Welcome

Central Ground Water Board
North Western Himalayan Region
Jammu

Hydrogeology and Ground Water Exploration in Leh District Union Territory Of Laddakh

Leh District
Union Territory Of Laddakh

Leh with an area of 45110* Sq Km makes it largest district in the country in terms of area.

It Is bounded by Gilgit Baltistan in the West, China in the north and eastern part, Kargil in the west and Lahul Spiti of Himachal Pradesh in South East.

Leh District
Union Territory Of Laddakh

The area is rugged and mountainous with little or no vegetation. The mountains are of varied types of rocks in process of disintegration due to weathering. Altitude varies between 5934-8510 m AMSL drained by The Indus, Nubra and Shyok Rivers.

Leh District
Union Territory Of Laddakh

Area constitutes of well-delineated southeast northwest and northeast trending parallel mountain ranges such as Zanskar, Laddakh and Karakoram Ranges. It has distinction of highest motorable road in the world passing through Khardungla (5490 m amsl).

Climate

The climate is classified as cold continental climate, temperature being as low as –35ºC to –45ºc during night in winter and remains sub-zero during the day.

The area falls in the rain shadow region of the Himalayas and as such precipitation is very less and scanty. The annual precipitation in the form of rainfall is of the order of 80-120 mm per year where as snowfall is of the order of about 140 mm/year.

Leh District-Drainage

The area is part of Indus River basin. Other two main rivers flowing in the district are Nobra and Shyok Rivers.

Nubra is a perennial river and originates from Siachan Glacier and flows from North West to South East direction. Many nalas originating from the higher peaks of the mountains flow into Nobra.

Leh District-Drainage

Shyok River a perennial river originates from South and Central Rimo Glaciers. On the way it meets many small glaciers such as Chong, Glacier and Tash Glacier. It initially flows in North West to South East direction. It takes a turn toward North-West near village Shyok. It meets Nobra River near Disket.

Geology

Geologically, the area is the **collision ground** of two continental masses, the Indian plate in the south and the Tibetan plate in the north bringing in juxtaposition of dissimilar rock assemblages with volcanic ultra basic rocks. The geological formations right from Pre-Cambrian to Recent are present in the Area.

Geology

Formation	Age
Alluvial Lacustrine deposits, fluvio-glacial out wash material, Lamayuru deposits and Laminated Clays	Recent to Sub-Recent
Siwalik Clays/Teritiaries, liyan formation, Shegol formations (with Ophiolites)	Miocene to Pleistocene
Ninden/kalche formation	Eocene
Khalsi formation/shyok volcanics/Karakoram formation	Cretaceous
Qazilanker Conglomerate/zangla formation/Kiota limestones	Jurassic
Murgo formation	Triassic
Panjal Traps	Permian
Pengong Granitoids, Kuling formation, Phe volcanics/sasar Brangsa formation, Lipak formation	Permo-Carboniferous
Muth Qurtzites/tacke/Kelung formation	Silurian-Devonian
Thankung Schists/Phe formation, Pengong meta sedimentary group	Cambro-Silurian
Karakoram Crystalline Complex/Lukung Schist, salkhalas, unclassified granites and gneisses	Pre-Cambrian

Hydrogeology

Based on geology and aquifer characteristics the area of the Laddakh region can be divided into two broad hydrogeological units. These units are

I. Porous formations

II. Fissured formations

Porous formations

Moraines and Fluvioglacial Deposits situated on the northern bank of Indus River and cover an area of about 100 sq. km between Phyang nala in the west to Sabu Nala in the east.

Sediments consist of morainic material, overlain by varved clays and silts of lacustrine origin, again overlain by morainic boulders and cobbles in mechanically disintegrated loose sandy matrix deposited by rivers.

Fissured formations

These includes hard igneous, sedimentary & metamorphic rocks. Maximum area of the district is underlain by consolidated formation. Ground water in these formations occur in fissures and fractures developed due to repeated tectonic activity.

Large scale ground water development is not feasible but limited development of ground water resources can be taken up.

HYDROGEOLOGY

Unconsolidated formations like alluvium, scree and talus deposits present along the river valleys plays a vital role in terms of occurrence and movement of ground water.

Ground water resources in these formations can be developed on sustainable basis.

HYDROGEOLOGY

The valley fill deposits are mainly boulders and gravel mixed with silt and sand. This is mainly transported material lying unsorted in the recent river valleys.

Ground water occurs as unconfined conditions in valley fill deposits. Depth to water is very shallow to as deep as 45m bgl and is related with river water level.

Leh Phyang Valley

Leh plains are underlain by moraine deposits of boulders, cobbles, pebbles embedded in an clayey matrix and lake deposits comprising predominantly of clays, sandy clays and silt.

Varved clays overlie the sediments and silts of lacustrine origin again succeeded by moraine boulders and cobbles in disintegrated, loose sandy matrix and alluvial deposits.

Nubra and Shyok Valleys

These valleys are underlain by Glacio-fluviatile deposits. These deposits are sand, gravel and glacial boulders, sand dunes are also found along southern side of Shyok River near Disket and Hunder.

Nubra and Shyok Valleys

Flood plain from north of Kalsar to Sammor comprises of fluvial sand, gravel, pebbles and boulders.

Porous formation along Nobra and Shyok River are also promising potential horizons for ground water development.

Ground Water Exploration

In the year 1973, a percussion rig was flown to Leh, heralded a new chapter in Ground water Exploration in India, in view of the unique location of the area.

Drilling for ground water exploration in Laddakh Region started on 20 August 1973 at **Chaklamsar** (ITBP) site in cold desert of Leh district of Laddakh region.

Ground Water Exploration

Ground Water Exploration by CGWB is confined to Leh Plains and Nubra Valley. beginning from the year 1973.

28 exploratory wells have been drilled in the district up to 2019.

Ground Water Exploration

Out of 26 Exploratory wells

24 are in **Leh-Phyang Valley**

4 in Nubra Valley

Ground Water Exploration

In Leh- Phyang valley: Exploratory wells at Trishul and Project Himank abandoned due to meager discharge.

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.

Ground Water Exploration

- The yield from remaining wells range from 197 lpm for 16.57 m drawdown at Skalzangling to as 1600 lpm for a drawdown of 3.0 m at Pituk site.


GW Exploration in Leh District

Ground Water Exploration

In Nubra Valley,

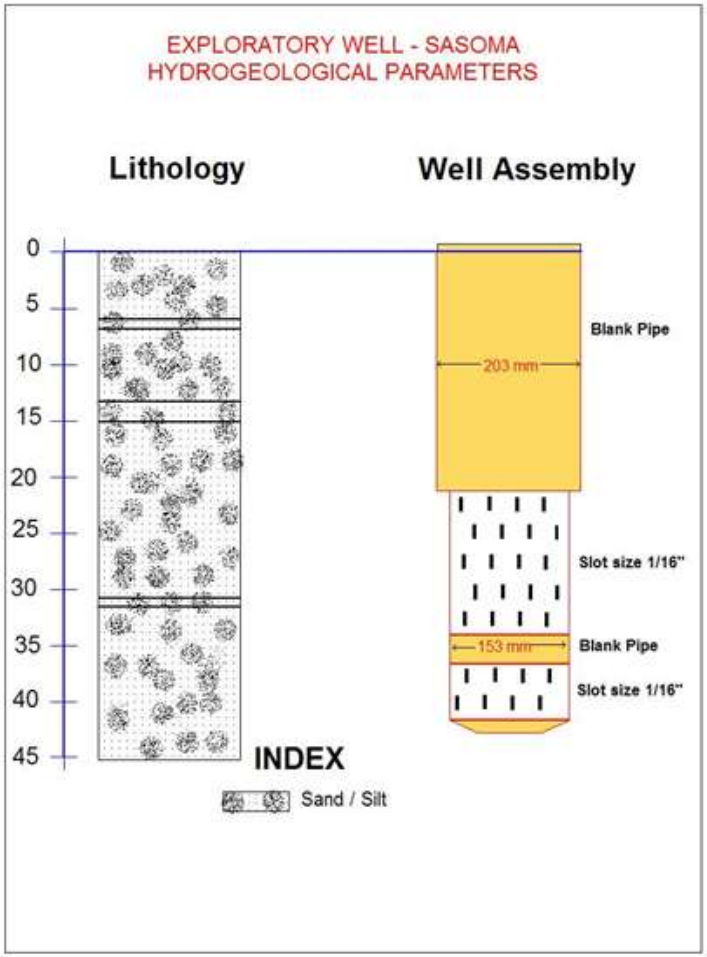
Depth of Exploratory wells ranges from 44m at Siachen-III to 59m at Partapur-I.

Yield varies from 1100 lpm at Saichan-III to 2300 lpm at Partapur-III

Depth to Water level range from 8m at Saichan-I to 24.0m (bgl) at Partapur-I,.

Litholog & Well design

Depth Range (m) bgl	Thickness (m)	Litholog
00.00-06.00	06	Pebbles with medium-fine sand, gravel & clay
06.00-07.00	01	Gravel and pebbles
07.00-13.00	06	Pebbles, gravel & medium-fine sand & clay
13.00-15.00	02	Fine –medium sand mixed with gravel
15.00-16.00	01	Fine –medium sand mixed with clay
16.00-17.00	01	Pebbles, gravel & coarse sand
17.00-18.00	01	Fine –medium sand mixed with gravel & Pebbles
18.00-31.00	13	Pebbles, gravel & medium-fine sand & clay
31.00-32.00	01	Gravel and pebbles
32.00-37.00	05	Medium-fine sand with gravels & pebbles
37.00-45.00		Coarse –medium sand mixed with gravel



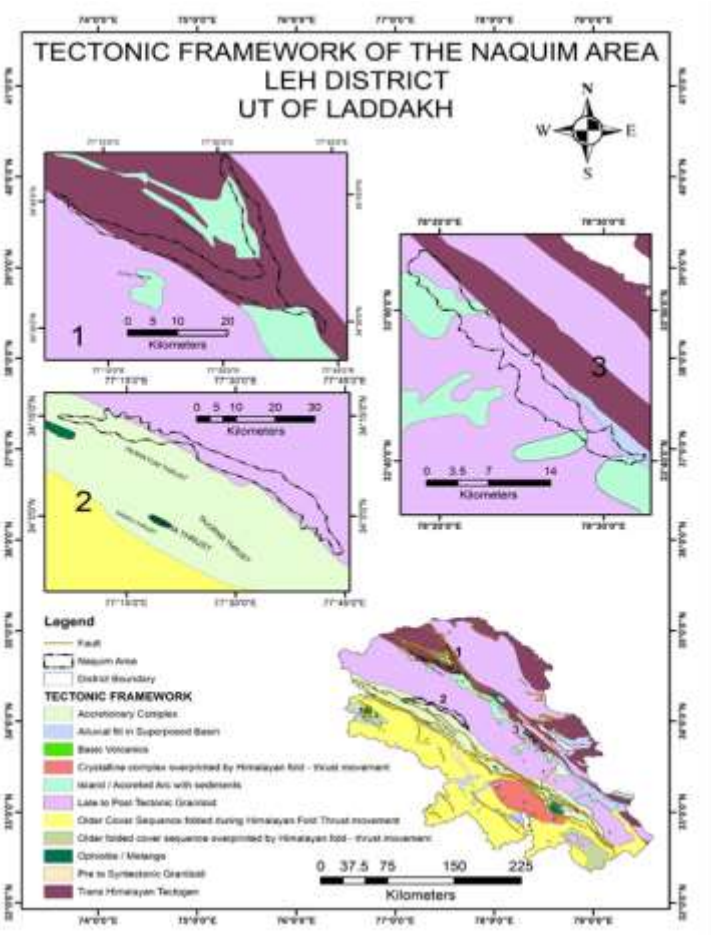
National Aquifer Mapping

The Aquifer mapping area of Leh district comprises of 714 Sq Km distributed in three different valley areas viz

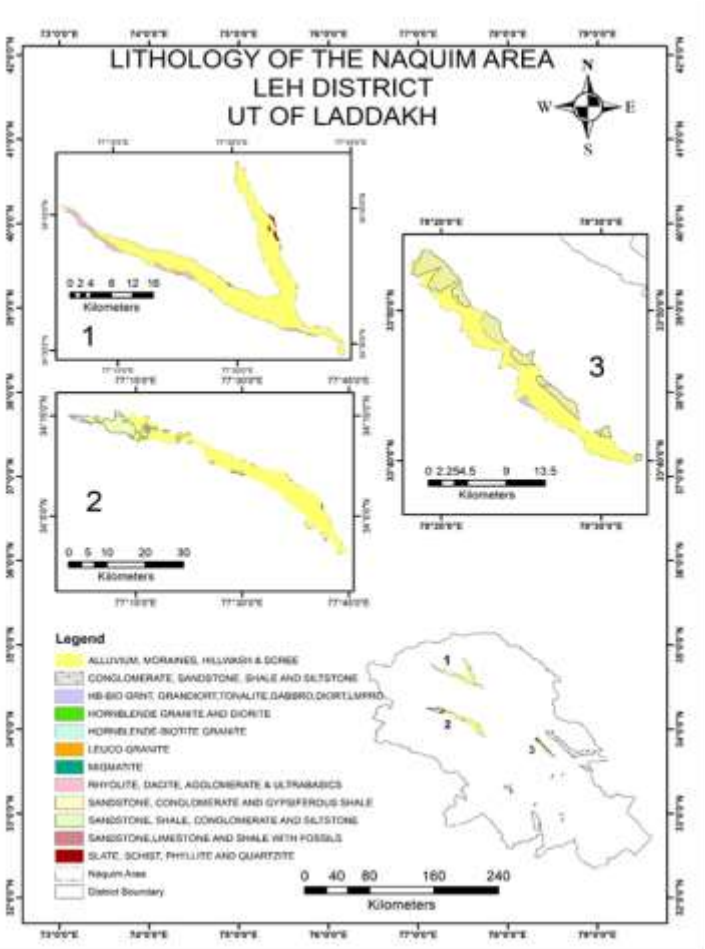
Phyang Valley, Nubra Valley and Chusul Valley. The area these valleys is as

1. Phyang Valley : 330.2 Sq Km
2. Nubra Valley : 290.5 Sq Km
3. Chusul Valley : 91.13 Sq Km

National Aquifer Mapping



National Aquifer Mapping



National Aquifer Mapping

Phyang valley comprises of 46% of the area and 50% samples were collected from this area. Whereas, Nubra and Chusul valley comprises of 41% and 13% area and a total of 43% and 7% samples were collected.

Water Management Plan

Supply Side Management

Aquifer protection Plan

- Discourage mining in river bed
- Discourage disposal of Domestic and industrial waste in river bed
- Discourage encroachment in flood zone of the river

Supply Side Management

Aquifer Augmentation Plan

- Construction of sub-surface dyke in river bed at suitable locations
- Identify the recharge area of springs and construct check dams and nallah bunds etc feasible locations.
- It will help in reducing the flash floods and enhance the ground recharge

Supply Side Management

Water conservation Plan

- Water distribution losses need to be reduced.
- All Public stand post need to be provided with tap to reduce the losses.
- Water supply from private tube wells/ tankers need to be discouraged

Demand Side Management

- Recycle the treated waste water for allied purposes
- Dual water supply in commercial establishments
- Water rationing and water pricing
- Capacity building and mass awareness about conjunctive use of water.

THANKS