COCHIN PORT
कोचिन पत्तन प्राधिकरण
Cochin Port Authority

सत्यमेव जयते
LAKSHADWEEP ADMINISTRATION

GOVERNMENT OF KERALA

HYDROGRAPHIC SURVEY WING

REPORT OF HYDROGRAPHIC SURVEY

KALPENI ISLAND

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THIRUVANANTHAPURAM

HYDROGRAPHIC SURVEY

FOR

VARIOUS PORT LED DEVELOPMENT ACTIVITIES

KALPENI ISLAND, LAKSHADWEEP

MAY 2024

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We would also like to thank Sri. B. Kasiviswanathan, IRSME Chair Person and Sri. Vikas Narwal, IAS Deputy Chairman, Cochin Port Authority.

We express our gratitude to the Chief Engineer and Executive Engineer, Cochin Port Authority for guidance and technical inputs in this project. Hydrographic Survey Wing is pleased to place on record their sincere thanks to other officers of Cochin Port Authority and Lakshadweep Administration.

Hydrographic Survey Wing is grateful to Cochin Port Authority for awarding the work and giving all assistance for the survey in Lakshadweep Islands. We would also like to express our sincere thanks to Lakshadweep Administration for arranging transportation facility to our Survey team and arrangement of boarding and lodging facilities in respective Islands.

The successful completion of the project would not have been possible without the valuable assistance and co-operation received from the Lakshadweep Harbour Department, who generously shared their expertise and benchmark data.

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1. INTRODUCTION

1.1 General

The Hydrographic Survey Wing is a specialist survey and investigation organization functioning under the Government of Kerala. This wing conducts pre-dredging, post-dredging, pre-monsoon, and post-monsoon surveys for developmental activities in the maritime sector to ascertain various aspects of investigation, such as the requirements of navigation, tourism and costal protection etc.

As per the work order **T9/Bathymetry-Lakshadweep/2024-C/317(W)** from the Chief Engineer's Office, Cochin Port Authority (CPA), dated 01/04/2024, the Kerala Institute of Hydrography & Advanced Studies (KIHAS) was entrusted to conduct a bathymetric survey of Kalpeni, Androth, and Kadamat islands in connection with various port-led development activities in the Lakshadweep Islands. Accordingly, the Hydrographic Survey Wing has completed the bathymetric survey for KIHAS and is submitting the report herewith.

Cochin Port or **Kochi Port** is a major port on the Arabian Sea – Laccadive Sea – Indian Ocean sea-route in the city of Kochi in Ernakulam district. It is also the first transshipment port in India. Cochin Port Authority is thus a vital hub for trade, logistics and maritime activities in India, playing a key role in the country's economy and regional development, planning, designing and executing various construction and development projects that enhance the port's capacity and efficiency.

Lakshadweep is a union territory of India, administered as a single district with Kavaratti as its capital. **Prime Minister** highlighted the government's commitment to environmental conservation and sustainable tourism practices of the region while promoting economic development. The Prime Minister announced strategic initiatives to improve connectivity, enhance accommodation facilities, and upgrade visitor amenities. The inauguration of new airports, expansion of port facilities, and investment in tourism infrastructure projects have facilitated easier access to Lakshadweep and elevated the overall tourist experience, making it more convenient and enjoyable for travelers.

1.2 Units

- WGS 84 Ellipsoid , Transverse Mercator projection, North , Zone 43
- Soundings are in Meters and Decimeters
- Angular values expressed in degrees(°),(‘),(“)

1.3 Notes

1. Soundings are reduced to Chart Datum which is 3.322 m below BM.
2. Sounding conducted at 200 KHz Frequency using EchoTrac E 20.
3. Positioning System Trimble DGPS.
4. Data logging and processing using Hypack software.
5. Line interval 50m and sounding interval 5m.

2. AIM & SCOPE OF WORK

2.1 Aim:

Conducting bathymetric survey in Kalpeni Island at Lakshadweep for the various port led developmental activities. Hence HSW through KIHAS entrusted by Cochin port authority to carryout survey in and around the island to acquire sea bed sounding profile.

2.2 Scope of Work:

1. Conducting Bathymetry survey in Androth, Kadamat and Kalpeni, islands in Lakshadweep using dual frequency echo sounder with DGPS (beacon based) and processing with "HYPACK" software in grids of 50 x 5m or less where sudden changes occur.

2. Surveys shall be conducted in Dual Frequency Echo Sounder/ Equipment with 200-210 kHz and 33 kHz frequencies capable of logging data compatible with computers. Apart from the facility of producing echo-charts and also separate chart shall be submitted for both frequencies.

3. For survey, the survey boat shall be equipped with DGPS, Echo Sounder, and HYPACK Max acquisition and navigating software or equivalent, qualified hydrographic survey personnel for conducting bathymetry survey.

4. Providing survey charts after duly processing above acquired data using HYPACK Max processing system of equivalent.

5. All sounding/depths are to be taken at an accuracy of 0.10 m and reduced to MSL or Chart Datum (CD) and the depths/heights shall be plotted in meters and decimeters. The vertical control/water level is to be established with respect to MSL/CD and the water level is to be taken at every 15 minutes during course of bathymetric survey. The raw data of bathymetry survey shall be handed over to Engineer-in-charge on completion of survey.

6. Submission of every sounding charts/survey reports (final product in HYPACK Max/HYPLOT) as per the "Sounding color settings" at no extra cost-5 Nos. hard copies and one soft copy in editable mode.

3. MISSION OF SURVEY

A bathymetric survey is a type of hydrographic survey that measures the depth of a body of water, such as an ocean, sea or lagoons. The mission of a bathymetric survey typically includes:

1. Mapping the Seafloor: Creating detailed maps of the seafloor topography, including depth soundings and contours.

2. Charting Navigation Channels: Identifying safe navigation channels and routes for maritime traffic.

3. Supporting Offshore Development: Providing data for offshore construction, such as wind farms, pipelines, oil rigs and comprehensive development of Islands.

4. Environmental Monitoring: Studying ocean currents, tides, and sediment transport to understand coastal erosion and deposition.

5. Search and Recovery: Locating and recovering underwater objects, such as shipwrecks or aircraft.

6. Scientific Research: Gathering data for oceanographic and geological research, such as studying marine habitats and ecosystems.

7. Hydrographic Charting: Updating and creating nautical charts for safe navigation.

8. Supporting Coastal Zone Management: Providing data for coastal planning, conservation, and costal protection management.

9. Coastal Security: Providing data for the coastal security of islands.

The mission of a bathymetric survey is crucial for various applications, including navigation, offshore development, environmental monitoring, and scientific research.

4. VISION OF SURVEY

The vision of a bathymetric survey is to:

1. Create Accurate and Detailed Maps: Produce high-resolution, accurate, and reliable bathymetric data to support various applications.

2. Enhance Maritime Safety: Provide critical data for safe navigation, reducing the risk of accidents and environmental damage.

3. Support Sustainable Development: Contribute to the responsible management of marine resources, balancing economic, social, and environmental needs.

4. Advance Scientific Knowledge: Expand our understanding of oceanography, geology, and ecosystems, driving innovation and discovery.

5. Foster International Cooperation: Collaborate globally to standardize methodologies, share data, and address common challenges.

6. Embrace Technological Advancements: Leverage cutting-edge technologies, such as autonomous underwater vehicles (AUVs), remotely operated vehicles (ROVs), and advanced sensors.

7. Ensure Data Accessibility and Sharing: Make bathymetric data widely available, supporting open science and informed decision-making.

8. Promote Environmental Stewardship: Contribute to the conservation and protection of marine ecosystems, habitats, and biodiversity.

The vision of a bathymetric survey is to harness the power of accurate and detailed seafloor mapping to drive progress, innovation, and sustainability in various fields.

5. SURVEY AREA

Survey Location: Kalpeni Island, Lakshadweep

Kalpeni is an inhabited Atoll in the Union Territory of Lakshadweep, India. It has a distance of 287 km (178 mi) west of the city of Kochi, Kerala.

Location: - Latitude: 10º 05' North

Longitude: 73º 39' East

Kalpeni is 218 kilometres (135 miles) west from the port of Kochi and lies 71 kilometres (44 miles) south of Androth and 201 kilometres (125 miles) to the North-Northeast of Minicoy, with the broad Nine Degree Channel between them. Suheli Par atoll lies 139 kilometres (86 miles) to the west of Kalpeni. Kalpeni is situated about 76 kilometers south of Androth. The area of the island is 2.28 sq. kms and the population is 4319.

Figure 1: Kalpeni Island

The island along with the satellite islands of Kodithala, Cheriyam, Thilakkam and Pitti lies in an extensive shallow lagoon. A peculiar feature of this island is the presence of huge storm bank of coral debris along the eastern and south-eastern shore. This island is often hit by cyclone. Kalpeni forms a single coral atoll along with the uninhabited islands of Cheriyam, Tilakkam, Kodithala and Pitti islet. The eastern and southern shorelines of the island have accumulations of coral debris, the result of a violent storm that hit the area in 1847. It has a

lagoon area of 25.6 km^2 (9.9 sq. mi). Kalpeni is a popular destination for ecotourism and water sports. The island is with crystal clear water and vibrant coral reefs.

Weather in Lakshadweep was warm and with clear skies. The sea was calm for survey with nearly 12 hours of sunlight daily.

Temperature: The temperature in Lakshadweep during April and May ranges from 25°C to 35°C (77°F to 95°F). The average temperature in April varies between approximately 26.6°C to 27.7°C, making it an ideal time to explore the islands.

Weather: The weather is warm and sunny, with clear skies, making it perfect for outdoor activities.

Rainfall: April receives moderate rainfall, with an average of 59 mm, while May receives more rainfall, with an average of 180 mm. The rainfall increases in May, marking the beginning of the monsoon season.

Sunshine: Lakshadweep receives plenty of sunshine during April and May, with an average of 7 to 6 hours of sunshine per day.

Environmental Concerns: Kalpeni, like other islands in Lakshadweep, faces environmental challenges such as coastal erosion, rising sea level and coastal reefs degradation due to climatic changes.

Economy: Primarily, based on fishing and coconut cultivation. Coir making is also a traditional craft practiced on the island. Tourism is an emerging industry.

6. RECONNAISSANCE SURVEY

As per the work order T9/Bathymetry- Lakshadweep/ 2024- C/317(W) from Chief Engineer's office, Cochin Port Authority dated 01/04/2024, HSW through KIHAS was entrusted to conduct bathymetric survey of Kalpeni, Androth and Kadamat islands in connection with various port led activities of Lakshadweep islands.

A Reconnaissance survey was conducted in 2015 and report was submitted to concerned authorities. Administration of Home Department of Union Territory of Lakshadweep Islands has requested for conducting Coastal mapping and bathymetric Survey of Lakshadweep Islands for the purpose of Coastal Security Vide Letter No-FNO1/4/213-CSS-2/372 dated 25/01/2015 and Government of Kerala accorded sanction for conducting reconnaissance survey. As per Go.RtNo.374/2015/F&PD Dated 11/05/2015 reconnaissance survey was conducted by the then Assistant Cartographer Sri. Geroshkumar V and Marine surveyor Sri. P.T.Thomas Kutty of Hydrographic Survey Wing on October 2015 and report regarding Bathymetric Survey & Coastal map preparation of Lakshadweep Island was submitted to the concerned authorities. But the survey was not executed as further instructions were not received

Subsequently, the Chief Hydrographer constituted a survey team under the two Marine surveyors of HSW for executing the survey works. Initial study of the work was made based on the above report and all Bench Mark details and locations available in the Island were collected from Cochin Port Authority. The preliminary planning was conducted and the survey team reached Lakshadweep Islands on 30th April 2024 and an initial reconnaissance of the survey site was conducted. Rented vessels were arranged for survey in every Island, tide poles were erected and survey started on 2nd May 2024.

7. PRE-SURVEY PLANNING

Selection of control point, identify and establish geodetic control point near survey area that can serve as reference (geodetic network such as WGS 84) to maintain consistency and accuracy. Real time Kinematic (RTK) data accruement using DGPS- for more accurate positioning, fixed base station and rover unit on the survey vessel.

The survey lines were carried out at a length of up to 100 m depth or more from the shoreline of the islands at 50-meter line spacing. Surveys were conducted at a grid spacing of 50x5 meters.

7.1 Geodetic Control

- **Horizontal Control**

  Trimble DGPS used for Positioning during Bathymetric survey, WGS 84 datum

  Control point CP-1 10º05’ 17.96674’N 073º 38’ 53.07175’’E
  (Established at roof top of Passenger hall near North Jetty)

  Control point CP-2, 10º05’ 12.9568’’N 073º38’ 57.3062’’E
  (Established at roof top of NIOT LTTD plant)

- **Vertical Control**

Soundings are reduced to Chart datum which is 3.322 m below the BM which is marked at the foot of the south pillar supporting the pulley of the well. The well is located near the transformer at North east compound of fisheries workshop near fisheries Jetty.

8. DIGITAL SURVEYING SYSTEM

Dual Frequency Echo Sounder (Echotrac E-20) and Trimble DGPS were used for bathymetry. The dual frequency data from the Echotrac-E20 Echo sounder capable of operating at 200 KHz and 33 KHz used for sounding operations, along with the differential positions obtained from Trimble DGPS was simultaneously logged on to the Hypack 2022 digital data logging software for obtaining the raw data. Sound velocity 1532 m/s was inputted to the Echo sounder during data logging.

Bathymetric data was acquired using a Dual Frequency Echo Sounder (Echotrac-E20). The transducer assembly was side mounted on a pole on the port side of the boat. The digital output was logged by the navigation computer for post processing.

Figure 2: Data Logging in Hypack

9. SURVEY INSTRUMENTS

9.1 Data Logging Software

Auto logging using Hypack survey software 2022. It provides a tool to design a survey, collect data, apply corrections to soundings, remove outliers, plot field sheets, export data to CAD, compute volume quantities, generate contours and create/modify electronic chart.Navigation data was processed using the Hypack navigation software. Single beam data from the Dual Frequency Echo Sounder (Echotrac-E20) was also processed using the Hypack software.

9.2 Echosounder

The dual frequency data from the Echotrac-E20 Echosounder capable of operating at 200 KHz and 33KHz used for sounding operations.

Figure 3: Echotrac-E20 Echosounder

Calibration

The echo sounder was calibrated at the survey location by conducting a bar-check. The bar-check is carried out by lowering a horizontal steel plate to known, fixed depths below the water surface directly below the echo sounder transducer. Acoustic reflections from the plate at different depths are then recorded and adjustments made to the settings for sound velocity and draft to get accurate results. A bar-check was carried out before commencing the survey every day and the average speed of sound obtained was entered into the unit.

9.3 DGPS

a. Trimble SPS 855 with Radio Modem and accessories

b. Trimble IR670 with Radio Modem and accessories

9.4 Levelling Instrument

Automatic Level SOKKIA B 40 with bar coded leveling staff and accessories.

9.5 Coast Lining

SP 20 Hand held DGPS was used.

10. SURVEY PROCEDURE

10.1 Data Collection:

- Offshore surveys were carried out using rented Survey boat.
- The survey was conducted with the help of local residents to identify the obstructions and sea conditions in the survey area.
- **Horizontal positioning** - Collect continuous horizontal position data as the survey vessel moves ensuring the data is synchronized with depth measurements and other survey data.
- **Vertical Positioning:** - Periodically verifying the position of the vessel relative to known control point to check for any discrepancies.
- **Coast line survey**- The coastline delineation including all permanent topographic features was carried out using hand held GPS to record precise locations along the shoreline.
- **Physical measurements** - Measure and record physical attributes of the coastal structures.

11. DETAILS OF SURVEY

Data Logging	**:** Auto logging using Hypack survey software 2022
Bathymetry	**:** Dual Frequency Echo Sounder (Echotrac-E20) and Trimble DGPS was used for Bathymetry
Scale of survey	**:** 1:5000
Sounding line interval	**:** 50 m
Contour Interval	**:** 10 m
Survey vessel Details	**:** Motorized Boat and Dinghy
Echosounder used	**:** Dual Frequency Echo Sounder (Echotrac-E20)
DGPS	**:** Trimble DGPS
Tide	**:** Manual Tide observation during survey period.

12. TIDES AND SOUNDING DATUM

Tides were obtained from Established Tide pole at Kalpeni Island south side of fisherman jetty and reduced to Chart datum which is 3.322 m below the BM.

12.1 Description of Bench Mark

The Benchmark 3.322 meter which is marked at the foot of the south pillar supporting the pulley of the well. The well is located near the transformer at North east compound of fisheries workshop near fisheries Jetty.

12.2 Bench Mark

Soundings are reduced to Chart datum which is 3.322 m below the BM which is marked at the foot of the south pillar supporting the pulley of the well. The well is located near the transformer at North east compound of fisheries workshop near fisheries Jetty.

Position of BM - 10º 04' 43.0656" N,
73º 38' 44.3073" E

Figure 4. Kalpeni Bench Mark

12.3 Tide Pole

Tides were obtained from Established Tide pole at Kalpeni Island. Manual tide was observed at regular intervals using this tide pole throughout the survey period, which was erected at a suitable location and leveling was done by connecting available benchmark.

Position of Tide pole - 10º 04' 43.7376" N,
73º 38' 38.1815"E

Tide pole is calibrated to a known reference point or datum such as Chart Datum.

Figure 5. Kalpeni Tidepole

12.4 Leveling Details

Leveling at Kalpeni - Lakshadweep

Date	-	02-05-2024
Survey Work	-	Lakshadweep Survey
General Area	-	Lakshadweep Island
Locality	-	Kalpeni Island
Observer	-	Devaraj P Kartha, Assistant Marine Surveyor
Recorder	-	Robert P J, Seaman
Staff Holder	-	Robin A.P, Seaman
Instrument Used	-	Sokia Auto level
Weather	-	Sunny
Visibility	-	Moderate
Bench Mark	-	Soundings are reduced to Chart datum which is 3.322 m below the BM which is marked at the foot of the south pillar supporting the pulley of the well. The well is located near the transformer at North East compound of fisheries workshop near fisheries Jetty, Kalpeni.

LEVELLING FROM BM TO TIDEPOLE

No. Legs	Stadia Wire	BS (m)	Centre Reading (m)	FS	Centre Reading	Remarks
01	Top	0.836				
	Centre	0.696	0.696			BM (+3.322)
	Bottom	0.556				
	Top			1.386		
	Centre			1.211	1.211	
	Bottom			1.036		
02	Top	1.985				
	Centre	1.815	1.815			
	Bottom	1.645				
	Top			1.527		
	Centre			1.374	1.374	
	Bottom			1.221		
03	Top	1.452				
	Centre	1.367	1.367			
	Bottom	1.282				
	Top			2.870		
	Centre			2.715	2.715	Staff kept at 3.00 m
	Bottom			2.560		
			3.878		5.300	

Staff kept at 3.00 m on Tide pole

(3.882+3.322) - (5.300+3.00)

7.204 - 8.300 = **1.100 m**

LEVELLING FROM TIDEPOLE TO TBM

No. Legs	Stadia Wire	BS (m)	Centre Reading (m)	FS	Centre Reading	Remarks
01	Top	2.882				
	Centre	2.740	2.740			Staff kept at 3.00 m
	Bottom	2.598				
	Top			1.572		
	Centre			1.434	1.434	
	Bottom			1.296		
02	Top	1.536				
	Centre	1.415	1.415			
	Bottom	1.294				
	Top			1.508		
	Centre			1.394	1.394	
	Bottom			1.280		
03	Top	1.020				
	Centre	0.795	0.795			
	Bottom	0.570				
	Top			0.848		
	Centre			0.700	0.700	BM (+3.322)
	Bottom			0.552		
			4.950		3.528	

Staff kept at 3.00 m on Tide pole

(4.950 +3.00) ~ (3.528+3.322)

7.950 ~6.850 = **1.10m**

Say 1.10m

Therefore, zero of the tide poles is 1.10m below Chart datum

12.5 Tide

Tide on 01-05-2024

TIME	TIDE
10.45	0.88
11.00	0.89
11.15	0.90
11.30	0.92
11.45	0.94
12.00	0.96
12.15	0.99
12.30	1.02
12.45	1.05
13.00	1.09
13.15	1.13
13.30	1.17
13.45	1.21
14.00	1.25
14.15	1.29
14.30	1.33
14.45	1.37
15.00	1.41
15.15	1.45
15.30	1.49
15.45	1.52
16.00	1.54
16.15	1.56
16.30	1.58
16.45	1.60
17.00	1.62
17.15	1.64
17.30	1.66
17.45	1.68
18.00	1.69

Tide on 02-05-2024

TIME	TIDE
7.00	1.2
7.15	1.18
7.30	1.16
7.45	1.14
8.00	1.12
8.15	1.1
8.30	1.08
8.45	1.06
9.00	1.04
9.15	1.02
9.30	1
9.45	0.98
10.00	0.96
10.15	0.95
10.30	0.94
10.45	0.93
11.00	0.92
11.15	0.91
11.30	0.9
11.45	0.9
12.00	0.9
12.15	0.92
12.30	0.94
12.45	0.97
13.00	1
13.15	1.03
13.30	1.06
13.45	1.09

TIME	TIDE
14.00	1.12
14.15	1.16
14.30	1.2
14.45	1.24
15.00	1.28
15.15	1.32
15.30	1.36
15.45	1.4
16.00	1.44
16.15	1.47
16.30	1.5
16.45	1.53
17.00	1.56
17.15	1.58
17.30	1.6
17.45	1.62
18.00	1.64
18.15	1.65
18.3	1.66
18.45	1.67
19.00	1.68

Tide on 03-05-2024

TIME	TIDE
7.00	1.32
7.15	1.3
7.30	1.28
7.45	1.26
8.00	1.24
8.15	1.22
8.30	1.2
8.45	1.18
9.00	1.16
9.15	1.14
9.30	1.12
9.45	1.1
10.00	1.08
10.15	1.06
10.30	1.04
10.45	1.02
11.00	1
11.15	0.98
11.30	0.97
11.45	0.96
12.00	0.95
12.15	0.94
12.30	0.94
12.45	0.94
13.00	0.95
13.15	0.97
13.30	0.99
13.45	1.01

TIME	TIDE
14.00	1.03
14.15	1.06
14.30	1.09
14.45	1.12
15.00	1.15
15.15	1.19
15.30	1.23
15.45	1.27
16.00	1.3
16.15	1.33
16.30	1.36
16.45	1.39
17.00	1.42
17.15	1.45
17.30	1.48
17.45	1.51
18.00	1.54
18.15	1.57
18.30	1.6
18.45	1.62
19.00	1.64

Tide on 04-05-2024

TIME	TIDE
7.00	1.45
7.15	1.43
7.30	1.41
7.45	1.39
8.00	1.37
8.15	1.35
8.30	1.33
8.45	1.31
9.00	1.29
9.15	1.27
9.30	1.25
9.45	1.23
10.00	1.22
10.15	1.21
10.30	1.19
10.45	1.17
11.00	1.15
11.15	1.13
11.30	1.11
11.45	1.1
12.00	1.1
12.15	1.1
12.30	1.1
12.45	1.1
13.00	1.1
13.15	1.12
13.30	1.14
13.45	1.16

TIME	TIDE
14.00	1.18
14.15	1.2
14.30	1.22
14.45	1.24
15.00	1.26
15.15	1.28
15.30	1.3
15.45	1.32
16.00	1.34
16.15	1.36
16.30	1.38
16.45	1.4
17.00	1.42
17.15	1.44
17.30	1.47
17.45	1.5
18.00	1.53
18.15	1.56
18.3	1.59
18.45	1.62

Tide on 05-05-2024

TIME	TIDE
7.00	1.37
7.15	1.39
7.30	1.41
7.45	1.43
8.00	1.45
8.15	1.47
8.30	1.49
8.45	1.51
9.00	1.51
9.15	1.51
9.30	1.49
9.45	1.48
10.00	1.47
10.15	1.45
10.30	1.43
10.45	1.41
11.00	1.39
11.15	1.37
11.30	1.35
11.45	1.33
12.00	1.31
12.15	1.28
12.30	1.25
12.45	1.23
13.00	1.21
13.15	1.19
13.30	1.17
13.45	1.15

TIME	TIDE
14.00	1.14
14.15	1.12
14.30	1.1
14.45	1.1
15.00	1.1
15.15	1.1
15.30	1.12
15.45	1.14
16.00	1.16
16.15	1.18
16.30	1.2
16.45	1.22
17.00	1.24
17.15	1.26
17.30	1.29
17.45	1.32
18.00	1.35

13. ANCILLARY OBSERVATIONS

Heavy breakers observed at east and west cape of the Kalpeni Island making it inaccessible to survey using motorboats or dinghies. Existence of Coral reefs found from shore to around 3km and the average depth varies from 5 meter to -1.5 meter inside area. Outer sea sounding varies from 10 meter to more than 90 meter in many areas and a steep fall causing a depth of around 200 – 300 meters immediately after 60 - 80 meters.

14. DATA PROCESSING AND DIGITAL CHART PREPARATION

- **Data processing**- Combined DGPS Co-ordinates and Echosounder data processed with Hypack Hydrographic software and also the physical measurements to create comprehensive data setting. The processed data from HYPACK was exported to AutoCAD and final fair sheet was prepared in AutoCAD 2014.
- **Geo referencing**- Ensure that all data are correctly geo-referenced to a consistent co-ordinate system.
- **Quality Control**- Checked the accuracy of the corrected data, correcting any errors or inconsistency.
- **Analysis**: -

i) **Shoreline mapping**: - Created detailed map of the coastline (including all topographic features)

ii) **Data Presentation**: - Charts and Photographs, contouring in the report to visually represent the data.

iii) **Report Preparation**: - Compiled a detailed report, summarizing the survey objectives, methodologies and findings.

15. LIST OF SURVEY PERSONNEL

The following staff of the Hydrographic Survey Wing participated in the survey activity.

Sri. Varghese C O, Marine Surveyor

Smt. Minimol L, Marine Surveyor

Sri. Devaraj P Kartha, Asst. Marine Surveyor

Sri. Manoj Kumar D, Field Assistant

Sri. Vinod V, Field Assistant

Sri. Paul P V, Survey Syrang Gr I

Sri. Sunilkumar S, Engine driver Gr III

Sri. Lenin R, Leadsman

Sri. Robert P J, Leadsman

Sri. Ajeshkumar V, Seaman

Sri. Sujith B, Seaman

Sri. Robin A P, Seaman

Personnel participated for Processing

Sri. Devaraj P Kartha, Asst. Marine Surveyor

Sri. Vinod V, Field Assistant

Smt. Sobha M R, Draftsman

16. CONCLUSION

The hydrographic survey has successfully met its objectives providing comprehensive data on Kalpeni Island, yielding valuable insights into bathymetry data. The findings highlight several important considerations for navigation safety, coastal development, environmental monitoring, and port development activities.

- **Key Findings**:
  1. **Bathymetry**: The survey has mapped the seabed topography with high precision, revealing Hidden dangers, Wrecks and Profile of the sea bed highlighting shallow areas.
  2. **Sediment Analysis**: No previous data for comparison of sediment deposition.
  3. **Hydrodynamics:** water current observation should be carried out for further investigations.
  4. **Environmental Conditions:** The data should be collected for water quality.

- **Recommendations:**

Based on the Chart, it is recommended that specific actions, further studies, or policy implications be undertaken to initiate development activities.

- **Future Work:**

Additional surveys should be undertaken to monitor post-monsoon transformations and their effects on the region's environmental dynamics.

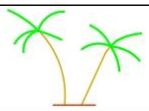
- **Final Remarks:**

The results of this hydrographic survey provide a crucial foundation for maritime planning, environmental assessment and will serve as an important reference for stakeholders involved in development activities. Continuous monitoring and analysis are essential to long-term goal, ensuring safe navigation, preserving marine ecosystems and infrastructure development.

17. ENCLOSURES

1. Hard copy of Bathymetric survey charts in scale 1:5000 - 3 sheets 50 x 18m grid (5copies).
2. Softcopies of
    a) Bathymetric survey charts in scale 1:5000 - 4 sheets 50 x 18m grid in pdf format.
    b) Bathymetric survey charts in scale 1:5000 - 4 sheets 50 x 18m grid in AutoCAD format.
    c) Bathymetric survey charts in scale 1:5000 – entire island 50 x 18m grid in AutoCAD format.
    d) Bathymetric survey charts in scale 1:5000 – entire island 50 x 5m grid in AutoCAD format.
    e) Hypack data.
    f) 5m sorted data.
    g) 18m sorted data.
    h) KML file.

ANNEXURE A. LEGENDS AND ABBREVATIONS

	Coral Reefs
	Buoy(IWAI)-Red
	Buoy(IWAI)-Green
	Breaks heavily
	coconut tree
	Light House
	house
	Ship wreckage
	Tower
BM	Bench Mark
CP	Control Point
NIOT LTTD	Low Temperature Thermal Desalination Plant
CD	Chart Datum
DGPS	Differential Global Positioning System
WGS 84	World Geodetic System 84

ANNEXURE B. METADATA

- Metadata File Date: Wednesday, July 31, 2024
- Survey Date: Wednesday, May 01, 2024
- Abstract: This dataset consists of locations below the surface of the water where the depth of water is precisely known relative to some reference.
- Purpose: Conducting bathymetric survey in Kalpeni Island at Lakshadweep for the various port led developmental activities and to acquire sea bed sounding profile.
- Project Name: KALPENI CPA 2024
- Element Name:
- Area of Coverage: 45 sq.kms
- Type of Survey: Hydrographic Survey
- Survey File Name: KALPENI 18.xyz
- Associated Data File: Kalpeni planned line 50.lnw
- Date File Delimiter: Comma
- Access Constraints: None
- Use Constraints: None
- Currentness Reference: None
- Progress: Complete
- Update Frequency: As Needed
- Keywords: Hydrographic, Topographic, Orthometric, Bathymetric, Survey, Sounding Point
- Team Leader: Devaraj P Kartha
- Survey Manager: Minimol L
- Project Manager: Minimol L
- Data Contact Person: Chief Hydrographer
- Organization: Hydrographic Survey Wing
- Telephone: 04712456123
- Address: Near Matsyafed Office, Kamaleshwaram
- City: Thiruvananthapuram
- State: Kerala
- Postal Code:
- Metadata File Author: Marine Surveyor
- Organization: Hydrographic Survey Wing
- Telephone: 04742748863
- Address: O/o the Marine Surveyor
- City: Kollam
- State: Kerala
- Postal Code: 691002
- QA Person: [To be filled out by individual reviewing this metadata form]
- QA Date: Wednesday, July 31, 2024
- Projected Coordinate System: UTM North
- Datum Name: WGS-84
- Horizontal Zone: Zone 43(72E-78E)
- Projected Coordinate Units: Meter
- Implied Horizontal Accuracy: +/- 1 mm
- Data Transformation Method/Value: Point to Point Software
- Vertical Reference Datum: Chart Datum from Benchmark
- Tidal Epoch: N/A
- Geoid Model: N/A
- Implied Vertical Accuracy: +/- 10 mm
- West Longitude: +073.355967

- East Longitude: +073.401866
- North Latitude: +10.0249692
- South Latitude: +10.0811500
- Vessel Name:
- Positioning System/Method: DGPS
- System/Method: Single Beam Echosounder
- Transducer Beam Angle: 3 Degrees (Single-beam)
- Multi-beam Swath Width: N/A
- Bin Size: N/A
- Shot Selection Method: Point Positioning
- Shot Selection Positioning Method: Point Positioning
- Edited for Bad Soundings: Yes
- Tide Applied: Yes
- Tide Gage Location: North east compound of fisheries workshop near fisheries Jetty at Kalpeni
- Controlling Benchmark(s): Soundings are reduced to Chart datum which is 3.322 m below the BM which is marked at the foot of the south pillar supporting the pulley of the well. The well is located near the transformer at North east compound of fisheries workshop near fisheries Jetty at Kalpeni.
- Tide Gage Application Method: Direct
- Squat Applied: No
- Squat Application Method: N/A
- Heave Applied: No
- Heave Applied Method: N/A
- Pitch/Roll Applied: No
- Topographic Data Included: Yes
- Topographic Method: Global Positioning System (GPS)

ANNEXURE C. PICTURES

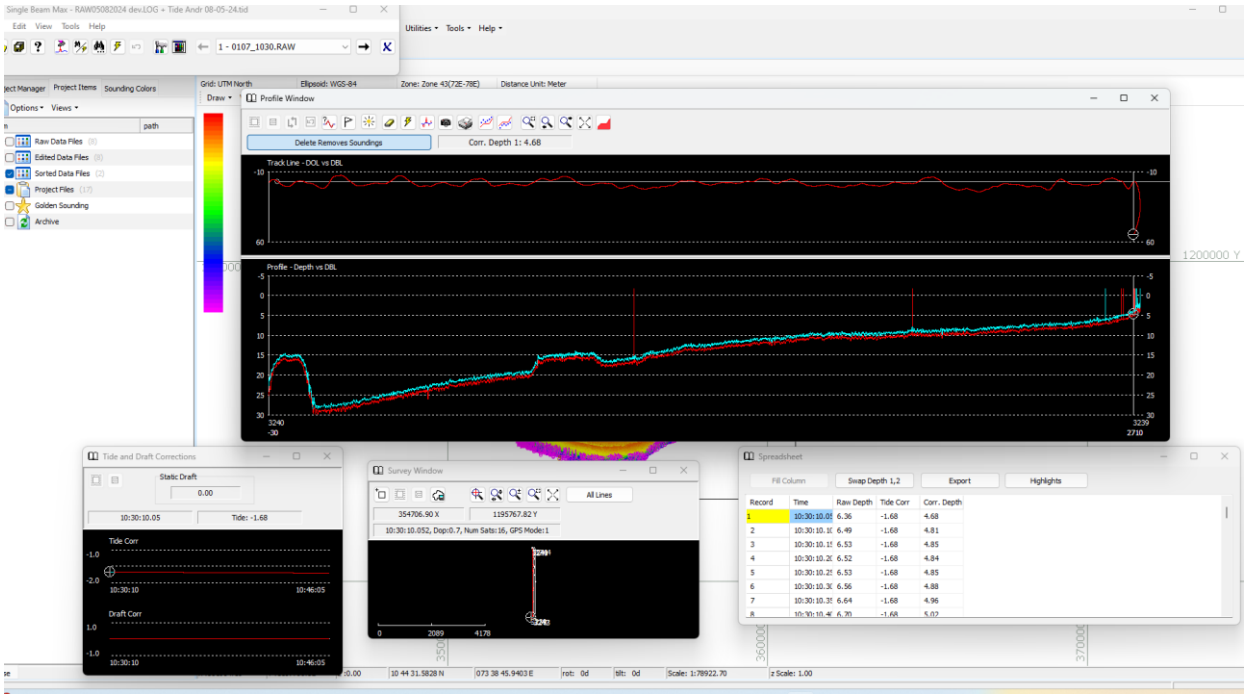


Figure 6. Single Beam Processing

Figure 7. Survey Preparation

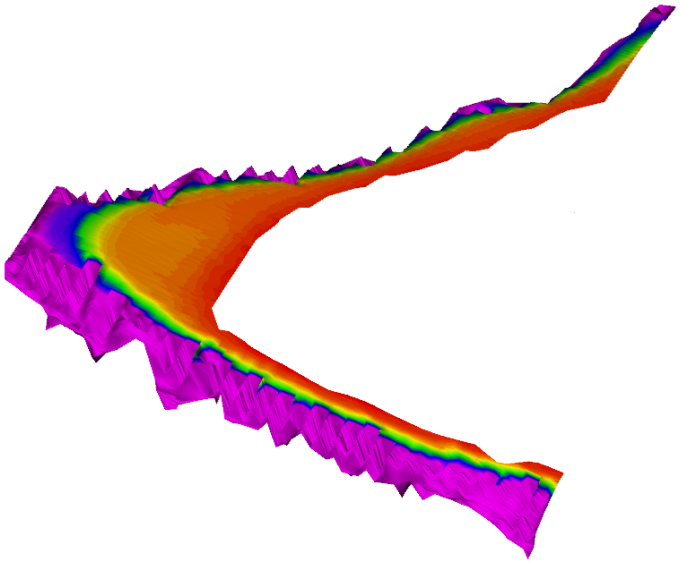


Figure 8. Terrain model

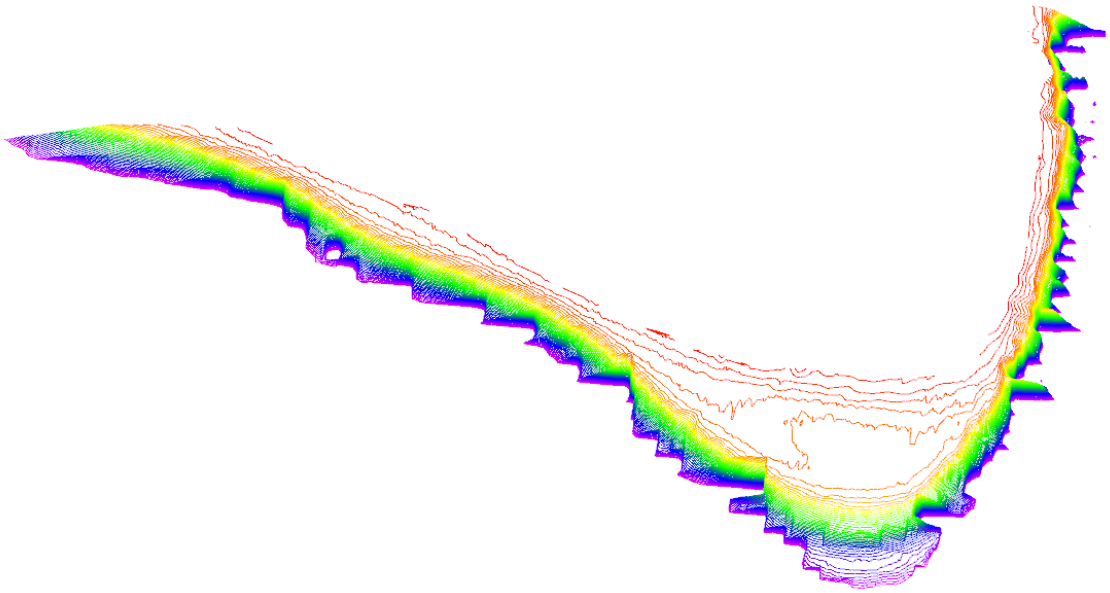


Figure 9. 2D contour

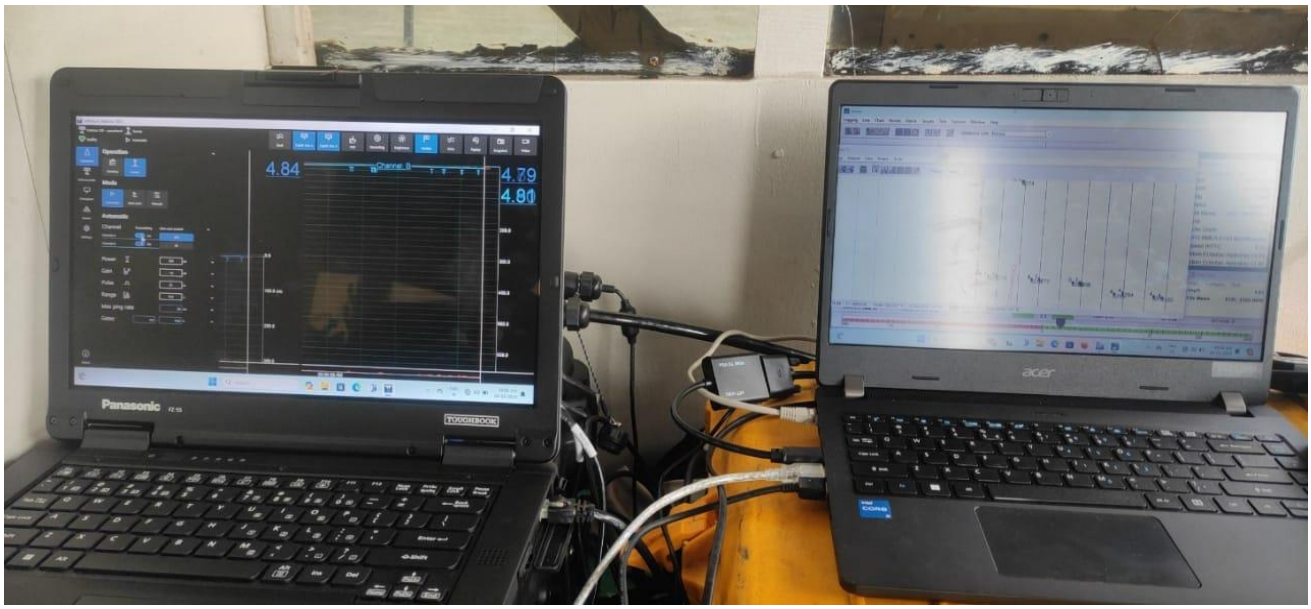


Figure 10. Survey window

Figure 11. DGPS Control point

ANNEXURE D. BENCH MARKS AT ISLANDS

फोन/Phone : (04896)
262134, 262351

भारत सरकार / Government of India
पत्तन पोत परिवहन और जलमार्ग मंत्रालय
Ministry of Ports, Shipping & Waterways
उप मुख्य अभियंता (लक्षद्वीप) का कार्यालय
Office of the Deputy Chief Engineer (Lakshadweep)
अण्डमान लक्षद्वीप बन्दरगाह संकर्म
Andaman Lakshadweep Harbour Works
कवरत्ती / Kavaratti – 682 555

ईमेल/E.Mail:
dbalhwkvt@gmail.com

By E Mail

No. DCE/KVT/DB/600/Vol- 0I / 843 Dated: 03/6 .05.2024.

To

The Chief Engineer,
Cochin Port Authority,
Willington Island, Kochi,
Pin 682009.

Sub:- Conducting Bathymetry Survey works for the various Port led development activities in Lakshadweep Island-Details of Bench Mark at Islands- reg.

Ref :- (1).No.T9/Bathymetry-Lakshadweep/2024-C/378(w) Dated. 24.04.2024
(2). No.T9/Bathymetry-Lakshadweep/2024-C/470(w) Dated. 28.05.2024

Sir,

Kindly refer to the letters cite on the subject matter. The Bench Mark description / Chart Datum Value of the following Islands have been furnished and detailed below for your reference and record.

Androth Island :- The Bench Mark 3.547 Meter ,which is on a Masonry Pillar 61x61x28cm above the ground level constructed near North wall of Passenger Hall at Androth jetty.

Kalpeni Island :- The Bench Mark 3.322 Meter, which is marked at the foot of the south pillar supporting the pulley of the well. The well is located near the Transformer at North East compound of Fisheries Work Shop near Fisheries jetty.

Kadmath Island :- The Bench Mark at top level of the Kadmath Passenger jetty ,which is 3.5 Meter above the Chart Datum.

Yours faithfully

Executive Engineer (civil)

Note:-

1. Soundings are reduced to Chart Datum which is 3.322 m below CD
2. Sounding conducted at 200KHz Frequency using Echo track E 20
3. Positioning System Trimble DGPS
4. Data logging and processing using Hypack software
5. Line interval 50m and sounding interval 18m along cross sections
6. Control point CP-1 10°05' 17.96674'N 073° 38' 53.07175''E
7. Control point CP-2, 10°05' 12.9568'' 073°38' 57.3062'' N

APPROVED BY:

CHIEF HYDROGRAPHER
HYDROGRAPHIC SURVEY WING

COCHIN PORT AUTHORITY

UNION TERRITORY OF
LAKSHADWEEP ADMINISTRATION

INDIA LAKSHADWEEP
KALPENI ISLAND

HYDROGRAPHIC SURVEY DURING MAY 2024

SURVEYED BY MARINE SURVEYOR
AND TEAM OF HYDROGRAPHIC SURVEY WING
UNDER THE DIRECTION OF THE CHIEF HYDROGRAPHER
TO THE GOVERNMENT OF KERALA

WGS 84 ELLIPSOID,UNIVERSAL TRANSVERSE MERCATOR PROJECTION, NORTH, ZONE-43
SOUNDINGS ARE IN METERS AND DECIMETERS

Meters 0 50 250 500 Meters 750 Meters

SCALE 1:5000

Soundings are reduced to Chart Datum which is 3.322m below chart Datum marked at the foot of south pillar supporting the pulley of the well.

SHEET 1/3

BREAKS HEAVILY
UNSURVEYED AREA
SEA
CORAL REEFS
CO
R
G
CHERIYAM ISLAND

SURVEYED BY:MINIMOL L, MARINE SURVEYOR

PROCESSED BY: VINOD V, FIELD ASSISTANT

COMPILED BY:DEVRAJ P KARTHA,ASSISTANT MARINE SURVEYOR

CHECKED BY: JISHA JOSEPH,ASSISTANT CARTOGRAPHER

COCHIN PORT AUTHORITY

UNION TERRITORY OF LAKSHADWEEP ADMINISTRATION

INDIA LAKSHADWEEP

KALPENI ISLAND

HYDROGRAPHIC SURVEY DURING MAY 2024

SURVEYED BY MARINE SURVEYOR

AND TEAM OF HYDROGRAPHIC SURVEY WING

UNDER THE DIRECTION OF THE CHIEF HYDROGRAPHER

TO THE GOVERNMENT OF KERALA

WGS 84 ELLIPSOID,UNIVERSAL TRANSVERSE MERCATOR PROJECTION, NORTH, ZONE-43

SOUNDINGS ARE IN METERS AND DECIMETERS

Meters 0 50 250 500 Meters 750 Meters

SCALE 1:5000

Soundings are reduced to Chart Datum which is 3.322m below chart Datum marked at the foot of south pillar supporting the pulley of the well.

SHEET 2/3

Note:-

1. Soundings are reduced to Chart Datum which is 3.322 m below CD
2. Sounding conducted at 200KHz Frequency using Echo track E 20
3. Positioning System Trimble DGPS
4. Data logging and processing using Hypack software
5. Line interval 50m and sounding interval 18m along cross sections
6. Control point CP-1 10°05' 17.96674'N 073° 38' 53.07175''E
7. Control point CP-2, 10°05' 12.9568''N 073°38' 57.3062''E

APPROVED BY:

CHIEF HYDROGRAPHER
HYDROGRAPHIC SURVEY WING

Mooring Buoy

CORAL REEFS

KALPENI ISLAND

UNSURVEYED AREA

BREAKS HEAVILY

SEA

CO

SURVEYED BY:MINIMOL L, MARINE SURVEYOR

PROCESSED BY:VINOD V,FIELD ASSISTANT

COMPILED BY:DEVRAJ P KARTHA,ASSISTANT MARINE SURVEYOR

CHECKED BY: JISHA JOSEPH,ASSISTANT CARTOGRAPHER

COCHIN PORT AUTHORITY

UNION TERRITORY OF
LAKSHADWEEP ADMINISTRATION

INDIA LAKSHADWEEP
KALPENI ISLAND

HYDROGRAPHIC SURVEY DURING MAY 2024

SURVEYED BY MARINE SURVEYOR
AND TEAM OF HYDROGRAPHIC SURVEY WING
UNDER THE DIRECTION OF THE CHIEF HYDROGRAPHER
TO THE GOVERNMENT OF KERALA

WGS 84 ELLIPSOID,UNIVERSAL TRANSVERSE MERCATOR PROJECTION, NORTH, ZONE-43
SOUNDINGS ARE IN METERS AND DECIMETERS

Meters 0 50 250 500 Meters 750 Meters

SCALE 1:5000

Soundings are reduced to Chart Datum which is 3.322m below chart Datum marked at the foot of south pillar supporting the pulley of the well.

SHEET 3/3

Note:-

1. Soundings are reduced to Chart Datum which is 3.322 m below CD
2. Sounding conducted at 200KHz Frequency using Echo track E 20
3. Positioning System Trimble DGPS
4. Data logging and processing using Hypack software
5. Line interval 50m and sounding interval 18m along cross sections
6. Control point CP-1 10°05' 17.96674'N 073° 38' 53.07175''E
7. Control point CP-2, 10°05' 12.9568''N 073°38' 57.3062''E

APPROVED BY:

CHIEF HYDROGRAPHER
HYDROGRAPHIC SURVEY WING

KALPENI ISLAND

SAND PATCH

SAND PATCH

SAND PATCH

SHORELINE

SHORELINE

SHORELINE

SHORELINE

BREAKS HEAVILY

BREAKS HEAVILY

BREAKS HEAVILY

BREAKS HEAVILY

UNSURVEYED AREA

UNSURVEYED AREA

UNSURVEYED AREA

SEA

CO

SURVEYED BY:MINIMOL L, MARINE SURVEYOR

PROCESSED BY: VINOD V,FIELD ASSISTANT

COMPILED BY:DEVRAJ P KARTHA, ASSISTANT MARINE SURVEYOR

CHECKED BY: JISHA JOSEPH, ASSISTANT CARTOGRAPHER