

# Comparative Assessment of Water Quality on Spring Water and Supplied PHED Water in Aizawl City, Mizoram India

<sup>1</sup>VL Thachunglura, <sup>2</sup>Lalnuntluanga, <sup>3</sup>Lalmuansangi

<sup>1</sup>Student, Department of Environmental Science, Mizoram University, Tanhril, Aizawl, Mizoram, India

<sup>2</sup>Professor, Department of Environmental Science, Mizoram University, Tanhril, Aizawl, Mizoram, India

<sup>3</sup>Research Fellow, Department of Environmental Science, Mizoram University, Tanhril, Aizawl, Mizoram, India

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### \*Corresponding Author

Email: [vlthachunglura\[at\]gmail.com](mailto:vlthachunglura[at]gmail.com)

## ABSTRACT

The present study was conducted during September 2019 to November 2019 and January 2020 to March 2020 respectively. The physico-chemical properties, viz. temperature, total solids, total dissolved solids, pH, alkalinity, acidity, total hardness, dissolved oxygen and biological oxygen demand were selected for determining and comparing the water quality of spring water and supplied PHED water. From the results, it is found out that supplied PHED water have higher temperature and pH value while spring water have higher value of total solids, total dissolved solids, alkalinity, acidity, total hardness, dissolved oxygen and biochemical oxygen demand. All the samples collected from spring water and PHED water meets the standard given by various scientific agencies. It was observed that the water quality of natural spring water changes due to the contact of rainwater with the sedimentary rock in the region leading to dissolution of ions into the aquifer and due to various anthropogenic activities. The supplied PHED water collected from three sites remained almost same in value; this could be due to the fact that the water is properly treated earlier.

## 1. Introduction

Water is the most important constituents of life support system, participating in virtually every process that occurs in humans, plants and animals, also plays a key role in the development of earth's surface, moderating climate and diluting pollutants. Water is inextricably linked to the health and wellbeing of people (Rice, 2000).

Human with all animal and plant life on the planet, is reliant upon water. We need water to produce our food, generate our power and run our industries, we also need it as a basic part of our daily lives - our bodies need to ingest water every day to continue functioning.

As its name indicates, spring water originates from a natural underground spring. Spring water is the common source of public water supply in most rural communities. To qualify as spring water, it must be deemed potable at the spring without requiring any purifying treatments. This water must also contain specific minerals and maintain their original chemical property from the time it's sourced to the time it's consumed.

There are 23 urban towns in Mizoram and Public Health Engineering Department (PHED) has been implementing and maintaining Urban Water Supply for the last two decades. The programmes are still underway to improve the level of water supply in quantity and quality. In Aizawl, PHED is entrusted with the responsibility of providing safe drinking water and sanitation facilities. (PHED, Mizoram)

Human existence mainly depends on fresh water supply which is less than 1% of the water available on earth (Reagan & Fisher 1997). Ground and spring water represents an important

source of drinking water and its quality is currently threatened by a combination of over- abstraction and microbiological and chemical contamination (Angulo et al. 1997).

The required water quality is determined by the purpose for which the water is to be used (domestic, urban, agricultural, or industrial). The evaluation of water for use purposes is based on the characteristics of the water compared to a required quality for that use. The required quality is defined by "standards" which mean concentrations of constituents, which causes no negative effect to the health of the consumer over the life of consumption. (WHO, 2016)

### 1.1. Water Quality and Pollution

The term water quality is intimately related to pollution. Water qualities refer to the physical, chemical and bacteriological characteristics of water. The quantity of usable water on earth is extremely small; any waste of this water by polluting it will further reduce the available supply.

Water pollution is one of the most serious problems faced by man today. Ground water, surface water rivers, sea, lakes, ponds, etc. are finding more and more difficult to escape from pollution. The toxins can penetrate through soil and rock into the groundwater resources, resulting in physical and substance changes and in changes in water quality (Pepper et al. 1996). For example, around 70% of the water in India has been turned out to be contaminated because of the release of household sewage and mechanical effluents into regular water sources (Singh, 2014).

**Table 1: Temperature**

MONTH	Site 1 Mualpui		Site 2 Tuikual		Site 3 Zotlang	
	SW	PHED	SW	PHED	SW	PHED
September	22.2	22.5	23.3	<b>23.6</b>	22.7	22.9
October	21.9	22.4	22.5	22.7	22.4	22.6
November	17.5	17.9	18.2	18.6	18.3	18.8
January	<b>13.3</b>	13.6	14.1	14.4	13.9	14.1
February	15.6	15.9	16.2	16.7	16.1	16.4
March	16.4	16.8	17.2	17.5	16.9	17.2

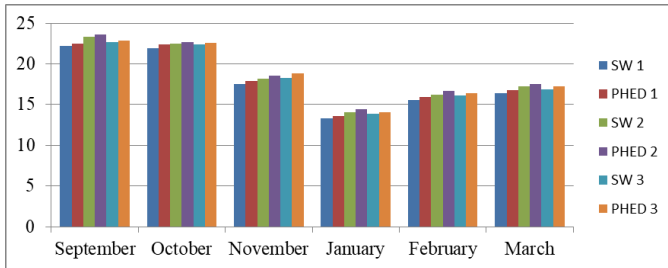


Fig 1: Graphical representation of temperature of water

**Table 2: Total Solids**

MONTH	Site 1 Mualpui		Site 2 Tuikual		Site 3 Zotlang	
	SW	PHED	SW	PHED	SW	PHED
September	130	84	142	84	180	84
October	136	82	150	80	<b>188</b>	82
November	118	78	124	76	176	80
January	108	<b>60</b>	116	64	154	74
February	114	68	124	72	160	78
March	126	78	130	78	178	80

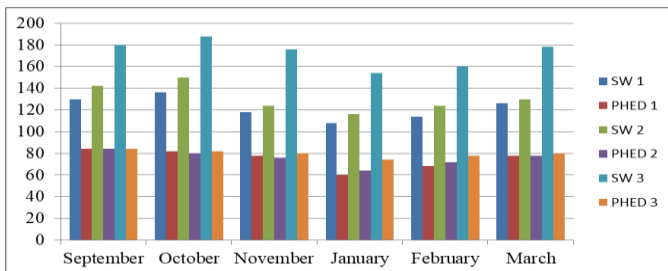


Fig 2: Graphical representation of total solids of water

**Table 3: Total Dissolved Solids**

MONTH	Site 1 Mualpui		Site 2 Tuikual		Site 3 Zotlang	
	SW	PHED	SW	PHED	SW	PHED
September	105	64	117	65	158	62
October	113	63	118	62	<b>171</b>	63
November	99	62	94	62	151	62
January	105	64	117	65	158	63
February	113	63	118	<b>60</b>	162	62
March	94	61	96	62	151	61

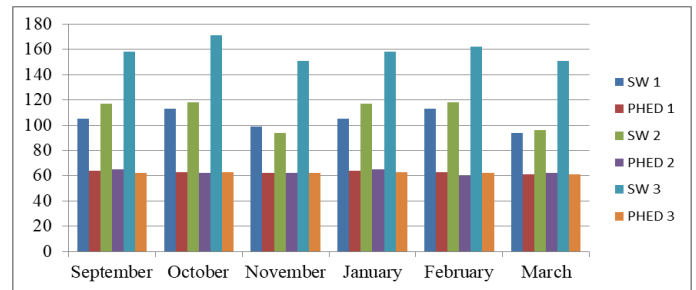


Fig 3: Graphical representation of TDS of water

**Table 4: pH**

MONTH	Site 1 Mualpui		Site 2 Tuikual		Site 3 Zotlang	
	SW	PHED	SW	PHED	SW	PHED
September	6.6	7.2	6.4	7.3	6	7.2
October	6.4	7.3	6.2	7.4	<b>5.8</b>	7.3
November	6.6	7.2	6.4	7.3	6.2	7.1
January	6.5	7.3	6.4	7.2	6.4	7.3
February	6.7	7.4	6.2	7.3	6.4	<b>7.5</b>
March	6.5	7.3	6.2	7.2	5.9	7.2

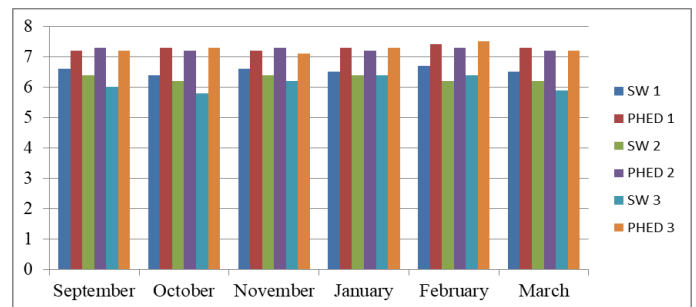


Fig 4: Graphical representation of pH of water

**Table 5: Alkalinity**

MONTH	Site 1 Mualpui		Site 2 Tuikual		Site 3 Zotlang	
	SW	PHED	SW	PHED	SW	PHED
September	65	55	60	50	65	50
October	70	50	65	55	60	40
November	65	60	55	55	55	50
January	55	40	50	<b>35</b>	55	40
February	70	60	70	40	<b>75</b>	50
March	65	50	60	45	60	50

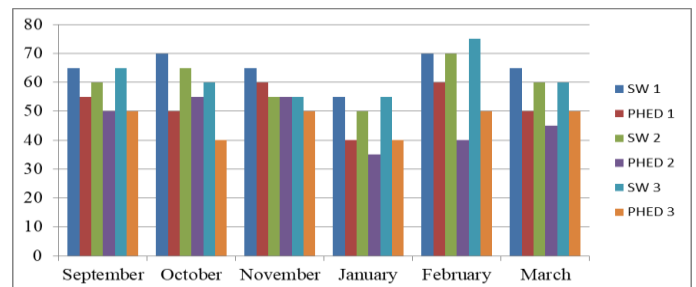


Fig 5: Graphical representation of alkalinity of water

**Table 6: Acidity**

MONTH	Site 1 Mualpui		Site 2 Tuikual		Site 3 Zotlang	
	SW	PHED	SW	PHED	SW	PHED
September	50	40	55	45	70	50
October	55	45	60	40	<b>80</b>	40
November	60	<b>30</b>	70	35	65	35
January	55	45	60	40	60	40
February	50	40	55	40	65	45
March	55	40	65	45	70	40

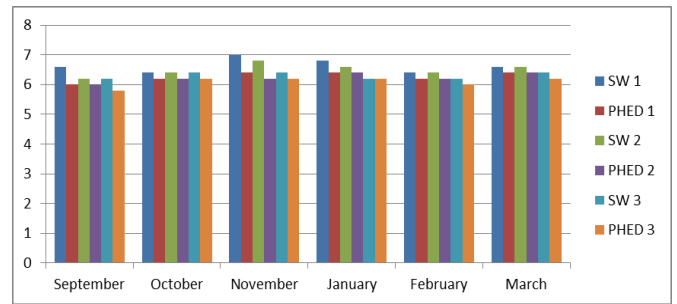


Fig 8: Graphical representation of DO of water

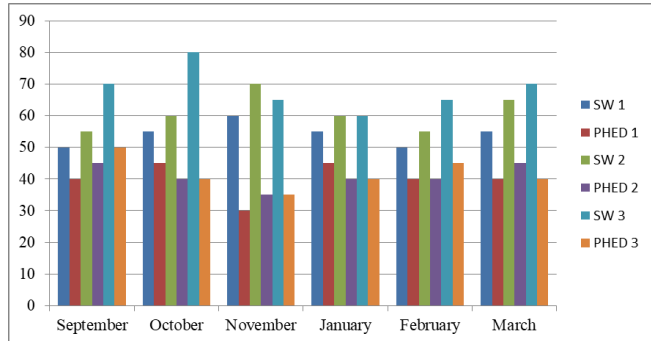


Fig 6: Graphical representation of acidity of water

**Table 7: Total Hardness**

MONTH	Site 1 Mualpui		Site 2 Tuikual		Site 3 Zotlang	
	SW	PHED	SW	PHED	SW	PHED
September	58	44	60	46	<b>62</b>	44
October	56	38	58	40	58	38
November	50	<b>34</b>	54	38	56	40
January	54	42	58	44	58	42
February	52	36	56	40	54	38
March	56	40	58	42	56	42

**Table 9: BOD**

MONTH	Site 1 Mualpui		Site 2 Tuikual		Site 3 Zotlang	
	SW	PHED	SW	PHED	SW	PHED
September	1.8	1.4	2	1.6	<b>2.2</b>	1.2
October	1.6	1.2	1.8	1.4	2	1.4
November	1.4	1.2	1.4	1.2	1.6	1.4
January	1.2	1.2	1.6	<b>1</b>	1.6	1.2
February	1.6	1.4	1.8	1.4	1.6	1.4
March	1.4	1.2	1.4	1.2	1.6	1.2

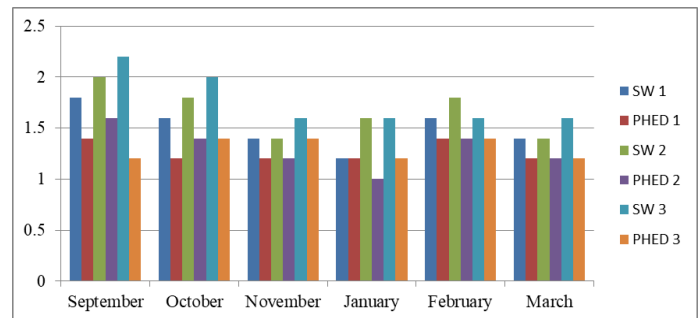


Fig 9: Graphical representation of BOD of water

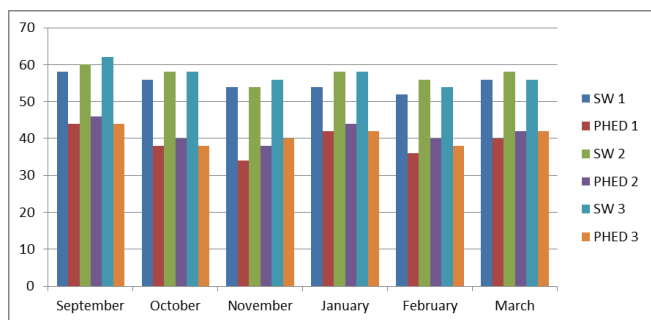


Fig 7: Graphical representation of total hardness of water

**Table 8: DO**

MONTH	Site 1 Mualpui		Site 2 Tuikual		Site 3 Zotlang	
	SW	PHED	SW	PHED	SW	PHED
September	6.6	6	6.2	6	6.2	<b>5.8</b>
October	6.4	6.2	6.4	6.2	6.4	6.2
November	<b>7</b>	6.4	6.8	6.2	6.4	6.2
January	6.8	6.4	6.6	6.4	6.2	6.2
February	6.4	6.2	6.4	6.2	6.2	6
March	6.6	6.4	6.6	6.4	6.4	6.2

## 2. Material and Methods

### 2.1 Study sites and area:

Aizawl, the capital and of Mizoram, is situated at about 1132 meters above sea level with an area of 457 km<sup>2</sup>. Aizawl lies just north of Tropic of cancer. It is an attractive city set on ridges of steep hills flanked on the north by the craggy peaks of Durtlang; the hill city overlooks the valley of the river Tlawng and ranges of blue hill beyond. The city is only about 130 years old and it is found on the top of a ridge running in the north-south direction. Aizawl district is bounded on the north by Kolasib district, on the west by Mamit district, on the south by Serchhip district, on the southwest by Lunglei district and on the east by Champhai district. The climate is pleasant throughout the year with the temperature ranging from 10°C to 30°C

The samples of natural spring water and supplied PHED water are collected from three different locations in Aizawl City as follow-

- Site 1:** Spring Water Mualpui & PHED Water Mualpui
- Site 2:** Spring Water Tuikual & PHED Water Tuikual
- Site 3:** Spring Water Zotlang & PHED Water Zotlang

### 2.2 Collection of samples:

The water collection was done during September 2019 to November 2019 and January 2020 to March 2020. The collection of water samples was done on monthly basis and the

sample was collected second week of every month. Three samples of spring water and three samples of supplied PHED were taken for each month.

Wide-mouth bottles were used to collect water samples for physico-chemical analysis. BOD bottles were used to collect samples for DO and BOD. Tags/labels for each batch and samples are given for easy identification. All the samples were analyzed immediately after the collection. Analysis for Biological Oxygen Demand was done after 5 days incubation at 20°C.

### 2.3 Analytical Method:

The American Public Health Agency, 1998 was employed for analyzing the water quality (APHA, 1998). The physico-chemical parameters include temperature, total solids, total dissolved solids, pH, alkalinity, acidity, total hardness, Dissolved Oxygen and Biological Oxygen Demand.

### 3. Result and Conclusion

The findings on physical attributes for spring water and supplied PHED water from different study sites are reflected in table below –

- 3.1. Temperature: The temperature of water is found to be highest in Site 2 Tuikual PHED supplied water in the month of September holding 23.6°C and lowest in Site 1 Mualpui spring water in the month of January with the value of 13.3°C. Water temperature mainly depends on atmospheric temperature, lower temperature at spring water could be due to location which does not receive direct sunlight while PHED supplied water come along in water pipeline which receive direct sunlight most of the time.
- 3.2. Total Solids: The total solids of water is found to be highest in Site 3 Zotlang spring water in month of October with the value of 188 mg/L, and lowest in Site 1 Mualpui PHED supplied water in the month of January with the value of 60 mg/L. From the observation, it was found out that the spring water contains more total solids than the PHED supplied water. Spring water has flowed through a region where the rocks have a high salt content whereas PHED supplied water undergoes several treatments to reduce total solids.
- 3.3. Total Dissolved Solids (TDS): The highest level of TDS is found in Site 3 Zotlang spring water in the month of October with the level of 171 mg/L., and the lowest level is found in Site 2 Tuikual PHED supplied water in the month of February with the level of 60 mg/L. From the observation, all the level of TDS found in supplied PHED water are almost same and contain lower level of TDS than spring water. Spring water contain higher TDS value due to the presence of silt and clay particles in water, urban runoff, weathering, dissolution of rocks and soil, many salts are found dissolved in water.
- 3.4. pH: The highest pH value is found in Site 3 Zotlang PHED supplied water in the month of February with the value of 7.5, and the lowest is found in Site 3 Zotlang spring water in the month of October with the value of 5.8. From the observation, it is found out that all the supplied PHED Water which is collected from different sites have higher pH value than Spring Water. This could be due to chlorination of treated water. The soils of Mizoram were mainly acidic in nature, as the pH of spring water which was continuously in contact with soil was lower in pH compare to PHED supplied water.
- 3.5 Alkalinity: The highest value of alkalinity is found in Site 3 Zotlang spring water in the month of February with the value of 75 mg/L and lowest in Site 2 Tuikual PHED supplied water in the month of January with the value of 35 mg/L. From the result, it was observed that alkalinity value was found to be higher in spring water than PHED supplied water. Alkalinity in water was presence of carbonate ions, hydroxyl ions and other alkyl group. Spring water contains minerals that make it more alkaline.
- 3.6 Acidity: The value of acidity is highest in Site 3 Zotlang Spring Water in the month of October with the value of 80 mg/L and lowest in Site 1 Mualpui PHED supplied water in the month of November with the value of 30 mg/L. Acidity in surface water is mainly due to dissolved carbon dioxide in the atmosphere forming carbonic acid; spring water which was in open space has more chance of carbon dioxide dissolve in water. This could be the reason why it has more acidity level as compare to PHED supplied water.
- 3.7. Total Hardness: Out of the sample analysed, the highest value for hardness of water is found in Site 3 Zotlang spring water in the month of September with the value of 62mg/L and lowest is found in Site 1 Mualpui PHED supplied water in the month of November with the value of 34 mg/L. From the observation, it was found that spring water contain higher hardness value than PHED supply water, this could be due to presence of calcium and magnesium ions in rocks and soil which enters in water while PHED supply water were treated using sedimentation and chlorination process which removes different ions present in water.
- 3.8. Dissolved Oxygen (DO): The highest value for dissolved oxygen is found in site 1 Mualpui Spring Water in the month of November with the value of 7 mg/L, and the lowest value is found in Site 3 Zotlang PHED Supplied Water in the month of September with the value of 5.8 mg/L. From the observation, it is found out that spring water contains more dissolved oxygen than PHED supplied water. Dissolved Oxygen enters water through the atmospheric air or as a plant by-product. As PHED supplied water were in a closed system it has less chance to get the atmospheric oxygen as compare to spring water.
- 3.9. Biological Oxygen Demand (BOD): The highest value for biological oxygen demand was found in Site 3 Zotlang spring water in the month of September with the value of 2.2 mg/L, and lowest in Site 2 Tuikual PHED supplied water in the month of January with the value of 1 mg/L. From the study, it was observed that Biological Oxygen Demand was higher in spring water than PHED supplied water. BOD in water was due to metabolic reaction of micro-organism in water. In PHED supplied water, most of the micro-organisms were died due to chlorination process results in lower BOD value compare to spring water which does not undergo any treatment.

#### 4. Conclusion

The analysis shows that there is not much cause for alarm as all the values obtained in the results are within permissible limits giving no cause for concern. However, we should bear in our mind that keeping the water free from pollutant is very important and pollution from all sources which can alter the quality should be kept at minimum level as far as possible so as to maintain the quality of water.

From the results, it is found out that supplied PHED water have higher temperature and pH value while spring water have higher value of total solids, total dissolved solids, alkalinity, acidity, total hardness, dissolved oxygen and biochemical

oxygen demand. It was observed that the water quality of natural spring water changes due to the contact of rainwater with the sedimentary rock in the region leading to dissolution of ions into the aquifer and due to various anthropogenic activities. The supplied PHED water collected from three sites was almost same in value; this could be due to the fact that the water is properly treated earlier.

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