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Evaluation Of Geoelectric Section Using Resistivity Method for Subsurface Interpretation at Student Affair Unit, Choba.

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Abstract
This research evaluates subsurface conditions using geoelectric resistivity methods at the Student Affairs Unit, Choba, within the Niger Delta region. The study employs Vertical Electrical Sounding (VES) and Electrical Resistivity Tomography (ERT) techniques to investigate lithological composition, groundwater potential, and geotechnical characteristics. VES data reveals a multilayer stratigraphy comprising topsoil, coarse sand, silty clay, and gravelly sand formations. The resistivity curve obtained is a Q-type ($\rho_1 < \rho_2 > \rho_3 < \rho_4$), indicating a complex subsurface system with alternating conductive and resistive layers. The second layer (346.7 Ωm) signifies a coarse sand formation, identified as a potential aquifer zone, while the fourth layer (559.8 Ωm) is a highly resistive gravel-rich unit, suggesting superior groundwater yield. Interpretation of resistivity variations enables identification of aquifer depth, estimation of layer thickness, and detection of zones prone to contamination or instability. The findings highlight that the deeper gravel layer offers the highest aquifer potential and is suitable for sustainable groundwater development. The study underscores the value of resistivity methods in non-invasive geological assessments, infrastructure planning, and environmental monitoring. Conclusively, this investigation contributes to hydrogeophysical understanding of Choba's subsurface, aiding resource management, especially in light of increased infrastructural demands around the University of Port Harcourt. Recommendations include optimal borehole siting in deeper gravel zones and integrating geophysical surveys into urban planning to mitigate flooding, enhance water supply, and ensure structural integrity of future developments.
Keywords: *Schlumberger, Substantial, Geoelectric, Resistive, Stratigraphy, Niger-Delta, Electrical.*

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I. Introduction

Geophysical exploration techniques are essential for understanding subsurface structures, particularly in hydrogeology, engineering, and environmental studies. One of the most widely used methods for subsurface investigations is the geoelectric resistivity method, which helps to characterize lithological variations, groundwater potential, and geotechnical properties. This method has proven effective in mapping geological formations by measuring the electrical resistivity of materials, offering significant advantages over invasive drilling techniques (Balasco et al., 2022). The resistivity method is based on the principle that different subsurface materials exhibit varying levels of electrical resistance. Factors such as porosity, saturation, and mineral composition influence resistivity values, making it possible to infer geological characteristics (Hölting & Coldewery, 2018). Various configurations, including Schlumberger, Wenner, and dipole-dipole arrays, are employed to optimize depth penetration and spatial resolution. Electrical Resistivity Tomography (ERT) and Vertical Electrical Sounding (VES) are two prominent techniques within this method, each offering unique advantages for geological and hydrogeophysical studies (Aweda et al., 2023). ERT, an advanced resistivity imaging technique, utilizes multiple electrodes to produce high-resolution subsurface profiles, making it invaluable for detecting contamination, delineating aquifers, and assessing foundation stability. This method has been widely applied in environmental and geotechnical investigations (Lapenna et al., 2022). Meanwhile, VES focuses on vertical resistivity variations, allowing researchers to determine aquifer depths and stratigraphic sequences. VES has been successfully implemented in Nigeria, especially in Rivers State, where studies have recommended optimal borehole depths for sustainable groundwater development (Nwankwoala & Kekwaru, 2019). Geoelectric resistivity studies have gained substantial recognition globally, with applications in various geological settings. In Africa, particularly Nigeria, these techniques have been instrumental in groundwater exploration and engineering site characterization. Case studies in Nigerian cities such as Akure and Ibadan demonstrate the effectiveness of resistivity surveys in delineating fracture zones and assessing soil stability for construction projects (Amadi, 2019). The integration of ERT and VES has further improved subsurface imaging accuracy, enabling better decision-making in resource management and urban planning. The geoelectric resistivity method provides a reliable approach to subsurface interpretation, offering non-invasive, cost-effective, and high-resolution imaging capabilities. Its application across hydrogeology, engineering, and environmental disciplines highlights its importance in understanding geological formations and optimizing resource management. As geophysical technology advances, further refinements in data processing and interpretation will enhance the accuracy and efficiency of resistivity studies, paving the way for improved geotechnical assessments worldwide.

The aim of this study is to evaluate the geoelectric section using resistivity methods for subsurface interpretation at the Student Affairs Unit, Choba. This research seeks to determine the lithological composition, groundwater potential, and geotechnical properties of the study area using Electrical Resistivity Tomography (ERT) and Vertical Electrical Sounding (VES) techniques. By analyzing variations in subsurface resistivity, the study aims to identify aquifer zones, assess foundation stability, and detect possible environmental hazards such as soil contamination or erosion risks. Additionally, the findings will provide valuable insights for infrastructure planning, groundwater resource management, and environmental sustainability, contributing to informed decision-making for future developments within the university area.

The study focuses on subsurface evaluation using geoelectric resistivity methods specifically Vertical Electrical Sounding (VES) within the Student Affairs Unit, Choba, Rivers State, Nigeria. It encompasses:

1. Lithological identification
2. Aquifer delineation
3. Foundation stability assessment
4. Environmental risk detection (e.g. soil contamination, flooding)

The study on geoelectric section using the resistivity method for subsurface interpretation is significant in hydrogeology, engineering, and environmental assessments. It aids in groundwater exploration by identifying aquifer zones and estimating water-bearing formations, ensuring sustainable water resource management. In engineering, it helps assess soil stability and foundation suitability, minimizing structural failures in construction projects. Additionally, the method is valuable in environmental studies, detecting contamination plumes and assessing soil integrity for pollution control. Academically, it contributes to geophysical research, expanding knowledge on subsurface properties and improving geophysical exploration techniques. Economically, resistivity surveys offer cost-effective solutions for preliminary site investigations, reducing project costs and optimizing resource utilization. Overall, this study enhances geological understanding, supports sustainable development, and informs decision-making in groundwater management, engineering, and environmental monitoring.

Despite their advantages, resistivity methods have limitations, such as sensitivity to noise, dependence on electrode spacing, and challenges in interpreting complex geological formations.

The resistivity method has evolved significantly since its inception. Early applications focused on mineral exploration, but advancements in instrumentation and data processing have expanded its use to groundwater studies and environmental monitoring (Adiat, 2019). Modern resistivity techniques, such as Electrical Resistivity Tomography (ERT), provide high-resolution imaging of subsurface conditions. Electrical resistivity techniques are based on the response of the Earth to the flow of electrical current. In these methods, an electrical current is passed through the ground, and two potential electrodes record the resultant potential difference between them (Al-Amri, 2018). The apparent resistivity is then a function of the measured impedance and the geometry of the electrode array.

Different electrode configurations are used in resistivity surveys, including Schlumberger, Wenner, and dipole-dipole arrays. Each configuration has unique advantages in terms of depth penetration and resolution (Adiat, 2019). The choice of configuration depends on the specific objectives of the investigation. Electrical Resistivity Tomogram is an advanced resistivity imaging technique that provides detailed subsurface resistivity distribution. It is widely applied in environmental studies, engineering site characterization, and hydrogeological investigations (Balasco et al., 2022). The method utilizes multiple electrodes arranged in specific configurations to generate high-resolution resistivity profiles. VES is a geophysical method used to determine vertical resistivity variations in subsurface layers. It is commonly employed in groundwater exploration and lithological mapping (Amadi, 2019). Resistivity methods are extensively used in hydrogeological studies to identify aquifer zones and assess groundwater potential. These techniques help determine water-bearing formations and estimate groundwater recharge rates (Al-Amri, 2018).

In engineering site characterization, resistivity surveys help assess soil stability and foundation suitability. These methods are crucial for infrastructure development, ensuring safe construction practices (Adiat, 2019). Resistivity techniques are valuable in environmental studies, particularly in detecting contamination plumes and assessing soil properties. ERT has been successfully applied to monitor pollution spread and evaluate soil remediation strategies (Balasco et al., 2022).

The geoelectric resistivity method has been widely used for subsurface investigations across the globe. It is a geophysical technique that helps in determining the electrical properties of subsurface materials, which is crucial for applications such as groundwater exploration, environmental studies, and engineering site characterization. Studies have demonstrated the relevance of electrical resistivity methods in engineering site characterization, particularly in basement complex terrains, where the technique has been used to unravel subsurface conditions (Adiat, 2019). Additionally, research has shown that resistivity mapping is useful for identifying rock structures and potential geothermal reservoirs (Al-Amri, 2018).

In Africa, the geoelectric resistivity method has been applied extensively for groundwater exploration and environmental assessments. A study conducted in Ogun State, Nigeria, utilized the Schlumberger electrode array to analyze groundwater potential, revealing multiple geoelectric layers that correspond to different subsurface materials (Airen & Babaiwa, 2023). Another study in Katsina State, Nigeria, applied the resistivity method to determine aquifer depth in low-permeability formations, highlighting the effectiveness of the technique in mapping fracture zones (Ahmed et al., 2020). Furthermore, research in Otuoke, Nigeria, estimated aquifer protective capacity using geoelectrical methods, identifying areas with good groundwater potential (Oghale & ThankGod, 2023). In Africa, resistivity methods have been extensively applied for groundwater exploration and environmental assessments. Studies in Nigeria have utilized the Schlumberger electrode array to analyze groundwater potential, revealing multiple geoelectric layers that correspond to different subsurface materials (Adiat, 2019).

In Nigeria, the electrical resistivity method has been widely used for hydro-geophysical investigations and engineering site assessments. A study in Southwestern Nigeria demonstrated the capability of the technique in characterizing subsurface conditions, particularly in areas with highly weathered basement formations (Olorunfemi et al., 2024). Another research in Ibadan assessed groundwater potential using resistivity methods, correlating aquifer depth with resistivity values (Adejumo & Adefehinti, 2024). Additionally, investigations in Akure applied resistivity techniques to evaluate engineering site characterization, classifying areas into low, moderate, and high groundwater zones (Adiat, 2019).

In Rivers State, geoelectrical resistivity surveys have been conducted to delineate lithology and groundwater depth. Geophysical resistivity methods, including ERT and VES, play a crucial role in subsurface investigations. Their ability to provide detailed insights into geological formations, groundwater resources, and environmental conditions makes them indispensable tools in geophysics. As technology advances, the integration of resistivity techniques with other geophysical methods will further enhance subsurface imaging capabilities, leading to more efficient and accurate geological assessments (Balasco et al., 2022). A study in Ndele Community used vertical electrical sounding to determine potable water depths and subsurface lithologic distribution, recommending an average borehole depth of 50 meters for optimal water yield (Nwankwoala & Kekwaru, 2019). Another research in Eleme Local Government Area applied resistivity methods to characterize aquifers, identifying confined aquiferous units at depths ranging from 60 to 65 meters (Amadi, 2019). These studies highlight the importance of geoelectric resistivity methods in understanding subsurface conditions and optimizing groundwater exploration in Rivers State.

Resistivity methods offer several advantages, including non-invasiveness, cost-effectiveness, and high-resolution imaging capabilities. They provide valuable insights into subsurface conditions without the need for extensive drilling, making them ideal for preliminary site investigations (Al-Amri, 2018).

Expatriates have played a significant role in advancing geophysical research and applications worldwide. Their expertise has contributed to the development of innovative methodologies and improved data interpretation techniques, facilitating knowledge transfer and technological advancements (Adiat, 2019).

Resistivity methods are crucial for environmental monitoring and engineering site characterization. They help assess soil stability, detect contamination spread, and evaluate foundation suitability for construction projects, ensuring sustainable development (Balasco et al., 2022).

Comparing different resistivity techniques, such as ERT and VES, reveals their strengths and limitations. While ERT provides high-resolution imaging, VES is more effective for depth-specific investigations (Al-Amri, 2018).

Resistivity methods are often integrated with other geophysical techniques, such as seismic and electromagnetic surveys, to enhance subsurface imaging accuracy. This multidisciplinary approach improves geological interpretations and resource management (Adiat, 2019).
Another investigation using Schlumberger resistivity profiling at "NASS" field (Choba) revealed similar layering and specified approximate depths and resistivity ranges:
Layer 1 (~1.6 m depth, 84.7Ωm)
Layer 2 (~2.7 m, 689Ωm)
Layer 3 (~14.1 m, 8,593Ωm)
Layer 4 (~46.8 m, 3,273Ωm)
Layer 5 (>46.8 m, 791Ωm)
The main aquifer layer has been located at around 46.8 m depth, based on resistivity methods.
Interpreted Stratigraphic Succession at Choba;

Layer	Depth (approx.)	Lithology
1	0 – 2 m	Topsoil
2	~2.7 m	Fine-to-medium sand
3	~14 m	Coarse/gravely sand
4	~46.8 m	Silty clay
5	>46.8 m	Coarse sand – main aquifer zone

These findings align with the regional stratigraphic framework of the Niger Delta and adjacent basins, which feature sequences ranging from Akata (Paleocene-Eocene marine shales) through Agbada (alternating sands and shales) to Benin (Pliocene-Quaternary continental sands).

Advancements in geophysical technology continue to improve resistivity methods. The integration of artificial intelligence and machine learning in data interpretation enhances the precision of subsurface imaging, leading to more efficient geological assessment.

Geology of the study area

Geologic History and Stratigraphic Succession of Choba, Port Harcourt (Niger Delta Region) The study area at the Student Affairs Unit, Choba which its geologic map is shown below in Figure 1, is part of the Niger Delta Basin, which has undergone progressive sedimentation since the Paleocene as a result of subsidence linked to the opening of the South Atlantic Ocean (Doust & Omatsola, 1990).

The Geologic History are;

1. Cretaceous Period (c. 145–66 Ma) The geologic evolution of the Niger Delta began with rifting between the African and South American plates, leading to the formation of early sedimentary basins inland (Reijers, 2011).
2. Paleocene–Eocene (c. 66–34 Ma) This period marked the initial development of the delta. Sediments were deposited in marine to transitional environments as the proto-Niger River delivered large volumes of clastics into the subsiding delta basin (Short & Stauble, 1967).
3. Oligocene–Miocene (c. 34–5 Ma) Rapid delta progradation occurred due to increased sediment input, leading to the formation of thick deltaic sequences (Doust & Omatsola, 1990).
4. Pliocene–Present (c. 5 Ma–present) The modern Niger Delta continued to evolve, with the development of the present-day topography and shallow aquifer-bearing formations such as those found in Choba (Avbovbo, 1978).

The subsurface geology of Choba follows the tripartite lithostratigraphy of the Niger Delta Basin:

1. Akata Formation (Paleocene–Recent) Composed mainly of marine shales with some silt and sand lenses. Acts as the main petroleum source rock. Deposited in deep marine environments (Reijers, 2011).
2. Agbada Formation (Eocene–Recent) Alternating sandstones and shales representing delta front to delta plain environments. Serves as the primary reservoir rock (Doust & Omatsola, 1990).
3. Benin Formation (Oligocene–Recent) – Surface Geology at Choba Composed of coarse, unconsolidated sands with minor shales and clay lenses. Represents continental fluvial deposits forming the uppermost aquifer-bearing strata (Avbovbo, 1978; Reijers, 2011).

Local Subsurface Sequence Based on geoelectric resistivity data, the typical succession beneath Choba includes:

1. Topsoil – Sandy or silty clay.
2. Clayey Sand or Sandy Clay – Transition zone.
3. Fine to Medium Sand – Increasing saturation.
4. Coarse Sand or Gravelly Sand – Highly resistive aquifer zone, within the Benin Formation (Adeleye et al., 2022).

In the specific context of Choba (Port Harcourt, Rivers State), geophysical studies such as resistivity surveys have identified and characterized subsurface layers in the region:

A five-layer geoelectric sequence has been delineated, comprising:

1. Topsoil
2. Fine-to-medium sand
3. Coarse/gravely sand
4. Silty clay
5. Coarse sand (potential aquifer zone).

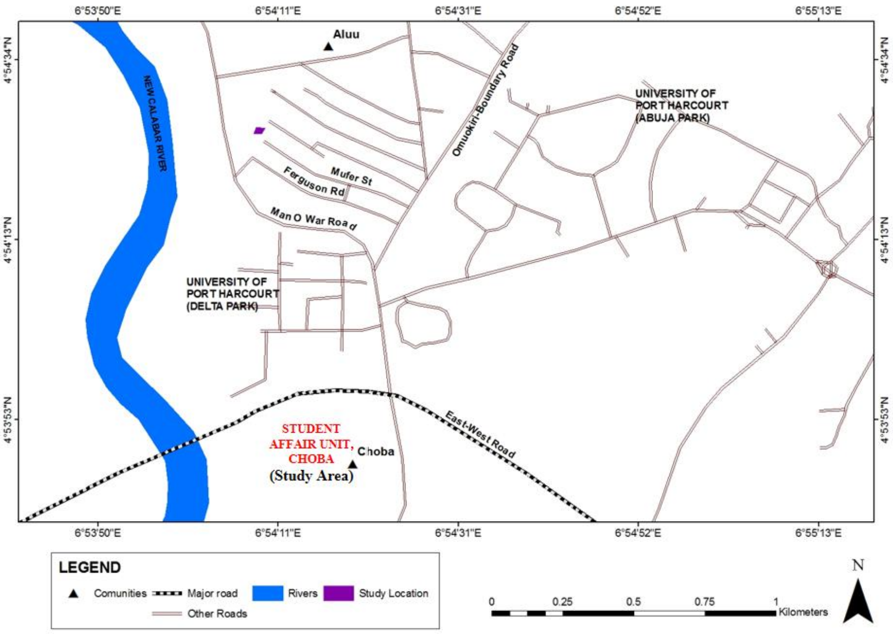

Figure 1: Geologic map of The Study area

The Student Affairs Unit, Choba is an essential administrative division responsible for managing student welfare, academic support, and extracurricular activities within the university. It serves as a bridge between students and the university administration, ensuring a conducive learning environment and fostering student development. The unit oversees various aspects of student life, including accommodation, counseling services, career guidance, and disciplinary matters. Additionally, it plays a crucial role in organizing orientation programs for new students, promoting peaceful coexistence among diverse student populations, and facilitating job placements for graduates. Located in Choba, Rivers State, Nigeria, the Student Affairs Unit operates within a dynamic academic setting, catering to the needs of students from different backgrounds. The geographical location of Choba, near the University of Port Harcourt, makes it a hub for educational activities and student engagement. The area's geology is characterized by sedimentary formations, which influence groundwater availability and subsurface conditions. This makes geoelectric resistivity studies particularly relevant for assessing soil stability, aquifer depth, and environmental sustainability in the region.

The significance of studying the subsurface conditions at the Student Affairs Unit, Choba, lies in its impact on infrastructure development and resource management. Understanding the geoelectric section using resistivity methods helps in identifying suitable locations for boreholes, assessing foundation stability for buildings, and detecting potential environmental hazards. Given the increasing student population and infrastructural expansion, geophysical investigations in this area contribute to informed decision-making and sustainable development.

Furthermore, the study area is subject to various environmental challenges, including flooding, soil erosion, and groundwater contamination. Conducting geoelectric resistivity surveys aids in mitigating these issues by providing insights into subsurface properties and guiding appropriate engineering solutions. The findings from such studies are valuable for university administrators, urban planners, and environmental agencies working to enhance the safety and functionality of student facilities.

Choba, located in Rivers State, Nigeria, experiences a tropical monsoon climate, characterized by high temperatures, heavy rainfall, and high humidity throughout the year. The region typically has two distinct seasons: the wet season, which lasts from March to October, and the dry season, occurring between November and February. During the wet season, intense rainfall is common, contributing to the area's lush vegetation and groundwater recharge. The dry season, while relatively cooler, still maintains high humidity levels, with occasional harmattan winds bringing dry and dusty conditions.

Temperatures in Choba generally range between 24°C and 32°C, with peak heat occurring between February and April. The high humidity, often exceeding 80%, makes the climate feel warmer than recorded temperatures. The annual rainfall in Rivers State averages between 2,000 mm and 2,500 mm, making it one of the wettest regions in Nigeria. This abundant rainfall supports agriculture and water resources but also contributes to flooding and erosion, which are common environmental challenges in the area.

Wind patterns in Choba are influenced by seasonal monsoon winds, which bring moisture from the Atlantic Ocean during the wet season, and harmattan winds, which originate from the Sahara Desert during the dry season. These climatic conditions play a crucial role in groundwater availability, soil stability, and infrastructure planning, making climate studies essential for sustainable development in the region.

The vegetation in Choba, Rivers State, Nigeria, is predominantly characterized by tropical rainforest and mangrove ecosystems. Due to its location in the Niger Delta region, the area supports dense forests, freshwater swamps, and coastal mangroves, which thrive in the humid and high-rainfall climate. The mangrove forests, which are among the largest in the world, play a crucial role in protecting the coastline from erosion and providing habitat for diverse aquatic species. However, studies indicate that mangrove depletion has been a growing concern due to human activities such as urban expansion, deforestation, and pollution. In addition to mangroves, Choba features freshwater swamp forests, which support a variety of plant species adapted to waterlogged conditions. These forests are essential for groundwater recharge, biodiversity conservation, and climate regulation. The region also contains secondary forests, which have regenerated after previous disturbances, including agricultural activities and logging. Some common tree species found in the area include Terminalia ivorensis and Terminalia catappa, which are widely used for environmental conservation, shade, and fuelwood.

Urbanization and land-use changes have significantly impacted vegetation cover in Choba. Research shows that built-up areas have expanded, leading to a reduction in natural vegetation and an increase in cultivated land. This shift has implications for soil stability, water retention, and local climate regulation, making vegetation management a critical aspect of sustainable development in the region.

Overall, Choba's vegetation is a mix of mangrove forests, freshwater swamps, and secondary forests, all of which contribute to the ecological balance of the area. However, deforestation and urban expansion pose challenges that require conservation efforts and sustainable land-use planning to preserve the region's rich biodiversity and environmental health.

Choba, located in Obio-Akpor Local Government Area of Rivers State, Nigeria, has experienced significant population growth over the years. As of 2008, the population was estimated at 27,253. The area has seen continuous expansion due to its proximity to Port Harcourt, a major commercial and educational hub. The presence of the University of Port Harcourt has contributed to an influx of students, faculty, and businesses, further increasing the population density.

Rivers State, where Choba is situated, has an estimated population of 9,567,892 as of 2025, growing at an annual rate of 2.96%. Port Harcourt, the state capital, is one of Nigeria's most populous cities, with a current population of 5,171,000, projected to reach 15,499,000 by 2035. Choba, being part of this metropolitan expansion, continues to attract residents due to educational opportunities, business activities, and urban development.

The demographic composition of Choba includes a mix of ethnic groups, predominantly Ikwerre, alongside other Nigerian communities such as Ijaw, Ogoni, and Igbo. The area also hosts a significant number of students, professionals, and traders, contributing to its vibrant social and economic landscape. The rapid urbanization and population growth in Choba highlight the need for sustainable infrastructure development, efficient resource management, and environmental planning to accommodate its expanding community.

Choba, located in Rivers State, Nigeria, has a drainage system influenced by its proximity to the New Calabar River and the Choba River. The New Calabar River, which flows through the region, serves as a major waterway, impacting both surface and groundwater movement (Nwankwo & Igboekwe, 2011). The Choba River, an extension of the New Calabar River, plays a crucial role in local drainage, helping to channel excess water and reduce flooding risks. However, studies have shown that the Choba River has been affected by pollution, including heavy metal contamination and waste disposal, which can impact water quality and drainage efficiency (Agbo & Uzoegbu, 2024).

The drainage network in Choba is characterized by natural watercourses, urban drainage systems, and swampy areas. Due to the high annual rainfall in Rivers State, effective drainage is essential to prevent waterlogging and erosion. The region experiences frequent flooding, especially during the rainy season, which can disrupt transportation and infrastructure. Poorly maintained drainage channels and blocked waterways contribute to urban flooding, making drainage management (Wali, 2020).

Within the University of Port Harcourt, studies have been conducted on drainage systems, particularly in Delta Park, where hydrological and hydraulic analyses have been performed to assess water flow and drainage capacity. Findings indicate that certain drainage channels exhibit trapezoidal shapes and interconnected segments, designed to manage storm water runoff efficiently. However, urban expansion and increased construction activities have placed additional pressure on existing drainage infrastructure (Agbo & Uzoegbu, 2024).

Efforts to improve drainage in Choba include channel dredging, flood control measures, and environmental monitoring. Sustainable drainage solutions, such as permeable pavements and improved storm water management, are being explored to mitigate flooding risks and enhance water flow. Given the area's sedimentary geology and swampy terrain, proper drainage planning is essential for maintaining infrastructure stability and preventing environmental degradation (Nwankwo & Igboekwe, 2011).

Overall, Choba's drainage system is shaped by its river networks, urban development, and climatic conditions. While natural waterways like the New Calabar River and Choba River provide drainage pathways, urbanization and pollution pose challenges that require effective management and sustainable solutions to ensure long-term environmental and infrastructural resilience (Wali, 2020).

II. Materials

To carry out the Geoelectric Section Using Resistivity Method for Subsurface Interpretation, several materials and equipment are required. These include:
1. Resistivity Meter: A device used to measure the electrical resistivity of subsurface materials. Popular models include the ABEM Terrameter and Ohmega Resistivity Meter.
2. Electrodes (Current and Potential Electrodes): Metallic stakes inserted into the ground to transmit and receive electrical signals.
3. Cables and Connectors: Used to connect the electrodes to the resistivity meter, ensuring proper signal transmission.
4. Power Source: Battery packs or generators to supply power to the resistivity meter during field measurements.
5. Measuring Tape: For accurate spacing of electrodes according to the survey configuration (e.g., Schlumberger or Wenner array).
6. GPS Device: To record the geographical coordinates of the survey points for mapping and analysis.
7. Data Logger: Stores resistivity readings during field investigations for later processing.
8. Hammer: Used to drive electrodes into the ground for stable contact.
10. Geophysical Software (e.g., RES2DINV, IP2WIN, Surfer): Used for processing and interpreting resistivity data to generate subsurface models.
11. Topographic Map: Helps in identifying site elevation and geological features.
12. Notebook and Pen: For documentation of field observations and readings.
13. Personal Protective Equipment (PPE): Safety gear such as gloves, boots, and reflective vests for field operations.
14. Rims: it holds the cable in place and for easy if the cable.

III. Methods

The geoelectric resistivity method employs several techniques to investigate subsurface properties effectively. The primary methods used in this study include:
1. Vertical Electrical Sounding (VES): This method involves varying the electrode spacing to probe deeper subsurface layers. It is widely used for groundwater exploration and lithological mapping, as it provides depth-specific resistivity variations.
2. Geoelectrical Profiling: This method is used to map lateral variations in resistivity across a study area. It helps in identifying geological structures such as faults, fractures, and buried objects.
3. Schlumberger and Wenner Electrode Configurations: These configurations are commonly used in resistivity surveys. The Schlumberger array is preferred for deeper investigations, while the Wenner array provides better resolution for shallow subsurface studies.
4. Data Processing and Interpretation: The collected resistivity data is analyzed using geophysical software such as RES2DINV and Surfer, which generate subsurface models and assist in geological interpretation.
These methods collectively enhance the accuracy of subsurface investigations, making them valuable for hydrogeological, environmental, and engineering applications.

IV. Results

The interpretation of resistivity curve begins after the acquisition of data, which is done in the field location at Student Affairs Unit, Choba, University of Port-Harcourt, Obio/Akpo Local government, Rivers State. Then it is subjected to analysis or processing of the data and then to the last known as the interpretation of the data. The resistivity curve in figure 4.1 and its depth and thickness illustrated in a table in table 4.1, and its Geoelectric Section in figure 4.2, were the result gotten from data acquisition first, as without data acquisition, there won’t be result nor interpretation of results.

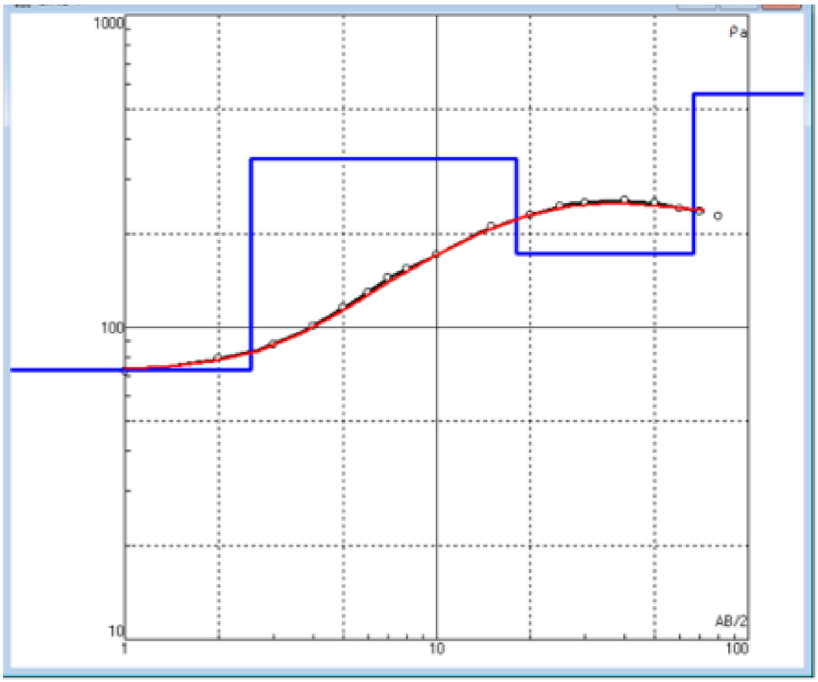

Figure 2: A vertical electrical sounding curve

Table 1: Table showing the apparent resistivity, depth and thickness of the curve

S/n	Resistivity (Ωm)	Depth (m)	Thickness (m)	Altitude
1	73.11	2.535	2.535	-2.535
2	346.7	18.03	15.5	-18.031
3	172.2	66.68	48.65	-66.683
4	559.8			

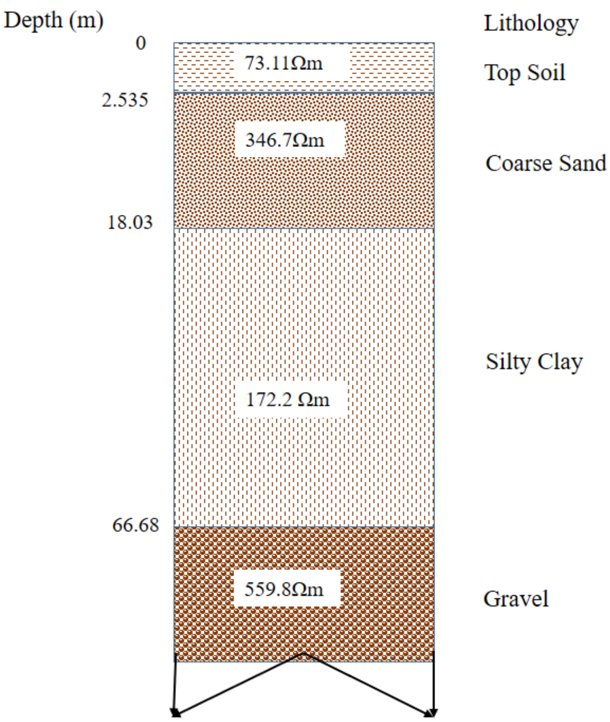

Figure 3: Geoelectric section of the VES curve using the apparent resistivity and depth

V. Discussion

The data was processed to obtain the apparent resistivity components of the layers, so that, a plot of apparent resistivity values and half-current electrode spacing values can be done using a software. The software produced a 2D resistivity curve and table of values called geophysical parameters. These parameters are used to produce a geoelectric section for lithological characterization and evaluation.

The resistivity curve in figure 1 revealed a five (5) sub-surface stratigraphic earth model, four thickness of medium, depth to potential aquifer Formation, suggesting a complex lithological structure beneath the Student Affair Unit, Choba. This vertical electrical sounding (VES) technique provides insight into varying resistivity properties of different geological formations at increasing depth. The resistivity trend is in the form of $\ell_1<\ell_2>\ell_3<\ell_4$. **Th**is indicates a multilayered earth model, often associated with a sand-clay-sand sequence, where a high resistivity layer is sandwiched between lower resistivity layers, typical aquifer system in sedimentary terrain, which is characteristic of **Q-type resistivity curve type** as seen in Figure 2. In this pattern:

Layer 1 has the lowest resistivity probably due to mixture of material at top surface, with an apparent resistivity of 73.11Ωm at the depth of 2.535m.

Layer 2 exhibits a higher resistivity (346.7Ωm) at depth 18.03m than both the overlying and underlying layers. Indicates the presence of a compact formation, possibly coarse-grain sediments or fractured rock with limited conductivity and may act as a semi-permeable zone, affecting groundwater movement. This layer is also an ideal for aquifer as its geoelectric further ascertain its authenticity using the lithology scale, the 346.7Ωm is classified as coarse sand which is suitable for portable ground water.

The geoelectric section further enlighten me in analysing my result as it significantly eased my interpretation as the importance of lithology cannot be neglected. Using the Geoelectric section in Figure 3 above, reveals that from;

0 – 2.535m is termed the topsoil or the earth surfaces (73.11Ωm) and also layer 1.

2.535 – 18.03m is dominantly a coarse sand (346.7Ωm) which is layer 2.

18.03 – 66.68m is silty clay zone (172.2Ωm) which is layer 3.

66.68m beyond is gravel zone (559.8Ωm) which is layer 4 and by far the best aquifer system as there is increase in resistivity as depth increases.

Layer 3 returns to a lower resistivity at 172.2Ωm. this drop in resistivity maybe as a result of conductive materials tainting its resistivity and as a result decreased as depth increases.

Layer 4 has a high resistivity, significantly greater than layer 3 and the other layers (559.8Ωm), distinguishing it from the low-resistivity layer 3. It suggests the presence of a consolidated rock formation or a dense lithological unit capable of influencing fluid retention and it is a potential indicator of aquifer formation.

VI. Summary and Conclusion

This research employed geoelectric resistivity techniques to assess subsurface characteristics of the Student Affairs Unit, Choba. Through VES, the study identified multiple geoelectric layers, varying in resistivity and depth, with the deepest layer showing high aquifer potential. The findings offer insight into local lithology and can guide groundwater resource management, environmental safety, and infrastructural development in the region.

In conclusion, the subsurface is made up of multiple stratigraphic layers, including topsoil, coarse sand, silty clay, and gravel, each with distinct resistivity. The deepest layer (gravel zone) exhibited the highest resistivity (559.8Ωm), indicating high aquifer potential.

Geoelectric resistivity methods are effective, non-invasive tools for identifying subsurface features and informing engineering and hydrogeological decisions.

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