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Modeling Total Dissolved Solid Using Multiple Linear Regression Model Developed From Em-34 Data Around Olushosun Dumpsite In Lagos, South-west, Nigeria

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Presentation Outline

- ✓ Introduction
  - Background to the study
  - Aim and Objectives of the study
  - Literature review
- ✓ Materials and method
- ✓ Results and Discussion
- ✓ Conclusions
- ✓ References

Background to the study

- The management of solid waste landfills has been a major problem of our urban centers in Nigeria and other developing economies worldwide.

- In these urban centres, wastes are generated daily and disposed indiscriminately in rivers and landfills without recourse to the subsurface environment, geology and their proximity to the living quarters (Ehirim et; al, 2009, Adeoti et; al, 2011).

Background to the study Cont’d

Fig 1.0: Pictorial view of part the Olushosun dumpsite

Aim and objectives of the study

The aim of the this research work is to assess the impact of leachates from the dumpsite on the soil and groundwater system around the study area.

The specific objectives are to:

- ✓ Carry out Frequency Domain Electromagnetic [FDEM] surveys to investigate the vertical and lateral distribution of contaminants around the dumpsite.
- ✓ Analyze the hydrophysical properties of water samples obtained from boreholes near the sites.
- ✓ Develop predictive TDS model for the study area

Literature review

- Electrical and electromagnetic geophysical methods are becoming increasingly accepted tools for the initial characterization of contaminant plumes from municipal and hazardous waste landfills (Greenhouse and Harris 1983; Sweeney 1984; Greenhouse and Monier-Williams 1985 Ayolabi et.al, 2015).

- Many other workers have investigated the contamination of groundwater by heavy metal around landfill site [Lee, et al., 1986, Christensen, et al., 1998, Ogundiran, and Afolabi, 2008, Ayolabi and Peters, 2004, Ayolabi and Oyelayo, 2005, Ayolabi et al., 2013, Ayolabi et.al, 2015]

Materials and methods

Data Acquisition

- EM data

Figure 1.2: EM-34 instrument

Materials and methods cont’d

- Water sample analysis

  The physical properties of water tested for are their total dissolved solid (TDS), pH values, temperatures, hardness and electrical conductivity (EC).

Materials and methods cont'd

- **Statistical analysis of data**

Considering the generalised Multiple Linear Regression;

$Y = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \cdots \beta_n X_n + \eta_i$…………………… (3.0)

Where Y = Dependent variable predicted by regression model

$\beta_0 =$ Intercept Of the regression line

β_1 through βn are the slopes of the regression line

X_1 throuhg X_n are the independent variables

$\eta_i =$ is the error term

Results and discussion

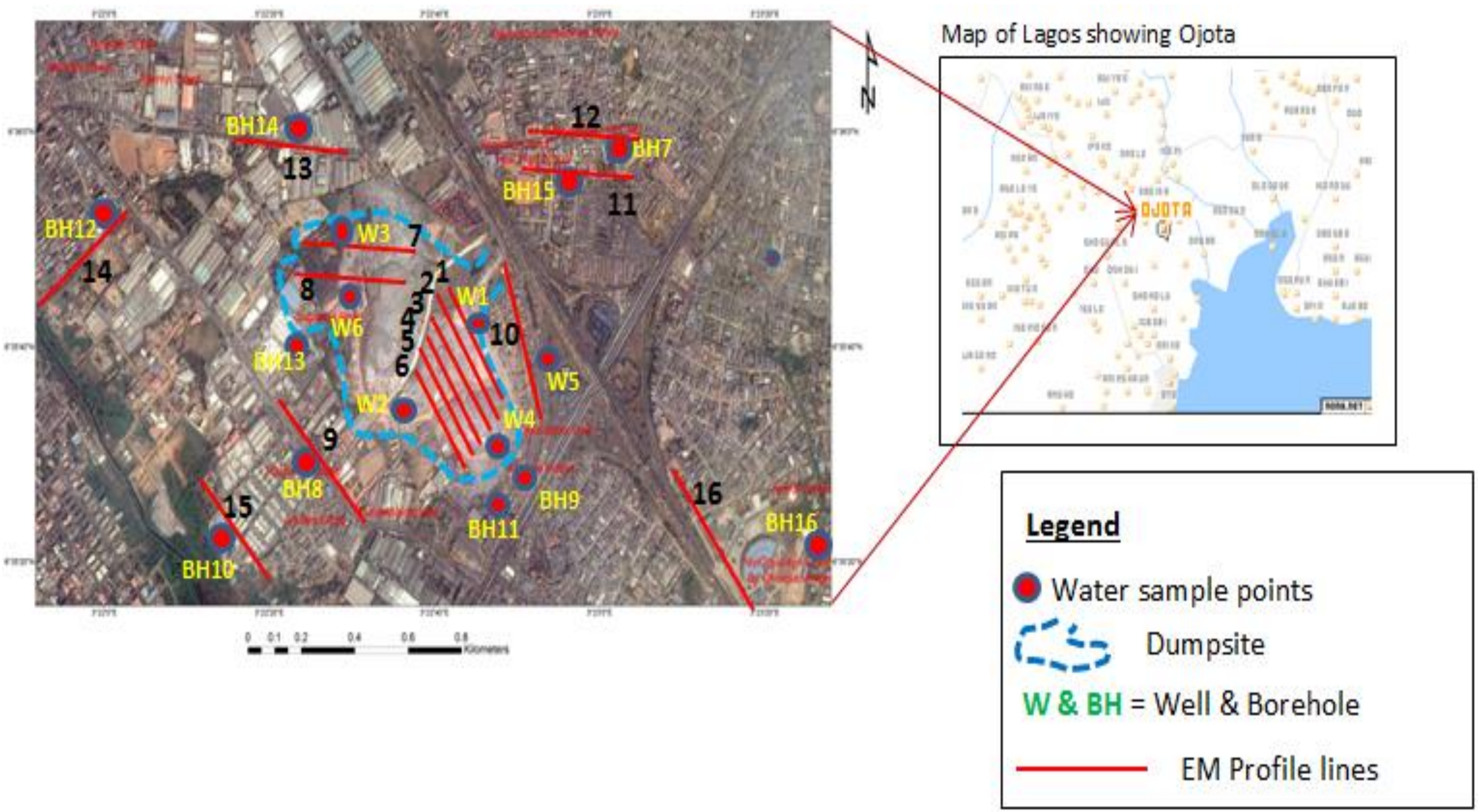


Figure 1.3: Satellite image of Olushosun dumpsite and surrounding areas showing water sample points and EM-34 data profiles

Results and discussion Cont'd

Table 1.1: Observed mean Terrain Conductivity and TDS Parameters around the Vicinity of Olushosun Dumpsite

EM-34	Coordinate	HD 10 (mS/m)	HD 20 (mS/m)	HD 40 (mS/m)	VD 10 (mS/m)	VD 20 (mS/m)	VD 40 (mS/m)	TDS (mg/l)
Traverse 1	**6^o 35' 38.71"N 3^o 22' 45.09"E**	151.06	199	200.82	161.5	150.13	108.71	1200
Traverse 2	**6^o 35' 38.08"N 3^o 22' 44.38"E**	141.93	205.18	200.68	109.81	160.68	139.44	738
Traverse 3	**6^o 35' 37.59"N 3^o 22' 43.61"E**	144.44	173.13	186.50	170.69	185.56	178.0	222
Traverse 4	**6^o 35' 36.82"N 3^o 22' 43.12"E**	110.25	149.68	211.35	96.25	90.06	107.23	992
Traverse 5	**6^o 35' 36.54"N 3^o 22' 42.06"E**	144.43	167.0	172.65	158.56	173.50	167.47	187
Traverse 6	**6^o 35' 36.27"N 3^o 22' 41.14"E**	138.63	196.0	217.0	73.69	178.38	186.59	496
Traverse 7	**6^o 35' 51.30"N 3^o 22' 35.57"E**	71.11	89.22	42.22	80.44	40.89	45.83	40
Traverse 8	**6^o 35' 47.97"N 3^o 22' 33.60"E**	126.74	196.17	176.59	185.84	189.17	178.41	161
Traverse 9	**6^o 35' 24.75"N 3^o 22' 30.63"E**	234.72	171.88	171.61	236.39	184.06	155.66	325
Traverse 10	**6^o 35' 42.48"N 3^o 22' 50.59"E**	203.0	212.37	173.75	34.37	174.32	168.30	193
Traverse 11	**6^o 35' 53.10"N 3^o 22' 58.10"E**	193.37	198.31	167.90	62.47	142.42	146.7	304
Traverse 12	**6^o 35' 56.94"N 3^o 22' 55.31"E**	25.65	28.55	47.5	77.30	46.3	50.9	48
Traverse 13	**6^o 35' 57.65"N 3^o 22' 26.99"E**	36.93	36.13	76.31	51.4	79.43	78.70	83
Traverse 14	**6^o 35' 50.30"N 3^o 22' 09.68"E**	21.37	38.88	38.56	27.32	37.12	39.38	56
Traverse 15	**6^o 35' 21.89"N 3^o 22' 24.51"E**	40.82	36.56	67.0	24.18	65.31	68.0	73
Traverse 16	**6^o 35' 25.00"N 3^o 23' 06.91"E**	19.25	27.69	65.27	24.44	75.81	70.07	50

Results and discussion Cont'd

Table 1.2: Summary statistics for regression model using all data variables

	Coefficients	Stand. Error	tStat	P-value	Lower 95%	Upper 95%	Lower 95%	Upper 95%
Intercept	60.42368	27.2158	2.22016	0.04642	1.12539043	119.721995	1.1253904	119.721995
HD 40	9.579794	0.32902	29.1156	1.69E-12	8.86291053	10.2966793	8.8629105	10.2966793
VD 20	3.533745	0.79573	4.44088	0.00081	1.79999782	5.26749358	1.7999978	5.26754935
VD 40	-12.7011	0.87967	-14.438	6.008E-9	-14.617793	-10.784481	-14.61779	-10.784482

$$Y = \beta_0 + \beta_1\,(\text{HD } 40) + \beta_2(\text{VD } 20) + \beta_3(\text{VD } 40) \;\ldots\ldots\ldots\; (2)$$

Where;

Y = Total Dissolved Solid obtained from borehole and hand dug well water within and around the site

HD 40 =Horizontal Dipole mode data obtained at 40 m coil spacing

VD 20 =Vertical Dipole mode data obtained at 20 m coil spacing

VD 40 =Vertical Dipole mode data obtained at 40 m coil spacing

Results and discussion Cont'd

linear regression equation becomes;

$$TDS = 60.42 + 9.58(HD\ 40) + 3.53(VD\ 20) - 12.70(VD\ 40) \ldots \ldots .(3)$$

Table 1.3: Record of the Observed and Predicted TDS

S/n	*Observed TDS (mg/l)*	*Predicted TDS (mg/l)*
1	1200	1134
2	738	779
3	222	241
4	992	1041
5	187	200
6	496	399
7	40	27
8	161	154
9	325	377
10	193	203
11	304	308
12	48	32
13	83	72
14	56	60
15	73	69
16	50	63

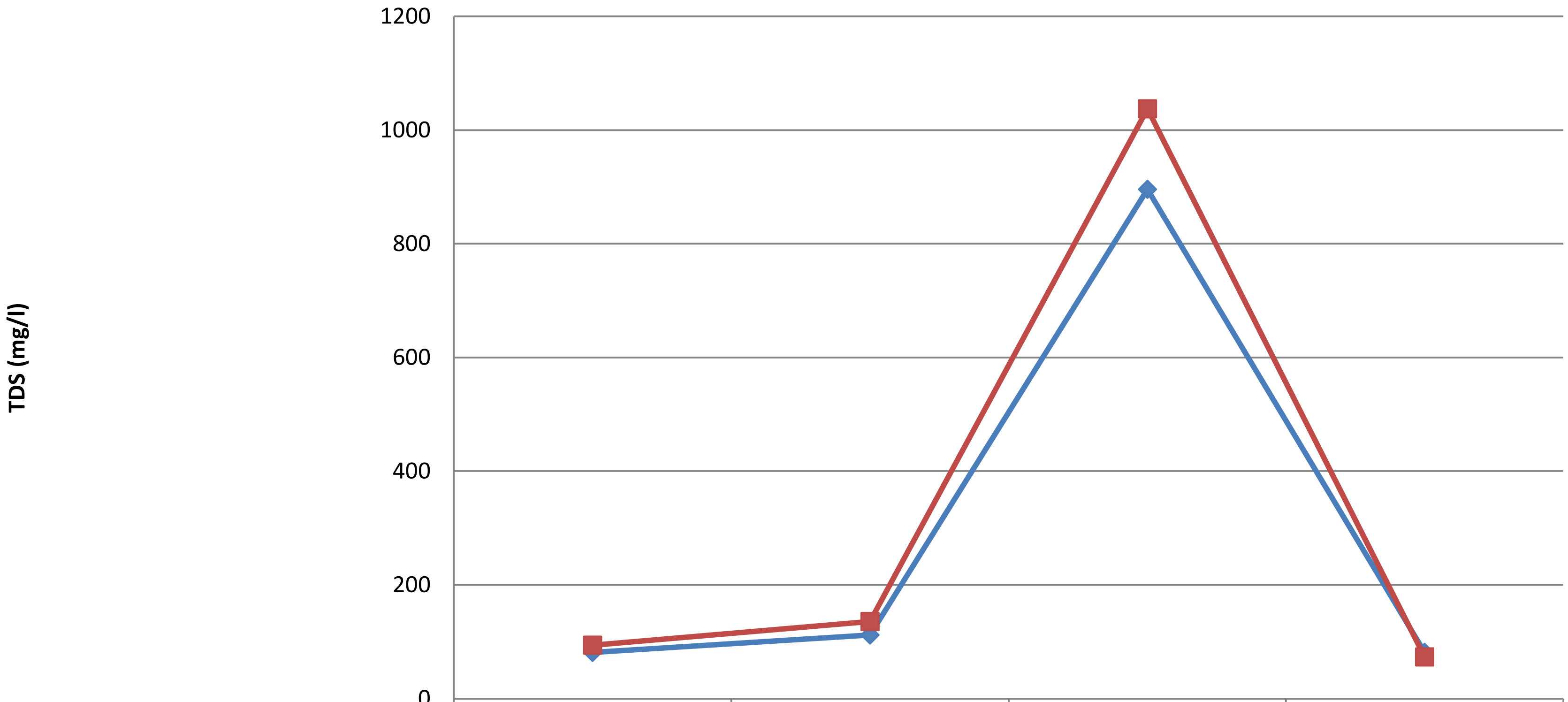
Results and discussion Cont'd

Model Validation

Table 1.4: Observed mean Terrain Conductivity and TDS Parameters around Olushosun dumpsite obtained from Ayolabi et.al 2015

Profile locations	Coordinates	VD20(mS/m)	HD40(mS/m)	VD40(mS/m)	Observed TDS from water samples (Ayolabi et.al 2015)	Predicted TDS using proposed model
P11	$6^{0}35^{1}20.26^{11}$N $3^{0}22^{1}31.20^{11}$E	27.3	17.3	18	81	93.9
P1	$6^{0}35^{1}45.00^{11}$N $3^{0}22^{1}42.36^{11}$E	110.0	80.0	85	112	135.62
P9	$6^{0}35^{1}40.05^{11}$N $3^{0}22^{1}38.85^{11}$E	143.5	140.0	69	896	1037.63
P10	$6^{0}35^{1}30.86^{11}$N $3^{0}22^{1}29.78^{11}$E	21.3	22.0	21.5	81	73.0

Results and discussion Cont’d



	P11	P1	P9	P10
Observed TDS by Ayolabi et.al 2015	81	112	896	81
Predicted TDS using proposed model	93.9	135.62	1037.63	73

Profile location

Figure 1.4: Plot of comparism between the observed TDS by Ayolabi et.al 2015b and predicted TDS using proposed model

Results and discussion Cont’d

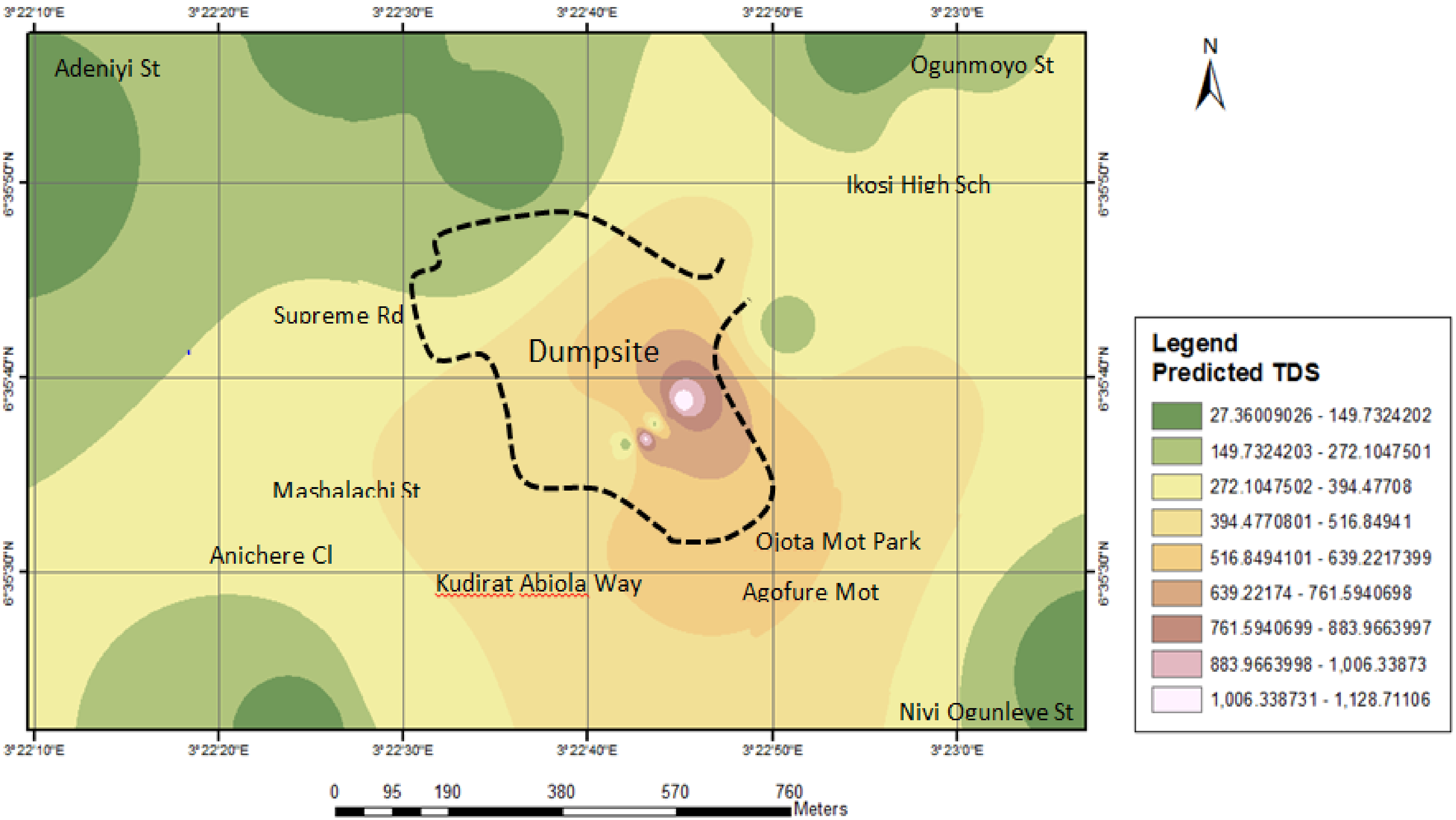


Figure 1.5: Spatial distribution of interpolated estimated TDS around Olushosun dumpsite

Results and discussion Cont'd

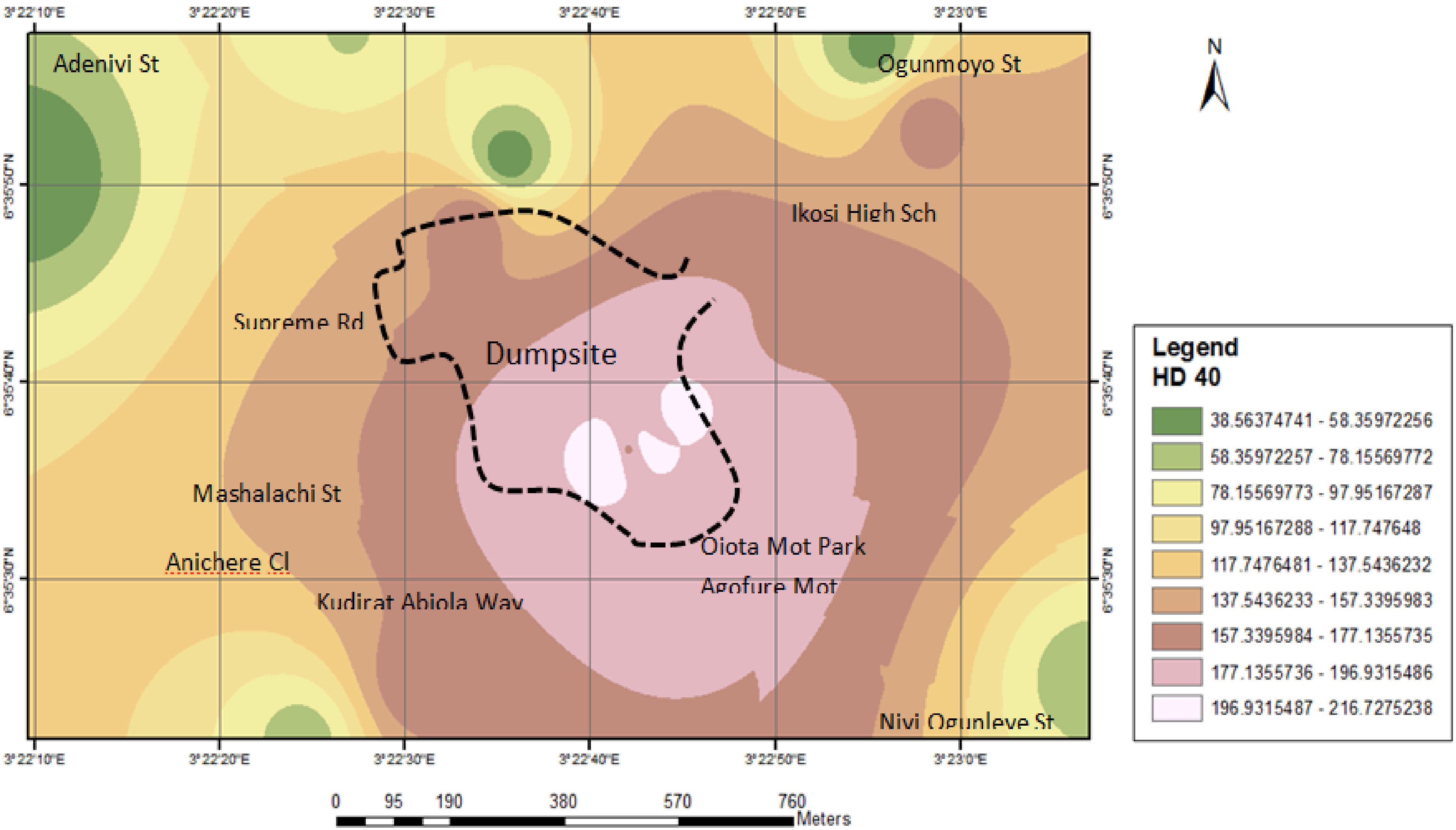


Figure 1.6: Spatial distribution plot of apparent soil electrical conductivity (σa – mS/m) measured using EM34 in horizontal dipole mode: 40 m (EM34-HD 40)

Results and discussion Cont'd

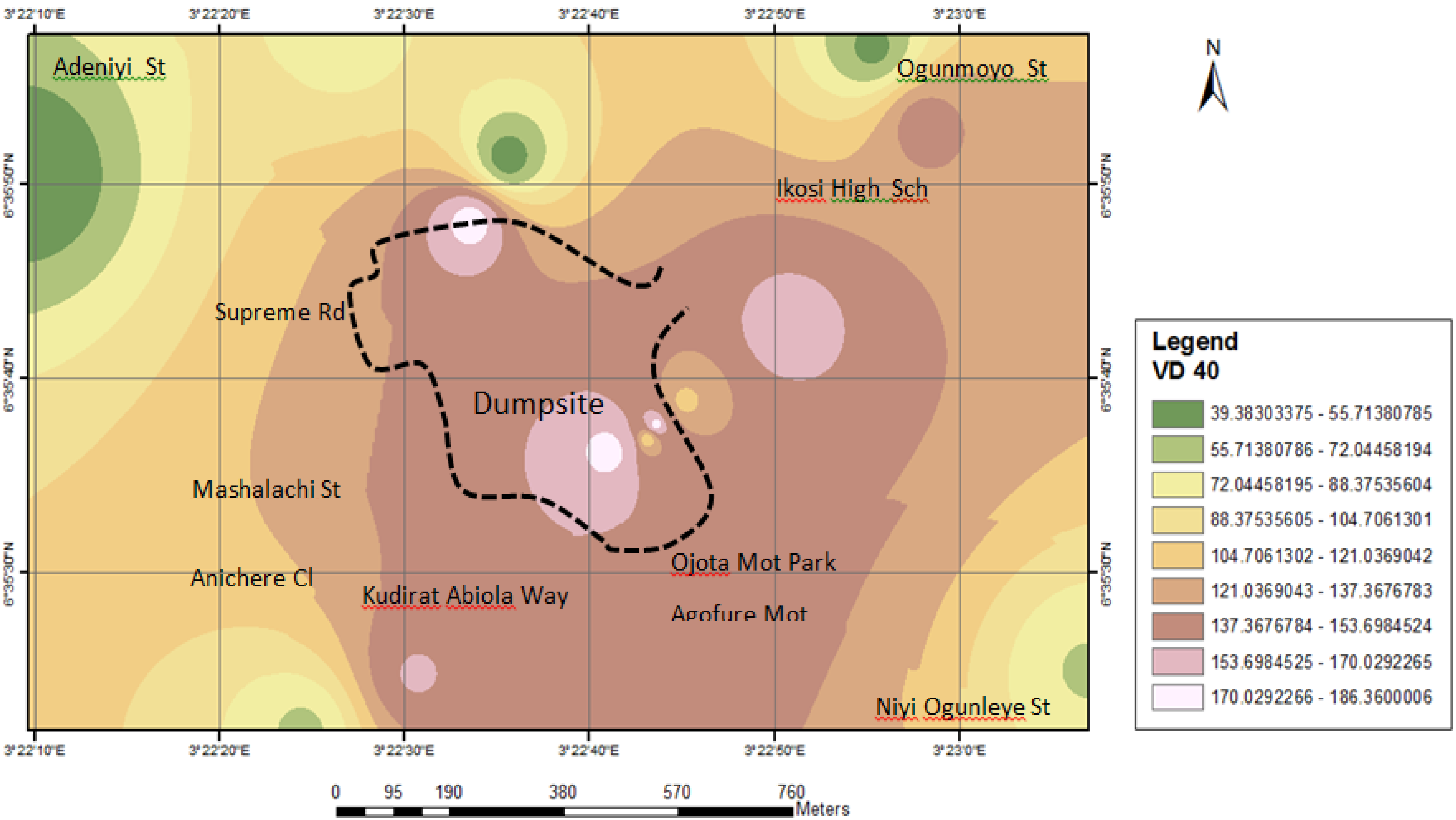


Figure 1.7: Spatial distribution plot of apparent soil electrical conductivity (σa – mS/m) measured using EM34 in Vertical dipole mode: 40 m (EM34-VD 40)

Conclusion

- The developed TDS models can easily be deployed to determine TDS concentration in groundwater around the study areas where the terrain conductivity data is available, thus reducing the time and cost of determining and monitoring both parameters separately

- The outcome of this research work will assist policy makers and environmental managers to take quality decisions required to preserve and sustain a healthy environment for mankind and the ecosystems in general, and to effectively and safely manage our natural resources

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Thank you for listening!!!