Technical Report Deries : D

No:10/2013-14

Ground Water Information Booklet
Bishnupur District, Manipur

Central Ground Water Board
North Eastern Region
Ministry of Water Resources
Guwahati

September 2013

Ground Water Information Booklet, Bishnupur District, Manipur

DISTRICT AT AGLANCE

Sl. No.	ITEMS	STATISTICS
1	GENERAL INFORMATION	
	i) Geographical Area (in sq.km)	496.00
	ii) Administrative Division (as on 31 March 2013) Number of Tehsil/CD Block Number of Panchayat/Villages	 2 25
	iii) Population (as per 2011 Census)	2,40,363
	iv) Average Annual Rainfall (mm)	
2	GEOMORPHOLOGY i) Major Physiographic Units ii) Major Drainages	i. Valley area, ii. Area under water (lakes), & iii. Hillocks with forests Small tributaries like Thongjaorock, Nambol, khuga, Ningthoukhong, Sunusiphai, Iram, Yangoi rivers which are flowing towards Loktak lake (except Khuga)
3	LAND USE (sq.km) i) Forest Area ii) Net Area Sown iii) Cultivable Area	 i) 15.00 ii) 386.71 iii) 423.66
4	MAJOR SOIL TYPES	i. Younger & Older alluvial soil ii. Red gravelly sandy and loamy soil
5	AREA UNDER PRINCIPAL CROPS in sq.km (as on March 2011)	177.20
6	IRRIGATION BY DIFFERENT SOURCES (sq.km) i) Dug Wells ii) Tube /Bore Wells iii) Tanks/Ponds iv) Canals (SLI+SFI) v) Other Sources, MIS vi) Net Irrigated Area vii) Gross Irrigated Area	 i) - ii) 0.33 iii) - iv) (6.48 + 34.90) =41.38 v) 41. 71 vi) 51.44 vii) 83.42
7	NUMBERS OF GROUND WATER MONITORING WELLS OF CGWB (as on 31-03-2013) –Dug wells	3 National Hydrograph Stations of CGWB in Bisnupur district that are regularly monitored prior to 1991. **No monitoring work is carried out since 1991 due to disturbed law and order situation in the state.**
8	PREDOMINANT GEOLOGICAL FORMATIONS	Disang and the Barail Group of rock consisting shale, siltstone & sandstone

		of Upper Cretaceous to Eocene age.	
9	HYDROGEOLOGY i) Major water Bearing Formations ii) Pre-monsoon Depth to Water Level iii) Post-monsoon Depth to Water iv) Long term Water Level Trend in 10 yrs (1997 –2006) in m/yr	i. Unconsolidated alluvium rocks ii. 2.73 to 16.02 mbgl iii. 1.47 to 3.36 mbgl iv. No significance change	
10	GROUND WATER EXPLORATION BY CGWB (as on 31-03-2013) i) No of Wells Drilled ii) Depth Range (m) iii) Discharge (lpm) iv) Transmissivity (m^2/day)	No new exploration work in the district Existing EWs : 2 EWs (CGWB) Kumbi 96.80 232.0 38.84	Bishnupur 45.70 100.0 4.30
11	GROUND WATER QUALITY i) Presence of Chemical Constituents more than Permissible Limit (e.g. EC, F, Fe, As) ii) Type of Water	Except Fe and As, other elements are within the Permissible limit. Fe and As are more than Permissible limit in the shallow aquifers Ca^+ - Mg^+ - $HCO3^-$ type	
12	DYANMIC GROUND WATER RESOURCES (as on March 2009) in mcm i) Annual Replenishable Ground Water Resources ii) Net Annual Ground Water Draft iii) Projected demand for Domestic and Industrial Use upto 2025 iv) Stage of Ground Water Development	i) 79.99 ii) 0.40 iii) 6.15 iv) 0.56%	
13	AWARENESS AND TRAINING ACTIVITY i)MassAwarenessProgrammes Organized ii) Date iv) Place v) No of Participants	Nil	
14	EFFORTS OF ARTIFICIAL RECHARGE AN RAINWATER HARVESTING i) Projects Completed by CGWB (No & amount spent) ii) Projects Under technical Guidance of CGWB (Numbers)	Nil	
15	GROUND WATER CONTROL AND REGULATION i) Number of OE Blocks ii) Number of Critical Blocks iii) Number of Blocks Notified	Nil	
16	MAJOR GROUND WATER PROBLEMS AND ISSUES	Higher concentration of Fe and As in ground water of the district is observed (at Keinouthonkhong)	

Ground Water Information Booklet
Bishnupur District, Manipur

1.0 Introduction

Bishnupur district is located in the south west of Manipur Central valley area between 24 ^{o}10' & 24 ^{o} 45' North latitude and 93 ^{o} 45' & 93 ^{o} 52' east longitude covering a total area is 496 sq.km. The average altitude is 822.18 m above MSL. The district is bounded on the North by Imphal West District, on the South by Churachandpur District, on the East by Imphal and Thoubal Districts. The original name of Bishnupur was Lumlangdong (now Lamangdong). Bishnupur is popularly known as the **'land of dancing deer'**.

As per 2011 census, the total population of the district is 2, 40,363. The density of population is 485 persons per square km. The district is the home of large number of different communities.

The district experiences fair cold climate during winter and hot in summers. The maximum temperature is 33oC during May to September and the minimum is dips down to 4 oC in the month of January. However, the temperature of the district as a whole is moderate and there is no extreme climate in the district. Irregular rain starts in the month of April with occasional and irregular light showers and continues up to the end of May. This rain occurs due to the influence of Northeastern wind. Normal monsoon rain begins from the early part of June and heavy rains occur in the district till the month of September. About 80% rainfall is from South West monsoon.

The district is primarily an agrarian as majority of the population depend their livelihood on agriculture and other allied activities. As major portion of the district is plain, wet cultivation is the main method of cultivation. The Principal agriculture crops

are paddy, maize, potato, pea, mustard, chilly, cabbage, etc. Sugarcane is the main cash crop of the district.

Physiographically the district may be divided into three main parts i.e. (i). Valley or alluvial plain area, (ii) area under water or wetland / lakes and (iii) area covered under Hillocks and Forest. Alluvial plains cover majority of the district area with a flat gentle regional slope towards Loktak Lake.

A considerable area of the district is covered by the lakes like Loktak, Ngakrapat, Awangsoi, Laisoi, Zingpat, Loukoipat, and Ikokpat etc. Loktakpat, which is the largest in Land Lake not only in Manipur but also in the North-eastern India, covers an area of about 247 sq.km during the rainy season with an average depth of about 10-15 metres. Keibul Lamjao, the National park is situated on the southeastern side of the Loktak Lake and it has an area of 40 sq.km. The sonapat, Utrapat, Samusang, Kharungpat and Ikokpat are also woth-mentioning lakes in Bishnupur district.

Hillocks and forests, having an area of about 34.12 acres, constitute rest of the district. Some of the worth mentioning hillocks are Lotpaching, Loukoiching, Sendra, Khongjaingambaching, Thangaching etc.

Locally originated small tributaries control the drainage of the district. There is no large-scale river in the district. Some of the small rivers, which are flowing in the district, are Thongjaorock, Sunusiphai, Nambol, Yangoimacha, Yangoiachouba, Khuga, and Iram etc. Except Khuga River all other river start from the hill located at the west of the Tiddim Road and flows towards east falling into Loktak Lake.

Geologically the district is occupied by the shale, siltstone and sandstone of the Disang Group and the Barail Group of Upper Cretaceous to Eocene age. It follows the tectonic strike of the general N 10 ^{o} folding direction of the Indo-Burmese range. The valley fill of Plio-Quarternary age consists of clay, sand and gravel deposited in a fluvio lacustrine environment. On the western edge of the valley, there are small alluvial fans such as those in Bishnupur and north of Leimakhong River. In Bishnupur, condensed

series show a progradation of gravel beds into lacustrine black sandy clay. At the bottom, lacustrine laminated sand and clay overlies the fresh Disang shale.

Ground water in the district occurs both under semi-confined and unconfined conditions. Water level rises in the months of May and June during pre-monsoon and falls during the month of February - March during the post-monsoon period. The level reaches its minimum during March-end. Rainfall starts from the month of April end and hence water level is found to be rise during April-May.

Hydrogeologically the entire district has been defined by semi consolidated to unconsolidated Formations of Quaternary age. These are shale, siltstone, sandstone and conglomerate, which belong to Disang and Barail group of rocks. Ground water is restricted to weathered residuum of semi-consolidated rocks and intergranular pore spaces of alluvial deposits. Further subdivisions like Older and Younger alluvium have been made on the basis of geomorphology including landuse, lithology, soil characteristics and hydrogeological properties like yield characteristics etc.

There are small alluvial fans in Bishnupur and north of Leimakhong River. In Bishnupur, condensed series show a progradation of gravel beds into lacustrine black sandy clay. At the bottom, lacustrine laminated sand and clay overlies the fresh Disang shale.

The ground water movement is essentially towards the lower topographic fenland from the tangential raised ground around Loktak Lake with west to east hydraulic gradient by showing radial pattern of the area since there are variations in the hydraulic gradient in the areas especially in between Disang and Barail parts of the area. As per the exploration data of C.G.W.B, there are more or less single horizon of aquifer exists within 44 metre depth having thin clay intercalations in and around the project area.

Aquifer thickness ranges from 10 to 20 mbgl in and around the project area in Bishnupur district. Piezometric head varies from 2.50 to 4.30 mbgl. The transmissivity

and hydraulic conductivity ranges between 4.30 and 89 m^2/day and 0.67 to 16 m/day. The average discharge of the existing tube wells recorded is about 10-30 m^3 /hr at 10-15 m drawdown. In fact there is great variation of lithology in both vertical and lateral even over small distances. Sand and gravel layers have indefinite and largely undefined boundaries.

The thickness of older alluvium in the project area reveals to be more than 50 m as per the existing exploratory data of CGWB. The potential aquifer is found in the southern part of the area bordering districts.

Based on the hydrogeological conditions, occurrence of potential aquifer horizons and their yield potential, prospects for ground water development in the project area is confined to the alluvial plains in and around the Lake. The eastern and northern region are feasible for the development of ground water through shallow to moderately deep tube wells down to 90 m tapping about 10 to 30 m cumulative thickness of granular horizon capable of yielding about 10 to 40 m^3/hr for draw down upto 15 m.

National Hydrograph Stations of CGWB in Bisnupur district that are regularly monitored prior to 1991. **No monitoring work has been carried out since 1991 due to disturbed law and order situation in the state.**

Computation of Dynamic Ground Water Resources of Bishnupur district has been carried out in the district as per GEC ’97 as on March 2011. **The Administrative district has been considered as the Assessment Unit due to paucity of block –wise data.** Computed Annual Replenishable Ground Water Resources is 79.37 mcm. Net Annual Ground Water Draft in the district is 0.40 mcm. Projected Demand for Domestic and Industrial Use up to the year 2025 is 6.07 mcm. Stage of Ground Water Development estimated is 0.56. The district as whole has been categorized as ‘Safe’.

2.0 Rainfall and Climate

Bishnupur district has got monsoon climate by receiving rainfall mainly from June to September every year. Irregular rain starts in the month of April with occasional and irregular light showers and continues up to the end of May. This rain occurs due to the influence of Northeastern wind. Normal monsoon rain begins from the early part of June and heavy rains occur in the district till the month of September. About 80% rainfall is from South West monsoon.

The district experiences fair cold climate during winter and hot climate during summer season. May to September is the hottest months and December and January are the coldest months. The maximum temperature is 33oC during May to September and the minimum is dips down to 4 o C in the month of January. In winter, slight and thin snowfalls are observed in colder years. However, the temperature of the district as a whole is moderate and there is no extreme climate in the district.

3.0 Geomorphology and Soil Types

3.1 Geomorphic Features and Landforms

Bishnupur district may divided into three main physiographic divisions i.e. (i). Valley or alluvial plain area, (ii) area under water or wetland / lakes and (iii) area covered under Hillocks and Forest. The plain area covers the major portion of the area of the district; secondly, the lakes cover a considerable area in the district. Alluvial plains are characterized by a flat gentle regional slope towards Loktak Lake.

The lakes like Loktak, Ngakrapat, Awangsoi, Laisoi, Zingpat, Loukoipat, and Ikokpat etc cover a considerable area of the district. Loktakpat, which is the largest in Land Lake not only in Manipur but also in the North-eastern India, covers an area of about 247 sq.km during the rainy season with an average depth of about 10-15 metres. Keibul Lamjao, the National park is situated on the southeastern side of the Loktak Lake

and it has an area of 40 sq.km. The sonapat, Utrapat, Samusang, Kharungpat and Ikokpat are also woth-mentioning lakes in Bishnupur district.

The Hillocks and forests, having an area of about 34.12 acres, constitute the third part of the district. Some of the worth mentioning hillocks are Lotpaching, Loukoiching, Sendra, Khongjaingambaching, Thangaching etc.

3.2 Drainage and Morphometric Features

The drainage of the entire area is controlled by locally originated small tributaries of the district. There is no large-scale river in the district. Some of the small rivers, which are flowing in the district, are Thongjaorock, Sunusiphai, Nambol, Yangoimacha, Yangoiachouba, Khuga, and Iram etc. Except Khuga River all other river start from the hill located at the west of the Tiddim Road and flows towards east falling into Loktak Lake. Discharging maximum quantity of water during the monsoon months (May – September), these tributaries frequently inundate the land along their banks by experiencing havocs of flood in every year.

3.3 Soil

The nature of the soil in the district is transported type of soils. The transported soils are of two types i.e. alluvial and organic . The area covered by plains and hillocks are mainly characterized by alluvial soils. These soils have general clayey warm texture and grey to pale brown colour. They contain a good proportion of potash and phosphate, a fair quantity of nitrogen and organic matter and are less acidic. The organic soils covered the low-lying areas surrounding the lakes. With dark grey colour and clayed loam texture, these peaty soils have high acidity, abundance of organic matter, a good amount of nitrogen and phosphorous but are poor in potash. The hill soils are more or less rich in organic carbon (1 to 3%) in the topsoil, but poor in available phosphorous and potash. They are acidic in nature.

Alluvial sediments belonging to Quaternary ages occupy the plain areas. Based sedimentation, soil characteristics and geomorphic features, the sediments can be divided into two subdivisions, viz. older and younger alluvium. The older alluvium by virtue of its relative maturity is composed of somewhat oxidized sediments comprising yellow and the reddish brown colour sand, silt and clay in contrast to the light colour, less compact Younger alluvium sediment. The older alluvium always occupies the higher grounds than the adjacent younger alluvium but takes the proper stratigraphy position underlying the younger alluvium sediments in the plain areas

4.0 Ground Water Scenario

4.1 Hydrogeology

Ground water in the district occurs both under semi-confined and unconfined conditions. Water level rises in the months of May and June during pre-monsoon and falls during the month of February - March during the post-monsoon period. The level reaches its minimum during March-end. Rainfall starts from the month of April end and hence water level is found to be rise during April-May.

Hydrogeologically the entire district has been defined by semi consolidated to unconsolidated Formations of Quaternary age. These are shale, siltstone, sandstone and conglomerate, which belong to Disang and Barail group of rocks. Ground water is restricted to weathered residuum of semi-consolidated rocks and intergranular pore spaces of alluvial deposits. Further subdivisions like Older and Younger alluvium have been made on the basis of geomorphology including landuse, lithology, soil characteristics and hydrogeological properties like yield characteristics etc.

There are small alluvial fans in Bishnupur and north of Leimakhong River. In Bishnupur, condensed series show a progradation of gravel beds into lacustrine black sandy clay. At the bottom, lacustrine laminated sand and clay overlies the fresh Disang shale.

The ground water movement is essentially towards the lower topographic fenland from the tangential raised ground around Loktak Lake with west to east hydraulic gradient by showing radial pattern of the area since there are variations in the hydraulic gradient in the areas especially in between Disang and Barail parts of the district. No exploration activities have been carried out since 1991 due to disturbed law and order situation. As per the exploration data of C.G.W.B, there are more or less single horizon of aquifer exists within 44 metre depth having thin clay intercalations in and around the project area.

Aquifers

Aquifer thickness ranges from 10 to 20 mbgl in the Bishnupur district. Piezometric head varies from 2.50 to 4.30 mbgl. The transmissivity and hydraulic conductivity ranges between 4.30 and 89 m^2/day and 0.67 to 16 m/day. The average discharge of the existing tube wells recorded is about 10-30 m^3 /hr at 10-15 m drawdown. In fact there is great variation of lithology in both vertical and lateral even over small distances. Sand and gravel layers have indefinite and largely undefined boundaries.

The thickness of older alluvium in the project area reveals to be more than 50 m as per the existing exploratory data of CGWB. The potential aquifer is found in the southern part of the area bordering districts.

Occurrence

Based on the hydrogeological conditions, occurrence of potential aquifer horizons and their yield potential, prospects for ground water development in the district is confined to the alluvial plains in and around Loktak Lake. The eastern and northern region are feasible for the development of ground water through shallow to moderately deep tube wells down to 90 m tapping about 10 to 30 m cumulative thickness of granular horizon capable of yielding about 10 to 40 m^3/hr for draw down upto 15 m.

Yield Potential of Aquifers

The summarized hydrogeological data of the existing exploratory wells of Central Ground Water Board is given below in table 1

Table 1: Summarized hydrogeological data of exploratory well of CGWB

Sl. No	Location	Depth Drilled (m)	Depth of Construction	Tapped Aquifer thickness (m)	S.W.L (mbgl)	Discharge (lpm)	Draw Down (m)	T (m^2/day)
1	Kumbi	96.80	93.00	27.00	2.86	232.00	10.67	38.84
2	Bishnupur	45.70	44.00	12.00	3.91	100.00	18.00	4.30

(N.B. Data is well construction data of CGWB)

4.2 Ground water regime and depth to water analysis

Pre-monsoon depth to water level in the project area ranges from 2.73 to 16.02 mbgl for pre-monsoon (2004) and it varies from 1.47 to 3.36 mbgl during post-monsoon period as per findings of CGWB (DGWMS, Manipur Valley, 2004-05). It is observed that the average annual water level fluctuation project area is 1.79.

Table.2- Depth to water level and water table data of DGWMS monitoring stations in Bishnupur district (after CGWB : DGWMS Report of Manipur Valley,2004-05)

Location	Type	MSL (m)	Drill Depth (m)	MP (m,agl)	DTW Apr' 04 (mbgl)	Water table Apr'04 (mbgl)	DTW Nov' 04 (mbgl)	Water table Nov'04 (mbgl)	Aquifer Parameter	Basin
Keinou Thonkhong	TW	778.341	61.00	0.41	16.02	762.32	3.36	774.98	Fine Sand	Manipur River Basin
Maibam Lokpa Hill	TW	778.644	50.3	0.42	2.73	772.11	1.47	777.17	Gravel and shale	

4.3 Water level trend analysis

Pre-monsoon depth to water level in the project area ranges from 2.73 to 16.02 mbgl for pre-monsoon and it varies from 1.47 to 3.36 mbgl during post-monsoon period as per findings of CGWB (DGWMS, Manipur Valley, 2004-05). It is observed that the average annual water level fluctuation project area is 1.79.

National Hydrograph Stations of CGWB in Bisnupur district that are regularly monitored prior to 1991 are given in table-3. **No monitoring work is carried out since 1991 due to disturbed law and order situation in the state.**

Table.3 Details of GWM Stations of NHNS in Bishnupur District, Manipur

Location	Well No	Well Type	Latitude	Longitude	M.P. (magl)	R.L of G.L. (mamsl)	Geology	Basin
Maibam	83H2D4	Dug Well	24°40'30"	93°48'15"	0.80	749.150	Alluvium	Imphal
Kongwai	83H3C3	Tube Well	24°26'24"	93°43'50"	0.50	780.950	Sandstone	Imphal
Kumbhi	83H3D4	Tube Well	24°29'00"	93°47'00"	0.67	777.860	Sandstone	Imphal

4.4 Ground Water Resources

Computation of Dynamic Ground Water Resources of Bishnupur district has been carried out in the district as per GEC ’97 as on March 2009. **The Administrative district has been considered as the Assessment Unit due to paucity of block –wise data.** Computed Annual Replenishable Ground Water Resources is 79.99 mcm. Net Annual Ground Water Draft in the district is 0.40 mcm. Projected Demand for Domestic and Industrial Use up to the year 2025 is 6.15 mcm. Stage of Ground Water Development estimated is 0.56. The district as whole has been categorized as ‘Safe’.

4.5 Ground Water Quality

The result of the chemical analysis of water samples shows that ground water is generally suitable for all purposes. In recent year, arsenic in ground water has been reported from some parts of Manipur valley, which are mostly fall in the vast riverine tracts of Imphal River. However clinical manifestation of *arsenicosis* is not seen till date among the people living in the area.

It is observed from the findings of DGWM study in Manipur Valley showed high concentration of some harmful elements in the ground water of the district. Iron content

in the ground water of the district is also observed high which is greater than permissible limit of BIS and WHO (after Chemical analysis report of CGWB).

4.5.1 Water Quality of Aquifers

The water sample analysis results showed that the value of EC ranges from 675 to 682 µmhos/cm at 25^{o}C and that of pH from 8.0 to 8.2. The concentrations of TDS is found to be 340 to 342 ppm, Ca from 20 to 26 ppm, Mg from 12 to 22 ppm, HCO_3 from 323 to 350 ppm, and that of Cl is from 7.1 to 10.2 ppm. The concentration of F is found to be 0.7 to 0.81ppm. Different constituents are within permissible limit.

The concentrations of Fe and As are found to be 5.3 ppm and 0.265 ppm respectively from the tube well of Keinou Thongkhong which is greater than the permissible limits of BIS and WHO.

4.5.2 Comparison of ground water quality w.r.t. previous study

Study undertaken by Central Ground Water Board reveals that in the majority of cases the PH, EC and all other parameters are well within permissible limits. The ground water in the area is dominated by calcium- magnesium- bicarbonate (Ca-Mg-HCO_3) type.

Comparison of ground water quality with respect to previous study reveals that there is no major change in the chemical quality of water for the last ten years.

4.6 Status of Ground Water Development

4.6.1 Present Ground Water Development

Ground water is used for drinking and irrigation purposes in the district. As there is no major industry in this district, ground water utilization for the same may be considered as negligible. Development of ground water in Bishnupur district is discussed below

i) Urban and Rural Water Supply Schemes:

In Bishnupur district out of 496 sq.km of total geographical area, 458.98 sq.km area if rural and only 37.02 sq.km area is under urban. The present water demand for the

small towns in the district is estimated to be 30.09 MLD and have been extended with water supply facility at the rural standard (i.e. at the rate of 40 litre per capita per day). Upgradation of water supply schemes of the towns at the Urban standard of supply i.e. 70 lpcal (litres per capita per day) are taken up in phases since the Ninth Five year plan Period (1997 - 2002)

ii) Rural Water Supply:

Rural Water Supply facilities are provided to the people in rural areas under centrally sponsored Minimum Need Programme (MNP) and Accelerated Rural Water Supply Programme (ARWSP). Majority of the habitations in the district were fully provided with drinking water facilities.

4.6.2 Ground Water for Irrigation

The main sources of water for irrigation are rivers, ponds, lakes, tanks, wells etc. And various means of distribution are canals and pumping sets through, which water is drawn from the sources. The Loktak Lift irrigation also supplied water to a considerable area of land in the district.

Table.4 MIS schemes, Type, irrigation, potential & utilization, lifting devices and used

Structure	**Frequency**	**Irrigation (in ha)**		**Lifting devices**		
		Potential	Utilisation	Diesel	Electrical	Others
STW	3	33	29	2	-	1
Surface Lift Irrigation	4	648	388	4	0	0
Surface Flow Irrigation	12	3490	2154	0	12	0

Source: 2nd Census, MIS of Manipur

Depending upon agro climatic conditions and rainfall distribution in the district, rice is the main crop, which is cultivated during two seasons i.e. autumn paddy (March to June) and winter paddy (June to November). The distributions of minor irrigation schemes for irrigation in the district are given below.

Table.5 Distribution of Minor Irrigation Schemes in the district

Structure	Frequency	Irrigation (in ha)			No. of Villages
		Potential	Utilisation	Share	
MIS	19	4171	2571	14.08	16

Source: 2nd Census, MIS of Manipur

5.0 Ground Water Management Strategy

5.1 Ground Water Development

Ground water is mostly exploited through open wells, occurs under sub-artesian conditions in the deeper aquifers. Through tube wells, the underground water is targeted to explore at the valley areas with the yields ranging from 0.6 to 4.0-cu.m/ hr and annual recharge of 80.60 mcm has been estimated. Considering the clayey nature of formation in the top aquifer, development of this resource is not considered promising on a large scale either in irrigation water supply. However, it can be exploited for local water supplied through open wells dug-cum-bore wells and tube wells.

Ground water development prospects in the district exist in the valley alluvial areas where ring wells and shallow tube wells are the feasible structures. Apart from this, ground water sources in the area can be augmented through spring development in the hill districts.

5.2 Water Conservation and Artificial recharge

Development of rain water harvesting for the drinking water supply is also one of the appropriate measures for solving the scarcity of potable water as it involves relatively low cost, less time for implementation and provides almost entirely safe drinking water which does not require costly purification and treatment process.

In most of the rural areas hamlets are small and therefore can provide a small catchments area. Considering social and economic background two types of rainwater harvesting structures can be designed.

Method of making ground water abstraction structure, type, design, depth of wells, number and spacing between two wells depends on size of aquifer material, depth range & hydraulic parameters of aquifer zones, which differ from place to place. As per earlier reports and present study, following design criteria is recommended.

5.2.1 Shallow Domestic Wells

Shallow domestic wells are feasible in the district by tapping upto 20 to 30 mbgl. The shallow aquifer zones are mainly concentrated in the southern part of the valley bordering Iril River from Sugnu to Kumbhi touching some parts of Churachandpur valley. The terrace zones running from Bishnupur to Sekmai in north which are mainly comprises pebbles, boulders with clay matrix.

5.2.2 Deep Tube Well for Irrigation Purpose

Deep tube wells are feasible in the district. Based on the hydrogeological conditions, occurrence of potential aquifer horizons and their yield potential, prospects for ground water development in the district mainly confined to the alluvial deposit plain areas surrounding the Loktak Lake. The eastern and northern region are feasible for the development of ground water through moderately deep tube wells down to 75 m tapping about 10 to 30 m of cumulative thickness of granular horizon capable of yielding 20 to 40 m^3/hr for draw down upto 12 m.

Diameter of casing pipe, when used as housing pipe, need to be decided based on the anticipated discharge. Housing pipe should be large enough to accommodate the pump. Based on the static water level, maximum draw down and seasonal fluctuation

length of housing pipe should be range from 25 to 30 mbgl. For avoiding corrosion and clogging of well screen, the entrance velocity should be less than 2 cm/sec.

6.0 Ground Water Related issues and problems

Prior to 1991 the chemical quality of ground water in the area showed suitable for drinking and domestic propose. But recent studies of ground water in valley parts showed concentration of some chemical quality especially iron and arsenic more than the permissible limits of BIS (1991) and WHO (1996).

Recently, the North Eastern regional Institute of Water and Land management (NERIWALM) and Central Pollution Control Board, Delhi has been reported the presence of arsenic in some of the existing underground water.

It is observed from the findings of DGWM study in Manipur Valley showed high concentration of some harmful elements in the ground water of the district. Iron content in the ground water of the district is also observed high which is greater than permissible limit of BIS and WHO (after Chemical analysis report of CGWB).

The concentrations of Fe and As are found to be 5.3 ppm and 0.265 ppm respectively from the tube well of Keinou Thongkhong which is greater than the permissible limits of BIS and WHO.

7.0 Awareness and Training activity

7.1 Mass Awareness Programme and Water Management Programme by CGWB.

No such programme and activity is carried out in the district till date.

7.2 Participation In Exhibition, Mela, Fair etc.

Till date no such Exhibition, Mela, Fair etc were organized and participation by CGWB does not arise.

7.3 Presentation and Lecture delivered in Public forum / radio / T.V / Institution of repute / Grassroots associations / NGO/ Academic institutions etc.

Till date CGWB is not involved in such programme in the district

8.0 Areas Notified by CGWA/SGWA

Nil.

9.0 Recommendations

Based on the hydrogeological conditions, future development of ground water is mainly confined to the alluvial plain area and low-lying lands surrounding the Loktak Lake. The eastern and northern region are feasible for the development of ground water through shallow to moderately deep tube wells down to 75 m tapping about 10 to 30 m of cumulative thickness of granular horizon capable of yielding 20 to 40 m^3/hr for draw down upto 12 m.

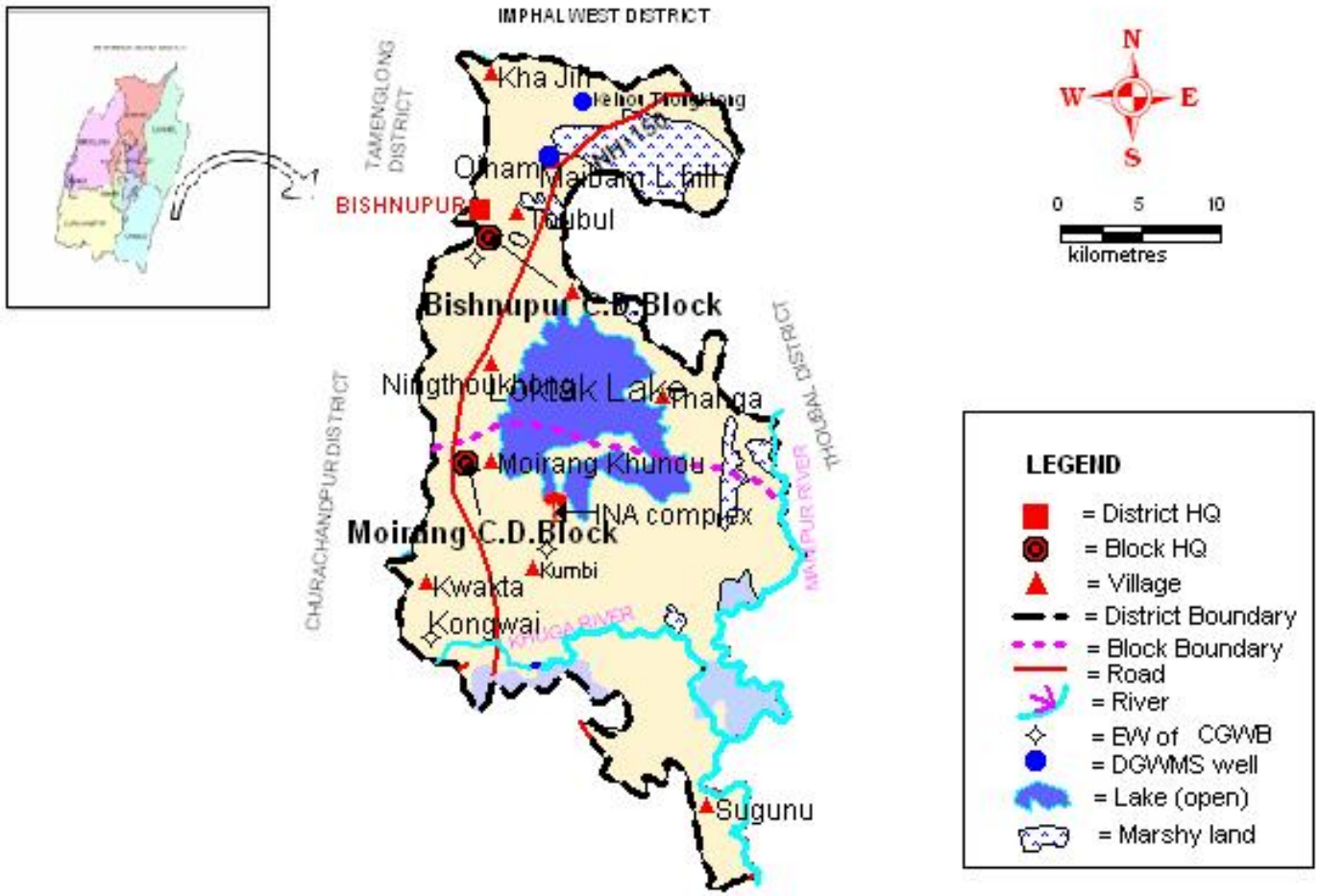
The potential aquifer is found in the southern part of the valley bordering Iril River from Sugnu to Kumbhi touching some parts of Churachandpur valley. The terrace zones running from Bishnupur to Sekmai in north which are mainly comprises pebbles, boulders with clay matrix.

Most of the chemical constituents are within the permissible limits both for the drinking and irrigational uses except high concentration of arsenic and iron in the ground water.

Ground water development prospects in the area can be carried out successfully by constructing ring wells and shallow tube wells are also feasible structures. Apart from this, ground water sources in the district can be augmented through spring development.

Based on the static water level, maximum draw down and seasonal fluctuation length of housing pipe should be range from 25 to 30 mbgl. For avoiding corrosion and clogging of well screen, the entrance velocity should be less than 2 cm/sec.

FIG.1 MAP SHOWING ADMINISTRATIVE SET UP OF BISHNUPUR DISTRICT, MANIPUR



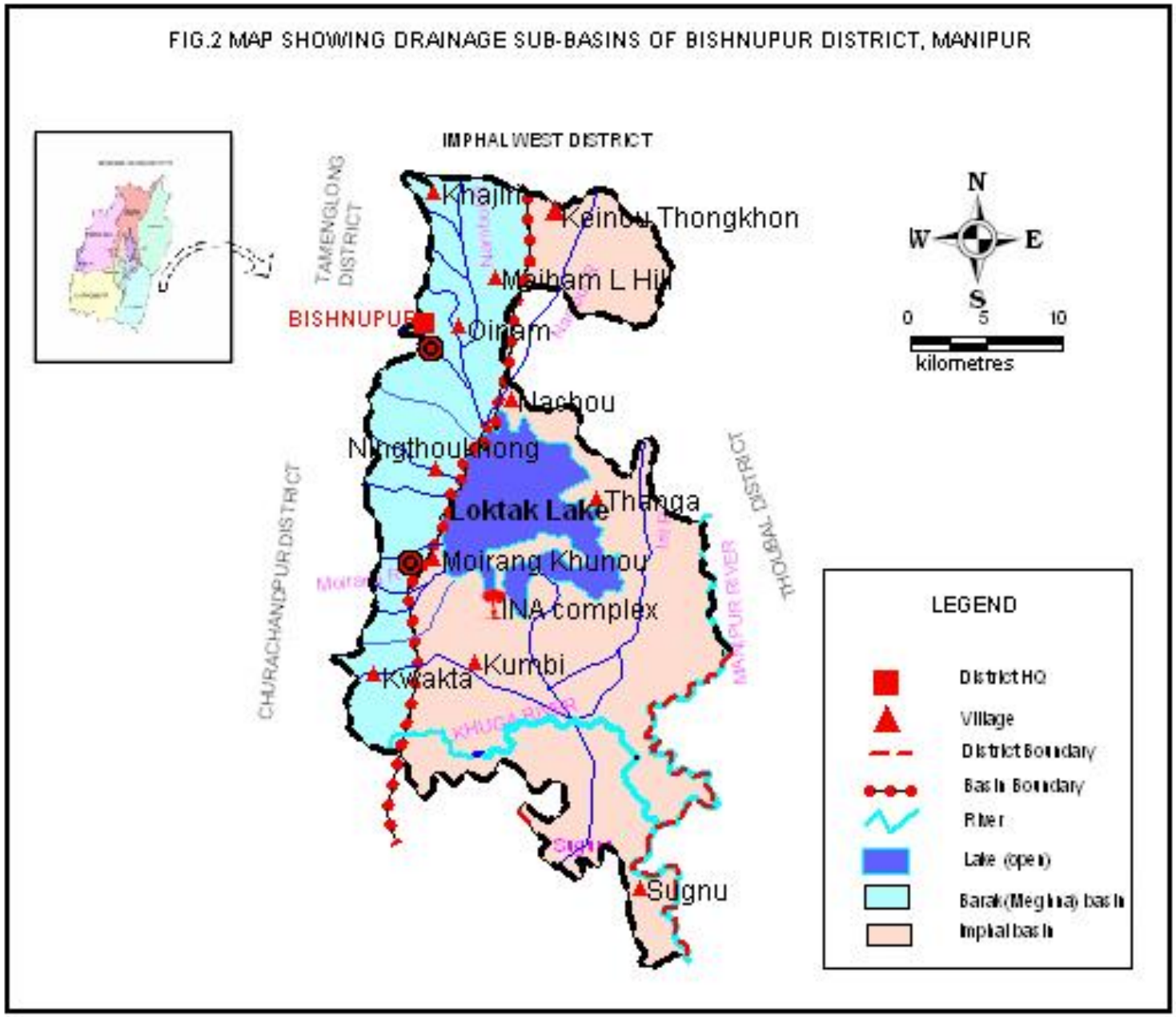


FIG.2 MAP SHOWING DRAINAGE SUB-BASINS OF BISHNUPUR DISTRICT, MANIPUR
IMPHAL WEST DISTRICT
TAMENGLONG DISTRICT
CHURACHANDPUR DISTRICT
THOUBAL DISTRICT
BISHNUPUR
Khajuri
Keinou Thongkhon
Maiham L Hill
Oinam
Nachou
Ningthoukhong
Loktak Lake
Thanga
Moirang Khunou
INA complex
Kumbi
Kwakta
Sugnu
MANIPUR RIVER
N
W
E
S
0
5
10
kilometres
LEGEND
District HQ
Village
District Boundary
Basin Boundary
River
Lake (open)
Barak(Meghna) basin
Imphal basin

FIG.3. SOIL AND GEOHYDROMORPHOLOGICAL SETUP OF BISHNUPUR DISTRICT, MANIPUR

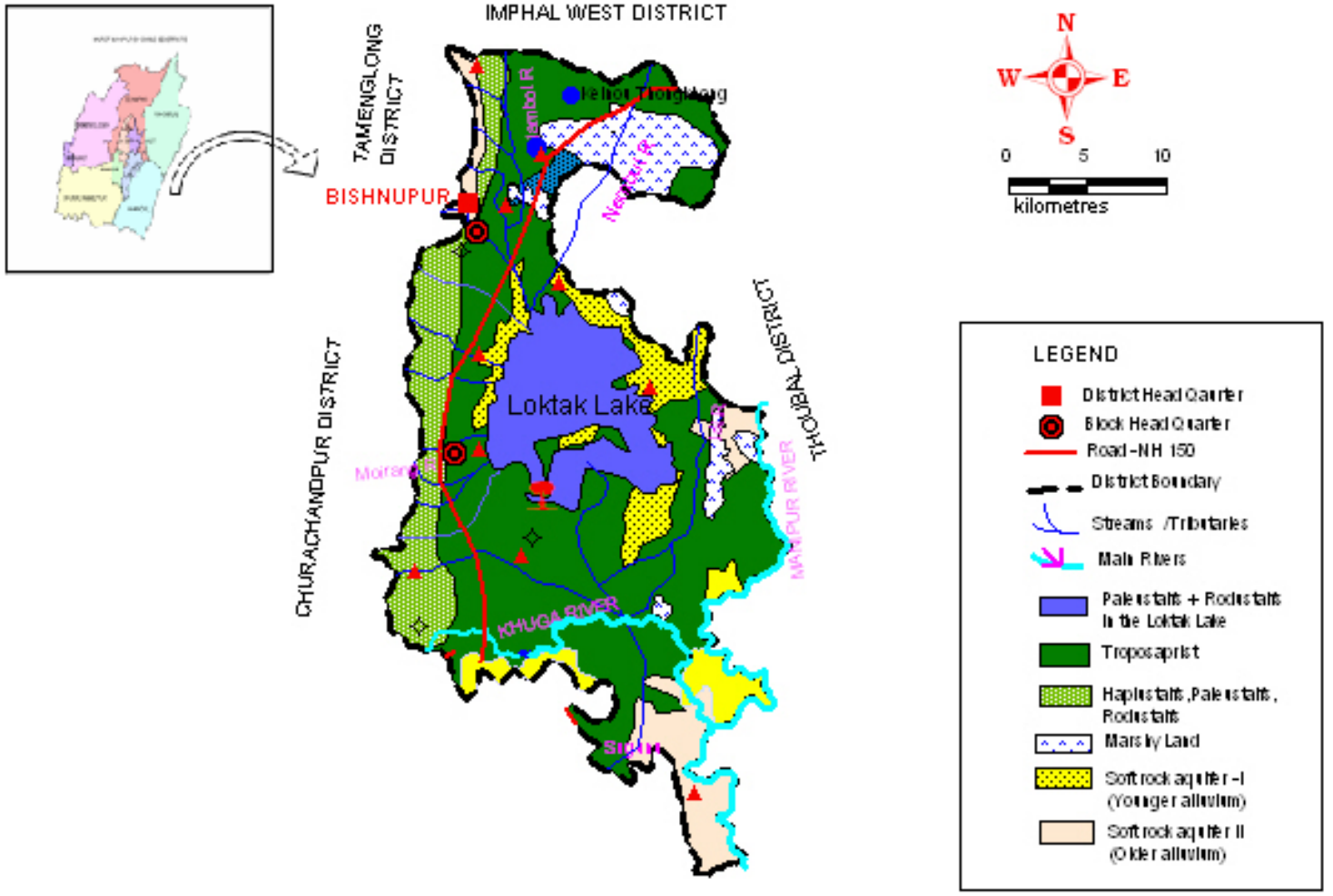
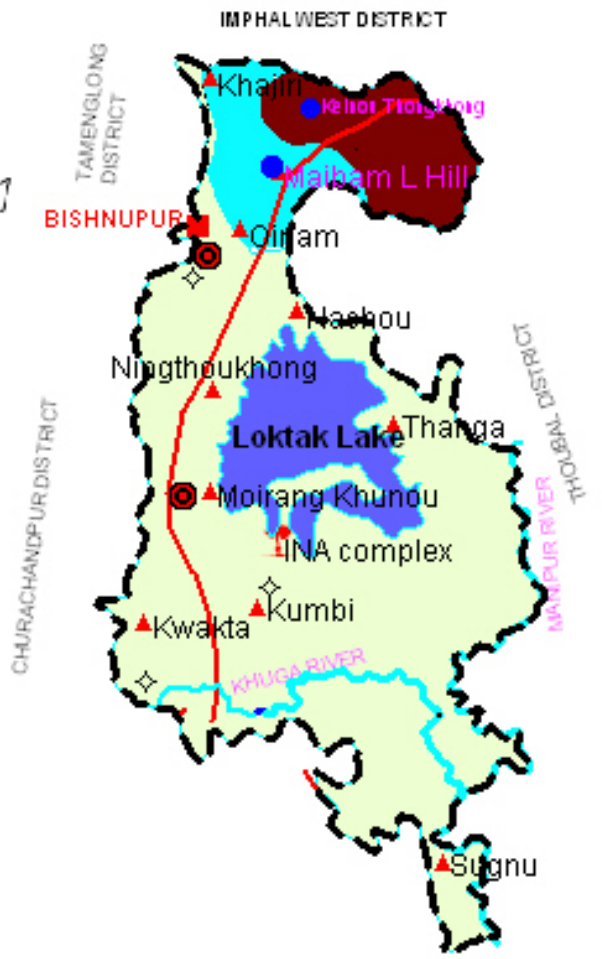
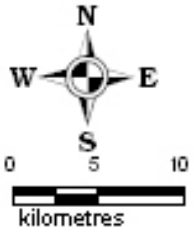


FIG.4a. PRE-MONSOON DEPTH TO WATER TABLE MAP FOR DGWMS WELLS IN BISHNUPUR DISTRICT, MANIPUR





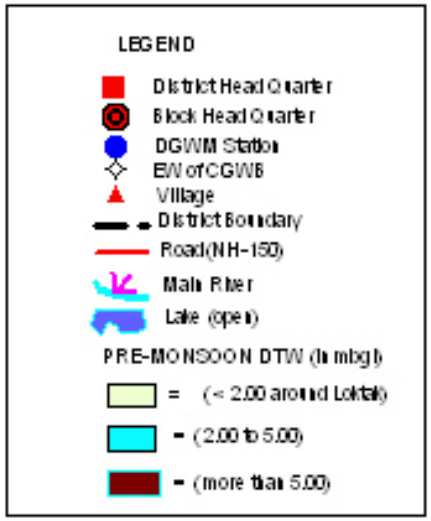


FIG.4b. POST-MONSOON DEPTH TO WATER TABLE MAP FOR DGWMS WELL IN BISHNUPUR DISTRICT MANIPUR

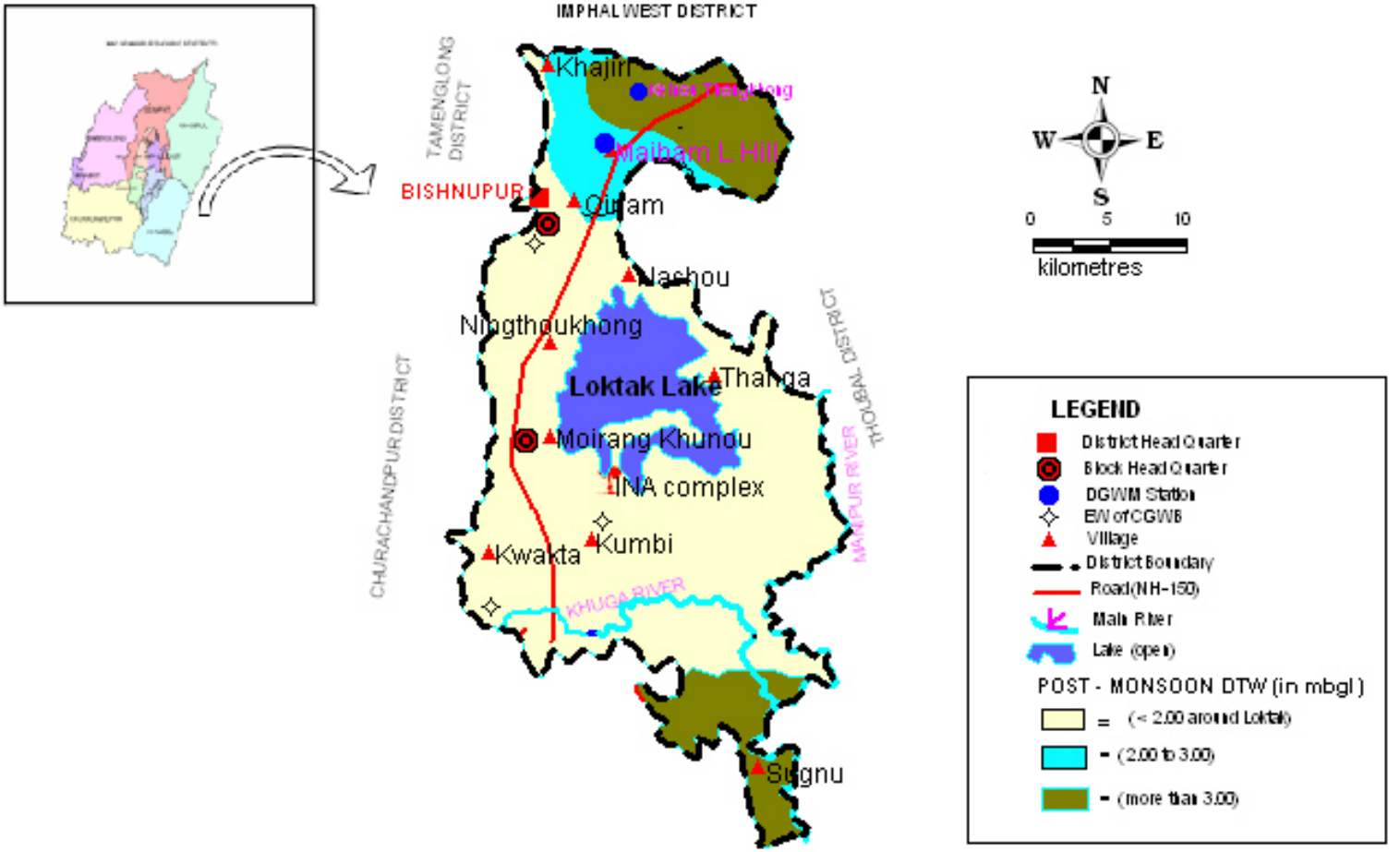


FIG.5. IRON AND ARSENIC CONCENTRATION IN THE GROUND WATER IN BISHNUPUR DISTRICT, MANIPUR

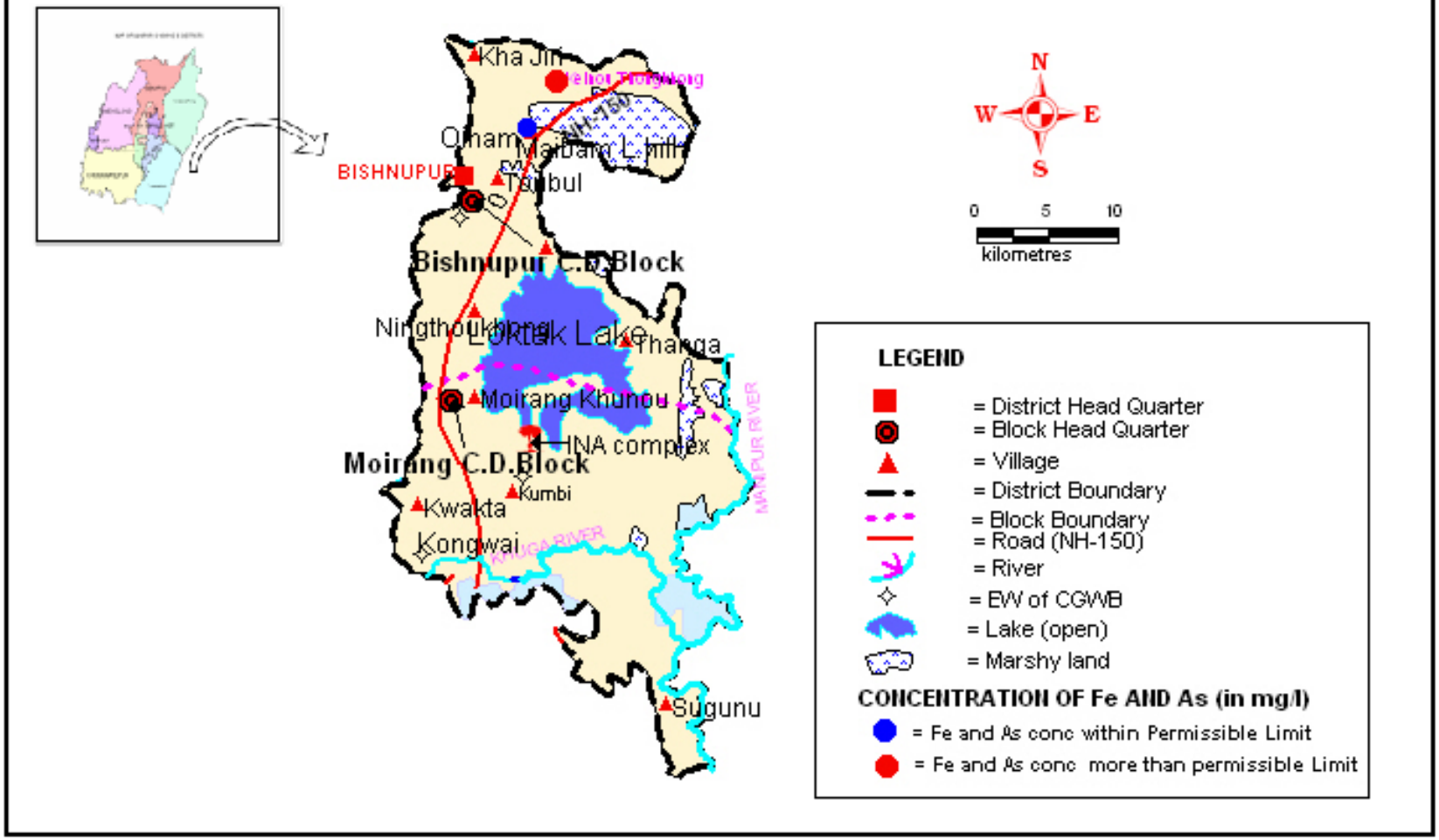
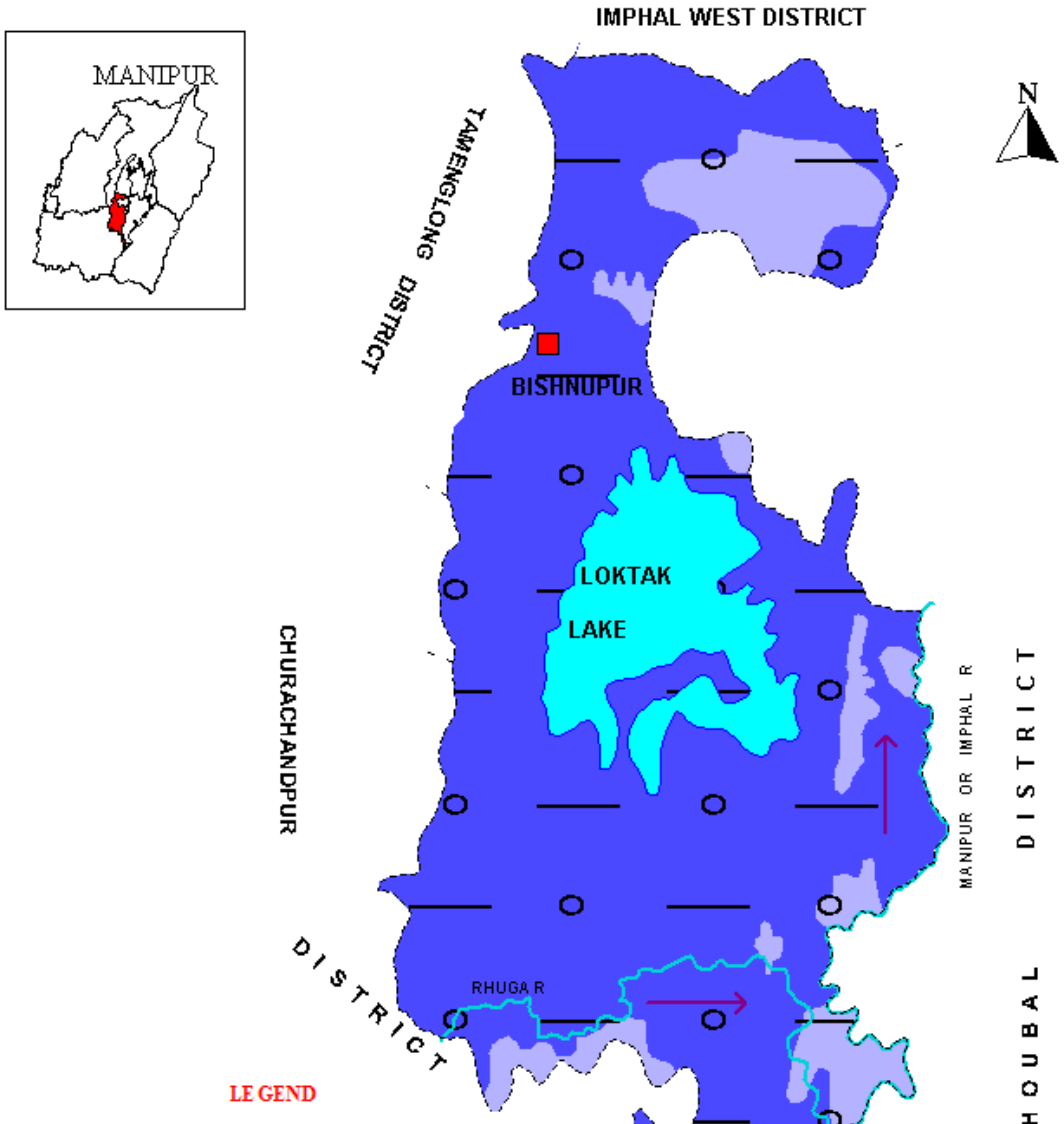


FIG.6 HYDROGEOLOGY OF BISHNUPUR DISTRICT



LE GEND

	Wells feasible	Rigs suitable	Depth of Well (m)	Discharge (lpm)
Soft Rock Aquifer	Tube wells	Direct Rotary	50 – 120*	80 - 750
Soft Rock Aquifer	Tube wells	Direct Rotary	50 – 120*	50-550
Major river / Drain District boundary	River Flow District Head Quarter		Water body	