



स्वच्छ सुरक्षित जल - सुन्दर खुशहाल कल  
CONSERVE WATER - SAVE LIFE



**Government of India**  
*Ministry of Water Resources*  
**CENTRAL GROUND WATER BOARD**

## **GROUND WATER INFORMATION BOOKLET SOLAN DISTRICT, HIMACHAL PRADESH**



**NORTHERN HIMALAYAN REGION  
DHARMSALA  
2007**



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**Our Vision**  
Water security through sound groundwater management

# **Ground Water Information Booklet**

## **Solan District, Himachal Pradesh**

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## SOLAN DISTRICT AT A GLANCE

<i>Sl. No</i>	<i>ITEMS</i>	<i>Statistics</i>
1.	<b>GENERAL INFORMATION</b>	
	i) Geographical area (sq km)	1936
	ii) Administrative Divisions (2001)	
	• Number of Tehsil & sub-tehsils	5 & 2
	• Number of CD Blocks	5
	• Number of Panchayats	211
	• Number of Villages	2536
	iii) Population (2001 Census)	500557
	• Population Density (pers/sq km)	258
	• Rural & Urban Population (%)	82 & 18
	• SC & ST Population (in percent)	28 & 0.70
	• Sex Ratio (F:M)	852: 1000
	iv) Average Annual Rainfall (mm)	851
2.	<b>GEOMORPHOLOGY</b>	
	Major Physiographic units	<ul style="list-style-type: none"> <li>• High structural hills &amp; mountains with intermountain valleys (elevation 1000-3000)</li> <li>• Denuded hills &amp; upland (elevation 650–1041 m asl)</li> <li>• Valley/ alluvial plain/ terraces (elevation 360-550 m asl)</li> </ul>
	Major Drainages	
	• Satjuj basin (65%)	Gambhar River, Sirsa nadi
	• Yamuna basin	Giri, Assan river
3.	<b>LAND USE (sq km)</b>	
	• Forest area	203
	• Cultivable area	478
	• Net area sown	389
4.	<b>MAJOR SOIL TYPES</b>	<ul style="list-style-type: none"> <li>• Mountainous Soil</li> <li>• Sub- Mountainous Soil</li> </ul>
5.	<b>AREA UNDER PRINCIPAL CROPS (2005-2006) in sq km</b>	
	• Rice	47.42
	• Wheat	266
	• Maize	228
	• Barley	16.82
	• Pulses	29.19



	Presence of Chemical constituents more than permissible limits (eg. EC, F, As, Fe)	Nil
	Quality of Ground Water (EC Range in $\mu\text{S}/\text{cm}$ )	Good (412 – 915)
12.	<b>DYNAMIC GROUND WATER RESOURCES (2004) (Nalagarh valley) in MCM</b>	
	<ul style="list-style-type: none"> <li>• Annual Replenishable Ground Water Resources</li> <li>• Net Annual Ground Water Draft</li> <li>• Projected Demand for Domestic and industrial Uses up to 2025</li> <li>• Stage of Ground Water Development</li> </ul>	77.07 10.25 6.84 15%
13.	<b>AWARENESS AND TRAINING ACTIVITY</b>	
	<ul style="list-style-type: none"> <li>• Mass Awareness Programmes</li> <li>• Date</li> <li>• Place</li> <li>• No of participants</li> </ul>	1 11-1-2007 Sukedi Khalsa, Nalagarh 500
14.	<b>EFFORTS OF ARTIFICIAL RECHARGE &amp; RAINWATER HARVESTING</b>	
	Projects completed by CGWB	Nil
	Technical guidance to NGOs for roof top rain water harvesting structures.	15
15.	<b>GROUND WATER CONTROL AND REGULATION</b>	
	<ul style="list-style-type: none"> <li>• Number of OE &amp; Critical Blocks</li> <li>• No of blocks notified</li> </ul>	Nil Nil
16.	<b>MAJOR GROUND WATER PROBLEMS AND ISSUES</b>	
	<ul style="list-style-type: none"> <li>• Hilly/Mountainous area</li> <li>• Valley area (Nalagarh)</li> </ul>	Forms runoff zone; Mostly hard rocks, low yield in favorable location; Springs & natural sources vulnerable to pollution due to unchecked sewerage dumps.  Declining trend discernible in recent years; Vulnerable to depletion and pollution due to rapid urbanization and industrialization. Needs immediate attention & monitoring.

# **DISTRICT GROUND WATER BOOKLET**

## **SOLAN DISTRICT, HIMACHAL PRADESH**

### **1.0 INTRODUCTION**

Solan is one of the south-western districts of Himachal Pradesh having geographical area of 1,936 sq km. The district lies between North latitude 30°44'53" to 31°22'01" and East longitude 76°36'10" to 77°15'14" and is covered by Survey of India degree-sheets 53A, 53B, 53E and 53F. The district is bounded by Bilaspur district in north-west & Mandi district in the north, Shimla & Sirmaur district in east & south-east respectively. District has inter-state boundary in the south and west with State of Haryana and Punjab respectively. The district is well connected by rail and road network. The nearest airports are at Shimla (Jubbal Hatti) and Chandigarh. Administratively, Solan town is the head quarter of the district. The district comprises of 4 sub-divisions viz., Arki, Kandaghat, Nalagarh and Solan and has 5 Tehsils (Arki, Kandaghat, Kasauli, Nalagarh and Solan) & 2 sub-tehsils (Krishangarh and Ramshahar). For development purpose district has been divided in to five community development blocks viz., Dharampur, Kandaghat, Kunihar, Nalagarh and Solan, 211gram panchayats, 2388 inhabited villages and 148 Un-inhabited villages. Important towns in the district are Solan, Nalagarh, Kasauli, Subathu, Dagshai, Arki, Kandaghat, Parwanoo etc.

The population of the district is 5,00,557 (2001 census), of which 2,70,291 (54 %) males, 2,30,266 (46 %) female, sex ratio (F:M) is 852:1000 and density of population is 258 per sq km. The rural & urban population is 4,09,362 (81.78 %) & 91,195 (18.22 %) respectively. The schedule caste and schedule tribes population in the district is 1,40,642 (28.09 %) & 3,542 (0.71 %) respectively.

The local inhabitants mainly depend on agriculture for their subsistence and adopt several traditional practices conducive for farming in sloping terrains. Large and small scale industrial development however has taken place randomly all over the district, especially rapid industrial development is taking place in areas adjoining Punjab plains viz., at Nalagarh valley with

in the Nagar Panchayat of Baddi and Gram Panchayats of Barotiwala, Gulurawala, Sandholi, Thana, Bhud areas.



Central Ground Water Board (CGWB) has carried out extensive hydrogeological studies and ground water exploration in the district. Hydrogeological studies and exploration commenced in sixties, and under exploratory drilling programme 15 exploratory wells ranging in depth from 65 to 300 m have been drilled. In all 12 EW have been drilled in valley area and three in hard rock hilly terrain. Further, CGWB under its national network maintains 12 stations for ground water regime monitoring where water level and ground water quality is monitored on regular basis.

## **2.0 CLIMATE & RAINFALL**

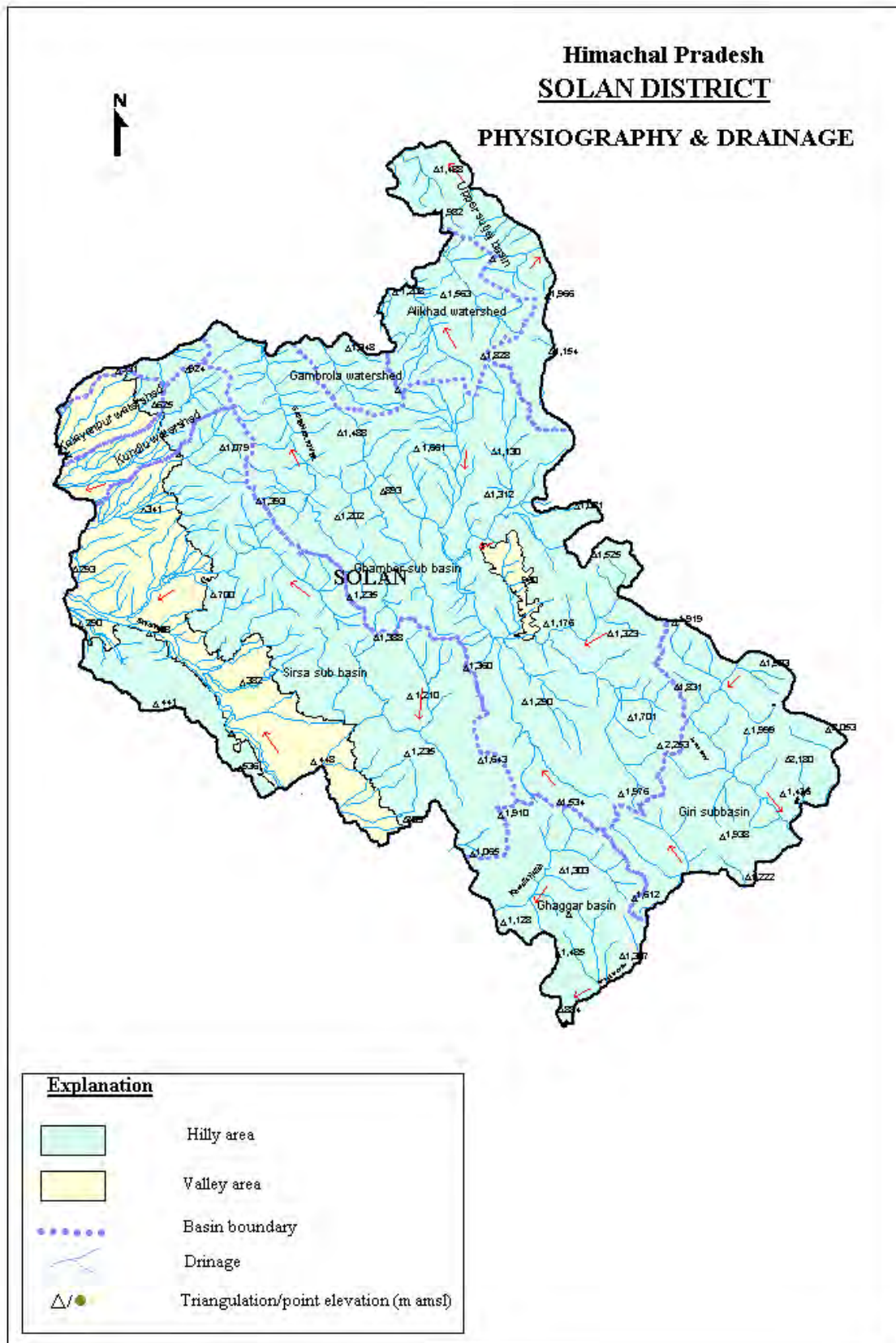
The climate of the district is sub-tropical in the valley and tends to be temperate in the hilltops. There are four major seasons. The winter season commences from Nov to Feb & ends in march; summer season extends from March to June followed by the monsoon period extending from July to September. Maximum precipitation occurs during the months from July to September. Average annual rainfall in the district is about 1450 mm with average of 64 rainy days. In the winter season precipitation as snowfall also occurs in the higher reaches upto 1000 m elevation and as rainfall in low hills and valleys of the district. Mean maximum and minimum temperature ranges between 34°C and 4°C.

## **3.0 GEOMORPHOLOGY & SOILS**

Solan district presents an intricate mosaic of high mountain ranges, hills and valleys with altitude ranging from 300 to 3000 m above MSL. The altitude of the hill ranges is higher in northern parts whereas south-western part of the district is represented by low denuded hill ranges of Siwalik. In the areas underlain by high hill ranges of Himalayas, the valleys are narrow and deep with steep slopes trending in NW-SE direction. The terrain is moderately to highly dissected with steep slopes.

Solan district is drained by streams/rivers forming part of the drainage basins of the Sutluj, the Yamuna and the Ghaggar rivers. However, major part of the district is drained by tributaries of Sutluj river viz., Ghambar river and Sirsa nadi. Ghambar River flows almost from the central part of

the district towards north-east to join Sutluj river in the Gobind sagar lake. Another important-tributary of Sutluj river is the Sirsa Nadi flowing



towards north-west in the Nalagarh valley. The Giri River and its tributary Assan, flows towards south in the eastern part over a small area and are part of Yamuna river basin. Ghaggar river flows towards south-west and marks the south-eastern boundary of the district. Most of the rivers/streams/*khads* maintain base flow for major part of the year. In hilly terrain the drainage density is high and fine but it become coarse in foothill, kandi areas and valleys.

Soil is generally sandy loam in valley areas of the district and in rest of the hilly and mountainous areas soil is skeletal, soil depth is generally shallow except in areas having good vegetative cover. It is generally dry, shallow and deficient in organic matter. Landslides are the common features in mountainous terrain. Soils are rich in nutrients and thus are fertile

## 4.0 GROUND WATER SCENARIO

### 4.1 Hydrogeology

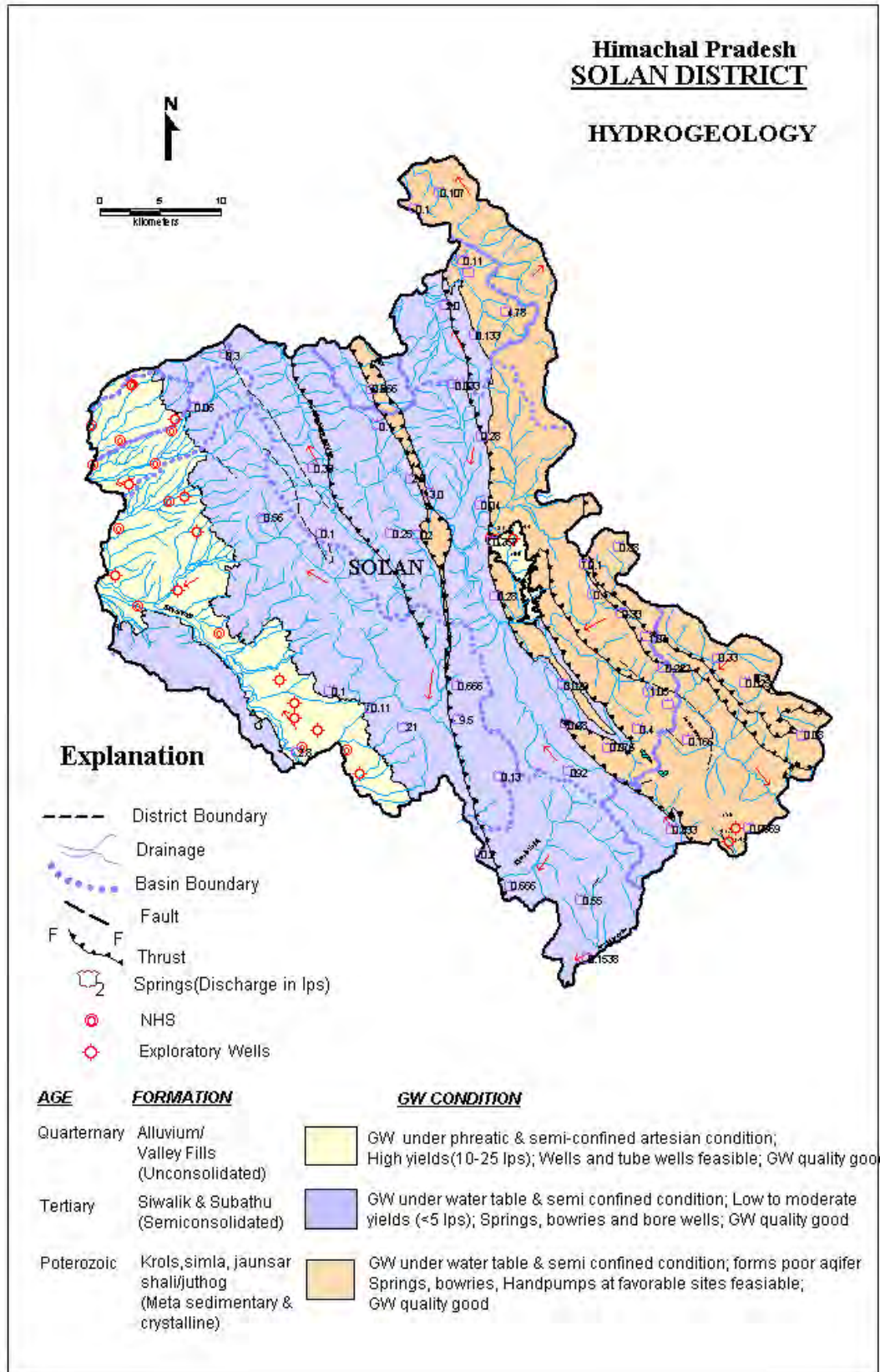
Geologically, the rock formations occupying the district range in age from pre-Cambrian to Quaternary period. The generalized geological succession in the district is given below

<u>Era</u>	<u>Period</u>	<u>Formation</u>	<u>Lithology</u>
Quaternary	Recent to Pleistocene	Alluvium /valley fills/ Older alluvium	Sand with pebble and clay, medium to coarse grained sand with pebble of sandstone and lenses of clay
Tertiary	Pliocene – M-Miocene	Siwalik Group	Sand stone, conglomerate, clay, gravel beds, shale, mudstone
	L-Miocene - Oligocene	Subathu	Sand stone, shale., nodular clay, L.St.
Proterozoic	Upper-III	Krols	Sandstone, red & Carbo.shale., slate, greywacke, , dolomitic limestone.
	Lower-III	Simla / Jaunsar	Siltstone, greywacke, sandstone, quartzite, conglomerate, Shale, slate, phyllite, dolomite and meta-volcanics
	Proterozoic-II	Shali/ Sundernagar	Cherty dolomite, quartzite, limestone, shale, slate, phylitised/ sporadic shale, meta-volcanics etc.,

Un-differentiated

Juthog Group

Shale, phyllite, schist, staurolite quartzite, dolomite, Limestone, and amphibolite



Hydro-geologically, the unconsolidated valley fill or alluvial formation occurring in the valley area; semi-consolidated formations belonging to Siwalik Group and older consolidated hard rocks form aquifer in the district. Intergarnular pore spaces in the sedimentary formations and secondary fissured porosity in hard rocks, topographical set up coupled with precipitation in the form of rain and snow, mainly govern occurrence and movement of ground water. Porous alluvial formation occurring in the valley area forms the most prolific aquifer system where as the sedimentary semi-consolidated formations and hard rocks form aquifer of low yield prospect.

Major parts of the district are hilly & mountainous with highly dissected and undulating terrain. These areas are underlain by semi-consolidated and consolidated hard rocks of Tertiary and Proterozoics period. Ground water potential in such areas is very low due to its hydro-geomorphic set up. Springs are the main ground water structures that provide water for domestic and irrigation in major rural and urban centers.

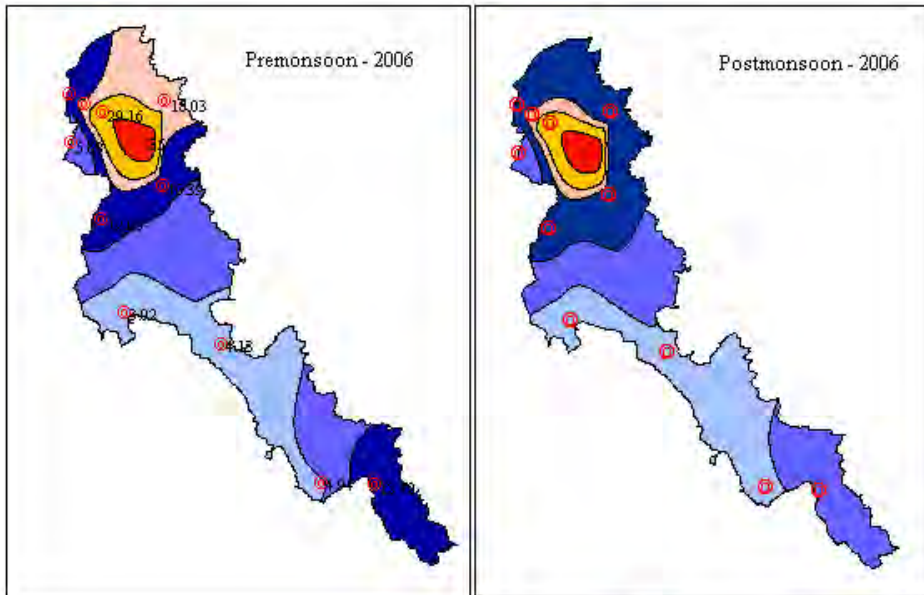
Springs in the district are mainly gravity, contact or fracture type and springs located along major thrust/faults or structurally weak planes are high yielding. The springs, locally called *Chasma*, discharges varies from seepages to as high as nine litres per second. *Bowries*, a type dug well, are another structure constructed in the hill slopes to tap the seepages. Such *Bowries* are very common and observed all over the district. Recently, state department have drilled shallow bore wells fitted with hand-pumps to provide domestic water. The hand pumps have depth up to average 50-60m depth have low discharges up to 1 lps.

In valley area of Nalagarh, the ground water occurs in porous unconsolidated alluvial formation (valley fills) comprising, sand, silt, gravel, cobbles/pebbles etc. Ground water occurs both under phreatic & confined conditions. Wells and tube wells are the main ground water abstraction structures. Ground water is being developed in the area by medium to deep tube wells, dug wells, dug cum bored wells. Depth of open dug wells and dug cum bored well in area ranges from 4.00 to 60.00 m bgl wherein depth to water level varies from near ground surface to more then 35 m bgl. Yield of shallow aquifer is moderate with well discharges up to 10 lps.



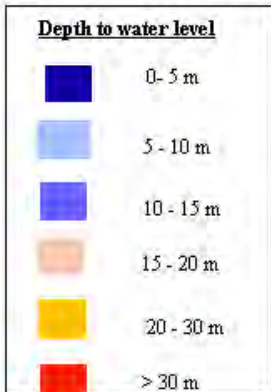
**Himachal Pradesh  
 NALAGARH VALLEY (SOLAN DISTRICT)**

**Depth to water level**

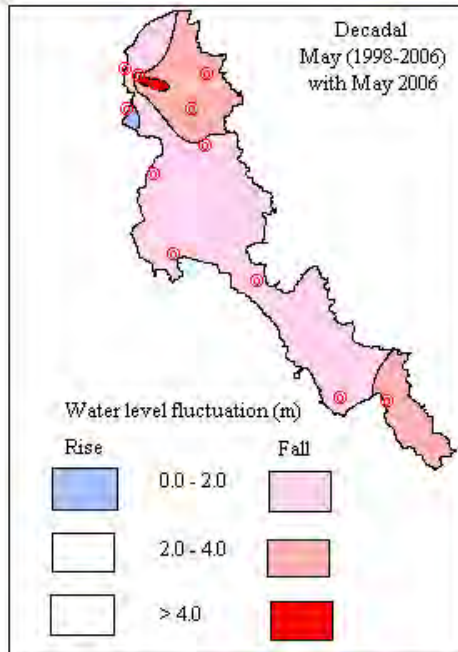


**EXPLANATION**

**Depth to water level**



NHS with DTW (mbgl)



Deeper semi-confined aquifers are being developed by tube wells ranging in depth from 65 to 120 m tapping 25-35 m granular zones. The well discharges vary from about 10 to 30 lps. CGWB has drilled/constructed 12 exploratory wells in the valley area in the depth range of 65.00 to 300.00 m bgl. Static water level of the tubewells ranges from 2.2 to 43.20 mbgl and discharge ranged from 394 to 1968 lpm for draw-down of 2 to 24 m.

In Nalagarh valley area, there are 12-hydrograph network stations where depth to water level is monitored four times a year and ground water quality once during pre-monsoon period. Depth to water table shows wide variation. During pre-monsoon period (May 2006) it ranged between 3.02 & 38.2 m bgl, while during the post-monsoon period (November 2006) depth to water level ranged from 3.3 to 36.86 m bgl. Deeper water levels are observed mainly in northwestern part and along the foothills. In major parts of the valley the depth to water level are less than 15.00 m bgl.

Fast pace of ground water development is observed in recent year in valley areas and this has resulted in declining water levels; in major part of the valley water level fall ranging from 0.05 to 6.20 metres is observed in the past one decade. There is thus need to initiate water conservation and artificial recharge measures in such areas.

## 4.2 Ground Water Resources

Rainfall is the major source recharge to the groundwater body apart from the influent seepage from the rivers, irrigated fields and inflow from upland areas. The discharge from ground water mainly takes place from wells and tube wells; effluent seepages of ground water in the form of springs and base flow in streams.

Ground water resources and irrigation potential for Nalagarh valley area of the district have been computed as per the GEC-97 methodology and the resources for the year 2004 are presented below.

1. Area of Nalagarh valley considered for GW Assessment	230	Sq km
2. Annual Replenishable GW Resource	77.07	MCM

3.	Natural Discharge during Non-monsoon Season	7.71	-do-
4.	Net Annual Ground Water Availability	69.36	-do-
5.	Annual Ground Water Draft	10.25	-do-
6.	Demand for Domestic and Industrial uses (Projected up to 2025)	6.84	-do-
7.	Ground Water Availability for Future Irrigation	55.34	-do-
8.	Stage of Ground Water Development	15	%

The stage of ground water development is 15% as on 2004 in nalagarh valley area and falls under “safe category”. This suggests that further ground water development can take place.

### 4.3 Ground Water Quality

Chemical quality data of ground water from shallow as well as deep aquifer in the district indicates that ground water is generally alkaline in nature and suitable for both domestic and irrigation use. All the parameters analyzed are well within the permissible limit of safe drinking water as per Bureau of Indian Standard (BIS). The range of chemical parameters hydrograph network stations of CGWB in the district are summarized below

Range	pH	EC μS/cm	HC O3	Cl	N O3	F	Ca	M g	Na	K	TH as CaCO3
Min	7.45	412	177	15	1.8	.16	36	8.5	20	1.2	50
Max	7.80	915	415	16 3	90	.72	104	27	137	7.9	355

Quality of ground water in shallow aquifer is thus good for domestic and irrigation purpose in the district.

Though contamination of ground water have not been reported in the district so far, however, the fast developing industrial area particularly in Nalagarh block, is highly vulnerable to pollution from industrial effluent.

There is thus need to have proper ETPs and waste disposal system with all the industries and major towns. Proper monitoring is very much required.

#### 4.4 Status of Ground Water Development

Ground water development particularly in valley areas in the district, underlain by alluvium/valley fills, is on moderate scale. In these areas, all the major irrigation, industrial and domestic water supplies depend on ground water viz., open wells & tube wells. In rest of the district area due to poor potentialities in hilly hard rock areas and hilly sloppy terrain, groundwater development is low. However, in these areas also, major water supply and sources of water are ground water based viz., perennial springs, *bowries* and hand pumps. Springs are tapped at the source so that the water can be supplied under gravity. All major towns and villages are supplied water from ground water sources. Large-scale ground water development is mainly restricted to Nalagarh valley only where wells and tube wells are feasible. In these areas, ground water is developed by large number of dug wells, shallow & tube well. All the major irrigation, drinking and industrial water supplies depend on these structures in addition to various water supply schemes based on base flow in rivers and streams or *nallas*.

As per MI census, there were about 742 dug wells, 217 shallow tube wells and 37 deep tube wells in the district as on 2000-01 in the Solan district.

### 5.0 GROUND WATER MANAGEMENT STRATEGY

#### 5.1 Ground Water Development

In hilly and mountainous area of the district ground water development through the traditional ground water sources viz. Springs (*chasmas*), *Bowries* and perennial streams are the only possible apart from the shallow bores or hand pumps in favorable locations. Proper development of springs is essential as it is observed that most of the spring does not have collection chamber or tanks from where water can be distributed under gravity. The objective of spring development should be to collect the flowing water underground, to protect it from surface contamination and store it in sanitary spring box for supply. Similarly, *seepage springs* along hill sides also need to develop for harnessing ground water in such areas.

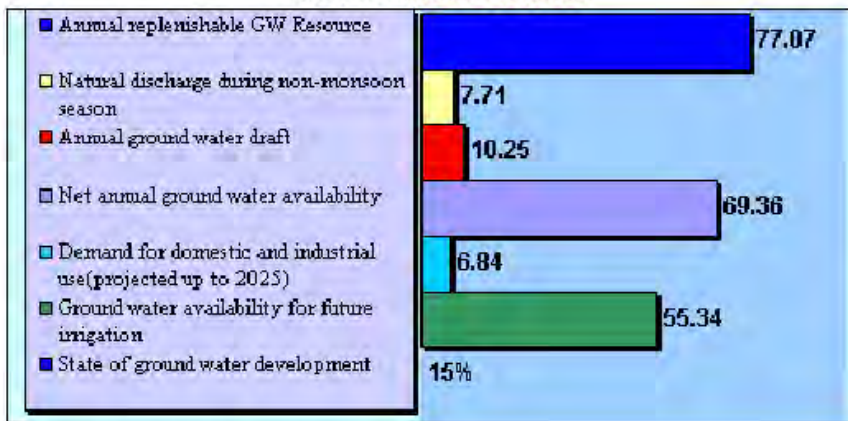
**Himachal Pradesh  
SOLAN DISTRICT**

**GROUND WATER RESOURCE &  
 ARTIFICIAL RECHARGE PROSPECTS**



**Explanation**

**GROUND WATER RESOURCES**



**RWH & AR FEASIBLE STRUCTURES**

**Valley area:** Percolation tanks, recharge well, recharge shaft, gabion structure, rainwater harvesting structure like check dam, ground water dam etc.

**Hilly Area:** Roof Top Rain Water Harvesting Structure & contour bund, check dam, gully plug etc. in favorable location

In the last decade number of shallow bore wells fitted with hand pumps have been constructed in these areas serving as the source of water supply for domestic uses in the district. In the hilly areas and shallow bore wells in favorable location are feasible. However, looking to the fragile eco-system drilling activity should be minimum.

In valley areas of the district, Nalagarh area, resource estimation shows only 15% the stage of ground water development (as on 2004). Thus this area falls in *safe category*. Thus the scope for further ground water development by constructing additional wells, shallow and medium depth tube-wells are feasible in these areas. However, in view of mild decline water levels, cautious development approach along with proper development monitoring is required.

## **5.2 Water Conservation & Artificial Recharge**

Ground water is the major source for irrigation & domestic water supply in both rural and urban areas. Water level observation data has revealed declining trend in water level in some parts of the district. Though the stage of ground water development in valley is still in *safe category*, however, declining water levels in recent years suggest need for cautious and well-planned ground water development. Further, there is an urgent need to monitor development pattern by the implementing agencies.

In many parts the availability of water during summer is limited particularly in hilly areas in drought/ low rain fall years. There is thus immediate need to conserve and augment water resource. Based upon the climatic conditions, topography, hydro-geology of the area, suitable structure for rain water harvesting and artificial recharge to ground water body need to be planned and implemented. Roof top rainwater harvesting in urban/rural areas and water harvesting in rural area need to be adopted and proper scientific intervention for spring development and revival of traditional water storage is required in water scarce hilly upland areas.

The hilly areas receive fair amount of rainfall & ample scope exist for implementing roof top rain water harvesting by constructing appropriate harvesting structures. An NGO named SUTRA working in the district has constructed such roof top rain water harvesting structures in number of schools and thus demonstrated its efficacy. Such structures should be

replicated to conserve and augment water resources. There should be mandatory provision under law to construct roof top rainwater harvesting structures in all schools, colleges, offices and *pucca* buildings. In similar way, the defence establishments can also have such water harvesting provisions.

## **6.0 GROUND WATER RELATED ISSUES & PROBLEMS**

Most of the ground water issues and problems in the district are localized and need to be treated independently by taking the micro level studies in a particular area. In hilly and mountainous parts, the most common issues relate to scarcity of water particularly in low precipitation year during non-monsoon period when dwindling levels and spring discharges are seen. Rainwater harvesting and awareness for water conservation, protection and water harvesting are measures that need to be taken.

Presently large development of ground water is observed in industrial belts of Nalagarh valley wherein fall of water level down to six metres have been observed in parts. Thus, ground water level depletion and also vulnerability to ground water pollution is major issues in this industrial belt.

## **7.0 AWARENESS & TRAINING ACTIVITY**

### **Mass Awareness Programme (MAP) & Water Management Training Programme (WMTP) by CGWB**

Under the aegis of Central Ground Water Authority, Northern Himalyan Region in association with department of agriculture, GoHP conducted one mass awareness programme on *rainwater harvesting for artificial recharge and water management* at Sukedi Khalsa village in Nalagarh tehsil. About 500 persons, mostly local people, farmers, NGO's, government officials and students from local Senior Secondary School attended the function.

An exhibition displaying models, maps & displays of rainwater harvesting, artificial recharge and other displays were arranged during the function. Lectures were delivered by the scientific officers and staff of CGWB & State Govt. department like agriculture, forest etc., local farmers & NGO

during the programme focusing on the need to conserve water and on rain water harvesting and artificial recharge to ground water for future use.

### **Participation in Exhibition, Mela, Fair etc**

To create the awareness about ground water resources, need for rain water harvesting and artificial recharge models, posters, displays etc. were exhibited during mass awareness programme conducted in the district.

### **Presentation & Lectures delivered in public forum / Radio/TV/Institution of repute/Grassroots association /NGO/Academic institutions etc**

So far presentation and lectures are delivered amongst the gathering during the MAP and WMTP only.

## **8.0 AREAS NOTIFIED BY CGWA / SGWA**

The stage of ground water development in Nalagarh valley of the district (as on 2004) is 15% only. No area or block has been notified for groundwater development point of view.

## **9.0 RECOMMENDATIONS**

- In alluvial areas of Nalagarh valley, though there is scope for ground water development as stage of ground water development is only 15%, however, there is need to adopt cautious and phased manner ground water development approach in view of depleting water levels in some parts. This decline can be attributed to fast pace of development in recent years, both in agriculture sector and industrial sector.
- This industrial area is highly prone and vulnerable to surface & ground water pollution thus water quality monitoring at close network is essential.
- Proper waste/effluent disposal measures are required to be adopted by industrial units and state authorities needs to check this.



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- There is need to protect traditional water harvesting structures like ponds, tanks, talavs to utilized these for rain water harvesting and recharging shallow aquifers.
- In hilly and mountainous terrain, traditional ground water sources viz., springs, *bowries* etc needs to be developed and protected for better health and hygiene with proper scientific intervention.
- Springs needs to be inventoried & studied for optimum utilisation of their discharge either by fracturing, horizontal drilling or by constructing galleries etc.
- Roof top rainwater harvesting practices can be adopted in hilly areas and urban areas, since the district receives fair amount of rainfall. Construction of roof top rain water harvesting structures should be made mandatory in all new construction and rain water harvesting in rural areas should be promoted. Traditional water storage systems need to be revived.
- People's participation is a must for any type of developmental activities. So proper awareness for utilization and conservation of water resources is required.

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**For Technical Assistance Relating to**  
**Rainwater Harvesting**  
**&**  
**Artificial Recharge to Ground Water**

**Contact:**

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