GROUNDWATER POTENTIAL EVALUATION USING SIMPLE REGRESSION ANALYSIS AT GIDAN KWANO CAMPUS PHASE II, MINNA, NORTH CENTRAL NIGERIA

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Abstract
The statistical method of simple regression analysis (SRA) is employed here to test for subsurface resistivity prediction of vertical electrical sounding (VES) data collected at the Gidan Kwano Campus Phase II. Usually, the 100m station-spacing specification implies that each VES was carried through to the 100m depth-mark, entailing 21 individual sequences of measurements; this obviously implies longer survey time. It is instructive, then, to enquire if a process exists by which an empirical route based on just a few survey sequences can be developed such that the entire 21 individual sequences of measurements of the VES stage can be fairly predicted to a high degree of accuracy. The aim of this study is the building of a valid VES statistical prediction model for the planned Gidan Kwano Campus Development Phase II. This investigation was aided by the SRA statistical tool; the SRA method shows the relationship between an independent and a dependent variable, as well as providing a means for the derivation of an equation to predict the dependent variable based on the values of the independent variable. The result of this study shows that a two-fifth or 40%positive correlation for y and y^1 *of groundwater prospect locations down to 40m for the first cross-profile means that the simple regression analysis route for this first cross-profile cannot be used as a cost-cutting routine. Based on the results of subsequent cross-profiles, it is not recommended to adopt the SRA method as a cost-cutting routine whereby maximum depths of survey of intervening prospect locations should be limited to just 40m.*

Keywords: SRA; VES; groundwater; correlation

Introduction

Each dual VES-IP point of a **4km²** survey completed at the planned Gidan Kwano Campus Development Phase II was carried through to the 100m depth-mark, entailing 21 individual sequences of measurements. The 100m station-spacing specification of the 2km x 2km grid implies that each VES survey carried through to the 100m depth-mark, entailing 21 individual sequences of measurements for the VES phase; this obviously implies longer survey time and its concomitant increased costs. It is instructive, in this respect, to enquire if a process exists by which an empirical route based on just a few survey sequences can be developed such that the entire 21 individual sequences of measurements of the VES stage can be fairly predicted to a high degree of accuracy thus saving expenses and time out there in the field; this investigation would be aided by the simple regression analysis statistical tool.

The aim of this study is the building of a valid VES statistical prediction model for the planned Gidan Kwano Campus Development Phase II, Federal University of Technology, Minna. The objective of this study is the following: the use of the simple regression analysis tool of statistics*to test for the correlation at the various depths of investigation between half-current spacing and resistivity for the geoelectrical data collected from several VES points coincident with the locations of groundwater prospects.*

The method of simple regression analysis shows the relationship between an independent and a dependent variable, as well as providing a means for the derivation of an equation to predict the dependent variable based on the values of the independent variable (Morenikeji, 2006). The regression equation is expressed as

$$y^1 = a + bx \qquad 1$$

In Eq.1, y^1 is the predicted value of the dependent variable for any particular value of x, the independent variable. Before Eq.1 can be used the values of a and b (constants) have to be determined from the data-set under analysis. Generally,

$$a = \bar{y} - b\bar{x} \qquad 2$$

and

$$b = \frac{n(\Sigma xy) - (\Sigma x)(\Sigma y)}{n(\Sigma x^2) - (\Sigma x)^2} \qquad 3$$

In Eq.2, $\bar{y}$ is the mean of the sum of the different values of y, while $\bar{x}$ is the mean of the sum of the different values of x. Usually, a table of values is produced so that the values of Σx, Σy, Σxy, Σx^2, and $(\Sigma x)^2$, as seen from Eq.3, can easily be computed. It is instructive to point out that in Eq.3, n is the total number of distinct values of the dependent or independent variable.

Jonah *et al.* (2009) have argued for the need to employ a predictive statistical technique to vertical electrical sounding (VES) surveys. The authors employed the method of simple regression analysisto test for the correlation at the various depths of investigation between half the current electrode spacing (i.e. AB/2) and resistivity for the geoelectrical data collected from six VES points (i.e. $A_1 – A_6$) along a profile at the Gidan Kwano Campus. The authors reported that the VES dataset had been interpreted in the usual manner to obtain information about number of layers, their thicknesses, and depths to basement along the profiles on which soundings were carried out. They pointed out that having applied the method of regression analysis to (i) maximum AB/2 = 100m, (ii) maximum AB/2 = 40m, it was found that the values of the standard error of estimates were within tolerable limits for VES points A_1, A_2, A_3, and A_4 (i.e. about 67% correlation). Thus the authors recommended thatbetween VES points A_1 and A_6, intermediate VES points (say 50m spacing) could be sounded with savings in time and cost. Now, instead of fourteen sounding sequences that are concerned with depth to basement, just the first six sequences could be sounded and the remaining dataset can be extrapolated to AB/2 = 40m (representing average depth to basement in the study area).

With respect to published and unpublished geoelectrical studies that have been carried out at the local Basement Complex of which the location of this study is a part, the following works are cited: Jonah *et al.* (2013); Jonah *et al.* (2014A); Jonah *et al.* (2014B); Jonah *et al.* (2014C); Jonah *et al.* (2015A); Jonah *et al.* (2015B); Jonah *et al.* (2015C); Jonah *et al.* (2015D); Jonah and Olasehinde, (2015E); Jonah *et al.* (2015F); Jonah and Olasehinde (2016A); Jonah and Olasehinde (2016B); Jonah (2016D); Jonah and Jimoh (2016E); Jonah (2016G); Jonah (2016H); Jonah *et al.* (2016I); Jonah and Olasehinde, (2017A); Jonah and Adamu (2017B).

The VES Data Baseline for Simple Regression Analysis

There arefive definite prospects along the first cross-profile, two along the second cross-profile, four along the third cross-profile, three along the fourth cross-profile, and two along the fifth cross-profile. These prospect locations with their appropriate co-ordinates are the following:

P2-1 ($09^0$30'57.80''; $006^0$25'42.24'')
P3-1 ($09^0$30'57.80''; $006^0$25'45.48'')
P4-1 ($09^0$30'57.80''; $006^0$25'48.72'')
P8-1 ($09^0$30'57.80''; $006^0$26'01.68'')
P9-1 ($09^0$30'57.80''; $006^0$26'04.92'')
P5-2 ($09^0$31'01.04''; $006^0$25'51.96'')
P6-2 ($09^0$31'01.04''; $006^0$25'55.20'')
P3-3 ($09^0$31'04.28''; $006^0$25'45.48'')
P6-3 ($09^0$31'04.28''; $006^0$25'55.20'')
P9-3 ($09^0$31'04.28''; $006^0$26'04.92'')
P15-3 ($09^0$31'04.28''; $006^0$26'24.36'')
P15-4 ($09^0$31'07.52''; $006^0$26'24.36'')
P20-4 ($09^0$31'07.52''; $006^0$26'40.56'')
P21-4 ($09^0$31'07.52''; $006^0$26'43.80'')
P1-5 ($09^0$31'10.76''; $006^0$25'39.00'')
P4-5 ($09^0$31'10.76''; $006^0$25'48.72'')

Tables of values for resistivities for these groundwater prospect locations are the VES data baseline for simple regression analysis and these are shown as Tables 1 and 2.

Table 1. VES results for P2-1, P3-1, P4-1, P8-1, P9-1, P5-2, P6-2, and P3-3

AB/2 (m)	Resistivity of P2-1 in Ωm	Resistivity of P3-1 in Ωm	Resistivity of P4-1 in Ωm	Resistivity of P8-1 in Ωm	Resistivity of P9-1 in Ωm	Resistivity of P5-2 in Ωm	Resistivity of P6-2 in Ωm	Resistivity of P3-3 in Ωm
1	126.14	66.075	158.07	7.927	148.033	66.632	82.808	148.73
2	52.899	32.304	89.868	6.108	355.298	25.984	33.673	110.31
3	52.964	25.578	66.783	6.583	563.450	22.136	24.950	95.106
5	82.320	19.795	45.578	4.153	720.428	28.029	31.572	71.099
6	97.826	21.756	42.610	8.335	296.464	30.690	31.028	57.476
6	98.774	19.030	44.427	8.912	215.93	26.849	27.249	56.205
8	134.21	25.264	58.320	10.554	274.725	35.922	36.224	43.216
10	170.78	32.254	40.439	11.408	365.664	45.090	38.334	40.643
10	177.91	23.191	41.465	14.654	310.167	45.559	37.297	42.464
15	257.72	37.820	54.702	36.312	343.322	72.351	57.410	60.223
20	307.08	49.962	74.477	33.849	264.355	95.275	71.390	79.622
30	481.44	84.013	112.67	52.961	204.815	142.80	132.29	119.69
40	502.57	116.39	152.98	48.398	160.801	182.29	172.39	155.39
40	470.61	163.09	141.10	48.343	153.092	67.652	167.04	55.827
50	546.88	200.90	176.43	45.041	139.126	198.42	206.01	66.739
60	520.13	215.21	192.37	61.806	135.400	225.37	245.26	83.297
70	563.52	217.18	268.78	65.031	162.068	252.08	283.97	99.072
80	STREAM BARRIER	224.78	317.29	41.773	146.376	282.11	301.66	112.82
80	STREAM BARRIER	224.37	299.89	70.885	144.863	266.06	197.42	107.30
90	STREAM BARRIER	240.90	345.65	73.049	206.118	292.20	217.74	117.63
100	STREAM BARRIER	255.59	403.45	47.639	241.254	315.86	301.92	135.77

Table 2. VES results for P6-3, P9-3, P15-3, P15-4, P20-4, P21-4, P1-5, and P4-5

AB/2 (m)	Resistivity of P6-3 in Ωm	Resistivity of P 9-3 in Ωm	Resistivity of P 15-3 in Ωm	Resistivity of P15-4 in Ωm	Resistivity of P20-4 in Ωm	Resistivity of P21-4 in Ωm	Resistivity of P1-5 in Ωm	Resistivity of P4-5 in Ωm
1	65.870	8.6411	76.521	668.89	70.398	122.67	39.362	126.53
2	38.129	24.370	46.772	190.62	39.599	88.628	28.584	22.880
3	30.975	25.918	80.770	87.050	32.001	104.68	29.912	20.243
5	25.890	32.166	77.808	98.806	43.857	132.66	48.767	7.4895
6	27.941	35.348	74.879	109.99	51.985	169.55	59.291	23.478
6	25.493	35.438	88.776	99.743	57.090	217.32	61.270	10.607
8	31.235	41.709	111.42	134.46	73.535	267.99	79.648	20.471
10	39.028	50.536	109.79	155.52	91.487	294.37	103.30	26.933
10	37.495	55.960	149.84	193.58	92.555	295.75	82.406	22.559
15	55.044	82.220	186.77	261.81	140.23	327.17	148.38	31.324
20	71.547	110.50	254.70	233.94	88.350	344.47	234.23	47.594
30	104.05	160.15	340.82	289.71	90.212	384.45	361.95	76.319
40	338.88	199.26	415.01	323.43	139.19	459.99	358.83	130.58
40	140.09	199.75	490.09	346.26	74.406	428.29	419.80	93.654
50	173.48	187.97	590.64	398.54	78.904	494.22	491.49	142.45
60	208.86	162.99	676.71	458.68	114.39	612.63	456.06	110.68
70	238.88	177.96	781.04	439.14	154.28	686.67	426.41	146.99
80	267.65	189.64	891.13	ERROR 1	119.92	719.12	454.23	150.46
80	82.991	189.43	718.36	ERROR 1	557.56	764.11	496.26	134.68
90	136.90	220.75	808.92	ERROR 1	610.48	784.47	513.15	143.01
100	128.28	253.64	903.53	ERROR 1	622.64	862.78	521.62	134.28

Simple Regression Analysis of the VES Data-Field of P2-1, P3-1, P4-1, P8-1, P9-1, P5-2, P6-2, P3-3, P6-3, P9-3, P15-3, P15-4, P20-4, P21-4, P1-5, P4-5:

The Analytical Procedure. It is important, at the outset, to consult Tables 1 and2 that details the values of the acquired dependent variable (that is, resistivities) for particular values of the independent variables (that is, AB/2, the current-electrode spacing). Thus, a comprehensive table of values for x and y should be drawn up; generally, as it is now obvious, x corresponds to AB/2 and y corresponds to the appropriate column of resistivities for each of Tables 1 and2.

Standard Error of Estimate (A_1). The standard error in the estimation of the predicted value, y^1, is evaluated from the expression

$$Syx = \frac{\sqrt{\Sigma\left(y - y^1\right)^2}}{n-2}$$

As a result of the considerations presented in the preceding section, Table 3 is now produced for P2-1 showing all the computational variables that lead to evaluation of y^1 and subsequently, how the standard error of estimate may be computed.Having completed this step for P2-1, this process was completed for P3-1, P4-1, P8-1, P9-1, P5-2, P6-2, P3-3, P6-3, P9-3, P15-3, P15-4, P20-4, P21-4, P1-5 and P4-5; the summary tables showing the corresponding values of y^1 are as shown in Tables 4 and 5.

Table 3. Simple regression analysis table of values for P2-1

x	y	x^2	y^2	xy	$y-\bar{y}$	$(\bar{y}-y)^2$	y^1	$y-y^1$	$(y-y^1)^2$
1.00	126.14	1.000	15911.300	126.140	-94.992	9023.489	209.824	-83.684	7003.093
2.00	52.90	4.000	2798.304	105.798	-168.233	28302.358	210.161	-157.262	24731.433
3.00	52.96	9.000	2805.185	158.892	-168.168	28280.492	210.498	-157.534	24817.000
5.00	82.32	25.000	6776.582	411.600	-138.812	19268.785	211.172	-128.852	16602.777
6.00	97.83	36.000	9569.926	586.956	-123.306	15204.381	211.509	-113.683	12923.730
6.00	98.77	36.000	9756.303	592.644	-122.358	14971.492	211.509	-112.735	12709.086
8.00	134.21	64.000	18012.324	1073.680	-86.922	7555.442	212.182	-77.972	6079.667
10.00	170.78	100.000	29165.808	1707.800	-50.352	2535.329	212.856	-42.076	1770.378
10.00	177.91	100.000	31651.968	1779.100	-43.222	1868.145	212.856	-34.946	1221.213
15.00	257.72	225.000	66419.598	3865.800	36.588	1338.678	214.540	43.180	1864.516
20.00	307.08	400.000	94298.126	6141.600	85.948	7387.051	216.224	90.856	8254.802
30.00	481.44	900.000	231784.474	14443.200	260.308	67760.230	219.592	261.848	68564.243
40.00	502.57	1600.000	252576.605	20102.800	281.438	79207.321	222.960	279.610	78181.501
40.00	470.61	1600.000	221473.772	18824.400	249.478	62239.249	222.960	247.650	61330.300
50.00	546.88	2500.000	299077.734	27344.000	325.748	106111.728	226.329	320.551	102753.172
60.00	520.13	3600.000	270535.217	31207.800	298.998	89399.776	229.697	290.433	84351.420
70.00	563.52	4900.000	317554.790	39446.400	342.388	117229.510	233.065	330.455	109200.483
80.00	0.00	6400.000	0.000	0.000	-221.132	48899.382	236.433	-236.433	55900.673
80.00	0.00	6400.000	0.000	0.000	-221.132	48899.382	236.433	-236.433	55900.673
90.00	0.00	8100.000	0.000	0.000	-221.132	48899.382	239.801	-239.801	57504.724
100.00	0.00	10000.000	0.000	0.000	-221.132	48899.382	243.170	-243.170	59131.465

Table 4. Simple regression analysis summary table of y^1 forP3-1, P4-1, P8-1, P9-1, P5-2, P6-2, P3-3, and P6-3

x	y^1:3-1	y^1:4-1	y^1:8-1	y^1:9-1	y^1:5-2	y^1:6-2	y^1:3-3	y^1:6-3
1.00	19.560	38.683	12.473	79.438	25.334	31.948	72.895	44.789
2.00	22.233	41.967	13.100	84.947	28.436	34.823	73.36	43.011
3.00	24.906	45.251	13.726	90.455	31.539	37.697	73.825	41.233
5.00	30.253	51.818	14.980	101.472	37.744	43.447	74.755	37.677
6.00	32.926	55.102	15.606	106.981	40.847	46.322	75.22	35.899
6.00	32.926	55.102	15.606	106.981	40.847	46.322	75.22	35.899
8.00	38.273	61.669	16.860	117.998	47.052	52.071	76.15	32.343
10.00	43.620	68.237	18.113	129.015	53.257	57.821	77.08	28.787
10.00	43.620	68.237	18.113	129.015	53.257	57.821	77.08	28.787
15.00	56.986	84.655	21.246	156.558	68.771	72.195	79.405	19.897
20.00	70.353	101.073	24.379	184.101	84.284	86.569	81.73	11.007
30.00	97.086	133.910	30.646	239.187	115.310	115.317	86.38	-6.773
40.00	123.820	166.747	36.912	294.273	146.336	144.065	91.03	-24.553
40.00	123.820	166.747	36.912	294.273	146.336	144.065	91.03	-24.553
50.00	150.553	199.584	43.179	349.358	177.362	172.813	95.68	-42.333
60.00	177.286	232.421	49.445	404.444	208.389	201.561	100.33	-60.113
70.00	204.019	265.258	55.712	459.530	239.415	230.309	104.98	-77.893
80.00	230.753	298.095	61.978	514.616	270.441	259.057	109.63	-95.673
80.00	230.753	298.095	61.978	514.616	270.441	259.057	109.63	-95.673
90.00	257.486	330.931	68.244	569.702	301.467	287.804	114.28	-113.453
100.00	284.219	363.768	74.511	624.787	332.493	316.552	118.93	-131.233

Table 5. Simple regression analysis summary table of y^1 forP9-3, P15-3, P15-4, P20-4, P21-4, P1-5 and P4-5

x	y^1:9-3	y^1:15-3	y^1:15-4	y^1:20-4	y^1:21-4	y^1:1-5	y^1:4-5
1.00	36.789	43.480	132.191	11.876	163.104	71.563	29.991
2.00	34.551	34.161	136.121	16.264	170.390	77.112	31.400
3.00	32.313	24.842	140.051	20.653	177.676	82.662	32.809
5.00	27.837	6.204	147.911	29.429	192.248	93.760	35.627
6.00	25.599	-3.115	151.841	33.817	199.534	99.309	37.037
6.00	25.599	-3.115	151.841	33.817	199.534	99.309	37.037
8.00	21.123	-21.753	159.701	42.594	214.106	110.407	39.855
10.00	16.647	-40.391	167.561	51.371	228.678	121.505	42.673
10.00	16.647	-40.391	167.561	51.371	228.678	121.505	42.673
15.00	5.457	-86.986	187.211	73.312	265.108	149.250	49.718
20.00	-5.733	-133.581	206.861	95.254	301.538	176.996	56.764

30.00	-28.113	-226.771	246.161	139.137	374.398	232.486	70.854
40.00	-50.493	-319.961	285.461	183.020	447.258	287.977	84.945
40.00	-50.493	-319.961	285.461	183.020	447.258	287.977	84.945
50.00	-72.873	-413.151	324.761	226.903	520.118	343.467	99.036
60.00	-95.253	-506.341	364.061	270.786	592.978	398.958	113.127
70.00	-117.633	-599.531	403.361	314.669	665.838	454.448	127.217
80.00	-140.013	-692.721	442.661	358.552	738.698	509.939	141.308
80.00	-140.013	-692.721	442.661	358.552	738.698	509.939	141.308
90.00	-162.393	-785.911	481.961	402.435	811.558	565.429	155.399
100.00	-184.773	-879.101	521.261	446.318	884.418	620.920	169.490

Tables of Correlations for P2-1, P3-1, P4-1, P8-1, P9-1, P5-2, P6-2,P3-3, P6-3, P9-3, P15-3,P15-4, P20-4, P21-4, P1-5 and P4-5. For each of these prospect locations, tables of correlations were generated for the 100m depth-mark and the 40m depth-mark; the rationale for the 100m depth-markwas to test for normal correlation because the original survey terminated at this depth. The choice of the 40m depth-mark herein is based on the pioneering effort of Jonah *et al.* (2009) in this regard; in that study, the overriding argument for doing simple regression analysis down to the 40m depth-mark was presented as follows: "the depth to basement along the profile of the study area is between 26.82m and 36.79m (with a mean value of 31.81m). Furthermore, the study area is just about centrally located in the middle of a large swath of land where information on lithology and depths to basement are readily available from six wells drilled as part of the Petroleum Trust Fund (PTF) – sponsored projects (Jimoh, 1998). In the drilling-for-water report of Jimoh (1998), the well around the School of Environmental Technology (S.E.T.) encountered the basement at about 31m.

The well around the Students' Centre (now Temporary Administration Complex) encountered the basement at 34m, while the well around the Students' Hostel indicated a depth of 37m to the basement. Furthermore, the wells drilled around the Staff Quarters, the planned Administration Complex, and Library Complex encountered the basement at depths of 37m, 34m, and 31m. Thus, it means that the six boreholes encountered the fresh basement at an average depth of 34m, which correlates strongly with the result of the Zohdy interpretation.Geological information from Jimoh (1998) indicates that a depth range of 31-34m is beyond the water-bearing zones characterised by weathered and fractured basement rocks. Thus, as the search for water goes, it is inappropriate to explore beyond 34m in the core area of study and in the outlying vicinity that could well stretch for over 2km x 2km. If this is the case, then the simple regression model could be tested for a maximum depth of AB/2 = 40m instead of the limit of AB/2 = 100m that was used in the analysis of…"

Suffice to point out that, several years removed from 2009, the statement concerning the conclusion "thus, as the search for water goes, it is inappropriate to explore beyond 34m in the core area of study and in the outlying vicinity that could well stretch for over 2km x 2km" may not be acceptable to all geoscientists working in the local basement complex. In fact, in Jonah *et al.* (2015A and 2015D), the survey crew explored down to the 200m depth-mark. Nonetheless, in fidelity to the work of Jonah *et al.* (2009), the 40m depth-mark is being tested herein as a limiting depth of penetration. The format of the correlation analyses for the 100m depth-mark and the 40m depth-mark for P2-1 is shown as Tables 6 and 7.

Table 6. Table of correlation for P2-1 down to the 100m depth-mark

AB/2	Acquired resistivity	Predicted resistivity	Difference	% Conformance	% Conformance Range	% Conformance Median
1.00	126.14	209.824	83.684	16.316	-230.455	
2.00	52.90	210.161	157.262	-57.262	-220.551	
3.00	52.96	210.498	157.534	-57.534	-190.433	
5.00	82.32	211.172	128.852	-28.852	-179.610	
6.00	97.83	211.509	113.683	-13.683	-161.848	
6.00	98.77	211.509	112.735	-12.735	-147.650	
8.00	134.21	212.182	77.972	22.028	-143.170	
10.00	170.78	212.856	42.076	57.924	-139.801	
10.00	177.91	212.856	34.946	65.054	-136.433	
15.00	257.72	214.540	43.180	56.820	-136.433	
20.00	307.08	216.224	90.856	9.144	-57.534	**-57.534**
30.00	481.44	219.592	261.848	-161.848	-57.262	
40.00	502.57	222.960	279.610	-179.610	-28.852	
40.00	470.61	222.960	247.650	-147.650	-13.683	
50.00	546.88	226.329	320.551	-220.551	-12.735	
60.00	520.13	229.697	290.433	-190.433	9.144	
70.00	563.52	233.065	330.455	-230.455	16.316	
80.00	0.00	236.433	236.433	-136.433	22.028	
80.00	0.00	236.433	236.433	-136.433	56.820	
90.00	0.00	239.801	239.801	-139.801	57.924	
100.00	0.00	243.170	243.170	-143.170	65.054	

Table 7. Table of correlation for P2-1 down to the 40m depth-mark

AB/2	Acquired resistivity	Predicted resistivity	Difference	% Conformance	% Conformance Range	% Conformance Median
1.00	126.14	209.824	83.684	16.316	-179.610	
2.00	52.90	210.161	157.262	-57.262	-161.848	
3.00	52.96	210.498	157.534	-57.534	-147.650	
5.00	82.32	211.172	128.852	-28.852	-57.534	
6.00	97.83	211.509	113.683	-13.683	-57.262	
6.00	98.77	211.509	112.735	-12.735	-28.852	
8.00	134.21	212.182	77.972	22.028	-13.683	
10.00	170.78	212.856	42.076	57.924	-12.735	**-13.209**
10.00	177.91	212.856	34.946	65.054	9.144	
15.00	257.72	214.540	43.180	56.820	16.316	
20.00	307.08	216.224	90.856	9.144	22.028	
30.00	481.44	219.592	261.848	-161.848	56.820	
40.00	502.57	222.960	279.610	-179.610	57.924	
40.00	470.61	222.960	247.650	-147.650	65.054	

Having produced similar tables for P3-1, P4-1, P8-1, P9-1, P5-2, P6-2, P3-3, P6-3, P9-3, P15-3, P15-4, P20-4, P21-4, P1-5 and P4-5, summary tables of percentage conformance medians are then shown as Tables 8 and 9.

Table 8. Summary table of percentage conformance medians for the 100m depth-mark

Prospect Locations Along the Second Cross-Profile	% Conformance Median
P2-1 (09^{0}30'57.80''; 006^{0}25'42.24'')	-57.534
P3-1 (09 30'57.80''; 006 25'45.48'')	86.839
P4-1 (09^{0}30'57.80''; 006^{0}25'48.72'')	78.468
P8-1 (09^{0}30'57.80''; 006^{0}26'01.68'')	91.093
P9-1 (09^{0}30'57.80''; 006^{0}26'04.92'')	-110.232
P5-2 (09^{0}31'01.04''; 006^{0}25'51.96'')	88.870
P6-2 (09^{0}31'01.04''; 006^{0}25'55.20'')	80.513
P3-3 (09^{0}31'04.28''; 006^{0}25'45.48'')	63.908
P6-3 (09^{0}31'04.28''; 006^{0}25'55.20'')	78.919
P9-3 (09^{0}31'04.28''; 006^{0}26'04.92'')	50.373
P15-3 (09^{0}31'04.28''; 006^{0}26'24.36'')	10.333
P15-4 (09^{0}31'07.52''; 006^{0}26'24.36'')	58.149
P20-4 (09^{0}31'07.52''; 006^{0}26'40.56'')	51.075
P21-4 (09^{0}31'07.52''; 006^{0}26'43.80'')	72.912
P1-5 (09^{0}31'10.76''; 006^{0}25'39.00'')	84.260
P4-5 (09^{0}31'10.76''; 006^{0}25'48.72'')	51.471

Table 9. Summary table of percentage conformance medians for the 40m depth-mark

Prospect Locations Along the Second Cross-Profile	% Conformance Median
P2-1 (09^{0}30'57.80''; 006^{0}25'42.24'')	-13.209
P3-1 (09^{0}30'57.80''; 006^{0}25'45.48'')	80.221
P4-1 (09^{0}30'57.80''; 006^{0}25'48.72'')	73.316
P8-1 (09^{0}30'57.80''; 006^{0}26'01.68'')	88.871
P9-1 (09^{0}30'57.80''; 006^{0}26'04.92'')	-183.907
P5-2 (09^{0}31'01.04''; 006^{0}25'51.96'')	84.684
P6-2 (09^{0}31'01.04''; 006^{0}25'55.20'')	69.239
P3-3 (09^{0}31'04.28''; 006^{0}25'45.48'')	50.469
P6-3 (09^{0}31'04.28''; 006^{0}25'55.20'')	21.092
P9-3 (09^{0}31'04.28''; 006^{0}26'04.92'')	31.698
P15-3 (09^{0}31'04.28''; 006^{0}26'24.36'')	-11.749
P15-4 (09^{0}31'07.52''; 006^{0}26'24.36'')	47.4505
P20-4 (09^{0}31'07.52''; 006^{0}26'40.56'')	-28.307
P21-4 (09 31'07.52''; 006 26'43.80'')	51.592
P1-5 (09 31'10.76''; 006 25'39.00'')	80.057
P4-5 (09^{0}31'10.76''; 006^{0}25'48.72'')	43.594

Discussion of Results

Statistical Weight of the Correlations:

For this study, a threshold correlation value between the acquired and predicted values of resistivities (y and y^1)is set at the high boundary pointof 75%. Overall, positivecorrelation between y and y^1 is achieved, if and only if, there are more threshold correlation valuesgreater than 75% than there are those less than 75% for the 100m depth mark and for the 40m depth-mark.

Statistical Weight of P2-1, P3-1, P4-1, P8-1, and P9-1 Down to the 100m Depth-Mark:-For the 100m depth mark, the statistical weight of the correlations of -58%:87%:78%:91%:-110% is three-fifth positive correlation (or 60%).

Statistical Weight of P2-1, P3-1, P4-1, P8-1, and P9-1 Down to the 40m Depth-Mark:-For the 40m depth mark the statistical weight of the correlations of -13%:80%:73%:89%:-183% is two-fifth positive correlation (or 40%).

Statistical Weight of P5-2 and P6-2 Down to the 100m Depth-Mark:-For the 100m depth mark, the statistical weight of the correlations of 89%:81% is 100%.

Statistical Weight of P5-2 and P6-2 Down to the 40m Depth-Mark:-For the 40m depth mark the statistical weight of the correlations of 85%:69% is 50%.

Statistical Weight of P3-3, P6-3, P9-3, and P15-3 Down to the 100m Depth-Mark:-For the 100m depth mark, the statistical weight of the correlations of 64%:79%:50%:10% one-fourth positive correlation (or 25%).

Statistical Weight of P3-3, P6-3, P9-3, and P15-3 Down to the 40m Depth-Mark:-For the 40m depth mark the statistical weight of the correlations of 50%:21%:32%:-11% is 0% correlation.

Statistical Weight of P15-4, P20-4, and P21-4 Down to the 100m Depth-Mark:-For the 100m depth mark, the statistical weight of the correlations of 58%:51%:73% is 0% correlation.

Statistical Weight of P15-4, P20-4, and P21-4 Down to the 40m Depth-Mark:-For the 40m depth mark the statistical weight of the correlations of 47%:-28%:52 % is 0% correlation.

Statistical Weight of P1-5 andP4-5 Down to the 100m Depth-Mark:-For the 100m depth-mark, the statistical weight of the correlations of 84%:51% is 50% positive correlation.

Statistical Weight of P1-5 andP4-5 Down to the 40m Depth-Mark:-For the 40m depth-mark the statistical weight of the correlations of 80%:44% is 50% positive correlation.

Conclusion

On P2-1, P3-1, P4-1, P8-1, and P9-1 of the First Cross-Profile:

Based on the high threshold correlation boundary values of 75% that was chosen for this study, a three-fifth or 60%positive correlation for y and y^1 of groundwater prospect locations down to 100m for the first cross-profile means that the reliability of the simple regression analysis route for this first cross-profile is high but not sufficiently excellent to be trusted. Also, a two-fifth or 40%positive correlation for y and y^1 of groundwater prospect locations down to 40m for the first cross-profile means that the simple regression analysis route for this first cross-profile cannot be used as a cost-cutting routine whereby maximum depths of survey of intervening prospect locations should be limited to just this 40m, and then other values downward would be appropriately predicted before inputting into any purpose-specific interpretation software.

On P5-2 and P6-2 of the Second Cross-Profile:

A 100%positive correlation for y and y^1 of groundwater prospect locations down to 100m for the second cross-profile means that the reliability of the simple regression analysis route for this second cross-profile is sufficiently excellent to be trusted. Also, a 50%positive correlation for y and y^1 of groundwater prospect locations down to 40m for the second cross-profile means that the simple regression analysis route for this second cross-profile cannot be used as a cost-cutting routine whereby maximum depths of survey of intervening prospect locations should be limited to just this 40m, and then other values downward would be appropriately predicted before inputting into any purpose-specific interpretation software.

On P3-3, P6-3, P9-3, and P15-3 of the Third Cross-Profile:

A one-fourthor 25%positive correlation for y and y^1 of groundwater prospect locations down to 100m for the third cross-profile means that the reliability of the simple regression analysis route for this third cross-profile is not high enough to be trusted. Also, a 0%correlation for y and y^1 of groundwater prospect locations down to 40m for the third cross-profile means that the simple regression analysis route for this third cross-profile cannot be used as a cost-cutting routine whereby maximum depths of survey of intervening prospect locations should be limited to just this 40m, and then other values downward would be appropriately predicted before inputting into any purpose-specific interpretation software.

On P15-4, P20-4, and P21-4 of the Fourth Cross-Profile:

A 0% correlation for y and y^1 of groundwater prospect locations down to 100m for the fourth cross-profile means that the reliability of the simple regression analysis route for this fourth cross-profile is not high enough to be trusted. Also, a 0%correlation for y and y^1 of groundwater prospect locations down to 40m for the fourth cross-profile means that the simple regression analysis route for this fourth cross-profile cannot be used as a cost-cutting routine whereby maximum depths of survey of intervening prospect locations should be limited to just this 40m, and then other values downward would be appropriately predicted before inputting into any purpose-specific interpretation software.

On P1-5 andP4-5of the Fifth Cross-Profile:
A 50%positive correlation for y and y^1 of groundwater prospect locations down to 100m for the fifth cross-profile means that the reliability of the simple regression analysis route for this fifth cross-profile is not high enough to be trusted. Also, a 50%positive correlation for y and y^1 of groundwater prospect locations down to 40m for the second cross-profile means that the simple regression analysis route for this fifth cross-profile cannot be used as a cost-cutting routine whereby maximum depths of survey of intervening prospect locations should be limited to just this 40m, and then other values downward would be appropriately predicted before inputting into any purpose-specific interpretation software.

Recommendation
Overall, it is not recommended to adopt the SRA method as a cost-cutting routine whereby maximum depths of survey of intervening prospect locations should be limited to just 40m, and then other values downward would be appropriately predicted before inputting into any purpose-specific interpretation software. However, this recommendation may be an over-exaggerationbecause of the high threshold correlation boundary values of 75% that was chosen for this study; whether this threshold value should be lowered or raised further presents an interesting vista to explore.

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