

## **NOTICE**

It is for the information of the General Public that Draft of District Survey Report w.r.t. Minor Mineral Quarries of District Solan has been prepared. This report has to be approved by the District Level Environment Impact Assessment Authority (DEIAA), for grant of Environment Clearance for category "B2" projects for mining of minor minerals having area either less than 5 hectares or equal to 5 hectares.

Before the approval of the draft of the District Survey Report, it is available for the public at the official website/ public domain of the district Solan to sought comments from the general public.

If, anyone have any objection or suggestion in this regard may submit their comments to the District Level Environment Impact Assessment Authority (DEIAA) within 21 days.

Date: 20.01.2018

*Sd/-*  
Deputy Commissioner-cum-  
District Level Environment Impact  
Assessment Authority (DEIAA)  
Solan, District Solan (H.P.)

# SURVEY DOCUMENT

## ***STUDY ON THE DRAINAGE SYSTEM, MINERAL POTENTIAL AND FEASIBILITY OF MINING IN RIVER/ STREAM BEDS OF DISTRICT SOLAN, HIMACHAL PRADESH.***



**“Geological Wing” Department of Industries,  
Government of Himachal Pradesh,  
Udyog Bhawan, Bemloi, Shimla -1 (H.P.)**

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## **SURVEY DOCUMENT**

### **STUDY ON THE DRAINAGE SYTEM, MINERA POTENTIAL AND FEASIBILITY OF MINING IN RIVER/ STREAM BEDS OF DISTRICT SOLAN HIMACHAL PRADESH**

#### **Preface**

Minerals are valuable natural resources being finite and non-renewable. They constitute the vital raw materials for many basic industries and are a major resource for development. The history of mineral extraction in India dates back to the days of the Harappan civilization. The wide availability of the minerals in the form of abundant rich reserves made it very conducive for the growth and development of the mining sector in India. The country is endowed with huge resources of many metallic and nonmetallic minerals. Mining sector is an important segment of the Indian economy. Since independence, there has been a pronounced growth in the mineral production both in terms of quantity and value. India produces as many as 87 minerals, which includes 4 fuel, 10 metallic, 47 non-metallic, 3 atomic and 23 minor minerals (including building and other materials).

Minerals are classified into two groups, namely (i) Major minerals and (ii) Minor minerals. Amongst these two groups minor mineral have been defined under section 3 (e) of Mines and Minerals (Regulation and development) Act, 1957 and further governed by the state River/Stream Bed Mining Policy and Guidelines. They include building stones, gravel, ordinary clay, ordinary sand, limestone used for lime burning, boulders, kankar, murum, brick earth, bentonite, road metal, slate, marble, stones used for making household utensils etc. and other minerals not defined as minor minerals in the said Act are treated as major minerals. They include coal, manganese ore, iron ore, bauxite, limestone, kyanite, sillimanite, barites, chromite, silica sand, fluorite, quartz, sand used for stowing purposes in coal mines and many other minerals used for industrial purposes.

The mining activities in the state of Himachal Pradesh can basically be categorized as in large sector and in small sector. The large sector comprises of

limestone projects for manufacturing lime, cement and other lime products while the small mining sector comprises mining of minor minerals like sand, stone, bajari, slate, shale and clay etc. which are basically building material to meet up the demand for infrastructure development of the state.

In pursuance to the orders, dated 27.02.2012 of the Hon'ble Supreme Court in the matter of Deepak Kumar Etc. Vs State of Haryana and Others, prior Environment Clearance has become mandatory for mining of minor Minerals irrespective of the area of Mining lease. As such, Ministry of Environment, Forest and climate Change, Govt. of India vide Notification dated 15.01.2016 and 20.01.2016 has constituted the District level Environment Impact Assessment Authority (DEIAA) for grant of Environment Clearance for category "B2" projects for mining of minor minerals.

In the aforesaid Notification of dated 15.01.2016 of Ministry of Environment, Forest and climate Change, Govt. of India, the procedure for preparation of District Survey Report which shall form the basis for application for Environment Clearance has been prescribed.

Accordingly, the rivers/streams of Solan were studied survey report of the river beds/ parts of river beds of District Solan have been prepared.

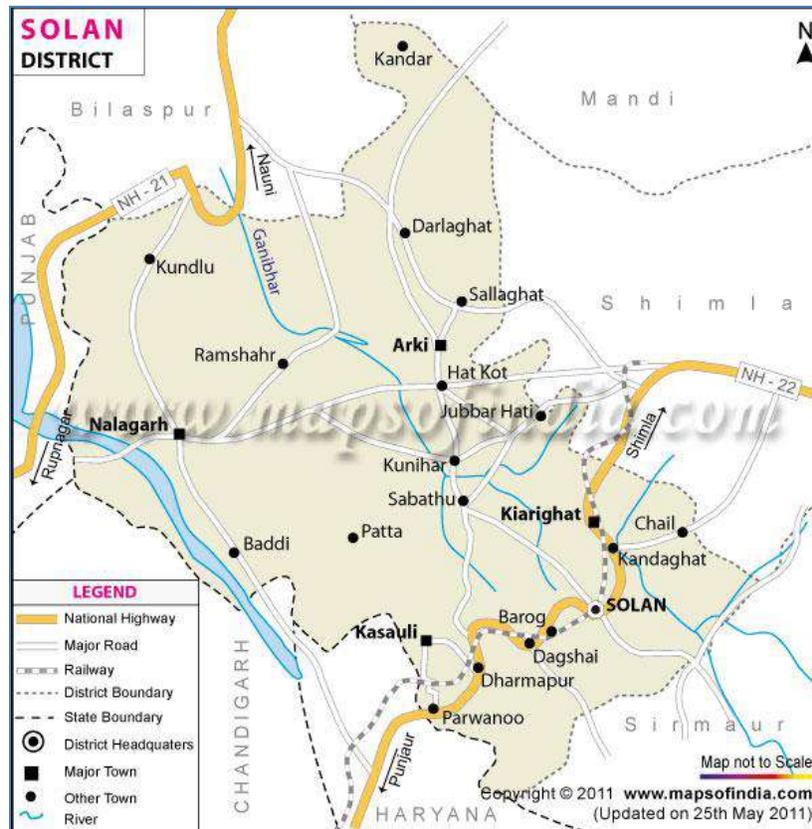
## **CHAPTER – 1**

### **INTRODUCTION:**

Solan as an independent District came into existence on 1<sup>st</sup> September, 1972, consequent upon reorganization of the districts of Himachal Pradesh. The District derives its name from Solan, the headquarter town. It is said that the name Solan is associated with Shoolini the local deity, located at a distance of 48 Kms. From Shimla, Solan is considered as the gateway to capital of Himachal Pradesh. The total area of the district is 1936 sq. km. The district has 7 towns and 2501 villages of these 2348 villages are inhabited. At the 2011 census the total population of the district was 576670. The people of Solan district are predominantly Hindus followed by Sikhs and Muslims. 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 and Mandi district in the north, Shimla and Sirmour districts in east and 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 6 Tehsils (Arki, Baddi, Kandaghat, Kasauli, Nalagarh and Solan) and 2 sub-tehsils (Krishangarh and Ramshahar). For development purpose, the district has been divided into five community development blocks viz., Dharampur, Kandaghat, Kunihar, Nalagarh and Solan, 198 Gram Panchayats. Important towns in the district are Solan, Nalagarh, Kasauli, Subathu, Dagshai, Arki, Kandaghat, Parwanoo etc. The population of the district is 5, 80, 320 (2011 census), out of which 3,08,754 (53 %) are males, and the rest 2,71,566 (47%) are female. Sex ratio (F:M) is 880:1000 and density of population is 300 per sq km. The rural and urban population is 82.40% and 17.60% respectively. The local inhabitants mainly depend on agriculture for their subsistence and adopt several traditional practices conducive for farming in sloping terrain.

The District was carved out of Solan and Arki Tehsils of the then Mahasu District and Tehsils of Kandaghat and Nalagarh of the then Shimla District. The District is bounded by Mandi and Bilaspur Districts in the North, Punjab State in the West, Haryana State and Sirmour District in the South and Shimla District in the East. The terrain of the District is mostly mountainous with an elevation ranging from 300 to 2250 Mtrs. above mean sea level. The highest peak in the District is Krol Tibba having the elevation of 2253 Mtrs. above mean sea level.

For administrative convenience, the District has been divided into four sub-divisions with headquarters at Solan, Kandaghat, Nalagarh and Arki. Solan Sub-division consists of Solan and Kasauli Tehsils and Krishangarh sub-Tehsil, Nalagarh sub-division consists of Nalagarh Tehsil and Ramshahr Sub-Tehsil, whereas Kandaghat and Arki sub-divisions cover respective Tehsil only.



## **CHAPTER – 2**

### **OVERVIEW OF MINING ACTIVITY IN THE DISTRICT:**

The Solan District is divided into 4(Four) Sub-Divisions. Out of these 4 Sub-Divisions, active mining operations for exploitation of minor mineral are being carried out in three Sub-Divisions. However, in the river/steam beds, the mining operations are strictly carried out as per the River/Stream Mining Policy Guidelines. There are two major rivers i.e. Sirsa and Gamber which are flowing through three Sub-Divisions i.e. Solan, Arki and Nalagarh. There are also other few Khads/ Nalla flowing in the said Sub-Divisions, from where the minor minerals are being exploited.

Minor Minerals such as building stones, Gravel, ordinary sand etc. are the main constituents required for the modern development activities. As such the consumption of minor minerals in the District has increased many folds with the pace of developmental activities and increased demand of minor minerals from the Neighboring States. The type and quantity of construction material used, depends upon the structural design and type and nature of work. The quantity of minor mineral consumption in a particular area is a thermometer to assess the development of the area. Thus with the pace of development activities, the consumption of minor minerals also increase.

In the district of Solan as on 31.12.2017 total of 45 numbers of mining leases have been granted under the ibid rules, out of which 3 mining leases have been granted under the category of major mineral and 41 under the category of minor minerals. The major mineral mining leases are granted for the mineral limestone and shale for manufacturing of cement and 11 mining leases for free sale of sand & stone and 30 number of mining leases have been granted for establishment of stone crusher unit under the category of Hill slope / river bed slope Mining.

**CHAPTER - 3**

**The List of mining leases in District Solan**

The details of the mining leases in the district Solan are as per the following tables:-

**Table 1: Mining leases granted for free sale of mineral**

S. No.	Name of the Party	Period	Location/ Mauza and Mohal	Area of the lease	Whether Mining lease area is hill slope or river bed	Name of minor mineral
1.	Sh. Mohan Lal S/o Sh. Sant Ram, Village Bawara, P.O. Basal, Solan	25.03.2014 to 24.03.2019	Masheevan (Free Sale)	5-14 bighas	Hill Slope	Sand
2.	Shri Rajinder Kumar, Village Kotla, P.O. Mashiwar, Tehsil & District Solan	22.12.2015 to 21.12.2020	Masheevan (Free Sale)	5-15 bighas	Hill Slope	Sand
3.	Shri Kishori Lal Bhardwaj, Village Parag, P.O. Solan Brewery, Solan	22.06.2016 to 21.06.2021	Parag (Free Sale)	05-14 bighas	----- do-----	Sand
4.	Sh. Sanjay Goyal, S/o Sh. Ramdhan, Sugandha Apartments, Saproon, Solan (H.P.)	02.06.2009 to 01.06.2019	Sharad (Free Sale)	18-12 bighas	----- do-----	Stone
5.	Shri Nirbhay Bhatnagar S/o Shri Deepak Bhatnagar R/o 2/365, Sunder Colony Nahan	19.07.2016 to 18.07.2021	Shamber (Free Sale)	11-09 bighas	Hill Slope	Sand
6.	Shri Sudhir Thakur S/o Shri Vinod Thakur, Village & P.O. Chambaghat, Solan	05.11.2016 to 04.11.2021	Basal Patti Jarash (Free Sale)	0-40-51 Hectare	Hill Slope	Sand
7.	Shri Laxmi Dutt, Village Drahan, P.O. Damkari, Tehsil & District Solan	25.03.2017 to 01.04.2018	Drahan (Free Sale)	09-08 bighas	Hill Slope	Sand

8.	Shri Shiv Kumar S/o Shri Puran Chand Thakur, R/o Thakur Niwas, P.O. Solan Brewery, Solan	16.08.2017 to 15.08.2022	Baila (Free Sale)	07-02 bighas	Hill Slope	Sand
9.	Smt. Rita Thakur, W/o Shri Ravinder Thakur, Village Kathar, P.O. Solan Brewery, Solan	19.09.2017 to 18.08.2022	Basal Patti Jarash (Free Sale)	0-74-40 hectare	Hill Slope	Sand
10.	Shri Ram Avtar Bindal R/o Bindal Colony Solan	10.10.2017 to 09.10.2022	Dalehan (Free Sale)	14-16 bighas	Hill Slope	Sand
11.	Sh. Chandan Swaroop, Prop. M/s D.K. Industries, Village Dera, P.O. Domehar Bani, P.O. Kandaghat, Solan	20.01.2009 to 19.01.2019	Bani (Free Sale)	5-00 bighas	----- do-----	Cut stone

**Table 2 : Mining leases granted for running stone crusher units**

S. No.	Name of the Party	Period	Mauza	Area of the lease	Hill slope or river bed
1.	Sh. Jitender Singh & Sh. Gaurav Prop. M/s S.S. Stone crusher, Village Kotla, P.O. Sultanpur, Tehsil & Distt. Solan (H.P.)	09.04.2008 to 08.04.2023	Kotla (Stone Crusher)	57-04 bighas	Hill Slope
2.	Kumar Rajinder, Prop. M/s Guru Parmeshwar Stone crusher, Village Gunai, P.O. Kot-beja, Tehsil Kasauli, District Solan	28.08.2015 to 27.08.2030	Banoi Ram Singh (Stone Crusher)	50-00 bighas	Hill Slope
3.	Sh. Hitender Kumar Sharma, Village Ghumahra, P.O. Kaba-Kalan, Tehsil & Distt. Solan	04.01.2012 to 03.04.2017	Kuther (Stone Crusher)	07-15 bighas	Hill Slope

4.	M/s C & C Construction, Naraini, Tehsil Kasauli, District Solan (H.P.)	23.12.2009 to 22.12.2019	Naraini (Stone Crusher)	48-13 bighas	----- do-----
5.	Smt. Kheemi Devi, Prop. M/s Thakur Stone Crusher, Village Kotla, P.O. Kanda, Tehsil Kasauli, District Solan	08.05.2015 to 07.05.2020	Kotla  (Stone Crusher)	4-13-78 Hectare	River Bed
6.	Shri Ganesh Dutt Sharma, Prop. M/s Sharma stone crusher, Village Talona, P.O. Kakkarhatti, Solan	03.11.2016 to 02.11.2026	Bugar Kaneta  (Stone Crusher)	26-15 bighas	Hill Slope
7.	Shri Ajay Verma S/o Shri Devi Singh Verma, Village Sirinagar, P.O. & Tehsil Kandaghat, Solan	07.09.2017 to 06.09.2022	Krishangarh  (Stone Crusher)	08-13-15 hectare	Hill Slope
8.	Sh. Tarsem Bharti, VPO Shoghi, Tehsil & Distt. Shimla (H.P.)	08.08.2014 to 07.08.2024	Chund  (Stone Crusher)	27-00 bighas	Hill Slope
9.	Shri Hamender Chandel S/o Shri Lokender Mohan Singh Chandel R/o Pawan Kunj, P.O. Anji Brahmana, Tehsil Kandaghat, District Solan	23.11.2016 to 22.11.2031	Neri  (Stone Crusher)	13-04 bighas 0.9933 Hectare	Hill Slope
10.	Smt. Suman Chandel, Prop. M/s Laxmi stone crusher, Village Lachog, P.O. Anji Brahmana, Tehsil Kandaghat, District Solan	03.08.2017 to 02.08.2032	Lacchog  (Stone Crusher)	24-09 bighas	Hill Slope
11.	Shri Brij Mohan Sharma Prop. M/s Sharma stone crusher, Village & P.O. Bhumti, Tehsil Arki, District Solan	14.05.2010 to 13.05.2020	Basantpur  (Stone Crusher)	15-12 bighas	----- do-----
12.	Sh. Deepak Joshi, Prop. M/s Ambey stone crusher, Village & P.O. Bhumti, Tehsil Arki, District Solan	18.02.2010 to 17.02.2025	Iqua-Kaneta  (Stone Crusher)	14-19 bigha	----- do-----

13.	Shri Sanjay Singh, Prop. M/s Shiva stone crusher, Village Gawda, P.O. Kakkarhatti, Tehsil Arki, District Solan (H.P.)	15.06.2009 to 14.06.2024	Chhoi (Stone Crusher)	24-02 bighas	River bed
14.	Sh. Raj Kumar, Partner M/s Bhagwati stone crusher, Village Banoh, P.O. Khararhatti, Tehsil Arki, District Solan (H.P.)	18.12.2008 to 17.12.2023	Banoh (Stone Crusher)	18-18 bighas	Hill slope
15.	Sh. Surender Aggarwal, Prop. M/s Bharat stone crusher, Village Khanalag, P.O. Manju, Tehsil- Arki, District Solan (H.P.)	04.09.2009 to 03.09.2024	Khanalag (Stone Crusher)	5-10 bighas	----- do-----
16.	Shri Arun Thakur S/o Sh. Gian Chand Thakur, Village Khanalag, P.O. Manjhu, Tehsil Arki, Distt. Solan (H.P.)	07.09.2015 to 06.09.2020	Khanalag (Stone Crusher)	12-00 bighas	----- do-----
17.	Shri Hem Raj Sharma, Prop. M/s Kamaksha Construction Co., Village Javi, P.O. Darlaghat, Tehsil Arki, District Solan	23.11.2016 to 22.12.2021	Bhel (Stone Crusher)	08-00 bighas	Hill Slope
18.	Shri Ramesh Thakur S/o Shri Nathu Ram, Village Deothal, P.O. Kunhar Tehsil Arki, District Solan	11.11.2016 to 10.11.2031	Devthal (Stone Crusher)	23-08 bighas	Hill Slope
19.	Sh. Parminder Bansal, Prop. M/s Gupta stone crusher, Village Malpur, P.O. & Tehsil Baddi, Solan	28.10.2011 to 27.10.2021	Juduwal (Stone Crusher)	12 bigha	----- do-----
20.	Sh. Navdesh Passi, Partner M/s Himachal Grit Udyog, Village Sansiwala, P.O. Barotiwala, Solan	09.06.2011 to 08.06.2026	Vidhi (Stone Crusher)	13 bigha	----- do-----
21.	Smt. Savitri Devi W/o Shri Chet Ram, Prop. M/s Babaji stone crusher, Village Changer, PO Manlog-Kalan, Tehsil Nalagarh, District Solan	22.06.2015 to 21.06.2020	Radhog, Chamyari (Stone Crusher)	59-05 bighas	River Bed

22.	Sh. Ram Kumar, Prop. M/s Rama & Kundlas stone crusher, Village & P.O. Haripur Sandholi, Tehsil Nalagarh, District Solan	09.03.2016 to 08.02.2021	Daso Majra, Khol, Bhud, Malpur  (Stone Crusher)	704-05 bighas	River bed
23.	Smt. Baggo Devi, W/o Shri Gurpal Singh, Village Dolowal, P.O. Bhogpur, Tehsil Nalagarh, District Solan	15.03.2016 to 14.03.2021	Aduwal Jandori  (Stone Crusher)	59-01 bighas	River bed
24.	Shri Gulzar Mohammed, Village Gulabpura, P.O. Panjhera, Tehsil Nlg.	26.04.2016 to 25.04.2021	Dhalaton (Stone Crusher)	17-04 bighas	Hill Slope
25.	Shri Sunil Garg, Prop. M/s Shiv Bhawani stone crusher, VPO Dabhota, Tehsil Nalagarh	04.06.2016 to 03.06.2021	Ratyor, Bhanglan (Stone Crusher)	309-11 bighas 23-29-30 Hectare	River bed
26.	Shri Gurcharan Singh, Prop. M/s Shiv Bhole stone crusher, Village & P.O. Haripur Sandholi, Tehsil Baddi, District Solan (H.P.)	03.03.2017 to 02.03.2022	Kishanpura  (Stone Crusher)	317-08 bighas	River bed
27.	Shri Jitender Singh, Prop. M/s Singh stone crusher, Village Katha, P.O. & Tehsil Baddi, District Solan	04.08.2017 to 03.08.2027	Tipra  (Stone Crusher)	16-13 bighas	Hill Slope
28.	Shri Anil Bansal, Prop. M/s Shiv stone crusher, Village Kattiwala, P.O. Mandhala, Tehsil Baddi, District Solan (H.P.)	16.08.2017 to 15.08.2032	Dhauler  (Stone Crusher)	16-17 bighas	Hill Slope
29.	Shri Anil Bansal, Prop. M/s Shiv stone crusher, Village Kattiwala, P.O. Mandhala, Tehsil Baddi, District Solan (H.P.)	04.09.2017 to 03.09.2032	Gurdasspur a  (Stone Crusher)	18-12 bighas	Hill Slope
30.	Shri Avtar Singh, Prop. M/s Saini Stone crusher, Village Berson, P.O. Manjholi, Tehsil Nalagarh, District Solan (H.P.)	23.12.2017 to 22.12.2022	Rampur  (Stone Crusher)	315-06 bighas	River bed

**Table 3 : Mining leases for Limestone and Shale**

In district Solan there are two major mining leases:

1. M/s Ambuja Cements Ltd., Darlaghat
2. M/s Ultra Tech Cement Ltd., Baga
3. M/s National Mineral Development Corporation Ltd.

## **CHAPTER - 4**

### **DETAILS OF ROYALTY OR REVENUE RECEIVED IN LAST THREE YEARS**

In earlier times, the houses/ buildings were constructed in form of small dwellings with walls made up of mud plaster, stone and interlocking provided with wooden frames. There were negligible commercial as well as developmental activities resulting in less demand of building material. However with the passage of time, construction techniques changed and new vistas of developmental activities were started with modern construction techniques. As such the demand of minor minerals in the District started an increasing trend. Mainly three types of minor mineral constituents such as sand, stone and bajri are required for the modern construction/ developmental activities apart from other material like cement and steel. In order to meet the requirement of raw material for construction, the extraction of sand, stone and bajri is being carried out exclusively from the river beds. The demand of sand is mainly met through by river borne sand whereas the demand of bajri/ grit is either met through river borne collection or through manufactured grit by stone crushers. The demand of dressed or undressed stone is met through the broken rock material from the hill slope. The royalty received from major and minor minerals since 2014-17 onwards is tabulated in the following table.

***Table 4 : Details of royalty or revenue received in last three years***

<b>S. No.</b>	<b>Year</b>	<b>Royalty in Crores</b>
1.	2014-15	65.44
2.	2015-16	55.32
3.	2016-17	42.58

## **CHAPTER – 5**

### **DETAILS OF PRODUCTION OF MINOR MINERALS IN LAST THREE YEARS**

Mainly three types of minor mineral constituents such as sand, stone and bajri are required for the modern construction/ developmental activities apart from other material like cement and steel. In order to meet the requirement of raw material for construction, the extraction of sand, stone and bajri is being carried out exclusively from the river beds. The demand of sand is mainly met through by river borne sand whereas the demand of bajri/ grit is either met through river borne collection or through manufactured grit by stone crushers. The demand of dressed or undressed stone is met through the broken rock material from the hill slope. The production of the minor minerals since 2014-17 onwards is tabulated in the following table.

**Table 5 : Details of Production of minor mineral**

<b>S. No.</b>	<b>Year</b>	<b>Production of Minor Mineral (in tons)</b>
1.	2014-15	236534
2.	2015-16	218361
3.	2016-17	607178

## **CHAPTER – 6**

### **Process of Deposition of Sediments in the Rivers of the District**

Solan District is covered by catchments area of three important rivers namely Satluj, Yamuna and Ghaggar. Main tributary of Yamuna is Asni and those of Satluj River are Kiar-Ka-Nala, Ghamber Khad, and Kuthar Nadi etc. Kaushalya Nadi is the main tributary of Ghaggar. Sirsa is the main stream in Nalagarh Sub-Division. It has its source in the Hill above Kalka and runs North-West along the base of the Shivalik eventually joining the Satluj at Avankot in Ropar District. The branching drainage pattern so established is tree like, is termed as ***dendrite drainage pattern***. There are sufficient water sources both for drinking and irrigation purposes. Quite a few of these have been tapped and there is a net work of drinking and irrigation water supply schemes all over the District. The entire tract of Kunihar forest division falls in the Satluj catchment, Gamber, Gamola and Kuni khads are perennial streams. Majority of the small streams and nallahs have discharge only during the rains. Volume of the flow and its duration depends upon the intensity of the rains. Thus drainage system is good though there is acute shortage of drinking water during the summer. River Sirsa and Gamber khads are the two main source of drainage of Nalagarh both these are perennial in nature.

Deposition is the opposite of erosion. Deposition is where a river lays down or drops the sediments or material that it is carrying. Rivers carries lots of different sediments, including rocks, boulders, silt, mud, pebbles and stones. Normally, a river has the power to carry sediments. If the force of a river drops, the river cannot carry sediment. This is when the river deposits its sediment.

The process of deposition in the dendrite drainage system of the district works on the basic principle i.e. Erosion, Transportation and Deposition.

The erosion and transport of material go hand in hand with the deposition of the latter. There is not a single river that doesn't carry fragmental material and deposit it. Even at the early stages, in the development of a river, when the erosion and transport definitely prevails over accumulation, the material carried by the river is deposited in some of the sections. During youthful stage of the river, these deposits are

unstable and when the volume of water and stream velocity increases (during flood), they may start moving again downstream. The load carried by a stream includes the rock waste supplied to it by rain wash, surface creep, slumping etc. The term load is technically defined as the total weight of solid detritus transported in unit time. The transporting capacity of a stream rises very rapidly as the discharge and the velocity increases and the debris of mixed shapes and sizes, the maximum load that can be carried is proportional to something between the third and fourth power of the velocity. As the velocity of a river is checked, the bed load s first to come to rest with continued slackening of the flow, the larger ingredients of the suspended load are dropped, followed by finer and finer particles. A river begins to sort out its load or burden as soon as it receives it. The proportion of fine to coarse amongst the deposited materials tend on average to increase downstream, but there may be interruptions of this tendency because of addition of coarse debris from tributaries or from landslides and steepening of the banks.

Both discharge and load depend on the climate and geology (litholgy, structure and relief) of the river basin concerned and both co-operate in carving out the channels down and down.

## **CHAPTER – 7**

### **GENERAL PROFILE OF SOLAN DISTRICT**

Solan district has emerged on the map of Himachal Pradesh on 1st September, 1972 as a result of reorganization of erstwhile Shimla and Mahasu districts. The Solan district is known as Gateway to Himachal Pradesh as the national Highway No. 22 passes through this district.

The important minerals available in the district are Lime Stone and building stone. The Lime stone mining is located at Darlaghat and Kashlog area of the district, whereas building stone is mostly found in Barog area of the district. Besides, some quantity of sand is also available in the district which is used for construction activity. On the basis of these resources, there is some scope of setting up ventures in the line of lime, cement, stone grit etc. in the district.

For Administrative purpose, the district has been divided 6 tehsils, namely Solan, Kandaghat, Kasauli, Nalagarh, Arki, Baddi and three sub-tehsil namely Krishangarh, Darlaghat & Ramshahar. There are five blocks in the district namely Solan, Kandaghat, Dharpur, Nalagarh and Kunihar. There are five blocks in the district namely Kunihar, Nalagarh, Dharpur, Solan & kandaghat. There are 211 panchayats in the district covering 2383 villages.

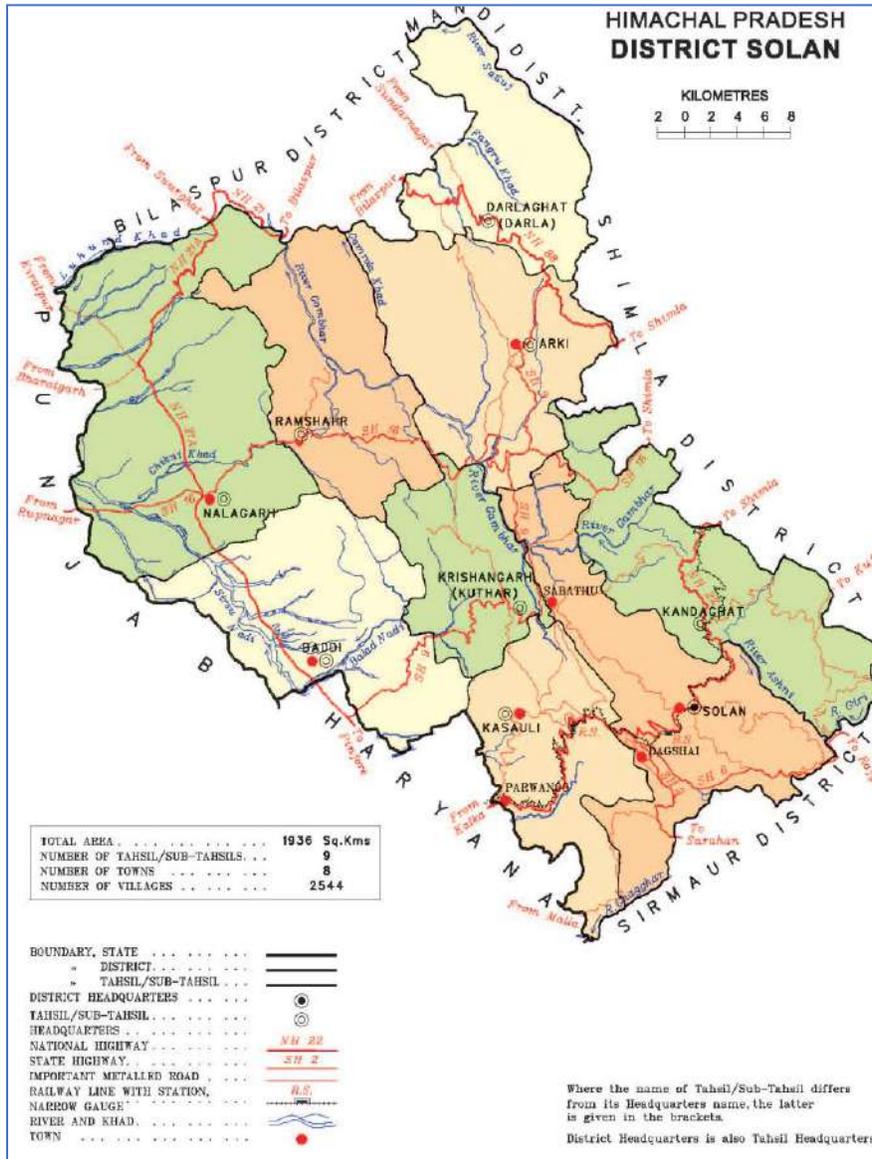
### **Salient Features**

#### **A) Geographical Data**

i). Latitude	30°5´ & 31°15
ii). Longitude	76°42´ & 77°20´
iii). Geographical Area	- 1936 Sq. Km

#### **B). Administrative Units**

Sub-Divisions	- 4
Tehsils	- 6
Blocks	- 5
Gram-Panchayats	- 211
Inhabited Villages (2011 Census)	- 2383
Assembly Area	- 5
<b>C). Population (Total)</b>	<b>5,76,670 (2011 census)</b>



## **CHAPTER - 8**

### **LAND USE PATTERN:**

The District is spread over the valleys and higher elevations. The cultivation is possible only in small terraces in the hills or along the stream/ Khad in most parts of the District. However, in the valleys the cultivation is spread over a vast area. Except the valley area most of the land is either under shrub forests or grassy land with chill trees up to the height of 1,500 Mtrs. from the mean sea level and Kail and Deodar on the high altitudes. It is only in the Doon, Saproon and Kunihar valleys that the land is mostly flat and fertile. The settlement operations in the District were carried out at different times as most of the area was forming the princely hill States.

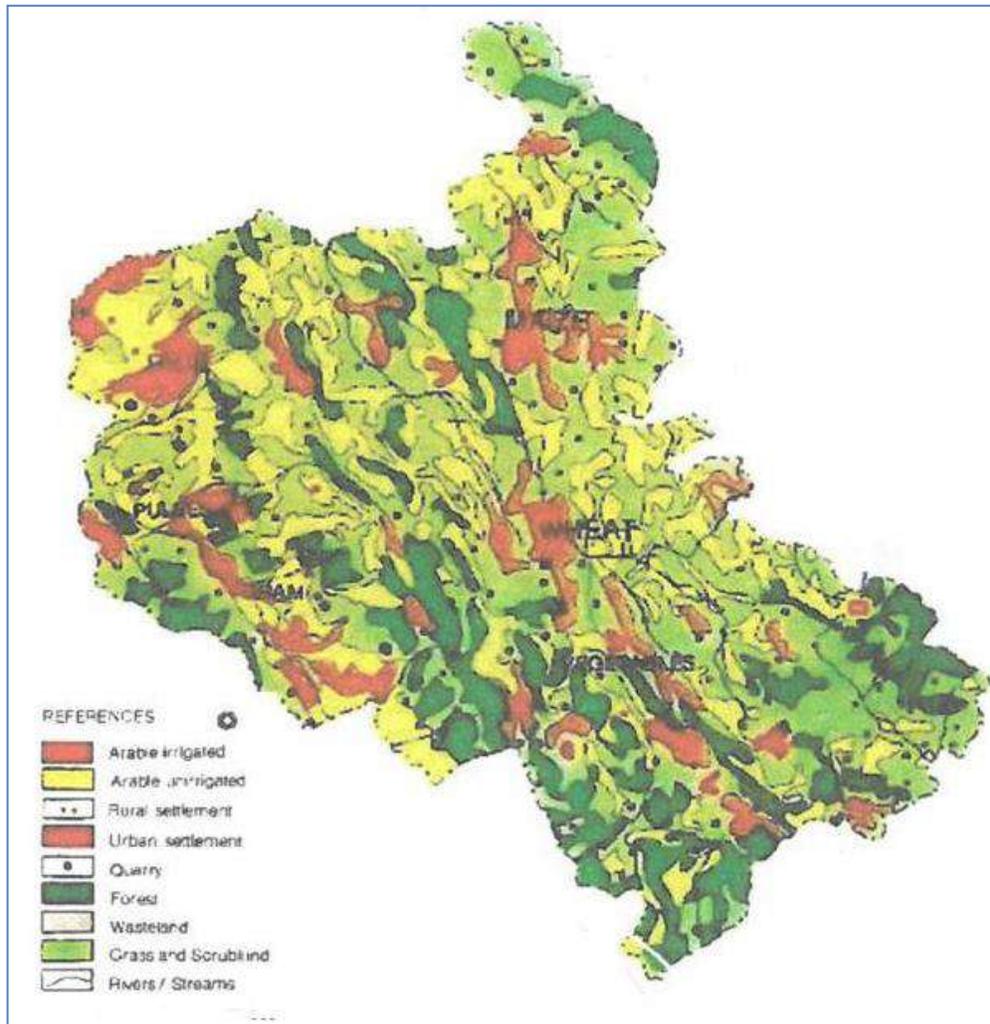
Agriculture is the main stay of the rural economy of the District 54.96 percent of the working population of the District is engaged in agriculture. Maize, Wheat, Rice and Pulses etc. are the main crops of the District. Cash crops such as sugarcane in Nalagarh Tehsil and Potato in Kandaghat Tehsil are grown. Besides, vegetable cultivation has also taken a boost. Despite hilly topography of the District additional area has been brought under cultivation.

A large number of cultivators in the District are growing mushroom on commercial scale, as the climatic conditions in the District are most conducive for growing mushrooms, special incentives are being offered to small and marginal farmers. The soil in the district varies from light to sandy heavy and in the valley areas it is sandy loam types of soil. Climate is the main factors responsible for the proper development of agriculture in the area. The district has different type of soils, which offer great potentialities for growing various types of cereals, fruits, vegetables and other cash crops. Climate of the District is mostly sub tropical in the lower reaches and moist temperature in upper reaches.

The hilly and agro-climatic condition of the district is very congenial for the development of the horticulture in general and cultivation of temperate and stone fruits in particular. Apart from stone and citrus fruits, apples are also being grown in the higher reaches of the district and its cultivation is mainly in Chail area of Kandaghat Tehsil.

Due to wide variations in the altitude, soil depth and available moisture, the vegetation met within this division shows a great variation. Chil, Khair, Bamboos and other broad leaved species like Chhal, Simbal, Jhingan etc. are the most important species met within this area. Tropical Euphorbia scrub forest to Shiwalik Chil, pine and little Ban oak forests are found in this area. Vegetation changes due to water and slopes. Undergrowth consists of Phullakri, Karaunda, Ghandela and top storey consists of Kashmal, Katni, Kainth, Tirmira, Khair, Bel, Banarasi, Kangu, Malkora, Dub, Dhaula and lobb are the various types of grasses found in this District. The climbers that are generally found are Hedera Lelix, Smilax, Bauhnia vehili, Smilaxspp, Gulab, Acacia Pinnata etc.

There is a great variety of wild life met within this District. The main wild life animals found are; Leopard, Ghoral, Indian wild Bear, Kakar, Hyena, Wild bear, Porcupine, Hone, Squirrels. Leopard is found throughout the area up to an elevation of about 2,200mtrs. In scrub forests Ghoral is found above an elevation of 1200mtrs. In Mangal area various types of birds like Chukar, Black Petridge, Kaleshna and Jungle fowl are also found in the District. Besides the already mentioned birds, a number of other birds like Peacock, Parrot, Sparrow, Piegeon and Doves are also found. The entire tract of Kunihar forest falls in Satluj catchment.



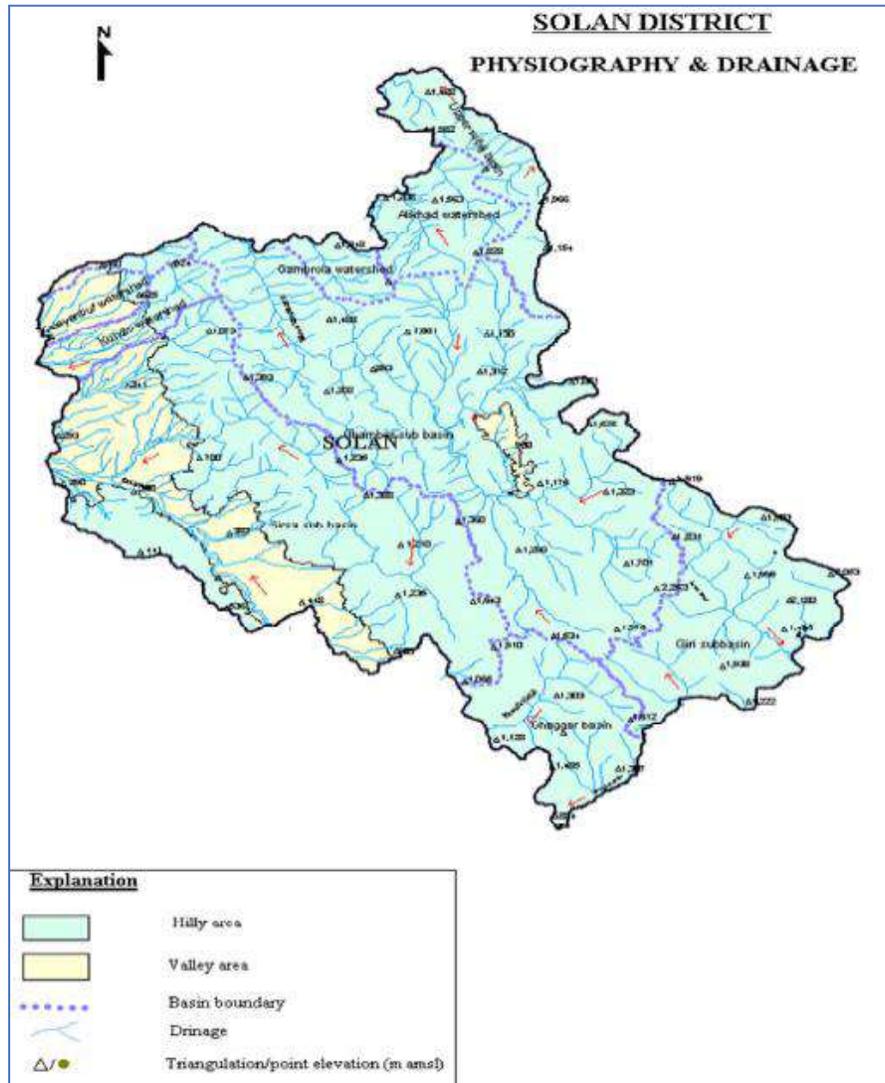
Map Showing land pattern of the District

## **CHAPTER -9**

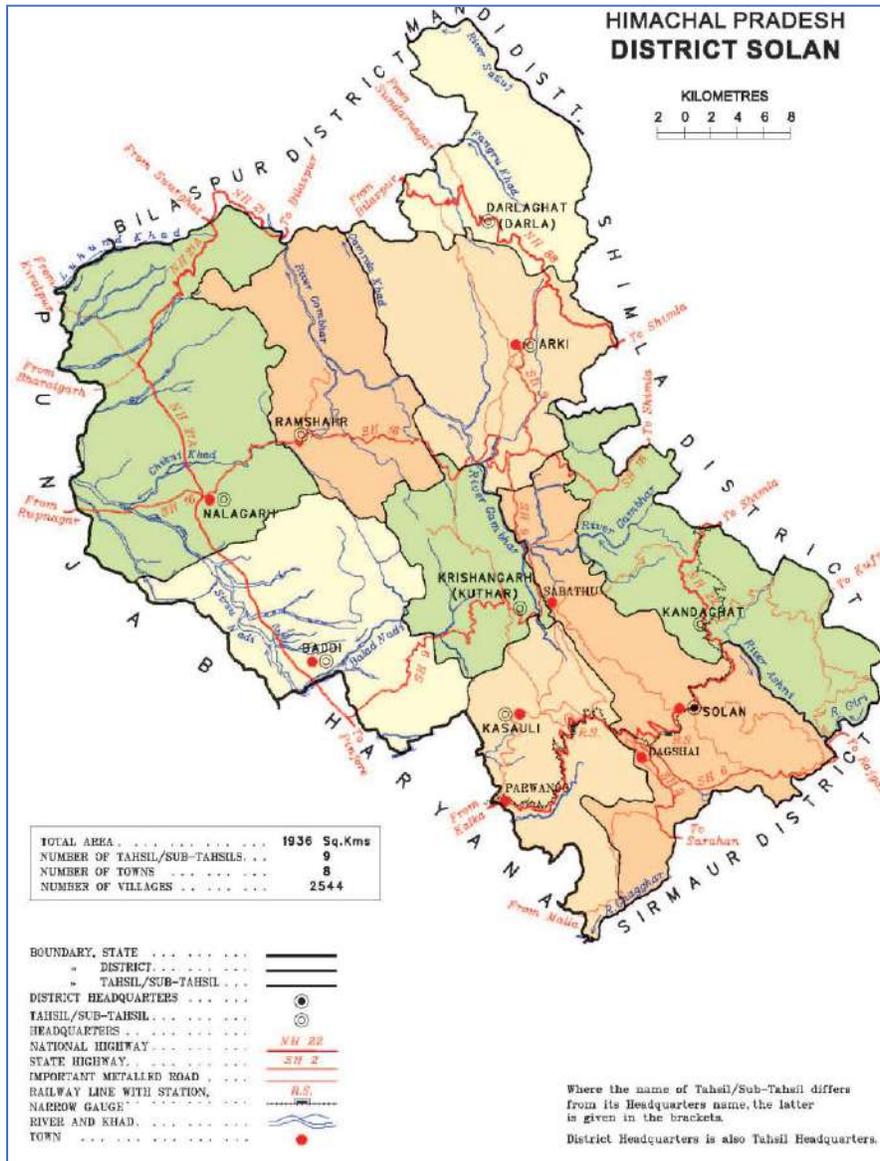
### **Physiography of the District Solan**

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 Mandi and Bilaspur Districts in the North, Punjab State in the West, Haryana State and Sirmour District in the South and Shimla District in the East. The elevation of the District ranges from 300 to 2200 Mtrs. above mean sea level. The District has some parts with a very low altitude. The terrain is mostly mountainous except valley of Sapruon in Solan, Tehsil Doon in Nalagarh Tehsil and Kunihar in Arki Tehsil. The mountains of lower elevations are found in Western and Southern parts of the District comprising of Nalagarh and Arki Tehsils while higher ranges start from Central region and extend up to North-Eastern corner of the District comprising Solan. Kasauli, Kandaghat and parts of Arki Tehsil, Mangal and Berrel Panchayats of Arki Tehsil are situated on a very high mountain ranges and difficult terrain.

District of Solan is covered by catchments area of three important rivers namely Satluj, Yamuna and Ghaggar. Main tributary of Yamuna is Asni and those of Satluj River are Kiar-Ka-Nala, Ghamber Khad, and Kuthar Nadi etc. Kaushalya Nadi is the main tributary of Ghagar. Sirsa is the main stream in Nalagarh Sub-Division. It has its source in the Hill above Kalka and runs North-West along the base of the Shivalik eventually joining the Satluj at Avankot in Ropar Distt. The branching drainage pattern so established is tree like, is termed as dendrite drainage pattern.



Map Showing Drainage Pattern & various features



Map Showing Administrative divisions & other features

## **CHAPTER - 10**

### **Rainfall and Climate**

The climate of the district is sub-tropical in the valley and tends to be temperate on the hilltops. There are four major seasons. The winter season commences from November to February and ends in March; summer season extends from March to June, followed by the monsoon period extending from July to September. Maximum precipitation occurs during July to September. Average annual rainfall in the district is about 1140.86 mm, out of which 85% rainfall occurs during June to September. In the winter season, precipitation as snowfall also occurs in the higher reaches up to 1000 m elevation and as rainfall in low hills and valleys of the district. Mean maximum and minimum temperature ranges between 32.2°C (May) and 0.6°C (January). The climate of the District is mostly sub-tropical in the lower reaches and moist temperate in the upper reaches. Winter, summer, Rainy and the autumn seasons are well marked. Generally the rainy season commences from the first week of July and continues up to the last week of August but sometimes it may advance by a fortnight and extends even up to the end of September. Winter rains generally commence from the last week of December and continue up to end of February, October, November and, May are relatively dry months. Snow is received during January/ February mainly around Chail, Kasauli and Krol Tibba, but occasionally does come down to even lower elevation of 800 Meters. Due to significant variations in altitudes in the District, the temperature also varies considerably. Minimum temperature goes down below 0<sup>0</sup> in higher reaches during the winter season and the maximum temperature exceeds even 40<sup>0</sup> C in lower reaches during the summer season. Rainfall is indispensable for the cultivation in the hilly areas. This is because irrigation facility could not be created here to the extent possible as in plains. Due to unfavorable climatic conditions only higher elevations with a facility of irrigation provide a good scope for vegetable cultivation in the District.

The average monthly rainfall in the District for the last five years is as per the Table 1.

Year	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEPT	OCT	NOV	DEC
	R/F	R/F	R/F	R/F	R/F	R/F	R/F	R/F	R/F	R/F	R/F	R/F
2012	67.8	9.2	12.4	41.5	3.0	15.1	317.9	366.8	195.0	1.0	2.4	19.1
2013	91.0	184.7	60.8	4.4	21.0	348.9	185.4	188.3	89.6	28.7	24.0	23.5
2014	67.0	99.9	121.1	62.9	71.5	125.8	354.9	157.0	137.0	24.6	0.0	122.5
2015	64.2	76.8	254.9	84.3	22.5	81.9	432.6	251.0	49.2	23.3	13.1	28.4
2016	6.4	33.2	109.6	13.2	109.9	253.4	274.6	316.5	54.4	16.9	0.0	5.9

**Table 1 Average Monthly data**

## **CHAPTER – 11**

### **GEOLOGY AND MINERAL WEALTH**

#### **GEOLOGY**

Solan District lying within the Lesser Himalaya and the Shivalik foothill comprises rocks ranging in age from Proterozoic to Quaternary. The oldest rocks of undifferentiated proterozoic age belong to the Jutogh group comprising carbonaceous phyllite, Schist, Gneiss, Quartzite and marble. The Sundernagar group of Rocks of Meso-Proterozoic age represented by quartzite with basic flows. The Deoban/Shali Group of Rocks (Meso-Proterozoic) comprising limestone, dolomite, (at Places tromatolytic) Slate & Quartzite occurs along the Main Boundary fault and also in the North-eastern part of the District. The argillo-arenaceous sequence of Shimla/ Jaunsur Group rests unconformable over the Deoban Group and assigned meso-Proterozoic age. Both Shimla and Jaunsaur Group, comprising diamictite, pink dolomite, carbonaceous shale and slate besides quartzite bands. The Krol Group, which overlies the Balaini Group, is dominantly a carbonaceous sequence with minor shale and sandstone. The Regional Geology and the General Stratigraphy of the Solan District are as given below:-

In the western side of the Solan District Shimla Group of rocks are exposed. It is divisible into four formations on the basis of certain characteristic lithological association and order of super position. Out of four formations, three are exposed in the Solan District.

<b>Formation</b>	<b>Member</b>	<b>Litho logy</b>	<b>Remarks</b>
<b>Sanjauli</b>	Upper	Conglomerate, arkosic sandstone, Proto quartzite, Grey and Purple Shale.	Exposed in Shimla
	Lower	Greywacke sandstone, Greywacke Siltstone, Shale and Siltstone alternation, Ortho quartzite.	
<b>Chhoasa</b>		Shale and siltstone alternation with siltstone and orthoquartzite.	
<b>Kunihar</b>		Shale and siltstone alternation with limestone.	

<b>Basantpur</b>	D.	Thick bedded to platy grayish blue limestone with interbedded shale.	Partially exposed in Shimla Distt. And partially exposed in Solan District.
	C.	Massive to bedded limestone-Dolomite.	
	B.	Shale, siltstone with interbeds of lenticular limestone; shale is Sporadically carbonaceous. Impersistent band of Quartzite and dolomite.	
	A.	Greyish white Quartzite and conglomerate	

----- **Unconformity** -----

The best development of the Basantpur formation is exposed between Tal village near Arki, pass Ghiana and northward up to the Satluj.

Kunihar formation succeeds the Bilaspur formation and is best developed in the vicinity of Kunihar and traceable from Kakarhatti to Bamot. Along the Kalthu Dhar, the limestone interbeds are exposed which contain algal, stromatolites.

Kunihar marks the contact between the former and the Chhaosa where the Kunihar latterly pinches out to facies, the Chhaosa directlt overlies the Basantpur.

The best development of the Chhaosa formation can be seen along the Shimla- Bilaspur highway between Danoghat and Theog.

In the Eastern side of the Solan District, Shimla sequences are succeeded by a younger sequence of formation designated as the Blaini, Infra Krol forming two parallel and apparently independent belts. These are respectively referred to as the outer Krol Belt over the Shimla Group and the inner Krol Belt over the Jauansar Grup. The Krol Hill, Kamli-Dhar synclinal complex belong to the outer Krol Belt. Blaini formation is seen from Halog towards the Giri Valley in the South-East and then extends towards Nago Dhar in the North. The Blaini forms the base of the infra Krol-Krol sequence of outer Krol Belt.

**Outer- Krol- Belt**

Formation	Member	Lithology
	E-	Pale calcareous sandstone, Quartzarenite
		1. Banded grey and pale cream white calcilutite with interbeds of red and black shale.
		Alternation of cherty limestone and shale
	D	Rare conglomerate and sandstone.
		Massive dark blue dolomite
	C-	
<b>Krol Formation:</b>	B-	2. Calcilutite
	A.	1. Red shale with subordinates green shale and thin dolomite and limestone.
		2. Dolomite, oolitic limestone.
		Alternation of calcilutite and shale, argillite.
<b>Krol Sandstone</b>		Quartzarenite and friable sandstone with fragments of phosphatic shale
<b>Infra Krol</b>		Black shale and slates closely interbedded with thin bands of Infra Krol, slaty Quartzite.

**Blaini Group**

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**Shimla Group**

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In the Solan area the black shale of Infra –Krol pass up through a transition unit of shale and slate Quartzite of Krol sandstone. North- West of Solan, development of thin bedded sand stone is noticed. Krol sandstone formation as generally massive and pale grey and coarse to medium grained rock. The friable variety is mainly developed in the Solan- Barog area.

The Tal Group of Early Cambrian age is heterolithic sequence of siltstone, dolomite, shale, ash grey tuff, chert/ phosphorite, carbonaceous shale, grit and quartz arenite and recorded algal structures and trilobite. Subathu Formation is composed of olive green shale, limestone, quartzite and laterite. The Sirmour Group is represented by a thick pile of palaeogene sediments exposed in the foothill, bounded by the Main Boundary Fault and Krol Thrust. It comprises shale, fossiliferous limestone, quartz arenite, siltstone,

clay, sandstone and local pebble bed. The Shiwalik Group of Middle Miocene and Early Pleistocene age comprises coarse clastic fluviatile deposits of sandstone, clay and conglomerates. The Quaternary sediments (Older Alluvium and Newer Alluvium) along prominent channels consisting of sand, silt, clay, pebbles and cobbles of Middle to Late Pleistocene and Holocene age.

The general trend of the rocks is NW-SE and E-W directions with dip varying from 10 to 40 on either side. Beside Main Boundary Fault, Krol, Giri, Chail and Jutogh Thrust, two major synformal axes running NW-SE also passes through Krol and Tal Group of rocks.

Nalagarh, Barsar and Bilaspur thrust are in general parallel to the Main Boundary Fault. The Pinjaur Dun is developed between the detached anticlinal ridges of Siwalik molasses (mainly Upper Siwalik Formation) in the south and Lower Tertiary (Dagshai, Kasauli and Subathu)/ Tertiary (Lower and Middle Siwalik) rocks in the North. Subathu, Dagshai and Kasauli formations occurrence within foot-hill Palaeogene belt are termed as Sirmour Group of rocks. They extend from the Ravi to the Yamuna in the Himachal Himalaya

**Lithostratigraphic Classification of the Sirmour Group**

<b><u>Formation</u></b>	<b><u>Member</u></b>	<b><u>Lithology</u></b>
Kasauli		Massive sandstone, subordinate shale
Dagshai	Pabo Chimnum	Alternation of sandstone and clay. Red, Green and Indigo blue coloured Mudstone, Shale, Quartzarenite.
Subathu	B.	Green Shale. Foraminiferal limestone and oyster marls, Quartzarenite, local Carbonaceous shale, calcareous sandstone.

In the main belt, the base of the Subathu formation is exposed at Subathu town, there is considerable tectonisation along the contact. The sabathu of the Himachal Foot-hill Palaeogene belt at places contain phosphatic nodules with olive green shales. This sequence contains fossils like Gastropods and divergent terrestrial vertebrates.

The Dagshai formation overlies the Subathu formation along a gradational contact. No break in sedimentation is noticed. The rocks of this formation are characterized by the presence of purple sandstone and clays with pink clay conglomerate and also grey sandstone. This formation is well developed/exposed at Kasauli.

The Kasauli Formation comprises essentially of sandstone with subordinate shale. From Dagshai to the Kasauli, the contact is normal and transitional. This formation is also fossiliferous contains plant fossils.

The close of sedimentation of the Sirmour basin almost coincided with the development of a new fore deep to its South for a new cycle of sedimentation of the Siwalik Group. The period witnessed a southward migration of the Cenozoic basin.

The rocks of the Sirsa Catchments are represented by the Siwalik Group, Older Alluvium and Newer Alluvium. The stratigraphy of the Sirsa catchments with lithology of the area is as given below in the table:

**Lithostratigraphy of the Kothiwal Khol catchment and its Surrounding**

<b><u>Group</u></b>		<b><u>Lithology</u></b>	<b><u>Age</u></b>
Newer	Chhanel Alluvium	Grey micaceous, fine to coarse grained sand, silt and clay. Cyclic sequence of grey clay micaceous sand, silt and clay. Brownish grey clay, sand and gravel boulders.	Quaternary
Older	Dun Alluvium Gravels	Multi cyclic sequence of brown to grey silt, clay with	

Siwalik Group	Upper Siwalik	Sand stone, clay and conglomerate alterations. Massive sandstone with minor conglomerate and local variegated clay stone.	Neogene
	Middle Siwalik  Lower B  Lower A	Predominantly medium to course grained sandstone and red clay alterations, soft pebbly with sub ordinate clay stone, locally thick prisms of conglomerate. Alteration of fine to medium Siwalik grained sporadically pebble sandstone, calcareous cement and prominent chocolate and medium maroon clay stone in the middle part. Red mauve clay stone with thin intercalations of sandstone.	

The Dun is boarded by Nalagarh thrust in the north and detached Siwalik hills (mainly comprising of **Upper Siwalik**) in the south. With in the Dun, Quaternary sediments are exposed as Alluvial fan and river terraces. North of Nalagarh thrust, Tertiary (**Siwalik Group**) and lower Tertiary (**Subathu Group**) rocks are exposed. The Sub Himalaya, the Southern most division of the Himalaya, is separated from the Lesser Himalaya by the Main Boundary Thrust (**MBT**) in the north and southern boundary is demarcated from the Indo-Gangetic Plain by the Himalayan frontal Fault (**HFF**). The northern part of the Sub-Himalaya is characterized by a series of intrabasinal thrusts.

The Nalagarh Thrust marks the northern boundary of the Dun, which brought the Tertiary/Lower Tertiary rocks over the quaternary Dun sediments. The Satluj River and its tributaries are the major drainage system in the Dun. The Satluj River flows in a longitudinal course from the north west to the southeast, whereas its tributaries originate from the higher reaches of Sub- Himalaya, between Nalagarh Thrust and Main Boundary.

Thrust and flow in transverse courses in a South- Southwest direction. The catchments areas of these piedmont rivers (tributaries of Satluj) are mainly comprised of Lower Tertiary and Tertiary (Lower and Middle Siwaliks ) rocks. Mudstones and sandstones are the predominant rock types in the Lower and Middle Siwaliks, respectively. The important geomorphic features observed within the Dun basin are alluvial fans and river terraces. Alluvial fans are fan- or cone-shaped sedimentary bodies that accumulated at the base of the Sub-Himalayan mountain front, south of Nalagarh thrust, down slope from the point where the piedmont rivers emerge from the uplands. Extensive road cuttings and river cuts provide an excellent opportunity to examine nearly continuous exposures (from fan head to toe and transverse view) of these fan sediments. A series of alluvial fans are observed exposed around present-day rivers, between Kiratpur in the West and Pinjaur in the East. Many alluvial fans are exposed around Luhund Khad, Kundlu-ki-khad, Chikni and Mahadeva River etc. The Kundlu-ki- Khad fan is about 15 Kms. long and 6 Kms. wide, whereas the Luhund Khad fan is about 11 Kms. long and 7 Kms.wide.

### **Siwalik Group:**

The Siwalik deposits are one of the most comprehensively studies fluvial sequences in the world. They comprise mudstones, sandstones and bedded conglomerated laid down when the region was a vast basin during Middle Miocene, to Upper Pleistocene times. The sediments were deposited by rivers flowing southwards from the Greater Himalayas, resulting in extensive multi-ordered drainage systems. Following this deposition, the sediments were uplifted through intense tectonic regimes (commencing in Upper Miocene times), subsequently resulting in a unique topographical entity i.e. the Siwalik Hills. The Siwaliks are divided stratigraphically into three major Sub-groups-Lower, Middle and Upper. These Sub-groups are further divided into individual formations that are all laterally and vertically exposed today in varying linear and random patterns.

Ongoing erosion and tectonic activity has greatly affected the topography of the Siwaliks. Their present-day morphology is comprised of hogback ridges, consequent, subsequent, obsequent and resquent valleys of various orders, gullies, chose

(seasonal streams ), earth-pillars, rilled earth buttresses of conglomerate formations, semi-circular chise-divides, talus cones, colluvial cones, water-gaps and chise terraces. Associated badlands features include the lack of vegetation, steep slopes, high drainage density and rapid erosion rates.

In the advent of Neogene, a depression was formed in front of the rising mountains (Proto-Himalaya). This depression becomes a repository of a thick sequence of molassic sediments of the Siwalik. The Siwalik Group comprises of conglomerates, friable micaceous sandstone, siltstone and clay stone.

The conglomerates in general are poorly cemented but at places they are very hard. These consist mainly of pebbles and cobbles of quartzite. The stray pebbles of granite, limestone, sandstone, breccia and lumps of clay stone are also observed at places. Often the size of pebbles is large enough to be called as boulders. The conglomerates not only occur as regular band but also as lenticular bands with alternative with micaceous sandstone and claybeds.

The sediments were brought down 2 to 25 million years ago by the numerous fast flowing rivers issuing forth from rapidly rising Mountain mass of the Himalaya, in the north.

The Siwalik Group is divisible into three sub-groups respectively the Lower, Middle and Upper on the basis of the lithostratigraphy as given in the table.

**a. Lower Siwalik:**

The Lower Siwalik consists essentially of a sandstone-clay alternation. In District Solan, the lower sequence of the lower Siwalik consists of medium grained sub graywacke inter bedded with thick red clay, but higher up in sequence, sandstones are coarser and clasts become more frequent while the clays are less developed. The uppermost horizon consists of conglomerate with well- rounded clast of grey quartzite possibly derived from the Shali. The total thickness is about 1600 Mtrs.

**b. Middle Siwalik:**

The Middle Siwalik Sub-group comprises of large thickness of coarse micaceous sandstone along with some interbeds of earthy clay and conglomerate. It normally succeeds the Lower Siwalik along a gradational contact. The sandstone is less sorted than those in Lower Siwalik. Clay bands are dull coloured and silty. The general thickness is 1400 to 2000 mtrs.

**c. Upper Siwalik:**

The Upper Siwalik is mainly represented by sandstone interbedded with silt and conglomerate. The lower portion of the Upper Siwalik mainly consists of soft, massive, pebbly sandstone with intercalations of conglomerates. In the upper portion, the conglomerate intercalation is replaced by the clay intercalations. The general thickness in the District is about 2300mtrs.

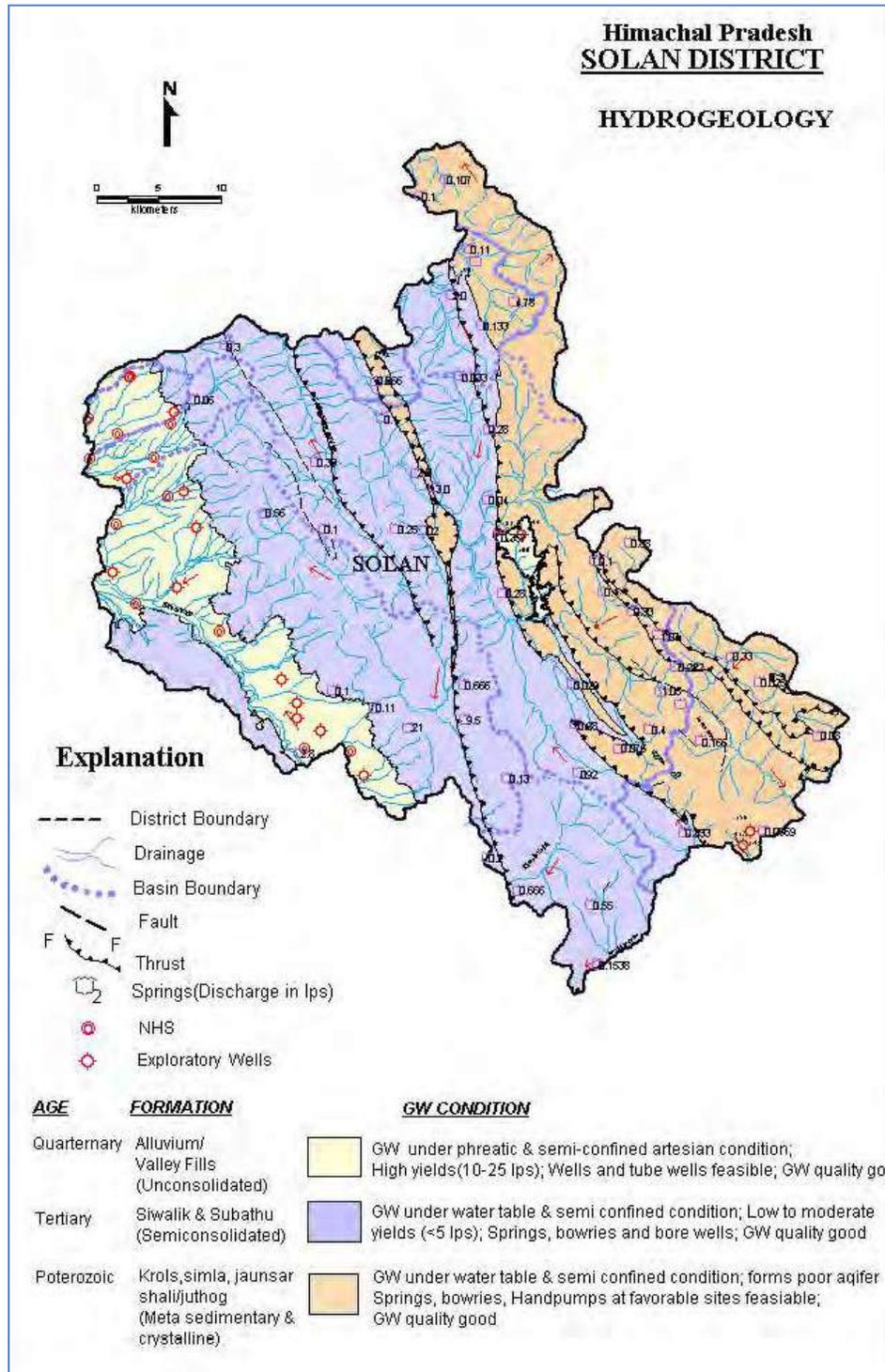
**8.2 Older Alluvium:**

The Older Alluvium in Dun valley is designated as Dun gravels while in the plains as Varanasi (Ambala). It is a multicyclic sequence of brown to grey silt, clay with Kankar and reddish brown to grey micaceous sand with pebbles.

**8.3 Newer Alluvium:**

Newer Alluvium has been subdivided into Fan Alluvium compassing of brownish grey clay, sand and gravel sequence, lies disconformable over Older Alluvium within a narrow zone immediately to the south of Siwalik hill and terrace alluvium exposed as depositional terraces of Satluj and Sirsa River and comprising of cyclic sequence of grey, micaceous, fine to coarse grained sand, silt and clays. Channel Alluvium exposed as point bar/channel bars within the active channels is composed of grey, fine to coarse micaceous sand and silts.

A number of minerals are found in the District but most of them except limestone and minor minerals like sand, stone and gravel are in insignificant quantity. These minerals are Barytes, Coal, Copper ore, Gypsum, Lead ore and Phosphate. There are huge deposits of limestone available in the District are as under (Geological Map of Solan District annexed as Annexure-1).



## **MINERAL WEALTH**

### **1. Bauxite:**

In District Solan the Bauxite has been reported in Deothal area ( $30^{\circ} 51' : 77^{\circ} 10'$  ). The Bauxite occurs as pisolitic ore having a thickness of 1 to 5 metres traceable for about 1.5 Km.

### **Barytes:**

The Barrytes have been reported in District Solan near Subathu ( $30^{\circ} 58' : 76^{\circ} 59'$  ), Haripur ( $31^{\circ} 01' : 76^{\circ} 59'$ ) and Sair ( $31^{\circ} 05' : 77^{\circ} 03'$ ). The Barrytes occurs in lenticular bands.

### **Copper:**

An old Copper mine was in existence near Solan ( $30^{\circ} 55' : 77^{\circ} 07'$ ) in Shimla Group of formation.

### **Gypsum:**

Gypsum occurs in Eocene rocks about 3 Km to the South-East of Subathu ( $30^{\circ} 58' : 76^{\circ} 59'$  ). Pockets of Gypsum occur in the area and in the nallas draining into Kuthar River from the western ridge 5 Kms. South-West of Subathu. The purple indurated clay of Dagshai near Dubrughat contains pockets of gypsum along the Bhakalag ( $30^{\circ} 00' : 76^{\circ} 57'$ ) - Dhundan ( $30^{\circ} 14' : 75^{\circ} 54'$ ) road.

### **Mineral Water:**

There are altogether 5 springs at Jaoni ( $31^{\circ} 32' : 77^{\circ} 50'$ ) the temperature of water is  $55^{\circ}$  C and water is clear with disagreeable sline and deposits ferruginous matter.

### **Rock Phosphate:**

The rock phosphate in Dati Deeb ( $30^{\circ} 12' 30'' : 76^{\circ} 56' 30''$ ) occurs as pellets in the green facies rocks of Subathu Formation. The sandstone and limestone of A Formation of the Krol Group are found to be phosphatic in Deoria ( $30^{\circ} 50' 30'' : 77^{\circ} 11' 15''$ ) area.

In Patta ( $31^{\circ} 21' 45'' : 76^{\circ} 55' 45''$ ) and Rakhalong Dedo ( $31^{\circ} 10' 00'' : 76^{\circ} 56' 40''$ ) areas, phosphatic nodules occur in the brown shales of Subathu Formation. The nodule varies in size upto 26 cm and contains 32%  $P_2O_5$ .

**Limestone:**

**Arki Limestone Deposit:**

The limestone belt of Arki is about 2Kms. NNW of Arki town, which is the Tehsil headquarter of Solan District, Arki is 39Kms. From Shimla via Shalaghat the State Headquarter & 58Kms. from Solan via Subathu. It lies between longitude  $76^{\circ} 58' 02''$  and  $76^{\circ} 56' 24''$  E and Latitudes  $31^{\circ} 11' 15''$  and  $31^{\circ} 9' 36''$ N.

**Nature of deposit:**

Limestone deposit of Arki area belongs to Basantpur formations of Shimla group of rocks & predominantly it is composed of limestone, dolomite and shales & siltstone.

**Reserves:**

Total mine able reserves of steel grade limestone have been proved to the tune of 119.06million tones. The said deposit has been leased out to NMDC for exploitation of the said reserves for further supply to Steel authority

**Quality:** Average grade of limestone up to the depth of 146 mtrs. is as below:

<b>CaO,</b>	<b>MG0,</b>	<b>SiO<sub>2</sub>,</b>	<b>Fe<sub>2</sub>O<sub>3</sub>,</b>	<b>Al<sub>2</sub>O<sub>3</sub>,</b>	<b>L.O.I</b>
53.46%	1.48%	0.50%	0.35%	0.27%	53.46%

**Bagha-Bhalag Limestone deposit:**

The deposit lies on the border of District Bilaspur and Solan. The Majority of limestone is exposed around village Bagha, tehsil Arki, Distt. Solan, H.P. and is located at a distance of 6 Kms. from Kharsi Falling on Darla Mor-Beri Road. Kharsi is 16Kms. away from Darla Mor towards Beri which onwards falls on National Highway No. 88 i.e. Shimla-Hamirpur-Mataur.

**Nature of Deposit:**

The limestone belongs to Sorgharwari Member of Shali formation comprises of pink and grey with thin shale partings. The rock units exposed in Bagha area forms a plunging syncline in which pink and grey limestone is refolded into minor syncline

and anticline thereby increases the thickness of the deposits. The limestone overlies the dolomites of Khatpul member and is well bedded and laminated with Shale partings.

**Average Chemical Analysis of the Limestone is as under:-**

Pink Limestone

CaO,	MgO,	SiO <sub>2</sub> ,	Fe <sub>2</sub> O <sub>3</sub> ,	Al <sub>2</sub> O <sub>3</sub> ,	L.O.I
46.81%	2.44%	9.00%	0.55%	1.17%	38.02%

Grey Limestone

CaO,	MgO,	SiO <sub>2</sub> ,	Fe <sub>2</sub> O <sub>3</sub> ,	Al <sub>2</sub> O <sub>3</sub> ,	L.O.I
40.00%	1.75%	20.00%	1.20%	2.80%	33.00%

**Reserves:**

The grey and pink limestone in the area rises from 1020 mtrs. to 1640mtrs. R.L. from the M.S.L. The total reserves inferred in the area are to the tune of 295 million tones out of which 95 million tones have been proved by drilling up to 1300 mtrs. R.L. from the M.S.L.

On the said deposits mining leases has been granted in favour of M/S Jay Pee Cements and company has established factory of 2.45 Million Tonn per annum at Bagha

**Kashlog-Mangu Limestone Deposit:**

\_ The deposit is at a distance of 10 Kms. From Kararaghat falling on Shimla- Bilaspur road at a distance of nearly 40Kms. From Shimla.

**Nature of Deposits:**

Limestone exposed in the area belongs to Basantpur formation of Shimla group of rocks. It is light grey, dark grey & blackish in colour. Hard compact & crises-crossed by calcite veins. General trend of rocks in the area is NW-SE dipping NE form 22<sup>0</sup> to 54<sup>0</sup> in amount.

**Total Reserves:**

Total reserves proved by drilling upto a depth of 100 mtrs. are to the tune of 130 million tonnes whereas estimated reserves are to the tune of 200 million tonnes.

Quality: Average chemical analysis of limestone is as under:

<b>CaO%</b>	<b>MgO<sup>2</sup>%</b>	<b>SiO<sup>2</sup>%,</b>	<b>R<sup>2</sup>O<sup>3</sup>%,</b>	Total carbonate
				Various from 76% to 97%
48.70	0.93	10.47	1.54	

**CHAPTER – 12**

**RIVER/ STREAM AND AVAILABILITY OF MINOR MINERALS**

The description and details of the major river and streams w.r.t. the availability of mineral is as under:-

**a). LOHAND KHUD:-**

- A tributary of Satluj River.
- Altitude at the origin - 500 mtrs. above mean sea level  
(Near Village Kothi)
- Total length - 11.5 Kms.
- General Width - 80-100 mtrs.
- Climate of Catchments - Humid.
- Seismicity -Seismic Zone-iv
- General slope: - 8<sup>0</sup> to 10<sup>0</sup> up to first 5 Kms.  
5<sup>0</sup> to 7<sup>0</sup> from 5 Kms. Onward up to  
Entrance point in Punjab.
- Total catchments are - 38 Sq. Kms.
- General direction of flow -NNW-SSE.

**Geological condition:**

The tributary flows through the moderately low hills and intervening valley of the Siwaliks and flood plains. The area is represented by admixture of Boulders, Cobbles, Pebbles and sand of Flood plain. The banks are controlled by stable lands. Therefore Geo-technically, the area is represented by Himalayan fore deep zone and structural ridges and valleys. The rocks belong to quaternary age.

Both the banks are stable and banks of flood plains are represented by lowslopes. The competency of the river is much up to 500 mtrs. Contours. All catchments area are represented by Middle Siwalik of Siwalik Formation. The carrying capacity is very less right from its origin to the entrance point in Punjab area leading to 2 to 4cm annual deposition of minerals.

The total calculation of boulders, river born bajri and sand is done by taking average %age of each mineral, but it may differ at specific site, depending upon the type of land form competency/capacity at that particular place.

**Total potential (M.T.) of minor mineral in the bed (up to 1 Mtrs. depth):-**

**Total Minor Mineral available in the bed = 1366200 M.T.**

Total boulder available in the bed 40% (approx.) = 546480 M.T.

Total sand available in the bed 30% (approx.) = 409860 M.T.

Total sand available in the bed 30% (approx.) = 409860 M.T.

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<b>Annual replenishment</b>	<b>Boulder 40%</b>	<b>Sand 30%</b>	<b>Bajri 30%</b>
<b>Total 40986 M.T.</b>	16394.4 M.T.	12295.8 M.T.	12295.8 M.T.

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Hence keeping into consideration the field observations and the availability of minor minerals, 40986 M.T. of the minerals can be allowed to be lifted from the river bed.

As the recommendation for grant of mineral concessions is based on the individual observations made during reconnaissance. Hence, the site specific observation/ conditions as specified by the Joint Inspection Committee and provisions for grant of mineral concession provided under various Acts, Rules & Policies may also be taken into consideration.

**b). RATTA NADI:-**

**General:**

- A tributary of Satluj River.
- Altitude at the origin - 500 Mtrs. above mean sea level  
(Near Village Chhoti Batauli).
- Total length - 8.5 Kms.
- General width - 60-80Mtrs.

- Altitude at confluence - 360mtrs. above mean sea level  
(Near at Malka Majra).
- Climate of catchments - Humid.
- Seismicity - Seismic zone IV.
- General slope - 8<sup>0</sup>-10<sup>0</sup> upto 2.5 Kms  
-2<sup>0</sup>-4<sup>0</sup> up to from 2.5Kms. onward up to confluence
- Total catchment area - 36.05 Sq.Kms.
- General direction of flow -NE-SW.

The tributary flows through the moderately low hills. Geologically, the area is represented by flood plains. The rocks of both banks are represented by flood plains and are embarked by the stable land. These flood plains belonging to quart nary age. The area is represented by Himalayan fore deep zone and structural ridges and valleys.

Both banks are stable banks of stable land of flood plains. The river banks are very low and hardly demarcated with the course of river bed, hence river bed mining can damage the banks. Thus extra care shall have to be taken at time of mining operations. All the catchment areas are represented by upper and Middle Siwalik formation and flood plains having Boulder/Cobbles/Pebbles and sand etc. Hence during rainy season when competency increases, it brings plenty of sand including Boulders, Cobbles/Pebbles and sand etc. The river bed is having wide width as it runs almost along the flood plains. Hence deposition of the mineral on river bed will increase the lateral erosion due to flat course of the river bed.

The carrying capacity suddenly reduces after 400 Mtrs. above MSL and leading to only 2cm. to 4cm. annual deposition of mineral.

<b>Total potential (M.T.) of minor minerals</b> (up to 1 mtrs. depth)	:	<b>785400 M.T.</b>
Boulders available in the river bed 40%(approx.)	:	314160 M.T.
Bajri available in the river bed 30%(approx.)	:	235620 M.T.
Sand available in the river bed 30%(approx.)	:	235620 M.T.

**Total annual replenishment**

Boulder replenishment in the river bed	40%(approx.)	: 9424.8 M.T.
Sand replenishment in the river bed	30%(approx.)	: 7068.6 M.T
Bajri Sand replenishment in the river bed	30%(approx.)	: 7068.6 M.T
<b>Total</b>		<b>: 23562 M.T</b>

Hence keeping into consideration the field observations and the availability of minor minerals, 23562 M.T. of the minerals can be allowed to be lifted from the river bed subject to the prevailing conditions of various Acts, Rules & Policies for grant of mineral concession and in accordance to the observations/ recommendations of the Joint Inspection Committee.

As the recommendation for grant of mineral concessions is based on the individual observations made during reconnaissance. Hence, the site specific observation/ conditions as specified by the Joint Inspection Committee and provisions for grant of mineral concession provided under various Acts, Rules & Policies may also be taken into consideration.

c). **SARSA NADI:-**

**GENERAL:**

- A tributary of Satluj River.
- Altitude at the origin - 400 mtrs. above mean sea level enters  
In H.P. (near Daso-Majra Village).
- Total length - 35 Kms.
- General Width - 80-100 mtrs. above mean sea level  
enters in Punjab near Village Paswala
- Main tributaries - 6, all are on right bank.
- Climate of Catchments - Humid.
- Seismicity -Seismic Zone-iv
- General slope :- 12<sup>0</sup> to 15<sup>0</sup> up to first 23Kms.  
-1<sup>0</sup> to 2<sup>0</sup> from 23Kms. Onward up to  
Punjab Border.
- General direction of flow -East to West
- Total catchments area -378.05 Sq.Kms.

The said Nadi flows through moderately low hills and all along the foothills of Siwalik Himalayas. The area represented by the flood plains and the deposits on both bank are represented by stable flood plains belonging to quaternary age.

Competency is not much; it brings very less boulders with it during rainy season. Since said river is fed mostly by flood plains and hence during rainy season sand is dominated and filled in the river bed. Since the said Nadi is almost flat, having very less gradient. Thus, carrying capacity is less in Himachal Pradesh as compare to Haryana. Annual deposition of mineral is 2 to 3cms.

The total potentials of minor mineral in the bed (up to 1 mtrs. depth) are given below:-

<b>Total potential (M.T.) of minor minerals</b>	:	<b>4158000 M.T.</b>
Boulders available in the river bed 30%(approx.)	:	1247400 M.T.
Sand available in the river bed 35%(approx.)	:	1455300 M.T.
Bajri available in the river bed 35%(approx.)	:	1455300 M.T.
<b><u>Total annual replenishment</u></b>		<b>103950 M.T.</b>
Boulder replenishment in the river bed 30%(approx.)	:	31185 M.T.
Bajri available in the river bed 35%(approx.)	:	36382.5 M.T.
Sand available in the river bed 35%(approx.)	:	36382.5 M.T.

Hence keeping into consideration the field observations and the availability of minor minerals, 103950 M.T. of the minerals can be allowed to be lifted from the river bed subject to the prevailing conditions of various Acts, Rules & Policies for grant of mineral concession and in accordance to the observations/ recommendations of the Joint Inspection Committee.

As the recommendation for grant of mineral concessions is based on the individual observations made during reconnaissance. Hence, the site specific observation/ conditions as specified by the Joint Inspection Committee and provisions for grant of mineral concession provided under various Acts, Rules & Policies may also be taken into consideration.

d). **BALAD NADI:-**

- A tributary of Satluj River.
- Altitude at the origin - 800 mtrs. above mean sea level  
(Near Chewag springs).
- Total length -17.5 Kms.
- General Width - 50-70 mtrs.
- Climate of Catchments - Humid.
- Seismicity -Seismic Zone-iv
- General slope :-  
-20<sup>0</sup> to 30<sup>0</sup> up to first 2Kms.  
-12<sup>0</sup> to 15<sup>0</sup> from 2Kms.to 6.5Km.  
- 18<sup>0</sup>-20<sup>0</sup> from 6.5Km to 9.5 Km.  
- 8<sup>0</sup>- 10<sup>0</sup> from 9.5Km to 17.5Km.
- General direction of flow -North to South
- Total catchments area -87.50 Sq.Kms.

The tributary flows through moderately steep to low flood plains. The area is represented by Himalayan fore deep zone. The rocks on both banks are represented Middle Siwaliks sandstone and clay bands of Siwalik Formation and in the lower part i.e. from Brotiwala to Baddi, the banks are embarked by flood plains. These formations are belonging to Middle Miocene to early Pleistocene age and Neocene age.

The river shows how the grading effected by geological structures. The point of least competency and carrying capacity coincide with sudden change in lithology. The riverbed where it enters from sand stone formation to flood plains there is sudden increase in the width of the river bed. With the increase of width of bed, the competency and carrying capacity reduces considerably. The carrying capacity of annual mineral deposition is only 3 to 4 cms per annum.

<b>Total potential (M.T.) of minor minerals in the bed:</b>	<b>1386000 M.T.</b>
Boulders available in the river bed 40% (approx.)	: 554400 M.T.
Bajri available in the river bed 30% (approx.)	: 415800 M.T.
Sand available in the river bed 35% (approx.)	: 415800 M.T.
<b>Total annual replenishment of minor minerals in the bed :</b>	<b>48510 M.T.</b>
Boulders available in the river bed 40% (approx.)	: 19404 M.T.
Bajri available in the river bed 30% (approx.)	: 14553 M.T.
Sand available in the river bed 30% (approx.)	: 14553 M.T.

Hence keeping into consideration the field observations and the availability of minor minerals, 48510 M.T. of the minerals can be allowed to be lifted from the river bed subject to the prevailing conditions of various Acts, Rules & Policies for grant of mineral concession and in accordance to the observations/ recommendations of the Joint Inspection Committee.

As the recommendation for grant of mineral concessions is based on the individual observations made during reconnaissance. Hence, the site specific observation/ conditions as specified by the Joint Inspection Committee and provisions for grant of mineral concession provided under various Acts, Rules & Policies may also be taken into consideration.

e). **PALIMAHDEV RIVER:-**

- A tributary of Satluj River.
- Altitude at the origin - 700 mtrs. above mean sea level  
(Near Village Bara & Belh).
- Total length - 22 Kms.
- General Width - 50-60 mtrs.
- Climate of Catchments - Humid.
- Seismicity -Seismic Zone-iv
- General slope:-
  - 25<sup>0</sup> to 30<sup>0</sup> up to first ½ Kms (From upstream).
  - 20<sup>0</sup> to 25<sup>0</sup> from ½ Kms.to 1Km.
  - 18<sup>0</sup> -20<sup>0</sup> from 1Km to 3.5 Kms.
  - 12<sup>0</sup>- 10<sup>0</sup> from 3.5Km to 10Kms.
- General direction of flow -North to South
- Total catchments area -45.75 Sq.Kms.

The tributary flows through moderately steep to low hills. Geologically, the area is represented by Himalayan fore deep zone of structural ridges and valleys. The rocks on both banks are represented by sandstone and clay bands of Siwalik Group belonging to Middle Miocene and in the lower part of the river bed, banks are represented by stable land of flood plains belonging to Neocene age.

The both banks are having stable banks of flood plains and sandstone rocks through all along its course. All catchment area is represented by sandstone and flood plains having boulders of different size cemented with matrix of Sand and Pebble/Cobbles etc. The point of least competency and carrying capacity coincide with sudden change in lithology. The river when it enters from sandstone formation to flood plains, there is sudden increase in width of the valley. The annual deposition of mineral is only 3cm to 4cms as catchment area is mostly represented by sandstone and flood plains.

**Total potential (M.T.) of minor minerals in the bed : 1597200 M.T.**  
**(up to Depth 1 Mtrs.)**

Boulders available in the river bed	40% (approx.)	:	638880 M.T.
Bajri available in the river bed	30% (approx.)	:	479160 M.T.
Sand available in the river bed	30% (approx.)	:	479160 M.T.

**Total annual replenishment of minor minerals in the bed : 55902 M.T.**

Boulders available in the river bed	40% (approx.)	:	22360.8 M.T.
Bajri available in the river bed	30% (approx.)	:	16770.6 M.T.
Sand available in the river bed	30% (approx.)	:	16770.6 M.T.

Hence keeping into consideration the field observations and the availability of minor minerals, 55902 M.T. of the minerals can be allowed to be lifted from the river bed subject to the prevailing conditions of various Acts, Rules & Policies for grant of mineral concession and in accordance to the observations/ recommendations of the Joint Inspection Committee.

As the recommendation for grant of mineral concessions is based on the individual observations made during reconnaissance. Hence, the site specific observation/ conditions as specified by the Joint Inspection Committee and provisions for grant of mineral concession provided under various Acts, Rules & Policies may also be taken into consideration.

f). **KUNDLU RIVER:-**

- A tributary of Satluj River.
- Altitude at the origin - 500 mtrs. above mean sea level  
(Near Village Jharni).
- Total length - 13 Kms.
- General Width - 40-50 mtrs.
- Climate of Catchments - Humid.
- Seismicity -Seismic Zone-IV
- General slope :-  
-20<sup>0</sup> to 22<sup>0</sup> from 2.75 Kms.  
-10<sup>0</sup> to 15<sup>0</sup> 2.75Km to 10.25 Kms.
- General direction of flow -NNW- SSE
- Total direction of flow -53.5 Sq.Kms.

Geomorphologically, the tributary flows through the moderately to low slope angle. All along its course the banks are represented by stable land of flood plains. Therefore river bed mining can be carried out without damage of banks. All the catchment represented by flood plains except near the origin, where it is represented by sandstone and alternate bands of clay. The flood plains consist boulders of different sizes cemented with matrix of sand and Pebbles/Cobbles. The annual deposition of mineral is about 3cm to 4cm as mostly the said river flows with very negligible grade.

<b>Total potential M.T. minor mineral in the bed :</b>	<b>772200 M.T.</b>
Boulders availability in the river bed 40% (approx.)	: 308880 M.T.
Sand availability in the river bed 30% (approx.)	: 231660 M.T.
Bajri availability in the river bed 30% (approx.)	: 231660 M.T.
<b>Annual replenishment of minor mineral are</b>	<b>27027 M.T.</b>
Boulders availability in the river bed 40% (approx.)	: 10810.8 M.T.
Sand availability in the river bed 30% (approx.)	: 8108.1 M.T.
Bajri availability in the river bed 30% (approx.)	: 8108.1 M.T.

Hence keeping into consideration the field observations and the availability of minor minerals, 27027 M.T. of the minerals can be allowed to be lifted from the river bed subject to the prevailing conditions of various Acts, Rules & Policies for grant of mineral concession and in accordance to the observations/ recommendations of the Joint Inspection Committee.

As the recommendation for grant of mineral concessions is based on the individual observations made during reconnaissance. Hence, the site specific observation/ conditions as specified by the Joint Inspection Committee and provisions for grant of mineral concession provided under various Acts, Rules & Policies may also be taken into consideration.

**g). CHIKNI RIVER:-**

- A tributary of Satluj River.
- Altitude at the origin - 360 mtrs. above mean sea level  
(Near Village Ghansot).
- Total length - 8.5 Kms.
- General Width - 50 to 60 mtrs.
- Climate of Catchments - Humid.
- Seismicity -Seismic Zone-IV
- General slope :- -10<sup>0</sup> to 15<sup>0</sup> in 8.5 Kms.
- Total catchment area -56.50 Sq.Kms.
- General direction -NNE to SSW

Geomorphologically, the tributary flows through the moderately to low hills of the Himalayan foothills. The area is represented by the flood plains and the rocks on both banks are represented by stable land of flood plains. Therefore geotechnically the area is represented by Himalayan fore deep zone and structural ridges and valleys. The rocks belong to quarternary age.

The both banks are stable banks of flood plains and are represented by boulders of different size cemented with matrix of sand and Pebbles/Cobbles etc. Hence during rainy season when competency increase it carries Boulders/ Pebble/Cobbles and Sand.

The carrying capacity is very less thus annual deposition of mineral leading to only 3cm to 4cms.

**Total potential of minor mineral in the bed :** **617100 M.T.**

Boulders availability in the river bed 40%(approx.) : 246840 M.T.

Sand availability in the river bed 30%(approx.) : 185130 M.T.

Bajri availability in the river bed 30%(approx.) : 185130 M.T.

**Annual replenishment of minor mineral in the river bed:** **21598.5 M.T.**

Boulders availability in the river bed 40%(approx.) : 8639.4 M.T.

Sand availability in the river bed 30%(approx.) : 6479.55 M.T.

Bajri availability in the river bed 30%(approx.) : 6479.55 M.T.

Hence keeping into consideration the field observations and the availability of minor minerals, 21598.5 M.T. of the minerals can be allowed to be lifted from the river bed subject to the prevailing conditions of various Acts, Rules & Policies for grant of mineral concession and in accordance to the observations/ recommendations of the Joint Inspection Committee.

As the recommendation for grant of mineral concessions is based on the individual observations made during reconnaissance. Hence, the site specific observation/ conditions as specified by the Joint Inspection Committee and provisions for grant of mineral concession provided under various Acts, Rules & Policies may also be taken into consideration.

**h). KARSOLI RIVER:**

**GENERAL:**

- A tributary of Satluj River.
- Altitude at the origin - 350 mtrs. above mean sea level  
(Near Village Banchha).
- Total length - 45 Kms.
- General Width - 20 to 30 mtrs.

- Climate of Catchments - Humid.
- Seismicity -Seismic Zone-IV
- General slope: - -10<sup>0</sup> to 15<sup>0</sup>
- Total catchment area -26.50 Sq.Kms.
- General direction -North to South

Geomorphologically, the tributary flows through the moderately to slope area along the flood plains. Geotechnically, the area is represented by Himalayan fore deep zone of structural ridges and valleys. The both banks are represented by stable land of flood plains belonging to quarternary age.

The both banks are stable banks of flood plains. All catchment area represented by the flood plains having boulders of different size cemented with sand and Pebbles/ Cobbles etc. However in smaller stretch of the river bed, there is very less competency of the river and it is unable to bring with it sufficient quantity of Boulders/ Pebble/Cobbles and Sand as such the carrying capacity is very less. Therefore it is recommended that lifting of Boulders/ Pebble/ Cobbles and Sand further cannot be allowed as it has already been over exploited. However, if there is any private agriculture land falls in the river bed, a mineral concession may be granted.

**i) KAUSHALYA RIVER:-**

- A tributary of Satluj River.
- Altitude at the origin - 900 mtrs. above mean sea level  
(Near Village Koti).
- Total length - 3.5 Kms.
- General Width - 20 to 25 mtrs.
- Climate of Catchments - Humid.
- Seismicity -Seismic Zone-IV
- Total catchment area -35 Sq.Kms.
- General direction of flow - North to South

Geomorphologically, the tributary flows through the moderately steep to steep low hills and intervening valley of Siwaliks/ Dharmshal formation. Geotechnically the area is represented by Himalayan fore deep zone and structural ridges and valleys. of the Himalayan foothills. The rocks on both banks are represented by moderately hard sandstone and alternate clay bands belonging to Middle Miocene to early Pleistocene age.

Both the banks are stable banks of moderately hard sandstone formation. The whole catchment area is represented by hard sandstone having boulders of different size and Pebbles/Cobbles etc. Since the gradient of the riverbed is higher, thereby carrying capacity increases leading to 5cm to 6cm annual deposition of mineral

**Total potential (M.T)of minor mineral in the bed : 101640 M.T.**

Boulders availability in the river bed 60%(approx.) : 60984 M.T.

Sand availability in the river bed 20%(approx.) : 20328 M.T.

Bajri availability in the river bed 20%(approx.) : 20328 M.T.

**Annual replenishment of minor mineral in the river bed: 5590 M.T.**

Boulders availability in the river bed 60%(approx.) : 3354 M.T.

Sand availability in the river bed 20%(approx.) : 1118 M.T.

Bajri availability in the river bed 20%(approx.) : 1118 M.T.

Hence keeping into consideration the field observations and the availability of minor minerals, 5590 M.T. of the minerals can be allowed to be lifted from the river bed subject to the prevailing conditions of various Acts, Rules & Policies for grant of mineral concession and in accordance to the observations/ recommendations of the Joint Inspection Committee.

As the recommendation for grant of mineral concessions is based on the individual observations made during reconnaissance. Hence, the site specific observation/ conditions as specified by the Joint Inspection Committee and provisions for grant of mineral concession provided under various Acts, Rules & Policies may also be taken into consideration.

j). **Mandhala River:-**

- A tributary of Satluj River.
- Altitude at the origin - 600 mtrs. above mean sea level  
(Near Village Koti).
- Total length - 6 Kms.
- General Width - 60-70 mtrs.
- Climate of Catchments - Humid.
- Seismicity -Seismic Zone-IV
- General slope :-  
-10<sup>0</sup> to 15<sup>0</sup> from 2 Kms.  
-5<sup>0</sup> to 10<sup>0</sup> from 2Km onward.
- General direction of flow -NNW- SSE
- Total direction of flow -15 Sq.Kms.

The tributary flows through the moderately low hills and intervening valley of the Siwaliks and flood plains. The area is represented by admixture of Boulders, Cobbles, Pebbles and sand of Flood plain. The banks are controlled by stable lands. Therefore Geo-technically, the area is represented by Himalayan fore deep zone and structural ridges and valleys. The rocks belong to quaternary age.

Both the banks are stable and banks of flood plains are represented by lowslopes. The competency of the river is much up to 600 mtrs. contours. All catchments area is represented by Middle Siwalik of Siwalik Formation. The carrying capacity is very less right from its origin to the entrance point in Punjab area leading to a 2 to 4cm annual deposition of minerals.

The total calculation of boulders, river born bajri and sand is done by taking average of each mineral, but it may differ at specific site, depending upon the type of land form competency/capacity at that particular point.

**Total potential (M.T.) of minor mineral in the bed (up to 1 Mtrs. depth):-**

Total Minor Mineral available in the bed = 514800 M.T.

Total Boulders available in the riverbed 30%(approx.)= 154440 M.T.

Total Sand available in the riverbed 40%(approx.) = 205920 M.T.

Total Bajri available in the riverbed 40%(approx.) = 205920 M.T.

**Total annual replenishment : 12870 M.T.**

Total Boulders availability in the river bed 30%(approx.) : 3861 M.T.

Total Sand availability in the river bed 35%(approx.) : 5148 M.T.

Total Bajri availability in the river bed 35%(approx.) : 5148 M.T.

Hence keeping into consideration the field observations and the availability of minor minerals, 12870 M.T. of the minerals can be allowed to be lifted from the river bed subject to the prevailing conditions of various Acts, Rules & Policies for grant of mineral concession and in accordance to the observations/ recommendations of the Joint Inspection Committee.

As the recommendation for grant of mineral concessions is based on the individual observations made during reconnaissance. Hence, the site specific observation/ conditions as specified by the Joint Inspection Committee and provisions for grant of mineral concession provided under various Acts, Rules & Policies may also be taken into consideration.

**k). Surajpur Chao:-**

- A tributary of Satluj River.
- Altitude at the origin - 520 mtrs. above mean sea level  
(Near Village Satinala).
- Total length - 8.5 Kms.
- General Width - 40-50 mtrs.
- Climate of Catchments - Humid.
- Seismicity -Seismic Zone-IV

- Total Catchment area -11.25Sq.Kms.
- General slope :-
  - 2<sup>0</sup> to 5<sup>0</sup> upto 5 Kms.
  - 5<sup>0</sup> to 10<sup>0</sup> from 5Km to 8 Kms.
- General direction of flow -NNW- SSE

Geomorphologically, the tributary flows through the moderately low hills intervening valley of the Shiwaliks and flood plains. The area presented by admixture of Boulders, Cobbles, Pebbles and Sand of Flood plains. The banks are controlled by the stable land. All the catchment represented by flood plains except near the origin, where it is represented by sandstone and alternate bands of clay. The annual deposition of mineral is about 2cm to 4cm. as most of the said river flows with very negligible grade.

**Total potential M.T. minor mineral in the bed : 504900 M.T.**

Boulders availability in the river bed 30%(approx.) : 151470 M.T.

Sand availability in the river bed 35%(approx.) : 176715 M.T.

Bajri availability in the river bed 35%(approx.) : 176715 M.T.

**Annual replenishment of minor mineral are: 15147 M.T.**

Boulders availability in the river bed 30%(approx.) : 4544.1 M.T.

Sand availability in the river bed 35%(approx.) : 5301.45 M.T.

Bajri availability in the river bed 35%(approx.) : 5301.45 M.T.

Hence keeping into consideration the field observations and the availability of minor minerals, 15147 M.T. of the minerals can be allowed to be lifted from the river bed subject to the prevailing conditions of various Acts, Rules & Policies for grant of mineral concession and in accordance to the observations/ recommendations of the Joint Inspection Committee.

As the recommendation for grant of mineral concessions is based on the individual observations made during reconnaissance. Hence, the site specific observation/ conditions as specified by the Joint Inspection Committee and provisions for grant of mineral concession provided under various Acts, Rules & Policies may also be taken into consideration.

**(l). Banbirpur/ Manpura Khad:-**

This stream is a tributary of Sarsa river. It originates near village Kharyana at an altitude of about 650 metres. It is about 6.50 Kms. In length and flows in East to West direction. The slope angle varies from  $10^{\circ}$  to  $15^{\circ}$  and general width is 50-70 metres. During the reconnaissance of the stream it has been observed that due to suspension of all mining activities since 2011, alluvial deposits have adequately been replenished.

As the recommendation for grant of mineral concessions is based on the individual observations made during reconnaissance. Hence, the site specific observation/ conditions as specified by the Joint Inspection Committee and provisions for grant of mineral concession provided under various Acts, Rules & Policies may also be taken into consideration.

**(m). Kulhariwala Khad:-**

Kulhariwala Khad is a tributary of Sarsa River. It originates from Dhaular PF at altitude of about 650 metres. It is about 7.5 Kms. in length and flows in NNE-SSW direction. The slope angle varies from  $5^{\circ}$  to  $10^{\circ}$  and general width is 40-50 metres. During the reconnaissance of the stream it has been observed that adequate alluvial deposits are available as no mining activities are being carried out in this Khad since long.

As the recommendation for grant of mineral concessions is based on the individual observations made during reconnaissance. Hence, the site specific observation/ conditions as specified by the Joint Inspection Committee and provisions for grant of mineral concession provided under various Acts, Rules & Policies may also be taken into consideration.

**(n). Nanakpur Nadi:-**

This stream of Nalagarh Sub-division is a tributary of Sarsa River and flows in the direction NNE-SSW direction. It has its origin from Banoi PF of Tehsil

Kasauli at altitude of about 900 metres. After flowing for a distance of about 4-5 Kms. in the State, it enters into the State of Haryana near village Khera. The slope angle varies from  $10^{\circ}$  to  $15^{\circ}$  and general width is 40-60 metres. During the reconnaissance of the stream it has been observed that adequate alluvial deposits are available as no mining activities are being carried out in this stream since long.

As the recommendation for grant of mineral concessions is based on the individual observations made during reconnaissance. Hence, the site specific observation/ conditions as specified by the Joint Inspection Committee and provisions for grant of mineral concession provided under various Acts, Rules & Policies may also be taken into consideration.

**(o). Ramnagar/ Kalujhanda Nadi:-**

This stream is the easternmost stream of Nalagarh Sub-division and is a tributary of Sarsa River. Most of the part of this stream falls in the State of Haryana however, it has its origin from Banoi PF of Tehsil Kasauli in the State of Haryana however, it has its origin Banoi PF of Tehsil Kasauli in the State of Himachal Pradesh at altitude of about 900 metres. The slope angle varies from  $10^{\circ}$  to  $15^{\circ}$  and general width is 60-70 metres. During the reconnaissance of the stream it has been observed that adequate alluvial deposits are available as no mining activities are being carried out in this stream since long.

As the recommendation for grant of mineral concessions is based on the individual observations made during reconnaissance. Hence, the site specific observation/ conditions as specified by the Joint Inspection Committee and provisions for grant of mineral concession provided under various Acts, Rules & Policies may also be taken into consideration.

**p). Gamber Khad:**

- A tributary of Satluj River.
- Altitude at the origin - 1120mtrs. above mean sea level  
(Near Village Koti).

- Total length - 107 Kms.
- General Width - 30-50 mtrs.
- Climate of Catchments - Humid.
- Seismicity -Seismic Zone-IV
- General slope :-
  - 10<sup>0</sup> to 15<sup>0</sup> upto 20 Kms.
  - 20<sup>0</sup> to 25<sup>0</sup> from 20Kms to 30.5Kms
  - 10<sup>0</sup> to 12<sup>0</sup> from 30.5Kms to 36.5Kms
  - 12<sup>0</sup> to 15<sup>0</sup> from 36.5Kms to 59Kms
  - 8<sup>0</sup> to 10<sup>0</sup> from 59Kms to 90Kms
  - 20<sup>0</sup> to 25<sup>0</sup> from 90Kms to 107Kms
- General direction of flow -SE-NW
- Total catchment area -15 Sq.Kms.

Geomorphologically, the river flows through the moderately low hills and intervening valley of the Siwaliks and its equivalent formations and flood plains. The area represented by admixture of Boulders, Cobbles, Pebbles and sand of Flood plain. The banks are controlled by sandstone and stable land of flood plains.

The competency of the river is much up to 700 mtrs. Contours. All catchments area is represented by Middle Siwaliks of Siwalik Formation. Since the river stretch is more, and the carrying capacity is very high due to high gradient from the origin to the entrance point in Gobind Sagar. Which may leads to 5-6cms annual deposition of minerals in the river bed.

The total calculation of boulders, river born bajri and sand is done by taking average percentage of each mineral, but it may differ at specific site, depending upon the type of land form competency/capacity at that particular point.

**Total potential (M.T.) of minor mineral in the bed (up to 1 Mtrs. depth):-**

Total Minor Mineral available in the bed	= 5649600 M.T.
Total Boulder available in the riverbed 60%(approx.)	= 3389760 M.T.
Total Sand available in the riverbed 20%(approx.)	= 1129920 M.T.
Total Bajri available in the riverbed 20%(approx.)	= 1129920 M.T.

<b>Annual replenishment of minor mineral in river bed:</b>	<b>=</b>	<b>310728 M.T.</b>
<b>Total availability of minor minerals in the river bed:</b>		<b>2259840 M.T.</b>
Total Boulders availability in the river bed	60%(approx.) :	1355904 M.T.
Total Sand availability in the river bed	20%(approx.) :	451968 M.T.
Total Bajri availability in the river bed	20%(approx.) :	451968 M.T.

Hence keeping into consideration the field observations and the availability of minor minerals, 310728 M.T. of the minerals can be allowed to be lifted from the river bed subject to the prevailing conditions of various Acts, Rules & Policies for grant of mineral concession and in accordance to the observations/ recommendations of the Joint Inspection Committee.

As the recommendation for grant of mineral concessions is based on the individual observations made during reconnaissance. Hence, the site specific observation/ conditions as specified by the Joint Inspection Committee and provisions for grant of mineral concession provided under various Acts, Rules & Policies may also be taken into consideration.

q). **ASNI RIVER:**

**General:**

- A tributary of Satluj River.
- Altitude at the origin - 1100 mtrs. above mean sea level  
(Near Village Paroth).
- Total length - 12 Kms.
- General Width - 10-20 mtrs.
- Climate of Catchments - Humid.
- Seismicity -Seismic Zone-IV
  
- General slope :-  
-8<sup>0</sup> to 10<sup>0</sup> from 4.5 Kms.  
-5<sup>0</sup> to 8<sup>0</sup> from 4.5Km to 8.5 Kms.
- General direction of flow -North to South

Geomorphologically, the tributary flows through the steep to low hills and intervening valley of Jutogh, Shimla Group of Krol Formation. The Valley is controlled by geological structures. Geo-technically, the area is represented by Himalayan fore deep zone and structural ridges and valleys. The rocks on both banks are represented by different types of rocks.

Both the banks are stable and banks of different formations and valley is represented by steep slopes of hard rocks and gentle slope of soft rocks. All catchments area is represented by different formations, hence during rainy season when its competency increases it brings plenty of Boulders/Cobbles/Pebbles and Sand. The carrying capacity is very less right from its origin to the entrance point in Punjab area leading to a 5cm to 6cm annual deposition of minerals.

**Total potential (M.T.) of minor mineral in the bed: = 237600 M.T.**

**(up to 1 Mtrs. depth):-**

Boulders available in the riverbed 50%(approx.) = 118800 M.T.

Sand available in the riverbed 250%(approx.) = 59400 M.T.

Bajri available in the riverbed 25%(approx.) = 59400 M.T.

**Annual replenishment of minor mineral in river bed: = 13068 M.T.**

Boulders availability in the river bed 50%(approx.) : = 6534 M.T.

Sand availability in the river bed 25%(approx.) : = 3267 M.T.

Bajri availability in the river bed 25%(approx.) : = 3267 M.T.

Hence keeping into consideration the field observations and the availability of minor minerals, 13068 M.T. of the minerals can be allowed to be lifted from the river bed subject to the prevailing conditions of various Acts, Rules & Policies for grant of mineral concession and in accordance to the observations/ recommendations of the Joint Inspection Committee.

As the recommendation for grant of mineral concessions is based on the individual observations made during reconnaissance. Hence, the site specific observation/ conditions as specified by the Joint Inspection Committee and provisions for grant of mineral concession provided under various Acts, Rules & Policies may also be taken into consideration.

r). **Daseran River:**

**General:**

- A tributary of Satluj River.
- Altitude at the origin - 1100 mtrs. above mean sea level  
(Near Village Palani Ghati).
- Total length - 4 Kms.
- General Width - 10-20 mtrs.
- Climate of Catchments - Humid.
- Seismicity -Seismic Zone-IV
  
- General slope: - -8<sup>0</sup> to 10<sup>0</sup> in the whole stretch.
- General direction of flow -South to North

Geomorphologically, the tributary flows through moderately steep hills and intervening valleys of the Dharamshala formation. Geo-technically, the area is represented by Himalayan fore deep zone and structural ridges and valleys. The rocks on both banks are represented by sandstone of Dharamshala formations. Both banks are stable banks of sandstone and alluvium. The competency of the river is much less as length of the river bed is very less and whole catchment area is represented by sandstone formation. Thus due to very less competency, the said river may not be put on auction or any type of concessions to anybody may not be granted.