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**GOVERNMENT OF INDIA**

**MINISTRY OF JAL SHAKTI  
DEPARTMENT OF WATER RESOURCES, RIVER  
DEVELOPMENT AND GANGA REJUVENATION**

**CENTRAL GROUND WATER BOARD**

**GROUNDWATER YEAR BOOK  
HIMACHAL PRADESH  
(2022-2023)**

**NORTHERN HIMALAYAN REGION  
DHARAMSHALA (H.P)  
July 2023**



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HIMACHAL PRADESH  
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**By**

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Scientist - B

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**NORTHERN HIMALAYAN REGION  
DHARAMSHALA (H.P)  
July 2023**

## **FOREWARD**

*For an efficient management and development of ground water resources, it is imperative to have a reliable database on water level and water quality. Central Ground Water Board, in addition to various other activities on scientific studies related to groundwater, collects data from a network of National Hydrograph Network Stations also called Ground Water Monitoring Wells and prepares a scientific base for the proper planning and judicious use of available groundwater resources.*

*Most of the area in Himachal Pradesh is hilly, mountainous with few intermountain valleys in between them. The traditional ground water structures, which are under observation at present, are open wells mostly located in the valley area. Therefore, the ground water regime monitoring programme is concentrated mostly in valley area of the state and at some places in hard rock area. Efforts are however going on to increase the number of observation wells and include the piezometers of state government under the groundwater regime monitoring.*

*The measurement of these National Hydrograph Network Stations is carried out four times in a year during the month of January, May, August and November and water samples are collected during pre-monsoon period viz., May for chemical analysis. The analysis of the data indicates the changes in ground water scenario and thereby helps in adopting measures if required in the area under monitoring for the sustainable development and management of the ground water resource. The human induced problems like depletion in water level, water logging, can be identified from the maps prepared during the analysis of water level data.*

*This report presents the water level data for the National Hydrograph Network Stations collected during the year 2022-23 and its analysis and interpretations in the form of tables, maps and their descriptions to bring out the overall ground water scenario and the changes in ground water regime during the ground water year. Preparation of Water level maps have been done by Smt. Anju, Draughtsman, NHR, Dharamshala and GEMS data provided by Smt Poonam, Draughtsman, CHQ Faridabad. The chemical results have been analyzed from chemical lab of CGWB, NWR, Chandigarh. Interpretation of chemical data is provided from CGWB, CHQ, Faridabad.*

*The field data has been collected, processed and compiled by the scientific officers of NHR, Dharamshala. This report has been compiled by Prasant Kumar Singh, STA (Hg.), under the supervision of Sh. B.K.Oraon, Regional Director. The efforts of Sh. Sanjay Pandey, Scientist-B in scrutiny, processing and issuance of report is also highly significant.*

*This ground water year book contains useful data for water year 2022-23 for all the planners and user agencies dealing with the development of ground water resources and it is hoped that it would be utilized fully for the real time management of ground water resources in the State.*

Dated: 25.08.2023

Dharamshala

(B. K. Oraon)  
Regional Director

# GROUNDWATER YEARBOOK 2022-2023 HIMACHAL PRADESH

## EXECUTIVE SUMMARY

- ❖ Central Ground Water Board, NHR has set up a network of 140 National Hydrograph Stations in the state of Himachal Pradesh. The monitoring commenced in the year 1969 with the establishment of 3 observation wells and since, then the number of monitoring stations are being increased regularly so as to get the overall picture of ground water scenario in different hydrogeological set up of the state.
- ❖ Most of the area in Himachal Pradesh is hilly enclosing few small intermontane valleys. The traditional ground water structures under observation at present are dug wells and are mostly located in the valley areas only. Therefore, the ground water regime monitoring programme is concentrated mainly in valley areas of the state and some places in hard rock areas.
- ❖ All the 140 National Hydrograph Stations are located only in 9 Districts out of the 12 Districts in Himachal Pradesh. The reason being hilly terrain, hard approachability and insignificant number of structures available for monitoring.
- ❖ The average annual rainfall in the state varies from 600 mm to more than 2400 mm. The rainfall increases from south to north. Dharamshala in District Kangra, receives the 2<sup>nd</sup> highest rainfall of about 3000 mm in the Country.
- ❖ Water levels are being monitored four times in a year during the month of May, August, November and January. Water samples are collected during the month of May every year for chemical analysis of ground water quality.
- ❖ The depth to water level, recorded during May 2022, ranged between 0.82 m (Mandi District) and 29.79 m bgl (Solan District). Out of 140 stations monitored, the majority of 122 NHS recorded DTWL, in the range between 2 - 20 m bgl. 7 stations recorded shallow water levels, less than 2m bgl and 6 stations, recorded deep water levels, more than 20 m bgl in the state.
- ❖ The depth to water level recorded during August 2022 ranges between (0.08) m bgl (Kangra District) to 36.92 m bgl (Sirmour District). Out of the 140 stations monitored the majority of 89 stations recorded DTW in the range between 2-20 m bgl, 45 stations have recorded shallow water level less than 2 m bgl, and only 6 stations have shown, more than 20 m bgl in the state.
- ❖ The depth to water level recorded during November 2022 ranged between 0.54 m bgl in (Kangra District) to 36.25 m bgl in (Sirmour District). Out of 140 stations monitored, the majority of 106 NHS recorded DTWL, in the range between 2 - 20 mbgl. 29 stations, recorded shallow water levels, less than 2 m bgl and 5 stations, recorded deep water levels, more than 20 m bgl in the State.
- ❖ The depth to water level recorded during January 2023 ranged between 0.29 m (Mandi District) to 38.21 m bgl (Sirmour District). Out of 140 stations which are monitored, the majority of 128 NHS recorded DTW in the range between 2 - 20 m bgl, 23 stations recorded shallow water levels, less than 2 m bgl and 6 stations recorded deep water levels, more than 20 m bgl in the state.
- ❖ Monsoonal fluctuation of water level was analyzed for 140 stations for the period May 2022 – November 2022. A perusal of data shows that out of the 140 stations, 119 stations have shown rise in water level and 14 stations have shown fall in water level. The minimum rise in water level of 0.01 m was observed in Mandi District and the maximum rise 8.54 m was noticed in Kangra District.

- ❖ Annual fluctuation of water level, has been worked out by comparing depth to water level of May 2021, with May 2022 and the data is shows that out of the 140 stations analysed, 76 stations have shown rise in water level ranging from 1.07 (Hamirpur District) to 4.11 m (Kangra District), whereas majority of 49 stations have shown fall ranging from 0.05 m (Mandi District) to 6.85 m (Kangra District).
- ❖ Annual fluctuation of water level, of August 2021, with August 2022 and the data shows that out of the 140 stations, 84 stations have shown rise in water level ranging from 0.01 m (Una District) to 11.60 m (Kangra District) whereas 47 stations have shown fall ranging from 0.01 m (Sirmaur District) to 6.89 m (Una District).
- ❖ Annual fluctuation of water level of November 2021 with November 2022 the data shows that out of the 140 stations, 85 stations have shown rise in water level ranging from 0.01 m (Kangra District) to 17.07 m (Sirmour District) whereas 47 stations have shown fall ranging from 0.01 m (Mandi District) to 3.83 m (Bilaspur District).
- ❖ Annual fluctuation of water level of January 2022 with January 2023 the data shows that out of the 140 stations, 39 stations have shown rise in water level ranging from 0.01 m (Solan District) to 3.31 m (Solan District) whereas 91 stations have shown fall ranging from 0.02 m (Mandi District) to 14.01 m (Sirmaur District).
- ❖ Decadal water level fluctuation by comparing water level data of May 2022 with the average mean of 10 years water level data of May (2012-2021) shows that out of 83 stations analyzed, 36 stations (43.37%) have shown rise and 47 stations (56.63%), have shown fall in water level. 32 stations (88.89%) are showing rise in water level between 0 to 2 m, 2 stations (5.55%) between 2 to 4 m and 2 stations (5.56%), more than 4 m. Out of 47 stations, 40 stations (85.10%) show fall in water level between 0 to 2m, 5 stations (10.64 %) between 2 to 4 m and 2 stations (4.26%) more than 4 m. A minimum rise in water level of 0.01 m was noticed in Una Districts and the maximum rise of 9.34 m is noticed in Sirmaur District. Similarly, the minimum fall of 0.00 m is noticed in Kangra District & maximum fall of 6.05 m is noticed in Kangra District.
- ❖ Decadal water level fluctuation of water level data of August 2021 with the average 10 years water level data of August (2012-2021) and shows that out of 88 stations analyzed, 26 stations (29.55%) have shown rise and 62 stations (70.45%), have shown fall in water level. 24 stations (92.31%) are showing rise in water level between 0 to 2 m, 2 stations (7.69%) between 2 to 4 m and no station (0%), more than 4 m. Out of 62 stations, 56 stations (90.32%) show fall in water level between 0 to 2 m, 4 stations (6.45%) between 2 to 4 m and 2 stations (3.23%) more than 4 m. A minimum rise in water level of 0.02 m was noticed in Una District and the maximum rise of 3.50 m is noticed in Solan District. Similarly, the minimum fall of 0.00 m is noticed in Una District & maximum fall of 8.32 m is also noticed in Una District.
- ❖ Decadal water level fluctuation by comparing water level data of November 2022 with the average water level data of November for 10 years (2012-2021) shows that out of 84 stations analyzed, 27 stations (32.14%) have shown rise and 57 stations (67.86%), have shown fall in water level. 23 stations (85.19%) are showing rise in water level between 0 to 2 m, 4 stations (14.81%) between 2 to 4 m and no station (0%), more than 4 m. Out of 57 stations, 52 stations (91.23%) show fall in water level between 0 to 2 m, 3 station (5.26%) between 2 to 4 m and 2 station (3.51 %) more than 4 m. A minimum rise in water level of 0.07 m was noticed in Kangra District and the maximum rise of 3.64 m is noticed in Solan District. Similarly, the minimum fall of 0.01 m is noticed in Una District & maximum fall of 18.29 m is noticed in Sirmour District.

- ❖ Decadal water level fluctuation by comparing water level data of January 2023 with the average water level data of January for 10 years (2013-2022) shows that out of 104 stations analysed, 34 stations (32.69 %) have shown rise and 70 stations (67.31%), have shown fall in water level. Out of 34 stations, 30 stations (88.24%) are showing rise in water level between 0 to 2m, 3 stations (8.82%) between 2 to 4 m and 1 stations (2.94%), more than 4 m Out of 70 stations, 61 stations (87.14%) show fall in water level between 0 to 2 m, 3 stations (4.29%) between 2 to 4 m and 6 stations (8.57%) more than 4 m. A minimum rise in water level of 0.03 m was noticed in Kangra District and the maximum rise of 10.45 m is noticed in Sirmaur District. Similarly, the minimum fall of 0.02 m is noticed in Una District & maximum fall of 11.02 m is noticed in Sirmaur District.



**GROUND WATER YEAR BOOK  
HIMACHAL PRADESH  
2022-2023**

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**1.0 INTRODUCTION**

Himachal Pradesh is located between the north latitude  $30^{\circ}22'40''$  &  $33^{\circ}12'40''$  and east longitude  $75^{\circ}47'55''$  &  $79^{\circ}04'20''$ . It falls in Survey of India topographic sheets Nos. 52D, 52H, 52L, 53A, 53B, 53F, 53E and 53I and covers an area of 55,673 sq km. It is one of the predominantly hilly states in India, which lies in the western Himalayas. The length of Himachal Pradesh is about 355 km i.e., from northwestern part of Chamba to southeastern part of Kinnaur. The breadth of the state is about 270 km i.e., from western part of Una to northeast part of Lahaul and Spiti District. The state is bounded by the state of Jammu & Kashmir in north, Punjab state in west, Haryana state in south and Uttarakhand state in southeast and shares an international border with China (Tibet) in northeast.

Administratively, the state is divided in 12 Districts, 76 Tehsils, 34 Sub-Tehsils and 78 Blocks. There are 20,690 villages, 3,226 Gram Panchayats, 59 towns, 28 Nagar Panchayats and 25 Nagar Parishads including Municipal Corporations. Lahaul & Spiti is the largest and Hamirpur is the smallest District of the state with geographical area of 12,835 and 1,118 sq km respectively.

The state has a population of 68,64,602 persons (Census 2011) having an average population density of 128 person per sq km. The male population in the state is 34,81,873 persons and female population is 33,82,729. The rural and urban population in the state is 61,76,050 and 6,00,552 persons respectively. The density of population in the state varies from as low as 2 persons/sq.km in Lahaul and Spiti District to 406 persons/sq km in Hamirpur District as compared to the state average of 128 persons/sq km.

Himachal region presents an intricate mosaic of mountain ranges, hills and valleys with altitude ranging from 350 m to 6500 m amsl. The Dhauladhar range looks in supreme majesty over the Kangra valley while the Pir Panjal, the Great Himalaya and the Zaskar ranges guard over Chamba, Lahaul & Spiti, Kullu and Kinnaur Districts. The mountain slopes are covered with forests and meadows. The valleys below are interspersed with numerous streams, fields and quiet homesteads. There is general increase in elevation from east to west and from south to north. The physiographic divisions from south to north are the Outer Himalayas also known as Siwaliks (350 to 1500 m amsl), the Lesser Himalayan Range (1500-5000 m amsl), Great Himalayan Range (5000 – 6000 m amsl) and Zaskar Range (> 6000 m amsl)

Himachal state has a unique distinction of having drainage systems of both the Indus and the Ganga basin. The major river systems of the region are the Chandra-Bhaga or the Chenab, the Ravi, the Beas, the Satluj and the Yamuna. The catchments of the rivers are fed by snow and rainfall,

And are protected by fairly extensive cover of natural vegetation. Major rivers of the Indus River basin are the Chenab, the Ravi, the Beas and the Satluj. The Yamuna is the only river contributing water to Ganga basin.

The southwestern monsoon contributes about 70% of rain fall during monsoon period from July to September and about 30% occurs during non-monsoon period due to western disturbances and in the form of thunder storm. Generally, rainfall increases from south to north. Western disturbances also shower rainfall in winters. Beyond Kullu towards Lahaul & Spiti and Kinnaur, rain fall decreases due to rain shadow effect. Spiti is the driest area with 50 mm rainfall because of being enclosed by High Mountain from all sides. The average annual rainfall in the Districts of the state varies from about 600 mm in Lahaul & Spiti to more than 2400 mm in Kangra.

Central Ground Water Board, under part of its national ground water monitoring programme has established a network of observation stations in the state for periodic monitoring of ground water level and water quality. The ground water regime monitoring programme commenced during the year 1969 when the erstwhile groundwater wing of Geological Survey of India established 3 stations in the State. At present there are 128 Ground Water Monitoring Station (GWMS) in Himachal Pradesh. The year wise increase in GWMS in the State is given in Table-1.

**Table-1: Year wise increase in GWMS, Himachal Pradesh**

Year	Total Number of Ground Water Monitoring Stations
1969-73	3
1974-77	19
1978	32
1979	34
1980	35
1981	68
1982	69
1983-88	71
1989	72
1990-2000	79
2000-2010	86
2011-2013	102
2015-2016	111
2016-2017	128
2017-2018	128
2018-2019	128
2019-2020	128
2021-2022	128
2022-2023	140

The ground water monitoring is being carried out by Northern Himalayan Region, Dharamshala, since 1996. All the 140 GWMS are dug wells and are located in 9 Districts of Himachal Pradesh out of the 12 Districts. The reason for not monitoring other Districts is being the hard approachability due to terrain conditions and non- availability of ground water monitoring structures. The District wise break up of Ground Water Monitoring Stations and their occurrence in different hydrogeological setup is given in Table-2.

**Table-2: District wise GWMS & Hydrogeological setup**

S. No	District	Number of GWMS			
		Total	Valley Area Porous Formation (Quaternary)	Fissured Formation (Tertiary)	Fissured Formation (Proterozoic to Mesozoic)
1.	Hamirpur	6	6	-	-
2.	Bilaspur	4	4		
3.	Kangra	49	34	15	-
4.	Kullu	2	2	-	-
5.	Mandi	10	10	-	-
6.	Sirmaur	19	17	2	-
7.	Solan	14	14	-	-
8.	Una	33	33	-	-
9.	Chamba	3	-	1	-
<b>TOTAL</b>		<b>140</b>	<b>122</b>	<b>18</b>	<b>-</b>

## 2.0 HYDROGEOLOGY

The major part of Himachal Pradesh is hilly and mountainous with few small intermontane valleys covering about 15% of the area. These valleys comprise of alluvial deposits, which form extensive aquifers and thus represent porous formations. Major valleys in the state are Indora- Nurpur and Kangra-Palampur valleys in District Kangra, Una valley in District Una, Balh valley in District Mandi, Nalagarh valley in District Solan and Paonta valley in District Sirmaur.

The Siwalik and Sirmaur group represent the Tertiary formation in the state. These two groups occur in the western part of the state and have northwest to southeast trend. The Siwalik comprises of boulder, conglomerate, sandstone and clay while, Sirmaur group comprises of shale, sandstone and clay. The primary porosity and permeability in the Tertiary formation is low to moderate and hence, these aquifers do not form high yielding aquifers.

The older rock formations of Proterozoic to Mesozoic eras constitute of igneous and metamorphic rocks like granite, gneiss, slate, schist, phyllite, quartzite etc. Because of their consolidated nature,

these rock formations serve as poor aquifers. However, due to tectonic movements, they have been traversed by faults, thrust and joints, which have enhanced their ground water potential.

The quality of ground water in hard rocks and alluvial areas is by and large good and suitable for domestic and irrigational use. The distribution of the hydrogeological formations discussed above and their yield potential are given below in Table -3.

**Table-3: Hydrogeological Formations and their Yield Potential, in Himachal Pradesh**

Age	Rock Formation	Districts	Hydrogeological Characteristics
<b><i>POROUS FORMATIONS</i></b>			
Recent to sub Recent	Boulder, Cobble, Pebble, Sand, Silt, Clay,	Kangra, Una, Solan, Sirmaur, Mandi and Kullu	High Yield 30-75 m <sup>3</sup> /hr
<b><i>FISSURED FORMATIONS</i></b>			
Tertiary	Boulder Conglomerate Sandstone, Clay	Kangra, Solan, Sirmaur Bilaspur, Una, Mandi, and Hamirpur.	Moderate to Low Yield < 30 m <sup>3</sup> /hr
Proterozoic to Mesozoic	Shale, Slate, phyllite, Limestone, dolomite, Sandstone, Quartzite, Granite, Schist,	Lahaul & Spiti, Kinnaur, Chamba, Mandi, Simla, Kangra, Sirmaur, Solan, and Kullu	Moderate to Low Yield <5 to 30 m <sup>3</sup> /hr

### 2.1 Proterozoic to Mesozoic Formations

Older formations of Proterozoic to Mesozoic age are constituted by groups like Sundernagar group, Shali-Deoban-Largi group, Vaikrita group, Jutogh group, Simla group, Krol group, Tal group, Kuling group, Lilang group, Tandi group etc. These groups comprise of granites, gneisses, slates, schists, phyllites, quartzites etc. and occur in Kangra, Chamba, Lahaul & Spiti, Kinnaur, Simla, Sirmaur, Kullu and Solan Districts. These rocks are dense and consolidated in nature therefore; they bear low primary porosity and permeability, thus forming poor yielding hard rock aquifers. Secondary porosities have developed due to the tectonic movements. Weathered, fractured and contact zones however, form potential ground water zones.

Groundwater in hard rocks area is either developed through bore wells or springs at favorable locations. Springs are the major ground water sources in these formations and its yield ranges from seepages to more than 25 lps and are utilized for both domestic and irrigation purposes. Weathered mantle in low topographic areas, also forms poor aquifers. In some areas, percolation wells are also

constructed. *Bowris* are also constructed in oozing out spring zones, for collection of water to fulfill the domestic water needs. Number of hot water springs also occurs in these formations.

## **2.2 Tertiary Formations**

The upper Tertiary formations ranging in age from Middle Miocene to Lower Pleistocene are represented by the rocks of Siwalik group and extend from northwest to southeastern part of the state. It comprises of great thickness of cobbles, pebbles, detritus rocks, clays and conglomerates. The Siwalik chain is widest in the valley of river Beas. On paleontological grounds the Siwalik are subdivided into three subgroups namely upper, middle and the lower Siwaliks.

The lower Tertiary formations ranging in age from Eocene to Lower Miocene are represented by the rocks of Sirmaur group. The Sirmaur group has also been sub-divided into three formations namely Kasauli, Dagshai and Subathu. The group comprises of shale, sandstone and clay. The Sirmaur group is separated by a fault from the Siwaliks.

Fracture zones and contact zones form important aquifers in the low topographic areas with poor to moderate yields. Yields of the tube wells are less than 30m<sup>3</sup>/hr constructed along the fault/fracture/contact zones. These fractures or faults zones form potential ground water zones for development.

## **2.3 Quaternary Formations**

The Quaternary formations occur either as major or minor valley fills/piedmont/fluvio-glacial deposits and alluvium. The major valley fill areas are Nurpur – Jawali – Nagrota Surian, Pragpur – Dadasiba, Palampur – Kangra valley fills in Kangra District; Shathlai and Sirkhad in Hamirpur District; Balh valley in Mandi District; Una valley in Una District; Nalagarh valley in Solan District; Paonta valley in Sirmaur District; Spiti valley in Lahaul & Spiti District. Ground water occurs under phreatic to semi-confined conditions in these deposits. In some of the valleys like Indora – Nurpur valley in Kangra District and Balh valley in Mandi District, confined aquifers are encountered.

The thickness of valley fills in Paonta, Una, Nalagarh, Nurpur and Andaura are generally more than 100 m whereas, in other areas its thickness is within 100 m. Groundwater occurs under unconfined to confined conditions. In general, depth to water level varies from 5 to about 60 m bgl. Artesian conditions also exist in lower and central part of Una valley, lower part of Nurpur, Andaura and Balh valley fills.

Ground water occurs under unconfined conditions in shallow valley fills areas developed along the river/streams. Discontinuous aquifers system is observed in Kangra, Sirmaur, Solan and Una Districts. Depth to water level varies from < 2 to 20 m bgl. Ground water is developed through open dug wells, shallow and deep tube wells. The discharge of the tube wells varies up to 40 lps but generally ranges between 15 to 25 lps. There are about 8000 tube wells constructed including

Exploratory wells of CGWB in the valley fill deposits both for drinking and irrigation purpose. A large number of shallow boreholes fitted with hand pumps also exist in the state for developing groundwater.

### **3.0 GROUNDWATER SCENARIO**

The ground water level in the state is monitored regularly to have a review over the changes in ground water regime. The maps generated from these data help in identifying the areas, which are under water level rising and water level declining. With the help of these maps, suitable measures as per the demand of the area can be adopted for the sustainable ground water development. It also helps the planners to formulate the future strategy in various fields of ground water development.

For the purpose of presentation, the water levels and their changes are shown separately in alluvial and hard rock areas because of aquifer discontinuity. As discussed earlier, the major alluvial areas are Indura-Nurpur and Kangra-Palampur valley in District Kangra, Una valley in District Una, Balh valley in District Mandi, Nalagarh valley in District Solan and Paonta valley in District Sirmaur. In hard rock areas point values are given at places.

The water level is being monitored in the State four times in a year

1. May : 20<sup>th</sup> to 30<sup>th</sup> : represents water level of Pre-monsoon period
2. August : 20<sup>th</sup> to 30<sup>th</sup> : represents peak monsoon water level.
3. November : 1<sup>st</sup> to 10<sup>th</sup> : represents water level of Post-monsoon period.
4. January : 1<sup>st</sup> to 10<sup>th</sup> : represents the recession stage of water level

The data has been analyzed for each set of measurement and report has been prepared which include following maps to understand the groundwater regime in the area.

The depth to water level, seasonal fluctuation and annual fluctuation has been presented in Annexure-I, II and III. The decadal mean fluctuation has been tabulated in Annexure-IV. The ground water behavior in the seven Districts of Himachal Pradesh has been discussed below.

- A. Depth to water level maps : Water level scenario for the month in the area.
- B. Seasonal fluctuation maps : Water level fluctuation in comparison to Pre-monsoon and Post-monsoon
- C. Annual fluctuation maps : Water level fluctuation in comparison to same month with the previous year.
- D. Decadal mean fluctuation maps : Water level fluctuation in the month of measurement with reference to the decadal average for the same month.



### 3.1 Depth to Water Level

#### 3.1.1 May 2022

The depth to water level, recorded during May 2022 (Annexure - I), ranged between 0.82 m (Mandi District) and 29.79 m bgl (Solan District) (Table-4). Out of 83 stations monitored, the majority of 71 NHS (87.65%) recorded DTWL, in the range between 2 - 20 m bgl. 6 stations (7.22%), recorded shallow water levels, less than 2 m bgl and 6 stations (7.23%), recorded deep water levels, more than 20 m bgl in the state.

**Table-4: District wise number & % of NHS distribution, in different DWL of May 2022**

2.1

Depth to Water Table  
Distribution of Percentage of Observation Wells  
2022/May

State : Himachal Pradesh

District	No. of Wells Analysed	Depth to		No. / Percentage of Wells Showing Depth to Water Table (mbgl) in the Range of					
		Min	Max	-	-	-	-	-	-
HAMIRPUR	3	2.79	10.53	0	2	0	1	0	0
KANGRA	25	1.06	15.00	2	14	5	4	0	0
KULLU	2	0.92	8.65	1	0	1	0	0	0
MANDI	7	0.82	5.63	2	3	2	0	0	0
SIRMAUR	10	2.18	27.65	0	1	3	5	1	0
SOLAN	7	12.61	29.79	0	0	0	4	3	0
UNA	29	1.10	29.30	1	10	11	5	2	0
<b>Total</b>	<b>83</b>	<b>0.82</b>	<b>29.79</b>	<b>6</b>	<b>30</b>	<b>22</b>	<b>19</b>	<b>6</b>	<b>0</b>

A perusal of the DTWL map of May 2022 shows that the shallow water level area of less than 2 m bgl, occurs in eastern and southern part of Kangra-Palampur valley, northern part of Kullu valley and southern part of Balh valley in Mandi District. 2-5 m bgl and 5-10 m bgl water level occupies in most of the monitoring area of all the valleys of Himachal Pradesh, mainly in Kangra- Palampur valley, Nurpur- Indora valley, southern part of Kullu valley and Balh Valley. Water level 10-20 m bgl in shown northern part of Kangra Palampur valley and northern part of Indora valley. Deeper water levels, between 20-40m bgl are shown in Nalagarh and western part of Paonta valley.

#### 3.1.2 August 2022

The depth to water level recorded during August 2022 (Annexure - I) ranges between (0.08) m bgl (Kangra District) to 36.92 m bgl (Sirmour District) (Table-5). Out of the 88 stations monitored the majority of 55 stations (62.50%) recorded DTW in the range between 2-20 m bgl, 27 stations (30.68%) have recorded shallow water level less than 2 m bgl, and only 6 stations (6.81%) have shown, more than 20 m bgl in the state.

**Table-5: –Depth to water level-August 2022**

Depth to Water Table  
Distribution of Percentage of Observation Wells  
2022/Aug

State : Himachal Pradesh

District	No. of Wells Analysed	Depth to		No. / Percentage of Wells Showing Depth to Water Table (mbgl) in the Range of					
		Min	Max	-	-	-	-	-	-
HAMIRPUR	2	0.99	1.09	2	0	0	0	0	0
KANGRA	26	0.08	8.27	12	12	2	0	0	0
KULLU	2	1.25	7.42	1	0	1	0	0	0
MANDI	6	0.45	3.66	3	3	0	0	0	0
SIRMAUR	13	1.53	36.92	1	4	3	3	2	0
SOLAN	9	5.10	29.58	0	0	3	4	2	0
UNA	30	0.59	29.29	8	8	8	4	2	0
<b>Total</b>	<b>88</b>	<b>0.08</b>	<b>36.92</b>	<b>27</b>	<b>27</b>	<b>17</b>	<b>11</b>	<b>6</b>	<b>0</b>

A perusal of the DTW map for August 2022 indicates that the shallow water level area less than 2 m bgl occurs in all the valleys of Himachal Pradesh, except Nalagarh valley, mainly in Balh valley (Mandi District), all the valleys of Kangra District including Kangra Palampur valley and Nurpur-Indaura valley, eastern & central part of Una valley and northern part of Kullu valley. 2-5 m bgl and 5-10 m bgl water level is recorded in couple of pockets in almost all the valley areas. 10-20 m bgl water level is recorded in pockets in Una Valley, northern part of Paonta valley and Nalagarh valley. Deeper water levels are found at some places in Nalagarh and Una valley.

**3.1.3 November 2022**

The depth to water level recorded during November 2022 (Annexure-I) ranged between 0.54 m bgl in (Kangra District) to 36.25 m bgl in (Sirmour District) (Table-6). Out of 84 stations monitored, the majority of 63 NHS (75%) recorded DTWL in the range between 2-20 m bgl. 16 stations (19.05%), recorded shallow water levels, less than 2 m bgl and 5 stations (5.95%), recorded deep water levels, more than 20 m bgl in the State.

A perusal of the DTWL map for November 2022 shows that the shallow water level areas of less than 2 m observed in southern part of Kangra Palampur valley and southern part of Balh valley. Water level of 2-5 m & 5-10 m bgl is observed in major part of Kangra Palampur valley, Indaura- Nurpur valley, Balh valley, Una Valley, Nalagargh valley Paonta valley respectively. 10-20 m bgl water level is shown in Una, Nalagah, Kangra-Palampur valley and Paonta valley only. Deeper water level more than 20 m is confined mainly in northern part of Paonta valley in Sirmour District, northern part of Nalagarh valley of Solan District and northern part of Una valley.

**Table- 6: Depth to Water Level–November 2022**

Depth to Water Table  
Distribution of Percentage of Observation Wells  
2022/Nov

State : Himachal Pradesh

District	No. of Wells Analysed	Depth to		No. / Percentage of Wells Showing Depth to Water Table (mbgl) in the Range of					
		Min	Max	-	-	-	-	-	-
HAMIRPUR	1	2.02	2.02	0	1	0	0	0	0
					100.00%				
KANGRA	22	0.54	10.05	7	10	4	1	0	0
				31.82%	45.43%	18.18%	4.55 %		
KULLU	1	6.82	6.82	0	0	1	0	0	0
						100.00%			
MANDI	6	1.91	4.56	1	5	0	0	0	0
				16.67%	83.33%				
SIRMAUR	13	1.79	36.25	1	2	2	6	2	0
				7.69%	15.38%	15.38%	46.15 %	15.38%	
SOLAN	10	5.40	29.32	0	0	2	7	1	0
						20.00%	70.00 %	10.00%	
UNA	31	0.75	29.10	7	11	6	5	2	0
				22.58%	35.48%	19.35%	16.13 %	6.43%	
<b>Total</b>	<b>84</b>	<b>0.54</b>	<b>36.25</b>	<b>16</b>	<b>29</b>	<b>15</b>	<b>19</b>	<b>5</b>	<b>0</b>

**3.1.4 January 2023**

The depth to water level recorded during January 2023 (Annexure - I) ranged between 0.29m (Mandi District) to 38.21 m bgl (Sirmour District) (Table-7). Out of 104 stations which are monitored, the majority of 98 NHS (94.23%) recorded DTW in the range between 2 - 20 m bgl, 16 stations (15.38%) recorded shallow water levels, less than 2 m bgl and 6 stations (5.77%) recorded deep water levels, more than 20 m bgl in the state.

A perusal of the DTW map of January 2023 shows that the shallow water level area occurs mainly in south southern part of Kangra Palampur valley (Kangra District), northern part of Balh valley (Mandi District) and northern and southern part of Kullu Valley. 2-5 m bgl & 5-10 m bgl water level is depicted in all the valleys of Himachal Pradesh. 10-20 m bgl water level occupies Nalagarh, Kangra-Palampur Valley and Una valley. Deeper water level, more than 20m are confined mainly in southern part of Nalagarh and at few places of Una valley.

**Table-7: Depth to Water Level–January 2023**

Depth to Water Table  
Distribution of Percentage of Observation Wells  
2023/Jan

State : Himachal Pradesh

District	No. of Wells Analysed	Depth to Water Table (m bgl)		No. / Percentage of Wells Showing Depth to Water Table (m bgl) in the Range of					
		Min	Max	0.0 - 2.0	2.0 - 5.0	5.0 - 10.0	10.0 - 20.0	20.0 - 40.0	> 40.0
HAMIRPUR	6	2.31	16.41	0	2	3	1	0	0
					33.33%	50.00%	16.67 %		
KANGRA	33	0.73	14.85	9	16	4	4	0	0
				27.27%	48.48%	12.12%	12.12 %		
KULLU	1	10.00	10.00	0	0	1	0	0	0
						100.00%			
MANDI	8	0.29	12.00	3	4	0	1	0	0
				37.50%	50.00%		12.50 %		
SIRMAUR	13	1.56	38.21	1	1	3	6	2	0
				7.69%	7.69%	23.08%	46.15 %	15.38%	
SOLAN	11	5.73	29.81	0	0	3	6	2	0
						27.27%	54.55 %	18.18%	
UNA	32	1.08	29.58	3	11	11	5	2	0
				9.38%	34.38%	34.38%	15.63 %	6.23%	
<b>Total</b>	<b>104</b>	<b>0.29</b>	<b>38.21</b>	<b>16</b>	<b>34</b>	<b>25</b>	<b>23</b>	<b>6</b>	<b>0</b>

**Seasonal Water Level Fluctuation**

To study the effect of monsoon and subsequent utilization for various needs like agriculture, irrigation and domestic etc, changes in water level are studied and are discussed below.

**3.1.5 May 2022 to November 2022**

Monsoonal fluctuation of water level was analyzed for 73 stations for the period May2022 – November 2022. A perusal of Table-8 shows that out of the 73 stations, 64 stations have shown rise in water level and remaining 9 stations have shown fall in water level.

The minimum rise in water level of 0.01 m was observed in Una District and the maximum rise 8.54 m was noticed in Kangra District. Out of the 64 stations which have shown rise in water level, 48 stations show rise between the range of 0 to 2 m, 10 stations between 2 to 4 m and remaining 6 stations show rise more than 4 m.

The minimum and maximum fall in water level of 0.07 m and 2.33 m was observed in Una District. Out of them 5 stations have shown fall between 0-2 m, 1 station has shown fall between 2-4 m and no station has shown fall >4 m.

A perusal of map for seasonal fluctuation shows a rise in water level in major part of Indora valley, Nurpur valley, Una valley, Balh valley. Except a fall which is noticed in eastern part of Indaura valley, western and northern part of Una valley, Balh Valley and whole part of Kullu valley.

**Table-8: Monsoonal Fluctuation -May2022 to November2022**

**District Wise - Fluctuation and Frequency Distribution From Different Ranges from One Period to Other**

From Year: 2022/May - To Year: 2022/Nov

State : Himachal Pradesh

District Name	No. of Wells	Range of Fluctuation (m)				No. of Wells/Percentage Showing Fluctuation						Total No. of Wells		
		Rise		Fall		Rise			Fall			Rise	Fall	
		Min	Max	Min	Max	0 to 2	2 to 4	>4	0 to 2	2 to 4	>4			
HAMIRPUR	1	0.93	0.93	-	-	1 100.00%	0	0	0	0	0	0	1	0
KANGRA	20	0.52	8.54	0.20	0.20	10 50.00%	6 30.00%	3 15.00%	1 5.00%	0	0	0	19	1
KULLU	1	1.83	1.83	-	-	1 100.00%	0	0	0	0	0	0	1	0
MANDI	5	0.77	1.63	0.19	0.19	4 80.00%	0	0	1 20.00%	0	0	0	4	1
SIRMAUR	10	0.21	5.09	2.70	2.70	7 70.00%	1 10.00%	1 10.00%	0	1 10.00%	0	0	9	1
SOLAN	7	0.23	4.26	-	-	5 71.43%	1 14.29%	1 14.29%	0	0	0	0	7	0
UNA	29	0.01	4.96	0.07	2.33	20 68.97%	2 6.90%	1 3.45%	5 17.24%	1 3.45%	0	0	23	6
<b>Total</b>	<b>73</b>	<b>1.83</b>	<b>0.93</b>	<b>0.00</b>	<b>2.70</b>	<b>48</b>	<b>10</b>	<b>6</b>	<b>7</b>	<b>2</b>	<b>0</b>	<b>0</b>	<b>64</b>	<b>9</b>

**3.2 Annual Water Level Fluctuation**

Annual fluctuation in water level of GWMS during different monitoring periods were analysed and discussed below.

**3.2.1 May 2021 to May 2022**

Annual fluctuation of water level, has been worked out by comparing depth to water level of May 2021, with May 2022 and the data is presented in Annexure – III and its frequency distribution in various rise and fall ranges is given in Table-9.

Out of the 81 stations analysed, 40 stations (49.38%) have shown rise in water level ranging from 0.01 (Solan District) to 16.60 m (Sirmaur District), whereas majority of 41 stations (50.62 %) have shown fall ranging from 0.03 m (Sirmaur District) to 29.79 m (Solan District).

Out of 40 stations which have shown rise in water level, 31 stations (77.50%) show rise between the range of 0 to 2 m, 5 station (12.5%) has shown rise between 2 to 4 m and 4 station (10.0%) shown rise more than 4 m.

Similarly, for 41 stations which have shown fall in water level, 36 stations (87.80%) show fall between the range of 0 to 2 m, 2 stations (4.88%) have shown fall between 2 to 4 m and 3 stations (7.32%) has shown fall more than 4 m.

A perusal of map of Annual Water Level Fluctuation for May 2021 to May 2022 shows fall in water level in majority of monitoring areas, specially in Una valley and Indora-Nurpur valley, except a couple of areas. Fall of 0-2 m in shown in Kangra-Palampur valley of Kangra District, Kullu Valley, major part of Nurpur and Indaura Valley and small pockets of Una Valley. Fall >4 m is noticed in small pockets of Nurpur valley and Indora Valley. Rise in water level is noticed in Kangra Palampur valley,

small pockets of Una valley, northern part of Kullu valley and southern of Part of Balh valley.

**Table-9: District wise number &% of NHS distribution in different Annual Water Level Fluctuation with Range (May 2021 - May 2022)**

District Wise - Fluctuation and Frequency Distribution From Different Ranges from One Period to Other  
From Year: 2021/May - To Year: 2022/May

State : Himachal Pradesh

District Name	No. of Wells	Range of Fluctuation (m)				No. of Wells/Percentage Showing Fluctuation						Total No. of Wells		
		Rise		Fall		Rise			Fall			Rise	Fall	
		Min	Max	Min	Max	0 to 2	2 to 4	>4	0 to 2	2 to 4	>4			
HAMIRPUR	3 0.00	-	-	0.18	0.83	0	0	0	3 100%	0	0	0	0	3
KANGRA	23 (2.94)	0.28	2.94	0.18	7.16	6 26.09%	3 13.04%	0	12 52.17%	1 4.35%	1 4.35%	9	14	
KULLU	2 0.00	-	-	0.04	0.56	0	0	0	2 100%	0	0	0	2	
MANDI	7 0.00	-	-	0.05	0.92	0	0	0	7 100%	0	0	0	7	
SIRMAUR	10 (16.60)	0.05	16.60	0.03	11.75	5 50.00%	1 10.00%	1 10.00%	2 20.00%	0	1 10.00%	7	3	
SOLAN	7 (4.40)	0.01	4.40	29.79	29.79	4 57.14%	1 14.29%	1 14.29%	0	0	1 14.29%	6	1	
UNA	29 (6.31)	0.02	6.31	0.05	2.95	16 55.17%	0	2 6.90%	10 34.48%	1 3.45%	0	18	11	
<b>Total</b>	81	0.28	2.94			31	5	4	36	2	3	40	41	

### 3.2.2 August 2021 to August 2022

Annual fluctuation of water level, has been worked out by comparing depth to water level of August 2021, with August 2022 and the data is presented in Annexure – III and its frequency distribution of rise and fall is given in Table-10.

Out of the 80 stations, 37 stations (46.25 %) have shown rise in water level ranging from 0.01 m (Una District) to 4.20 m (Kangra District) whereas 43 stations (53.75 %) have shown fall ranging from 0.01 m (Una District) to 8.84 m (Sirmaur District).

Out of 37 stations, which have shown rise in water level, 34 stations (91.89%) show rise between the range of 0 to 2 m, 1 station (2.70 %) show rise between the range of 2 to 4 m and remaining 2 station (5.41%) show rise more than 4 m. Similarly, for the 43 stations which have shown fall in water level, 40 stations (93.02%) show fall between the range of 0 to 2 m, no station (0%) between 2 to 4m and remaining 3 stations (6.98%) show fall more than 4 m.

A perusal of map of Annual Water Level Fluctuation for August 2021 to August 2022 shows fall in water level in all the monitoring areas including Kangra Palampur valley, of Indora-Nurpur valley, Nallagarh valley, Kullu valley and of Una valley. Areas are showing water level rise in small parts of Paonta valley, kangra palampur valley and Nurpur Indora valley.

**Table-10: Annual Fluctuation August 2021-August 2022**

**District Wise - Fluctuation and Frequency Distribution From Different Ranges from One Period to Other**

From Year: 2021/Aug - To Year: 2022/Aug

State : Himachal Pradesh

District Name	No. of Wells	Range of Fluctuation (m)				No. of Wells/Percentage Showing Fluctuation						Total No. of Wells		
		Rise		Fall		Rise			Fall			Rise	Fall	
		Min	Max	Min	Max	0 to 2	2 to 4	>4	0 to 2	2 to 4	>4			
HAMIRPUR	2 (0.87)	0.72	0.87	-	-	2 100.00%	0	0	0	0	0	0	2	0
KANGRA	24 (4.20)	0.04	4.20	0.03	1.39	13 54.17%	1 4.17%	1 4.17%	9 37.50%	0	0	0	15	9
KULLU	2 0.00	-	-	0.18	0.82	0	0	0	2 100%	0	0	0	0	2
MANDI	6 (0.34)	0.12	0.34	0.14	0.68	2 33.33%	0	0	4 66.67%	0	0	0	2	4
SIRMAUR	13 (0.71)	0.18	0.71	0.21	8.84	6 46.15%	0	0	4 30.77%	0	3 23.08%	0	6	7
SOLAN	5 (0.91)	0.61	0.91	0.09	0.29	2 40.00%	0	0	3 60.00%	0	0	0	2	3
UNA	28 (4.02)	0.01	4.02	0.01	1.59	9 32.14%	0	1 3.57%	18 64.29%	0	0	0	10	18
<b>Total</b>	80	0.72	0.34			34	1	2	40	0	3		37	43

**3.2.3 November 2021 to November 2022**

Annual fluctuation of water level has been worked out by comparing DTWL of November 2021 with November 2022 and data is presented in Annexure –III and its frequency distribution in various rise and fall ranges is given in Table-11.

Out of the 75 stations, 19 stations (25.33%) have shown rise in water level ranging from 0.01m (Mandi District) to 2.25 m (Una District) whereas 56 stations (74.67%) have shown fall ranging from 0.01 m (Kangra District) to 17.07 m (Sirmour District).

Out of 19 stations which have shown rise in water level, 18 stations (94.74%) show rise between the range of 0 to 2 m and remaining 1 station (5.26%) between 2 to 4 m. Similarly, for the 56 stations which have shown fall in water level, 51 stations (91.07%) show fall between the range of 0 to 2m, 2 station (3.57 %) has shown fall between 2 to 4 m and 3 stations (5.36%) shown fall more than 4 m.

A perusal of map of annual fluctuation of November 2021 to November 2022 showing fall in water levels in Nurpur Indora valley and central part of Una valley, Paonta Valley, Balh Valley and Nalagarh Vally. Similarly rise in water level 0-2 m is noticed along the fringe areas of all monitoring valleys except Kullu Valley and Balh Valley (Mandi District).

**Table-11: Annual Fluctuation-November 2021 to November 2022**

District Wise - Fluctuation and Frequency Distribution From Different Ranges from One Period to Other

From Year: 2021/Nov - To Year: 2022/Nov

State : Himachal Pradesh

District Name	No. of Wells	Range of Fluctuation (m)				No. of Wells/Percentage Showing Fluctuation						Total No. of Wells	
		Rise		Fall		Rise			Fall			Rise	Fall
		Min	Max	Min	Max	0 to 2	2 to 4	>4	0 to 2	2 to 4	>4		
HAMIRPUR	1 (0.00)	-	-	0.12	0.12	0	0	0	1 100%	0	0	0	1
KANGRA	21 (0.48)	0.03	0.48	0.01	1.02	7 33.33%	0	0	14 66.67%	0	0	7	14
KULLU	1 (0.00)	-	-	0.36	0.36	0	0	0	1 100%	0	0	0	1
MANDI	4 (0.01)	0.01	0.01	0.02	0.63	1 25.00%	0	0	3 75.00%	0	0	1	3
SIRMAUR	12 (0.30)	0.10	0.30	0.09	17.07	3 25.00%	0	0	7 58.33%	1 8.33%	1 8.33%	3	9
SOLAN	7 (0.50)	0.10	0.50	0.20	1.27	3 42.86%	0	0	4 57.14%	0	0	3	4
UNA	29 (2.25)	0.05	2.25	0.05	13.45	4 13.79%	1 3.45%	0	21 72.41%	1 3.45%	2 6.90%	5	24
<b>Total</b>	75	0.10	0.01			18	1	0	51	2	3	19	56

**3.2.4 January 2022 to January 2023**

Annual fluctuation of water level has been worked out by comparing depth to water level of January 2022 with January 2023 and data is presented in Annexure – III and its frequency distribution in various rise and fall ranges is given in Table-12.

Out of the 104 stations analyzed, 25 stations (24.04%) have shown rise in water level ranging from 0.01 (Solan District) to 3.31 m (Solan District) whereas 77 stations (74.34%) have shown fall ranging from 0.02 (Mandi District) to 29.81 m (Solan District) 2 stations shows no change.

Out of 25 stations which have shown rise in water level, 20 stations (80 %) show rise between the range of 0 to 2m, 5 stations (20%) between 2 to 4 m and no station shows more than 4m. Similarly, for 77 stations which have shown fall in water level, 68 stations (88.32%) show fall between the range of 0 to 2m, 3 stations (3.9 %) between 2 to 4m and 6 stations (7.79) has shown fall >4m.

A perusal of map of annual fluctuation of January 2022 to January 2023 is showing rise and fall in water levels in all of valley areas. The fall in water level 0-2m is shown in few places of Indora valley, and central part of Kangra Palampur valley and a part of Paonta valley. Fall in water level, more than 4m is observed in northern part of Nalagarh valley only. Similarly rise in water level 0-2m is noticed in central & southern part of Indaura and Nurpur valley, northern part of Balh valley, northern part of Una valley and small pockets of Nalagarh valley.



**Table-12: Annual Fluctuation, January 2022 to January 2023**

**District Wise - Fluctuation and Frequency Distribution From Different Ranges from One Period to Other**

From Year: 2022/Jan - To Year: 2023/Jan

State : Himachal Pradesh

District Name	No. of Wells	Range of Fluctuation (m)				No. of Wells/Percentage Showing Fluctuation						Total No. of Wells	
		Rise		Fall		Rise			Fall			Rise	Fall
		Min	Max	Min	Max	0 to 2	2 to 4	>4	0 to 2	2 to 4	>4		
HAMIRPUR	5	-	-	0.63	5.96	0	0	0	3 60.00%	1 20.00%	1 20.00%	0	5
KANGRA	34	0.02	3.11	0.09	10.88	5 14.71%	2 5.88 %	0	24 70.59%	0	2 5.8%	7	26
KULLU	1	-	-	2.61	2.61	0	0	0	0	1 100.00%	0	0	1
MANDI	8	1.01	1.01	0.02	4.44	1 12.50%	0	0	5 62.50%	0	1 12.5%	1	6
SIRMAUR	13	0.10	2.99	0.12	3.81	5 38.46%	2 15.38 %	0	5 38.46%	1 7.69%	0	7	6
SOLAN	11	0.01	3.31	0.24	29.81	4 36.36%	1 9.09 %	0	4 36.36%	0	2 18.18%	5	6
UNA	32	0.09	1.62	0.05	1.34	5 15.62%	0	0	27 84.38%	0	0	5	27
<b>Total</b>	<b>104</b>	<b>1.01</b>	<b>1.01</b>	<b>0.02</b>	<b>29.81</b>	<b>20</b>	<b>5</b>	<b>0</b>	<b>68</b>	<b>3</b>	<b>6</b>	<b>25</b>	<b>77</b>

**3.3 Decadal Fluctuations**

The decadal variations were analyzed considering the decadal average of water level and the water level for the respective period.

**3.3.1 Decadal average of May (2012-2021) to May 2022**

Decadal water level fluctuation has been worked out by comparing water level data of May 2022 with the average mean of 10 years water level data of May (2012-2021) and is presented in Annexure-IV and frequency distribution in various ranges is presented in Table -13.

A perusal of Table-13 shows that out of 83 stations analysed, 36 stations (43.37%) have shown rise and 47 stations (56.63%), have shown fall in water level. 32 stations (88.89%) are showing rise in water level between 0 to 2 m, 2 stations (5.55%) between 2 to 4 m and 2 stations (5.56%), more than 4 m. Out of 47 stations, 40 stations (85.10%) show fall in water level between 0 to 2 m, 5 stations (10.64 %) between 2 to 4 m and 2 stations (4.26%) more than 4 m. A minimum rise in water level of 0.01 m was noticed in Una Districts and the maximum rise of 9.34 m is noticed in Sirmaur District. Similarly, the minimum fall of 0.00 m is noticed in Kangra District & maximum fall of 6.05 m is noticed in Kangra District.

A perusal of map of Decadal Variation - Average of May (2012 - 2021) with May 2022 reveals fall less than 2 m, in all the valleys of Kullu District, and part of Bahl valley under Mandi District. Central part of Una valley is also showing fall Una District except at some places in Indaura valley, Balh valley & Kangra-Palampur valley and Nurpur valley, which is showing rise. A fall is 2- 4 m and >4 m is shwon in Nurpur valley, central part of Kullu valley and Nalagarh Valley.

**Table-13: District wise number & % of NHS distribution in different Decadal Water Level Fluctuation Range for May (2012-2021) to May 2022**

**District Wise - Fluctuation of Water Level with Mean and Selected Period**

10 Years Mean ( 2012 May - 2021 May ) - 2022/May

State : Himachal Pradesh

District Name	No. of Wells	Range of Fluctuation				No. of Wells/Percentage Showing Fluctuation						Total No. of Wells	
		Rise (m)		Fall (m)		Rise (m)			Fall (m)			Rise	Fall
		Min	Max	Min	Max	0 to 2	2 to 4	>4	0 to 2	2 to 4	>4		
HAMIRPUR	3	-	-	0.08	1.76	0	0	0	3	0	0	0	3
KANGRA	25	0.04	1.62	0.00	6.05	6	0	0	16	2	1	6	19
KULLU	2	-	-	0.16	2.38	0	0	0	1	1	0	0	2
MANDI	7	1.43	1.43	0.09	1.39	1	0	0	6	0	0	1	6
SIRMAUR	10	0.05	9.34	0.02	1.03	5	0	1	4	0	0	6	4
SOLAN	7	0.21	7.20	4.70	4.70	4	1	1	0	0	1	6	1
UNA	29	0.01	2.44	0.08	3.66	16	1	0	10	2	0	17	12
<b>Total</b>	<b>83</b>	<b>1.43</b>	<b>1.43</b>	<b>0.00</b>	<b>6.05</b>	<b>32</b>	<b>2</b>	<b>2</b>	<b>40</b>	<b>5</b>	<b>2</b>	<b>36</b>	<b>47</b>

**3.3.2 Decadal Average of August (2012-2021) to August 2022**

Decadal water level fluctuation has been worked out by comparing water level data of August 2022 with the average 10 years water level data of August (2012-2021) and is presented in Annexure -IV and frequency distribution in various ranges is presented in Table-14.

A perusal of Table-14 shows that out of 88 stations analyzed, 26 stations (29.55%) have shown rise and 62 stations (70.45%), have shown fall in water level. 24 stations (92.31%) are showing rise in water level between 0 to 2 m, 2 stations (7.69%) between 2 to 4 m. and no stations (0%), more than 4 m. Out of 62 stations, 56 stations (90.32%) show fall in water level between 0 to 2 m, 4 stations (6.45%) between 2 to 4 m and 2 stations (3.23%) more than 4 m. A minimum rise in water level of 0.02 m was noticed in Una District and the maximum rise of 3.50 m is noticed in Solan District. Similarly, the minimum fall of 0.00 m is noticed in Una District & maximum fall of 8.32 m is also noticed in Una District.

A perusal of map Decadal Average of August (2012 - 2021) to August 2022 shows fall in water level majority areas of all the valley areas, except a few places in all valleys which are showing rise. Fall is shown in Nurpur and Nalagarh valley, central part of Sirmaur District complete Nalagargh valley of Solan District, central part of Una valley of Una District, some part of Balh valley of Mandi District and north central part of Kangra Palampur valley of Kangra District. Fall in water level, >4 m is shown in Una valley and Sirmaur District. Similarly rise in water level is noticed in Balh valley of Mandi District, Southern part of Una valley in Una District part of Kangra valley of Kangra District.

**Table-14: Decadal Fluctuation August (2012-2021) to August 2022**

District Wise - Fluctuation of Water Level with Mean and Selected Period  
10 Years Mean ( 2012 Aug - 2021 Aug ) - 2022/Aug

State : Himachal Pradesh

District Name	No. of Wells	Range of Fluctuation				No. of Wells/Percentage Showing Fluctuation						Total No. of Wells		
		Rise (m)		Fall (m)		Rise (m)			Fall (m)			Rise	Fall	
		Min	Max	Min	Max	0 to 2	2 to 4	>4	0 to 2	2 to 4	>4			
HAMIRPUR	2	0.67	0.70	-	-	2 100%	0	0	0	0	0	0	2	0
KANGRA	26	0.04	1.25	0.04	3.05	11 42.31%	0	0	14 53.85%	1 3.85%	0	0	11	15
KULLU	2	-	-	0.41	1.45	0	0	0	2 100%	0	0	0	0	2
MANDI	6	0.12	0.37	0.10	0.55	2 33.33%	0	0	4 66.67%	0	0	0	2	4
SIRMAUR	13	0.14	2.05	0.27	4.67	1 7.69%	1 7.69%	0	10 76.92%	0	1 7.69%	0	2	11
SOLAN	9	0.06	3.50	0.33	1.71	2 22.22%	1 11.11%	0	6 66.67%	0	0	0	3	6
UNA	30	0.02	1.67	0.00	8.32	6 20.00%	0	0	20 66.67%	3 10.00%	1 3.33%	0	6	24
<b>Total</b>	<b>88</b>	<b>0.37</b>	<b>0.67</b>	<b>0.00</b>	<b>8.32</b>	<b>24</b>	<b>2</b>	<b>0</b>	<b>56</b>	<b>4</b>	<b>2</b>	<b>0</b>	<b>26</b>	<b>62</b>

### 3.3.3 Decadal average of November (2012-2021) to November 2022

Decadal water level fluctuation has been worked out by comparing water level data of November 2022 with the average water level data of November for 10 years (2012-2021) and is presented in Annexure - IV and frequency distribution in various ranges in Table 15.

A perusal of Table-15 shows that out of 84 stations analyzed, 27 stations (32.14%) have shown rise and 57 stations (67.86%), have shown fall in water level. 23 stations (85.19%) are showing rise in water level between 0 to 2m, 4 stations (14.81 %) between 2 to 4m. and no stations (0%), more than 4 m.

Out of 57 stations, 52 stations (91.23%) show fall in water level between 0 to 2 m, 3 station (5.26%) between 2 to 4 m and 2 station (3.51 %) more than 4 m.

A minimum rise in water level of 0.07 m was noticed in Kangra District and the maximum rise of 3.64 m is noticed in Solan District. Similarly, the minimum fall of 0.01 m is noticed in Una District & maximum fall of 18.29 m is noticed in Sirmour District.

A perusal of map of Decadal average of November (2012-2021) to November 2022 reveals rise in water level less than 2 m is shown in whole part of Kangra- Palampur valley & Indaura valley of Kangra District except a few places, major part of Nalagarh valley, Balh valley, a couple of places in Paonta valley. The fall between 2 to 4 m was noticed in, Una valley and Paonta valley. Similarly, rise is noticed in all the valleys from 0-2 m except Kullu Valley.

**Table-15: Decadal Fluctuation November (2012-2021) to November 2022**

4.1

District Wise - Fluctuation of Water Level with Mean and Selected Period

10 Years Mean ( 2012 Nov - 2021 Nov ) - 2022/Nov

State : Himachal Pradesh

District Name	No. of Wells	Range of Fluctuation				No. of Wells/Percentage Showing Fluctuation						Total No. of Wells		
		Rise (m)		Fall (m)		Rise (m)			Fall (m)			Rise	Fall	
		Min	Max	Min	Max	0 to 2	2 to 4	>4	0 to 2	2 to 4	>4			
HAMIRPUR	1	0.17	0.17	-	-	1 100 %	0	0	0	0	0	0	1	0
KANGRA	22	0.07	0.88	0.05	1.26	9 40.91 %	0	0	13 59.09%	0	0	0	9	13
KULLU	1	-	-	0.78	0.78	0	0	0	1 100%	0	0	0	0	1
MANDI	6	0.18	2.01	0.28	0.89	2 33.33 %	1 16.67%	0	3 50.00%	0	0	0	3	3
SIRMAUR	13	0.37	0.77	0.05	18.29	3 23.08 %	0	0	8 61.54%	1 7.69 %	1 7.69%	0	3	10
SOLAN	10	0.15	3.64	0.22	0.57	3 30.00 %	1 10.00%	0	6 60.00 %	0	0	0	4	6
UNA	31	0.10	2.30	0.01	8.05	5 16.13 %	2 6.45 %	0	21 67.74%	2 6.45 %	1 3.23 %	0	7	24
<b>Total</b>	<b>84</b>	<b>0.17</b>	<b>0.37</b>	<b>0.00</b>	<b>18.29</b>	<b>23</b>	<b>4</b>	<b>0</b>	<b>52</b>	<b>3</b>	<b>2</b>	<b>0</b>	<b>27</b>	<b>57</b>

### 3.3.4 Decadal average of January (2013-2022) to January 2023

Decadal water level fluctuation has been worked out by comparing water level data of January 2023 with the average water level data of January for 10 years (2013-2022) and is presented in Annexure - IV and frequency distribution in various ranges is presented in Table -16.

A perusal of Table-16 shows that out of 104 stations analysed, 34 stations (24.29 %) have shown rise and 70 stations (63.31%), have shown fall in water level. Out of 34 stations, 30 stations (88.24%) are showing rise in water level between 0 to 2 m, 3 stations (8.82%) between 2 to 4 m. and 1 stations (2.94%), more than 4 m. Out of 70 stations, 61 stations (86.94%) show fall in water level between 0 to 2 m, 3 stations (4.29%) between 2 to 4 m and 6 stations (8.57%) more than 4 m.

A minimum rise in water level of 0.03 m was noticed in Kangra District and the maximum rise of 10.45 m is noticed in Sirmaur District. Similarly, the minimum fall of 0.02 m is noticed in Una District & maximum fall of 11.02 m is noticed in Sirmaur District.

**Table-16: Decadal Fluctuation January (2013-2022) to January 2023**

2.1

<u>District Wise - Fluctuation of Water Level with Mean and Selected Period</u>													
10 Years Mean ( 2013 Jan - 2022 Jan ) - 2023/Jan													
State : Himachal Pradesh													
District Name	No. of Wells	Range of Fluctuation				No. of Wells/Percentage Showing Fluctuation						Total No. of Wells	
		Rise (m)		Fall (m)		Rise (m)			Fall (m)			Rise	Fall
		Min	Max	Min	Max	0 to 2	2 to 4	>4	0 to 2	2 to 4	>4		
HAMIRPUR	5	0.25	0.25	0.44	2.79	1 20.00 %	0	0	3 60.00%	1 20.00 %	0	1	4
KANGRA	34	0.03	3.25	0.08	9.14	9 26.47 %	2 5.88%	0	21 61.76%	0	2 5.88%	11	23
KULLU	1	-	-	3.41	3.41	0	0	0	0	1 100.0 %	0	0	1
MANDI	8	0.12	1.70	0.49	5.35	4 50.00 %	0	0	3 37.50%	0	1 12.50%	4	4
SIRMAUR	13	0.03	10.45	0.03	11.02	6 46.15 %	0	1 7.69%	4 30.77%	1 7.69 %	1 7.69%	7	6
SOLAN	11	0.66	3.94	0.14	7.73	2 18.18 %	1 9.09%	0	7 63.64%	0	1 9.09%	3	8
UNA	32	0.03	1.45	0.02	5.13	8 25.00 %	0	0	23 71.88%	0	1 3.13%	8	24
<b>Total</b>	104	0.25	0.66	0.02	11.02	30	3	1	61	3	6	34	70

A perusal of map of Decadal average of January (2013-2022) to January 2023 reveals rise in water level less than 2m. to 4m shown in central part of Kangra - Palampur valley & at small areas of Indaura valley of Kangra District, Balh valley, complete Una valley, Paonta valley and major part of Nalagarh valley. The fall between 2 to 4 m and >4 m was noticed in few places of Kangra Palampur valley and Nalagarh valley. Similarly, rise is noticed in all the valleys from 0-2 m and 2- 4m except in major part of Nalagarh valley and Kangra Palampur valley.

#### 4.0 Chemical Quality May 2022 Hydro-chemical studies

For the evaluation of Hydro-Chemical status and distribution of various chemical constituents in Ground water of Himachal Pradesh, 160 water samples were collected from monitoring station during pre-monsoon, 2022. (Annexure V)

The quality of water depends on its physical and chemical properties. Physical properties include colour, odour & turbidity which can be determined by our senses. The chemical properties depend on the nature & quantity of various chemical constituents individually or jointly. The possible sources, effect on human health & distribution of some major chemical constituents are described in following chapter. All chemical parameters fall within permissible limit except Nitrate in few locations.

##### (1) *Electrical Conductance (EC)*

Electrical Conductance is the ability of a substance to conduct an electric current. Chemically pure water in liquid form has a very low conductance. The presence of dissociated ions in solution renders the solution conductive. EC of a solution, therefore, gives an idea about the quantity of ions or dissolved solids present in it. EC value in the state ranges from 127 to 1751  $\mu\text{s}/\text{cm}$ . No sample was found to have EC beyond permissible limit ( $>3000 \mu\text{s}/\text{cm}$ ).

##### (2) *Chloride (Cl)*

It is one of the most common constituents presents in natural water and remains soluble in water unaffected by biological processes therefore reducible by dilution. Natural mineral origin can also be a cause of high chloride content. Industrial effluents (galvanizing plants, water softening plants, oil wells, refineries and paper works) may also leach into ground water.

Sewage effluents contain a larger concentration of Chlorides. The tolerance limits of chloride vary with climate and excretion. Cation associated with chloride usually has harmful effects on human body. Individual affected by heart and kidney disease should restrict water consumption with a high chloride concentration. Chloride value ranges from 7.1 mg/l to 187.9mg/l in the state. All the values of Chloride fall within the maximum permissible limit ie  $>1000 \text{ mg/l}$  (as per BIS)

##### (3) *Nitrate ( $\text{NO}_3$ )*

Sources of Nitrate are mineral deposits (sodium and potassium nitrates), soils, sea water and atmosphere. Nitrate is used as a fertilizer, as a food preservative and as an oxidizing agent in the chemical industries. Higher concentrations are expected where fertilizers are used, in decayed animals and vegetable matter, in leachates from sludge and refuse disposal and in industrial discharges. Higher concentration of nitrate causes methemoglobinemia disease in bottle fed infants (3 months old). High nitrate concentrations have been observed in ground water at several places and ranges between 1.2 to

143 mg/l. Around 89.86 % of samples have nitrate values within acceptable limit & remaining 10.14 % samples have nitrate value beyond permissible limit.

#### **(4) Fluoride (F)**

Fluoride is an inherent component of igneous rocks. The main sources of fluoride in natural water are Fluorite ( $\text{CaF}_2$ ), Cryolite ( $\text{Na}_2\text{AlF}_6$ ), Fluorapatite. In minerals like mica, amphiboles and topaz etc, the fluoride ions are bound on the mineral surfaces. Food in the diet is the major source of fluoride. Tea contains high fluoride concentration. Fluoride reduces dental caries, Very high concentration may cause crippling skeletal fluorosis in human body. Fluoride value ranges from 0 to

1.7 mg/l. Fluoride (F) values higher than the BIS permissible limit ( $>1.5$  mg/l) for drinking water, have been observed in Sirmour District. Only 2 samples out of 138 have F value more than permissible limit hence only 1.45% ground water samples contain fluoride beyond permissible limits.

#### **(5) Uranium (U)**

Both surface and ground water play an important role in migration of radio nuclides in earth's crust with their concentration. In water depending on the physical and chemical characteristics of aquifer and geological formations involved. The migration and/or mixing of contaminant chemicals in the groundwater are put into motion by certain drivers. These drivers can be anthropogenic factors, such as drainage, irrigation, groundwater pumping, waste or wastewater disposal from industry. Natural uranium can also be released into the environment from various anthropogenic or man-made activities such as the use of phosphate fertilizers, pesticides, combustion of coal in thermal power plants, and mining, depleted uranium from the wars. As per BIS standards uranium content up to  $30 \mu\text{g/l}$  in drinking water is acceptable, while AERB has set the limit at  $60 \mu\text{g/l}$  for drinking water. Uranium concentration in ground water ranges from 0 ppb to 8.7 ppb.

**Annexure-I Depth to water level of May 2022, August 2022, Nov 2022 & Jan 2023 (in m bgl)**

DISTRICT	LOCATION	LATITUDE	LONGITUDE	MAY-22	AUG-22	NOV-22	Jan-23
<b>UNA</b>	JAWAR	31.7433333	76.195	3.07	1.07	1.11	1.08
	AMB	31.6852778	76.1213889	6.23	5.68	3.85	4.37
	KATHOR-KALAN	31.6572222	76.1177778	7.59	5.03	5.48	6.2
	MUBARIKPUR	31.7083333	76.0841667	4.71	4.62	3.81	4.37
	BHADRAKALI	31.7797222	76.0388889	5.96	5.26	5.65	5.73
	DAULATAPUR	31.7788889	75.9972222	6.69	5.34	5.00	5.5
	BABEHR	31.7897222	75.9916667	3.28	1.58	1.96	2.45
	RAIPUR MARWADI	31.8002778	75.9836111	14.43	13.93	12.92	14.01
	MAWA KALAN	31.7547222	76.0083333	18.23	16.61	17.00	18.07
	GHANERI	31.7263889	76.0222222	8.98	5.92	7.35	8.56
	SINGHNEI	31.6913889	76.035	20.46	20.46	20.40	20.71
	AMBOTA	31.6705556	76.0480556	29.30	29.29	29.10	29.58
	GAGRET	31.6605556	76.0619444	8.11	8.44	7.85	8.24
	KUTHERA JASWALAN	31.6058333	76.1180556	6.53	6.02	6.42	6.65
	LOHARLI	31.5927778	76.1263889	5.24	4.13	4.70	5.19
	GUGHLEHAR	31.5666667	76.1433333	3.61	3.18	0.75	4.02
	PANJAWAR	31.5472222	76.1427778	12.18	12.44	12.70	12.82
	ISHPUR	31.5055556	76.1788889	2.51	2.29	2.50	2.84
	BADSALI	31.4777778	76.1788889	14.46	13.91	14.53	14.43
	JHALERA	31.4905556	76.2383333	4.51	4.52	4.45	4.81
	KHAWAJA	31.5036111	76.2272222	2.52	1.68	2.06	2.39
	PANOH	31.535	76.2008333	3.39	2.23	2.65	3.16
	JANKAUR	31.4305556	76.2747222	5.37	4.94	4.70	5.11
	NANGRAN	31.3980556	76.2919444	5.12	5.21	5.30	5.58
	KHANPUR	31.3780556	76.3069444	5.33	5.05	7.66	5.09
	SANTOSHGARH	31.3577778	76.3013889	5.32	5.39	4.97	5.28
	TAHLIWAL	31.3513889	76.2758333	2.21	1.28	1.52	1.76
	LALHERI	31.3733333	76.2633333	12.10	11.47	12.20	12.44
	DHARAMPUR	31.4452778	76.2283333	3.48	2.19	3.42	2.88
	UNA	31.4694444	76.2708333	2.79	1.82	2.25	2.58
BAWAL	31.5480556	76.3066667	1.10	1.03	1.20	0	
BANGANA	31.625	76.3408333	2.10	0.88	1.00	1.33	
RAJLI PANJAL	31.5363889	76.405	4.51	0.59	1.73	2.89	
<b>SOLAN</b>	BAGHERI	31.1941667	76.6419444	17.61	15.08	13.35	16.08
	BHATOLI	31.1652778	76.6083333	12.17	12.69	11.75	12.59
	BARUNA	31.1541667	76.6052778	29.79	29.58	29.30	29.81
	PALAH I	31.1275	76.6119444	5.88	5.10	5.76	5.73



	PANJIARA	31.135	76.6563889	21.32	21.20	19.82	20.94
	JAGATPUR	31.1594444	76.6786111	16.04	14.01	13.90	15.43
	MAHADEVA	31.1083333	76.6786111	12.77	11.18	11.12	12.43
	DABOTA	31.0877778	76.6305556	12.61	12.46	12.38	12.59
	NALAGARH	31.0441667	76.7119444	5.57	3.87	4.85	5.06
	KHERCHAK	31.0138889	76.6786111	Dry	5.14	5.40	6.31
	THEDA	31.9997222	76.76	3.35	3.44	3.48	3.89
	KISHANPURA	30.9713889	76.7580556	11.97	10.00	9.85	10.74
	BADDI	30.9241667	76.7944444	Dry	5.10	8.61	5.98
	BAROTIWALA	30.9055556	76.84	20.58	19.39	19.10	19.44
<b>SIRMOUR</b>	AKKAWALA	30.5202778	77.2866667	11.33	10.76	11.12	11.29
	SHIBPUR	30.4758333	77.6697222	27.65	24.49	26.75	27.61
	KHODEWALA	30.4872222	77.705	14.37	11.06	13.60	14.28
	BADRIPUR	30.4758333	77.6697222	8.40	9.97	11.10	12.39
	AJJIWALA	30.4702778	77.5866667	6.22	3.80	4.93	5.7
	KIAYARDA	30.4730556	77.5488889	10.25	3.78	5.16	8.94
	NAYAGAON	30.4861111	77.5227778	12.92	6.31	9.85	11.9
	SAINWALA-1	30.4919444	77.5111111	4.47	1.36	3.57	3.8
	MESERWALA	30.4791667	77.5444444	7.92	3.57	4.40	6.08
	DHAULA-KUAN	30.5016667	77.4730556	7.05	3.29	3.85	5.34
	KODEWALA	30.4766667	77.4061111	2.46	2.23	2.32	2.24
	KOLAR	30.4977778	77.4408333	12.00	3.02	10.40	12.34
	BOLION	30.51	77.3747222	4.73	2.73	2.85	3.89
	SHAMBUWALA	30.5236111	77.3208333	11.65	8.55	10.23	8.7
	SAINWALA-2	30.5386111	77.2522222	2.49	1.66	1.98	2.02
	KALA-AMB	30.4977778	77.2119444	Dry	13.06	13.60	14.01
	KHERI	30.5261111	77.1916667	2.51	2.07	2.35	2.16
	TRILOKPUR	30.54	77.2033333	2.18	1.53	1.70	1.56
	NARIWALA	30.4911111	77.6436111		36.92	36.25	38.21
<b>KANGRA</b>	OLD MATOUR	32.1372222	76.2883333	DRY	5.28	10.58	0
	RAIT	32.1855556	76.2122222	9.95	3.23	7.60	9.2
	39 Miles (Shahpur)	32.2191667	76.1761111	8.61	2.85	6.99	8.4
	CHAKBAN AMBADI	32.1069444	76.4111111	4.66	3.00	4.35	4.53
	MANJ GRAM	32.2277778	76.1619444	1.37	0.96	0.99	1.5
	BHALI	32.2230556	76.1075	2.91	1.15	1.37	1.73
	KOTLA	32.2361111	76.0483333	2.63	-0.08	0.72	2.3
	MAO	32.2602778	76.0105556	2.80	0.42	1.03	1.15
	BHALAD	31.1916667	75.9955556	4.05	0.35	1.01	1.69
	DARKATI	32.1622222	75.9911111	2.28	0.72	1.60	1.89
	BHARMAR	32.1625	75.9636111	13.67	8.43	10.20	11.93
	RAJA KA TALAB	32.2097222	75.9216667	4.84	2.70	4.01	4.42

	THALI	32.2538889	75.8863889	1.86	2.36	2.50	2.56
	BASA-BAZIRA	32.2694444	75.8697222	9.74	8.27	8.86	9.15
	BOD	32.2869444	75.8697222	5.10	2.05	3.42	3.03
	BHATKA	32.3155556	75.8877778	1.15	0.83	0.93	1.09
	PARNALLA	32.3572222	75.8613889	3.34	2.20	2.50	2.76
	NAURA	31.9988889	76.4883333	2.06	0.84	1.29	1.57
	LAKHNAUT	32.3855556	75.9097222	3.13	0.83	1.05	2.1
	SADWAN	32.3488889	75.9075	2.13	0.87	1.63	1.47
	KUTH KHANA	32.1830556	75.9147222	12.02	9.78	9.72	10.88
	BAROT	32.1283333	75.9313889	3.48	2.00	2.99	2.68
	JAGIR	31.9730556	75.9027778	3.18	2.53	2.84	2.91
	RIYALI	32.0188889	75.8133333	4.67	3.07	4.06	4.28
	BAROTA	32.0388889	75.7194444	DRY	5.05	5.95	6.73
	OLLEHRIYAN	32.0747222	75.6375	3.74		2.74	2.79
	KATHGARH	32.1172222	75.6347222	4.32	3.12	3.89	0
	INDORA	32.1369444	75.6894444	3.63	2.02	2.88	3.07
	CHANNOUR	32.1444444	75.6869444	3.20	2.20	2.43	2.38
	CHANGARA	32.1713889	75.6952778	2.83	1.19	1.63	2.25
	MOHTLI	32.2127778	75.6783333	4.85	3.55	3.98	14.35
	PANJPIR	32.28	75.7922222	4.83	2.25	4.19	4.27
	JASSUR	32.2802778	75.8411111	4.18	1.76	3.18	4.52
	GUJREDA SARAH	32.1638889	76.2755556	3.81			0
	PAPROLA	32.0536111	76.6338889	15.93	4.41	10.05	12.91
	KUTHED	32.1966667	76.0625	2.58	0.97	1.51	1.88
	BASANTPUR	32.1447222	76.0216667	6.30	5.30	7.30	7.49
	KANGRA	32.1066667	76.2752778	DRY		8.81	0
	OLD KANGRA	32.0933333	76.2647222	11.89	1.26	3.61	3.8
	TAKIPUR	32.0502778	76.2538889	5.42	0.93	3.06	4.13
	BANDH	32.0041667	76.23	2.99	-0.56	1.23	1.78
	HARIPUR	32.0036111	76.1608333	3.90	5.04	3.49	3.46
	DEHRA GOPIPUR	31.8822222	76.2152778	5.74	4.62	4.37	4.44
	JAWALA JI	31.8775	76.3163889	2.43	0.88	1.77	1.96
	DEHRIAN	31.9247222	76.2727778	1.88	1.06	1.45	1.56
	BHAROLI	31.7919444	76.3338889	11.23	6.95	6.31	4.58
	HARDOGRI	31.7836111	76.2952778	4.51	2.91	3.16	3.75
	RAKKAR (CHOULI}	31.7872222	76.2580556	3.97	2.10	3.23	3.7
	PANDTEHR	32.0372222	76.6461111	0.51	0.45	0.54	0.73
<b>HAMIRPUR</b>	BHAGNALLAH	31.7752778	76.3427778	5.68	5.07	5.85	5.92
	KANGOO	31.6863889	76.4244444	10.53	5.32	7.76	5.96
	GALORE	31.6147222	76.4747222	2.79	1.75	2.32	5.3
	BIJARI	31.5227778	76.5394444	2.95	1.44	2.02	2.37

	BARSAR MAIRE	31.5280556	76.4647222	17.06	16.23	16.02	16.41
	BHALAT	31.4969444	76.4794444	3.55	1.28	1.70	2.31
<b>BILASPUR</b>	SHAHTALAI	31.4555556	76.5158333	7.91	4.05	4.05	6.61
	JHABOLA	31.4244444	76.5463889	5.62	2.82	2.82	4.75
	LOHARWIN	31.4252778	76.7158333	6.89	1.58	1.58	5.26
	NASWAL	31.4691667	76.6861111	2.70	0.64	0.64	1.65
<b>CHAMBA</b>	UPPER THULEL	32.2333333	76.1441667	6.67	1.55	2.12	0.57
	TARA GARH	32.4130556	75.9486111	4.33		3.13	3.13
	CHIKADIYANI	32.5985	76.0940556	0.29(agl)	0.29(agl)	0.29(agl)	0.29(agl)
<b>MANDI</b>	BANGROTU	31.6108333	76.9197222	4.72	2.80	3.09	3.2
	RATTI	31.5997222	76.9019444	4.96	3.60	4.43	4.82
	JARL	31.5513889	76.8961111	0.57	0.45		0.29
	DINAK	31.5647222	76.9238889	5.53	3.21	5.31	4.92
	KANED	31.5788889	76.9136111	1.72	1.10	1.91	1.85
	LOHARA	31.5886111	76.9452778	3.55	2.75	3.23	3.27
	GAAGAL	31.6302778	76.9613889	1.91	1.46	2.70	1.49
	GUTKAR	31.6572222	76.9441667	DRY	DRY	4.56	0
	NAGWAIN	31.8191667	77.1802778	2.95	1.23	2.09	1.54
	JHIRI	31.8347222	77.1713889	5.19	3.66	4.44	4.7
<b>KULLU</b>	KULLU	31.9647222	77.1152778	0.72	1.25		0
	GADURI	31.9033333	77.1313889	8.39	7.42	6.82	7.33

## Monsoon Fluctuation of May wrt November 2022

S.N.	DISTRICT	LOCATION	Pre-Monsoon Water Level (m bgl)	Post-Monsoon Water Level (m bgl)	Fluctuation (m)
1	UNA	JAWAR	3.07	1.11	1.96
2		AMB	6.23	3.85	2.38
3		KATHOR-KALAN	7.59	5.48	2.11
4		MUBARIKPUR	4.71	3.81	0.90
5		BHADRAKALI	5.96	5.65	0.31
6		DAULATAPUR	6.69	5.00	1.69
7		BABEHR	3.28	1.96	1.32
8		RAIPUR MARWADI	14.43	12.92	1.51
9		MAWA KALAN	18.23	17.00	1.23
10		GHANERI	8.98	7.35	1.63
11		SINGHNEI	20.46	20.40	0.06
12		AMBOTA	29.30	29.10	0.20
13		GAGRET	8.11	7.85	0.26
14		KUTHERA JASWALAN	6.53	6.42	0.11
15		LOHARLI	5.24	4.70	0.54
16		GUGHLEHAR	3.61	0.75	2.86
17		PANJAWAR	12.18	12.70	-0.52
18		ISHPUR	2.51	2.50	0.01
19		BADSALI	14.46	14.53	-0.07
20		JHALERA	4.51	4.45	0.06
21		KHAWAJA	2.52	2.06	0.46
22		PANOH	3.39	2.65	0.74
23		JANKAUR	5.37	4.70	0.67
24		NANGRAN	5.12	5.30	-0.18
25		KHANPUR	5.33	7.66	-2.33
26		SANTOKHGARH	5.32	4.97	0.35
27		TAHLIWAL	2.21	1.52	0.69
28		LALHERI	12.10	12.20	-0.10
29		DHARAMPUR	3.48	3.42	0.06
30		UNA	2.79	2.25	0.54
31		BAWAL	1.10	1.20	-0.10
32		BANGANA	2.10	1.00	1.10
33		RAJLI PANJAL	4.51	1.73	2.78
34	SOLAN	BAGHERI	17.61	13.35	4.26

35		BHATOLI	12.17	11.75	0.42
36		BARUNA	29.79	29.30	0.49
37		PALAH	5.88	5.76	0.12
38		PANJIARA	21.32	19.82	1.50
39		JAGATPUR	16.04	13.90	2.14
40		MAHADEVA	12.77	11.12	1.65
41		DABOTA	12.61	12.38	0.23
42		NALAGARH	5.57	4.85	0.72
43		KHERCHAK	Dry	5.40	-
44		THEDA	3.35	3.48	-0.13
45		KISHANPURA	11.97	9.85	2.12
46		BADDI	Dry	8.61	-
47		BAROTIWALA	20.58	19.10	1.48
48	<b>SIRMOUR</b>	AKKAWALA	11.33	11.12	0.21
49		SHIBPUR	27.65	26.75	0.90
50		KHODEWALA	14.37	13.60	0.77
51		BADRIPUR	8.40	11.10	-2.70
52		AJJIWALA	6.22	4.93	1.29
53		KIAYARDA	10.25	5.16	5.09
54		NAYAGAON	12.92	9.85	3.07
55		SAINWALA-1	4.47	3.57	0.90
56		MESERWALA	7.92	4.40	3.52
57		DHAULA-KUAN	7.05	3.85	3.20
58		KODEWALA	2.46	2.32	0.14
59		KOLAR	12.00	10.40	1.60
60		BOLION	4.73	2.85	1.88
61		SHAMBUWALA	11.65	10.23	1.42
62		SAINWALA-2	2.49	1.98	0.51
63		KALA-AMB	Dry	13.60	-
64		KHERI	2.51	2.35	0.16
65		TRILOKPUR	2.18	1.70	0.48
66		NARIWALA		36.25	-
67	<b>KANGRA</b>	OLD MATOUR	DRY	10.58	-
68		RAIT	9.95	7.60	2.35
69		39 Miles (Shahpur)	8.61	6.99	1.62
70		CHAKBAN AMBADI	4.66	4.35	0.31
71		MANJ GRAM	1.37	0.99	0.38
72		BHALI	2.91	1.37	1.54
73		KOTLA	2.63	0.72	1.91
74		MAO	2.80	1.03	1.77
75		BHALAD	4.05	1.01	3.04
76		DARKATI	2.28	1.60	0.68
77		BHARMAR	13.67	10.20	3.47

78		RAJA KA TALAB	4.84	4.01	0.83
79		THALI	1.86	2.50	-0.64
80		BASA-BAZIRA	9.74	8.86	0.88
81		BOD	5.10	3.42	1.68
82		BHATKA	1.15	0.93	0.22
83		PARNALLA	3.34	2.50	0.84
84		NAURA	2.06	1.29	0.77
85		LAKHNAUT	3.13	1.05	2.08
86		SADWAN	2.13	1.63	0.50
87		KUTH KHANA	12.02	9.72	2.30
88		BAROT	3.48	2.99	0.49
89		JAGIR	3.18	2.84	0.34
90		RIYALI	4.67	4.06	0.61
91		BAROTA	DRY	5.95	-
92		OLLEHRIYAN	3.74	2.74	1.00
93		KATHGARH	4.32	3.89	0.43
94		INDORA	3.63	2.88	0.75
95		CHANNOUR	3.20	2.43	0.77
96		CHANGARA	2.83	1.63	1.20
97		MOHTLI	4.85	3.98	0.87
98		PANJPIR	4.83	4.19	0.64
99		JASSUR	4.18	3.18	1.00
100		GUJREDA SARAH	3.81		-
101		PAPROLA	15.93	10.05	5.88
102		KUTHED	2.58	1.51	1.07
103		BASANTPUR	6.30	7.30	-1.00
104		KANGRA	DRY	8.81	-
105		OLD KANGRA	11.89	3.61	8.28
106		TAKIPUR	5.42	3.06	2.36
107		BANDH	2.99	1.23	1.76
108		HARIPUR	3.90	3.49	0.41
109		DEHRA GOPIPUR	5.74	4.37	1.37
110		JAWALA JI	2.43	1.77	0.66
111		DEHRIAN	1.88	1.45	0.43
112		BHAROLI	11.23	6.31	4.92
113		HARDOGRI	4.51	3.16	1.35
114		RAKKAR (CHOULI}	3.97	3.23	0.74
115		PANDTEHR	0.51	0.54	-0.03
116	<b>HAMIRPUR</b>	BHAGNALLAH	5.68	5.85	-0.17
117		KANGOO	10.53	7.76	2.77
118		GALORE	2.79	2.32	0.47
119		BIJARI	2.95	2.02	0.93
120		BARSAR MAIRE	17.06	16.02	1.04

121		BHALAT	3.55	1.70	1.85
122	<b>BILASPUR</b>	SHAHTALAI	7.91	4.05	3.86
123		JHABOLA	5.62	2.82	2.80
124		LOHARWIN	6.89	1.58	5.31
125		NASWAL	2.70	0.64	2.06
126	<b>CHAMBA</b>	UPPER THULEL	6.67	2.12	4.55
127		TARA GARH	4.33	3.13	1.20
128		CHIKADIYANI	0.29(agl)	0.29(agl)	0.00
129	<b>MANDI</b>	BANGROTU	4.72	3.09	1.63
130		RATTI	4.96	4.43	0.53
131		JARL	0.57		-
132		DINAK	5.53	5.31	0.22
133		KANED	1.72	1.91	-0.19
134		LOHARA	3.55	3.23	0.32
135		GAAGAL	1.91	2.70	-0.79
136		GUTKAR	DRY	4.56	-
137		NAGWAIN	2.95	2.09	0.86
138		JHIRI	5.19	4.44	0.75
139	<b>KULLU</b>	KULLU	0.72		0.72
140		GADURI	8.39	6.82	1.57

**Annexure-III**

**Annual Fluctuation of May 2021- May 2022, August 2021- August 2022, November 2021- November 2022 and January 2021- January 2022**

S.N.	DISTRICT	LOCATION	May-21- May 22	Aug 21- Aug-22	Nov 21- Nov-22	Jan 22- Jan-23
1	<b>UNA</b>	JAWAR	6.31	0.11	0.2	0.09
2		AMB	0.25	-0.22	-0.32	0.09
3		KATHOR-KALAN	1.52	1.47	0.3	0.43
4		MUBARIKPUR	0.05	-0.71	-0.15	-0.38
5		BHADRAKALI	-0.1	0.17	-0.4	-0.53
6		DAULATAPUR	0.61	0.71	0.17	0.15
7		BABEHR	0.26	0.02	-0.34	-0.96
8		RAIPUR MARWADI	0.11	-0.01	-0.87	-0.84
9		MAWA KALAN	-0.79	-0.91	-1	-1.07
10		GHANERI	-0.13	-0.19	-0.4	-0.19
11		SINGHNEI	-0.06	-0.33	-0.73	-0.84
12		AMBOTA	-0.81	-0.52	-6.8	-1
13		GAGRET	-0.41	-1.59	-1.05	-0.69
14		KUTHERA JASWALAN	-0.14	-0.5	-0.7	-0.41
15		LOHARLI	-0.05	0.07	-1	-0.86
16		GUGHLEHAR	0.55	0.12	2.25	-0.7
17		PANJAWAR	0.07	-0.01	-0.32	-0.44
18		ISHPUR	0.59	0.01	-0.6	-0.88
19		BADSALI	-0.4	0.34	-0.38	-0.32
20		JHALERA	0.19	-0.05	-0.5	-0.5
21		KHAWAJA	0.58	-0.13	-0.86	-1.01
22		PANOH	0.02	-0.61	-1.18	-1.34
23		JANKAUR	0.21	-0.42	-0.59	-0.56
24		NANGRAN	0.67	-0.14	-0.2	-0.2
25		KHANPUR	-0.28	-0.44	-3.27	-0.5
26		SANTOKHGARH	0.18	-0.82	-0.3	-0.46
27		TAHLIWAL	-0.06	-0.69	-0.33	-0.35
28		LALHERI	0.8	-0.57	-1	-0.58
29		DHARAMPUR	-0.26	-0.19	-1.36	-0.75
30		UNA	0.19	0.32	-0.41	-0.49
31		BAWAL	0.19	0.17	-0.05	0
32		BANGANA	0.91	0.12	0.3	-0.05
33		RAJLI PANJAL	4.13	4.02	0.05	1.62
34	<b>SOLAN</b>	BAGHERI	1.36	1.92	-0.35	0.4



35		BHATOLI				-0.69
36		BARUNA				0
37		PALAH	-0.11	-0.29	-0.6	-0.67
38		PANJIARA	0.7		0.1	3.31
39		JAGATPUR	2.74	-0.11	-1.27	-1.43
40		MAHADEVA	0.87	0.91	-0.2	-0.24
41		DABOTA	0.01	0.44	0.2	0.09
42		NALAGARH	0.22	0.93	0.07	0.16
43		KHERCHAK				0
44		THEDA	1.08	1.14	-0.38	0.03
45		KISHANPURA	-0.21		0.5	-5.49
46		BADDI		-0.09	-2.94	0.01
47		BAROTIWALA	4.3	0.61	0.5	1.04
48	<b>SIRMOUR</b>	AKKAWALA	0.08	0.36	0.1	-0.12
49		SHIBPUR	-0.44	-6.89	-17.07	-0.34
50		KHODEWALA	-0.04	-1.46	-0.45	0.09
51		BADRIPUR		-1.1	-1.44	-0.69
52		AJJIWALA	0.37	-0.37	-0.28	2.89
53		KIAYARDA	0.23	-0.72	0.16	0.02
54		NAYAGAON	2.55	0.29	-0.1	0.57
55		SAINWALA-1	0.32	0.11	-0.4	-0.28
56		MESERWALA	0.75	-1.12	-0.79	0.02
57		DHAULA-KUAN	3.2	0.71	0.3	0.4
58		KODEWALA	0.16	-0.01	0.09	0.1
59		KOLAR	0.43	-0.21	-1.63	-0.79
60		BOLION	1.15	0.25	0.23	-0.94
61		SHAMBUWALA	0.05	0.54	-0.09	1.64
62		SAINWALA-2	0.8	0.45	-0.15	-0.26
63		KALA-AMB		0.18		-14.01
64		KHERI	-0.15	0.18	0.13	-0.18
65		TRILOKPUR	-0.03	0.2	-0.25	0.24
66		NARIWALA		-4.57	-3.4	-1.66
67	<b>KANGRA</b>	OLD MATOUR		3.62	-0.396	0
68		RAIT	-0.11	2.63	0.11	-0.09
69		39 Miles (Shahpur)	-0.03	3.35	0.22	-0.42
70		CHAKBAN AMBADI	-0.79	-1.16	-0.07	-0.87
71		MANJ GRAM	0	-0.19	0.04	-0.85
72		BHALI	-1.25	0.59	0.03	-0.34
73		KOTLA	0.25	0.56	0.31	-1.19
74		MAO	1.98	1.85	0.08	-0.21
75		BHALAD	1.31	0.8	-0.24	-1.38
76		DARKATI	3.14	0.73	-0.48	-0.98

77		BHARMAR	1.08	1.65	-1.52	-1.11
78		RAJA KA TALAB	0.4	0.18	-0.4	-0.7
79		THALI	3.2	0.57	0.03	-0.18
80		BASA-BAZIRA	1.26	0.92	-0.32	-0.52
81		BOD	-1.87	0.27	-0.44	-1.52
82		BHATKA	0.32	0.7	0.05	-0.17
83		PARNALLA		-0.35	-0.05	-0.69
84		NAURA	-0.55	-0.14	-0.46	-0.68
85		LAKHNAUT	0.7	0.8	0.68	-0.61
86		SADWAN	1.3	0.54	-0.09	-0.75
87		KUTH KHANA	-0.59	1.64	0.13	-0.51
88		BAROT	-0.12	0.03	0.25	-1.14
89		JAGIR	-0.15	0.22	-0.05	-0.64
90		RIYALI	0.28	-0.31	-0.19	-0.44
91		BAROTA		-0.29	-1.11	-0.9
92		OLLEHRIYAN		4.08	-0.08	-0.21
93		KATHGARH	0.78			v
94		INDORA	0.2	0.83	-0.21	-0.21
95		CHANNOUR	0.06	0.4	-0.1	-0.1
96		CHANGARA	0.5	0.69	0.28	0.28
97		MOHTLI		11.6	0.48	0.48
98		PANJPIR	-0.27	0.4	-0.14	-0.14
99		JASSUR	-0.12	0.56	-0.35	-0.35
100		GUJREDA SARAH	-0.59	2.47	-0.45	-0.45
101		PAPROLA	-2.42	2.3	-1.02	-1.02
102		KUTHED	0.94	0.57	0.03	0.03
103		BASANTPUR	-0.41	0.02	-0.4	-0.4
104		KANGRA				
105		OLD KANGRA	-6.9	1.57	-0.4	-0.4
106		TAKIPUR	1.62	1.15	-0.64	-0.64
107		BANDH	3.6	0.92		
108		HARIPUR	0.89	0.36	0.24	0.24
109		DEHRA GOPIPUR	-0.38	0.09	-0.13	-0.13
110		JAWALA JI	-0.28	0.52	0.72	0.72
111		DEHRIAN	6.53	4.54	0.19	0.19
112		BHAROLI	-1.83	-0.25	-0.12	-0.12
113		HARDOGRI	1.14	2.19	0.48	0.48
114		RAKKAR (CHOULI}	1.33	-0.1	-0.29	-0.29
115		PANDTEHR	0.16	0.5	-0.01	-0.01
116	<b>HAMIRPUR</b>	BHAGNALLAH	0.19	0.07	-0.98	-0.98
117		KANGOO	-0.18			
118		GALORE	-0.28	0.87	0.1	0.1
119		BIJARI	-0.83	0.72	-0.12	-0.12
120		BARSAR MAIRE	0.76	1.61	0.4	0.4

121		BHALAT	-1.8	-0.35	-0.12	-0.12
122	<b>BILASPUR</b>	SHAHTALAI	0.29	3	1.8	1.8
123		JHABOLA	1.49	3.38	1.88	1.88
124		LOHARWIN	0.33	3.82	3.83	3.83
125		NASWAL	-0.13	0.14	0.61	0.61
126	<b>CHAMBA</b>	UPPER THULEL		-0.23	-0.14	-0.14
127		TARA GARH	0.99	3.28	-0.238	-0.238
128		CHIKADIYANI	-0.29	-0.29	-0.29	-0.29
129	<b>MANDI</b>	BANGROTU	-0.92	-0.48	0.04	-0.81
130		RATTI	-0.18	0.04	0.01	-0.36
131		JARL	-0.22	0.19	0.33	0
132		DINAK	0.11	-0.64	-2.23	-0.1
133		KANED	-0.44	-0.34	-0.4	-0.8
134		LOHARA	0	0.57	-0.02	-0.02
135		GAAGAL	0.26	0.17	-0.25	1.01
136		GUTKAR			0.42	0
137		NAGWAIN	-0.37	0.73	0.2	0.8
138		JHIRI	-0.55	0.64	-0.63	-0.82
139	<b>KULLU</b>	KULLU	0.16	-0.62	0.99	0
140		GADURI	-0.3	0.24	-0.36	0.06

## Annexure-IV

Decadal mean Fluctuation January 2012-2021 with Jan 2022) May (2012-2021 with May 2022), August (2012-2021 with Aug 2022) November (2012-2021 with Nov 2022)

sr no	Location	Decadal fl May 2012 2021 wrt May 2022	Decadal fl Aug 2012- 2021 wrt Aug 2022	Decadal fl Nov 2012- 2021 wrt Nov 2022	Decadal fl Jan 2013- 2022 wrt Jan 2023
<b>District</b>	<b>Hamirpur</b>				
1	Bagnalla	0.27	-1.08	-1.04	-0.7835
2	Bijari	-0.17	0.22	0.19	-0.5245
3	Galore	-0.088	16.29	0.11	-2.84
4	Kangu	-1.76	-0.6	-0.958	-2.395
<b>District</b>	<b>Kangra</b>				
5	Andora	0	0	0	0
6	Bandh	0.37	0.99	0.124	-0.499
7	Barota	0	-1.6	-1.43	-1.076
8	Basa Bazira	-0.69	-1.66	-1.24	-0.7
9	Bhalad	-0.908	-0.01	0.38	-0.81
10	Bhali	0.12	0.081	0.45	-0.025
11	Bharmar	-0.41	-3.37	-1.06	-1.42
12	Bharoli	-2.866	-3.06	-0.74	2.02
13	Bod	-1.65	-0.8	-0.51	-0.813
14	Chakban Ambari	-0.05	0.09	-0.11	-0.485
15	Channaur	0.55	0.48	0.8	0.275
16	Darkati	0.58	0.15	-0.13	-0.48
17	Dehra Gopipur	-0.806	-1.75	-0.87	-0.355
18	Dehrian	0.642	0.36	0.08	0.16
19	Hardogri	0.111	-0.23	-0.27	-0.08
20	Jagir	-0.02	-0.23	0.1	-0.625
21	Jassur	0.23	1.245	0.18	-1.375
22	Jwalaji	2.13	-0.178	0.08	1.435
23	Kangra	0	0	-0.92	1.965
24	Kathgarh	0.164	0	-0.27	1.8715
25	Kotla	0.04	0.29	0.91	-0.535
26	Manjgram	0.052	-0.55	0.092	-0.57
27	Mao	0.57	0.27	0.292	-0.065
28	Mohtli	4.4	1.19	1.45	-9.755
29	Nagrota	0	0	0	0
30	Old Kangra	-5.79	0.25	-0.38	0.02

31	Olherian	0.02	-0.33	0.08	-0.075
32	Pandtehr	0.38	-0.037	-0.04	-0.2
33	Panjpir	-0.246	-0.3	-0.61	-1.445
34	Paprola	-3.27	0.04	-0.46	-0.392
35	Rait	-0.07	0.41	0.31	-0.18
36	Raja-ka-talab	-0.56	-1.16	-1.386	-0.88
37	Rakkar	1.35	-0.87	-0.69	-0.344
38	Riali	-0.37	-0.48	-0.32	-0.425
39	Takipur	0.74	-0.12	-0.32	-0.085
40	Thali	2.06	0.18	0.15	-0.03
41	Thirtynine Mile	0.253	1.47	0.42	-0.31
<b>District</b>	<b>Kullu</b>				
42	Gadauri	-2.12	-1.45	-0.78	-0.32
43	Hathithan	6.26	3.41	2.85	1.162
44	Kullu	0.06	-0.41	1.12	1.065
<b>District</b>	<b>Mandi</b>	0.192	0.12	-0.74	
45	Bahangrotu	1.43	0.881	2.01	0.675
46	Gagal	0.192	0.12	-0.74	0.815
47	GUTKAR	0	0	0.87	.895
48	Jarl	-0.017	-0.16	0.383	0.065
49	Jhiri	-0.767	-0.31	-0.34	-0.6845
50	Kaned	-0.378	-0.55	-0.89	-0.8745
51	Lohara	0.194	0.37	0.18	0.1065
52	Ratti	-0.716	-0.097	-0.28	-0.5485
<b>District</b>	<b>Sirmour</b>				
53	Ajiwala	-0.153	-0.99	-0.18	1.277
54	Akkawala	0.394	-0.98	0.32	-0.025
55	Badripur	9.34	-1.59	-2.51	-0.488
56	Dhaulakuan	0.653	0.14	-0.05	0.306
57	Kala-Amb	0	-1.406	-0.18	1.265
58	Khodawala	0	9.12	12.89	8.365
59	Kiyarda	0.32	0	0	0.05
60	Kolar	0.763	2.05	0.74	-0.075
61	Nayagaon	0.353	-1.94	-0.44	0.092
62	Shambuwala	-1.02	-1.61	-1.518	1.167
63	Shibpur	-0.496	-4.666	-3.11	-1.055
64	Trilokpur	0.251	-0.26	-0.13	0.21
<b>District</b>	<b>Solan</b>				
65	Baddi	0	-0.82	-4.28	-0.38
66	Barotiwala	2.21	3.5	3.64	2.76
67	Barun	-4.697	-0.5	-0.36	-1.97

68	Bhagheri	0.61	1.714	1.461	-0.1
69	Bhatoli	12.573	10.28	11.81	5.79
70	Dhabota	0.24	-1.706	-0.22	-0.085
71	Jagatpur	0.22	0.46	0.132	-0.095
72	Khera-chak	0	-0.93	-0.4	-3.685
73	Mahadev	0.21	-1.17	-0.23	-0.255
74	Panjahra	7.2	0.06	0.56	1.705
75	Phalahi	0.17	-0.33	-0.348	-0.615
<b>District</b>	<b>Una</b>				
76	Amb	-0.1	-1.79	0.37	0.111
77	Ambota	-2.99	-8.317	-8.05	-3.358
78	Babehr	0.81	-0.29	0.113	-0.295
79	Bawal	0.47	0	-0.02	1.237
80	Bhadsali	0.34	0.304	-0.77	-0.185
81	Bhangana	0.2	-0.197	0.67	-0.06
82	Daulatpur	1.39	1.25	1.77	0.825
83	Dharampur	-0.09	0.11	-0.63	-0.52
84	Gagret	0.52	-0.84	-0.73	-0.659
85	Ghaneri	-0.47	-0.39	-0.29	2.756
86	Guglahar	0.55	-0.527	2.302	-0.5985
87	Ishapur	0.54	0.02	-0.186	-0.698
88	Jankaur	-1.04	-2.64	-1.72	-1.2995
89	Jawar	-0.19	-0.12	-0.006	0.0415
90	Jhalera	0.75	-0.63	-0.349	-0.295
91	Khanpur	-0.41	-1.42	-3.19	-0.35
92	Khwaja	0.04	-0.71	-0.11	-0.76
93	kuluwal	0	0	0	0
94	Kuthera Jaswala	0.27	-0.71	-0.196	-0.155
95	Lalehri	0.13	-2.49	-2.43	-0.925
96	Loharli	-0.92	-1.89	-0.25	-1.2
97	Mawa Kalan	-0.56	1.67	2.05	0.225
98	Mubarikpur	0.813	-0.98	-0.06	-0.285
99	Nangran	0.27	-0.86	-0.53	-0.3385
100	Panjawar	0.64	-0.04	-0.44	-0.393
101	Panoh	-0.5	-1.35	-0.607	-1.163
102	RaipurMarwadi	2.433	-0.29	1.05	0.124
103	RajliPanjal	1.21	0.78	-0.13	0.67
104	Santokhgarh	0.02	-1.56	-0.24	-0.43
105	Singhnei	-1.76	-2.38	-1.68	-0.47
106	Tahliwala1	0	0	0	0
107	Una	0.53	-0.13	-0.12	-0.233

	Sl. No.	DISTRICT	LOCATION	LONGITUDE	LATITUDE	TYPE OF SAMPLE	pH	EC in $\mu\text{S}/\text{cm}$ at 25° C	CO <sub>3</sub>	HCO <sub>3</sub>	Cl	SO <sub>4</sub>	NO <sub>3</sub>	F	Ca	Mg	Na	K	SiO <sub>2</sub>	TH as CaCO <sub>3</sub>
									mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l
1	1	Kangra	OLD MATOUR	76°17'18"	32°8'14"	NHS	7.44	190	0	79	21	0	9	0.22	24	6.1	8	1.6	15	85
2	2	Kangra	RAIT	76°12'44"	32°11' 8"	NHS	7.76	430	0	207	28	0	24	0.25	40	15	25	7.3	15	160
3	3	Kangra	39 Miles (Shahpur)	76°10'34"	32°13'9"	NHS	8.15	500	0	256	21	24	7	0.16	32	44	6	2.2	13	260
4	4	Kangra	CHAKBAN AMBADI	76°24'40"	32°6'25"	NHS	8.25	220	0	49	21	38	11	0.14	20	12	8	1.0	13	100
5	5	Kangra	MANJ GRAM	76°09'43"	32°13'40"	NHS	8.08	400	0	207	21	5	5	0.18	40	19	14	2.4	12	180
6	6	Kangra	BHALI	76°06'27"	32°13'23"	NHS	8.03	780	0	207	78	67	60	0.21	76	12	71	13	11	240
7	7	Kangra	KOTLA	76°02'54"	32°14'10"	NHS	8.23	515	0	281	21	0	14	0.18	32	34	23	2.4	12	220
8	8	Kangra	MAO	76°00'38"	32°15'37"	NHS	8.55	380	18	122	21	38	1	0.19	36	22	12	1.2	20	180
9	9	Kangra	BHALAD	75°59'44"	31°11'30"	NHS	8.24	630	0	268	28	53	14	0.30	32	41	38	2.6	15	250
10	10	Kangra	DARKATI	75°59'28"	32°09'44"	NHS	8.64	460	30	165	28	0	18	0.20	44	17	22	12	14	180
11	11	Kangra	BHARMAR	75°57'49"	32°09'45"	NHS	8.58	320	12	159	7	0	11	0.17	28	19	10	1.6	12	150
12	12	Kangra	RAJA KA TALAB	75°55'18"	32°12'35"	NHS	8.52	320	12	98	14	48	13	0.15	36	19	6	0.7	36	170
13	13	Kangra	THALI	75°53'11"	32°15'14"	NHS	8.42	260	12	110	14	0	7	0.23	24	15	8	1.4	29	120
14	14	Kangra	BASA-BAZIRA	75°52'11"	32°16'10"	NHS	8.02	560	0	323	14	0	19	0.17	52	32	15	0.6	17	260
15	15	Kangra	BOD	75°52'11"	32°17'13"	NHS	8.41	1000	48	354	64	0	83	0.20	92	41	41	21	22	400
16	16	Kangra	BHATKA	75°53'16"	32°18'56"	NHS	8.01	670	0	366	21	14	4	0.27	64	32	28	2.5	17	290
17	17	Kangra	PARNALLA	75°51'41"	32°21'26"	NHS	8.24	330	0	159	7	29	1	0.29	48	9.7	6	1.2	16	160
18	18	Kangra	NAURA	76°29'18"	31°59'56"	NHS	8.52	440	24	207	21	0	1	0.20	40	24	14	1.7	14	200
19	19	Kangra	LAKHNAUT	75°54'35"	32°23'8"	NHS	8.14	580	0	317	21	0	21	0.21	84	15	13	0.7	23	270
20	20	Kangra	SADWAN	75°54'27"	32°20'56"	NHS	7.92	600	0	366	14	0	5	0.19	64	32	10	1.9	14	290
21	21	Kangra	KUTH KHANA	75°54'53"	32°10'59"	NHS	8.37	210	6	73	14	17	9	0.19	12	17	7	1.6	9	100
22	22	Kangra	BAROT	75°55'53"	32°07'42"	NHS	8.24	300	0	153	28	0	12	0.22	28	13	18	4.6	12	125
23	23	Kangra	JAGIR	75°54'10"	31°58'23"	NHS	8.42	480	24	171	43	12	27	0.23	48	19	30	9.3	9	200
24	24	Kangra	RIYALI	75°48'48"	32°01'8"	NHS	8.24	320	0	134	28	24	10	0.23	24	22	12	5.8	9	150
25	25	Kangra	BAROTA	75°43'10"	32°02'20"	NHS	8.26	550	0	195	28	91	13	0.24	20	51	22	6	10	260
26	26	Kangra	OLLEHRIYAN	75°38'15"	32°04'29"	NHS	8.61	851	24	207	85	120	2	0.30	24	34	50	126	11	200
27	27	Kangra	KATHGARH	75°38'5"	32°07'2"	NHS	8.85	1100	90	317	64	19	130	0.41	68	56	64	72	9	400
28	28	Kangra	INDORA	75°41'22"	32°08'13"	NHS	8.27	400	0	183	21	38	14	0.35	28	27	24	0.8	9	180
29	29	Kangra	CHANNOUR	75°41'13"	32°08'40"	NHS	8.68	580	36	220	36	19	22	0.67	24	32	66	1.4	9	190
30	30	Kangra	CHANGARA	75°41'43"	32°10'17"	NHS	8.27	390	0	159	36	14	32	0.42	28	22	27	1.9	9	160
31	31	Kangra	MOHTLI	75°40'42"	32°12'46"	NHS	8.25	553	0	110	107	34	34	0.32	56	15	46	6.6	9	200
32	32	Kangra	PANJPIR	75°47'32"	32°16'48."	NHS	8.16	258	0	122	36	0	1	0.33	40	4.9	11	1.9	10	120
33	33	Kangra	JASSUR	75°50'28"	32°16'49"	NHS	7.84	670	0	293	43	58	21	0.30	48	56	16	2.1	9	350
34	34	Kangra	GUJREDA SARAH	76°16'32"	32°9'50"	NHS	8.21	380	0	183	43	0	0	0.35	12	15	52	3.7	9	90
35	35	Kangra	PAPROLA	76°38'2"	32°3'13"	NHS	7.98	233	0	73	28	0	29	0.35	28	4.9	13	5.5	9	90
36	36	Kangra	KUTHED	76°3'45"	32°11'48"	NHS	8.26	430	0	195	21	38	17	0.28	24	41	9	2.2	10	230

	Sl. No.	DISTRICT	LOCATION	LONGITUDE	LATITUDE	TYPE OF SAMPLE	pH	EC in $\mu\text{S/cm}$ at 25° C	CO <sub>3</sub>	HCO <sub>3</sub>	Cl	SO <sub>4</sub>	NO <sub>3</sub>	F	Ca	Mg	Na	K	SiO <sub>2</sub>	TH as CaCO <sub>3</sub>
37	37	Kangra	BASANTPUR	76°1'18"	32°8'41"	NHS	8.55	380	30	122	21	31	2	0.80	56	15	9	1.7	9	200
38	38	Kangra	KANGRA	76°16'31"	32°06'24"	NHS	8.26	477	0	183	64	10	28	0.31	44	22	33	4.3	9	200
39	39	Kangra	OLD KANGRA	76°15'53"	32°5'36"	NHS	8.53	470	48	159	28	0	19	0.31	60	17	11	21	11	220
40	40	Kangra	TAKIPUR	76°15'14"	32°03'1"	NHS	8.26	315	0	134	21	12	24	0.27	28	17	15	1	9	140
41	41	Kangra	BANDH	76°13'48"	32°00'15"	NHS	7.83	360	0	159	46	0	5	0.51	30	15	26	3.1	15	135
42	42	Kangra	HARIPUR	76°9'39"	32°0'13"	NHS	8.54	500	18	134	71	5	12	0.48	22	15	52	29	17	115
43	43	Kangra	DEHRA GOPIPUR	76°12'55"	31°52'56"	NHS	8.60	553	30	116	75	0	45	0.57	24	33	47	1.3	26	195
44	44	Kangra	JAWALA JI	76°18'59"	31°52'39"	NHS	8.66	552	24	159	78	0	15	0.57	16	23	74	1.5	18	135
45	45	Kangra	DEHRIAN	76°16'22"	31°55'29"	NHS	8.48	293	12	67	46	0	18	0.45	20	15	19	0.7	22	110
46	46	Kangra	BHAROLI	76°20'2"	31°47'31"	NHS	8.60	540	18	122	82	29	3	0.36	28	33	35	3.2	18	205
47	47	Kangra	HARDOGRI	76°17'43"	31°47'1"	NHS	8.65	380	12	134	46	0	6	0.38	28	19	25	2.3	13	150
48	48	Kangra	RAKKAR (CHOULI)	76°15'29"	31°47'14"	NHS	8.48	388	18	128	60	0	1	0.46	22	28	25	0.7	22	170
49	49	Kangra	PANDTEHR	76°38'46"	32°2'14"	NHS	8.37	200	6	49	43	0	1	0.40	16	9.7	14	1.8	14	80
50	50	Kangra	GAGGAL	76°17'18"	32°8'14"	NHS	8.40	220	12	55	32	10	1	0.45	24	8.5	10	1.6	28	95
51	51	Chamba	UPPER THULEL	76°8'39"	32°14'0"	NHS	8.49	256	18	92	25	0	0	0.46	18	13	20	1.7	10	100
52	52	Chamba	TARA GARH	75°56'55"	32°24'47"	NHS	8.58	210	12	55	18	24	0	0.35	12	17	6	4.8	16	100
53	53	Chamba	CHIKADIYANI	76°05'38.6"	32°35'54.6"	NHS	8.61	362	18	122	46	0	0	6.40	14	16	43	9.1	12	100
54	54	Mandi	BANGROTU	76°55'11"	31°36'39"	NHS	8.65	400	18	98	46	32	1	0.58	26	8.5	38	24	11	100
55	55	Mandi	RATTI	76°54'7"	31°35'59"	NHS	8.44	341	12	61	39	58	1	0.36	54	1.2	21	5.9	13	140
56	56	Mandi	JARL	76°53'46"	31°33'5"	NHS	8.62	300	12	116	39	0	1	0.43	18	17	21	4.7	17	115
57	57	Mandi	DINAK	76°55'26"	31°33'53"	NHS	8.68	401	18	128	50	19	1	0.42	22	27	30	2.5	13	165
58	58	Mandi	KANED	76°54'49"	31°34'44"	NHS	8.64	464	18	85	46	72	1	0.49	28	16	41	20	13	135
59	59	Mandi	LOHARA	76°56'43"	31°35'19"	NHS	8.39	815	12	73	156	121	1	0.36	46	43	61	8.9	12	290
60	60	Mandi	GAAGAL	76°57'41"	31°37'49"	NHS	8.57	260	18	73	28	14	1	0.49	30	8.5	13	8.2	19	110
61	61	Mandi	GUTKAR	76°56'39"	31°39'26"	NHS	8.45	430	12	92	43	67	26	0.65	36	26	21	7.7	19	195
62	62	Mandi	NAGWAIN	77°10'49"	31°49'9"	NHS	8.67	219	12	61	28	0	7	0.36	20	4.9	15	11	12	70
63	63	Mandi	JHIRI	77°10'17"	31°50'5"	NHS	8.47	350	12	79	36	29	37	0.39	34	17	16	5.4	14	155
64	64	Mandi	LOHARA 1 Dugwell	76°56'30"	31°35'24"	NHS	8.49	494	12	140	60	53	12	0.35	30	21	46	22	12	160
65	65	Mandi	LOHARA 2 Dugwell	76°56'29"	31°35'26"	NHS	8.50	460	12	104	46	72	15	0.28	36	26	29	5.4	18	195
66	66	Mandi	LOHARA 3 (Daar) Dugwell	76°58'22"	31°33'41"	NHS	8.41	250	6	61	32	0	43	0.27	20	12	18	1.9	22	100
67	67	Kullu	KULLU	77°6'55"	31°57'53"	NHS	8.58	300	12	116	25	10	6	0.24	36	15	4	6.0	8	150
68	68	Kullu	GADURI	77°7'53"	31°54'12"	NHS	8.41	389	6	98	43	0	90	0.19	54	13	12	6.2	10	190
69	1	Mandi	Lower Hara Bag	76°49'9"	31°59'31"	SPRING	8.54	280	12	110	32	0	5	0.18	30	11	17	3.0	15	120
70	2	Mandi	Bhulana Padhar	76°52'34"	31°56'27"	SPRING	8.51	307	12	85	25	43	6	0.21	48	9.7	6	5.7	12	160
71	3	Mandi	Maher	76°56'24"	31°46'50"	SPRING	8.47	330	12	159	21	0	8	0.19	16	34	3	2.2	11	180
72	4	Mandi	Rani ki Bawari (Rainba)	76°56'48"	31°40'22"	SPRING	8.56	300	12	110	25	0	29	0.16	14	29	3	1.1	12	155



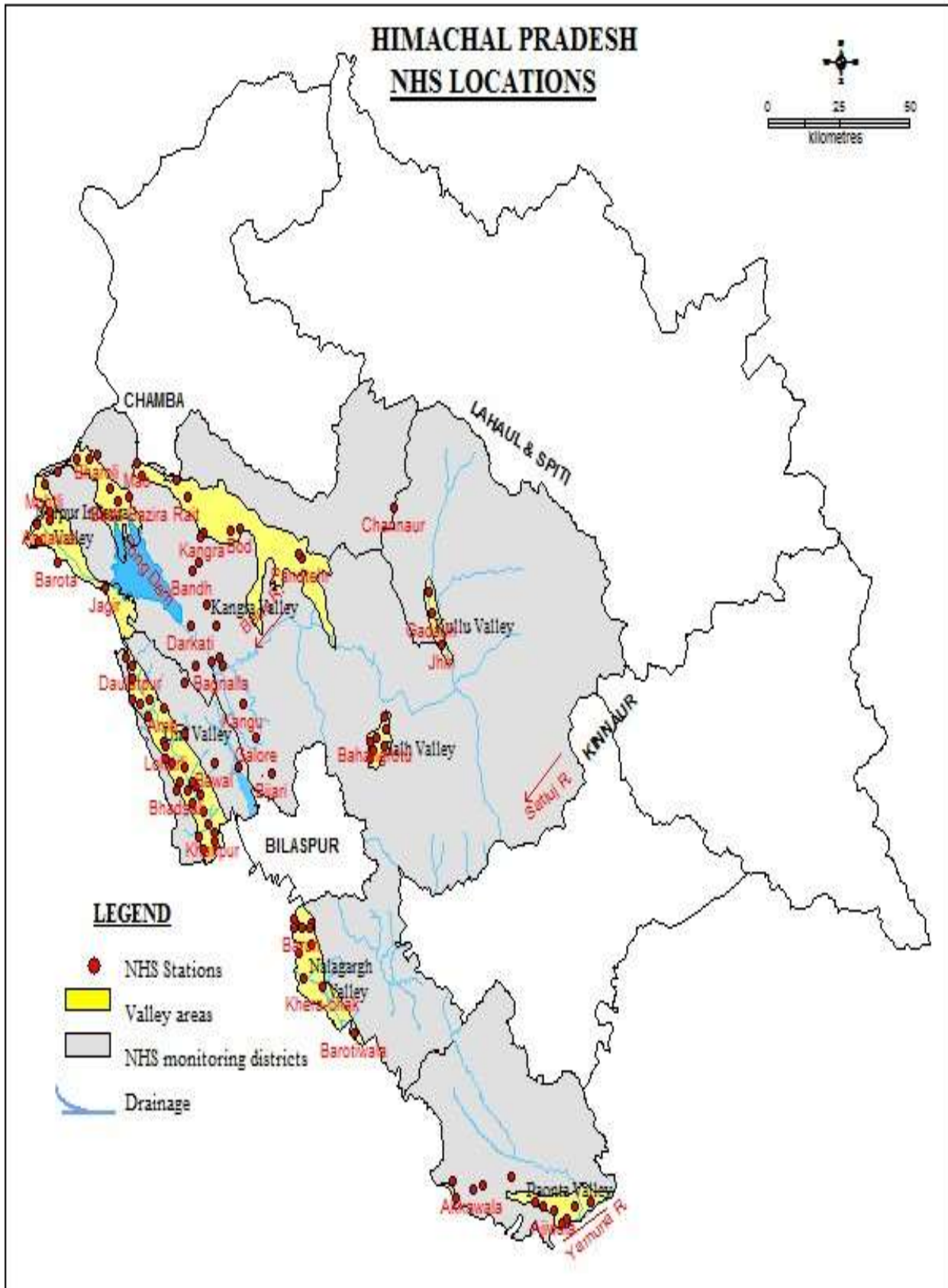
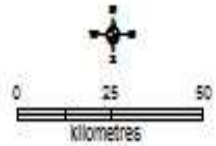
	Sl. No.	DISTRICT	LOCATION	LONGITUDE	LATITUDE	TYPE OF SAMPLE	pH	EC in $\mu\text{S/cm at } 25^\circ \text{C}$	CO <sub>3</sub>	HCO <sub>3</sub>	Cl	SO <sub>4</sub>	NO <sub>3</sub>	F	Ca	Mg	Na	K	SiO <sub>2</sub>	TH as CaCO <sub>3</sub>
73	5	Kangra	Samela	76°15'37"	32°5'6"	SPRING	8.48	245	12	85	28	0	15	0.17	14	21	7	1.8	17	120
74	6	Kangra	OLD KANGRA	76°15'58"	32°5'45"	SPRING	8.69	320	12	116	36	0	20	0.23	26	15	24	5.0	13	125
75	7	Chamba	Kamala, Bhattiyat	76°4'43"	32°19'15"	SPRING	8.45	140	6	43	21	0	6	0.25	12	6.1	9	2.8	13	55
76	8	Chamba	Kharet, Bhattiyat	76°1'20"	32°20'56"	SPRING	8.64	210	12	73	18	0	7	0.17	16	17	1	0.5	12	110
77	9	Chamba	Mundi, Bhattiyat	76°0'45"	32°22'1"	SPRING	8.38	320	18	122	32	0	11	0.15	24	27	3	1.0	19	170
78	10	Chamba	Naini Khad	75°55'53"	32°29'23"	SPRING	8.39	197	6	67	28	0	6	0.18	24	9.7	4	0.4	19	100
79	11	Chamba	Panjpulla	75°56'32"	32°30'23"	SPRING	8.38	164	9	49	21	0	6	1.30	24	3.6	6	2.1	12	75
80	12	Chamba	Devidchra Bathri, Banikhet	75°59'29"	32°33'59"	SPRING	8.37	160	6	49	21	0	11	0.87	18	7.3	7	2.3	14	75
81	13	Chamba	chahala	76°2'22"	31°35'14"	SPRING	8.46	220	12	85	18	0	6	1.40	14	17	7	1.3	12	105
82	14	Chamba	Mangla	76°6'16"	32°31'59"	SPRING	8.60	225	18	73	11	0	6	4.85	10	18	9	1.3	18	100
83	15	Chamba	Gunjnui	76°5'28"	32°31'45"	SPRING	8.38	160	6	49	25	0	5	0.57	16	7.3	8	1.3	22	70
84	16	Chamba	Khajjiyar	76°3'56"	32°32'21"	SPRING	8.59	200	12	85	11	0	6	0.31	8	11	17	4.8	13	65
85	69	Una	JAWAR	76°11'42"	31°44'36"	NHS	8.67	510	12	73	46	115	18	0.30	24	26	50	13	17	165
86	70	Una	AMB	76°07'17"	31°41'07"	NHS	8.63	400	18	153	36	10	15	0.16	20	32	22	1.9	12	180
87	71	Una	KATHOR-KALAN	76°07'04"	31°39'26"	NHS	8.42	350	12	67	50	33	15	0.18	26	11	39	2.4	16	110
88	72	Una	MUBARIKPUR	76°05'03"	31°42'30"	NHS	8.59	410	18	85	75	0	12	0.23	22	30	18	2.1	8	180
89	73	Una	BHADRAKALI	76°02'20"	31°46'47"	NHS	8.65	350	12	85	36	0	78	0.28	18	18	36	2.0	14	120
90	74	Una	DAULATAPUR	75°59'50"	31°46'44"	NHS	8.62	380	18	92	43	17	16	1.60	24	17	33	2.4	11	130
91	75	Una	BABEHR	75°59'30"	31°47'23"	NHS	8.60	385	12	79	71	0	38	1.70	28	21	26	1.4	11	155
92	76	Una	RAIPUR MARWADI	75°59'01"	31°48'01"	NHS	8.52	280	12	67	50	0	15	0.58	34	8.5	15	1.3	23	120
93	77	Una	MAWA KALAN	76°00'30"	31°45'17"	NHS	8.42	315	9	85	50	0	25	0.58	24	16	22	2.4	13	125
94	78	Una	GHANERI	76°01'20"	31°43'35"	NHS	8.51	285	12	85	53	0	0	0.03	32	12	15	1.4	24	130
95	79	Una	SINGHNEI	76°02'06"	31°41'29"	NHS	8.62	315	24	92	18	0	35	0.35	10	27	17	1.7	25	135
96	80	Una	AMBOTA	76°02'53"	31°40'14"	NHS	8.49	492	12	73	92	0	58	0.01	40	24	27	1.6	13	200
97	81	Una	GAGRET	76°03'43"	31°39'38"	NHS	8.23	262	0	110	32	0	17	0.35	36	6.1	16	1.6	12	115
98	82	Una	KUTHERA JASWALAN	76°07'05"	31°36'21"	NHS	8.51	355	12	104	53	0	31	0.19	18	26	22	1.7	20	150
99	83	Una	LOHARLI	76°07'35"	31°35'34"	NHS	8.27	603	0	177	64	38	45	0.17	98	1.2	31	2.6	18	250
100	84	Una	GUGHLEHAR	76°08'36"	31°33'60"	NHS	8.62	355	12	110	28	19	40	0.23	26	18	27	6.1	10	140
101	85	Una	PANJAWAR	76°08'34"	31°32'50"	NHS	8.54	370	12	73	67	0	24	1.10	22	23	17	2.1	20	150
102	86	Una	ISHPUR	76°10'44"	31°30'20"	NHS	8.49	625	18	159	82	53	1	2.30	22	15	95	12	14	115
103	87	Una	BADSALI	76°10'44"	31°28'40"	NHS	8.42	650	6	43	199	0	35	1.40	30	30	66	3.0	15	200
104	88	Una	JHALERA	76°14'18"	31°29'26"	NHS	8.65	459	18	92	92	0	33	1.20	32	22	42	3.0	13	170
105	89	Una	KHAWAJA	76°13'38"	31°30'13"	NHS	8.62	675	12	104	156	0	37	1.00	32	23	71	22	14	175
106	90	Una	PANOH	76°12'03"	31°32'06"	NHS	8.69	440	24	134	67	0	7	0.96	26	7.3	70	2.1	21	95
107	91	Una	JANKAUR	76°16'29"	31°25'50"	NHS	8.47	630	18	116	156	0	12	2.60	20	27	82	15	13	160
108	92	Una	NANGRAN	76°17'31"	31°23'53"	NHS	8.46	342	18	122	39	10	0	0.89	16	16	42	2.1	21	105

	Sl. No.	DISTRICT	LOCATION	LONGITUDE	LATITUDE	TYPE OF SAMPLE	pH	EC in $\mu\text{S/cm}$ at 25° C	CO <sub>3</sub>	HCO <sub>3</sub>	Cl	SO <sub>4</sub>	NO <sub>3</sub>	F	Ca	Mg	Na	K	SiO <sub>2</sub>	TH as CaCO <sub>3</sub>
109	93	Una	KHANPUR	76°18'25"	31°22'41"	NHS	8.42	735	12	98	227	0	4	1.00	22	58	52	3.3	22	295
110	94	Una	SANTOKHGARH	76°18'56"	31°21'28"	NHS	8.49	574	12	104	156	0	4	0.85	50	19	52	3.8	23	205
111	95	Una	TAHLIWAL	76°16'33"	31°21'05"	NHS	8.42	485	6	43	142	0	34	0.96	16	39	31	2.4	11	200
112	96	Una	LALHERI	76°15'48"	31°22'24"	NHS	8.43	432	6	49	67	96	8	1.10	20	30	34	0.6	22	175
113	97	Una	DHARAMPUR	76°13'42"	31°26'43"	NHS	8.48	395	12	92	71	0	33	0.83	12	27	33	3.5	12	140
114	98	Una	UNA	76°16'15"	31°28'10"	NHS	8.44	674	12	73	178	14	34	0.94	8	38	92	2.8	13	175
115	99	Una	BAWAL	76°18'24"	31°32'53"	NHS	8.43	664	6	49	75	201	5	1.20	24	24	95	6.7	10	160
116	100	Una	BANGANA	76°20'27"	31°37'30"	NHS	8.46	475	18	146	71	0	25	0.74	6	45	33	0.9	18	200
117	101	Una	RAJLI PANJAL	76°24'18"	31°32'11"	NHS	8.44	588	12	61	170	0	3	0.98	22	23	71	6.0	10	150
118	102	Solan	BAGHERI	76°38'31"	31°11'39"	NHS	8.43	393	6	67	50	77	14	0.63	16	4.9	77	3.1	19	60
119	103	Solan	BHATOLI	76°36'30"	31°09'55"	NHS	8.47	310	12	61	43	0	45	0.72	16	17	23	2.7	19	110
120	104	Solan	BARUNA	76°36'19"	31°09'15"	NHS	8.42	255	6	49	36	0	43	0.65	26	2.4	27	1.8	27	75
121	105	Solan	PALAH	76°36'43"	31°07'39"	NHS	8.43	555	6	110	67	43	53	1.00	34	28	41	3.8	29	200
122	106	Solan	PANJIARA	76°39'23"	31°08'06"	NHS	8.44	390	6	85	64	0	36	0.83	22	11	48	2.3	47	100
123	107	Solan	JAGATPUR	76°40'43"	31°09'34"	NHS	8.42	298	6	92	43	14	11	1.10	16	7.3	43	4.2	14	70
124	108	Solan	MAHADEVA	76°40'43"	31°06'30"	NHS	8.52	345	12	85	60	0	24	0.81	18	15	39	2.3	15	105
125	109	Solan	DABOTA	76°37'50"	31°05'16"	NHS	8.49	900	12	98	121	154	45	0.74	10	24	163	3.1	13	125
126	110	Solan	NALAGARH	76°42'43"	31°02'39"	NHS	8.47	635	12	128	124	0	41	0.62	14	17	100	0.6	17	105
127	111	Solan	KHERCHAK	76°40'43"	31°00'50"	NHS	8.48	476	12	116	64	24	29	1.40	16	17	66	6.0	22	110
128	112	Solan	THEDA	76°45'36"	31°59'59"	NHS	8.46	364	12	85	46	0	47	0.96	20	17	31	5.2	12	120
129	113	Solan	KISHANPURA	76°45'29"	30°58'17"	NHS	8.39	945	6	61	231	91	24	1.10	54	55	65	4.4	10	360
130	114	Solan	BADDI	76°47'40"	30°55'27"	NHS	8.38	285	6	61	67	0	10	0.66	18	16	22	2.6	10	110
131	115	Solan	BAROTIWALA	76°50'24"	30°54'20"	NHS	8.49	274	24	98	11	0	15	0.22	16	12	26	3.5	11	90
132	116	Sirmour	AKKAWALA	77°17'12"	30°31'13"	NHS	8.62	314	30	146	7	0	0	0.17	18	13	32	6.9	10	100
133	117	Sirmour	SHIBPUR	77°40'11"	30°28'33"	NHS	8.69	275	30	110	14	0	3	0.19	28	16	10	1.5	18	135
134	118	Sirmour	KHODEWALA	77°42'18"	30°29'14"	NHS	8.64	340	24	122	18	0	18	0.19	26	23	8	1.7	11	160
135	119	Sirmour	BADRIPUR	77°40'11"	30°28'33"	NHS	8.50	345	18	122	18	0	33	0.17	24	15	23	6.4	10	120
136	120	Sirmour	AJJIWALA	77°35'12"	30°28'13"	NHS	8.49	202	18	73	11	0	14	0.20	22	8.5	8	4.9	9	90
137	121	Sirmour	KIAYARDA	77°32'56"	30°28'23"	NHS	8.49	200	18	73	7	0	12	0.16	18	11	7	2.0	10	90
138	122	Sirmour	NAYAGAON	77°31'22"	30°29'10"	NHS	8.42	185	6	85	11	0	7	0.15	16	11	7	1.5	9	85
139	123	Sirmour	SAINWALA-1	77°30'40"	30°29'31"	NHS	8.54	175	18	61	7	0	9	0.23	16	8.5	8	1.0	9	75
140	124	Sirmour	MESERWALA	77°32'40"	30°28'45"	NHS	8.58	264	18	92	18	0	13	0.25	12	15	19	4.9	12	90
141	125	Sirmour	DHAULA-KUAN	77°28'23"	30°30'06"	NHS	8.39	178	12	61	11	0	12	0.28	18	4.9	13	2.2	11	65
142	126	Sirmour	KODEWALA	77°24'22"	30°28'36"	NHS	8.61	338	24	153	11	0	1	0.24	18	7.3	43	4.1	10	75
143	127	Sirmour	KOLAR	77°26'27"	30°29'52"	NHS	8.52	255	18	73	14	0	30	0.20	22	11	16	2.9	11	100
144	128	Sirmour	BOLION	77°22'29"	30°30'36"	NHS	8.55	275	12	134	14	0	10	0.24	28	12	15	1.4	14	120
145	129	Sirmour	SHAMBUWALA	77°19'15"	30°31'25"	NHS	8.54	210	18	85	11	0	4	0.23	22	11	8	1.4	12	100

	Sl. No.	DISTRICT	LOCATION	LONGITUDE	LATITUDE	TYPE OF SAMPLE	pH	EC in $\mu\text{S/cm}$ at 25° C	CO <sub>3</sub>	HCO <sub>3</sub>	Cl	SO <sub>4</sub>	NO <sub>3</sub>	F	Ca	Mg	Na	K	SiO <sub>2</sub>	TH as CaCO <sub>3</sub>
146	130	Sirmour	SAINWALA-2	77°15'08"	30°32'19"	NHS	8.64	700	48	238	71	0	2	0.33	16	16	115	8.9	19	105
147	131	Sirmour	KALA-AMB	77°12'43"	30°29'52"	NHS	8.41	400	6	61	99	0	16	0.18	16	12	55	2.8	21	90
148	132	Sirmour	KHERI	77°11'30"	30°31'34"	NHS	8.54	264	15	98	21	0	12	0.26	16	7.3	31	2.9	21	70
149	133	Sirmour	TRILOKPUR	77°12'12"	30°32'24"	NHS	8.54	460	24	134	64	0	0	2.20	30	13	50	1.7	23	130
150	134	Sirmour	NARIWALA	77°38'37"	30°29'28"	NHS	8.67	260	18	73	28	0	7	0.35	22	8.5	21	2.0	21	90
151	135	Hamirpur	BHAGNALLAH	76-20'-34"	31-46'-31"	NHS	8.49	216	12	61	32	0	6	0.00	18	6.1	20	2.6	23	70
152	136	Hamirpur	KANGOO	76-25'-28"	31-41'11"	NHS	8.39	310	12	104	36	0	16	0.20	16	19	19	1.9	10	120
153	137	Hamirpur	GALORE	76-28'-29"	31-36'-53"	NHS	8.47	265	12	110	21	0	1	0.18	22	8.5	18	10.5	25	90
154	138	Hamirpur	BIJARI	76-32'-22"	31-31'-22"	NHS	8.48	312	12	61	57	0	11	0.17	22	13	22	1.5	23	110
155	139	Hamirpur	BARSAR MAIRE	76-27'-53"	31-31'-41"	NHS	8.39	295	6	43	71	0	17	0.14	8	17	30	2.3	10	90
156	140	Hamirpur	BHALAT	76-28'-46"	31-29'-49"	NHS	8.49	300	12	73	53	0	9	0.20	20	15	22	1.3	17	110
157	141	Bilaspur	SHAHTALAI	76-30'-57"	31-27'-20"	NHS	7.38	210	0	98	25	0	7	0.29	12	9.7	17	9.4	12	70
158	142	Bilaspur	JHABOLA	76-32'-47"	31-25'-28"	NHS	8.53	342	15	98	36	0	28	0.94	22	13	30	5.2	11	110
159	143	Bilaspur	LOHARWIN	76-42'-57"	31-25'-31"	NHS	8.59	315	18	79	53	0	3	0.78	12	16	31	6.7	10	95
160	144	Bilaspur	NASWAL	76-41'-10"	31-28'-9"	NHS	8.61	390	18	61	57	10	38	1.40	26	16	34	2.3	11	130
161	1	Dharmshala	Bharatpur I	76.309824	32.238519	PUMPING TEST	8.42	264	18	85	21	10	6	0.40	16	6.1	33	3.4	14	65
162	2	Dharmshala	Bharatpur II	76.309824	32.238519	PUMPING TEST	8.22	338	0	183	25	0	4	0.28	30	8.5	32	3.4	12	110
163	3	Dharmshala	MT APT I	76.30799	32.23137	PUMPING TEST	8.53	248	12	92	25	0	4	0.95	16	6.1	32	3.4	19	65
164	4	Dharmshala	MT APT II	76.30799	32.23137	PUMPING TEST	8.64	284	12	122	28	0	2	0.25	24	6.1	34	3.4	21	85
165	5	Dharmshala	MT APT III	76.30799	32.23137	PUMPING TEST	8.51	266	12	128	18	0	1	0.45	14	6.1	41	3.7	21	60
166	6	Dharmshala	MT APT IV	76.30799	32.23137	PUMPING TEST	8.64	294	12	134	18	0	5	0.70	18	4.9	41	3.5	23	65
167	7	Hamirpur	NERI I	76.470803	31.697302	PUMPING TEST	8.76	1200	48	348	107	106	3	0.34	10	3.6	274	3.2	21	40
168	8	Hamirpur	NERI II	76.470803	31.697302	PUMPING TEST	8.79	1480	24	342	149	230	5	0.61	6	3.6	347	3.5	23	30

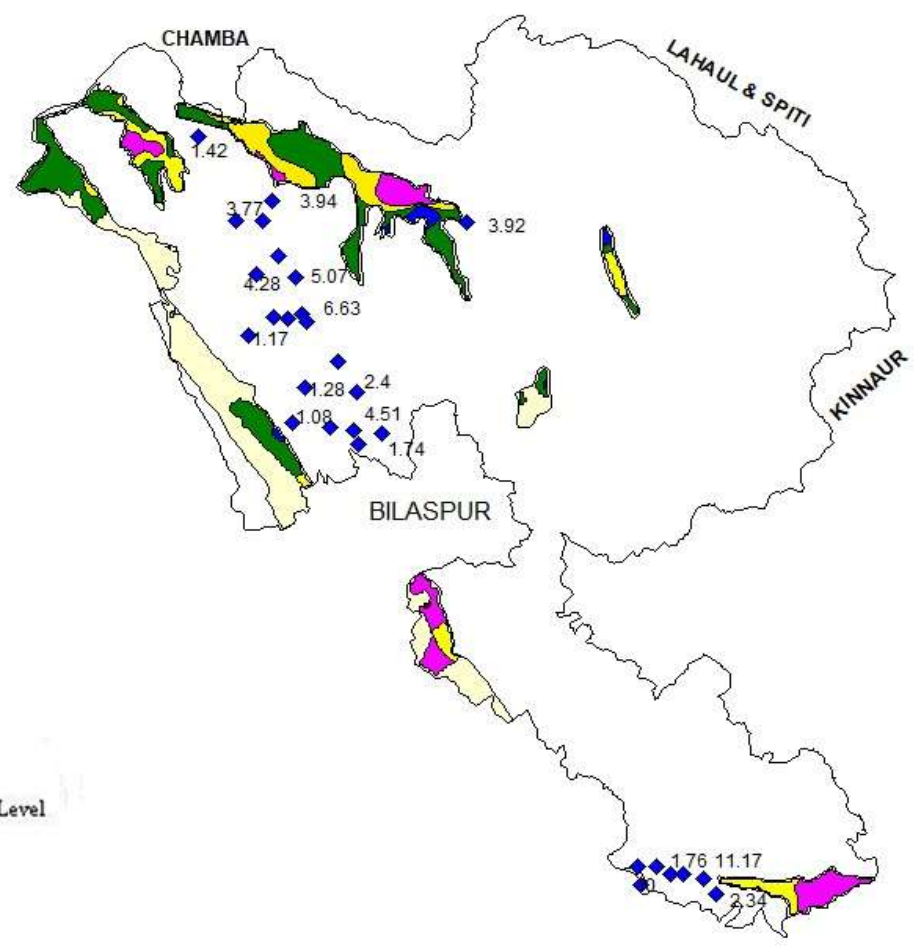
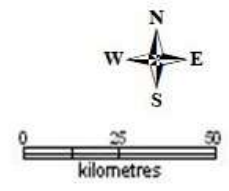


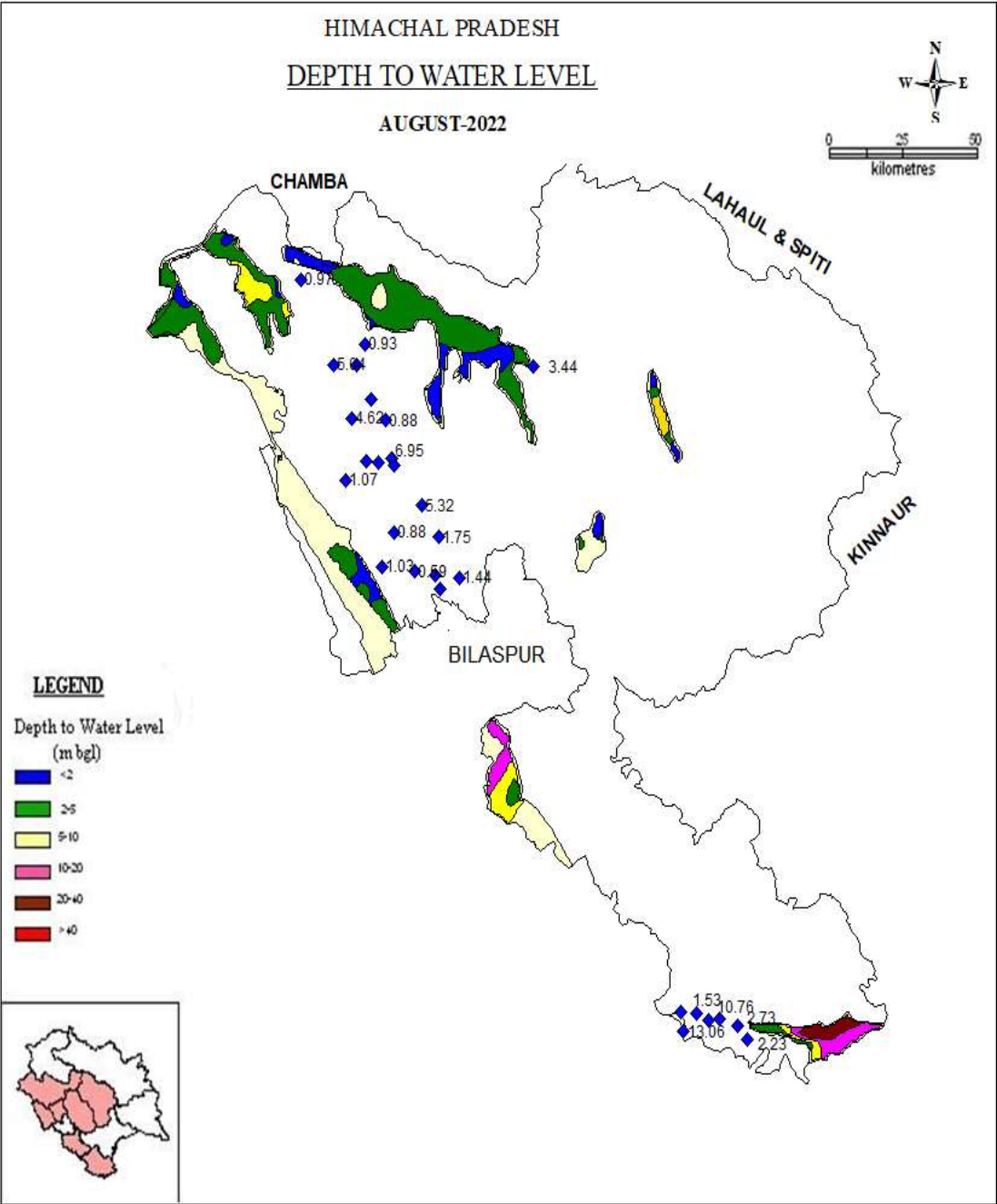
# HIMACHAL PRADESH NHS LOCATIONS



HIMACHAL PRADESH  
DEPTH TO WATER LEVEL

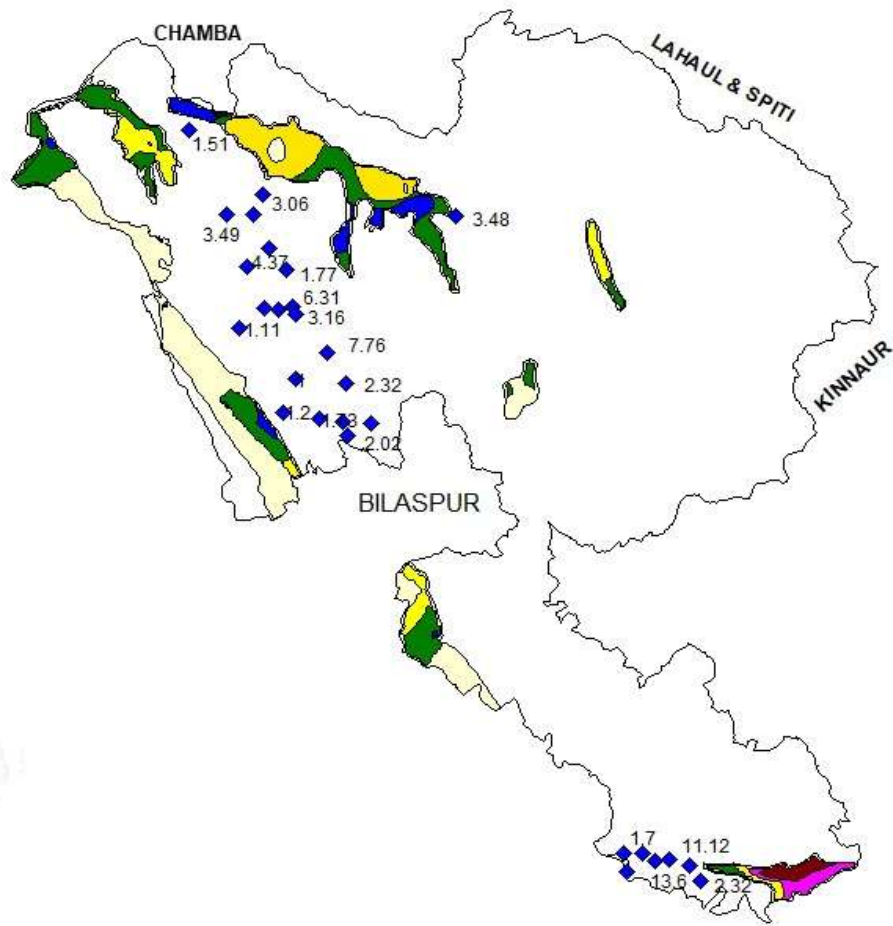
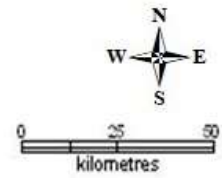
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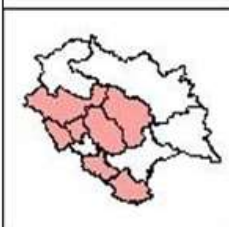
HIMACHAL PRADESH  
DEPTH TO WATER LEVEL

NOVEMBER -2022



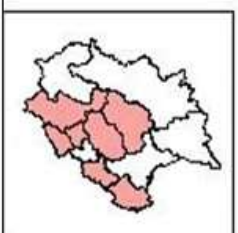
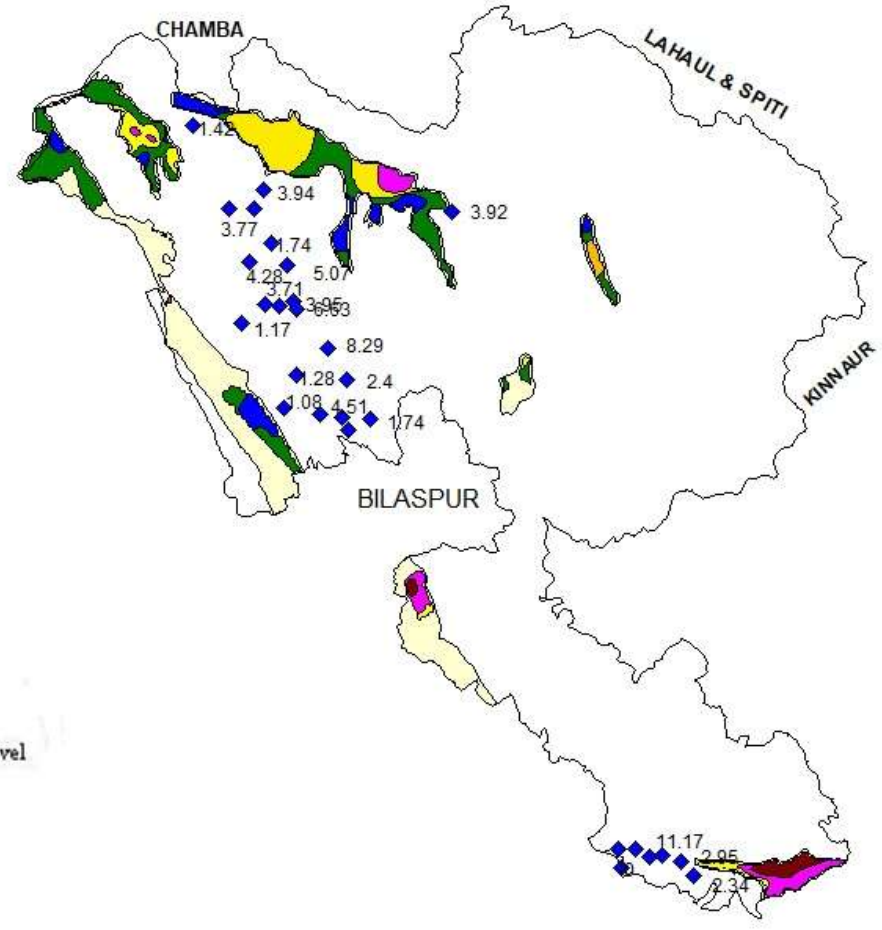
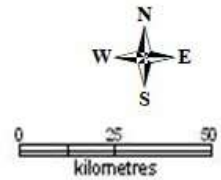
**LEGEND**

Depth to Water Level  
(m bgl)



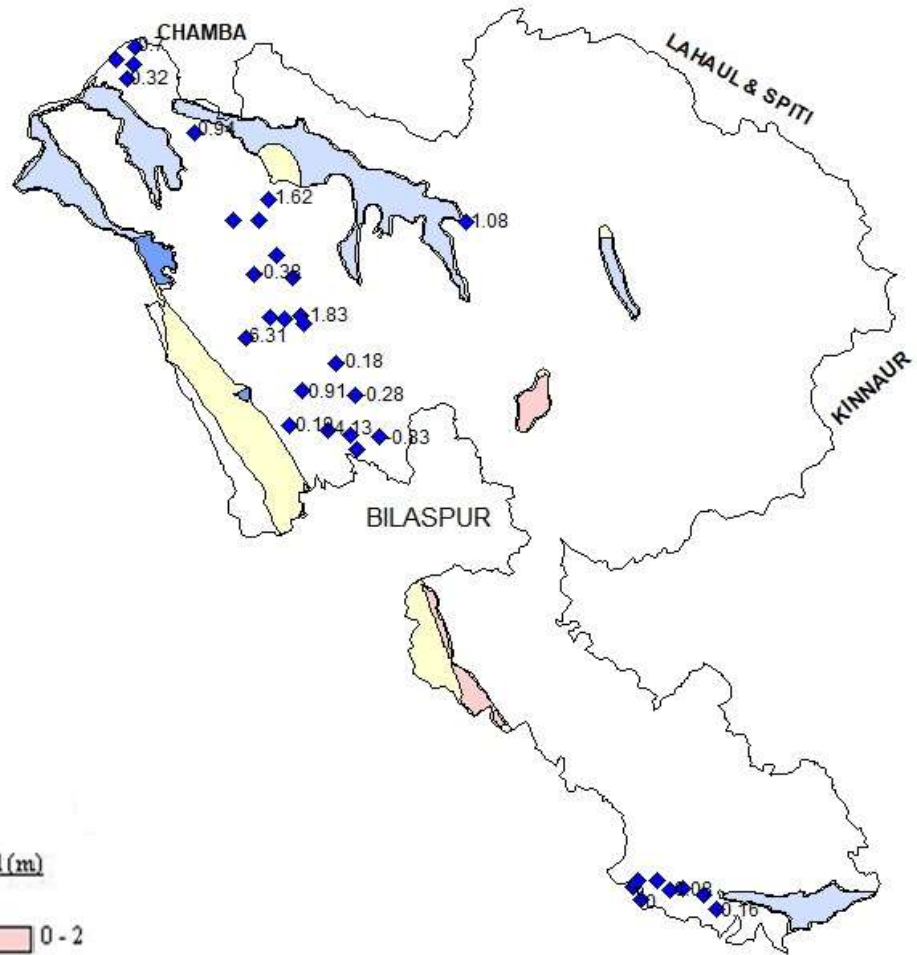
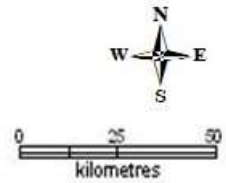


HIMACHAL PRADESH  
DEPTH TO WATER LEVEL  
 JANUARY - 2023



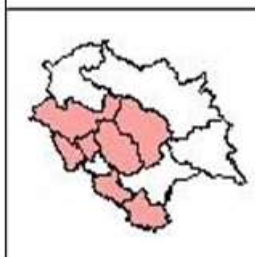
# HIMACHAL PRADESH ANNUAL FLUCTUATION

(May 2021 w.r.t. May 2022)



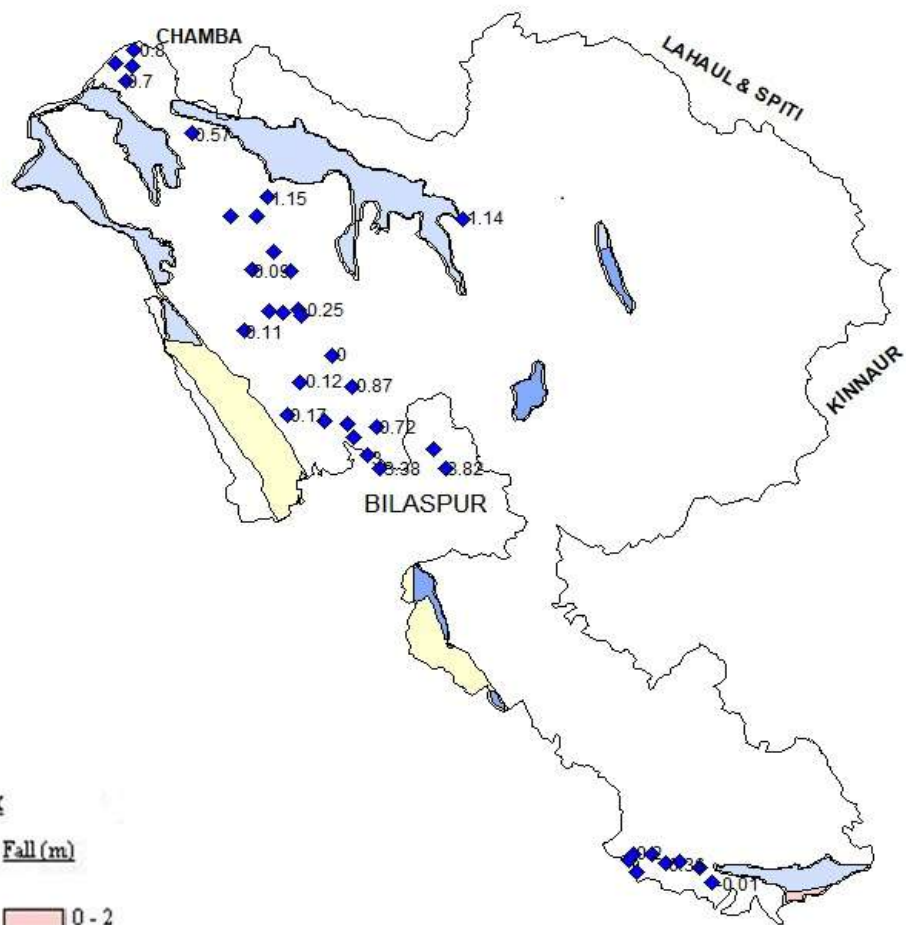
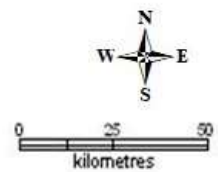
### INDEX

Rise (m)	Fall (m)
0 - 2	0 - 2
2 - 4	2 - 4
>4	>4



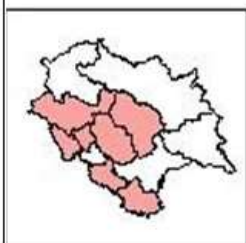
# HIMACHAL PRADESH ANNUAL FLUCTUATION

(Aug 2021 w.r.t Aug 2022)



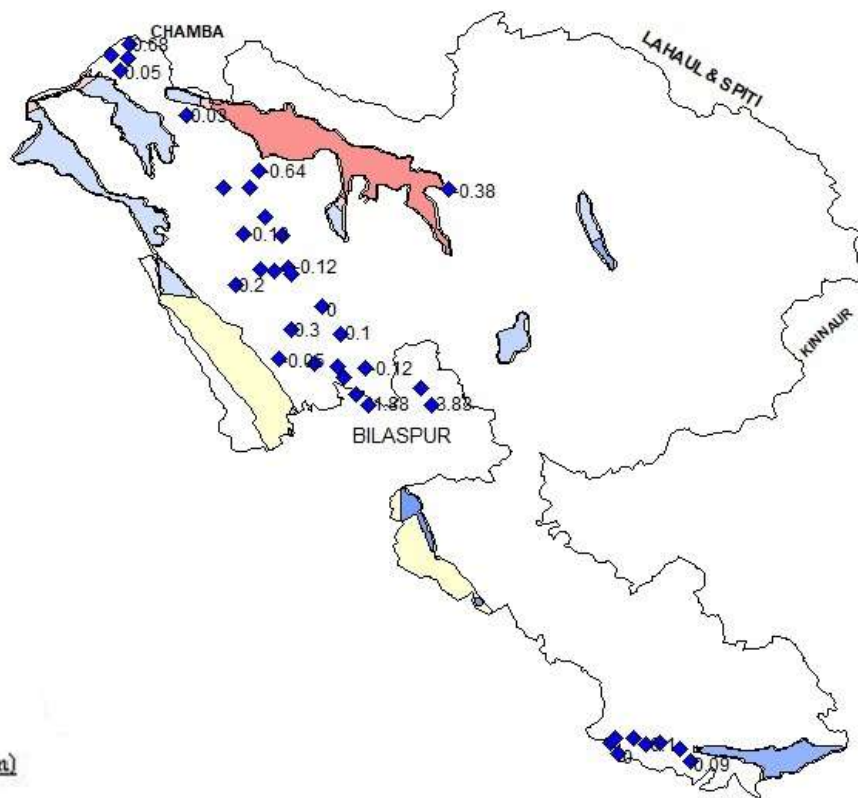
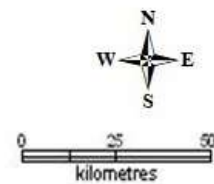
**INDEX**

Rise (m)	Fall (m)
0 - 2	0 - 2
2 - 4	2 - 4
>4	>4



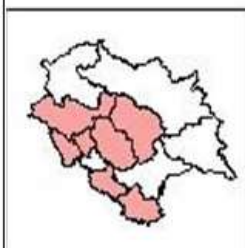
HIMACHAL PRADESH  
ANNUAL FLUCTUATION

(Nov 2021 w.r.t. Nov 2022)



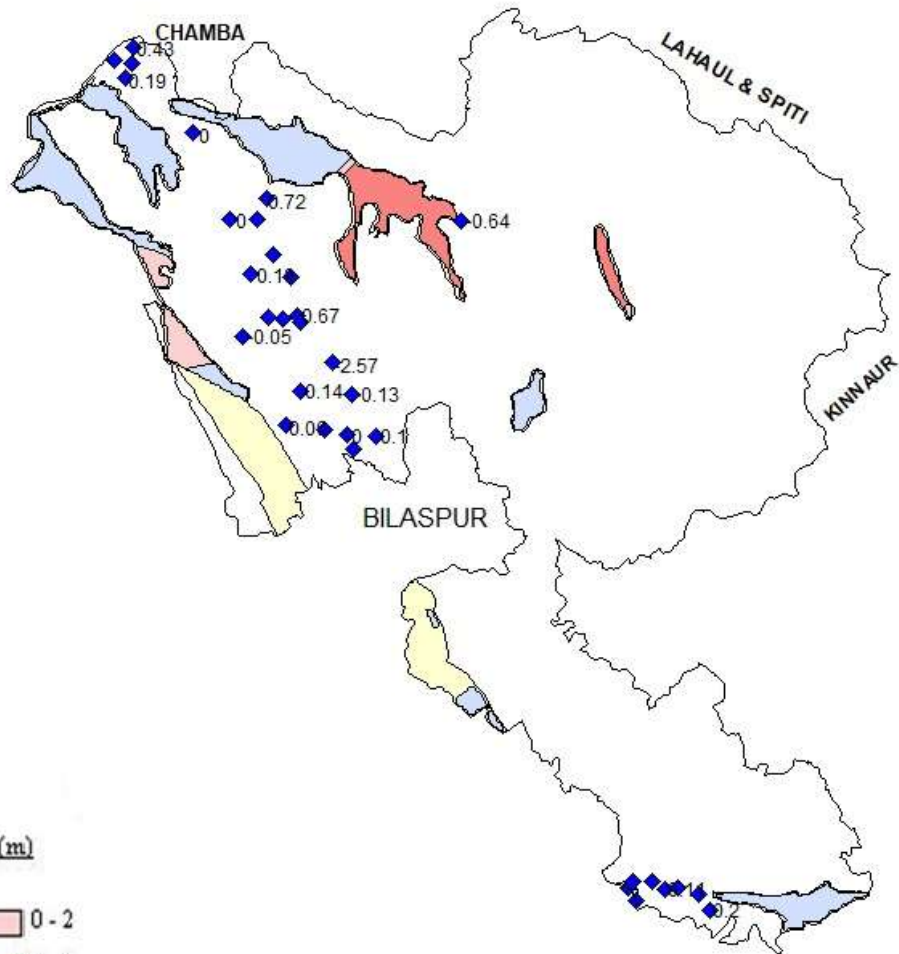
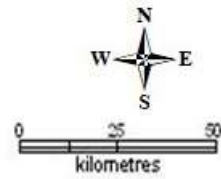
**INDEX**

Rise (m)	Fall (m)
0 - 2	0 - 2
2 - 4	2 - 4
>4	>4



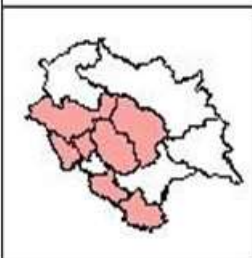
HIMACHAL PRADESH  
ANNUAL FLUCTUATION

(January-22 w.r.t. January 2023)



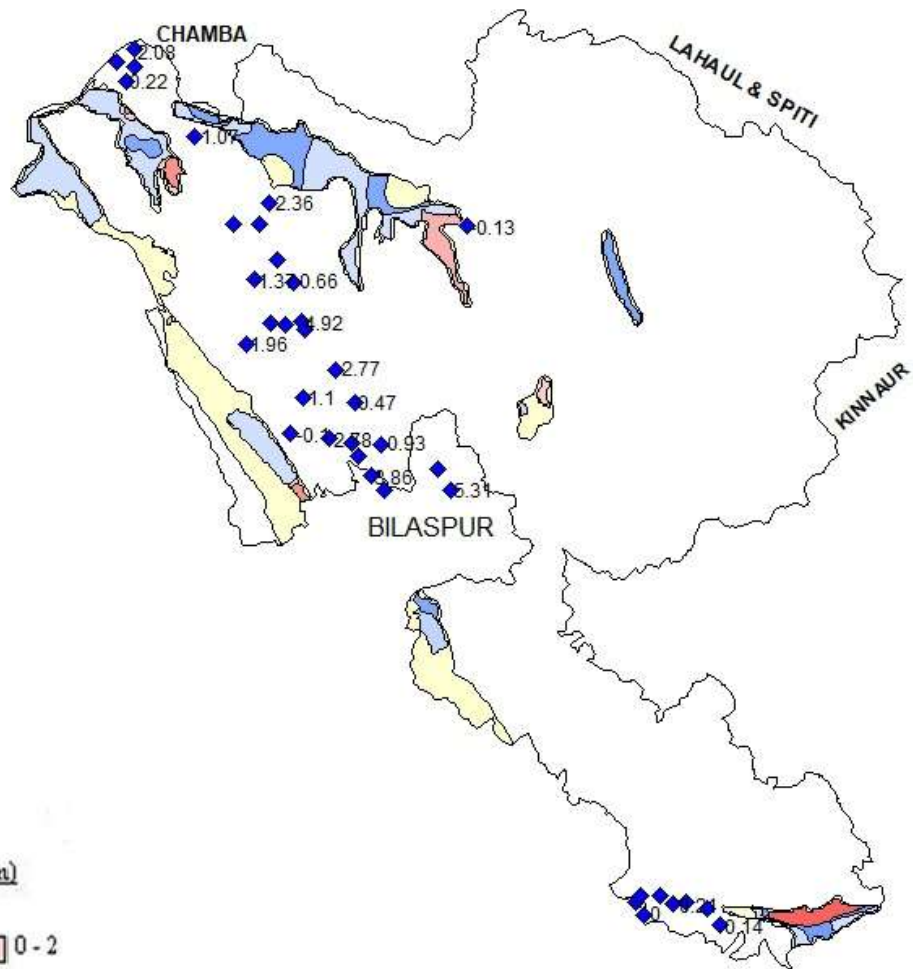
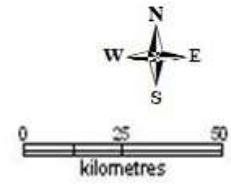
INDEX

Rise (m)	Fall (m)
0 - 2	0 - 2
2 - 4	2 - 4
>4	>4



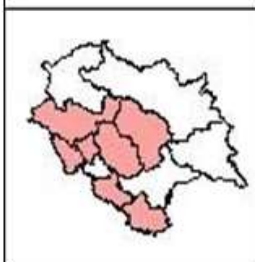
# HIMACHAL PRADESH SEASONAL FLUCTUATION

(May 2022 w.r.t. Nov 2022)



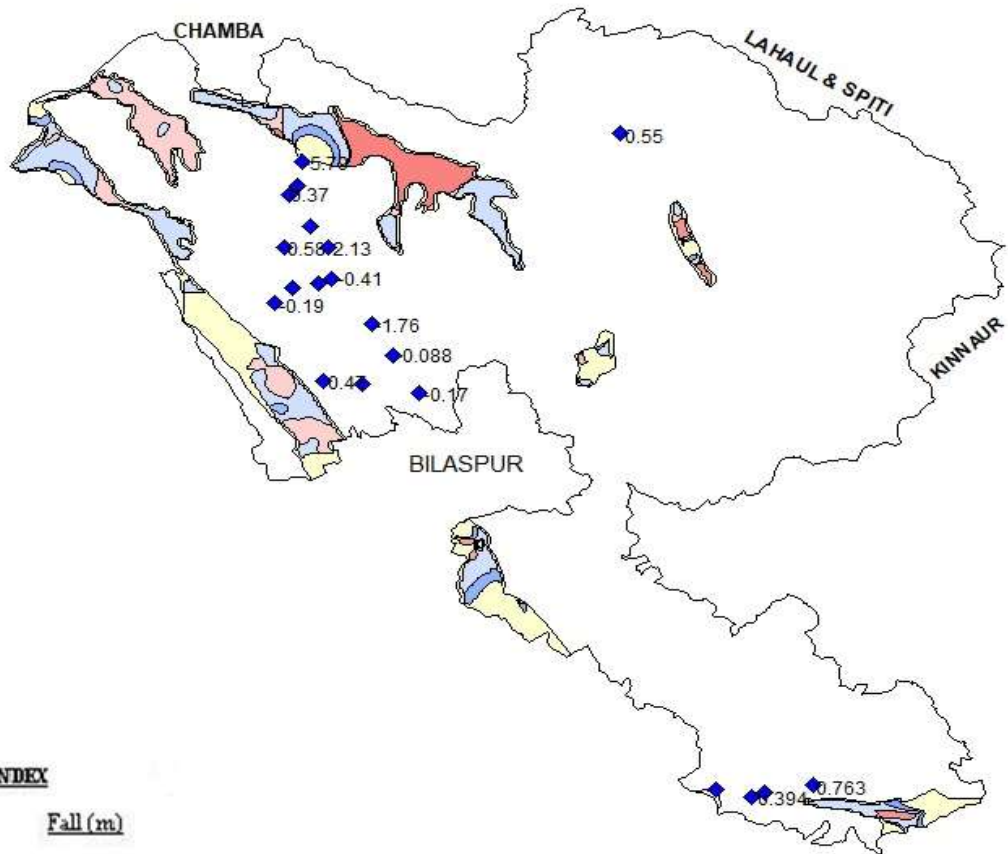
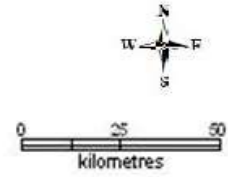
### INDEX

Rise (m)	Fall (m)
0 - 2	0 - 2
2 - 4	2 - 4
>4	>4



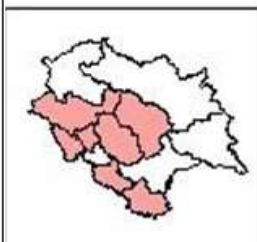
# HIMACHAL PRADESH DECADAL FLUCTUATION

(May 2012 – May 2021) w.r.t. May 2022



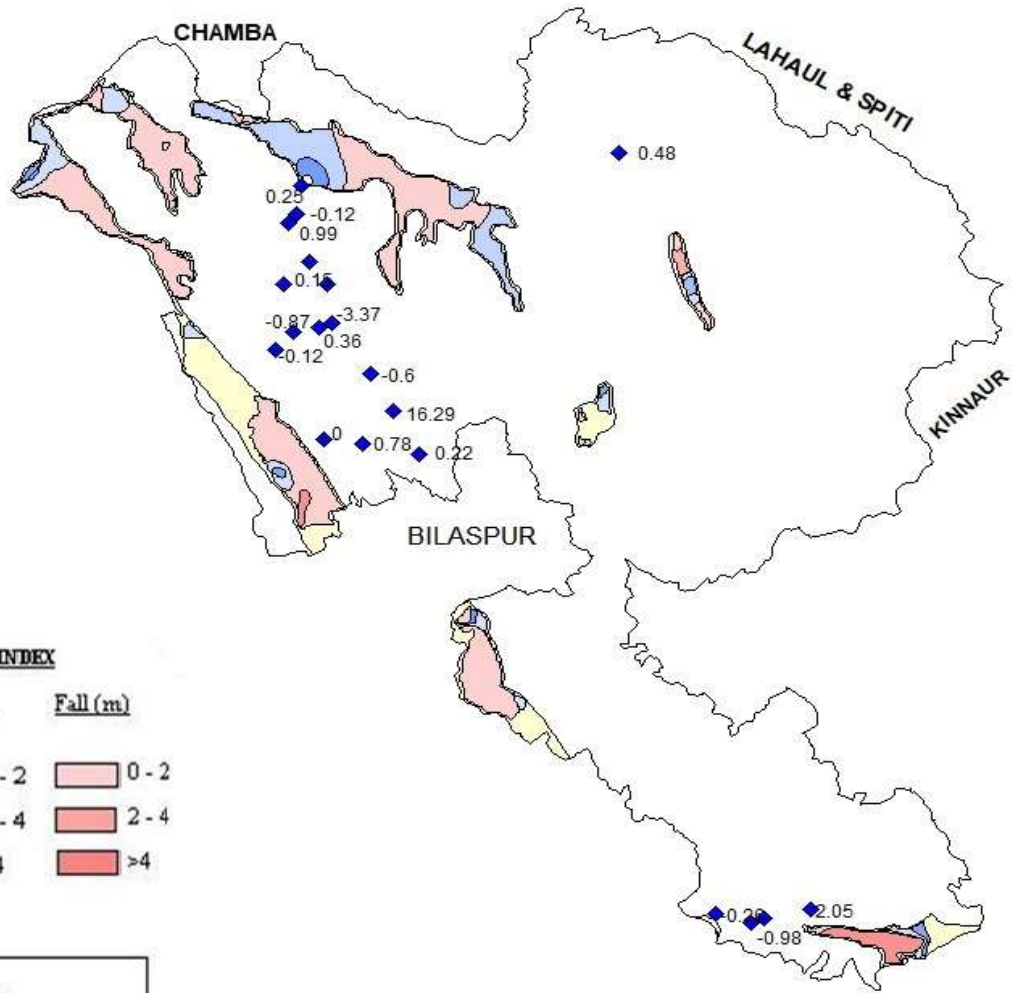
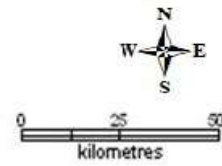
**INDEX**

Rise (m)	Fall (m)
0 - 2	0 - 2
2 - 4	2 - 4
>4	>4



HIMACHAL PRADESH  
DECADAL FLUCTUATION

(Aug 2012 – Aug 2021) w.r.t. Aug 2022



**INDEX**

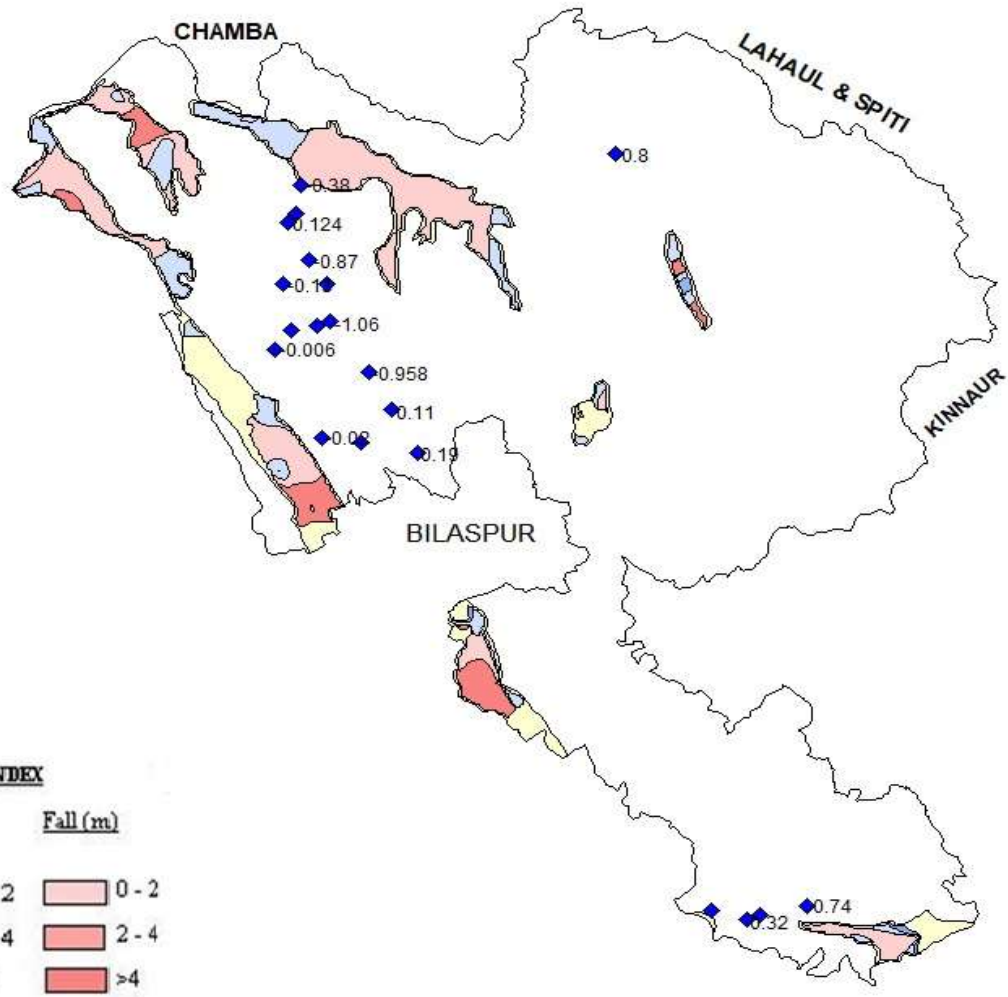
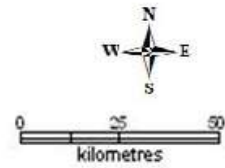
Rise (m)	Fall (m)
0 - 2	0 - 2
2 - 4	2 - 4
>4	>4





# HIMACHAL PRADESH DECADAL FLUCTUATION

(Nov 2012 – Nov 2021) w.r.t. Nov 2022



**INDEX**

Rise (m)	Fall (m)
0 - 2	0 - 2
2 - 4	2 - 4
>4	>4



HIMACHAL PRADESH  
**DECADAL FLUCTUATION**  
 (Jan-2013 – Jan-22 w.r.t. Jan-2023)

