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The needs for bathymetry survey of part of Eleyele lake at Ibadan, Nigeria

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Abstract

Hydrography is: "The art and science of compiling and producing charts, or maps, of water-covered areas of the Earth's surface". The writeup aimed at producing a bathymetric survey of Eleyele Lake at Ido Local Government Area, Oyo State, Nigeria. With an objective of showing variation in depth across the sea bed. The methodology adopted was based on the use of Echo Sounder SDE 28 and its accessories and other surveying equipment's such as GPS, Level and accessories etc. to determine the X, Y coordinates

and the depth of points across the sea bed. Further analysis on the data obtained was carried out using ArcGIS 10.3 and Surfer 13. The result from the bathymetric maps and charts can be used to determine the locations of shallow depth and its topography of which suggestion was made to Engineers in case of obstructions to navigation, and pipelines works). For futuristic analysis, further bathymetry survey in the study area will show if changes have occurred in accretion and dredging of the Lake.

Keywords: Bathymetric, Echo Sounder, Charts, 3D Surface, Depth profile

Introduction

Actually, Hydrographic survey can be defined as the art of collection of the various measurements of the water bodies, the bottom topography of the water bodies, to facilitate safe navigation of the water vessels. The domain of hydrographic survey may be of different scale ranging from a lake to river and oceans. (Wikipedia).

Hydrography is the science of measurement and description of features which affect maritime navigation, marine construction, dredging, offshore oil exploration/offshore oil drilling and related activities (Handbook of Offshore Surveying 2006).

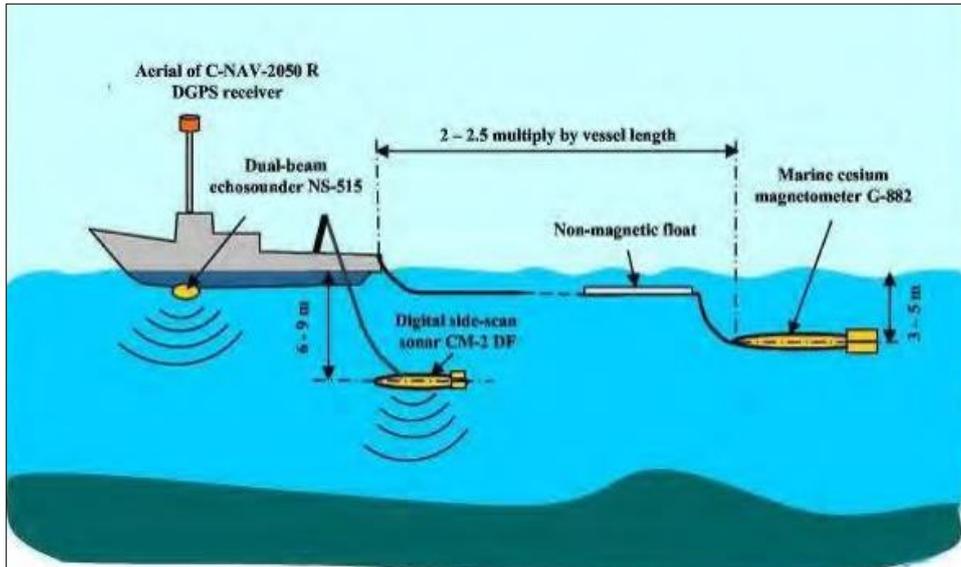
One of the related activities in Hydrography is Bathymetry, Bathymetry is the study of under water depth of lake and ocean floors. Bathymetric surveys are conducted primarily to show bottom contours of waterbody. (Ukim 2005) ^[11]. On bathymetric smooth sheets, soundings that delineate the depth contours are displayed

This study is having the aim of revealing the purpose of Bathymetric surveys as a prepared information in terms of checking sedimentation accretion or erosion now and future for Eleyele lake. Thus, availability of bathymetry data will help in proper understanding of the depth of the Lake, since there has not been data on bathymetry survey in the study area before. Therefore, there is need to carry out a survey that will be useful for proper planning and usage of the water. This aim is achieved by producing the Chart and Topographic map for the study area by sounding to determine the depth and position of points below the water.

Other relevant purpose of Hydrographic surveying is to measure tides for sea coast, establishment of levelling datum, determination of seabed depth for navigation, location of rocks, sand bars, navigation light. Shoreline configuration, man-made infrastructure and all other features on shore that are of interest to mariners.

The information on bathymetry and the change in bathymetry can be useful not only for the study of morphological evolution of seafloor but also for aquatic environmental planning and management (Jaffe *et al.* 1998) ^[9].

The prominent vessel used for mapping and survey is boat or ship, it is designed to float and travel on water. Multi Beams Echo-sounder System (MBES) or Single Beam Echo-sounder System (SBES) are also significant tools for hydrographic survey to detect small objects and full depth coverage. Other methodology that can be adopted is Side-scan sonar investigations that can be used for identification and mapping of obstacles on the sea bottom.



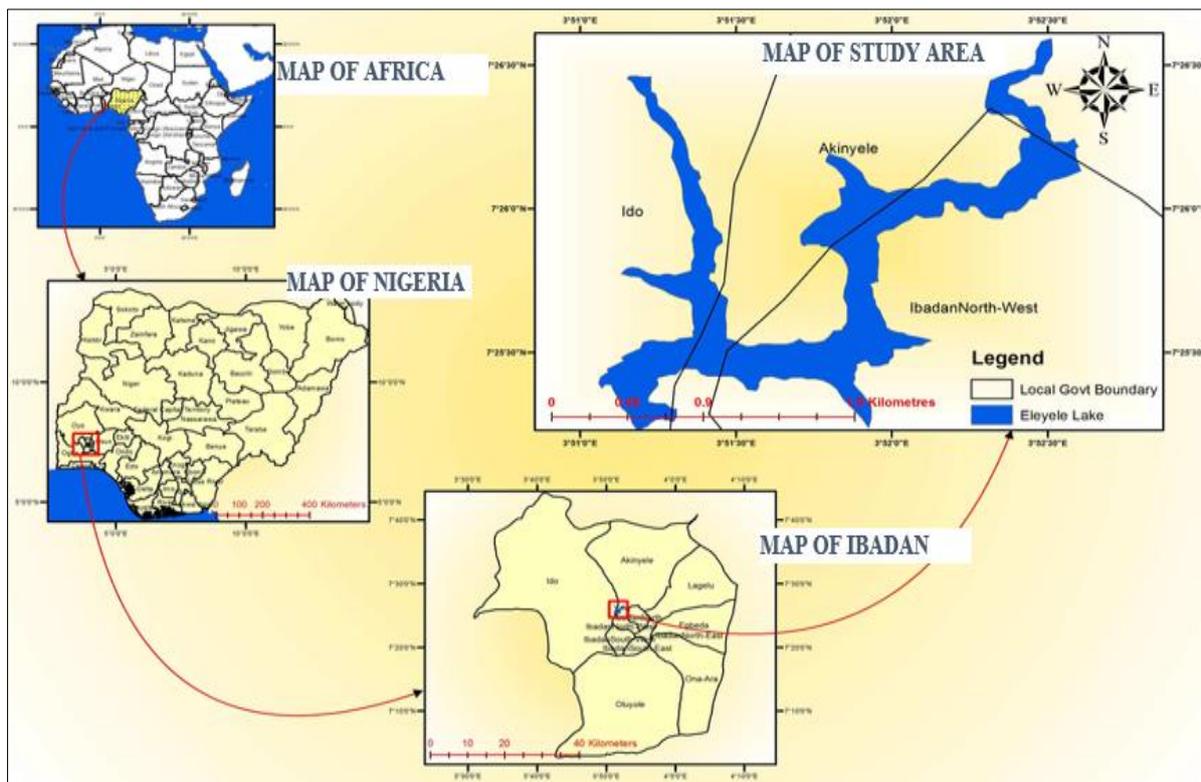
Source: Group of Service Companies “MORINZHGEOLGIA” Member of the Russian Oil & Gas Builders Union JSC “

Fig 1: Pictorial view of a sounding setup with a Sonar

Echo sounding, concurrently with side-scan sonar investigations and hydromagnetic surveys is always the first stage of offshore site investigations at any location when construction is involved.

Study area

The study area is the Eleyele Lake. The area to be covered is about 44.013sqkm which is about 0.3km in width towards the shoreline and about 3km along the shoreline with longitude 3°51’15” and latitude 7°25’26”.



Source: www.google.com.ng

Fig 2: Map showing the study area



Fig 3: Satellite imagery showing the study area

Methodology

The acquisition of field data commenced after an effective planning. The data for this task was collected using the two sources, they are: (i.) Secondary Data- data collected from satellite imagery downloaded and (ii.) Primary Data-

Collected using GPS observation and Sounding using echo sounder. Other logistic put in place, was to locate the already established Gauge Bench Mark and also mark out other necessary points for control such as ELD/OY 01, and ELD/OY 03.

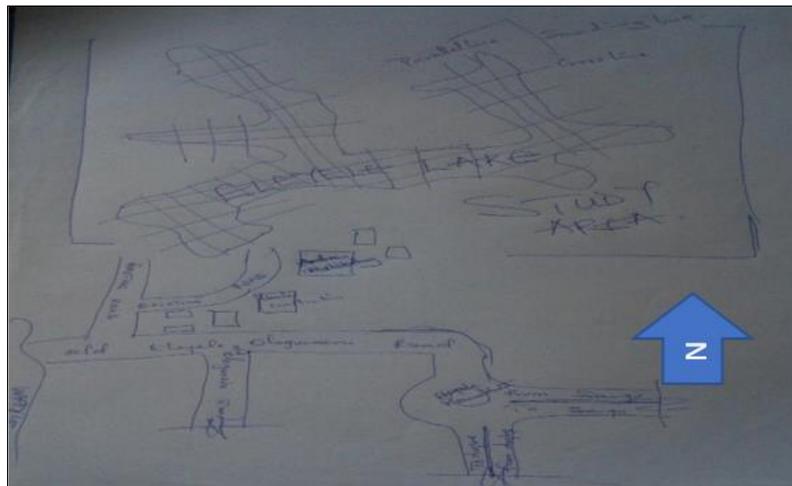


Fig 4: Reconnaissance Diagram (Not Drawn to Scale)

Instrument used: The hardware instrument used are; Hi-Target GNSS receiver with its accessories and Garmin GPSMAP 78S Hand held GPS receiver, Levelling instrument and accessories, SDE28 Single Beam Echo Sounder and accessories, A 12 Volt battery, A Boat with 40 horse power

engine, Bar Check Plate with graduated rope, Hp Laptop Envy M6 64-bit 8gb Ram, 1tb intel@core™ i5 cpu @2.5Hz. The software used are; HYPACK (to download and process the field work), AutoCAD (for plotting), ArcGIS 10.3 (for database creation and analysis), Suffer 13

Table 2: Horizontal position accuracy check (Self)

Instrument	Easting(m)	Northing(m)
Garmin GPSMAP 78S Hand held on ELD/OY 03	594280.91	820176.877
Hi-target DGPS on ELD/OY 03	594281.942	820175.356
Discrepancy	-1.032	1.521

Also, bar check was ascertained to be sure that the echo sounder was in good working condition for depth acquisition.

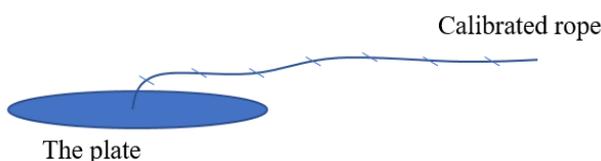


Fig 5: Bar check plate

Height transfer: The height used for processing was transferred with a level instrument (2.494) which was related to the study area tide gauge. Coordinates of established controls ELD/OY 01 and 03 were referenced to Primary datum ICS147P of Eleyele hill, with the aim of achieve X, Y and the Orth metric Z of the points.

Instrument setup

After navigating to the project location, the Echo Sounder

was setup as described below.

- The Transducer was connected to the South SDE 28 Echo Sounder port using a serial connector.
- The echo sounder was connected to a 12-volt car battery for power supply.

- Software key (Dongle) and a handheld GPS Receiver were also connected to their ports.
- The Transducer was lowered into the water by a means of an Over-the-Side-Pole-Mount.

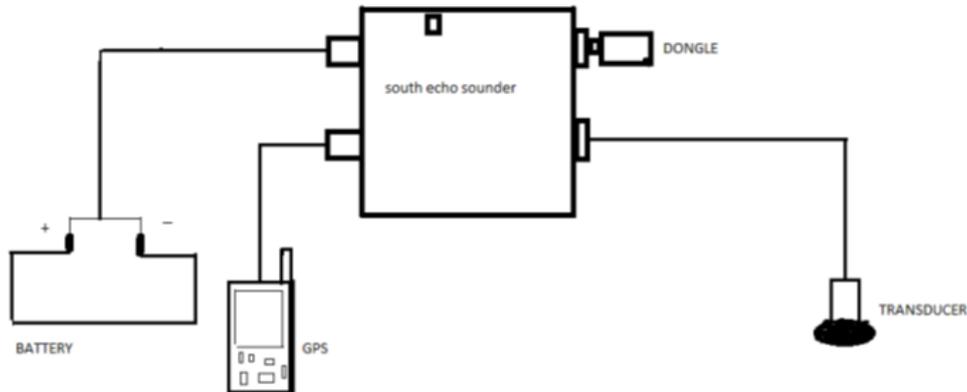


Fig 5: Diagram of Echo Sounder Setup

Data Acquisition procedure

Data was collected using a Single Beam Echo-Sounder SDE 28 with its transducer, a level instrument and its accessories, DGPS and Handled GPS. The depth was acquired to sound about 3 kilometres long in addition and about 0.3 kilometre width. The sounding was done based on the already marked out running and cross lines. The echo sounder positioned on a sit in the vessel and the transducer was connected to it and the transducer was immersed in water tightened to the vessel with the use of a Side-Pole-Mount and the draft was measured to be 0.5m, also the GPS cable was plugged and the dongle which is the key that allows the echo sounder to work in it the software (SDE and POWERNAV). This two software’s were lunched simultaneously. The SDE for depth measurements and the PowerNav for X, Y data and all necessary parameters was set (the Datum, Draft). Having done the instrument set up the bar check was done to check the echo sounder and the GPS was also cross checked, start was click on screen of the echo sounder followed by record, the sounding operation began by instructing the Captain of

the vessel to navigate and running through parallel and cross lines at a certain speed 2.77m/sec (10km/hr) The boat was then made to navigate through the entire study area. Data were later downloaded and processed. ArcGIS 10.2, AutoCAD (landdev09), suffer 13 were further used for post processing such as presented in form of charts, plan/map.

Results and discuss

Result presented showed the Topographic operations carried out to determine the Base characteristics obtained by Echo sounder, and the height transferred by levelling having almost the same value with the tidal gauge on the dam which is 2.494 to 2.0 respectively.

Result

Result 1: The Digital Terrain Model (DTM) shows the true nature of the bottom terrain (sea bed) of the study area using Suffer 13 for model generation. It uses shades and shadow and colours to emphasis the data. Each colour has its own representative in elevation.

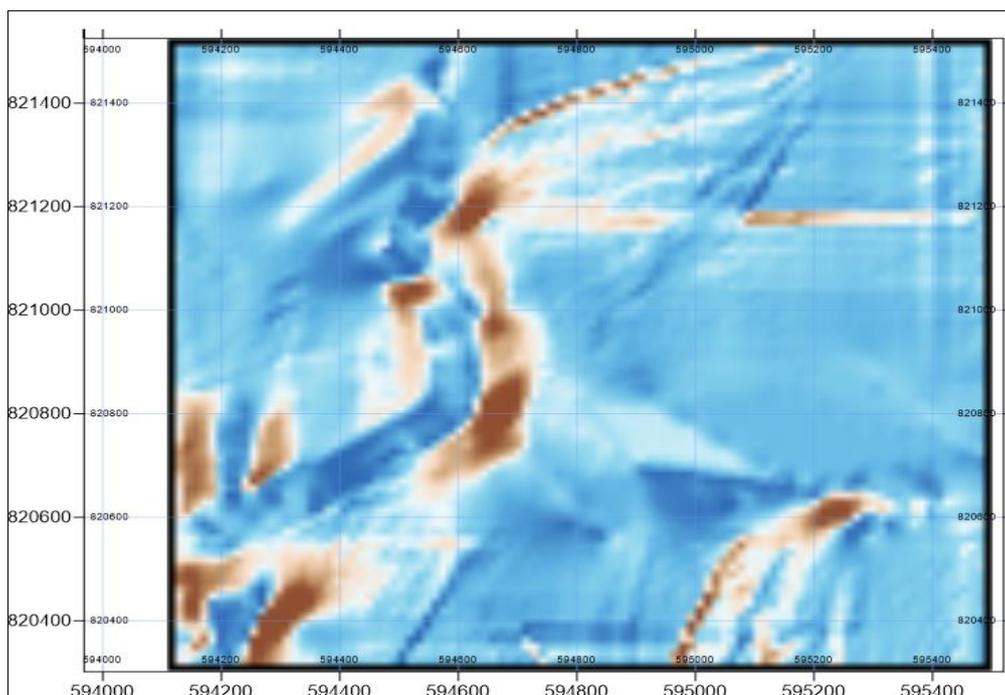


Fig 6: Digital terrain model of Eleyele Lake

Result 2: This provides a three-dimension (3D) impression in form of Wireframe, by connecting the Z value with X and

Y coordinates. This can be employed in line of sight analysis, relief maps, terrain analysis to show the sea bed topography.

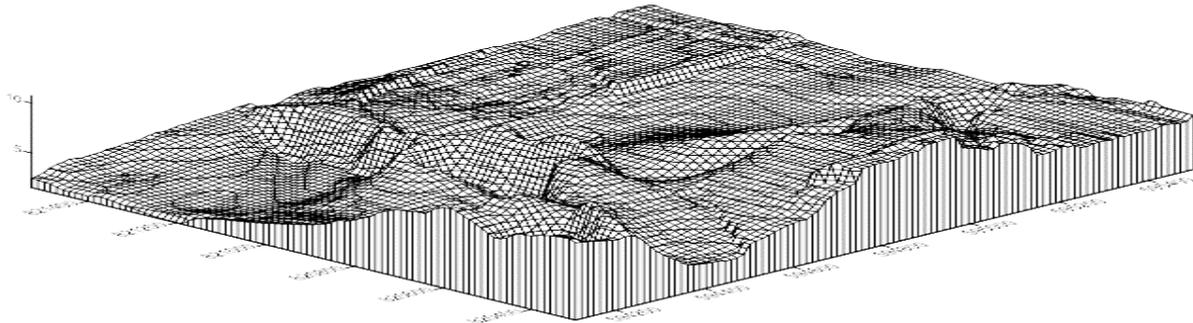


Fig 7: 3-D Wireframe of Eleyele Lake using surfer 13

Result 3: Contour map, showing lines that connect point of equal height values. The line changed across the surface. Where there is little change in value, the line spaced far-flung

apart, where the values rise or fall rapidly, the lines are closer together.

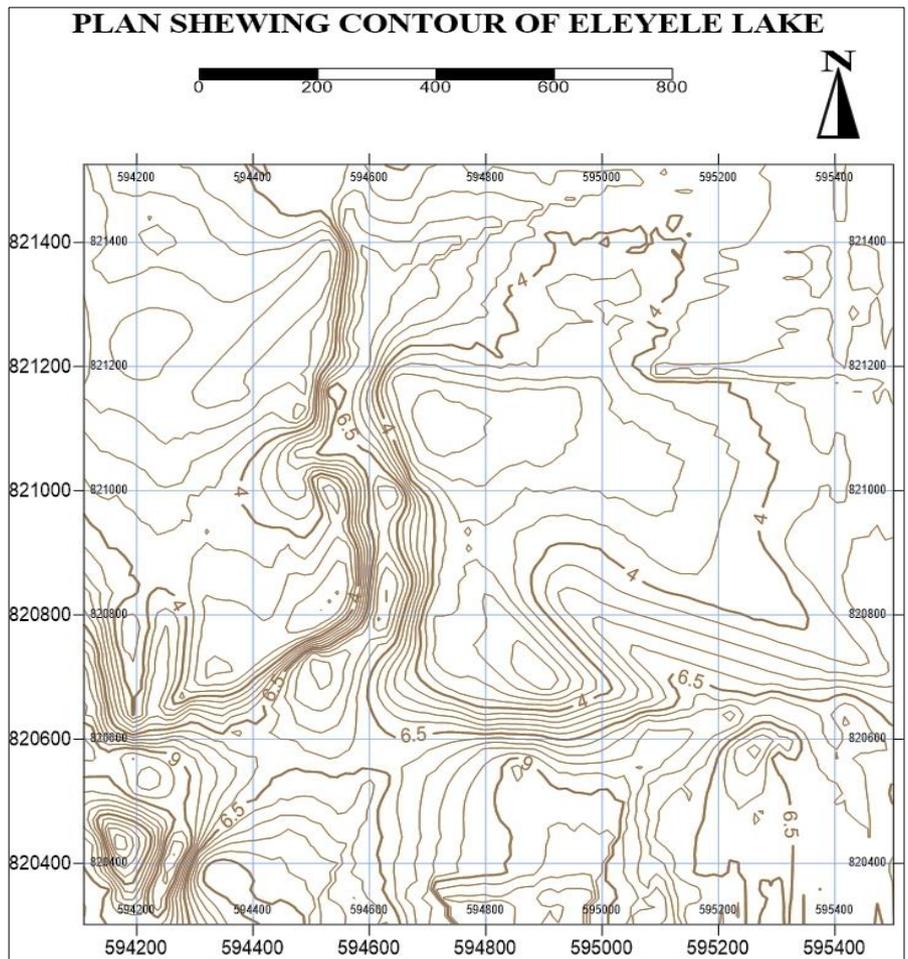


Fig 8: Contour of Eleyele Lake using surfer 13

Result 4: TIN (Triangulated Irregular Network) of seabed elevations was created using triangulation interpolation methods and clip surface map using conventional

hydrographic shading, artificial illumination, and bottom morphology.

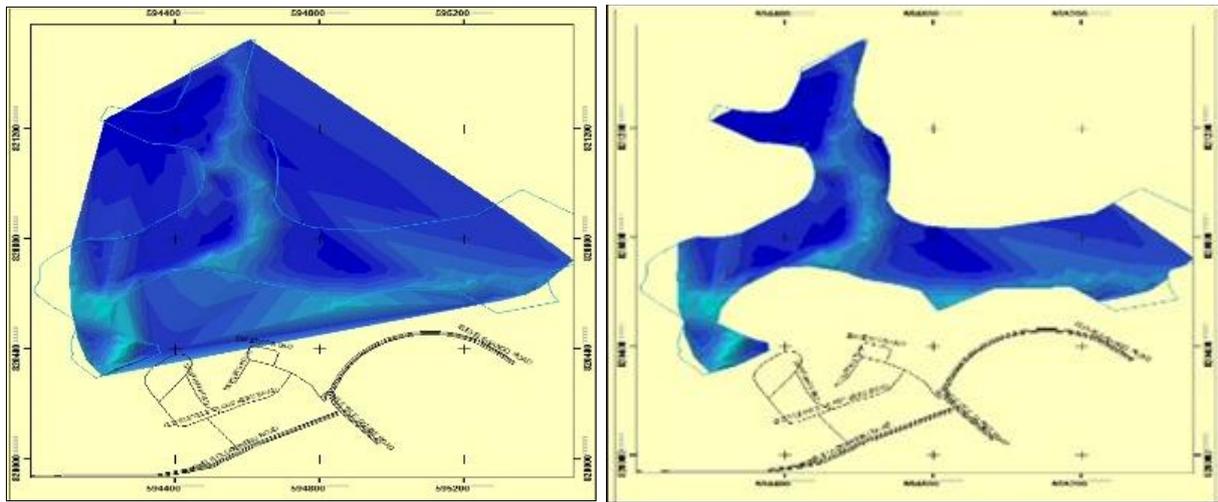


Fig 9: Tin before and after clipping the area covered

Result 5: Three-dimension Surface representations of the grid depth, that can be used for future analysis, comparison of erosion and deposits.

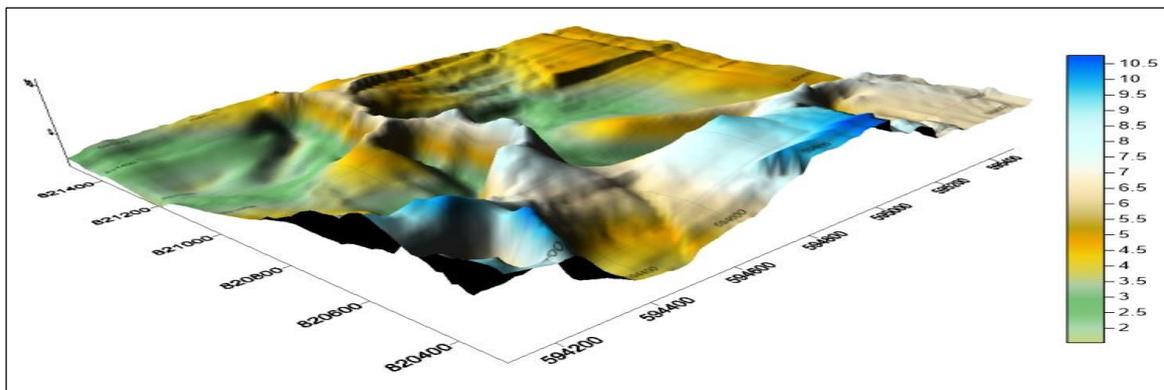


Fig 10: 3D surface of Eleyele Lake

Result 6: Shows a sample of Profile levelling below the water bodies, purposely for engineering works or construction. It involves the determination of elevation at small spatial interval along a line of Echo sounding.

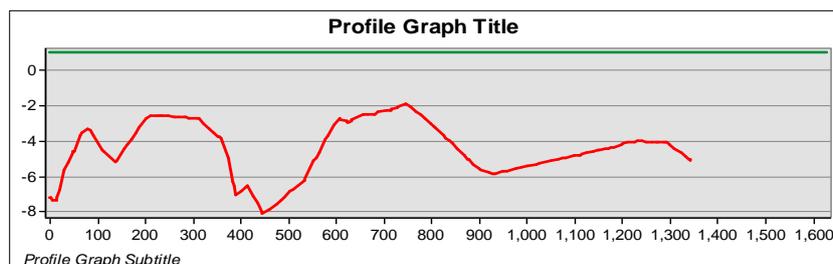


Fig 11: Profile of water depth Eleyele Lake

Recommendations

When embarking on such projects, it is recommended that all logistics should be properly taken care of, bearing in mind, that offshore environment is high importance and it require safety.

Bathymetry is highly recommended for acquiring information about an ocean, lake etc. which could serve as a means of monitoring and maintaining of our oceans, lakes and also a basis for future comparisons

In conclusion, the purpose of this task is to produce a detailed bathymetry survey and up-to-date chart of part of the study area, Eleyele Lake, Ibadan Oyo State and also to have it as a history for future use. Geoinformatics has proven to be the best available tools for monitoring any spatial- related

changes. With these different maps for annotation of bathymetric, physical planning will be enhancing, future development and decision making of Eleyele Lake will be easy.

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