

**PROPOSED EXPANSION OF CONTAINER TERMINAL CT10 – CT19  
AND ITS ASSOCIATED WORKS AT WESTPORTS,  
PULAU INDAH, PORT KLANG,  
SELANGOR DARUL EHSAN  
TOPOGRAPHIC & BATHYMETRIC SURVEY**

**SURVEY REPORT  
EGS JOB NO 43718  
JULY 2018**

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Appendix B	- Horizontal Traverse Control Survey Result
Appendix C	- Sample of Sounding Bar-check records before and end of survey day
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**1.0 INTRODUCTION**

**1.1 THE PROJECT**

Westports Malaysia Sdn Bhd is desirous for expansion of container terminal CT10 – CT19. The location of the proposed development is outlined on Figure 1 below.

Project conceptual planning stage requires input of various field in-situ data collection, measurements and surveying; including provision for topographic and bathymetric survey to provide detail survey and delineate the seabed topography over the survey limit area as instructed.

**1.2 INSTRUCTIONS**

On receiving the Letter of Award from Westports Malaysia Sdn Bhd (Fax dated 17/5/18-09:20 – Re-WP/LA/CS/18076 : EGS carried out Topographic and Bathymetric survey services for proposed expansion of container terminal CT10-CT19 and its associated works at Westports, Pulau Indah, Selangor.

The scope of field surveying can be summarized as follows:

1. Topographic Survey:
  - a. Establishment Horizontal Baseline controls by static GPS RTKnet survey method.
  - b. Carry out conventional planimetric control traverses over topographic-survey area.
  - c. Carry out Strip Topographical Survey over area as outlined (see Figure 2, below)
2. Bathymetric Survey:
  - a. Survey and delineate the seabed topographic over area as outlined (see Figure 2, below).
  - b. Runs the main echo-sounding traverses at 100m interval; including provision for cross-check QA/QC lines tranverse the main sounding lines at 500m spacing.

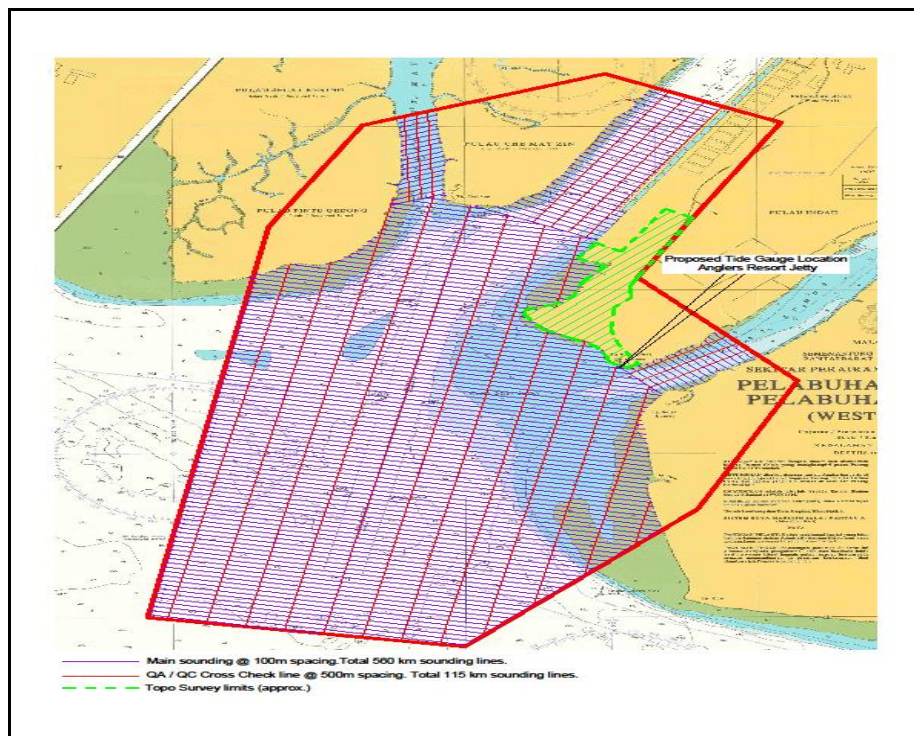
## 2.0 LOCATION OF SURVEY AREA AND SURVEY PERIOD

### 2.1 SURVEY LOCATION

Figure 1 : Google image of the proposed area (not to scale)



Figure 2 : Approach to Westport Pulau Indah Topographic and Hydrographic Survey Limits



The proposed survey area covers Selat Klang Selatan, Selat Lumut and Selat Che Mat Zin extending approximately 10 km offshore of Westports, Port Klang – see Figure 1 and Figure 2 above. The field data collection and surveying were carried out in accord of survey requirements, as follows:

1. Topographic Survey Limit:

Topographic survey area was located along the Selat Klang Selatan estuary, approximately 4 km with total surface area approximately 524 acres. The topographic survey is outlined in green dotted line (See Figure 2).

2. Bathymetry survey limit:

The Bathymetry survey area covers the waterways of Selat Klang Selatan, Selat Lumut and Selat Che Mat Zin extended approximately 10 km offshore. Single-beam echo sounder (SBES) was used to delineate the sea bed-topography of the survey area approximately 13,092 acres.

### **3.0 FIELD DATA COLLECTION AND MEASUREMENTS**

#### **3.1 EXISTING INFORMATION**

The following existing information and data were acquired and deliberated prior the field measurements:

- a. The predicted tidal levels of Port Klang and its vicinity; published by the National Hydrography Centre (RMN)
- b. The Chart Datum (CD) reference benchmark surveyed and established by the National Hydrography Centre (RMN)
- c. National Hydrography Centre (RMN) published Tidal Levels at Pintu Gedong and its vicinity
- d. Copies of certified property boundary markers in the vicinity of Westports proposed development surveyed and established by JUPEM
- e. JUPEM published LSD benchmark
- f. Published Marine Chart No MAL 5300

#### **3.2 EQUIPMENT**

The following equipment was mobilised for the survey:

For Land Topography, establishment of controls and transferring vertical:

- TOPCON ES105 Total Station c/w accessories (*for topographic Strip survey and Cross sectional profiling*)
- Topcon GPS - GR-5 (*establishment of planimetric control survey*)
- Topcon AT-G6 – Auto Level (*transferring vertical*)
- GPS GALAXY G1 GNSS survey referenced to existing JUPEM RTKnet system.

For Hydrography (Bathymetric) survey:

- 2 units of Knudsen 320M; single frequency acoustic echo sounder and accessories.
- 2 units of C-Nav GcGPS (Globally corrected GPS) Positioning System  
C/w C-View data processing Software and  
EGS in-house Navigation Software
- Teledyne TSS DMS-H – Heave Compensator Sensor

- Valeport model 740; self-recording tide gauge (c/w one spare unit)
- 2 x locally chartered survey boat were used:
  - Boat #1:** Over water depth greater than 3m., seabed profiling survey – a Licensed Survey boat – BPK997P
  - Boat #2:** Over water depth less than 3m., the shoreline and riverine survey – a local shallow draft dinghy

### 3.3 PERSONNEL

The following experience personnel were mobilized and carry out the field data collection and measurements:

- 2 x Hydrographic Surveyors
- 2 x Land Topographic survey team
- 1 x Navigator
- 1 x Electronic Engineer cum Navigator

## 4.0. FIELD PROCEDURE

### 4.1 LAND TOPOGRAPHIC SURVEYS

#### 4.1.1 ESTABLISHMENT OF HORIZONTAL CONTROL

##### 4.1.1.1 Planimetric Horizontal Control

Topcon ES-105 Total Station was mobilized and used for the establishment of Planimetric (Horizontal) controls, traversed by closed-loop survey method; surveyed and established with the following accuracy:

- a) **Loop #1 – Northern Area**
  - i) Total horizontal distance traverses : 3034.641
  - ii) Linear mis-closure : 1: 1,304,410
  - iii) Angular mis-closure: 0.21” per station; a total of 14 survey-station were established.
- b) **Loop #2 – Southern Area (Mangrove Area)**
  - Total horizontal distance traverses :4267.938
  - Linear mis-closure :1: 137,067
  - Angular mis-closure: 0.21” per station; a total of 14 survey-station were established.

Detail of closed-loop traverse survey is included in *Appendix B* of this report

##### 4.1.1.2 GPS Baseline Markers

Seven (7) GPS markers were installed along the planimetric control traverses. The markers were survey referenced to JUPEM published RTKnet CORS (continuously Operating Reference Station) parameters by Kinematic Static GPS observation technique using Topcon GPS-GR5 and GPS GALAXY G1 GNNS. The so-observed coordinates were subsequently post-processed and transformed to Selangor State Cassini Grids projection system for final plotting.



The baseline survey findings can be outlined as follows:

Selangor State Cassini Coordinates		
GPS Baseline Markers	Northing (m)	Easting (m)
EGS00	-31908.449	-46461.460
EGS01	-31830.102	-46638.399
EGS02	-30264.074	-46483.296
EGS03	-29986.431	-46614.827
EGS04	-31645.471	-46435.500
EGS05	-29028.135	-45718.100
EGS06	-28846.846	-45835.748

For details of the GPS markers see Section 4.1.4 below; the locations of the GPS markers are outlined on Drawing EGS43718/Sheet 3.

#### 4.1.2 ESTABLISHMENT OF VERTICAL CONTROL

##### 4.1.2.1 Vertical Control (Elevation) and Datum

Vertical (heights) and datum for the survey were established by combination of conventional Topcon AT-G6 auto level and Static GPS GALAXY G1 GNSS surveys.

Existing benchmarks BM B5008, surveyed and established by JUPEM and BM1004 B, established by National Hydrography Centre (RMN) respectively were located and adopted as datum for the survey.

The survey findings can be summarized as follows:

Station	Geocentric elevation surveyed by GPS Static Observation	Elevation Reduced to L.S.D (DTGSM) in Meter	Elevation Reduced to above CD in meter	Remarks	Diff between CD and LSD
BM B5008	2.641	<b>2.567</b>	5.372	<b>LSD established by JUPEM. Adopted LSD Datum (DTGSM)</b>	2.81
BM 1004B	2.869	2.795	<b>5.600</b>	<b>Chart Datum (CD) established by RMN. Adopted Datum for the survey.</b>	2.81
EGS 00	3.253	3.179	5.984	Temporary Benchmark (TBM), nail embedded on concrete kerb	2.81
EGS 01	3.484	3.410	6.215	GPS Baseline marker	2.81
EGS 02	3.639	3.565	6.370	GPS Baseline marker	2.81
EGS 03	3.428	3.354	6.159	GPS Baseline marker	2.81
EGS 04	3.283	3.209	6.014	GPS Baseline marker	2.81
EGS 05	3.100	3.026	5.831	GPS Baseline marker	2.81
EGS 06	4.130	4.056	6.861	GPS Baseline marker	2.81




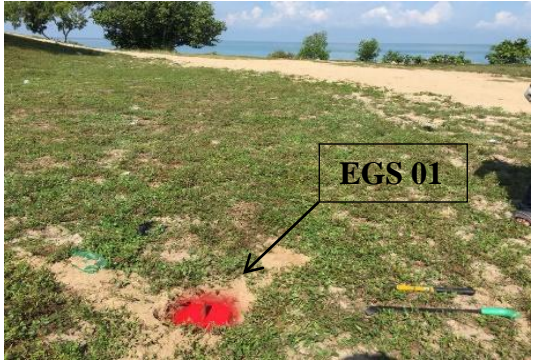


**4.1.3 TOPOGRAPHIC STRIP SURVEY**

The total surface area for topographic survey covered approximately 524 acres; 308 acres over developed area and 216 acres over the mangrove area.

All existing salient features and land-surface topography were surveyed and delineated by Topcon ES105 conventional theodolite and GPS-GR5 (Master-Rover system). The surface profile and elevations were surveyed approximate 100m line intervals running prolongation of the bathymetric traverses. All topographic elevations were post processed and reduced to Survey Datum (i.e. Chart Datum) for final plotting.

**4.1.4 VIEW OF MONUMENTS**

Seven (7) Survey Markers (Monuments) were established over the site for future references. The markers were established by GPS RTKNet static observation method.

<p><b>EGS00:</b> E-46461.460, N-31908.449 (Nail embedded on concrete kerb, painted red)</p>  <p><b>EGS 00</b></p>	<p><b>EGS01:</b> E-46638.399, N-31830.102 (Nail embedded in pipe on concrete monument, painted red)</p>  <p><b>EGS 01</b></p>
<p><b>EGS02:</b> E-46483.296, N-30264.074 (Nail embedded in pipe on concrete monument, painted red)</p>  <p><b>EGS 02</b></p>	<p><b>EGS03:</b> E-46614.827, N-29986.431 (Nail embedded on concrete kerb, painted red)</p>  <p><b>EGS 03</b></p>

**EGS04:** E-46435.500, N-31645.471  
(Nail on top of concrete drain, painted red)



**EGS05:** E-45718.100, N-29028.135  
(Nail embedded on road, painted blue)



**EGS06:** E-45835.748, N-28846.846  
(Nail embedded on road, painted blue)





**4.2 HYDROGRAPHIC SURVEYS**

**4.2.1 VERTICAL CONTROL and DATUM**

**4.2.1.1 Recording Tide Gauge**

A Valeport model 740 pressure sensor water-level recording tide gauge was installed at the existing Anglers Resort jetty; located approximately 400 metre east of Selat Lumut estuary. The gauge was maintained duration of the survey.

 <p style="text-align: center;"><b>Valeport 740 Digital Recording</b></p>	
<p><b>Tidal-gauge Location</b> The Valeport 740 pressure sensor recording was installed at the Anglers Resort Jetty and maintained duration of the survey</p>	<p>View of Valeport 740 Data Logging Unit; was configured to retrieve tidal-levels at 10 minutes intervals</p>

The so-observed tidal heights were used to reduce all soundings records to survey datum (Chart Datum (CD) established by the RMN was adopted as datum for the survey) which was 5.60 meters below BM 1004B or 2.81 meters below Land Survey Datum.

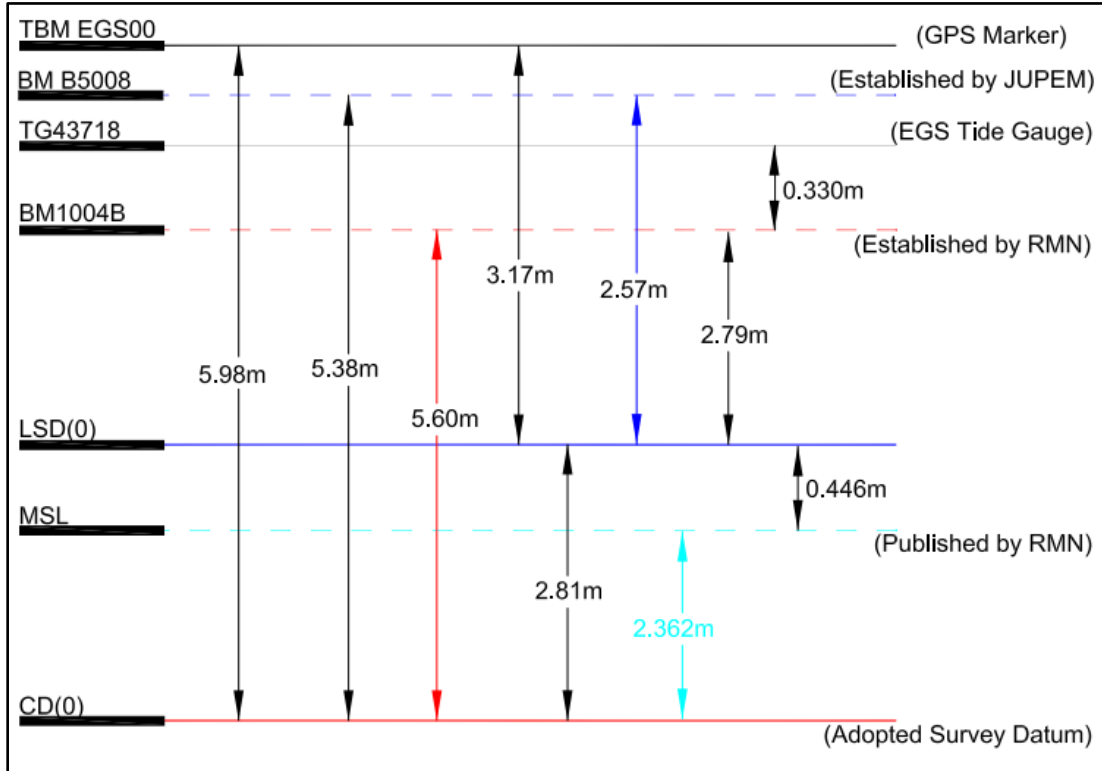
The National Hydrographic Centre (RMN) has established the Tidal Plane of Pintu Gedong and its vicinity above CD and can be summarized as follows:

<i>LAT/CD</i>	:	<i>0.0 adopted datum</i>
<i>MLWS</i>	:	<i>0.59m</i>
<i>MLWN</i>	:	<i>1.79m</i>
<i>MSL (Z<sub>0</sub>)</i>	:	<i>2.36m</i>
<i>MHWN</i>	:	<i>2.94m</i>
<i>MHWS</i>	:	<i>4.14m</i>
<i>HAT</i>	:	<i>4.94m</i>

These Tidal Plane were computed based on 43 days (5<sup>th</sup> Dec. 2012 to 18<sup>th</sup> Jan. 2013) of harmonic analysis published by National Hydrographic Centre (RMN).





A schematic diagram of tidal plane (relationship between the Chart Datum (the survey datum - CD) and Land Survey Datum (LSD) established by JUPEM) can be summarized as below:





- |                  |  |
|------------------|--|
| <b>TBM EGS00</b> | - Nail embedded on concrete curb, located at the entrance of Anglers Resort,                 |
| <b>BM B5008</b>  | - Located at Port Klang Police Station’s main entrance. (Established by JUPEM)               |
| <b>TG43718</b>   | - Located at Anglers Resort Jetty (install by EGS)   |
| <b>BM 1004B</b>  | - Located on the left side of the main entrance of anglers resort Jetty (established by RMN) |

#### 4.2.1.2 Positioning of Survey Boat

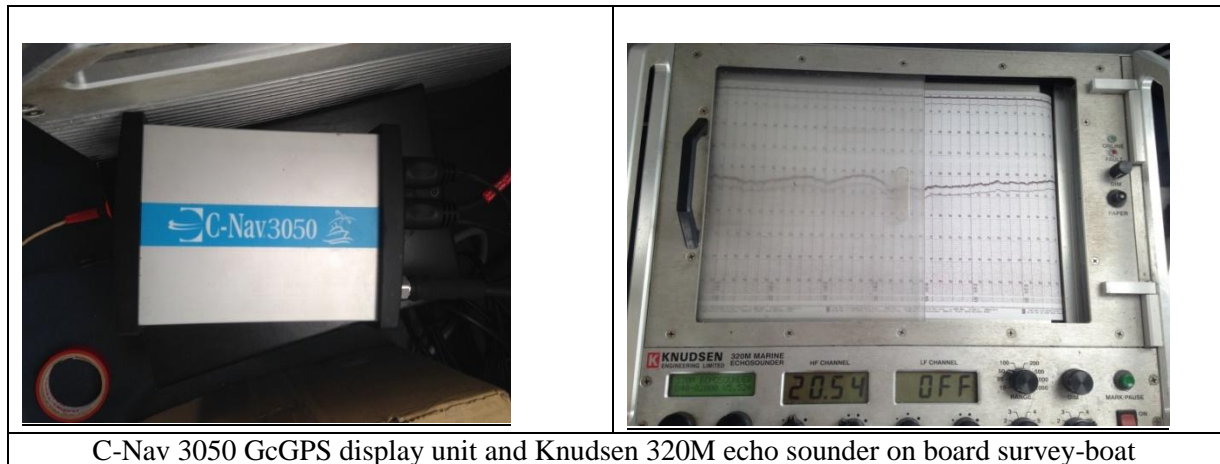
The survey boat was located by C-Nav GcGPS (Globally corrected Differential GPS) system, surveyed and coordinated on WGS84 Zone 47N. The so-collated positions were post processed and reduced to UTM grids projection for final plotting. The system provides corrected positions to an accuracy of  $\pm 1.0m$  without the need for a shore-based DGPS transmitting system.

 <p><b>Survey Boat #1</b></p>	 <p><b>Survey Boat #2</b></p>
<p>Mobilizing a shallow draft dinghy for near shore bathymetric survey, over area of water-depth &lt; 3m. The survey was carried out during the daylight hours at higher-high tides slag tidal cycle.</p>	<p>View of a licensed-survey boat “BPK997P” was used for bathymetric survey over offshore area (water depth &gt; 3m) during day-light hours only.</p>

### 4.2.1.3 Computerized Navigation System

	
<p>C-View Nav System to navigate the proposed survey lines</p>	

### C-Nav3050 GcGPS system and Knudsen 320M echo sounder



The EGS computerized navigation system was added to the positioning system to control the steering of the boat along the traverses specified, and to log all horizontal and vertical control data. The system provides the user with a dynamic analogue and digital screen display on which the following are continuously updated:

Skewed grid set parallel to the desired line direction

- Boat position
- Water depth
- Date and Time
- GPS diagnostics enabling quality control

#### **4.2.2 BATHYMETRIC SURVEY (Echo Sounding)**

The seabed topography was surveyed and delineated using Knudsen 320M, a single frequency acoustic echo sounder. The sounder was configured to retrieve seabed-profile-sounding sampling at 8 seconds intervals along the sounding-traverses (approximately 1.0 ~2.0 metres spacing per sampling).

The main sounding lines were sailed approximately E-West direction at 100 meter interval; with cross correlation QA/QC lines transverse the main lines at 500 meter spacing; surveyed during daylight hours.

Two survey boats were mobilized for the survey. A shallow draft dinghy was used for near shore bathymetric survey over area of water-depth < 3 meter surveyed at higher-high tides slag tidal cycle and a licensed-survey boat “BPK997P” area of water depth > 3 meter, respectively.

All soundings records and the observed tidal heights were reduced to Chart Datum (CD); which is 5.60 meters below BM 1004B. – (See Section 4.2.1.1)

**4.3.2 CALIBRATING HORIZONTAL POSITIONING SYSTEM**

C-NAV Positioning System



View of **TBM EGS 00** at Anglers Resort, Pulau Indah.

Prior commencement of the survey, the Positioning System C-NAV3050 GcGPS was calibrated by checking the coordinates displayed by the navigation system over a known TBM (observed by RTK method) -TBM EGS00. The GcGPS health check-survey findings can be summarized as follow:

Reference Station: **EGS00**

(Coordinates in UTM Zone 47N (WGS84 projection))

RTK Coordinates OBS:	N 319187.450 ; E 753968.450
Observed Coordinates:	N 319187.545 ; E 753968.960
-----	
Diff.	-0.095m      -0.51m
=====	

Prior demobilization of the survey, the Positioning System C-NAV3050 GcGPS was calibrated again by checking the coordinates displayed by the navigation system over a known TBM (observed by RTK method) -TBM EGS00. The GcGPS health check-survey findings can be summarized as follow:

Reference Station: **EGS00**

(Coordinates in UTM Zone 47N (WGS84 projection))

RTK Coordinates OBS:	N 319187.450 ; E 753968.450
Observed Coordinates:	N 319187.500 ; E 753968.933
-----	
Diff.	-0.050m      -0.48m
=====	

The above quality assurance procedure ensured that the horizontal positioning was surveyed to an accuracy of  $\pm 1.0m$  or better.



Topcon GPS-GR5

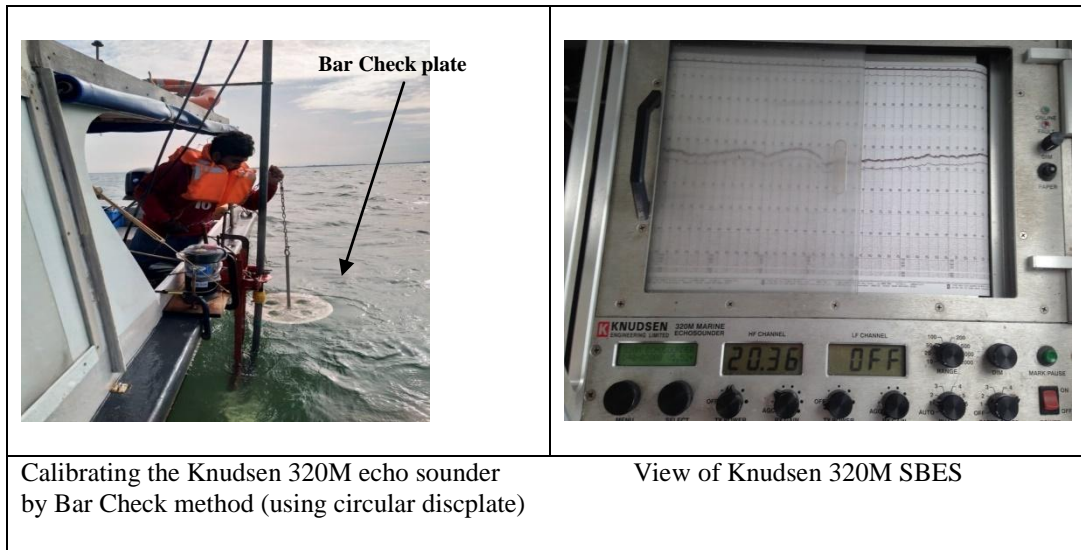
The Topcon GPS-GR5 system was calibrated at The Topcon equipment supplier prior mobilization to the site. (See Appendix D)



Topcon GPS GR5

Echo Sounder

The echo sounder was calibrated on site by the bar check method. A bar (in fact a circular disc) was lowered below the transducer over known distance, marked on the bar chain, and the sounder run over all depths; adjustments to the transducer depth and the speed of sound secure a full scale quality compliance.



Calibrating the Knudsen 320M echo sounder by Bar Check method (using circular discplate)

View of Knudsen 320M SBES

The sounder was calibrated prior commencement and at the end of each survey-day provides QA of so-collected sounding records. Sample of Bar Check records are included in APPENDIX C of this report.

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## 5.0 DATA PROCESSING AND PRESENTATION OF RESULTS

### 5.1 REDUCTION OF OBSERVATIONS

#### 5.1.1 Echo Sounding Data

The so-collected digital sounding data (depths) were post processed using EGS in-house processing software package. The software includes facility to manually viewed and removed (if found necessary) any erroneous echo-records (e.g. spike-data, etc) and to correct any influence of wave action (however, in this case the survey was carried out during good weather condition).

All of the data were then processed using licensed Terramodel software ver. 10.13 to generate the 1m contour vertical interval and presented on to all charts and also DTM (Detain Terrain Model) of the cross section. The processed data were exported to AutoCAD ver. 2004 for final plotting.

All soundings records and the observed tidal heights were reduced to Chart Datum (CD); which is 5.60 meters below BM 1004B.

#### 5.1.2 Accuracy of Seabed Levels

In theory, at least the following factors can affect the overall accuracy of an echo sounding survey:

- Incorrect bench mark level.
- Settlement of bench mark between successive surveys.
- Error in setting up the tide gauge.
- Reading off errors of the tide gauge data.
- Surveyor bias in sea bed interpretation.
- Incorrect removal of the effects of waves.
- The (inevitable) assumption that there is nowater surface gradient between the tide gauge and the survey boat from time to time.
- Variations in the salinity of the sea wateracross the survey period which in turn affect the speed of sound in water.
- Minor errors in the bar checks.
- Error in horizontal control.
- Beam width of the transducer.
- Variations in boat 'balance'.
- Manufacturer's stated echo sounder accuracy.

The Quality Assurance procedure seeks to eliminate many of the above factors.

However, some errors perforce remain such that even under ideal sea state conditions, the minimum error will be +/- 0.15m.

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## 6.0 PRESENTATION SURVEY FINDINGS AND DRAWINGS

The survey findings and result are presented as follows:

### **DRAWINGS:**

Drawing ref:

Layout Plan with Contour; Scale 1:20,000  
EGS43718/LP1

Topographic and Bathymetric Plan – Seabed contour at 1m vertical interval; scale 1:5,000  
EGS43718/Sheet 1  
EGS43718/Sheet 2  
EGS43718/Sheet 3  
EGS43718/Sheet 4  
EGS42718/Sheet 5  
EGS42718/Sheet 6  
EGS42718/Sheet 7

Cross Section Plan - Horizontal Scale 1:10,000; Vertical Scale 1:1,000  
EGS42718/CS 1 – (Section CH 0 – CH 1400)  
EGS42718/CS 2 – (Section CH 1600 – CH 3000)  
EGS42718/CS 3 – (Section CH 3200 – CH 4600)  
EGS42718/CS 4 – (Section CH 4800 – CH 6200)  
EGS42718/CS 5 – (Section CH 6400 – CH 7800)  
EGS42718/CS 6 – (Section CH 8000 – CH 9400)  
EGS42718/CS 7 – (Section CH 9600 – CH 13200)

### **APPENDICES:**

- Appendix A** - Tidal Plot- 18 days of continuous tidal observation
- Appendix B** - Horizontal Traverse Control Survey Result
- Appendix C** - Sample of Sounding Bar-check records before and end of survey day
- Appendix D** - Equipments Specifications
- Appendix E** - CD – Digital Data

### **SOFT COPY DATA:**

1. Digital drawings in AutoCAD ver. 2004
2. Digital observed tidal levels, reduced to CD
3. Digital Drawings in PDF Format
4. Survey Soundings data in ASCII format (Plotting Scale 1:5000)
5. Survey Soundings data in ASCII format (Plotting Scale 1:1000)
6. Survey Text Report in PDF format
7. Appendices in PDF format

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