Observed controls on urban groundwater quality in a humid tropical environment

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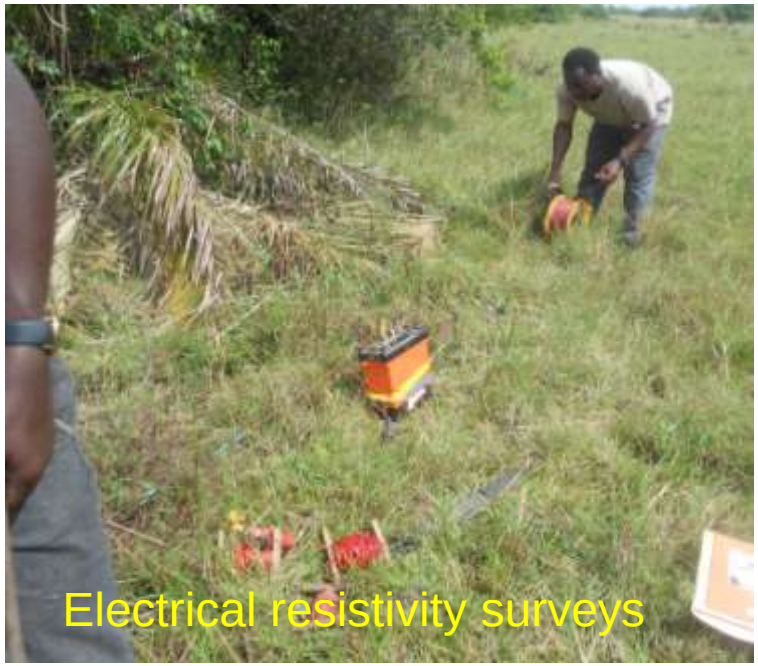
- Shallow groundwater via wells and springs
- A bid to achieve (SDG 6.1)

- Sanitation facilities and management
- SDG 6.2?

Understanding controls on Groundwater quality

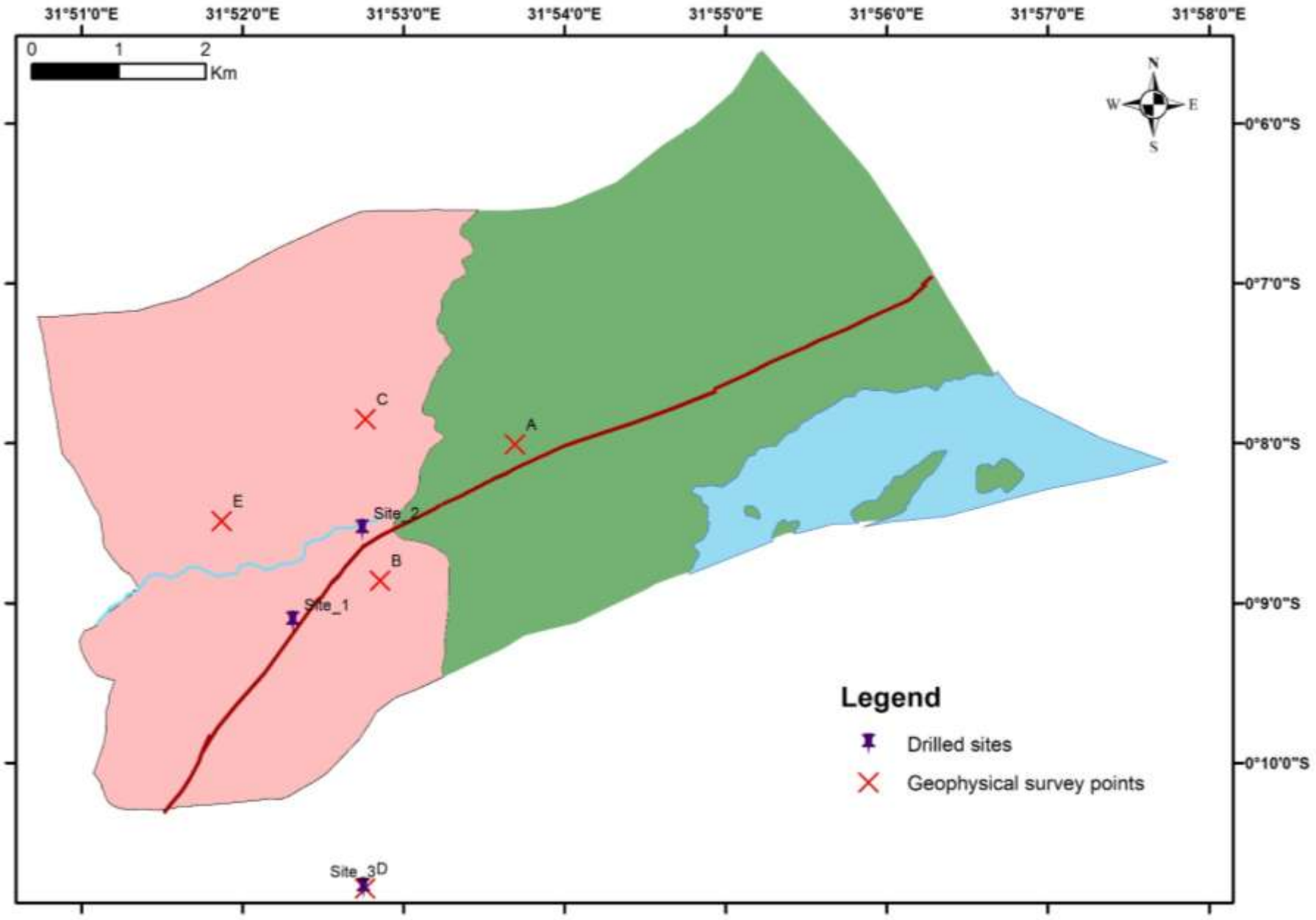

Electrical resistivity surveys


water sources and sanitation facilities mapping.


Drilling and logging

Water quality sampling

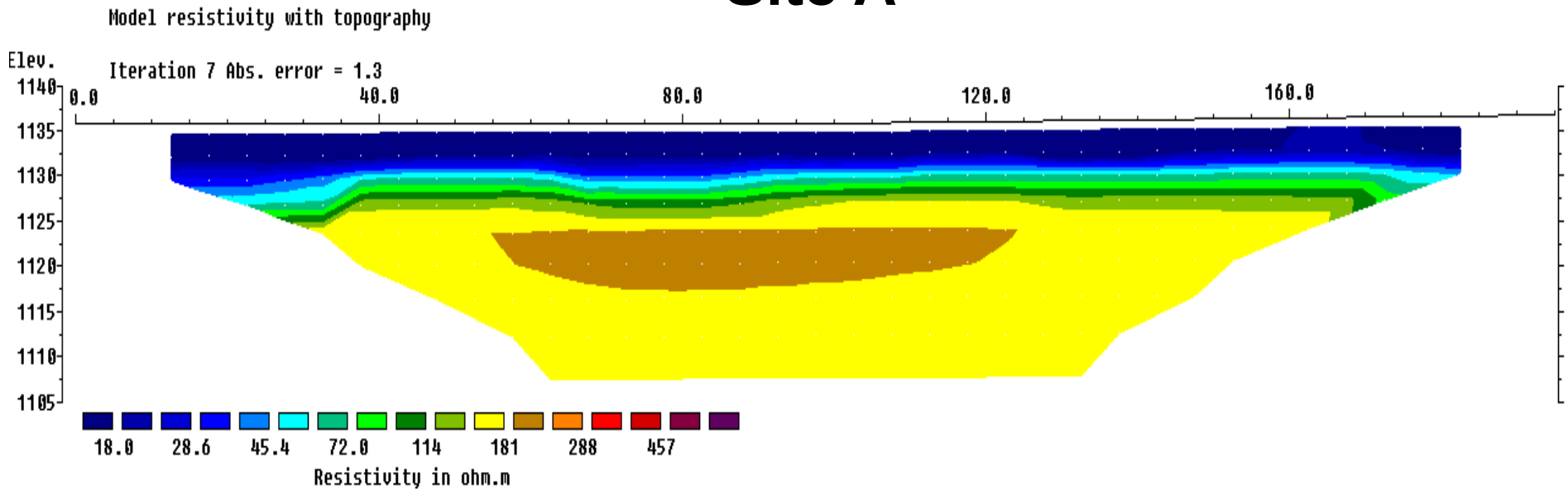
Lessons learnt

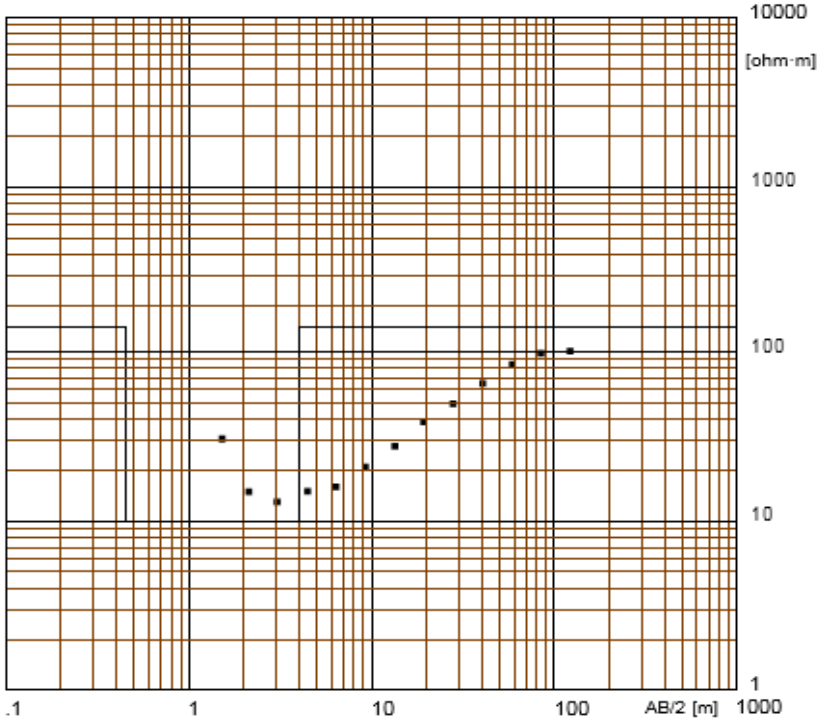


Electrical Resistivity Tomography (ERT)

Vertical Electrical Sounding (VES)

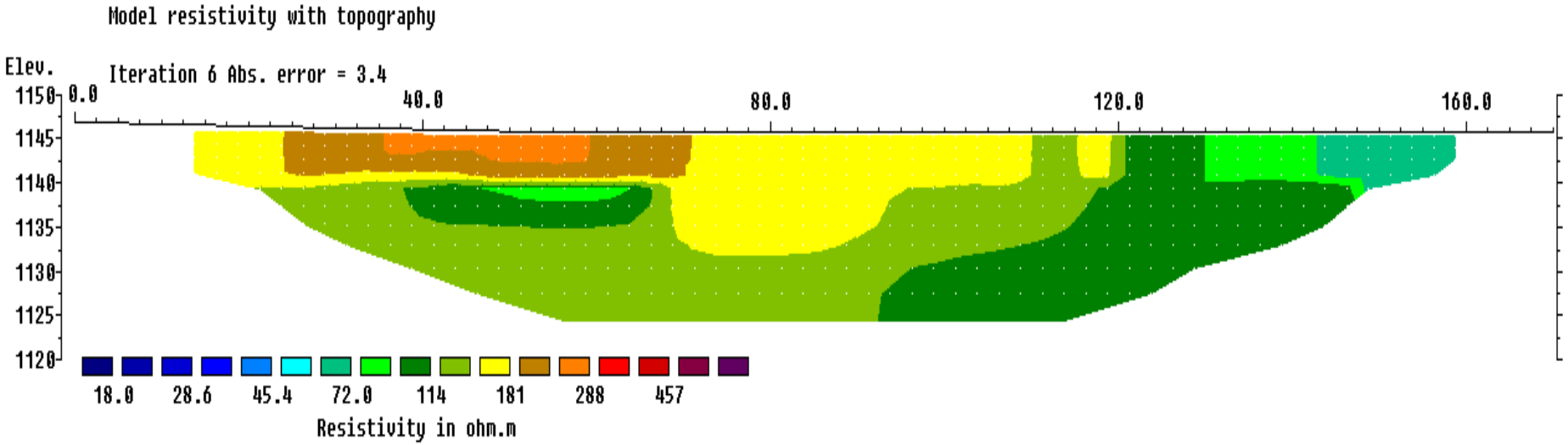
Site A



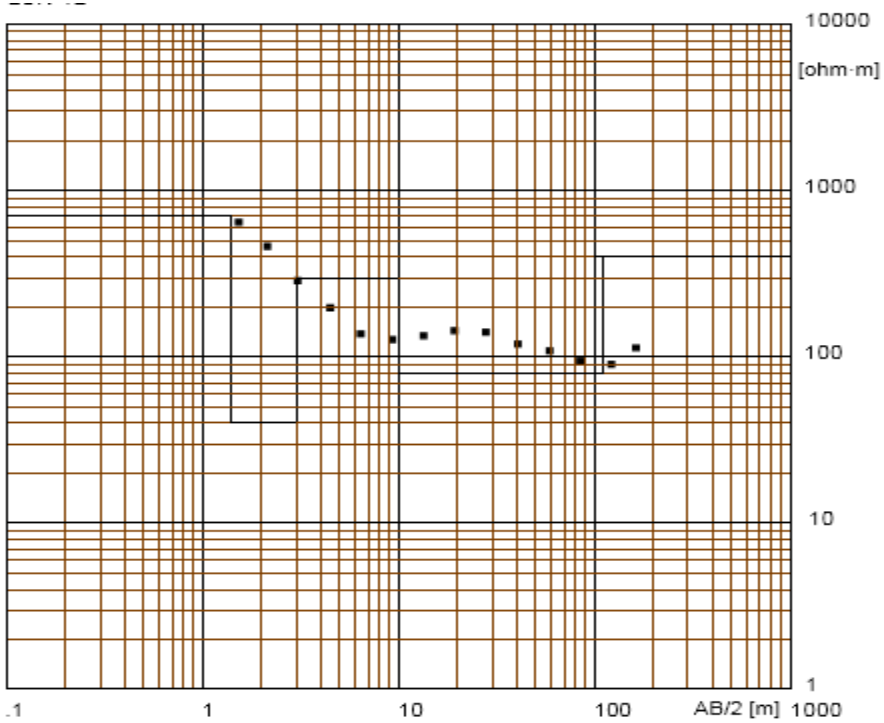


- Horizontal stratification
- Low surficial resistivity 0 to 1.5m probably clays
- 1.5 to 28m, probably saturated sediments
- drop in resistivity at deeper than 30m suggest change in Lithology

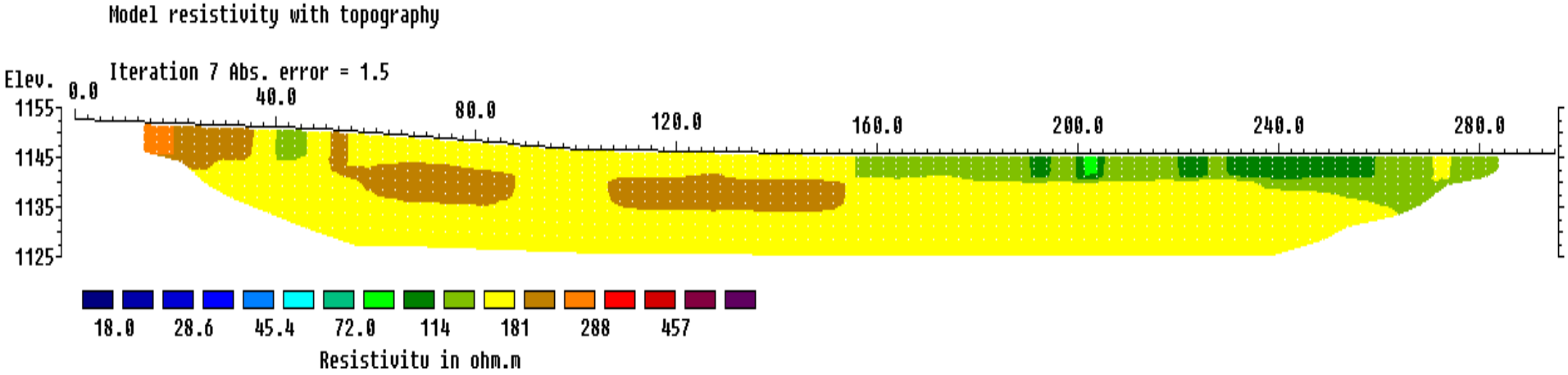
Site B



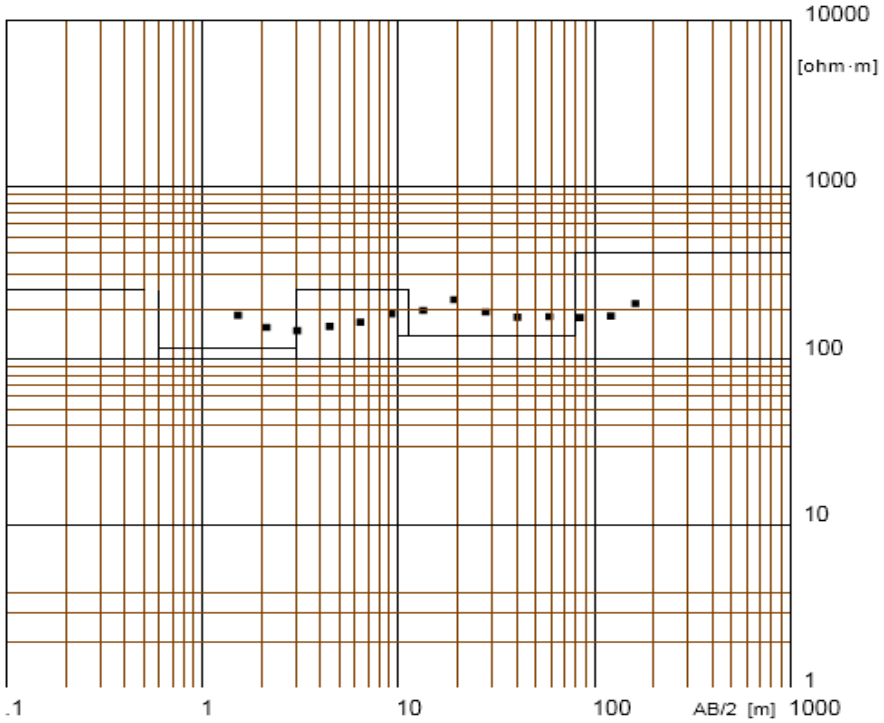
- Highly resistive surface up to 3.2m probably alluvium sediments
- 3.2m to 12m likely saturated coarse sediments
- >12m varying resistivity likely saturated sediments to basement complex?



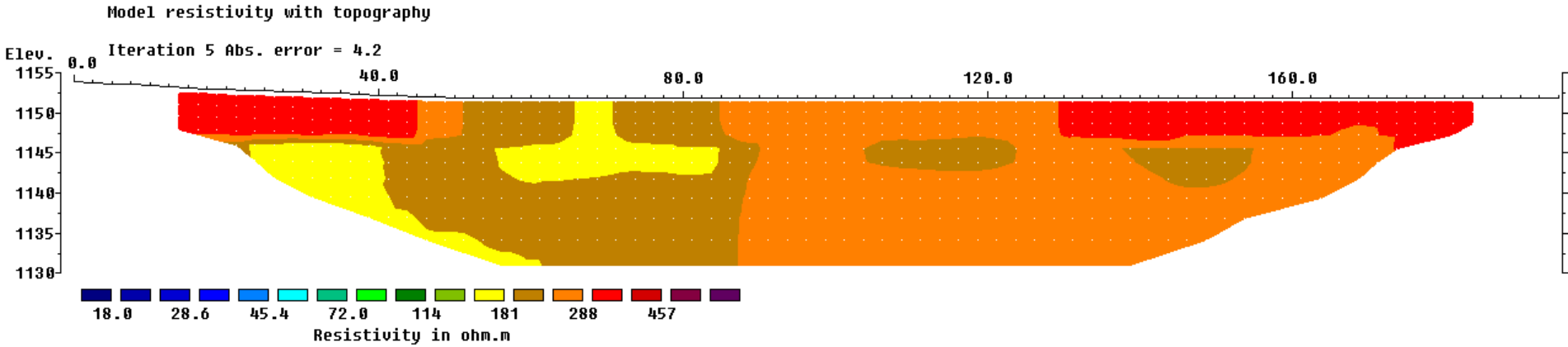
Site C



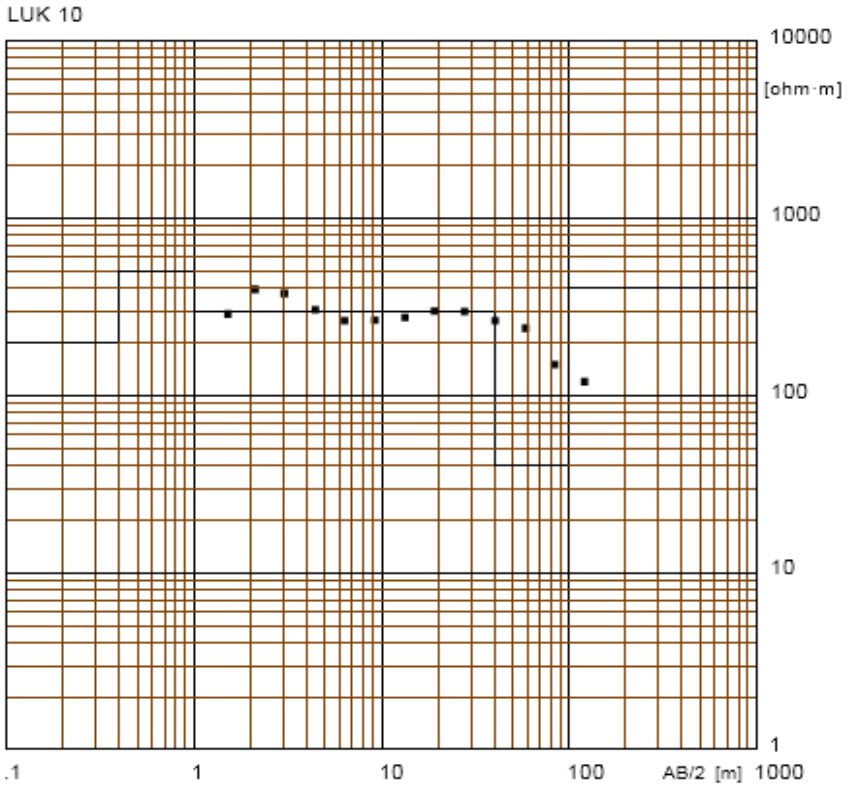
- high resistive formations (likely saturated clayey) on the left and low on the right
- VES shows alternating layers likely sediments



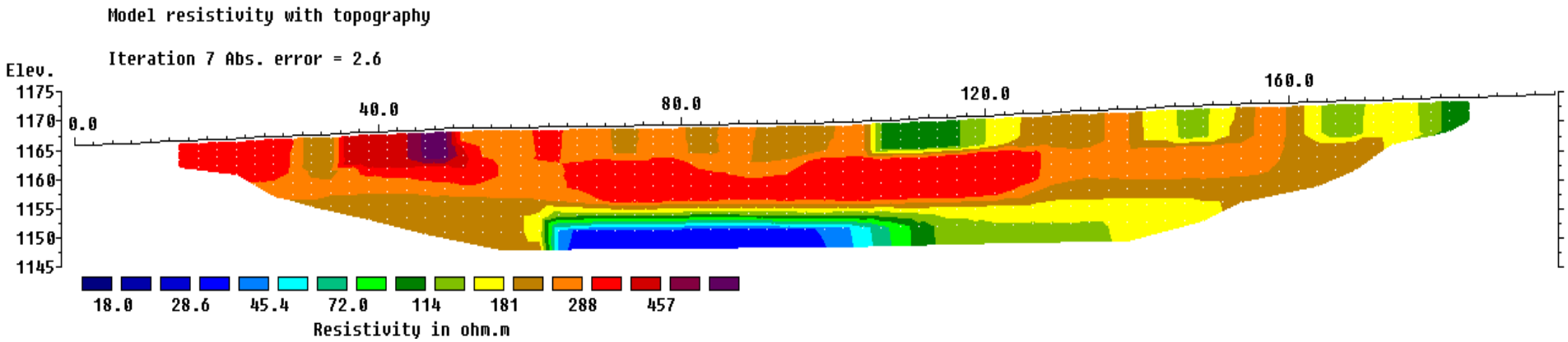
Site D



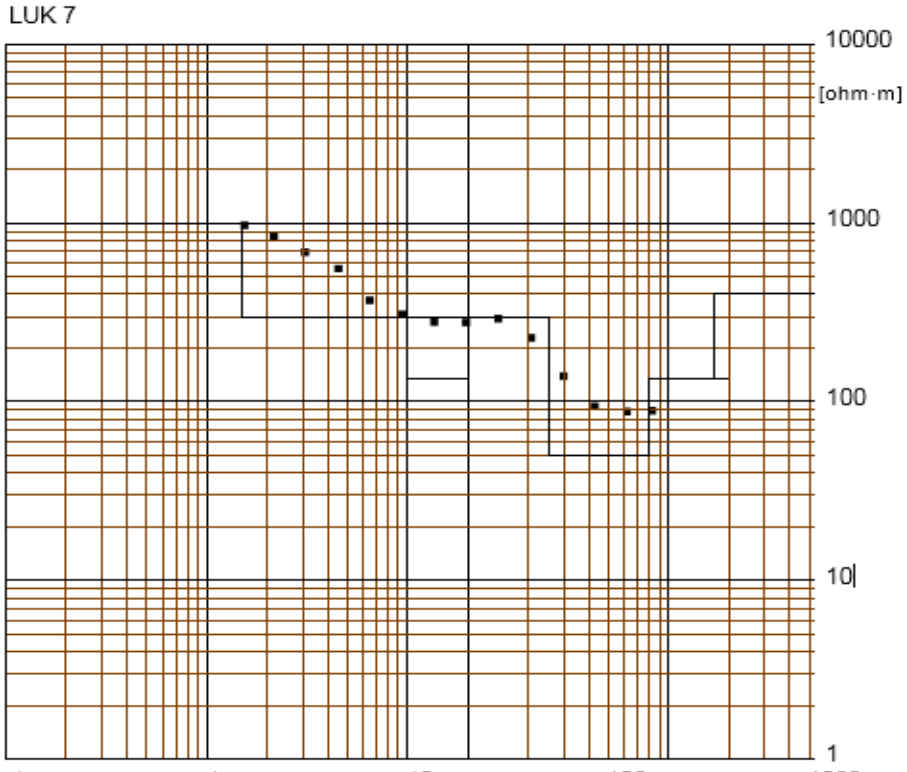
- Heterogeneous formations;
- Highly resistive near surface 0 to 1m;
- Variable medium relativity down the profile

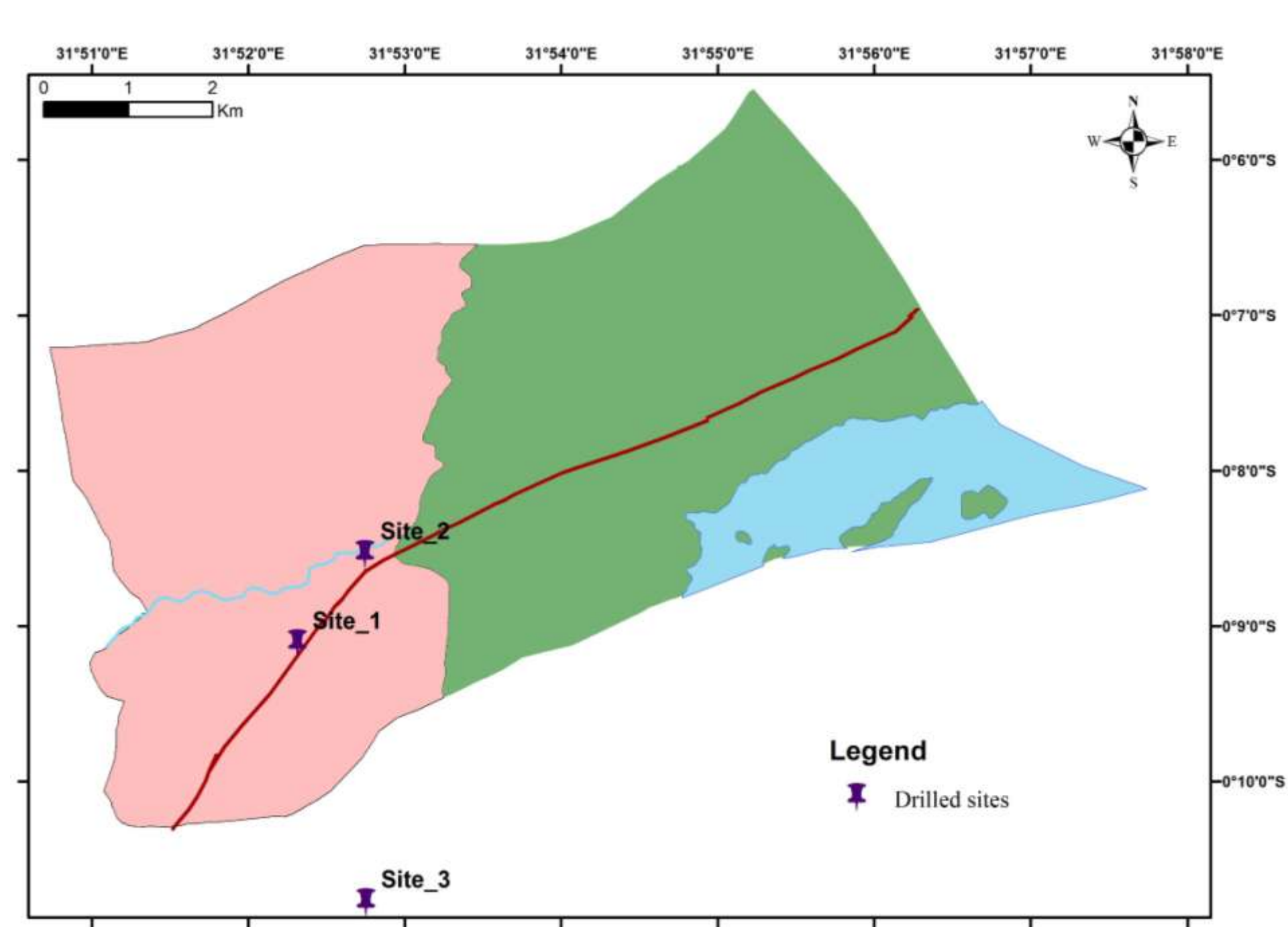


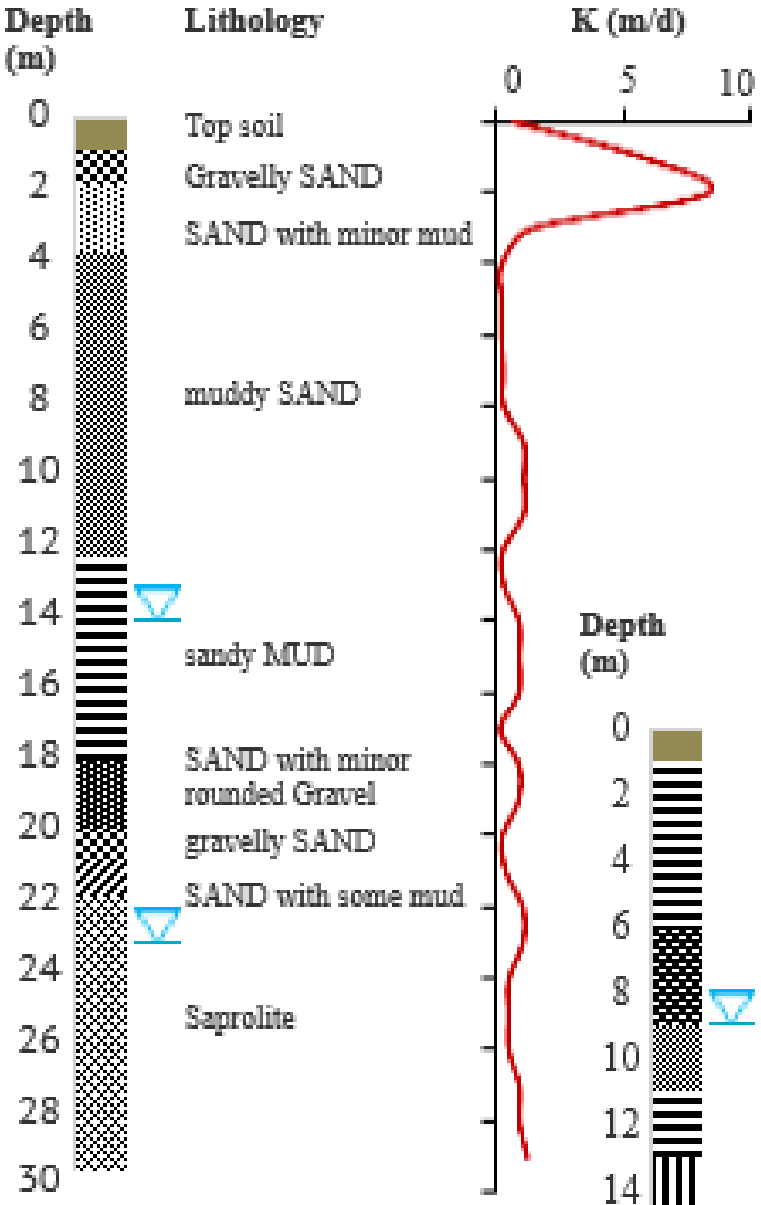
Site E



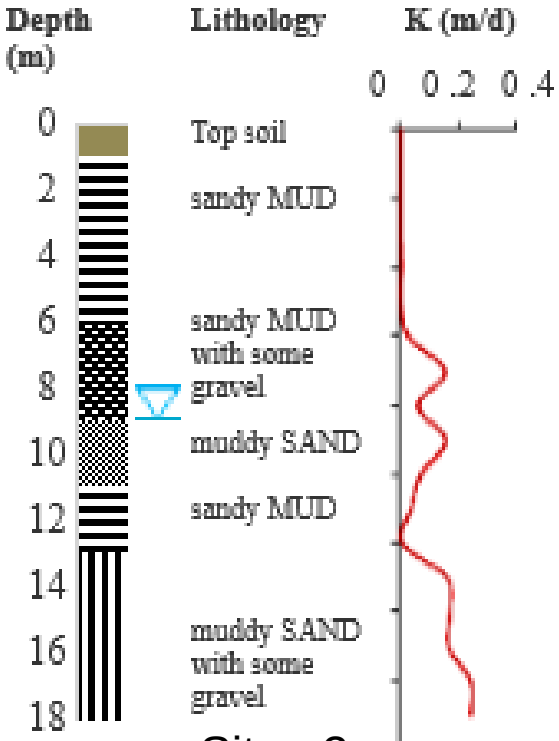
- Heterogeneous formations;
- Very highly resistive near surface 0- 4m.
- Relatively medium resistivity (4 - 8m
- Low resistivity at lower depth (saturated zone)



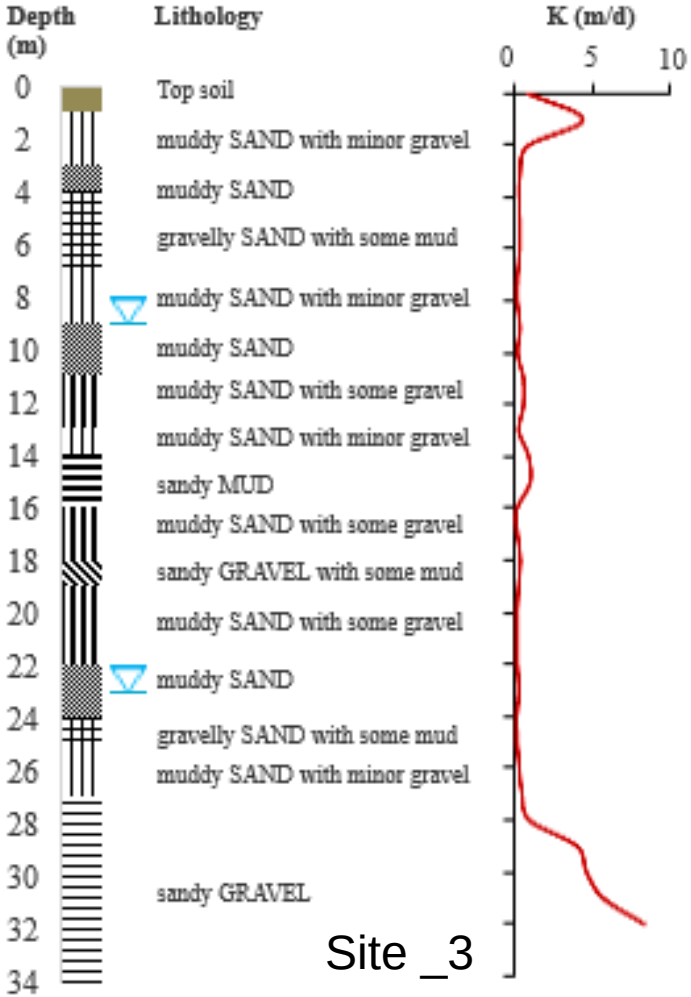

31°51'0"E
31°52'0"E
31°53'0"E
31°54'0"E
31°55'0"E
31°56'0"E
31°57'0"E
31°58'0"E
0°6'0"S
0°7'0"S
0°8'0"S
0°9'0"S
0°10'0"S
0
1
2
Km
N
W
E
S
Site_2
Site_1
Site_3
Legend
Drilled sites



Site_1

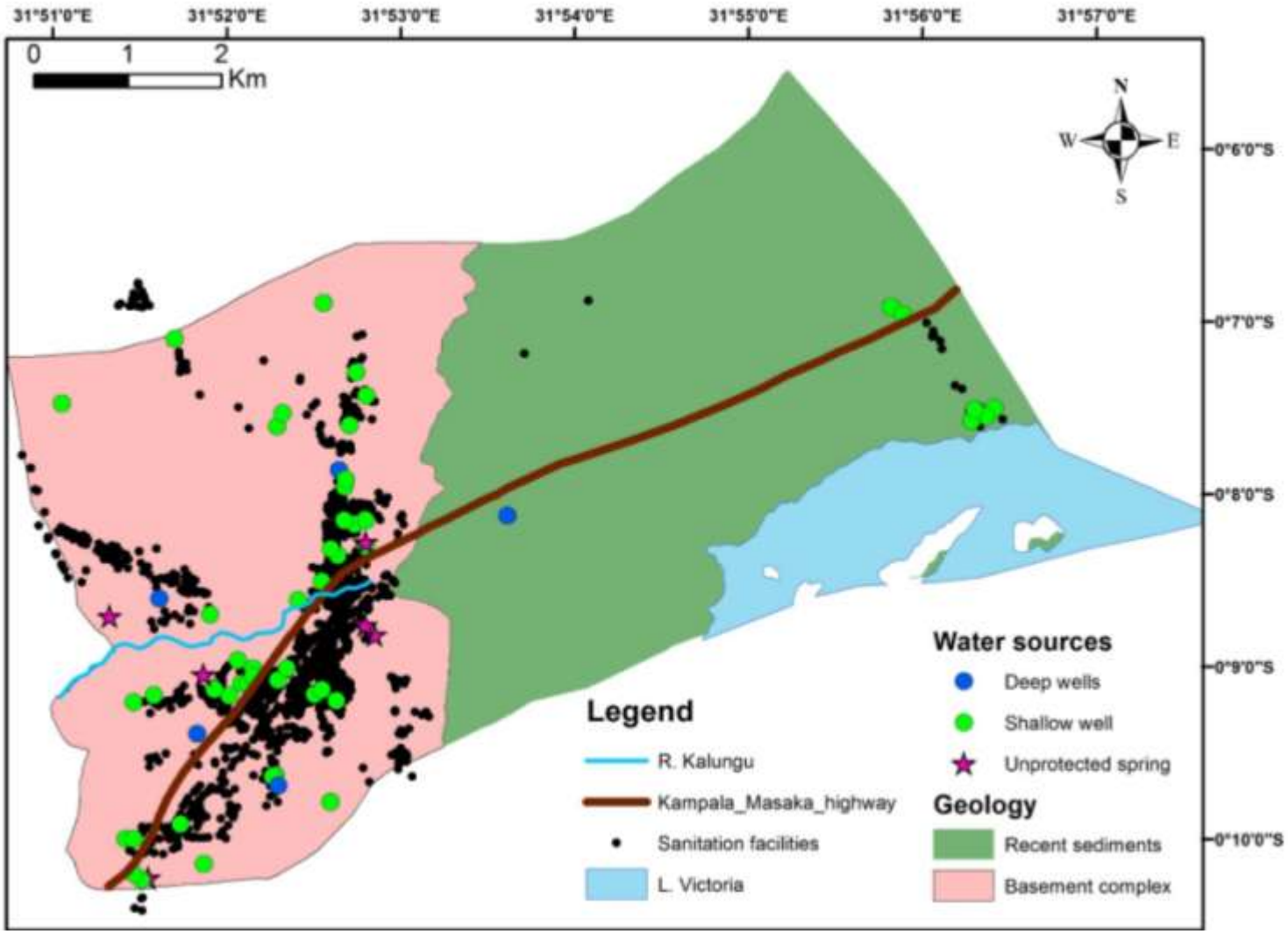


Site _2

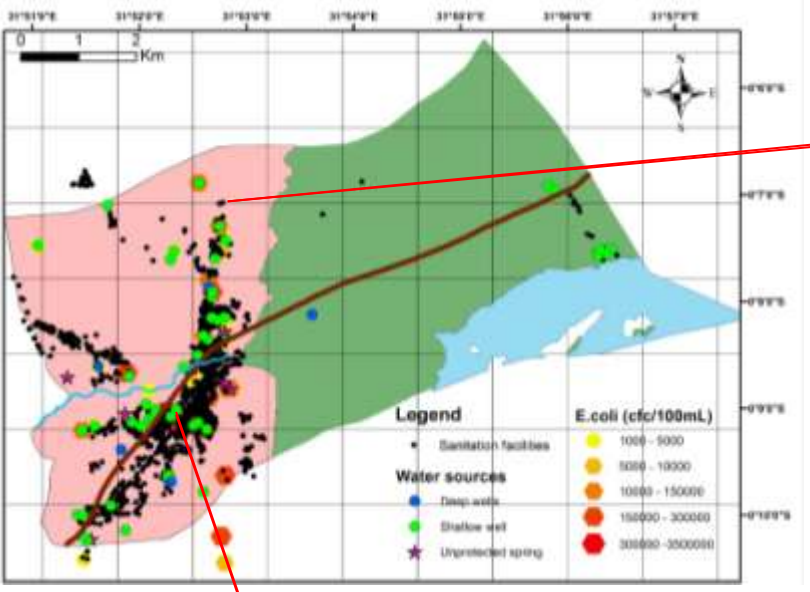


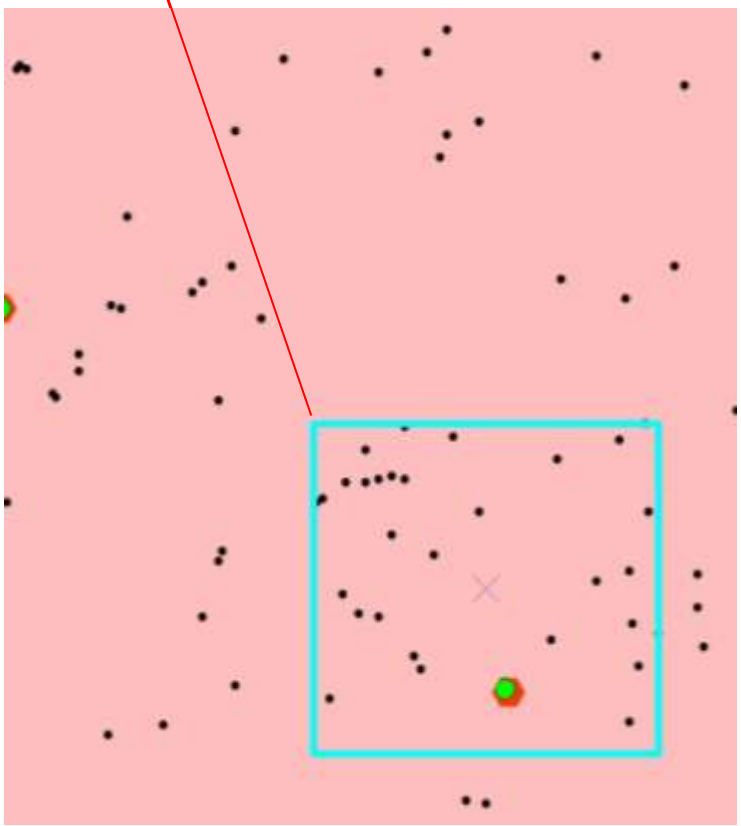
Site _3

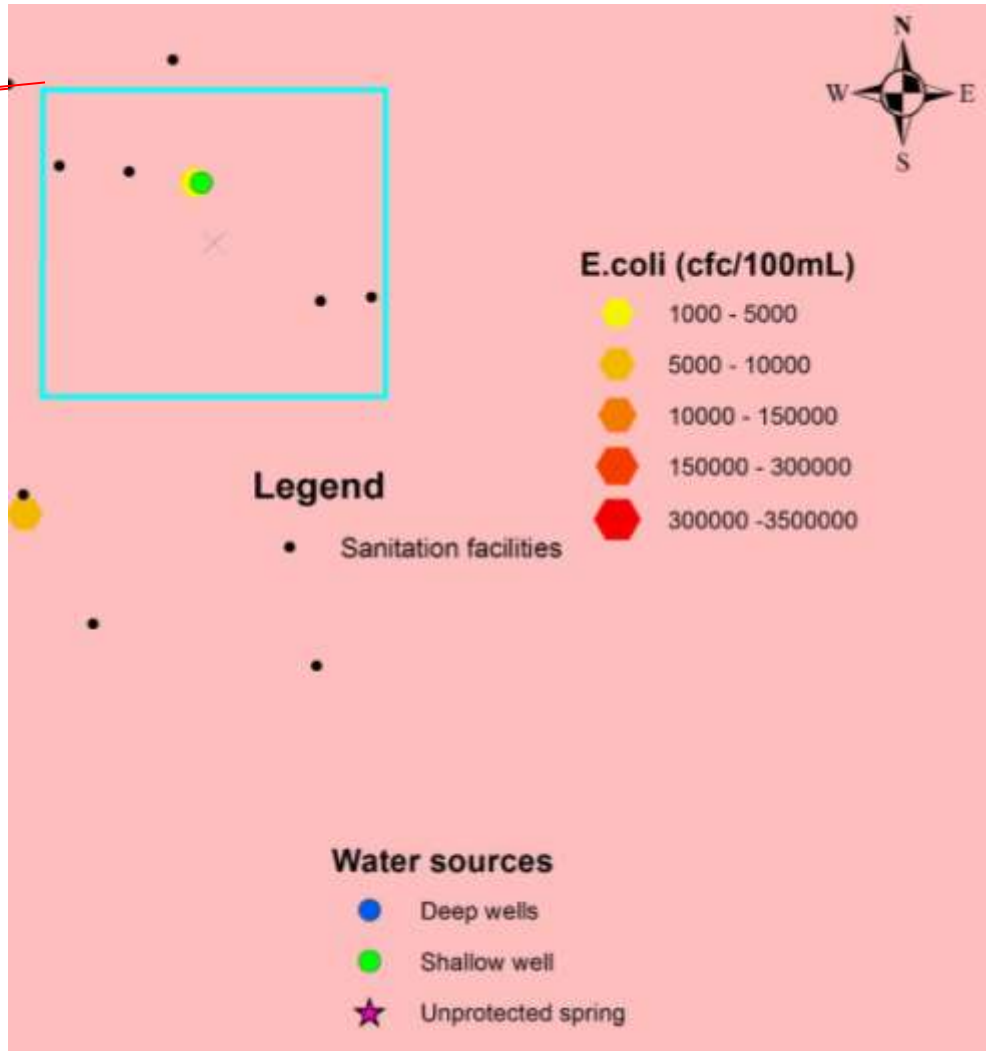
- Upper layers highly conductive



- ~80% shallow wells and unprotected springs,
- water table ~ 0.5-5mbgl
- ~64% unimproved pit latrine.







- >25 latrines/hectare, (TC) counts > 10^5 cfu/100mL (10^3 cfu/100mL)
- <5 per hectare, (TCs <10^3 cfu/100 mL)

Source ID	Type	T (°C)	pH	EC (µS/cm)	Turbidity (NTU)	NO3 (mg/L)	*E. coli (cfu/100mL)*	TTC Risk (WHO, 1997)	JMP (2019) type	Facility	JMP (2019) service level
ALW-1	SW	24.6	4.63	166	24	21.4	33 x 10^3	Intermediate	Improved		Basic
ALW-4	SW	24.6	4.88	163	3	19.7	92 x 10^3	Intermediate	Improved		Basic
ALW-7	SW	24.3	5.24	92	1	10.5	11.5 x10^3	Very High	Improved		Basic
ALW-8	SW	24.7	6.5	1402	29	270	3.3 x 10^3	High	Improved		Limited
ALW-9	SW	25.4	5.9	771	28	350	2.8 x 10^3	Very High	Improved		Basic
ALW-10	SW	25.2	4.79	77	2	6.9	0	High	Improved		Basic
ALW-11	SW	24.4	5.03	170	2	24	0	High	Improved		Basic
ALW-12	SW	24.3	5.07	91	0	ND	9.5 x 10^3	High	Improved		Basic
ALW-14	SW	24.4	5.2	78	18	4	9.5 x 10^3	Very High	Improved		Limited
ALW-15	SW	23.9	5.88	76	25	29	1 x 10^3	Very High	Improved		Basic
ALW-16	SW	25.1	4.74	150	0	29	0	Intermediate	Improved		Limited
ALW-13	SW	25.7	4.71	263	0	2	4.5 x 10^3	Intermediate	Improved		Basic
ALW-17	DW	23.2	4.99	58	28	1.4	0	Low	Improved		Limited
ALW-18	SW	24.9	5.17	143	0	6.8	23.5 x 10^3	Low	Improved		Basic
ALW-19	SW	25.1	5.39	238	0	0.3	0	High	Improved		Basic
ALW-20	SW	24.2	5.02	291	0	24.4	0	Very High	Improved		Basic
ALW-21	US	24.5	5.4	269	29	20	1.8 x 10^3	Very High	Unimproved		Unimproved
ALW-22	US	24.4	5.4	306	28	18	0.3 x 10^3	Very High	Unimproved		Unimproved
ALW-23	SW	24.6	5.39	274	7	ND	0	Extreme	Improved		Basic
ALW-24	SW	24	5.27	361	8	5.2	37 x 10^3	Extreme	Improved		Limited
ALW-25	US	24.5	4.88	282	9	26.2	14.5 x 10^3	Extreme	Unimproved		Unimproved
ALW-26	SW	25	4.94	67	0	6.4	0	Intermediate	Improved		Basic
ALW-27	SW	25	4.92	69	6	ND	5.5 x 103	Intermediate	Improved		Basic
ALW-28	SW	24.4	5.13	46	17	ND	4.5 x 10^3	Extreme	Improved		Basic
ALW-29	US	24.8	5.08	55	12	7.4	0	Very High	Unimproved		Unimproved
ALW-30	SW	25.57	4.81	56	18	ND	11.5 x 10^3	Extreme	Improved		Limited
ALW-31	SW	24.7	5.6	404	23	5.7	0	Very High	Improved		Basic
ALW-32	SW	25.5	5.46	126	9	ND	0	Extreme	Improved		Basic
ALW-33	SW	23.72	5.42	208	0	15	0	Low	Improved		Limited
ALW-34	SW	24.3	5.13	79	3	6.3	0	Intermediate	Improved		Limited
ALW-35	SW	23.8	6.13	209	15	6	2 x 10^3	Very Low	Improved		Limited
ALW-36	SW	24.4	4.97	79	0	5.7	0	Intermediate	Improved		Basic
ALW-37	SW	24.4	6.28	480	0	ND	25.5 x 10^3	Extreme	Improved		Basic
ALW-38	DW	24.5	5.35	154	12	6.6	1.2 x 10^3	High	Improved		Basic
ALW-39	SW	23.9	5.19	131	3	5.4	16.5 x 10^3	High	Improved		Limited
ALW-40	SW	24.7	5.12	177	1	3.3	0	Intermediate	Improved		Limited
ALW-41	SW	24.9	4.88	129	9	4.5	14 x 10^3	Very Low	Improved		Limited
WHO		**NS**	**NS**	**500**	**5**	**Low**	**50**	**Improved**	**Safely managed**		

Source: Nayebare et al., 2019

Conclusions

- Lukaya town depends primarily on the sub surface for on-site water supply and disposal of faecal matter
- Majority access shallow groundwater by means of hand-dug shallow wells
- Main form of sanitation facilities are on-site elevated pit latrine;
- Where sanitation facilities are> 25/hectare, shallow groundwater is grossly contaminated;
- 90% are improved water sources
- 67% provide basic service due to microbial contamination
- 57% had E.coli count of >10^3 cfc/100 mL)


Thank you for your attention!