For Official Use Only

GOVERNMENT OF INDIA

MINISTRY OF WATER RESOURCES
CENTRAL GROUND WATER BOARD

GROUND WATER YEAR BOOK HIMACHAL PRADESH (2017-2018)

NORTHERN HIMALAYAN REGION
DHARAMSHALA
(H.P)
March, 2019

GOVERNMENT OF INDIA
MINISTRY OF WATER RESOURCES
RIVER DEVELOPMENT AND GANGA REJUVENATION
CENTRAL GROUND WATER BOARD

GROUND WATER YEAR BOOK HIMACHAL PRADESH (2017-2018)

By

Rachna Bhatti
Scientist 'C'

Vidya Bhooshan
Senior Technical Assistant
(Hydrogeology)

NORTHERN HIMALAYAN REGION
DHARAMSHALA
(H.P)
March, 2019

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 2017-2018 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. The chemical results are awaited and will be issued separately.

The field data has been collected, processed and compiled by the scientific officers of NHR, Dharamsala. This report has been compiled by Smt. Rachna Bhatti, Scientist 'C' & Sh. Vidya Bhooshan, Senoir Technical Assistant (Hg). A untiring work of map preparation was done by Ms Poonam, Draughtsman from CHQ, Faridabad. The samples were collected by Sh. Jugal Kishore Surveyor and entered in GEMS by Smt. Anju Devi draftsman. Analysis was done by C.G.W.B, NWR, Chandigarh. The efforts of Report & Processing Section in scrutiny, processing and issuance of report is also highly significant.

This ground water year book contains useful data for water year 2017-18 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: 26.03.2019

Dharamshala

26/3/19

(Dr.Onkar Nath Tiwari)

H.O.O

GROUND WATER YEAR BOOK
HIMACHAL PRADESH
2017-2018
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 2017 ranged between 0.34m (Kullu district) and 54.48 m bgl (Solan district).Out of 104 stations monitored, the majority of 87 NHS (83.65%) recorded DTWL, in the range between 2 - 20 m bgl. 7 stations (6.73%), recorded shallow water levels, less than 2 m bgl and 9 stations (8.65%), recorded deep water levels, more than 20 m bgl in the state. and one well is showing greater than 40m, which is dry well.

- The depth to water level recorded during August 2017 ranges between (-0.07) m bgl (Kangra districts) to 55.00 m bgl (Solan district).

- The depth to water level recorded during November 2017 ranged between 0.41 m bgl in Balh valley (Mandi district) to 55.00 m bgl in (Solan district)

- The depth to water level recorded during January 2018 ranged between 0.34m bgl Balh Valley(Mandi district) to 55.00 m bgl (Solan district).

- Monsoonal fluctuation of water level was analyzed for 103 stations for the period May 2017 – November 2017. A perusal of Table-8 shows that out of the 103 stations, 85 stations (82.52%) have shown rise in water level and remaining 18 stations (17.47%) have shown fall in water level.

- Out of the 85 stations analysed, 57 stations (67.05 %) have shown rise in water level ranging from 0.02 (Solan district) to 14.13 m (Sirmaur district), whereas 16 stations (88.88%) have shown fall ranging from 0.01m (Mandi district) to 4.97 m (Una district).

- Annual fluctuation data of water levels in May 2016 wrt May 2017 shows frequency distribution of rise and fall. Out of the 74 stations analysed, 22 stations (29.72%) have shown rise in water level ranging from 0.06 (Mandi and Una district) to 6.96 m (Sirmaur district), whereas 51 stations (68.91 %) have shown fall ranging from 0.04m (Mandi district) to 27.48 m (Solan district).

- Annual fluctuation of water level has been worked out by comparing DTW of November 2016 with November 2017. Out of the 79 stations, 35 stations (44.30%) have shown rise in water level ranging from 0.02m (Sirmaur district) to 12.39 m (Sirmaur district) whereas 42 stations (53.16%) have shown fall ranging from 0.01 m (Kangra district) to 55.00 m (Solan district).

- Annual fluctuation of water level has been worked out by comparing depth to water level of January 2017 with January 2018 . . Out of the 98 stations analyzed, 51 stations (57.95%) have shown rise in water level ranging from 0.02 (Kangra district) to 4.69 m (Una district) whereas 45 stations (45.91%) have shown fall ranging from 0.01 (Una district) to 55.00 m (Solan district).

- Decadal water level fluctuation has been worked out by comparing water level data of May 2017 with the average mean of 10 years water level data of May (2007-2016).. A perusal of data shows that out of 99 stations analysed, 30 stations (30.30%) have shown rise and 69 stations (69.69%), have shown fall in water level. 24 stations (80.00%) are showing rise in water level between 0 to 2m, 3 stations (10.00%) between 2 to 4m. and 3 stations (10.00%), more than 4m.

- Decadal water level fluctuation has been worked out by comparing water level data of August 2017 with the average 10 years water level data of August (2007-2016) A perusal of data shows that out of 103 stations analyzed, 46 stations (44.66%) have shown rise and 57 stations (55.33%), have shown fall in water level. 33 stations (71.73%) are showing rise in water level between 0 to 2m, 5 stations (10.86%) between 2 to 4m. and 8 stations (17.39%), more than 4m.

- Decadal water level fluctuation has been worked out by comparing water level data of November 2017 with the average water level data of November for 10 years (2007-2016) A perusal of data shows that out of 108 stations analyzed, 35 stations (32.40%) have shown rise and 73 stations (67.59%), have shown fall in water level. 25 stations (71.42%) are showing rise in water level between 0 to 2m, 4 stations (11.42%) between 2 to 4m. and 6 stations (17.14%), more than 4m.

- Decadal water level fluctuation has been worked out by comparing water level data of January 2018 with the average water level data of January for 10 years (2008-2017). A perusal of data shows that out of 105 stations analysed, 32 stations (30.47%) have shown rise and 73 stations (69.52%), have shown fall in water level. 26 stations (81.25%) are showing rise in water level between 0 to 2m, 3 stations (9.37%) between 2 to 4m. and 3 stations (9.37%), more than 4m. Out of 73 stations, 58 stations (79.45%) show fall in water level between 0 to 2m, 9 stations (12.32%) between 2 to 4 m and 6 stations (8.21%) more than 4m.

GROUND WATER YEAR BOOK
HIMACHAL PRADESH
2017-2018

TABLES

ANNEXURE

LIST OF PLATES

GROUND WATER YEAR BOOK
HIMACHAL PRADESH

(2017-2018)

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

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 2017

The depth to water level, recorded during May 2017 (Annexure - I), ranged between 0.34m (Kullu district) and 54.48 m bgl (Solan district) (Table-3). Out of 104 stations monitored, the

majority of 87 NHS (83.65%) recorded DTWL, in the range between 2 - 20 m bgl. 7 stations (6.73%), recorded shallow water levels, less than 2 m bgl and 9 stations (8.65%), recorded deep water levels, more than 20 m bgl in the state. and one well is showing greater than 40m, which is dry well.

A perusal of the DTWL map of May 2017 shows that the shallow water level area of less than 2m bgl, occurs in eastern part of Kangra Palampur valley and 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 and Nurpur- Indora valley. Water level 10-20m bgl in shown in major part of Nallagarh and Paonta valley. Deeper water levels, between 20-40m bgl are shown in Northern part of Paonta valley, outer fringes of Nalagarh valley and at few places of Una valley.

Table-3: District wise number & % of NHS distribution, in different DWL of May 2017

Depth to Water Table
Distribution of Percentage of Observation Wells
2017/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	2.93	11.12	0	2 50.00%	1 25.00%	1 25.00 %	0	0
KANGRA	35	0.42	14.06	3 8.57%	19 54.29%	8 22.86%	5 14.29 %	0	0
KULLU	3	0.34	8.17	1 33.33%	0	2 66.67%	0	0	0
MANDI	7	0.40	10.13	2 28.57%	2 28.57%	2 28.57%	1 14.29 %	0	0
SIRMAUR	12	2.07	28.83	0	1 8.33%	3 25.00%	6 50.00 %	2 16.67%	0
SOLAN	12	5.66	54.48	0	0	3 25.00%	4 33.33 %	4 33.33%	1 8.33%
UNA	31	1.07	24.00	1 3.23%	8 25.81%	14 45.16%	5 16.13 %	3 9.68%	0
Total	104	0.34	54.48	7	32	33	22	9	1

3.1.2 August 2017

The depth to water level recorded during August 2017 (Annexure - I) ranges between (-0.07) m bgl (Kangra districts) to 55.00 m bgl (Solan district) (Table-5). Out of the 103 stations monitored the majority of 61 stations (59.22%) recorded DTW in the range between 2-20 m bgl, 35 stations (33.98%) have recorded shallow water level less than 2 m bgl, and only 6 stations (5.82%) have shown, more than 20 m bgl in the state. one well is showing greater than 40m, which is dry well.

A perusal of the DTW map for August 2017 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 and eastern & central part of Una 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, eastern part of Paonta valley and in fringes of Nalagarh valley. Deeper water levels are found at some places in Nalagarh and Una valley.

Table-5:– Depth to water level - August 2017

Depth to Water Table
Distribution of Percentage of Observation Wells
2017/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	4	1.54	5.73	2 50.00%	1 25.00%	1 25.00%	0	0	0
KANGRA	36	-0.07	14.40	16 44.44%	17 47.22%	2 5.56%	1 2.78 %	0	0
KULLU	2	1.27	6.90	1 50.00%	0	1 50.00%	0	0	0
MANDI	8	0.36	4.20	3 37.50%	5 62.50%	0	0	0	0
SIRMAUR	11	1.08	18.68	2 18.18%	4 36.36%	2 18.18%	3 27.27 %	0	0
SOLAN	12	4.54	55.00	0	2 16.67%	2 16.67%	3 25.00 %	4 33.33%	1 8.33%
UNA	30	0.37	21.73	11 36.67%	10 33.33%	4 13.33%	3 10.00 %	2 6.67%	0
Total	103	-0.07	55.00	35	39	12	10	6	1

3.1.3 November 2017

The depth to water level recorded during November 2017 (Annexure - I) ranged between 0.41 m bgl in Balh valley (Mandi district) to 55.00 m bgl in (Solan district) (Table-6). Out of 104 stations monitored, the majority of 81 NHS (77.88%) recorded DTWL, in the range between 2 - 20 m bgl. 16 stations (15.38%), recorded shallow water levels, less than 2 m bgl and 6 stations (5.76%), recorded deep water levels, more than 20 m bgl in the State. one well is showing greater than 40m, which is dry well.

A perusal of the DTWL map for November 2017 shows that the shallow water level areas of less than 2 m observed in eastern part of Kangra Palampur valley and in pockets of all the valleys, except Nalagarh and Una and Indora valleys. Water level of 2-5m & 5-10 m bgl is observed in major part of Kangra Palampur valley, whole of Indaura-Nurpur valley, Balh valley, southern part of Una Valley, Nalagargh valley Paonta valley respectively. 10-20 m bgl water level is shown in Una, Nalagah and Paonta valley only. Deeper water level more than 20m is confined mainly in eastern part of Paonta valley in Sirmaur district, southern part of Nalagarh valley of Solan district and small part of Una valley.

Table- 6: Depth to Water Level – November 2017

Depth to Water Table
Distribution of Percentage of Observation Wells
2017/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	4	1.82	5.78	1 25.00%	1 25.00%	2 50.00%	0	0	0
KANGRA	36	0.49	11.34	7 19.44%	22 61.11%	5 13.89%	2 5.56 %	0	0
KULLU	3	1.24	8.47	1 33.33%	0	2 66.67%	0	0	0
MANDI	8	0.41	6.18	3 37.50%	3 37.50%	2 25.00%	0	0	0
SIRMAUR	12	1.11	26.78	1 8.33%	3 25.00%	3 25.00%	4 33.33 %	1 8.33%	0
SOLAN	13	5.93	55.00	0	0	4 30.77%	5 38.46 %	3 23.08%	1 7.69%
UNA	28	1.04	22.32	3 10.71%	13 46.43%	8 28.57%	2 7.14 %	2 7.14%	0
Total	104	0.41	55.00	16	42	26	13	6	1

3.1.4 January 2018

The depth to water level recorded during January 2018 (Annexure - I) ranged between 0.34mBalh Valley (Mandi district) to 55.00 m bgl (Solan district) (Table-7). Out of 103 stations which are monitored, the majority of 82 NHS (79.61%) recorded DTW in the range between 2 - 20 m bgl. 14 stations (13.59%) recorded shallow water levels, less than 2 m bgl and 6 stations (5.82%) recorded deep water levels, more than 20 m bgl in the state. one well is showing greater than 40m, which is dry well.

A perusal of the DTW map of January 2018 shows that the shallow water level area occurs mainly in south eastern part of Kangra Palampur valley (Kangra district), southern part of Balh valley (Mandi district). 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 Paonta valley and small parts of Nalagarh and Una valley. Deeper water level, more than 20m are confined mainly in eastern part of Paonta valley, Nalagarh and at few places of Una valley.

Table- 7: Depth to Water Level – January 2018

Depth to Water Table
Distribution of Percentage of Observation Wells
2018/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	4	2.04	8.98	0	2 50.00%	2 50.00%	0	0	0
KANGRA	36	0.49	13.06	7 19.44%	20 55.56%	6 16.67%	3 8.33 %	0	0
KULLU	3	1.46	8.47	1 33.33%	0	2 66.67%	0	0	0
MANDI	8	0.34	7.78	2 25.00%	4 50.00%	2 25.00%	0	0	0
SIRMAUR	11	1.84	27.64	1 9.09%	0	2 18.18%	7 63.64 %	1 9.09%	0
SOLAN	13	5.52	55.00	0	0	4 30.77%	5 38.46 %	3 23.08%	1 7.69%
UNA	28	1.14	23.06	3 10.71%	10 35.71%	10 35.71%	3 10.71 %	2 7.14%	0
Total	103	0.34	55.00	14	36	28	18	6	1

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 2017 to November 2017

Monsoonal fluctuation of water level was analyzed for 103 stations for the period May 2017 – November 2017. A perusal of Table-8 shows that out of the 103 stations, 85 stations (82.52%) have shown rise in water level and remaining 18 stations (17.47%) have shown fall in water level.

The minimum rise in water level of 0.02 m was observed in Solan District and the maximum rise 14.13 m was noticed in Sirmaur District. Out of the 85 stations which have shown rise in water level, 57 stations (67.05%) show rise between the range of 0 to 2m, 18 stations (21.17%) between 2 to 4m and remaining 10 stations (11.76%) show rise more than 4m.

The minimum and maximum fall in water level of 0.01 m and 4.97 m was observed in Mandi and Una District. Out of them 16 stations (88.88%) have shown fall between 0-2 m, 1 stations (5.55%) have shown fall between 2-4 m and remaining 1 stations (5.55%) has shown fall >4m.

A perusal of map for seasonal fluctuation shows a rise in water level in major part of Paonta valley, Nalagargh valley, Una valley, Balh valley and Kangra valley. Except a fall which is noticed in central part of Nallagarh valley, Una valley and eastern part of Kangra Palampur valley.

Table-8: Monsoonal Fluctuation - May 2017 to November 2017

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

From Year: 2017/May - To Year: 2017/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	4	0.91	5.34	-	-	3 75.00%	0	1 25.00%	0	0	0	4	0
KANGRA	35	0.14	13.44	0.07	0.17	23 65.71%	6 17.14 %	2 5.71%	4 11.43%	0	0	31	4
KULLU	3	1.47	1.47	0.30	0.90	1 33.33%	0	0	2 66.67%	0	0	1	2
MANDI	7	0.34	3.95	0.01	0.28	3 42.86%	1 14.29 %	0	3 42.86%	0	0	4	3
SIRMAUR	12	0.96	14.13	-	-	4 33.33%	5 41.67 %	3 25.00%	0	0	0	12	0
SOLAN	12	0.02	4.71	0.52	1.09	5 41.67%	0	1 8.33%	6 50.00%	0	0	6	6
UNA	30	0.12	10.08	0.12	4.97	18 60.00%	6 20.00 %	3 10.00%	1 3.33%	1 3.33%	1 3.33%	27	3
Total	103	1.47	1.47	0.00	4.97	57	18	10	16	1	1	85	18

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 2016 to May 2017

Annual fluctuation of water level, has been worked out by comparing depth to water level of May 2016, with May 2017 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 74 stations analysed, 22 stations (29.72%) have shown rise in water level ranging from 0.06 (Mandi and Una district) to 6.96 m (Sirmaur district), whereas 51 stations (68.91 %) have shown fall ranging from 0.04m (Mandi district) to 27.48 m (Solan district).

Out of stations which have shown rise in water level, 20 stations (90.90%) show rise between the range of 0 to 2m, 1 station (4.54)has shown rise between 2 to 4m and only 1 stations (4.54%) show rise more than 4m.

Similarly, for the stations which have shown fall in water level, 38 stations (74.50%) show fall between the range of 0 to 2m, 6 stations (11.76%) between 2 to 4m and remaining 7 stations (13.72%) show fall more than 4m.

A perusal of map of Annual Water Level Fluctuation for May 2016 to May 2017 shows fall in water level in majority of monitoring areas. Fall of 0-2m in shown in Nurpur Indora valley, Kangra-Palampur valley of Kangra district, and major part of Nalagarh valley of Solan district,

Paonta valley of Sirmour district. Fall >4 m is noticed in small pockets of Bahl valley and Nallagah valley. Rise in water level is noticed in Kangra Palampur valley, southern part of Nalagarh valley and at some places in Paonta valley and Balh valley.

Table-9: District wise number & % of NHS distribution in different Annual W/L Fluctuation Range (May 2016 - May 2017)

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

From Year: 2016/May - To Year: 2017/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	0.10	0.10	0.13	2.43	1 25.00%	0	0	2 50.00%	1 25.00%	0	1	3
KANGRA	8	0.26	3.12	0.12	1.26	4 50.00%	1 12.50 %	0	3 37.50%	0	0	5	3
KULLU	3	-	-	0.34	5.99	0	0	0	2 66.67%	0	1 33.33%	0	3
MANDI	7	0.06	0.06	0.04	10.13	1 14.29%	0	0	4 57.14%	0	1 14.29%	1	5
SIRMAUR	11	0.16	6.96	0.39	3.42	6 54.55%	0	1 9.09%	2 18.18%	2 18.18%	0	7	4
SOLAN	12	0.07	0.44	0.21	27.48	2 16.67%	0	0	5 41.67%	0	5 41.67%	2	10
UNA	29	0.06	1.88	0.28	3.92	6 20.69%	0	0	20 68.97%	3 10.34%	0	6	23
Total	74	0.26	0.06	0.04	27.48	20	1	1	38	6	7	22	51

3.3.2 August 2016 to August 2017

Annual fluctuation data of water level is presented in Annexure – III and its frequency distribution of rise and fall is given in Table-10. Out of the 102 stations, 48 stations (28.42%) have shown rise in water level ranging from 0.01 m (Una district) to 13.25 m (Solan district) whereas 52 stations (71.57%) have shown fall ranging from 0.01 m (Kangra district) to 55.0 m (Solan district).

Out of stations which have shown rise in water level, 41 stations (85.41%) show rise between the range of 0 to 2m, 2 stations (4.16 %) between 2 to 4m and remaining 5 stations (10.41%) show rise more than 4m.

Similarly, for the stations which have shown fall in water level, 45 stations (86.53%) show fall between the range of 0 to 2m, 4 stations (7.69%) between 2 to 4m and remaining 3 stations (5.76%) show fall more than 4m.

A perusal of map of Annual Water Level Fluctuation for August 2017 to August 2018 shows fall in water level in some of monitoring areas of central part of Kangra Palampur valley, Bahl valley, in small pockets of Indora-Nurpur valley, Nallagarh valley, Una valley and in small patch of Paonta valley. Areas are showing water level rise in all the valleys, under monitoring area.

Table-10: Annual Fluctuation August 2016 - August 2017

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

From Year: 2016/Aug - To Year: 2017/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	3	0.01	0.68	0.15	0.15	2 66.67%	0	0	1 33.33%	0	0	2	1
KANGRA	35	0.12	3.75	0.01	8.16	14 40.00%	1 2.86 %	0	19 54.29%	0	1 2.86%	15	20
KULLU	3	8.47	8.47	1.09	1.74	0	0	1 33.33%	2 66.67%	0	0	1	2
MANDI	8	0.02	0.50	0.11	0.91	2 25.00%	0	0	6 75.00%	0	0	2	6
SIRMAUR	10	0.06	9.97	0.31	0.64	6 60.00%	1 10.00 %	1 10.00%	2 20.00%	0	0	8	2
SOLAN	13	0.21	13.25	0.03	55.00	1 7.69%	0	1 7.69%	6 46.15%	1 7.69%	2 15.38%	2	9
UNA	30	0.01	12.64	0.02	3.81	16 53.33%	0	2 6.67%	9 30.00%	3 10.00%	0	18	12
Total	102	8.47	0.50	0.01	55.00	41	2	5	45	4	3	48	52

3.3.3 November 2016 to November 2017

Annual fluctuation of water level has been worked out by comparing DTW of November 2016 with November 2017 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 79 stations, 35 stations (44.30%) have shown rise in water level ranging from 0.02m (Sirmaur district) to 12.39 m (Sirmaur district) whereas 42 stations (53.16%) have shown fall ranging from 0.01 m (Kangra district) to 55.00 m (Solan district).

Out of stations which have shown rise in water level, 30 stations (85.71%) show rise between the range of 0 to 2m, 1 stations (2.85 %) between 2 to 4m and remaining 4 station(11.42%) show rise more than 4m.

Similarly, for the stations which have shown fall in water level, 30 stations (71.42%) show fall between the range of 0 to 2m, 3 station (7.14%) between 2 to 4m and remaining 9 stations (21.42%) show fall more than 4m.

A perusal of map of annual fluctuation of November 2016 to November 2017 showing fall in water levels in majority of valley areas. Nallagarh valley of Solan district is completely under fall conditions. 0-2m fall is shown in some part of Paonta valley, more than 4m is observed in the small pocket of Una, & Nallagh valley. 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 Kangra valley, Paonta valley and at few places of Una valley.

Table-11: Annual Fluctuation -November 2016 to November 2017

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

From Year: 2016/Nov - To Year: 2017/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	4	0.69	1.96	-	-	4 100.00%	0	0	0	0	0	4	0
KANGRA	11	0.91	0.91	0.01	0.93	1 9.09%	0	0	10 90.91%	0	0	1	10
KULLU	3	1.13	1.13	0.34	8.47	1 33.33%	0	0	1 33.33%	0	1 33.33%	1	2
MANDI	8	0.04	0.53	0.04	0.55	4 50.00%	0	0	3 37.50%	0	0	4	3
SIRMAUR	10	0.02	12.39	0.24	10.49	4 40.00%	1 10.00 %	1 10.00%	3 30.00%	0	1 10.00%	6	4
SOLAN	12	0.13	0.13	0.57	55.00	1 8.33%	0	0	4 33.33%	2 16.67%	5 41.67%	1	11
UNA	31	0.03	8.16	0.07	7.18	15 48.39%	0	3 9.68%	9 29.03%	1 3.23%	2 6.45%	18	12
Total	79	1.13	0.13	0.00	55.00	30	1	4	30	3	9	35	42

3.3.4 January 2017 to January 2018

Annual fluctuation of water level has been worked out by comparing depth to water level of January 2017 with January 2018 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 98 stations analyzed, 51 stations (57.95%) have shown rise in water level ranging from 0.02 (Kangra district) to 4.69 m (Una district) whereas 45 stations (45.91%) have shown fall ranging from 0.01 (Una district) to 55.00 m (Solan district).

Out of stations which have shown rise in water level, 46 stations (90.19%) show rise between the range of 0 to 2m, 2stations (3.92%) between 2 to 4m and remaining 3 stations (5.88%) show rise more than 4m.

Similarly, for the stations which have shown fall in water level, 36 stations (85.41%) show fall between the range of 0 to 2m, 3 stations (6.66%) between 2 to 4m and remaining 6 stations (13.33%) show fall more than 4m.

A perusal of map of annual fluctuation of January 2017 to January 2018 is showing fall & rise, about in same proportions. The fall in water level 0-2m is shown in Indora valley, and few places of Kangra Palampur valley, Balh valley, a part of Nalagargh valley, part of Una valley and a part of Paonta valley. Fall in water level, more than 4m is observed in Nallagh valley only. Similarly rise in water level 0-2m is noticed in central & southern part of Kangra valley, southern part of Balh valley, southern part of Una valley and part of Paonta valley.

Table-12: Annual Fluctuation, January 2017 to January 2018

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

From Year: 2017/Jan - **To Year:** 2018/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	0.95	0	0	0	4 100.00%	0	0	0	4
KANGRA	34	0.02	3.03	0.04	2.08	19 55.88%	1 2.94 %	0	13 38.24%	1 2.94%	0	20	14
KULLU	3	0.03	0.03	0.09	0.09	1 33.33%	0	0	1 33.33%	0	0	1	1
MANDI	8	0.27	1.00	0.03	0.75	2 25.00%	0	0	5 62.50%	0	0	2	5
SIRMAUR	10	0.26	2.55	0.04	6.68	5 50.00%	1 10.00 %	0	3 30.00%	0	1 10.00%	6	4
SOLAN	10	0.13	4.06	0.59	55.00	1 10.00%	0	1 10.00%	2 20.00%	1 10.00%	5 50.00%	2	8
UNA	29	0.04	4.69	0.01	3.72	18 62.07%	0	2 6.90%	8 27.59%	1 3.45%	0	20	9
Total	98	0.27	0.03	0.01	55.00	46	2	3	36	3	6	51	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 (2007-2016) to May 2017

Decadal water level fluctuation has been worked out by comparing water level data of May 2017 with the average mean of 10 years water level data of May (2007-2016) 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 99 stations analysed, 30 stations (30.30%) have shown rise and 69 stations (69.69%), have shown fall in water level. 24 stations (80.00%) are showing rise in water level between 0 to 2m, 3 stations (10.00%) between 2 to 4m. and 3 stations (10.00%), more than 4m.

Out of 69 stations, 49stations (71.01%) show fall in water level between 0 to 2m, 13 stations (18.84 %) between 2 to 4 m and 7 stations (10.14%) more than 4m.

A minimum rise in water level of 0.04 m was noticed in Kangra districts and the maximum rise of 12.64m is noticed in Sirmaur district. Similarly, the minimum and maximum fall of 0.02 m is noticed in Sirmaur district & maximum fall of 33.61 m is noticed in Solan district.

A perusal of map of Decadal Variation - Average of May (2007 - 2016) with May 2017 reveals fall less than 2m, in all the valleys of Kangra district, Mandi district, Sirmaur district, Solan

district & Una district except at some places in Indaura valley, Balh valley and Paonta & Kangra-Palampur valley and Nurpur valley, which is showing rise. A fall is 2-4m and >4 m is shwn in Una and Nallagarh valley.

Table-13: District wise number & % NHS distribution in different Decadal W/L Fluctuation Range (May (2007 - 2016) with May 2017

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

10 Years Mean (2007 May - 2016 May) - 2017/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	0.10	0.10	0.13	2.43	1 25.00 %	0	0	2 50.00%	1 25.00 %	0	1	3
KANGRA	30	0.04	7.13	0.12	3.46	13 43.33 %	3 10.00%	2 6.67%	11 36.67%	1 3.33 %	0	18	12
KULLU	3	1.08	1.08	2.68	4.62	1 33.33 %	0	0	0	1 33.33 %	1 33.33%	1	2
MANDI	7	0.18	0.96	0.03	2.49	4 57.14 %	0	0	2 28.57%	1 14.29 %	0	4	3
SIRMAUR	12	0.42	12.64	0.02	9.01	3 25.00 %	0	1 8.33%	5 41.67%	2 16.67 %	1 8.33%	4	8
SOLAN	12	0.18	0.18	0.51	33.61	1 8.33 %	0	0	4 33.33%	3 25.00 %	4 33.33%	1	11
UNA	31	0.45	0.45	0.15	4.74	1 3.23 %	0	0	25 80.65%	4 12.90 %	1 3.23%	1	30
Total	99	0.10	1.08	0.02	33.61	24	3	3	49	13	7	30	69

CGWB, Northern Himalayan Region Page 1 of 1 07-February-2019

3.4.2 Decadal Average of August (2007 - 2016) to August 2017

Decadal water level fluctuation has been worked out by comparing water level data of August 2017 with the average 10 years water level data of August (2007-2016) 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 103 stations analyzed, 46 stations (44.66%) have shown rise and 57 stations (55.33%), have shown fall in water level. 33 stations (71.73%) are showing rise in water level between 0 to 2m, 5 stations (10.86%) between 2 to 4m. and 8 stations (17.39%), more than 4m.

Out of 57 stations, 41 stations (71.92%) show fall in water level between 0 to 2m, 6 stations (10.52%) between 2 to 4 m and 10 stations (17.54%) more than 4m.

A minimum rise in water level of 0.08m was noticed in Kangra district and the maximum rise of 31.02 m is noticed in Una district. Similarly, the minimum and maximum fall of 0.01 m is noticed in Mandi district & maximum fall of 40.88 m is also noticed in Solan district.

A perusal of map Decadal Average of August (2007 - 2016) to August 2017 shows fall in water level in Paonta 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 Nallagah valley and couple of pockets of Una valley and Kangra-Palampur valley. Similarly rise in water level is noticed in Balh valley of Mandi district, central part of Una valley in Una district part of Kangra valley of Kangra district,

Table-14: Decadal Fluctuation August (2007-2016) to August 2017

2.1

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

10 Years Mean (2007 Aug - 2016 Aug) - 2017/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	4	0.41	1.08	0.06	0.90	2 50.00 %	0	0	2 50.00%	0	0	2	2
KANGRA	31	.00	8.07	0.02	7.50	17 54.84 %	1 3.23%	2 6.45%	10 32.26%	0	1 3.23%	20	11
KULLU	3	0.33	3.91	1.90	1.90	1 33.33 %	1 33.33%	0	1 33.33%	0	0	2	1
MANDI	8	0.08	0.18	0.01	0.81	2 25.00 %	0	0	6 75.00%	0	0	2	6
SIRMAUR	12	2.92	9.78	0.07	2.43	0	2 16.67%	2 16.67%	6 50.00%	2 16.67 %	0	4	8
SOLAN	13	1.00	11.64	1.25	40.88	1 7.69 %	0	1 7.69%	2 15.38%	2 15.38 %	7 53.85%	2	11
UNA	32	0.17	31.02	0.05	5.57	10 31.25 %	1 3.13%	3 9.38%	14 43.75%	2 6.25 %	2 6.25%	14	18
Total	103	0.18	2.92	0.01	40.88	33	5	8	41	6	10	46	57

CGWB, Northern Himalayan Region Page 1 of 1 07-February-2019

3.4.3 Decadal average of November (2007-2016) to November 2017

Decadal water level fluctuation has been worked out by comparing water level data of November 2017 with the average water level data of November for 10 years (2007-2016) and is presented in Annexure - IV and frequency distribution in various ranges in Table 15.

A perusal of Table-15 shows that out of 108 stations analyzed, 35 stations (32.40%) have shown rise and 73 stations (67.59%), have shown fall in water level. 25 stations (71.42%) are showing rise in water level between 0 to 2m, 4 stations (11.42%) between 2 to 4m. and 6 stations (17.14%), more than 4m.

Out of 73 stations, 55 stations (75.34%) show fall in water level between 0 to 2m, 11 stations (15.06%) between 2 to 4 m and 7 stations (9.58%) more than 4m.

A minimum rise in water level of 0.03 m was noticed in Kangra district and the maximum rise of 20.81 m is noticed in Una district. Similarly, the minimum and maximum fall of 0.06 m is noticed in Kangra district & maximum fall of 40.03 m is also noticed in Solan district.

A perusal of map of Decadal average of November (2007-2016) to November 2017 reveals fall in water level less than 2m.is shown in central part of Kangra - Palampur valley & Nurpur Indaura valley of Kangra district, major part of Una valley, Balh valley, a couple of places in Paonta valley and all Nalagarh valley. The fall between 2 to 4 m was noticed in, Una and Nalagarh valley. Similarly, rise is noticed in all the valleys from 0-2 m and 2- 4m except in major part of Nallagah valley.

Table-15: Decadal Fluctuation November (2007-16) to November 2017

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

10 Years Mean (2007 Nov - 2016 Nov) - 2017/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	4	0.04	1.27	-	-	4 100.00 %	0	0	0	0	0	4	0
KANGRA	37	0.03	10.23	0.06	1.65	11 29.73 %	1 2.70%	2 5.41%	23 62.16%	0	0	14	23
KULLU	3	0.20	0.20	0.77	4.11	1 33.33 %	0	0	1 33.33%	0	1 33.33%	1	2
MANDI	8	0.08	0.42	0.16	0.73	3 37.50 %	0	0	5 62.50%	0	0	3	5
SIRMAUR	12	0.13	10.15	0.39	3.61	2 16.67 %	1 8.33%	2 16.67%	6 50.00%	1 8.33 %	0	5	7
SOLAN	13	-	-	0.33	40.03	0	0	0	3 23.08%	6 46.15 %	4 30.77%	0	13
UNA	31	0.03	20.81	0.09	7.03	4 12.90 %	2 6.45%	2 6.45%	17 54.84%	4 12.90 %	2 6.45%	8	23
Total	108	0.20	0.20	0.00	40.03	25	4	6	55	11	7	35	73

CGWB, Northern Himalayan Region Page 1 of 1 07-February-2019

3.4.4 Decadal average of January (2008-2017) to January 2018

Decadal water level fluctuation has been worked out by comparing water level data of January 2018 with the average water level data of January for 10 years (2008-2017) 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 105 stations analysed, 32 stations (30.47%) have shown rise and 73 stations (69.52%), have shown fall in water level. 26 stations (81.25%) are showing rise in water level between 0 to 2m, 3 stations (9.37%) between 2 to 4m. and 3 stations

(9.37%), more than 4m. Out of 73 stations, 58 stations (79.45%) show fall in water level between 0 to 2m, 9 stations (12.32%) between 2 to 4 m and 6 stations (8.21%) more than 4m.

A minimum rise in water level of 0.03 m was noticed in Sirmaur district and the maximum rise of 22.13 m is noticed in Sirmaur district. Similarly, the minimum and maximum fall of 0.01 m is noticed in Hamirpur and Una district & maximum fall of 38.97 m is noticed in Solan district.

A perusal of map of Decadal average of January (2008-2017) to January 2018 reveals fall in water level less than 2m.is shown in central part of Kangra - Palampur valley & at small areas of Nurpur-Indaura valley of Kangra district, Balh valley, major part of Una valley, Paonta valley and all Nalagarh valley. The fall between 2 to 4 m and >4 m was noticed in few places of Una valley, Nalagargh valley and Paonta valley of Sirmour district. Similarly, rise is noticed in all the valleys from 0-2 m and 2- 4m except in major part of Nallagah valley.

Table –15: Decadal Fluctuation January (2008-2017) to January 2018

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

10 Years Mean (2008 Jan - 2017 Jan) - 2018/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	-	-	0.01	1.58	0	0	0	4 100.0 %	0	0	0	4
KANGRA	35	0.04	6.56	0.03	1.89	16 45.71 %	1 2.86%	1 2.86%	17 48.57%	0	0	18	17
KULLU	3	0.12	0.12	0.65	4.06	1 33.33 %	0	0	1 33.33%	0	1 33.33%	1	2
MANDI	8	.00	0.85	0.12	1.13	4 50.00 %	0	0	4 50.00%	0	0	4	4
SIRMAUR	11	0.03	22.13	0.07	5.99	3 27.27 %	0	1 9.09%	6 54.55%	0	1 9.09%	4	7
SOLAN	13	-	-	0.26	38.97	0	0	0	4 30.77%	5 38.46 %	4 30.77%	0	13
UNA	31	0.04	28.02	0.01	3.76	2 6.45 %	2 6.45%	1 3.23%	22 70.97%	4 12.90 %	0	5	26
Total	105	0.12	0.12	0.01	38.97	26	3	3	58	9	6	32	73

CGWB, Northern Himalayan Region Page 1 of 1 07-February-2019

Annexure-I

Depth to water level of May 2017, August2017, Nov 2017 & Jan 2018

State	Himachal Pradesh				
District	**HAMIRPUR**	**Dtw May 2017**	**Dtw Aug 2017**	**Dtw Nov 2017**	**Dtw Jan 2018**
1	Bagnalla	6.43	3.43	5.04	5.64
2	Bijari	2.93	1.54	2.02	2.04
3	Galore	3.04	1.76	1.82	2.81
4	Kangu	11.12	5.73	5.78	8.98
District	**KANGRA**				
5	Andaura	2.99	1.50	2.53	2.73
6	Bandh	1.42	0.43	1.59	1.97
7	Barota	7.70	2.93	4.86	5.82
8	Basa Bazira		6.84	8.31	8.38
9	Bhalad	3.24	0.15	1.54	1.43
10	Bhali	2.58	1.21	2.05	2.27
11	Bharmar	14.06	6.13	10.17	11.67
12	Bharoli	8.64	3.49	6.13	6.69
13	Bod	4.91	1.49	3.07	2.63
14	Chakban Ambari	4.32	3.39	4.39	4.51
15	Channaur	2.53	2.16	2.39	2.57
16	Darkati	2.54	0.81	1.49	1.86
17	Dehra Gopipur	5.17	3.08	4.29	4.18
18	Dehrian	2.09	1.21	1.47	1.81
19	Hardogri	4.62	2.62	2.68	3.32
20	Jagir	3.31		2.94	
21	Jassur	3.57	3.16	2.74	3.07
22	Jwalaji	5.53	1.11	2.59	2.19
23	Kangra	11.17	4.83	9.52	10.26
24	Kathgarh	4.27	3.09	3.66	3.93
25	Kotla	3.07	-0.07	2.18	2.58
26	Manjgram	0.80	0.33	0.96	1.35
27	Mao	3.83	0.61	1.96	1.62
28	Mohtli	3.80	2.48	3.49	3.62
29	Nagrota	13.44	14.40	0.00	9.22
30	Old Kangra	8.72	1.09	3.08	3.06
31	Olherian		2.69	3.21	3.06
32	Pandtehr	0.42	0.23	0.49	0.49
33	Panjpir	4.66	2.11	4.47	3.92
34	Paprola	12.03	4.29	11.34	13.06
35	Rait	10.34	4.71	8.62	9.39
36	Raja-ka-talab	5.34	1.38	3.27	3.59
37	Rakar	3.87	0.94	3.24	3.31
38	Riali	4.11	3.68	3.68	3.64
39	Takipur	6.28	0.96	4.04	4.54
40	Thali	3.84	2.71	2.57	2.73
41	Thirtynine Mile	8.76	4.59	7.65	7.79
District	**KULLU**				
42	Gadauri	7.65	6.90	6.18	6.74
43	Hathithan	8.17	0.00	8.47	8.47

		Dtw May 2017	Dtw Aug 2017	Dtw Nov 2017	Dtw Jan 2018
44	Kullu	0.34	1.27	1.24	1.46
District	**MANDI**				
45	Bahangrotu	6.50	4.20	5.84	5.93
46	Gagal		1.81	1.76	2.74
47	GUTKAR	10.13	4.08	6.18	7.78
48	Jarl	0.40	0.36	0.41	0.34
49	Jhiri	5.50	3.86	4.30	4.47
50	Kaned	0.67	0.60	0.95	0.62
51	Lohara	3.77	3.25	3.43	3.49
52	Ratti	4.01	3.86	4.07	4.09
District	**SIRMAUR**				
53	Ajiwala	6.26	0.00	4.98	5.78
54	Akkawala	13.51	1.33	11.33	11.54
55	Badripur	24.62	9.61	10.49	
56	Dhaulakuan	9.40	4.20	4.60	11.67
57	Kala-Amb	16.00	11.48	12.74	13.05
58	Khodawala	15.26	12.92	2.98	14.18
59	Kiyarda	9.55	2.59	6.62	8.86
60	Kolar	12.04	3.87	10.71	
61	Nariwala				11.57
62	Nayagaon	13.04	4.72	9.66	11.24
63	Shambuwala	11.74	8.44	9.93	10.27
64	Shibpur	28.83	18.68	26.78	27.64
65	Trilokpur	2.07	1.08	1.11	1.84
District	**SOLAN**				
66	Baddi	5.66	6.75	6.75	6.75
67	Barotiwala	27.71	25.11	26.09	26.82
68	Barun	36.96	37.56	37.56	37.56
69	Bhagheri	22.03	21.62	21.68	22.21
70	BHATOLI	13.81	14.10	13.79	14.10
71	Dhabota	14.60	0.00	12.77	12.83
72	Jagatpur	22.35	22.65	17.64	17.94
73	Jharmajri	12.72	13.62	13.62	13.62
74	Khera-chak		4.83	5.99	6.69
75	Mahadev	13.71	14.25	14.25	14.25
76	Manjhauli	6.20	7.00	7.00	7.00
77	Panjahra	54.48	55.00	55.00	55.00
78	Phalahi	6.08	4.54	5.93	5.52
District	**UNA**				
79	Amb	7.58	4.26	6.56	5.96
80	Ambota		0.00	0.00	0.00
81	Babehr	5.84	1.27	2.59	3.21
82	Bawal	1.07	1.06	1.19	1.14
83	Bhadsali	15.98	15.44		15.77
84	Bhangana	3.03	0.56	8.00	1.41
85	Daulatpur	10.14	7.88	8.53	8.74
86	Dharampur	4.88	5.67	2.84	3.07
87	Gagret	10.61	12.00	7.41	8.28
88	Ghaneri	8.58	4.69	8.46	9.39
89	Guglahar	5.13	2.92	3.55	4.23

		Dtw May 2017	Dtw Aug 2017	Dtw Nov 2017	Dtw Jan 2018
90	Ishapur	3.77	1.71	2.54	2.64
91	Jankaur	5.94	0.00	0.00	0.00
92	Jawar	2.11	0.99	1.04	1.17
93	Jhalera	5.49	4.04	4.87	5.26
94	Khanpur	5.11	4.06	4.11	6.72
95	Khwaja	2.52	0.53	2.11	2.21
96	Kuluwal	5.14	3.66	0.00	0.00
97	Kuthera Jaswala	7.67	5.86	7.33	7.89
98	Lalehri	13.75	9.96	3.67	
99	Loharli	5.56	2.34	9.00	4.32
100	Mawa Kalan	22.63	20.94	22.32	23.06
101	Mubarikpur	7.29	3.47	4.54	5.13
102	Nangran	6.02	4.51	4.58	5.38
103	Panjawar	14.82	0.99	14.51	13.49
104	Panoh	3.34	0.44	2.43	2.58
105	Raipur Marwadi	21.18	18.37	18.57	19.12
106	Rajli Panjal	7.57	0.37	3.62	4.74
107	Santokhgarh	6.30	4.19	5.03	5.09
108	Singhnei	24.00	21.73	22.17	22.06
109	Tahliwala 1	2.74	0.60	1.71	2.04
110	Una	4.49	1.68	2.86	2.93

Annexure-II

Monsoonal Fluctuation of - Pre and post for 2017

State	Himachal Pradesh	
District	**HAMIRPUR**	**Monsoon fl (may17-Nov17**
1	Bagnalla	1.39
2	Bijari	0.91
3	Galore	1.22
4	Kangu	5.34
District	**KANGRA**	
5	Andaura	0.46
6	Bandh	-0.17
7	Barota	2.84
8	Basa Bazira	-
9	Bhalad	1.70
10	Bhali	0.53
11	Bharmar	3.89
12	Bharoli	2.51
13	Bod	1.84
14	Chakban Ambari	-0.07
15	Channaur	0.14
16	Darkati	1.05
17	Dehra Gopipur	0.88
18	Dehrian	0.62
19	Hardogri	1.94
20	Jagir	0.37
21	Jassur	0.83
22	Jwalaji	2.94
23	Kangra	1.65
24	Kathgarh	0.61
25	Kotla	0.89
26	Manjgram	-0.16
27	Mao	1.87
28	Mohtli	0.31
29	Nagrota	13.44
30	Old Kangra	5.64
31	Olherian	-
32	Pandtehr	-0.07
33	Panjpir	0.19
34	Paprola	0.69

State	Himachal Pradesh	Monsoon fl (may17-Nov17
35	Rait	1.72
36	Raja-ka-talab	2.07
37	Rakar	0.63
38	Riali	0.43
39	Takipur	2.24
40	Thali	1.27
41	Thirtynine Mile	1.11
District	**KULLU**	
42	Gadauri	1.47
43	Hathithan	-0.30
44	Kullu	-0.90
District	**MANDI**	
45	Bahangrotu	0.66
46	Gagal	-
47	GUTKAR	3.95
48	Jarl	-0.01
49	Jhiri	1.20
50	Kaned	-0.28
51	Lohara	0.34
52	Ratti	-0.06
District	**SIRMAUR**	
53	Ajiwala	1.28
54	Akkawala	2.18
55	Badripur	14.13
56	Dhaulakuan	4.80
57	Kala-Amb	3.26
58	Khodawala	12.28
59	Kiyarda	2.93
60	Kolar	1.33
61	Nariwala	
62	Nayagaon	3.38
63	Shambuwala	1.81
64	Shibpur	2.05
65	Trilokpur	0.96
District	**SOLAN**	
66	Baddi	-1.09
67	Barotiwala	1.62
68	Barun	-0.60
69	Bhagheri	0.35
70	BHATOLI	0.02
71	Dhabota	1.83

State	Himachal Pradesh	Monsoon fl (may17-Nov17
72	Jagatpur	4.71
73	Jharmajri	-0.90
74	Khera-chak	-
75	Mahadev	-0.54
76	Manjhauli	-0.80
77	Panjahra	-0.52
78	Phalahi	0.15
District	**UNA**	
79	Amb	1.02
80	Ambota	-
81	Babehr	3.25
82	Bawal	-0.12
83	Bhadsali	-
84	Bhangana	-4.97
85	Daulatpur	1.61
86	Dharampur	2.04
87	Gagret	3.20
88	Ghaneri	0.12
89	Guglahar	1.58
90	Ishapur	1.23
91	Jankaur	5.94
92	Jawar	1.07
93	Jhalera	0.62
94	Khanpur	1.00
95	Khwaja	0.41
96	Kuluwal	5.14
97	Kuthera Jaswala	0.34
98	Lalehri	10.08
99	Loharli	-3.44
100	Mawa Kalan	0.31
101	Mubarikpur	2.75
102	Nangran	1.44
103	Panjawar	0.31
104	Panoh	0.91
105	Raipur Marwadi	2.61
106	Rajli Panjal	3.95
107	Santokhgarh	1.27
108	Singhnei	1.83
109	Tahliwala 1	1.03
110	Una	1.63

- data not available

Annual Fluctuation of May 2016- May 2017, August 2016- August 2017 November 2016- November 2017 and January 2017- January 2018

State	**Himachal Pradesh**				
District	**HAMIRPUR**	**Annual fl may (16-17)**	**Annual fl Aug (16-17)**	**Annual fl Nov (16-17)**	**Annual fl Jan (17-18)**
1	Bagnalla	-0.39	0.68	0.99	-0.95
2	Bijari	0.10		0.69	-0.10
3	Galore	-0.13	-0.15	0.86	-0.37
4	Kangu	-2.43	0.01	1.96	-0.76
District	**KANGRA**				
5	Andaura	0.42	-0.83	-0.27	-0.42
6	Bandh	1.22	-0.24	4.40	-0.95
7	Barota	-0.77	0.55	-0.67	-1.53
8	Basa Bazira		-0.14	-0.01	
9	Bhalad	1.04	0.13	-0.33	0.71
10	Bhali	3.12	-0.06	-0.50	-0.57
11	Bharmar	1.04	-0.46	-0.37	0.28
12	Bharoli	4.35	0.37	0.00	3.03
13	Bod	-1.26	-0.09	-0.32	-0.14
14	Chakban Ambari	-0.03	0.22	-0.16	-0.19
15	Channaur	0.58	-0.07	2.79	-0.04
16	Darkati	0.04	-0.14	-0.13	0.11
17	Dehra Gopipur	0.26	-0.17	-0.31	0.20
18	Dehrian	-0.06	-0.14	-0.16	0.12
19	Hardogri	-0.04	0.90	0.44	0.34
20	Jagir				
21	Jassur	0.92	0.59	0.91	0.78
22	Jwalaji	6.19	-0.15	-0.45	0.03
23	Kangra	1.26	0.31	-2.06	1.40
24	Kathgarh	0.32	-0.48	0.46	0.31
25	Kotla	-0.12	0.22	-0.93	-0.13
26	Manjgram	0.50	0.12	-0.06	-0.15
27	Mao	0.16	-0.20	-0.62	0.37
28	Mohtli	0.93	-0.60	-0.77	-0.49
29	Nagrota	0.96	-8.16	8.83	1.71
30	Old Kangra	-3.31	3.75	0.01	1.22
31	Olherian		0.14	-0.25	0.28
32	Pandtehr	0.09	0.20	0.00	0.02
33	Panjpir	0.15	-0.01	-0.67	0.33
34	Paprola	0.75	0.37	-1.90	-2.08

State	Himachal Pradesh	Annual fl may (16-17)	Annual fl Aug (16-17)	Annual fl Nov (16-17)	Annual fl Jan (17-18)
35	Rait	0.42	-0.06	-0.67	0.21
36	Raja-ka-talab	-0.94	0.52	-0.02	1.06
37	Rakar	2.11	0.44	-0.12	-0.17
38	Riali				0.04
39	Takipur	1.66	-0.34	-1.41	-0.51
40	Thali	0.26	-0.21	-0.02	-0.13
41	Thirtynine Mile	-0.46	-0.16	-0.05	
District	**KULLU**				
42	Gadauri	-1.64	-1.74	1.13	-0.09
43	Hathithan	-5.99	8.47	-8.47	0.00
44	Kullu	-0.34	-1.09	-0.34	0.03
District	**MANDI**				
45	Bahangrotu	0.06	0.50	-0.05	-0.28
46	Gagal		-0.17	0.18	-0.75
47	GUTKAR	-10.13	-0.69	-0.55	-0.69
48	Jarl	-0.04	0.02	0.00	0.27
49	Jhiri	-1.25	-0.91	0.53	-0.04
50	Kaned	-0.05	-0.28	0.32	1.00
51	Lohara	-0.08	-0.11	0.04	0.00
52	Ratti	0.00	-0.55	-0.04	-0.03
District	**SIRMAUR**				
53	Ajiwala	0.16	3.41	-0.29	-0.25
54	Akkawala	-2.67	9.97	0.23	-0.04
55	Badripur	0.38	-0.31	-10.49	
56	Dhaulakuan	-3.42		0.02	-6.68
57	Kala-Amb	0.75	1.82	2.46	2.55
58	Khodawala	-0.39		12.39	0.94
59	Kiyarda	0.46	0.11	0.73	0.55
60	Kolar	0.99	0.06	-0.24	
61	Nariwala				
62	Nayagaon	6.96	0.23		0.70
63	Shambuwala		-0.64		-1.37
64	Shibpur	-0.60	1.84	-0.45	0.26
65	Trilokpur	0.26	0.27	0.89	0.41
District	**SOLAN**				
66	Baddi	-5.66	-1.10	-6.75	-6.75
67	Barotiwala	-0.21	-1.63	-3.04	-2.52
68	Barun	-14.01	-10.16	-11.61	-37.56
69	Bhagheri	-0.43	-0.21	-1.58	
70	BHATOLI	-0.81	-0.10		
71	Dhabota	-1.35	13.25	0.13	0.13

State	Himachal Pradesh	Annual fl may (16-17)	Annual fl Aug (16-17)	Annual fl Nov (16-17)	Annual fl Jan (17-18)
72	Jagatpur	-0.95	-2.70	-1.79	4.06
73	Jharmajri	-12.72	0.00	-13.62	-13.62
74	Khera-chak		-0.03	-1.14	-0.59
75	Mahadev	0.44	-0.57	-0.57	
76	Manjhauli	-6.20	0.00	-7.00	-7.00
77	Panjahra	-27.48	-55.00	-55.00	-55.00
78	Phalahi	0.07	0.21	-2.08	-1.12
District	**UNA**				
79	Amb	-1.09	-0.50	-1.01	0.38
80	Ambota			0.00	
81	Babehr	-0.91	0.04	-0.67	0.47
82	Bawal		-0.02	0.05	0.32
83	Bhadsali	-0.56	-0.72		0.22
84	Bhangana	-0.37	0.09	-7.18	-0.13
85	Daulatpur	-1.35	-0.05	-0.27	0.25
86	Dharampur	-1.00	-2.64	0.75	0.65
87	Gagret	-1.79	-3.81	0.87	0.66
88	Ghaneri	0.93	1.93	0.37	0.33
89	Guglahar	-0.52	0.16	0.49	0.29
90	Ishapur	-0.58	0.85	0.32	
91	Jankaur	-0.55	4.57	4.96	4.17
92	Jawar	-0.95		-0.08	-0.20
93	Jhalera	0.43	-3.16	0.61	0.34
94	Khanpur	1.88	-0.07	1.75	-0.73
95	Khwaja	0.40	1.25	0.11	0.08
96	Kuluwal	-0.28	0.23	4.72	4.69
97	Kuthera Jaswala	1.11	-1.09	0.30	0.83
98	Lalehri	-1.09	0.72	8.16	
99	Loharli	-0.65	0.73	-5.66	0.11
100	Mawa Kalan	-1.16	-0.50	-0.25	-0.76
101	Mubarikpur	-1.91	1.00	1.37	1.30
102	Nangran		0.46	0.54	-0.01
103	Panjawar	-1.33	12.64	0.50	1.96
104	Panoh	0.06	1.19	0.03	0.11
105	Raipur Marwadi	-3.92	-1.28	-1.35	-0.31
106	Rajli Panjal	-3.52	0.09	-3.04	-3.72
107	Santokhgarh	-0.82	0.09	-0.17	-0.03
108	Singhnei	-3.21	-0.11	0.59	0.76
109	Tahliwala 1	-0.37	0.01	-0.07	-0.42
110	Una	-0.88	0.91	-0.68	0.04

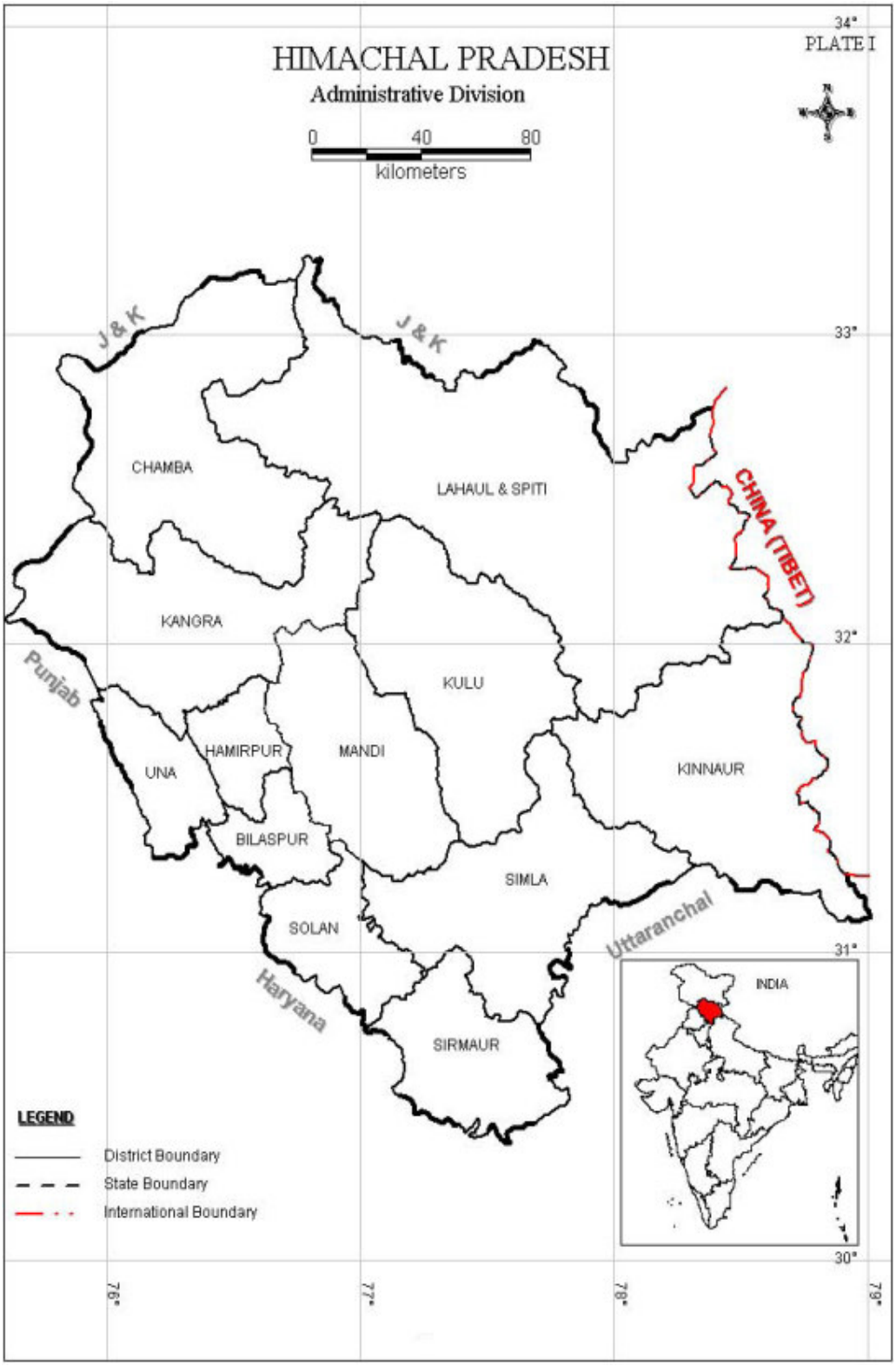
Decadal mean Fluctuation May (2007-2016 with May 2017), August (2007-2016 with Aug 2017) November (2007-2016 with Nov 2017) January 2008-2017 with Jan 2018)

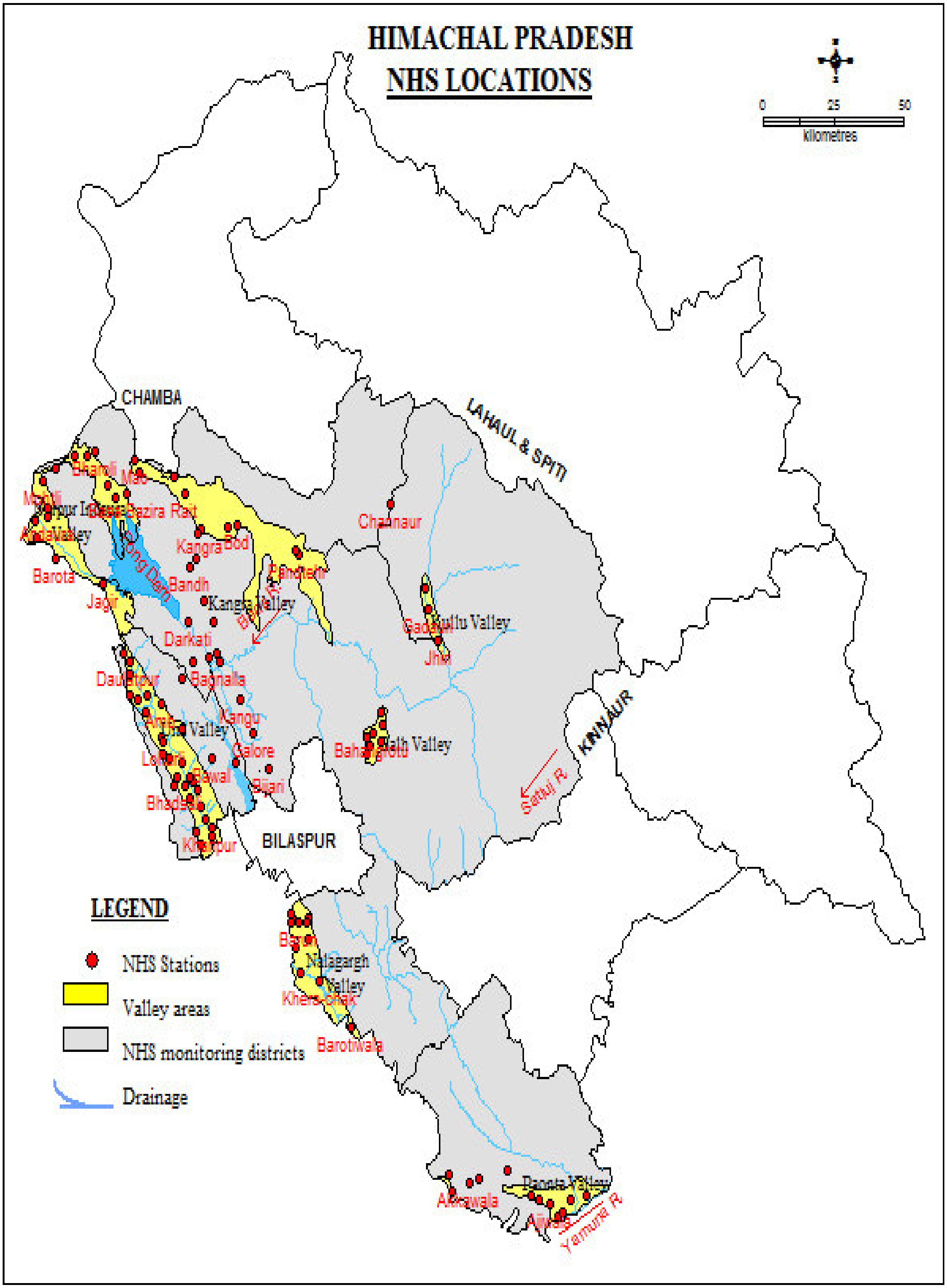
State	**Himachal Pradesh**				
District	**HAMIRPUR**	**Decadal fl may(2007-2016)wrt May 17**	**Decadal fl Aug(2007-2016)wrt Aug17**	**Decadal fl Nov(2007-2016)wrt Nov17**	**Decadal fl Jan(2008-2017)wrt Jan18**
1	Bagnalla	-0.17	1.03	0.04	-0.35
2	Bijari	0.10	-0.90	0.53	-0.01
3	Galore	-0.13	-0.11	0.85	-0.13
4	Kangu	-2.43	0.21	1.27	-1.58
District	**KANGRA**				
5	Andaura	1.84	1.57	1.24	1.36
6	Bandh	1.77	0.53	0.59	0.54
7	Barota	-0.94	0.13	-0.57	-0.63
8	Basa Bazira	-0.14	0.86	1.86	2.86
9	Bhalad	0.29	0.71	-0.13	0.30
10	Bhali	3.12	-0.06	-0.48	-0.10
11	Bharmar	0.04	2.12	0.11	-0.49
12	Bharoli	0.38	0.86	-1.05	-0.36
13	Bod	-1.52	-0.36	-0.30	0.04
14	Chakban Ambari	-0.03	0.22	-0.17	-0.03
15	Channaur	0.95	0.58	1.20	0.84
16	Darkati	-0.04	-0.14	-0.02	0.34
17	Dehra Gopipur	-0.14	0.02	-0.47	-0.25
18	Dehrian	0.38	-0.03	0.38	0.23
19	Hardogri	0.11	0.51	0.33	0.04
20	Jassur	2.73	-0.50	2.45	3.12
21	Jwalaji	-2.39	-0.53	-1.37	-0.83
22	Kangra	1.56	1.21	-0.70	0.74
23	Kathgarh	-0.34	-0.48	-0.25	-0.42
24	Kotla	-0.41	0.22	-0.81	-0.06
25	Manjgram	0.71	0.08	0.09	-0.06
26	Mao	0.99	0.27	-0.18	1.03
27	Mohtli	6.36	6.98	5.25	6.56
28	Nagrota	-0.64	-7.66	9.88	1.66
29	Old Kangra	-3.31	3.75	0.08	1.26
30	Olherian	0.00	0.23	-0.55	-0.19

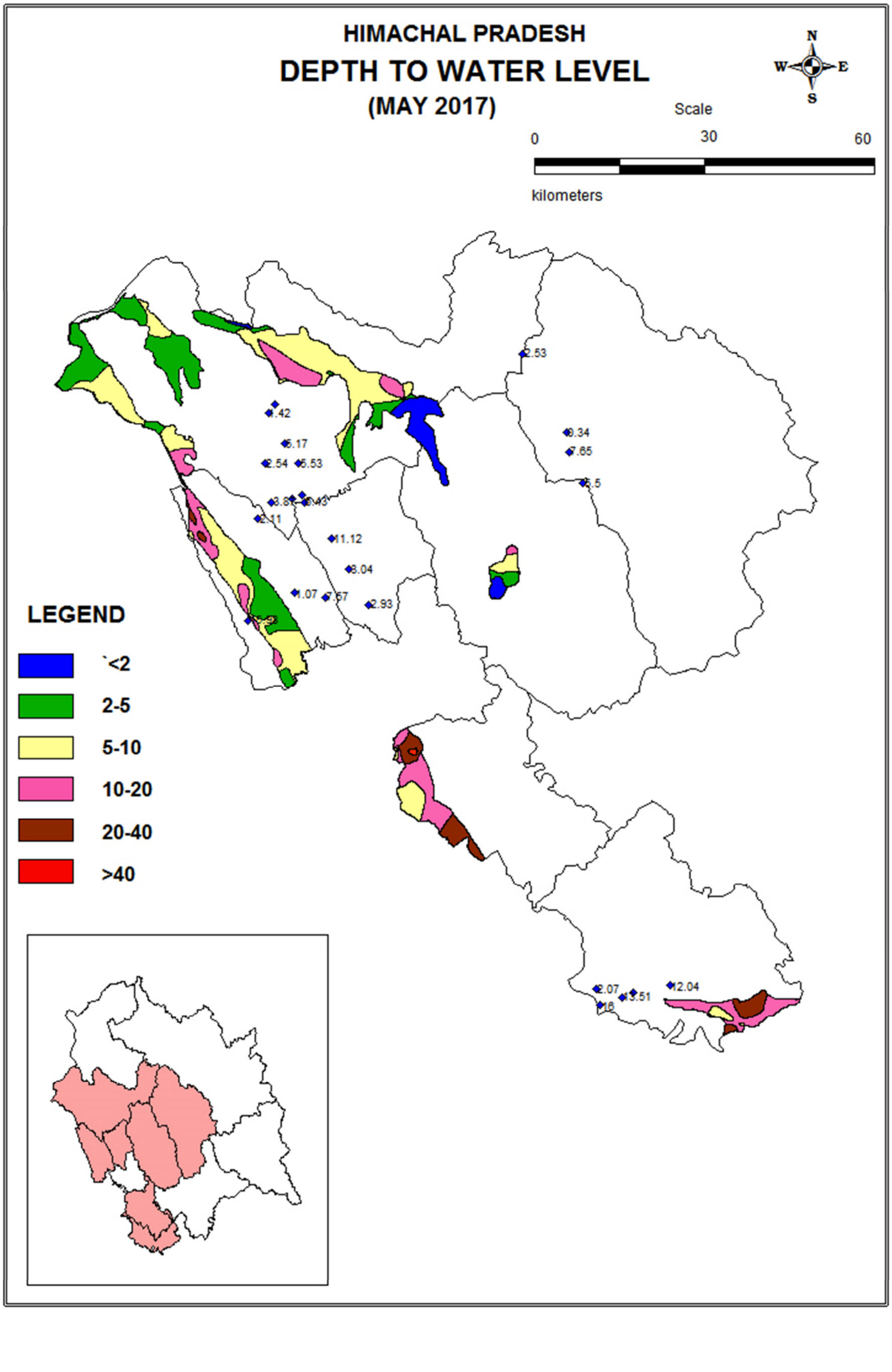
		Decadal fl may(2006-2015)wrt May 16	Decadal fl Aug(2006-2015)wrt Aug16	Decadal fl Nov(2006-2015)wrt Nov16	Decadal fl Jan(2007-2016)wrt Jan17
31	Pandtehr	0.59	0.15	0.08	0.17
32	Panjpir	-0.30	-0.32	-1.10	-0.08
33	Paprola	0.99	3.70	-1.39	-1.89
34	Rait	-0.62	0.35	-0.71	-0.43
35	Raja-ka-talab	-1.33	-0.03	-0.40	0.09
36	Riali	0.00	0.00	-0.38	0.04
37	Rakar	4.08	0.21	-0.08	-0.12
38	Takipur	0.62	-0.04	-1.06	0.05
39	Thali	0.26	-0.21	-0.06	-0.16
40	Thirtynine Mile				
District	**KULLU**				
41	Gadauri	-2.68	-1.88	-0.77	-0.65
42	Hathithan	-4.62	4.56	-4.11	-4.06
43	Kullu	1.08	0.13	0.20	0.12
District	**MANDI**				
44	Bahangrotu	0.34	-0.13	-0.17	0.50
45	Gagal	0.00	-0.63	-0.17	-0.89
46	GUTKAR	-2.49	-0.79	-0.73	-1.13
47	Jarl	0.21	0.00	0.10	0.21
48	Jhiri	-1.53	-0.83	-0.42	-0.37
49	Kaned	0.96	0.12	0.42	0.85
50	Lohara	0.18	0.05	0.08	0.00
51	Ratti	-0.03	-0.51	-0.16	-0.12
District	**SIRMAUR**				
52	Ajiwala	-0.22	3.34	-0.39	-0.73
53	Akkawala	-2.43	9.72	0.18	-0.12
54	Badripur	-9.01	-2.08	-3.61	0.00
55	Dhaulakuan	-1.55	-1.23	-0.87	-5.99
56	Kala-Amb	-2.21	-1.06	0.13	0.36
57	Khodawala	0.34	-1.11	10.15	-0.41
58	Kiyarda	0.91	-0.05	-1.49	-0.45
59	Kolar	12.64	8.39	8.45	
60	Nayagaon	-0.02	-0.74	-1.00	0.26
61	Shambuwala	-1.33	-1.96	-1.81	-0.98
62	Shibpur	-0.35	2.71	-0.41	-0.07
63	Trilokpur	0.49	-0.07	2.05	0.03
District	**SOLAN**				
64	Baddi	-0.83	-2.61	-2.75	-2.08

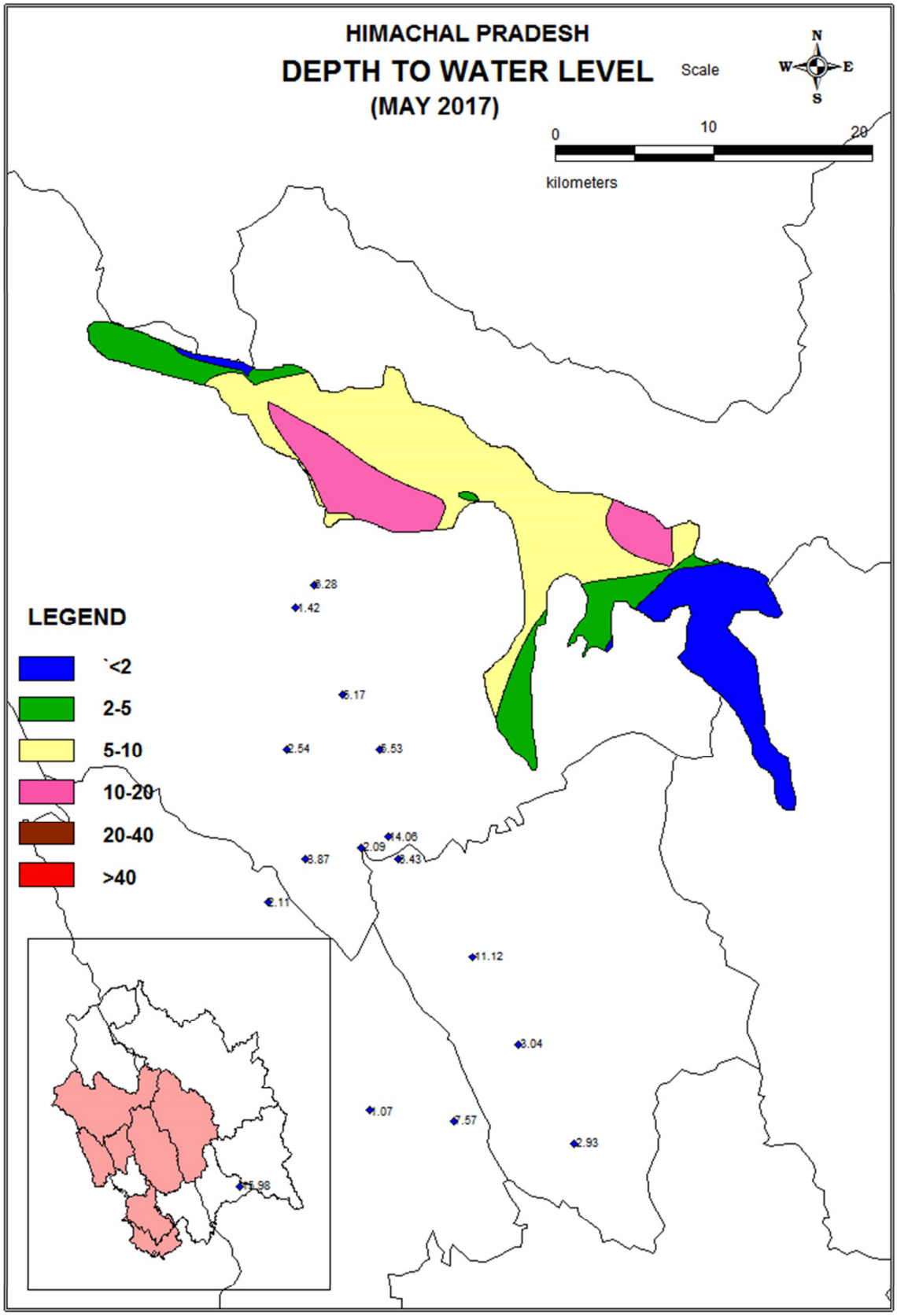
		Decadal fl may(2006-2015)wrt May 16	Decadal fl Aug(2006-2015)wrt Aug16	Decadal fl Nov(2006-2015)wrt Nov16	Decadal fl Jan(2007-2016)wrt Jan17
65	Barotiwala	-0.51	-1.63	-1.29	-1.25
66	Barun	-9.08	-9.55	-10.60	-13.14
67	Bhagheri	-4.77	-7.00	-8.48	-8.41
68	BHATOLI	-1.65	-2.67	-3.91	-3.77
69	Dhabota	-2.20	11.64	-1.22	-1.00
70	Jagatpur	-3.65	-9.95	-2.68	-1.46
71	Jharmajri	-5.91	-2.74	-7.46	-6.45
72	Khera-chak	0.00	-1.25	-2.15	-2.36
73	Mahadev	-1.62	-4.21	-3.77	-3.08
74	Manjhauli	-2.62	-4.21	-3.66	-3.25
75	Panjahra	-33.61	-40.88	-39.52	-38.97
76	Phalahi	0.18	1.00	-0.33	-0.26
District	**UNA**				
77	Amb	-0.40	0.78	-1.98	-0.53
78	Ambota	0.00	31.02	20.81	28.02
79	Babehr	-1.59	-0.02	-0.55	0.04
80	Bawal	0.45	0.11	0.25	0.66
81	Bhadsali	-0.69	-0.88	0.00	-0.39
82	Bhangana	-0.93	0.24	-7.03	-0.06
83	Daulatpur	-2.04	-1.43	-2.05	-1.83
84	Dharampur	-1.48	-3.15	-0.10	-0.23
85	Gagret	-2.80	-5.37	-0.15	-0.55
86	Ghaneri	-0.52	0.46	-2.39	-2.20
87	Guglahar	-1.15	-0.47	-0.64	-0.82
88	Ishapur	-0.26	0.79	0.03	-0.01
89	Jankaur	-1.18	2.78	3.78	3.42
90	Jawar	-0.98	-0.22	-0.09	-0.13
91	Jhalera	-0.15	0.07	-0.44	-0.40
92	Khanpur	-0.26	-0.78	0.79	-1.83
93	Khwaja	-0.21	0.42	-0.63	-0.57
94	Kuluwal	-0.61	-0.41	3.73	3.82
95	Kuthera Jaswala	-0.76	-0.43	-1.08	-1.08
96	Lalehri	-1.61	-0.70	7.01	0.00
97	Loharli	-1.57	-0.48	-3.81	-0.36
98	Mawa Kalan	-1.93	-2.23	-1.88	-3.04
99	Mubarikpur	-1.79	0.41	-0.74	-0.94

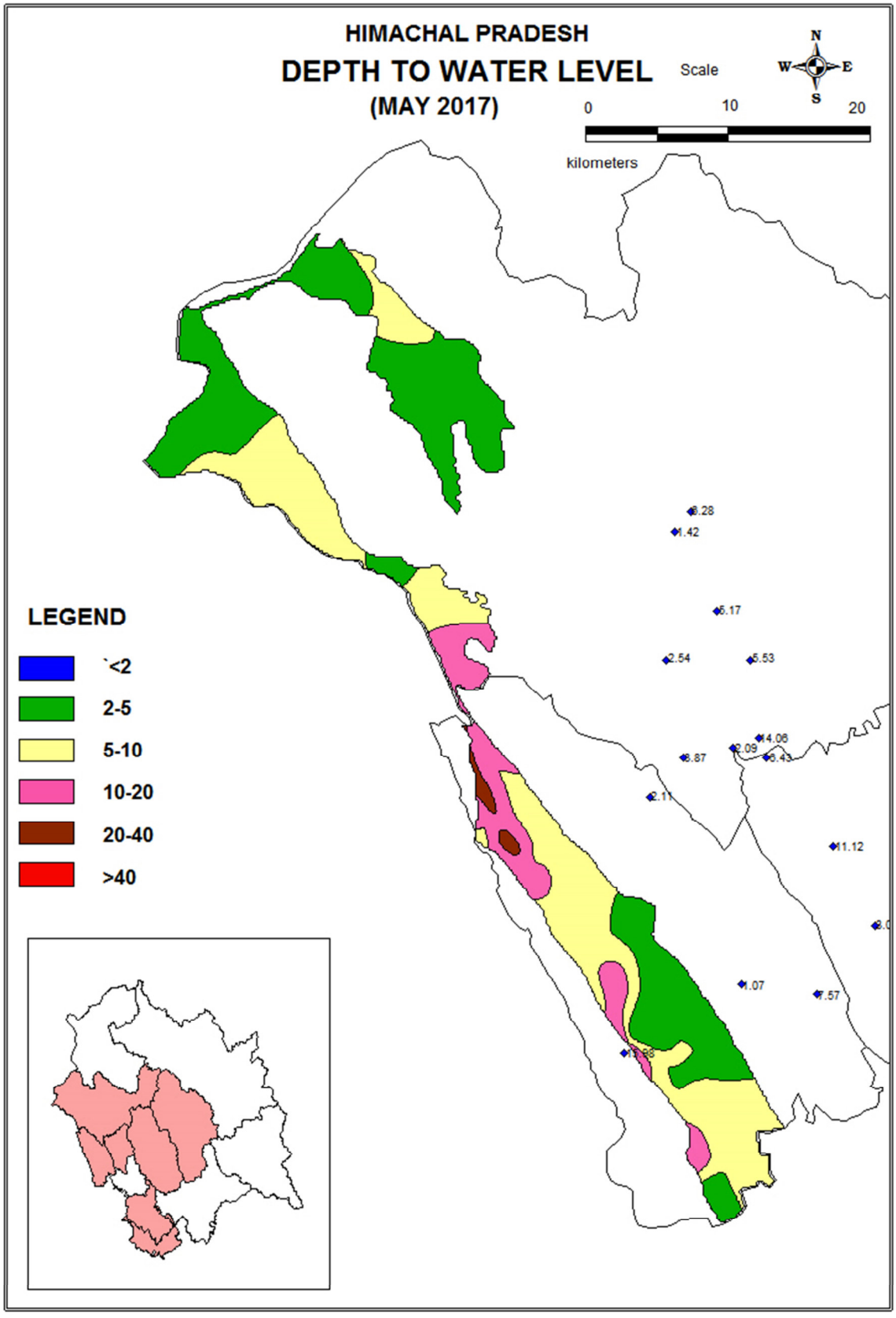
		Decadal fl may(2006-2015) wrt May 16	Decadal fl Aug(2006-2015) wrt Aug16	Decadal fl Nov(2006-2015) wrt Nov16	Decadal fl Jan(2007-2016) wrt Jan17
100	Nangran	-0.89	-0.34	0.13	-0.30
101	Panjawar	-1.83	11.17	-1.89	-0.02
102	Panoh	-0.27	0.83	-0.12	-0.22
103	Raipur Marwadi	-4.74	-3.58	-4.07	-3.76
104	Rajli Panjal	-3.37	1.25	-2.25	-2.01
105	Santokhgarh	-1.27	-0.46	-0.58	-0.15
106	Singhnei	-3.01	-1.33	-1.68	-1.00
107	Tahliwala 1	-0.48	3.04	-0.41	-0.47
108	Una	-1.33	-0.17	-0.61	-0.16

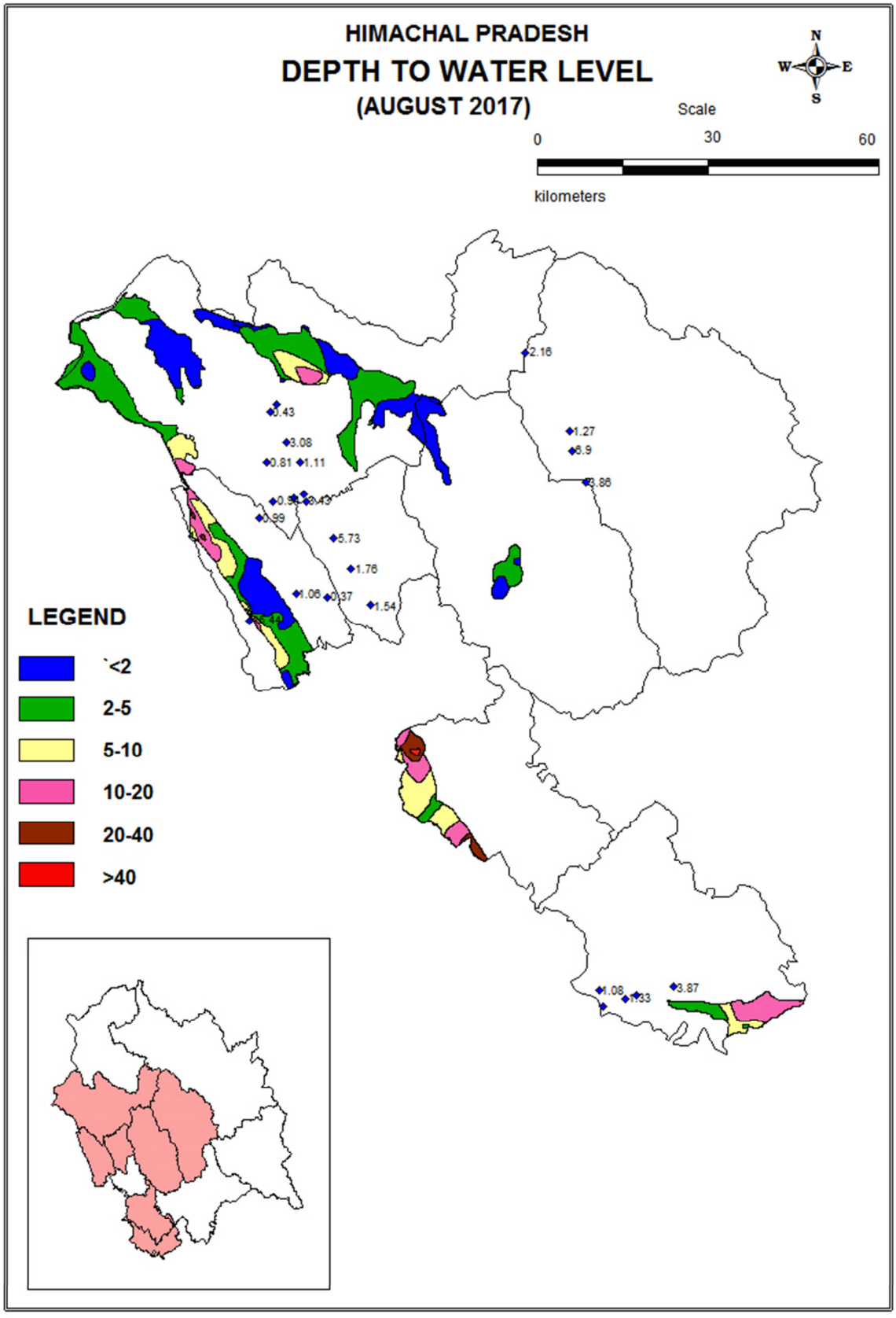

HIMACHAL PRADESH
Administrative Division
PLATE I
0 40 80
kilometers
34°
33°
32°
31°
30°
76°
77°
78°
79°
J & K
J & K
CHAMBA
LAHAUL & SPITI
CHINA (TIBET)
KANGRA
Punjab
KULU
HAMIRPUR
MANDI
UNA
KINNAUR
BILASPUR
SIMLA
SOLAN
Uttaranchal
Haryana
SIRMAUR
INDIA
LEGEND
District Boundary
State Boundary
International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

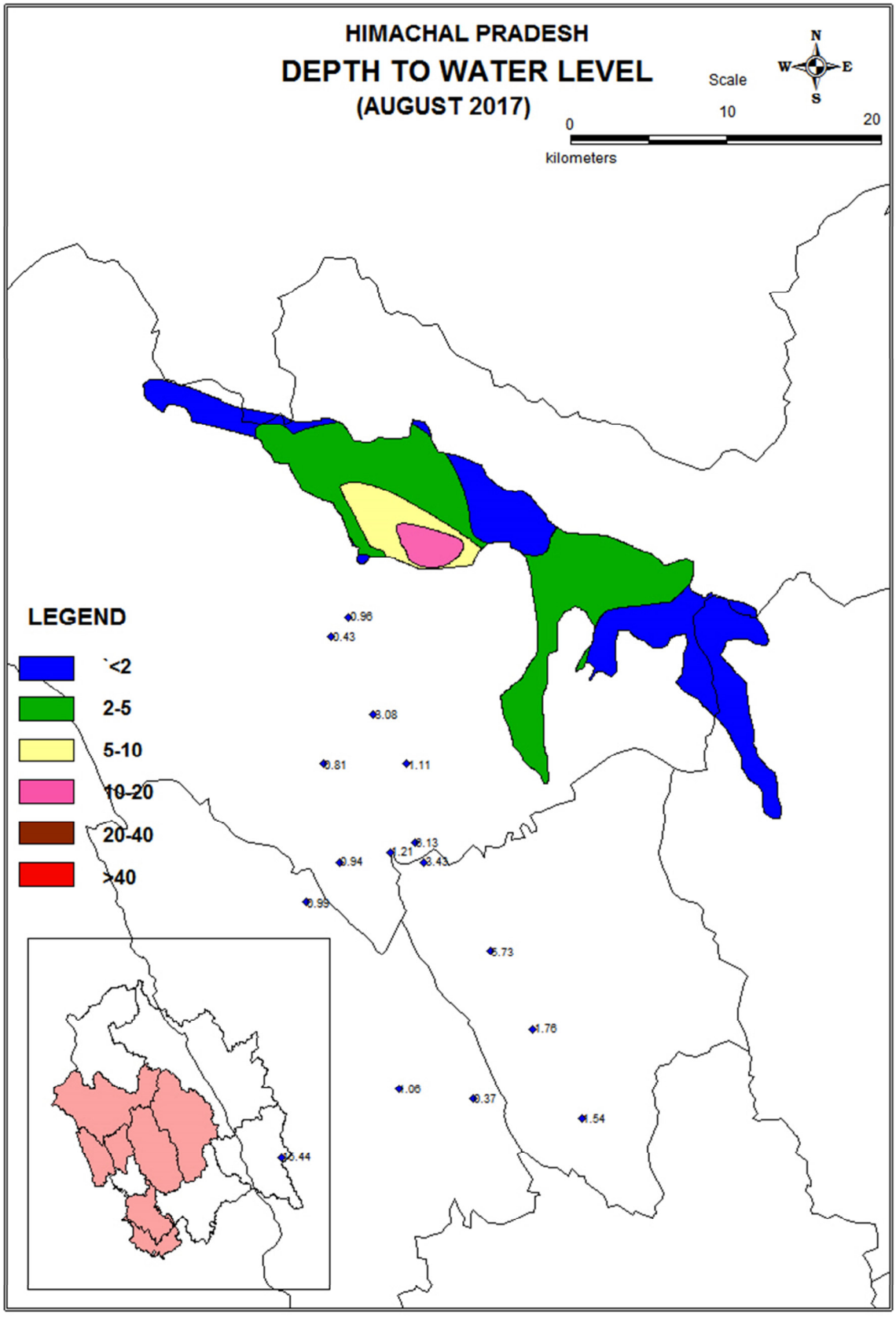

HIMACHAL PRADESH
NHS LOCATIONS
0
25
50
kilometres
CHAMBA
LAHAUL & SPITI
KINNAUR
BILASPUR
Bharoli
Mao
Rait
Kangra
Bod
Barota
Bandh
Kangra Valley
Darkati
Bagnalla
Kangu
Galore
Bijari
Bawal
Bhadsali
Kullu Valley
Jhiri
Balh Valley
Sutlej R
Nalagargh
Valley
Barotiwala
Paonta Valley
Yamuna R
LEGEND
NHS Stations
Valley areas
NHS monitoring districts
Drainage

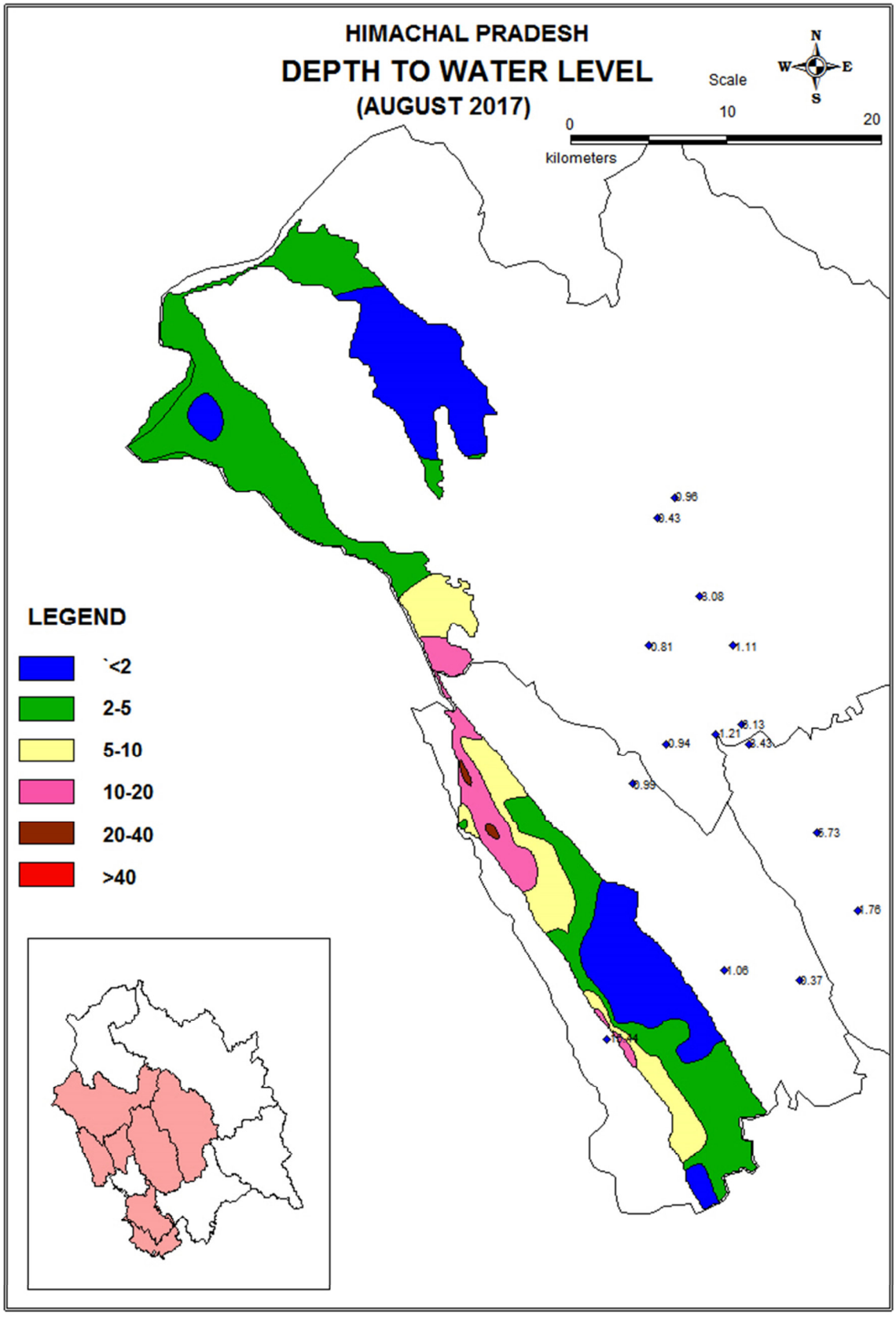

HIMACHAL PRADESH
DEPTH TO WATER LEVEL
(MAY 2017)
N
W
E
S
Scale
0
30
60
kilometers
2.53
2.54
11.12
2.93
2.07
12.04
LEGEND
`<2
2-5
5-10
10-20
20-40
>40

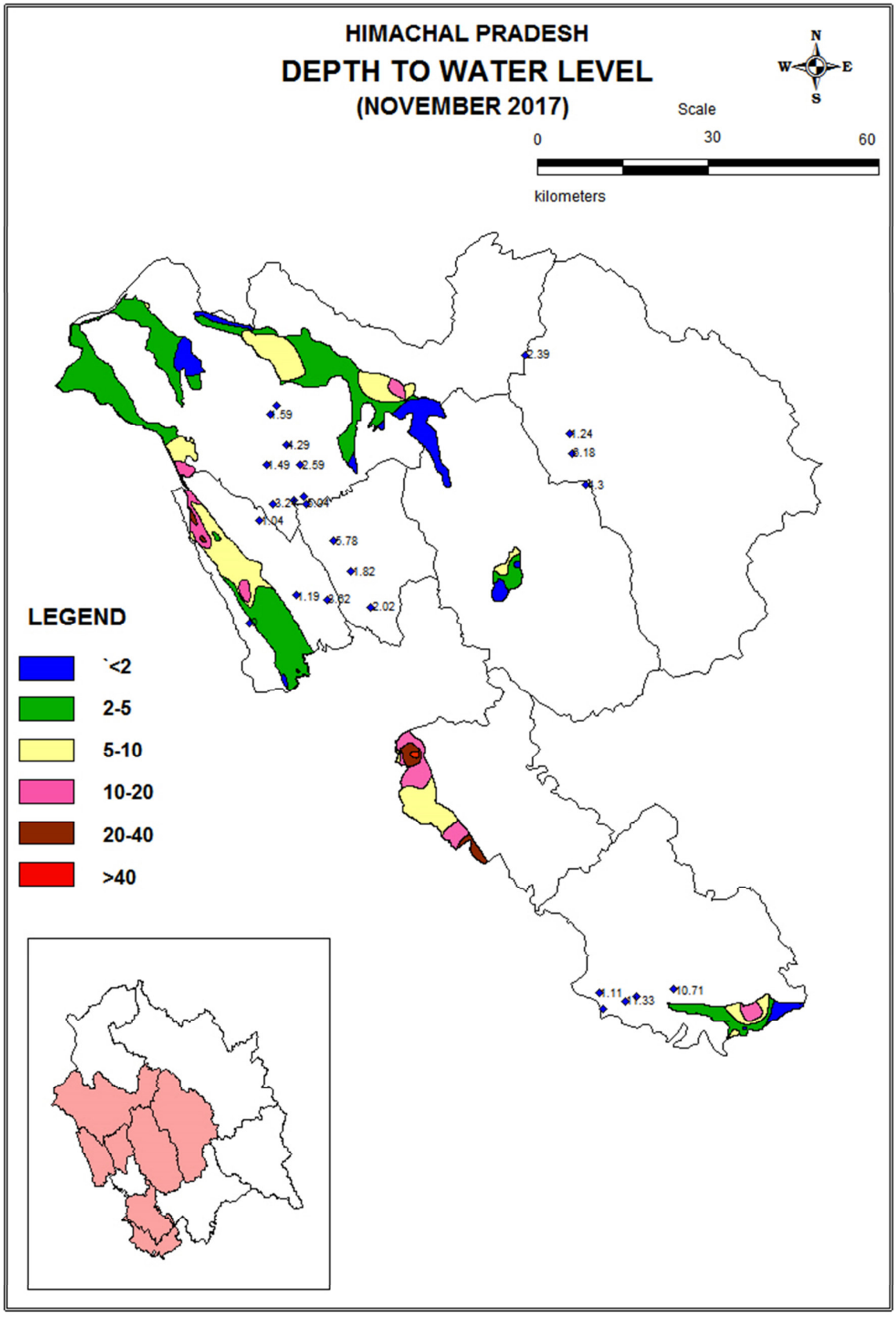

HIMACHAL PRADESH
DEPTH TO WATER LEVEL
(MAY 2017)
Scale
N
W
E
S
0
10
20
kilometers
LEGEND
`<2
2-5
5-10
10-20
20-40
>40
8.28
1.42
5.17
2.54
5.53
14.06
2.09
8.43
3.87
2.11
11.12
8.04
1.07
7.57
2.93
15.98

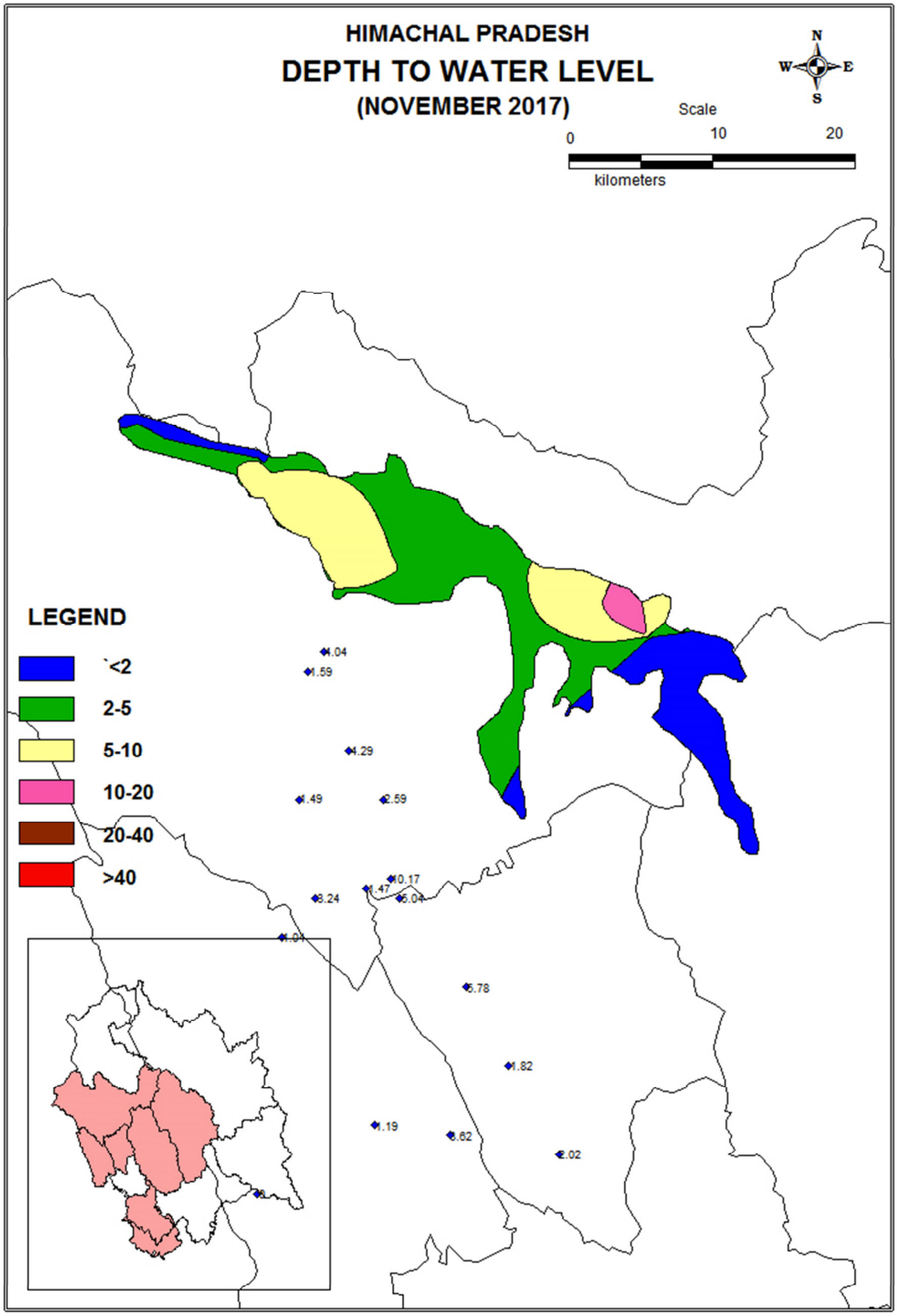

HIMACHAL PRADESH
DEPTH TO WATER LEVEL
(MAY 2017)
Scale
0
10
20
kilometers
N
W
E
S
LEGEND
`<2
2-5
5-10
10-20
20-40
>40
8.28
1.42
5.17
2.54
5.53
4.06
2.09
6.87
6.43
2.11
11.12
1.07
7.57

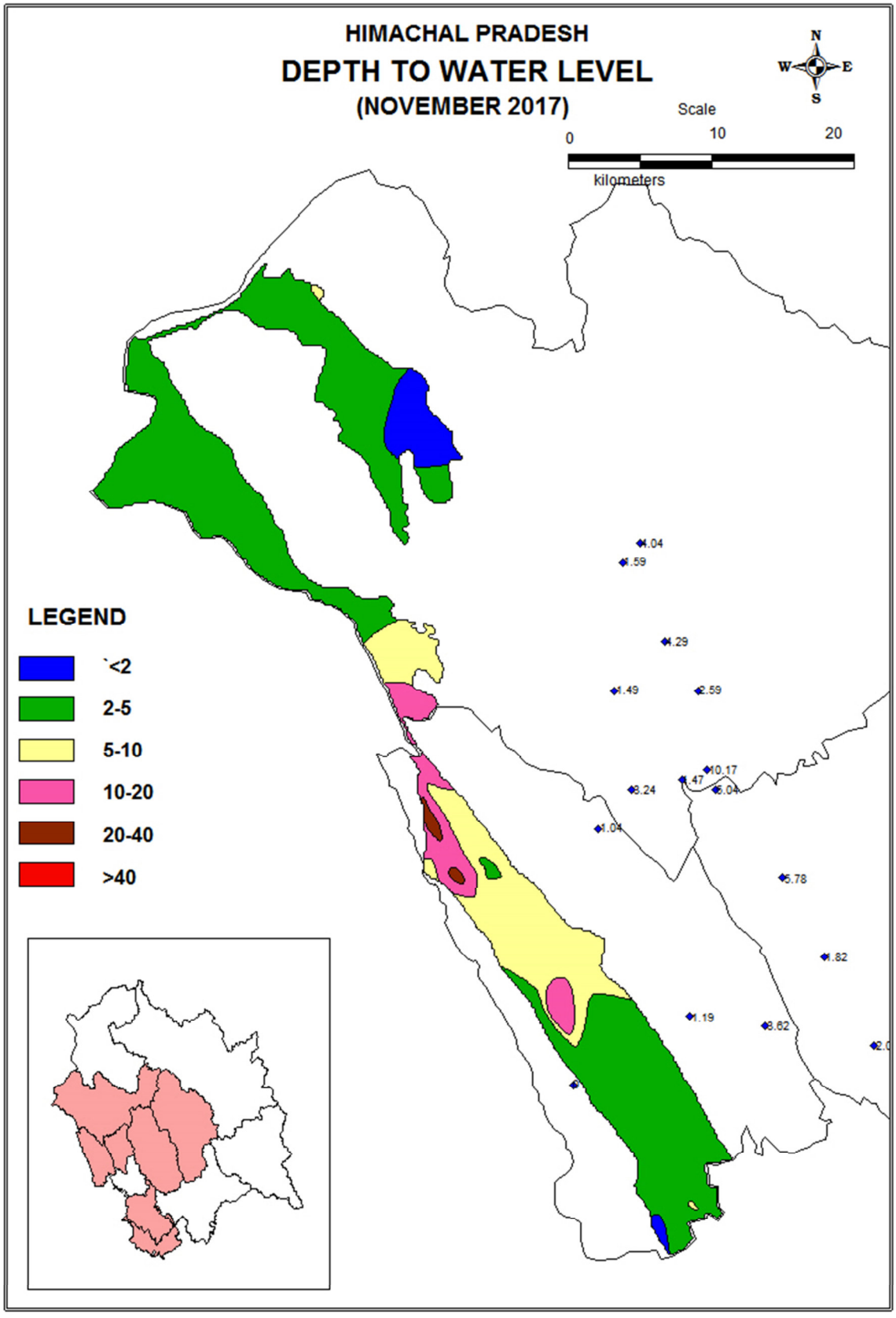

HIMACHAL PRADESH
DEPTH TO WATER LEVEL
(AUGUST 2017)
N
W
E
S
Scale
0
30
60
kilometers
2.16
3.43
3.08
0.81
1.11
1.27
6.9
3.86
0.99
5.73
1.76
1.06
0.37
1.54
1.08
1.33
3.87
LEGEND
<2
2-5
5-10
10-20
20-40
>40

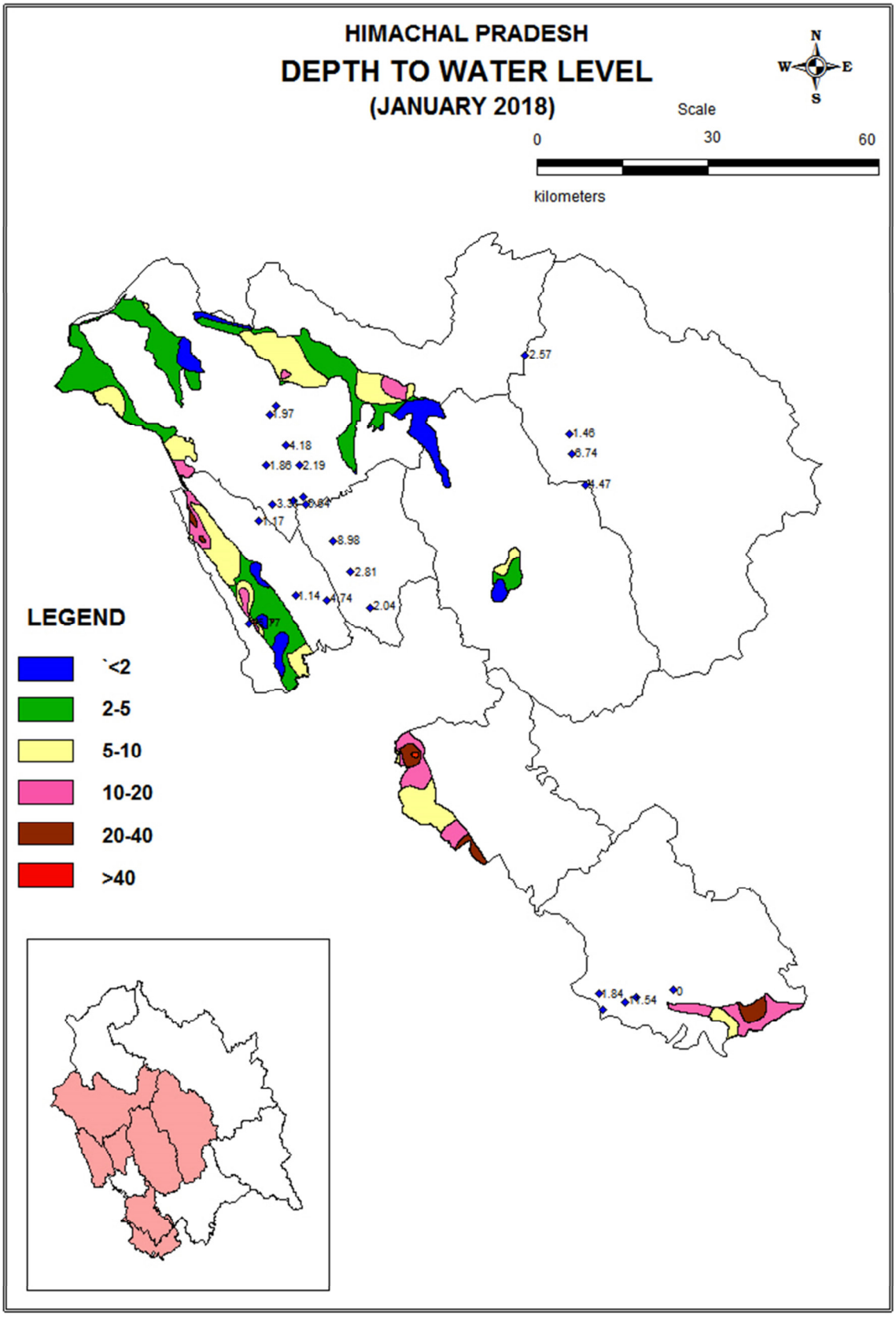

HIMACHAL PRADESH
DEPTH TO WATER LEVEL
(AUGUST 2017)
N
W
E
S
Scale
0
10
20
kilometers
LEGEND
<2
2-5
5-10
10-20
20-40
>40
0.96
0.43
8.08
0.81
1.11
8.13
1.21
3.43
0.94
0.99
5.73
1.76
.06
9.37
1.54
0.44

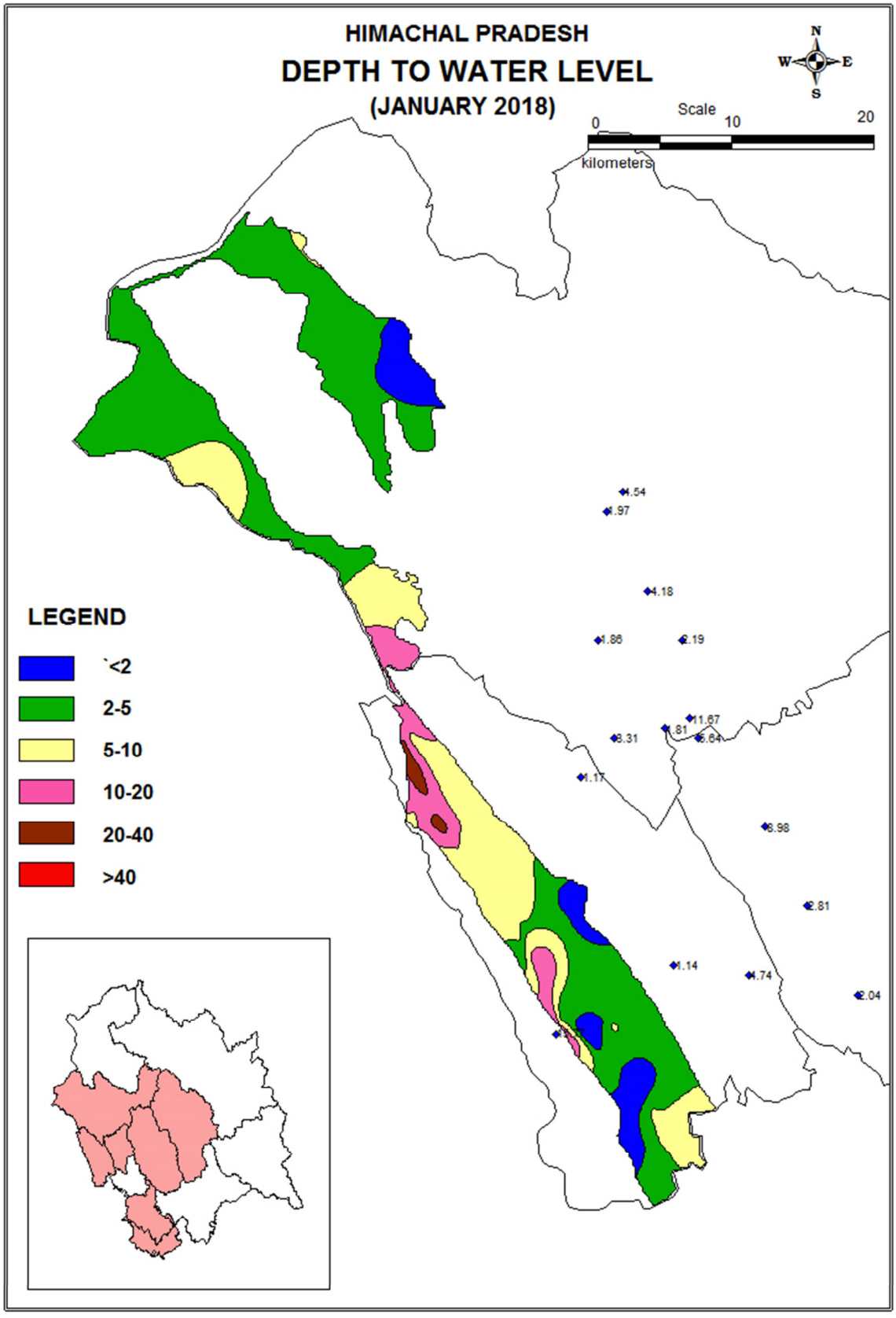

HIMACHAL PRADESH
DEPTH TO WATER LEVEL
(AUGUST 2017)
N
W
E
S
Scale
0
10
20
kilometers
LEGEND
`<2
2-5
5-10
10-20
20-40
>40
0.96
0.43
3.08
0.81
1.11
0.94
1.21
3.13
3.43
0.99
5.73
4.76
1.06
0.37

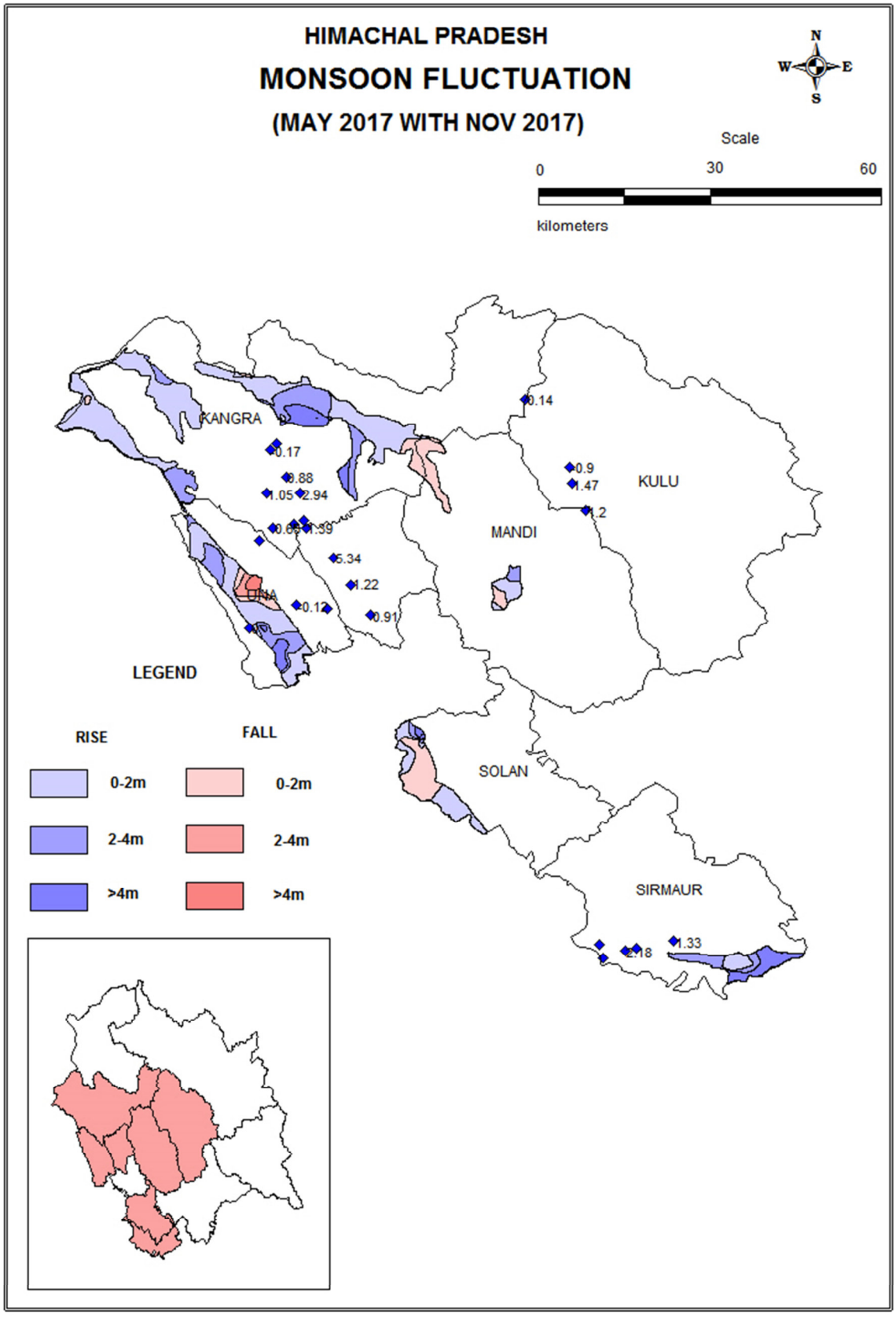

HIMACHAL PRADESH
DEPTH TO WATER LEVEL
(NOVEMBER 2017)
N
W
E
S
Scale
0
30
60
kilometers
2.39
1.59
1.29
1.49
2.59
1.24
8.18
1.3
3.2
0.04
1.04
6.78
1.82
1.19
2.02
2.02
LEGEND
`<2
2-5
5-10
10-20
20-40
>40
1.11
1.33
10.71

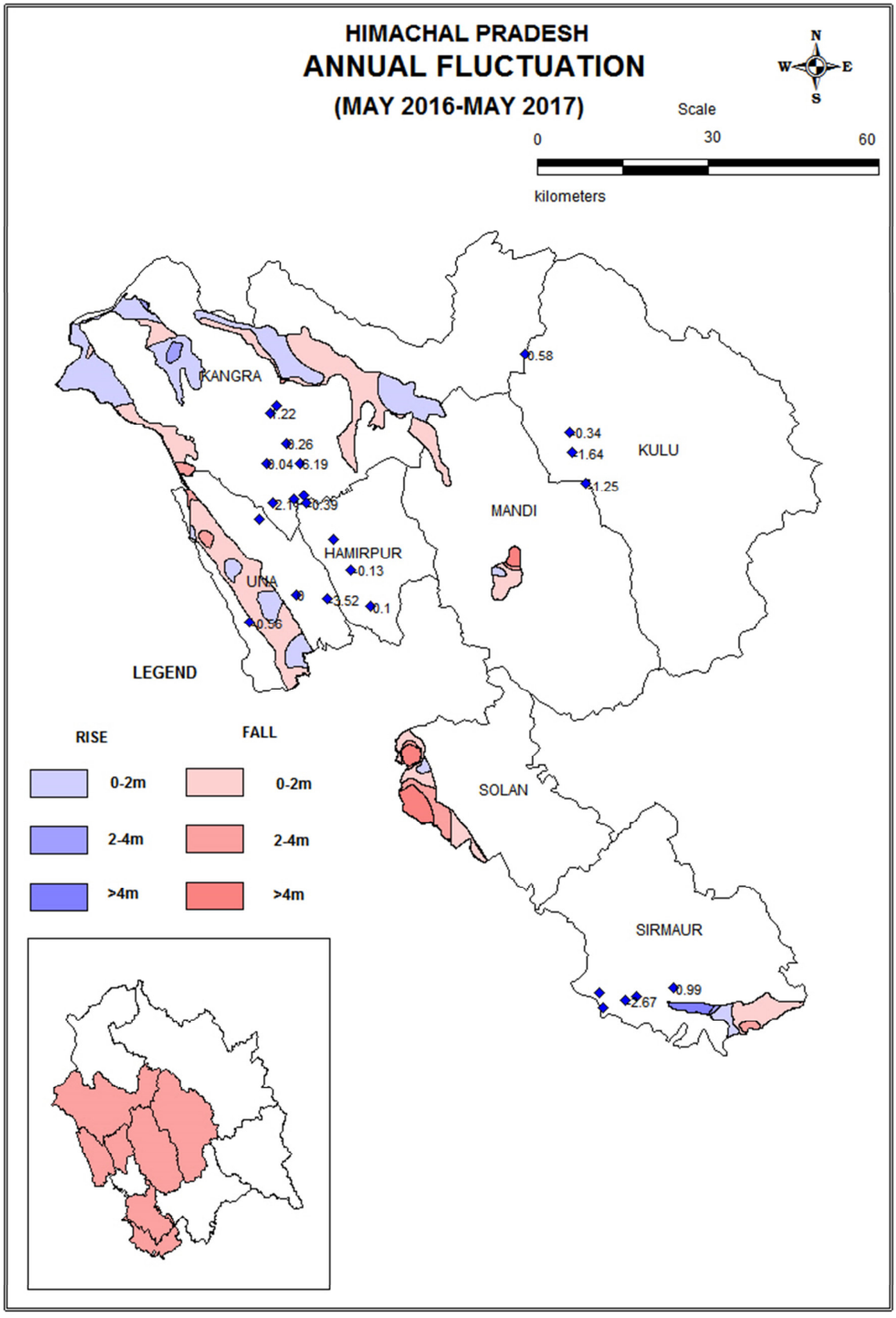

HIMACHAL PRADESH
DEPTH TO WATER LEVEL
(NOVEMBER 2017)
N
W
E
S
Scale
0
10
20
kilometers
LEGEND
`<2
2-5
5-10
10-20
20-40
>40
4.04
1.59
4.29
1.49
2.59
0.17
1.47
5.04
3.24
1.01
6.78
1.82
1.19
3.62
2.02

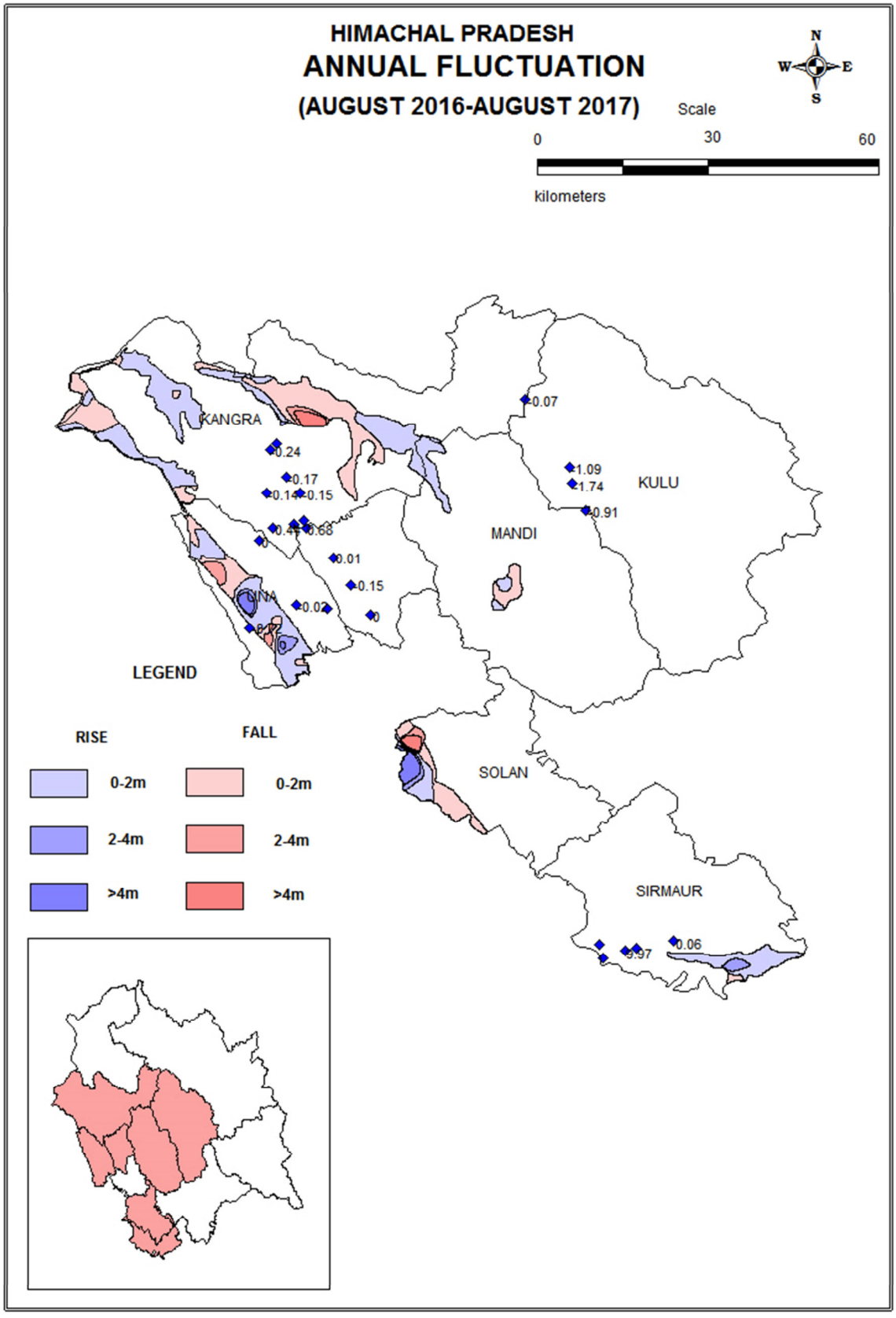

HIMACHAL PRADESH
DEPTH TO WATER LEVEL
(NOVEMBER 2017)
N
W
E
S
Scale
0
10
20
kilometers
LEGEND
`<2
2-5
5-10
10-20
20-40
>40
4.04
4.59
4.29
1.49
2.59
10.17
1.47
6.04
8.24
1.04
5.78
1.82
1.19
8.62

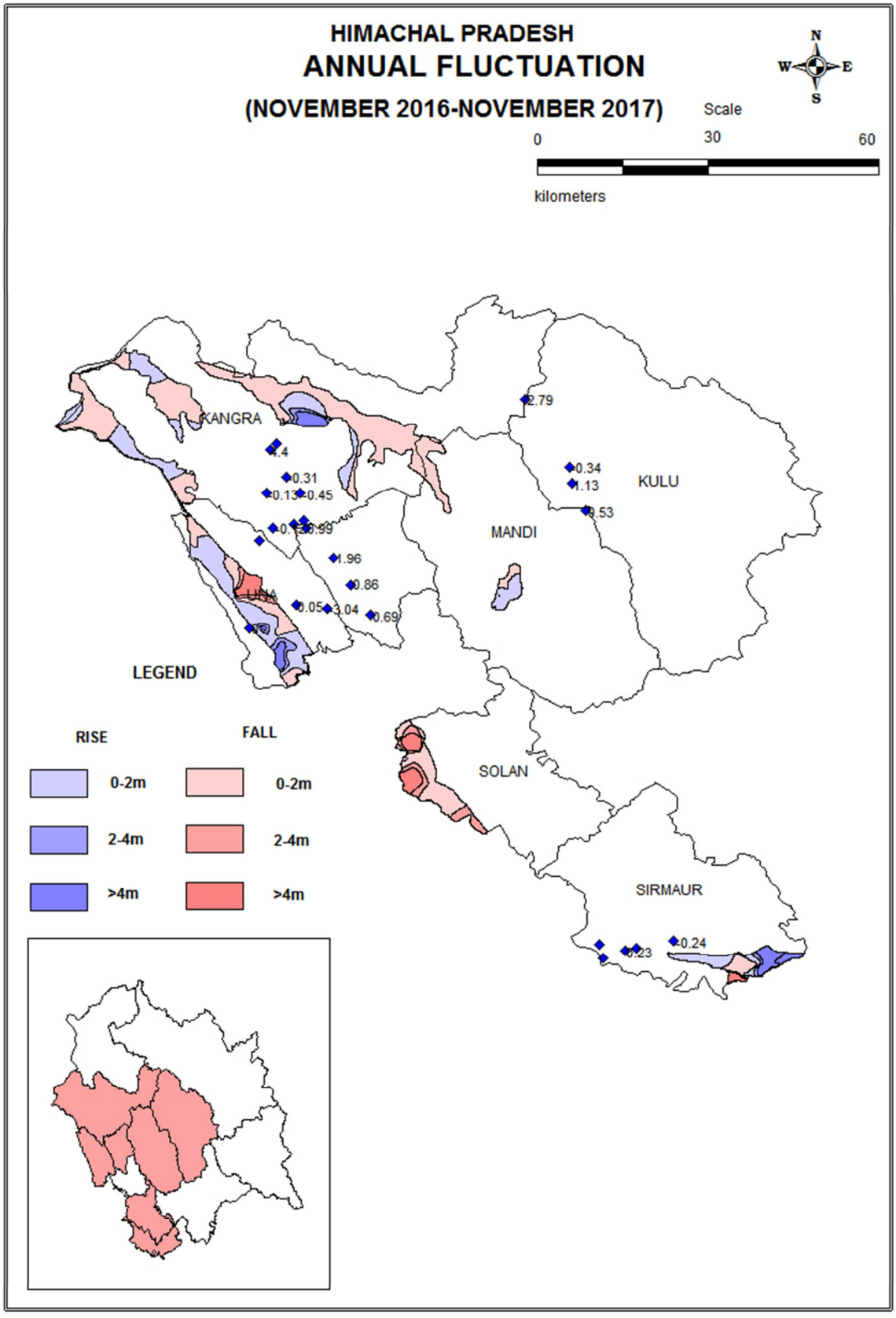

HIMACHAL PRADESH
DEPTH TO WATER LEVEL
(JANUARY 2018)
N
W
E
S
Scale
0
30
60
kilometers
2.57
1.97
4.18
1.88
2.19
1.46
5.74
4.47
1.17
8.98
2.81
1.14
4.74
2.04
1.84
1.54
0
LEGEND
<2
2-5
5-10
10-20
20-40
>40

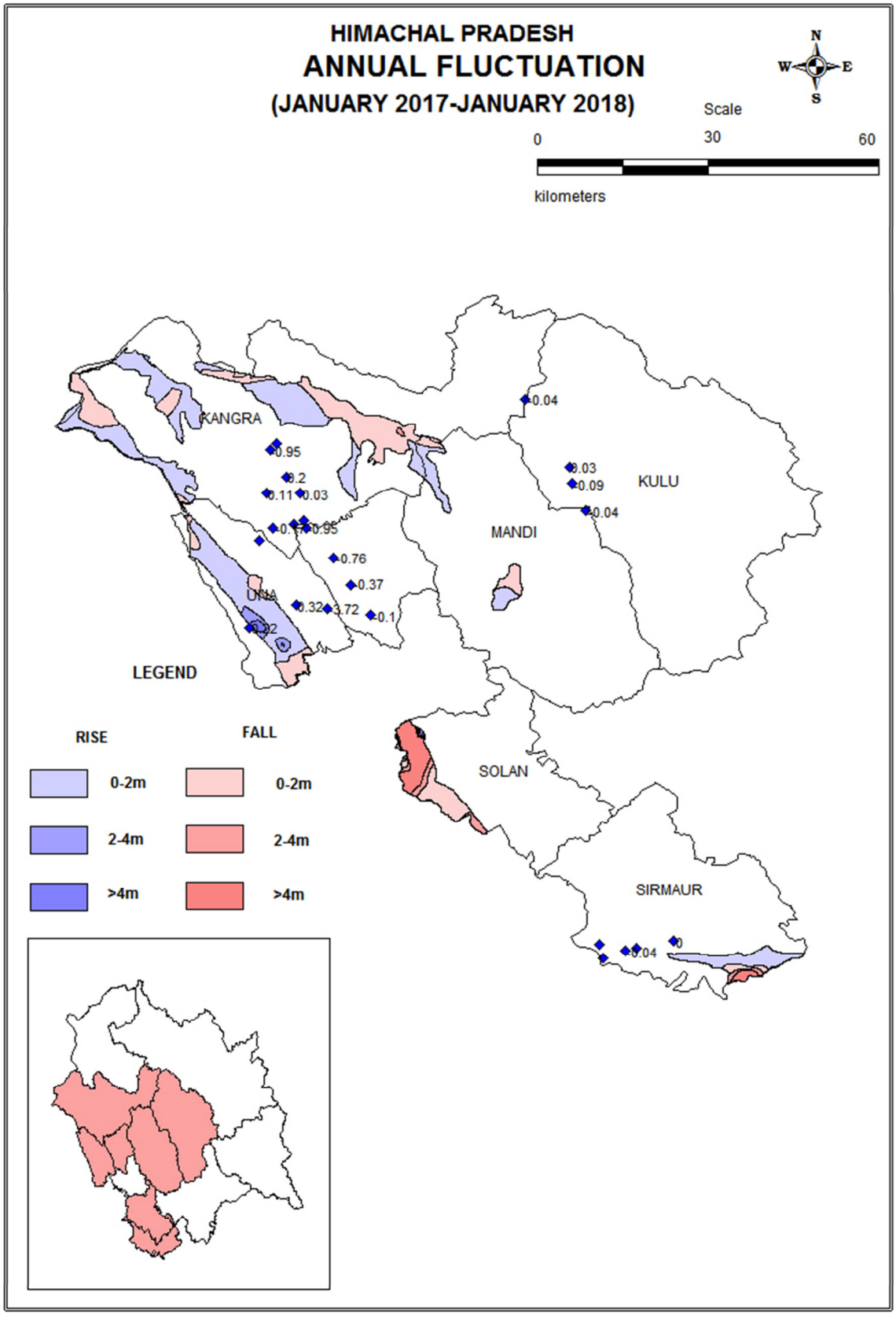

HIMACHAL PRADESH
DEPTH TO WATER LEVEL
(JANUARY 2018)
N
W
E
S
Scale
0
10
20
kilometers
LEGEND
`<2
2-5
5-10
10-20
20-40
>40
4.54
4.97
4.18
1.86
2.19
11.67
1.81
6.64
3.31
1.17
8.98
2.81
1.14
1.74
2.04

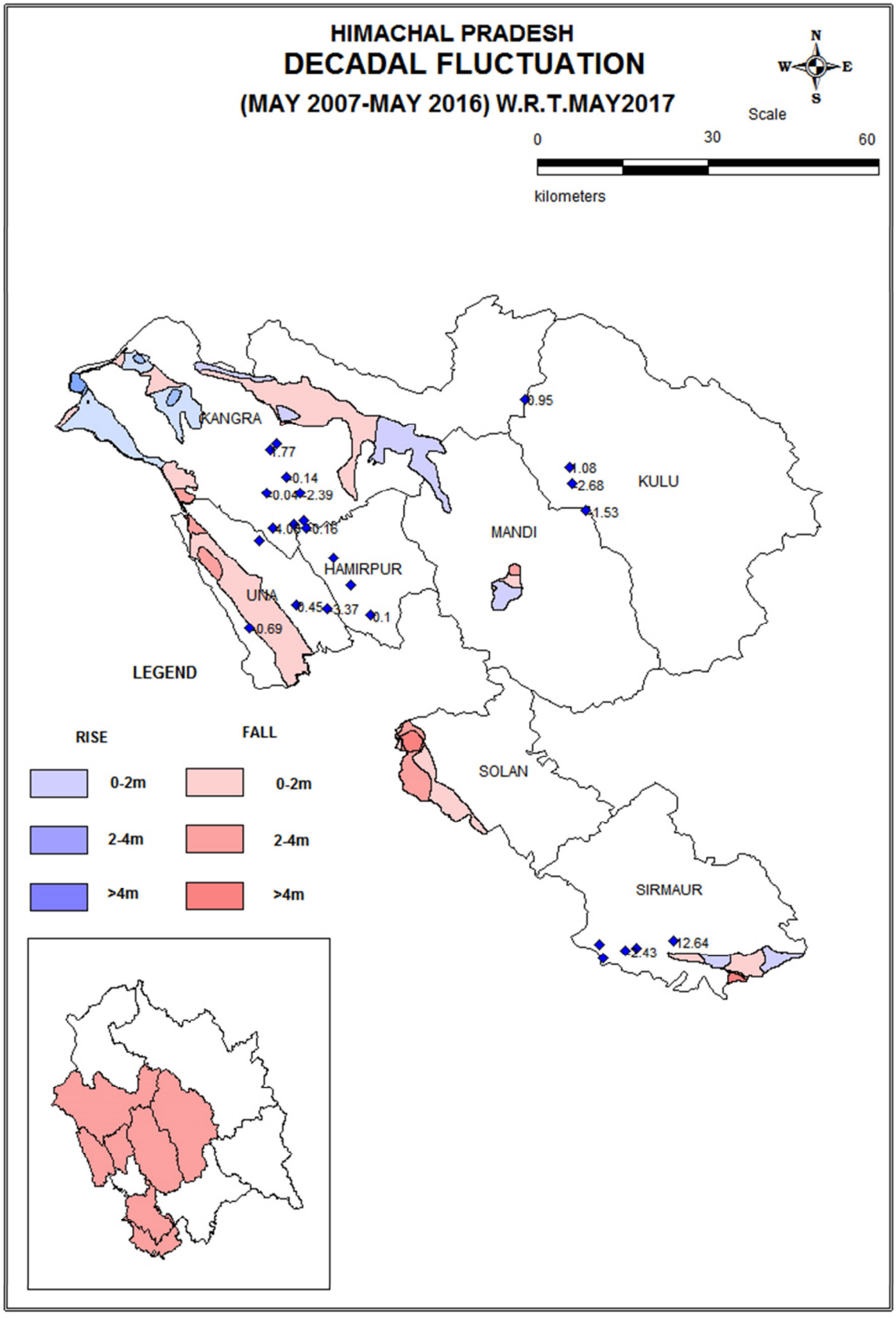

HIMACHAL PRADESH
MONSOON FLUCTUATION
(MAY 2017 WITH NOV 2017)
N
W
E
S
Scale
0
30
60
kilometers
KANGRA
UNA
MANDI
KULU
SOLAN
SIRMAUR
0.14
0.17
0.88
1.05
2.94
0.9
1.47
1.2
1.39
5.34
1.22
0.12
0.91
1.33
LEGEND
RISE
FALL
0-2m
2-4m
>4m
0-2m
2-4m
>4m

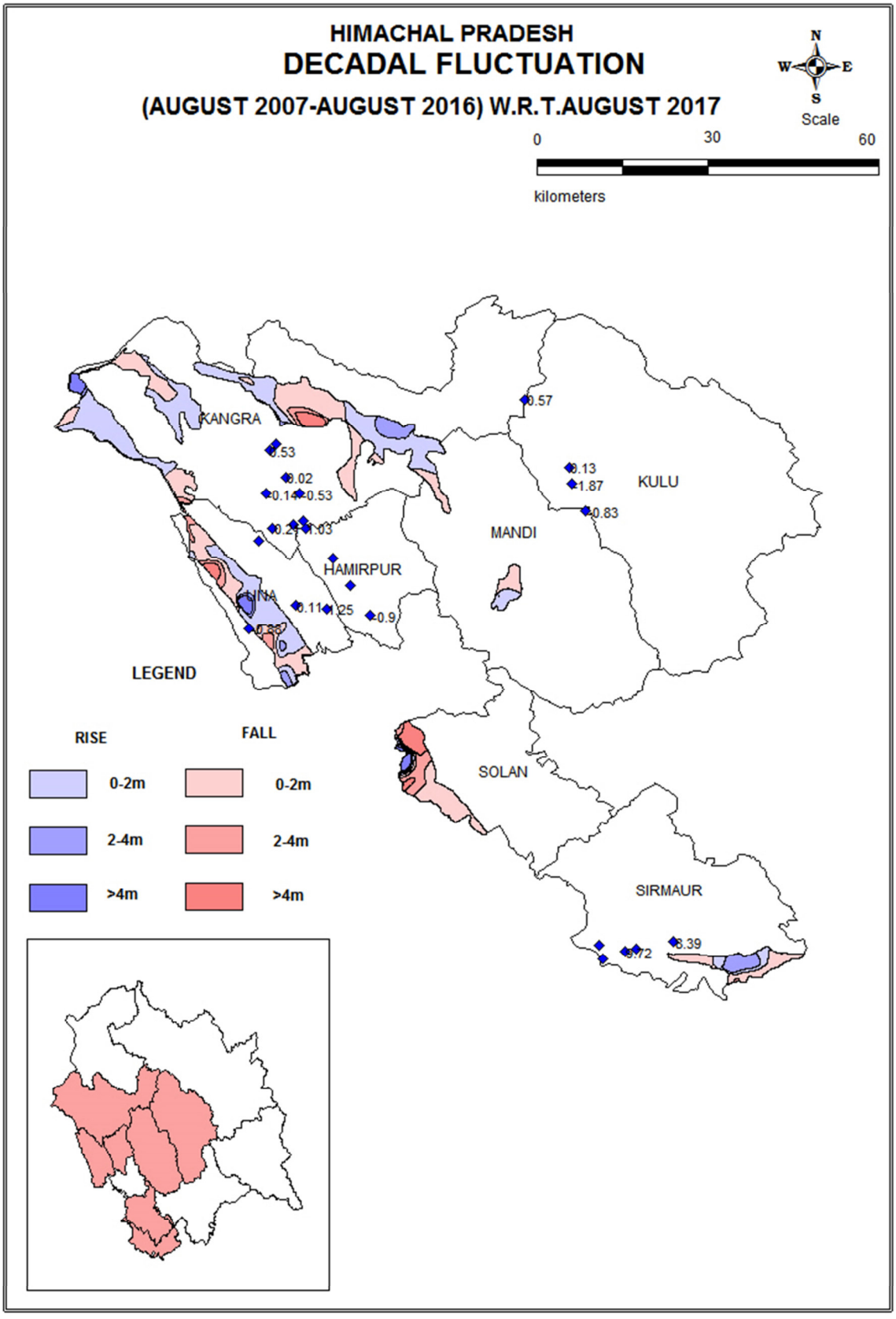

HIMACHAL PRADESH
ANNUAL FLUCTUATION
(MAY 2016-MAY 2017)
N
W
E
S
Scale
0
30
60
kilometers
KANGRA
0.58
0.22
0.26
0.04
6.19
0.34
1.64
KULU
1.25
2.1
0.39
MANDI
HAMIRPUR
0.13
UNA
3.52
0.1
0.56
LEGEND
RISE
FALL
0-2m
0-2m
2-4m
2-4m
>4m
>4m
SOLAN
SIRMAUR
0.99
2.67

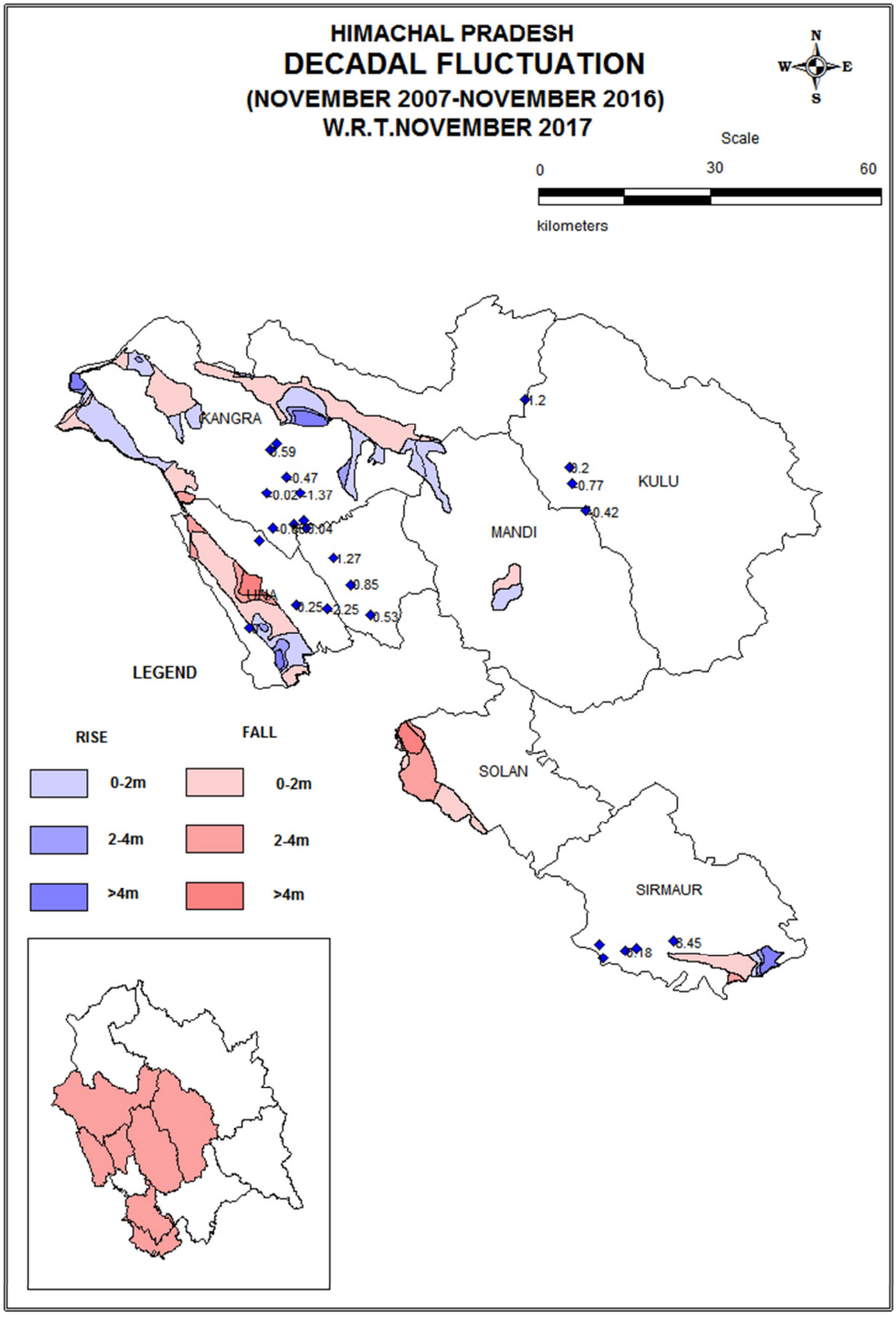

HIMACHAL PRADESH
ANNUAL FLUCTUATION
(AUGUST 2016-AUGUST 2017)
N
W
E
S
Scale
0
30
60
kilometers
KANGRA
KULU
MANDI
SOLAN
SIRMAUR
UNA
0.07
0.24
0.17
0.14
0.15
1.09
1.74
0.91
0.45
0.68
0
0.01
0.15
0.02
0
0.97
0.06
LEGEND
RISE
FALL
0-2m
2-4m
>4m
0-2m
2-4m
>4m

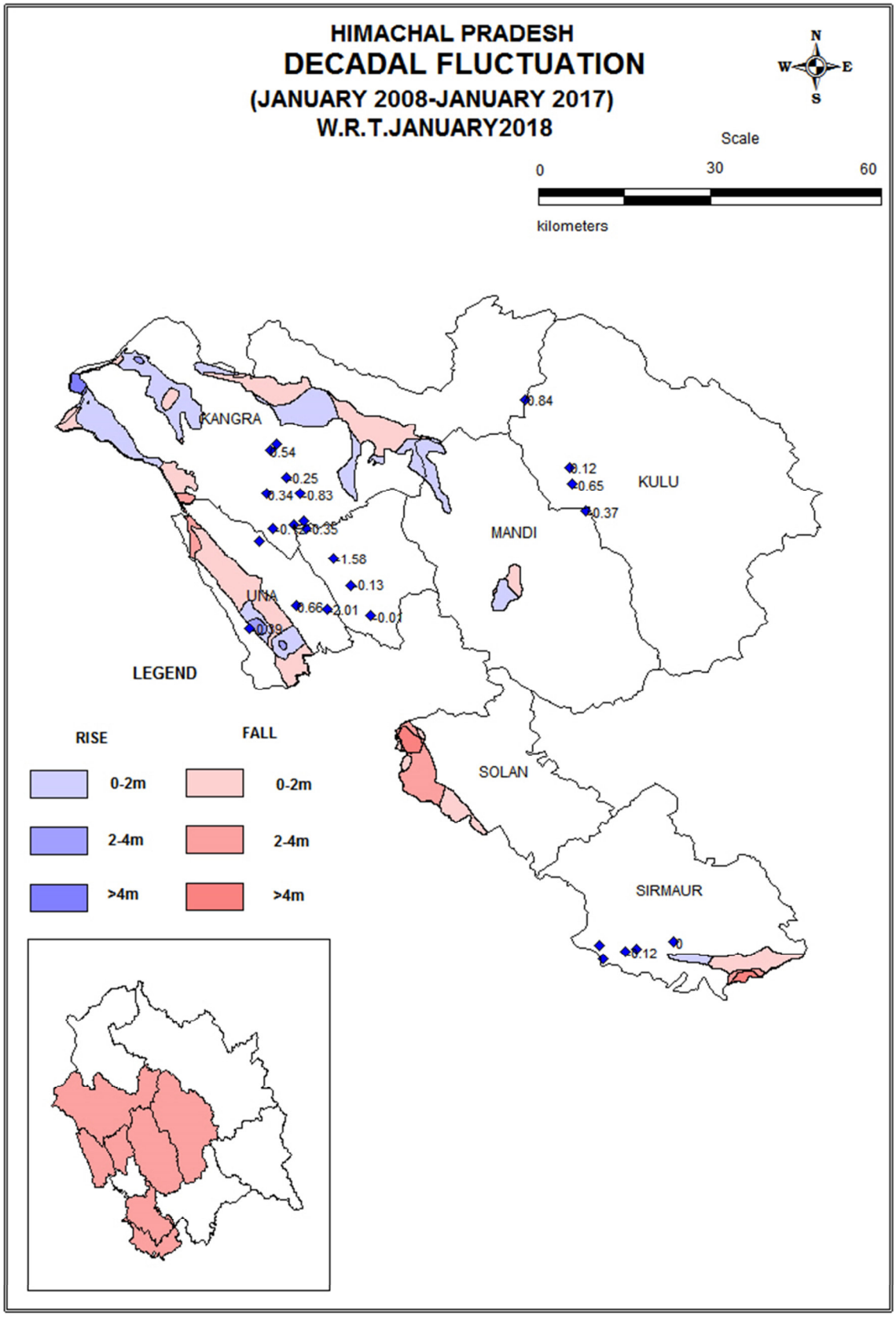

HIMACHAL PRADESH
ANNUAL FLUCTUATION
(NOVEMBER 2016-NOVEMBER 2017)
N
W
E
S
Scale
0
30
60
kilometers
KANGRA
MANDI
KULU
SOLAN
SIRMAUR
2.79
0.34
1.13
0.53
0.31
0.13
0.45
1.96
0.86
0.05
3.04
0.69
0.24
0.23
LEGEND
RISE
FALL
0-2m
2-4m
>4m
0-2m
2-4m
>4m


HIMACHAL PRADESH
ANNUAL FLUCTUATION
(JANUARY 2017-JANUARY 2018)
N
W
E
S
Scale
0
30
60
kilometers
KANGRA
KULU
MANDI
SOLAN
SIRMAUR
UNA
0.04
0.95
0.2
0.11
0.03
0.03
0.09
0.04
0.95
0.76
0.37
0.32
3.72
0.1
0.22
0.04
0
LEGEND
RISE
FALL
0-2m
2-4m
>4m
0-2m
2-4m
>4m


HIMACHAL PRADESH
DECADAL FLUCTUATION
(MAY 2007-MAY 2016) W.R.T.MAY2017
N
W
E
S
Scale
0
30
60
kilometers
KANGRA
MANDI
KULU
SOLAN
SIRMAUR
HAMIRPUR
UNA
0.95
1.08
2.68
1.53
7.77
0.14
0.04
2.39
4.06
0.16
0.45
3.37
0.1
0.69
12.64
2.43
LEGEND
RISE
FALL
0-2m
2-4m
>4m
0-2m
2-4m
>4m


HIMACHAL PRADESH
DECADAL FLUCTUATION
(AUGUST 2007-AUGUST 2016) W.R.T.AUGUST 2017
N
W
E
S
Scale
0
30
60
kilometers
KANGRA
HAMIRPUR
UNA
MANDI
KULU
SOLAN
SIRMAUR
0.57
0.13
1.87
0.83
0.53
0.02
0.14
0.53
0.25
1.03
0.11
0.25
0.9
8.39
0.72
LEGEND
RISE
FALL
0-2m
2-4m
>4m
0-2m
2-4m
>4m


HIMACHAL PRADESH
DECADAL FLUCTUATION
(NOVEMBER 2007-NOVEMBER 2016)
W.R.T.NOVEMBER 2017
N
W
E
S
Scale
0
30
60
kilometers
KANGRA
MANDI
KULU
SOLAN
SIRMAUR
1.2
0.59
0.47
0.02
1.37
0.2
0.77
0.42
0.04
1.27
0.85
0.25
2.25
0.53
0.18
8.45
LEGEND
RISE
FALL
0-2m
2-4m
>4m
0-2m
2-4m
>4m


HIMACHAL PRADESH
DECADAL FLUCTUATION
(JANUARY 2008-JANUARY 2017)
W.R.T.JANUARY2018
N
W
E
S
Scale
0
30
60
kilometers
KANGRA
MANDI
KULU
SOLAN
SIRMAUR
UNA
0.84
0.54
0.25
0.34
0.83
0.12
0.65
0.37
0.35
1.58
0.13
0.66
2.01
0.07
0.12
0
LEGEND
RISE
FALL
0-2m
2-4m
>4m
0-2m
2-4m
>4m

Annexure-V

Chemical Quality Data

Sampling in : 2017/May

State : Himachal Pradesh

District : KANGRA

Tahsil : HARCHAKIAN

Block : HARCHAKIAN

Site Name	Sample Id by lab	pH	Electrical Conductivity µS/cm at 25°C	Concentration (mg/l)									
				Calcium	Magnesium	Carbonate	Bicarbonate	Chloride	Nitrate	Flouride	Sulphate	Sodium	Pottasium
Rait	May2017	8.34	380.00	44.00	7.35	12.00	84.00	43.00	38.00	0.21	15.00	24.00	5.00
Chakban Ambari	May2017	8.17	92.00	28.00	0.00	-	71.00	14.00	19.00	0.00	5.00	14.00	2.20
Thirtynine Mile	May2017	8.50	235.00	24.00	17.00	23.00	107.00	7.10	5.35	0.08	-	5.50	2.00

Tahsil : KANGRA

Block : KANGRA

Site Name	Sample Id by lab	pH	Electrical Conductivity µS/cm at 25°C	Concentration (mg/l)									
				Calcium	Magnesium	Carbonate	Bicarbonate	Chloride	Nitrate	Flouride	Sulphate	Sodium	Pottasium
Nagrota	May2017	8.45	274.00	32.00	12.00	12.00	84.00	71.00	0.22	0.00	5.00	30.00	2.80
Manjgram	May2017	8.40	262.00	32.00	10.00	23.00	72.00	14.00	3.69	0.00	22.00	11.00	2.20

Tahsil : TEHSIL 4 (BAIJNATH)

Block : TEHSIL 4 (BAIJNATH)

Site Name	Sample Id by lab	pH	Electrical Conductivity µS/cm at 25°C	Concentration (mg/l)									
				Calcium	Magnesium	Carbonate	Bicarbonate	Chloride	Nitrate	Flouride	Sulphate	Sodium	Pottasium
Pandtehr	May2017	8.08	185.00	20.00	0.00	-	71.00	14.00	17.00	0.32	-	18.00	4.00
Paprola	May2017	7.80	77.00	12.00	5.00	-	35.00	7.10	5.20	0.00	-	5.50	0.80

District : SIRMAUR

Tahsil : NAHAN

Block : NAHAN

Site Name	Sample Id by lab	pH	Electrical Conductivity µS/cm at 25°C	Concentration (mg/l)									
				Calcium	Magnesium	Carbonate	Bicarbonate	Chloride	Nitrate	Flouride	Sulphate	Sodium	Pottasium
Shambuwala	May2017	8.20	185.00	22.00	9.00	-	92.00	7.10	4.80	0.16	10.00	5.20	0.80

Tahsil : PAONTA SAHIB

Block : PAONTA SAHIB

Site Name	Sample Id by lab	pH	Electrical Conductivity µS/cm at 25°C	Concentration (mg/l)									
				Calcium	Magnesium	Carbonate	Bicarbonate	Chloride	Nitrate	Flouride	Sulphate	Sodium	Pottasium
Khodawala	May2017	8.64	315.00	16.00	13.00	12.00	159.00	11.00	0.87	0.22	6.00	35.00	2.50
Kolar	May2017	8.30	385.00	44.00	15.00	6.00	116.00	11.00	31.00	0.08	48.00	14.00	1.00
Akkawala	May2017	8.45	2.78	28.00	15.00	23.00	107.00	11.00	3.40	-	30.00	20.00	3.70

District : SOLAN

Tahsil : NALAGARH

Block : NALAGARH

Site Name	Sample Id by lab	pH	Electrical Conductivity µS/cm at 25°C	Concentration (mg/l)									
				Calcium	Magnesium	Carbonate	Bicarbonate	Chloride	Nitrate	Flouride	Sulphate	Sodium	Pottasium
Barotiwala	May2017	8.45	240.00	20.00	10.00	12.00	96.00	7.10	8.00	0.07	24.00	22.00	2.20
Khera-chak	May2017	7.98	1305.00	92.00	29.00	-	84.00	213.00	160.00	0.24	122.00	123.00	12.00
Dhabota	May2017	8.48	580.00	32.00	19.00	23.00	107.00	57.00	45.00	0.22	50.00	63.00	1.80
Mahadev	May2017	8.52	305.00	28.00	2.00	12.00	96.00	14.00	16.00	0.10	25.00	36.00	1.40
Phalahi	May2017	8.32	600.00	48.00	24.00	12.00	84.00	50.00	115.00	0.16	44.00	37.00	2.30
Panjahra	May2017	8.40	270.00	28.00	7.00	12.00	84.00	14.00	19.00	0.18	30.00	26.00	1.40
Barun	May2017	8.48	265.00	24.00	10.00	47.00	48.00	14.00	19.00	0.11	-	24.00	1.70
Bhagheri	May2017	8.50	295.00	24.00	10.00	23.00	84.00	14.00	24.00	0.01	22.00	33.00	0.90
Jagatpur	May2017	8.50	335.00	24.00	7.00	35.00	96.00	14.00	17.00	0.29	8.00	40.00	3.10
BHATOLI	May2017	8.42	315.00	28.00	10.00	23.00	84.00	14.00	38.00	0.33	-	23.00	1.70

Chemical Quality Data May 2016

Annexure-VI

Sampling in **2016/May**
State **Himachal Pradesh**

District	HAMIRPUR	EC µS/cm at 25°C	Calcium (mg/l)	Magnesium (mg/l)	Carbonate (mg/l)	Bi Carbonate (mg/l)	Chloride (mg/l)	Nitrate (mg/l)	Flouride (mg/l)	Sulphate (mg/l)	Sodium (mg/l)	Potassium (mg/l)
Bijari	May2016	331.00	49.00	20.00	25.00	90.00	50.00	13.00	0.02	37.00	17.00	1.00
Galore	May2016	304.00	49.00	15.00	25.00	103.00	43.00	11.00	0.06	0.00	11.00	3.00
Kangu	May2016	400.00	78.00	13.00	25.00	154.00	28.00	6.81	0.12	49.00	8.90	3.70
Bagnalla	May2016	363.00	41.00	18.00	38.00	115.00	43.00	12.00	0.08	0.00	20.00	2.00
District	**KANGRA**											
Bharoli	May2016	567.00	29.00	34.00	13.00	148.00	74.00	11.00	0.40	46.00	39.00	2.60
Jwalaji	May2016	531.00	16.00	21.00	13.00	173.00	60.00	12.00	0.26	42.00	76.00	1.50
Dehra Gopipur	May2016	468.00	29.00	26.00	19.00	122.00	53.00	30.00	0.00	18.00	35.00	1.20
Jagir	May2016	860.00	33.00	20.00	25.00	128.00	191.00	12.00	0.00	0.00	122.00	6.50
Rait	May2016	468.00	44.00	13.00	19.00	167.00	21.00	12.00	0.39	27.00	17.00	5.00
Chakban Amba	May2016	100.00	16.00	7.54	0.00	26.00	21.00	3.68	0.08	0.00	4.50	1.20
Thirtynine Mile	May2016	369.00	33.00	18.00	19.00	167.00	21.00	6.00	0.32	0.00	18.00	1.94
Barota	May2016	354.00	25.00	22.00	38.00	77.00	35.00	0.00	0.02	19.00	15.00	6.00
Olherian	May2016	998.00	62.00	32.00	88.00	282.00	71.00	26.00	0.35	38.00	59.00	104.00
Kathgarh	May2016	765.00	41.00	50.00	76.00	295.00	43.00	18.00	0.40	0.00	41.00	36.00
Andaura	May2016	381.00	28.00	25.00	50.00	128.00	28.00	0.00	0.19	0.00	33.00	1.40
Channaur	May2016	595.00	37.00	27.00	25.00	295.00	35.00	22.00	0.31	0.00	66.00	1.00
Bharmar	May2016	250.00	29.00	10.00	19.00	103.00	14.00	5.00	0.36	0.00	10.00	1.00
Bhalad	May2016	496.00	29.00	27.00	25.00	141.00	57.00	21.00	0.16	24.00	48.00	1.60
Mohtli	May2016	353.00	33.00	13.00	38.00	64.00	57.00	15.00	0.13	0.00	30.00	1.70
Bandh	may 2016	312.00	33.00	10.00	6.30	148.00	28.00	0.00	0.13	0.00	21.00	0.80
Takipur	may 2016	279.00	27.00	15.00	10.00	96.00	35.00	7.32	0.25	0.00	10.00	0.80
Old Kangra	may 2016	598.00	66.00	16.37	19.00	237.00	50.00	21.00	0.03	0.00	25.00	25.00

District	Kangra	EC µS/cm at 25°C	Calcium (mg/l)	Magnesium (mg/l)	Carbonate (mg/l)	Bi Carbonate (mg/l)	Chloride (mg/l)	Nitrate (mg/l)	Flouride (mg/l)	Sulphate (mg/l)	Sodium (mg/l)	Potassium (mg/l)
Kangra	may 2016	246.00	25.00	7.42	0.00	96.00	21.00	18.00	0.00	0.00	14.00	1.80
Manjgram	may 2016	333.00	25.00	18.00	0.00	128.00	30.00	4.10	0.36	19.00	14.00	1.80
Darkati	May2016	395.00	25.00	24.00	38.00	103.00	57.00	6.74	0.11	0.00	35.00	9.00
Raja-ka-talab	May2016	258.00	33.00	10.00	0.00	128.00	14.00	11.00	0.36	0.00	5.00	0.00
Bhali	May2016	1062.00	83.00	8.00	0.00	269.00	91.00	16.00	0.45	168.00	125.00	7.30
Kotla	May2016	407.00	21.00	25.00	25.00	128.00	21.00	14.00	0.36	15.00	20.00	1.80
Thali	May2016	205.00	37.00	12.00	25.00	103.00	21.00	0.78	0.02	0.00	12.00	1.10
Mao	May2016	266.00	45.00	7.42	25.00	103.00	35.00	0.06	0.09	0.00	12.00	1.00
Basa Bazira	May2016	342.00	29.00	32.00	38.00	141.00	35.00	16.00	0.02	0.00	16.00	0.90
Panjpir	May2016	266.00	45.00	10.00	25.00	103.00	28.00	10.00	0.19	0.00	10.00	1.00
Jassur	May2016	384.00	33.00	30.00	38.00	103.00	50.00	20.00	0.06	0.00	16.00	1.00
Bod	May2016	952.00	52.00	38.00	38.00	167.00	63.00	24.00	0.36	182.00	70.00	22.00
Rakar	May2016	3.57	23.00	21.00	13.00	135.00	39.00	0.32	0.00	0.00	22.00	1.70
Hardogri	May2016	2.82	21.00	16.00	16.00	122.00	35.00	0.87	0.00	0.00	22.00	3.80
Dehrian	May2016	276.00	25.00	10.00	13.00	96.00	28.00	17.00	0.00	0.00	20.00	1.00
Pandtehr	May2016	140.00	21.00	12.00	0.00	64.00	28.00	3.89	0.13	0.00	5.00	1.00
Paprola	May2016	184.00	33.00	4.99	0.00	77.00	43.00	11.00	0.28	0.00	12.00	5.00
District	**KULLU**											
Gadauri	May2016	354.00	52.00	10.00	25.00	90.00	43.00	30.00	0.00	0.00	9.00	3.70
Kullu	May2016	290.00	48.00	5.00	38.00	77.00	21.00	5.03	0.07	0.00	3.90	4.90
District	**MANDI**											
Jhiri	May2016	342.00	58.00	10.00	38.00	77.00	35.00	28.00	0.08	0.00	12.00	4.10
Bahangrotu	May2016	1157.00	58.00	55.00	25.00	77.00	220.00	39.00	0.00	188.00	112.00	27.00
Jarl	May2016	329.00	33.00	18.00	38.00	90.00	43.00	1.51	0.14	0.00	23.00	2.80
Kaned	May2016	414.00	37.00	27.00	25.00	128.00	57.00	6.82	0.10	0.00	23.00	12.00
Lohara	May2016	526.00	45.00	45.00	0.00	243.00	71.00	25.00	0.08	0.00	24.00	2.50
Ratti	May2016	363.00	41.00	15.00	25.00	90.00	57.00	29.00	0.04	0.00	24.00	4.10
Gagal	May2016	244.00	45.00	4.99	38.00	64.00	28.00	3.88	0.95	0.00	11.00	2.50

District	SIRMAUR	EC µS/cm at 25°C	Calcium (mg/l)	Magnesium (mg/l)	Carbonate (mg/l)	Bi Carbonate (mg/l)	Chloride (mg/l)	Nitrate (mg/l)	Flouride (mg/l)	Sulphate (mg/l)	Sodium (mg/l)	Potassium (mg/l)
Shambuwala	May2016	210.00	36.00	7.00	0.00	140.00	7.00	3.70	0.00	2.00	4.00	1.00
Badripur	May2016	480.00	46.00	30.00	0.00	183.00	28.00	42.10	0.02	56.00	18.00	2.00
Ajiwala	May2016	270.00	40.00	9.00	0.00	134.00	7.00	8.36	0.38	27.00	8.00	3.00
Kiyarda	May2016	320.00	36.00	22.00	0.00	201.00	4.00	5.13	0.00	19.00	6.00	2.00
Shibpur	May2016	520.00	52.00	33.00	0.00	98.00	36.00	26.20	0.32	156.00	20.00	4.00
Nayagaon	May2016	290.00	24.00	24.00	0.00	189.00	7.00	2.35	0.21	6.00	6.00	1.00
Khodawala	May2016	520.00	44.00	49.00	0.00	214.00	7.00	8.90	0.00	128.00	7.00	1.00
Kala-Amb	May2016	760.00	56.00	10.00	0.00	189.00	92.00	60.60	0.12	91.00	83.00	54.00
Dhaulakuan	May2016	370.00	44.00	15.00	0.00	128.00	14.00	13.00	0.00	241.00	99.00	2.00
Kolar	May2016	560.00	22.00	60.00	60.00	134.00	14.00	31.80	0.00	81.00	17.00	2.00
Akkawala	May2016	380.00	28.00	26.00	0.00	244.00	14.00	1.65	0.00	20.00	28.00	4.00
Trilokpur	May2016	1070.00	16.00	5.00	0.00	195.00	252.00	12.40	0.00	139.00	278.00	5.00
District	**SOLAN**											
Barotiwala	May2016	240.00	32.00	5.00	24.00	73.00	18.00	11.00	0.16	0.00	20.00	1.90
Khera-chak	May2016	754.00	52.00	10.00	31.00	109.00	124.00	4.84	0.24	56.00	86.00	7.70
Dhabota	May2016	599.00	40.00	19.00	19.00	135.00	67.00	43.00	0.25	37.00	62.00	1.50
Mahadev	May2016	382.00	40.00	12.21	0.00	212.00	14.00	16.00	0.14	47.00	43.00	2.50
Phalahi	May2016	460.00	36.00	27.00	25.00	115.00	39.00	66.00	0.11	25.00	29.00	1.80
Panjahra	May2016	288.00	32.00	7.30	0.00	128.00	25.00	23.00	0.30	0.00	24.00	1.00
Barun	May2016	281.00	32.00	12.00	25.00	103.00	18.00	21.00	0.25	0.00	19.00	1.40
Bhagheri	May2016	346.00	15.00	12.00	25.00	115.00	32.00	36.00	0.00	0.00	39.00	0.80
Jagatpur	May2016	310.00	16.00	11.00	19.00	115.00	18.00	7.76	0.28	32.00	39.00	3.10
BHATOLI	May2016	320.00	40.00	12.00	0.00	166.00	21.00	24.00	0.29	0.00	24.00	2.00
District	**UNA**											
Panjawar	May2016	1330.00	40.00	68.00	72.00	415.00	192.00	47.00	0.40	229.00	280.00	14.00
Gagret	May2016	830.00	20.00	28.00	0.00	366.00	57.00	78.00	0.00	143.00	195.00	2.00
Singhnei	May2016	520.00	36.00	24.00	42.00	177.00	43.00	6.10	0.26	37.00	57.70	2.30
Jawar	May2016	530.00	58.00	26.00	0.00	354.00	21.00	12.00	0.12	60.00	60.60	8.20

District	UNA	EC µS/cm at 25°C	Calcium (mg/l)	Magnesium (mg/l)	Carbonate (mg/l)	Bi Carbonate (mg/l)	Chloride (mg/l)	Nitrate (mg/l)	Flouride (mg/l)	Sulphate (mg/l)	Sodium (mg/l)	Potassium (mg/l)
Mawa Kalan	May2016	400.00	40.00	23.00	0.00	146.00	50.00	26.00	0.08	74.00	42.40	0.90
Daulatpur	May2016	910.00	84.00	34.00	0.00	116.00	146.00	183.00	0.00	80.00	81.90	2.30
Babehr	May2016	380.00	42.00	27.00	0.00	207.00	18.00	13.00	0.34	98.00	41.80	1.40
Raipur Marwad	May2016	770.00	38.00	22.00	0.00	372.00	53.00	78.00	0.01	187.00	207.00	2.00
Bawal	May2016	620.00	54.00	54.00	0.00	195.00	67.00	44.00	0.18	221.00	67.60	14.50
Bhangana	May2016	150.00	28.00	2.00	0.00	85.00	7.00	5.70	0.10	5.00	3.80	1.00
Lalehri	May2016	310.00	60.00	2.00	0.00	146.00	21.00	16.00	0.03	38.00	17.10	3.90
Dharampur	May2016	1530.00	112.00	51.00	0.00	665.00	188.00	45.00	0.44	267.00	283.50	14.00
Kuluwal	May2016	400.00	42.00	17.00	0.00	146.00	50.00	25.00	0.03	57.00	43.10	0.60
Guglahar	May2016	360.00	50.00	17.00	0.00	183.00	150.00	34.00	0.17	46.00	29.40	1.00
Tahliwala 1	May2016	400.00	42.00	35.00	0.00	232.00	25.00	8.80	0.13	79.00	28.30	2.30
Santokhgarh	May2016	630.00	62.00	23.00	0.00	207.00	64.00	44.00	0.10	111.00	66.30	12.90
Khanpur	May2016	870.00	90.00	39.00	0.00	336.00	99.00	72.00	0.23	115.00	94.90	1.00
Nangran	May2016	500.00	50.00	28.00	24.00	220.00	39.00	6.00	0.08	81.00	55.90	2.10
Jankaur	May2016	770.00	46.00	40.00	0.00	244.00	103.00	73.00	0.23	82.00	95.70	1.10
Una	May2016	140.00	26.00	1.00	0.00	79.00	7.00	5.80	0.00	0.00	3.70	1.10
Bhadsali	May2016	440.00	46.00	18.00	0.00	177.00	21.00	16.00	0.29	97.00	44.50	1.90
Jhalera	May2016	320.00	44.00	13.00	0.00	195.00	21.00	21.00	0.23	2.00	16.60	3.60
Ishapur	May2016	140.00	22.00	6.00	0.00	92.00	4.00	5.00	0.00	7.00	4.70	1.00
Khwaja	May2016	910.00	74.00	29.00	0.00	238.00	117.00	114.00	0.31	61.00	94.80	3.50
Rajli Panjal	May2016	630.00	48.00	46.00	0.00	232.00	18.00	12.00	0.18	220.00	61.80	7.70
Panoh	May2016	930.00	80.00	30.00	0.00	140.00	146.00	177.00	0.03	45.00	83.40	2.40
Loharli	May2016	400.00	38.00	32.00	0.00	201.00	25.00	9.70	0.00	78.00	28.20	2.40
Kuthera Jaswal	May2016	310.00	40.00	19.00	0.00	110.00	11.00	29.00	0.00	68.00	8.40	0.90
Amb	May2016	650.00	82.00	45.00	0.00	439.00	21.00	6.10	0.49	59.00	29.90	1.30
Ghaneri	May2016	610.00	62.00	10.00	0.00	110.00	67.00	84.00	0.06	117.00	81.90	1.10
Mubarikpur	May2016	150.00	26.00	7.00	0.00	85.00	7.00	6.70	0.01	19.00	3.90	1.10