



GOVERNMENT OF INDIA

**MINISTRY OF WATER RESOURCES
CENTRAL GROUND WATER BOARD**

**GROUND WATER YEAR BOOK
HIMACHAL PRADESH
(2013-2014)**

**NORTHERN HIMALAYAN REGION
DHARAMSHALA
(H.P)
November, 2014**



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By

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NORTHERN HIMALAYAN REGION
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FOREWARD

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

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

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

This report presents the water level data for the National Hydrograph Network Stations collected during the year 2013-2014 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, Dharamshala. This report has been compiled by Dr. Anukaran Kujur, Assistant Hydrogeologist under the supervision of Sh. Dalel Singh, Superintending Hydrologist. The efforts of Smt Rachna Bhatti, Assistant Hydrogeologist in scrutiny, processing and issuance of report is also highly significant.

This ground water year book contains useful data for water year 2013-14 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: 17.11.2014

Dharamshala

(J.S.Sharma)
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GROUND WATER YEAR BOOK
HIMACHAL PRADESH
2013-2014
EXECUTIVE SUMMARY

- ❖ Central Ground Water Board, NHR has set up a network of 110 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 110 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.
- ❖ In majority of the stations (88.05% of the stations), depth to water level varies from 0 to 20 m bgl during the pre-monsoon 2013. Deeper water levels more than 20m were observed in Sirmaur Solan, and Una districts.
- ❖ The shallow water levels less than 2 m bgl, (6.52% of the stations) were observed in Kangra, Kullu, Mandi and Una districts.
- ❖ The long-term ground water scenario as observed in 71 stations show a decline in water level majority in the state during pre-monsoon 2013 with respect to the decadal average of the pre-monsoon water levels. Rise of water level observed in 45.07% and fall of water level in 54.93%.
- ❖ A focused vision of administrative and policy makers is required towards implementing the suitable measures for ground water development, management and its sustainability. There is a need to adopt measures like artificial recharge to ground water in water level depleted areas, public awareness for water conservation and water pollution to preserve our precious resource.

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1.0 INTRODUCTION

Himachal Pradesh is located between the north latitude 30°22'40" & 33°12'40" and east longitude 75°47'55" & 79°04'20". It falls in Survey of India topographic sheets Nos. 52D, 52H, 52L, 53A, 53B, 53F, 53E and 53I and covers an area of 55,673 sq km. It is one of the predominantly hilly states in India, which lies in the western Himalayas. The length of Himachal Pradesh is about 355 km i.e. from northwestern part of Chamba to southeastern part of Kinnaur. The breadth of the state is about 270 km i.e. from western part of Una to northeast part of Lahaul and Spiti district. The state is bounded by the state of Jammu & Kashmir in north, Punjab state in west, Haryana state in south and Utrakhnad 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 75 blocks. There are 20,118 villages, 3,037 Gram Panchayats, 57 towns, 28 Nagar Panchayats and 21 Nagar Parishads including Municipal Corporations. Lahaul & Spiti is the largest and Hamirpur is the smallest district of the state with geographical area of 12,835 and 1,118 sq km respectively.

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

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

Himachal state has a unique distinction of having drainage systems of both the Indus and the Ganga basin. The major river systems of the region are the Chandra-Bhaga or the Chenab, the Ravi, the Beas, the Satluj and the Yamuna. The catchments of 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 110 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
2013-2014	110

The ground water monitoring is being carried out by Northern Himalayan Region, Dharamshala, since 1996. All the 110 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	37	23	14	-
3.	Kullu	3	3	-	-
4.	Mandi	8	8	-	-
5.	Sirmaur	13	11	2	-
6.	Solan	12	12	-	-
7.	Una	34	32	2	-
TOTAL		110	92	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 intermontane 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
<i>POROUS FORMATIONS</i>			
Recent to sub Recent	Boulder, Cobble, Pebble, Sand, Silt, Clay,	Kangra, Una, Solan, Sirmaur, Mandi and Kullu	High Yield 30-75 m ³ /hr
<i>FISSURED FORMATIONS</i>			
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 through bore wells or springs at favorable locations. Springs are the major ground water sources in these formations and its yield ranges from seepages to more than 25 lps and are utilized for both domestic and irrigation purposes. Weathered mantle in low topographic areas, also forms poor aquifers. In some areas, percolation wells are also constructed. Borewells 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 30m³/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 : 20th to 30th : represents water level of Pre-monsoon period
2. August : 20th to 30th : represents peak monsoon water level.
3. November : 1st to 10th : represents water level of Post-monsoon period.
4. January : 1st to 10th : 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 2013

The depth to water level recorded during May 2013 (Annexure - I) ranged between 0.60m (Mandi district) to 29.45 m bgl (Una district) (Table-4). Out of the 92 stations monitored the majority of stations (88.05%) recorded DTW in the range between 2 - 20 m bgl, 6.52% stations recorded shallow water level, less than 2 m bgl and 5.43% stations recorded deep water level, more than 20 m bgl.

A perusal of the DTW map (Plate III) indicating that the shallow water level area less than 2m occurs mainly in Kangra valley (Kangra district), Kullu valley (Kullu district), Balh valley (Mandi district) and Una valley (Una district) 2-5m is in major part of Kangra valley, southern part of Kullu valley, major part of Balh valley, western part of Paonta valley and central part of Una valley. Deep water level more than 20m is recorded in eastern part of Paonta valley in Sirmour district, western part of Nalagarh valley and in Una valley.

Table-4: Depth to water level - May 2013

District	No. of Wells Analysed	Depth to water Table (m bgl)		No. /Percentage of Wells showing Depth to Water Table (mbgl) in the Range of					
		Min	Max	0 – 2	2 – 5	5 – 10	10–20	20 – 40	> 40
Hamirpur	4	2.70	9.35	-	2 50%	2 50%	-	-	-
Kangra	26	1.03	13.84	2 7.69%	15 57.69%	5 19.23%	4 15.38%	-	-
Kullu	3	1.62	4.87	1 33.3%	2 66.67%	-	-	-	-
Mandi	8	0.60	8.84	2 25%	4 50%	2 25%	-	-	-
Sirmaur	11	2.32	27.70	-	1 9.09%	3 27.27%	6 54.55%	1 9.09%	-
Solan	10	5.41	27.84	-	-	2 20%	6 60%	2 20%	-
Una	30	1.64	29.45	1 3.33%	10 33.33%	12 40%	5 16.67%	2 6.67%	-
Total	92	0.60	29.45	6 6.52%	34 36.96%	26 28.26%	21 22.83%	5 5.43%	-

3.1.2 August 2013

The depth to water level recorded during August 2013 (Annexure - I) ranges between 0.20 m bgl (Kangra and Mandi districts) to 28.18m bgl (Solan district) (Table-5). Out of the 102 stations monitored the majority of stations (55.88%) recorded DTW in the range between 2 - 20 m bgl,

40.19% stations recorded shallow water level less than 2 m bgl and 3.93% stations recorded deep water levels, more than 20 m bgl in the state.

A perusal of the DTW map (Plate IV) indicating that the shallow water level area less than 2m occurs mainly in Balh valley (Mandi district), Kullu valley (Kullu district), Kangra valley (Kangra district) and Una valley (Una district). 2-5m is observed in central part of Una valley, Paonta valley (Sirmaur), southern part of Nalagargh valley, Balh valley, Kullu valley and parts of Kangra valley. Deep water level more than 20m is confined mainly in Nalagargh valley and Una valley.

Table-5:- Depth to water level - August 2013

District	No. of Wells Analysed	Depth to water Table (m bgl)		No. /Percentage of Wells showing Depth to Water Table (mbgl) in the Range of					
		Min	Max	0 – 2	2 – 5	5 – 10	10–20	20 – 40	> 40
Hamirpur	4	1.54	4.53	2 50.00%	2 50.00%	-	-	-	-
Kangra	36	0.20	9.28	18 50.00%	17 47.22%	1 2.78%	-	-	-
Kullu	3	1.51	5.14	1 33.33%	1 33.33%	1 33.33%	-	-	-
Mandi	8	0.20	4.67	4 50.00%	4 50.00%	-	-	-	-
Sirmaur	9	0.54	12.38	4 44.44%	3 33.33%	1 11.11%	1 11.11%	-	-
Solan	11	2.94	28.18	-	2 18.18%	2 18.18%	5 45.45%	2 18.18%	-
Una	31	0.59	27.03	12 38.71%	9 29.03%	4 12.90%	4 12.90%	2 6.45%	-
Total	102	0.20	28.18	41 40.19%	38 37.26%	9 8.82%	10 9.80%	4 3.93%	-

3.1.3 November 2013

The depth to water level recorded during November 2013 (Annexure - I) ranged between 0.50 m bgl in Balh valley (Mandi district) to 28.21m bgl in Nalagarh valley (Solan district) (Table-6). Out of the 110 stations 101 stations monitored, the majority of NHS (75.25%) recorded DTW in range between 2 - 20 m bgl. 20.79% stations recorded shallow water level less than 2 m bgl and 3.96% stations recorded deep water level more than 20 m bgl in the state.

A perusal of the DTWL map (Plate V) shows that the shallow water level areas of less than 2 m occurs in central part of Kangra valley, southern part of Balh valley, western part of Paonta valley and southern, central and northern part of Una valley. 2-5m is observed in major part of Kangra

valley, part of Kullu valley, Balh valley, Una Valley, Paonta vally, Nalagargh valley and major part of Una valley. Deep 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 2013

District	No. of Wells Analysed	Depth to water Table (m bgl)		No. /Percentage of Wells showing Depth to Water Table (mbgl) in the Range of					
		Min	Max	0 – 2	2 – 5	5 – 10	10–20	20 – 40	> 40
Hamirpur	4	2.43	6.53	-	3 75.00%	1 25.00%	-	-	-
Kangra	32	0.63	9.00	8 25.00%	17 53.13%	7 21.88%	-	-	-
Kullu	2	4.30	5.13	-	1 50.00%	1 50.00%	-	-	-
Mandi	8	0.50	4.58	3 37.50%	5 62.50%	-	-	-	-
Sirmaur	12	0.93	26.58	1 8.33%	2 16.67%	5 41.67%	3 25.00%	1 8.33%	-
Solan	11	3.88	28.21	-	2 18.18%	2 18.18%	5 45.45%	2 18.18%	-
Una	32	0.62	27.42	9 28.13%	11 34.38%	6 18.75%	5 15.63%	1 3.13%	-
Total	101	0.50	28.21	21 20.79%	41 40.59%	22 21.78%	13 12.88%	4 3.96%	-

3.1.4 January 2014

The depth to water level recorded during January 2014 (Annexure - I) ranged between 0.45m (Mandi district) to 29.62m bgl (Sirmaur district) (Table-7). 90 stations monitored, the majority of NHS (76.66%) recorded DTW in the range between 2 - 20 m bgl. 15 stations (16.67%) recorded shallow water levels, less than 2 m bgl and 6 stations (6.67%) recorded deep water levels, more than 20 m bgl in the state.

A perusal of the DTW map (Plate VI) shows that the shallow water level area of less than 2m occurs mainly in central part of Kangra valley (Kangra), southern part of Balh valley (Mandi), western part of Paonta valley (Sirmaur) and central part of Una Valley (Una district). Deep water level, more than 20m are confined mainly in eastern part of Paonta valley, Nalagargh and Una valleys.

Table- 7: Depth to Water Level – January 2014

District	No. of Wells Analysed	Depth to water Table (m bgl)		No. /Percentage of Wells showing Depth to Water Table (mbgl) in the Range of					
		Min	Max	0 – 2	2 – 5	5 – 10	10–20	20 – 40	> 40
Hamirpur	4	2.04	6.68	0	2 50.00%	2 50.00%	0	0	0
Kangra	23	0.58	11.71	6 26.09%	12 52.17%	4 17.39%	1 4.35%	0	0
Kullu	1	4.95	4.95	0	1 100.00%	0	0	0	0
Mandi	8	0.45	5.77	2 25.00%	4 50.00%	2 25.00%	0	0	0
Sirmaur	13	1.113	29.62	1 7.69%	2 15.38%	2 15.38%	6 46.15%	2 15.38%	0
Solan	10	3.39	28.23	0	2 20.00%	2 20.00%	5 50.00%	1 10.00%	0
Una	31	0.72	28.33	6 19.35%	13 41.94%	5 16.13%	4 12.90%	3 9.68%	0
Total	90	0.45	29.62	15 16.67%	36 40.00%	17 18.89%	16 17.77%	6 6.67%	0

3.2 Seasonal Water Level Fluctuation

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

3.2.1 May 2013 to August 2013

Seasonal fluctuation of water level has been worked out by comparing depth to water level of May 2013 with August 2013 and data is presented in Annexure – II and its frequency distribution in various rise and fall ranges is given in Table-8. It is observed that 89 stations analyzed, 86 stations (96.62%) show rise ranges between 0.06 m to 10.74 m and fall in 3 stations (3.38%) between 0.27 m to 0.34 m.

A perusal of seasonal fluctuation map (Plate VII) indicating rise in water level in Kullu valley, Paonta valley, Una valley, Balh valley and Kangra valley most part of Nalagarh valley. Fall of water level is noticed in part of Kullu and Nalagarh valleys.

Table-8: Seasonal Fluctuation - May 2013 to August 2013

District Name	No. of Wells	Range of Fluctuation (m)				No. of wells/ percentage showing Fluctuation (m)						Total No. of Wells	
		Rise		Fall		Rise			Fall			Rise	Fall
		Min	Max	Min	Max	0 to 2	2 to 4	>4	0 to 2	2 to 4	>4		
Hamirpur	4	1.16	4.82	-	-	2 50.00%	1 25.00%	1 25.00%	-	-	-	4	-
Kangra	26	0.10	10.10	-	-	9 34.62%	9 34.62%	8 30.77%	-	-	-	26	-
Kullu	3	0.11	0.49	0.27	0.27	2 66.67%	-	-	1 33.33%	-	-	2	1
Mandi	8	0.06	6.87	-	-	7 87.50%	-	1 12.50%	-	-	-	8	-
Sirmaur	9	1.08	10.74	-	-	2 22.22%	1 11.11%	6 66.67%	-	-	-	9	-
Solan	10	0.32	3.14	0.24	0.34	6 60.00%	2 20.00%	-	2 20.00%	-	-	8	2
Una	29	0.34	4.35	-	-	10 34.48%	15 51.72%	4 13.79%	-	-	-	29	-
Total	89	0.06	10.74	0.27	0.34	38 42.69%	28 31.46%	20 22.48%	3 3.37%	-	-	86 96.62%	3 3.38%

3.2.2 May 2013 to November 2013

Seasonal fluctuation of water level has been worked out by comparing depth to water level of May 2013 with November 2013 and data is presented in Annexure – II and its frequency distribution in various rise and fall ranges is given in Table-9. It is observed that out of 89 stations analyzed, 80 stations (89.89%) show rise ranges between 0.08 m to 7.87 m and fall in 9 stations (11.11%) between 0.10 m to 5.26m.

A perusal of map (Plate VIII) showing fall in water level 0-2m in Kangra valley of Kangra district, north part of Kullu valley of Kullu district southern part of Nalagargh valley of Solan district and south eastern part of Balh valley of Mandi district. Rise in water level is noticed in major part of Paonta valley, Nalagargh valley, Una valley, Balh valley and Kangra valley.

Table-9: Seasonal Fluctuation - May 2013 to November 2013

District Name	No. of Wells	Range of Fluctuation (m)				No. of wells/ percentage showing Fluctuation (m)						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	0.52	2.82	0.47	0.47	2 50.00%	1 25.00%	-	1 25.00%	-	-	3	1
Kangra	24	0.45	6.64	0.10	0.20	11 45.83%	7 29.17%	4 16.67%	2 8.33%	-	-	22	2
Kullu	2	-	-	0.26	0.28	-	-	-	2 100.00%	-	-	-	2
Mandi	8	0.10	4.47	0.12	0.12	6 75.00%	-	1 12.50%	1 12.50%	-	-	7	1
Sirmaur	11	0.37	7.87	-	-	6 54.55%	2 18.18%	3 27.27%	-	-	-	8	2
Solan	10	0.28	3.20	0.37	0.65	4 40.00%	4 40.00%	-	2 20.00%	-	-	8	2
Una	30	0.08	5.68	5.26	5.26	15 50.00%	11 36.67%	3 10.00%	-	-	1 3.33%	29	1
Total	89	0.08	7.87	0.10	5.26	44 49.45%	25 28.08%	11 12.37%	8 8.98%	-	1 1.12%	80 89.89%	9 11.11%

3.2.3 May 2013 to January 2014

Seasonal fluctuation of water level was analyzed for 83 stations for the period May 2013 – January 2014. A perusal of Table-10 shows that out of the 83 stations, 75 stations (90.36%) have shown rise in water level and remaining 7 stations (8.43%) have shown fall in water level. The minimum rise in water level of 0.04m was observed in Nalagargh valley and the maximum rise 7.22 m was noticed in Paonta valley. Out of the 75 stations which have shown rise in water level, 48 stations show rise between the range of 0 to 2m, 23stations between 2 to 4m and remaining 4 stations show rise more than 4m. The minimum and maximum fall in water level of 0.08 m and 0.74m was observed in Kullu and Paonta valleys. Out of 7 stations, all stations show fall in the range of 0 to 2m.

A perusal of map (Plate IX) showing water level fall 0-2m in northern part of Kangra valley of Kangra district, Kullu valley of Kullu district, Balh valley of Mandi district, Paonta valley of Sirmaur district and Nalagargh valley of Solan district. Rise in water level is noticed in part of Paonta valley, Nalagargh valley, Una valley, Balh valley and Kangra valley.

Table -10: Seasonal Fluctuation - May 2013 to January 2014

District Name	No. of Wells	Range of Fluctuation (m)				No. of wells/ percentage showing Fluctuation (m)						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	0.66	2.67	-	-	3 75.00%	1 25.00%	-	-	-	-	4	-
Kangra	22	0.36	5.50	0.17	0.17	11 50.00%	7 31.82%	2 9.09%	1 4.55%	-	-	20	1
Kullu	1	-	-	0.08	0.08	-	-	-	1 100.00%	-	-	-	1
Mandi	8	0.15	3.64	0.54	0.64	5 62.50%	1 12.50%	-	2 25.00%	-	-	6	2
Sirmaur	11	0.19	7.22	0.74	0.74	8 72.73%	1 9.09%	1 9.09%	1 9.09%	-	-	10	1
Solan	9	0.04	3.12	0.39	0.52	3 33.33%	4 44.44%	-	2 22.22%	-	-	7	2
Una	28	0.39	4.23	-	-	18 64.29%	9 32.14%	1 3.57%	-	-	-	28	-
Total	83	0.04	7.22	0.08	0.74	48 57.83%	23 27.72%	4 4.81%	7 8.43%	-	-	75 90.36%	7 8.43%

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 2012 to May 2013

Annual fluctuation of water level arrived by comparing depth to water level of May 2012 with May 2013 and data is presented in Annexure – III and its frequency distribution of rise and fall are given in Table-11. Out of the 67 GWMS, 38 stations (56.72%) have shown rise in water level ranging from 0.03 to 17.98m whereas 29 stations (43.28%) have shown fall ranging from 0.01 to 2.28m.

A perusal of annual fluctuation map (Plate X) indicating fall in water level between 0-2m in most of the part of Paonta valley of Sirmaur district, Nalagarh valley of Solan district, Una valley of Una district, Kullu valley in Kullu district and Kangra valley of kangra district. Similarly rise in water level is observed in parts of Kangra, Nalagarh valley, Paonta valleys and Una valley.

Table-11: Annual Fluctuation May 2012 to May 2013

District Name	No. of Wells	Range of Fluctuation (m)				No. of wells/ percentage showing Fluctuation (m)						Total No. of Wells	
		Rise		Fall		Rise			Fall			Rise	Fall
		Min	Max	Min	Max	0 to 2	2 to 4	>4	0 to 2	2 to 4	>4		
Hamirpur	1	0.20	0.20	-	-	1 100%	-	-	-	-	-	1 100%	-
Kangra	22	0.07	6.14	0.13	2.28	11 50%	-	1 4.55%	8 36.36%	2 9.09%	-	12 54.55%	10 45.45%
Kullu	3	0.09	0.64	0.13	0.13	2 66.67%	-	-	1 33.33%	-	-	2 66.67%	1 33.33
Mandi	8	0.03	1.81	0.50	0.50	7 87.50%	2 33.33%	-	1 12.50%	-	-	7 87.50%	1 12.50%
Sirmaur	10	0.05	17.98	0.19	0.22	6 60%	1 10%	1 10%	2 20%	-	-	8 80%	2 20%
Solan	8	0.12	3.91	0.09	0.51	4 50%	1 12.50%	-	3 37.50%	-	-	5 62.50%	3 37.50%
Una	15	0.03	0.15	0.01	1.25	3 20%	-	-	12 80%	-	-	3 20%	12 80%
Total	67	0.03	17.98	0.01	2.28	34 50.75%	4 5.98%	2 2.98%	27 40.30%	2 2.98%	-	38 56.72%	29 43.28%

3.3.2 August 2012 to August 2013

Annual fluctuation data of water level is presented in Annexure – III and its frequency distribution of rise and fall is given in Table-12. Out of the 69 stations, 44 stations (63.76%) have shown rise in water level ranging from 0.02 to 20.16m whereas 24 stations (34.78%) have shown fall ranging from 0.08 to 3.33m.

A perusal of annual fluctuation map (Plate XI) indicating fall in water level between 0-2m in eastern and western part of Paonta valley, western part of Nalagargh valley, central and northern part of Una valley, Kullu valley, southern part of Kangra, northern part of Indora valleys and southern part of Balh valley, 2-4m water level fall is observed in the north part of Paonta and Nalagargh valleys. Similarly rise in water level is observed in major part of Balh valley, Kangra valley, Nalagargh valley, Paonta valley and Una valley.

Table-12: Annual Fluctuation August 2012 - August 2013

District Name	No. of Wells	Range of Fluctuation (m)				No. of wells/ percentage showing Fluctuation (m)						Total No. of Wells	
		Rise		Fall		Rise			Fall			Rise	Fall
		Min	Max	Min	Max	0 to 2	2 to 4	>4	0 to 2	2 to 4	>4		
Hamirpur	1	0.25	0.25	-	-	1 100.00%	-	-	-	-	-	1	-
Kangra	23	0.02	3.30	0.08	0.73	13 56.52%	2 8.70%	-	7 30.43%	-	-	15	7
Kullu	3	-	-	0.08	0.38	-	-	-	3 100.00%	-	-	-	3
Mandi	8	0.02	0.35	0.15	1.42	3 37.50%	-	-	5 62.50%	-	-	3	5
Sirmaur	9	0.81	20.16	0.39	3.33	5 55.56%	1 11.11%	1 11.11%	1 11.11%	1 11.11%	-	7	2
Solan	9	0.30	1.12	0.10	2.72	3 33.33%	-	-	3 33.33%	3 33.33%	-	3	6
Una	16	0.13	3.30	0.16	0.16	10 62.50%	5 31.25%	-	1 6.25%	-	-	15	1
Total	69	0.02	20.16	0.08	3.33	35 50.72%	8 11.59%	1 1.44%	20 28.98%	4 5.79%	-	44 63.76%	24 34.78%

3.3.3 November 2012 to November 2013

Annual fluctuation of water level has been worked out by comparing DTW of November 2012 with November 2013 and data is presented in Annexure – III and its frequency distribution in various rise and fall ranges is given in Table-13. Out of the 70 stations, 40 stations (57.14%) have shown rise in water level ranging from 0.03 to 12.12m whereas 29 stations (41.42%) have shown fall ranging from 0.02 to 4.71m.

A perusal of map showing annual fluctuation (Plate XII) fall in water level 0-2m major part of Kangra valley, Balh valley, Nalagargh valley, northern part of Una valley and south western part of Paonta valley, more than 4m is observed in the small pocket of Paonta valley. Similarly rise in water level 0-2m is noticed in southern part of Kangra valley, northern part of Kullu valley, northern part of Balh valley, southern part of Una valley and north eastern part of Nalagargh valley and major part of Paonta valley.

Table-13: Annual Fluctuation -November 2012 to November 2013

District Name	No. of Wells	Range of Fluctuation (m)				No. of wells/ percentage showing Fluctuation (m)						Total No. of Wells	
		Rise		Fall		Rise			Fall			Rise	Fall
		Min	Max	Min	Max	0 to 2	2 to 4	>4	0 to 2	2 to 4	>4		
Hamirpur	1	0.46	0.46	-	-	1 100.00%	-	-	-	-	-	1	-
Kangra	22	0.14	3.13	0.02	2.34	11 50.00%	3 13.64%	-	6 27.27%	1 4.55%	-	14	7
Kullu	2	0.03	0.52	-	-	2 100.00%	-	-	-	-	-	2	-
Mandi	8	0.12	1.25	0.13	0.35	4 50.00%	-	-	4 50.00%	-	-	4	4
Sirmaur	11	0.35	12.12	0.08	4.71	5 45.45%	-	2 18.18%	3 27.27%	-	1 9.09%	7	4
Solan	9	0.14	0.81	0.06	0.86	2 22.22%	-	-	7 77.78%	-	-	2	7
Una	17	0.09	1.70	0.03	3.20	10 58.82%	-	-	6 35.29%	1 5.88%	-	10	7
Total	70	0.03	12.12	0.02	4.71	35 50.00%	3 4.28%	2 2.85%	26 37.14%	2 2.85%	1 1.42%	40 57.14%	29 41.42%

3.3.4 January 2013 to January 2014

Annual fluctuation of water level has been worked out by comparing depth to water level of January 2013 with January 2014 and data is presented in Annexure – III and its frequency distribution in various rise and fall ranges is given in Table-14. Out of the 88 stations, 64 stations (72.72%) have shown rise in water level ranging from 0.01 to 0.50m whereas 24 stations (27.28%) have shown fall ranging from 0.01 to 6.80m.

A perusal of map (Plate XIII) shows annual water level fall in central part of Paonta valley of Sirmaur district, northern part of Nalagargh valley of Solan district, northern part of Una valley of Una district, north eastern part of Balh valley of Mandi district and north eastern part of Kangra valley of kangra district. Similarly rise in water level is noticed in Kullu valley of Kulu district Balh valley of Mandi district, southern part of Una valley in Una district and part of Kangra valley of Kangra district.

Table-14: Annual Fluctuation, January 2013 to January 2014

District Name	No. of Wells	Range of Fluctuation (m)				No. of wells/ percentage showing Fluctuation (m)						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	0.11	0.50	0.03	0.03	3 75.00%	0	0	1 25.00%	0	0	3	1
Kangra	23	0.15	3.30	0.01	1.88	14 60.87%	3 13.04%	0	6 26.09%	0	0	17	6
Kullu	1	3.23	3.23	-	-	-	1 100.00%	0	0	0	0	1	0
Mandi	8	0.01	2.17	0.67	1.36	5 62.50%	1 12.50%	0	2 25.00%	0	0	6	2
Sirmaur	12	0.12	5.27	0.25	1.43	7 58.33%	0	1 8.33%	4 33.33%	0	0	8	4
Solan	10	0.17	5.98	0.14	1.35	4 40.00%	1 10.00%	1 10.00%	4 40.00%	0	0	6	4
Una	30	0.12	3.83	0.06	6.80	21 70.00%	2 6.67%	0	6 20.00%	0	1 3.33%	23	7
Total	88	0.01	0.50	0.01	6.80	54 61.36%	8 9.10%	2 2.27%	23 26.14%	0	1 1.13%	64 72.72%	24 27.28%

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 (2003-2012) to May 2013

Decadal water level fluctuation has been worked out by comparing water level data of May 2013 with the average 10 years water level data of May (2003-2012) 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 the 71 stations analysed, 32 stations (45.07%) have shown rise and 39 stations (54.93%) have shown fall in water level. 26 stations (36.62%) are showing rise in water level between 0 - 2m, 4 stations (5.63%) between 2 to 4m. and 2 stations (2.82%) more than 4m. A minimum of 0.04 m and maximum of 17.41m rise in water level noticed in Balh valley and Paonta valley respectively. Out of 39 stations (54.93%) showing fall in water level, 37 stations (52.11%) are in the range of 0-2m, 1 station (1.41%) in 2-4m and in one station (1.41%) more than 4m .

A perusal of map (Plate XIV) indicating water level rise less than 2m in major part of Una valley of Una district, Balh valley of Mandi district and Kangra valley of Kangra district, between 2 - 4 m is noticed in isolated pockets of Kangra and Nalagargh valley. Fall of water level 0-2m is recorded in major part of Kangra valley, Kullu valley, Balh valley, Paonta valley, northern part of Nalagargh

valley and Una valley between 2-4m is recorded in Una valley. More than 4m fall in parts of Kangra valley.

Table-15: Decadal Fluctuation May (2003-2012) to May 2013

District Name	No. of Wells	Range of Fluctuation (m)				No. of wells/ percentage showing Fluctuation(m)						Total No. of Wells	
		Rise		Fall		Rise			Fall			Rise	Fall
		Min	Max	Min	Max	0 to 2	2 to 4	>4	0 to 2	2 to 4	>4		
Hamirpur	1	0.26	0.26	-	-	1 100%	-	-	-	-	-	1 100%	-
Kangra	24	0.09	2.80	0.17	4.17	9 37.50%	1 4.17%	-	13 54.17%	-	1 4.17%	10 41.67%	14 58.33%
Kullu	3	0.09	0.09	0.19	0.20	1 33.33%	-	-	2 66.67	-	-	1 33.33%	2 67.67%
Mandi	8	0.04	9.94	0.43	0.43	6 75%	-	1 12.50%	1 12.50%	-	-	7 87.50%	1 12.50%
Sirmaur	10	0.25	17.41	0.28	0.69	5 50%	-	1 10%	4 40%	-	-	6 60%	4 40%
Solan	9	0.44	3.57	0.19	1.21	2 22.22%	3 33.33%	-	4 44.44%	-	-	5 55.55%	4 44.44%
Una	16	0.19	0.67	0.05	2.45	2 12.50%	-	-	13 81.25%	1 6.25%	-	2 12.50%	14 87.50%
Total	71	0.04	17.41	0.05	4.17	26 36.62%	4 5.63%	2 2.82%	37 52.11%	1 1.41%	1 1.41%	32 45.07%	39 54.93%

3.4.2 Decadal Average of August (2003 - 2012) to August 2013

Decadal water level fluctuation has been worked out by comparing water level data of August 2013 with the average 10 years water level data of August (2003-2012) and is presented in Annexure - IV and frequency distribution in various ranges is presented in Table -16.

A perusal of Table-16 shows that out of 74 stations analysed, 53 stations (71.63%) have shown rise and 21 stations (28.37%) have shown fall in water level. 40 stations (54.05%) are showing rise in water level between 0 to 2m, 8 stations (10.83%) between 2 to 4 m and 5 stations (6.75%) more than 4m. Minimum 0.03 m and maximum 18.25 m rise of water level is noticed in Kangra valley and Paonta valley respectively. Out of 21 stations (28.37%) showing fall in water level, in 20 stations (27.02%) fall 0 - 2m and 1 station (1.35%) is 2-4m.

A perusal of map (Plate XV) shows annual water level fall in central part of Paonta valley of Sirmaur district, northern part of Nalagargh valley of Solan district, northern part of Una valley of Una district, north eastern part of Balh valley of Mandi district and north eastern part of Kangra valley of kangra district. Similarly rise in water level is noticed in Kullu valley of Kulu district Balh

valley of Mandi district, southern part of Una valley in Una district and part of Kangra valley of Kangra district.

Table-16: Decadal Fluctuation August (2003-2012) to August 2013

District Name	No. of Wells	Range of Fluctuation (m)				No. of wells/ percentage showing Fluctuation(m)						Total No. of Wells	
		Rise		Fall		Rise			Fall			Rise	Fall
		Min	Max	Min	Max	0 to 2	2 to 4	>4	0 to 2	2 to 4	>4		
Hamirpur	1	0.86	0.86	-	-	1 100.00%	-	-	-	-	-	1	-
Kangra	27	0.03	5.71	0.03	0.90	16 59.26%	5 18.52%	1 3.70%	5 18.52%	-	-	22	5
Kullu	3	0.11	0.11	0.05	0.49	1 33.33%	-	-	2 66.67%	-	-	1	2
Mandi	8	0.23	10.30	0.16	0.72	3 37.50%	-	1 12.50%	4 50.00%	-	-	4	4
Sirmaur	9	0.44	18.25	3.05	3.05	5 55.56%	-	3 33.33%	-	1 11.11%	-	8	1
Solan	10	0.14	3.93	0.04	1.76	3 30.00%	1 10.00%	-	6 60.00%	-	-	4	6
Una	16	0.13	3.81	0.21	1.12	11 68.75%	2 12.50%	-	3 18.75%	-	-	13	3
Total	74	0.03	18.25	0.03	3.05	40 54.05%	8 10.83%	5 6.75%	20 27.02%	1 1.35%	-	53 71.63%	21 28.37%

3.4.3 Decadal average of November (2003-2012) to November 2013

Decadal water level fluctuation has been worked out by comparing water level data of November 2013 with the average water level data of November for 10 years (2003-2012) and is presented in Annexure - IV and frequency distribution in various ranges in Table 17.

A perusal of Table -17 shows that out of 73 stations analyzed, 48 stations (65.75%) have shown rise and 25 stations (34.25%) have shown fall in water level. Rise in 39 stations (53.44%) is between 0-2m, in 5 stations (6.84%) between 2-4m and in 4 stations (5.47%) more than 4m. Out of 25 stations showing fall in water level 24 stations (32.89%) have shown fall between 0 - 2m and in 1 station (1.36%) between 2 - 4 m. A minimum rise in water level of 0.03m is noticed in Kullu valley of Kullu district and the maximum of 12.11m in Paonta valley of Sirmaur district. Similarly the minimum and maximum fall of 0.01 m and 2.64 m was notice in Kangra and Una valleys respectively.

A perusal of map (Plate XVI) reveals water level fall less than 2m.in major part of Kangra valley, north part of Una valley, south eastern part of Balh valley, western and eastern part of Paonta valley, Major part of Nalagargh valley and northern part of Kullu valley. The fall between 2 to 4 m was noticed in northern part of Una valley of Una district. Rise of water level noticed in eastern part of Paonta valley, southern part of Kullu valley, northern part of Nalagargh valley, northern part of Balh valley, southern part of Una valley and part of Kangra and Una valley.

Table-17: Decadal Fluctuation November (2003-12) to November 2013

District Name	No. of Wells	Range of Fluctuation (m)				No. of wells/ percentage showing Fluctuation(m)						Total No. of Wells	
		Rise		Fall		Rise			Fall			Rise	Fall
		Min	Max	Min	Max	0 to 2	2 to 4	>4	0 to2	2 to 4	>4		
Hamirpur	1	0.49	0.49	-	-	1 100.00%	-	-	-	-	-	1	-
Kangra	24	0.03	3.16	0.01	0.71	16 66.67%	2 8.33%	-	6 25.00%	-	-	18	6
Kullu	2	0.03	0.03	0.36	0.36	1 50.00%	-	-	1 50.00%	-	-	1	1
Mandi	8	0.08	9.77	0.12	0.12	6 75.00%	-	1 12.50%	1 12.50%	-	-	7	1
Sirmaur	11	0.22	12.11	0.37	1.49	3 27.27%	2 18.18%	2 18.18%	4 36.36%	-	-	7	4
Solan	10	1.10	4.25	0.34	1.00	3 30.00%	-	1 10.00%	6 60.00%	-	-	4	6
Una	17	0.10	3.30	0.04	2.64	9 52.94%	1 5.88%	-	6 35.29%	1 5.88%	-	10	7
Total	73	0.03	12.11	0.01	2.64	39 53.44%	5 6.84%	4 5.47%	24 32.89%	1 1.36%	-	48 65.75%	25 34.25%

3.4.4 Decadal average of January (2004-2013) to January 2014

Decadal water level fluctuation has been worked out by comparing water level data of January 2014 with the average water level data of January for 10 years (2004-2013) and is presented in Annexure - IV and frequency distribution in various ranges is presented in Table -18.

A perusal of Table 18 shows that out of the 90 stations analyzed, 67 stations (74.44%) have shown rise and 23 stations (25.56%) shown fall in water level. 52 stations (57.77%) are showing rise in water level between 0 - 2m , 10 stations (11.11%) between 2 - 4m and 5 stations (5.55%) more than 4m. Out of 23 stations, 22 stations (24.45%) showing fall in water level between 0 - 2 m and 1 station (1.12%) more than 4m. A minimum rise in water level of 0.02m is noticed in Una valley of Una district and the maximum rise of water level 10.25m, is notice in Paonta valley of Sirmaur district. Similarly the minimum and maximum fall of 0.03 m and 6.80m is noticed in Hamirpur district and Una valley of Una district.

A perusal of map (Plate XVII) reveals fall in water level 0-2m in major part of Kangra valley of Kangra district, Balh valley, western part of Paonta valley, central part of Nalagargh valley and northern part of Una valley. More than 4m water level fall is observed in northern part of Una valley. Rise of water level 0-2m is noticed in major part of Kangra valley, Kullu valley, Balh valley, Paonta valley, Nalgargh valley and Una valley. 2-4m is observed in Kangra valley, Balh valley, Paonta valley, Nalagargh valley and Una valley.. More than 4m is observed in Balh valley and Paonta valley.

Table –18: Decadal Fluctuation January (2004-2013) to January 2014

District Name	No. of Wells	Range of Fluctuation (m)				No. of wells/ percentage showing Fluctuation(m)						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	0.23	0.71	0.03	0.03	3 75.00%	0	0	1 25.00%	0	0	3	1
Kangra	23	0.06	3.26	0.00	1.47	17 73.91%	1 4.35%	0	5 21.74%	0	0	18	5
Kullu	1	0.71	0.71	-	-	1 100.00%	0	0	0	0	0	1	0
Mandi	8	0.15	9.13	1.08	1.08	5 62.50%	1 12.50%	1 12.50%	1 12.50%	0	0	7	1
Sirmaur	13	0.05	10.25	0.07	1.13	6 46.15%	2 15.38%	3 23.08%	2 15.38%	0	0	11	2
Solan	10	0.40	3.61	0.17	1.39	2 20.00%	3 30.00%	0	5 50.000%	0	0	5	5
Una	31	0.02	7.99	0.05	6.80	18 58.06%	3 9.68%	1 3.23%	8 25.81%	0	1 3.23%	22	9
Total	90	0.02	10.25	0.03	6.80	52 57.77%	10 11.11%	5 5.55%	22 24.45%	0	1 1.12%	67 74.44%	23 25.56%

Annexure-I

Depth to water level of May, August, November 2013 and January 2014

Disriect	Sr No	Location	Latitude	Longitude	DWL May-13 (mbgl)	DWL AUG-13 (mbgl)	DWL NOV-13 (mbgl)	DWLJAN -14(mbgl)
Hmirpur	1	Bagnalla	31.78	76.34	6.30	3.76	4.59	5.14
	2	Bijari	31.52	76.53	2.70	1.54	3.17	2.04
	3	Galore	31.61	76.47	2.95	1.79	2.43	2.23
	4	Kangu	31.69	76.42	9.35	4.53	6.53	6.68
Kangra	5	Andaura	32.13	75.69	6.62	2.69	3	2.98
	6	Bandh	32.01	76.23	3.90	0.2	1.28	1.71
	7	Barota	32.03	75.72		2.38	4.14	4.66
	8	Bhalad	32.19	75.99	3.26	0.22	0.82	0.8
	9	Bharmar	32.18	75.95	13.84	4.36	7.2	8.34
	10	Bharoli	31.8	76.33	7.65	3.17	5.9	7.29
	11	Bod	32.29	75.87	3.05	1.08	2.6	3.22
	12	Basa Bazira	32.27	75.87		3.63	7.57	
	13	Bhali				1.11		
	14	Chakban Ambari	32.11	76.41		3.61	3.88	
	15	Channaur	32.15	75.69	7.60	3.41	3.75	3.28
	16	Darkati	32.16	76.99		0.74	1.05	
	17	Dehra Gopipur	31.88	76.22	4.72	1.85	3.13	3.44
	18	Dehrian	31.93	76.28	2.08	0.73	1.19	1.17
	19	Hardogri	31.79	76.3	4.42	2.65	2.79	3.19
	20	Jagir	31.97	75.9	3.20	3	3.4	
	21	Jassur	32.28	75.84		1.74	5.2	
	22	Jwalaji	31.88	76.32	2.42	0.68	1.66	1.73
	23	Kangra	32.1	76.27	13.32	3.22	8.86	11.71
	24	Kathgarh	32.12	75.64	4.18	2.69	3.24	3.34
	25	Kotla	32.24	76.04			0.63	
	26	Manjgram	32.23	76.17	1.96	0.35	1	0.58
	27	Mao	32.27	76.02	4.53	0.59	1.25	0.93
	28	Mohtli	32.22	75.67	13.48	9.28	9	9.87
	29	Nagrota				3.73		
	30	Old Kangra	32.09	76.26		0.5	2.99	
	31	Olherian	32.08	75.65	4.45	1.81	2.37	2.4
	32	Panjpir	32.28	75.79	4.69	1.39	3.75	3.21
	33	Rait	32.19	76.21	9.10	2.61	6.99	8.35
	34	Raja-katalab	32.21	75.92	4.13	0.68	2.6	3
	35	Rakar	31.78	76.24	3.28	0.71	2.22	3.28
	36	Takipur	32.03	76.25	7.58	0.5	2.17	3.69
	37	Pandtehr	32.04	76.64	1.03	0.41		
	38	Paprola	32.05	76.63	12.73	4.25		

Disrict	Sr No	Location	Latitude	Longitude	DWL May-13 (mbgl)	DWL AUG-13 (mbgl)	DWL NOV-13 (mbgl)	DWLJAN -14(mbgl)
	39	Riali	32.02	75.8	3.20	3.1	3.3	
	40	Thali	32.25	75.72		2.3	2.47	
	41	Thirty nine mile				3.91		
Kull	42	Gadauri	31.91	77.13	4.87	5.14	5.13	4.95
	43	Hathithan	31.88	77.14	4.02	3.53	4.3	
	44	Kullu	31.96	77.12	1.62	1.51		
Mandi	45	Bahangrotu	31.61	76.92	6.54	4.67	4.58	5.77
	46	Gagal	31.63	76.96	2.31	1.29	1.38	2.85
	47	GUTKAR	31.66	76.95	8.84	1.97	4.37	5.2
	48	Jarl	31.56	76.9	0.60	0.2	0.5	0.45
	49	Jhiri	31.83	77.17	4.17	3.11	3.87	4.81
	50	Kaned	31.58	76.91	1.79	1.01	0.63	0.71
	51	Lohara	31.59	76.95	3.72	3.02	3.84	3.35
	52	Ratti	31.6	76.9	4.07	4.01	3.83	3.84
Sirmaur	53	Ajiwala	30.47	77.59	5.63	2.92	4.54	4.55
	54	Badripur	30.44	77.62			7.81	10.55
	55	Dhaulakuan	30.45	77.64	7.03	1.71	2.54	4.29
	56	Kala-Amb	30.5	77.22	13.46	12.38	13.09	12.56
	57	Khodawala	30.49	77.73	16.20	8.09	8.33	8.98
	58	Kiyarda	30.48	77.55	9.68	2.22	5.86	8.33
	59	Kolar	30.55	77.43	11.97	1.23	10.54	12.71
	60	Nayagaon	30.49	77.52	10.89	1.23	6.34	10.03
	61	Shambuwal	30.53	77.32	10.48	4.62	7.82	10.29
	62	Shibpur	30.48	77.67	27.70	27.7	26.58	25.76
	63	Trilokpur	30.54	77.21	2.32	0.54	0.93	1.13
	64	Akkawala						11.24
	65	Nariwala						29.62
	66	Barotiwala	30.9	76.84	26.29	25.97	26.94	
	67	Barun	31.15	76.64	27.84	28.18	28.21	28.23
	68	Bhagheri	31.16	76.62	13.78	12.34	11.07	10.74
	69	BHATOLI	31.17	76.61	11.68	9.74	8.78	8.9
	70	Dhabota	31.09	76.63	12.28	11	11.91	12.8
	71	Jagatpur	31.16	76.68	15.68	12.54	12.48	12.56
	72	Khera-chak	31.01	76.72	5.41	3.31	4.19	3.88
	73	Mahadev	31.11	76.68	11.77	11.07	10.41	11.73
	74	Manjhauli	31.03	76.65		2.94	3.88	3.39
	75	Panjahra	31.14	76.67	19.19	19.43	16.88	17.1
	76	Phalahi	31.14	76.61	6.32	5.59	6.04	6.05
Una	77	Amb	31.68	76.12	6.92	2.69		3.31
	78	Bhangana	31.62	76.2		0.59	13.69	1.1
	79	Daulatpur	31.78	76		6.16	0.76	6.45
	80	Dharampur	31.45	76.23		1.72	6.19	1.85

Disriect	Sr No	Location	Latitude	Longitude	DWL May-13 (mbgl)	DWL AUG-13 (mbgl)	DWL NOV-13 (mbgl)	DWLJAN -14(mbgl)
	81	Gagret	31.66	76.06		7.19	1.81	7.48
	82	Ghaneri	31.7	76		5.79	7.14	7.21
	83	Ambota	31.67	76.04	29.45	27.03	2.37	27.93
	84	Babehr	31.79	75.82	5.44	1.23	27.42	2.3
	85	Bawal	31.55	76.31	1.64	0.94	1.53	0.72
	86	Bhadsali	31.48	76.17	16.48	15.01	1.09	13.82
	87	Guglahar	31.56	76.13	4.78	2.18	3.36	2.99
	88	Ishapur	31.5	76.18	4.51	1.24	2.56	2.43
	89	Jankaur	31.43	76.27	5.01	1.99	2.08	3.89
	90	Jawar	31.74	76.2		0.63	0.94	1.39
	91	Jhalera	31.49	76.24	5.98	3.51	4.24	4.16
	92	Khanpur	31.38	76.31	4.13	2.88	3.42	3.68
	93	Khwaja	31.5	76.23	3.06	0.85	1.61	1.34
	94	Kuluwal	31.48	76.21	5.28	2.62	2.84	2.99
	95	Kuthera Jaswala	31.6	76.12	6.64	4.84	5.36	6.25
	96	Lalehri	31.37	76.25	12.93	8.64	9.74	9.93
	97	Loharli	31.59	76.13	4.48	1.38	9.74	
	98	Mawa Kalan	31.75	76	19.88	17.99	18.82	19.24
	99	Mubarikpur	31.7	76.07	6.64	4.02	4.23	4.47
	100	Nangran	31.4	76.29	5.55	3.62	4.51	4.99
	101	Panjawar	31.55	76.14	13.21	11.98	10.99	11.44
	102	Panoh	31.54	76.2	3.02	0.81	1.82	1.82
	103	Raipur Marwadi	31.8	75.98	16.64	12.29	12.54	13.41
	104	Rajli Panjal	31.54	76.4	6.3		0.62	2.07
	105	Santokhgarh	31.36	76.31		3.22	3.89	4.83
	106	Singhnei	31.69	76.03	21.43	21.09	19.83	20.28
	107	Tahliwala	31.34	76.27	2.97	0.66	1.06	
	108	Una	31.47	76.26	3.88	0.91	2.17	2.75

Annexure-II

**Seasonal Fluctuation of May-2013-August 2013, May 2013 - November 2013 and
May 2013-January-2014**

District	Sr No.	Location	SF May13- Aug13 (in m)	SF May13- Nov13 (in m)	SF May 13 - JAN 14 (in m)	
HAMIRPUR	1	Bagnalla	2.54	1.71	1.16	
	2	Bijari	1.16	-0.47	0.66	
	3	Galore	1.16	0.52	0.72	
	4	Kangu	4.82	2.82	2.67	
KANGRA	5	Andaura	3.93	3.62	3.64	
	6	Bandh	3.7	2.62	2.19	
	7	Barota				
	8	Bhalad	3.04	2.44	2.46	
	9	Bharmar	9.48	6.64	5.5	
	10	Bharoli	4.48	1.75	0.36	
	11	Bod	1.97	0.45	-0.17	
	12	Basa Bazira				
	13	Chakban Ambari				
	14	Channaur	4.19	3.85	4.32	
	15	Darkati				
	16	Dehra Gopipur	2.87	1.59	1.28	
	17	Dehrian	1.35	0.89	0.91	
	18	Hardogri	1.77	1.63	1.23	
	19	Jagir	0.2	-0.2		
	20	Jassur				
	21	Jwalaji	1.74	0.76	0.69	
	22	Kangra	10.1	4.46	1.61	
	23	Kathgarh	1.49	0.94	0.84	
	24	Kotla				
	25	Manjgram	1.61	0.96	1.38	
	26	Mao	3.94	3.28	3.6	
	27	Mohtli	4.1	4.38	3.51	
	28	Old Kangra				
	29	Olherian	2.64	2.08	2.05	
	30	Panjpir	3.3	0.94	1.48	
	31	Rait	6.49	2.11	0.75	
	32	Raja-ka-talab	3.45	1.53	1.13	
	33	Rakar	2.57	1.06		
	34	Takipur	7.08	5.41	3.89	
	35	Pandtehr	0.62			
	36	Paprola	8.48			
	37	Riali	0.1	-0.1		
	38	Thali				
	KULLU	39	Gadauri	-0.27	-0.26	-0.08
		40	Hathithan	0.49	-0.28	
		41	Kullu	0.11		
	MANDI	42	Bahangrotu	1.87	1.96	0.77
43		Gagal	1.02	0.93	-0.54	

District	Sr No.	Location	SF May13-Aug13 (in m)	SF May13-Nov13 (in m)	SF May 13 - JAN 14 (in m)
	44	GUTKAR	6.87	4.47	3.64
	45	Jarl	0.4	0.1	0.15
	46	Jhiri	1.06	0.3	-0.64
	47	Kaned	0.78	1.16	1.08
	48	Lohara	0.7	-0.12	0.37
	49	Ratti	0.06	0.24	0.23
SIRMOUR	50	Ajiwala	2.71	1.09	1.08
	51	Badripur			
	52	Dhaulakuan	5.32	4.49	2.74
	53	Kala-Amb	1.08	0.37	0.9
	54	Khodawala	8.11	7.87	7.22
	55	Kiyarda	7.46	3.82	1.35
	56	Kolar		1.43	-0.74
	57	Nayagaon	9.66	4.55	0.86
	58	Shambuwala	5.86	2.66	0.19
	59	Shibpur		1.12	1.94
	60	Trilokpur	1.78	1.39	1.19
	61	Akkawala			0.39
	62	Nariwala			
SOLAN	63	Baddi			
	64	Barotiwala	0.32	-0.65	
	65	Barun	-0.34	-0.37	-0.39
	66	Bhagheri	1.44	2.71	3.04
	67	Bhatoli	1.94	2.9	2.78
	68	Dhabota	1.28	0.37	-0.52
	69	Jagatpur	3.14	3.2	3.12
	70	Khera-chak	2.1	1.22	1.53
	71	Mahadev	0.7	1.36	0.04
	72	Manjhauli			
	73	Panjahra	-0.24	2.31	2.09
	74	Phalahi	0.73	0.28	0.27
Una	75	Amb	4.23	4.55	3.61
	76	Bhangana	1.91	1.74	1.4
	77	Daulatpur	2.23	2.2	1.94
	78	Dharampur	2.49	2.4	2.36
	79	Gagret	1.89	1.94	1.6
	80	Ghaneri	2.05	0.08	0.63
	81	Ambota	2.42	2.03	1.52
	82	Babehr	4.21	3.91	3.14
	83	Bawal	0.7	0.55	0.92
	84	Bhadsali	1.47	2.79	2.66
	85	Guglahar	2.6	2.22	1.79
	86	Ishapur	3.27	2.43	2.08
	87	Jankaur	3.02	1.65	1.12
	88	Jawar			
	89	Jhalera	2.47	1.74	1.82

District	Sr No.	Location	SF May13-Aug13 (in m)	SF May13-Nov13 (in m)	SF May 13 - JAN 14 (in m)
	90	Khanpur	1.25	0.71	0.45
	91	Khwaja	2.21	1.45	1.72
	92	Kuluwal	2.66	2.44	2.29
	93	Kuthera Jaswala	1.8	1.28	0.39
	94	Lalehri	4.29	3.19	3
	95	Loharli	3.1	-5.26	
	96	Mawa Kalan	1.89	1.06	0.64
	97	Mubarikpur	2.62	2.41	2.17
	98	Nangran	1.93	1.04	0.56
	99	Panjawar	1.23	2.22	1.77
	100	Panoh	2.21	1.2	1.2
	101	Raipur Marwadi	4.35	4.1	3.23
	102	Rajli Panjal		5.68	4.23
	103	Santokhgarh			
	104	Singhnei	0.34	1.6	1.15
	105	Tahliwala 1	2.31	1.91	
	106	Una	2.97	1.71	1.13
	107	Badshara			

Annexure-III

**Annual Fluctuation of May 2012- May 2013, August 2012- August 2013
November 2012- November 2013 and January 2013- January 2014**

District	Sl No.	Location	AF May12-13 (in m)	AF Aug 12-13 (in m)	AF Nov-12-13 (in m)	AF JAN-13-14 (in m)
HAMIRPUR	1	Bagnalla	0.2	0.25	0.46	0.11
	2	Bijari	0			-0.03
	3	Galore	0			0.23
	4	Kangu	0			0.5
KANGRA	5	Andaura	-0.44	3.3	3.13	3.3
	6	Bandh	0.08	0.41	0.19	1.91
	7	Barota	0	2.55		1.41
	8	Bhalad	0.07	0.16	0.8	1.08
	9	Bharmar	0.58		0.49	-0.9
	10	Bharoli	-0.3	0.93	-0.6	-1.14
	11	Bod	0.07	-0.53	0.14	-0.7
	12	Basa Bazira	0			
	13	Chakban Ambari	0			
	14	Channaur	-2.19	1.37	2.01	2.83
	15	Darkati	0			
	16	Dehra Gopipur	0.54	1.79	0.23	0.3
	17	Dehrian	0.08	0.25	0.42	0.55
	18	Hardogri	0.17	1.02	0.34	0.38
	19	Jagir	0			
	20	Jassur	0	-0.42	0.76	
	21	Jwalaji	-0.75	-0.35	-0.93	-0.79
	22	Kangra	-0.13	-0.73	-2.34	-1.88
	23	Kathgarh	-0.19	0.3	-0.08	0.15
	24	Kotla	0			
	25	Manjgram	-0.4	0.08	0	0.72
	26	Mao	0.25	-0.22	-0.16	1.36
	27	Mohtli	-2.28	0.02	2.25	2.34
	28	Old Kangra	0			
	29	Olherian	-0.57	1.81		1.03
	30	Panjpir	0	0.15	-0.25	0.75
	31	Rait	0.8		-0.02	-0.01
	32	Raja-ka-talab	0.13	0.14	0.29	0.86
	33	Rakar	6.14	0	0.42	0.22
	34	Takipur	-1.3	-0.08	0.92	1.12
	35	Pandtehr	1.24	-0.08		
	36	Paprola	0			
	37	Riali	0			
	38	Thali	0			

District	Sl No.	Location	AF May12-13 (in m)	AF Aug 12-13 (in m)	AF Nov-12-13 (in m)	AF JAN-13-14 (in m)
KULLU	39	Gadauri	0.64	-0.08	0.52	3.23
	40	Hathithan	0.09	-0.15	0.03	
	41	Kullu	-0.13	-0.38		
MANDI	42	Bahangrotu	1.06	-0.67	1.25	0.23
	43	Gagal	-0.5	-0.15	0.12	-0.67
	44	GUTKAR	1.43	0.35	0.97	2.17
	45	Jarl	0.26	0.13	-0.13	0.01
	46	Jhiri	0.03	-0.34	-0.35	-1.36
	47	Kaned	1.81	-0.66	0.42	0.53
	48	Lohara	0.17	0.02	-0.34	0.07
	49	Ratti	0.32	-1.42	-0.14	0.14
SIRMOUR	50	Ajiwala	0.59	0.81	-0.13	0.65
	51	Badripur	0		0.39	-0.25
	52	Dhaulakuan	0.98	1.35	1.46	1.42
	53	Kala-Amb	-0.22	-3.33	0.35	1.28
	54	Khodawala	0.48	1.89	6.1	5.27
	55	Kiyarda	1.19	-0.39	-1.38	0.39
	56	Kolar	17.98			-1.39
	57	Nayagaon	-0.19	1.93	1.85	1.43
	58	Shambuwala	0.05	2.12	-0.08	-1.43
	59	Shibpur	0.32		-4.71	-0.74
	60	Trilokpur	2.53	1.63	1.23	1.06
	61	Akkawala	0			0.12
	62	Nariwala	0			
SOLAN	63	Baddi	0			
	64	Barotiwala	0			
	65	Barun	0	-0.1	-0.67	-0.79
	66	Bhagheri	0.6	0.3	-0.15	2.09
	67	Bhatoli	-0.51			0.99
	68	Dhabota	-0.09	1.12	-0.24	-1.35
	69	Jagatpur	3.91	-0.76	0.14	5.98
	70	Khera-chak	-0.4	-0.42	-0.74	0.17
	71	Mahadev	0.43	-2.18	0.81	-0.14
	72	Manjhauli	0	-2.62	-0.86	0.59
	73	Panjahra	0.43	-2.72	-0.08	1.72
	74	Phalahi	0.12	0.45	-0.06	-0.45
Una	75	Amb	-0.73	3.3		1.69
	76	Bhangana	-0.26	0.65		-0.06
	77	Daulatpur	-0.67	1.3	-0.09	0.16
	78	Dharampur	-0.98		-0.18	1.46
	79	Gagret	-0.9	1.4	1.24	0.39
	80	Ghaneri	-0.01	0.72	-0.1	-0.14
	81	Ambota	0		1.62	-6.8

District	Sl No.	Location	AF May12-13 (in m)	AF Aug 12-13 (in m)	AF Nov-12-13 (in m)	AF JAN-13-14 (in m)
	82	Babehr	0			1.45
	83	Bawal	0			1.22
	84	Bhadsali	0			3.83
	85	Guglahar	-0.27	1.09		1.15
	86	Ishapur	-1.25	2.24	0.13	0.77
	87	Jankaur	0		0.69	-1.79
	88	Jawar	0	0.24	-0.03	-0.08
	89	Jhalera	-0.39	1.47	0.24	0.88
	90	Khanpur	0			0.41
	91	Khwaja	-0.79	-0.16	-0.17	0.12
	92	Kuluwal	0.03	1.41	0.59	0.5
	93	Kuthera Jaswala	0.12	2.2	1.7	0.27
	94	Lalehri	-0.84	2.37	0.97	1.3
	95	Loharli	0			
	96	Mawa Kalan	0			-0.66
	97	Mubarikpur	0.15	1.68	-1.22	-0.75
	98	Nangran	0			0.28
	99	Panjawar	0			2.54
	100	Panoh	-0.15	0.13	0.09	0.2
	101	Raipur Marwadi	0			1.66
	102	Rajli Panjal	0			1.99
	103	Santokhgarh	0			0.13
	104	Singhnei	0			1.18
	105	Tahliwala 1	0			
	106	Una	0	2.16	0.62	0.27
	107	Badshara				

Annexure-IV

Decadal mean Fluctuation May (2003-2012 with 2013), August (2003-2012 with 2013)
November (2003-2012 with 2013) January 2004-2013 with 2014)

District	Sl No.	Location	DF May(2003-12 mean) - May 13 (in m)	DF Aug (2003-12 Mean)-Aug 2013(in m)	DF Nov (2003-12 mean)-Nov 2013 (in m)	DF JAN (2004-13 mean) - JAN 2014 (in m)
HAMIRPUR	1	Bagnalla	-0.26	0.86	0.49	0.71
	2	Bijari				-0.03
	3	Galore				0.23
	4	Kangu				0.5
KANGRA	5	Andaura	1.78	0.55	1.14	1.38
	6	Bandh	1.01	0.36	0.22	0.44
	7	Barota		0.54	-0.29	0.69
	8	Bhalad	-0.58	0.66	0.64	0.95
	9	Bharmar	0.17	5.71	3.16	3.26
	10	Bharoli	-1.89	2.77	-0.01	-1.47
	11	Bod	-0.45	-0.03	0.03	-0.66
	12	Basa Bazira				
	13	Chakban Ambari				
	14	Channaur	4.17	-0.9	-0.58	0
	15	Darkati				
	16	Dehra Gopipur	-0.31	1.86	1.14	0.99
	17	Dehrian	-0.52	0.49	0.7	0.83
	18	Hardogri	-0.40	1.17	0.89	0.57
	19	Jagir				
	20	Jassur		1.25	0.89	
	21	Jwalaji	0.91	-0.22	-0.71	-0.59
	22	Kangra	0.72	2.87	-0.68	-1.2
	23	Kathgarh	0.31	-0.09	0.03	0.11
	24	Kotla				
	25	Manjgram	0.38	0.03	0.06	0.79
	26	Mao	-0.89	0.25	0.54	1.95
	27	Mohtli	0.96	1.69	2.31	1.62
	28	Old Kangra				
	29	Olherian	0.84	1.03	0.34	0.49
	30	Panjpir	0.60	0.54	-0.48	0.5
	31	Rait	-0.29	2.24	0.73	0.37
	32	Raja-ka-talab	0.25	0.56	0.3	0.52
	33	Rakar	-2.80	0.72	0.78	0.06
	34	Takipur	1.25	0.28	0.4	0.74
	35	Pandtehr	0.20	-0.06		
	36	Paprola	-0.53	2.96		
	37	Riali				
	38	Thali				

District	Sl No.	Location	DF May(2003-12 mean) - May 13 (in m)	DF Aug (2003-12 Mean)-Aug 2013(in m)	DF Nov (2003-12 mean)-Nov 2013 (in m)	DF JAN (2004-13 mean) - JAN 2014 (in m)
KULLU	39	Gadauri	0.20	-0.49	-0.36	0.71
	40	Hathithan	0.19	0.11	0.03	
	41	Kullu	-0.09	-0.05		
MANDI	42	Bahangrotu	-0.98	-0.24	1.14	0.85
	43	Gagal	0.43	-0.16	0.08	-1.08
	44	GUTKAR	-0.77	1.72	1.5	2.38
	45	Jarl	-0.10	0.23	0.19	0.15
	46	Jhiri	-9.94	10.3	9.77	9.13
	47	Kaned	-0.23	-0.36	0.84	1.34
	48	Lohara	-0.57	0.59	-0.12	0.43
	49	Ratti	-0.04	-0.72	0.11	0.16
	SIRMOUR	50	Ajiwala	-0.34	0.53	-0.53
51		Badripur			0.78	1.02
52		Dhaulakuan	-1.79	1.93	1.59	1.71
53		Kala-Amb	0.36	-3.05	-1.49	-0.07
54		Khodawala	0.28	4.5	5.24	6.01
55		Kiyarda	-0.45	0.44	-1.45	0.05
56		Kolar	-17.41			10.25
57		Nayagaon	-1.89	4.65	3.06	2.3
58		Shambuwala	0.36	1.71	0.22	-1.13
59		Shibpur	0.69		-0.37	2.37
60		Trilokpur	-0.25	0.58	2.09	1.37
61		Akkawala				0.12
62		Nariwala				7.67
SOLAN	63	Baddi				
	64	Barotiwala				
	65	Barun	-0.62	-0.32	-0.63	-0.27
	66	Bhagheri	-2.43	1.96	1.93	3.61
	67	Bhatoli	-0.44	1.73	1.95	2.35
	68	Dhabota	0.31	-0.47	-0.99	-1.39
	69	Jagatpur	-2.09	-1.14	1.1	2.14
	70	Khera-chak	1.21	-0.04	-0.71	-0.2
	71	Mahadev	0.79	-1.76	-1	-0.97
	72	Manjhaul		-0.87	-0.77	0.4
	73	Panjahra	-3.57	3.93	4.25	0.97
74	Phalahi	0.19	0.14	-0.34	-0.17	
Una	75	Amb	-0.67	3.81	3.3	3.03
	76	Bhangana	0.26	0.65	-0.09	-0.05
	77	Daulatpur	0.82	0.13	-0.43	-0.36
	78	Dharampur	0.98		1.24	0.89
	79	Gagret	2.45	-0.99	-0.4	-0.69

District	Sl No.	Location	DF May(2003-12 mean) - May 13 (in m)	DF Aug (2003-12 Mean)-Aug 2013(in m)	DF Nov (2003-12 mean)-Nov 2013 (in m)	DF JAN (2004-13 mean) - JAN 2014 (in m)
	80	Ghaneri	0.74	-1.12	-2.64	-1.32
	81	Ambota				-6.8
	82	Babehr				1.45
	83	Bawal				1.22
	84	Bhadsali				3.83
	85	Guglahar	1.12	0.4	0.23	0.4
	86	Ishapur	0.84	1.45	0.52	0.34
	87	Jankaur				-1.79
	88	Jawar		0.15	-0.14	-0.17
	89	Jhalera	0.66	1.21	0.23	0.93
	90	Khanpur				0.41
	91	Khwaja	0.65	-0.21	-0.36	0.33
	92	Kuluwal	1.01	0.71	1.04	0.69
	93	Kuthera Jaswala	-0.19	1.04	0.78	0.28
	94	Lalehri	0.62	2.06	0.96	1.32
	95	Loharli				
	96	Mawa Kalan				-0.66
	97	Mubarikpur	1.17	0.61	-0.04	0.02
	98	Nangran				0.28
	99	Panjawar				2.54
	100	Panoh	0.05	0.32	0.37	0.48
	101	Raipur Marwadi				1.66
	102	Rajli Panjal				1.99
	103	Santokhgarh				0.13
	104	Singhnei				1.18
	105	Tahliwala 1				
	106	Una	0.92	0.62	0.1	-0.09
	107	Badshara				7.99



HIMACHAL PRADESH NHS LOCATIONS































