Research Article [Suresh *et al.*, 6(10-11): Oct.-Nov, 2015:4780-4788]
CODEN (USA): IJPLCP ISSN: 0976-7126

INTERNATIONAL JOURNAL OF PHARMACY & LIFE SCIENCES
(Int. J. of Pharm. Life Sci.)

Analysis of Ground Water in Selected Areas of Siruguppa Taluk in Karnataka

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Abstract

The quality of forty four groundwater samples have been analyzed from Siruguppa taluk located in the Bellary district, Karnataka, India. The taluk consists mainly of migmatites, granodiorite and later granite. The analysis of water quality for its suitability for agricultural and domestic purposes was carried out. The quality analysis was performed through the estimation of calcium, magnesium, sodium, potassium, iron, zinc, manganese, carbonate, bicarbonate, sulphate, chloride, fluoride, nitrate, total alkalinity, total dissolved solids, turbidity, pH, electrical conductance and total hardness. Based on the analysis, certain parameters like sodium adsorption ratio, percent sodium and magnesium ratio were calculated. The hydrochemical pattern diagram helps in hydrochemical facies classification. The investigation reveals that, out of 44 samples analyzed, 34 samples were found to be of C_2S_1, C_2S_2, C_3S_1 and C_3S_2 type which are suitable for irrigation purpose. Remaining samples were not suitable for irrigation as per USSL classification. The trilinear diagram shows that the majority of samples in the study area having enrichment of magnesium and calcium among cations and of bicarbonate among anions. This enrichment is due to the dissolution of mineral dolomite [(Mg, Ca) CO_3]. In the present study, all the samples were found to be free from Coliforms. Fluoride was most dominant ion responsible for contamination of the ground water. Fluoride concentration in 02 samples was above the permissible limit and in 10 samples having above the excessive limit. The investigation indicates the need for periodic monitoring of ground water in the study area

Key-Words: Ground Water, Karnataka

Introduction

Water is a fundamental and basic need for sustaining biotic and abiotic components. Among the various sources of water, ground water is the safest water for drinking and domestic purposes. Nevertheless, several factors, like discharge of agricultural, domestic and industrial wastes, land use practices, geological formation, rainfall patterns and infiltration rate are reported to affect the quality of ground water in an area (APHA, 1975). As groundwater moves along flow lines from recharge to discharge areas, its chemistry is altered by the effect of a variety of geochemical processes (Freeze and Cherry, 1979). In Karnataka, there is no significant work on water quality except by Jayanthi (1993), Ayed (2002), Jayalakshmi Devi et al. (2005) and Kottureshwara et al. (2015). In view of the above, it is clear that water quality assessment studies in Karnataka especially in Siruguppa taluk, Bellary district are not sufficient.

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Therefore, the present study has been undertaken to assess the water quality of Siruguppa taluk of Bellary district in Karnataka.

Siruguppa taluk is situated between $15^0\ 29^1$ to $15^0\ 50^1$ north latitude and $76^0\ 42^1$ to $77^0\ 08^1$ east longitude. It covers an area about 1042 sq.km.The climate of the taluk is characterized by dryness in the major part of the year and a hot summer.

Material and Methods

The present study provides a detailed description of the chemical criteria of ground water. Forty-four water samples were collected and analyzed for calcium, magnesium, sodium, potassium, iron, zinc, manganese, chloride, carbonate, bicarbonate, fluoride, sulphate, nitrate, total hardness (TH), total alkalinity (TA), total dissolved solids (TDS), pH, electrical conductance (EC), turbidity and coliform bacteria. Further the sodium adsorption ratio (SAR), corrosivity ratio (CR), percent sodium and magnesium ratio were calculated. The techniques and methods followed for collection, preservation, analysis and interpretation are those given by Rainwater and Thatcher (1960), Brown et al. (1970), ICMR (1975), Hem (1985) and APHA (1995).

Results and Discussion

The results obtained from the analysis of water samples from different villages of siruguppa taluk are shown in Table 1. Standard methods (APHA, 1975) have been employed in the analysis of the water samples. A comparison of the physico-chemical ground water samples has been made with WHO (1988), and ISI (1991) drinking water standards. From Table 1 the following observations were made for different parameters.

pH

The pH values of ground water varied from 7.4 to 8.5 indicating slightly alkaline nature. The range of desirable pH of water prescribed for drinking purpose by ISI (1991) and WHO (1988) is 6.5 to 8.5. The analyzed ground water samples are within the permissible limits. There is no much distinct variation of pH in the different wells selected for the present study, indicating that the ground water is tapping from aquifers of a single formation. The slight alkaline nature of ground water may be due to the presence of fine aquifer sediments mixed with clay and mud, which are unable to flush off the salts during the monsoon rain and hence retained longer on other seasons.

Electrical Conductance (EC)

The mineral components of the water are directly related to agricultural utility and its parametric value decides the suitability for drinking and irrigation purposes. Wilcox (1955) made an attempt and succeeded in clarifying the quality of water with respect to irrigational use by taking into consideration of sodium and electrical conductance as a vital parameter. It is well known that electrical conductance is a good measure of dissolved solids and excessive presence of sodium in water is not only unsafe for irrigation but also makes the soil uncultivatable (Neeraj Verma, 1994). In the present investigation the electrical conductivity of the samples varies from 470 to 3000 μ mhos/cm. This is within the permissible limit for 30 samples as per WHO standards. However, the higher values of EC (>2000 μ mhos/cm) for 14 samples may be due to the long residence time and factors of lithology of water bodies (Harish Babu et al., 2004).

Total Dissolved Solids (TDS)

TDS indicate the nature of water quality for salinity. The water samples in the study area fall in the range of 128 to 1410 mg/l. Out of 44 samples collected, 39 samples fall into the 'Fresh Water' category while 05 samples fall into the 'Brakish Water' category (Suresh et al.2009)

Waters can be classified based on the concentration of TDS (Wilcox, 1955; ICMR, 1975) as given below:

Up to 500 mg/l	Desirable for drinking
Up to 1000 mg/l	Permissible for drinking
Up to 2000 mg/l	Useful for irrigation
Above 3000 mg/l	Not useful for drinking and irrigation

Based on the above classification only 85% samples in the study area will come under desirable and permissible for drinking.

Total Hardness

Total hardness is due to the presence of divalent cations of which Ca and Mg are the most abundant in ground water. The waters of the study area are classified according to hardness as suggested by Hem (1985). In the present study, the total hardness of water samples ranged from 100 to 860 mg/l. This indicates that, out of 44 samples, only 17 samples have total hardness content within ISI permissible limit (300 mg/l) while 20 samples in the range of (300-600 mg/l) and 7 samples fall into the very hard cat
egory. The total hardness values obtained very well correlate with TDS.

Total Alkalinity (TA)

Most of the ground waters contain substantial amounts of dissolved carbon dioxide, bicarbonates and hydroxides. These constituents are the results of dissolution of minerals in the soil and atmosphere (Nagaraju et al., 2006). In the present study, alkalinity ranges between 50 to 468 mg/l. The high amount of alkalinity in the study area samples may be due to the presence of country rocks.

Chloride (Cl)

The origin of chloride in surface and ground water may be from diverse sources such as weathering and leaching of sedimentary rocks and soils, domestic and industrial waste discharge, etc. Chloride in excess (>250 mg/l) imparts a salty taste to water and people who are not accustomed to high chlorides may be subjected to laxative effects. The chloride content in the study area ranged between 22 and 268 mg/l. The WHO and ISI permissible limit of chloride for drinking water is 200 and 250 mg/l respectively. The chloride value of the water samples studied is well within the permissible limit of WHO and ISI for 42 samples and only 02 samples have high value.

Fluoride (F)

High concentration of fluoride, often significantly above 1.5 mg/l constitute a severe problem in large parts of Karnataka (Handa, 1975 and 1988). Teotia et al., (1984) found variations in fluoride concentrations with depth in ground water from two Indian villages affected by fluorosis. The trend is contrary to observations from high fluoride ground waters elsewhere. This clearly shows increasing fluoride concentrations with depth are due to increased chemical reaction with increasing ground water residence time. Long term use of ground water for drinking has resulted in the onset of wide spread fluorosis symptoms, from mild forms of dental fluorosis to crippling skeletal fluorosis. The concentration of fluoride in the study area varies from 0.2 to 2.80 mg/l . The fluoride value of the water samples studied is well within the permissible limit of ISI for 32 samples, where as 12 samples, have high value of fluoride (>1.2 mg/l) and not safe for drinking purpose.

Nitrate (NO_3)

The concentration of nitrate in the present water samples varies from 2.7 to 71.0 mg/l. The determination of nitrate is important particularly in drinking water as it has adverse effects on health above 50 mg/l. When water with high nitrogen concentration is used for drinking, it causes diseases like *methaemoglobinaenia* (Kottureshwara et al 2015). Few data are available for concentrations of nitrate in ground water from Karnataka. Manjappa et al., (2003) quoted values between 0.08 mg/l and 308 mg/l for ground waters from Davanagere taluk in Karnataka. In the present study, out of 44 samples collected, 35 samples are well within the permissible limit of ISI and 09 samples have excessive limit.

Iron

In the present study, the iron varied from 0.0 to 0.70 mg/l. The permissible limit for iron is 1.0 mg/l (ISI 1983). The concentration of iron in all the water samples of the study area was well below the permissible limit.

Zinc

The concentration of zinc in water samples varied from 0.40 to 1.30 mg/l (ISI 1983). The permissible limit of zinc is 5 mg/l. These results were well below the permissible limit.

Manganese

The manganese ranged from 0.00 to 0.40 mg/l (ISI 1983).The permissible limit for manganese is 0.4 mg/l. The results indicated that all the samples of the study area are within the permissible limit.

Sodium Adsorption Ratio (SAR)

Excessive sodium in waters produces the undesirable effects of changing soil properties and reducing soil permeability (Kelly, 1951). The degree to which irrigation water tends to exchange positive ions (cations) in the soil and cations in the irrigation water can be represented by the sodium adsorption ratio (US Salinity Laboratory, 1954). SAR is an important parameter for the determination of the suitability of irrigation water because it is responsible for the sodium hazard (Todd, 1980). The waters were classified in relation to irrigation based on the ranges of SAR values (Richards, 1954). All the samples of the study area are suitable for irrigation purpose. SAR values of the water samples vary from 4.5 to 17.6.

US Salinity Laboratory (USSL) Classification

According to a method formulated by the US Salinity Laboratory (1954), water used for irrigation can be rated based on salinity hazards and sodium or alkali hazard. According to USSL classification (Table 2), 44 samples of ground waters of the study area, majority of the samples fall into C_3S_1 (high salinity with low sodium), and C_3S_2 (high salinity with medium sodium). Out of 44 samples the 33 samples are suitable for irrigation use in almost all soil types and they facilitate good soil drainage. However, remaining 11 samples (C_3S_3, C_4S_1, C_4S_2 and C_4S_3) have very high sodium. Therefore, they are not suitable for irrigation use.

Percent Sodium

Sodium concentration is important in classifying the irrigation water because sodium reacts with soil to reduce its permeability. (Todd, 1980; Demenico and Schwartz, 1990). Soils containing a large proportion of sodium with carbonate as the predominant anion are termed alkali soils; those with chloride or sulphate as the predominant anion are saline soils. Percent sodium in water is a parameter computed to evaluate the suitability for irrigation (Wilcox, 1948). The percent sodium values of the study area samples vary from 20.2 to 63.3. Percent sodium is plotted against electrical conductance, which is designated as a Wilcox diagram. From this figure, it is clear that 03 samples fall into the category of 'Excellent to Good', 27 samples fall into the category of 'Good to Permissible', 14 samples fall into the category of 'Doubtful to Unsuitable'.

Corrosivity Ratio (CR)

Water samples having corrosivity ratio of less than 1 are considered to be non-corrosive, while the value above 1 is corrosive (Jayalakshmi Devi and Belagali, 2005). In the present study, 21 samples are considered as corrosive, while remaining 23 samples have CR values of less than 1.

Graphical Methods of Representing Analysis

Piper diagram Collins (1923) first proposed a graphical method of representation of chemical analysis. The method was latter modified by Piper (1944, 1953), based on the concentration of dominant cations and anions, and trilinear diagram was proposed to show the percentages at milli equivalents per liter of cations and anions in water samples. This is useful to understand the total chemical character of water samples in terms of cation-anion pairs.

The piper diagram (Fig.1) consisting of 2 triangular and 1 intervening diamond-shaped fields. All 3 sides of the 2 triangular fields and the 4 sides of the diamond – shaped field are divided into 100 parts. The percentage reacting values at the 3 cation groups – Ca, Mg and (Na + K) – are plotted as a single point in the left triangulare field and the 3 anion groups – (HCO_3 + CO_3), SO_4 and Cl – similarly on the right triangular field. The 2 points in each triangular field show the relative concentration of several dissolved constituents of the water sample. Later a third point is plotted in the central diamond – shaped field after computing percentage reacting values for anions and cations separately. This field shows the complete chemical character of the water samples that gives the relative composition of ground water about the cation–anion point. These 3 fields reflect the chemical character of ground water according to the relative concentration of its constituent but not according to the absolute concentrations.

Later Piper (1953) classified the diamond – shaped field of the trilinear diagram into 9 areas to know quickly the quality of water and they are given below.

Area-1: Alkaline earth's (Ca+Mg) exceeds alkalies (Na+K) (includes areas 5,6 and 9a).

Area-2: Alkalies exceed alkaline earth's (includes areas 7,8 and 9b).

Area-3: Weak acids (CO_3 + HCO_3) exceed strong acids (SO_4 + Cl + F) (includes areas 5, 8 and 9b).

Area-4: Strong acids exceed weak acids (includes areas 6, 7 and 9b).

Area-5: Carbonate hardness (secondary alkalinity) exceeds 50%.

Area-6: Non-carbonate hardness (secondary salinity) exceeds 50%.

Area-7: Non-carbonate alkali (primary salinity) exceeds 50%.

Area-8: Carbonate alkali (primary alkalinity) exceeds 50%.

Area-9: None of the cation and anion pairs exceed 50%.

In the present study, it is noted that 30 samples of study area fall under area-1, 14 samples fall under area-2; 28 samples fall under area-3; 16 samples fall under area-4; 21 samples fall under area-5; 17 samples from study area fall under area-9; 6 samples fall under area-7; and no samples fall under area-8.

Most of the water samples of study area exhibit higher amount of Ca and Mg ions among the cations and bicarbonates among anions. This may be due to the dissolution of carbonates of Ca and Mg. Ground waters of the study area are characterized by both temporary and permanent hardness. However, 80% of the water samples have temporary hardness. Concentration of Ca in ground water samples of study area ranges from 20.0 to 199 mg/l.

Coliforms

The bacteriological content is one of the most important aspects in drinking water quality. The most common and widespread health risk associated with drinking water is the bacterial contamination caused either directly or indirectly by human or animal excretia. *E.Coli* a typical facel coliform is selected as an indicator of facel contamination. In the study area all samples are free from coliform contamination. The permissible limit of bacterial coliforms is 4/100ml as per WHO.

Conclusion

On the basis of the present study, analysis of ground water of Siruguppa taluk in Karnataka state shows that only 70% of water samples have physico-chemical properties well within the permissible limits. According to USSL classification (Table 2), 44 samples of ground waters of the study area, majority of the samples fall into C_3S_1 (high salinity with low sodium), and C_3S_2 (high salinity with medium sodium). Out of 44 samples the 33 samples are suitable for irrigation use in almost all soil types and they facilitate good soil drainage. However, remaining 11 samples (C_3S_3, C_4S_1, C_4S_2 and C_4S_3) have very high sodium. Therefore, they are not suitable for irrigation use.

The value of SAR in the study area, 03 samples fall into the category of 'Excellent to Good', 27 samples fall into the category of 'Good to Permissible', 14 samples fall into the category of 'Doubtful to Unsuitable'. Whereas 21 samples were showing corrosivity ratio higher than 1. According to Piper's diagram, the study area is characterized by water having both temporary and permanent hardness. The concentration of fluoride in the study area, 32 samples were found within the permissible limit and 12 samples having higher concentration of fluoride (>1.2 mg/l) were not suitable for drinking purpose. The results also suggested that the contamination problem is alarming at present in the study area but ground water indicates potentially dangerous situation, and require immediate attention.

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Table 2: Irrigational specification values of groundwater samples of Siruguppa Taluk

S No.	Sample Location	USSL Salinity	S No.	Sample Location	USSL Salinity
1	**Haaglur**	C_3S_2	**23**	**Huttanur**	C_3S_2
2	**Hosahalli**	C_3S_2	**24**	**Budaguppa**	C_4S_3
3	**Thallur**	C_2S_2	**25**	**K. Belagallu**	C_3S_2
4	**Thanavasapura**	C_3S_2	**26**	**Byrapur**	C_4S_3
5	**Konchigeri**	C_3S_1	**27**	**Upparhosalli**	C_4S_2
6	**Dharur**	C_3S_1	**28**	**Halekote**	C_3S_2
7	**Karur**	C_4S_2	**29**	**Haraganur**	C_3S_2
8	**Hulluru**	C_4S_4	**30**	**Devalapura**	C_4S_1
9	**Gopula**	C_3S_2	**31**	**Karai**	C_3S_2
10	**Byrapura**	C_4S_2	**32**	**Narangi**	C_3S_2
11	**Sirigeri**	C_3S_2	**33**	**Karjiganur**	C_3S_2
12	**Havinahalu**	C_3S_2	**34**	**Kuruvalli**	C_3S_3
13	**Muddhattanur**	C_3S_1	**35**	**Nagalapura**	C_2S_1
14	**Mannur**	C_3S_2	**36**	**Sridaragadda**	C_3S_1
15	**Mannursugur**	C_3S_3	**37**	**Volaballary**	C_2S_1
16	**Nadahalli**	C_3S_1	**38**	**Naganahalli**	C_4S_2
17	**Hungulam**	C_3S_2	**39**	**Hagasanur**	C_4S_3
18	**Tekklakote**	C_3S_1	**40**	**Kottalakunte**	C_3S_2
19	**Nittur**	C_2S_1	**41**	**Biranahalli**	C_3S_2
20	**Kenchanagudda**	C_3S_2	**42**	**Chellekuthalur**	C_3S_2
21	**Devasugur**	C_3S_2	**43**	**Siruguppa**	C_3S_2
22	**Bagewadi**	C_3S_2	**44**	**Heccholli**	C_3S_3

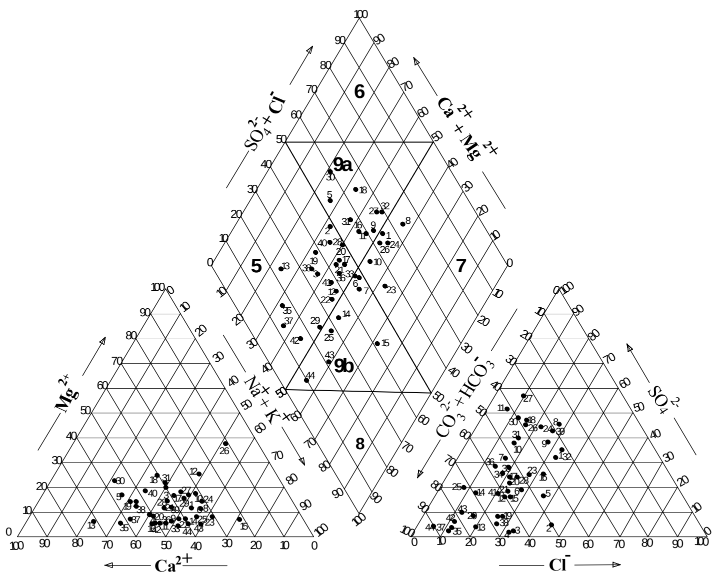

Fig.1 Piper trilinear diagram of borewell samples of Siruguppa taluk

How to cite this article

Kottureshwara N. M., Suresh T., Kotresh D. and Jayashree M. (2015). Analysis of Ground Water in Selected Areas of Siruguppa Taluk in Karnataka. *Int. J. Pharm. Life Sci.*, 6(10-11):4780-4788.

Source of Support: Nil; Conflict of Interest: None declared

Received: 01.09.15; Revised: 10.09.15; Accepted: 29.09.15

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Research Article [Suresh *et al.*, 6(10-11): Oct.-Nov, 2015:4780-4788]
CODEN (USA): IJPLCP ISSN: 0976-7126

Table 1: Analysis of Physico-chemical factors of water samples of Siruguppa Taluk, Karnataka

Sample N0.	Turbidity (NTU)	pH	EC (µmhos/cm)	TH (mg/l)	Ca^{2+} (mg/l)	Mg^{2+} (mg/l)	Na^{+} (mg/l)	K^{+} (mg/l)	Cl^{-} (mg/l)	CO_3^{2-} (mg/l)	HCO_3^{-} (mg/l)	F^{-} (mg/l)	SO_4^{2-} (mg/l)	NO_3^{-} (mg/l)	TA (mg/l)	TDS (mg/l)	Fe^{2+} (mg/l)	Zn^{2+} (mg/l)	Mn^{2+} (mg/l)	Coliform Bacteria (MPN/100ml)
1	0.9	7.4	1300	368	55.0	26.0	79.0	3.9	191.0	0.0	201	1.10	180.0	16.0	196	560	0.00	0.84	0.05	**00**
2	1.4	7.8	1300	475	150.0	38.0	92.0	1.3	226.0	10.0	236	0.61	20.0	19.0	245	540	0.09	1.02	0.06	--
3	1.3	7.8	470	192	80.2	40.0	77.0	1.1	141.0	24.0	248	0.81	7.5	9.0	284	280	0.00	0.43	0.05	--
4	1.3	7.4	1100	245	89.0	16.2	68.0	0.0	104.0	20.0	196	0.87	10.0	23.0	261	380	0.09	1.05	0.04	--
5	1.4	7.9	1100	260	120.4	8.0	45.0	14.0	189.0	0.0	242	0.49	80.0	44.5	144	390	0.00	1.03	0.07	--
6	1.1	8.1	1500	235	28.5	9.4	36.0	4.8	153.0	12.0	256	2.51	100.0	18.0	344	550	0.00	0.69	0.05	--
7	0.1	8.1	2700	640	32.1	10.2	46.0	4.1	117.0	0.0	250	2.30	210.0	27.0	269	1120	0.00	0.56	0.05	--
8	1.1	8.5	3000	330	47.0	17.0	81.0	3.4	268.0	0.0	242	2.38	400.0	59.0	252	1410	0.00	0.61	0.06	--
9	1.4	8.2	2200	308	67.2	12.1	76.0	0.4	192.0	14.0	284	1.07	306.0	30.0	262	780	0.09	1.04	0.04	--
10	0.9	8.4	2800	750	34.1	18.0	54.0	1.8	91.0	22.0	260	1.16	235.0	35.0	289	1210	0.09	0.56	0.06	**2**
11	1.5	7.6	2100	425	70.5	10.7	70.0	1.8	36.0	0.6	164	0.77	210.0	27.0	138	840	0.00	0.86	0.04	**--**
12	2.0	7.7	1600	453	44.1	39.8	79.0	2.4	83.0	0.0	226	0.93	52.5	19.0	206	620	0.00	1.06	0.05	**--**
13	1.6	8.0	980	285	136.0	6.9	48.0	0.4	62.5	10.0	232	0.78	10.0	48.0	268	260	0.00	0.78	0.03	--
14	1.0	7.4	1100	206	27.3	5.8	36.0	2.8	36.5	0.0	186	1.95	52.5	24.0	50	380	0.00	1.26	0.06	--
15	1.0	7.7	950	210	20.4	10.2	69.0	9.4	90.0	0.0	216	2.06	60.0	10.0	52	320	0.00	0.62	0.03	**00**
16	2.0	7.9	1400	380	57.3	6.4	38.0	9.2	180.5	0.0	235	0.97	148.0	17.0	206	480	0.18	0.78	0.03	-
17	2.0	8.3	1200	265	39.6	5.1	44.0	2.4	117.0	24.0	282	2.76	130.0	61.0	311	390	0.00	1.04	0.05	--
18	2.0	7.5	1200	230	41.2	5.8	34.0	2.0	121.0	0.0	256	2.04	325.0	42.0	310	340	0.36	0.78	0.06	--
19	1.0	8.2	750	160	69.3	6.4	38.0	3.0	147.0	0.8	302	0.80	45.0	49.0	214	240	0.00	0.64	0.06	**00**
20	2.0	8.3	2200	520	60.1	10.3	48.0	2.2	129.0	0.0	294	0.97	110.0	71.0	329	780	0.09	0.84	0.07	--
21	1.0	8.0	1900	305	40.1	9.4	38.0	1.1	116.0	10.0	270	0.66	92.0	30.0	265	650	0.00	0.76	0.03	--
22	1.0	8.2	1380	323	29.6	6.4	34.0	0.8	123.0	10.0	288	1.28	40.0	2.7	202	446	0.09	0.68	0.06	-
23	2.0	8.1	1300	345	32.5	7.2	66.0	1.8	180.0	32.0	252	0.89	150.0	21.0	285	472	0.00	0.62	0.05	**00**
24	1.0	8.0	2300	635	42.9	8.4	72.0	1.8	131.0	18.0	196	0.74	270.0	56.0	245	820	0.65	0.84	0.04	--

Sample N0.	Turbidity (NTU)	pH	EC (µmhos/cm)	TH (mg/l)	Ca^{2+} (mg/l)	Mg^{2+} (mg/l)	Na^{+} (mg/l)	K^{+} (mg/l)	Cl^{-} (mg/l)	CO_3^{2-} (mg/l)	HCO_3^{-} (mg/l)	F^{-} (mg/l)	SO_4^{2-} (mg/l)	NO_3^{-} (mg/l)	TA (mg/l)	TDS (mg/l)	Fe^{2+} (mg/l)	Zn^{2+} (mg/l)	Mn^{2+} (mg/l)	Coliform Bacteria (MPN/100ml)
25	1.0	8.2	850	130	32.1	7.5	38.0	10.8	39.0	0.0	302	0.77	84.0	13.0	406	270	0.00	0.68	0.06	--
26	1.2	7.8	2600	860	20.0	63.0	86.0	1.9	100.0	0.6	246	2.10	290.0	23.0	311	1080	0.00	0.89	0.05	--
27	1.4	8.1	2300	670	84.0	41.0	98.0	6.0	83.0	0.0	262	0.62	450.0	24.0	268	880	0.27	0.69	0.04	**02**
28	1.6	8.2	1900	410	60.0	26.0	56.0	1.4	129.0	0.0	284	0.91	140.0	54.0	425	670	0.27	0.88	0.07	--
29	1.5	8.5	2200	580	40.0	6.2	52.0	3.6	89.5	0.0	394	0.86	41.0	14.0	468	760	0.09	0.64	0.02	--
30	1.4	8.0	2600	622	113.0	42.0	40.0	3.4	65.0	10.0	204	0.59	260.0	21.0	246	980	0.00	0.58	0.05	--
31	1.0	7.8	2200	540	70.2	38.0	68.0	1.7	85.0	0.0	230	0.20	210.0	25.0	210	780	0.00	0.72	0.05	**00**
32	1.4	8.4	1500	266	35.3	6.1	36.0	2.0	137.0	12.0	318	0.45	151.6	19.0	303	460	0.09	0.86	0.04	--
33	1.8	8.2	1600	380	76.2	7.2	84.0	6.8	110.0	24.0	260	1.43	160.0	44.0	268	560	0.09	0.78	0.42	--
34	1.6	8.1	1500	320	40.1	4.2	48.0	1.6	96.0	10.0	284	1.91	140.0	36.0	244	490	0.00	1.04	0.06	--
35	1.0	7.9	700	115	176.0	17.2	84.0	8.0	40.0	12.0	268	0.67	12.0	16.0	185	190	0.09	0.96	0.03	--
36	1.4	7.7	1100	185	42.1	4.6	36.0	2.8	64.5	10.0	248	1.09	130.0	41.0	312	220	0.00	0.76	0.02	**00**
37	2.0	7.7	600	109	79.4	7.2	48.0	3.2	30.0	0.0	246	1.18	5.0	44.0	186	128	0.54	0.86	0.05	--
38	2.0	8.2	2600	670	199.0	41.0	116.0	12.0	112.0	0.0	264	0.16	20.0	41.0	298	1080	0.18	1.02	0.05	**00**
39	2.0	7.6	2300	536	124.0	36.0	128.0	3.4	108.0	0.0	138	0.85	190.0	52.0	449	730	0.27	0.58	0.04	--
40	2.0	8.1	1100	110	120.2	47.0	86.0	4.4	115.0	0.0	278	0.74	100.0	23.0	198	210	0.09	0.78	0.03	--
41	1.4	7.8	1068	320	79.7	35.4	96.0	2.2	83.0	10.0	226	0.79	65.0	22.0	295	400	0.65	0.84	0.04	--
42	1.8	8.1	1200	310	94.9	9.6	84.0	2.6	41.0	0.0	294	0.69	19.0	11.0	136	585	0.36	0.64	0.04	--
43	1.8	8.2	1400	326	41.7	4.2	68.0	0.4	46.0	10.0	284	1.61	30.0	12.0	312	445	0.09	1.02	0.04	**00**
44	1.6	8.1	980	130	97.8	9.7	122.0	12.0	22.0	0.0	270	0.78	6.7	24.0	165	260	0.09	0.74	0.07	--
Min.	0.1	7.4	470	109	20.0	4.2	34.0	0.0	22.0	0.0	138.0	0.2	5.0	2.7	50	128	0.0	0.4	0.0	00
Max.	2.0	8.5	3000	860	199.0	63.0	128.0	14.0	268.0	32.0	394.0	2.8	450.0	71.0	468	1410	0.7	1.3	0.4	2.0
SD	0.4	0.3	664	188	42.1	15.3	25.1	3.5	54.7	8.8	43.7	0.6	111.3	16	88.0	304	0.2	0.2	0.1	1.4