GROUND WATER INFORMATION BOOKLET OF LEH DISTRICT JAMMU AND KASHMIR STATE

NORTH WESTERN HIMALAYAN REGION

CENTRAL GROUND WATER BOARD

JAMMU

MAY 2009

GROUND WATER INFORMATION BOOKLET
OF
LEH DISTRICT, JAMMU & KASHMIR

CONTENTS

LEH DISTRICT AT A GLANCE

S. No	*ITEMS*	*Statistics*
1.	GENERAL INFORMATION	
	i) Geographical area (Reporting area) (sq km)	45110
	ii) Administrative Divisions (2001) • Number of Tehsil & Sub-tehsils • Number of CD Blocks (2006-07) • Number of Panchayats (2006-07) • Number of Villages • Number of Inhabited viallges	 1 9 67 113 112
	iii) Population (2001 Census) • Total population • Population Density (persons/sq km) • Rural & Urban Population • Buddhists & Others Population (in percent) • Sex Ratio	 1,17,232 persons 3 91.37% & 8.63% 77.3 % & 22.70% 823
	iv) Average Annual Precipitation in the form of snow fall (mm)	150 mm
2.	GEOMORPHOLOGY	
	Major Physiographic units	• High table lands of U-Shape valleys developed by glacier erosion and deposition. Important plains are Leh plain, More plain, Hanle plain, Dipsang Plain and Soda plain • Sharp ridges of hard rock • Intervening valleys & River Terraces • Valley fill deposits and scree and talus
	Altitude Range	5934 to 8510 m AMSL
	Major Drainages Indus Basin	Indus, Shyok and Nubra are the main rivers
3.	LAND USE (2006-07)	
	• Forest area • Net area sown • Area under food grains • Fruits and Vegetables • Oil seeds • Fodder	29 Sq. km (estimated) 10187 Ha 8447 Ha 346 Ha 61 Ha 2090 Ha
4.	MAJOR SOIL TYPES	Sandy soil and hilly soils
5.	IRRIGATION BY DIFFERENT SOURCES (MI census 2006-07) (sq km)	
	 Dug wells & shallow Tubewells Surface water Springs Other sources	*Area (sq km)* Nil 101.87 Nil Nil

S. No	*ITEMS*	*Statistics*
6.	NUMBERS OF GROUND WATER MONITORING WELLS OF CGWB (As on 31.3.2007) • No. of Dug Wells • No. of Piezometers	 Nil Nil
7.	PREDOMINANT GEOLOGICAL FORMATIONS	Zanskar Sediments, Lamayaru flysch, Indus flysch, Drass Volcanics, Ladakh Batholith, Khardunga volacanics, granitoids, Kargil Molasse
8.	HYDROGEOLOGY	
	Major Water Bearing Formations	
	1. Consolidated Formations/ Hard Rocks	
	• Yield prospects • GW structures	Low yield -100 to 150 lpm Handpumps and Tubewells at hydrogeologically suitable locations
	2. Unconsolidated layered formations-Valley fill deposits, Gravel, boulders, talus, scree material, moraine deposits in terraces and U-shaped valleys	
	• Yield prospects • GW structures	Moderate yields(300-500 lpm) Deep tubewells and Handpumps
	3.Unconsolidated porous sediments (Alluvium) adjacent to major river	Moderate yields-500-600 lpm Handpumps, dugwells and tubewells
	Avg. Depth to water level	In Valley fill deposits adjacent to rivers water levels is very shallow ranging from 5.00 to 10.00 m bgl and in Terraces and moraine deposits in higher elevations, depth to water level is deep reaching to 60 to 70 m bgl.
9	GROUND WATER EXPLORATION BY CGWB (As on 31.12.2008)	
	• No of wells drilled	24 EW & 1 OW
	• Depth Range (m)	43.00 to 84.00
	• Discharge (lps)	Meagre discharge
11.	GROUND WATER QUALITY	
	Presence of Chemical constituents more than permissible limits EC, F, As, Fe)	All the constituents analysed are under the permissible limits of drinking water standards.
12.	DYNAMIC GROUND WATER RESOURCES	Being hilly district, ground water resources are not estimated

S. No	*ITEMS*	*Statistics*
13.	AWARENESS AND TRAINING ACTIVITY	
	Mass Awareness Programmes	Nil
	Water Management Training Programmes	Nil.
14.	EFFORTS OF ARTIFICIAL RECHARGE & RAINWATER HARVESTING	
	Snow Water Harvesting	Nil
15.	GROUND WATER CONTROL AND REGULATION	
	Number of OE Blocks	Nil
	No of Critical Blocks	Nil
	No of blocks notified	Nil
16.	MAJOR GROUND WATER PROBLEMS AND ISSUES	
	1. Presence of loose and collapsing bouldery formation causing difficulties in drilling tubewells	
	2. Deep water levels in talus scree and moraine deposits	
	3. High hydraulic gradient resulting rapid outflow of ground water from the area and causing hardship during dry season of August to November	

GROUND WATER BROCHURE
OF
LEH DISTRICT, JAMMU & KASHMIR

1.0 INTRODUCTION

Ladakh region consists of two districts Leh and Kargil. Leh with an area of 45110 Sq Km makes it largest district in the country in terms of area. It is situated between 32 degree to 36 degree North Latitude and 75 degree to 80 degree East Longitude. The district is bounded by Pakistan occupied Kashmir in the West, China in the north and eastern part, Kargil in the west and Lahul Spiti of Himachal Pardesh in South East. It is at a distance of 434 Kms from Srinagar and 474 Kms from Manali. Administratively, the district consists of one tehsil and nine CD blocks (Leh, Khaltsi, Nobra, Nyoma, Durbuk, Kharoo, Saspol, Panamic and Chuchol) and 67 Village Panchayats. The district comprises of Leh town and 112 inhabited villages and one un-inhabited village. As per the census 2001, the population of the district is 117232 persons with density of population 3 persons per sq. km. The male and female population in the district is 64306 and 52926 persons respectively with male and female sex ratio of 823. As per census of 1981 the population of the district is 0.684 lacs, which is estimated to have risen to 0.895 lacs during 1991. Population growth rate of 31.96% has been recorded during the decade 1971-81, during 1981-91, it was 31.91% and during 91 to 2001 it was 29.97%. As per 2001 census 75% population is residing in the rural area. But as per the 1981 census about 87.25% of people are living in rural areas. This shows that urban population is growing at much higher rate than the rural population mainly due to migration from rural areas to urban areas.

The main source of Irrigation is canals and an area of 10187 hectares is brought under irrigation by canals. Ground water based irrigation is nil in this district. About 2482 ha of land is under wheat crop, 127 ha of land is under barley, 5216 ha area is under millets, 276 has of area is under pulses and 346 has area is under fruits in this district. Canals irrigate all these crops.

Central Ground Water Board has carried out extensive hydro-geological studies under Ground Water Management Studies in Nubra valley area. CGWB has constructed number of exploratory deep tubewells in this district including Siachin base camp. CGWB has carried out hydrogeological investigations in number of defence establishments in this district and recommended suitable areas for ground water development.

2.0 CLIMATE AND RAINFALL

Ladakh lies on the rain shadow side of the Himalayan. Where dry monsoon winds reaches Leh after being robbed of its moisture in plains and the Himalayan mountain. The district combines the condition of both arctic and desert climate. Therefore Ladakh is often called " **COLD DESERT**"

The main features of this **COLD DESERT** are:

- ✓ Wide diurnal and seasonal fluctuations in temperature with -40°C in Winter and + 35°C in Summer
- ✓ Precipitation is very low with annual precipitation of 10cm mainly in the form of snow.
- ✓ Air is very dry and relative humidity ranges from 6-24%

- ✓ Due to high altitude and low humidity the radiation level is very high. The global solar radiation is as high as 6-7 Kwh/mm (which is among the highest in the World)
- ✓ Dust storms are very common in the afternoon
- ✓ Soil is thin, sandy and porous
- ✓ The entire area is devoid of any natural vegetation
- ✓ Irrigation is mainly through channels from the glacier-melted snow

3.0 GEOMORPHOLOGY AND SOILS

The area is rugged and mountainous with little or no vegetation. The mountains are of sedimentary rocks and are in process of disintegration due to weathering. The altitude varies between 3000-5000 m AMSL. It is drained by the Nubra and Shyok Rivers. The former river takes its origin from Siachian glacier and later originates from South and Central Rimo glacier. The lower altitude is valley foothill and highest being peaks of the Karakoram Range. The area constitutes of well-delineated southeast northwest northeast trending parallel mountain range such as Laddakh and Karakoram range. The area has distinction of highest motorable road in the world passing through Khardungla (5490 m amsl).

Drainage: The area is part of Indus river basin. Two main rivers flowing in this area Nobra and Shyok rivers. **Nubra** is a perennial river and is originated from Siachan Glacier and flows in North west to South east direction. Many nalas originating from the higher peaks of the mountains flow into Nobra. The nalas are locally termed as Lungpa. The main perennial Lungpas are Warshi Lungpa: originating from Warhi glacier, Phukpochhe lungpa originating from Phukpochhe glacier, Panamic lungpa originating from Panamic glacier, Chameshan lungpa, originating from Stondok & Phukatang glacier and Sumur lungpa originating from snow fall at the higher reaches, All these have the origin from Karakoram range and flow in North east to South West direction . The other nalas which flow from South-west to North east direction are - Nyungsted lungpa originating from Nyungsted glacier, Khimi lungpa originating from Khimi glacier, and Kubed lungpa originating from Kubed glacier.

Syok River is also a perennial river and it originates from South Rimo Glacier and Central Rimo Glacier. On the way it meets many small glaciers such as Chong Glacier, Thangman Glacier and Tash Glacier. It initially flows in Northwest to South east direction. It takes a turn toward North- west near village Shyok . It meets Nobra river near Disket. In Nobra block, there are many perennial and ephemeral rivulets. The main rivulets which flows from north to south and meets Shyok river are Starga Lungpa, Fastman lungpa – originating from Thursa Glacier, Warshi Lungpa - originating from Urdolep Glacier. The rivulets flowing from south to north in direction and join Shyok river are Khalsr Dok, Tashi lungpa, Sumdo N, Glachurap N, Taru lungpa, Yaglung lungpa, and Malasha N.

Lake: There is a lake in the valley called as Panamic lake. This lake is of small dimension.

The soil of the district is sandy to loamy in nature and deficient in organic matter and availability of phosphorus and potashes low and mixed with stones and gravels. It is shallow in formation, weak friable and being sandy it is vulnerable to all types of erosion. Soils developed on river terraces highly porous and coarse grained in nature. Fertility of the soil varies from place to place and growing season is very short.

4.0 GROUND WATER SCENARIO

4.1 GEOLOGY

The rocks of the district constituted by igneous, metamorphic and sedimentary rocks that are sandwiched Tertiary granitoid batholith of Ladakh and Karakoram. Five megmatic cycles have been established. Viz the Shyok volcanics composed of basalt and andesite. Khardung acidic volcanics of non marine lava flows, emplacement of granitoids on regional scale and porphyritic andsetie eruption of the Saltoro hills. The area remained magmatically active from Cretaceous to post-Oligocene time. The upper Cretaceous–Eocene flyschoidal sediments are exposed along the south of Saltoro hills constituted of shale and limestone. The Stratigraphic correlation of Indus and Nubra Valley is given in the table below

Table :- The Stratigraphic Correlation of Indus and Nubra Valley

Period	Nubra Valley	Indus Valley
Pleistocene Miocene	Saltoro Molasse, andesite, acid and basic dykes	Kargil Molasse
Oligocene Eocene	Khardung Volcanics Granitodes of Saltoro	Ladakh Batholith
Early Eocene Cretaceous	Saltoro flysch , ophiolitic mélange and Shyok Volcanics	Indus flysch, Indus ophiolitic mélange and Drass Volcanics
Triassic Permian	Karakoram metasediments	Lamayuru flysch ,Zanskar sediments

4.2 Hydrogeology

The district is underlain by consolidated formation in maximum part. Ground water in these formations occur in fissures and fractures developed due to repeated tectonic activity. Large scale ground water development is not possible in consolidated formations but limited development of ground water resources can be taken up. As the settlement pattern of people in this district mainly concentrated in the river valleys and few broad valleys formed due to erosional activity of glaciers, ground water development in these areas is of utmost importance. The unconsolidated formations like alluvium, scree and talus formations present along the river valleys plays an vital role in terms of occurrence and movement of ground water. Ground water resources of these formations can also be developed on sustainable basis These moraine formations (Talus and scree formations) consists of boulders and clasts in a matrix of sand, silt, clay and gravel. The aquifer is made up of boulders and clastic material in clay, silt and sand matrix. Depth to water levels in moraine formations is very deep and varies between 60 to 75 m bgl. The valley fill deposits are mainly boulders and gravel mixed with silt and sand material. This is mainly transported material lying un-sorted in the recent river valleys. Ground water occurs as un-confined condition in this formation. Depth to ground water is in contiguous with river water table and is very shallow to as deep as about 25 m bgl.

Leh valley plains are underlain by morainic deposits consisting of boulders, cobbles, pebbles embedded in an arenaceous matrix and the lake deposits comprising predominantly of clays, sandy clays and silt. Varved clays overlie the sediments and silts of lacustrine origin again succeeded by morainic boulders and cobbles in disintegrated loose sandy matrix and alluvial deposits. The Nubra and Syok valleys are underlain by Glacio-fluviatile deposits. These deposits are constituted of sand,

gravels, and glacial boulders. Apart from Glacio-fluviatile deposits sand dunes are also found along southern side of Shyok river near Disket and Hunder. Flood plain from the north of Kalsar to Suspension bridge (Sammor) comprises of fluvial sand, gravels, pebbles and boulders. The porous formation along Nobra and Shyok river can also promise the potential zones for ground water development.

Ground Water Exploration by CGWB is confined to Leh Plains and Nubra Valley. A Total 16 exploratory wells, beginning from the year 1973 have been drilled in the district upto 1997. It is concluded that depth to water level in the constructed wells ranges from 1.30 m bgl at Zorawar fort to 43.36 m bgl at ITBP II site. The yield obtained from these wells ranged from 197 lpm for 16.57 m drawdown at Skalzangling to 1600 lpm for a drawdown of 3.0 m at Pituk site. Ground water exploration activities again resumed in the Leh district during the AAP 2005-2006. A total no. of 08 exploratory tube wells and 01 Observation well were constructed in Leh plains and Nubra Valley. The Depth of tube wells ranges from 43 m at Siachen to 84 m at Patter Sahib and the yield varies from 1000 lpm at Patter Sahib to 1200 lpm at Siachen Base-III. The transmissivity values ranges between 204 to 28465 m^2/day. In Nubra valley, PHE department for meeting the water supply to the villagers has constructed a number of hand pumps. It is revealed that depth of these hand pumps ranges between 21.336 m in Disket to 51.816 m in Diskit Khemathong. The depth to water level ranges between 9.75m in Disket to 34.74m in Quarter Diskit.

4.3 Springs

During the hydrogoelogical investigation in 2004-05, eighteen springs were inventoried. A perusal of the data reveals that yield from these springs ranges from 1.5 lps (Yulkum) to 290 lps (Boudang). These springs normally are being used for domestic purpose, but they also serve as the source of irrigation. The springs are the prominent seepage zone of the area, which receives their recharge from glaciers located at the higher altitude. These springs are present at the contact of valley fill deposits with the older formations and also along week zones, such as fractures, faults and thrust zones. Hot water springs are located near Pananic and Changlum along thrust zones. The springs are yielding (9 – 20 lps) nearly boiling water (95ºC) at the source point, which infers that the ground water is oozing from the deep-seated thrust zone.

4.4 Ground Water Resources

The district is predominantly hilly terrain, ground water resources can not be estimated and quantified. Ground water development through construction of tubewells and hand pumps is very much possible in this district. Till date ground water development in this district is in nascent stage. People mainly depend on surface water sources and springs for meeting water supply requirements. Thus the stage of ground water development is very minimum. As per the data provided by PHE department, the number of villages covered by piped water supply is 112 and population covered is 0.70 lakhs. PHE has constructed 42 tubewells and 7 dugwells during 2001-02, 13 tubewells and 7 dugwells each during 2002-03, 2003-04, 2004-05, 2005-06 respectively.

4.5 Ground Water Quality

CGWB has carried out scientific Ground Water Management studies in parts of Leh district. The quality of ground water in the area is fresh and potable. The Electric Conductance ranges between 37 μ mho/Cm (Khardung Chik-chik) to 760 μ mho/Cm (Panamic Yogma). The exceptional value of 1073 μ mho/Cm is recorded in water sample lake (Panamic Lake). The pH values ranges between 7.1 (Murgi) to 8.8 (Skampuk-TW) The pH value of lake sample at Panamic Yogma village is recorded to be 9.2 .

4.6 Status Of Ground Water Development

Ground water development in the district is on moderate scale restricted to the valley portions. All the major irrigation and drinking water supplies depend on natural springs, rivers and nallas. Recently PHE department constructed hand pumps in villages to mitigate the drinking water problems. Public Health Engineering and Irrigation and Flood control departments are the nodal agencies in the district concerned with the water supplies for drinking and irrigation respectively. The depth of the hand pumps is about 60 to 70 m bgl. Few tubewells tapping valley fill deposits are also present in this district, which is being used, mainly for domestic water requirements.

5. GROUND WATER MANAEMENT STRATAGY

5.1 Ground Water Development

Most of the district is concentrated in valley portion drained by major river Indus and its tributaries. In the past development of ground water was mainly through dug wells and percolation wells along the riverbeds, nallas and also some springs has played a major role for sustainable domestic and irrigational purposes. In some of the areas, at present too these are the only sources of water. However, in recent years modern means of ground water development have been employed. Public Health Engineering has been constructing number of hand pumps and shallow-moderate depth tube wells for large-scale water supplies.

5.2 Snow Water Harvesting and Artificial Recharge

Snow water harvesting is a technique of preservation of snow and delaying the melting so that snow melt water is available for longer duration in a year. Selection of sites for snow harvesting shall depends on insolation of an area, wind direction, wind velocity and Relative Humidity.

In the hilly areas roof top rainwater harvesting structures like storage tanks are recommended, while in low hill ranges, check dams and snow water harvesting structure can be adapted. These structures were already constructed by local people on their own initiation and at some places government of Jammu and Kashmir has constructed few snow water harvesting structures.

6.0 GROUND WATER RELATED ISSUES AND PROBLEMS

Because of global climatic changes, springs which are traditional sources of water supply for villages and habitats are getting dried up and causing hard ship to the people. Moreover, it is also being reported that the snow fall during winter period is also reduced. To mitigate the water supply crisis, hand pumps and tubewells can be constructed at suitable locations by deploying the suitable rig units like DTH rig unit or percussion rig units. To avoid failure of tubewells, before selecting the sites,

surface geophysical surveys should be carried out while constructing deep tubewells. Valley fill deposits and moraine deposits are highly productive zones for construction of tubewells, shallow as well as deep tubewells can be constructed for water supply.

7.0 AWARENESS AND TRAINING ACTIVITY

So far neither Mass Awareness Programme (MAP) nor Water Management Training Programme (WMTP) is conducted by CGWB.

8.0 AREAS NOTIFIED BY CGWA/SGWA

As the district is hilly in nature, quantification of ground water resources is not possible. But at present the development of ground water resources is very meagre and ground water resources of valley fill deposits and moraine deposits of terraces can be developed. On terraces, proper recharge structures like check dams and nala bunds can also be constructed to avoid over-exploitation of ground water resources at local level. Till date no area or block has been notified for ground water development.

9.0 RECOMMENDATIONS

- In Valley areas, like Suru valley, Drass valley and Indus valley, ground water resources can be developed by constructing infiltration galleries (Percolation wells) and dugwells. Shallow tubewells can also be constructed by deploying the percussion rig units or DTH rig units.
- In hilly terrain, springs and perennial nallas are the major sources of water. These springs shall be developed based on modern scientific knowledge base and their sources need to protect.
- On terraces which are underlain by moraine formations, deep tubewells of depth about 100 to 120 m are recommended to be constructed for water supply. Hand pumps of depth about 70 to 80 m are also recommended in small hamlets to meet the water supply requirements.
- It is observed that irrigation channels which are carrying irrigation water from higher reaches need to be maintained properly and if require cemented properly so that the water can be transported to greater distances. Along the channels, small ponds can be constructed at suitable locations so that water can be stored in these ponds, which can also acts as recharge structures for the terraces present at lower depths.
- Monitoring of springs both for discharge and quality shall be taken up regularly. Scientific studies shall be taken up to study the source and recharge characters of springs in this district.
- Traditional resources like springs needs to be revived, developed & protected on scientific lines for various use. All the springs shall be enumerated and listed properly and data shall be properly maintained. The discharge of such springs can be sustained by construction of small check dams or subsurface dykes across the nallas/tributaries in the downstream at favourable locations.
- Small ponds/tanks can be utilized for recharging ground water. These structures can be constructed for harvesting water and utilized for both recharging and meeting the domestic needs.
- Roof top rainwater harvesting practices must be adopted in hilly areas since the district receives precipitation in the form of snow and rain.

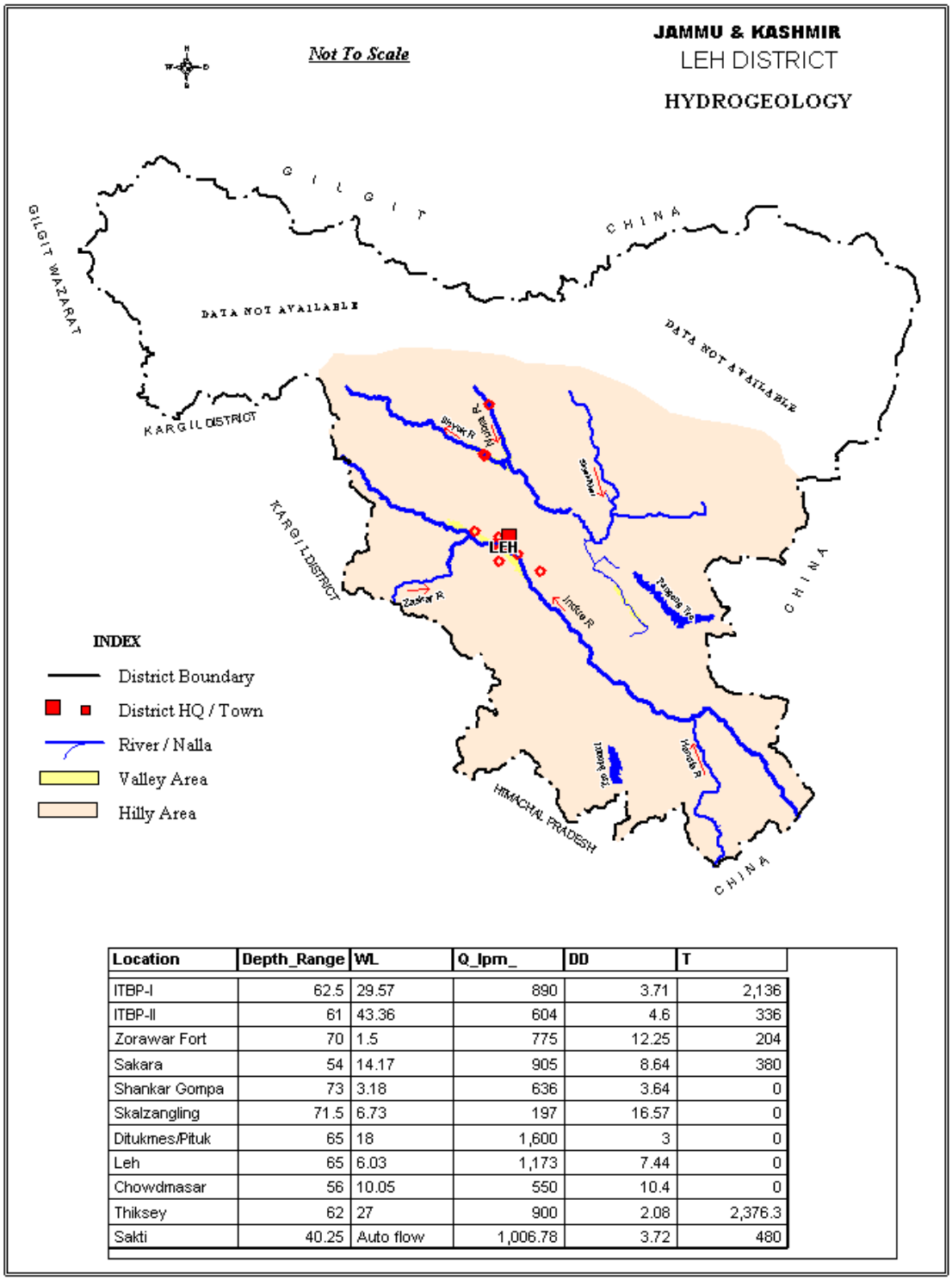
GROUND WATER INFORMATION BOOKLET OF LEH DISTRICT JAMMU & KASHMIR STATE

CONTRIBUTORS

The ground Water Information Booklet of Leh district of J & K State has been prepared by Sh. S.K. Mohiddin, Scientist-C, North Eastern Himalayan Region, Jammu. The maps and drawings are prepared by Shri S.S. Purty, AHG, CGWB, SUO, Srinagar. This booklet has been scrutinized by Sh. S..K. Juneja, Scientist 'D' under the overall supervision and guidance of Sh. Arun Kumar, Regional Director, NWHR, Jammu.

The data generated in scientific studies carried out by various scientific officers and staff of the SUO, Srinagar and NWHR, Jammu has been utilized in preparation of this booklet.

PLATE I



Location	Depth_Range	WL	Q_lpm_	DD	T
ITBP-I	62.5	29.57	890	3.71	2,136
ITBP-II	61	43.36	604	4.6	336
Zorawar Fort	70	1.5	775	12.25	204
Sakara	54	14.17	905	8.64	380
Shankar Gompa	73	3.18	636	3.64	0
Skalzangling	71.5	6.73	197	16.57	0
Ditukmes/Pituk	65	18	1,600	3	0
Leh	65	6.03	1,173	7.44	0
Chowdmasar	56	10.05	550	10.4	0
Thiksey	62	27	900	2.08	2,376.3
Sakti	40.25	Auto flow	1,006.78	3.72	480

PLATE II

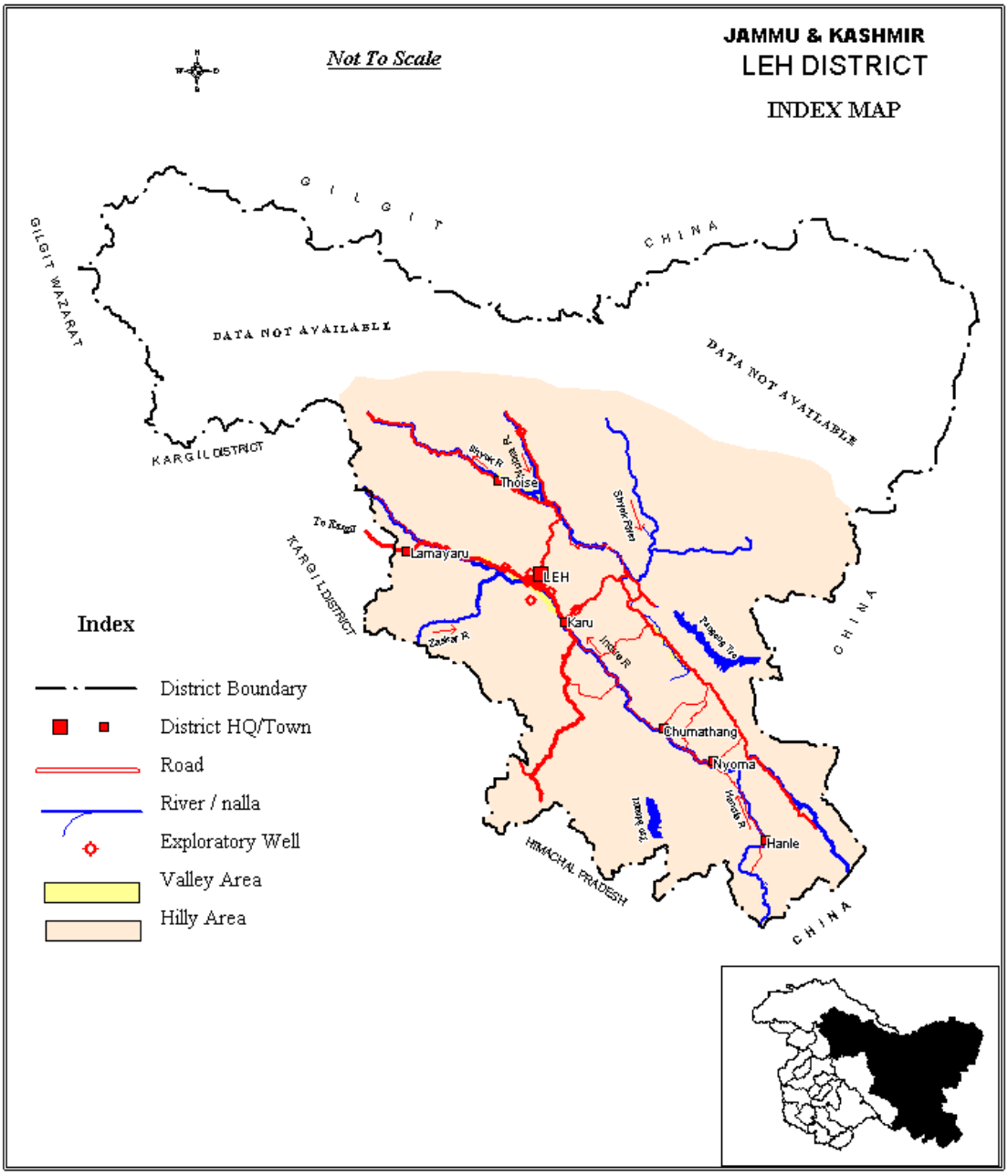

JAMMU & KASHMIR
LEH DISTRICT
INDEX MAP
Not To Scale
GILGIT WAZARAT
DATA NOT AVAILABLE
KARGIL DISTRICT
CHINA
DATA NOT AVAILABLE
Thoise
Lamayaru
LEH
Karu
Chumathang
Nyoma
Hanle
HIMACHAL PRADESH
CHINA
Index
District Boundary
District HQ/Town
Road
River / nalla
Exploratory Well
Valley Area
Hilly Area

PLATE III

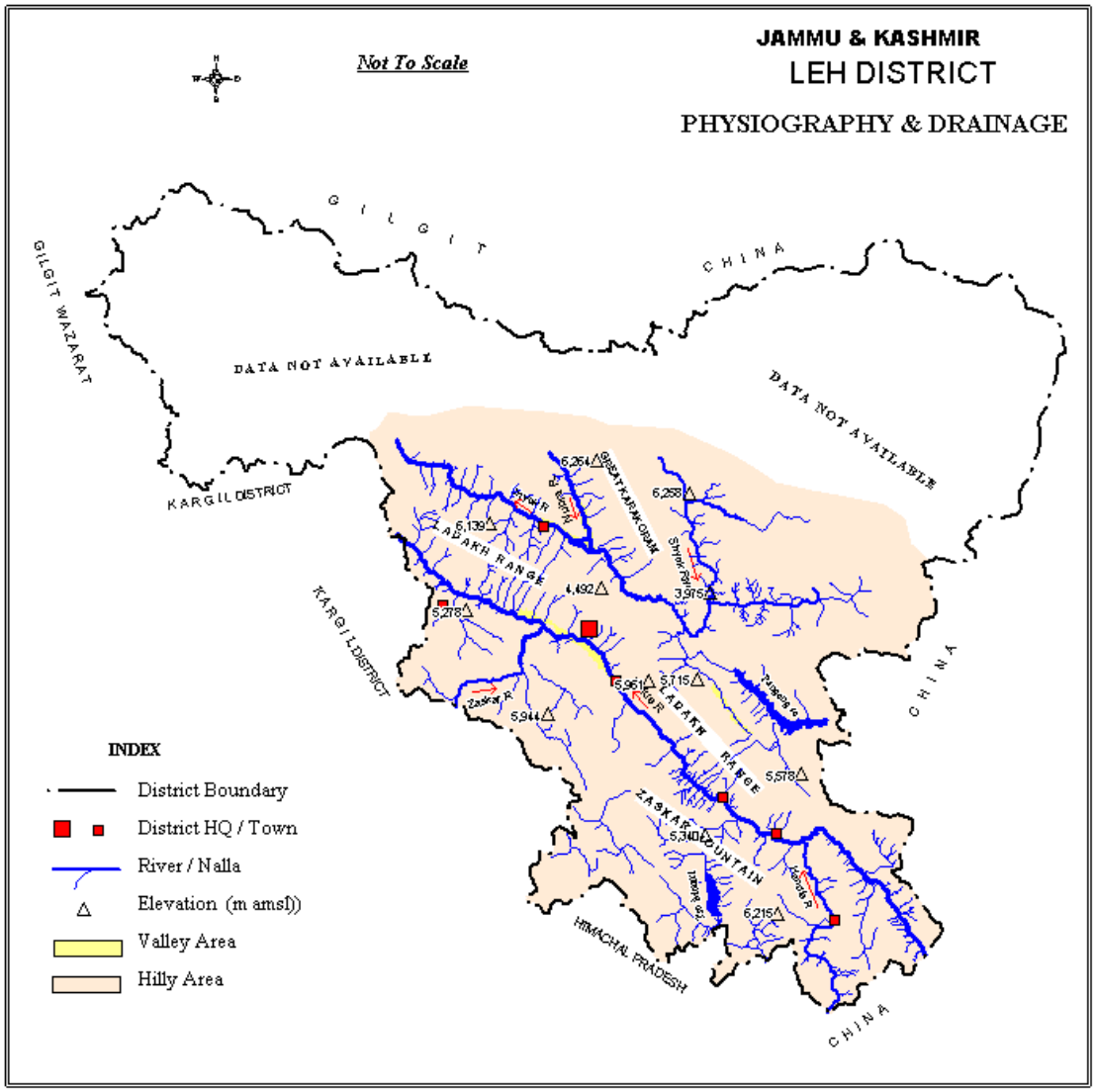
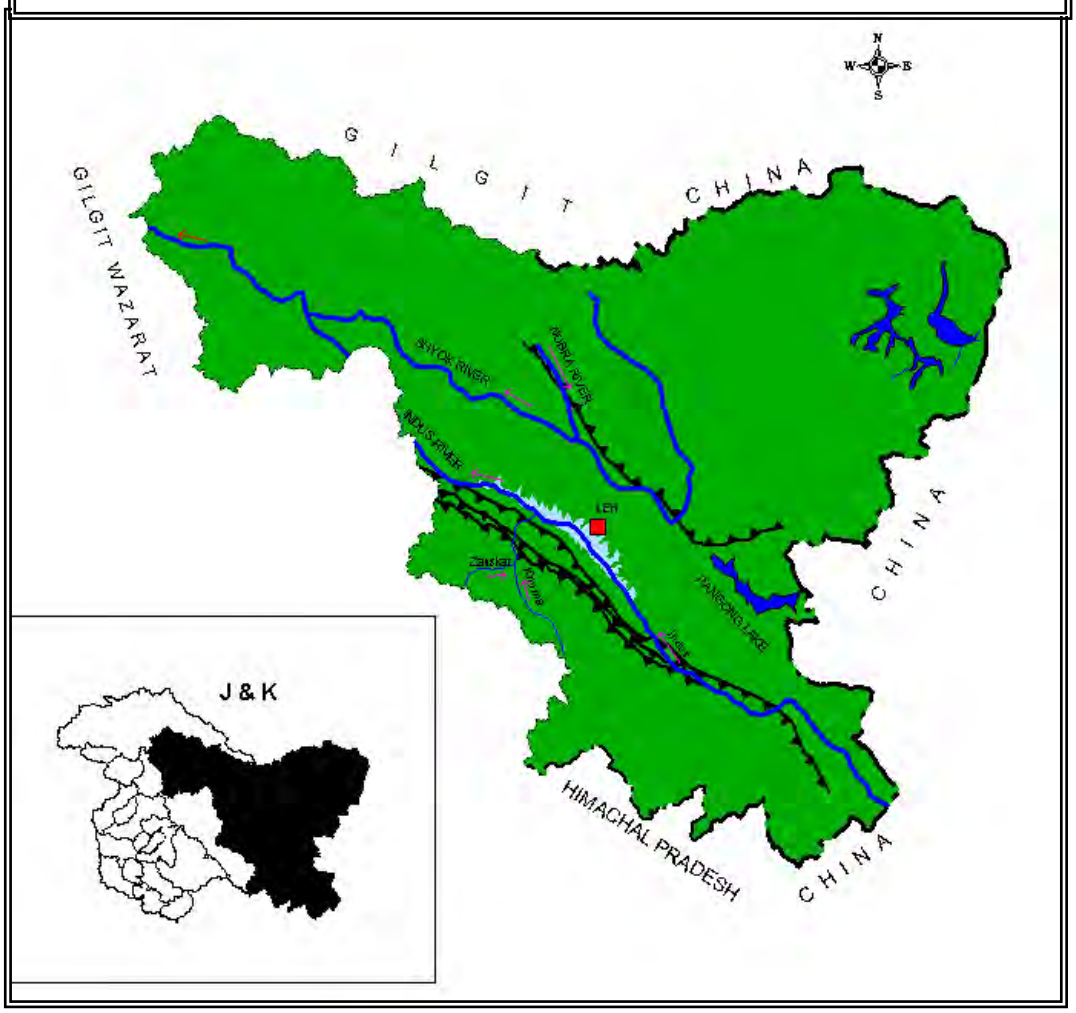

JAMMU & KASHMIR
LEH DISTRICT
PHYSIOGRAPHY & DRAINAGE
Not To Scale
GILGIT
CHINA
GILGIT WAZARAT
DATA NOT AVAILABLE
DATA NOT AVAILABLE
KARGIL DISTRICT
KARGIL DISTRICT
CHINA
LADAKH RANGE
ZASKAR MOUNTAIN RANGE
HIMACHAL PRADESH
CHINA
INDEX
District Boundary
District HQ / Town
River / Nalla
Elevation (m amsl))
Valley Area
Hilly Area

PLATE IV

JAMMU & KASHMIR
LEH DISTRICT
GROUND WATER USER MAP



	Wells feasible	Rigs suitable	Depth of well (m)	Discharge (lpm)	Suitable artificial recharge structures
Soft rock aquifers	Tube well	DTH with Odex	40 to 90*	1000 to 2500	Snow harvesting and Check Dam cum ground Water dam
Hard rock aquifers	Tube well Spring Development	DTH with Odex	40 to 90	300 to 750 30 to 1250	

5 Water level contour (m bgl)
(Pre monsoon decadal mean, 1993-2002)

Springs

Reservior

Tehsil boundary

District boundary

Thrust

International boundary

Tehsil HQ

District HQ

ajor Drainage