IMPROVING ENUGU URBAN WATER SOURCING AND DISTRIBUTION USING GEOSPATIAL TECHNOLOGIES

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Presented by Amos Ugwuoti

INTRODUCTION

DATA ACQUISITION

- Map of the existing distribution network
- Records of water production and quantity supplied
- Surface water discharge measurement
- Population /census data of Enugu Metropolis
- Topographic Information (from LIDAR Image)
- Coordination of all the water facility locations within the interest area
- Underground water sourcing using ABEM terrameter

DATA MANAGEMENT AND PROCESSING

- Application of Geographic Information System in production of map showing the extent of distribution and locations of major piped water facilities in the interest area
- Application of Arc GIS software in processing and extraction of digital terrain model form LIDAR image
- Re-designing the distribution pattern using EPANET modeling software
- Application of Vertical Electrical Sounding (VES) to determine the aquifer that can supply underground water to augment the quantity obtained from existing sources

STUDY AREA

❖Enugu is the capital of Enugu State in Nigeria. It is located in South eastern Nigeria.

❖ It has a population of 722,664 according to the 2006 Nigerian census.

❖It is located between Lat. 06° , 26’ and 06° , 30’ N and Long. 07° , 27’ and Long. 07° , 37’ E and lies east of Niger Delta.

❖It stands on Udi hills at an elevation between 125m and 380m above mean sea level with intervening hills and valleys.

❖Its temperature lies between 20°C and 35ºC with average range of rain fall of 8mm and 252mm


NIGERIA
0 km 60 120 180 km
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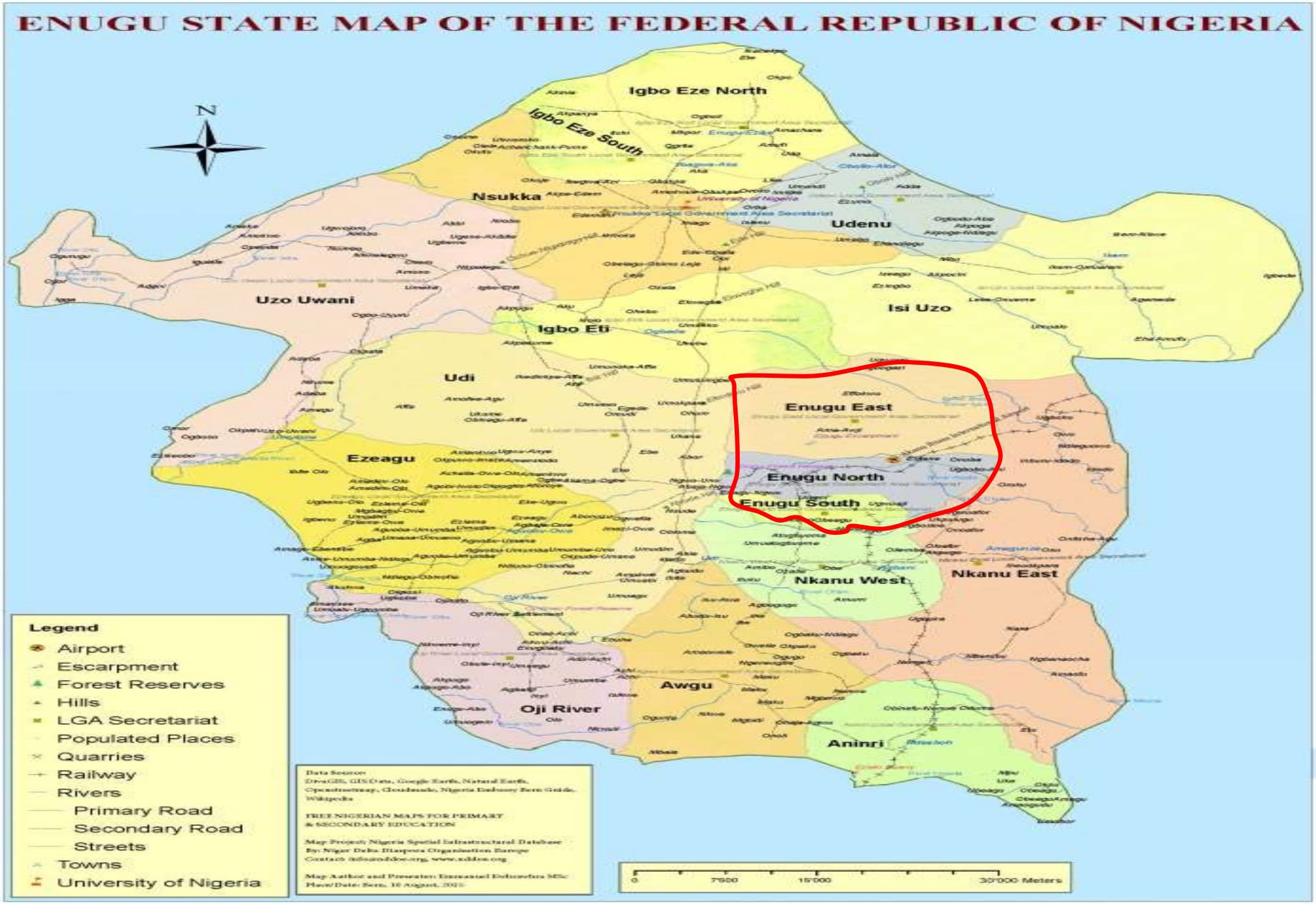
SOKOTO
ZAMFARA
KATSINA
KANO
JIGAWA
YOBE
BORNO
KEBI
KADUNA
NIGER
BAUCHI
GOMBE
ADAMAWA
PLATEAU
NASSARAWA
ABUJA
FEDERAL CAPITAL TERRITORY
KWARA
OYO
OGUN
OSHUN
EKITI
ONDO
KOGI
BENUE
TARABA
ENUGU
EBONYI
ANAMBRA
EDO
DELTA
IMO
ABIA
CROSS RIVER
AKWA IBOM
RIVERS
BAYELSA
LAGOS
Sokoto
Kano
Katsina
Kaduna
Zaria
Jos
Bauchi
Gombe
Maiduguri
Minna
Ilorin
Ogbomosho
Oshogbo
Ibadan
Abeokuta
Lagos
Benin City
Onitsha
Enugu
Makurdi
Lafia
Port Harcourt
Calabar
BENIN
CAMEROON
Lake Chad
Zinder
Maradi
Maroua
Garoua
Bamenda
Bafoussam
Douala
Yaoundé
Parakou
Cotonou
Porto-Novo
Bight of Benin
Gulf of Guinea
Slave Coast
Mouths of the Niger
National Capital (340,000 in 99)
over 1,000,000
(Greater Lagos had a population of 12,750,000 in 1999)
over 600,000
over 300,000
over 100,000
other main city
other city
Capital of State


ENUGU STATE MAP OF THE FEDERAL REPUBLIC OF NIGERIA
N
Igbo Eze North
Igbo Eze South
Nsukka
Udenu
Uzo Uwani
Isi Uzo
Igbo Eti
Udi
Enugu East
Enugu North
Enugu South
Ezeagu
Nkanu West
Nkanu East
Awgu
Oji River
Aninri
Legend
Airport
Escarpment
Forest Reserves
Hills
LGA Secretariat
Populated Places
Quarries
Railway
Rivers
Primary Road
Secondary Road
Streets
Towns
University of Nigeria
0
7500
15000
30000 Meters

RESEARCH SIGNIFICANCE

S/N	WATER SOURCES	(2014) m^3 Designed capacity m^3	Actual volume	Actual volume (2015) m^3	Actual Volume (2016) m^3	Actual volume (2017) m^3	Actual volume (2018) m^3	Average volume day m^3	Average Volume litres
1	**Eva (water Head)**	4,500	1,747.4	2,085	1,527.18	1,129	2,007.71	1,699.258	1,699,250
2	**Oji**	50,000	13,832	6,670	5,135	10,118	13,912.23	9,933.446	9,933,446
3	**Ajalli River**	77,000	8,300	5,614.29	3,427	829	4,400.17	4,514.092	4,514,092

S/N	WATER SOURCES	Designed capacity	Actual volume (2014) m^3	Actual volume (2015) m^3	Actual volume (2016) m^3	Actual volume (2017) m^3	Actual volume (2018) m^3	Average volume m^3	Average Volume litres
4	**9th Mile (Old Road)**	6,000	271	56.25	Nil	Nil	Nil	65.45	65,450
5	**9th Mile (bore Holes)**	17,280	Nil	Nil	246.44	Nil	Nil	49.288	49,288
6	**TOTAL**	**154,780**	**24,150.4**	**14,425.54**	**10,335.62**	**12,076**	**20,320.11**	**16,261.534**	**16,261,534**

SUMMARY OF THE TABLE

- ✓ Only 16%, 9%, 7%, 8% and 13% for the year 2014, 2015 2016 , 2017 & 2018 respectively of the designed/expected volume of water were supplied
- ✓Hence, a total of 16,261.543m3 is supplied every day

- ✓This according to the agency is as a result of water loses through pipe leakages, malfunctioning of existing facilities
and rugged topography

THE GRAVE SITUATION

- Population projection from 2006 to 2018 for Enugu metropolitan area is **1,026,097**

This computation was done using linear population projection method of United Nations. (United Nations, 1974)

- Quantity of water supplied per day = 16,261,534 litres

- **Quantity of water supplied per capita per day = 15.8 litres**

WHO's STANDARD ON DOMESTIC WATER USAGE

World Health Organization's (WHO) specification on the minimum quantity of water needed per Capita per day is 150litres; (10 litres)for Drinking, (20L) for Cooking, (30L) for Personal washing, (40L) for Washing of clothes and (50L) for Cleaning of the house (Reed , 2005)

Where do we classify 15.8 L currently supplied per person per day ?

Possibly for drinking alone

To supply 150 litres as required, additional 137,653,016 litres is needed to be supplied every day

Assuming the designed capacity (15478000litres) is achievable, the quantity will just be enough as each person will access 151L

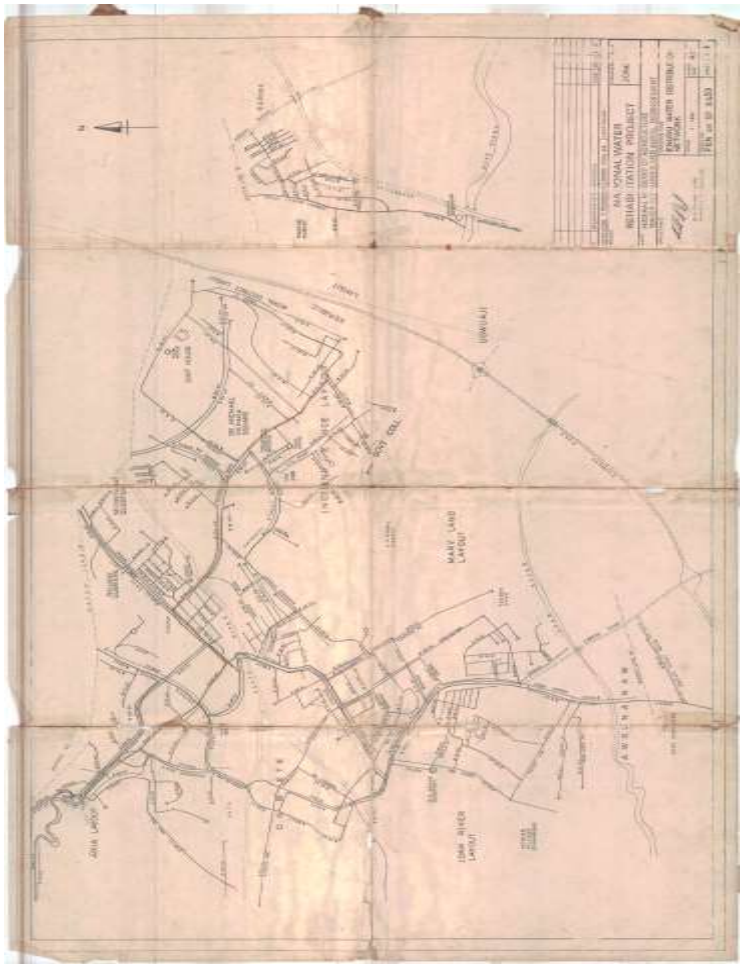
WATER SURVIVAL STRATEGIES IN ENUGU

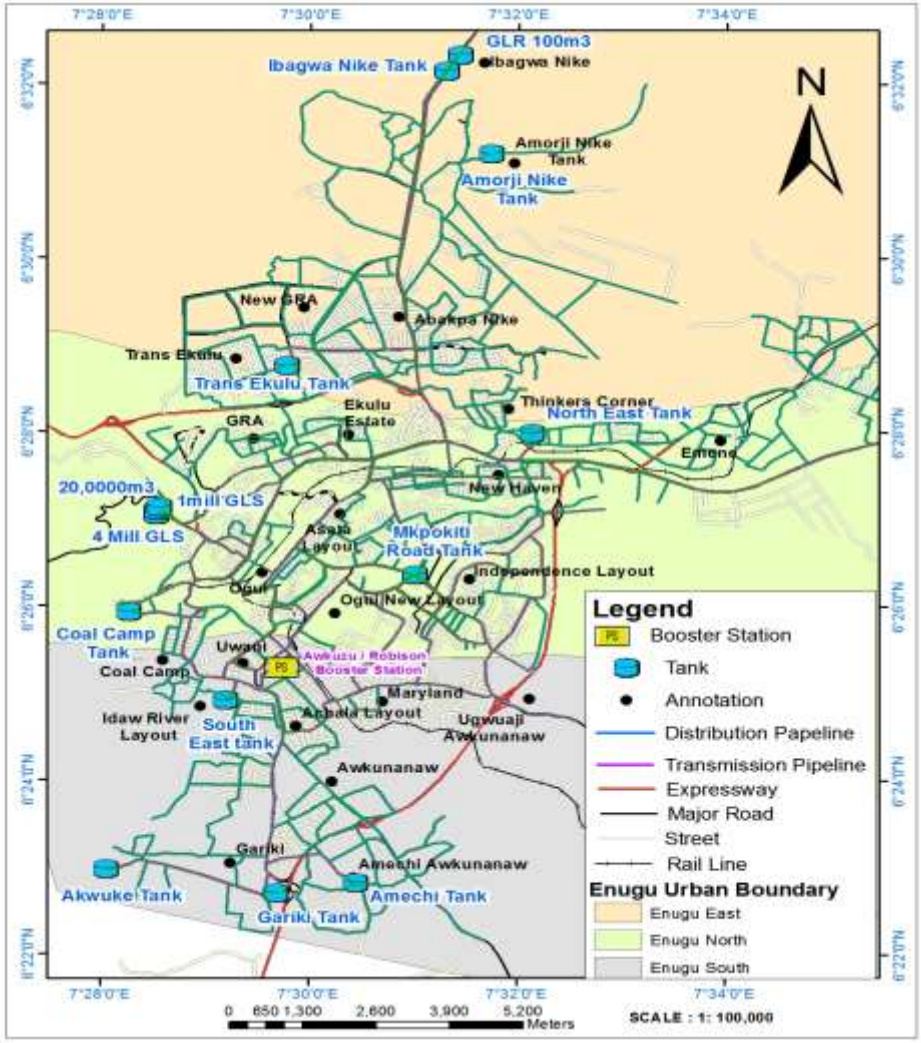
Contaminated Shallow water well

Water vendor

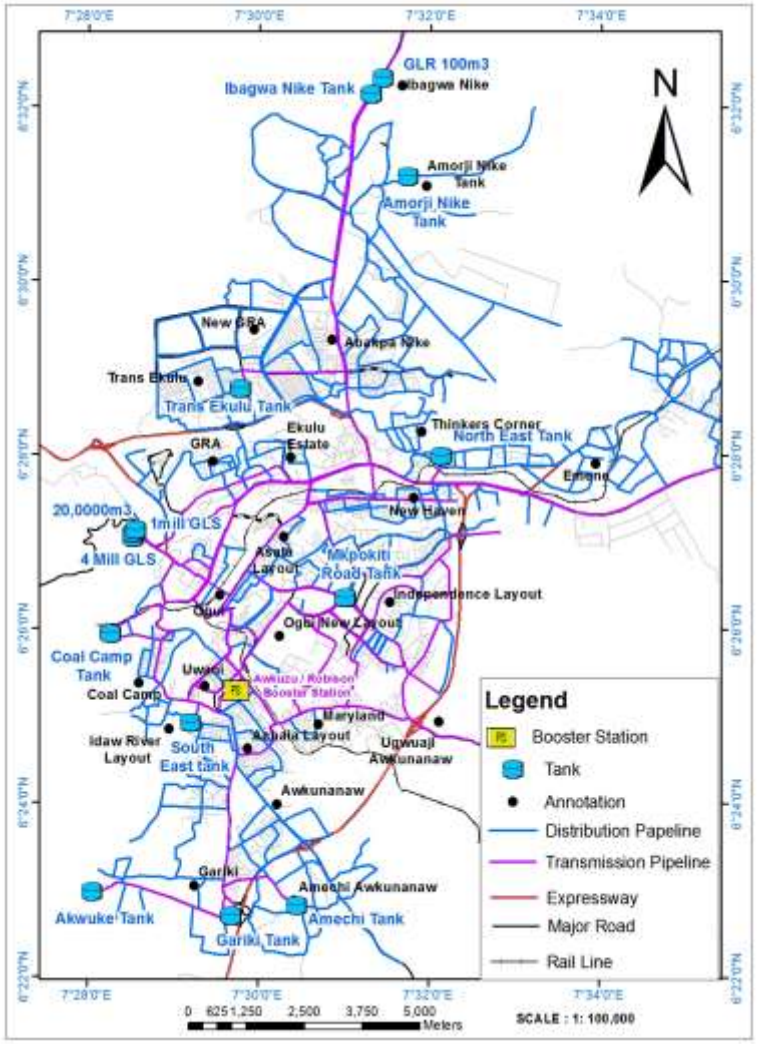
STEPS TO REMEDY THE SITUATION

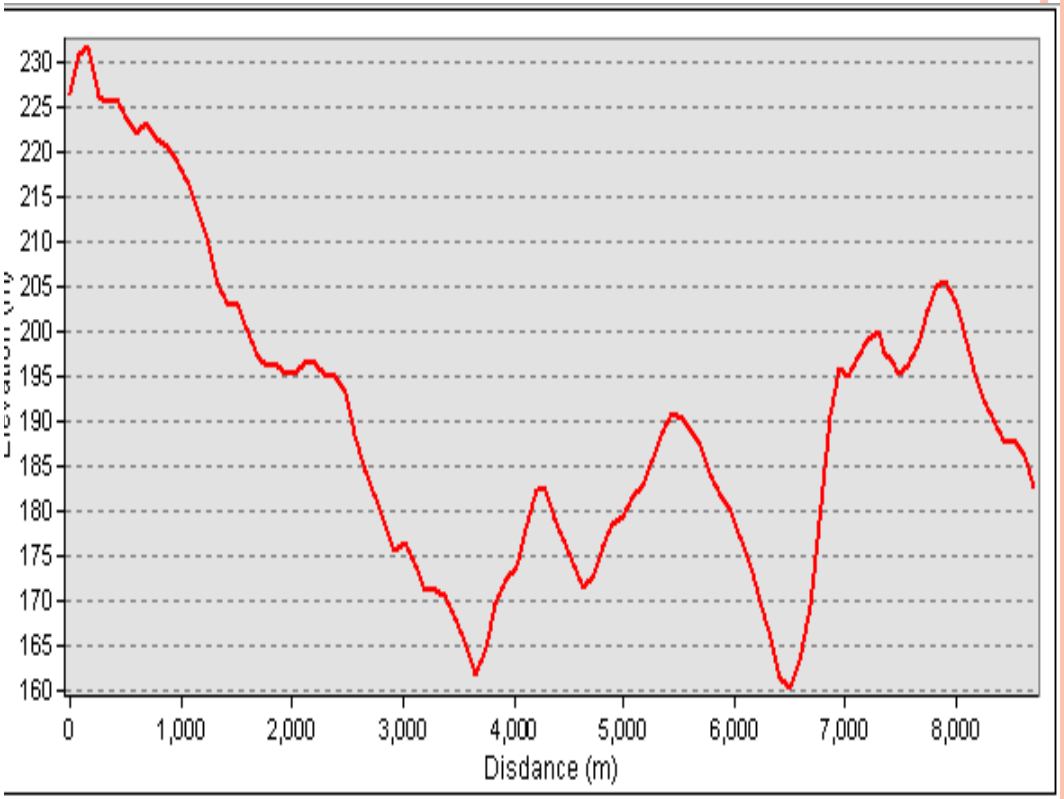
- WHAT WE HAVE DONE





POSSIBILITY OF WATER FLOW BY GRAVITY





Profile showing Gravity of Water Pipeline From Ibagwa Nike tank to Abakpa Junction (Nike Road).

Water current measurement at Ajalli

✓ **Bore-hole depth of 40.0m to 55.0m**

Geoelectric layer	Resistivity (Ωm)	Thickness *d*(m)	Elevation (m)	Lithology
First layer ($_1$)	987.60	0.8	153.2	Top Lateritic Clay
Second layer ($_2$)	63.80	7.2	146.0	Wet Clay
Third layer ($_3$)	5.80	51.2	94.8	Wet Gray Shale
Fourth layer ($_4$)	22.10	51.9	42.9	Wet weathered Shale
Fifth layer ($_5$)	66.60	–	–	Wet un-weathered Shale

EXPECTED RESULTS

Map showing a patterned water distribution network with the proposed locations for new water facilities (EPANET)

A seasonal representation of the quantity of water attainable from the existing surface source depicted in a hydrograph

A tabular presentation of the possible maximum and minimum quantity of water obtainable from the existing sources.

A prediction of the locations of aquifer for possible underground water sources within Enugu urban

THANK YOU FOR LISTENING

University of Nigeria Nsukka

FIG 2019
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