Supplementary Material

Water quality evaluation of groundwater and Dam reservoir water. Application of water quality indices in study sites of Greece

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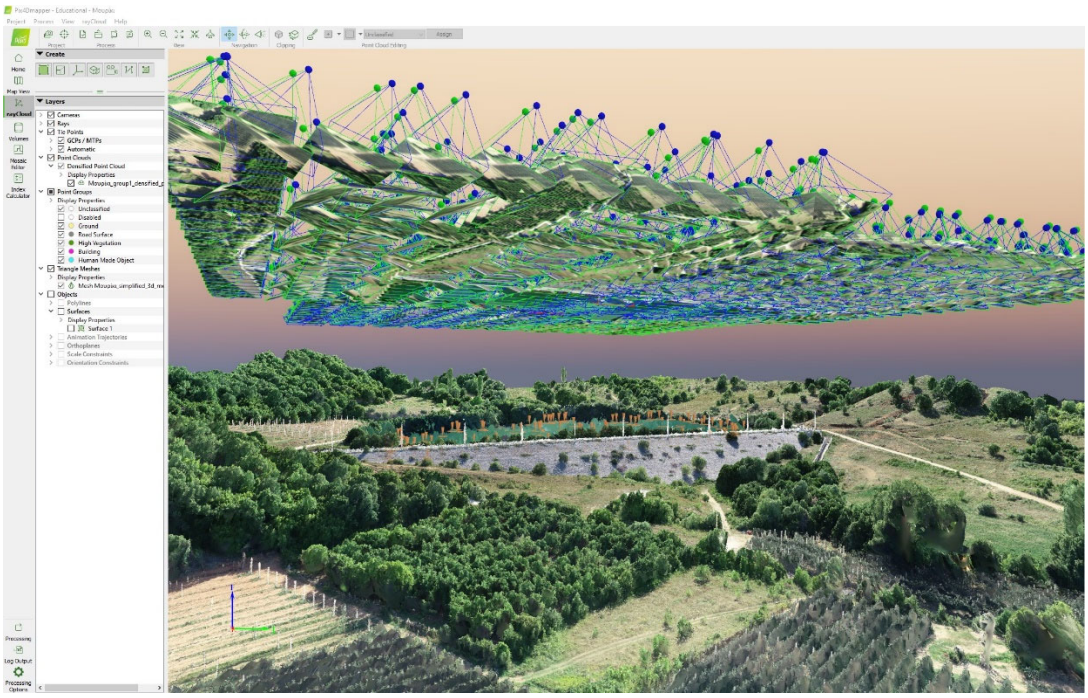

Figure S1: Image still from the Pix4D orthophoto processing program of Mouriki dam.

Table S1: Parameters examined for CCME implementation method for determination and detection limit.

	Units	Regulation limit	Determination Method	Detection limit
pH	-	6.5 – 9.5	4500-H+ B	
E.C. (25°C)	µS/cm	2500	2510-B	
HCO_3^-	mg/L	-	2320 B	5
Na^+	mg/L	200	3111 B	
K^+	mg/L	12	3111 B	
Ca^{2+}	mg/L	-	3500 Ca B	
Mg^{2+}	mg/L	-	3500 Mg B	
Cl^-	mg/L	250	4500 Cl^- F	2
SO_4^{2-}	mg/L	250	4500 SO_4^{2-} B	2
NO_2^-	mg/L	0.5	4500 NO_2^- B	0.01
NO_3^-	mg/L	50	4500 NO_3^- C	2
PO_4^{3-}	mg/L	3	4500 P C	0.01
NH_4^+	mg/L	0.5	4500 NH_3 C	0.05
Sb	µg/L	5	3113 B	2
As	µg/L	10	3113 B	1
Cd	µg/L	5	3113 B	0.1
Pb	µg/L	10	3113 B	1
Hg	µg/L	1	3113 B	0.2

Table S2: Results of physical chemical analysis for Marathonas Basin.

Oct-21											
	G_1	G_2	G_3	G_4	G_5	G_6	G_7	G_8	G_9	G_10	D_7
pH	7.2	7.3	7.2	7.1	7.2	7.2	7.3	7.3	7.3	7.2	7.9
E.C. (25°C)	3707	2199	2635	4692	3828	3519	1060	1879	1544	1718	349
HCO_3^-	421	372	390	384	281	445	372	378	329	305	165
Na^+	360	246	305	487	304	435	54	188	135	96	16
K^+	7.5	8.0	8.9	7.5	7.4	9.6	2.1	5.7	6.8	5.0	1.7
Ca^{2+}	315	176	208	450	325	232	130	138	146	224	48
Mg^{2+}	63	30	40	40	98	64	23	46	26	24	8
Cl^-	781	452	565	1150	970	822	106	372	285	285	19
SO_4^{2-}	200	115	167	340	172	212	37	76	67	95	20
NO_2^-	0.04	0.025	0.018	0.043	0.022	0.030	0.008	0.007	0.022	0.015	0.018
NO_3^-	230	58	85	87	135	69	58	44	34	150	ND
PO_4^{3-}	ND	ND	ND	ND	ND	0.030	ND	0.02	0.03	ND	ND
NH_4^+	0.3	0.15	0.15	0.15	ND	0.08	ND	0.05	0.05	0.17	0.1
Sb	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
As	ND	3.2	ND	ND	ND	ND	ND	2.5	2.7	ND	ND
Cd	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Pb	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Hg	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
May-22											
pH	7.2	7.3	7.3	7.2	7.4	7.3	7.3	7.5	7.6	7.4	8.1

E.C. (25°C)	4257	2234	2660	4879	3948	3526	1046	1696	1318	1794	417
HCO_3^-	400	384	403	415	293	445	378	403	336	323	171
Na^+	379	229	269	493	312	384	60	175	122	98	21
K^+	5.4	7.4	8.1	6.2	7.5	8.9	2.1	6.0	5.9	2.3	1.8
Ca^{2+}	362	187	225	480	337	230	123	118	118	224	55
Mg^{2+}	75	33	45	42	64	80	21	43	20	24	9
Cl^-	890	440	540	1195	959	810	107	288	210	287	33
SO_4^{2-}	248	114	167	350	115	192	37	85	61	55	26
NO_2^-	0.03	ND	ND	0.09	0.550	0.020	ND	ND	0.015	ND	0.020
NO_3^-	257	65	92	80	100	59	40	37	23	176	ND
PO_4^{3-}	ND	0.02	0.02	0.03	ND	ND	0.03	0.22	0.06	ND	ND
NH_4^+	0.1	0.1	0.1	0.1	0.3	0.1	ND	7	ND	0.1	0.1
Sb	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
As	ND	2.6	ND	ND	ND	ND	1.3	2.2	2.6	ND	1.2
Cd	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Pb	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Hg	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND

Table S3: Results of physical chemical analysis for Anthemountas Basin.

Oct-21											
	G_11	G_12	G_13	G_14	G_15	G_16	G_17	G_18	G_19	G_20	G_21
pH	7.7	7.5	8.0	7.9	7.4	8.2	7.2	7.1	7.5	7.5	7.1
E.C. (25°C)	849	1487	861	574	639	592	1938	1339	1914	1443	1652
HCO_3^-	397	744	567	329	281	323	817	665	470	525	796
Na^+	48	245	7	21	52	23	202	103	148	125	105
K^+	1,9	1,9	0,9	0,6	4,1	1,5	7,0	7,9	2,4	2,5	13,0
Ca^{2+}	69	54	23	39	51	32	124	124	104	92	192
Mg^{2+}	39	33	105	42	23	46	75	56	90	62	47
Cl^-	61	76	9	15	36	23	247	127	320	157	156
SO_4^{2-}	17	53	5	23	40	11	40	32	54	32	32
NO_2^-	ND	0.56	ND	ND	ND	ND	ND	0.015	ND	ND	ND
NO_3^-	21	34	23	ND	17	12	5	13	72	92	13
PO_4^{3-}	0.13	0.13	0.08	0.03	0.09	ND	0.12	1.04	0.05	0.04	0.07
NH_4^+	ND	ND	ND	ND	ND	ND	0.05	0.07	0.09	ND	0.1
Sb	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
As	6.1	ND	ND	11.5	ND	ND	2	426	ND	3.2	500
Cd	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Pb	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Hg	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
May-22											
pH	8.1	7.4	8.1	7.8	7.3	8.3	7.2	7.3	7.3	7.4	6.9

E.C. (25°C)	742	1437	818	567	585	544	1906	1416	4375	1475	1598
HCO_3^-	375	747	573	336	262	293	805	695	366	512	689
Na^+	58	310	20	28	49	19	210	99	211	101	105
K^+	1.72	2.0	1.1	0.7	4.6	0.9	3.8	9.0	5.0	3.4	13.6
Ca^{2+}	59	64	17	47	49	27	128	125	243	95	168
Mg^{2+}	36.8	5	105	34	22	47	79	61	267	86	46
Cl^-	61	92	11	18	38	28	284	135	1207	171	165
SO_4^{2-}	14	61	27	17	38	14	34	12	123	115	34
NO_2^-	ND	ND	ND	ND	ND	ND	ND	0.070	0.030	ND	ND
NO_3^-	18	53	6	ND	13.5	10	5	22	49	38	32
PO_4^{3-}	0.12	0.12	0.08	0.03	0.080	ND	ND	0.4	0.06	0.04	1.14
NH_4^+	ND	ND	ND	ND	ND	ND	0.18	0.3	ND	0.07	0.05
Sb	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
As	3.2	ND	2.3	9.5	ND	ND	31.1	426	ND	1.2	554
Cd	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Pb	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Hg	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND

Oct-21									
	G_22	G_23	G_24	G_25	D_1	D_2	D_3	D_4	D_5
pH	7.2	7.6	7.5	7.4	7.8	8.6	8.0	8.5	8.7
E.C. (25°C)	1556	1050	833	10522	683	505	363	584	1031
HCO_3^-	726	390	378	372	189	256	186	232	305
Na^+	175	75	67	1365	76	16	15	53	97
K^+	4.7	3.5	2.7	46.8	6.6	2.0	3.2	6.5	4.5
Ca^{2+}	90	68	76	352	35	35	36	40	43
Mg^{2+}	64	48	25	400	20	41	17	19	48
Cl^-	135	105	66	3195	120	18	15	65	152
SO_4^{2-}	88	46	25	546	22	51	22	20	49
NO_2^-	ND	ND	ND	ND	ND	ND	ND	ND	ND
NO_3^-	ND	21	11	212	ND	ND	ND	ND	ND
PO_4^{3-}	0.14	ND	ND	0.08	ND	ND	ND	ND	ND
NH_4^+	0.09	ND	ND	ND	0.55	0.15	0.4	0.4	0.4
Sb	3	ND	ND	ND	ND	ND	ND	ND	ND
As	33.3	ND	ND	2	4.5	2.3	2.4	8.5	3.9
Cd	ND	ND	ND	ND	ND	ND	ND	ND	ND
Pb	ND	ND	ND	ND	ND	ND	ND	ND	ND
Hg	ND	ND	ND	ND	ND	ND	ND	ND	ND
May-22									
pH	7.2	7.7	7.5	7.4	8.9	8.3	8.5	8.7	8.6
E.C. (25°C)	1675	1054	806	8806	678	485	459	418	1029

HCO_3^-	811	390	403	390	244	250	201	153	329
Na^+	214	82	67	1147	40	14	18	30	95
K^+	6.5	4.3	3.1	33.6	3.2	1.1	0.9	0.5	4.4
Ca^{2+}	85	68	80	382	70	41	45	39	49
Mg^{2+}	71	57	28	346	31	36	25	19	52
Cl^-	172	137	71	2703	78	17	24	58	143
SO_4^{2-}	64	46	29	487	36	38	41	19	50
NO_2^-	0.015	ND	ND	ND	0.01	0.07	ND	ND	ND
NO_3^-	ND	37	6	336	ND	ND	3.4	ND	ND
PO_4^{3-}	0.15	0.070	ND	0.09	0.16	ND	ND	ND	ND
NH_4^+	0.67	ND	ND	ND	ND	0.1	0.15	0.08	0.17
Sb	ND	ND	ND	ND	ND	ND	ND	ND	ND
As	13.4	1.4	ND	1.7	3.7	1.8	ND	5.4	2.7
Cd	ND	ND	ND	ND	ND	ND	ND	ND	ND
Pb	ND	ND	ND	ND	ND	ND	ND	ND	ND
Hg	ND	ND	ND	ND	ND	ND	ND	ND	ND

Table S4: Results of physical chemical analysis for Mouriki Basin.

Oct-21					
	G_26	G_27	G_28	G_29	D_6
pH	6.8	7.7	7.9	7.9	7.8
E.C. (25°C)	381	338	261	250	190
HCO_3^-	183	183	159	146	107
Na^+	27	16	12	14	10
K^+	4.3	4.6	5.8	4.8	2.6
Ca^{2+}	34	36	33	30	24
Mg^{2+}	16	15	8.5	8.7	10
Cl^-	17	11	3	3	20
SO_4^{2-}	19	20	10	11	10
NO_2^-	ND	ND	ND	ND	ND
NO_3^-	27	3	ND	3	ND
PO_4^{3-}	0.06	0.14	ND	ND	ND
NH_4^+	ND	0.1	0.1	ND	ND
Sb	ND	ND	ND	ND	ND
As	ND	ND	ND	ND	ND
Cd	ND	ND	ND	ND	ND
Pb	ND	ND	ND	ND	ND
Hg	ND	ND	ND	ND	ND
May-22					
pH	6.8	7.3	7.3	7.9	7.7

E.C. (25°C)	426	354	269	254	126
HCO_3^-	159	177	159	140	67
Na^+	19	16	12	7	8
K^+	4.7	4.5	6.7	5.3	1.7
Ca^{2+}	37	37	32	31	11
Mg^{2+}	17	14	8	9	6.2
Cl^-	21	13	3	4	3
SO_4^{2-}	21	19	9	10	10
NO_2^-	ND	ND	ND	ND	0.035
NO_3^-	32	6	ND	3	ND
PO_4^{3-}	0.08	0.11	0.030	0.020	ND
NH_4^+	ND	ND	ND	0.05	ND
Sb	ND	ND	ND	ND	ND
As	ND	ND	ND	ND	ND
Cd	ND	ND	ND	ND	ND
Pb	ND	ND	ND	ND	ND
Hg	ND	ND	ND	ND	ND

Table S5: CCME score for all water samples.

Name	CCME WQI score	Classification
D_1	95	Excellent
D_2	100	Excellent
D_3	100	Excellent
D_4	100	Excellent
D_5	100	Excellent
D_6	100	Excellent
D_7	100	Excellent
G_1	73	Fair
G_2	87	Good
G_3	80	Good
G_4	69	Fair
G_5	72	Fair
G_6	78	Fair
G_7	95	Excellent
G_8	77	Fair
G_9	95	Excellent
G_10	85	Good
G_11	100	Excellent
G_12	90	Good
G_13	100	Excellent

G_14	95	Excellent
G_15	100	Excellent
G_16	100	Excellent
G_17	89	Good
G_18	56	Marginal
G_19	81	Good
G_20	95	Excellent
G_21	53	Marginal
G_22	87	Good
G_23	100	Excellent
G_24	100	Excellent
G_25	57	Marginal
G_26	100	Excellent
G_27	100	Excellent
G_28	100	Excellent
G_29	100	Excellent

Table S6: CCME score changes by the removal of variables.

Removal		**pH**	**E.C. (25°C)**	**Cl^-**	**SO_4^{2-}**	**NO_2^-**	**NO_3^-**	**PO_4^{3-}**	**NH_4^+**	**Sb**	**As**	**Cd**	**Pb**	**Hg**
G_1	F	F	F	G	F	F	G	F	F	F	F	F	F	F
G_2	G	G	G	G	G	G	G	G	G	G	G	G	G	G
G_3	G	F	G	G	F	F	G	F	F	F	F	F	F	F
G_4	F	F	F	F	F	F	F	F	F	F	F	F	F	F
G_5	F	F	F	G	F	F	F	F	F	F	F	F	F	F
G_6	F	F	G	G	F	F	G	F	F	F	F	F	F	F
G_7	E	E	E	E	E	E	E	E	E	E	E	E	E	E
G_8	G	G	G	E	G	G	G	G	G	G	G	G	G	G
G_9	E	E	E	E	E	E	E	E	E	E	E	E	E	E
G_10	G	G	G	G	G	G	G	G	G	G	G	G	G	G
D_7	E	E	E	E	E	E	E	E	E	E	E	E	E	E
G_11	E	E	E	E	E	E	E	E	E	E	E	E	E	E
G_12	G	G	G	G	G	E	E	G	G	G	G	G	G	G
G_13	E	E	E	E	E	E	E	E	E	E	E	E	E	E
G_14	E	E	E	E	E	E	E	E	E	E	E	E	E	E
G_15	E	E	E	E	E	E	E	E	E	E	E	E	E	E
G_16	E	E	E	E	E	E	E	E	E	E	E	E	E	E
G_17	G	G	G	G	G	G	G	G	G	G	E	G	G	G
G_18	M	M	M	M	M	M	M	M	M	M	E	M	M	M
G_19	G	G	G	G	G	G	G	G	G	G	G	G	G	G

G_20	E	E	E	E	E	E	E	E	E	E	E	E	E	E
G_21	M	F	F	F	F	F	F	F	F	F	F	F	F	F
G_22	G	E	E	E	E	E	E	E	E	E	E	E	E	E
G_23	E	E	E	E	E	E	E	E	E	E	E	E	E	E
G_24	E	E	E	E	E	E	E	E	E	E	E	E	E	E
G_25	M	G	G	G	G	G	G	G	G	G	G	G	G	G
D_1	E	E	E	E	E	E	E	E	E	E	E	E	E	E
D_2	E	E	E	E	E	E	E	E	E	E	E	E	E	E
D_3	E	E	E	E	E	E	E	E	E	E	E	E	E	E
D_4	E	E	E	E	E	E	E	E	E	E	E	E	E	E
D_5	E	E	E	E	E	E	E	E	E	E	E	E	E	E
G_26	E	E	E	E	E	E	E	E	E	E	E	E	E	E
G_27	E	E	E	E	E	E	E	E	E	E	E	E	E	E
G_28	E	E	E	E	E	E	E	E	E	E	E	E	E	E
G_29	E	E	E	E	E	E	E	E	E	E	E	E	E	E
D_6	E	E	E	E	E	E	E	E	E	E	E	E	E	E

Where P: Poor, M: Marginal, F: Fair, G: Good, E: Excellent

Table S7: CCME sensitivity index.

	pH	**E.C. (25°C)**	**Cl^-**	**SO_4^{2-}**	**NO_2^-**	**NO_3^-**	**PO_4^{3-}**	**NH_4^+**	**Sb**	**As**	**Cd**	**Pb**	**Hg**
G_1	-0.43	-1.03	-1.40	-0.43	-0.43	-1.75	-0.43	-0.43	-0.43	-0.43	-0.43	-0.43	-0.58
G_2	-0.55	-0.55	-1.25	-0.55	-0.54	-1.18	-0.54	-0.54	-0.54	-0.54	-0.54	-0.54	-0.59
G_3	-0.49	-1.14	-1.31	-0.49	-0.47	-1.24	-0.47	-0.47	-0.47	-0.47	-0.47	-0.47	-0.56
G_4	-0.43	-1.25	-1.70	-1.15	-0.37	-1.13	-0.37	-0.37	-0.37	-0.37	-0.37	-0.37	-0.54
G_5	-0.45	-1.19	-1.58	-0.45	-0.89	-1.28	-0.39	-0.39	-0.39	-0.39	-0.39	-0.39	-0.53
G_6	-0.49	-1.18	-1.47	-0.49	-0.46	-1.12	-0.46	-0.46	-0.46	-0.46	-0.46	-0.46	-0.57
G_7	-0.60	-0.60	-0.60	-0.60	-0.60	-1.08	-0.60	-0.60	-0.60	-0.60	-0.60	-0.60	-0.61
G_8	-0.60	-0.60	-1.21	-0.60	-0.59	-0.59	-0.59	-0.59	-0.59	-0.59	-0.59	-0.59	-0.62
G_9	-0.60	-0.60	-1.08	-0.60	-0.60	-0.60	-0.60	-0.60	-0.60	-0.60	-0.60	-0.60	-0.61
G_10	-0.56	-0.56	-1.09	-0.56	-0.52	-1.49	-0.52	-0.52	-0.52	-0.52	-0.52	-0.52	-0.60
D_7	-0.64	-0.64	-0.64	-0.64	-0.64	-0.64	-0.64	-0.64	-0.64	-0.64	-0.64	-0.64	-0.64
G_11	-0.64	-0.64	-0.64	-0.64	-0.64	-0.64	-0.64	-0.64	-0.64	-0.64	-0.64	-0.64	-0.64
G_12	-0.56	-0.56	-0.56	-0.56	-1.06	-1.06	-0.56	-0.56	-0.56	-0.56	-0.56	-0.56	-0.58
G_13	-0.64	-0.64	-0.64	-0.64	-0.64	-0.64	-0.64	-0.64	-0.64	-0.64	-0.64	-0.64	-0.64
G_14	-0.60	-0.60	-0.60	-0.60	-0.60	-0.60	-0.60	-0.60	-0.60	-1.08	-0.60	-0.60	-0.61
G_15	-0.64	-0.64	-0.64	-0.64	-0.64	-0.64	-0.64	-0.64	-0.64	-0.64	-0.64	-0.64	-0.64
G_16	-0.64	-0.64	-0.64	-0.64	-0.64	-0.64	-0.64	-0.64	-0.64	-0.64	-0.64	-0.64	-0.64
G_17	-0.57	-0.57	-1.02	-0.57	-0.56	-0.56	-0.56	-0.56	-0.56	-1.16	-0.56	-0.56	-0.58
G_18	-0.63	-0.63	-0.63	-0.63	-0.51	-0.51	-0.51	-0.51	-0.51	-7.31	-0.51	-0.51	-0.64
G_19	-0.52	-1.05	-1.43	-0.52	-0.49	-0.98	-0.49	-0.49	-0.49	-0.49	-0.49	-0.49	-0.56

G_20	-0.61	-0.61	-0.61	-0.61	-0.60	-1.11	-0.60	-0.60	-0.60	-0.60	-0.60	-0.60	-0.61
G_21	-2.43	-2.78	-4.21	-2.55	-2.26	-2.83	-2.26	-2.26	-2.26	-2.36	-2.26	-2.26	-2.44
G_22	-0.96	-0.96	-0.96	-0.96	-0.96	-0.96	-0.96	-0.96	-0.96	-1.39	-0.96	-0.96	-0.96
G_23	-0.64	-0.64	-0.64	-0.64	-0.64	-0.64	-0.64	-0.64	-0.64	-0.64	-0.64	-0.64	-0.64
G_24	-0.64	-0.64	-0.64	-0.64	-0.64	-0.64	-0.64	-0.64	-0.64	-0.64	-0.64	-0.64	-0.64
G_25	-4.04	-4.74	-4.74	-4.74	-4.04	-4.74	-4.04	-4.04	-4.04	-4.04	-4.04	-4.04	-4.04
D_1	-0.64	-0.64	-0.64	-0.64	-0.64	-0.64	-0.64	-0.64	-0.64	-0.64	-0.64	-0.64	-0.64
D_2	-0.64	-0.64	-0.64	-0.64	-0.64	-0.64	-0.64	-0.64	-0.64	-0.64	-0.64	-0.64	-0.64
D_3	-0.64	-0.64	-0.64	-0.64	-0.64	-0.64	-0.64	-0.64	-0.64	-0.64	-0.64	-0.64	-0.64
D_4	-0.64	-0.64	-0.64	-0.64	-0.64	-0.64	-0.64	-0.64	-0.64	-0.64	-0.64	-0.64	-0.64
D_5	-0.64	-0.64	-0.64	-0.64	-0.64	-0.64	-0.64	-0.64	-0.64	-0.64	-0.64	-0.64	-0.64
G_26	-0.64	-0.64	-0.64	-0.64	-0.64	-0.64	-0.64	-0.64	-0.64	-0.64	-0.64	-0.64	-0.64
G_27	-0.64	-0.64	-0.64	-0.64	-0.64	-0.64	-0.64	-0.64	-0.64	-0.64	-0.64	-0.64	-0.64
G_28	-0.64	-0.64	-0.64	-0.64	-0.64	-0.64	-0.64	-0.64	-0.64	-0.64	-0.64	-0.64	-0.64
G_29	-0.64	-0.64	-0.64	-0.64	-0.64	-0.64	-0.64	-0.64	-0.64	-0.64	-0.64	-0.64	-0.64
D_6	-0.64	-0.64	-0.64	-0.64	-0.64	-0.64	-0.64	-0.64	-0.64	-0.64	-0.64	-0.64	-0.64

The calculated sensitivity index was done by:

$$WQI = \left(\frac{\frac{WQI}{n} - \frac{WQI'}{n'}}{WQI} \right) \times 100$$

Where WQI is the water quality index with all parameters; n, number of parameters; WQI' is the water quality index after removal of any parameter; n', the new number of parameters.