Islamic Relief
30 Years of Transforming Lives in Pakistan

VOCAL
Save Nature for Future

PAKISTAN COUNCIL OF RESEARCH IN WATER RESOURCES
PCRWR

Water Quality Status of Natural Springs and Supply Water Sources in City Bagh, AJK

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

ACKNOWLEDGMENT

The authors would like to express their deepest appreciation to all those who provided them the possibility to complete this report. The authors are highly indebted to all members of Water Quality Testing Laboratory, PCRWR Muzaffarabad for their Scientific Contributions. Sincere and warm gratitude are to Mr. Muhammad Waseem and Mr. Waqas Ahmed Laboratory Assistant for Sampling and Testing of all Water Samples.

My thanks and appreciation goes to Dr. Tehmina Bibi, Assistant Professor, Institute of Geology, University of Azad Jammu and Kashmir, Muzaffarabad for GIS mapping. The authors are also thankful to M/s Sohail Anjum, Zeeshan Munawar and Abdul Rasheed for compiling & formatting the report. The Authors would like to extend thanks and special complements to Dr. Muhammad Iqbal Khan, Area Program Manager, Shah Faisal, WASH Specialist and Zeeshan Maqbool, Senior Child Sponsorship Officer, Islamic Relief Pakistan for facilitating this initiative aimed to improve drinking water quality in Bagh. Special thanks to Ateeq-Ur-Rehman, Advocacy Officer for active coordination with PCRWR for the publication of this report.

Authors:
Akram Aziz
Hifza Rasheed
Farah Naz
Shah Faisal, WRM Specialist IRP

EXECUTIVE SUMMARY

Access to adequate and safe drinking water is a human right and its provision is the responsibility of state. This responsibility has been conferred through the Constitution of Islamic Republic of Pakistan, Vision 2025, National and Provincial drinking water Policies and International Commitments such as Sustainable Development Goals (SDGs).

Drinking water is basic necessity for human survival and a highly important water resource. Drinking water is important to daily life and plays a vital role in the development of society. Its monitoring to assess its fitness for drinking is a first step towards its management. Pakistan Council of Research in Water Resources (PCRWR) Muzaffarabad Office with the collaboration of Islamic Relief Pakistan has conducted a water quality assessment survey of water supply sources of Bagh City AJ&K under the project Sustainable and Equitable Water Solutions in AJK (SEWA), during the period of October-2020 to April-2021. Total 50 water sources were tested, out of these 26 in phase one and 24 in second Phase. After finding the results it was found that 84.62 % and 58.33% unsafe sources were exceeded the National Drinking Water Quality Standards (NDWQS) respectively. However, the Islamic Relief has improved the community safe water supply from 15.38% to the 41.67% by the installation of filtration units on the unsafe water sources/ contaminated springs water at City Bagh by following the recommendations of PCRWR. The analytical result further shows that overall 66% of the sources were found unsafe. The main reasons were microbial contamination (66%), Fecal Contamination (50%) and Turbidity (44%). Presence of fecal contamination represented by the E-coli in 25 water sources is important and requires immediate attention.

These findings demand the due attention of implementing agencies to undertake appropriate remedial measures such as source protection, pollution control, water treatment, capacity enhancement of water supply professionals and mass awareness on value of springs and safe water. Springs in Bagh are a unique and invaluable natural resource, however these are under constant threat due to degrading environment. A comprehensive understanding of the spring systems and monthly water quality monitoring of spring water will provide the basis for their protection and wise use.

CHAPTER 1: INTRODUCTION

BACKGROUND

Safe and affordable water is a basic human right. Following the 18th amendment to the constitution of the Islamic Republic of Pakistan, the provision of safe drinking water is the responsibility of the provinces. However, Pakistan's Vision 2025 that Government of Pakistan sets a goal to provide clean drinking water for all by 2025. Similarly, Sustainable Development Goal SDG 6.1 focuses exclusively on providing safe drinking water for all by 2030.

Developing countries in Asia especially in Pakistan, India, Bangladesh and other neighboring countries are facing serious health problems due to polluted water. There is therefore, a great need for measuring drinking water sources to assess their safety for human consumption. Water levels are influenced by local processes for waste disposal. Toxins can enter the soil, rocks and enter the groundwater, leading to physical and water quality parameters. Pakistan's water resources management law is weak and little work has been done on the issue of water pollution.

The 2016 AJ&K Water and Sanitation Program reported that most households in AJ&K rely on springs as the main source of water for domestic use. Women are responsible for fetching water from household springs and this work affects 78% of girls and women regardless of water source and distance. The average watering time is 0 to 15 minutes for most households. Deterioration of water levels in springs can also affect school activities due to short-term absenteeism caused by water-borne diseases. In addition, UNDP has reported that according to a water and sanitation study a large number of people in this region lack basic services and resources such as clean drinking water and safe waste disposal (UNDP, 2018).

The level of unsafe water in springs is due to households exercising, open defecation, and ignorance of the importance of safe water. A

large number of people do not treat drinking water well because of the traditional notion that the water is flowing, clean and tasty and of good quality. Therefore, about 56% of households did not pay the full amount of water and sanitation, while others paid less. A well-designed water supply system with resource protection and water treatment does not exist and as a result, over the past few years, diarrhea and hepatitis-A have emerged as major water-borne diseases in rural Muzaffarabad, AJK (Water and Sanitation, 2016).

Natural resources, fresh spring water sources and streams are the main source of drinking water for AJK residents. It has been reported that 68.50% of drinking water samples were contaminated by Escherichia coli (International Journal of Biosciences, 2013). However, more than 80% of diseases in AJK have been identified due to the low use of water availability of water sources (Javid, 2008).

Lack of awareness, misconduct and lack of resources are the reasons why participants do not have satisfactory levels of knowledge and even those who did not have enough knowledge did not use it, a questionnaire survey was conducted on 492 university students at AJ&K. Information assessment, attitude and procedures for monitoring water quality, sanitation and hygiene. It was found that 93.67% of participants did not know about water sources in their home, 59.55% believe there is no need to clear and close water containers. However, 69.92 percent have come to realize that contaminated water contains pathogens; 75% knew that hand washing could prevent infections, but 63.82% did not wash their hands before eating. In addition, this research article concluded that lack of motivation; self-regulation, adequate social support and awareness programs appear to be influential factors in AJ&K (Rawal Medical Journal, 2018).
EPA and WHO suggest that turbidity below 5 NTU is acceptable for daily use and for health purposes should be below I NTU, high pollution in water prevents the release of pathogens, thereby posing a health risk (Journal of Chemical, Biological and Physical Sciences, 2012). However, in AJK, no municipality is provided with long-term drinking water and streams have been the main source of drinking water for local people and the random dumping of large amounts of solid waste directly pollutes water bodies (Brunel University, 2008). Water Sources in AJK are under high stress due to manifolds challenges including climate change, population growth, urbanization and unprecedented rain fall. This has not only led to unpredictable water quantity, but also water quality due to the degraded environment. The Hydrological cycle is not uniform. Forest cutting, excessive grazing and solid erosion has deterred the water quality.

Urbanization has been increased drastically in district Bagh after earthquake 2005 which has increased the burden on available clean drinking water in urban set up. Earthquake 2005 disturbed the underground water channels which increased the contamination of water sources. As per study of Public health and Engineering Department (PHED) in 2014 for AJK, water sources of district Bagh for urban area are 100% contaminated. Islamic Relief Pakistan installed four water filtration plants in different localities of urban Bagh which are contributing in providing the clean drinking water that has reduced water borne diseases significantly. Clean drinking water is available to some of the communities through these plants, however larger part of communities are still looking for clean drinking water. PHED is also providing chlorinated water to some urban areas, however larger community is dependent on raw water for drinking purpose.

It is true that a large number of people use drinking water from unsafe and polluted springs

in the Neelum Valley AJ&K, especially during the summer due to the unavailability of well-planned water supply systems and the lack of sanitation facilities or uncontrolled sewage disposal. A study in 2012 in the Neelum region has recorded that 52 out of 64 samples showing Escherichia-coli contamination due to leaks of human and animal fluids. In addition, the questionnaire survey found that regardless of age of people affected by waterborne diseases, such as diarrhea (22.7) %, cholera (12.2%), typhoid (4%), skin diseases (9.2%), eye infections (9.2%), hepatitis (2.3%), intestinal infections (worms (7.82%), intestinal infections (7%), kidney infections (3.67%) and (14.33%) hemorrhagic fever (COMSATS, 2012).

The Heavy Metals testing was conducted in the Muzaffarabad region in 2019 and 53 samples were collected from different water sources and tested for six metals namely Iron, lead, chromium, zinc, copper and manganese. These concentrations of metals ranged from 0.0 to 0.718 mg/liter between different drinking water samples and reported that 5 out of 6 metals were found in only one sample (Lacharaat), while three metals were obtained (43%) in most samples. However, 20% of the samples were found to be unsafe in the chromium (Cr) parameter compared to the WHO. At the same time, 10 drinking water sources were unsafe in the Lead parameter compared to the Government of Pakistan guidelines for drinking water. Excess lead in tap water has been shown to rust or tap water use in the distribution system and concentrations of chromium are added to the soil and Iron, zinc, copper and manganese are identified within the WHO ranges (International Journal of Hydrology, 2019).).

Bahria University, Islamabad conducted a descriptive study of the Rawalakot region during 2017-2018 and 45 samples were collected from different water sources. However, 73.33% bacterial growth was found in water sources. In addition, it is important to note that 33.33% of Escherichia coli were reported (Khyber Medical Journal, 2019).

To assess existing water quality and propose precautionary measures for the improvements of local water supply networks at city Bagh AJ&K, this current research is being conducted.

However, the overall purpose of the Technical Assessment Survey of Springs and Water Supply Schemes monitoring is to identify the contaminants such as microorganisms, chemicals that making water unsuitable for drinking. Such contamination causes serious or chronic health effects as circulatory problems, skin diseases, kidney damage, bone damage, intestinal depression, blue baby syndrome and increased risk of cancer and nervous system disorders.

PCRWR team collecting water from water supply source

CHAPTER 2: METHODOLOGY

The general methodological approach used to monitor the drinking water quality of City Bagh. The detail methods for sampling, sampling design and sampling frequency, field and laboratory testing are discussed as below.'

2.1 Study Area Characteristics

The "Bagh" region was part of the pre-independence "Poonch" region (occupying Kashmir) and was the seat of the "Poonch" region until 1987. The district Bagh consisting of three sub-divisions namely Dhirkot, Bagh and Haveli and its headquarters in Bagh. It is said that Bagh (garden) was founded by the owner of the site, where the Forest Department is now located. As a result, the area was renamed "Bagh", which is now the regional capital. It is bounded on the north by the Muzaffarabad region, on the east by the Jammu and Kashmir counties on the south by the Poonch District and on the west by Rawalpindi and the Abbottabad Districts of Pakistan.

In terms of climate, the whole region of Bagh is a mountainous region, usually descending from northeast to southwest. The area falls into a small part of the Himalayas. The main list in the region is Pir-Panjal. Haji-Pir Pass is located at an altitude of 3421 meters above sea level. The average altitude is between 1500 to 2500 meters above sea level. The mountains are usually covered with coniferous forests. The Mahl Nala in the sub-division of Bagh and the Betar Nala in the sub-division of Haveli are two major streams. However, many other rivulets flowed in the region.

Regional climate varies according to length. Temperatures typically range between 2 °c to 40 °c. The eastern part of the region is very cold in winter and mid-summer. However, the lowlands, the areas bordering the Bagh in Kohala and the surrounding areas (Mongbajri and Ajra-Bagh) remain cold in winter and hot in summer. May, June, and July are the hottest months. The highest and lowest temperatures during June are about 40 ° C and 22 ° C respectively. December, January and February are the coldest months. The maximum temperature in January can be 16 ° C and the minimum temperature is 3 ° C respectively.

The annual rainfall is about 1500 millimeters. Pine, kail, fir and other trees such as poplar, shisham, kikar, willow, walnut, ban-akhore, chinar and mannu are found in abundance in the region. Among the flowers zianna, dahlia, merrygold, cosmos, daffodil, aster and rose of various species are found in the region. Rural communities are particularly committed to planting fruit crops to meet the needs of the people. As a result, agricultural and fruit farms have been established by the Department of Agriculture.

Regional wildlife is most common in the Haveli area where Markhore, Himalayan thar, cat leopard and bear are found. Among the birds murgh zareen, chakore and moned pheasant are found. Murgh zareen and shahin are confined to high mountain forests and chakore is often found on low vegetation. The main crops of the region are maize and wheat but in some areas rice, gram, bajra and jawar are also cultivated. Pulses of different types are also planted in different parts of the region. Similarly, the soil of the region is also suitable for sunflower, mustard and basmati rice. Buffaloes and sheep / goats are kept in almost every home for milk and other dairy products (District Profile Bagh ERRA, 2007)

AJ&K's fresh water sources are based on rainstorms, snow and melting ice, which is very sensitive to climate change. The patterns, locations and intensity of heavy rainfall, as

well as the time of snowfall change due to global warming. Azad Kashmir's Mountainous Ecosystems are reportedly at high risk of global warming and are expected to show their impact soon. In addition to the anthropogenic causes of the increase in water quality pollution, the effects of climate change have also contributed to the increase in water pollution (Climate Change Policy AJK, 2017).

The figure 2.1 shows the existing administrative features of district Bagh AJ&K that is developed by GIS digitalized Laboratory of Land Use Planning and Development Department, Government of AJ&K Muzaffarabad.

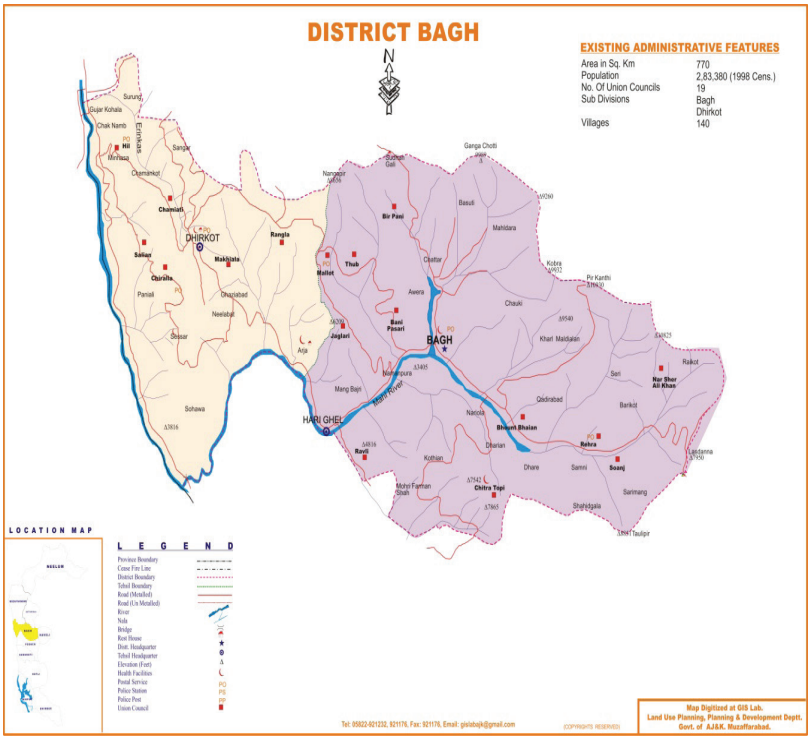

Figure 2.1 Map of District Bagh AJ&K

2.2 STUDY DESIGN:

A uniform and statistically valid criteria was followed for site selection and grid size, i.e. 1 km2. Samples were taken from locations that are representative of the water source, treatment plant, storage facilities, distribution network, points at which water is delivered to the consumer and points of use. Monitoring was conducted at regular sites ("fixed stations") on a continuous basis. In this regard, fixed public points were given preference for the long term monitoring to gauge changes over time.

The two monitoring points kept apart at minimum distance of 1 km. Site identification mark was done on each city map according to the grid. Sample ID for monitoring purpose was marked on the basis of actual sampling visit sequence of various sites. The details regarding grid size and sampling points (number) are shown in Table 1.

Table 2.1 Detail of Number of samples collected along with grid size

Sr. #	City Name	Sample Code	Grid Size	Total Sample points
1.	Bagh AJ&K	IR-BAG	1	50

In total 50 samples were collected by Following the American Public Health Association Protocols (APHA, 2012) for sampling, Laboratory testing and quality control. The water samples from springs and supply water located in District Bagh were collected during October-2020 to April-2021. The selected sampling sites at city Bagh and their GIS position are elaborated below in the Figure 2.2.

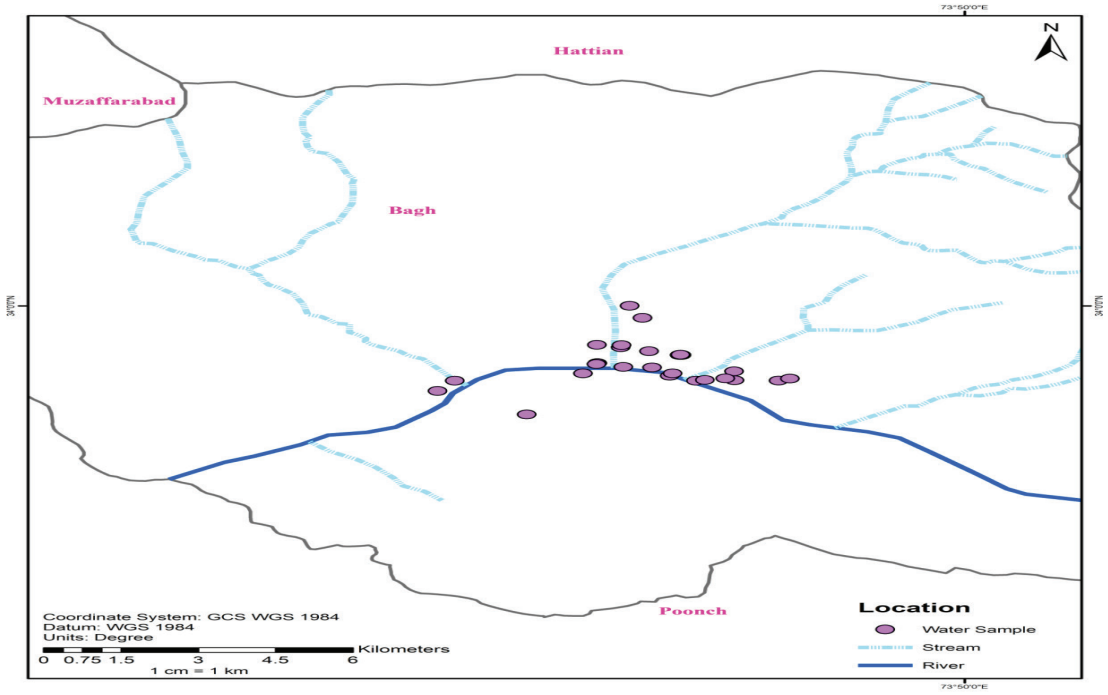

Figure 2. 2 GIS map of sampling sites in Bagh, AJK

2.3 Sampling Pre-Requisites and Procedure

The sampling team were well aware of monitoring objectives comprised of a technical officer, a Laboratory technician. Following a uniform methodology in accordance with the American Public Health Association Protocols (APHA, 2017), four types of samples were collected from each site, preserved, labeled and transported to the PCRWR water quality laboratory Muzaffarabad. The details of these samples and preservatives used for each sample are given below in Table 2.2.

Table 2.2 Details of samples identification, sampling container, and preservatives

Samples type per site	Purpose	Sites	Sampling container	Preservatives
Type A	Microbiological testing	All sites	Pre-sterilized sampling bottles of 200 ml capacity	Pre-sterilized sampling bottles
Type B	Trace elements	All sites	Polystyrene bottles of 0.5 liter	2 ml/liter Nitric Acid (HNO3) added in the bottles before going to field
Type C	Nitrate	All sites	-do-	1 ml/100 ml, 1 Molar Boric acid added in the bottles before going to field
Type D	Other physio-chemical parameters	All sites	Polystyrene bottles of 1.0 liter	No preservative

Before collecting samples and adding preservatives, bottles (B, C and D) were washed properly and rinsed thoroughly with deionized water. The samples collected for chemical analysis were transported to the laboratory without ice boxes. Residual chlorine, pH and turbidity were tested immediately after sampling as they could change during storage and transportation.

The water samples for microbiological contamination were collected in clean, sterile plastic bottles (200 ml). Proper care was taken to ensure that no accidental contamination occurs during sampling. Samples were not taken from those taps, which were leaking between the spindle and gland to avoid outside contamination. The type-A samples were transported to the laboratory under controlled temperature (2 and 8 oC) in a properly light proof and disinfected insulated box. Water samples containing traces of chlorine were treated with sodium thiosulfate to neutralize any chlorine present, incase chlorine is not neutralized, microbes may be killed during transit and an erroneous result will be obtained. The time between sample collection and analysis did not exceed 6 hours. All samples were accompanied by an appropriate samples collection form. Field observations and information regarding each sample (such as sample types, sample ID, sample code given to the sample, GPS reading, date and time of sample collection, physical conditions like water-table depth etc.) were recorded on the sample collection Proforma. Following procedures and precautionary measures were followed while collecting samples from different water sources.

2.3.1 Tap

Un-rusted taps were selected for collection of water samples. These taps were properly disinfected and allowed to flow for a few minutes before collecting the sample.

2.3.2 Distribution Network

The water samples from the distribution network were collected from the source of supply (as closely as possible) to minimize the effects of pollution in the distribution system and from point of use (PoU) to evaluate the actual quality of water being used. All water sample containers were filled slowly to avoid turbulence and air bubbles after flushing the system for sufficient time.

2.3.3 Stream

Water samples were collected from the center by standing in the middle of the stream. Care was taken to keep the bottle well above the bed of the stream to avoid unwanted bed material going into the sample.

2.3.4 Spring Water

Water samples were collected directly from the spring in sterilized sampling bottles for microbiology and bottles used with or without preservatives for other water quality parameters.

Figure 2. 3 Sampling and field chlorine testing of water sources

2.4 Collaboration and Capacity Building

PCRWR Regional Office, Muzaffarabad conducted the training sessions for capacity building of the officers and staff of the Islamic Relief on water quality importance, sampling procedures and domestic water treatment techniques. However, different meeting were conducted during the technical water quality assessment survey, the PCRWR office working on collaboration with Islamic Relief on an efficient strategies development on water resource management and climate change adaptations.

Figure 2. 4 PCRWR and Islamic Relief officers' regional meetings during survey

2.5 Quality Assurance

For the quality assurance purpose, cross, field blank and replicate samples were also collected.

- Sites for cross samples were selected owing to site number divisible by 10. (10%)
- Sites for field blank and replicates were on the basis of site number divisible by 20 (5%).

Field blank and replicate samples were planned to be analyzed in the same laboratory to see the quality of distilled water and reproducibility of analytical results.

2.6 Distribution of Water Sources

The detail of types and number of sources monitored during the period from October-2020 to April-2021 is tabulated as Table 3:

Table 2- 3 Distribution of Water Sources

Sr.#	City	Total No. of Samples	Types and Number of Water Sources Monitored
1.	Bagh	50	Water Supply (14), Filtration Plants (10), Spring Water (26)

2.7 Laboratory Testing

The water samples were analyzed for aesthetic, physico-chemical and bacteriological parameters by using American Public Health Association (APHA) standard methods [Americana Public Health Association, 23rd Addition]. The details of the parameters and methods used for their testing are listed in Table 4.

Table 2- 4 Water quality parameters and methods used

Sr.#	Parameters	Analysis Method
1	Alkalinity (mg/l as CaCO3)	2320, Standard method (2017)
2	Arsenic (ppb)	AAS Vario 6, Analytik Jena AG (3111B APHA) 2017
3	Bicarbonate (mg/l)	2320, Standard method (2017)
4	Calcium (mg/l)	3500-Ca-D, Standard Method (2017)
5	Carbonate (mg/l)	2320, Standard method (2017)
6	Chloride (mg/l)	Titration (Silver Nitrate), Standard Method (2017)
7	Conductivity (mS/cm)	E.C meter, Hach-44600-00, USA
8	Hardness (mg/l)	EDTA Titration, Standard Method (2017)
9	Magnesium (mg/l)	2340-C, Standard Method (2017)
10	Nitrate as Nitrogen (mg/l)	Cd. Reduction (Hach-8171) by Spectrophotometer
11	pH	pH Meter, Hanna Instrument, Model 8519, Italy
12	Potassium (mg/l)	Flame photometer PFP7, UK
13	Sodium (mg/l)	Flame photometer PFP7, UK
14	Sulfate (mg/l)	SulfaVer4 (Hach-8051) by Spectrophotometer
15	Phosphate (mg/l)	8190 and 8048 Colorimeters (HACH)
16	TDS (mg/l)	2540C, Standard method (2017)
17	Turbidity (NTU)	Turbidity Meter, Lamotte, Model 2008, USA
18	Fluoride (mg/l)	4500-FC.ion-Selective Electrode Method Standard (2017)
19	Total Coliforms	9221-B,C&D, Standard Methods (2017) APHA
20	E-coli	9221-B,C&D, Standard Methods (2017) APHA

All test results were compared with the permissible limits of National Drinking Water Quality Standards of Pakistan (NDWQS) (Table 5) to evaluate the degree of fitness of water sources for drinking purpose.

Figure 2. 5 PCRWR team performing tests at District Bagh AJK

Table 2- 5 Water quality permissible limits for drinking water

Sr. #	Parameter	Units	Permissible Limits of NDWQS
1.	Alkalinity	mg/l	NGVS
2.	Bicarbonate	mg/l	NGVS
3.	Calcium	mg/l	NGVS
4.	Carbonate	mg/l	NGVS
5.	Chloride	mg/l	250
6.	Colour	TCU	Colourless
7.	Conductivity	µS/cm	NGVS
8.	Fluoride	mg/l	1.5
9.	Hardness	mg/l	500
10	Iron	mg/l	0.3
11.	Magnesium	mg/l	NGVS
12.	Odour	-	Unobjectionable
13.	Nitrate-N	mg/l	10
14.	pH	-	6.5-8.5
15.	Potassium	mg/l	NGVS
16.	Sodium	mg/l	NGVS
17.	Sulfate	mg/l	NGVS
19.	TDS	mg/l	1000
20.	Turbidity	NTU	←5
22.	Arsenic	µg/l	50
23.	*Total Coliforms	CFU/100ml	0
24.	*E-Coli	CFU/100ml	0

CFU = Colony Forming Unit
TCU= Total Colour Units
WHO= World Health Organization
NGVS= No Guideline Value Set
NDWQS= National Drinking Water Quality

Chapter 3: Results & Discussion

A Water Quality Assessment survey of Water Supply Sources at City Bagh was conducted during the period from October-2020 to April-2021. Total 50 water sources were tested, out of these 26 in phase-I and 24 in Phase-II. After finding the results it was found that 84.62 % and 58.33% unsafe sources were exceeded the National Drinking Water Quality Standards (NDWQS). However, the Islamic relief has improved the community safe water supply from 15.38% to the 41.67% by the installation of filtration units on the unsafe water sources/ contaminated springs water by following the recommendation of PCRWR. The detail analysis is given at the annexure-IV.

Table 3.1 Water Quality Status of City Bagh

	Total No. of samples Analyzed	Water Quality Status	Safe		Unsafe	
			No.	(%)	No.	(%)
1.	26	2020	04	15.38	22	84.62
2.	24	2021	10	41.67	14	58.33

The analytical results show that 66.00% of the sources were found unsafe. The main reasons were microbial contamination (66.00%), Fecal Contamination (50.00%) and Turbidity (44.00%). The detail is shown (Table 7). Presence of fecal contamination represented by the E-coli in 25 water sources is important and requires immediate attention.

Table 3.2 The level of major parameters exceeding the NDWQS in City Bagh AJ&K

Water Quality Parameter	Unit	Total No. of Samples Analyzed	Number of contaminated samples	%age of contaminated samples
Turbidity	NTU	50	22	44%
Total Coliforms	CFU/100ml	50	33	66%
E-coli	CFU/100ml	50	25	50%

Figure 6 shows the comparison of the water quality results of 26 samples in phase-one and 24 samples in Phase-two and improvements were recorded in the safe water supply in the second phase of the testing as done by Islamic Relief Area Office Bagh, AJK.

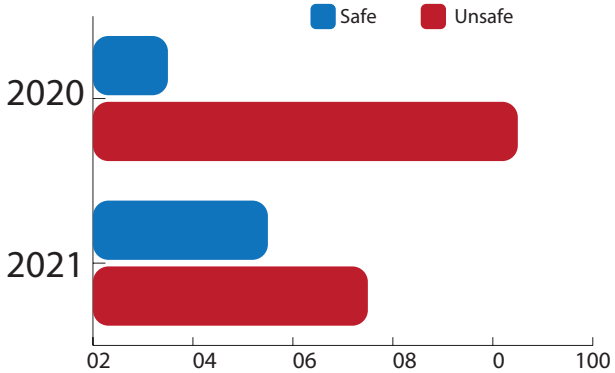

Figure 3. 1 Two year comparison of Water Quality Status of City Bagh AJ&K

Figure 3.2 shows the technical assessment survey GIS location of the water quality contaminants sites at the city Bagh AJ&K.

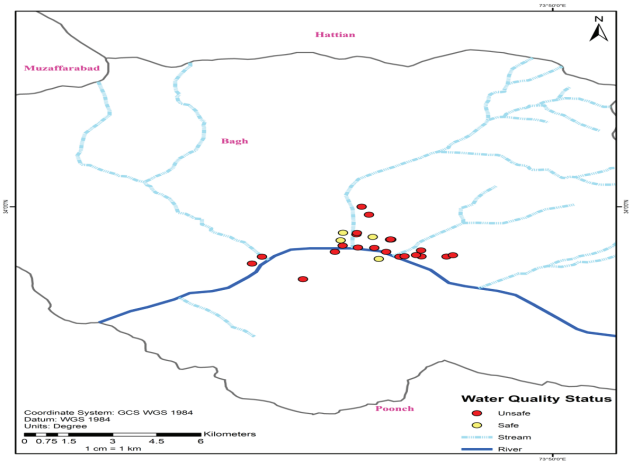

Figure 3. 2 GIS Characterization of Tested Water Sources Contamination

CHAPTER 4: CONTRIBUTION OF ISLAMIC RELIEF IN ADDRESSING WATER CONTAMINATION

Under this project according to the plan a total of 10 water filtration plants have been installed in different urban localities of Bagh AJK town. The location for installations of water filtration plants were identified with the collaboration and technical backstopping of the Public Health and Engineering Department (PHED) Bagh, AJK and communities of that particular area.

Water sources selected for installation of water filtration plants were based on results of water sample test through Pakistan Council of Research in Water Sources (PCRWR). All the 10 identified water sources were highly contaminated with E.coli, faucal material and other biological contaminations reported in water quality report. After installation of water filtration plants again water samples were taken to PCRWR for analyses.

The test reports of the post installed schemes were satisfactory and safe for human consumption. This will ultimately reduce the water borne diseases in the target communities. Islamic Relief Pakistan (IRP) also established a water testing laboratory in Bagh, the district headquarter.

All these 10 water filtration plants and water quality testing laboratory were handed over to PHED department in the presence of additional chief secretary AJK and country director IRP to ensure the sustainability of project in future. The chief secretary committed to provide additional technical staff to run the water quality testing laboratory effectively. This will provide an opportunity to the local and adjoining communities to bring their water samples for quality testing purpose. This facility was not available in district Bagh hence there was no way for the communities to know in the past that the water they were drinking was fit for human consumption or not.

Through the advocacy and coordination meetings with the District level stakeholders and PHED a total of 56 participants from the Government line department and civil society organizations (CSOs) were engaged to discuss the importance of water and results of the water contamination shared. The water quality results would serve as reference to maintain the quality of water in future. The PHED official ensured to extend their departmental support in sustaining the project deliverables and maintaining the water quality of the plants.

A total of 120 community activists from the 10 community organization remained engaged with the project team for project planning, execution and completion of its activities. The engagement enhanced the awareness, interest, and buy-in of the communities relating these water filtration plants and the importance of clean drinking water for human health. This participation of communities was inclusive as it included the female, PWDs and elderly members of the communities.

For each scheme a committee was formed and provided repair and maintenance training for the upkeep of the water filtration plants in future. Along with the training the participants were also provided tool kits for maintenance work relating these schemes.

The project team also raised awareness of the communities, stakeholders, and Civil Society Organizations about the climate change impacts. They learned about the importance of clean water and how clean and safe water can reduce the

burden of common illnesses, such as diarrheal disease, especially among children.

IRP has been following strategic priority and guiding Integrated Water Resource Management (IWRM 2017 - 2021), which supplemented the Sustainable Development Goal No. 6 and demand for safely managed water and sanitation services.

Figure 4. 1 Inauguration of Water Filtration plant DHQ hospital and water quality testing laboratory

Figure 4. 2 Project Lead briefing to donor Green Lane Mosque (GLM) representative visit

Figure 4. 3 Children are filling their bottles with water

Figure 4. 4 Filtration Plant view

Figure 4. 4 Filtration Plant view

Figure 4. 5 Handing over ceremony of FPs and water quality testing lab to PHED Bagh

Chapter 5: Conclusion and Recommendations

It is evident from the table 6 & 7 and figure 6 that the 26 out of 50 tested water resources were exceeding the National Standards of Drinking Water Quality (NSDWQ) and WHO drinking water quality guideline values. The prevalent microbial contamination (60%) revealed that there is dire needed to identify the major causes of contamination, and disinfect unsafe sources as these are the only sources of drinking water for community and causing water borne diseases at city Bagh AJ&K.

The probability of some mixing of sewage in water supply pipelines due to less distance between water supply and sewage pipes, unsafe storage in water tanks or disposal of domestic wastes in the surroundings of natural springs (Figures 8). Moreover, open defecation and disposal of untreated wastewater are two important sources of fecal contamination of these water sources. Lack of public awareness on water pollution and related implications is also another constraint to be overcome.

Figure 5. 1 PCRWR team collecting water samples from spring source in District Bagh AJK

5.1 RECOMMENDATIONS

The National Water Policy, Pakistan Vision 2025 and UN Sustainable Development Goals (SDG's) 2030 impose obligations to ensure access to clean drinking water for all. To achieve this goal following recommendations are given in the light of this monitoring outcome:

a. Water Source protection and maintenance of hygienic conditions at the sites of springs, tube wells, hand pumps and water supply schemes should be ensured in this context, a surveillance program in AJ&K may also be established to identify incompatible land uses or potential contaminant threats within the catchment area and vicinity of water sources. There is a need to develop the water quality protection framework (as part of the Pakistan's National Drinking Water Policy) for public drinking water source areas to safeguard from contamination.

b. Capacity Building of professionals of PHED Department, Local Agencies for water quality Monitoring disinfection of water sources is highly recommended. Awareness among local citizens is about proper disposal of wastewater, trash into springs and safe storage of water at household level.

c. Natural springs that are found unsafe under current survey immediately should be marked as "Unsafe" by displaying a board and people should be educated to use alternate source. There is dire needed to install water treatment plants such as community water filtration plants to ensure safe water supply and people should be educated to use alternate water sources.

d. Government of AJK may develop policies, projects and awareness campaigns on the importance of the safe spring water supply by engaging all stakeholders focused to

improve knowledge, perception, attitude and practices of citizens on safe spring water and related WASH practices.

e. Use of water purification and disinfection methods either at source-to-supply network or at household level is required. This also requires the need of diligent and effective water quality monitoring and purification by the PHED and local community to prevent potential health risks.

f. The provision of safe water, sanitation and hygienic conditions is essential for protecting human health during currently on-going life-threatening pandemic of COVID. Thus, ensuring evidence based and consistently applied WASH and waste management practices in communities, homes, schools, workplaces and health-care facilities will help to prevent human to human transmission of COVID- 19.

REFERENCES

1. The Azad Government of the State of Jammu & Kashmir, the Planning & Development Department, Statistical Yearly Book, 2020.
2. The Azad Government of the State of Jammu & Kashmir, the Planning & Development Department, Climate Change Policy, 2017.
3. Water and Sanitation Program, Local Government and Rural Development Department, Government of Azad Jammu & Kashmir, 2016.
4. Idris I. Local Capacity Development Investments for MDG Localization in Pakistan. Islamabad: UNDP: 2018
5. Javid, S., Shah, S. G. S., Chaudhary, A. J., & Khan, M. H. (2008). Assessment of trace metal contamination of Drinking Water in the Pearl Valley, AJK, Clean-Soil, Air, Water, 36(2), 216-221.
6. S. Ali, A. Hussain, A. Ali, and M. S. Awan, "Drinking Water Quality Assessment in some selected villages of Nagar Valley Gilgit Baltistan, Pakistan. Journal of Chemical Biological and Physical Sciences, Vol. 3, pp.567-574, 2012.
7. Javed. A, Tabbasum. T, and others, Knowledge, Attitude and Practices of Water Sanitation and Hygiene of students in AJK Shifa International Hospital, Islamabad and Zia-un-deen Hospital Karachi, Pakistan. Rwal Medical Journal: Vol. 43. No.3, July-Sept. 2018.
8. Javid, S., Sarwar, G. S., Jabbar, A. C., and Haleem, M. K. (2008). Assessment of trace metal Contamination of drinking water in the pearl Valley, AJK, Brunel University, 36 (2), pp. 216-219.
9. A scientific journal of COMSATS-SCIENCE VISION Vol.18 No.1&2, January to December 2012.
10. Ali. U, Batool. A, Ghufran. M. A, et al. Assessment of heavy metal contamination in the drinking water of Muzaffarabad, Azad Jammu and Kashmir, Pakistan. International Journal Hydrology 2019; 3(5):331□337.
11. Shoukat S. W, Khan S. A, Ishtiaq M, Shah I, Jamil S. U. U, Khan T. Bacteriological assessment of drinking water of Rawalkot district, Azad Kashmir, Pakistan. Khyber Medical University Journal 2019; 11(4):222-5.
12. District Profile – Bagh, Earthquake Reconstruction & Rehabilitation Authority (ERRA), June 2007.

ANNEXURE-I

Detailed Pictorial View of the activities performed before and during the Technical Assessment report compilation of Bagh City, AJ&K.












ANNEXURE-II

Detailed GIS Co-ordinates and Water Quality Results of Bagh City, Phase-I

Sample Codes	Locations	Latitude	Longitude	Altitude	Over All Water Quality Status
IRP-01-2020	Spring near Turki Masjid Hassan Abad	73.78640000	33.97307333	1078.60	Unsafe
IRP-02-2020	Water Supply Hassan Abad	73.78795333	33.97334667	1102.50	Unsafe
IRP-03-2020	Water Supply, Grid Colony	73.76916500	33.97941333	1057.80	Safe
IRP-04-2020	Grid Colony Spring	73.76901500	33.97905667	1048.60	Unsafe
IRP-05-2020	Water Supply, Khan Mullaha	73.78182500	33.97486167	1067.10	Safe
IRP-06-2020	Imamia Colony Spring	73.77871333	33.97782333	1072.30	Unsafe
IRP-07-2020	Anwar-e-Mustafa Spring, Main By-pass	73.465471400	33.582959200	1068.50	Unsafe
IRP-08-2020	Water Supply District Complex	73.79303333	33.97646500	1168.00	Unsafe
IRP-09-2020	Plain Batti Spring, Kana Mori	73.78353500	33.98231333	1222.20	Unsafe
IRP-10-2020	Water Supply, Plain Batti	73.78388000	33.98233667	1249.10	Unsafe
IRP-11-2020	Water Supply Ganga view shop, Officer Colony	73.77820000	33.98371667	1129.20	Safe
IRP-12-2020	Bagloor Spring	73.80081833	33.97313000	1240.30	Unsafe
IRP-13-2020	Water Supply, Bagloor	73.80277500	33.97385500	1333.50	Unsafe
IRP-14-2020	Alkharia Spring No.1, Near Police Line	73.77323800	33.98512500	1025.20	Unsafe
IRP-15-2020	Alkharia Spring No.2, Near Women University	73.77338833	33.98586667	1016.16	Unsafe
IRP-16-2020	HSpring Water	73.77368934	33.97802434	1169.00	Unsafe
IRP-17-2020	Mohri	73.78368100	33.98243868	1220.00	Unsafe
IRP-18-2020	DHQ Khwaja Mullaha Baglor	73.79313434	33.97323600	1168.00	Unsafe
IRP-19-2020	BagloorKalss	73.76911600	33.98596760	1215.00	Safe
IRP-01-2021	NandariRehmanGali, Jamia Masjid Alamia	73.77707/67	33.9957033	1218.50	Unsafe
IRP-02-2021	Jamia Masjid NaumanPura	73.74125833	33.9693933	965.30	Unsafe
IRP-03-2021	Nandari Cross (2)	73.77480833	34.000033	1237.90	Unsafe
IRP-04-2021	By Pass spring field	73.76664667	33.97568833	104.60	Unsafe
IRP-05-2021	BaniPassari By Pass	73.78232667	33.97568833	1079.60	Unsafe
IRP-06-2021	DHQ Hospital Bagh	73.79150833	33.97392833	1228.90	Unsafe
IRP-07-2021	Naumanpura Petrol Pump (Masjid)	73.74428333	33.97306167	987.70	Unsafe

Detailed GIS Coordinates and Water Quality Results of Bagh City, Phase-II

Sample Codes	Locations	Latitude	Longitude	Altitude	Over All Water Quality Status
IRP-01	Hassan Abad	33.97329000	73.78770500	1113.30	Safe
IRP-02	DHQ Hospital	33.97402833	73.79171669	1180.50	Safe
IRP-03	PHED DHQ	33.97680167	73.79175667	1232.50	Safe
IRP-04	Plane Bhatti	33.982305000	73.78355667	1232.50	Safe
IRP-05	Nindari	33.99589833	73.7768167	1217.10	Safe
IRP-06	Paddar	34.01064833	73.77535167	1243.10	Safe
IRP-07	Grid Colony	33.97918333	73.76940333	1050.00	Safe
IRP-08	By pass colony Imamia	33.97769333	73.77862500	1065.70	Safe
IRP-09	Bagloor	33.97534500	73.79430667	1222.40	Safe
IRP-10	Mohri	33.97834833	73.78714000	1199.10	Safe
IRP-11	By pass Near National Science	33.97845333	73.77579000	1060.00	Unsafe
IRP-12	Hullar Sydain	33.97034667	73.78516667	1107.30	Unsafe
IRP-13	Hullar Saydain Exchange Road	33.96099833	73.79443667	1193.20	Unsafe
IRP-14	Paddar Nala	34.01531833	73.9761200	1201.50	Unsafe
IRP-15	Lari Ada Near Masjid	33.98353667	73.772615000	1073.00	Unsafe
IRP-16	PHED Lab	33.98405000	73.77354667	1062.30	Unsafe
IRP-17	Ali Abad Near Private House	33.99377833	73.78719667	1846.80	Unsafe
IRP-18	Chowk Qadriabad	33.95622833	73.8134933	1165.70	Unsafe
IRP-19	Bani Passari	33.98242500	73.75376000	1078.60	Unsafe
IRP-20	Saver Matwali	34.01781667	73.79203500	1338.00	Unsafe
IRP-21	Bani Pasari Near Agosh House	33.97649167	73.76319500	1009.00	Unsafe
IRP-22	Halan Near ARC camp	34.01468833	73.79858333	1313.60	Unsafe
IRP-23	Kotera Mast Khan	33.97731000	73.7336500	1218.80	Unsafe
IRP-24	Bhount Lower	33.95820667	73.80997000	1171.00	Unsafe

Islamic Relief AJ&K, Detailed Water Quality Results of Bagh City, Phase-I,

Sample Code	Location	Source	EC	pH	Turbidity	Cl	HCO3/ ALK	CO3	Ca	Mg	Hard	Nitrate (N)	Flouride	Sodium	Potassium	As	Sulphate	TDS	Total Coliform	E.coli	Remarks
Units		-	µS/cm	–	NTU	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	ug/l	mg/l	mg/l	(CFU/100 ml)	(CFU/100 ml)	
Maximum Permissible Limits NSDWQ		-	NGVS	6.5-8.5	5.00	250	NGVS	NGVS	NGVS	NGVS	500	10.00	1.50	NGVS	NGVS	50.00	NGVS	1000	0	0	Safe/ Unsafe
IRP-01	Spring near Turki Masjid Hassan Abad	Spring Water	515	7.82	8.3	10	260	BDL	60	24	250	4.18	BDL	9	1.9	BDL	16	283	60	6	Unsafe
IRP-02	Water Supply, Hassan Abad	Water Supply	283	7.9	7.5	16	180	BDL	44	7	140	0.75	0.15	5	1	BDL	15	155	30	0	Unsafe
IRP-03	Water Supply, Grid Colony	Water Supply	285	7.95	0.6	12	170	BDL	72	3	190	0.66	0.3	5	0.9	BDL	14	157	0	0	Safe
IRP-04	Grid Colony Spring	Spring Water	314	7.96	10.7	14	150	BDL	60	5	170	0.78	0.02	6	1.3	BDL	15	172	70	25	Unsafe
IRP-05-2020	Water Supply Khan Mullaha	Water Supply	277	7.24	0.8	9	160	BDL	48	10	160	0.71	0.27	4	0.8	BDL	14	152	0	0	Safe
IRP-06	Imamia Colony Spring	Spring Water	415	7.2	1.3	14	210	BDL	64	17	230	3.36	0.03	9	1.6	BDL	18	228	18	11	Unsafe
IRP-07	Anwar-e-Mustafa Spring, Main By-pass	Spring Water	432	7.13	1.9	17	200	BDL	40	26	210	2.55	BDL	8	1.6	BDL	16	237	7	0	Unsafe
IRP-08	Water Supply District Complex	Water Supply	284	7.25	0.5	14	180	BDL	40	12	150	0.72	BDL	11	0.8	BDL	13	156	10	0	Unsafe
IRP-09	Plain Batti Spring, Kana Mori	Spring Water	728	7.08	8.9	24	340	BDL	24	19	140	8	BDL	15	0.7	BDL	26	400	56	16	Unsafe
IRP-10	Water Supply, Plain Batti	Water Supply	283	7.7	6.5	12	200	BDL	48	9	160	0.73	BDL	4	0.8	BDL	16	155	0	0	Unsafe
IRP-11	Water Supply Ganga view shop, Officer Colony	Water Supply	267	7.82	1.9	10	140	BDL	44	26	220	0.73	BDL	4	0.9	BDL	15	146	0	0	Safe
IRP-12	Bagloor Spring	Spring Water	550	7.41	8.6	14	270	BDL	36	26	200	2.95	0.03	9	1.2	BDL	19	302	0	0	Unsafe
IRP-13	Water Supply , Bagloor	Water Supply	408	7.24	10.1	12	210	BDL	32	38	240	1.15	BDL	7	1.1	BDL	15	224	4	0	Unsafe
IRP-14-2020	Alkharia Spring No.1, Near Police Line	Spring Water	354	8.1	6.9	14	350	BDL	24	29	180	1.76	BDL	6	1	BDL	15	194	6	3	Unsafe

IRP-15	Alkharia Spring No.2, Near Women University	Spring Water	308	7.9	1	12	180	BDL	24	24	160	0.99	0.04	5	1	BDL	15	169	40	9	Unsafe
IRP-16	House of Rasheed Khan	Spring Water	436	7.72	7.2	19	240	BDL	44	26.73	220	1.25		6.9	1.5	BDL	14	239	10	0	Unsafe
IRP-17	Mohee	Water Supply	293	7.66	2	24	180	BDL	48	14.58	180	1.35	0.06	4	0.9	BDL	12	161	8	0	Unsafe
IRP-18	DHQ Khwaja Mullaha Bagloor	Water Supply	308	7.68	10.1	24	190	BDL	44	19.44	190	BDL	0.05	6	1.23	BDL	13	169	0	0	Unsafe
IRP-19	Bagloor Kalss	Water Supply	300	7.64	1.1	2.6	160	BDL	40	19.44	180	0.99	BDL	8	1.2	BDL	14	165	0	0	Safe
IRP-01	Nandari Rehman Gali, Jamia Masjid Alamia	Water Supply	353	7.5	9.4	14	150	BDL	40	12.5	150	1.07	0.03	12	1.4	BDL	10	194	27	2	Unsafe
IRP-02	Jamia Masjid Nauman Pura	Spring Water	733	7.57	11.5	19	280	BDL	48	41	290	2.1	0.34	16	1.6	BDL	15	403	20	6	Unsafe
IRP-03	Nandari Cross (2)	Water Supply	605	7.35	1.09	17	220	BDL	36	34	230	1.07	BDL	13.05	1.2	BDL	12	332	40	3	Unsafe
IRP-04	By Pass spring field	Spring Water	625	7.1	1.08	19	230	BDL	40	34	240	1.09	0.33	14	1.02	BDL	10	343	80	0	Unsafe
IRP-05	Bani Passari By Pass	Spring Water	504	7.15	9.04	19	190	BDL	44	21	200	1.09	0.56	14.9	1.05	BDL	13.6	277	76	0	Unsafe
IRP-06	DHQ Hospital Bagh	Water Supply	356	6.9	9.9	14	150	BDL	48	14.58	180	0.05	0.62	5	0.9	BDL	12.6	196	30	20	Unsafe
IRP-07	Naumanpura Petrol Pump (Masjid)	Spring Water	405	7.4	8.7	19	150	BDL	40	19	180	1.03	0.45	6.05	1.25	BDL	12.09	223	78	75	Unsafe

Islamic Relief AJ&K, Detailed Water Quality Results of Bagh City, Phase-II,

ANNEXURE-IV

Sr. No.	Sample Code	Location	Source	EC	pH	Turbidity	Cl	HCO3/ ALk	CO3	Ca	Mg	Hard	Nitrate (N)	Flouride	Sodium	Potassium	As	Sulphate	TDS	Total Coliform	E.coli	Remarks
Units			-	µS/ cm	–	NTU	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	ug/l	mg/l	mg/l	(CFU/100 ml)	(CFU/100 ml)	Safe/ Unsafe
Maximum Permissible Limits NSDWQ			-	NGVS	6.5-8.5	5.00	250	NGVS	NGVS	NGVS	NGVS	500	10.00	1.50	NGVS	NGVS	50.00	NGVS	1000	0	0	
1	IRP-01	Hassan Abad	Filter Plant	535	7.15	0.3	21	280	BDL	48	41	290	1.3	BDL	16	0.9	BDL	11	267	0	0	Safe
2	IRP-02	DHQ Hospital	Filter Plant	266	7.11	0.2	12	150	BDL	32	17	150	0.9	0.16	13	1.2	BDL	10	146	0	0	Safe
3	IRP-03	PHED DHQ	Filter Plant	265	7.5	BDL	12	150	BDL	28	19	150	0.8	0.12	14	1.2	BDL	10	146	0	0	Safe
4	IRP-04	Plane Bhatti	Filter Plant	268	7.75	0.2	10	160	BDL	36	14	140	0.7	BDL	14	1.3	BDL	9	147	0	0	Safe
5	IRP-05	Nindari	Filter Plant	278	7.12	0.3	14	150	BDL	32	19	160	1	BDL	10	0.9	BDL	12	152	0	0	Safe
6	IRP-06	Paddar	Filter Plant	468	7.15	0.1	14	240	BDL	28	38	230	0.7	0.17	18	1.9	BDL	11	257	0	0	Safe
7	IRP-07	Grid Colony	Filter Plant	569	7.6	0.2	22	240	BDL	24	46	250	1	BDL	16	1.5	BDL	12	313	0	0	Safe
8	IRP-08	By pass colony Imamia	Filter Plant	410	7.25	BDL	19	220	BDL	28	39	230	1.4	0.15	16	1.2	BDL	10	229	0	0	Safe
9	IRP-09	Bagloor	Filter Plant	297	7.95	0.1	12	180	BDL	20	31	180	0.8	0.18	16	1.5	BDL	9	163	0	0	Safe
10	IRP-10	Mohri	Filter Plant	300	7.05	0.2	14	180	BDL	28	24	180	0.9	BDL	15	1.2	BDL	12	165	0	0	Safe
11	IRP-11	By pass Near National Science	Spring Water	477	7.95	4.2	10	230	BDL	48	29	240	1.3	BDL	14	1.2	BDL	12	262	120	50	Unsafe
12	IRP-12	Hullar Sydain	Spring Water	730	7.6	5.7	31	300	BDL	40	53	320	1	0.12	20	1.9	BDL	16	402	113	41	Unsafe
13	IRP-13	Hullar Saydain Exchange Road	Spring Water	587	7.85	4.5	21	260	BDL	28	51	280	0.9	0.26	12	1.2	BDL	14	323	40	10	Unsafe
14	IRP-14	Paddar Nala	Spring Water	361	8.1	3.9	12	210	BDL	20	36	200	0.9	BDL	14	1.5	BDL	10	199	36	5	Unsafe

15	IRP-15	Lari Ada Near Masjid	Spring Water	381	7.15	4.8	14	220	BDL	28	36	220	0.8	BDL	17	1	BDL	13	210	130	62	Unsafe
16	IRP-16	PHED Lab	Spring Water	394	7.96	4.5	14	230	BDL	28	32	200	1.2	BDL	10	1	BDL	10	217	132	67	Unsafe
17	IRP-17	Ali Abad	Spring Water	455	7.56	5.6	19	220	BDL	24	41	230	1	0.16	16	1.4	BDL	14	250	123	58	Unsafe
18	IRP-18	Chowk Qadriabad	Spring Water	433	7.69	4.8	14	220	BDL	20	44	230	1	0.23	12	0.9	BDL	14	238	56	18	Unsafe
19	IRP-19	Bani Passari	Spring Water	607	7.95	5.5	19	270	BDL	28	51	280	1.3	BDL	16	1.2	BDL	14	334	43	16	Unsafe
20	IRP-20	Saver Matwali	Spring Water	531	7.83	6.2	14	230	BDL	20	46	240	1.2	0.1	11	1	BDL	10	292	105	59	Unsafe
21	IRP-21	Bani Pasari	Spring Water	424	7.5	5.3	12	210	BDL	48	24	210	1.5	BDL	12	0.9	BDL	15	233	74	20	Unsafe
22	IRP-22	Halan Near ARC camp	Spring Water	676	7.92	5.6	26	270	BDL	40	46	290	1.4	BDL	16	1	BDL	13	372	31	3	Unsafe
23	IRP-23	Kotera Mast Khan	Spring Water	750	7.81	5.9	31	270	BDL	36	51	300	1.4	0.25	14	0.9	BDL	12	413	90	75	Unsafe
24	IRP-24	Bhount Lower	Spring Water	400	7.9	6.1	14	210	BDL	32	29	220	0.8	0.26	16	1.5	BDL	14	220	63	18	Unsafe

30 Years of Transforming Lives in Pakistan

Islamic Relief Pakistan
IRM Complex, 07, Sunrise Avenue,
Park Road, Near COMSATS
University, Islamabad
Pakistan

Tel: +92 51 2114212 - 17

www.islamic-relief.org.pk