Investigation of Bolgoda Lake to Establish a Ferry Service for University of Moratuwa

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Abstract

Colombo is one of the major cities which has a high population density with a smaller number of transportation facilities over many years. Even though it has a good canal system, waterway transportation is not implemented for no reason. With the idea of establishing a ferry service from the University of Moratuwa to Panadura along the Bolgoda lake, our research was carried out to determine the main parameters relevant to the aim of the project. Prioritise factors considered are Bolgoda lake bathymetry, identification of restricted areas, highly sensitive areas, material type to be dredged, and possible locations for terminals. Initially, the research area was narrowed down from the boatyard of the University of Moratuwa to the Vijayarama temple. There are several ways to determine the bathymetry of a water body, and echo-sounding techniques were used in our research. Bathymetry of the region was determined with cut volume to be dredged to make the ferry path safe using "Hondex PS 7" echo sounder and Surfer software. "ArcGIS" software was utilised to generate maps, and "Slope W" software was used in analysing dredge slope and its stability. The research was carried out during the dry season, and the water level was indicated as 4.2 m on the gauge at the bridge.

Keywords: Bathymetry, Bolgoda Lake, Echo sounding, Ferry

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1. Introduction

Lakes are known as water bodies surrounded by land and water in them is less mobile than in a river. Lakes are more important in storing water in lowlands and urban areas with less hazards. Bolgoda Lake is situated in the South West of Sri Lanka, 19 km from the city of Colombo. It is one of the major water resources in the Colombo district. The lake consists of two major water bodies and covers 374 km^2, partly fresh and brackish water. The largest freshwater lake on the island, the Bolgoda lake, stretches from Anguruwatota to Piliyandala. The northern section of the waters stretches from Colombo to Kalutara while the south side of the lake finds its way to the open seas through the Thalpe canal [1]. It has a great potential of developing tourism with its natural beauty and fisheries in the nearby area [2]. Bolgoda Lake has high biodiversity and has become a home to many animals and fish kinds as well.

Colombo district is a highly populated area with the very limited land facility. Since the high population density, transportation

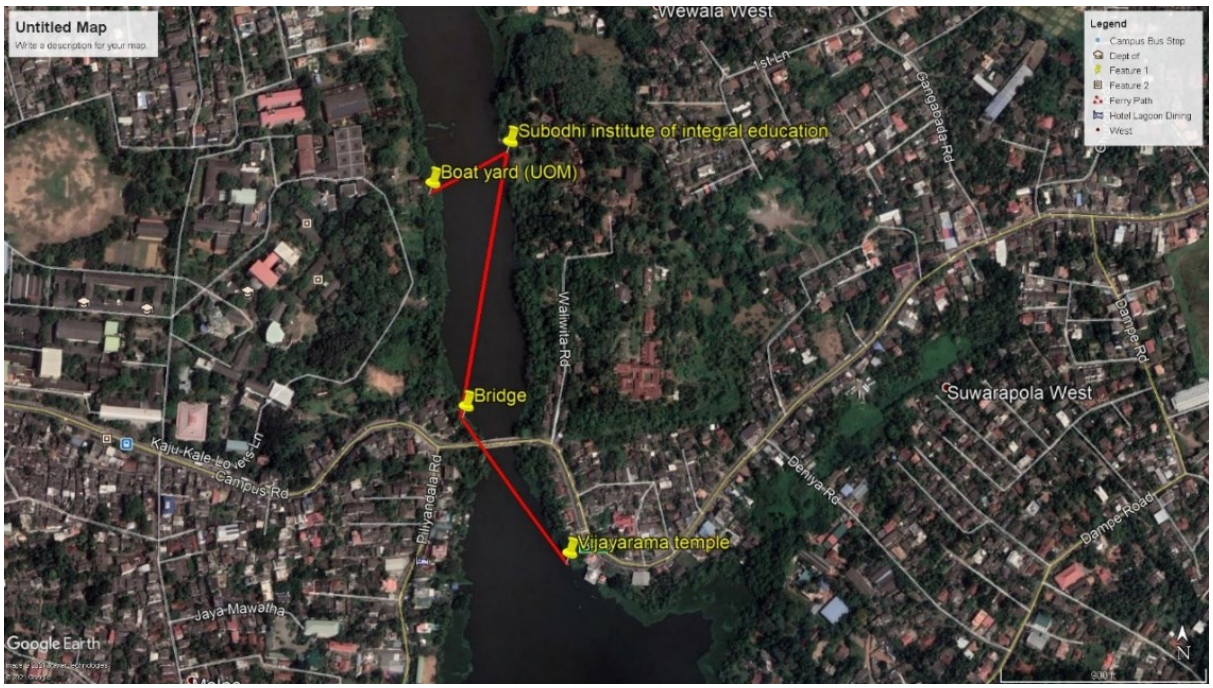

Figure 1: Initial model of ferry service.

facilities should have to be efficient and adequate. The main method of transportation in this area are buses, railways, and private vehicles. Even though trains have the capacity to carry more passengers, located away from the inner cities lead to occur heavy traffic conditions on roads. Ferry transportation will be a great opportunity to have an extra choice for people with less obstacles than roads which leads to saving much time [3].

The research is to determine the potential of Bolgoda lake and its environment to establish a ferry service for the University of Moratuwa. To have a safe and reliable ferry transportation, the path needs to be well suitable. The under-keel clearance, obstacles and restricted sensitive areas should be pre-identified. A detailed bathymetric survey provides such information in a certain path to determine the above-mentioned factors.

2. Methodology

2.1. Study area

This research is to determine the potential for establishing a ferry service from the University of Moratuwa to Panadura. We have identified suitable potential places to establish ferry terminals between University and Panadura through Bolgoda Lake. After that, it is narrowed down to the Vijayarama temple from the University of Moratuwa as the initial stage (Figure 1).

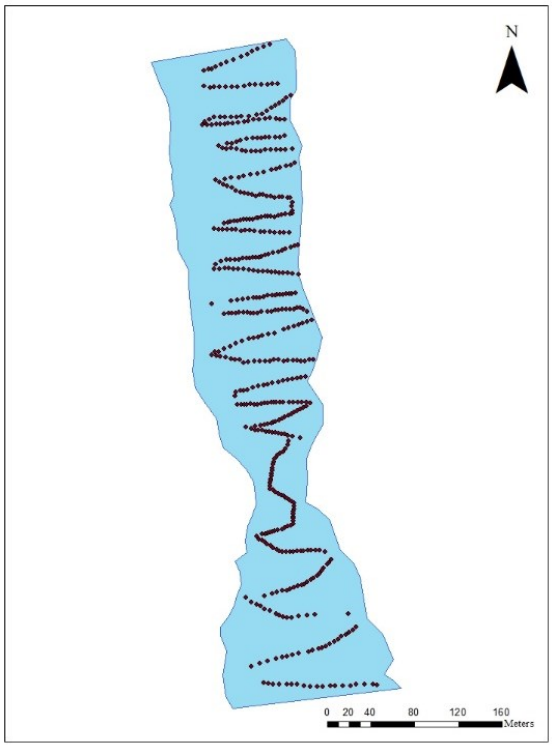

Figure 2: Actual survey path.

2.2. Materials and methodology

2.2.1. Data acquisition

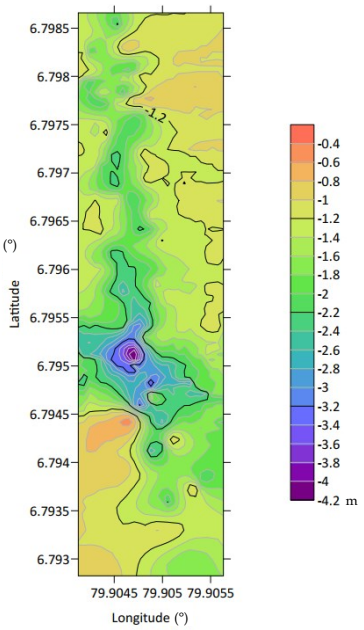

Figure 3: Contour map of the region.

either sonic or ultra-sonic, achieve good penetration and propagation through all elastic media once these media can be made to vibrate when exposed to pressure variations. Most of the sensors used for depth determination use acoustic waves. There are several conventional and sophisticated ways of determining the depth values of a water body. Handheld rope and lead method, Echo sounding methods (Simple echosounder, single beam echosounder, Multibeam echosounder, Acoustic Doppler Current Profiler and Sub-bottom profilers) and other methods (lidar and remote sensing) [5]. Bathymetric Surveys were carried to cover the whole area as per Figure 2. Spot depth Echo Sounder (Hondex PS-07) was used for spot depth measurements. Corresponding GPS locations were captured using Magellan eXplorist 510 GPS receiver. The survey was

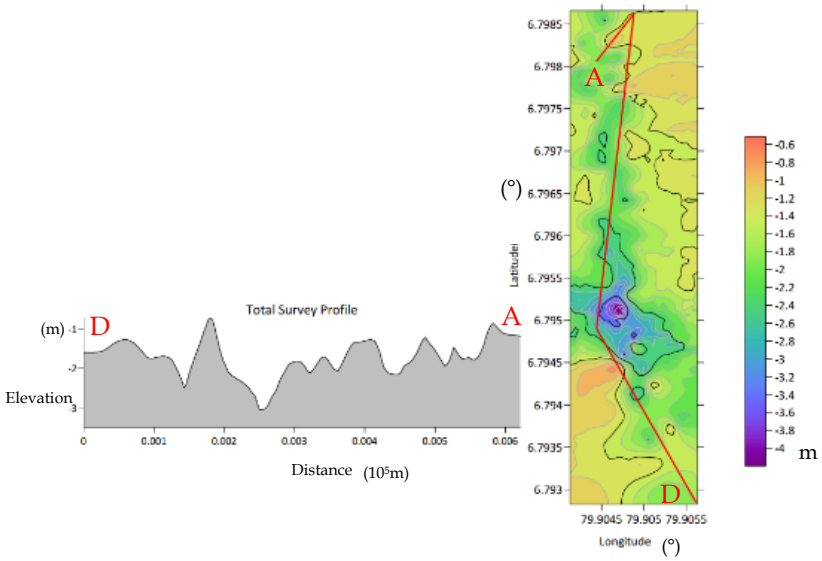

Figure 4: Depth variation along the path.

International Hydrographic Organization has declared the types of hydrographic surveys and required features that should be followed to be a standard survey. It provides safety for navigating across the surveyed areas to an expected level. According to the required accuracy and depth limitations, the survey method is varied among Special order, Order 1A, Order 1B and Order 2 [4]. Acoustic waves, done on March 25th, 2021, when the water level of the gauge at the bridge was indicated as 4.2 m.

2.2.2. Data processing

Collected data was arranged using "MS-Excel" software to a CSV (Comma Separated Values) file, and post-processing was done with "Surfer", "ArcGIS" and "Slope W"

software platforms to generate contour map (Figure 3), depth variation profiles (Figure 4), 3D model (Figure 6) and determine the Cut volume and slope parameters (Figure 5).

3. Results

It can clearly be identified that the bridge area is deeper than anywhere else in the region.

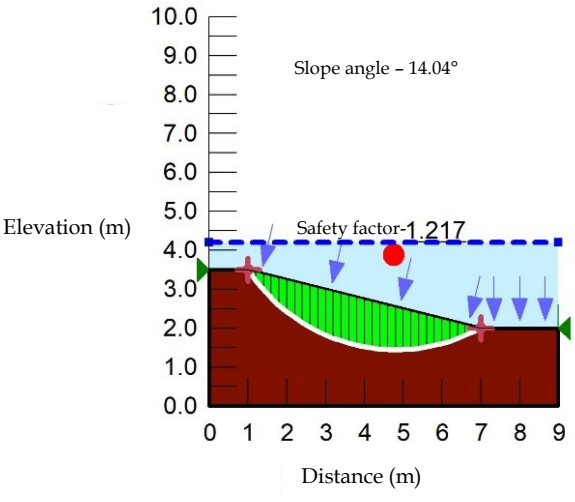

Figure 5: Proposed slope design.

Depth variations between each proposed terminal is given above (Figure 4). All the distance values are in 10^5 m.

It was selected that 2.2 m depth for dredging from the water level for easiness of ferry transportation. The cut volume was observed as 3484.5326601540 m^3 using "Surfer" software according to the Trapezoidal rule.

There should be nearly 10° angle for the slope to have a factor of safety as 1.2 (Figure 6). The material type was taken as sandy clay.

4. Discussion

As the expected objectives of our research, A dredging process should be carried out to remove material at shallow areas, which was mostly along the border of Bolgoda Lake. There were few private and single public land near the proposed terminal locations in the considering zone. The water column has very high turbidity; therefore, it was identified some false reflections during the survey. It was identified that the main problem in this area is the water hyacinth population. It can be packed well like a very thick cover. The actual path was narrowed to the middle region of the lake due to very shallow depths, growth of plants and boat turning radius.

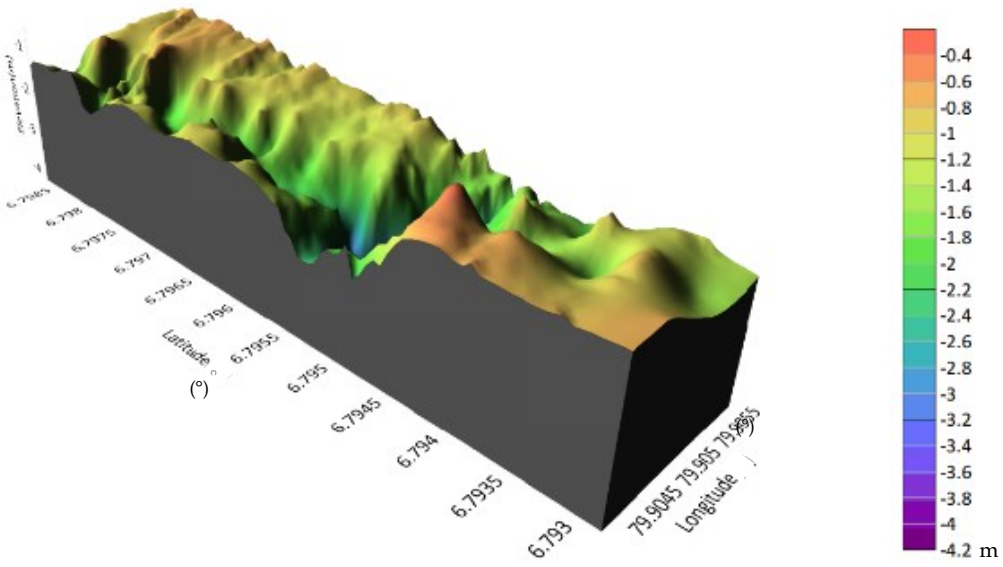

Figure 6: 3D model of the lake bottom in the region.

5. Conclusion

It is possible to establish a ferry service from Panadura to the University of Moratuwa, and the selected path and selected ferry terminal locations are free from disturbances or restrictions. By continuing development of the basic ferry by research work, it should be able to develop either to power by solar + fuel (Hybrid) to cut down the cost and also to minimise the environmental pollution. A stable slope was designed, and there is a much lower angle than we expected. It may be limited to some value due to the width of the lake, and the safety factor would be a low value than this. Therefore, frequent dredging has to be carried out along the path to remove the collapsed material. Otherwise, a proper stabilising process can be implemented. The excavated soil can be utilised as a construction material after carrying out tests and proper beneficiation process. Once the ferry service is established, the next step should be linking this service with other paths of transport facilities such as busses and trains, which will be a nationally important model to establish integrated transport facility accessible even from a website for bookings and travel planning by the individuals.

Acknowledgement

The authors are grateful to the following personnel who helped us in various ways to complete this research project. Final year research project supervisor, Dr. G.V.I. Samaradivakara, the Head of the Department of Earth Resource Engineering, lecturer Eng. A.V.P. Vijitha, final year research project coordinator, Eng. (Mrs.) M.A.D.M.G. Wickrama and other staff members of the Department of Earth Resources Engineering, University of Moratuwa, for the immense support given by being behind us always, guiding us and providing us with all the necessary support throughout our research work.

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