MASKAYA WATER
CONSULTANCY LIMITED
P.O. BOX 42634,

# TECHNICAL REPORT

## GEOPHYSICAL AND HYDROGEOLOGICAL SURVEY REPORT FOR GROUNDWATER INVESTIGATION IN (PANGANI RIVER BASIN) RAU JUU (MOSHI DISTRICT) KILIMANJARO REGION

*Prepared by:*
*MASKAYA Water Consultancy Ltd*
*Po Box 42634*
*Dar es Salaam*

*Submitted To*
*Msamaria Children's Home*
*Po Box 7343*
*MOSHI - KILIMANJARO*

November 13, 2024

+255 718 600 290
+255 745 687 585
service@maskayaconsultancy.co.tz
Temeke, Dar es salaam - Tanzania

## ABBREVIATIONS

CP: Central Point of Vertical Electrical Sounding

H: Anticipated Regolith Thickness

RDD: Recommended Drilling Depth

VES: Vertical Electrical Sounding

WRMA: Water Resources Management Act

## EXECUTIVE SUMMARY

The hydrogeological/geophysical survey work was conducted by **MASKAYA Water Consultancy Limited** on 13/11/2024 in the above-mentioned area. This was done for the purpose of getting reliable clean and safe water for domestic uses.

The entire survey task carried out by starting gathering general information from key stakeholders from neighboring community to a proposed site. Then followed by technical step of which geophysical survey method of the Geophysics Science Resistivity were applied. These groundwater surveys were very instrumental for the location of the potential borehole drilling site earmarked and released for future drilling.

A total VES of two points was measured in a targeted area for the detection of maximum recharge, positions of weak zones in relation to the selected borehole drilling site, lastly the resistivity survey results, information and factors considered were taken into account in these surveys in releasing the borehole drilling site.

And one was recommended as the best borehole drilling site to be drilled up to a depth of **100metres.**

## INTRODUCTION

This report describes the execution of the hydrogeological/geophysical investigation conducted at Rau Juu (Moshi District) in Kilimanjaro region and provides the description of methodology, results, conclusion and recommendations of the investigation.

The Board of Msamaria Children's Home requested MASKAYA Water Consultancy Limited to conduct hydrogeological/geophysical investigations to locate a suitable site for borehole drilling at his house located in the above-mentioned area in order to subsidize the available water source (Water from Pangani River Basin).

## PROJECT OBJECTIVES

(i) To investigate the subsurface water-bearing horizons that warrant productive water well drilling in order to acquire reliable and sustainable groundwater sources for community water supply.

(ii) To determine important hydrogeological parameters such as depth to bedrock (regolith thickness), anticipated water strike levels, degree of weathering and fracturing of the rock forming minerals.

## LOCATION AND ACCESSIBILITY OF THE PROJECT AREA

The project area (surveyed area) is located in Rau Juu (Moshi District) in Kilimanjaro Region.

### PHYSIOGRAPHY, CLIMATE AND DRAINAGE

Moshi District, located in the northeastern part of Tanzania within the Kilimanjaro Region, is known for its temperate highland climate, shaped by its proximity to Mount Kilimanjaro, Africa's highest peak. The district experiences two rainy seasons: the long rains from March to May and the short rains from October to December. The dry season, which spans from June to September, brings cooler, less humid conditions. Average temperatures in Moshi range from 15°C to 30°C (59°F to 86°F), with temperatures varying according to altitude; the higher elevations near the mountain are notably cooler.

Annual rainfall in Moshi is substantial, though it varies significantly by altitude. Lower-lying areas typically receive around 800mm to 1200mm (31 to 47 inches) annually, while the highland areas near Mount Kilimanjaro can receive much more, particularly on the southeastern slopes where rainfall is heaviest.

Moshi's geography is marked by its strategic location at the base of Mount Kilimanjaro, giving it a unique combination of highland and lowland features. To the north, the district shares a border with Kenya. To the west Moshi is bordered by the Hai District, which shares similar highland climate characteristics. The eastern boundary meets the Rombo District, another district in the Kilimanjaro Region, while to the south, Moshi borders the Mwanga District in the Kilimanjaro Region as well.

The elevation of Moshi varies widely, ranging from about 800 meters in the lower areas to over 1,500 meters above sea level in the foothills of Kilimanjaro. This elevation not only contributes to the district's cooler climate but also supports diverse flora and fauna, especially in the higher, forested regions.

These geographical and climatic factors make Moshi District a vital part of the Kilimanjaro Region.

## HYDROGEOLOGY

The occurrence of groundwater under the geological conditions of the surveyed area is mainly restricted in the following zones:

(i) In fractured/joint zones (faults)

(ii) In weathered bedrock which act as groundwater reservoirs

Rocks are compact and have virtually no intergranular (or primary porosity). On the other hand these rocks have a type of porosity that can be termed as fracture (secondary) porosity; this implies that they can hold water in a network of fissures, cracks, joints, fractures or faults. The secondary porosity is caused by the system of "macro pores" and "micro pores". Macro pores are fissures and fractures of structural origin. Micro pores are interstices created by weathering. These two types of porosity are usually closely related, as cracks and fissures facilitate the percolation of water and hence intensive weathering. The thickness and mineral characteristics of weathered layers play important role in the determination of the amount of water it can hold.

## INVESTIGATION METHODOLOGY

One type of investigation methods were employed in locating the Potential boreholes namely electrical method in form of ADMT series was used as a confirmatory method. The details of the methods are discussed below:

## GEO-ELECTRICAL INVESTIGATION METHOD

The ADMT series instrument use natural electromagnetic field of the earth as the working field source to study the electrical structure inside the Earth. According to the principle that different frequencies of electromagnetic waves have different skin depth in the conductive coal, the surface is measured from high frequency to the low Earth electromagnetic field response sequence studies the difference in electrical variation of geological bodies at different depth in the subsurface and determines the occurrence of underground geological material.

The electromagnetic waves are sent to the ground, and propagate to the subsoil or subsurface of the Earth to measure the natural electromagnetic field of the rocks below the earth surface.

## RESULTS AND DISCUSSION

Interpretation of VES indicates presence of potential water-bearing horizons in different parts of the area of study. The interpretation has revealed different contour map which show different color and frequency unit, low-frequency and blue color intermediate water-bearing layer, also green contour depict potential rocks to store groundwater.

In general, the area has portrayed relatively more promising results with water-bearing horizons having potential blue and green color.

## CONCLUSIONS AND RECOMMENDATIONS

Detailed geological, hydrogeological, topographical and geophysical analysis has been taken into consideration to select the suitable drilling site

- Basing on geophysical investigation results, the area is dominated by sandy clay formation and small stones which is a good aquifer formation hence there's a possibility to abstract groundwater at the client's site due to observed deep seated rock formations which have tendency to recharge and percolation of groundwater.
- The recommended depth for borehole to be drilled is 100m VES 1.
- Direct air rotary method of drilling is recommended.
- The final drilling depth can be altered by hydrologist depending on the on rock strata penetrated, quality and quantity of water struck during the drilling operation.
- Installation of μPVC liners is strongly recommended in order to avoid corrosion and formation of iron bacteria in the boreholes.
- Proper borehole completion procedures have to be adhered to; including installation of uniform size gravel pack (2-4mmϕ), thorough borehole development and at least 12-hours pumping test.
- After construction a borehole should be fully developed by compressed air until water becomes absolutely silt free.
- The actual quantity and quality of water to be known only after drilling.
- Drilling permit and water use permit must be obtained as per Water Resources Management Act (WRMA) of 2009 No.11.

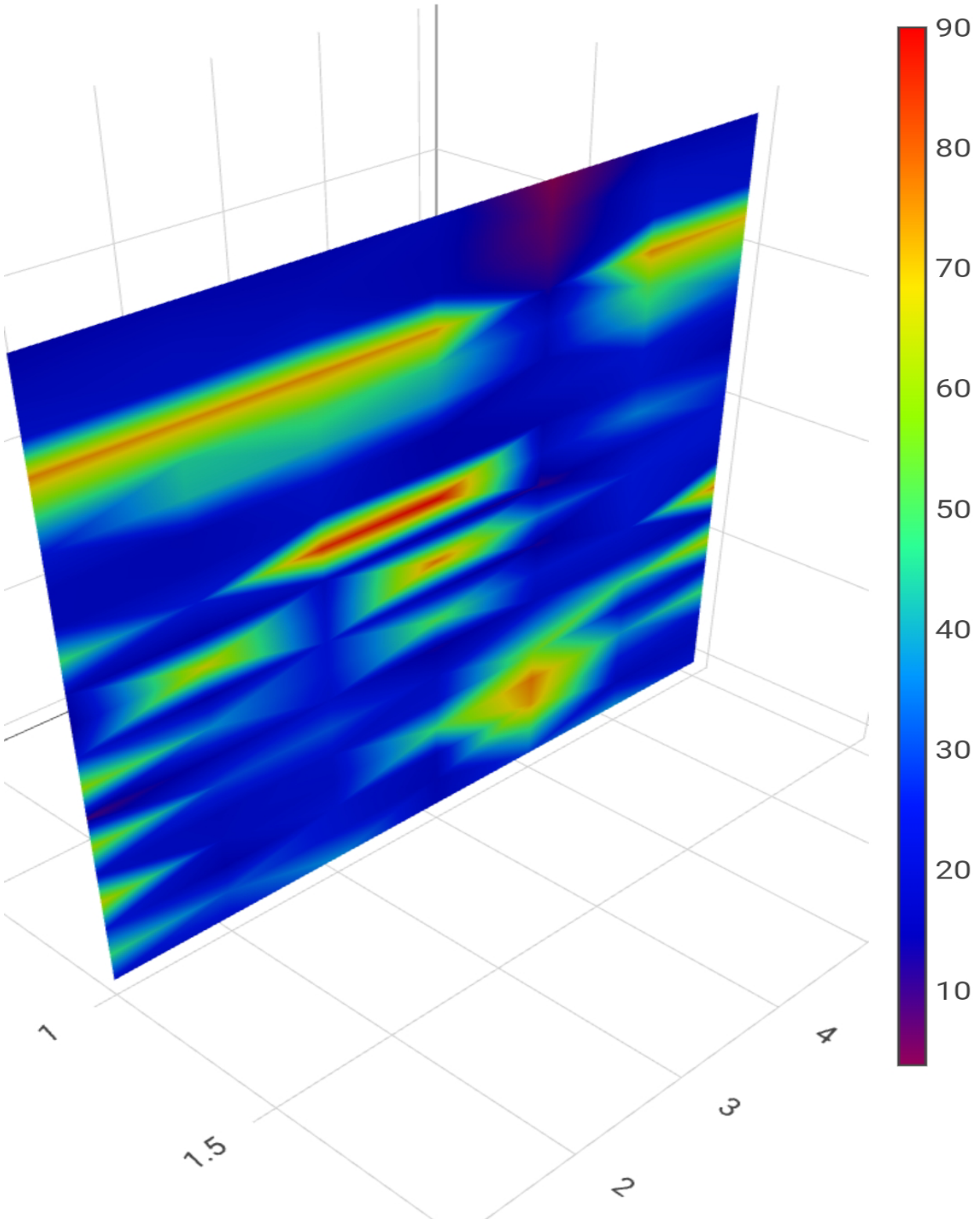
# APPENDECIES

APPENDEX I

| VES No. | Type of Layers | Apparent Resistivity (Ohm's) | Place COORDINATES | Remarks |
|---|---|---|---|---|
| 1 | 1 | | 3°18'33"S 37°20'42"E | Drilling to 100M deep as the first choice Point no 01 |
| | 2 | | | |
| | 3 | | | |
| | 4 | | | |

Summary of predicted lithological description:

| VES No | Type of Layers | Interpreted lithological description |
|---|---|---|
| 1 | 1 | Surgical, dry sandy clay formation |
| | 2 | Sticky clay formation which prohibits aquifer recharge and groundwater flow. |
| | 3&4 | Sandy clay intercalated with weathered undifferentiated rock formation. |


90
80
70
60
50
40
30
20
10
1
1.5
2
3
4