केंद्रीय भूमि जल बोर्ड

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भारत सरकार

Central Ground Water Board

Department of Water Resources, River Development and Ganga Rejuvenation,

Ministry of Jal Shakti

Government of India

AQUIFER MAPPING AND MANAGEMENT OF GROUND WATER RESOURCES

THOUBAL DISTRICT, MANIPUR

उत्तर पूर्वी क्षेत्र, गुवाहाटी

North Eastern Region, Guwahati

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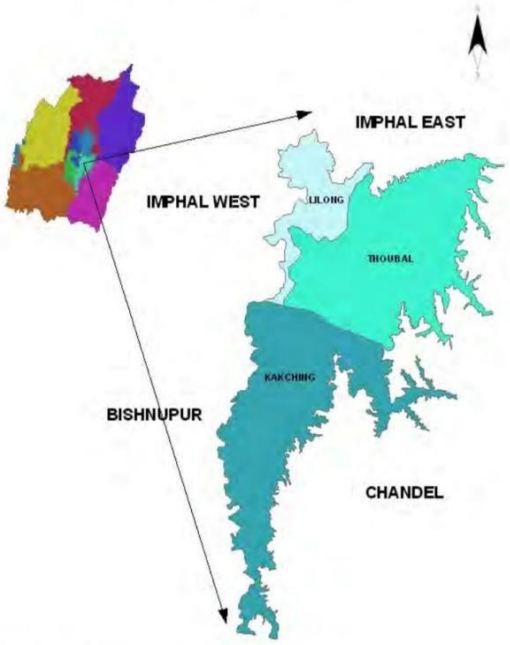
Govt. of India

AQUIFER MAPPING IN THOUBAL DISTRICT, MANIPUR
ANNUAL ACTION PLAN 2017-18



Ministry of Jal Shakti
Department of Water Resources, River Development &Ganga Rejuvenation
Central Ground Water Board North Eastern Region
Guwahati
March- 2018

AQUIFER MAPPING IN THOUBAL DISTRICTS, MANIPUR

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CHAPTER 1
INTRODUCTION

1.0 INTRODUCTION

Central Ground Water Board, North Eastern Region has carried out Aquifer mapping and management plan in Thoubal district, Manipur during AAP 2017-18 covering an area of 514 sq.km. Under National Aquifer Mapping and Management (NAQUIM) program, combination of geologic, geophysical, hydrologic and hydro chemical information is applied to characterize the quantity, quality and sustainability of ground water aquifers. Systematic aquifer mapping will improve our understanding of the geologic framework of aquifers, their hydrogeological characteristics, quality and also quantifying the available ground water resources potential and proposing plans appropriate to the scale of demand and the institutional arrangements for management. Aquifer mapping at the appropriate scale can help to prepare, implement and monitor the efficacy of various management interventions aimed at long-term sustainability of our precious ground water resources, which, in turn, will help achieve drinking water security, improved irrigation facilities and sustainability in water resources development.

Objectives: As part of national aquifer mapping programme, part of the Tertiary aquifer and the unconsolidated alluvial aquifer of Thoubal district of Manipur was taken covering an area of 514sq.km.
The objective of the study can be defined as follows:

- To define the aquifer geometry, type of aquifers, ground water regime behaviors, hydraulic characteristics and geochemistry of aquifer systems on 1:50,000 scale and
- To understand existing scenario of groundwater regime in shallow/deep aquifer
- To work out a management plan for sustainable development of groundwater.

Scope of the Study: The activities of this Aquifer Mapping and management plan can be envisaged as follows:

Data Compilation & Data Gap Analysis: One of the important aspects of aquifer mapping program was the synthesis of the large volume of data already collected during specific studies carried out by Central Ground Water Board and various Government organizations with a new data set generated that broadly describe an aquifer system. The data were assembled, analyzed, examined, synthesized and interpreted from available sources. These sources were predominantly non computerized data, which was converted into computer-based GIS data sets. On the basis of available data, data gaps were identified.

Data Generation: There was also a strong need for generating additional data to fill the data gaps to achieve the task of aquifer mapping. This was achieved by multiple activities such as hydro-geochemical analysis, remote sensing, besides detailed hydrogeological surveys to delineate multi aquifer system; to bring out the efficacy of various geophysical techniques and a protocol for use of geophysical techniques for aquifer mapping in different hydrogeological environs.

Aquifer Map Preparation: On the basis of integration of data generated from various studies of hydrogeology, aquifers have been delineated and characterized in terms of quality and potential. Various maps have been prepared bringing out characterization of Aquifers, which can be termed as Aquifer maps providing spatial variation (lateral & vertical) in reference to aquifer extremities, quality, water level, potential and vulnerability (quality &quantity).

Approach and Methodology

- Aquifer mapping has been carried out by adopting a multi-disciplinary approach:
- Geophysical Surveys through Vertical Electrical Sounding (VES).
- Exploratory drilling and construction wells tapping various aquifers.
- Ground Water Regime monitoring by establishing monitoring wells tapping different aquifers at different depths for long term monitoring of water level and quality.
- Collection of various relevant technical data from the field in aquifer mapping area and also from the concerned State Govt. Agencies and other Institutes dealing with ground water and incorporating these data along with CGWB data for final output.
- Preparations of a micro level mapping of existing aquifers, their potentials depth wise and sideways in 2D and 3D forms viewed from different angles by various GIS Layers.
- Formulating a complete sustainable aquifer management plan for groundwater development.

Area Details:

Thoubal district is situated in the Southern part of Manipur between 93°45′E longitude and 23°45′ to 24°45′N latitude covering a geographical area of 514 sq.km. It is bounded on the north by Imphal District, on the east by Ukhrul and Chandel District, on the south by Chandel and Churachandpur District, and on the West by the Districts of Imphal and Bishnupur.

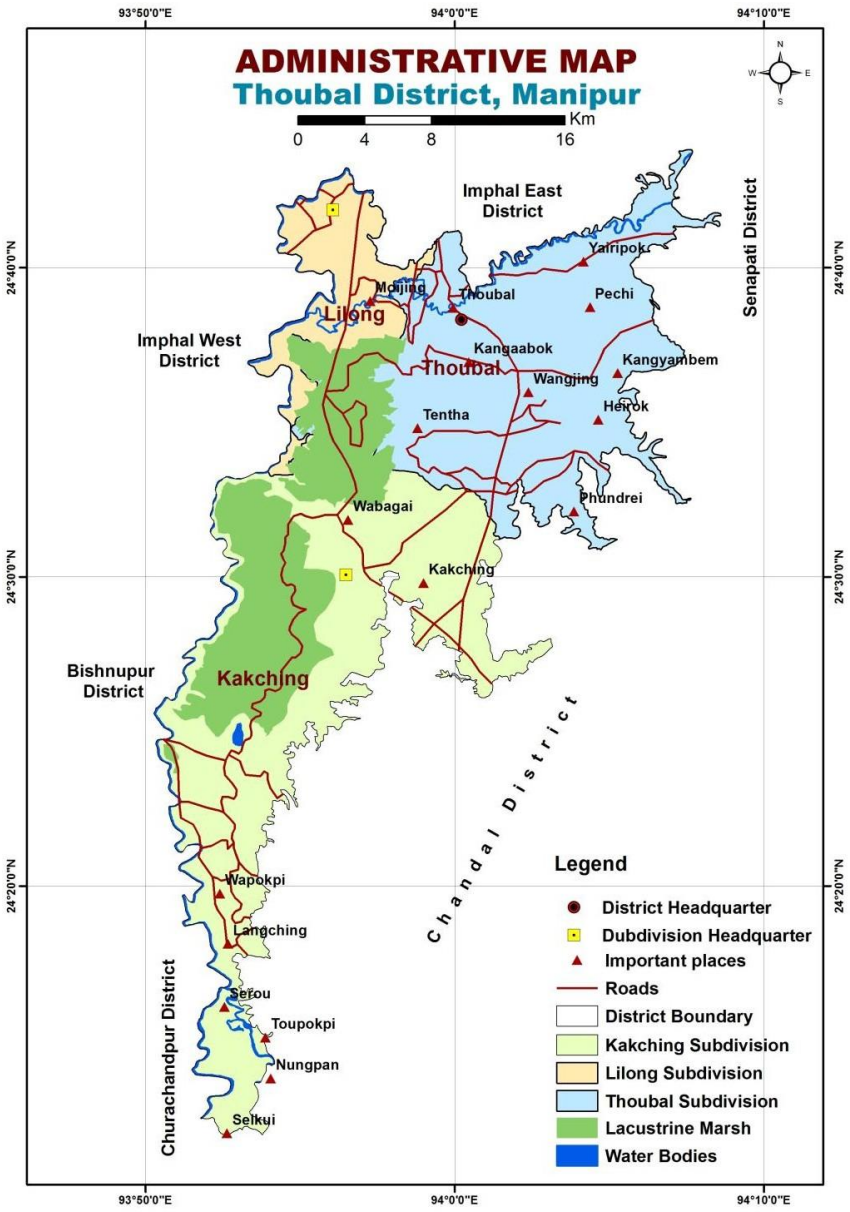


Fig. 1.1. Administrative map of Thoubal district, Manipur

Altitude of theDistrict is 781mabove themeansea level (MSL).Thedistrict is dotted by a few hillocks and hills oflow heights.Of these, Punamhill has anelevation of 1009 mabove msl.Thedistricthasthree sub- divisions - Lilong, Thoubal and Kakching.There are two revenue circles in the district viz. Kakching and Waikhong. The district has community development blocks one in each sub-division. There are 9 small towns - Lilong, Thoubal, Yairipok, Sikhong Sekmai, Wangjing, Heirok, Kakching, Kakching Khunou and Sugnu and apart ofSmurou whose majorpart is in theImphal district. Thoubal and Kakching are Municipality towns. According to the 2011 census the district has 286687 populations having 82 villages with a population density of 821 person/ sq.km. Its population growth rate over the decade 2001– 2011 was 15.48%.

Drainage: The Imphal and the Thoubal rivers are the most significant rivers that flow through the district. The Thoubal River originates from the hill ranges of Ukhrul and is an important tributary of the Imphal River. It passes through Yairipok and Thoubal before joining the Imphal River at Irong near Mayang Imphal. The Imphal River originates from the hills of Senapati district and flows southern wards. It forms the northern and western boundaries of Thoubal district. Other rivers in the district are the Wangjing, the Arong and the Sekmai. These rivers originate from the hills of Ukhruldistrict. TheArong Riverflows through charangpat and Khangabok fall into Kharung Pat. The Wangjing River flows towardswest via Heirok and Wangjing before joining the Loushi Pat. Drainage map of Thoubal District is shown in**Fig.1.2**

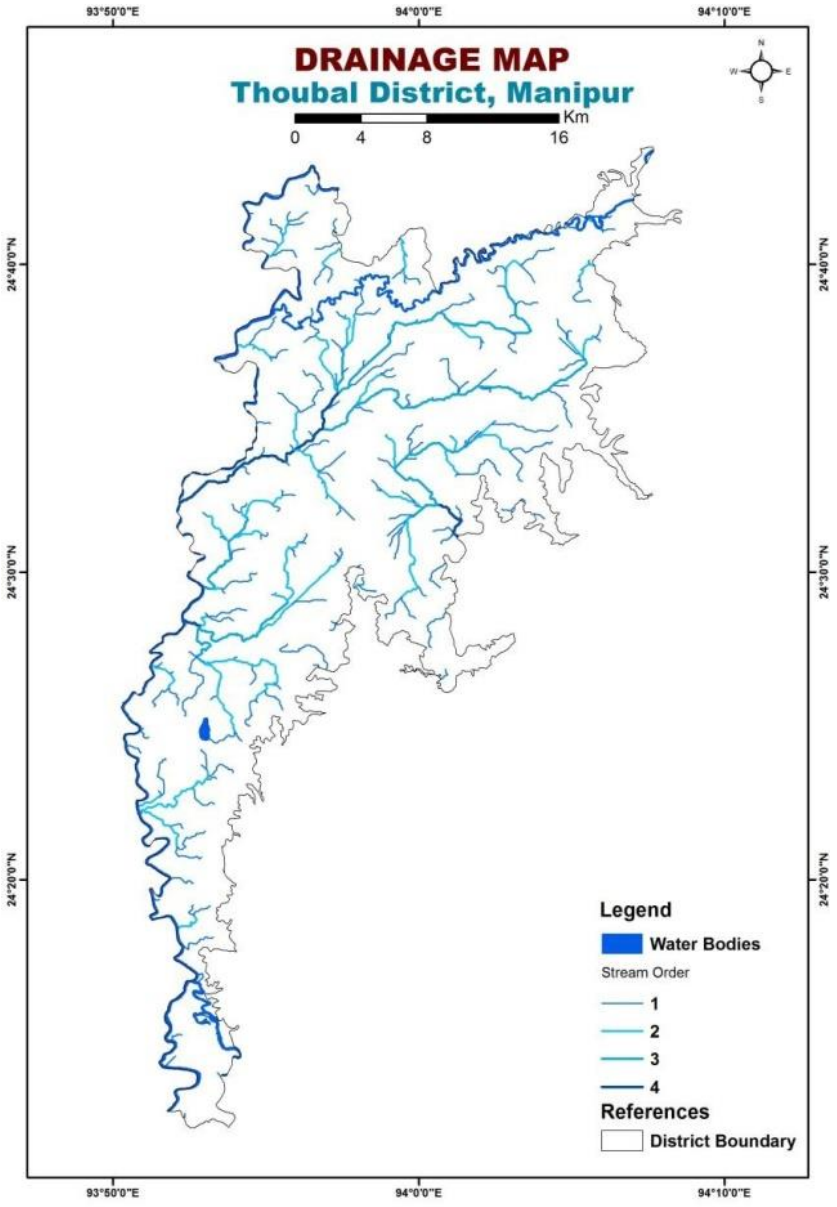


Fig. 1.2. Drainage map of Thoubal District, Manipur

Rainfall:

Rainfall is relatively abundant and widespread in the district. The rainy season starts in June with the onset of the south-west monsoon and last upto September. Intermittent rains continue even upto October along with the retreat of the monsoon. During the winter months, light rainfall occurs under the influence of the North-East monsoon. On the whole, the district has an equitable and pleasant climate. The summer months are never oppressive with the average maximum temperature fluctuating between 32°C and 35°C during April-June. Monthly Rainfall data (Period: 10 years from 2007 to 2016) is given in**Table.1.2.**

Table.1.2: Monthly Rainfall data (Period: 10 years from 2007 to 2016)
(Rainfall in mm)

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
2007	0.0	184.7	6.6	158.5	256.7	220.2	129.1	89.8	156.9	140.6	49.7	0.2	1393
2008	33.3	31.7	78.9	14.8	93.2	170.1	256	200.5	85.6	95.8	0.9	2.0	1063
2009	0.0	22.5	40.1	74.4	105.3	108.1	183.1	203.4	113.9	152.1	5.2	0.0	968
2010	7.8	7.0	98.4	248.4	222.2	260.2	300.9	93	136.9	194.2	16.1	47.3	2060
2011	25.1	2.3	45.5	35.6	299.2	332.5	287.1	302.9	126.4	27.4	0.0	0.0	1484
2012	19.6	0.0	56.8	158.7	93.3	311.9	270.8	246.3	272.3	137.4	80.8	0.0	1648
2013	0.0	1.7	31.8	83.6	335.1	135.5	254.1	414.3	291.3	30.3	0.0	1.4	1639
2014	0.0	31.2	28	47.5	277.3	385	85	263.9	106.7	29.0	0.0	0.0	1118
2015	21	0.3	11.8	555.7	176	377.2	486.4	362	157.7	35.2	2.6	11.2	2197
2016	0.5	65.2	111.1	561.7	643.2	642.9	484	372.4	737.6	237	52.9	0.8	3909
Average Annual Rainfall for the last 10 years													1717

(Source: IMD Rainfall Data, Imphal)

Geology:

Major part of the area is made up of alluvium of fluvial origin. The principal constituents are clay, silt and sand whereas sand, gravel, pebbles and boulders are found in the foothill regions. Carbonaceous shales cover as patches in the extreme south- and south-central parts of the district. A narrow patch of Shale, sandstone is found in the central part of the district in north-south direction. Shale, sandstone, siltstone with plant fossils is found in the extreme eastern boundary of the district in the north.

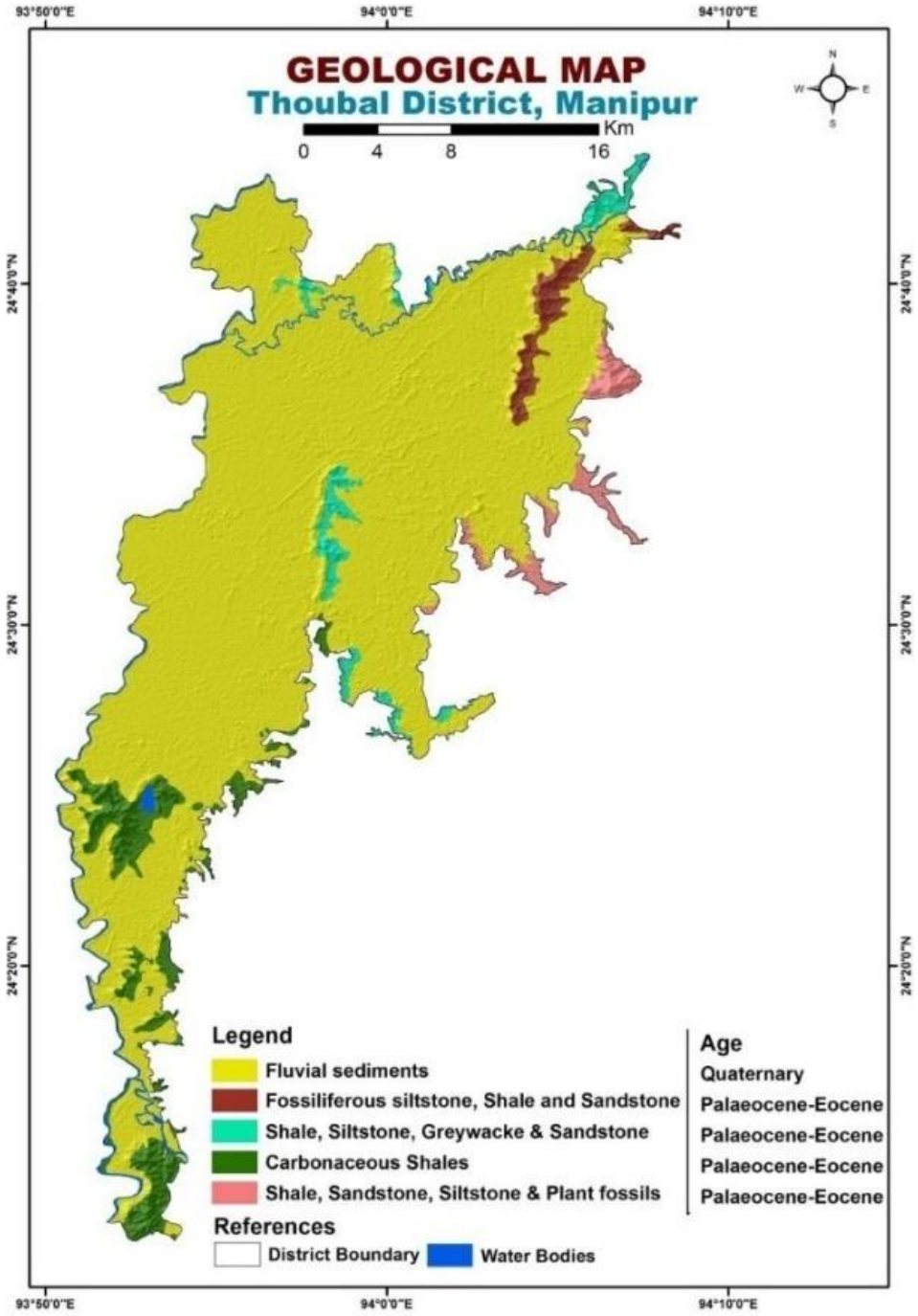


Fig. 1.3. Geology map of Thoubal district, Manipur

Geomorphology:

Geomorphologically Thoubal district occupies largest portion of the eastern half of Manipur valley with a flat alluvium plain of Fluvio-lacustrine origin. Major part of the district is covered by younger alluvial plain while older alluvial plain is found in the extreme western border of the district. Moderately dissected structural hills are found in the extreme southern and northern part of the district as isolated hillocks. Lacustrine marshy land covers a sizable area in the western part of the district. These Rivers have a nearly NNE-SSW trend

concurring with the regional structural trend. The principal subsurface constituents are sand, gravel, pebbles, boulders, silt and clay. The hillocks inside the valley are basically composed of Disang shale.

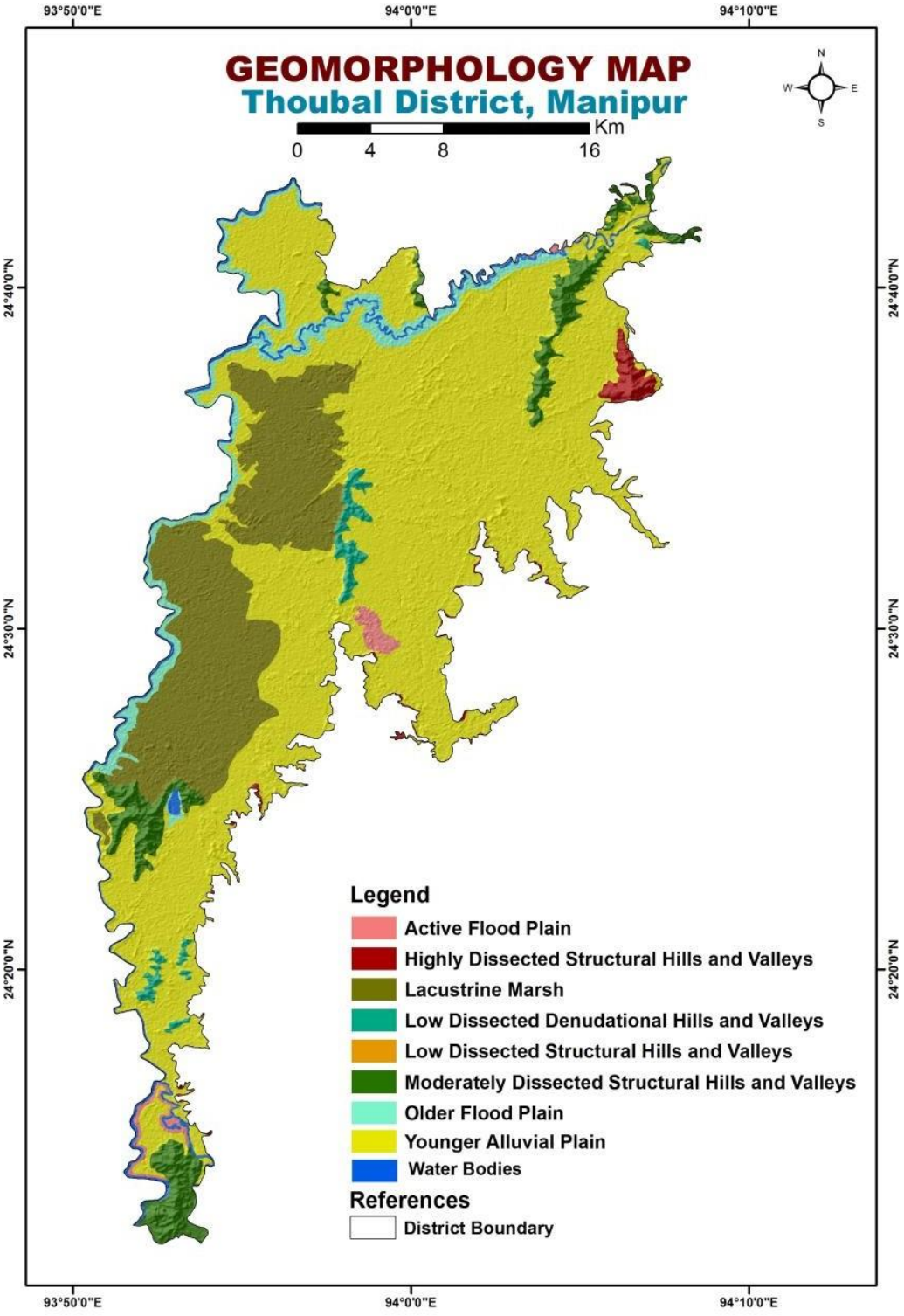


Fig. 1.4. Geomorphology map of Thoubal district, Manipur

Soil: The soils of Thoubal District are heterogeneous in nature and developed on gently sloping narrow valleys and strongly sloping to moderate steep side slopes of hills with moderate to severe erosion hazards. Soils are well to extensively drain. The texture of soil varies from fine to loamy skeletal and classified at Umbric dystrochrepts, typic Dystrochepts and typic haplohumults.

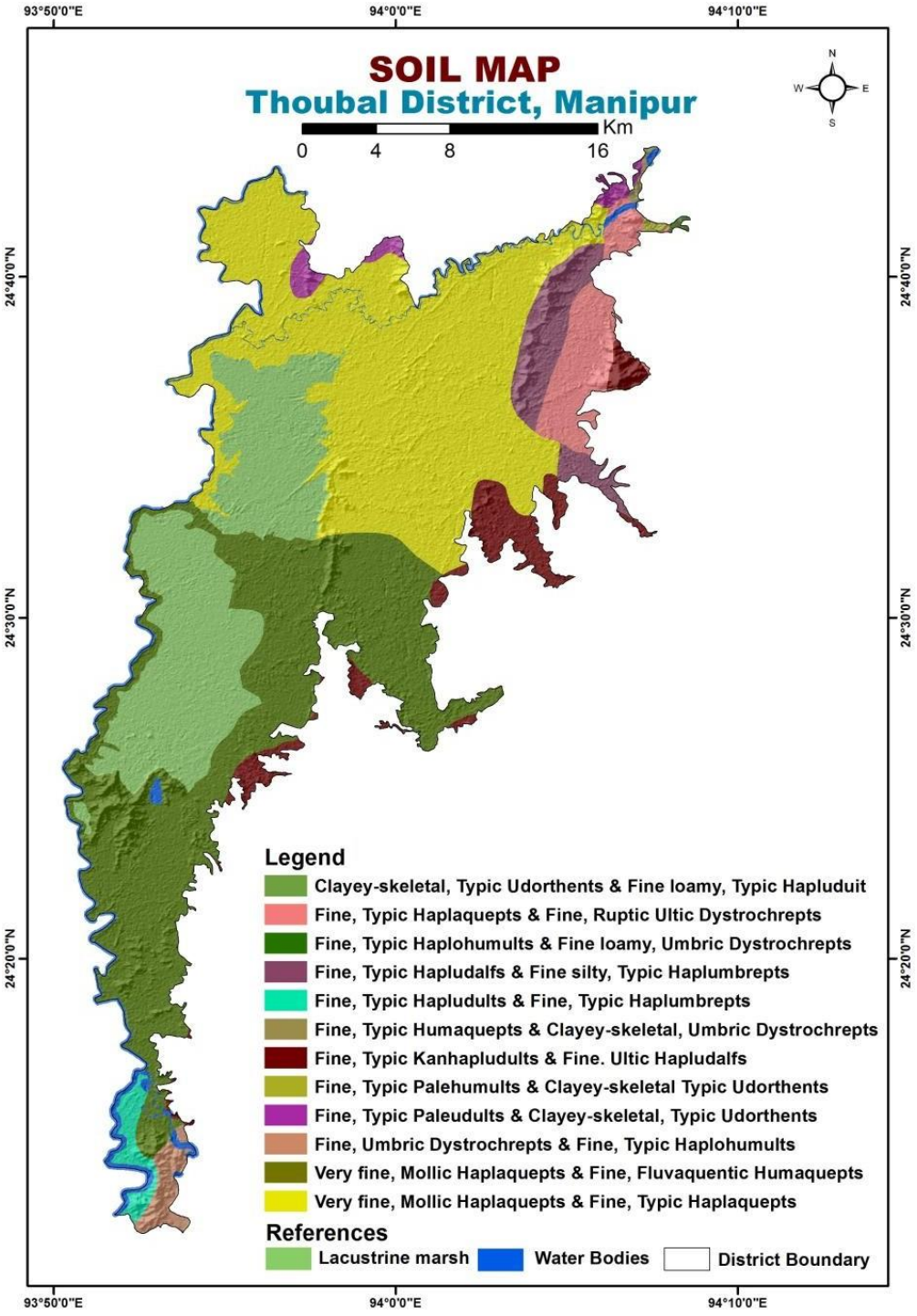


Fig. 1.5. Soil map of Thoubal district, Manipur

Land use pattern:

The district is having a geographical area of 51400 ha. Dense forest covers about 1187 ha while moderately dense/ open forest covers 2593 ha. Marshy/ swampy land covers 4346 ha while water body covers about 3388 ha area.

As per agricultural land use pattern, gross cropped area of the district is 37300 ha. Net sown area is 33,210 ha. of which area sown more than once is 4090 ha. Land use map of the district is given in **Fig.1.3.** while agricultural land use pattern is given in**Table.1.3.**

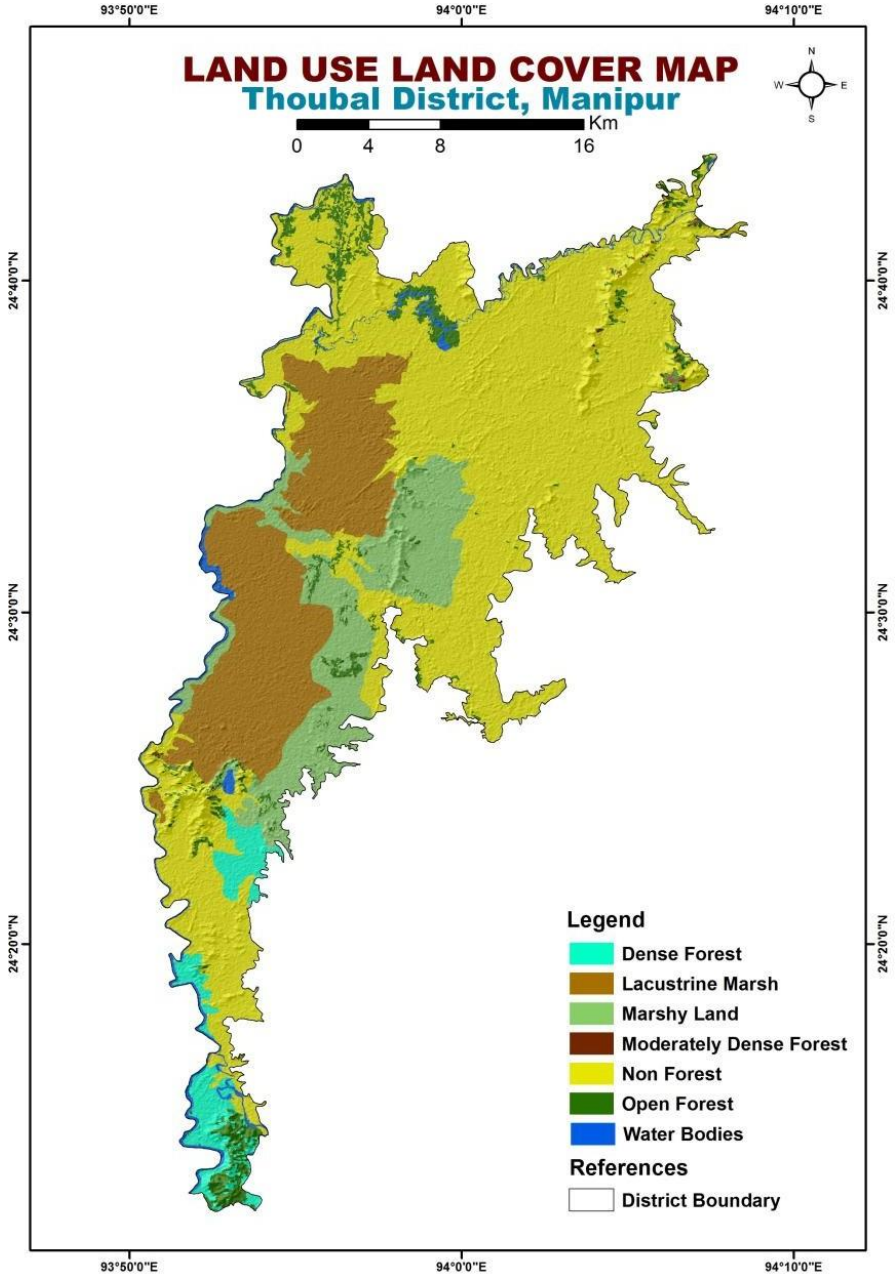


Fig. 1.6. Land Use Land Couver map of Thoubal district, Manipur

Table.1.3: Agricultural land use pattern-Thoubal district

Agricultural land use	Area ('000 ha)
Net sown area	33.21
Area sown more than once	4.09
Gross cropped area	37.30
Cropping intensity	149.6%

Agriculture:

Agriculture is the most important source of livelihood for the people of the district. More than 70 per cent of the total population of the district is directly or indirectly depended on agricultural activities. The valley is fertile and the topography of the district provides good opportunity for irrigation. Rice accounts for above 90 percent of the total land area under cultivation. In respect of rice production, Thoubal accounts for 25 percent of the total production of rice in Manipur. The Kakching belt which provides more than 50 percent of the total rice exports of the district may be rightly termed as the 'rice basket of Manipur'. Among the fruit crops, pineapple is grown in a considerable area in the district. Cabbage, caulifloer and lady's finger are main vegetable crops of the district. The district is the largest producer of sugarcane in the State. Its cultivation is mainly confined to Thoubal, Wangjing, Kakching Khunou and Wabagai. Maize is mainly grown in Serou, Pallel and Kakching. Pineapple constitutes the most important plantation crop in the district. It is cultivated on the slopes of low hills and hillocks at Langum, Waithou and Poirou Tangkhul area.

Double cropping is widely practised (11690 ha) in the district. In some areas, even triple cropping is prevalent. First paddy cropping starts in the late February or early March, second cropping in July and early August and the third cropping of mustard seeds, pulses, vegetables, etc. in November.

Irrigation:

The district is endowed with a number of rivers and small streams which pr ovide good irrigation potential for the district. Important irrigation works taken up in the district are the Sekmai Barrage, Thoubal Multipurpose Project and the Imphal Barrage. The Thoubal Multipurpose Project involves construction of a Barrage across Thoubal river at Keithelmanbi and hydro-power generation at Phayeng. The Project is yet to be completed. The river which has a catchment area of 900 sq. km and has an irrigation potential of 34,000 hectares spread in the districts of Thoubal and Imphal. Though the project is yet to be completed, it has already benefited a number of farmers. Sekmai Barrage with an irrigation potential of 8000 hectares is another important irrigation project of the district. It

is constructed over the Sekmai river and has benefited directly the cultivators of Kakching Sub-division. Another project is the Imphal Barrage Project. It irrigates both sides of the Imphal river. The eastern part belongs to Thoubal District and the Western part to Imphal District.

In Thoubal district, 26350 ha paddy land is covered under irrigation schemes and 2540 ha paddy land is yet to bring under irrigation projects (Source: Directorate of Economics and Statistics, Govt. of Manipur).

CHAPTER 2.0

DATA COLLECTION AND GENERATION

Data Collection

The preliminary works covers collection and review of all existing hydrogeological and exploration data of CGWB and State departments. All data were plotted in base map on GIS Platform (MapInfo Encom discovers 11 using Projection category longitude/latitude: Indian for Pakistan, India, Bangladesh, Nepal projection).

Data Generation:

Depth to Water Level

11wells were established and monitored to know the water level and its behavior. Depth to water level (**Table-2.1**) ranges from 0.2 to 4.24 m bgl during pre-monsoon and 0.45 to3.1 m bgl during post-monsoon season with a maximum seasonal fluctuation of 1.43 m.

Table 2.1: Depth to water level in Thoubal district

Sl. No	Location / Village	Block	AMSL (m)	M.P. (m. agl)	Depth to water level (in m bgl)		Fluctuation (m)	Water Table (m)
					Pre-monsoon	Post-monsoon		
1	Irung Mapal	Kakching	782.292	1.00	0.2	0.5	0.3	783.292
2	Mairenbam	Kakching	780.588	0.56	4.24	3.1	1.14	776.348
3	SapamManing	Kakching	781.102	0.56	1.76	1	0.76	779.342
4	Phundrei	Kakching	793.131	0.53	1.2	0.8	0.4	791.931
5	Tuwa Band	Thoubal	783.190	0.61	0.38	1.2	0.82	782.810
6	Tentha High	Kakching	780.145	0.51	2.66	1.23	1.43	777.485
7	Khangbok	Thoubal	780.829	0.47	2.78	1.45	1.33	778.049
8	Nepra Company	Kakching	782.497	0.52	2.24	2	0.24	780.257
9	HeiyenLoubuk	Kakching	781.172	0.50	0.88	0.45	0.43	780.292
10	Aripat	Thoubal	808.050	0.42	3.1	2.45	0.65	804.950
11	Yairipok	Thoubal	791.620	0.37	1.35	1.05	0.3	790.270
12	Chingkham	Thoubal	781.621	0.34	2.1	1.1	1	779.521
13	Lilong	Thoubal	781.970	0.28	1.08	0.56	0.52	780.890

Ground Water Exploration:

CGWB has constructed 9 nos. of exploratory wells in different parts of the district to delineate the potential aquifers and their geometry and to determine the hydrogeological parameters of the aquifer systems. The details of tube wells constructed in the district are given in **Table.2.2**.

Table 2.2: Details of tube wells constructed by C.G.W.B

Sl. No.	Location	Depth drilled (inm)	Depth of construction (in m)	Aquifer thickness tapped (m)	S.W.L (m. bgl)	Discharge (lpm)	Drawdown (m)	T (m^2/day)	Remarks
1	Khangabok	102.6	80	30	8	503	14.5	59	Auto flow
2	Lilong	90.4	89	24	0.5	450	11		
3	Wabagai	115.9	45	11	0.95	58	3.42		
4	Yairipok	108.7	54	12	4.7	484.47	6	255.5	
5	Wangjing	115.8	103.3	30	1.49	462	7.65	43	Auto flow
6	Kakching	98.5	96.7	18.14	1.62	611.3	8.94	72	Auto flow
7	Pangaltabi	65.8	61	18	5.98	18	13		
8	Waikhong	79.3	69	21	1.62	42.7	12.27		
9	Khongjom	115.8	67.5	12	5.2	31.66	20		

Ground water quality:

To know the water quality of the study area, water sampling were done from shallow aquifers. Water samples were collected from 8 nos. of key observation wells established during aquifer mapping for checking the chemical quality of ground water in the district. Samples were analyzed in the Regional chemical laboratory of CGWB, NER Guwahati and given in **Table2.3.**

Table 2.3 Ground water quality

Location	Source	Longitude (°)	Latitude (°)	Temperature(°C)	pH	EC(µs/cm)25° C	TDS	Cl-	F-	Na	K	Fe
Irung Mapal	STW	94.001	24.49	18	8.25	1944	1283.04	173.71	0.61	99.92	19.68	0.36
Mairenbam	STW	94.003	24.52	19	8.27	645	425.70	10.64	1.80	82.55	1.28	4.68
SapamManing	STW	94.007	24.55	18	8.10	263.2	173.71	21.27	0.35	21.37	0.59	0.24
Phundrei	STW	94.053	24.55	19	8.01	1117	737.22	63.81	1.00	153.24	1.62	1.10
Aripat	STW	93.974	24.57	15	7.92	274.9	181.43	21.27	0.22	8.63	4.72	1.21
Mongei	STW	93.998	24.58	16	8.24	745.8	492.23	7.09	0.85	103.02	1.50	4.67
Koirangei	STW	94.005	24.61	15	7.75	168.1	110.95	17.73	0.24	11.74	3.00	0.65
Khongkhapai	STW	94.023	24.63	16	8.08	304.9	201.23	17.73	0.88	42.56	1.53	6.74

Concentration of arsenic in the ground water beyond permissible limit has been recorded in few villages under Kakching and Thoubal Block. A detailed finding of the chemical analysis is given in Table2.4.

Table 2.4 Arsenic & iron concentration in the ground water

Location / Village	PH	Iron (mg/l)	Arsenic (mg/l)
Irung Mapal/ Kakching	7.2	1.82	0.1776
Tentha High School/ Tentha	7.1	3.21	0.1969
Nepra Company/Khongjom, Thoubal	6.4	16.52	0.4997

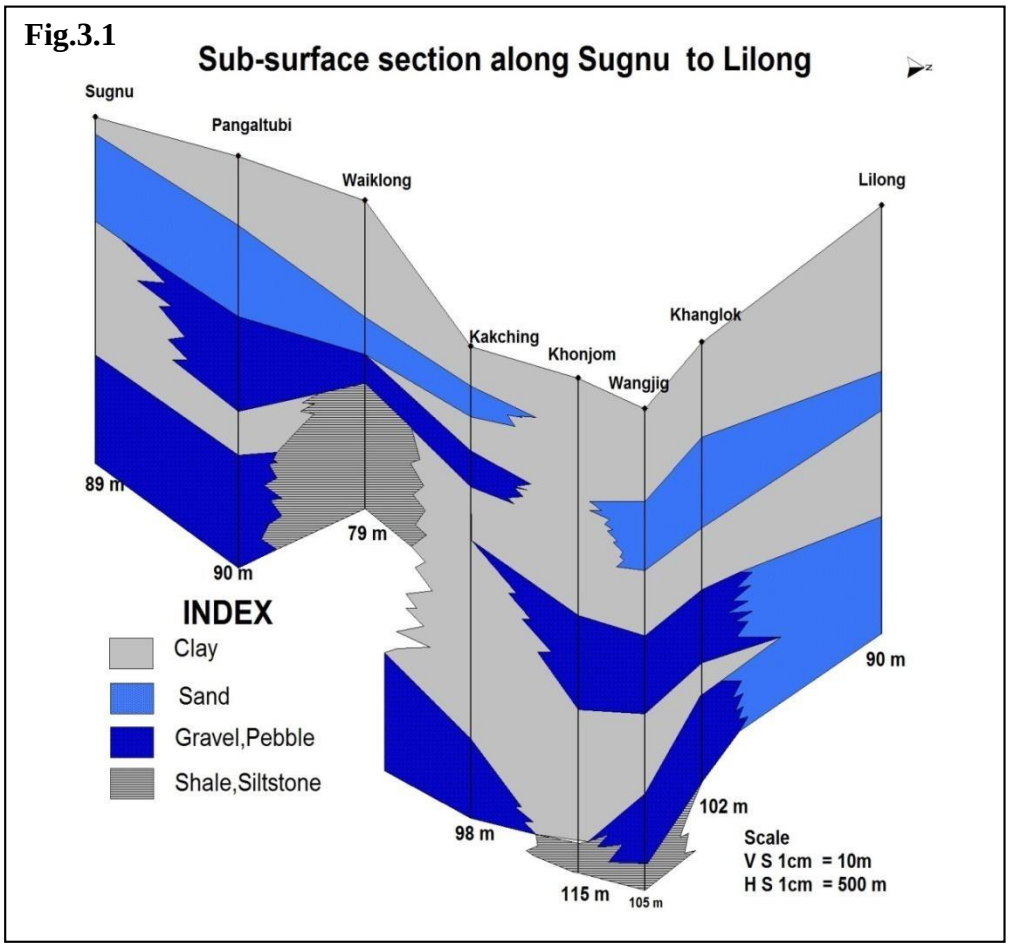
CHAPTER 3.0

DATA INTERPRETATION, INTEGRATION AND AQUIFER MAPPING

Data Interpretation

The subsurface geology of the study area is interpreted based on available drilling data of CGWB. The main objective of the study is to delineate the horizontal and vertical disposition of aquifer as well as to study the aquifer character. The exploratory drilling revealed presence of two granular horizons from north to south, extending from Lilong to Sugnu. Lateral and vertical aquifer disposition is shown in **Fig. 3.1**. From the ground water exploration studies, the aquifer thickness ranges from 11 to 30 m, discharge of the well ranges from 18 to 611.3 lpm, transmissivity ranges from 43 to 255.5 m^2/day, drawdown ranges from 3.42 to 20 m and some of the wells were auto flow. From the below figure it is observed that first granular horizon exists at Sugnu between 3 to 21 m while the granular zone encounters between 19 to 37 mbgl at Pangaltabi and between 23 and 45 m at Khngabok (Thoubal) and 39 and 47 m at Lilong. Second granular zone encountered at Pangaltabi-Sugnu between 57 and 90 m. The same zone encountered at Thoubal and Lilong with an increase in thickness i.e., between 56 to 90 m and 70 to 110 m respectively. Thus, the cumulative thickness of aquifer is found to increase from 36 m at Sugnu in the south to 49 m at Khangbok-Lilong in the North.

Fig.3.1



Depth to Water Level

To study ground water regime and depth to water level, 13 monitoring stations are measured seasonally. During pre-monsoon, water level ranges from 0.38 to 4.24 m bgl. Pre-monsoon depth to water level map is shown in **Fig.3.2**. From the map it is observed that major part of the district is having water level within 2 m bgl i.e. under water logging condition.

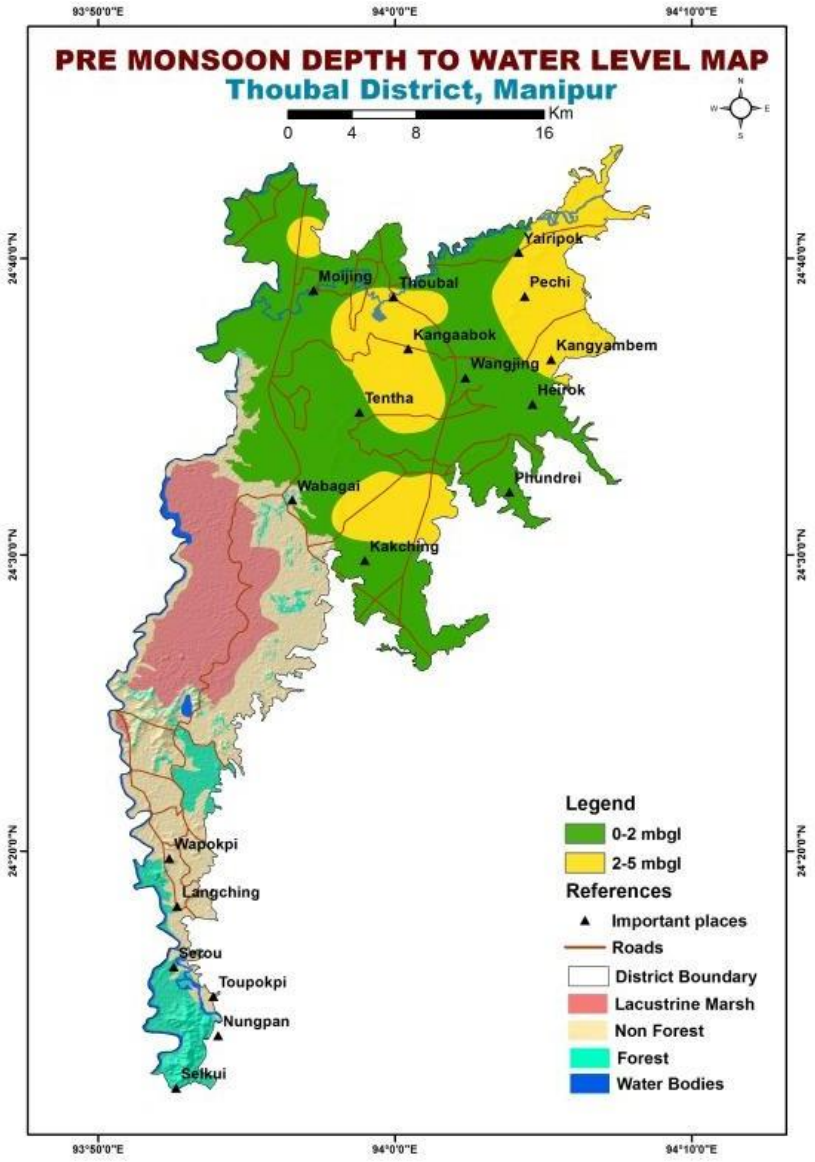


Fig. 3.2. Depth to water level (Pre Monsoon) map of Thoubal District, Manipur

During post-monsoon, water level ranges from 0.45 to 3.1 m bgl. About 95% of the area is having a water level within 2 m bgl. Near Aripat and Mairenbam villages depth to water level is more than 2 m bgl. Post-monsoon depth to water level map is shown inFig.3.2.

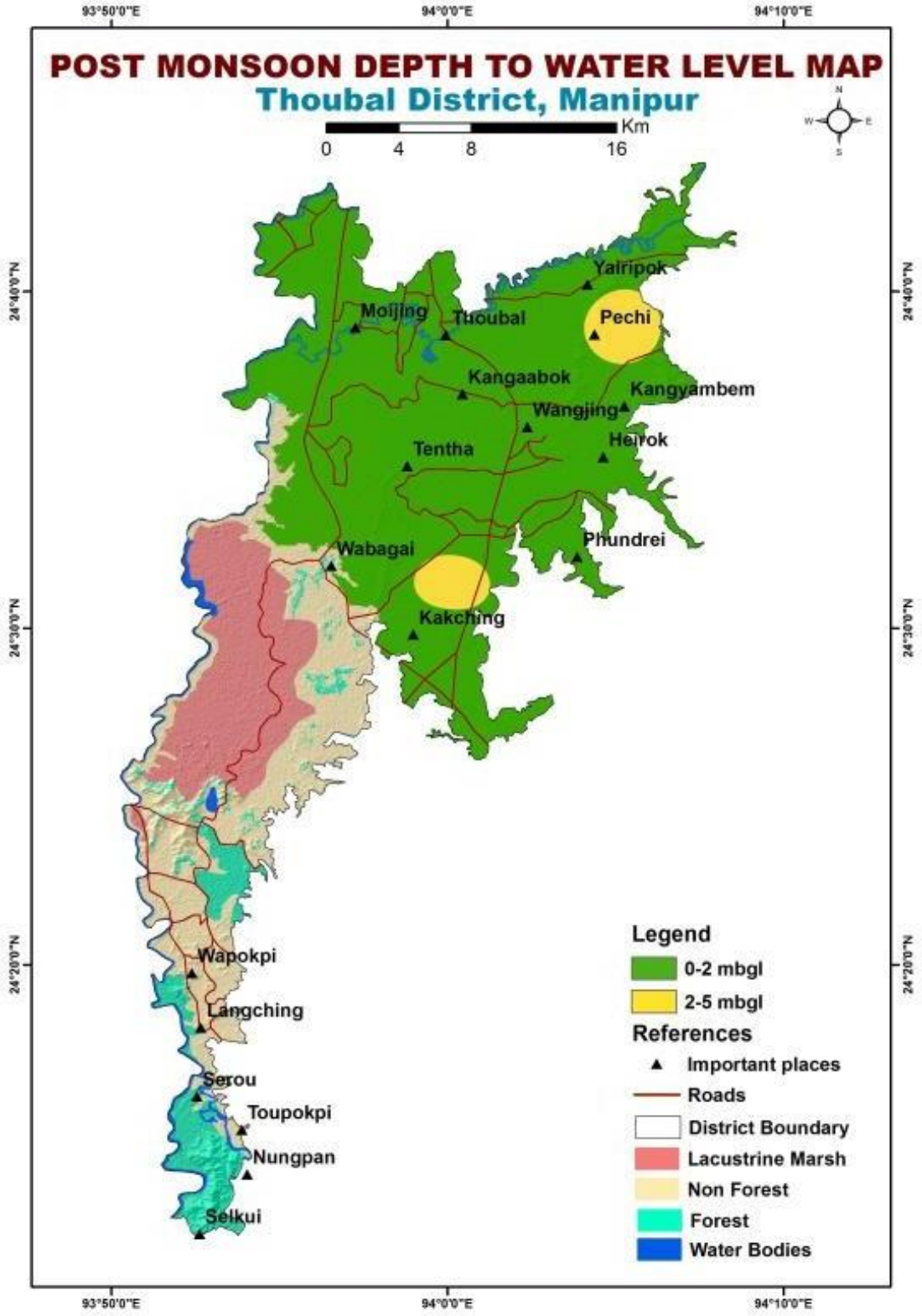


Fig. 3.3. Depth to water level (Post Monsoon) map of Thoubal district, Manipur

In major part of the study area, seasonal fluctuation varies from 0.5 to 1 m. Seasonal fluctuation map is shown in **Fig.3.4**.

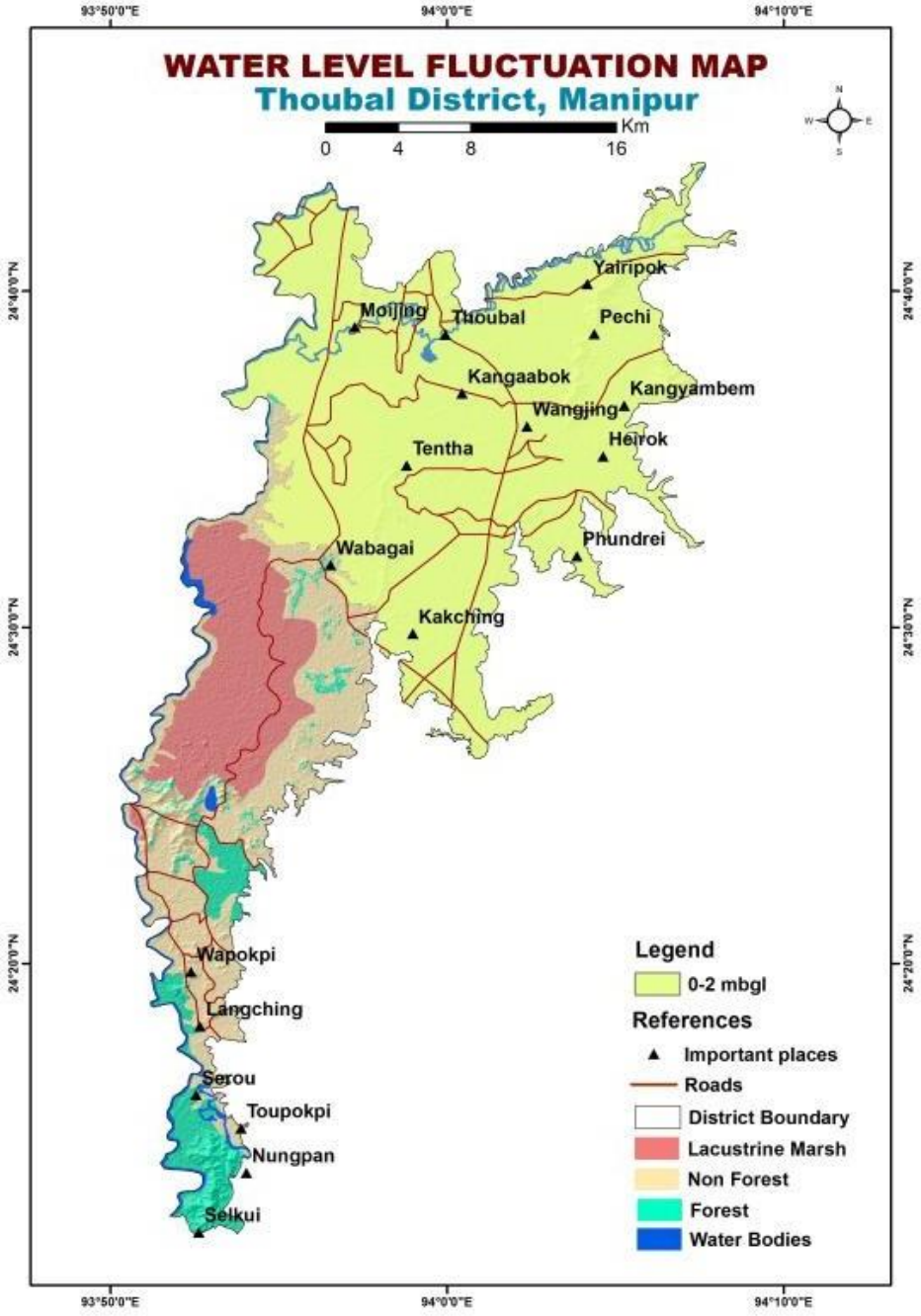


Fig. 3.4. Water level fluctuation map of Thoubal district, Manipur

Water table contour map is given in **Fig.3.5.** From the map it is observed that the regional ground water flows towards south west and ultimately forming marshy land in the south western boundary of the district nearby Nongmaikong- Arong Nongmaikh-Laphupat villages.

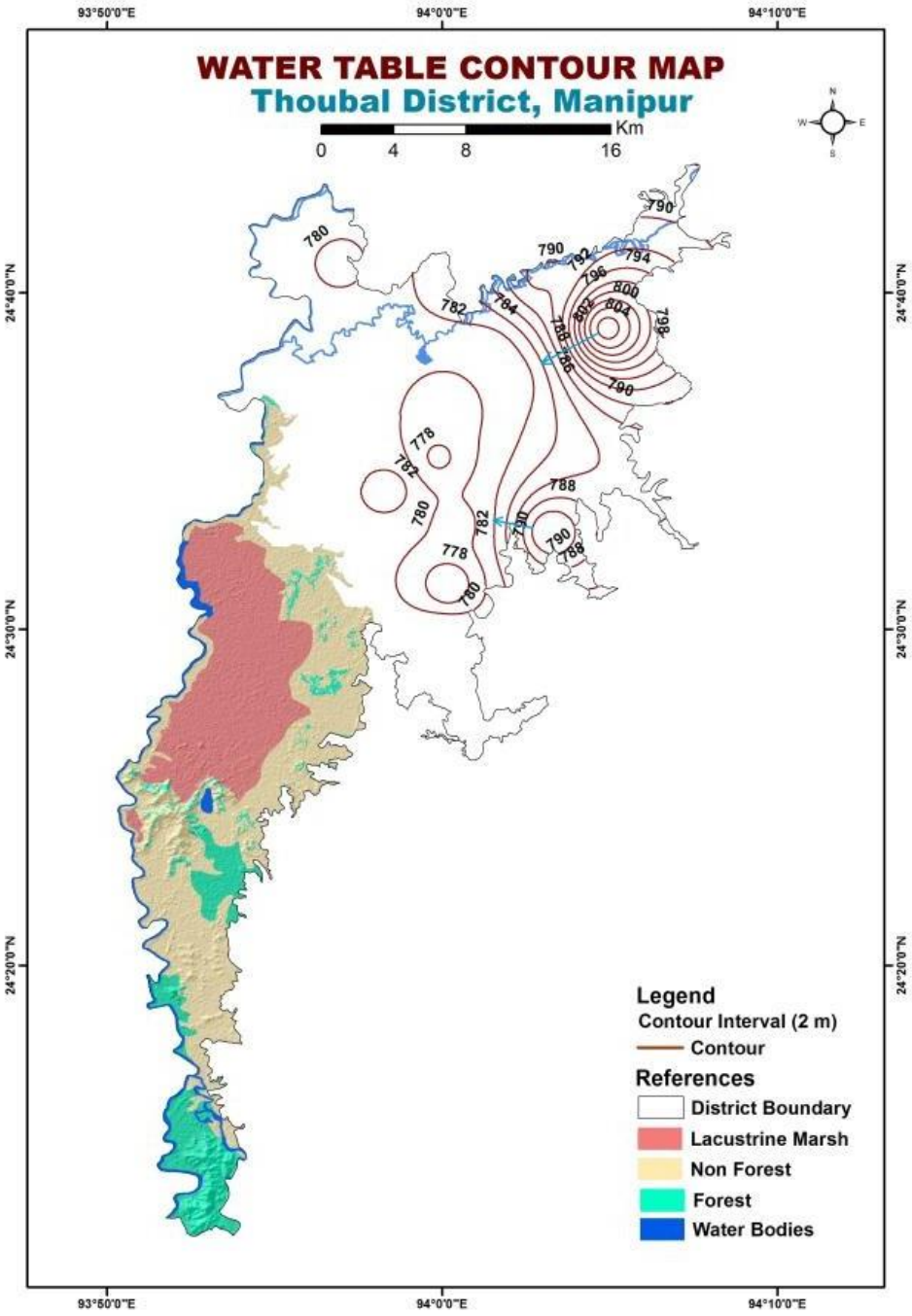


Fig. 3.5. Water table contour map of Thoubal district, Manipur

Ground water quality:

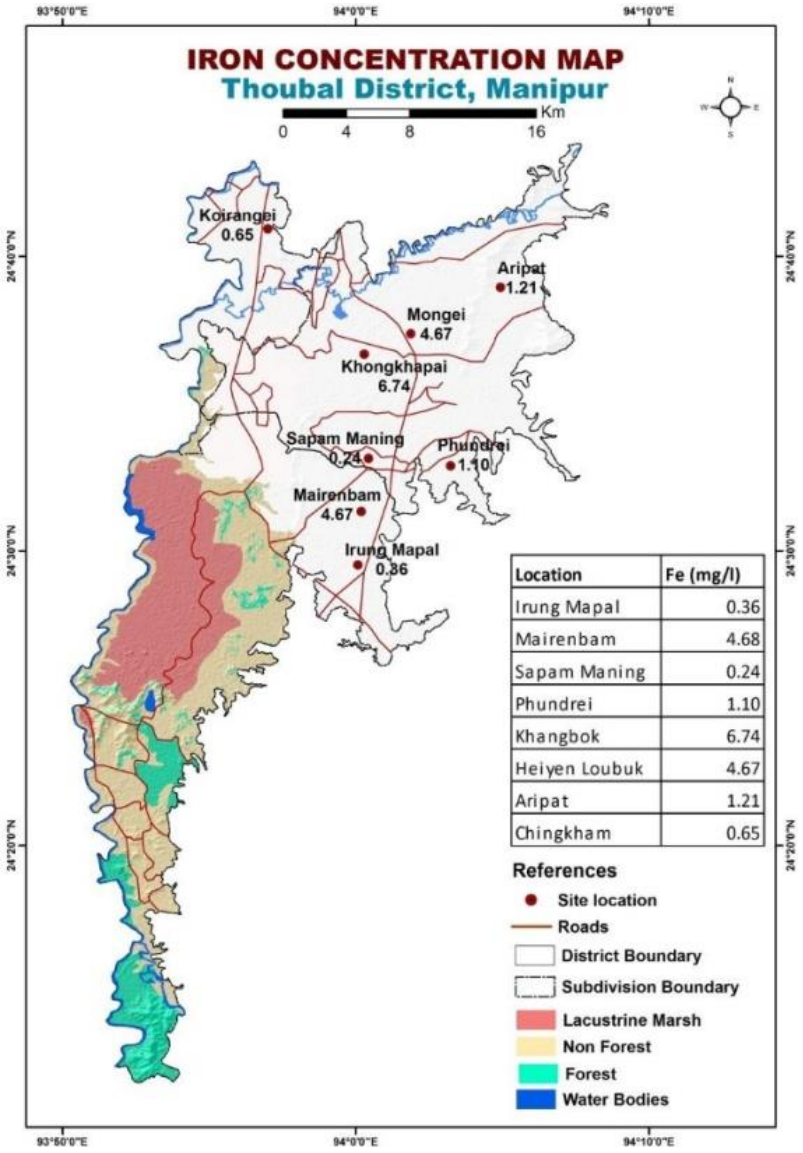
To find out the different chemical parameters water samples were collected from 15 dug wells and analysed in the Regional Laboratory of CGWB, NER. The samples were tested for 8 physico-chemical parameters like pH, total dissolved solids (TDS), Electrical conductivity (EC), sodium, potassium, chloride, fluoride, nitrate, sulphate, total hardness, calcium, magnesium, carbonate, bicarbonate and iron.

Chemical analysis shows that all the major anions and cations are within the permissible limit (as per Bureau of Indian Standards) except iron. The pH of the Groundwater

varies from 7.92 to 8.27 indicating slightly basic character of the ground water. The value of EC during pre monsoon varies from 168 to 746 μs/cm at 25^{0}C.

The fluoride content of ground water samples varies from 0.24 to 1.80 mg/l.In one water sample collected from STW (at Mairenbam village) is showing concentration beyond permissible limit i.e.1.8mg/l.

Ground water in the area is having high iron content, ranges from 0.24 to 6.75 mg/l. Maximum concentration of iron with a value of 6.75 mg/l detected at Khongkhapai. Concentration of iron in the shallow aquifer is shown in **Fig. 3.6**.



Arsenic concentration in the groundwater of some selected sites of Thoubal district in Manipur valley is found ranging from 0.1776 to 0.4997 mg/l. Arsenic concentration in these sites are greater than the prescribed limits of BIS and WHO.

CHAPTER 4.0

GROUND WATER RESOURCES

Groundwater Resources

The study area covers Kakching &Thoubal blocks of Thoubal district where rechargeable area is 514000 ha i.e. the whole district. The computation of ground water resources available in the district has been done using GEC 2015 methodology. Data and assumptions used in the assessment: Following data and assumptions are used in the assessment:

Rainfall recharge has been computed by both RIF following the norms recommended by GEC'2015. The normal monsoon and non-monsoon rainfall in the district is the average of rainfall data of last 31 years and is 753.6 mm and 552.31 mm respectively.

The population figures were collected from Census, 2011and projected to 2017. The per capita domestic requirement for the district is considered as 60lpcd. Ground water extraction for irrigation and industrial use is **126.23 ham**.

Recharge: The aquifers of the study area are recharged by rainfall. The area experiences south- east monsoon. Monsoon rainfall contributes approximately 57 percent of total rainfall (June, July, August, and September). Total ground water recharge is **8054.86 ham**.
Extraction: The agriculture in the area generally rain fed and whatever irrigation potential created and utilized is by surface source only. For agricultural use annual ground water extraction is only 90.30 ham. Industrial activity in the district is almost nil and ground water extraction is for industry is thus considered as nil. Ground water extraction for **domestic use** is **35.93 ham**. Dependency on ground water is calculated from village amenities part of census 2011. Dependency is the ratio of number of household extracting groundwater from various sources (covered well, uncovered well, hand pump, tube well and spring) to the total number of households. The dependency of Roing-Koronu block on ground water is 40.82%.
Gross ground water extraction is 126.23**ham**.
Allocation of resources up to 2025: The net ground water resource is allocated for domestic use is 987.82 ham.
Net available resource for future use is **7014.51 ham**.

Stage of groundwater development: Groundwater is mainly utilized for domestic purposes. The stage of groundwater development in the district is mere**1.5%.**

The net groundwater availability, existing ground water (G.W.) extraction and stage of development as on March 2017 is shown in Table4.1.

Table 4.1: Net groundwater availability, existing draft and stage of G.W. extraction

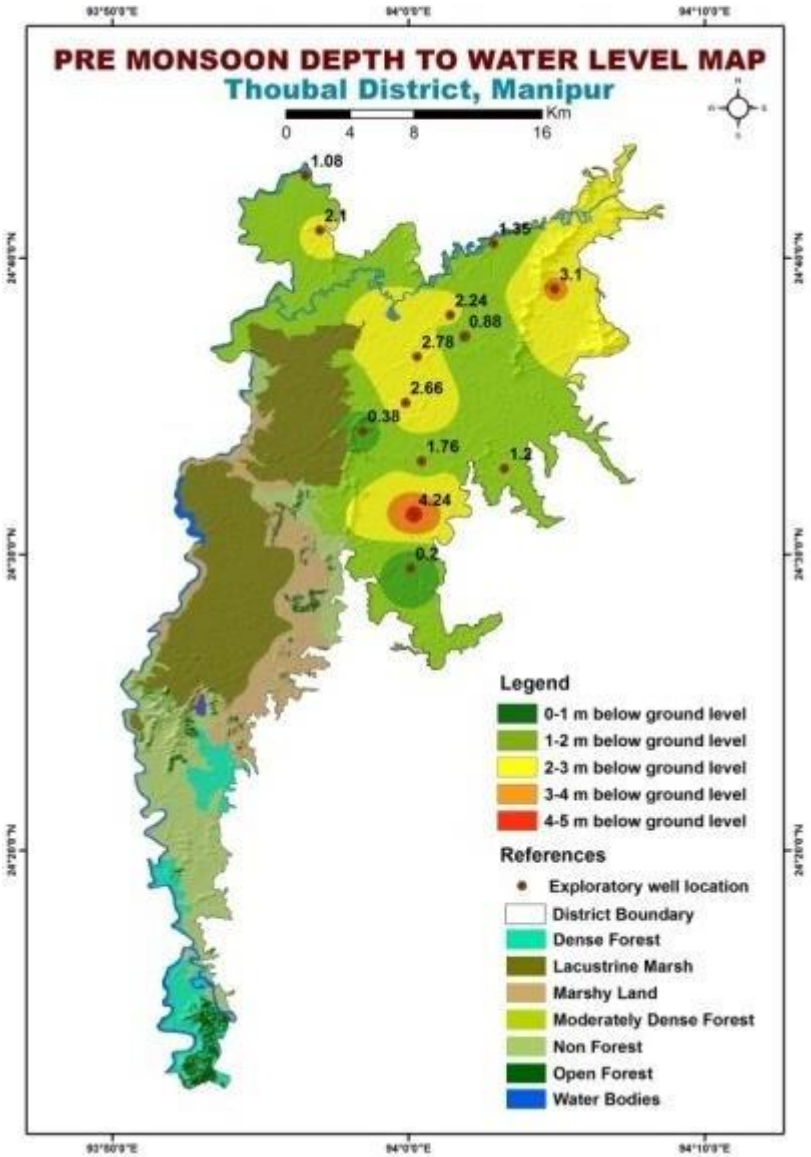
Recharge worthy area (in Ha)	Total annual GW recharge (in Ham)	Environmental flow (in Ham)	Annual extractable GW resource (in Ham)	Existing gross GW extraction for all uses (inHam)	Stage of GW extraction (%)
51400	8991.81	899.18	8092.63	126.23	1.5

GROUNDWATER RELATED ISSUES

Identification of issues: Groundwater related issues present in the district are:

- Low stage of ground water development
- Stage of ground water extraction in the district is only 1.56%.
- Water logged and prone to water logged condition

Based on pre-monsoon depth to water level data recorded in the district it is observed that mostly the area is having water level within 2 m bgl i.e. under water logged condition while in the extreme north-eastern part, central and south central parts of the district prone to water logging condition is observed.



Ground water quality issues

Water sample collected from STW (at Mairenbam village) is showing concentration beyond permissible limit i.e.,1.8mg/l.

Ground water in the area is having high iron content, ranges from 0.24 to 6.75 mg/l. Maximum concentration of iron with a value of 6.75 mg/l detected at Khongkhapai.

Concentration arsenic beyond permissible limit in the shallow aquifer at Irung Mapal (Kakching Block), Tentha High School (Thoubal Block) and Nepra Company (Thoubal Block) are found to belocalized and are not uniformly distributed.

CHAPTER 6.0

MANAGEMENT STRATEGIES

The objective of management is to utilize the available ground water resources to fulfill human needs and also to boost economy of an area without hampering the interest of future generation. That objective can be achieved by finding out demand of various sectors and adjusting the demand with available resource.

The demands of various sectors in the area are worked out and it is observed that the available dynamic ground water resource of this area is sufficient to meet the demand of domestic as well as agricultural and industrial sectors. Various issues pertaining to the management of ground water resources will be discussed in the following paragraphs.

As per agriculture census data 2017-18, during Kharif season, paddy is cultivated in 26350 ha of land and after Kharif season is over, 2540 ha remains fallow during the Rabi season. A management plan has been envisaged to use this vast fallow land for double cropping by utilizing the available groundwater resources. Basic aim is to increase the gross cropped area from 2540 ha to 5080 ha.

To use the groundwater for irrigation purpose a cropping plan has been designed for the district by using CROPWAT model developed by FAO. A suitable cropping plan for the district was prepared in consultation with scientists of Assam Agricultural University, Jorhat. Cropping pattern data for the district is presented in **Table 6.1**. Present cropping pattern, proposed cropping pattern, targeted increase in cropping intensity is shown in **Table 6.2** and proposed cropping pattern with water deficit months and irrigation water requirement is shown in **Table 6.3**.

Table 6.1 Cropping pattern Thoubal district, Manipur (*Source: CROPWAT)*

CROPPING PATTERN DATA

(File: C:\ProgramData\CROPWAT\data\sessions\Thoubal.PAT)

Cropping pattern name: Thoubal

No.	Crop file	Crop name	Planting date	Harvest date	Area %
1	...Data\CROPWAT\data	Rice	11/06	08/10	50
2	...ata\CROPWAT\data\	MAIZE (Grain)	30/10	03/03	10
3	rape___mustard.CRO	Mustard	25/10	08/03	10
4	...\CROPWAT\data\cro	Potato	04/11	13/03	10
5	...a\CROPWAT\data\cr	Pulses	15/11	04/03	10
6	...CROPWAT\data\crop	Small Vegetables	21/11	23/02	10

Crop-wise and month-wise irrigation water requirement (Precipitation deficit) has been estimated from CROPWAT after giving necessary meteorological, soil, crop plan inputs and the same has been shown in **Table 6.4**. Crop-wise and month-wise Irrigation water requirement in ham has been further calculated in **Table6.5**.

Table 6.2 Cropping pattern, proposed cropping pattern & irrigation water requirement Thoubal District, Manipur

Rice based cropping pattern				
Rice-Potato Rice-Mustard Rice-Vegetables	Present Cultivated area **(ha)**	Area to be cultivated **(%)**	Area to be cultivated **(ha)**	Irrigation requirement **(ha m)**
	1	2	3(= % of 1)	4
Rice	2540	2540	100	375
MAIZE (Grain)		508	20	85
Mustard		508	20	81
Potato		508	20	102
Pulses		508	20	79
Small Vegetables		508	20	79
Gross cultivated area (1+potato/+mustard/+Veg+pulses)				
Total irrigation requirement	**2540**	**5080**		**801**
Cropping intensity			**200 % (intended)**	

Table 6.3 Proposed cropping pattern with water deficit months and irrigation water requirement

Rice based cropping pattern			
Crop	**Growing period (Months)**	**Periods/months of water deficit**	**Irrigation requirement (ha m)**
Rice	4	2	375
MAIZE (Grain)	5	3	85
Mustard	6	5	81
Potato	4	1	102
Pulses	3	2-3	79
Small Vegetables	4	2	79

The total area of rice cultivation is comprised of (2540 ha) 50% of the targeted cultivated area of (5080 ha). During kharif season, rice is cultivated from June to July. Since this huge area cannot be cultivated in a single day (one planting date), so it is considered/ planned to cultivate rice in four stages during this period. It is planned to utilize rice fallow of 2540 ha for the cultivation of potato, rape & mustard, pulses and vegetables.

Table 6.4 Crop-wise and month and year wise precipitation deficit (mm) using CROPWAT 8 in Thoubal District Manipur

Crop Name	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
	Precipitation deficit (mm)											
1. Rice	0	0	0	0	49.5	98	0	0	0	0	0	0
2. MAIZE (Grain)	67.3	25.3	0	0	0	0	0	0	0	1.9	13.2	58.9
3. Mustard	51.7	20.1	0.1	0	0	0	0	0	0	0	29.8	56.9
4. Potato	65.6	44	14.8	0	0	0	0	0	0	0	23.6	53.8
5. Pulses	66.3	36.3	0	0	0	0	0	0	0	0	11.5	42
6. Small Vegetables	59.2	32.8	0	0	0	0	0	0	0	0	14.8	48.9

Table 6.5 Crop-wise month and year wise Irrigation water requirement (ham) in Thoubal district, Manipur

	Area	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	IWR
1. Rice	2540	0.00	0.00	0.00	0.00	125.73	248.92	0.00	0.00	0.00	0.00	0.00	0.00	374.65
2. MAIZE (Grain)	508	34.19	12.85	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.97	6.71	29.92	84.63
3. Mustard	508	26.26	10.21	0.05	0.00	0.00	0.00	0.00	0.00	0.00	0.00	15.14	28.91	80.57
4. Potato	508	33.32	22.35	7.52	0.00	0.00	0.00	0.00	0.00	0.00	0.00	11.99	27.33	102.51
5. Pulses	508	33.68	18.44	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	5.84	21.34	79.30
6. Small Vegetables	508	30.07	16.66	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	7.52	24.84	79.10
													Total	**800.76**

The aquifer in most part of the district is having good potential, having an average discharge of about 45 m^3/hr. but can be sustainably developed and use for irrigation purpose.

As per dynamic ground water resource estimation 2017, the stage of ground water development is just 1.56 %.

The net irrigation requirement, calculated using 'CROPWAT' software, of the study area with the recommended cropping plan calculated as 801 ham. **Gross irrigation requirement considering 70% irrigation efficiency would be 1145 ham.** As available groundwater resource is **7014 ham** for future irrigation therefore, above-mentioned cropping plan can mostly be safely implemented for the area.

CGWB's exploration has established that the aquifer of the district is medium to high yielding. A tube well of 50 m depth tapping 20 m saturated thickness of aquifer can yield 20 m^3/hr. If the well is allowed to run for 8 hrs for 100 days, it will create a draft of 1.6 ham. Considering 200 m safe distance between two tube wells, 635 numbers of TW can be constructed in the area (2540 ha or 25.4 sq.km.) and considering the demand **715** numbers of tube wells need to be constructed. Therefore, **635** numbers of **tube wells can be constructed to meet 1016 ham irrigation demand**. Rest **125 ham** water requirement need to be meet from available surface water sources.

As such on implementation of the ground water-based irrigation plan as suggested for the district, it is expected that it will help for irrigation of Rabi crops as well as will increase stage of groundwater extraction. This will also help in lowering of groundwater level to a desired level.

Recommendation to tackle Arsenic problem in Ground water

Concentration of arsenic beyond permissible limit in the shallow aquifer at Irung Mapal (Kakching Block), Tentha High School (Thoubal Block) and Nepra Company (Thoubal Block). Use of ground water in the identified villages, specifically for domestic use, is not suggested and existing shallow tube well of the villages need to be sealed. Deep tube well in the arsenic affected villages may be constructed by proper cement sealing and clay filling as shown in **Fig.6.1.**

Apart from this, now many arsenic removal plants are also available in the market for house hold use.

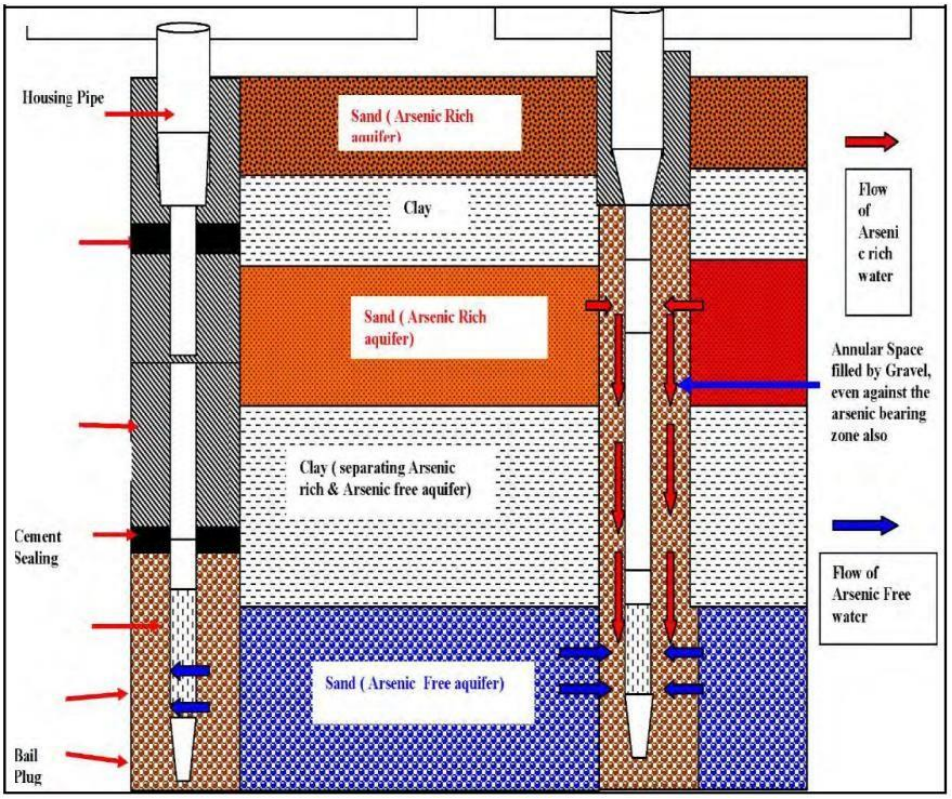


Fig.6.1: Tube-well design of a deep tube well tapping safe deeper aquifer (Source: Concept note on geogenic contamination of groundwater in India).

Concentration of iron beyond permissible limit has been observed in the shallow tube wells. At Khongkhapai village where concentration of iron is 6.75 mg/l. Therefore, before consumption aeration/ filtering/ installation of Iron Removal Plant is necessary.