m
SD roll offset	:	0.050 °
SD pitch offset	:	0.050 °
SD heading offset	:	0.500 °
SD roll stabilization	:	0.000 °
SD pitch stabilization	:	0.000 °
SD heave compensation	:	0.000 m
SD sound velocity	:	0.050 m/s

Time Synchronization System

Time In

Interfacing

Type	:	Time Synchronization System			
Driver	:	POS MV V5 (Binary Group 112 - NMEA ZDA) (Network)			
Executable and Cmdlir	:	DrvQPSCountedUDP.exe POSMV PPS			
Port	:	5602	Latency	:	0.000 s
Acquired by	:	[Directly into QINSy] (No additional time tags)			
Observation time from	:	N/A			
Number of slots	:	1			

PPS Pulse System

PPS Pulse System

Interfacing

Type	:	PPS Pulse System			
Driver	:	QPS PPS Adaptor			
Executable and Cmdlir	:	DrvPpsPulse.exe			
Port	:	1			
Baud rate	:	1200	Data bits	:	0
Parity	:	None	Stop bits	:	1
Update rate	:	0.000 s	Latency	:	0.000 s
Acquired by	:	[Directly into QINSy] (No additional time tags)			
Observation time from	:	N/A			
Number of slots	:	0			

AIS System

AIS

Interfacing

Type	:	AIS System			
Driver	:	AIS Standard VDO/VDM Messages			
Executable and Cmdlir	:	DrvQPSTerminated.exe AIS			
Port	:	12			
Baud rate	:	9600	Data bits	:	8
Parity	:	None	Stop bits	:	1
Update rate	:	0.000 s	Latency	:	0.000 s
Acquired by	:	[Directly into QINSy] (No additional time tags)			
Observation time from	:	N/A			
Number of slots	:	0			

Miscellaneous System

True Heave

Interfacing

Type	:	Miscellaneous System		
Driver	:	Network - POS MV V5 (Binary Group 111 - True Heave)		
Executable and Cmdlir	:	DrvQPSCountedUDP.exe POSMV PPS		
Port	:	5602	Latency :	0.000 s

Acquired by	:	[Directly into QINSy] (No additional time tags)
Observation time from	:	N/A

Number of slots : 1

Connected Observations

Realtime Heave			: Generic
Slot 1	:	Real	
True Heave			: Generic
Slot 1	:	True	

Connected Nodes

Sidescan Sonar

8125H Sidescan

Interfacing

Type	: Sidescan Sonar			
Driver	: Reson Seabat 7K (TCP/Network)			
Executable and Cmdlir	: DrvSeabat7K.exe			
IP address	: 11. 0. 11. 2			
Update rate	: 0.000 s			
Port	: 7000	Latency	:	0.000 s

Acquired by	: [Directly into QINSy] (No additional time tags)
Observation time from	: N/A

Number of slots	: 0

System Parameters

Manufacturer	: Reson
Model	: Reson 8125
Number of beams	: 1
Number of channels	: 2
Associated multibeam system	: Seabat 8125H
Object location	: Navigator
Use sound velocity from unit	: Yes

Node name	: 8125 Tx
Orientation	: Port
Sidescan Sonar Channel:	: 0
Slot ID	: 0
Roll offset	: 0.000 °
Pitch offset	: 0.000 °
Heading offset	: 0.000 °
Frequency	: 455.000 kHz
Number of beams	: 1
Horizontal beam width	: 0.000 °
Vertical beam width	: 0.000 °
Vertical tilt angle	: 0.000 °

Node name	: 8125 Tx
Orientation	: Starboard
Sidescan Sonar Channel:	: 1
Slot ID	: 0
Roll offset	: 0.000 °
Pitch offset	: 0.000 °
Heading offset	: 0.000 °
Frequency	: 455.000 kHz
Number of beams	: 1
Horizontal beam width	: 0.000 °
Vertical beam width	: 0.000 °
Vertical tilt angle	: 10.000 °

Multibeam Echosounder

Riegl VZ-2000

Interfacing

Type	:	Multibeam Echosounder		
Driver	:	Laser Scanning - RIEGL VZ-2000 (With UTC)		
Executable and Cmdlir	:	DrvLaser.exe RIEGL_VZ2000 PPS		
IP address	:	192.168. 0.125		
Update rate	:	0.000 s		
Port	:	20002	Latency :	0.000 s

Acquired by	:	[Directly into QINSy] (No additional time tags)
Observation time from	:	N/A
Number of slots	:	0

System Parameters

Node name	:	Riegl VZ-2000
X (Stbd = Positive):	:	0.113 m
Y (Bow = Positive):	:	-0.346 m
Z (Up = Positive):	:	1.948 m
A-priori SD	:	0.010 m
Description	:	Riegl VZ-2000
Object	:	Navigator
Number of transducers	:	Single
Transducer node TX	:	Riegl VZ-2000
Heading offset	:	-1.230 °
Roll offset	:	0.670 °
Pitch offset	:	15.600 °
Unit is roll stabilized	:	No
Unit is pitch stabilized	:	No
Unit is heave compensated	:	No
Beam steering (flat transducer)	:	No
Beam angle width along	:	1.500 °
Beam angle width across	:	1.500 °
Maximum number of beams per ping	:	40000
Use sound velocity from unit	:	Yes
Slot	:	1
SD type	:	Angle, Range
SD beam angle	:	0.050 °
SD beam range	:	0.050 m
SD roll offset	:	0.050 °
SD pitch offset	:	0.050 °
SD heading offset	:	0.500 °
SD roll stabilization	:	0.000 °
SD pitch stabilization	:	0.000 °
SD heave compensation	:	0.000 m
SD sound velocity	:	0.050 m/s

AIS System

D700 Camera

Interfacing

Type	:	AIS System
Driver	:	DSLR Camera - Nikon D90/D5000
Executable and Cmdlir	:	DrvQPSFreeBaseUI.exe NIKON_D5000

Appendix C

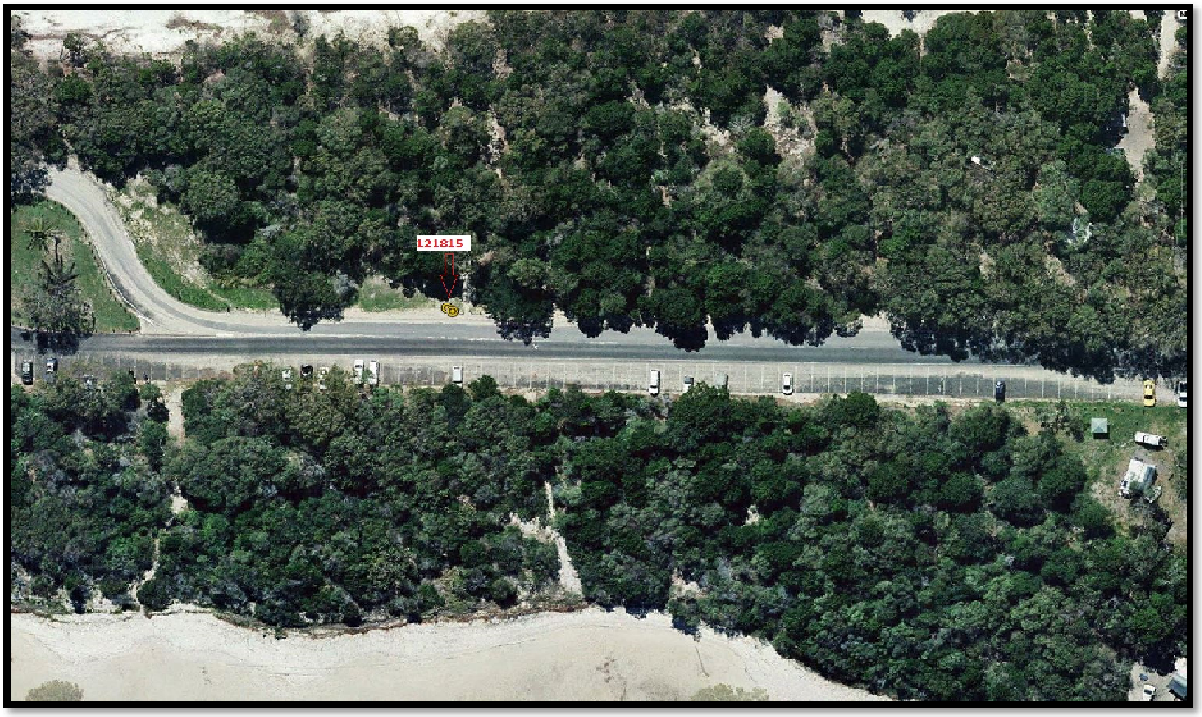
PSM Information and Checks

Rainbow Beach (Inskip Point) Control Survey 14th - 16th October 2015

Conducted by R Slater using Trimble R8 and Smartnet NB (Nearest Base)

All Coordinates are in GDA and Heights are AHD

	PSM	Easting	Northing	Elevation
QLD Globe	121815	505187.834	7145394.194	1.367
OBS		505187.835	7145394.113	1.306
OBS - Known		0.001	-0.081	-0.061



Images are courtesy of Google Earth and QLD GLOBE/Location

Survey Control Mark Report

ADMINISTRATIVE

Mark Number	**121815**		
Alternate Names		Town	
		Local Authority	**GYMPIE REGIONAL**
Locality Description	**INSKIP POINT CAR PARK**		
Related Information			

DETAILS

Mark Type	**DDM**		
Installed By	**DNR**	Connections	
Installed Date	**09-May-1998**		
Mark Condition	**GOOD**		
Last Visited	**10-Jun-2005**		
Sketch Available	**Yes**		

GDA94 COORDINATES

Lineage	**Derived**		
Latitude	**25º 48' 34.76370" S**	Horizontal Uncertainty	**CLASS A / 1st ORDER**
Longitude	**153º 03' 06.31783" E**		
Ellipsoidal Height		Vertical Uncertainty	
MGA94 Easting	**505187.834m**	MGA94 Point Scale	**0.99960033**
MGA94 Northing	**7145394.194m**	MGA94 Grid Conv	**0º 01' 21.12"**
MGA94 Zone	**56**		
Published	**25-Oct-2000**	Fixed By	**GPS**
Adjustment	**GDA - TRANSFORMED QLD_0900 GRID**		

AHD HEIGHT

Lineage	**Derived**		
Height	**1.367m**	Vertical Uncertainty	**Class A / 4th ORDER**
Published	**01-Jun-1998**	Fixed By	**GPS**
Origin Mark	**44679**	NLN Section	
Source	**Model: AUSGEOID93 INTERPOLATED / N Value: 11.107m**		

QUEENSLAND GOVERNMENT

QUEENSLAND - DEPARTMENT OF NATURAL RESOURCES

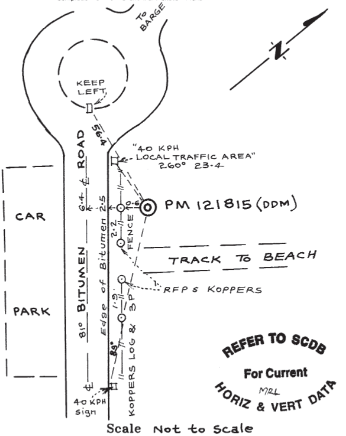
PERMANENT MARK SKETCH PLAN

REGD NO. 121815

NATURAL RESOURCES

Bearings are MAG (Magnetic, AMG) Distances are metres

Sketch plan to be completed in accordance with the Department's QA document; "Completion of Permanent Mark Sketch Plans"



Scale Not to Scale

Suited to GPS
Yes/No YES
Date 5/98

SCDB DETAILS ON REVERSE ARE TO BE COMPLETED

I certify that the permanent mark sketch has been prepared in accordance with the "The Survey Co-ordination Act of 1952-1989".

Date 3-8-98 Signature [signature]

Appendix D

Survey Plans

132361 (2 Sheets)

Surveyor: Robert Slater
Field Book: H15696/9
Vessel: Navigator
Data Type: MINIMUM DEPTHS
Data File: 18455004

DESIGN DIMENSIONS
Depth: N/A
Ins. Depth: N/A

VERTICAL MEASUREMENTS
Equipment: Seabat 8125H/Riegl VZ2000
Calibration: 13/10/2015
Tide Gauge: Smartnet iMax
Benchmark: Smartnet iMax
Datum: L.A.T.

HORIZONTAL POSITIONING
Equipment: POS MV
Mode: RTK
Base Station: Smartnet
Datum: GDA94

Notes:
- Image Courtesy of Google Earth
- 0.0m AHD = 0.0m LAT + 1.12m
- Positive Heights ; Negative Depths
- Contour Interval = 1m

SPECIFIED SYSTEM ACCURACY
Vertical Tolerance (95%): ± 0.15 m
Horizontal Tolerance (95%): ± 0.5 m
Typical Coverage: 100%
Survey Class: A

CLIENT: Queensland Parks and Wildlife Service
PURPOSE OF SURVEY: Investigation
ROBERT SLATER — SURVEYED AND CHECKED — DATE
AARON WILLCOCK — SUPERVISING SURVEYOR (AHSCP LEVEL 1) — DATE
GILES STIMSON — APPROVED — DATE

BATHYMETRY COLOUR MAP (m)
1.0 -5.0 -10.0 -15.0 -20.0 -25.0

SCALE 1:1000 (Before Reduction from A1 sheet)
Metres
0 20 40 60 80 100

LEVEL DATUM: L.A.T. AZIMUTH DATUM: GDA94

Assessment of Near Shore Instability

Inskip Point (Sheet 1 of 2)

INVESTIGATION SURVEY 14/10/2015 to 15/10/2015

PORT OF BRISBANE PTY LTD 3 PORT CENTRAL AVENUE PORT OF BRISBANE QUEENSLAND 4178 Phone 07 32584888

PORT of BRISBANE
Here for the future

Dwg. No. 132361 - 1
Proj. File: Inskip.lwf

Surveyor: Robert Slater Field Book: H15696/9 Vessel: Navigator Data Type: MINIMUM DEPTHS Data File: 18455004	DESIGN DIMENSIONS Depth: N/A Ins. Depth: N/A	VERTICAL MEASUREMENTS Equipment: Seabat 8125H/Riegl VZ2000 Calibration: 13/10/2015 Tide Gauge: Smartnet iMax Benchmark: Smartnet iMax Datum: L.A.T.	HORIZONTAL POSITIONING Equipment: POS MV Mode: RTK Base Station: Smartnet Datum: GDA94

Notes:
- Image Courtesy of Google Earth
- 0.0m AHD = 0.0m LAT + 1.12m
- Positive Heights ; Negative Depths

SPECIFIED SYSTEM ACCURACY

Vertical Tolerance (95%): ± 0.15 m
Horizontal Tolerance (95%): ± 0.5 m
Typical Coverage: 100%
Survey Class: A

CLIENT: Queensland Parks and Wildlife Services

PURPOSE OF SURVEY: Investigation

ROBERT SLATER — SURVEYED AND CHECKED — DATE

AARON WILLCOCK — SUPERVISING SURVEYOR (AHSCP LEVEL 1) — DATE

GILES STIMSON — APPROVED — DATE

BATHYMETRY COLOUR MAP (m)

1.0 -5.0 -10.0 -15.0 -20.0 -25.0

SCALE 1:5000 (Before Reduction from A1 sheet)

Metres

0 100 200 300 400 500

LEVEL DATUM: L.A.T.   AZIMUTH DATUM: GDA94

Assessment of Near Shore Instability

Inskip Point (Sheet 2 of 2)

INVESTIGATION SURVEY 14/10/2015 to 15/10/2015

GDA

PORT OF BRISBANE PTY LTD 3 PORT CENTRAL AVENUE PORT OF BRISBANE QUEENSLAND 4178 Phone 07 32584888

PORT of BRISBANE
Here for the future

Dwg. No. 132361 - 2

Proj. File: Inskip.lwf