



# GROUND WATER YEAR BOOK 2020-21

## JAMMU & KASHMIR



**CENTRAL GROUND WATER BOARD**  
**North Western Himalayan Region**  
**Jammu**

**GOVERNMENT OF INDIA**

**Ministry of Jal Shakti**

**Department of Water Resources**

**River Development and Ganga Rejuvenation**

**GROUND WATER YEAR BOOK 2020 – 21**

**UNION TERRITORY OF JAMMU & KASHMIR**

**CENTRAL GROUND WATER BOARD**

**NORTH WESTERN HIMALAYAN REGION**

**Jammu – 181 223**

**September 2021**

## FOREWORD

WATER is one of the essential natural resources for sustaining life on blue planet “**Earth**”. The demand of fresh / usable water has increased manifold globally due to rapid growth in population, which in turn caused change in agricultural pattern and increase in industrial activities. To meet the demand of fresh water of various sectors, there is an enormous stress on ground water resources as the surface water pollution is increasing day by day. This has resulted in the water level decline in many parts of the country.

Central Ground Water Board, the apex organization under the Ministry of Water Resources River Development & Ganga Rejuvenation, Government of India, monitors the behaviour of the ground water regime through a network of ground water monitoring wells spread across the country. The water level data collected from such observation wells in each state are compiled, processed and the salient features brought out as a “Ground Water Year Book” every year. This report pertains to the scenario of ground water regime in the UT of Jammu and Kashmir for the year 2020-2021.

Central Ground Water Board, North Western Himalayan Region, Jammu is monitoring the groundwater regime under various hydrogeological setting through Dug wells and Piezometers in valley areas of Jammu and Kashmir UT, viz. Jammu, Kathua, Rajouri, Reasi, Samba and Udhampur districts four times in a year (January, May, August and November) and Anantnag, Bandipora, Baramulla, Budgam, Ganderbal, Kupwara, Pulwama and Srinagar Districts three times in a year (May, August and November). Due to the snowfall monitoring of January month is not feasible. The effect of rainfall/snowfall on the ground water regime is studied through the fluctuations between pre and post monsoon. Similarly, water level fluctuations between the two consecutive seasons are studied and comparisons of water level for the year are done with the long-term mean of at least one decade. The spatial and temporal variations in the chemical quality of the ground water are studied through chemical analysis of water samples collected from the ground water monitoring wells during the month of May each year.

The present report Ground Water Year Book, 2020 – 2021 is the outcome of efforts made by **Rayees Ahmad Pir**, Assistant Hydrogeologist, and **Sh K S Rawat** Chemist (Sc-B). The efforts in depicting the groundwater scenario in in union territory of Jammu & Kashmir through maps and giving proper shape to this report, is highly appreciable.

The information and data presented in this report will serve as a database to the user agencies, ground water planners and managers and will be of immense use to understand the regional picture on the quantitative and qualitative aspects of ground water regime in union territory of Jammu & Kashmir.

Place: Jammu  
Date: 30.09.2021

Sd-  
M L Angurala  
Regional Director I/C

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## EXECUTIVE SUMMARY

The present report discusses the behaviour of water levels and chemical quality of groundwater in the phreatic aquifers of outer plains of Jammu region, extending between River Ravi in the east to Munawar Tawi in west covering parts of Jammu, Samba and Kathua districts J&K, India. Dun Belt covering alluvium areas of Kathua Samba and Udhampur, Reasi and Rajouri district. In this area, the water supply mainly depend on groundwater either from the springs, shallow/ or deep aquifer systems. The groundwater also forms the main source to the surface water bodies through base flow. Monitoring of groundwater levels is carried out four times a year, month of May, August, November 2020 and January 2021. Further, in order to understand the spatiotemporal fluctuations of groundwater in response to ground water recharge and/or discharge, the groundwater level contour maps were generated. The chemical quality evaluation of the groundwater was also carried out on the basis of 214 water samples collected from shallow aquifers during pre-monsoon season (May 2020). The groundwater level maps showed that the water levels in Kandi formation is deeper than areas in Sirowal formation and is significantly controlled by the monsoons. At certain places particularly in urban and industrial areas the groundwater levels are showing declining trend in response to over exploitation. The chemical analysis indicated overall a good quality of the groundwater that is suitable for drinking and other domestic purposes. The EC was generally low indicating groundwater as fresh and potable. The pH showed the neutral to alkaline nature of water. The total hardness was found to be within the acceptable limits (BIS-2012) for drinking purposes. The chloride and fluoride concentrations were also found within the maximum permissible limits of BIS standards. The calcium and magnesium, concentration in general is low with the exception of certain places where the concentration of Magnesium is relatively found to be high. The chemical quality analysis show that, the ion concentration is within the permissible ranges. Thus, proper protection measures are required to be taken to avoid contamination of groundwater in the area. For instance, proper monitoring for ions and other trace elements in urban & industrial areas like Bari-Brahmana, Gangyal etc. shall be taken up and monitoring network stations need to be established all along the nalas and drains carrying industrial effluents and municipal wastes in the area.

## 1. INTRODUCTION

Jammu and Kashmir is the northern most UT of India after Ladakh. It lies within latitudes of 32°17' and 36°08' N and longitudes of 73°23' and 76°47' E. The UT has a total geographical area of 42,241 Sq. Km. The Union Territory has international border with Pakistan in the west. The States of Punjab and Himachal Pradesh form its southern border and UT of Ladakh forms the northern and north eastern border. Major parts of the J&K UT represent high and rugged mountainous terrain. The Jammu & Kashmir is divided into two administrative divisions' viz. Kashmir Division and Jammu division. NHS monitoring is being done for valley parts (Alluvium area) of 6 districts in Jammu region (Jammu, Samba, Kathua, Rajouri, Reasi and Udhampur) and 7 districts of Kashmir Region (Kupwara, Baramulla, Budgam, Srinagar, Pulwama, Anantnag, Srinagar). Therefore, the ground water estimation is computed by the rainfall infiltration method only. There are total 22 districts in J&K UT. The administrative map of the UT is shown in figure 1.

The Central Ground Water Board started monitoring of ground water regime through All India network of hydrograph stations from 1969 onwards. The density of observation wells was increased year after year. Earlier ground water monitoring was carried out through a network of open wells, generally dug wells for drinking purpose tapping shallow aquifers. Keeping in view the importance of future ground water development, the network was subsequently strengthened by construction of purpose built piezometers. Presently in Jammu and Kashmir, a total of 317 dug wells are being monitored for this purpose. The Central Ground Water Board, North Western Himalayan Region is monitoring water levels in observation wells in Jammu and Kashmir UT four times a year viz. May, August, November and January. Water samples from observation wells are collected once in a year during May to assess ground water. The water level and chemical analysis data thus collected is analyzed and interpreted using GEMS and Map Info software and Ground Water Regime Monitoring Bulletin is prepared and issued seasonally with interpreted data and thematic maps depicting ground water scenario, J&K UT.

The present report discusses regional behaviour of water levels in phreatic aquifers for the period May, August, November 2020 and January 2021 which will enable user agencies to plan development strategies. The results of chemical analysis of water samples collected in May 2020 from observation wells established by Central Ground Water Board, North Western Himalayan Region are also discussed.

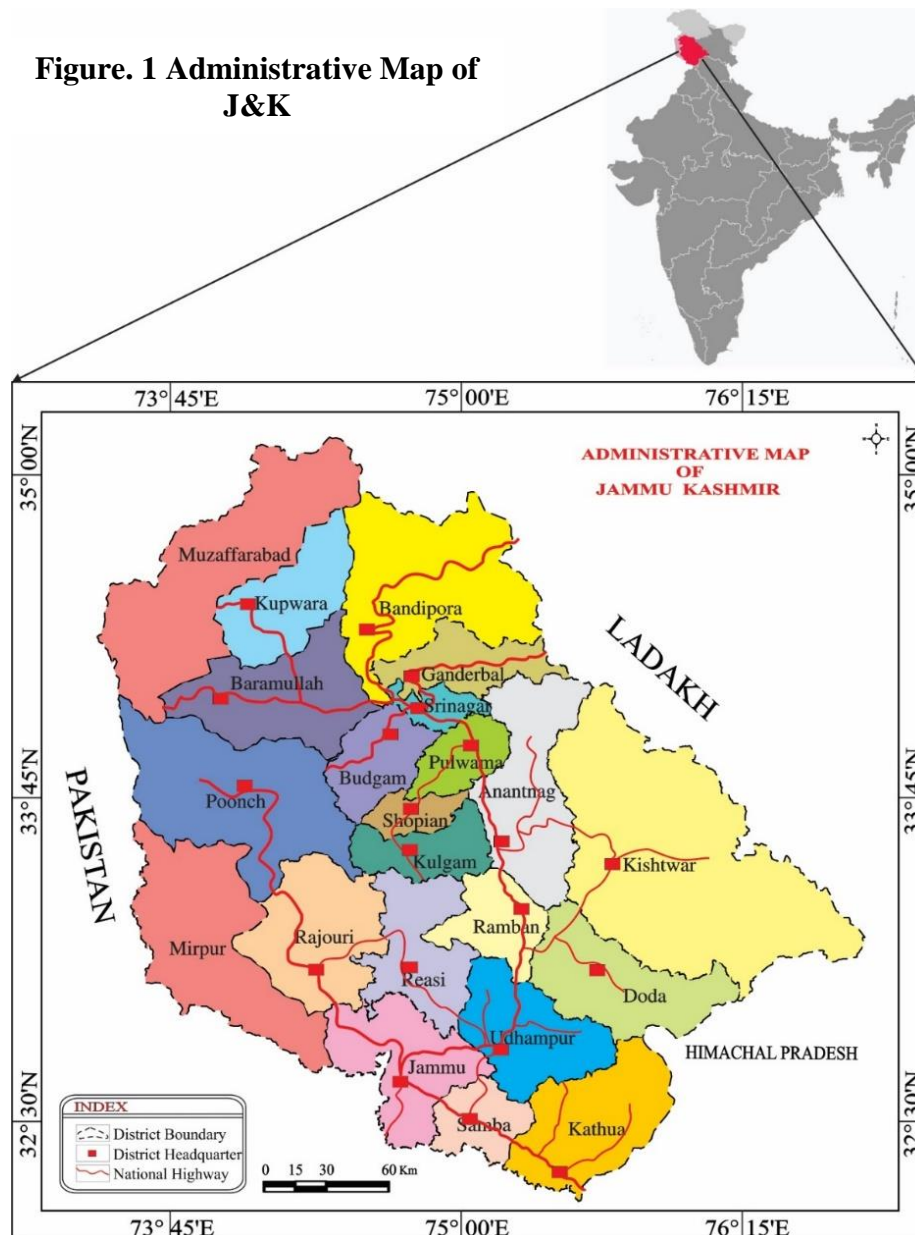
The main objectives of ground water regime monitoring in Jammu and Kashmir may be summarised as follows:



To study fluctuation of water levels both spatially and temporally in response to ground water recharge and/or discharge.

1. To evaluate changes in ground water level with respect to preceding year for the same period.
2. To evaluate changes in ground water levels with respect to a long term average water level such as decadal mean.
3. To study fluctuation of water level during different seasons.
4. To study hydro-chemical behaviour of phreatic aquifers.

**Figure. 1 Administrative Map of J&K**



### Status of Hydrograph Network Stations

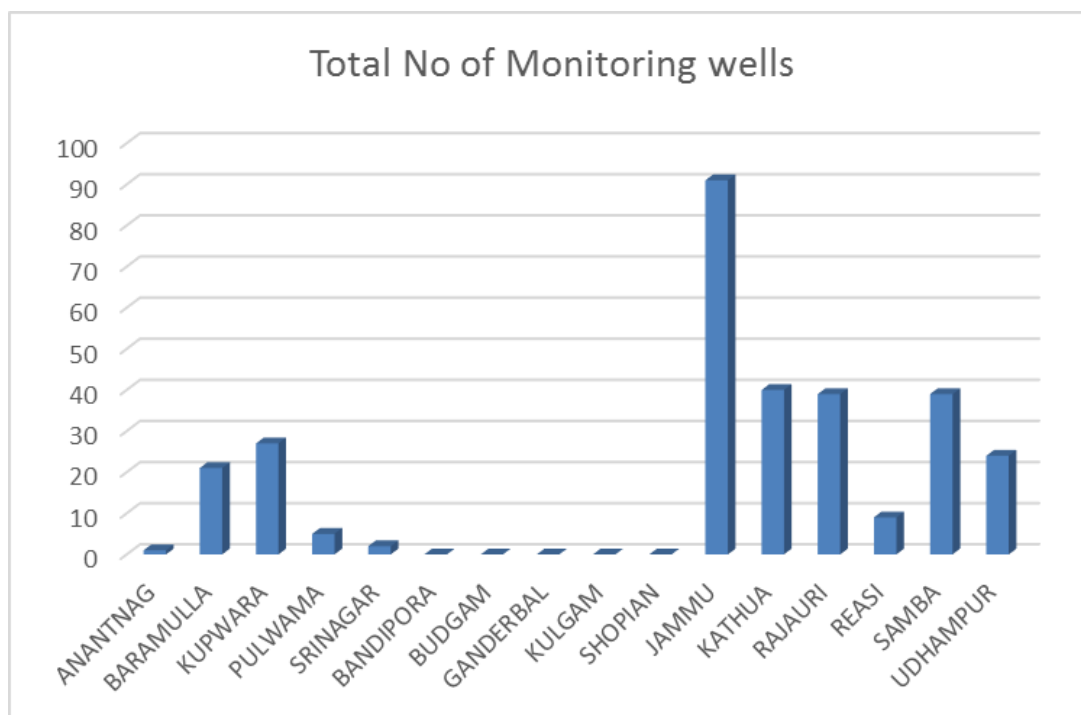
In Jammu & Kashmir, at present there are 317 Hydrograph Network Stations which are being monitored every year. 261 NHS exist in Jammu Region and 56 stations in Kashmir Region. District-

wise number of hydrograph network stations as on 31.03.2021 is given in table-1 and their locations are shown in Figure 2.

**Table: 1 District-wise break-up of Ground Water Monitoring Wells in Alluvial Aquifers of J&K UT (as on January 2021)**

Sl. No.	Region	District	Total No of Monitoring wells
1	KASHMIR	Anantnag + Shopian	1
2		Baramulla + Bandipora	21
3		Kupwara	27
4		Pulwama + Kulgam	5
5		Srinagar + Ganderbal	2
6		Budgam	0
<b>Total</b>			<b>56</b>
11	JAMMU	Jammu	91
12		Kathua	40
13		Rajouri	39
14		Reasi	9
15		Samba	39
16		Udhampur	24
<b>Total</b>			<b>242</b>
<b>TOTAL J&amp;K</b>			<b>298</b>

**Graph. District-wise Graphical representation of Ground Water Monitoring Wells in Alluvial Aquifers of J&K UT (as on March 2021)**



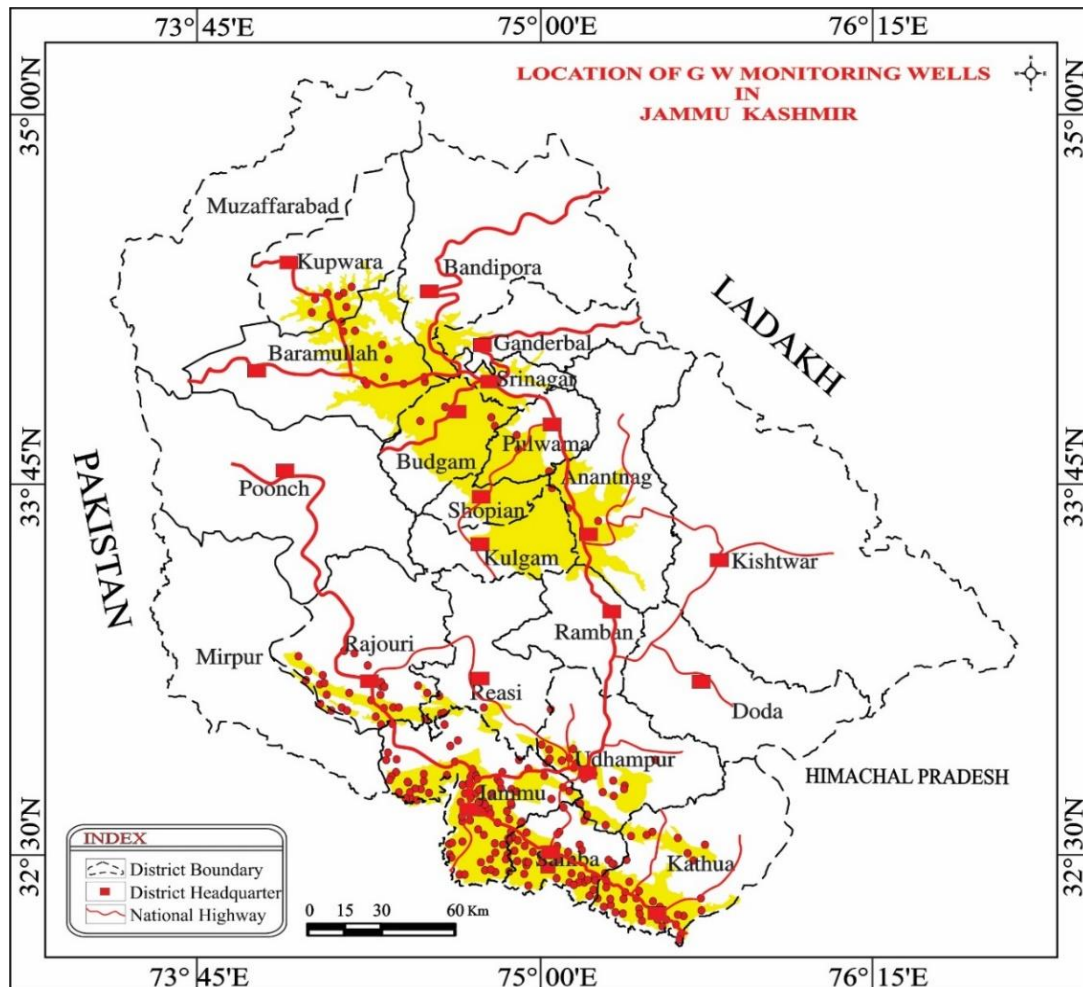


Figure 2. Location Map of Ground Water monitoring wells in Alluvial Aquifers in J&K

## 1.1 PHYSIOGRAPHY

Physiography of the Jammu & Kashmir UT is highly varied with highest mountain ranges of the world, extensive plateau, enormous valleys, deep gorges and large canyons in Middle and Trans-Himalayan Regions. The individual ranges have characteristic steep slopes towards south and much gentle slope towards north. The northern slopes are covered with thick and dense growth of vegetation. While the southern slopes are mostly bare, with thin sparse forest cover. The Zaskar range separates Ladakh Region with Kashmir Valley while Pir Panjal range divides Jammu Region and Kashmir Valley (Figure 3). The UT can be divided into six distinct physiographic units as discussed below.

**Sirowal Belt:** The Sirowal belt covers an area of about 1000 km<sup>2</sup> and has an average topographic gradient of 1:250 to 1:300 in southwest direction. The land elevation of Sirowal belt above mean sea level is normally within 320 m. Southern parts of Jammu Samba and Kathua Districts fall in this belt.

**Kandi Belt:** The elevation of Kandi belt ranges between 320 m and 400 m above mean sea level (m amsl). The average topographic gradient varies between 1:60 and 1:100. Kandi belt covers an area of about 1500 km<sup>2</sup> and occupies parts of Jammu, Samba and Kathua Districts imperceptibly north of Sirowal

belt. Kandi belt in Jammu & Kashmir UT runs in northwest - southeast direction as a narrow strip between rivers Munnawar Tawi in the northwest and Ravi in the southeast. The belt is occupied by reworked Siwalik debris, which has master slope towards south-west.

**Siwalik Region:** Land elevation of Siwalik region ranges between 400 m and 750 m above mean sea level. Ridges and small independent valleys are the prominent features of Siwalik region which covers parts of Kathua, Jammu, Udhampur and Rajouri Districts.

**Kashmir Valley:** The elevation of valley floor above mean sea level ranges between 1500 m and 2000 m. Kashmir valley is spread over an area of 5600 km<sup>2</sup>, covering all ten districts in Kashmir valley, Budgam, Pulwama, Srinagar, Anantnag, Baramulla, Kupwara, Bandipora, Ganderbal, Shopian and Kulgam Districts.

**Hilly Mountains:** The high mountain ranges have the elevation between 2000 m and 5000 m above mean sea level and form parts of Udhampur, Anantnag, Baramulla, Srinagar and Kupwara Districts.

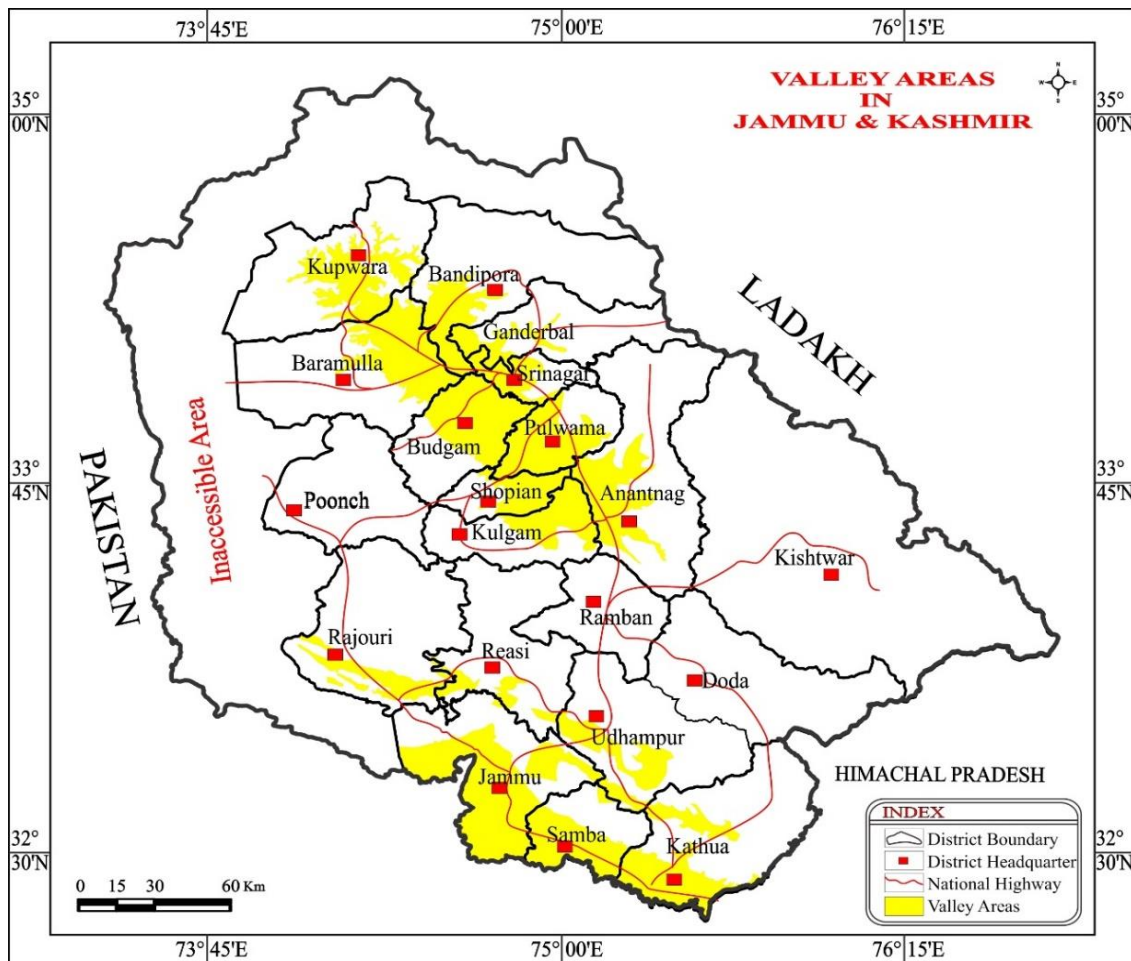


Figure 3. Map showing Valley areas in J&K

## 1.2. GEOLOGY

Geological formations ranging in age from Pre-Cambrian to Recent are found in the UT. These formations can broadly be classified into three categories. Hard or consolidated- rocks comprising granites, slates, quartzite, Panjal traps, limestone etc. Semi-consolidated rocks comprising of claystone, siltstone, sandstone etc. Unconsolidated formations from Quaternary to Recent age are comprised of Clay, Silt, Sand, Gravel, pebbles, Boulder etc. The brief geological setting of the UT is given in Table-2.

**Table 2 Geological Setting in J&K UT**

Age	Formation
Recent to Sub-recent	Alluvium
Pleistocene	Karewas
Middle Pliocene to Pleistocene	Siwaliks
Miocene	Murees
<b>Unconformity</b>	
Eocene	Subathu Formation
Cretaceous/ Eocene	Volcanics/ Basic Intrusives
Cretaceous	Flysch Beds
Jurassic	Punch-Mandi Formations
Triassic	Mandi& Infra-Triassic Formations
Palaeozoic	Panjal Traps/ Tanwal
Carboniferous / Permian	Agglomeratic Slates Fenestella Shales Gondwana Formations Zewan Beds
Silurian-Devonian	Muth Quartzites
Upper Pre-Cambrian to Lower Cambrian	Dogra Slates
Lower Pre-Cambrian	Salkhala Series
Pre-Cambrian	Granite & Basic Intrusives

The Salkhala out crops have been traced in the form of hairpin bend around the northwestern end of the Kashmir Valley. The salkhala group comprises of succession of Carbonaceous Shales, Schists, graphitic phyllites, carbonaceous limestones, dolomites, marbles, quartzites. The Salkhala group is stratigraphically overlain by Dogra Saltes, which conformably grades into the lower paleozoic succession. In southern part of Kahmir, the Dogra Slates are conformably overlain by a succession of phyllites, sand stones, massive qurtzites, grits and conglomerates known as Tanawals and suggested that the succession bridges the gap between Dogra Slatea and upper Paleozoic rocks in south and south western Kashmir.

The Paleozoic formations of Kashmir exposed along the pir-panjal range and great Himalayan ranges rest either over Dogra slates or pre Cambrian crystalline rocks of the Salkhal group. A succession of white quartzites, Shales, siltstones and dolomitic limestones exposed around Kashmir synclinorium has been reffered as Muth formation. In Northern part of the Kashmir, the Muth Qurtzites is conformably overlain by Syringothris limestone, a succession of Grey and dark blue limestone with a few interbedded shales, quarzites and traps. The formation exposed along the southern slopes of Pirpanjal near Banihal.

Agglomeratic slate series is well exposed in the Pir Panjal range Baramulla district, Liddar valley, Anantnag District and Kistwar in Doda district. The polymictites consists of rock fragments derived from glacial erosion as well as from volcanic outburst. It is a succession of slates, sandstone, quartzite and with a few bands of conglomerates. The Agglomeratic slate series is overlain and often intermixed with thick succession of Andesitic and basaltic traps known as Panjal volcanics. The volcanics occupy the steep slopes and high peaks of the pir panjal ranges and higher reaches of liddar valley. The volcanic activity seems to have persisted in Kashmir from late carboniferous to late Triassic epochs.

Permian rocks of Kashmir are conformly overlain by thick succession of limestones and shales known as zeewan formation.

The out crops of Jurassic rock have restricted distribution in Kashmir. A major part of the rock is buried beneath the quarternary sediments and reported in northern slopes of Pir Panjal range Baltal and Joji-la areas. The cretaceous rocks have not been reported from the Kashmir Himalayas.

The Murrens extensively exposed on the Jammu-Srinagar highway around batote consists of basal conglomerate bed overlain by intercalations of bright red purple clay and green sand stones and is overlain by Siwalik group rock formations.

Most of the Kashmir valley is occupied by this gravel-sand and mud succession known in Indian Stratigraphy as 'Karewa formation'. There are different opinions about the deposition of Karewa formations. But based on detailed geological mapping Bhatt (1978, 1982) proposed that sedimentation of karewa deposits took place in a lake basin, but suggested that during deposition of Lower Karewa lake occupied the whole Kashmir valley floor, but during Upper Karewa time the lake was localized only in the north-eastern flank of the basin.

Karawas cover an area of about 5600 Sq.Km in Kashmir Valley. Karewa group is defined to include the more or less unconsolidated layered sedimentary succession deposited in fluvio-lacustrine environments in the Kashmir valley, overlying the Precambrian-Mesozoic basement and overlain by Holocene alluvium of modern rivers etc'. Karewa group is divided into two formations viz., Lower Karewa and Upper Karewa. The Lower Karewa formation is characterized by plastic grey to bluish grey clay, light grey sandy clay, lignite and lignitic-clay, coarse to medium grained sand and conglomerates. It is about 1200-mt thick formations.

The Upper Karewa formation is characterized by brown, grey sandy clay, medium to coarse-grained sand, cream coloured marl, conglomerate and loam (loess) sediments. In this upper Karewas lignitic shale and grey bluish shale are absent. Thickness of this formation is about 50 to 200 mt. The loamy sediments are present throughout the valley making the top of the Karewa Plateau. The Upper Karewa formation sediments are exposed extensively on the Pir Panjal flank due to uplift of Pir Panjal range along with its Karewa sediments.

The top of Karewa terraces are capped by a fine grained mostly silty succession without any bedding structures. These mainly loam or loess formation. The formation is in some places extremely muddy, silty or rather sandy. In some cases, sand layers are intercalated.

### **1.3. DRAINAGE**

Entire UT of Jammu and Kashmir falls in the Indus River Basin and the only exception is the small area in the extreme north-east which is part of Quraqush River Basin.

#### **1.3.1. Jhelum Sub-Basin**

The Jhelum is known in Kashmir as the Veth River. Most parts of Kashmir valley are drained by Jhelum River, which flows in northwesterly direction. The Jhelum River (Sanskrit-Vitasta, Greek-Hydaspes, Latin-Bipaspes) originates from Verinag Spring. The River has various tributaries in the valley, several of which come from the everlasting snows of the Liddar valley. Near Srinagar it is received by the Sind River, and then forms the Wular Lake in Baramulla District which, in fact, is a delta of Jhelum River. Below Baramulla, the river leaves the fertile banks of the valley and rushes headlong down a deep gorge at Khadnayar and joins the Chenab River at Trimmu in Pakistan.

#### **1.3.2. Chenab Sub-Basin**

The Chenab River or Asikin, as it was known in Vedic times, is formed by two important tributaries, the Chandra and the Bhaga, which join near Keylong in Himachal Pradesh to form Chandra-Bhaga or the Chenab River in Himachal Pradesh.

The River then flows through the Kashmir Himalayas to emerge into the plains at Akhnoor in Jammu District, at about 250 km from its source. Ranbir canal takes off from its left bank in Akhnoor tehsil.

#### **1.3.3. Ravi Sub-Basin**

Very small parts of the UT, mainly the extreme south-eastern parts, fall in the RaviSub-basin. The RaviRiver rises from the northern face of Rohtang Pass in Himachal Pradesh at an elevation of 4116 m. After passing through Dhaula dhar hill ranges, the river emerges from the foothills near Madhopur where the head works of the Upper Bari Doab Canal exist. It has the smallest catchment area among the rivers of the Indus System. An important tributary of Ravi River, the Ujh River Which originates from the Basohli hills of Kathua District joins the mainstream to its right at Lassian.

### **1.4. HYDROMETEOROLOGY**

The UT of Jammu and Kashmir has great diversity in its temperature and precipitation. Excepting the plain, south of the Siwaliks of the Jammu Division, the climate over the greater parts of the UT resembles that of the mountainous and continental parts of the temperate latitudes.

#### **1.4.1. Climate of Jammu Division**

Climate of Jammu division is sub-humid to sub-tropical. It is divisible into two parts namely (i) the plain region, lying to the south of the Siwaliks and (ii) the mountainous region, stretching over the Middle and the Greater Himalayas in the districts of Doda, Rajouri, Poonch and Udhampur.



The climate of the plain region and Middle Himalayas including the Pir Panjal is characterized by a rhythm of seasons which is caused by the reversal of winds in the form of south-west and north-east monsoons. The reversal of pressure takes place regularly twice a year. This region has sub-tropical climate with hot and dry climate in summer and cold climate in winter. It lies in the northern hemisphere above the tropic of Cancer. The Minimum and Maximum temperature of the district varies between 4°C to 47°C and the monsoon starts from the beginning of July to the first week of September. From October to June the precipitation and temperature patterns resemble closely the valley temperature zones. However, the summer rainfall and temperature resemble the precipitation pattern in the sub-tropical zone. The region receives an average annual precipitation of 1070 mm mainly in the form of rainfall. Snowfall occurs in high mountainous parts of Jammu region due to south-west monsoon from July to September and contributes about 80% of the total rainfall. The temperature in plain areas of Jammu region goes up to 45°C during summer and drops to as low as 3°C during winter season. Average number of Annual rainy days in Jammu region is 59.

#### **1.4.2. Climate of Kashmir Division**

The weather and climate of Kashmir Division are intrinsically linked with the weather mechanism of the subcontinent in general. The location of the Kashmir Valley at a high altitude (about 1600m amsl) in the north-western corner of the subcontinent, surrounded by high mountains on all sides, gives it a unique geographical character with distinctive climatic characteristics. It experiences Temperate-cum-Mediterranean type of climate. The average annual precipitation is 660 mm. In winters, rainfall occurs from the western disturbances (temperate cyclones). These disturbances have their origin in the Mediterranean Sea. The rainfall generated by these cyclones is fairly widespread locally known as *Alamgir*. About 65% of the precipitation occurs in the form of snow tail during winter season, i.e. December to February. March and April are the months of rainfall. May to September are relatively dry months. The mercury drops between -8°C and 12°C during winter and attains a moderate temperature of around 35°C during summer.

### **1.5. SOILS**

The soils of J&K UT have been classified into the undermentioned 8 groups:

**1.5.1. Brown Earth/Brown Forest Soils:** These soils have been spotted in parts of Kathua, Udhampur, Doda, Poonch, Rajouri, Anantnag and Baramulla District. Their water holding capacity exceeds 40%. They belong to groups Haplustalfs, Ochraualfs, Eustrochrepts, Hapludolls, Udorthrents, Cryothrents and Udifluvents.

**1.5.2. Degraded or Grey Brown Podzolic Soils:** These soils occur in parts of Baderwah, Ramnagar, Poonch, Gulmarg, Pahalgam and are of loam to clay texture at their surface and clay



loam to clay texture at their sub-surface and of fine granular well developed angular block structure. They belong to great groups Hapludalfs, Hapludolls, Eutrochrepts and Haplumbrepts.

**1.5.3. Red and Yellow Podzolic Soils:** These soils occur in parts of Udhampur, Kathua, Rajouri and Poonch. They are of coarse texture, Water holding capacity is 40%. They belong to great group hapludalfs, haplustalfs.

**1.5.4. Hill or Mountain Forest Soils:** These are sandy loam to loamy, fine to weakly granular soils. They occur at lower elevations and have 32-41% water holding capacity. They belong great group cryoboralfs and hapludolls.

**1.5.5. Mountain Meadow Soils:** Sandy loam to clay loam fine to coarse granular mountain meadow soils occur in Gulmarg, Pahalgam, Sonamarg, Lolab, Gurez, and Changthang. Water holding capacity of (51-61%) They belong to great groups Cryoboralfs and Argiudolls.

**1.5.6. Lithosols:** Gravelly loam to gravelly silty loam, coarse to weak granular soils. Lithosols occur on steep slopes in the forest hills of 400 to 600 meters above sea level Jammu, Udhampur, Kathua, Rajouri, and Poonch Districts. They contain 33 to 38% water holding capacity. They belong to great group Ustorthrents.

**1.5.7. Saline Alkali Soils:** These soils occur in alluvial belt of Jammu (RS Pura/Bishna), Kathua (Ramkol/Challain). They belong to Ustifluvents, Hapluquents and Ustorthents great groups.

**1.5.8. Alluvial Soils:** These soils cover plains of Kathua, Jammu Rajouri, Poonch, Udhampur in Jammu, Valleys in Kashmir. They are situated in the flood plains of Ravi, Chenab, Jhelum and their tributaries. They are old and new alluvial soils. They belong to great group Ustifluvents and Udifluvents

#### **Based on the Kashmiri Nomenclature**

- **Nambal (Peaty Soils):** Near the banks of the Jhelum River and in the vicinity of the Wular, Manasbal and Anchar lakes is found the rich peaty soil, locally known as Nambal.
- **Tand (Mountainous Soils):** The land on the slopes of mountains, reclaimed from the forests is called Tand soil. After reclamation the tand gives good productivity, but declines by accelerated soil erosion as land loses its natural strength and after many years the land acquires the shape of a pasture and culturable waste.
- **Zabelzamin (Alkaline Soils):** Patches of irrigated land if excessively irrigated lose their fertility and develop alkaline formations. Such adversely affected patches of saline and alkaline formations are known as zabelzamin. These soils are unproductive from the agricultural point of view unless especially treated with gypsum, water and manures. There

are numerous other types of soils recognized by the Kashmiri farmers, such soils are Kharzamin, Tresh, Limb, Ront, Shath and Tats.

- **Karewa Soil (Wudur):** Karewas are fresh-water (fluvial and lacustrine) deposits found as low flat mounds or elevated plateaus in the Valley of Kashmir and the Kishtwar and Bhadarwah tracts of the Jammu Division. The important Karewas are found in Kulgam, Shopian, Budgam, Qazigund, Tangmarg, Gulmarg, Baramulla, Laithpora, Chandhara, Pampore, Bijbehara, Awantipora, Islamabad (Anantnag), Mattan, Tral and Ganderbal. The Karewa soils are composed of fine, silty clays with sand boulder gravel, the coarse detritus being as a rule, restricted to the peripheral parts of the valley, while the finer variety prevails towards the central parts.
- **Clayey Soil (Gurti):** This soil is found in the flood plains of Jhelum in the southern parts of Srinagar city and is subjected to annual fresh silt deposition. Gurti soil contains a large proportion of clay. Its water retaining capacity is high.
- **Loamy Soil (Bahil):** This soil is found above the level of flood plain, on the right bank of Jhelum, is highly fertile and suitable for paddy cultivation. The humus content is high which enriches the soil fertility.
- **Sandy Loam (Sekil):** It has usually been found to the Sind valley in the north west of the city. In the Sekil soil, if field is artificially irrigated, good crops of rice are harvested in summer season.
- **Sandy Silt (Dazanlad):** This soil is the mixture of sand and clay. A peculiar characteristic of Dazanlad is that the field turns red in colour when irrigation water stands in the fields. This soil is generally found in the low lying areas in the west of the city and also occurs at the hilly areas also in the north (Husain, 2000).

## **2. HYDROGEOLOGY**

The hydrogeological set up in the UT is very complicated owing to varied geological settings and ground water conditions. All the three regions of Jammu & Kashmir UT represent entirely different ground water regimes. Based on geology and aquifer characteristics, the area of the UT can be divided into two broad hydrogeological units. These are Porous and Fissured formations.

### **2.1. Porous Formation**

Porous formations are best suitable for the exploration and development. Potential zones are encountered in these formations. Region wise porous formations are described hereunder: -

#### ***Jammu Region***

In Outer Plains of Jammu Region, extending between River Ravi in the east to Munawar Tawi in the west, the ground water occurs in piedmont deposits belonging to upper Pleistocene to Recent age. The deposits comprise unconsolidated sediments in the form of terraces and coalescent alluvial fans developed by the streams debauching out of Siwalik Hills. The sediments consist of coarse clastics ranging in size from boulder to gravel in the loose clay matrix and occasionally alternating bands of clay of varying thickness. Kankar is also intercalated with these sediments at different intervals and in variable quantity.

These deposits are graded into finer sediments from north to south in that order. Down south it comprises alternate bands of sands of all grades and clay with subordinate peck of gravels and pebbles.

#### **2.1.1. Kandi Formation**

Kandi formation comprises very coarse material with little clay but in the Outer Plain of Jammu & Kashmir UT, the typical Kandi formations are not seen. Instead, they comprise boulders, gravels, pebbles and coarse sand with substantial amount of clay sometimes hard and sticky of varying thickness. The clay proportion increases towards southwest. Occurrence of perched water bodies is a common phenomenon in the Kandi belt of Jammu & Kashmir UT. The ground water generally occurs under unconfined conditions in Kandi formation.

#### **2.1.2. Sirowal Formation**

The Kandi formation coalesces into Sirowal formation in the south, finer outwash of Siwalik debris, brought by streams. Ground water occurs under both confined as well as unconfined conditions in Sirowal formation. A spring line demarcates the contact between Kandi and Sirowal formations because the ground water oozes out along this line causing marshy conditions. The spring line has undergone deformation due to decline of water level resulting from development of ground water in Sirowal area. However, the base flow could be seen in streams south of this line, which also in the Sirowal formation is the existence of auto-flow conditions in the deeper aquifer system.

The Dun Belt separates the Siwalik hills from the middle Himalayas and runs as a series of river terraces between Basohli (32°30', 76°49'30") in the east to Riasi (33°05', 74°50') and beyond in the west. The sediments are in the form of isolated Sub-Recent to Recent valley fill deposits ranging in thickness between a few metres to a few tens of metres. These deposits are often dissected as a result of the present day drainage pattern. The deposits comprise of coarse clastics such as boulders, cobbles, pebbles etc. inter-bedded with lenticular clays.

### ***2.1.3. Isolated Valley Fills in Middle Himalayas***

There exist a number of isolated valleys in middle Himalayas where ground water occurs in valley fill deposits comprising of lacustrine to fluvio-glacial sediments. A few meter-thick layer of loess overlies these deposits, which is windblown.

Ground water in such valleys generally occurs under confined conditions. One of the prominent isolated valleys in middle Himalayas is Kishtwar valley in Kishtwar district of Jammu Region.

### ***Kashmir Region***

Kashmir valley covers an area of 5600 km and is occupied by Karewas that consist of a huge pile of alternating bands of sand, silt and clay interspersed by glacial boulder beds. The sands are mostly fine to very fine grained and it is very rare that they are medium to coarse grained. There is considerable lateral facies variation in the nature of sediments. The aggregate thickness of these sediments is of the order of 2500-3000 m. Ground water in the Karewas of Kashmir valley occurs under both confined as well as unconfined conditions.

### **2.2. Fissured Formation**

About 15000 sq. km. area in Jammu Region is occupied by hilly terrain. It comprises rocks ranging in age from Precambrian (Salkhala series) to Miocene or even Pliocene (Murees and upper-middle Siwaliks). The rock types range from soft or friable sandstones, Clays, Shales, Conglomerates to hard traps and metamorphics such as quartzite and crystalline limestone. In the Siwalik terrain, where groundwater is tapped, it comes mainly either from the weathered mantle or from the joints or cracks of these rocks. Friable Siwalik sandstones do possess primary porosity but are not very potential aquifers.

### **3. BEHAVIOUR OF WATER LEVELS**

#### **3.1. DEPTH TO WATER LEVEL**

The water levels in Ground Water Monitoring Wells of Jammu and Kashmir UT were measured four times during the period 2020 – 2021 (May 2020, August 2020, November 2020 and January 2021). The water levels observed are shown in Annexures – I & II. The ground water levels in different seasons were analysed to evaluate the temporal behaviour of water level. The behaviour of water levels during the period May 2020 to January 2021 has been compared with the previous water levels as well as with the average water level for the last decade (decadal behaviour) to ascertain the changes in the ground water regime. All the data has been put in the GIS format and the data has been analysed. After analysis, the contours of water levels below the ground surface have been created by joining the areas with same water levels and the areas have been demarcated with uniform contour intervals. The contouring has been done by Natural Neighbourhood Interpolation method. District wise categorization of water levels observed during May, August, November 2020 and January, 2021 is given in Annexure-I

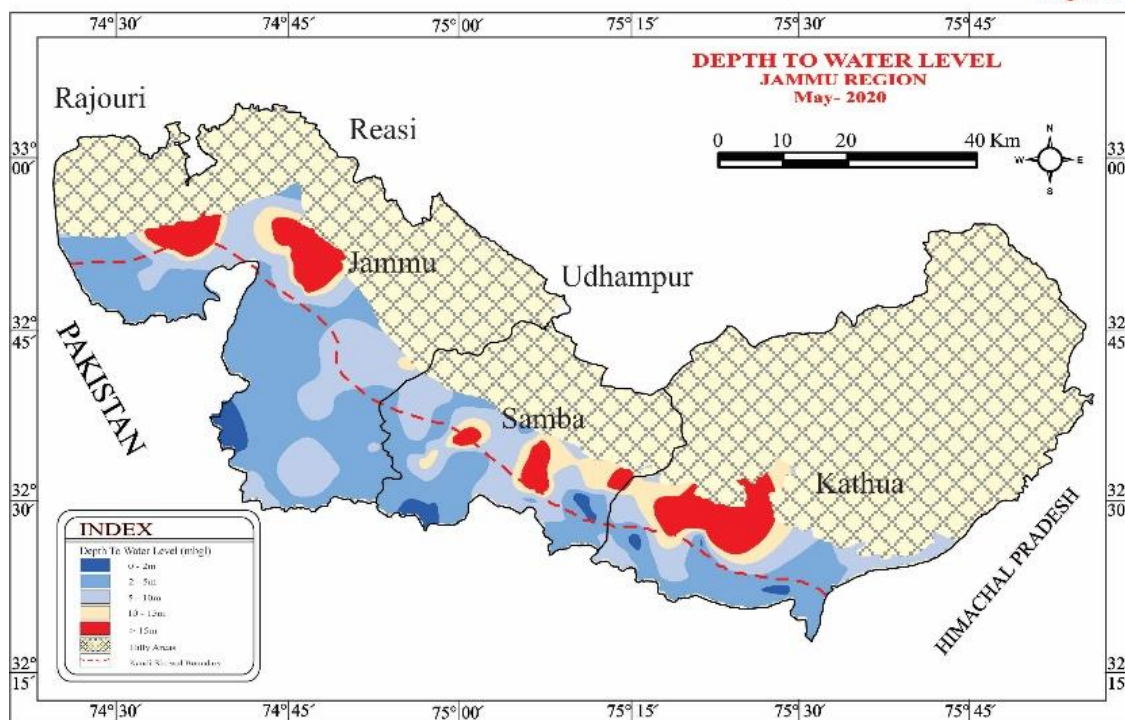
##### **3.1.1. Depth to Water Level -May 2020**

**Jammu Region:** The water level data in respect of 198 wells for the month of May 2020 were analysed. The depth to water level varied from 0.50m bgl (Bhatta Morh in Rajouri District) to 38.42 m bgl (Taryai in Jammu district). Categorization of depth to water level May 2020 is given in table 3.

44 wells (22.22%) have recorded the water level less than 2.0 m bgl. About 48.99% of the total wells analysed have shown depth to water level in the range 2-5 m bgl. Whereas 37 wells (18.69%) have shown water levels in the range of 5-10 m bgl. 8 (4.04%) wells have registered deeper water levels, in the range of 10-15 m bgl. Another 12 wells (6.06%) of the total wells analysed have shown water levels in the range of >15 m bgl.

Valley areas of Jammu, Samba and Kathua districts below the contact of Kandi Sirowal show water level between 2-5 m bgl except few patches that show water levels between 0-2m bgl. In Sirowal area of Outer Plains, most of the water levels have been recorded between 2 - 10 m bgl except a few small patches that show water levels from 0 to 2 m & above 10 m bgl. In Kandi Belt, the water levels are deeper ranging between 5-10 m bgl and a few patches northern and north western Jammu, central, parts of Samba & north & central parts of Kathua respectively) having water levels more than 15 m bgl (Figure 4).

**Figure 4**



**Table 3: CATEGORIZATION OF DEPTH TO WATER LEVEL- MAY 2020**

District	No. Of wells Analyzed	Depth to Water Level (mbgl)		Number of Wells Showing Depth to Water Level (mbgl) in the Range of					Percentage of Wells Showing Depth to Water Level (mbgl) in the Range of				
		Min	Max	0 – 2	2 – 5	5 – 10	10 – 15	> 15	0 – 2	2 – 5	5 – 10	10 – 15	> 15
Jammu	74	0.86	38.42	8	38	18	4	6	10.81	51.35	24.32	5.41	8.11
Kathua	29	1.11	22.82	5	12	8	2	2	17.24	41.38	27.59	6.90	6.90
Rajauri	32	0.50	6.44	16	15	1	0	0	50.00	46.88	3.13	0.00	0.00
Reasi	7	1.87	5.90	2	4	1	0	0	28.57	57.14	14.29	0.00	0.00
Samba	36	0.94	23.83	4	17	9	2	4	11.11	47.22	25.00	5.56	11.11
Udhampur	20	0.72	4.99	9	11	0	0	0	45.00	55.00	0.00	0.00	0.00
<b>Total</b>	<b>198</b>	<b>0.50</b>	<b>38.42</b>	<b>44</b>	<b>97</b>	<b>37</b>	<b>8</b>	<b>12</b>	<b>22.22</b>	<b>48.99</b>	<b>18.69</b>	<b>4.04</b>	<b>6.06</b>

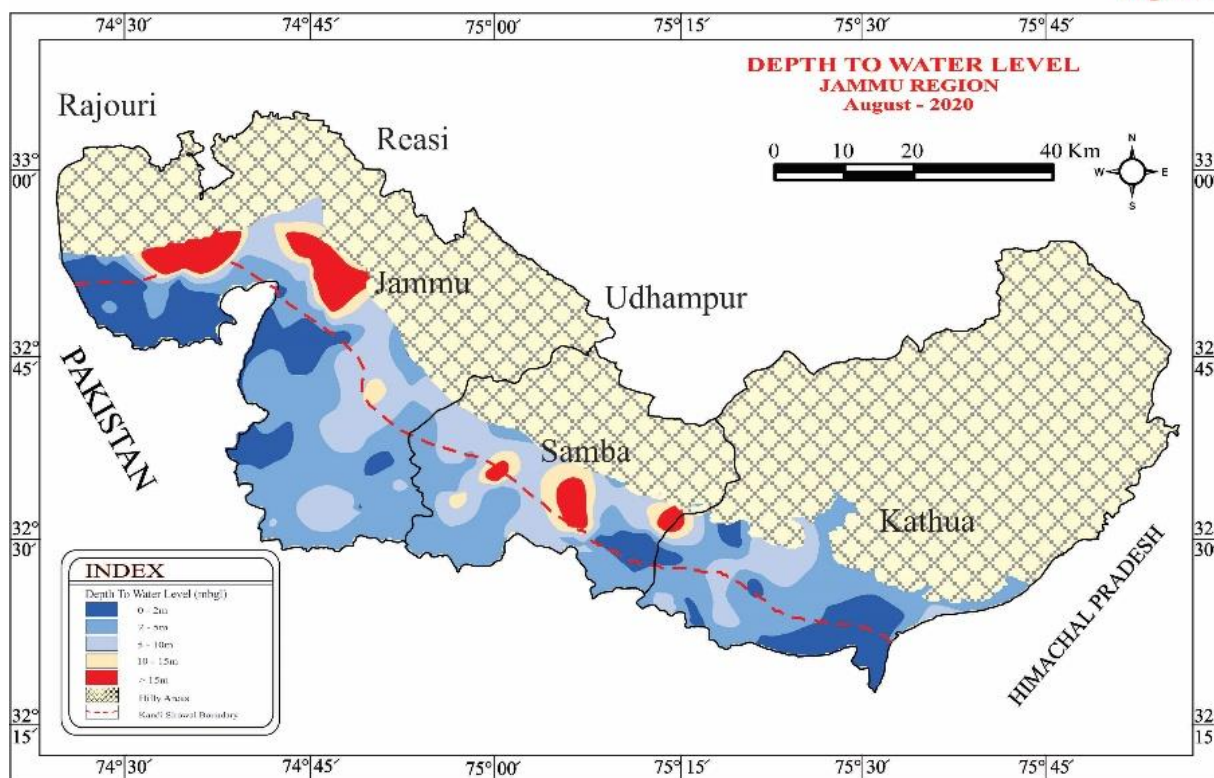
### 3.1.2. Depth to Water Level -August 2020

The water level data in respect of 212 wells for the month of August 2020 were analysed. The depth to water levels varied from 0.03 m bgl (in Jallow Udhampur district) to a maximum of 35.70 m bgl (Taryai in Jammu district). Categorization of DTWL August 2020 is given in table 4.

The water level less than 2 meters below ground level was recorded in 102 wells (48.11%). 65 wells (30.66%), have shown water level in the range of 2 to 5 m bgl, whereas 29 wells (13.68%) have shown water level in the range of 5 to 10 m bgl. 4 wells (1.89%) have shown deeper water levels i.e. in the range of 10 to 15 m bgl. 12 wells (5.66%) have shown very deep water level of >15 m bgl.

In Sirowal formation, water levels varied between 0 to 5 in major portion and 5-10 m bgl at a few places. The transition part of Sirowal belt and Kandi belt of both Jammu and Kathua Districts shows varied water levels. Water levels deeper than 15m bgl were observed in the extreme north-western portion of Jammu district in Kandi belt and middle and N-Eastern areas in Samba district (Figure 5).

**Figure 5**



**Table 4: CATEGORIZATION OF DEPTH TO WATER LEVEL- AUGUST 2020**

District	No. Of wells Analyzed	Depth to Water Level (mbgl)		Number of Wells Showing Depth to Water Level (mbgl) in the Range of					Percentage of Wells Showing Depth to Water Level (mbgl) in the Range of				
		Min	Max	0 – 2	2 – 5	5 – 10	10 – 15	> 15	0 – 2	2 – 5	5 – 10	10 – 15	> 15
Jammu	82	0.07	35.70	30	29	13	3	7	36.59	35.37	15.85	3.66	8.54
Kathua	34	0.08	8.37	18	10	6	0	0	52.94	29.41	17.65	0.00	0.00
Rajauri	33	0.13	5.30	26	6	1	0	0	78.79	18.18	3.03	0.00	0.00
Reasi	4	0.75	23.42	1	1	1	0	1	25.00	25.00	25.00	0.00	25.00
Samba	36	0.14	20.85	12	12	7	1	4	33.33	33.33	19.44	2.78	11.11
Udhampur	23	0.03	7.03	15	7	1	0	0	65.22	30.43	4.35	0.00	0.00
<b>Total</b>	<b>212</b>	<b>0.03</b>	<b>35.70</b>	<b>102</b>	<b>65</b>	<b>29</b>	<b>4</b>	<b>12</b>	<b>48.11</b>	<b>30.66</b>	<b>13.68</b>	<b>1.89</b>	<b>5.66</b>

### 3.1.3. Depth to Water Level -November 2020

The water level data in respect of 215 wells for the month of November 2020 were analysed. The depth to water level ranges from 0.09 m bgl (Jagati Jammu district) to 34.50 m bgl (Taryai in Jammu district). Categorization of DTWL Nov. 2020 is given in table 5.

A total of 43 numbers of wells (20.00%) have recorded the water level less than 2.0 m bgl. Majority of the wells (113 wells, 52.56% of the total wells) analysed have shown depth to water level in the range of 2-5 m bgl. Whereas 43 wells (20.00%) have shown water levels in the range of 5-10 m bgl. 5 (2.33%) wells have registered deeper water levels, in the range of 10-15 m bgl. Another 11 wells (5.12%) of the total wells analysed have shown water levels in the range of >15 m bgl.



In Sirowal formation of Jammu, Samba and Kathua, water levels varied between 0 to 5 in major parts and 0-2 m bgl at a few parts. Major part of Sirowal belt in all the three Districts shows water levels between 2 and 5 m bgl and water levels in the range of 0-2 m & 5 – 10 m bgl have been observed at a few patches. In Kandi belt, the water levels generally found are within the range of 5 - 15 mbgl. Water levels deeper than 15m bgl were observed in the extreme north & north-western portion of Jammu district in Kandi belt and central & eastern parts in Samba district (Figure 6).

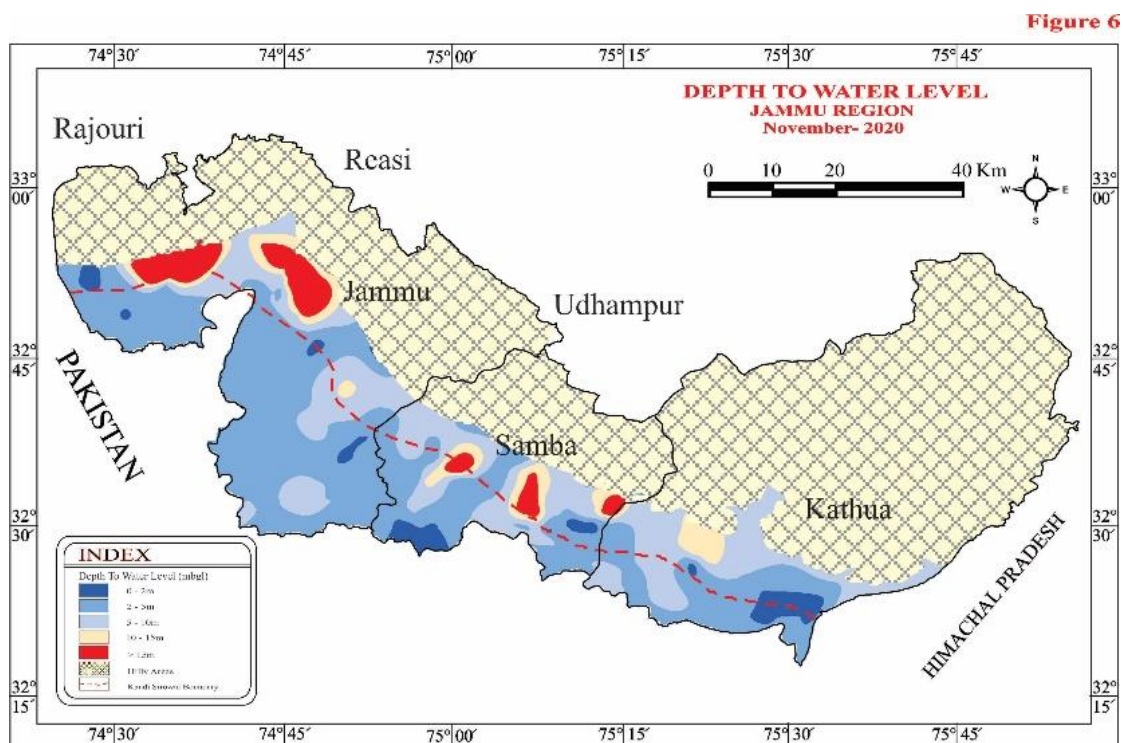


Table 5: CATEGORIZATION OF DEPTH TO WATER LEVEL- NOVEMBER 2020

District	No. Of wells Analyzed	Depth to Water Level (mbgl)		Number of Wells Showing Depth to Water Level (mbgl) in the Range of					Percentage of Wells Showing Depth to Water Level (mbgl) in the Range of				
		Min	Max	0 – 2	2 – 5	5 – 10	10 – 15	> 15	0 – 2	2 – 5	5 – 10	10 – 15	> 15
Jammu	80	0.09	34.50	10	44	16	4	6	12.50	55.00	20.00	5.00	7.50
Kathua	32	0.18	13.69	6	14	11	1	0	18.75	43.75	34.38	3.13	0.00
Rajauri	33	0.62	5.13	11	21	1	0	0	33.33	63.64	3.03	0.00	0.00
Reasi	8	2.00	25.00	1	5	1	0	1	12.50	62.50	12.50	0.00	12.50
Samba	38	0.98	23.36	7	17	10	0	4	18.42	44.74	26.32	0.00	10.53
Udhamapur	24	0.35	6.43	8	12	4	0	0	33.33	50.00	16.67	0.00	0.00
<b>Total</b>	<b>215</b>	<b>0.09</b>	<b>34.50</b>	<b>43</b>	<b>113</b>	<b>43</b>	<b>5</b>	<b>11</b>	<b>20.00</b>	<b>52.56</b>	<b>20.00</b>	<b>2.33</b>	<b>5.12</b>

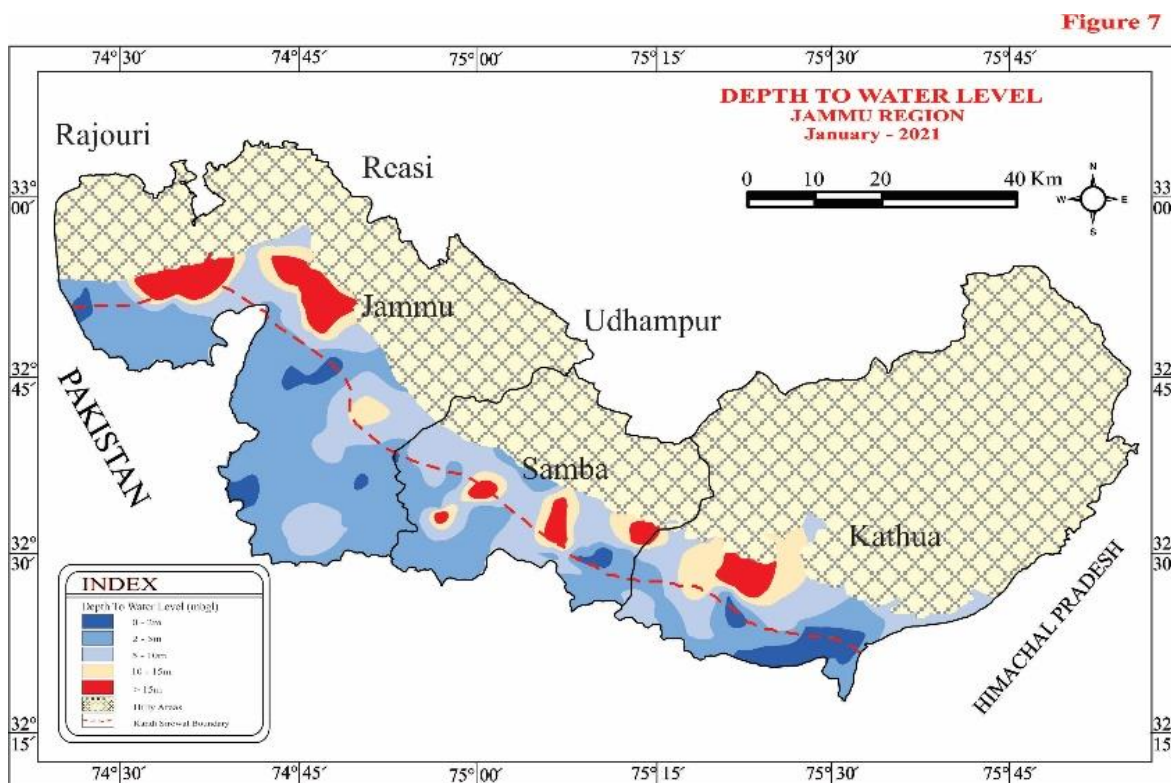
### 3.1.4. Depth to Water Level -January 2021

The water level data in respect of 221 wells for the month of January 2021 were analysed. The depth to water levels varied from 0.06 at Jagati District to 34.90 m bgl in Taryai Jammu District. Categorization of depth to water level January 2021 is given in table 6.

A total of 77 wells (34.84% of the total wells analysed) have recorded the water level less than 2.0 m bgl. 87 wells (39.37%) have shown depth to water level in the range 2-5 m bgl, whereas 37 wells (16.74%) wells have shown water levels in the range of 5-10 m bgl, 6 (2.71%) wells have shown the deeper water levels i.e. 10-15 m bgl and 14 (6.33%) wells have shown water level more than 15 m bgl.



In entire Sirowal area, the water levels varied between 2 to 5 m bgl with few small patches of 0-2 and 5-10 m. Besides, small portions of all the three districts recorded water level in the range of 5 to 10 mbgl. The Kandi belt shows deeper water levels between 5 to 15 m bgl. of all the three districts, the deeper water levels deeper i.e. more than 15 m bgl were also observed in north & north western part of Jammu, central & north eastern parts of Samba and northern parts of Kathua districts (Figure 7).



**Table 6: CATEGORIZATION OF DEPTH TO WATER LEVEL- JANUARY 2021**

District	No. Of wells Analyzed	Depth to Water Level (mbgl)		Number of Wells Showing Depth to Water Level (mbgl) in the Range of					Percentage of Wells Showing Depth to Water Level (mbgl) in the Range of				
		Min	Max	0 – 2	2 – 5	5 – 10	10 – 15	> 15	0 – 2	2 – 5	5 – 10	10 – 15	> 15
Jammu	79	0.06	34.90	15	41	13	3	7	18.99	51.90	16.46	3.80	8.86
Kathua	37	0.78	21.50	11	12	10	3	1	29.73	32.43	27.03	8.11	2.70
Rajauri	35	0.09	4.45	25	10	0	0	0	71.43	28.57	0.00	0.00	0.00
Reasi	8	1.54	25.00	3	4	0	0	1	37.50	50.00	0.00	0.00	12.50
Samba	39	0.11	24.00	7	15	12	0	5	17.95	38.46	30.77	0.00	12.82
Udhampur	23	0.16	6.50	16	5	2	0	0	69.57	21.74	8.70	0.00	0.00
<b>Total</b>	<b>221</b>	<b>0.06</b>	<b>34.90</b>	<b>77</b>	<b>87</b>	<b>37</b>	<b>6</b>	<b>14</b>	<b>34.84</b>	<b>39.37</b>	<b>16.74</b>	<b>2.71</b>	<b>6.33</b>

### 3.2. SEASONAL FLUCTUATION OF WATER LEVEL

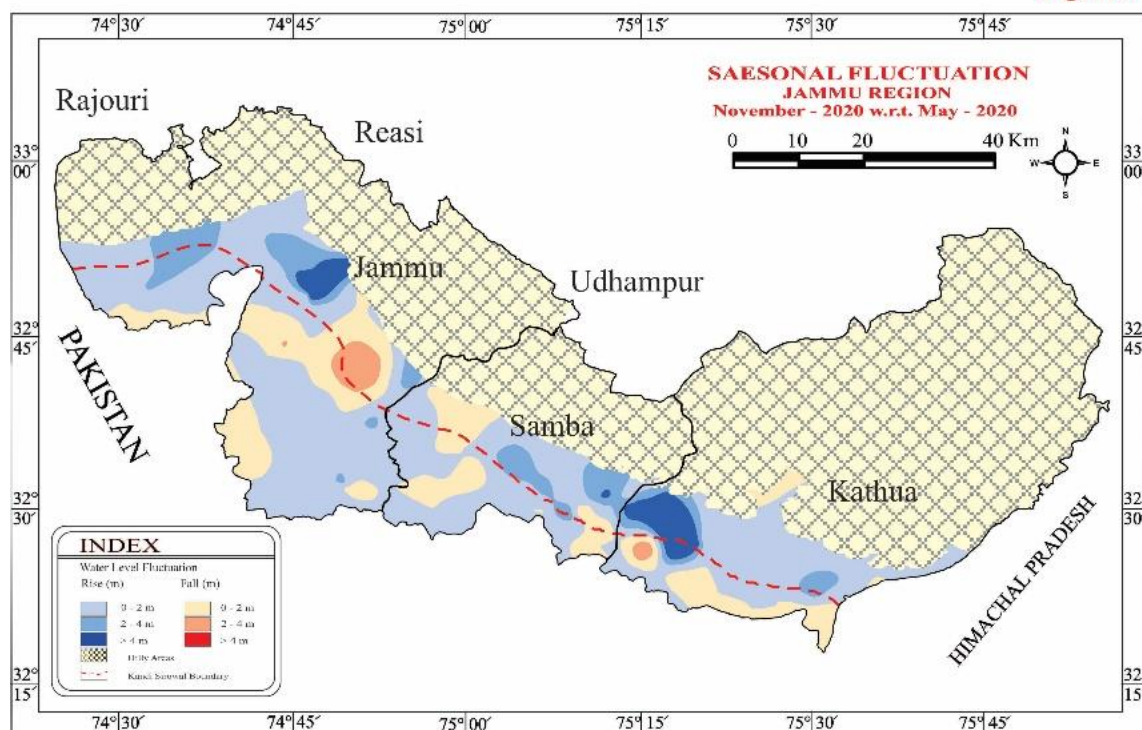
#### 3.2.1. November 2020 with respect to May 2020

The seasonal water level fluctuation between November 2020 & May 2020 in respect of 184 National Hydrograph Stations are analysed. It is observed that 120 stations have shown rise in water level where as only 64 stations have shown fall in water levels in the range of 0-2 m, 2-4 m and >4 m. Categorization of fluctuations in water levels is given in Table 7.

Out of 184 stations showing rise in water levels, 93 wells (50.54%) have shown rise less than 2 m. 20 wells (10.87%) and 07 wells (3.80%) have shown rise in the range of 2-4 m and >4 m respectively. 56 wells (30.43%) have shown decline between 0-2 m and 6 wells (3.26%) have shown fall between 2-4 and 2 wells (1.09%) have shown decline of >4 m.

Effect of rainfall is directly reflected in all parts of the area monitored during November 2020. Almost all the valley areas are showing rise in the water levels except for small patches in all districts. A few locations of each district have registered fall of water level within 0-5 m bgl (Figure 8).

**Figure 8**



**Table 7. CATEGORIZATION OF CHANGES IN WATER LEVEL BETWEEN MAY 2020-NOVEMBER 2020 - JAMMU DIVISION**

District	No. Of wells Analyzed	Range of Fluctuation (m)				No. of Wells Showing Fluctuation (m)						Percentage of wells Showing Fluctuation						Total No. Of Wells	
		Rise		Fall		Rise			Fall			Rise			Fall			Rise	Fall
		Min	Max	Min	Max	0-2	2-4	>4	0-2	2-4	>4	0-2	2-4	>4	0-2	2-4	>4		
Jammu	70	0.01	7.24	0.03	4.24	40	15	2	10	2	1	57.14	21.43	2.86	14.29	2.86	1.43	57	13
Kathua	23	0.04	9.6	0.07	3.37	9	2	3	8	1	0	39.13	8.70	13.04	34.78	4.35	0.00	14	9
Rajauri	29	0.04	1.39	0.03	2.31	13	0	0	15	1	0	44.83	0.00	0.00	51.72	3.45	0.00	13	16
Reasi	7	0.10	0.15	0.32	7.79	2	0	0	4	0	1	28.57	0.00	0.00	57.14	0.00	14.29	2	5
Samba	35	0.17	4.17	0.08	1.50	20	3	2	10	0	0	57.14	8.57	5.71	28.57	0.00	0.00	25	10
Udhampur	20	0.01	1.82	0.01	2.95	9	0	0	9	2	0	45.00	0.00	0.00	45.00	10.00	0.00	9	11
<b>TOTAL</b>	<b>184</b>	<b>0.01</b>	<b>9.60</b>	<b>0.01</b>	<b>7.79</b>	<b>93</b>	<b>20</b>	<b>7</b>	<b>56</b>	<b>6</b>	<b>2</b>	<b>50.54</b>	<b>10.87</b>	<b>3.80</b>	<b>30.43</b>	<b>3.26</b>	<b>1.09</b>	<b>120</b>	<b>64</b>

### 3.3. ANNUAL FLUCTUATION OF WATER LEVEL

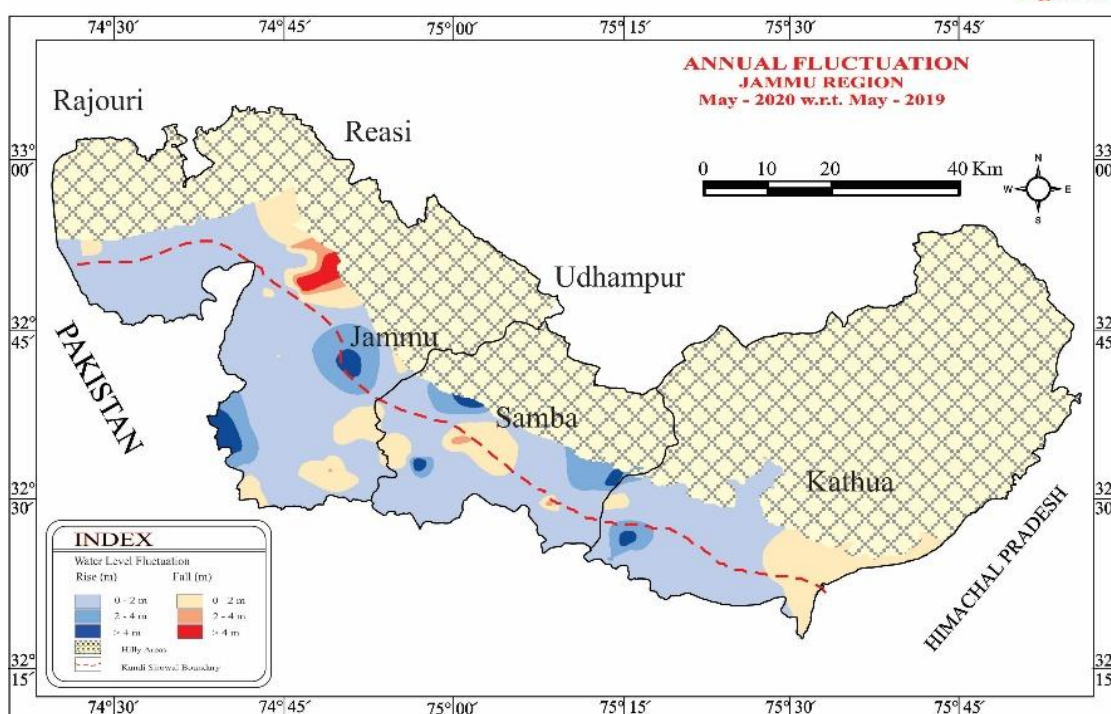
#### 3.3.1. May 2020 and May 2019

The water level data in respect of 190 National Hydrograph Stations for the month of May 2020 was analysed. It was compared with those monitored during May 2019. Majority of the wells have shown rise in water levels. A total of 149 wells have shown rise and 41 wells have shown fall in water levels in the range of 0-2 m, 2-4 m and >4 m. Categorization of fluctuations in water levels is given in table 8.

Rise is shown by 130 wells (48.42%) in the range of 0-2 m. 10 wells (5.26%) have registered rise from 2-4 m bgl and 9 wells (4.74%) are showing rise of >4 m. Among 41 wells showing fall, 34 wells (17.89%) have shown fall in water level in the range of 0-2 m, 6 wells (3.16%) have shown fall between 2-4 m, and 1 (0.53%) well have shown fall of >4 m.

Major parts of all the districts, have shown rise in water levels in all range where as a significant portion have shown decline in water level. All the districts have registered rise in water levels at few locations, but in water levels in the range of 0-2 m is observed in sufficient portions in all the districts. Northern parts of Jammu district have shown decline >4m i.e (Figure 9).

**Figure 9**



**Table 8 CATEGORIZATION OF CHANGES IN WATER LEVEL BETWEEN MAY 2020 AND MAY 2019**

District	No. Of wells Analyzed	Range of Fluctuation (m)				No. of Wells Showing Fluctuation (m)						Percentage of wells Showing Fluctuation						Total No. Of Wells	
		Rise		Fall		Rise			Fall			Rise			Fall			Rise	Fall
		Min	Max	Min	Max	0-2	2-4	>4	0-2	2-4	>4	0-2	2-4	>4	0-2	2-4	>4		
Jammu	70	0.02	0.01	0.01	7.19	44	1	3	17	4	1	62.86	1.43	4.29	24.29	5.71	1.43	48	22
Kathua	27	0.05	4.68	0.31	0.74	17	2	2	6	0	0	62.96	7.41	7.41	22.22	0.00	0.00	21	6
Rajauri	31	0.07	4.66	0.50	0.91	23	3	2	3	0	0	74.19	9.68	6.45	9.68	0.00	0.00	28	3
Reasi	7	0.07	2.48	0.33	1.40	4	1	0	2	0	0	57.14	14.29	0.00	28.57	0.00	0.00	5	2
Samba	35	0.22	6.67	1.19	2.54	26	3	2	2	2	0	74.29	8.57	5.71	5.71	5.71	0.00	31	4
Udhampur	20	0.03	1.70	0.18	0.38	16	0	0	4	0	0	80.00	0.00	0.00	20.00	0.00	0.00	16	4
<b>Total</b>	<b>190</b>	<b>0.02</b>	<b>6.67</b>	<b>0.01</b>	<b>7.19</b>	<b>130</b>	<b>10</b>	<b>9</b>	<b>34</b>	<b>6</b>	<b>1</b>	<b>68.42</b>	<b>5.26</b>	<b>4.74</b>	<b>17.89</b>	<b>3.16</b>	<b>0.53</b>	<b>149</b>	<b>41</b>

### 3.3.2. August 2020 and August 2019

For analysing the annual fluctuation, the water level data in respect of 186 National Hydrograph Network Stations for the month of August 2020 were analysed and compared with the water levels of August 2019. Categorization of fluctuations in water levels is given in table 9.

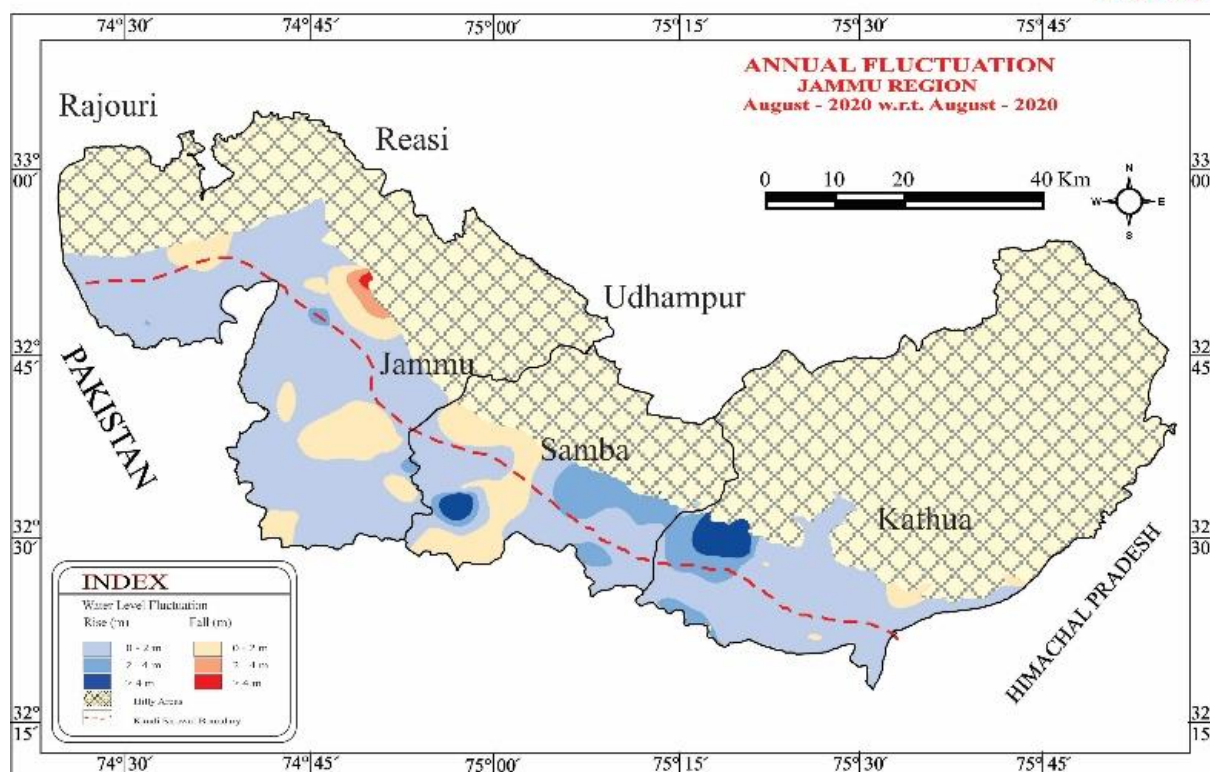
A total of 155 wells have shown rise and 31 wells have shown fall in water levels. Rise is shown by 130 wells (69.89%) in the range of 0-2 m, 21 wells (11.29%) in the range of 2-4 m bgl and 4 wells (2.15%)



have registered rise of >4 m. Among 31 wells showing decline, a total of 82 wells (15.05%) have registered fall in the range of 0-2 m, 1 well (0.54%) have shown fall between 2-4 m and 2 wells (1.08%) have shown fall of >4 m.

Jammu Region is showing rise in water levels in all districts. The decline in the range of 0 – 2 m has been observed in major parts in Jammu, and Samba districts. Major portions of all the districts have shown rise in water levels. In Kathua rise is shown in whole district (Figure 10).

**Figure 10**



**Table 9 CATEGORIZATION OF CHANGES IN WATER LEVEL BETWEEN AUGUST 2020 AND AUGUST 2019**

District	No. Of wells Analyzed	Range of Fluctuation (m)				No. of Wells Showing Fluctuation (m)						Percentage of wells Showing Fluctuation						Total No. Of Wells	
		Rise		Fall		Rise			Fall			Rise			Fall			Rise	Fall
		Min	Max	Min	Max	0-2	2-4	>4	0-2	2-4	>4	0-2	2-4	>4	0-2	2-4	>4		
Jammu	72	0.02	2.76	0.04	5.65	50	7	0	13	1	1	69.44	9.72	0.00	18.06	1.39	1.39	57	15
Kathua	30	0.02	9.43	0.01	0.49	19	4	1	6	0	0	63.33	13.33	3.33	20.00	0.00	0.00	24	6
Rajauri	31	0.41	6.61	0.16	1.13	22	5	1	3	0	0	70.97	16.13	3.23	9.68	0.00	0.00	28	3
Reasi	4	0.45	2.18		5.21	2	1	0	0	0	1	50.00	25.00	0.00	0.00	0.00	25.00	3	1
Samba	29	0.02	8.85	0.74	1.45	19	4	2	4	0	0	0.00	13.79	6.90	13.79	0.00	0.00	25	4
Udhampur	20	0.05	1.62	0.90	1.02	18	0	0	2	0	0	90.00	0.00	0.00	10.00	0.00	0.00	18	2
<b>Total</b>	<b>186</b>	<b>0.02</b>	<b>9.43</b>	<b>0.01</b>	<b>5.65</b>	<b>130</b>	<b>21</b>	<b>4</b>	<b>28</b>	<b>1</b>	<b>2</b>	<b>69.89</b>	<b>11.29</b>	<b>2.15</b>	<b>15.05</b>	<b>0.54</b>	<b>1.08</b>	<b>155</b>	<b>31</b>

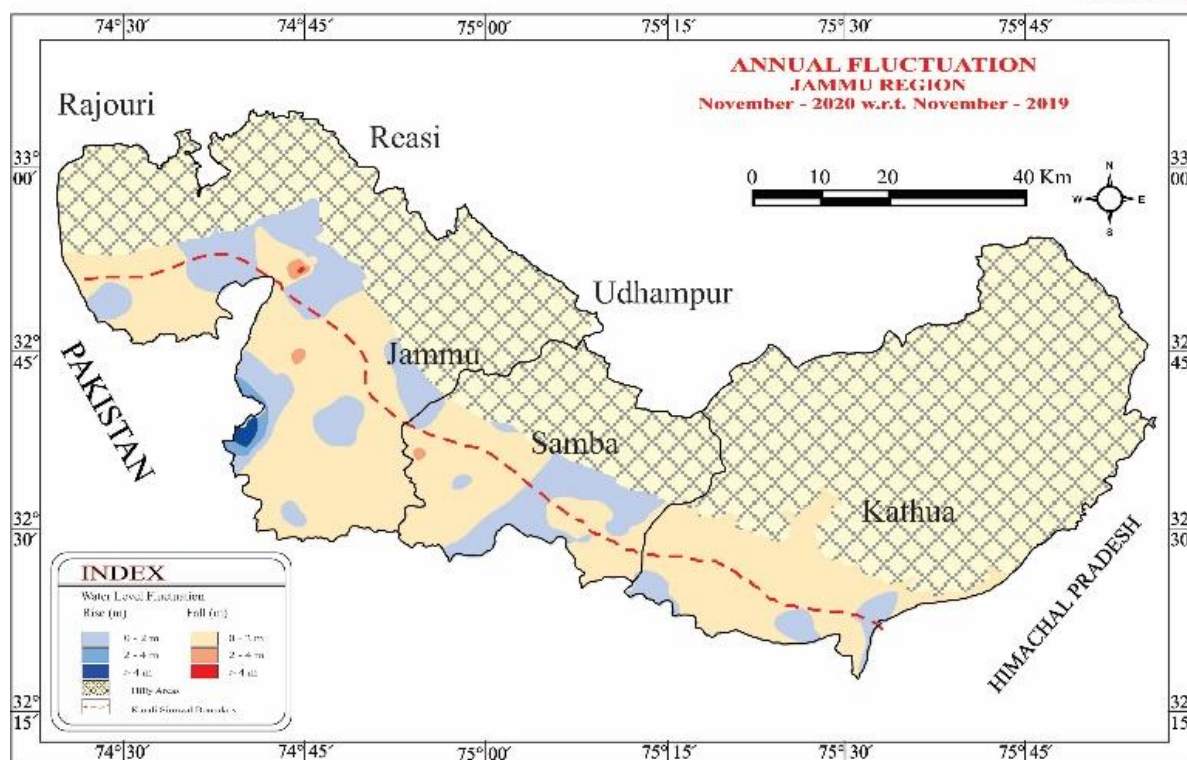
### 3.3.3. November 2020 and November 2019

The water level data, in respect of 204 National Hydrograph Stations for the month of November 2020 was analysed. It was compared with those monitored during November 2019. Majority of the wells have shown rise in water levels. A total of 59 wells have shown rise and 145 wells have shown fall in water levels. Categorization of fluctuations in water levels is given in table 10.

Rise is shown by 55 wells (26.96%) in the range of 0-2 m. 2 wells (0.98%) have recorded rise in the range of 2-4 m bgl and only 2 well (0.98%) has shown rise of >4 m. Among 145 wells showing fall, 130 wells (63.73%) have shown fall in the range of 0-2 m. 13 wells (6.37%) have shown fall between 2-4 m, and 2 (0.98%) wells have shown fall of >4 m.

Major parts of all the districts have shown decline in water levels in the range of 0-2 m and some pockets have shown rise in water level in Jammu district. Major parts of Samba and Kathua district have shown decline in 0-2m with few exceptions in northern and southern western Jammu, central Samba, and north eastern parts of Kathua district (Figure 11).

**Figure 11**



**Table 10 CATEGORIZATION OF CHANGES IN WATER LEVEL BETWEEN NOVEMBER 2020 AND NOVEMBER 2019**

District	No. Of wells Analyzed	Range of Fluctuation (m)				No. of Wells Showing Fluctuation (m)						Percentage of wells Showing Fluctuation						Total No. Of Wells	
		Rise		Fall		Rise			Fall			Rise			Fall			Rise	Fall
		Min	Max	Min	Max	0-2	2-4	>4	0-2	2-4	>4	0-2	2-4	>4	0-2	2-4	>4		
Jammu	78	0.05	5.07	0.02	4.46	20	0	2	52	3	1	25.64	0.00	2.56	66.67	3.85	1.28	22	56
Kathua	31	0.01	2.57	0.01	2.03	8	0	0	22	1	0	25.81	0.00	0.00	70.97	3.23	0.00	8	23
Rajauri	27	0.02	2.26	0.04	2.25	11	1	0	14	1	0	40.74	3.70	0.00	51.85	3.70	0.00	12	15
Reasi	8	3.07		0.34	2.70	0	1	0	6	1	0	0.00	12.50	0.00	75.00	12.50	0.00	1	7
Samba	36	0.03	1.93	0.05	2.17	15	0	0	20	1	0	41.67	0.00	0.00	55.56	2.78	0.00	15	21
Udhampur	24	0.95		0.10	4.67	1	0	0	16	6	1	4.17	0.00	0.00	66.67	25.00	4.17	1	23
<b>Total</b>	<b>204</b>	<b>0.01</b>	<b>5.07</b>	<b>0.01</b>	<b>4.67</b>	<b>55</b>	<b>2</b>	<b>2</b>	<b>130</b>	<b>13</b>	<b>2</b>	<b>26.96</b>	<b>0.98</b>	<b>0.98</b>	<b>63.73</b>	<b>6.37</b>	<b>0.98</b>	<b>59</b>	<b>145</b>

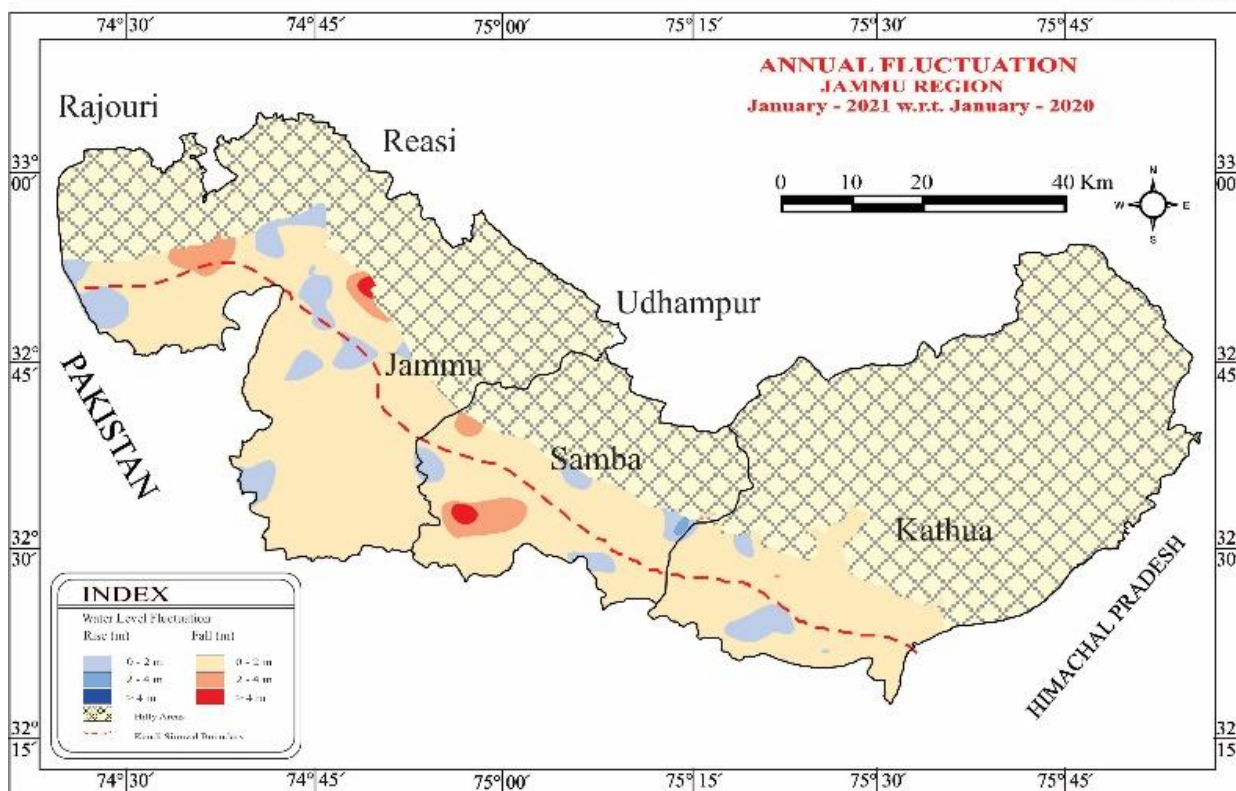
### 3.3.4. January 2021 and January 2020

The water level data, in respect of 216 National Hydrograph Stations for the month of January 2021 was analysed. It was compared with those monitored during January 2020. Majority of the wells have shown rise in water levels. A total of 70 wells have shown rise and 146 wells have shown fall in water levels. Categorization of fluctuations in water levels is given in table 11.

Rise is shown by 66 wells (30.56%) in the range of 0-2 m. 3 wells (1.39%) have recorded rise in the range of 2-4 m bgl and 1 well (0.46%) have shown rise of >4 m. Among 146 wells showing fall, 136 wells (62.96%) have shown fall in the range of 0-2 m, 7 wells (3.24%) have shown fall between 2-4m, and 3 wells (1.39%) has shown fall of >4 m.

In Jammu district, decline in water levels in the range of 0-2 m has been observed equally in entire areas except few portions. Some pockets have shown rise in water level of 2 m scattered areas in all districts. Very small pockets have shown decline above 4m in central Samba and northern Jammu (Figure 12)

**Figure 12**



**Table 11. CATEGORIZATION OF CHANGES IN WATER LEVEL BETWEEN JANUARY 2020 AND JANUARY 2021**

District	No. Of wells Analyzed	Range of Fluctuation (m)				No. of Wells Showing Fluctuation (m)									Percentage of wells Showing Fluctuation						Total No. Of Wells	
		Rise		Fall		Rise			Fall			Rise			Fall			Rise	Fall			
		Min	Max	Min	Max	0-2	2-4	>4	0-2	2-4	>4	0-2	2-4	>4	0-2	2-4	>4					
Jammu	77	0.04	2.15	0.01	6.44	21	1	0	51	3	1	27.27	1.30	0.00	66.23	3.90	1.30	22	55			
Kathua	37	0.01	0.50	0.01	2.02	7	0	0	29	1	0	18.92	0.00	0.00	78.38	2.70	0.00	7	30			
Rajauri	33	0.01	2.79	0.02	1.89	17	1	0	15	0	0	51.52	3.03	0.00	45.45	0.00	0.00	18	15			
Reasi	8	0.03	4.50	0.26	0.12	4	0	1	3	0	0	50.00	0.00	12.50	37.50	0.00	0.00	5	3			
Samba	38	0.26	2.74	0.09	8.25	8	1	0	25	3	1	21.05	2.63	0.00	65.79	7.89	2.63	9	29			
Udhampur	23	0.01	1.16	0.03	5.05	9	0	0	13	0	1	39.13	0.00	0.00	56.52	0.00	4.35	9	14			
<b>Total</b>	<b>216</b>	<b>0.01</b>	<b>4.50</b>	<b>0.01</b>	<b>8.25</b>	<b>66</b>	<b>3</b>	<b>1</b>	<b>136</b>	<b>7</b>	<b>3</b>	<b>30.56</b>	<b>1.39</b>	<b>0.46</b>	<b>62.96</b>	<b>3.24</b>	<b>1.39</b>	<b>70</b>	<b>146</b>			



### 3.4. DECADAL FLUCTUATION OF WATER LEVEL

#### 3.4.1. May 2020 decadal mean of May 2010 – May 2019

The water level fluctuation for the month of May 2020 Vs. (Mean of May 2010 – May 2019) has been worked out in respect of 175 observation wells. It is observed that a total of 123 wells have shown rise and 52 wells have shown decline in water level (especially in Kandi areas of Outer plains). Categorisation of fluctuations in water level is given in table 12.

Out of 123 number of wells showing rise, 109 wells (62.29%) have shown rise less than 2 m, 10 wells (5.71%) have shown rise from 2-4 m and 4 (2.29%) wells have shown rise of > 4 m. Out of 52 wells showing fall, 43 wells (24.57%) have shown fall in the range of 0-2 m, 7 wells (4.00%) have shown fall between 2-4 m and 2 wells (1.14%) have shown fall of >4 m.

All of the areas have shown rise as well as decline in water levels in all ranges in Jammu Region. In Jammu district, the rise in range of 0-5m was found in entire area except north western and some southern patches. In Samba major areas have shown rise except western areas, and in Kathua district whole area is in rise except in the eastern area where decline of 0-2m was recorded. (Figure 13).

Figure 13

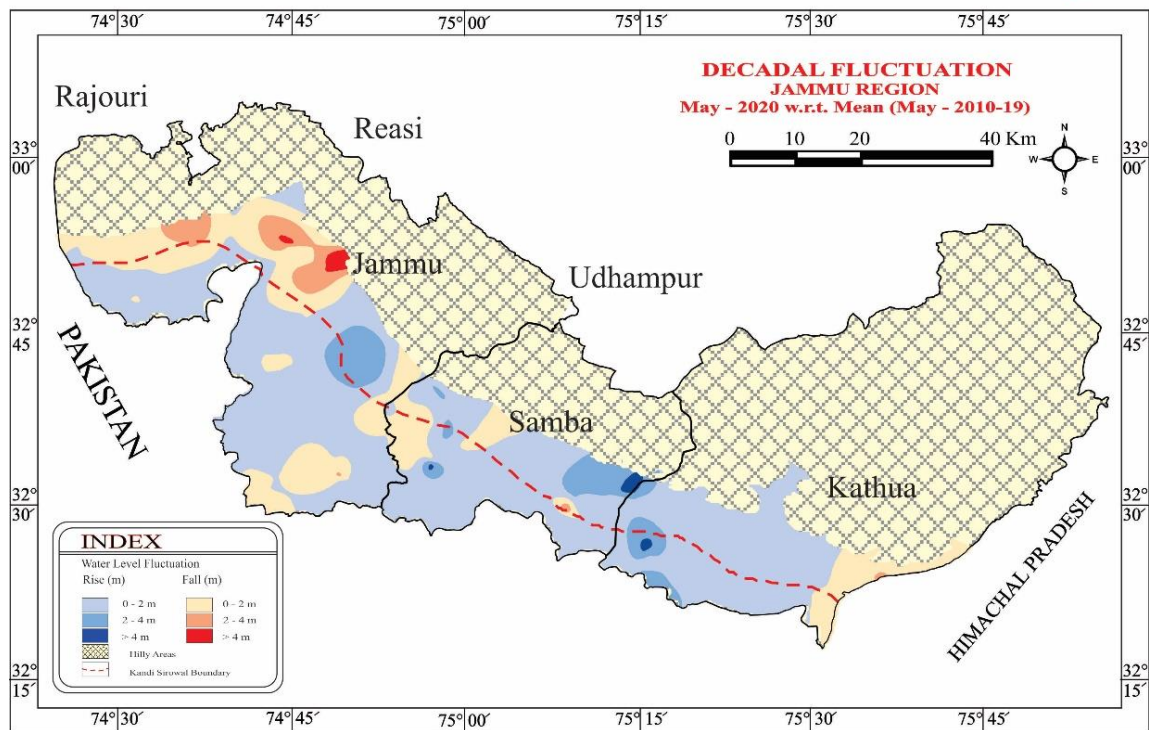


Table 12. Categorization Of Changes In Water Level Between May 2020 To Decadal Mean (May 2010-May 2019)

District	No. Of wells Analyzed	Range of Fluctuation (m)				No. of Wells Showing Fluctuation (m)						Percentage of wells Showing Fluctuation						Total No. Of Wells	
		Rise		Fall		Rise			Fall			Rise			Fall			Rise	Fall
		Min	Max	Min	Max	0-2	2-4	>4	0-2	2-4	>4	0-2	2-4	>4	0-2	2-4	>4		
Jammu	67	0.02	3.90	0.02	6.75	35	1	0	24	5	2	52.24	1.49	0.00	35.82	7.46	2.99	36	31
Kathua	25	0.06	4.31	0.32	2.09	19	1	2	2	1	0	76.00	4.00	8.00	8.00	4.00	0.00	22	3
Rajauri	26	0.01	3.95	0.13	1.25	20	2	0	4	0	0	76.92	7.69	0.00	15.38	0.00	0.00	22	4
Reasi	7	0.22	1.18	0.40	1.47	4	0	0	3	0	0	57.14	0.00	0.00	42.86	0.00	0.00	4	3
Samba	35	0.02	5.45	0.08	2.97	20	5	2	7	1	0	57.14	14.29	5.71	20.00	2.86	0.00	27	8
Udhampur	15	0.11	3.39	0.16	0.80	11	1	0	3	0	0	73.33	6.67	0.00	20.00	0.00	0.00	12	3
<b>TOTAL</b>	<b>175</b>	<b>0.01</b>	<b>5.45</b>	<b>0.02</b>	<b>6.75</b>	<b>109</b>	<b>10</b>	<b>4</b>	<b>43</b>	<b>7</b>	<b>2</b>	<b>62.29</b>	<b>5.71</b>	<b>2.29</b>	<b>24.57</b>	<b>4.00</b>	<b>1.14</b>	<b>123</b>	<b>52</b>

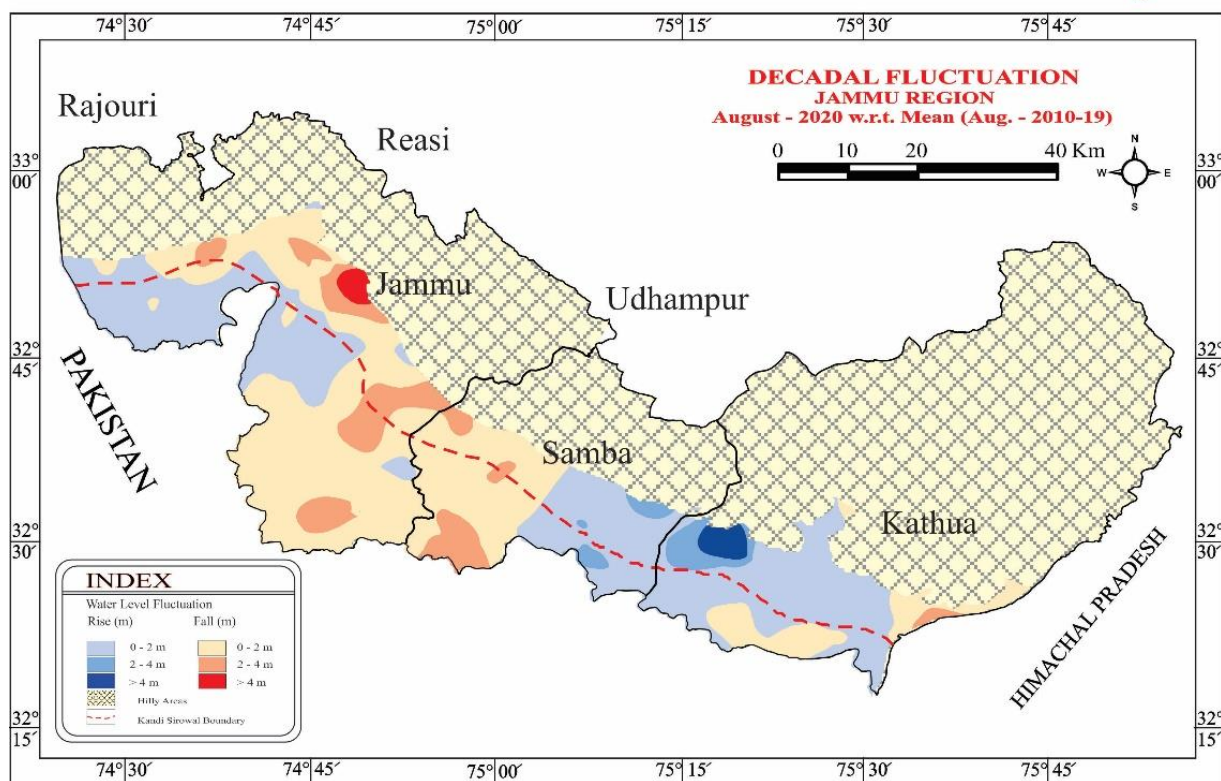
### 3.4.2. August 2020 decadal mean of August 2010– August 2019

The water level fluctuation for the month of August 2020 Vs. (Mean of Aug. 2010 – Aug.2019 has been worked out in respect of 191 wells. It is observed that a total of 118 wells have shown rise and 73 wells have shown decline in water level. Categorisation of fluctuations in water level is given in table 13.

Out of 118 number of wells showing rise, 112 wells (58.64%) have shown rise less than 2 m, 4 wells (2.09%) have shown rise from 2-4 m whereas 2 well (1.05%) shown rise of > 4 m. Out of 73 wells showing fall, 53 wells (27.75%) have shown fall in the range of 0-2 m, 17 well (8.90%) has shown fall between 2-4 m and 3 wells (1.57%) has shown fall of >4 m bgl.

Almost half of Jammu and Samba districts have shown equal rise and fall, where as in Kathua decline is observed in small area. Rise in Jammu is shown in western and north-western areas and rest areas showing decline. In Samba district western areas show decline and eastern areas show rise. In Kathua district entire area show rise except small portions of southern and eastern areas. (Figure 14).

**Figure 14**



**Table 13. Categorization Of Changes In Water Level Between August 2020 To Decadal Mean (August 2010-August 2019)**

District	No. Of wells Analyzed	Range of Fluctuation (m)				No. of Wells Showing Fluctuation (m)						Percentage of wells Showing Fluctuation						Total No. Of Wells	
		Rise		Fall		Rise			Fall			Rise			Fall			Rise	Fall
		Min	Max	Min	Max	0-2	2-4	>4	0-2	2-4	>4	0-2	2-4	>4	0-2	2-4	>4		
Jammu	78	0.03	1.58	0.02	12.36	38	0	0	27	12	1	48.72	0.00	0.00	34.62	15.38	1.28	38	40
Kathua	28	0.01	7.38	0.04	2.62	18	1	1	7	1	0	64.29	3.57	3.57	25.00	3.57	0.00	20	8
Rajauri	25	0.03	1.94	0.29	1.68	20	0	0	5	0	0	80.00	0.00	0.00	20.00	0.00	0.00	20	5
Reasi	4	0.86	1.29	0.06	6.08	2	0	0	1	0	1	50.00	0.00	0.00	25.00	0.00	25.00	2	2
Samba	35	0.01	4.33	0.41	2.45	19	2	1	9	4	0	54.29	5.71	2.86	25.71	11.43	0.00	22	13
Udhampur	21	0.03	2.04	0.45	5.31	15	1	0	4	0	1	71.43	4.76	0.00	19.05	0.00	4.76	16	5
<b>TOTAL</b>	<b>191</b>	<b>0.01</b>	<b>7.38</b>	<b>0.02</b>	<b>12.36</b>	<b>112</b>	<b>4</b>	<b>2</b>	<b>53</b>	<b>17</b>	<b>3</b>	<b>58.64</b>	<b>2.09</b>	<b>1.05</b>	<b>27.75</b>	<b>8.90</b>	<b>1.57</b>	<b>118</b>	<b>73</b>



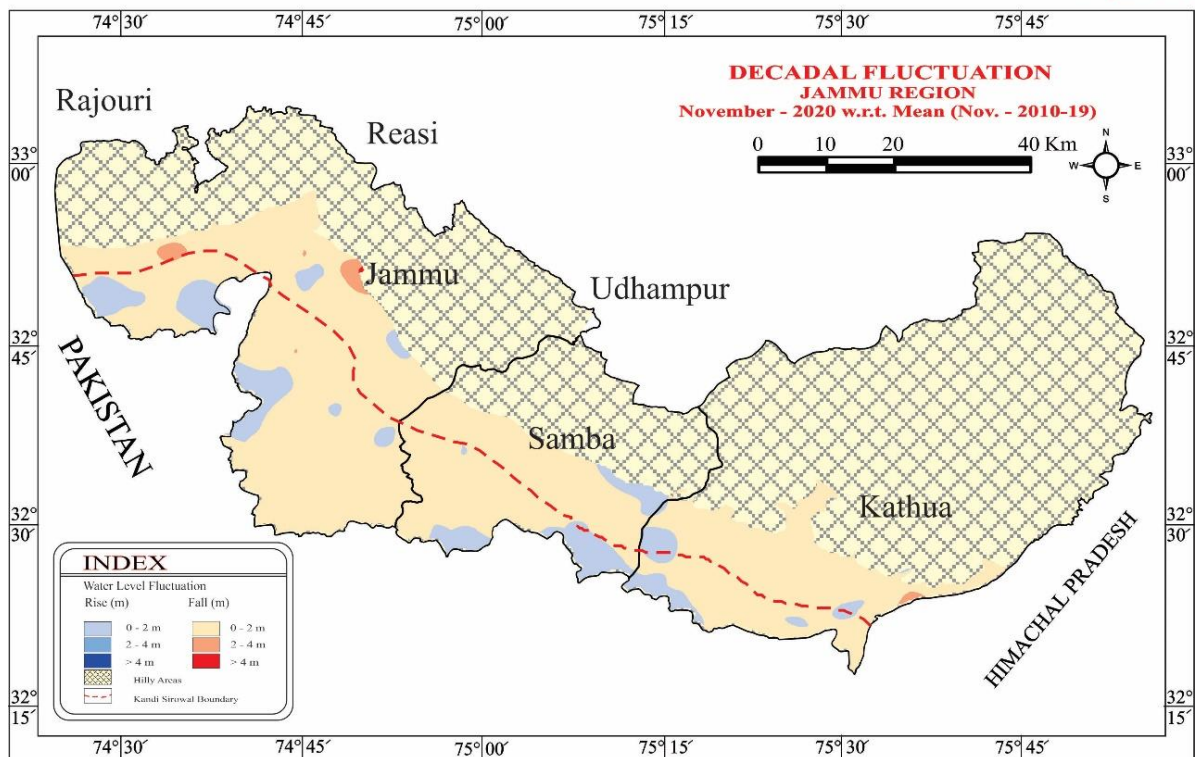
### 3.4.3. November 2020 with respect to mean of November 2010 – November 2019

The water level fluctuation for the month of November 2020 w.r.t. (mean of November 2010 to November 2019) has been worked out in respect of 188 observation wells. It is observed that a total of 47 wells have shown rise and 141 wells have shown decline in water levels. Categorisation of fluctuations in water level is given in table 14.

Out of 47 number of wells showing rise, 46 wells (24.47%) are showing rise less than 2 m, 1 well (0.53%) have shown rise from 2-4 m and 0 wells (0%) have shown rise of more than 4 m. Out of 141 wells, which are showing fall, 130 wells (69.15%) have shown fall in water levels in the range of 0-2 m, 9 wells (4.79%) have shown fall between 2-4 m and 2 wells (1.06%) have shown fall of >4 m.

Decline in water levels was observed in all the districts of Jammu Region. A few areas have shown rise in water levels above 0- 2m i.e. in all districts. Western areas of Jammu district, southern areas of Samba and western areas of Kathua districts have shown rise in water levels. Few small portions in Jammu and Kathua show decline in between 2-4 m. (Figure 15).

**Figure 15**



**Table 14. Categorization Of Changes In Water Level Between November 2020 To Decadal Mean (November 2010-November 2019)**

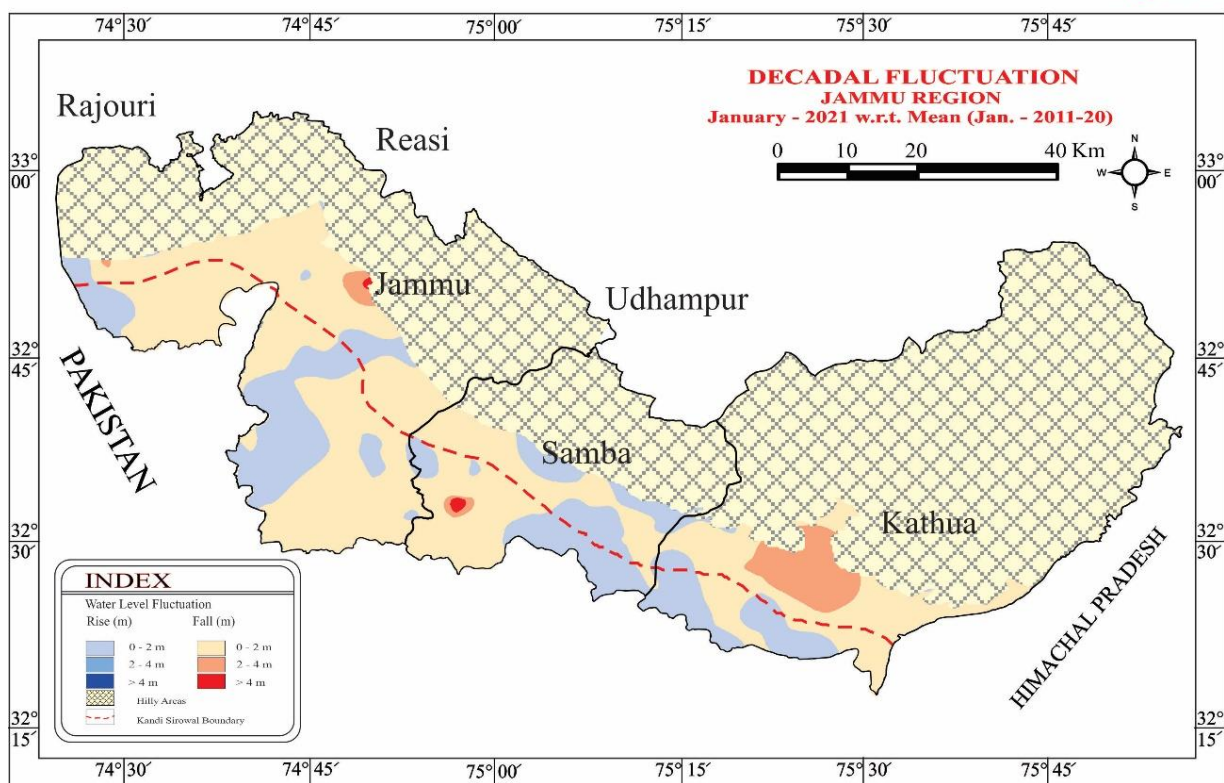
District	No. Of wells Analyzed	Range of Fluctuation (m)				No. of Wells Showing Fluctuation (m)						Percentage of wells Showing Fluctuation						Total No. Of Wells	
		Rise		Fall		Rise			Fall			Rise			Fall			Rise	Fall
		Min	Max	Min	Max	0-2	2-4	>4	0-2	2-4	>4	0-2	2-4	>4	0-2	2-4	>4		
Jammu	76	0.05	0.82	0.04	4.56	15	0	0	55	4	2	19.74	0.00	0.00	72.37	5.26	2.63	15	61
Kathua	25	0.02	1.01	0.04	2.24	6	0	0	18	1	0	24.00	0.00	0.00	72.00	4.00	0.00	6	19
Rajauri	26	0.04	1.01	0.04	2.14	11	0	0	14	1	0	42.31	0.00	0.00	53.85	3.85	0.00	11	15
Reasi	7	0.63		0.16	2.41	1	0	0	5	1	0	14.29	0.00	0.00	71.43	14.29	0.00	1	6
Samba	34	0.03	2.38	0.01	1.93	9	1	0	24	0	0	26.47	2.94	0.00	70.59	0.00	0.00	10	24
Udhampur	20	0.08	1.65	0.02	2.97	4	0	0	14	2	0	20.00	0.00	0.00	70.00	10.00	0.00	4	16
<b>TOTAL</b>	<b>188</b>	<b>0.02</b>	<b>2.38</b>	<b>0.01</b>	<b>4.56</b>	<b>46</b>	<b>1</b>	<b>0</b>	<b>130</b>	<b>9</b>	<b>2</b>	<b>24.47</b>	<b>0.53</b>	<b>0.00</b>	<b>69.15</b>	<b>4.79</b>	<b>1.06</b>	<b>47</b>	<b>141</b>

### 3.4.4. January 2021 with respect to mean of January 2011 – January 2020

The water level fluctuation for the month of January 2021 w.r.t. (mean of January 2011 to January 2020) has been worked out in respect of 186 observation wells. It is observed that a total of 67 wells have shown rise and 119 wells have shown decline in water levels. Categorisation of fluctuations in water level is given in table 15.

Out of 67 number of wells showing rise, 62 wells (33.33%) have shown rise less than 2 m, 5 wells (2.69%) have shown rise from 2-4 m and 0 well (0 %) have shown rise of more than 4 m. Out of 119 wells showing fall in water levels, 107 wells (57.53%) have shown fall in the range of 0-2 m, 9 wells (4.84%) has shown fall between 2-4 m and 2 wells (1.61%) has shown fall of >4 m. In Jammu Region, Decline as well as rise is in water levels is observed in all the districts of Jammu Region. Decline is shown in northern and eastern Jammu areas, Western and central areas of Samba and central and entire northern Kathua district. (Figure 16)

**Figure 16**



**Table 15. Categorization Of Changes In Water Level Between January 2021 To Decadal Mean (January 2011-January 2020)**

District	No. Of wells Analyzed	Range of Fluctuation (m)				No. of Wells Showing Fluctuation (m)						Percentage of wells Showing Fluctuation						Total No. Of Wells	
		Rise		Fall		Rise			Fall			Rise			Fall			Rise	Fall
		Min	Max	Min	Max	0-2	2-4	>4	0-2	2-4	>4	0-2	2-4	>4	0-2	2-4	>4		
Jammu	71	0.05	2.09	0.01	4.82	20	1	0	47	2	1	28.17	1.41	0.00	66.20	2.82	1.41	21	50
Kathua	30	0.01	2.35	0.05	3.21	15	1	0	12	2	0	50.00	3.33	0.00	40.00	6.67	0.00	16	14
Rajauri	28			0.22	5.35	0	0	0	23	4	1	0.00	0.00	0.00	82.14	14.29	3.57	0	28
Reasi	8			0.30	2.31	0	0	0	7	1	0	0.00	0.00	0.00	87.50	12.50	0.00	0	8
Samba	35	0.08	3.17	0.03	7.02	16	1	0	17	0	1	45.71	2.86	0.00	48.57	0.00	2.86	17	18
Udhampur	14	0.12	2.35	0.39		11	2	0	1	0	0	78.57	14.29	0.00	7.14	0.00	0.00	13	1
<b>TOTAL</b>	<b>186</b>	<b>0.01</b>	<b>3.17</b>	<b>0.01</b>	<b>7.02</b>	<b>62</b>	<b>5</b>	<b>0</b>	<b>107</b>	<b>9</b>	<b>3</b>	<b>33.33</b>	<b>2.69</b>	<b>0.00</b>	<b>57.53</b>	<b>4.84</b>	<b>1.61</b>	<b>67</b>	<b>119</b>

#### 4. HYDROCHEMISTRY

The chemical quality of ground water in the Union Territory (UT) of Jammu & Kashmir has been evaluated on the basis of 642 number of water samples (214 for basic, 214 for Uranium and 214 for Arsenic) collected from shallow aquifers during pre-monsoon season in month of May-June, 2020. All the collected samples were analysed by adopting standard methods of analysis from APHA. Chemical analysis data of ground water samples collected during May 2020 monitoring in Jammu & Kashmir UT is given in Annexure – II.

#### Ground Water Quality Characterization of J&K

##### Specific Conductance

Electrical Conductivity of ground water is generally low. Majority of samples (86.44%) are found to have specific conductance less than 750  $\mu\text{S}/\text{cm}$  at 25°C (Table 16). Hence the ground water is fresh and potable. In Jammu & Kashmir, specific conductance varies between 200 and 2240  $\mu\text{S}/\text{cm}$  at 25°C. More than 3000  $\mu\text{S}/\text{cm}$  is not observed in any sample.

##### pH

In Jammu & Kashmir, groundwater is neutral to alkaline in nature. Most of the samples collected from shallow ground water of Jammu & Kashmir are alkaline in nature. The pH values ranges between 7.47 at Sidhra to 9.16 at Suchetgarh II. 43.9% samples are dominated with carbonate type in nature.

Figure. 17

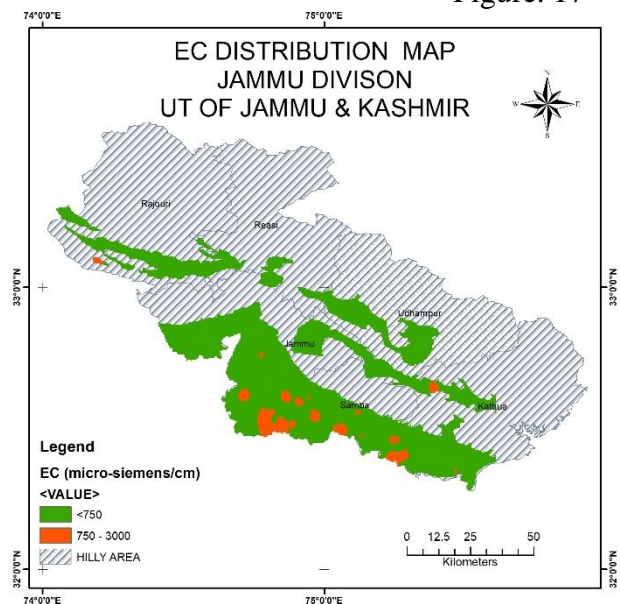


Figure. 18

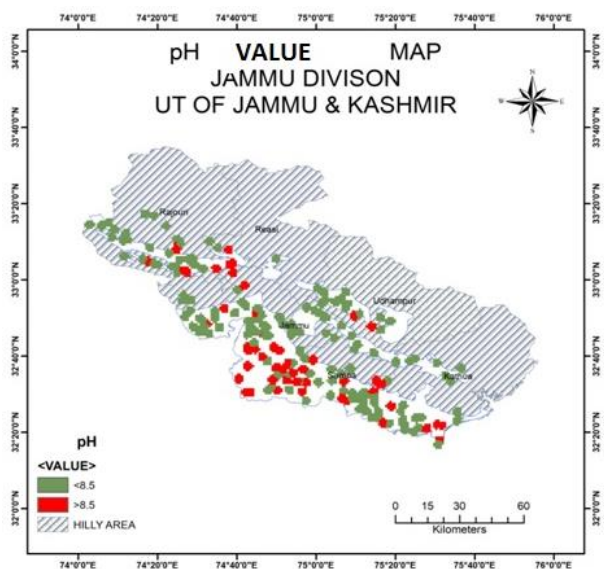




Figure. 19

### Chloride

The Chloride concentration varies from 7 to 259 mg/l. The Chloride concentrations in all the wells are within the maximum permissible limit 1000 mg/l as prescribed by BIS for drinking water purpose. In majority of samples (99.53%) chloride concentration is less than 250. The highest value is observed in Gangu chak which is 259 mg/l. None of the samples has shown Chloride concentration >1000 mg/l (Table 16).

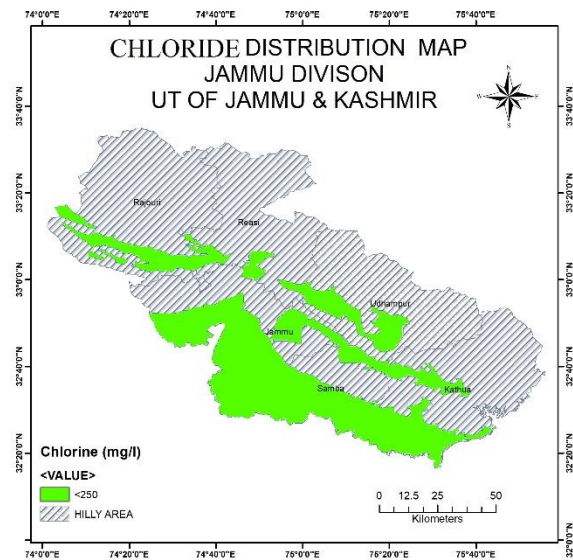


Figure. 20

### Fluoride

The concentration of fluoride ion in majority of the samples (95.3%) is within desirable limit of 1 mg/l. 3.74 % of the samples (8 locations), the fluoride concentrations vary from 1.01 – 1.50 mg/l and are within permissible limit as prescribed by BIS. 2 samples show greater than 1.50 mg/l fluoride concentration. Those samples are which are having high fluoride concentration may be due to Geogenic sources (Table 16).

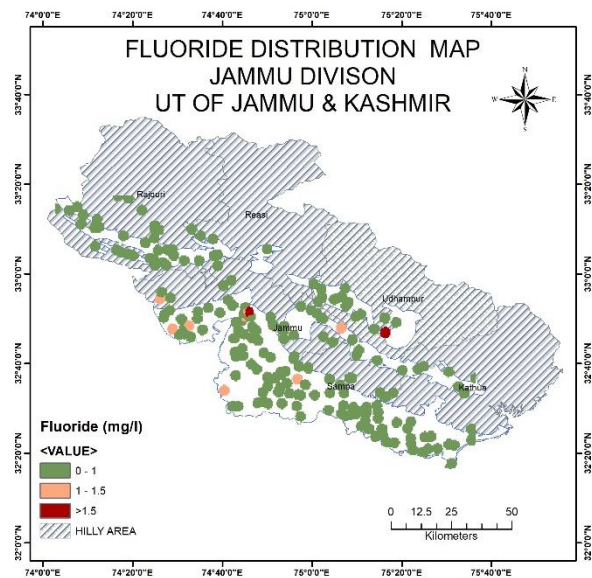
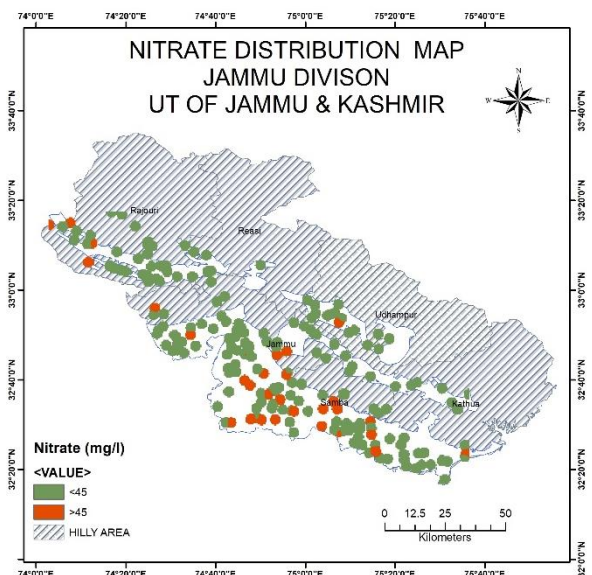


Figure. 21

### Nitrate

Nitrate Concentration in 85.5% samples is low, but high values are also reported in some of the samples (14.5%). The details of samples having Nitrate concentration more than maximum permissible limit of BIS (>45mg/l) are summarized in the table 16.



**Table 16 Ground Water Quality during May 2020**

S. No.	Parameters	Samples Analyzed	Permissible limit	Ranges	No. of Samples	Percentage %
1	Sp. Conductance $\mu\text{s}/\text{cm}$ at 25°C	214	--	<250 250-750 750-2000 >2000	13 198 34 02	5.26 80.16 13.76 0.8
2	Chloride (mg/l)	214	250-1000	<250 >250	213 1	99.53 0.47
3	Fluoride (mg/l)	214	1.50 mg/l	<1.00 1.01-1.50 >1.50	204 8 2	95.3 3.74 0.93
4	Nitrate (mg/l)	214	45 mg/l	<45 >45	183 31	85.5 14.5

Figure. 22

### Calcium

Calcium concentration varies from 8.7 to 66.7 mg/l. The Calcium concentrations in all the wells are within the maximum permissible limit up to 200 mg/l as prescribed by BIS for drinking water purpose. In fact, in all the samples (214 samples), calcium concentration are less than 75mg/l i.e. well within acceptable limits prescribed by BIS.

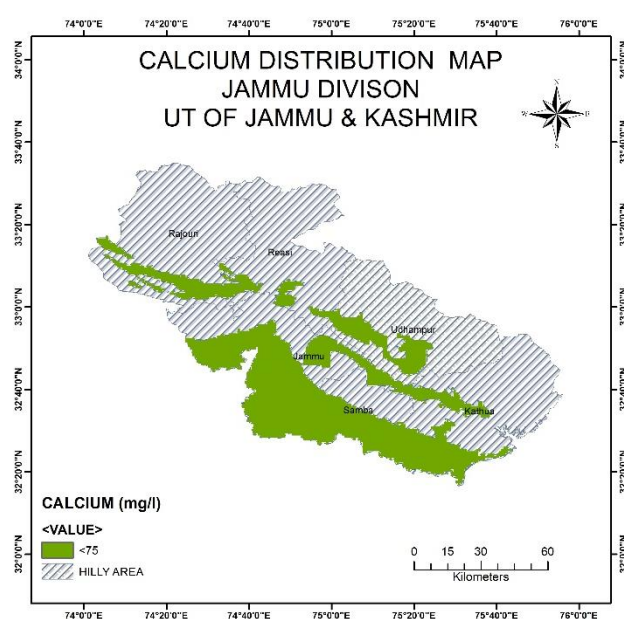
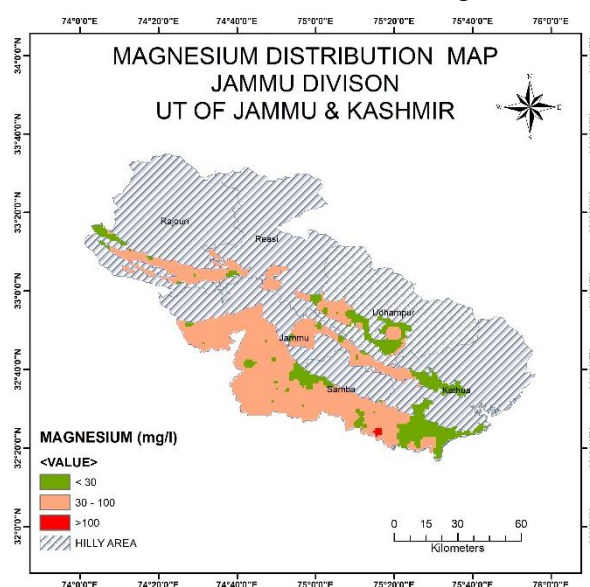


Figure. 23

### Magnesium

The Magnesium concentration varies from 8 to 216 mg/l. In 83 samples Magnesium concentration are less than 30 mg/l i.e. within desirable limits whereas 127 samples are with high values then the acceptable limits but are less than the 100 mg/l permissible limits prescribed by BIS. Only 4 samples have shown magnesium concentration >100 mg/l.



## Total Hardness

The salts of Calcium and Magnesium such as carbonates, sulphate salts in ground water causes hardness. High hardness values in water can cause scaling in water supply lines and prevent the foam production with the soap solution. High concentration of hardness in ground water is social economic problem; hence it is also an important water quality parameter.

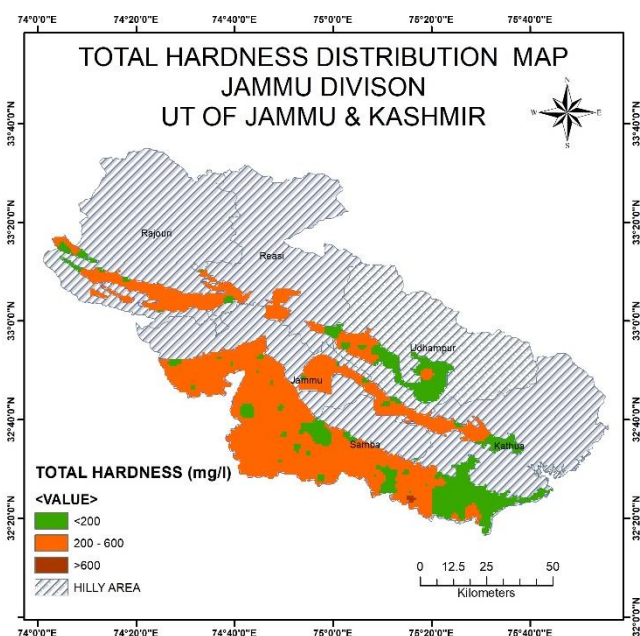


Figure. 24

## Classification of Hardness

As per the classification of hardness, 148 samples fall under very hard category i.e. greater than 180 mg/l and 59 samples fall in hard category (121-180 mg/l). Six samples are found in moderately hard category i.e. 61-120 mg/l. Only one sample has less than 60 mg/l of hardness thus falling in the soft category.

As per the BIS Standards, 200 and 600 mg/l is the acceptable and permissible limit respectively for total hardness in drinking water. All samples are within the maximum permissible limit (i.e. 600 mg/l), except one location where high value of total Hardness > 600 mg/l is observed.

## Sulphate

Sulphate concentration varies from 0 to 290 mg/l. The sulphate concentrations in all locations are within the permissible limit (400 mg/l) prescribed by BIS for drinking water purpose. In 212 samples, sulphate concentration are less than 200mg/l i.e. within desirable limits whereas 2 samples with high values (but < 400 mg/l within permissible limits) are also observed.

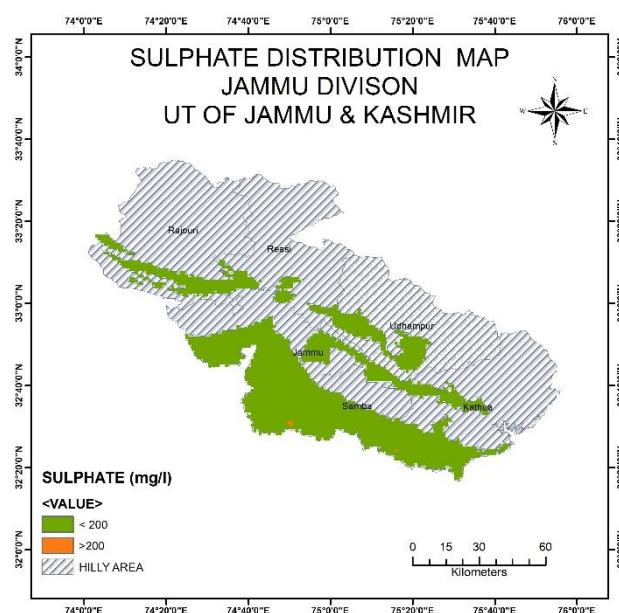


Figure. 25



## Arsenic

Arsenic was determined in the 214 samples collected from the NHS during May 2020. All the samples were preserved and analyzed using the standard procedures prescribed in the BIS and APHA. All the water samples are having arsenic concentration below the permissible limit of 0.05 mg/l as per the BIS Standards.

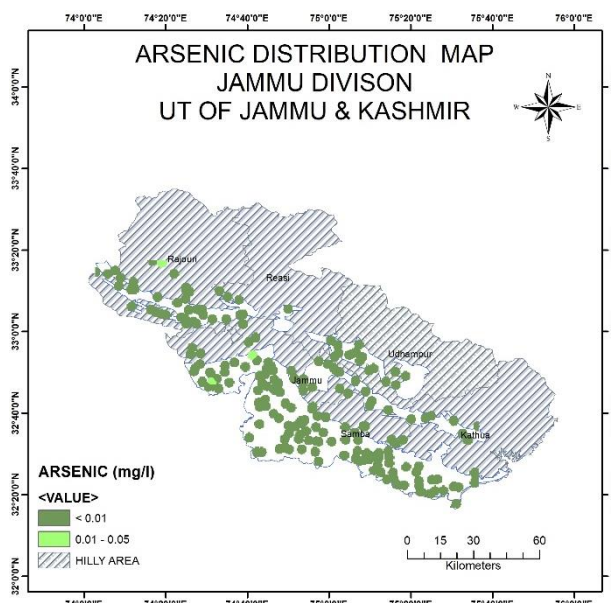


Figure. 26

## Uranium

Uranium was also detected in all the 214 samples collected. All the samples were having uranium concentration below the permissible limit of 30 ppb prescribed by the World Health Organization.

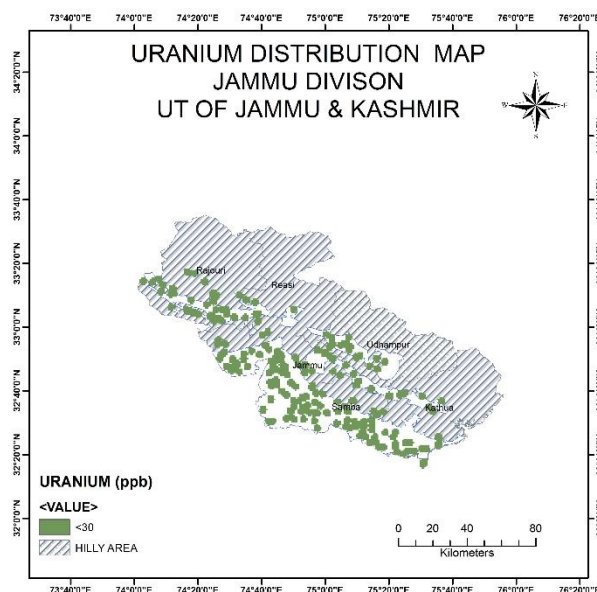


Figure. 27

## District wise variation of Chemical Data

The maximum and minimum values of various chemical constituents of the groundwater in the Jammu division are given below:

Name of District	Table 17. Variation in Ground Water Quality Parameters																	
		pH	EC μs/cm	(mg/l)													U ppb	
				TDS	CO <sub>3</sub>	HCO <sub>3</sub>	Cl	TH	Ca	Mg	Na	K	NO <sub>3</sub>	F	SO <sub>4</sub>	PO <sub>4</sub>		As
Jammu	Max	9.16	1680	1008	78.12	689	197	499	66.7	103	190	350	267	8.6	290	2.6	0.024	28
	Min.	7.55	230	138	0	119	7	141	8.7	13	2.3	1.6	0.7	0	0	0.6	0	0
Rajouri	Max	8.79	980	588	65.1	477	177	413	62.3	89	171	10	140	1	81	ND	0.048	20
	Min.	7.89	240	144	0	119	20	130	8.9	10	9	1	3	0	6	ND	0	0
Samba	Max	9.02	1270	762	65.1	371	163	467	53.4	100	187.2	109.1	252.9	1	148	1.8	0.005	28.6
	Min.	7.47	290	174	0	146	14	141	13.3	10	4.8	1.9	3.5	0	7.1	0.5	0	0
Kathua	Max	9.01	2240	1344	65.1	503	259	1010	56.5	216	195	57	422	1	245	0	0.009	14
	Min.	7.61	200	120	0	106	7	98	8.7	8	5	2	0	0	4	0	0	0
Udhampur	Max	8.85	680	408	13.02	450	68	315	43.5	63	170	5.3	72.4	2	87	ND	0.007	6.1
	Min.	7.55	290	174	0	106	14	54	8.7	8	6.2	1.4	0.2	0	6.8	ND	0.001	0
Reasi	Max	8.86	560	336	39.06	331	34	380	40	68	18	19	26	0	21	ND	0.007	5
	Min.	7.98	270	162	0	146	7	163	22.2	21	6	2	1	0	6	ND	0	0

## **Chemical Result and Discussion**

Ground water in Jammu and Kashmir is fresh and potable in most of the areas. The groundwater type in the area is of Ca-Mg-HCO<sub>3</sub> and Na-K-HCO<sub>3</sub> type. In terms of pH values, the groundwater is found to be alkaline in nature. The electrical conductivity of majority of the samples is well below the 750  $\mu$ S/cm at 25°C representing that the salinity is not an issue in the UT of J&K.

The major anions such as Carbonates, Bicarbonates, Chloride, Nitrate, Sulphate and Fluoride are analyzed to assess the groundwater quality. Bicarbonate is the dominating anion present in the groundwater. The values of chlorides are well within the range prescribed by BIS also suggesting that salinity is not a matter of concern. However, the values of Nitrate are found to be higher in 31 samples than their limits prescribed by the BIS. The high values of nitrate may be due to the Human and animal excreta adding nitrate to water by bacterial decomposition and usage of nitrogen pesticides/ fertilizers in agriculture and horticulture. The mixing from septic tank and sewage discharges etc in groundwater can also leads to increase in nitrate concentration in groundwater. High nitrate concentration can cause methaemoglobinemia to infants. This is also known as blue baby disease.

The fluoride in some amount is required by human body. However, high concentration of the fluoride can cause fluorosis. In J&K, the majority of the water samples have fluoride concentration well within the range prescribed by the BIS. Only two samples have higher values of greater than 1.5 mg/l. These may be due to geogenic sources.

The major cations analysed are Calcium, Magnesium, Sodium and Potassium. The groundwater samples are found to have high hardness values. The hardness is due to the salts of Calcium and Magnesium ions. Majority of the samples falls in the very hard category. The high values of hardness can cause scaling in the pipes and can cause skin, hair and gastro problems etc.

The trace elements Arsenic and radioactive element Uranium was also analysed in the groundwater samples. Both the parameters are found well within the range prescribed by concerned authorities.



## RECOMMENDATIONS

1. Ground water in Jammu and Kashmir UT is fresh and potable in most of the areas. Water supply in this UT is mainly dependant on ground water whether it is spring source, shallow ground water or deep ground water. Ground water is the main source for surface water bodies in the form of base flow in lean periods. Proper protection measures need to be taken to avoid contamination of ground water.
2. Even though salinity is not a major concern in the UT, based on the previous studies, there are problems of ground water contamination like iron (Fe) (in Tertiary belt and in Kashmir valley) marshy gases (in shallow and deep aquifers of Kashmir valley), Fluoride in localized areas like in parts of Doda dist. Nitrate contamination, Bacteriological contaminations, ground water pollution is due to pesticides/ fertilizers in agriculture and horticulture. The quality surveillance needs to be increased by UT Government Organisations. Ground water quality shall be monitored once in a year for all major elements, trace metals and bacteriological contaminations.
3. Most of the ground water is hard to very hard category causing gastro-intestinal problems. This type of water may be treated properly before supplying the water for drinking purposes.
4. Deeper aquifers in both Jammu region and Kashmir valley can be developed for mitigating the water supply requirements. Micro-level planning is required to develop these aquifers based on the available data of aquifer geometry, parameters and water resources. Groundwater from deeper aquifers in Kashmir valley consists of iron and marshy gasses which need to be treated properly before supplying the water. It is better to identify the iron free aquifers through scientific ground water exploration techniques couples with modern techniques of geophysics so that iron problem can be mitigated. Tube wells shall be constructed by tapping only iron free aquifers and avoiding iron rich aquifers through cement sealing and putting gravel pack only around the iron free aquifers.
5. The reality of climate change is the most significant long term threat to water resources. In hilly region water supply is still based on springs, where discharges of springs are drastically being reduced. Systematic enumeration/inventory of springs including its quality, snow water harvesting techniques and other available techniques is required to develop ground water resources on sustainable basis need to be adopted.
6. Fast developing urban & industrial areas need special attention/quality surveillance by the UT government authorities. Proper monitoring for trace elements in industrial areas like Bari-Brahmana, Gangyal and other industrial areas located in Kashmir valley shall be taken up. Monitoring network stations shall be established all along the nalas and drains carrying industrial effluents.

7. As the water supplies in Jammu city and parts of areas in Srinagar city are ground water based, proper well head protection measures need to be taken to avoid bacteriological contamination like coliform bacteria and E-coli.
8. There is lack of proper sewage and sanitation in all over the UT resulting into ground water and surface water contaminations. This issue need to be addressed immediately by the authorities. Village sewages shall be disposed of properly after proper treatment. In water logging areas, where ground water is being contaminated by polluted surface water, proper drainage shall be created for avoiding the water logging conditions.
9. Ground water contamination by improper disposal of domestic and industrial solid wastes is of another concern. Special efforts shall be made to address this problem.
10. There is an urgent need to take-up comprehensive studies on ground water quality of both shallow and deep ground waters analysing major elements, heavy metals, pesticides, microbial contamination is the need of the hour. Areas identified in this report where higher concentrations of heavy metals, nitrates and fluorides need to be given special attentions.
12. The existing data base on quality with different organizations like CGWB, PHED, UT pollution control board, academic institutions like Jammu university and Kashmir university need to integrated and a comprehensive data base need to be established.
13. Scientific research projects on ground water contamination especially geo-genic contamination like Iron, gasses and fluoride need to be taken up immediately
14. Proper management strategies need to be drawn up to combat the problems of geo-genic contamination. Cost effective community level treatment plants need to be established. The treatment plants as recommended in this report shall be constructed with trained manpower as in charges so that these treatment plants may work efficiently for longer periods.
16. As the ground water is hard to very hard type and consists of iron, proper treatment shall be followed before using this water for irrigation through modern irrigation methods like sprinkler and drip irrigation systems. This type of water may choke the sprinklers and drips.

**ANNEXURE – I**

**Depth to Water Level Data of Dug Wells (in m) for all Seasons (Jammu Region)**

S. No	Location	District	May-20	Aug-20	Nov-20	Jan-21
1	Agre Chak	Jammu	3.31	1.84	2.71	2.37
2	Akhnoor (Batera)	Jammu	16.77	12.99	13.82	14.83
3	Alla	Jammu	3.53	3.24	3.60	3.67
4	Arnia	Jammu	10.04	9.89	9.52	9.52
5	Badsoo	Jammu	1.99	0.09	1.54	1.15
6	Bakore	Jammu		1.80	4.00	4.74
7	Baradow	Jammu	8.14	4.73	7.88	5.13
8	Batera	Jammu	10.65	7.50	8.05	9.31
9	Bega	Jammu			2.60	2.67
10	Bera	Jammu			2.46	
11	Bhagwanachak	Jammu		27.30	28.87	27.49
12	Bishnah	Jammu	4.19	2.14	1.9	2.53
13	Chatta	Jammu	8.90	6.23	6.29	6.22
14	Chowki chowra	Jammu	5.95		3.15	0.76
15	Devipur	Jammu	7.31	4.05	6.60	7.85
16	Dhanpur	Jammu	6.03	4.05	3.95	4.97
17	Dharam Khu	Jammu	26.31	22.19	23.93	24.99
18	Dhora	Jammu	2.94	1.06		4.45
19	Gajansoo	Jammu	3.15	1.78	3.23	3.95
20	Garhi (Jammu)	Jammu	8.30	3.73	7.24	7.25
21	Gho-Manhasan	Jammu	2.25	0.71	4.34	1.54
22	Gigrial	Jammu	3.40	2.17	2.32	2.22
23	Greater Kailash	Jammu	10.82	9.90	7.87	9.29
24	Gura	Jammu	13.55	10.48	11.53	12.88
25	Hamirpur Kohna	Jammu	3.28	1.66	3.31	3.36
26	Hamirpur Sidhar	Jammu	3.79	1.90	3.28	3.43
27	Hazuribag	Jammu		6.95		
28	Jagati	Jammu	1.68	0.42	0.09	0.06
29	Jaswan	Jammu	4.72	3.36	4.55	4.33
30	Jhiri	Jammu	6.34	2.90	5.23	6.04
31	Jindrah	Jammu				
32	Jogwan	Jammu	5.90	4.18	4.28	4.82
33	Jourian	Jammu	5.54	1.67	2.91	4.01
34	Kachrial	Jammu	3.89	2.38		3.91
35	Kalah	Jammu	2.70	1.23	2.23	1.94
36	Kaluchak	Jammu			4.83	
37	Kamila	Jammu	5.87	5.36	5.39	
38	Kana Chak	Jammu	4.20	1.84	3.4	3.90
39	Kangar	Jammu	17.76	16.88	12.86	15.40
40	Karnaile Chak	Jammu				8.09
41	Katcha-Pind Dansal	Jammu	2.35	1.90	2.27	1.91
42	Khairi (Raipur)	Jammu	5.42	6.32	5.74	7.44
43	Khanpur Nagrota	Jammu	4.70	1.30	4.29	4.86
44	Khour	Jammu	4.31	1.16	2.8	3.74
45	Kot Kaswal	Jammu	1.94	0.17	1.42	0.25
46	Kothey Saini	Jammu	4.65	2.19	3.9	4.24
47	Kotli Charkan	Jammu	3.48	4.59	3.2	2.91
48	Kunihala	Jammu	1.08	1.18	1.46	1.31
49	Lalyal	Jammu	3.59	2.84	3.53	3.47
50	Lam	Jammu	2.33	0.23	2.36	2.39
51	Laswara	Jammu	2.19	1.01	1.6	1.68
52	Leherian	Jammu		7.48	9.05	9.65
53	Makwal	Jammu	3.82	2.61	2.71	2.64
54	Marh	Jammu		1.48	2.38	2.66
55	Marjholi	Jammu				

S. No	Location	Jammu	May-20	Aug-20	Nov-20	Jan-21
56	Miran Sahib	Jammu	7.08	8.78	6.78	6.83
57	Mothlian Kalan	Jammu		5.00	5.62	
58	Muthi	Jammu		0.39	1.74	1.15
59	Nagbani	Jammu	4.18	1.28	3.73	4.13
60	Nagrota (Kandoli)	Jammu		3.25	3.25	3.53
61	Nagrota (Uttarbani)	Jammu	8.11	5.82	6.1	
62	Nandpur	Jammu	2.70	3.47	2.66	2.84
63	Nikowal	Jammu	6.10	5.05	5.33	4.99
64	Painthi	Jammu		3.34	5.8	5.71
65	Palatan	Jammu	2.09	0.61	2.08	1.89
66	Pallanwala	Jammu	2.90	0.33	1.38	1.60
67	Pangli Colony	Jammu	2.87	0.07	1.83	2.75
68	Pata Khu	Jammu	23.41	21.48	20.1	21.85
69	Patyale Chak	Jammu	3.97	2.43	3.49	4.04
70	Poal	Jammu	5.75	1.81	3.05	3.06
71	Purkhoo	Jammu	24.10	17.34	16.86	17.66
72	Rangoora	Jammu		0.93	0.64	0.82
73	Rehal	Jammu	5.12	5.23	4.57	4.88
74	Sajwal	Jammu	2.58	0.41	2.51	2.79
75	Salehar	Jammu	4.10	2.64	3.15	2.66
76	Sandhwan	Jammu	3.37	2.34	3.5	3.10
77	Satwari	Jammu	7.08	10.62	10.37	11.13
78	Sei Khurd	Jammu	4.47	4.49	3.84	4.80
79	Senth	Jammu	2.08	0.49	2.46	2.54
80	Shame Chak	Jammu	7.40	3.91	3.63	5.40
81	Sidhra	Jammu	3.68	2.80	3.04	3.21
82	Sobka	Jammu		20.71	21.1	22.50
83	Sohanjana	Jammu	3.86	2.41	3.63	3.74
84	Suchetgarh	Jammu				
85	Suchetgarh-II	Jammu	1.58	2.05	3.18	1.49
86	Sugetar	Jammu	2.00	2.07	6.24	3.91
87	Sumah	Jammu	3.44	2.63	3.1	3.30
88	Surinsar	Jammu	0.86	0.34		0.47
89	Tanda Sheoda	Jammu	2.03			
90	Taryai	Jammu	38.42	35.70	34.5	34.90
91	Trikuta Nagar	Jammu		4.56		
92	Upperla kanhal	Jammu	3.83	2.59	3.1	3.62
93	Uttarbani	Jammu	0.95	1.54	1.66	
94	Barni	Kathua	7.15	3.48	5.73	6.01
95	Bhagwal	Kathua	22.82	8.37	13.69	21.50
96	Billawar	Kathua				
97	Chak hariya	Kathua	2.45			1.14
98	Chakara	Kathua		2.25		3.10
99	Chan ranga	Kathua		1.22	9.37	10.82
100	Chann Khatrian	Kathua	9.48		4.51	8.10
101	Chapki Kalan	Kathua	17.88	5.95	8.28	13.58
102	Feru chak	Kathua	3.94	1.27	2.01	3.00
103	Gangu chak	Kathua	2.25	1.81	2.49	2.06
104	Gond More	Kathua	2.95	1.09	3.73	2.06
105	Hore	Kathua		0.80	0.37	1.34
106	Jandi	Kathua		1.63	3.25	3.75
107	Jindore	Kathua	12.54	4.62	6.89	9.18
108	Karol Krishna	Kathua	7.25	5.73	6.94	7.30
109	Kathua	Kathua	2.44	0.44	0.81	1.28
110	Kerian Gandyal-II	Kathua			3.47	
111	Kerian Ramnagar	Kathua			3	3.03
112	Khanpur	Kathua	1.87	1.41	1.65	1.82
113	Khukhial	Kathua	1.57	1.20	1.64	1.46

S. No	Location	District	May-20	Aug-20	Nov-20	Jan-21
114	Konthal	Kathua	1.40	3.70	4.77	4.79
115	Kote punnu	Kathua	2.06	1.49	2.19	1.79
116	Kothian	Kathua	2.63	0.08	0.18	1.41
117	Lakhanpur	Kathua	6.50	5.48	6.59	6.57
118	Lakhnot	Kathua				
119	Lakri	Kathua	2.37	2.19		2.32
120	Londi	Kathua	5.70	4.23	5.2	5.51
121	Mahi Chak	Kathua				
122	Mandli	Kathua	1.97	1.13		1.92
123	Mukandpur	Kathua	4.11	3.72	4.07	3.91
124	Nagri	Kathua	2.10	1.53	2.04	1.71
125	Nagrota-Gujaroo	Kathua	4.62	1.25	6.14	4.60
126	Nanke Chak (Sherpur)	Kathua		0.40	1	1.60
127	Pallan	Kathua	1.11	0.40		0.78
128	Pansar	Kathua	5.66	5.65	7.14	5.62
129	Patiari	Kathua		2.95		7.41
130	Patyari	Kathua			4.36	
131	Patyari II	Kathua	2.52	1.29	2.44	2.21
132	Phinter	Kathua	5.19	2.88		5.99
133	Ramkot	Kathua	6.45	3.68	6.93	5.49
134	Rehian	Kathua				
135	Saida	Kathua		0.67	2.16	2.40
136	Sallan	Kathua				
137	Sumwan	Kathua	11.73	6.93	8.29	11.35
138	Ainpur	Rajouri	1.94	0.50	1.88	0.72
139	Bagnoti	Rajouri	6.44	5.30	5.13	3.67
140	Bajabain	Rajouri	1.90	0.70	2.87	
141	Bakhar	Rajouri	1.62	0.13	1.56	0.49
142	Banpari	Rajouri	3.56	1.22	4.05	1.12
143	Bareri	Rajouri	4.21	2.89	4.25	2.60
144	Bhatta Mohra	Rajouri	0.50	0.15		1.51
145	Channi Parat	Rajouri	3.05	2.41	3.08	0.31
146	Chittiar	Rajouri	1.40	0.80	3.71	0.35
147	Chowki Handa	Rajouri	1.72	1.10	3.15	1.22
148	Darhal Quila	Rajouri	2.67	2.00		2.33
149	Dharamsal	Rajouri			3.75	2.60
150	Dhok Baniar	Rajouri	2.74	2.60	2.64	2.45
151	Ding	Rajouri	3.40	3.10	3.33	3.33
152	Dyala	Rajouri	2.90	1.70	2.76	2.30
153	Gagrote	Rajouri	1.90	1.19	2.34	2.41
154	Jabah	Rajouri	1.70	1.00	2.37	0.86
155	Jhangar	Rajouri	4.65	2.50	4.51	4.45
156	Kalal	Rajouri			3.55	3.14
157	Kalsian	Rajouri	0.95	0.50	0.95	0.10
158	Kangri (Grid Station)	Rajouri	2.34	1.63	2.8	0.89
159	Lam	Rajouri	3.81	0.40	4.1	1.16
160	Laroka	Rajouri	1.75	0.30	1.9	0.60
161	Lower Kharak	Rajouri	0.95	0.60	0.78	0.25
162	Marchola	Rajouri	2.59	1.87	1.2	1.18
163	Narian	Rajouri				
164	Naunihal	Rajouri	1.58	1.00	1.51	0.25
165	Panja	Rajouri	1.06	0.75	1.25	0.95
166	Potha	Rajouri	2.13	1.61		
167	Pukharni	Rajouri			1.19	0.64
168	Rumli Dara	Rajouri			2.23	1.45
169	Salote	Rajouri	2.23	1.50	2.8	0.65
170	Seri	Rajouri	2.96	1.65	3.07	1.04
171	Sial	Rajouri	0.83	0.39	0.62	0.09

S. No	Location	District	May-20	Aug-20	Nov-20	Jan-21
172	Siot	Rajouri	2.54	1.25	3	1.37
173	Solki	Rajouri	1.96	0.81	2.54	1.56
174	Thanda Paani	Rajouri	1.39	0.50	1.35	0.93
175	Aliyah	Reasi	1.87		2.05	1.54
176	Bhamla	Reasi	5.90		3.2	2.05
177	Dadua	Reasi	1.87	7.61	2.19	0.74
178	Garan Jagir	Reasi	3.20		3.1	2.37
179	Nanora	Reasi	3.80		4.8	2.05
180	Riasi	Reasi		23.42	25	25.00
181	Talwara	Reasi	4.92	2.24	5.45	4.70
182	Thangrot	Reasi	2.15	0.75	2	0.91
183	Bassi Kalan	Samba	4.58	2.50	3.31	4.56
184	Bengular	Samba	6.71	6.67	6.1	6.36
185	Birpur	Samba	12.92	13.89		20.99
186	Channi	Samba				7.44
187	Channi Mansar	Samba	1.27	0.14	0.98	0.11
188	Daboh	Samba	4.41		3.51	2.73
189	Didyal	Samba	1.87	3.37	1.47	2.08
190	Dulme Chak	Samba	3.10	2.32	3.28	3.12
191	Gho-Brahamna	Samba	7.80	7.80	7.55	7.77
192	Gho-Rakwalan	Samba	4.30	3.05	3.56	3.60
193	Gudwal	Samba	2.82	3.54	3.25	3.74
194	Jasath	Samba	11.77	7.50	7.6	9.90
195	Kainthpur	Samba	2.14	4.56	3.64	3.70
196	Khairi (Bishnah)	Samba	4.26	3.83	4.09	2.22
197	Kootah	Samba	23.83	20.47	23.36	24.00
198	Lale Chak	Samba	1.85	1.12	2.87	2.25
199	Lokli	Samba	4.30	1.58	3.98	4.22
200	Madun	Samba	2.35	1.14	2.62	1.87
201	Mahal Shah Kalandrian	Samba	4.50	5.36	5.33	5.34
202	Maheen Charkan	Samba	7.84	8.63	8.05	9.46
203	Majua Laxmi	Samba	4.60	4.18	3.39	3.96
204	Naran	Samba	5.64	3.58	5.23	5.75
205	Nauni	Samba	2.55	0.83	1.87	1.27
206	Nilcha	Samba	9.20	3.67	6.86	7.40
207	Nud	Samba	2.99	0.87	2.55	2.43
208	Palli	Samba	2.62	1.98	2.13	1.79
209	Pangdour	Samba	3.81	3.44	3.93	3.48
210	Patli	Samba	8.96	6.58	7.26	7.92
211	Phalora	Samba	5.95	1.13	1.92	1.64
212	Raghu chak	Samba	3.11	0.60	1.56	2.93
213	Raiyan	Samba	20.78	18.72	18.56	17.96
214	Sadoh	Samba	7.45	5.36	6.79	6.61
215	Sagoon	Samba	2.36	0.95	2.65	1.35
216	Samba	Samba	16.89	15.78	15.6	16.16
217	Sanoora	Samba	0.94	0.85	1.02	0.92
218	Supwal	Samba	6.47		3.76	5.57
219	Swankha More	Samba	20.98	20.85	20.74	20.54
220	Badola	Udhampur	4.49	1.28	2.67	1.67
221	Battal Ballian	Udhampur	3.66	2.46	3.75	3.94
222	Birmah	Udhampur	2.56	1.88	2.47	2.29
223	Dalsar	Udhampur	0.72	0.07	0.35	0.30
224	Dehari	Udhampur	2.17	0.25	5.12	0.81
225	Dhanu Kanal	Udhampur	1.60	0.58	0.93	0.88
226	Eastern Mand	Udhampur	3.20	0.64	2.31	1.48
227	Garhi (Udh)	Udhampur		0.72	0.55	0.94
228	Jallow	Udhampur	1.26	0.03	3.97	0.85
229	Jhakkar	Udhampur	4.99	2.18	4.98	3.04

<b>S. No</b>	<b>Location</b>	<b>District</b>	<b>May-20</b>	<b>Aug-20</b>	<b>Nov-20</b>	<b>Jan-21</b>
230	Kahpotha	Udhampur	1.97	0.10	2.12	0.16
231	Kotli Pain Megaini	Udhampur	1.45	0.68	0.82	0.68
232	Kuperlah	Udhampur	2.95	2.04	3.41	0.56
233	Manwall	Udhampur		4.39	6.43	5.64
234	Nagrota Panjarain	Udhampur	1.68	1.40	1.67	1.55
235	Phangyal	Udhampur	3.27	2.55	3.88	1.94
236	Rakh Badali	Udhampur	3.82	2.40	3.96	1.76
237	Ramnagar	Udhampur		3.47	5.18	3.35
238	Ritti	Udhampur	1.08	0.08	1.71	0.24
239	Salabra	Udhampur	1.62	1.02	1.51	1.36
240	Seen Thakaran	Udhampur	3.37	2.38	3.38	2.59
241	Sunal	Udhampur	2.04	0.84	2.72	1.19
242	Talpad	Udhampur	1.30	0.65	1.77	0.55
243	Upper Ban	Udhampur		7.03	5.04	6.50

## ANNEXURE – II

## Result of Chemical Analysis of water samples of NHS collected during May 2020 Jammu &amp; Kashmir

S. No	District	Site Name	Latitude	Longitude	pH	EC (µs/cm) at 25°C	Mg/l														U (ppb)	
							TDS	CO3	HCO <sub>3</sub>	Total Alkalinity	Cl	TH as CaCO <sub>3</sub>	Ca	Mg	Na	K	NO <sub>3</sub>	F	SO <sub>4</sub>	PO <sub>4</sub>		As
1	jammu	Khanpur (Nagrota)	32.79	74.89	7.56	550	330	0	212	174	54	206	34.8	29	45.7	2.0	4.4	0.467	39	ND	0.001	4.0464
2	samba	Sidhra	32.76	74.89	7.47	730	438	0	371	304	34	413	34.8	79	30.4	2.2	67.9	0	55.74	ND	0.002	0.6745
3	jammu	Surinsar	32.77	75.04	8.15	480	288	0	291	239	14	250	52.2	29	20.3	5.1	12.4	0.363	19.5	ND	0.002	1.3819
4	samba	Sagoon	32.75	75.08	8.10	460	276	0	278	228	34	195	30.4	29	52.8	3.0	19.5	0.461	12.6	ND	0.001	4.30978
5	udhampur	Chhani Mansar	32.70	75.16	7.66	450	270	0	318	260	20	250	39.1	37	23.0	1.7	0.42	0.49	9.4	ND	0.001	1.6621
6	jammu	Katcha Pind (Dansal)	32.87	75.00	8.29	490	294	0	172	141	61	217	34.8	32	46.2	3.3	0.96	0	0	ND	0.002	2.1696
7	jammu	Badsoo	32.85	75.02	8.15	330	198	0	146	119	20	163	43.5	13	9.9	1.8	15.9	0.22	20.09	ND	0.002	2.844
8	jammu	Kah Pahuta	32.83	75.04	8.22	460	276	0	305	250	20	261	34.8	42	24.2	2.0	4.82	0.22	21.76	ND	0.002	1.9673
9	jammu	Kunihala	32.84	75.03	8.05	540	324	0	265	217	48	293	43.5	45	22.0	6.3	23.3	0.46	30	ND	0.002	1.2162
10	jammu	Kot Kaswal	32.80	75.11	7.95	410	246	0	199	163	27	195	30.4	29	20.9	1.8	10.2	1.04	24.9	ND	0.002	2.7495
11	udhampur	Manwall	32.76	75.15	7.55	470	282	0	291	239	27	271	43.5	40	14.3	2.6	20.8	0.66	8.26	ND	0.002	1.3082
12	udhampur	Salabra	32.72	75.18	7.85	360	216	0	199	163	20	185	26.1	29	11.46	2.2	3.5	0.63	11.7	ND	0.002	2.4492
13	udhampur	Sunal	32.68	75.24	7.71	410	246	0	252	206	20	250	34.8	40	6.2	2.15	3.2	0.33	16.8	ND	0.002	1.3837
14	kathua	Ramkot	32.64	75.34	7.78	480	288	0	305	250	20	250	21.7	48	25.1	8.77	7.48	0.36	17.5	ND	0.002	2.385
15	kathua	Nagrota Guproo	32.65	75.39	7.88	1010	606	0	356	292	129	293	30.4	53	114.5	13.3	33.5	0.36	76.77	ND	0.003	1.3842
16	kathua	Lakri	32.66	75.42	8.03	400	240	0	199	163	14	163	39.1	16	20.98	2.79	11.17	0.3	12.9	ND	0.003	1.2554
17	kathua	Mandli	32.64	75.51	7.88	620	372	0	305	250	68	228	43.5	29	70.25	3.95	2.3	1	25.9	ND	0.003	0.7213
18	kathua	Phinter	32.58	75.54	8.29	420	252	0	159	130	34	195	43.5	21	13.93	2.93	40	0.39	25.4	ND	0.005	0.0397
19	kathua	Billawar	32.61	75.61	8.50	330	198	13.02	146	141	34	98	21.7	11	44.81	4.73	3.9	0.69	11.6	ND	0.004	1.7508
20	kathua	Pallan	32.56	75.57	8.46	310	186	13.02	159	152	20	174	56.5	8	11.06	1.88	0.109	0.36	15.1	ND	0.005	0.0454
21	udhampur	Talpad	32.84	75.27	8.24	290	174	0	185	152	14	152	34.8	16	12.58	2.34	0.282	0.51	9.7	ND	0.006	0.0494
22	udhampur	Nagrota Panjgrain	32.84	75.27	8.12	340	204	0	212	174	20	195	34.8	26	12.84	2.46	5.49	0.415	8.9	ND	0.004	0.0512
23	udhampur	Dalsar	32.82	75.31	7.86	580	348	0	384	315	34	228	26.1	40	76.64	2.96	1.14	0.48	17.3	ND	0.006	3.1296
24	udhampur	Dehari	32.78	75.27	8.49	650	390	13.02	397	347	27	98	17.4	13	151.8	5.26	3.34	1.958	23.07	ND	0.005	6.1384
25	udhampur	Jallow	32.80	75.23	8.53	420	252	13.02	265	239	14	119	17.4	18	71	3.25	0.893	0.637	6.78	ND	0.006	2.3198
26	udhampur	Ritti	32.84	75.16	8.85	680	408	13.02	450	391	20	54	8.7	8	170	3.98	1.07	0.79	13.9	ND	0.006	6.11
27	udhampur	Kuperlah	32.85	75.18	7.95	340	204	0	212	174	14	185	13.0	37	7.8	1.4	6.1	0.45	8.9	ND	0.006	0.2488
28	udhampur	Phangyal	32.90	75.14	8.34	320	192	6.51	106	98	41	174	39.1	18	8.7	1.7	28.27	0.37	17.48	ND	0.005	0.0646
29	udhampur	Battal Ballian	32.88	75.13	8.45	650	390	13.02	132	130	68	315	39.1	53	18.9	2.3	70.448	0	87.04	ND	0.006	1.3073
30	reasi	Talwara	33.09	74.83	7.98	500	300	0	318	260	14	304	26.1	58	6.4	3.1	25.7	0	15.53	ND	0.006	0
31	reasi	Dhanu Kannal	32.96	75.01	8.23	270	162	0	199	163	7	163	30.4	21	7.1	1.5	1.18	0	5.7	ND	0.007	0.681
32	udhampur	Jhakkar	32.95	75.12	7.91	370	222	0	238	195	27	206	30.4	32	15.85	2.3	5.77	0.354	13.76	ND	0.007	0
33	udhampur	Badola	32.94	75.03	7.85	430	258	0	185	152	27	228	26.1	40	8.6	2.5	40.16	0	18.28	ND	0.001	1.6228
34	udhampur	Eastern Mand	32.90	75.02	7.88	550	330	0	305	250	41	304	17.4	63	28	3.5	9.7	0.319	37.6	ND	0.001	1.4788
35	jammu	Jagati	32.81	74.90	7.94	340	204	0	185	152	14	174	34.8	21	8.3	2.8	7.6	0.253	14.07	ND	0	5.866
36	jammu	Sugetar	32.88	74.96	8.10	550	330	0	358	293	34	293	26.1	55	42.3	3.5	9.77	0.518	25.35	ND	0	3.2169
37	udhampur	Seen Thakaran	32.91	75.04	8.20	320	192	0	159	130	27	152	34.8	16	22	1.5	7.37	0.325	22.5	ND	0.002	1.2771
38	jammu	Garhi (Jammu)	32.79	74.79	8.02	430	258	0	159	130	41	174	26.1	26	36	1.9	26.8	0.196	37.96	ND	0.002	1.1909
39	udhampur	Kotli Pain	32.91	75.09	8.01	320	192	0	185	152	20	174	30.4	24	10.9	1.7	3.5	0.405	22.07	ND	0.002	2.0422
40	udhampur	Birmah	32.92	75.11	8.22	290	174	0	159	130	20	141	30.4	16	14.2	3.1	0.213	0.321	16.3	ND	0.002	0.5316
41	udhampur	Rakh Badali	32.92	75.11	8.03	480	288	0	199	163	41	261	21.7	50	15	1.8	72.41	0.351	15.39	ND	0.003	0.2358
42	jammu	Muthi	32.75	74.80	8.15	670	402	0	278	228	34	315	13.0	69	23.4	8.7	2.44	0.42	80.14	ND	0.001	4.95018



S. No	District	Site Name	Latitude	Longitude	pH	EC (µs/cm) at 25 <sup>o</sup> C	Mg/l														U (ppb)	
							TDS	CO3	HCO <sub>3</sub>	Total Alkalinity	Cl	TH as CaCO3	Ca	Mg	Na	K	NO3	F	SO4	PO4		As
43	jammu	Patyale Chak	32.76	74.78	8.55	670	402	26.04	358	336	20	271	21.7	53	81.3	2.7	12.57	1.02	56.9	ND	0	4.16926
44	jammu	Nagbani	32.76	74.78	8.44	1030	618	26.04	397	369	54	445	8.7	103	98.04	6.9	66.4	0.88	178.7	ND	0.001	9.7915
45	jammu	Sandhwan	32.71	74.71	8.55	350	210	13.02	172	163	20	174	21.7	29	12.1	2.7	14.3	0.261	7.4	ND	0	0.0187
46	jammu	Gho Manhasan (Talab Tillo)	32.72	74.74	8.11	420	252	0	278	228	20	228	8.7	50	16.55	2.42	4.2	0.26	16.5	ND	0	0
47	jammu	Gajansoo	32.76	74.71	8.09	440	264	0	278	228	27	250	17.4	50	21	5.8	0.65	0.38	22.58	ND	0	0.6625
48	jammu	Marh	32.78	74.75	8.1	520	312	0	238	195	41	250	8.7	55	28.3	12.2	5.3	0.224	54.6	ND	0	5.7081
49	jammu	Jaswan	32.79	74.73	8.17	400	240	0	225	185	14	228	13.0	47	5.7	2.9	11.22	0.251	27.4	ND	0	0.128
50	jammu	Shama Chak	32.83	74.74	8.29	280	168	0	146	119	14	163	30.4	21	4.3	1.9	8.2	1.5	30.4	ND	0	0.3011
51	jammu	Jhiri	32.83	74.74	8.36	410	246	13.02	238	217	14	239	13.0	50	6.1	4.4	11.1	0.2	2.2	ND	0	1.1137
52	jammu	Kana Chak	32.82	74.72	8.25	430	258	0	172	141	27	217	30.4	34	16.2	8.2	25.17	0.335	49.9	ND	0	0.4811
53	jammu	Pata Khu	32.84	74.77	7.92	410	246	0	265	217	7	250	8.7	55	6.9	2.9	13.12	0.374	19.66	ND	0	0.866
54	udhampur	Garhi (Udh)	32.91	75.08	8.1	380	228	0	225	185	27	239	13.0	50	8.3	1.8	10.95	0.202	24.5	ND	0.001	0.017
55	jammu	Purkhoo	32.80	74.78	7.90	470	282	0	318	260	20	282	17.4	58	24.4	2.5	35.23	0	10.59	ND	0	0.00414
56	jammu	Gura (Akhnoor)	32.88	74.71	7.62	610	366	0	358	293	34	369	13.0	82	18.89	2.81	44.2	0.32	23.3	ND	0	0.9942
57	jammu	Leherian	32.90	74.69	7.76	580	348	0	291	239	7	271	21.7	53	8.14	2.43	17.42	0.385	17.36	ND	0.024	0.0079
58	jammu	Devipura	32.86	74.66	8.11	330	198	0	185	152	7	195	30.4	29	2.33	2	9.86	0.49	23.1	ND	0	1.0113
59	jammu	Jourian	32.83	74.58	8.05	450	270	0	172	141	34	228	30.4	37	18.1	4.2	74.04	0.22	32.636	ND	0	1.6629
60	jammu	Dhanpur	32.81	74.54	8.51	420	252	26.04	238	239	7	261	39.1	40	6.4	1.88	4.866	1.469	19.4	ND	0.003	0.0549
61	jammu	Khour	32.83	74.52	8.08	400	240	0	146	119	27	185	26.1	29	21.83	4.54	28.56	0.766	49.28	ND	0.001	4.2678
62	jammu	Pangli Colony	32.79	74.52	7.72	430	258	0	252	207	27	228	13.0	47	18.2	4.83	5.52	0.68	32.39	ND	0.023	2.2986
63	jammu	Hamirpur Sidhar	32.78	74.53	7.76	300	180	0	199	163	7	141	21.7	21	14	3.6	2.6	0.779	2.7	ND	0.005	2.1785
64	jammu	Senth	32.77	74.51	7.55	740	444	0	410	336	34	434	30.4	87	32	5.9	3.14	0.27	106	ND	0.001	2.3615
65	jammu	Gigrial	32.80	74.48	7.84	430	258	0	291	239	14	250	21.7	47	8.2	2.1	5.01	1.4	14.3	ND	0.001	0
66	jammu	Lam	32.83	74.51	7.97	600	360	0	397	325	20	347	56.5	50	9.1	15.6	16.8	0.675	25.7	2.6	0.001	1.6608
67	jammu	Palatan	32.84	74.45	7.91	520	312	0	291	239	20	293	21.7	58	9.5	2	9.3	0.356	40	ND	0.001	0
68	jammu	Palanwala	32.85	74.45	8.29	310	186	0	146	119	14	152	34.8	16	8.3	1.8	12.9	0.5	21.4	ND	0	2.0068
69	jammu	Sumah	32.96	74.67	8.47	370	222	13.02	265	239	7	239	17.4	47	5.5	3.2	3.5	0.217	7.4	ND	0.001	0.9688
70	jammu	Taryai	32.87	74.61	8.58	360	216	6.51	212	185	20	195	21.7	34	17	2.4	24.82	0.38	5.6	ND	0.001	0.568
71	jammu	Bhagwanchak	32.86	74.58	8.28	540	324	0	358	293	14	282	21.7	55	38.1	2	16.2	0.66	25	ND	0.001	0
72	jammu	Kalah	32.91	74.47	8.5	350	210	6.51	238	206	14	174	26.1	26	23.5	4	7.1	0.177	6.1	ND	0.006	3.4793
73	jammu	Jogwan	32.93	74.44	8.20	590	354	0	225	185	41	250	21.7	47	42.3	28.5	92	0.307	55.6	ND	0.003	1.3251
74	jammu	Baradow	32.91	74.44	8.25	400	240	0	278	228	7	195	13.0	39	22.5	2.8	1.7	1.04	5.4	ND	0.003	0
75	jammu	Lower Barnai	32.76	74.79	8.28	540	324	0	318	260	20	304	60.9	37	8	19.5	21.7	0.447	23.9	2.1	0.002	0.1416
76	jammu	Batera	32.85	74.75	8.90	440	264	13.02	212	195	20	261	21.7	50	4.3	4.2	11.9	0.66	28.38	ND	0.004	1.3906
77	jammu	Akhnoor	32.86	74.75	8.42	350	210	6.51	199	174	14	206	26.1	34	6.1	3.9	11.98	0.68	28	ND	0.002	1.3455
78	jammu	Sajwal	32.79	74.59	8.22	430	258	0	252	206	7	250	17.4	50	7.2	8.3	2.9	0.95	60.29	ND	0.002	2.7126
79	jammu	Hamirpur Kohna	32.77	74.55	7.90	660	396	0	344	282	20	326	17.4	69	13	49	26.67	0.56	71.7	ND	0	12.9256
80	jammu	Sobka	32.88	74.75	8.25	310	186	0	172	141	7	174	13.0	34	4.2	3.7	7.5	0.3	27.5	ND	0	0.8907
81	jammu	Dharam Khu	32.86	74.76	8.23	340	204	0	199	163	14	206	17.4	40	7.1	3.3	10.1	8.58	21.2	ND	0.002	1.1329
82	jammu	Khairi (Raipur)	32.81	74.86	8.27	440	264	0	212	174	20	250	21.7	47	10.6	1.8	40.98	0.4	30.4	ND	0	0.1758
83	jammu	Kangar	32.84	74.85	8.20	440	264	0	305	250	20	271	13.0	58	10.08	2.4	11.74	0.57	5.4	ND	0.002	0
84	jammu	Kachrial	32.87	74.47	8.23	310	186	0	199	163	7	174	30.4	24	9.05	2.4	7	0.46	19.4	ND	0.002	1.2422
85	kathua	Jindore	32.39	75.60	7.62	240	144	0	106	87	14	141	26.1	18	16.8	5.28	90.1	0.82	10.5	0.14	0.003	0.1176
86	kathua	Barni	32.42	75.59	8.10	250	150	0	172	141	14	152	21.7	24	8.8	1.84	7.9	0.38	7	ND	0.001	0.1064
87	kathua	Lakhanpur Fort	32.38	75.59	8.09	270	162	0	119	98	7	130	39.1	8	8.2	4.08	17.1	0.53	23.7	0.18	0.002	0.0246

S. No	District	Site Name	Latitude	Longitude	pH	EC (µs/cm) at 25 <sup>0</sup> C	Mg/l														U (ppb)	
							TDS	CO3	HCO <sub>3</sub>	Total Alkalinity	Cl	TH as CaCO <sub>3</sub>	Ca	Mg	Na	K	NO <sub>3</sub>	F	SO <sub>4</sub>	PO <sub>4</sub>		As
88	kathua	Kerian Gandyal II	32.30	75.52	8.52	350	210	6.51	119	109	34	141	21.7	21	12.3	8.89	5.5	0.22	17.5	ND	0.001	0.5106
89	kathua	Kerian Ramnagar	32.28	75.51	8.24	380	228	0	159	130	14	195	17.4	37	10.2	5.42	4.9	0.5	75.8	ND	0.009	9.9518
90	kathua	Kathua	32.36	75.53	8.80	450	270	13.02	212	195	41	152	30.4	18	62.26	6.01	14.9	0.44	30.1	ND	0.002	0.1251
91	kathua	Kothian	32.37	75.51	8.68	350	210	6.51	132	119	14	163	13.0	32	12.8	2.5	35.1	0.76	31.5	ND	0.005	0
92	kathua	Khukhial	32.35	75.47	8.70	830	498	65.1	331	380	68	391	52.2	63	41.96	56.51	32.45	0.77	57.17	ND	0.001	1.9377
93	kathua	Nagri	32.35	75.43	8.41	270	162	6.51	119	108	14	119	30.4	10	13.36	3.45	2.7	0.58	21.6	ND	0.001	0.0827
94	kathua	Gond More	32.34	75.41	7.70	460	276	0	291	239	20	261	13.0	55	25.04	1.98	2.6	0.46	45.9	ND	0.002	1.421
95	kathua	Sumwan	32.39	75.42	8.22	210	126	0	119	98	14	119	21.7	16	8.61	2.53	8.6	0.84	14.3	ND	0.002	1.7023
96	kathua	Patiani	32.40	75.44	8.12	200	120	0	106	87	14	119	34.8	8	5.99	1.86	9.48	0.41	19.3	ND	0.001	0
97	kathua	Mahi Chak			8.46	260	156	13.02	119	119	20	152	21.7	24	8.3	2.49	11.638	0.527	16.5	ND	0.001	0
98	kathua	Bhagwal	32.45	75.37	8.29	340	204	0	238	195	20	217	21.7	40	9.91	2.14	17.63	0.267	11.635	ND	0	0
99	kathua	Chapki Kalan	32.45	75.31	8.58	310	186	13.02	199	185	14	195	8.7	42	8.89	2.98	12.5	0.591	10.398	ND	0	0.1099
100	kathua	Khanpur	32.43	75.36	8.03	250	150	0	172	141	20	163	21.7	26	8.43	1.8	4.56	0.22	9.51	ND	0	0.6401
101	kathua	Chakhariya	32.39	75.37	7.99	260	156	0	146	120	20	141	26.1	18	9.15	4.57	9.45	0.283	9.96	ND	0	1.6993
102	kathua	Mukandpur	32.37	75.37	7.98	320	192	0	199	163	14	163	17.4	29	11.96	12.41	10.88	0.254	20.04	ND	0	2.5841
103	kathua	Kotepanu	32.35	75.38	8.04	250	150	0	159	130	27	141	30.4	16	16.9	3.85	2.88	0.235	16.23	ND	0.001	0
104	kathua	Konthal	32.42	75.26	8.15	240	144	0	172	141	14	152	17.4	26	7.68	1.93	7.4	0.214	6.16	ND	0.001	0.4103
105	kathua	Pansar	32.37	75.31	8.27	560	336	0	331	271	34	206	17.4	40	64.2	6.8	6.34	0.34	14.81	ND	0	1.5544
106	kathua	Karol Krishna	32.40	75.24	8.03	1090	654	0	503	412	116	293	34.8	50	195.24	5.08	22.19	0	98.3	ND	0.001	0.3837
107	kathua	Gangu Chak	32.40	75.26	8.06	2240	1344	0	503	412	259	1010	47.8	216	138	8.62	421.67	0.467	245	ND	0.001	2.0492
108	kathua	Jandi	32.46	75.25	8.36	1160	696	6.51	106	98	123	445	26.1	92	107.6	3.18	355	0	148	ND	0.002	0
109	kathua	Feruchak	32.38	75.28	9.01	500	300	39.06	252	271	20	293	17.4	61	17.64	1.82	11.7	0.325	13.46	ND	0.001	0
110	kathua	Kootah	32.51	75.24	8.91	600	360	26.04	252	250	61	315	26.1	61	40.21	10.26	45.9	0	28.2	0.483	0.001	0.0755
111	kathua	Nilcha	32.56	75.25	8.75	300	180	13.02	185	174	14	195	21.7	34	5.74	2.32	5.02	0.236	5.02	ND	0.001	0.662
112	kathua	Patyari II	32.55	75.27	8.78	460	276	39.06	212	239	34	250	17.4	50	23.57	2.51	3.73	0.348	3.73	ND	0.002	0.884
113	kathua	Lokli	32.54	75.27	8.83	240	144	13.02	132	130	20	152	43.5	11	4.84	1.74	7.96	0.171	5.62	0.232	0.001	0
114	kathua	Nauni	32.56	75.30	8.46	290	174	13.02	159	152	27	174	8.7	37	9.56	3.37	4.49	0.313	11.9	ND	0.001	0.5643
115	samba	Samba	32.56	75.12	8.60	840	504	39.06	344	347	68	423	17.4	92	67	6.58	81.2	0	43.9	ND	0.002	0
116	kathua	Pangdour	32.48	75.11	8.79	650	390	65.1	291	347	34	337	39.1	58	43.66	3.55	9.8	0.696	39.226	ND	0.003	0.9482
117	samba	Bengular	32.49	75.06	7.89	980	588	0	331	271	82	380	17.4	82	84.02	44.04	22.5	0.247	64.44	ND	0.001	2.1434
118	kathua	Sadoh	32.47	75.13	8.65	770	462	52.08	291	326	34	402	26.1	82	26.71	4.67	52.61	0.338	33.27	ND	0.001	1.7354
119	kathua	Phalora	32.48	75.14	8.35	780	468	39.06	265	282	68	185	26.1	29	115.1	2	27.42	0.57	51.33	ND	0	4.1341
120	kathua	Madun	32.48	75.16	8.12	580	348	0	305	250	48	239	17.4	47	47.64	2.36	17.29	0.448	17.16	ND	0	14.4079
121	kathua	Naran	32.50	75.15	8.25	420	252	0	225	185	20	185	17.4	34	29.86	2.69	24.65	0.225	10.85	ND	0	0
122	kathua	Raghu Chak	32.49	75.20	8.21	340	204	0	185	152	20	174	26.1	26	12.79	2.79	3.6	0.264	16.22	ND	0.001	1.6244
123	kathua	Jasath	32.50	75.20	8.25	360	216	0	238	195	27	206	26.1	34	23.48	3.87	6.8	0.568	21.1	ND	0.003	0.8526
124	kathua	Sanoora	32.49	75.18	8.23	250	150	0	172	141	14	152	30.4	18	7.93	1.76	3.07	0.339	10.02	ND	0	1.4658
125	kathua	Chan Khatrian	32.49	75.25	7.61	310	186	0	185	152	14	152	17.8	26	9.78	3.7	4.4	0.535	9.03	ND	0	1.0279
126	kathua	Londi	32.43	75.21	8.13	270	162	0	185	152	14	163	26.7	23	11.45	2.04	8.55	0.194	4.44	ND	0	1.8718
127	kathua	Lale Chak	32.45	75.20	8.21	350	210	0	199	163	34	163	22.2	26	34.4	1.68	2.66	0.43	25.38	ND	0.002	7.1409
128	kathua	Dulme Chak	32.43	75.18	8.47	280	168	13.02	172	163	14	152	26.7	21	19.14	2.14	5.27	0.209	4.5	ND	0.003	2.7441
129	samba	Daboh	32.59	75.11	8.25	500	300	0	159	130	68	228	17.8	45	37.45	2.62	70.04	0.179	35.18	ND	0.001	2.9952
130	samba	Nud	32.61	75.15	8.45	310	186	6.51	159	141	34	174	13.3	34	9.84	4.03	3.5	0.321	12.6	ND	0.001	28.57
131	samba	Raiyan	32.51	75.12	8.45	340	204	13.02	225	206	14	206	22.2	37	9.81	2.3	7.7	0.388	7.1	ND	0.005	1.5088
132	samba	Dhora	32.61	75.14	8.27	530	318	0	305	250	34	282	13.3	60	22.08	9.35	10.5	0.23	27.65	ND	0.004	0.2404
133	jammu	Arnia II	32.52	74.80	8.42	1610	966	39.06	424	413	150	326	13.3	71	148	262	231.6	0.35	129.7	ND	0.001	28.03
134	jammu	Allah	32.52	74.84	8.57	1150	690	39.06	503	478	197	499	57.8	86	190	320	267	0.21	290	ND	0.001	3.5759
135	jammu	Agre Chak	32.62	74.72	8.67	890	534	13.02	265	239	68	250	13.3	53	103.32	10.84	15.28	0.98	116.8	ND	0.001	2.5921

S. No	District	Site Name	Latitude	Longitude	pH	EC (µs/cm) at 25°C	Mg/l															U (ppb)
							TDS	CO3	HCO <sub>3</sub>	Total Alkalinity	Cl	TH as CaCO <sub>3</sub>	Ca	Mg	Na	K	NO <sub>3</sub>	F	SO <sub>4</sub>	PO <sub>4</sub>	As	
136	jammu	Bishnah	32.61	74.86	8.65	1680	1008	78.12	689	695	109	380	8.9	87	106.8	350	85.46	0.89	95.2	ND	0.001	6.787
137	samba	Bassi Kalan	32.64	74.90	8.44	440	264	13.02	146	141	41	174	31.1	23	14.29	5.1	10.4	0.27	11.84	ND	0.001	5.3866
138	samba	Birpur	32.66	74.95	8.27	310	186	0	159	130	34	174	22.2	29	16.6	2.11	23.1	0.33	10.1	ND	0.002	1.8626
139	jammu	Chatta	32.69	74.93	8.29	340	204	0	199	163	14	195	13.3	39	7.08	2.28	18.6	0.46	13.7	ND	0	1.0865
140	samba	Didyal	32.47	74.96	8.36	360	216	26.04	185	195	20	185	13.3	37	22.7	2.14	6.3	0.31	8.1	ND	0	0
141	samba	Gho Brahmna	32.55	74.96	8.70	1270	762	39.06	159	195	163	467	22.2	100	126.1	10.06	252.9	0.46	148	ND	0.001	0
142	samba	Gudwal	32.55	75.01	8.35	660	396	26.04	238	239	61	261	35.6	42	40.8	13.81	19.3	0	11.9	0.46	0.002	0.9837
143	samba	Gho Rakawalan	32.55	74.95	8.45	580	348	13.02	212	195	54	206	26.7	34	70.7	1.9	33.9	0.533	51.1	ND	0.001	2.982
144	samba	Kainthpur	32.59	74.98	8.10	310	186	0	146	119	27	152	22.2	23	13.95	2.26	16.288	0.25	11.97	ND	0.002	0.7653
145	samba	Khairi (Bishnah)	32.59	74.91	8.80	1020	612	52.08	371	391	88	261	22.2	50	109.25	109.08	82.685	0.488	75.898	ND	0	4.4029
146	samba	Kamila	32.61	75.07	8.21	290	174	0	146	119	14	141	40.0	10	5.89	3.12	5.75	0	15.44	ND	0.001	0.2281
147	jammu	Kothey Saini	32.58	74.88	8.40	340	204	13.02	172	163	14	174	31.1	23	25.88	1.63	13.11	0.52	29.3	ND	0.001	0.1381
148	jammu	Kotli Charkan	32.62	74.83	8.60	260	156	13.02	119	119	20	174	26.7	26	7.04	1.82	3.74	0	32.38	ND	0	0.1066
149	jammu	Lalyal	32.66	74.77	8.71	630	378	13.02	212	195	68	282	31.1	50	56.9	52.8	56.65	0	113	ND	0.001	3.6481
150	jammu	Laswara	32.59	74.84	8.38	330	198	6.51	172	152	20	206	40.0	26	9.48	3.51	13.601	0.211	28.85	ND	0.001	0.1765
151	jammu	Makwal	32.69	74.72	8.65	230	138	26.04	119	141	14	141	31.1	15	8.36	2.7	3.42	0.175	4.99	ND	0.002	0
152	samba	Majua Laxmi	32.56	74.92	8.75	370	222	13.02	159	152	34	185	22.2	31	28.53	3.39	31.5	0.394	14.5	ND	0.001	5.8864
153	samba	Mahal Kalandrian	32.51	74.94	8.51	610	366	39.06	318	326	34	217	40.0	28	97.23	2.17	20.53	0.93	26.46	ND	0.001	2.0314
154	samba	Maheen Charkan	32.65	74.99	8.71	370	222	26.04	172	184	14	206	53.4	18	4.75	9.56	19.1	0	14.55	1.78	0.002	0.2533
155	jammu	Miran Sahib	32.65	74.79	8.41	720	432	13.02	172	163	102	337	22.2	68	67.91	3.31	117	0.23	84.1	ND	0.002	1.2273
156	samba	Nandpur	32.52	74.89	7.94	800	480	0	225	185	68	271	26.7	50	71.84	51.32	144	0	81.116	ND	0.001	2.9248
157	jammu	Nikowal	32.51	74.71	8.90	520	312	52.08	265	304	20	239	22.2	45	55.5	3.36	2.9	0.345	13.4	ND	0.002	18.8072
158	jammu	Nagrota Utterbani	32.77	74.93	8.45	560	336	13.02	172	163	68	250	31.1	42	44.76	16.54	82.661	0.275	47.1	ND	0.001	4.0462
159	samba	Patli	32.61	74.95	9.02	790	474	65.1	358	402	61	152	22.2	23	187.16	4.2	13.92	1.024	39.944	ND	0	0
160	jammu	Palli	32.63	74.89	8.46	400	240	26.04	146	163	27	185	35.6	23	21.08	1.86	11	0.24	21	ND	0	3.0839
161	jammu	Poal II	32.53	74.82	8.45	390	234	26.04	119	141	34	174	31.1	23	33.9	5.03	12.17	0.235	49	ND	0	1.7276
162	jammu	Rehal	32.56	74.88	8.76	370	222	26.04	225	228	14	195	22.2	34	38	2.64	2.95	0.55	18.5	ND	0	1.6278
163	jammu	Salehar II	32.56	74.82	8.70	780	468	52.08	318	347	61	206	17.8	39	68.44	108.97	5.25	0.275	72.46	ND	0	2.388
164	jammu	Satwari	32.69	74.85	8.62	460	276	13.02	172	163	48	217	26.7	37	35.93	3.46	47.7	0.155	29	ND	0	1.6841
165	jammu	Sei Khurd	32.51	74.72	8.61	410	246	13.02	252	228	75	293	31.1	52	91.3	44.21	125.6	0.23	87.3	ND	0	8.3147
166	jammu	Sohanjana	32.70	74.74	8.71	580	348	6.51	265	228	48	206	40.0	26	29.8	50.2	14.43	0	14.43	ND	0	2.7095
167	jammu	Suchetgarh II	32.57	74.68	9.16	730	438	65.1	318	369	61	326	35.6	58	83.75	8.61	8.37	1.061	37.45	ND	0	5.8033
168	samba	Suphal	32.56	75.07	8.25	460	276	0	212	174	27	261	40.0	39	23.3	2.26	80.7	0.25	23.4	ND	0	1.5764
169	samba	Upralakanhal	32.63	74.88	8.73	600	360	13.02	265	239	61	206	31.1	31	86.25	3.17	11.7	0.34	44.6	ND	0	7.753
170	jammu	Greater Kailash	32.69	74.93	8.19	540	324	0	159	130	48	239	66.7	18	47.2	2.56	106.5	0.277	71.84	ND	0	1.4236
171	jammu	Karnaile Chak	32.71	74.82	8.60	290	174	6.51	146	130	20	174	31.1	23	8.7	3.83	24.52	0	19.84	ND	0	0
172		Chambliyal			8.96	340	204	26.04	199	206	20	130	22.2	18	57.1	2.46	3.23	0	9.4	ND	0	4.3522
173		Moualiyan			8.37	1010	606	26.04	583	521	75	510	17.8	113	38.83	73.73	9.2	0.39	50	ND	0	6.0016
174	jammu	Tanda Sheeda	32.98	74.70	8.60	370	222	13.02	185	174	20	206	26.7	34	4.88	4.22	6.2	0	9.1	ND	0	0
175	jammu	Chowkichora	33.03	74.65	8.97	520	312	39.06	225	250	34	282	62.3	31	33.1	12.8	3.3	0.22	53.4	0.6	0	4.4213
176	reasi	Bhamla	33.05	74.58	8.75	470	282	26.04	225	228	20	282	22.2	55	8.16	3.23	21.86	0.26	20.6	ND	0.001	3.3675
177	reasi	Dadua	33.07	74.64	8.55	320	192	13.02	146	141	34	195	40.0	23	10.01	1.58	9.6	0	13.6	ND	0	0
178	reasi	Garan Jagir	33.07	74.65	8.67	270	162	13.02	159	152	20	163	31.1	21	18.33	1.89	4.26	0.25	16.4	ND	0	4.5067
179	reasi	Nanora	33.13	74.63	8.86	560	336	39.06	331	336	34	380	40.0	68	11.77	19.11	11.38	0.247	19.77	ND	0.001	1.9143
180	rajouri	Thangrot	33.14	74.59	8.23	620	372	0	437	358	27	413	17.8	89	8.81	3.26	9.9	0.17	16	ND	0.001	0

S. No	District	Site Name	Latitude	Longitude	pH	EC (µs/cm) at 25°C	Mg/l														U (ppb)	
							TDS	CO3	HCO <sub>3</sub>	Total Alkalinity	Cl	TH as CaCO <sub>3</sub>	Ca	Mg	Na	K	NO <sub>3</sub>	F	SO <sub>4</sub>	PO <sub>4</sub>		As
181	reasi	Aliyah	33.17	74.55	8.20	320	192	0	199	163	14	195	22.2	34	6.22	1.66	9.4	0.2	10	ND	0.001	0.5895
182	rajouri	Salote	33.05	74.52	7.99	460	276	0	199	163	82	293	22.2	58	10.5	1.71	8.6	0.273	26	ND	0.001	0
183	rajouri	Banpari	33.03	74.46	8.63	540	324	39.06	278	293	34	337	8.9	76	11.69	4.22	19.5	0.35	19.8	ND	0.001	1.2782
184	rajouri	Ainpur	33.04	74.45	8.75	380	228	26.04	199	206	20	206	13.3	42	14.83	1.78	4.1	0.29	9	ND	0.001	0.64495
185	rajouri	Dhok Baniar	33.03	74.42	8.44	350	210	6.51	185	163	34	174	35.6	21	28.03	1.6	11.9	0.24	20.4	ND	0.002	2.9734
186	rajouri	Bajabain	33.05	74.41	8.42	380	228	13.02	172	163	34	228	31.1	37	18.6	2.3	26.4	0.27	27	ND	0.002	0
187	rajouri	Kangri (grid Station)	33.06	74.40	8.28	620	372	0	344	282	54	347	40.0	60	43.8	4.12	28.4	0.82	50.7	ND	0.001	4.1695
188	rajouri	Jabah	33.07	74.33	8.29	370	222	0	159	130	34	141	35.6	13	27	1.41	3.1	0.35	22.54	ND	0.001	3.1383
189	rajouri	Sial	33.07	74.32	8.15	550	330	0	384	315	41	293	17.8	60	55	2.45	3.4	0.38	22.53	ND	0.001	3.5264
190	rajouri	Seri	33.08	74.29	8.72	650	390	65.1	146	228	82	282	13.3	61	66.2	1.96	9.204	0.245	58.5	ND	0.001	2.8327
191	rajouri	Ding	33.09	74.28	8.18	610	366	0	384	315	27	358	13.3	79	23.34	1.69	21.96	0.225	22.7	ND	0.002	0.0554
192	rajouri	Gagrote	33.09	74.27	8.10	700	420	0	450	369	27	402	17.8	87	40.5	3.94	20.8	0.309	49.3	ND	0.002	3.8285
193	rajouri	Bareri	33.10	74.19	8.44	980	588	26.04	146	163	177	206	22.2	37	170.92	5.84	89.27	0.745	81.3	ND	0.001	19.84
194	rajouri	Naunihal	33.18	74.21	8.27	480	288	0	132	109	41	185	26.7	29	31.5	1.95	62.97	0.28	27.4	ND	0.002	4.2829
195	rajouri	Bhatta Morh	33.20	74.20	8.28	300	180	0	132	108	27	130	35.6	10	16.1	2.06	3.95	0.245	22.2	ND	0.003	2.9007
196	rajouri	Darhal Quilla	33.22	74.15	8.21	270	162	0	146	120	20	141	31.1	15	10	2	4.92	0.263	15.63	ND	0.002	3.4263
197	rajouri	Lam (Rajouri)	33.25	74.13	8.42	480	288	39.06	172	206	34	293	62.3	33	17.5	10.06	46.5	0.365	43.8	ND	0.002	1.709
198	rajouri	Laroka	33.24	74.10	8.27	340	204	0	145	119	34	152	40.0	13	22	1.5	13.07	0.211	29.35	ND	0.002	3.632
199	rajouri	Jhangar	33.24	74.05	8.24	710	426	0	146	120	82	217	31.1	34	82.1	2.79	140	0.204	64	ND	0	2.515
200	rajouri	Kalsian	33.19	74.14	8.35	350	210	6.51	185	162	27	195	26.7	31	17.4	1.3	6.074	0.409	17.8	ND	0.001	2.6245
201	rajouri	Chowki Handa	33.17	74.19	8.05	460	276	0	291	239	27	271	22.2	52	15.5	1.51	4.9	0.214	20.64	ND	0	1.4163
202	rajouri	Siot	33.12	74.38	7.89	480	288	0	198	162	48	206	22.2	37	28.8	6.06	21.5	0.25	22.25	ND	0.001	3.9477
203	rajouri	Bakhar	33.09	74.43	8.45	380	228	13.02	225	206	20	206	13.3	42	18.76	2	4.5	0.26	17.5	ND	0.001	0.4386
204	rajouri	Thandapani	33.07	74.49	8.12	400	240	0	172	141	48	195	48.9	18	31.02	1.55	15.2	0.28	45.6	ND	0.001	4.3095
205	rajouri	Bagnoti	33.14	74.30	8.38	440	264	13.02	119	119	61	173	35.6	20	45	2.8	28	0.32	35	ND	0.002	5.9544
206	rajouri	Lower Kharak	33.17	74.42	8.54	240	144	13.02	159	152	27	152	26.7	21	22.8	2.49	12.05	0.27	11.73	ND	0.001	4.557
207	rajouri	Channi Parat	33.09	74.46	8.26	670	402	0	477	391	34	347	40.0	60	65.4	2.26	5.83	0.58	26.8	ND	0.001	2.1164
208	rajouri	Marchola	33.09	74.48	8.29	660	396	0	450	369	27	369	22.2	76	38.1	3.48	6.3	0.245	24.75	ND	0.001	2.1578
209	rajouri	Dharamsal	33.13	74.41	8.79	530	318	26.04	304	293	27	228	8.9	50	59.46	3.12	17.7	0.18	13.65	ND	0.002	0.0551
210	rajouri	Solki	33.16	74.43	8.02	430	258	0	278	228	27	239	13.3	50	23	5.11	10	0.29	14.95	ND	0.001	2.5439
211	rajouri	Panja	33.18	74.42	8.42	420	252	13.02	132	130	48	206	31.1	31	18.5	2.04	31.9	0.32	28	ND	0.001	3.2149
212	rajouri	Dyala	33.24	74.37	8.41	270	162	13.02	119	119	20	141	22.2	21	11.1	1.49	3.74	0.264	10.63	ND	0.001	0
213	rajouri	Potha	33.28	74.32	8.37	350	210	13.02	132	130	34	185	31.1	26	23.42	5	leak	leak	leak	ND	0.048	leak
214	rajouri	Chittiar	33.29	74.28	8.50	360	216	13.02	252	228	20	217	17.8	42	16.94	1.98	3.1	0.22	5.56	ND	0	0.2077