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GOVERNMENT OF INDIA

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

CENTRAL GROUND WATER BOARD

GROUND WATER YEAR BOOK HIMACHAL PRADESH (2021-2022)

NORTHERN HIMALAYAN REGION
DHARAMSHALA
(H.P)
September 2022

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By

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NORTHERN HIMALAYAN REGION
DHARAMSHALA
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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 intermontane 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 2021-22 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 Poonam, Draughtsman,CHQ Faridabad. The chemical results have been analysed 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, Dharamsala. This report has been compiled by Rachna Bhatti, Scientist-D, 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 2021-22 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: 29.09.2022

(J.N.Bhagat)

Dharamshala

Head Of Office

GROUND WATER YEAR BOOK 2021-2022
HIMACHAL PRADESH

EXECUTIVE SUMMARY

- Central Ground Water Board, NHR has set up a network of 128 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 station 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 dugwells 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 128 National Hydrograph Stations are located only in 7 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 2nd 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 2021, ranged between 0.35m (Mandi district) and 28.49 m bgl (Una district). Out of 99 stations monitored, the majority of 86 NHS (86.23%) recorded DTWL, in the range between 2 - 20 m |bgl. 7 stations (7.64%), recorded shallow water levels, less than 2 m bgl and 6 stations (6.15%), recorded deep water levels, more than 20 m bgl in the state.

- The depth to water level recorded during August 2021 ranges between (0.05) m bgl (Kangra district) to 32.35 m bgl (Sirmour district). Out of the 86 stations monitored the majority of 58 stations (67.44%) recorded DTW in the range between 2-20 m bgl, 25 stations (29.41%) have recorded shallow water level less than 2 m bgl, and only 3 stations (3.52%) have shown, more than 20 m bgl in the state.

- The depth to water level recorded during November 2021 ranged between 0.24 m bgl in (Kangra district) to 32.85 m bgl in (Sirmour district). Out of 86 stations monitored, the majority of 61 NHS (70.93%) recorded DTWL, in the range between 2 - 20 m bgl. 23 stations (26.74%), recorded shallow water levels, less than 2 m bgl and 3 stations (3.48%), recorded deep water levels, more than 20 m bgl in the State.

- The depth to water level recorded during January 2022 ranged between 0.24m (Kangra district) to 36.55 m bgl (Sirmour district) . Out of 100 stations which are monitored, the majority of 72 NHS (72%) recorded DTW in the range between 2 - 20 m bgl, 23 stations (23%) recorded shallow water levels, less than 2 m bgl and 3 stations (3%) recorded deep water levels, more than 20 m bgl in the state.

- Monsoonal fluctuation of water level was analyzed for 83 stations for the period May 2021 – November 2021. A perusal of data shows that out of the 83 stations, 73 stations have shown rise in water level and remaining 10 stations have shown fall in water level. The minimum rise

in water level of 0.02 m was observed in Mandi District and the maximum rise 17.53 m was noticed in Sirmour District.

- Annual fluctuation of water level, has been worked out by comparing depth to water level of May 2020, with May 2021 and the data is shows that out of the 78 stations analysed, 8 stations (10.25%) have shown rise in water level ranging from 1.07 (Hamirpur district) to 4.11 m (Kangra district), whereas majority of 69 stations (88.46 %) have shown fall ranging from 0.05m (Mandi district) to 6.85 m (Kangra district).

- Annual fluctuation of water level, of August 2020, with August 2021 and the data shows that out of the 85 stations, 12 stations (14.11 %) have shown rise in water level ranging from 0.03 m (Mandi District) to 5.44 m (Sirmaur district) whereas 72 stations (84.70 %) have shown fall ranging from 0.01 m (Kangra district) to 4.50 m (Una district).

- Annual fluctuation of water level of November 2020 with November 2021 and data shows that out of the 86 stations, 53 stations (61.62%) have shown rise in water level ranging from 0.01m (Solan district) to 17.06 m (Sirmour district) whereas 33 stations (38.37%) have shown fall ranging from 0.01 m (Una district) to 29.77 m (Sirmour district).

- Annual fluctuation of water level of depth to water level of January 2021 with January 2022 shows that out of the 103 stations analyzed, 58 stations (56.31%) have shown rise in water level ranging from 0.06 (Una district) to 29.29 m (Solan district) whereas 45 stations (43.68%) have shown fall ranging from 0.03 (Sirmour district) to 5.51 m (Sirmour district).

- Decadal water level fluctuation by comparing water level data of May 2021 with the average mean of 10 years water level data of May (2011-2020) shows that out of 100 stations analysed, 83 stations (83%) have shown rise and 57 stations (57%), have shown fall in water level. 36 stations (43.37%) are showing rise in water level between 0 to 2m, 4 stations (4.81%) between 2 to 4m and 3 stations (3.61%), more than 4m. Out of 57 stations, 40 stations (70.17%) show fall in water level between 0 to 2m, 12 stations (21.05 %) between 2 to 4 m and 5 stations (8.77%) more than 4m. A minimum rise in water level of 0.01 m was noticed in kangra districts and the maximum rise of 28.68 is noticed in Solan district. Similarly, the minimum fall of 0.04 m is noticed in Sirmour district & maximum fall of 8.64 m is noticed in Sirmour district.

- Decadal water level fluctuation of water level data of August 2021 with the average 10 years water level data of August (2011-2020) and shows that out of 86 stations analyzed, 27 stations (31.39%) have shown rise and 59 stations (68.60%), have shown fall in water level. 21 stations (77.77%) are showing rise in water level between 0 to 2m, 4 stations (14.81%) between 2 to 4m. and 2 stations (7.40%), more than 4m. Out of 59 stations, 45 stations (76.27%) show fall in water level between 0 to 2m, 12 stations (20.33%) between 2 to 4 m and 2 stations (3.38%) more than 4m. A minimum rise in water level of 0.01 m was noticed in Solan district and the maximum rise of 7.78 m is noticed in Sirmaur district. Similarly, the minimum fall of 0.04 m is noticed in Sirmour district & maximum fall of 9.10 m is also noticed in Una district.

- Decadal water level fluctuation by comparing water level data of November 2021 with the average water level data of November for 10 years (2011-2020) shows that out of 86 stations analyzed, 47 stations (54.65%) have shown rise and 38 stations (44.23%), have shown fall in water level. 40 stations (85.10%) are showing rise in water level between 0 to 2m, 5 stations (12.06 %) between 2 to 4m. and 2 stations (4.25%), more than 4m. Out of 38 stations, 36 stations (94.73%) show fall in water level between 0 to 2m, 1 stations (2.63%) between 2 to 4 m and 1 stations (2.63 %) more than 4m. A minimum rise in water level of 0.03 m was noticed in Una district and the maximum rise of 14.87 m is noticed in Sirmour district. Similarly, the minimum fall of 0.03 m is noticed in Hamirpur district & maximum fall of 29.77 m is noticed in Sirmour district.

- Decadal water level fluctuation by comparing water level data of January 2022 with the average water level data of January for 10 years (2012-2021) shows that out of 104 stations analysed, 58stations (55.76 %) have shown rise and 46 stations (44.23%), have shown fall in water level. 47stations (81.03%) are showing rise in water level between 0 to 2m, 7 stations (12.06%) between 2 to 4m. and 4 stations (6.89%), more than 4m. Out of 46 stations, 40 stations (86.95%) show fall in water level between 0 to 2m, 4 stations (8.69%) between 2 to 4 m and 2 stations (4.34%) more than 4m. A minimum rise in water level of 0.03 m was noticed in Kangra district and the maximum rise of 25.89 m is noticed in Solan district. Similarly, the minimum fall of 0.02 m is noticed in Una district & maximum fall of 12.47 m is noticed in Sirmaur district.

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1.0 INTRODUCTION

Himachal Pradesh is located between the north latitude 30°22'40" & 33°12'40" and east longitude 75°47'55" & 79°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 disrtict. The state is bounded by the state of Jammu & Kashmir in north, Punjab state in west, Haryana state in south and Uttrakhand 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 Zanskar 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 Zanskar 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 these 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 rainfall during monsoon period from July to September and about 30% occurs during non-monsoon period due to western disturbances and in the form of thunderstorm. Generally, rainfall increases from south to north. Western disturbances also shower rainfall in winters. Beyond Kullu towards Lahaul & Spiti and Kinnaur, rainfall 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

The ground water monitoring is being carried out by Northern Himalayan Region, Dharamshala, since 1996. All the 128 GWMS are dug wells and are located in 7 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	4	4	-	-
2.	Kangra	46	31	15	-
3.	Kullu	4	4	-	-
4.	Mandi	9	9	-	-
5.	Sirmaur	17	15	2	-
6.	Solan	16	16	-	-
7.	Una	31	31	-	-
8.	Chamba	1	-	1	-
TOTAL		**128**	**110**	**18**	**-**

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
POROUS FORMATIONS			
Recent to sub Recent	Boulder, Cobble, Pebble, Sand, Silt, Clay,	Kangra, Una, Solan, Sirmaur, Mandi and Kullu	High Yield 30-75 m^3/hr
FISSURED FORMATIONS			
Tertiary	Boulder Conglomerate Sandstone, Clay	Kangra, Solan, Sirmaur Bilaspur, Una, Mandi, and Hamirpur .	Moderate to Low Yield < 30 m^3/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^3/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 though 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 $30m^3$/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 GROUND WATER 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^{th} to 30^{th} : represents water level of Pre-monsoon period
2. August : 20^{th} to 30^{th} : represents peak monsoon water level.
3. November : 1^{st} to 10^{th} : represents water level of Post-monsoon period.
4. January : 1^{st} to 10^{th} : 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.

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.
C. Annual fluctuation maps : Water level fluctuation in comparison to same month in 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.

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.

3.1 Depth to Water Level

3.1.1 May 2021

The depth to water level, recorded during May 2021 (Annexure - I), ranged between 0.35m (Mandi district) and 28.49 m bgl (Una district) (Table-3). Out of 99 stations monitored, the majority of 86 NHS (86.23%) recorded DTWL, in the range between 2 - 20 m |bgl. 7 stations (7.64%), recorded shallow water levels, less than 2 m bgl and 6 stations (6.15%), recorded deep water levels, more than 20 m bgl in the state.

Table-3: District wise number & % of NHS distribution, in different DWL of May 2021

Depth to Water Table
Distribution of Percentage of Observation Wells
2021/May

State : Himachal Pradesh

District	No. of Wells Analysed	Depth to Water Table (mbgl)		No. / Percentage of Wells Showing Depth to Water Table (mbgl) 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	4	2.12	10.35	0	2 50.00%	1 25.00%	1 25.00 %	0	0
KANGRA	33	0.67	17.15	3 9.09%	12 36.36%	13 39.39%	5 15.15 %	0	0
KULLU	2	0.88	8.09	1 50.00%	0	1 50.00%	0	0	0
MANDI	8	0.35	12.00	2 25.00%	5 62.50%	0	1 12.50 %	0	0
SIRMAUR	12	2.15	27.21	0	2 16.67%	1 8.33%	7 58.33 %	2 16.67%	0
SOLAN	9	5.77	24.98	0	0	3 33.33%	4 44.44 %	2 22.22%	0
UNA	31	1.29	28.49	1 3.23%	11 35.48%	12 38.71%	5 16.13 %	2 6.45%	0
Total	99	0.35	28.49	7	32	31	23	6	0

A perusal of the DTWL map of May 2021 shows that the shallow water level area of less than 2m 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 10-20m 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 2021

The depth to water level recorded during August 2021 (Annexure - I) ranges between (0.05) m bgl (Kangra district) to 32.35 m bgl (Sirmour district) (Table-4). Out of the 86 stations monitored the majority of 58 stations (67.44%) recorded DTW in the range between 2-20 m bgl, 25 stations (29.41%) have recorded shallow water level less than 2 m bgl, and only 3 stations (3.52%) have shown, more than 20 m bgl in the state.

Table-4:– Depth to water level - August 2021

Depth to Water Table
Distribution of Percentage of Observation Wells
2021/Aug

State : Himachal Pradesh

District	No. of Wells Analysed	Depth to Water Table (mbgl)		No. / Percentage of Wells Showing Depth to Water Table (mbgl) 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	2	1.71	1.96	2 100.00%	0	0	0	0	0
KANGRA	25	0.05	8.59	10 40.00%	10 40.00%	5 20.00%	0	0	0
KULLU	2	0.43	7.24	1 50.00%	0	1 50.00%	0	0	0
MANDI	8	0.29	4.00	3 37.50%	5 62.50%	0	0	0	0
SIRMAUR	13	1.73	32.35	1 7.69%	5 38.46%	3 23.08%	3 23.08 %	1 7.69%	0
SOLAN	6	4.81	20.00	0	1 16.67%	1 16.67%	4 66.67 %	0	0
UNA	30	0.59	28.77	8 26.67%	9 30.00%	6 20.00%	5 16.67 %	2 6.67%	0
Total	86	0.05	32.35	25	30	16	12	3	0

A perusal of the DTW map for August 2021 indicates that the shallow water level area less than 2m bgl occurs in all the valleys of Himachal Pradesh, except Nalagarh and Paonta 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 . 2-5m 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 2021

The depth to water level recorded during November 2021 (Annexure - I) ranged between 0.24 m bgl in (Kangra district) to 32.85 m bgl in (Sirmour district) (Table-5). Out of 86 stations monitored, the majority of 61 NHS (70.93%) recorded DTWL, in the range between 2 - 20 m bgl. 23 stations (26.74%), recorded shallow water levels, less than 2 m bgl and 3 stations (3.48%), recorded deep water levels, more than 20 m bgl in the State.

A perusal of the DTWL map for November 2021shows that the shallow water level areas of less than 2 m observed in southern part of Kangra Palampur valley and northern part of Kullu valley. Water level of 2-5m & 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 20m is confined mainly in northern part of Paonta valley in Sirmaur district, northern part of Nalagarh valley of Solan district and northern part of Una valley.

Table- 5: Depth to Water Level – November 2021

Depth to Water Table
Distribution of Percentage of Observation Wells
2021/Nov

State : Himachal Pradesh

District	No. of Wells Analysed	Depth to Water Table (mbgl)		No. / Percentage of Wells Showing Depth to Water Table (mbgl) 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	3	1.90	4.87	1 33.33%	2 66.67%	0	0	0	0
KANGRA	26	0.24	9.03	8 30.77%	14 53.85%	4 15.38%	0	0	0
KULLU	2	0.99	6.46	1 50.00%	0	1 50.00%	0	0	0
MANDI	6	0.33	4.44	2 33.33%	4 66.67%	0	0	0	0
SIRMAUR	12	1.45	32.85	1 8.33%	2 16.67%	5 41.67%	3 25.00 %	1 8.33%	0
SOLAN	8	5.16	19.92	0	0	2 25.00%	6 75.00 %	0	0
UNA	29	1.15	22.30	10 34.48%	7 24.14%	6 20.69%	5 17.24 %	1 3.45%	0
Total	86	0.24	32.85	23	29	18	14	2	0

3.1.4 January 2022

The depth to water level recorded during January 2022 (Annexure - I) ranged between 0.24m (Kangra district) to 36.55 m bgl (Sirmour district) (Table-6). Out of 100 stations which are monitored, the majority of 72 NHS (72%) recorded DTW in the range between 2 - 20 m bgl, 23 stations (23%) recorded shallow water levels, less than 2 m bgl and 3 stations (3%) recorded deep water levels, more than 20 m bgl in the state.

A perusal of the DTW map of January 2021 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 & 5-10m 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- 6: Depth to Water Level – January 2022

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

State : Himachal Pradesh

District	No. of Wells Analysed	Depth to Water Table (mbgl)		No. / Percentage of Wells Showing Depth to Water Table (mbgl) 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	3	1.74	5.16	1 33.33%	1 33.33%	1 33.33%	0	0	0
KANGRA	34	0.24	12.93	10 29.41%	15 44.12%	7 20.59%	2 5.88 %	0	0
KULLU	2	1.08	7.39	1 50.00%	0	1 50.00%	0	0	0
MANDI	8	0.29	7.56	2 25.00%	5 62.50%	1 12.50%	0	0	0
SIRMAUR	13	1.80	36.55	1 7.69%	1 7.69%	3 23.08%	6 46.15 %	2 15.38%	0
SOLAN	9	5.06	24.25	0	0	2 22.22%	5 55.56 %	2 22.22%	0
UNA	31	1.08	28.58	8 25.81%	11 35.48%	5 16.13%	6 19.35 %	1 3.23%	0
Total	100	0.24	36.55	23	33	20	19	5	0

3.2 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.

3.2.1 May 2021 to November 2021

Monsoonal fluctuation of water level was analyzed for 83 stations for the period May 2021 – November 2021. A perusal of Table-8 shows that out of the 83 stations, 73 stations have shown rise in water level and remaining 10 stations have shown fall in water level.

The minimum rise in water level of 0.02 m was observed in Mandi District and the maximum rise 17.53 m was noticed in Sirmour District. Out of the 73 stations which have shown rise in water level, 46 stations show rise between the range of 0 to 2m, 10 stations between 2 to 4m and remaining 17 stations show rise more than 4m.

The minimum and maximum fall in water level of 0.09 m was observed in Una District. Out of them 8 stations have shown fall between 0-2 m, No stations has shown fall between 2-4 m 2 stations have shown fall >4m.

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 - May 2021 to November 2021

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

From Year: 2021/May - **To Year:** 2021/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	3	0.09	1.00	-	-	3 100.00%	0	0	0	0	0	3	0
KANGRA	24	0.14	6.77	0.34	0.41	12 50.00%	5 20.83 %	5 20.83%	2 8.33%	0	0	22	2
KULLU	2	1.63	1.63	0.11	0.11	1 50.00%	0	0	1 50.00%	0	0	1	1
MANDI	6	0.02	0.83	0.23	0.28	4 66.67%	0	0	2 33.33%	0	0	4	2
SIRMAUR	12	0.19	17.53	10.53	32.85	4 33.33%	1 8.33 %	5 41.67%	0	0	2 16.67%	10	2
SOLAN	8	0.04	6.15	-	-	3 37.50%	2 25.00 %	3 37.50%	0	0	0	8	0
UNA	28	0.14	13.45	0.09	1.95	19 67.86%	2 7.14 %	4 14.29%	3 10.71%	0	0	25	3
Total	83	1.63	0.83	0.00	32.85	46	10	17	8	0	2	73	10

3.3 Annual Water Level Fluctuation

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

3.3.1 May 2020 to May 2021

Annual fluctuation of water level, has been worked out by comparing depth to water level of May 2020, with May 2021 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 78 stations analysed, 8 stations (10.25%) have shown rise in water level ranging from 1.07 (Hamirpur district) to 4.11 m (Kangra district), whereas majority of 69 stations (88.46 %) have shown fall ranging from 0.05m (Mandi district) to 6.85 m (Kangra district).

Out of 8 stations which have shown rise in water level, 6 stations (75%) show rise between the range of 0 to 2m, 1 station (12.5%) has shown rise between 2 to 4m and only 1 stations (12.5%) shown rise more than 4m.

Similarly, for 69 stations which have shown fall in water level, 55 stations (79.71%) show fall between the range of 0 to 2m, 10stations(14.49%) has shown fall between 2 to 4m and 4 stations (5.79%) has shown fall more than 4m.

A perusal of map of Annual Water Level Fluctuation for May 2020 to May 2021 shows fall in water level in majority of monitoring areas, specially in complete Una valley and Indora-Nurpur valley, except a couple of areas. Fall of 0-2m 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 2020 - May 2021)

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

From Year: 2020/May - **To Year:** 2021/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	4	1.07	1.07	0.24	3.96	1 25.00%	0	0	2 50.00%	1 25.00%	0	1	3
KANGRA	33	0.06	4.11	0.06	6.85	3 9.09%	1 3.03 %	1 3.03%	19 57.58%	7 21.21%	2 6.06%	5	28
KULLU	2	-	-	0.34	1.75	0	0	0	2 100.0%	0	0	0	2
MANDI	8	0.16	1.66	0.05	0.41	2 25.00%	0	0	5 62.50%	0	0	2	5
UNA	31	-	-	0.08	6.15	0	0	0	27 87.10%	2 6.45%	2 6.45%	0	31
Total	78	1.07	1.07	0.05	6.85	6	1	1	55	10	4	8	69

3.3.2 August 2020 to August 2021

Annual fluctuation of water level, has been worked out by comparing depth to water level of August 2020, with August 2021 and the data is presented in Annexure – III and its frequency distribution of rise and fall is given in Table-10.

Out of the 85 stations, 12 stations (14.11 %) have shown rise in water level ranging from 0.03 m (Mandi District) to 5.44 m (Sirmaur district) whereas 72 stations (84.70 %) have shown fall ranging from 0.01 m (Kangra district) to 4.50 m (Una district).

Out of 12 stations, which have shown rise in water level, 11 stations (91.66%) show rise between the range of 0 to 2m, 7 and remaining 1 station (8.33%) show rise more than 4m.

Similarly, for the 72 stations which have shown fall in water level, 60 stations (83.33%) show fall between the range of 0 to 2m, 10 stations (13.88%) between 2 to 4m and remaining 2 stations (2.77%) show fall more than 4m.

A perusal of map of Annual Water Level Fluctuation for August 2020 to August 2021 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 2020 - August 2021

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

From Year: 2020/Aug - **To Year:** 2021/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	-	-	0.05	0.18	0	0	0	2 100.0%	0	0	0	2
KANGRA	25	1.14	1.14	0.01	4.11	1 4.00%	0	0	21 84.00%	1 4.00%	1 4.00%	1	23
KULLU	2	-	-	0.03	0.90	0	0	0	2 100.0%	0	0	0	2
MANDI	8	0.03	0.48	0.04	1.39	5 62.50%	0	0	3 37.50%	0	0	5	3
SIRMAUR	13	0.08	5.40	0.09	2.48	4 30.77%	0	1 7.69%	6 46.15%	2 15.38%	0	5	8
SOLAN	6	-	-	0.46	3.68	0	0	0	3 50.00%	3 50.00%	0	0	6
UNA	29	0.31	0.31	0.13	4.50	1 3.45%	0	0	23 79.31%	4 13.79%	1 3.45%	1	28
Total	85	1.14	0.31	0.01	4.50	11	0	1	60	10	2	12	72

3.3.3 November 2019 to November 2020

Annual fluctuation of water level has been worked out by comparing DTWL of November 2020 with November 2021 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 86 stations, 53 stations (61.62%) have shown rise in water level ranging from 0.01m (Solan district) to 17.06 m (Sirmour district) whereas 33 stations (38.37%) have shown fall ranging from 0.01 m (Una district) to 29.77 m (Sirmour district).

Out of 53 stations which have shown rise in water level, 48 stations (90.56%) show rise between the range of 0 to 2m, 1 station (1.88%) between 2 to 4m and 4 stations (7.54%) more than 4m rise. Similarly, for the 33 stations which have shown fall in water level, 31 stations (93.93%) show fall between the range of 0 to 2m, 1 station (3.03 %) has shown fall between 2 to 4m and and more than 4m.

A perusal of map of annual fluctuation of November 2020 to November 2021 showing fall in water levels in Nurpur Indora valley and central part of Una valley . Nallagarh valley of Solan district and in Paonta valley, are showing rise in water level when compared from previous year. .Similarly rise in water level 0-2m is noticed along the fringe areas of all monitoring valleys. Rise more than 4 m is shown in western part of Kangra Palampur Valley part of Una valley , small pockets of Nurpur and Indaura Valley.

Table-11: Annual Fluctuation -November 2020 to November 2021

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

From Year: 2020/Nov - **To Year:** 2021/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	3	0.17	0.24	-	-	3 100.00%	0	0	0	0	0	3	0
KANGRA	26	0.17	2.08	0.03	1.69	15 57.69%	1 3.85 %	0	10 38.46%	0	0	16	10
KULLU	2	0.29	0.29	0.10	0.10	1 50.00%	0	0	1 50.00%	0	0	1	1
MANDI	6	0.08	0.76	0.59	0.59	5 83.33%	0	0	1 16.67%	0	0	5	1
SIRMAUR	12	0.16	17.06	0.01	29.77	6 50.00%	0	1 8.33%	4 33.33%	0	1 8.33%	7	5
SOLAN	8	0.01	0.89	0.09	1.24	3 37.50%	0	0	5 62.50%	0	0	3	5
UNA	29	0.06	11.81	0.01	2.99	15 51.72%	0	3 10.34%	10 34.48%	1 3.45%	0	18	11
Total	86	0.29	0.24	0.00	29.77	48	1	4	31	1	1	53	33

3.3.4 January 2021 to January 2022

Annual fluctuation of water level has been worked out by comparing depth to water level of January 2021 with January 2022 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 103 stations analyzed, 58 stations (56.31%) have shown rise in water level ranging from 0.06 (Una district) to 29.29 m (Solan district) whereas 45 stations (43.68%) have shown fall ranging from 0.03 (Sirmour district) to 5.51 m (Sirmour district).

Out of 58 stations which have shown rise in water level, 52 stations (89.65 %) show rise between the range of 0 to 2m, 2 stations(3.44%) between 2 to 4m and 4 stations(6.89%) more than 4m.

Similarly, for 45 stations which have shown fall in water level, 36 stations (80%) show fall between the range of 0 to 2m, 7 stations (15.55 %) between 2 to 4m and 2 stations (4.45) has shown fall >4m.

A perusal of map of annual fluctuation of January 2021 to January 2022 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 2021 to January 2022

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

From Year: 2021/Jan - **To Year:** 2022/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	4	0.10	5.72	0.13	0.53	1 25.00%	0	1 25.00%	2 50.00%	0	0	2	2
KANGRA	35	0.10	3.88	0.09	3.77	24 68.57%	2 5.71 %	0	7 20.00%	2 5.71%	0	26	9
KULLU	2	-	-	0.30	0.38	0	0	0	2 100.0%	0	0	0	2
MANDI	7	0.15	1.72	0.11	0.23	5 71.43%	0	0	2 28.57%	0	0	5	2
SIRMAUR	13	0.11	13.35	0.03	5.51	7 53.85%	0	1 7.69%	2 15.38%	2 15.38%	1 7.69%	8	5
SOLAN	11	0.08	29.29	0.07	4.89	3 27.27%	0	2 18.18%	4 36.36%	1 9.09%	1 9.09%	5	6
UNA	31	0.06	0.83	0.05	2.47	12 38.71%	0	0	17 54.84%	2 6.45%	0	12	19
Total	103	0.15	0.83	0.03	5.51	52	2	4	36	7	2	58	45

3.4 Decadal Fluctuations

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

3.4.1 Decadal average of May (2011-2020) to May 2021

Decadal water level fluctuation has been worked out by comparing water level data of May 2021 with the average mean of 10 years water level data of May (2011-2020) 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 100 stations analysed, 83 stations (83%) have shown rise and 57 stations (57%), have shown fall in water level. 36 stations (43.37%) are showing rise in water level between 0 to 2m, 4 stations (4.81%) between 2 to 4m and 3 stations (3.61%), more than 4m.

Out of 57 stations, 40 stations (70.17%) show fall in water level between 0 to 2m, 12 stations (21.05 %) between 2 to 4 m and 5 stations (8.77%) more than 4m.

A minimum rise in water level of 0.01 m was noticed in kangra districts and the maximum rise of 28.68 is noticed in Solan district. Similarly, the minimum fall of 0.04 m is noticed in Sirmour district & maximum fall of 8.64 m is noticed in Sirmour district.

A perusal of map of Decadal Variation - Average of May (2011 - 2020) with May 2021 reveals fall less than 2m, 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 2-4m and >4 m is shwon in Nurpur valley,central part of Kullu valley.

Table-13: District wise number & % of NHS distribution in different Decadal Water Level Fluctuation Range for May (2011-2020) to May 2021

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

10 Years Mean (2011 May - 2020 May) - 2021/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	4	0.15	0.73	1.76	1.76	3 75.00 %	0	0	1 25.00%	0	0	3	1
KANGRA	33	0.01	2.36	0.28	8.50	12 36.36 %	1 3.03%	0	15 45.45%	3 9.09 %	2 6.06%	13	20
KULLU	2	-	-	0.17	2.20	0	0	0	1 50.00%	1 50.00 %	0	0	2
MANDI	8	0.05	2.70	0.08	4.92	3 37.50 %	1 12.50%	0	3 37.50%	0	1 12.50%	4	4
SIRMAUR	12	0.15	13.05	0.04	8.64	2 16.67 %	1 8.33%	1 8.33 %	4 33.33%	3 25.00 %	1 8.33%	4	8
SOLAN	10	0.19	28.68	0.87	2.76	2 20.00 %	0	2 20.00%	3 30.00%	3 30.00 %	0	4	6
UNA	31	.00	2.62	0.04	7.29	14 45.16 %	1 3.23%	0	13 41.94%	2 6.45 %	1 3.23%	15	16
Total	100	0.73	0.19	0.04	8.64	36	4	3	40	12	5	43	57

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3.4.2 Decadal Average of August (2011 - 2020) to August 2021

Decadal water level fluctuation has been worked out by comparing water level data of August 2021 with the average 10 years water level data of August (2011-2020) 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 86 stations analyzed, 27 stations (31.39%) have shown rise and 59 stations (68.60%), have shown fall in water level. 21 stations (77.77%) are showing rise in water level between 0 to 2m, 4 stations (14.81%) between 2 to 4m. and 2 stations (7.40%), more than 4m.

Out of 59 stations, 45 stations (76.27%) show fall in water level between 0 to 2m, 12 stations (20.33%) between 2 to 4 m and 2 stations (3.38%) more than 4m.

A minimum rise in water level of 0.01 m was noticed in Solan district and the maximum rise of 7.78 m is noticed in Sirmaur district. Similarly, the minimum fall of 0.04 m is noticed in Sirmour district & maximum fall of 9.10 m is also noticed in Una district.

A perusal of map Decadal Average of August (2011 - 2020) to August 2021 shows fall in water level majority areas of all the valley areas, except a few palces in all valleys which are showing rise. Fall is shown in Nurpur and Nalagarh valley except 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 couple of pockets of Kangra-Palampur valley. 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 (2011-2020) to August 2021

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

10 Years Mean (2011 Aug - 2020 Aug) - 2021/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	-	-	0.06	0.18	0	0	0	2 100.0%	0	0	0	2
KANGRA	25	.00	1.67	0.05	4.24	7 28.00 %	0	0	14 56.00%	3 12.00 %	1 4.00%	7	18
KULLU	2	0.37	0.37	1.82	1.82	1 50.00 %	0	0	1 50.00%	0	0	1	1
MANDI	8	0.02	1.64	0.24	0.80	6 75.00 %	0	0	2 25.00%	0	0	6	2
SIRMAUR	13	2.31	7.78	0.58	2.65	0	2 15.38%	2 15.38%	6 46.15%	3 23.08 %	0	4	9
SOLAN	6	0.01	3.21	0.69	2.16	2 33.33 %	1 16.67%	0	2 33.33%	1 16.67 %	0	3	3
UNA	30	.00	2.90	0.04	9.10	5 16.67 %	1 3.33%	0	18 60.00%	5 16.67 %	1 3.33%	6	24
Total	86	0.37	2.31	0.04	9.10	21	4	2	45	12	2	27	59

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3.4.3 Decadal average of November (2011-2020) to November 2021

Decadal water level fluctuation has been worked out by comparing water level data of November 2021 with the average water level data of November for 10 years (2011-2020) and is presented in Annexure - IV and frequency distribution in various ranges in Table 15.

A perusal of Table-15 shows that out of 86 stations analyzed, 47 stations (54.65%) have shown rise and 38 stations (44.23%), have shown fall in water level. 40 stations (85.10%) are

showing rise in water level between 0 to 2m, 5 stations (12.06 %) between 2 to 4m. and 2 stations (4.25%), more than 4m.

Out of 38 stations, 36 stations (94.73%) show fall in water level between 0 to 2m, 1 stations (2.63%) between 2 to 4 m and 1 stations (2.63 %) more than 4m.

A minimum rise in water level of 0.03 m was noticed in Una district and the maximum rise of 14.87 m is noticed in Sirmour district. Similarly, the minimum fall of 0.03 m is noticed in Hamirpur district & maximum fall of 29.77 m is noticed in Sirmour district.

A perusal of map of Decadal average of November (2011-2020) to November 2021 reveals rise in water level less than 2m is shown in whole part of Kangra - Palampur valley & Indaura valley of Kangra districtexcept 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, eastern part of Indaura Valley, Balh valley and Paonta valley. Similarly, rise is noticed in all the valleys from 0-2 m and 2- 4m except in major part of Una valley.

Table-15: Decadal Fluctuation November (2011-2020) to November 2021

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

10 Years Mean (2011 Nov - 2020 Nov) - 2021/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	3	.00	0.32	0.03	0.03	2 66.67 %	0	0	1 33.33%	0	0	2	1
KANGRA	26	0.06	1.24	0.02	1.07	12 46.15 %	0	0	14 53.85%	0	0	12	14
KULLU	2	0.22	0.22	0.47	0.47	1 50.00 %	0	0	1 50.00%	0	0	1	1
MANDI	6	0.07	0.26	0.36	0.60	3 50.00 %	0	0	3 50.00%	0	0	3	3
SIRMAUR	12	0.07	14.87	0.12	29.77	4 33.33 %	1 8.33%	1 8.33 %	5 41.67%	0	1 8.33%	6	6
SOLAN	8	0.13	3.53	0.07	1.42	3 37.50 %	2 25.00%	0	3 37.50%	0	0	5	3
UNA	29	0.03	13.24	0.13	2.58	15 51.72 %	2 6.90%	1 3.45 %	9 31.03%	1 3.45 %	0	18	10
Total	86	0.22	0.22	0.02	29.77	40	5	2	36	1	1	47	38

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3.4.4 Decadal average of January (2012-2021) to January 2022

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

A perusal of Table-15 shows that out of 104 stations analysed, 58stations (55.76 %) have shown rise and 46 stations (44.23%), have shown fall in water level. 47stations (81.03%) are showing rise in water level between 0 to 2m, 7 stations (12.06%) between 2 to 4m. and 4 stations (6.89%), more than 4m. Out of 46 stations, 40 stations (86.95%) show fall in water level between 0 to 2m, 4 stations (8.69%) between 2 to 4 m and 2 stations (4.34%) more than 4m.

A minimum rise in water level of 0.03 m was noticed in Kangra district and the maximum rise of 25.89 m is noticed in Solan district. Similarly, the minimum fall of 0.02 m is noticed in Una district & maximum fall of 12.47 m is noticed in Sirmaur district.

Table –15: Decadal Fluctuation January (2012-2021) to January 2022

2.1

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

10 Years Mean (2012 Jan - 2021 Jan) - 2022/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	4	0.12	7.13	0.05	0.05	2 50.00 %	0	1 25.00%	1 25.00%	0	0	3	1
KANGRA	35	0.03	3.74	0.02	3.35	18 51.43 %	3 8.57%	0	13 37.14%	1 2.86 %	0	21	14
KULLU	2	-	-	0.03	0.76	0	0	0	2 100.0%	0	0	0	2
MANDI	8	0.13	2.97	0.15	1.31	3 37.50 %	1 12.50%	0	4 50.00%	0	0	4	4
SIRMAUR	13	0.07	12.05	0.04	12.47	3 23.08 %	0	1 7.69 %	6 46.15%	2 15.38 %	1 7.69%	4	9
SOLAN	11	0.11	25.89	0.03	3.21	1 9.09 %	2 18.18%	2 18.18%	5 45.45%	1 9.09 %	0	5	6
UNA	31	0.04	2.59	0.02	4.72	20 64.52 %	1 3.23%	0	9 29.03%	0	1 3.23%	21	10
Total	104	2.59	0.13	0.02	12.47	47	7	4	40	4	2	58	46

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A perusal of map of Decadal average of January (2012-2021) to January 2022 reveals rise in water level less than 2m. to 4m is 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 Nalagargh valley. Similarly, rise is noticed in all the valleys from 0-2 m and 2- 4m except in major part of Nallagah valley and Kangra Palampur valley.

4.0 Chemical Quality May 2021

Hydro-chemical studies

For the evaluation of Hydro-Chemical status and distribution of various chemical constituents in Ground water of Himachal Pradesh, 138 water samples were collected from monitoring station during pre-monsoon, 2021. (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 1751µs/cm. No sample was found to have EC beyond permissible limit (>3000 µs/cm).

(2) Chloride (Cl)

`It is one of the most common constituent present 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 187.9 mg/l in the state. All the values of Chloride fall within the maximum permissible limit ie >1000 mg/l (as per BIS)

(3) Nitrate (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 refuge 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 as inherent component of igneous rocks. The main sources of fluoride in natural water are Fluorite (CaF_2), Cryolite(Na_2AlF_2), 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 carries, 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 radionuclides 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 µg/l in drinking water is acceptable, while AERB has set the limit at 60 µg/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 2021, August2021, Nov 2021& Jan 2022 (in m bgl)

State	**Himachal Pradesh**				
District	**HAMIRPUR**	**May-21**	**Aug-21**	**Nov-21**	**Jan-22**
1	Bagnalla	5.87		4.87	5.16
2	Bijari	2.12	1.71	1.90	1.74
3	Galore	2.51	1.96	2.42	2.40
4	Kangu	10.35			0.00
District	**KANGRA**				
5	Bandh	6.59	0.24	0.24	0.24
6	Barota	8.50			5.83
7	Basa Bazira		8.59	8.54	8.50
8	Bhalad	5.36			0.31
9	Bhali	1.66	1.19	1.40	1.39
10	Bharmar	14.75			10.82
11	Bharoli	9.40	6.35	6.19	6.63
12	Bod	3.23	2.32	2.98	1.51
13	Chakban Ambari	3.87	1.61	4.28	3.66
14	Channaur	3.26			2.15
15	Darkati	5.42	0.96	1.12	0.91
16	Dehra Gopipur	5.36	4.27	4.24	4.28
17	Dehrian	8.41	5.26	1.64	1.74
18	Hardogri	5.65	4.25	3.64	3.95
19	Jagir	3.03	2.48	2.79	2.27
20	Jassur	4.06	2.18	2.83	2.94
21	Jwalaji	2.15	0.83	2.49	5.07
22	Kangra	10.31	4.81		8.47
23	Kathgarh	5.10			0.00
24	Kotla	2.88	0.05	1.03	1.11
25	Manjgram	1.37	0.44	1.03	0.65
26	Mao	4.78	1.79	1.11	0.31
27	Mohtli	17.15			3.47
28	Old Kangra	4.99	2.38	3.21	3.84
29	Olherian	4.50			2.58
30	Pandtehr	0.67	0.40	0.53	0.54
31	Panjpir	4.56	2.65	4.05	2.51
32	Paprola	13.51	5.62	9.03	12.93
33	Rait	11.10	5.86	7.71	9.11
34	Raja-ka-talab	5.24	2.88	3.61	3.72
35	Rakkar	0.00	0.00	2.94	3.71
35	Riali	4.95		3.87	3.84

36	Takipur	7.04	1.71	2.42	3.94
37	Thali	5.06	2.49	2.53	2.38
38	Thirtynine Mile	8.58			7.98
District	**KULLU**				
39	Gadauri	8.09	7.24	6.46	7.39
40	Kullu	0.88	0.43	0.99	1.08
District	**MANDI**				
41	Bahangrotu	3.80	2.32		2.39
42	Gagal	2.17	1.32	2.45	2.50
43	GUTKAR	12.00	2.22		7.56
44	Jarl	0.35	0.29	0.33	0.29
45	Jhiri	4.64	4.00	3.81	3.88
46	Kaned	1.28	0.76	1.51	1.05
47	Lohara	3.55	2.87	3.21	3.25
48	Ratti	4.78	2.92	4.44	4.46
District	**SIRMAUR**				
49	Ajiwala	6.59	3.43	4.65	8.59
50	Akkawala	11.41	11.12	11.22	11.17
51	Badripur	25.00	8.87	9.66	11.70
52	Dhaulakuan	10.25	4.00	4.15	5.74
53	Kala-Amb	17.00	13.24		17.00
54	Khodawala	2.62	2.22	13.15	2.34
55	Kiyarda	10.48	3.06	5.32	8.96
56	Kolar	12.43	2.81	8.77	11.55
57	Nariwala	0.00	32.35	32.85	36.55
58	Nayagaon	15.47	6.60	9.75	12.47
59	Shambuwala	11.70	9.09	10.14	10.34
60	Shibpur	27.21	17.60	9.68	27.27
61	Trilokpur	2.15	1.73	1.45	1.80
District	**SOLAN**				
62	Baddi	6.75	5.01	5.67	5.99
63	Barotiwala	24.98	20.00	19.60	20.48
64	Barun	0.00			0.00
65	Bhagheri	18.97	17.00	13.00	16.48
66	Dhabota	12.62		12.58	12.68
67	Jagatpur	18.78	13.90	12.63	14.00
68	Khera-chak	7.98			0.00
69	Mahadev	13.64	12.09	10.92	12.19
70	Panjahra	22.02		19.92	24.25
71	Phalahi	5.77	4.81	5.16	5.06
District	**UNA**				
72	Amb	6.48	5.46	3.53	4.46
73	Ambota	28.49	28.77	22.30	28.58

74	Babehr	3.54	1.60	1.62	1.49
75	Bawal	1.29	1.20	1.15	1.08
76	Bhadsali	14.06	14.25	14.15	14.11
77	Bhangana	3.01	1.00	1.30	1.28
78	Daulatpur	7.30	6.05		5.65
79	Dharampur	3.22	2.00	5.17	2.13
80	Gagret	7.71	6.85	6.80	7.55
81	Ghaneri	8.85	5.73	6.95	8.37
82	Guglahar	4.16	3.30	3.00	3.32
83	Ishapur	3.10	2.30	1.90	1.96
84	Jankaur	5.58	4.52	4.11	4.55
85	Jawar	9.38	1.18	1.31	1.17
86	Jhalera	4.70		3.95	4.31
87	Khanpur	5.05	4.61	4.39	4.59
88	Khwaja	3.10	1.55	1.20	1.38
89	Kuthera Jaswala	6.39	5.52	5.72	6.24
90	Lalehri	12.90	10.90	11.20	11.86
91	Loharli	5.19	4.20	3.70	4.33
92	Mawa Kalan	17.44	15.70	16.00	17.00
93	Mubarikpur	4.76	3.91	3.66	3.99
94	Nangran	5.79	5.07	5.10	5.38
95	Panjawar	12.25	12.43	12.38	12.38
96	Panoh	3.41	1.62	1.47	1.82
97	Raipur Marwadi	14.54	13.92	12.05	13.17
98	Rajli Panjal	8.64	4.61	1.78	4.51
99	Santokhgarh	5.50	4.57		4.82
100	Singhnei	20.40	20.13	6.95	19.87
101	Tahliwala		0.59	1.19	
102	Tahliwala 1	2.15			1.41
103	Una	2.98	2.14	1.84	2.09

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Annexure-II

Monsoon Fluctuation of May wrt November 2021

State	**Himachal Pradesh**			
District	**:**	**Pre-Monsoon WL (in mbgl)**	**Post-Monsoon WL (in mbgl)**	**Fluctuation(m)**
1	Bagnalla	5.87	4.87	1.00
2	Bijari	2.12	1.90	0.22
3	Galore	2.51	2.42	0.09
4	Kangu	10.35	-	-
District	**:**			
5	Bandh	6.59	0.24	6.35
6	Barota	8.50	-	-
7	Basa Bazira	-	8.54	-
8	Bhalad	5.36	-	-
9	Bhali	1.66	1.40	0.26
10	Bharmar	14.75	-	-
11	Bharoli	9.40	6.19	3.21
12	Bod	3.23	2.98	0.25
13	Chakban Ambari	3.87	4.28	-0.41
14	Channaur	3.26	-	-
15	Darkati	5.42	1.12	4.30
16	Dehra Gopipur	5.36	4.24	1.12
17	Dehrian	8.41	1.64	6.77
18	Hardogri	5.65	3.64	2.01
19	Jagir	3.03	2.79	0.24
20	Jassur	4.06	2.83	1.23
21	Jwalaji	2.15	2.49	-0.34
22	Kangra	10.31	-	-
23	Kathgarh	5.10	-	-
24	Kotla	2.88	1.03	1.85
25	Manjgram	1.37	1.03	0.34
26	Mao	4.78	1.11	3.67
27	Mohtli	17.15	-	-
28	Old Kangra	4.99	3.21	1.78
29	Olherian	4.50	-	-
30	Pandtehr	0.67	0.53	0.14
31	Panjpir	4.56	4.05	0.51
32	Paprola	13.51	9.03	4.48
33	Rait	11.10	7.71	3.39
34	Raja-ka-talab	5.24	3.61	1.63
35	Rakar	-	2.94	-
36	Riali	4.95	3.87	1.08
37	Takipur	7.04	2.42	4.62

38	Thali	5.06	2.53	2.53
39	Thirtynine Mile	8.58	-	-
District	**KULLU**			
40	Gadauri	8.09	6.46	1.63
41	Kullu	0.88	0.99	-0.11
District	**MANDI**			
42	Bahangrotu	3.80	-	-
43	Gagal	2.17	2.45	-0.28
44	GUTKAR	12.00	-	-
45	Jarl	0.35	0.33	0.02
46	Jhiri	4.64	3.81	0.83
47	Kaned	1.28	1.51	-0.23
48	Lohara	3.55	3.21	0.34
49	Ratti	4.78	4.44	0.34
District	**SIRMAUR**			
50	Ajiwala	6.59	4.65	1.94
51	Akkawala	11.41	11.22	0.19
52	Badripur	25.00	9.66	15.34
53	Dhaulakuan	10.25	4.15	6.10
54	Kala-Amb	17.00	-	-
55	Khodawala	2.62	13.15	-10.53
56	Kiyarda	10.48	5.32	5.16
57	Kolar	12.43	8.77	3.66
58	Nariwala	0.00	32.85	-32.85
59	Nayagaon	15.47	9.75	5.72
60	Shambuwala	11.70	10.14	1.56
61	Shibpur	27.21	9.68	17.53
62	Trilokpur	2.15	1.45	0.70
District	**SOLAN**			
63	Baddi	6.75	5.67	1.08
64	Barotiwala	24.98	19.60	5.38
65	Barun	0.00	-	-
66	Bhagheri	18.97	13.00	5.97
67	Dhabota	12.62	12.58	0.04
68	Jagatpur	18.78	12.63	6.15
69	Khera-chak	7.98	-	-
70	Mahadev	13.64	10.92	2.72
71	Panjahra	22.02	19.92	2.10
72	Phalahi	5.77	5.16	0.61
District	**UNA**			
73	Amb	6.48	3.53	2.95
74	Ambota	28.49	22.30	6.19
75	Babehr	3.54	1.62	1.92
76	Bawal	1.29	1.15	0.14
77	Bhadsali	14.06	14.15	-0.09
78	Bhangana	3.01	1.30	1.71
79	Daulatpur	7.30	-	-
80	Dharampur	3.22	5.17	-1.95

81	Gagret	7.71	6.80	0.91
82	Ghaneri	8.85	6.95	1.90
83	Guglahar	4.16	3.00	1.16
84	Ishapur	3.10	1.90	1.20
85	Jankaur	5.58	4.11	1.47
86	Jawar	9.38	1.31	8.07
87	Jhalera	4.70	3.95	0.75
88	Khanpur	5.05	4.39	0.66
89	Khwaja	3.10	1.20	1.90
90	Kuthera Jaswala	6.39	5.72	0.67
91	Lalehri	12.90	11.20	1.70
92	Loharli	5.19	3.70	1.49
93	Mawa Kalan	17.44	16.00	1.44
94	Mubarikpur	4.76	3.66	1.10
95	Nangran	5.79	5.10	0.69
96	Panjawar	12.25	12.38	-0.13
97	Panoh	3.41	1.47	1.94
98	Raipur Marwadi	14.54	12.05	2.49
99	Rajli Panjal	8.64	1.78	6.86
100	Santokhgarh	5.50	-	-
101	Singhnei	20.40	6.95	13.45
102	Tahliwala	-	1.19	-
103	Tahliwala 1	2.15	-	-
104	Una	2.98	1.84	1.14

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Annexure-III

Annual Fluctuation of May 2020- May 2021, August 2020- August 2021 November 2020- November 2021 and January 2021- January 2022

sr no	Location	Annual fl (May 20-May 21)	Annual fl (Aug 20-Aug21)	Annual fl (Nov 20-Nov 21)	Annual fl (May 20-May 21)
	District	**Hamirpur**			
1	Bagnalla	-1.03	0.00	0.23	-0.53
2	Bijari	1.07	-0.05	0.24	0.10
3	Galore	-0.24	-0.18	0.17	-0.13
4	Kangu	-3.96	0.00	0.00	5.72
	District	**Kangra**			
5	Andora	0.00	0.00	0.00	0.00
6	Bandh	-4.18	-0.48	1.23	1.87
7	Barota	-1.78	0.00	0.00	1.56
8	Basa Bazira	0.00	-1.79	-0.15	-0.09
9	Bhalad	-3.10	0.00	0.00	1.50
10	Bhali	4.11	-0.04	1.28	0.22
11	Bharmar	-3.42	0.00	0.00	1.24
12	Bharoli	-2.58	-0.85	0.17	0.67
13	Bod	0.06	-1.57	2.08	3.73
14	Chakban Ambari	0.68	1.14	-0.22	0.42
15	Channaur	-0.67	0.00	0.00	0.25
16	Darkati	-2.29	-0.31	1.00	1.09
17	Dehra Gopipur	-0.74	-1.46	-0.22	0.19
18	Dehrian	-6.85	-4.11	-0.17	-0.16
19	Hardogri	-1.22	-0.92	0.27	0.13
20	Jagir	-0.19	-0.37	0.31	0.77
21	Jassur	-0.87	-0.01	-0.32	-0.27
22	Jwalaji	-0.08	-0.38	-0.50	-3.18
23	Kangra	2.31	-1.42	0.00	-0.25
24	Kathgarh	-1.11	0.00	0.00	3.88
25	Kotla	-0.59	-0.05	1.16	1.25
26	Manjgram	-0.06	0.00	0.66	0.74
27	Mao	-2.99	-1.29	0.75	0.75
28	Mohtli	-3.69	0.00	0.00	0.39
29	Nagrota	0.00	0.00	0.00	0.00
30	Old Kangra	-1.28	-1.86	0.44	-0.36
31	Olherian	-1.55	0.00	0.00	0.44
32	Pandtehr	0.09	-0.04	-0.03	0.10
33	Panjpir	-0.33	-1.15	-0.53	0.68

34	Paprola	-0.70	-1.67	1.54	1.08
35	Rait	-1.99	-2.13	0.58	-3.77
36	Raja-ka-talab	-0.76	-1.48	-1.69	-1.68
37	Rakkar	0.00	0.00	-0.03	-0.70
38	Riali	-0.82	0.00	0.22	0.40
39	Takipur	-2.78	-0.26	1.12	0.72
40	Thali	-0.89	-0.14	0.24	0.29
41	Thirtynine Mile	-0.15	5.27	0.00	0.27
	District	**Kullu**			
42	Gadauri	-1.75	-0.90	0.29	-0.38
43	Hathithan	0.00	0.00	0.00	0.00
44	Kullu	-0.34	-0.03	-0.10	-0.30
	District	**Mandi**			
45	Bahangrotu	1.66	-1.39	0.00	1.72
46	Gagal	0.16	0.39	0.24	-0.23
47	GUTKAR	0.00	0.48	0.00	0.00
48	Jarl	-0.05	0.03	0.08	0.15
49	Jhiri	-0.29	-0.04	0.76	0.52
50	Kaned	-0.41	-0.68	-0.59	-0.11
51	Lohara	-0.10	0.23	0.14	0.23
52	Ratti	-0.24	0.48	0.12	0.22
	District	**Sirmour**			
53	Ajiwala	0.00	-2.26	0.57	-2.63
54	Akkawala	0.00	-1.06	-0.01	0.11
55	Badripur	0.00	0.08	1.93	1.06
56	Dhaulakuan	0.00	-0.16	-0.59	0.82
57	Kala-Amb	0.00	-0.09	0.00	-3.03
58	Khodawala	0.00	0.21	1.89	13.35
59	Kiyarda	0.00	-0.28	1.85	0.76
60	Kolar	0.00	0.12	0.80	0.86
61	Nayagaon	0.00	-2.48	-0.06	-0.05
62	Shambuwala	0.00	-1.77	-0.33	0.24
63	Shibpur	0.00	1.54	17.06	0.26
64	Trilokpur	0.00	-0.30	0.16	-0.03
65	Baddi	0.00	-0.76	0.02	-0.07
66	Barotiwala	0.00	-0.89	-0.19	-0.69
	District	**Solan**			
67	Barun	0.00	0.00	0.00	29.29
68	Bhagheri	0.00	-3.68	-0.66	-2.38
69	Bhatoli	0.00	0.00	0.00	0.22
70	Dhabota	0.00	0.00	-0.44	-0.37
71	Jagatpur	0.00	-3.20	-0.09	0.08
72	Khera-chak	0.00	0.00	0.00	5.73

73	Mahadev	0.00	-3.22	0.89	-0.98
74	Panjahra	0.00	0.00	-1.24	-4.89
75	Phalahi	0.00	-0.46	0.01	0.37
	District	**Una**			
76	Amb	-1.76	-2.17	0.55	0.25
77	Ambota	-1.01	-1.35	5.29	-1.29
78	Babehr	-1.66	-0.47	4.92	0.83
79	Bawal	-0.10	-0.26	0.07	0.06
80	Bhadsali	-1.82	-1.99	-1.67	-1.55
81	Bhangana	-1.38	-0.52	-0.15	0.14
82	Daulatpur	-1.40	-1.08	0.00	0.48
83	Dharampur	-0.96	-0.14	-2.99	0.11
84	Gagret	-1.93	-1.53	-0.68	-0.86
85	Ghaneri	-1.36	0.31	0.46	-2.47
86	Guglahar	-1.12	-1.60	-0.01	-0.14
87	Ishapur	-1.19	-1.11	0.09	0.12
88	Jankaur	-1.27	-1.95	0.22	-0.44
89	Jawar	-4.81	-0.13	0.25	-0.05
90	Jhalera	-0.32	0.00	0.18	0.25
91	Khanpur	-0.61	-1.19	1.20	-0.24
92	Khwaja	-0.87	-0.73	0.96	0.79
93	kuluwal	0.00	0.00	0.00	0.00
94	Kuthera Jaswala	-0.36	-1.30	0.17	-0.56
95	Lalehri	-1.67	-2.00	-0.53	-0.37
96	Loharli	-1.82	-2.72	-0.57	-0.11
97	Mawa Kalan	-2.45	-2.36	-1.18	-1.48
98	Mubarikpur	-1.54	-1.37	-0.58	-0.51
99	Nangran	-0.96	-1.16	0.06	-0.32
100	Panjawar	-1.03	-1.28	-1.79	-1.35
101	Panoh	-1.16	-0.79	1.15	0.77
102	Raipur Marwadi	-2.66	-3.37	-1.05	-1.10
103	Rajli Panjal	-6.15	-4.50	0.66	-2.05
104	Santokhgarh	-0.08	-0.81	0.00	0.40
105	Singhnei	-0.97	-0.78	11.81	-0.82
106	Tahliwala 1	-0.99	0.00	0.32	-0.14
107	Una	-0.77	-1.54	0.19	0.12

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Annexure-IV

Decadal mean Fluctuation May (2011-2020 with May 2021), August (2011-2020 with Aug 2021) November (2011-2020 with Nov 2021) January 2012-2021 with Jan 2022)

sr no	Location	Decadal fl may2011-2020 wrt May 2021	Decadal fl Aug2011-2020 wrt Aug2021	Decadal fl Nov 2011-2020 wrt Nov 2021	Decadal fl Jan 2012-2021 wrt Jan 2022
	District	**Hamirpur**			
1	Bagnalla	0.13	0.00	-0.01	0.00
2	Bijari	0.94	-0.05	0.27	0.21
3	Galore	0.23	-0.19	-0.02	0.16
4	Kangu	-1.50	0.00	0.00	7.12
	District	**Kangra**			
5	Andora	0.00	0.00	0.00	0.00
6	Bandh	-3.70	0.36	1.29	2.77
7	Barota	-1.74	0.00	0.00	-0.42
8	Basa Bazira	0.00	-2.00	-1.14	-0.12
9	Bhalad	-2.40	0.00	0.00	1.22
10	Bhali	1.96	0.04	0.47	0.64
11	Bharmar	-1.14	0.00	0.00	-0.21
12	Bharoli	-1.37	-2.56	-0.83	0.00
13	Bod	0.45	-1.19	-0.01	1.35
14	Chakban Ambari	0.98	1.48	-0.01	0.75
15	Channaur	0.42	0.00	0.00	0.90
16	Darkati	-2.87	-0.10	0.42	1.06
17	Dehra Gopipur	-0.41	-1.39	-0.77	-0.38
18	Dehrian	-6.43	-3.96	-0.06	0.07
19	Hardogri	-1.12	-1.70	-0.84	-0.62
20	Jagir	0.12	-0.21	0.13	0.73
21	Jassur	0.38	0.71	0.53	0.56
22	Jwalaji	2.29	-0.20	-0.77	-3.30
23	Kangra	1.62	-0.35	0.00	1.19
24	Kathgarh	-0.74	0.00	0.00	3.80
25	Kotla	-0.23	0.15	0.70	1.34
26	Manjgram	0.03	-0.04	0.05	0.58
27	Mao	-1.26	-1.15	0.30	1.56
28	Mohtli	-9.58	0.00	0.00	1.82
29	Nagrota	0.00	0.00	0.00	0.00
30	Old Kangra	1.40	-1.08	-0.05	-0.04
31	Olherian	-0.87	-0.02	0.00	0.33

32	Pandtehr	0.13	-0.76	-0.04	-0.02
33	Panjpir	0.02	-1.26	-0.44	0.86
34	Paprola	-0.90	-1.95	0.81	-1.03
35	Rait	-1.25	0.00	0.32	-0.62
36	Raja-ka-talab	-0.93	-1.40	-1.11	-0.29
37	Rakkar	0.00	0.00	-0.28	-0.70
38	Riali	-0.79	0.00	-0.17	-0.01
39	Takipur	-0.99	-0.93	0.41	0.14
40	Thali	-1.15	0.06	0.08	0.28
41	Thirtynine Mile	0.34	0.00	0.00	0.22
	District	**Kullu**			
42	Gadauri	-2.00	-1.38	-0.34	-0.81
43	Hathithan	-0.16	0.00	0.16	-0.02
44	Kullu	0.00	0.37	0.00	0.00
45	Bahangrotu	2.61	1.29	0.00	2.90
46	Gagal	-0.05	0.25	-0.52	-0.34
47	GUTKAR	-4.76	0.88	0.00	-1.23
48	Jarl	0.18	0.02	0.07	0.15
49	Jhiri	-0.18	-0.66	0.31	0.26
50	Kaned	-0.05	-0.28	-0.50	-0.11
51	Lohara	0.23	0.26	0.21	0.24
52	Ratti	-0.57	0.55	-0.32	-0.33
	District	**Sirmour**			
53	Ajiwala	-0.35	-0.69	0.13	-3.16
54	Akkawala	-0.18	-1.84	0.35	-0.29
55	Badripur	-8.72	-0.75	-0.23	1.46
56	Dhaulakuan	-2.63	-0.63	-0.32	-0.04
57	Kala-Amb	-2.33	-1.86	0.00	-3.26
58	Khodawala	12.92	7.40	0.03	12.22
59	Kiyarda	-0.07	-0.47	0.70	0.21
60	Kolar	1.76	1.65	2.73	1.22
61	Nayagaon	-1.06	-2.25	-0.37	-0.72
62	Shambuwala	0.42	-2.24	-1.57	-0.88
63	Shibpur	0.20	1.87	15.52	-0.87
64	Trilokpur	0.00	-0.59	0.10	0.01
65	Baddi	-1.39	-0.73	-1.26	-0.70
66	Barotiwala	-1.44	2.61	3.47	3.77
67	Barun	28.17	0.00	0.00	26.02
68	Bhagheri	-0.08	0.14	2.57	-1.14
69	Bhatoli	0.00	0.00	0.00	-0.18
70	Dhabota	0.50	0.00	-0.38	-0.28
71	Jagatpur	-2.00	0.32	2.13	2.63
72	Khera-chak	-2.51	0.00	0.00	5.40
73	Mahadev	-0.69	-1.76	0.35	-0.01

74	Panjahra	5.47	0.00	-0.15	-3.39
75	Phalahi	0.37	-0.07	0.26	-0.09
	District	**Una**			
76	Amb	-0.21	-1.79	0.49	0.20
77	Ambota	-2.33	-6.23	0.21	-4.29
78	Babehr	0.72	-0.36	1.23	1.40
79	Bawal	0.25	-0.20	0.08	0.43
80	Bhadsali	0.87	-0.24	-0.43	0.24
81	Bhangana	-0.68	-0.37	0.19	0.06
82	Daulatpur	1.00	0.49	-2.59	1.41
83	Dharampur	0.26	0.90	0.32	0.55
84	Gagret	0.51	0.40	0.00	0.11
85	Ghaneri	-0.34	-0.49	0.18	-0.23
86	Guglahar	0.06	-0.70	0.11	0.29
87	Ishapur	-0.07	-0.30	0.49	0.43
88	Jankaur	-1.13	-2.20	-0.75	-1.26
89	Jawar	-7.25	-0.19	-0.23	-0.11
90	Jhalera	0.70	-0.97	0.26	0.44
91	Khanpur	-0.08	0.00	0.29	0.43
92	Khwaja	-0.61	-0.71	0.79	0.62
93	kuluwal	0.00	0.00	0.00	0.00
94	Kuthera Jaswala	0.56	-0.28	0.78	0.58
95	Lalehri	-0.78	-1.88	-1.70	-1.13
96	Loharli	-0.84	-2.13	0.67	-0.63
97	Mawa Kalan	1.06	2.56	3.64	2.51
98	Mubarikpur	0.87	-0.40	0.14	0.30
99	Nangran	-0.45	-0.75	-0.37	-0.29
100	Panjawar	0.80	-0.99	0.01	0.27
101	Panoh	-0.49	-0.87	0.72	0.47
102	Raipur Marwadi	2.85	0.14	2.90	1.90
103	Rajli Panjal	-3.73	-3.61	0.00	-1.95
104	Santokhgarh	-0.07	-0.79	0.00	0.10
105	Singhnei	-1.41	-1.50	13.36	0.72
106	Tahliwala 1	-0.09	0.91	0.26	-0.05
107	Una	0.33	-0.61	0.32	0.53

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RESULTS OF CHEMICAL QUALITY OF WATER SAMPLES COLLECTED DURING NHS- MAY-2021 **ANNEXURE-V**

S. No	State	District	Village	Lat	Long	pH	EC	CO_3	HCO_3	Cl	SO_4	NO_3	TH	Ca	Mg	Na	K	F	TDS	Uranium
							µS/cm	mg/l												ppb
1	Himanchal Pra	Una	JAWAR	31°44'36"	76°11'42"	7.1	380	0	153	28	8	19	150	42	11	18	2.4	0.16	201	1.442
2	Himanchal Pra	Una	AMB	31°41'07"	76°07'17"	8.0	525	0	262	18	11	3	155	28	21	44	7.6	0.15	277	4.9321
3	Himanchal Pra	Una	KATHOR-KALAN	31°39'26"	76°0704"	7.5	603	0	250	32	10	51	250	80	12	20	2.2	0.08	320	3.5507
4	Himanchal Pra	Una	MUBARIKPUR	31°42'30"	76°05'03"	7.8	517	0	171	32	12	66	175	26	27	33	1.7	0.07	273	BDL
5	Himanchal Pra	Una	BHADRAKALI	31°46'47"	76°02'20"	7.8	400	0	189	18	13	8	165	32	21	14	1.5	0.08	212	1.0432
6	Himanchal Pra	Una	DAULATAPUR	31°46'44"	75°59'50"	8.0	840	0	238	53	50	116	200	34	28	101	2.2	0.08	445	0.8292
7	Himanchal Pra	Una	BABEHR	31°47'23"	75°59'30"	7.9	454	0	171	39	18	16	165	34	19	28	1.6	0.08	241	2.3133
8	Himanchal Pra	Una	RAIPUR MARWADI	31°48'01"	75°59'01"	7.7	388	0	140	18	8	53	160	44	12	14	1.2	0.09	205	0.0762
9	Himanchal Pra	Una	MAWA KALAN	31°45'17"	76°00'30"	7.8	258	0	92	21	15	9	105	30	7	11	1.1	0.65	137	BDL
10	Himanchal Pra	Una	GHANERI	31°43'35"	76°01'20"	8.2	453	0	214	18	9	22	200	64	10	12	1.3	0.59	240	0.1608
11	Himanchal Pra	Una	SINGHNEI	31°41'29"	76°02'06"	8.0	406	0	171	35	6	9	160	36	17	18	1.0	0.78	215	0.6582
12	Himanchal Pra	Una	AMBOTA	31°40'14"	76°02'53"	7.7	390	0	183	14	15	11	170	36	19	14	1.3	0.05	206	BDL
13	Himanchal Pra	Una	GAGRET	31°39'38"	76°03'43"	8.0	483	0	195	25	10	38	210	64	12	10	1.1	0.05	256	BDL
14	Himanchal Pra	Una	KUTHERA JASWALA	31°36'21"	76°07'05"	7.9	359	0	110	21	10	57	130	36	10	19	1.7	0.05	190	0.5862
15	Himanchal Pra	Una	LOHARLI	31°35'34"	76°07'35"	7.6	480	0	220	18	9	33	215	72	9	9	6.3	0.07	254	2.2891
16	Himanchal Pra	Una	GUGHLEHAR	31°33'60"	76°08'36"	7.8	579	0	287	25	6	8	215	68	11	29	1.8	0.07	306	1.1872
17	Himanchal Pra	Una	PANJAWAR	31°32'50"	76°08'34"	7.9	402	0	183	21	13	9	145	36	13	26	1.6	0.07	213	2.0635
18	Himanchal Pra	Una	ISHPUR	31°30'20"	76°10'44"	8.0	297	0	122	14	6	25	105	34	5	20	2.1	0.06	157	BDL
19	Himanchal Pra	Una	BADSALI	31°28'40"	76°10'44"	7.4	1068	0	378	28	53	143	390	66	55	61	2.2	0.06	566	1.6799
20	Himanchal Pra	Una	JHALERA	31°29'26"	76°14'18"	7.9	418	0	171	28	10	23	155	44	11	22	1.3	0.07	221	1.87
21	Himanchal Pra	Una	KHAWAJA	31°30'13"	76°13'38"	8.0	508	0	159	46	30	32	145	32	16	44	7.6	0.09	269	0.8487
22	Himanchal Pra	Una	PANOH	31°32'06"	76°12'03"	7.7	579	0	275	32	13	6	145	46	7	65	2.2	0.09	306	0.815
23	Himanchal Pra	Una	JANKAUR	31°25'50"	76°16'29"	8.0	332	0	153	18	8	6	100	28	7	27	4.1	0.10	175	4.6233
24	Himanchal Pra	Una	NANGRAN	31°23'53"	76°17'31"	7.9	1751	0	610	188	49	87	415	54	68	200	13.9	0.19	922	5.7715
25	Himanchal Pra	Una	KHANPUR	31°22'41"	76°18'25"	8.1	594	0	214	60	21	7	200	30	30	41	2.5	0.18	315	3.8244
26	Himanchal Pra	Una	SANTOKHGARH	31°21'28"	76°18/'56"	8.0	350	0	171	18	12	1	135	36	11	16	2.8	0.17	185	1.3388
27	Himanchal Pra	Una	TAHLIWAL	31°21'05"	76°16'33"	7.4	730	0	232	106	15	12	315	38	53	23	2.0	0.12	387	BDL
28	Himanchal Pra	Una	LALHERI	31°22'24"	76°15'48"	7.9	438	0	220	18	6	7	160	44	12	24	2.1	0.09	232	8.4903
29	Himanchal Pra	Una	DHARAMPUR	31°26'43"	76°13'42"	7.5	580	0	256	21	14	39	245	36	38	22	1.1	0.11	307	3.2465
30	Himanchal Pra	Una	UNA	31°28'10"	76°16'15"	7.9	718	0	262	67	23	26	245	38	36	52	0.0	0.13	380	4.0226
31	Himanchal Pra	Una	BAWAL	31°32'53"	76°18'24"	8.0	658	0	348	21	9	3	180	44	17	68	4.2	0.18	349	1.0453

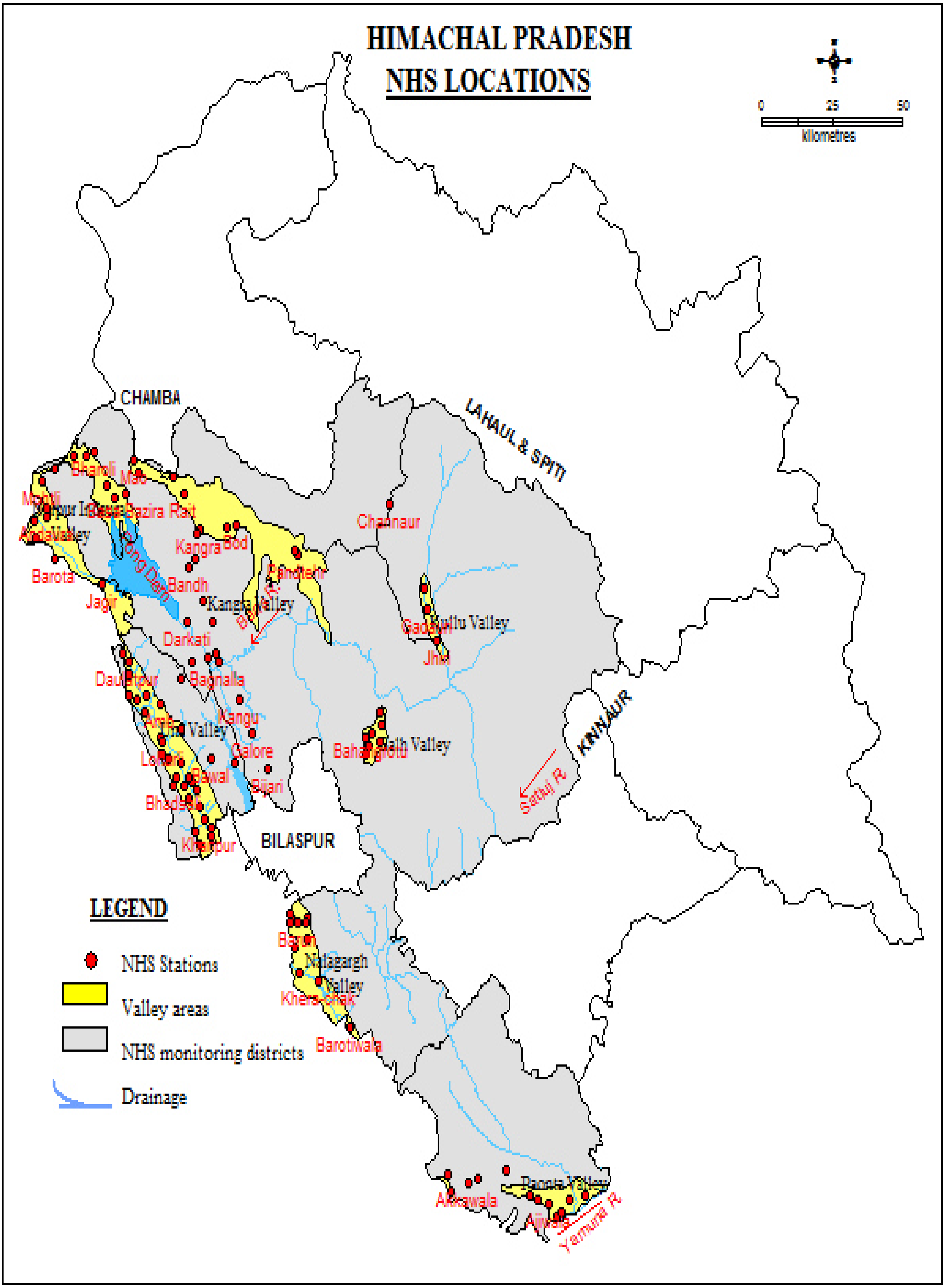
S. No	State	District	Village	Lat	Long	pH	EC	CO_3	HCO_3	Cl	SO_4	NO_3	TH	Ca	Mg	Na	K	F	TDS	Uranium
							µS/cm	mg/l												ppb
32	Himanchal Pra	Una	BANGANA	31°37′30″	76°20′27″	7.7	467	0	201	21	17	25	175	30	24	24	0.6	0.13	247	2.1655
33	Himanchal Pra	Una	RAJLI PANJAL	31°32′11″	76°24′18″	8.1	546	0	232	28	30	14	135	24	18	63	3.1	0.13	289	0.6221
34	Himanchal Pra	Solan	BAGHERI	31°11′39″	76°38′31″	7.9	393	0	177	25	7	12	115	24	13	40	1.8	0.07	212	0.0745
35	Himanchal Pra	Solan	BHATOLI	31°09′55″	76°36′30″	7.8	324	0	134	18	5	28	115	28	11	22	1.5	0.06	172	0.0611
36	Himanchal Pra	Solan	BARUNA	31°09′15″	76°36′19″	7.7	381	0	140	18	17	37	150	22	23	19	1.3	0.06	202	0.0708
37	Himanchal Pra	Solan	PALAHI	31°07′39″	76°36′43″	7.7	556	0	189	28	6	92	210	42	26	30	2.9	0.06	231	4.3407
38	Himanchal Pra	Solan	PANJIARA	31°08′06″	76°39′23″	7.6	256	0	116	11	6	10	80	20	7	19	2.1	0.11	137	3.0164
39	Himanchal Pra	Solan	JAGATPUR	31°09′34″	76°40′43″	7.5	337	0	122	35	10	10	105	20	13	27	2.8	0.11	178	5.3242
40	Himanchal Pra	Solan	MAHADEVA	31°06'30″	76°40′43″	7.9	741	0	201	99	19	57	145	46	7	101	2.1	0.10	393	2.8288
41	Himanchal Pra	Solan	DABOTA	31°05′16″	76°37′50″	8.0	724	0	287	53	21	38	170	24	27	89	0.6	0.10	383	8.1465
42	Himanchal Pra	Solan	NALAGARH	31°02′39″	76°42′43″	7.9	510	0	195	35	12	42	125	36	9	58	4.0	0.22	270	3.174
43	Himanchal Pra	Solan	KHERCHAK	31°00′50″	76°40′43″	7.7	424	0	165	25	16	29	155	26	22	22	2.2	0.13	224	2.4034
44	Himanchal Pra	Solan	THEDA	31°59′59″	76°45′36″	7.7	745	0	299	43	33	37	235	52	26	62	2.4	0.13	385	2.3043
45	Himanchal Pra	Solan	KISHANPURA	30°58′17″	76°45′29″	7.8	296	0	122	18	6	12	105	30	7	18	1.9	0.10	157	3.5502
46	Himanchal Pra	Solan	BADDI	30°55′27″	76°47′40″	7.7	472	0	238	14	8	14	185	32	26	20	2.3	0.08	251	1.3395
47	Himanchal Pra	Solan	BAROTIWALA	30°54′20″	76°50′24″	7.8	292	0	140	14	4	5	85	18	10	27	4.7	0.06	155	0.1465
48	Himanchal Pra	Sirmour	AKKAWALA	30°31′13″	77°17′12″	7.8	249	0	122	11	5	5	105	22	12	8	1.1	0.07	132	0.0318
49	Himanchal Pra	Sirmour	SHIBPUR	30°28′33″	77°40′11″	7.8	448	0	201	14	20	16	200	26	33	8	1.3	0.06	237	BDL
50	Himanchal Pra	Sirmour	KHODEWALA	30°29′14″	77°42′18″	7.7	466	0	153	32	17	45	185	28	28	19	3.4	0.54	247	BDL
51	Himanchal Pra	Sirmour	BADRIPUR	30°28′33″	77°40′11″	7.7	338	0	146	14	17	11	145	26	19	9	1.0	0.59	179	BDL
52	Himanchal Pra	Sirmour	AJJIWALA	30°28′13″	77°35′12″	7.8	305	0	122	14	13	15	130	26	16	7	1.4	0.59	163	1.2925
53	Himanchal Pra	Sirmour	KIAYARDA	30°28′23″	77°32′56″	7.8	270	0	128	11	5	6	120	28	12	7	1.1	0.06	143	BDL
54	Himanchal Pra	Sirmour	NAYAGAON	30°29′10″	77°31′22″	7.7	256	0	110	14	10	10	105	26	10	7	0.8	0.05	135	BDL
55	Himanchal Pra	Sirmour	SAINWALA-1	30°29′31″	77°30′40″	7.9	452	0	189	21	12	36	190	26	30	15	1.9	0.05	239	BDL
56	Himanchal Pra	Sirmour	MESERWALA	30°28′45″	77°32′40″	7.9	354	0	153	11	25	16	150	26	21	11	1.8	0.05	187	BDL
57	Himanchal Pra	Sirmour	DHAULA-KUAN	30°30′06″	77°28′23″	8.1	366	0	140	14	42	4	80	20	7	44	3.1	0.06	194	BDL
58	Himanchal Pra	Sirmour	KODEWALA	30°28′36″	77°24′22″	7.9	489	0	195	21	23	34	200	36	27	14	2.1	0.05	259	3.4952
59	Himanchal Pra	Sirmour	KOLAR	30°29′52″	77°26′27″	7.8	363	0	140	21	17	26	145	32	16	16	1.3	0.05	197	BDL
60	Himanchal Pra	Sirmour	BOLION	30°30′36″	77°22′29″	7.8	258	0	104	18	9	7	105	20	13	7	1.1	0.07	137	0.6326
61	Himanchal Pra	Sirmour	SHAMBUWALA	30°31′25″	77°19′15″	8.5	772	23	354	50	14	4	120	26	13	119	6.7	0.07	407	BDL
62	Himanchal Pra	Sirmour	SAINWALA-2	30°32′19″	77°15′08″	7.8	559	0	177	60	20	29	195	36	26	38	1.9	0.07	296	2.8596

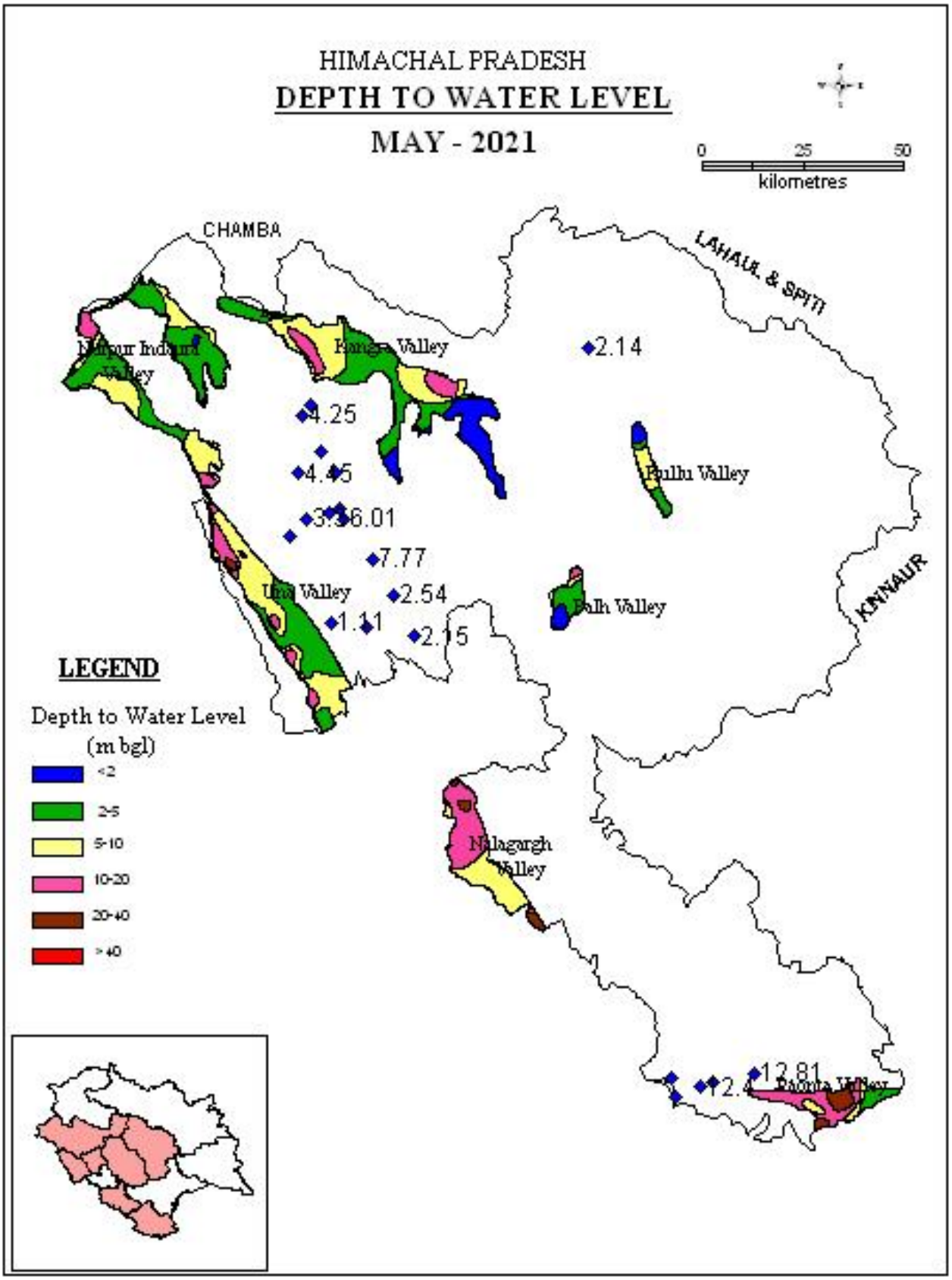
S. No	State	District	Village	Lat	Long	pH	EC	CO_3	HCO_3	Cl	SO_4	NO_3	TH	Ca	Mg	Na	K	F	TDS	Uranium
							µS/cm	mg/l												ppb
63	Himanchal Pra	Sirmour	KALA-AMB	30°29’52”	77°12’43”	7.7	565	0	128	78	42	27	200	38	26	37	1.8	1.68	299	2.1969
64	Himanchal Pra	Sirmour	KHERI	30°31’34”	77°11’30”	8.6	405	23	183	18	11	17	120	26	13	37	2.2	0.15	214	BDL
65	Himanchal Pra	Sirmour	TRILOKPUR	30°32’24”	77°12’12”	7.9	802	0	354	64	13	3	35	6	5	165	2.8	1.71	424	0.7705
66	Himanchal Pra	Kangra	OLD MATOUR	32-8'-14''	76-17'-18''	7.3	163	0	55	25	2	9	60	16	5	10	3.4	0.08	105.95	0.0561
67	Himanchal Pra	Kangra	RAIT	32-11'- 8"	76-12'-44"	7.1	537	0	244	18	20	27	210	66	11	21	6.8	0.10	349.05	0.2911
68	Himanchal Pra	Kangra	39Miles(Shahpur)	32-13'-9''	76-10'-34''	7.6	473	0	159	35	43	12	185	34	24	21	2.8	0.06	307.45	0.1348
69	Himanchal Pra	Kangra	CHAKBAN AMBADI	32-6'-25''	76-24'-40''	7.6	127	0	43	14	4	15	45	12	4	9	0.7	0.05	82.55	BDL
70	Himanchal Pra	Kangra	MANJ GRAM	32-13'-40"	76-09'-43"	7.5	374	0	122	35	19	11	150	50	6	15	2.5	0.06	243.1	0.1684
71	Himanchal Pra	Kangra	BHALI	32-13'-23''	76-06'-27"	7.6	690	0	183	78	50	28	165	48	11	75	12.1	0.06	448.5	1.8349
72	Himanchal Pra	Kangra	KOTLA	32-14'-10''	76-02'-54"	7.9	376	0	140	28	14	21	135	40	9	21	2.6	0.05	244.4	0.4139
73	Himanchal Pra	Kangra	MAO	32-15'-37"	76-00-38"	7.8	305	0	122	11	14	7	110	40	2	16	2.4	0.05	198.25	1.8901
74	Himanchal Pra	Kangra	BHALAD	31-11'-30"	75-59'-44"	7.9	503	0	171	39	34	22	180	60	7	30	2.0	0.07	326.95	2.3407
75	Himanchal Pra	Kangra	DARKATI	32-09'-44''	75-59'-28''	7.8	475	0	122	35	58	36	130	40	7	46	2.7	0.07	308.75	0.063
76	Himanchal Pra	Kangra	BHARMAR	32-09'-45"	75-57'-49"	7.8	280	0	116	14	7	10	80	20	7	25	3.9	0.09	182	BDL
77	Himanchal Pra	Kangra	RAJA KA TALAB	32-12'-35"	75-55'-18"	7.6	240	0	116	7	4	19	95	20	11	11	2.0	0.07	156	BDL
78	Himanchal Pra	Kangra	THALI	32-15'-14''	75-53'-11''	7.5	178	0	61	18	3	7	65	10	10	8	2.0	0.08	115.7	BDL
79	Himanchal Pra	Kangra	BASA-BAZIRA	32-16'-10''	75-52'-11''	7.5	375	0	67	74	18	16	150	40	12	16	2.3	0.05	243.75	0.0691
80	Himanchal Pra	Kangra	BOD	32-17'-13"	75-52'-11"	7.9	930	0	305	71	53	81	295	32	52	74	7.8	0.05	604.5	1.7992
81	Himanchal Pra	Kangra	BHATKA	32-18'-56"	75-53'-16"	8.0	315	0	122	21	35	8	100	24	10	18	19.2	0.07	204.75	2.5088
82	Himanchal Pra	Kangra	PARNALLA	32-21'-26"	75-51'-41''	7.9	485	0	183	35	16	23	180	44	17	26	2.9	0.07	315.25	0.1676
83	Himanchal Pra	Kangra	NAURA	31-59'-56''	76-29'-18''	7.8	265	0	92	25	14	5	105	24	11	10	2.0	0.06	172.25	BDL
84	Himanchal Pra	Kangra	LAKHNAUT	32-23'-8"	75-54'-35''	7.5	530	0	214	35	4	26	150	40	12	51	2.0	0.05	344.5	0.5583
85	Himanchal Pra	Kangra	SADWAN	32-20'-56"	75-54'-27"	7.7	339	0	159	11	6	6	90	20	10	32	2.0	0.05	220.35	0.1819
86	Himanchal Pra	Kangra	KUTH KHANA	32-10'-59"	75-54'-53"	7.9	153	0	55	11	8	14	60	16	5	7	1.2	0.04	99.45	BDL
87	Himanchal Pra	Kangra	BAROT	32-07'-42"	75-55'-53"	7.5	268	0	110	21	8	12	115	22	15	5	1.5	0.04	174.2	BDL
88	Himanchal Pra	Kangra	JAGIR	31-58'-23"	75-54'-10"	7.8	503	0	244	21	9	11	210	18	40	17	3.6	0.05	326.95	1.8521
89	Himanchal Pra	Kangra	RIYALI	32-01'-8"	75-48'-48''	7.8	318	0	122	11	21	11	105	24	11	19	8.1	0.04	206.7	2.5411
90	Himanchal Pra	Kangra	BAROTA	32-02'-20''	75-43'-10''	7.7	420	0	122	35	38	20	180	52	12	12	4.9	0.03	273	BDL
91	Himanchal Pra	Kangra	OLLEHRIYAN	32-04'-29''	75-38'-15''	7.7	871	0	305	103	24	14	260	50	33	76	7.8	0.04	566.15	8.7214
92	Himanchal Pra	Kangra	KATHGARH	32-07'-2"	75-38'-5"	7.8	442	0	153	35	24	11	150	40	12	28	7.7	0.05	287.3	1.8666
93	Himanchal Pra	Kangra	INDORA	32-08'-13''	75-41'-22"	7.8	330	0	122	25	27	14	110	40	2	25	5.3	0.21	214.5	0.7163

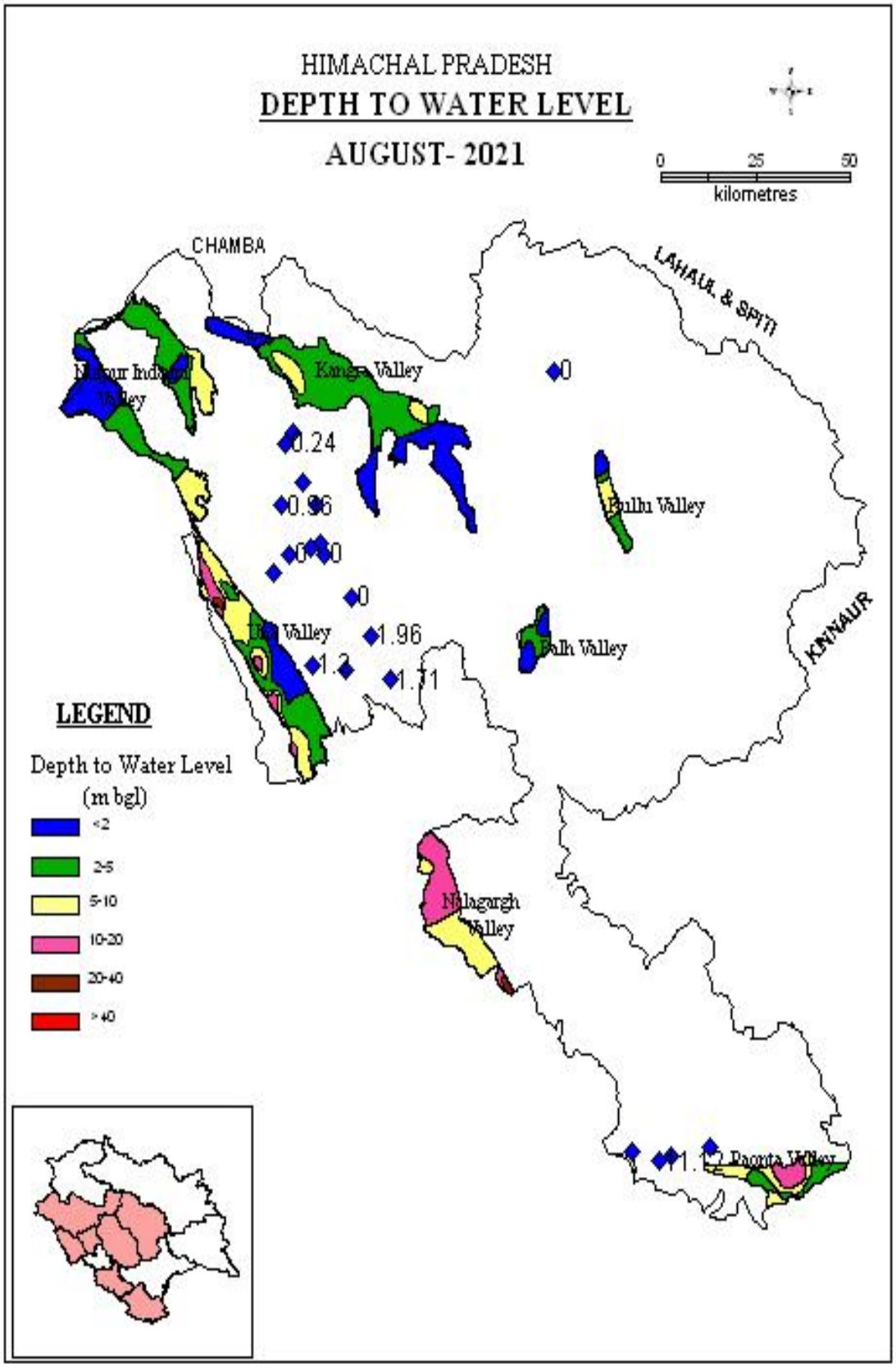
S. No	State	District	Village	Lat	Long	pH	EC	CO_3	HCO_3	Cl	SO_4	NO_3	TH	Ca	Mg	Na	K	F	TDS	Uranium
							µS/cm	mg/l												ppb
94	Himanchal Pra	Kangra	CHANNOUR	32-08'-40"	75-41'-13"	7.9	630	0	336	14	4	26	200	50	18	53	1.0	0.11	409.5	2.6734
95	Himanchal Pra	Kangra	CHANGARA	32-10'-17"	75-41'-43"	7.9	375	0	122	39	28	8	150	40	12	17	1.6	0.04	243.75	BDL
96	Himanchal Pra	Kangra	MOHTLI	32-12'-46"	75-40-42"	7.9	544	0	183	25	7	84	200	44	22	32	6.0	0.05	353.6	BDL
97	Himanchal Pra	Kangra	PANJPIR	32-16'-48.'	75-47'-32"	7.8	245	0	85	21	14	7	90	28	5	12	1.6	0.04	159.25	BDL
98	Himanchal Pra	Kangra	JASSUR	32-16'-49"	75-50'-28"	7.8	425	0	128	39	27	25	140	42	9	30	2.9	0.31	276.25	1.3729
99	Himanchal Pra	Kangra	GUJREDA SARAH	32-9'-50	76-16'-32''	7.8	665	0	183	85	38	6	190	50	16	60	2.4	0.14	432.25	0.0143
100	Himanchal Pra	Kangra	PAPROLA	32-3'-13''	76-38'-2''	7.8	193	0	55	21	10	12	60	16	5	13	4.0	0.08	125.45	BDL
101	Himanchal Pra	Kangra	KUTHED	32-11'-48''	76-3'-45''	7.4	376	0	183	18	3	14	165	40	16	9	3.1	0.10	244.4	0.4245
102	Himanchal Pra	Kangra	BASANTPUR	32-8'-41''	76-1'-18''	7.7	336	0	122	28	22	6	150	50	6	12	3.9	0.07	218.4	BDL
103	Himanchal Pra	Kangra	KANGRA	32-06'-24"	76-16'-31"	7.8	323	0	122	28	4	22	130	32	12	17	2.5	0.06	209.95	0.4789
104	Himanchal Pra	Kangra	OLD KANGRA	32-5'-36"	76-15'-53"	7.5	354	0	122	25	25	22	125	40	6	14	14.5	0.05	230.1	0.2168
105	Himanchal Pra	Kangra	TAKIPUR	32-03'-1"	76-15'-14"	7.7	325	0	85	46	24	9	135	40	9	12	1.3	0.09	211.25	BDL
106	Himanchal Pra	Kangra	BANDH	32-00'-15"	76-13'-48"	7.7	475	0	183	39	30	12	150	44	10	38	1.4	0.07	308.75	BDL
107	Himanchal Pra	Kangra	HARIPUR	32-0'-13"	76-9'-39"	7.9	660	0	244	71	14	17	210	62	13	55	2.1	0.08	429	BDL
108	Himanchal Pra	Kangra	DEHRA GOPIPUR	31-52'-56"	76-12'-55"	8.0	562	0	244	39	9	7	200	42	23	36	2.0	0.09	365.3	BDL
109	Himanchal Pra	Kangra	JAWALA JI	31-52'-39"	76-18'-59"	8.1	517	0	244	50	38	10	210	56	17	46	1.4	0.10	336.05	BDL
110	Himanchal Pra	Kangra	DEHRIAN	31-55'-29"	76-16-'-22'	8.1	387	0	153	35	27	24	170	40	17	13	4.6	0.08	251.55	BDL
111	Himanchal Pra	Kangra	BHAROLI	31-47'-31"	76-20'-2"	7.7	577	0	183	28	58	10	175	52	11	32	2.6	0.05	375.05	BDL
112	Himanchal Pra	Kangra	HARDOGRI	31-47'-1''	76-17'-43''	7.7	481	0	275	43	10	4	260	60	27	20	1.8	0.04	312.65	0.4544
113	Himanchal Pra	Kangra	RAKKAR (CHOULI}	31-47'-14''	76-15'-29''	7.8	396	0	153	39	38	6	165	44	13	19	0.6	0.06	257.4	BDL
114	Himanchal Pra	Kangra	PANDTEHR	32-2'-14''	76-38'-46''	7.7	171	0	104	28	6	4	105	30	7	14	2.1	0.27	111.15	BDL
115	Himanchal Pra	Hamirpur	BHAGNALLAH	31-46'-31''	76-20'-34''	7.5	459	0	189	35	8	30	190	56	12	17	1.9	0.08	246	BDL
116	Himanchal Pra	Hamirpur	KANGOO	31-41'11''	76-25'-28''	7.8	438	0	146	35	6	54	180	52	12	15	0.7	0.08	311	0.6686
117	Himanchal Pra	Hamirpur	GALORE	31-36'-53''	76-28'-29''	8.0	336	0	153	14	5	23	130	36	10	11	6.6	0.06	176	1.802
118	Himanchal Pra	Hamirpur	BIJARI	31-31'-22''	76-32'-22''	7.8	416	0	153	43	8	15	175	52	11	15	1.2	0.05	221	1.0192
119	Himanchal Pra	Hamirpur	BARSAR MAIRE	31-31'-41''	76-27'-53''	7.9	349	0	140	28	5	23	150	40	12	11	6.3	0.05	185	1.1831
120	Himanchal Pra	Hamirpur	BHALAT	31-29'-49''	76-28'-46''	7.9	1576	0	622	28	160	4	170	44	15	264	4.3	0.05	834	2.7388
121	Himanchal Pra	Bilaspur	SHAHTALAI	31-27'-20''	76-30'-57''	7.8	546	0	238	28	6	36	215	56	18	23	2.1	0.05	290	1.982
122	Himanchal Pra	Bilaspur	JHABOLA	31-25'-28''	76-32'-47''	7.9	512	0	207	28	10	39	200	52	17	23	3.5	0.06	271	5.3071
123	Himanchal Pra	Bilaspur	LOHARWIN	31-25'-31''	76-42'-57''	7.9	512	0	195	57	9	10	200	52	17	21	4.8	0.06	272	6.8657
124	Himanchal Pra	Bilaspur	NASWAL	31-28'-9''	76-41'-10''	7.8	379	0	159	28	11	10	115	28	11	28	2.3	0.09	201	5.4366

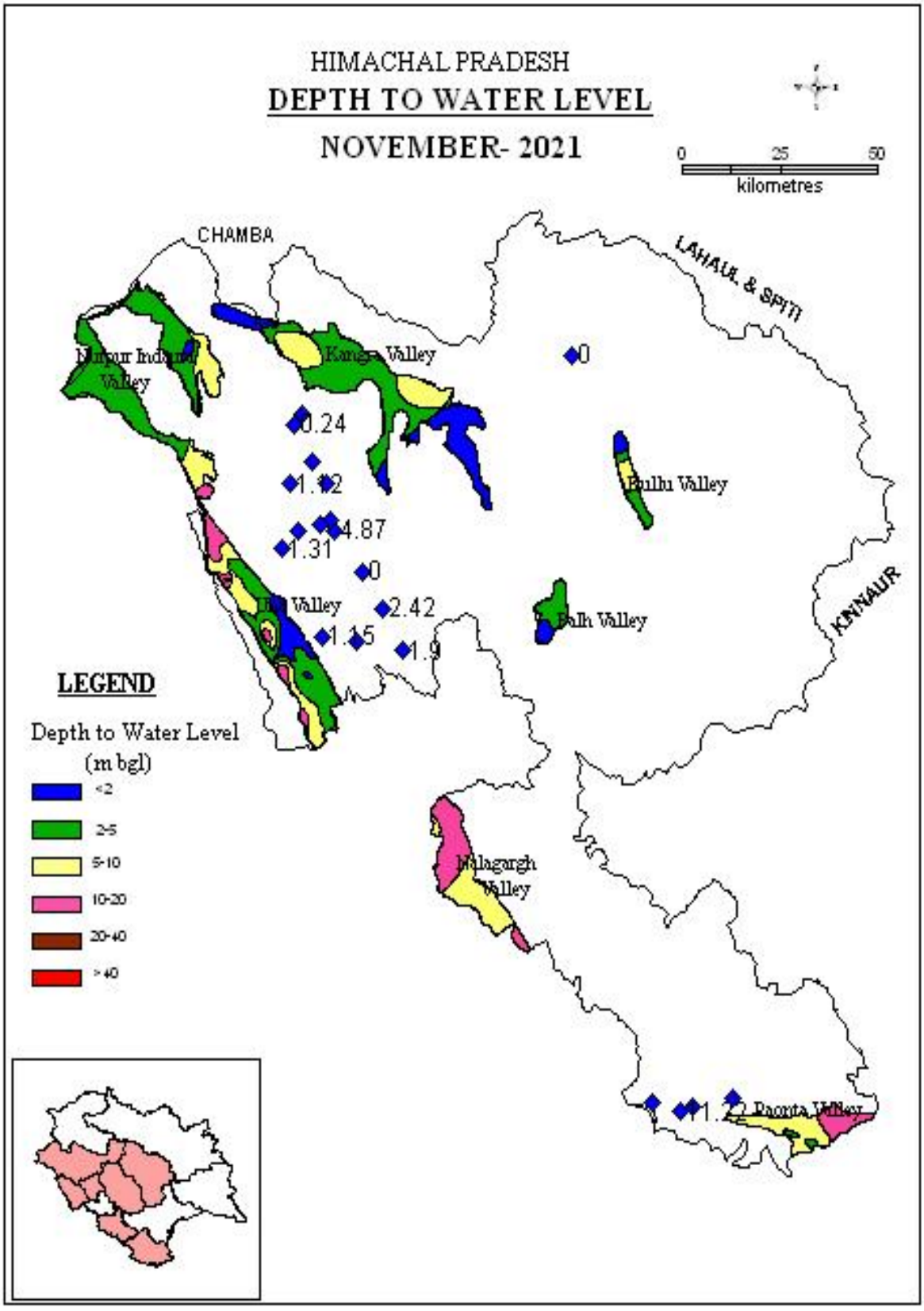
S. No	State	District	Village	Lat	Long	pH	EC	CO_3	HCO_3	Cl	SO_4	NO_3	TH	Ca	Mg	Na	K	F	TDS	Uranium
							µS/cm	mg/l												ppb
125	Himanchal Pra	Chamba	UPPER THULEL	32-14'-0''	76-8'-39''	7.9	406	0	171	28	12	5	75	20	6	54	3.4	0.25	215	BDL
126	Himanchal Pra	Chamba	TARA GARH	32-24'-47''	75-56'-55''	7.9	409	0	189	14	10	17	175	48	13	7	4.2	0.08	215	BDL
127	Himanchal Pra	Mandi	BANGROTU	31-36'-39''	76-55'-11''	7.38	379	0	146	35	6	17	140	40	10	18	6.4	0.10	200	0.7486
128	Himanchal Pra	Mandi	RATTI	31-35'-59''	76-54'-7''	7.74	502	0	171	50	7	44	190	48	17	24	5.4	0.04	265	BDL
129	Himanchal Pra	Mandi	JARL	31-33'-5''	76-53'-46''	8.04	344	0	110	43	6	21	130	24	17	16	3.4	0.04	183	0.0222
130	Himanchal Pra	Mandi	DINAK	31-33'-53''	76-55'-26''	7.53	591	0	262	43	7	15	250	56	27	20	1.3	0.05	312	4.3512
131	Himanchal Pra	Mandi	KANED	31-34'44''	76-54'49''	7.43	604	0	214	50	9	57	190	36	24	43	12.1	0.08	320	BDL
132	Himanchal Pra	Mandi	LOHARA	31-35'-19''	76-56'-43''	7.83	450	0	171	35	6	36	165	32	21	23	3.7	0.01	238	4.5581
133	Himanchal Pra	Mandi	GAAGAL	31-37'-49''	76-57'-41''	7.57	216	0	67	21	8	12	70	20	5	11	5.8	0.08	114	BDL
134	Himanchal Pra	Mandi	GUTKAR	31-39'-26''	76-56'-39''	7.71	424	0	165	50	6	5	170	32	22	17	5.2	0.22	224	4.0826
135	Himanchal Pra	Mandi	NAGWAIN	31-49'-9''	77-10'49''	7.85	382	0	165	21	9	28	150	44	10	13	8.7	0.13	202	0.3879
136	Himanchal Pra	Mandi	JHIRI	31-50'-5''	77-10'-17	7.94	431	0	177	28	8	35	180	58	9	13	4.0	0.07	228	0.6948
137	Himanchal Pra	Kullu	KULLU	31-57'-53''	77-6'-55''	7.83	239	0	98	14	4	16	105	24	11	3	4.2	0.04	126	0.3433
138	Himanchal Pra	Kullu	GADURI	31-54'-12''	77-7'-53''	7.82	415	0	140	28	9	52	175	36	21	10	4.3	0.04	220	0.3032

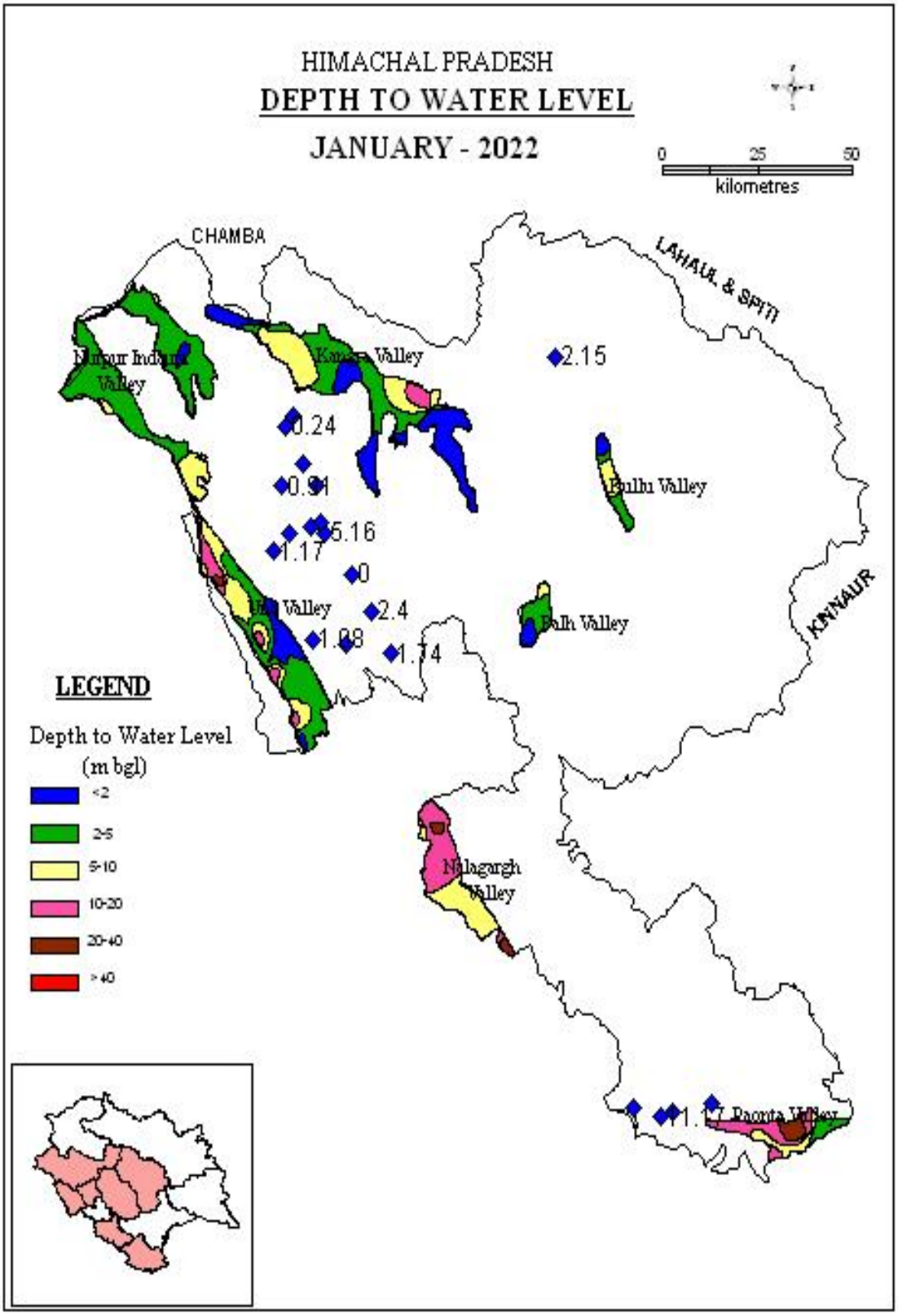

HIMACHAL PRADESH
Administrative Division
PLATE I
0 40 80
kilometers
34°
33°
32°
31°
30°
76°
77°
78°
79°
J & K
J & K
CHAMBA
LAHAUL & SPITI
CHINA (TIBET)
KANGRA
Punjab
KULU
HAMIRPUR
MANDI
UNA
KINNAUR
BILASPUR
SIMLA
SOLAN
Uttaranchal
Haryana
SIRMAUR
INDIA
LEGEND
District Boundary
State Boundary
International Boundary

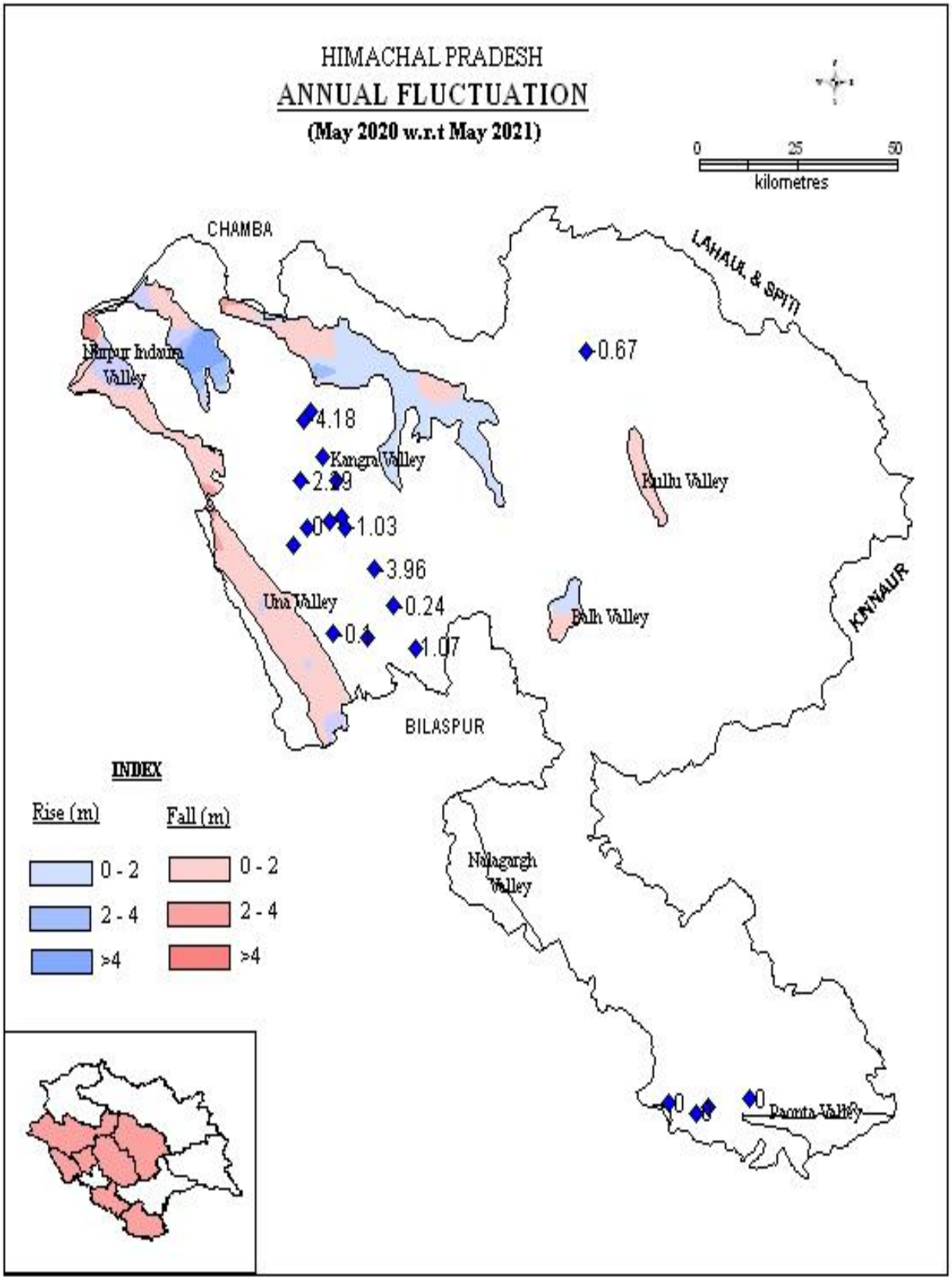

HIMACHAL PRADESH
NHS LOCATIONS
0
25
50
kilometres
CHAMBA
LAHAUL & SPITI
KINNAUR
BILASPUR
Chamba
Bharoli
Mao
Kangra
Bod
Barota
Jagir
Bandh
Kangra Valley
Panditar
Channaur
Kullu Valley
Jhiri
Darkati
Bagnalla
Kangu
Galore
Bijari
Balh Valley
Satluj R.
Lohara
Bawal
Khanpur
Nalagarh
Valley
Barotiwala
Yamuna R.
LEGEND
NHS Stations
Valley areas
NHS monitoring districts
Drainage

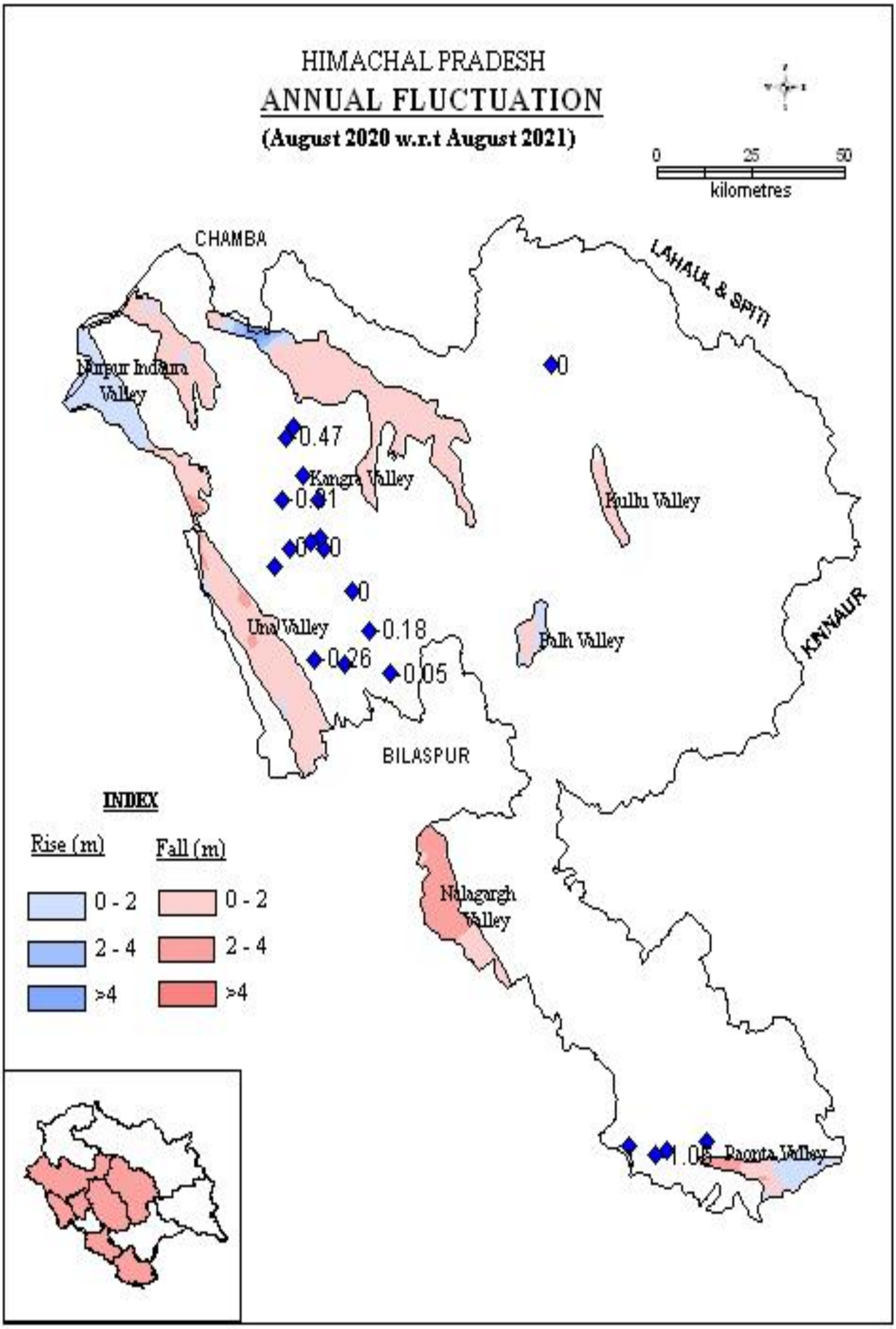

HIMACHAL PRADESH
DEPTH TO WATER LEVEL
MAY - 2021
0
25
50
kilometres
CHAMBA
LAHAUL & SPITI
KINNAUR
Pangi Valley
Pooh Valley
Nalagargh Valley
2.14
4.25
6.01
7.77
2.54
1.11
2.15
12.81
LEGEND
Depth to Water Level
(m bgl)
<2
2-5
5-10
10-20
20-40
>40

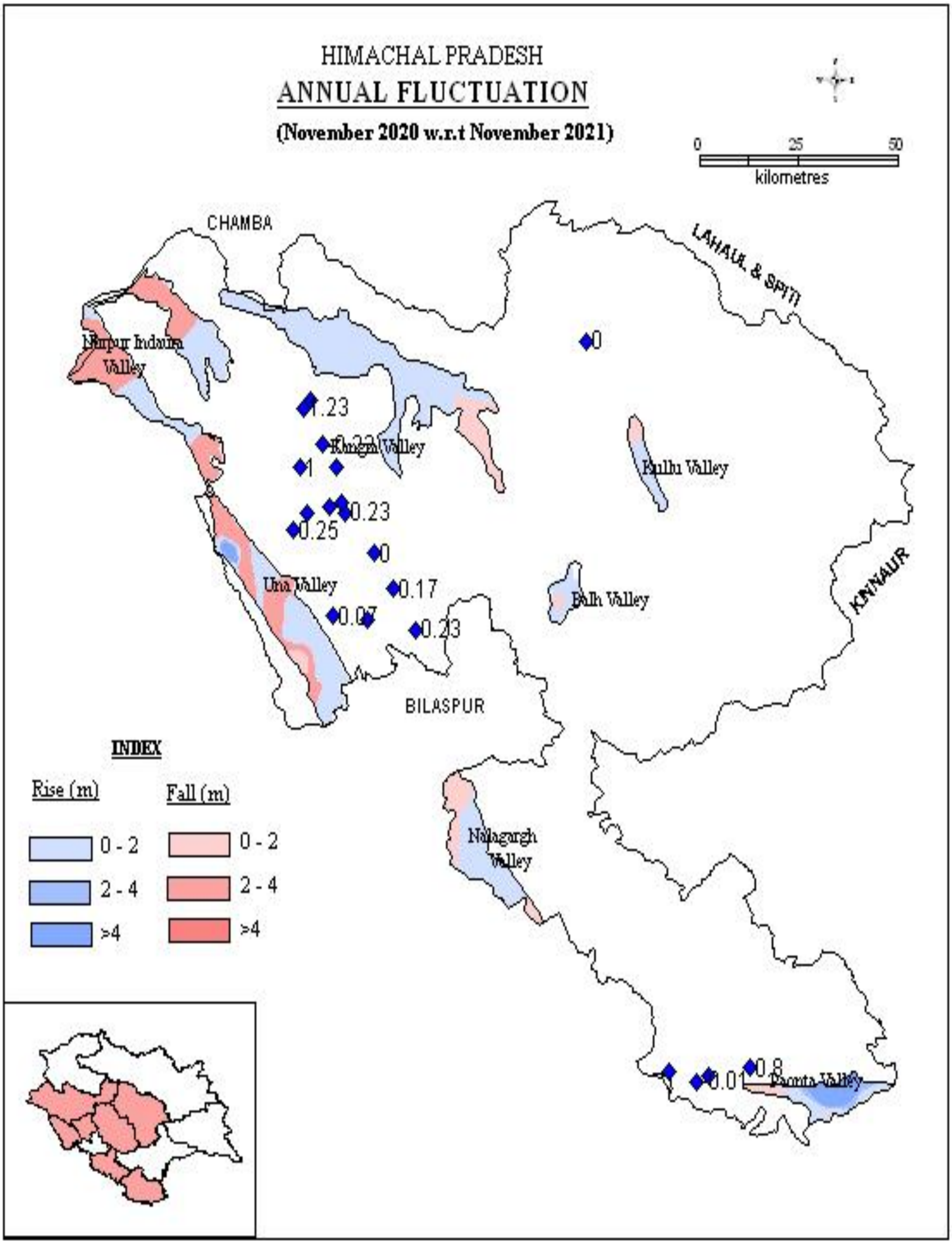

HIMACHAL PRADESH
DEPTH TO WATER LEVEL
AUGUST- 2021
0 25 50
kilometres
CHAMBA
LAHAUL & SPITI
KINNAUR
Kangra Valley
Kullu Valley
Nalagargh Valley
0
0.24
0.96
1.96
1.71
LEGEND
Depth to Water Level
(m bgl)
<2
2-5
5-10
10-20
20-40
>40


HIMACHAL PRADESH
DEPTH TO WATER LEVEL
NOVEMBER- 2021
0 25 50
kilometres
CHAMBA
LAHAUL & SPITI
KINNAUR
Kangra Valley
Pooh Valley
Palh Valley
Nalagargh Valley
0
0.24
1.2
4.87
1.31
0
2.42
1.15
1.9
LEGEND
Depth to Water Level
(m bgl)
<2
2-5
5-10
10-20
20-40
>40

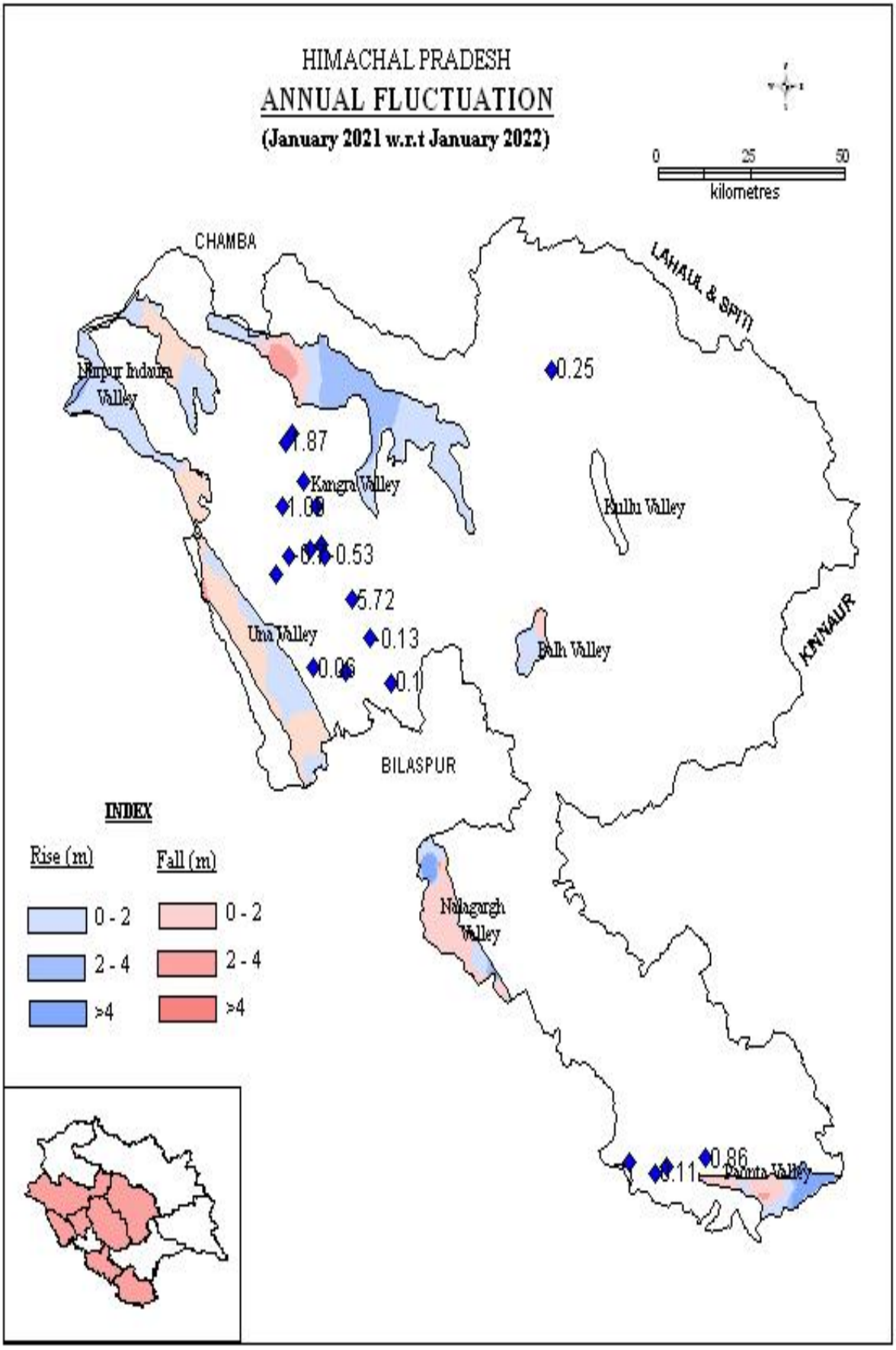

HIMACHAL PRADESH
DEPTH TO WATER LEVEL
JANUARY - 2022
0
25
50
kilometres
CHAMBA
LAHAUL & SPITI
KINNAUR
Kangra Valley
2.15
0.24
0.91
Kullu Valley
5.16
1.17
0
2.4
Bulh Valley
1.88
1.74
Nalagarh Valley
LEGEND
Depth to Water Level
(m bgl)
<2
2-5
5-10
10-20
20-40
>40

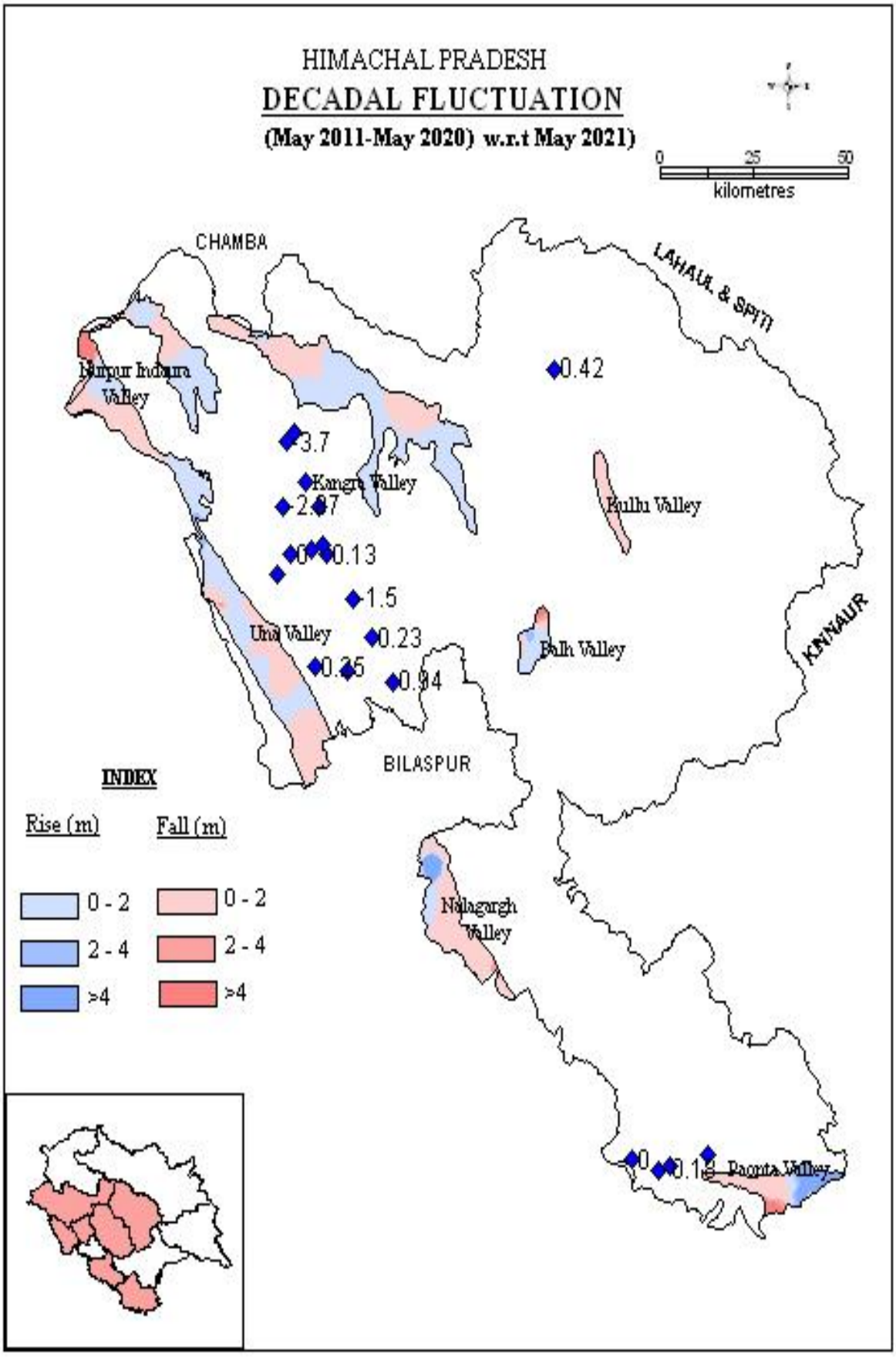

HIMACHAL PRADESH
ANNUAL FLUCTUATION
(May 2020 w.r.t May 2021)
0
25
50
kilometres
CHAMBA
LAHAUL & SPITI
KINNAUR
BILASPUR
Pong Indora Valley
Kangra Valley
Kullu Valley
Una Valley
Bilh Valley
Nalagarh Valley
Paonta Valley
0.67
4.18
1.03
3.96
0.24
1.07
INDEX
Rise (m)
Fall (m)
0 - 2
2 - 4
>4
0 - 2
2 - 4
>4

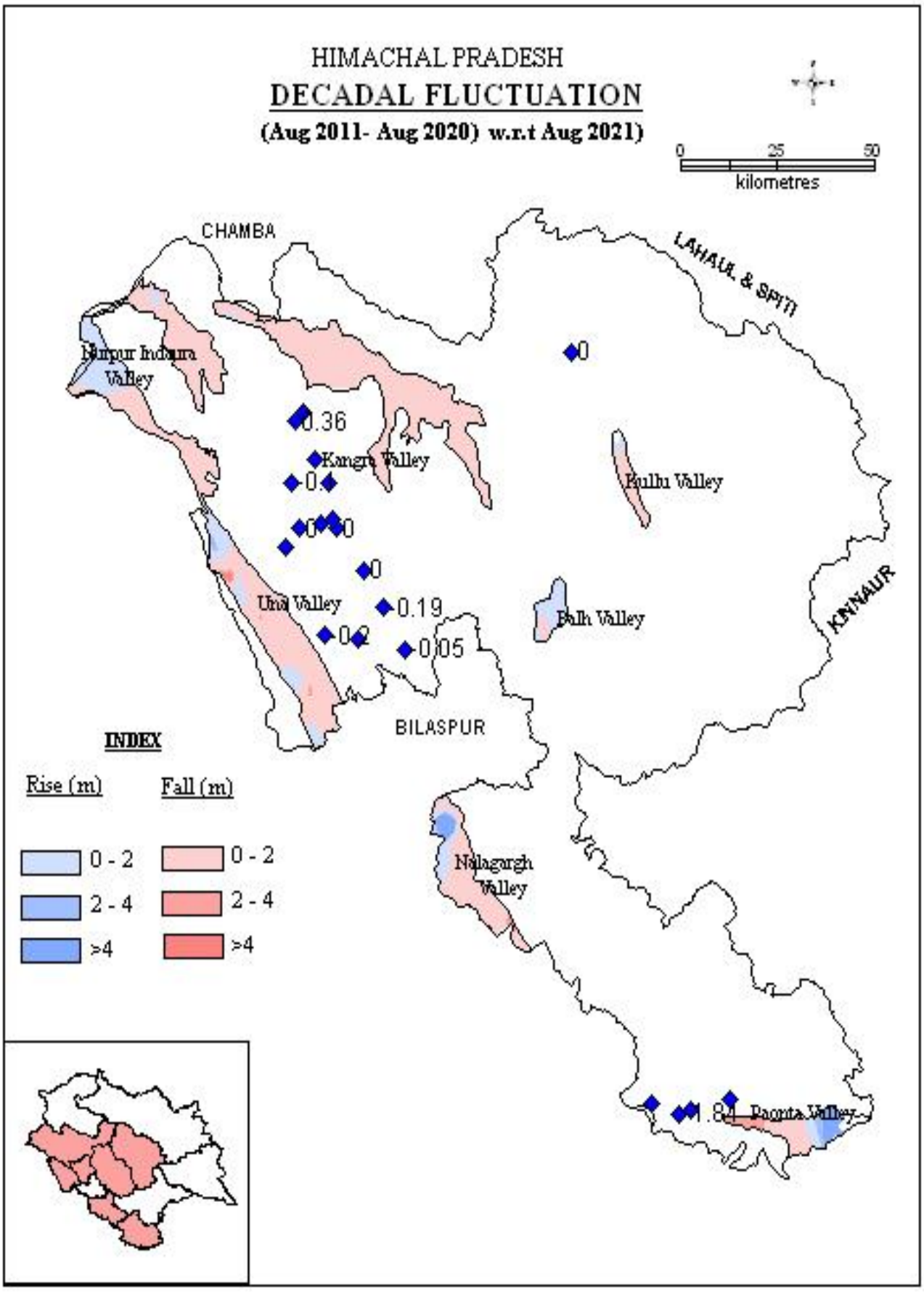

HIMACHAL PRADESH
ANNUAL FLUCTUATION
(August 2020 w.r.t August 2021)
0 25 50
kilometres
CHAMBA
LAHAUL & SPITI
KINNAUR
BILASPUR
Nurpur Indaura Valley
Kangra Valley
Kullu Valley
Balh Valley
Una Valley
Nalagarh Valley
Paonta Valley
0
0.47
0.31
0.50
0
0.18
0.26
0.05
1.06
INDEX
Rise (m)
Fall (m)
0 - 2
2 - 4
>4
0 - 2
2 - 4
>4

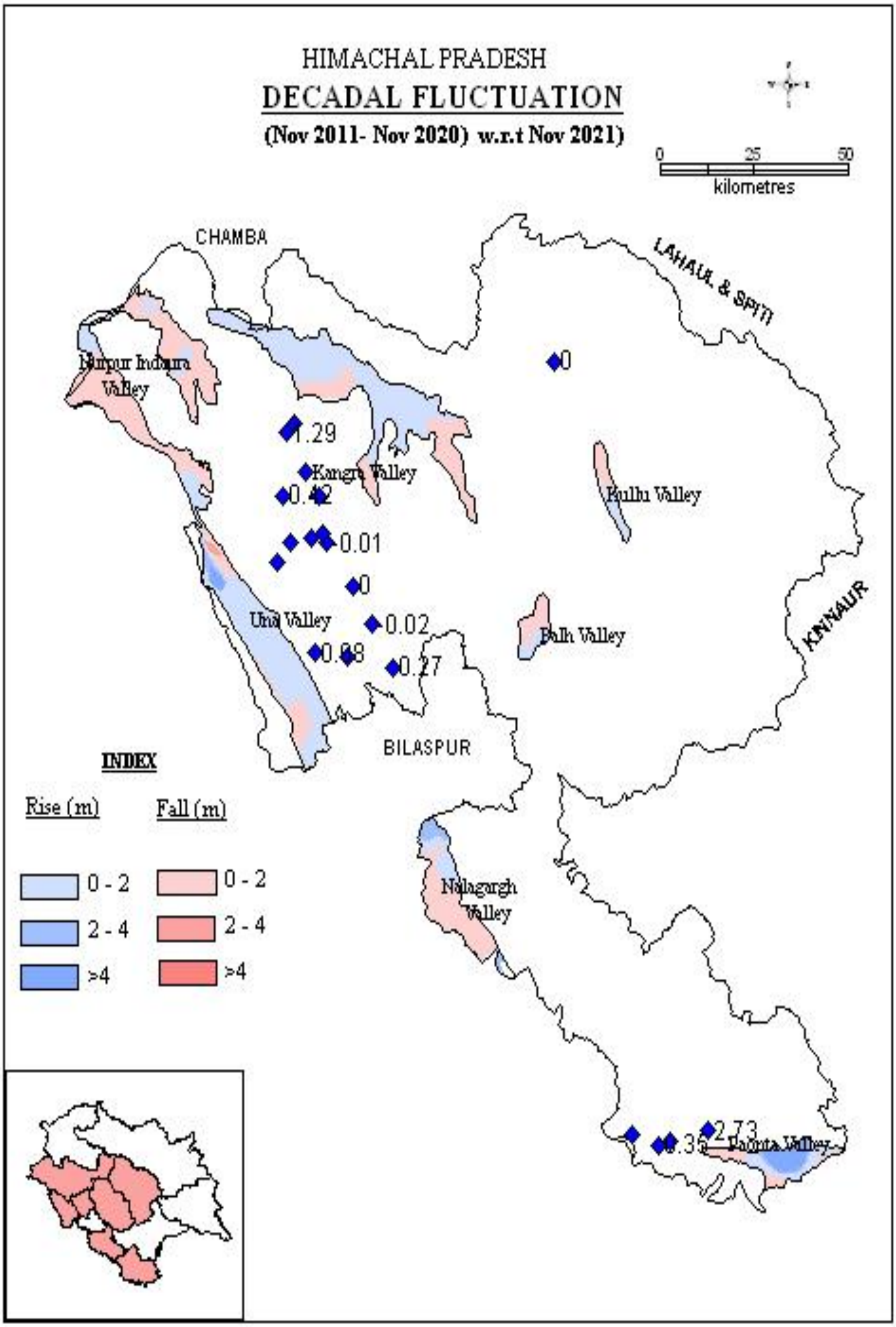


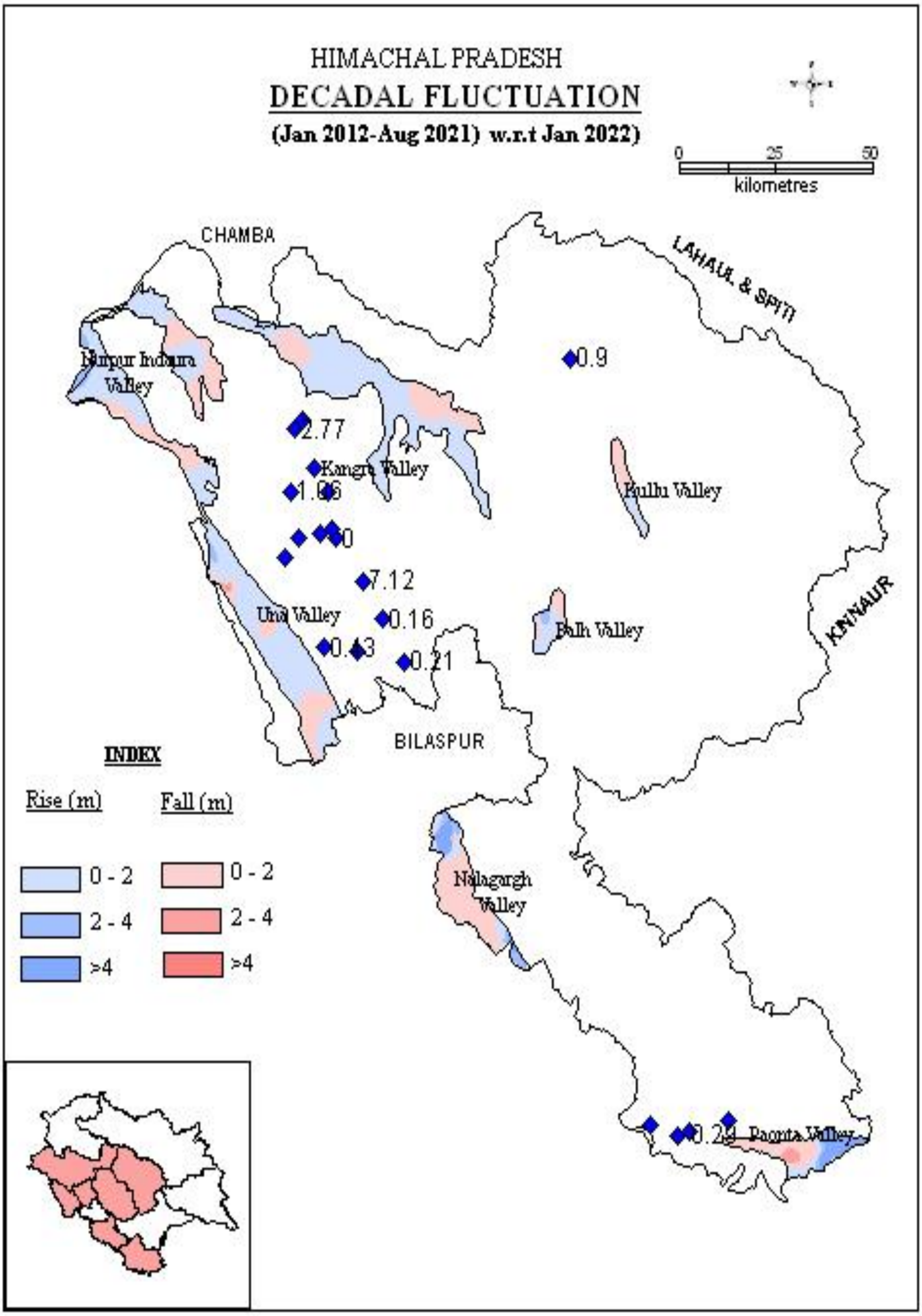
HIMACHAL PRADESH
ANNUAL FLUCTUATION
(November 2020 w.r.t November 2021)
0
25
50
kilometres
CHAMBA
LAHAUL & SPITI
KINNAUR
BILASPUR
Kullu Valley
Balh Valley
Una Valley
Nalagargh Valley
Paonta Valley
INDEX
Rise (m)
Fall (m)
0 - 2
2 - 4
>4
0 - 2
2 - 4
>4
0
1.23
1
0.23
0.25
0
0.17
0.23
0.01
0.8


HIMACHAL PRADESH
ANNUAL FLUCTUATION
(January 2021 w.r.t January 2022)
0
25
50
kilometres
CHAMBA
LAHAUL & SPITI
Pangi Indwara Valley
0.25
1.87
Kangra Valley
Kullu Valley
0.53
5.72
Una Valley
0.13
Balh Valley
KINNAUR
BILASPUR
INDEX
Rise (m)
Fall (m)
0 - 2
2 - 4
>4
0 - 2
2 - 4
>4
Nalagarh Valley
0.86
Paonta Valley


HIMACHAL PRADESH
DECADAL FLUCTUATION
(May 2011-May 2020) w.r.t May 2021)
0
25
50
kilometres
CHAMBA
LAHAUL & SPITI
Pangi Indaura Valley
0.42
3.7
Kangra Valley
Kullu Valley
0.13
1.5
Una Valley
0.23
Bilh Valley
KINNAUR
0.94
BILASPUR
INDEX
Rise (m)
Fall (m)
0 - 2
2 - 4
>4
0 - 2
2 - 4
>4
Nalagargh Valley
Paonta Valley


HIMACHAL PRADESH
DECADAL FLUCTUATION
(Aug 2011- Aug 2020) w.r.t Aug 2021)
0
25
50
kilometres
CHAMBA
LAHAUL & SPITI
Nurpur Indaura Valley
0
0.36
Kangra Valley
0
Kulhu Valley
0
0
0
0
Una Valley
0.19
0.2
0.05
Balh Valley
KINNAUR
BILASPUR
INDEX
Rise (m)
Fall (m)
0 - 2
2 - 4
>4
0 - 2
2 - 4
>4
Nalagargh Valley
1.81
Paonta Valley


HIMACHAL PRADESH
DECADAL FLUCTUATION
(Nov 2011- Nov 2020) w.r.t Nov 2021)
0 25 50
kilometres
CHAMBA
LAHAUL & SPITI
KINNAUR
BILASPUR
Kangra Valley
Kullu Valley
Una Valley
Balh Valley
Nalagarh Valley
1.29
0.42
0.01
0
0.02
0.27
0
2.73
INDEX
Rise (m)
Fall (m)
0 - 2
2 - 4
>4
0 - 2
2 - 4
>4


HIMACHAL PRADESH
DECADAL FLUCTUATION
(Jan 2012-Aug 2021) w.r.t Jan 2022)
0
25
50
kilometres
CHAMBA
LAHAUL & SPITI
KINNAUR
BILASPUR
Nurpur Indaura Valley
Kangra Valley
Kullu Valley
Balh Valley
Una Valley
Nalagargh Valley
Paonta Valley
0.9
2.77
7.12
0.16
0.21
INDEX
Rise (m)
Fall (m)
0 - 2
2 - 4
>4
0 - 2
2 - 4
>4