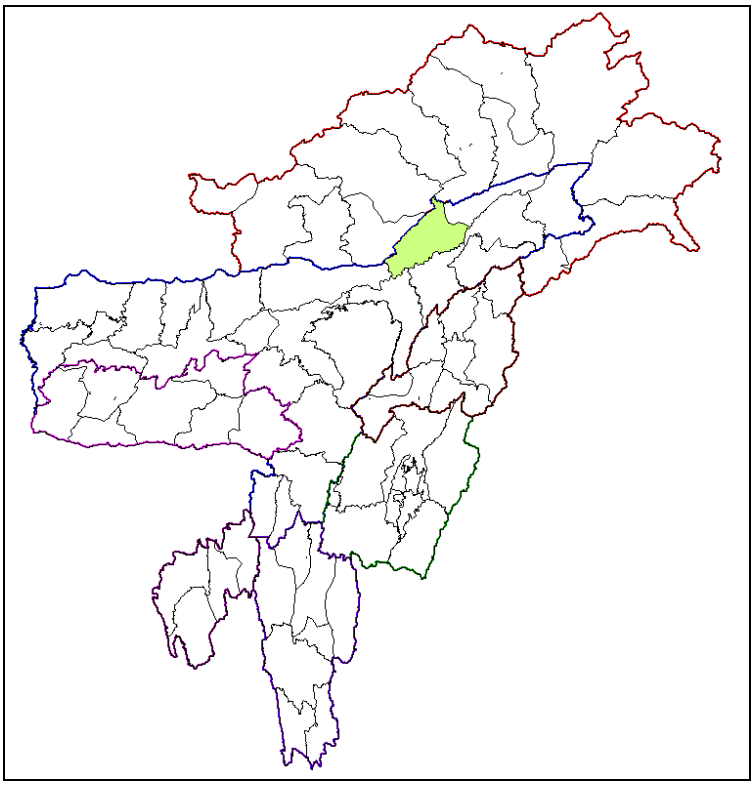
Technical Report Series: D

No:

Ground Water Information Booklet
Lakhimpur District, Assam



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

November 2013

LAKHIMPUR DISTRICT AT A GLANCE

Sl NO	ITEMS	Statistics
1.	GENERAL INFORMATION	
	i) Geographical area (Sq Km)as on 2011	2277 sq. km
	ii) Administrative Divisions (As on 31-03-13) Number of Blocks Number of Gaon Panchayat	2 Nos. Sub-division 09 81
	iii) Population (As on 2011 census)	1,040,644
	iv) Average annual rainfall (mm)	3268mm
2.	GEOMORPHOLOGY	Hilly tract, the foothill region and the extensive flood plain
	Major physiographic units	
	Major drainages	Subansiri, Ranga Nadi, Dikrong, Boginadi
3.	LAND USE (in Ha)	
	a) Forest area	32816.112
	b) Net area sown	
	c) Cultivated area	
4.	MAJOR SOIL TYPES	Red loamy soils, lateritic soil, new alluvial soils and older alluvial Soil
5.	AREA UNDER PRINCIPAL CROPS	
6.	IRRIGATION BY DIFFERENT SOURCES (Area and numbers of structures)	Surface and Ground Water Irrigation schemes
	Dug wells	Data not available
	Tube wells/ Bore wells	Data not available
	Tanks/ Ponds	8104
	Net irrigated area	Data not available
	Gross irrigated area	Data not available
7.	NUMBERS OF GROUND WATER MONITORING WELLS OF CGWB (As on 31-3-2013) No of Dug wells No of Piezometers	 20 Nos Nil
10.	PREDOMINANT GEOLOGICAL FORMATIONS	Neogene Siwalik Group and Quaternary Alluvium
11.	HYDROGEOLOGY	
	➢ Major Water bearing formation ➢ Pre-monsoon depth to water level during 2012 ➢ Post-monsoon depth to water level during 2012 ➢ Long term water level trend during 2001-2010 (in m/yr)	Sand, gravel and pebbles 1.59 to 5.33 m bgl 0.36 to 3.60 m bgl Post-monsoon WL of 59% of GWMS indicate a declining trend of 0.017 to 0.298 metre/yr and 41% of GWMS indicate a rising trend of 0.005 to 0.139metre/year

12.	GROUND WATER EXPLORATION BY CGWB (as on 31-3-2013)	
	No of wells drilled (EW, OW, PZ, SH, Total)	22Nos. of EW
	Depth Range (m)	18- 200.35
	Discharge (litres per second)	
	Storativity (S)	
	Transmissivity (m^2/day)	
13.	GROUND WATER QUALITY	
	Presence of chemical constituents more than permissible limit (e.g., EC, F, As, Fe)	Most of the chemical parameters are within the permissible limit set by BIS, except Fe. Iron content range from 0.13 to 6.90mg/l.
14.	DYNAMIC GROUND WATER RESOURCES (2009) in mcm	
	Net Ground Water Availability	**1198.15**
	Net Annual Ground Water Draft	128.76
	Projected Demand for Domestic and Industrial Uses upto 2025	32.14
	Stage of Ground Water Development	11%
15.	AWARENESS AND TRAINING ACTIVITY	NA
	Mass Awareness Programmes organized Date Place No of participants	NA
16.	EFFORTS OF ARTIFICIAL RECHARGE & RAINWATER HARVESTING	NA
	Projects completed by CGWB (No & Amount spent)	NA
	Projects under technical guidance of CGWB (Numbers)	1
17.	GROUND WATER CONTROL AND REGULATION	N.A
	Numbers of OE Blocks	
	No of Critical Blocks	
	No of Blocks notified	
18.	MAJOR GROUND WATER PROBLEMS AND ISSUES	High iron concentrations of 354 habitations. (Source: http://indiawater.gov.in/IMIS Web)

1.0 INTRODUCTION

Lakhimpur district of Assam is located between $26^0$48'00'' and $27^0$53'00'' North Latitude and $93^0$42'00'' and $94^0$20'00'' East Longitude. The district is bounded on the north by Siang and Papumpare District of Arunachal Pradesh and on the east by Dhemaji District and Subansiri River. Majuli Sub Division of Jorhat District stands on the southern side and Gohpur sub division of Sonitpur District is on the West. (Fig.1).

The district is divided into two sub divisions viz. North Lakhimpur and Dhakuakhana and seven revenue circles, nine civil blocks and 81 Gaon Panchayats. There are 1184villages in the district.

Drainage System: The Brahmaputra river controls the main drainage system in the district. The Subansiri–Ranganadi–Dikrong–System that debouches in Brahmaputra forms an intricate drainage network in the district. The Subansiri the largest tributary of river Brahmaputra is a Trans-Himalayan river originating from the Western part of Mount Pororu (5059 m) in the Tibetan Himalaya. The tributaries are in general meandering as well as braided in nature. Peak discharge observed during monsoon and generally perennial in nature. However, near the foothills small streams generally dry up during the month of March/April. The riverbed and the bank materials are boulders, cobbles, pebbles and sands of various grades with very low clay materials concentration.

Irrigation: Irrigation facilities in the district are very poor. Agriculture mainly depends on rainfall and the farmers are accustomed to raise a single crop only. However, the State Govt. has formulated some irrigation facilities through Irrigation and Agriculture Depts. The Agriculture Dept. has constructed shallow tube wells and encouraged the farmers to utilize the ground water resources through registered Farmers Management Committee (FMC).

The Assam irrigation Dept., which is responsible for the implementation of the major / medium irrigation schemes, has taken up different schemes in the district. But most of the schemes are defunct due to improper planning, poor maintenance etc. As per 2011 provisional census report total irrigated area for both Kharif and rabi-pre-kharif crops is 858hectre of which irrigated area for kharif crop is 670hectres.

Previous Studies by CGWB: Systematic hydrogeological studies in the area were carried out by Sri A.M. Khan, Asst. Hg., K.N. Murthy, Abhijit Ray and G.C. Saha, Jr. Hg. Short term water supply investigations were carried out by Shri A.M. Khan for N.F. Railway in Dhemaji, Silapathar and Murkengselek in the year 1977 in the then undivided Lakhimpur district. Ground water resource potential and development prospects in North Lakhimpur district were assessed by Shri G. Dholappa Sr. Hg. during 1986-87. Shri G.V. Reddy, Jr. Hg. during 1997-98, carried out Ground water management studies in Lakhimpur district and part of Dhemaji district was carried out by Shri Sanjib Chakraborty, Asst. Hg in 2003-04. and by Dr. D.J. Khound, Asst.

Hg in 2007-08. Shri A.Kar, Scientist-D had prepared rain water harvesting plan as per request of District Administration in2009-10.

2.0 Rainfall and Climate

The climate of the district is subtropical and humid characterized by high rainfall. The annual rainfall is 3268mm and relative humidity 74 to 89 percent with a mean of 81 percent. The district receives SW monsoon rainfall from the month of April and continues up to September/October. The highest rainfall areas of the district are located near the foothills of Arunachal Himalayas, i.e., in the northern part of the district. The maximum temperature goes up to 35^{o}C during June / July and minimum temperature falls to 8^{o}C in December and January.

3.0 Physiography and Soil

Physiography

Phisiographically the area can broadly be divided into three parts, i.e., the hilly tract, the foothill region and the extensive flood plain created by the river Brahmaputra and its tributaries in southern part. The hilly tracts comprise Siwalik sediments of lesser Himalayas. The southern limit of the sub-Himalaya is marked by Himalayan Frontal Fold (HFF). The foothill region is characterised by older terrace deposit. Two terrace surfaces have been identified as the Harmuti and Joyhing surfaces that represent high and low level terraces. These terrace deposits are characterised by undulating surface comprising boulders, pebbles of quartzitic and gneissic rocks with fine sand, silt and clay act as matrix. The alluvial flood plain consists of younger and older alluvial deposits. It represents various sub-features, viz., palaeochannel, swampy/marshy land, river terraces, flood plains, point bars, channel bar and river channel. The average altitude in the central and southern flood plain varies from 80-85m above MSL with very gentle slope throughout. The 92m contour marks the northern limit of the flood plain area. The slope of the entire the district drops from northern and eastern corners towards south.

Soil

The soils of the district can broadly be classified into the following groups:

1. Red Loamy soils: These are found in the northern border of the district. This soil type develops in the hill slopes under high rainfall condition. This soil is characterized by low nitrogen, low phosphate and medium to high potash. P^{H} is acidic.
2. Lateritic Soil: The lateritic soils are the product of high leaching and found in hilly region. Soil P^{H} is acidic due to intensive leaching of bases and formation of clay minerals and ferric hydroxides. The lateritic soils are characterized by brick red to brownish red colour and poor plant nutrient.
3. New Alluvial Soils: The new alluvial soils are found in the flood plain area and are subjected to occasional floods and consequently receive considerable silt deposit after the flood recedes. These are yellow to yellowish grey in colour and are admixtures of sand, silt and clay in varying proportions. Mineral

weathering and geo-chemical changes are nominal. But incipient changes in the top layer have been noticed due to biological activity. Soil P^H is feebly alkaline and moderately rich in plant nutrient.

4. Older Alluvial Soil: It develops at higher levels and practically unaltered alluvium representing a broad spectrum of sand, silt and humus rich clay depending on landform. The soils are comparatively more acidic than the newer alluvial soil and hence more crop sensitive.

The soils of the district as classified by NBSS and ICAR Nagpur are: Udalfs-Orchapts-Acquents, Fluvent-Aquepts, Aquepts-Aqualfs-Fluvent.

4.0 Ground Water Scenario

4.1 Hydrogeology

The district can be divided into two distinct hydrogeological units, *viz*., semi-consolidated and unconsolidated (Fig. 2) formations based on geology and hydrogeological character. The semi-consolidated formation composed of Neogene Siwalik Group of rocks bordering the northern boundary of the district. The Siwalik rocks are not suitable for ground water development

The major water bearing formations include alluvial sediments in foothills and flood plain that constitute the unconsolidated formation. The piedmont zone extends over 8-10km from the foothill, which is laterally followed by younger flood plain area extending up to northern bank of the Brahmaputra River in south. The railway line roughly marks the southern boundary of the piedmont zone (Bhabar Belt). The alluvial formations in the foothills are composed of sand, pebble, cobble and boulders. These materials have high permeability. In the flood plain area, however, little gravel mingles with different grades of sand.

Shallow Aquifer

The water bearing horizons occur within 30-50mbgl is considered to constitute shallow aquifer system. Ground water in this aquifer occurs under unconfined to semi-confined conditions. The aquifer materials comprise sands of different grades with varying proportions of gravels. The grain size of the aquifer materials is found to decrease towards the southern part of the district. The semi-confining layers are not persistent throughout the district. The top-confining layer is consisted of clay with interlayer sand and its thickness is varying from 15m to nearly 1m. The lower confining layer is generally 3m thick and is not regionally extensive.

Deeper Aquifer

In the deeper aquifers, ground water occurs under semi-confined to confined conditions. The upper confining layer is generally 3 to nearly 9m thick. The aquifer materials are composed of sands and gravels of different size grade. In this district, CGWB, NER had explored the subsurface down to the depth of 200m in Panigaon and Jalukata areas. The cumulative thickness of the granular zones in the deeper aquifer varies from 60 to 150m. There is a clear distinction of grain size of aquifer materials in the northern, southern and western part of the district. Presence of multi

aquifer system in the western part of the district around Dholpur, Narayanpur is deciphered from lithologs. The confining layers are not persistent.

However, towards east, around Panigaon and Dhakuakhana areas, single aquifer zone is found down to the depth of 130 mbgl. The grain size of the aquifer material increases towards north, i.e., towards the foothill.

Ground Water Movement

As mentioned earlier the district is bounded in the north by Arunachal Himalayas and the south by the Brahmaputra River, evidently the ground water flow direction is from the higher elevation in north towards the plain area in the south. In the western part of the district the ground water flow is from northwest to southeast. Whereas in the central and eastern part (around Dhakuakhana and Ghilamara area) of the district the flow is almost north – south. The highest water table is 110 m above mean sea level in the flood plain area towards south. In general the gradient of flow is high towards west as compared to the gradient in the eastern part. In the northern foothill region, the water table gradient is steeper (1.5m/km) and it forms the recharge zone for the entire district.

Depth to Water Level

CGWB is monitoring 20 ground water wells (GWW) in Lakhimpur district. During 2012, pre-monsoon depth to water level varied from 1.59 to 5.33 mbgl (Fig. 3) and post-monsoon depth to water level varied from 0.36 to 3.60 mbgl (Fig. 4).

During pre-monsoon period about 50% of GWM stations showed water level above 3mbgl and rests showed water level below 3 m bgl. During post-monsoon period about 10% of GWM stations showed water level above 3mbgl and rests showed water level below 3 m bgl.

Water Level Fluctuations

The study of the water level data has revealed that the general fluctuation of water table during pre and post-monsoon is in between 0 to 2 m in plain area and more than 2 m in areas adjacent to river Dikrang. The major parts of the gross rise in water table during April to July dissipates quickly. Low ground water fluctuation in the area is due to low ground water draft and rapid ground water movement through the aquifer where by and large scale draft at one place is compensated by ground water recharge from other places.

Long Term Water Level Trend

Long term ground water level trend for post-monsoon period (Nov, 2001 to 2010) shows that 7 (41%) GWMS indicate rise in water level whereas 11 (59%) GWMS indicate fall. Rise in water level ranges from 0.005 to 0.139metre/year while fall in water level ranges from 0.017 to 0.298 metre/yr.

4.2 Ground Water Resources

The dynamic ground water resources estimation of Lakhimpurr district has been calculated as per GEC-97 methodology.

Almost entire district is occupied by unconsolidated alluvial sediments, except the hilly areas in the northern part. 65sq.km of hilly area has slope greater than 20% district and this area is excluded from resource calculation as this area is not likely to contribute to groundwater recharge. There is no command area in the district. So entire district has been considered as non-command area and calculation was done for non-command area only. The bottom of the unconfined aquifer is found within 10 to 20mbgl.The total annual ground water recharge of the district estimated as 1,30,597ham. An allowances of 5% of the total was kept for natural discharge and the Net Ground Water Availability in the district has been worked out as 117537ham.

Table 4.1 Ground Water Resources Potential of the District (as on 31st March 2009) (ham)

Total Geographi-cal Area	Area available for recharge	Recharge from Rainfall (ham)			Recharge from other sources (ham)			Total Annual Ground Water Recharge (ham)	Natural Discharge (ham)	Net Ground Water Availability (ham)
		Monsoon	Non-monsoon	Total	Monsoon	Non-monsoon	Total			
227700	227700	80114	48773	128887	3385	856	4214	133128	13313	119815

The gross yearly ground water draft has been calculated for irrigation, domestic and Industrial uses (Table 4.2). The gross ground water draft for irrigation use during 2009 has been calculated considering the fourth census data of 2006-07 and projected 2% per year. Total number of shallow tube wells are 1758. The annual unit draft of 2.6 ham per tube well has been taken for irrigation purposes. The drafts for domestic and industrial uses are computed by considering the water requirement and dependency on ground water sources. The population figures were collected from Census, 2011. The per capita domestic requirement for the rural population has been considered as 60 lpcd and for urban population, it is 135 lpcd. The dependency on ground water resource for domestic and industrial water supply in rural areas is considered as 90% and for urban areas, the dependency is 50%. The total annual draft calculated for the district was 128.76mcm where irrigation draft is 105.98mcm and domestic and industrial draft is 22.78mcm respectively.

The net annual ground water availability in the district is to be apportioned between domestic, industrial and irrigation uses. Among these as per the National Water Policy, 2003 requirement for the domestic water supply has been given maximum weightage. The allocation for domestic and industrial water supply up to year 2025 has been worked out to be 32.14 mcm The balance ground water resources for future irrigation use are 1060.03 mcm Thus the balance available is 1198.15, mcm.

Table 4.2 Additional Potential Recharge under specific condition of the Lakhimpur District (In ham)

District	Potential Recharge		Total annual Additional Potential G.W Recharge
	Water logged and shallow water table area	Flood prone area	
Lakhimpur	84249	1571	85820

4.3 Ground Water Quality

Water samples were collected from Ground Water Monitoring Stations (GWMS) of the district for assessing the chemical quality of ground water and determining the suitability for drinking and irrigation purposes.

From the chemical analysis data of ground water samples, it can be said that the ground water of dug well of the district is slightly acidic to slightly alkaline (pH= 5.83 to 7.11). Electrical conductance (EC) of ground water varies from 89 to 473 □S/cm. The ground water is soft. Fluoride content is in general within below detectable limit. However, in Panigaon, Dolonghat Chariali and Kadam GWMS fluoride content are 0.44, 0.18 and 0.11 mg/l respectively, which are within permissible limit. Iron content generally varies from 0.13 to 6.98 mg/l. It is observed that iron content is generally high in permanently water-logged areas like Bhogpur Chariali, Bihpuria and Kadam.

As per the information available in National Rural Drinking Water Mission, there are 354 habitats affected by iron contamination (source: http://indiawater.gov.in\IMIS Report).

4.4 Status of Ground Water Development

Drinking and Domestic

Groundwater is the main source for supply of water for drinking and domestic uses both in urban and rural areas. Public Health and Engineering Department (PHED), Sonitpur district has constructed various ground water abstraction structures for supply of water.

The Public Health Engineering Department (PHED), Assam is supplying water to the population from 3173 water supply schemes through 397 delivery points. In Lakhimpur subdivision, the PHED has so far installed 5940 numbers of Hand Tube well out of which 5667 numbers of hand tube wells are functioning. Besides these PHED has supplied water through 951 ring well. In Dhakuakhana subdivision 692 hand tube wells, 225 numbers of tara pump, 78numbers of Mark-III and 15 ring wells are used for water supply.

In addition to this most of the people have their own dug wells / hand pumps for domestic use.

Industry

There is no major industry in the district. The tea industries located in different parts of the district are utilizing ground water through dug wells and deep tube wells for drinking and tea plantation.

Irrigation

The Irrigation potentiality created in the district through flow irrigation, lift irrigation and Ground water lift. Shallow tube wells are the most common ground water abstraction structures used for irrigation with yields ranging from 10 to 30 m^3/hr for a drawdown of less than 2 m. The total ground water draft for irrigation in the district has been worked out to be about 105.98 mcm

5.0 Ground Water Management Strategy

The district can be divided into three sectors based on the subsurface geology and yield potential of different groundwater abstraction structures. This division will help to formulate rational and judicious plan for groundwater development in the district.

Sector I: This unit is characterized by unconsolidated sand and gravel of Quaternary alluvium. Sand is fine to coarse and gravel size ranges from granule to pebbles. The grain size decreases southwards. This unit is fairly thick and regionally extensive. The aquifers are unconfined to semi-confined and shallow tube wells down to the depth of 30 to 50mbgl with 30-35m^3/hr yield capacity are feasible. The recommended distance between two shallow tube wells is 200m. Deep tube wells are feasible down to the depth of 200m tapping an average cumulative thickness of 30-35m aquifer with yield 50 to 300m^3/hr for a drawdown of less than 5m. The minimum distance between two adjacent well should not be less than 1000m. In this sector, deployment of rotary or reverse rotary rig is advisable for construction of deeper tube wells.

Sector II: The aquifers in this sector are discontinuous but thick. The aquifer materials in this unit are comprised of unconsolidated materials of gravel, sand and clay. Gravel size ranges from granule to boulder. The aquifer has very high hydraulic conductivity value. Occurrence of bouldery materials at shallow depth make this unit unsuitable for the construction of shallow tube wells. Deep tube wells are feasible down to the depth of 100-120mbgl, tapping an aquifer thickness of 20-30m. The yield of tube wells are expected to be 40 to 100m^3/hr for drawdown more than 5m. Percussion or combination rig are necessary for construction of deep tube wells.

Sector III: This unit comprises the hilly area and covered by forest and is not suitable for ground water development.

6.0 Water Conservation and Artificial Recharge

In Lakhimpur district, the foothill region is suffering from sustainable supply of water particularly in lean period. Various types of water conservation structures can be constructed in the foothill regions after conducting a thorough feasibility study. However, in the flood plain area rain water-harvesting structure may be constructed to harvest rainwater for domestic/ drinking uses as also for its use as source water.

Since post monsoon water level in this hydrogeologic unit is less than 3mbgl, artificial recharge is not feasible.

7.0 Ground Water Related issues and Problems

The area has high Ground Water Resources potential with a net Ground Water availability of 1198.15 mcm. Nearly 37% of the district is under water logging condition through out the year where there is no sign of water level decline for a decade. The chemical analysis of the water samples collected quality of the water collected from the GWMS and established key wells has revealed that the chemical parameters are within the permissible limit specified by B IS (2003) except high concentration of iron which ranges from 0.16 to 3.76 mg/l in most of the area. As per the information available in National Rural Drinking Water Mission, there are 354 habitats affected by iron contamination (source: http://indiawater.gov.in\IMIS Report).

Awareness & Training Activity

7.1 Mass awareness programme (MAP) & Water Management Training programme (WMTP) by CGWB

CGWB has not organized any Mass Awareness (MAP) and Water Management Training Programme (WMTP) in the district.

7.2 Participation in Exibition, Mela, Fair etc

In the district ground water related exhibition, mela, fair, etc. are not organized.

7.3 Presentation & Lectures delivered in public forum/ Radio/ T.V./ Institution of repute/ Grassroots associations/ NGO/ Academic institutions etc.

8.0 Areas notified by CGWB/ SGWA

Nil.

9.0 Recommendations

a) The alluvial tracts of Lakhimpur district form prolific aquifers. Only a scanty amount of the district vast ground water resources are in use for various purposes. Therefore, plan should be formulated for optimum exploitation of this ground water resource which will boost the agricultural economy of the district.

b) The net ground water resource available for future irrigation is estimated to be 1122.93MCM. For optimum utilization of this resource, different ground water abstraction structures can be constructed. Shallow tube wells are feasible large part of the district. If the annual average unit ground water draft for one shallow tube well is considered to be 0.03 MCM then 37431 shallow tube wells are feasible in the district. Construction of these shallow tube wells will irrigate nearly 74862 Ha lands, if the command area created by one shallow tube well is considered to be 2Ha. Construction of deep tube wells should also be emphasized to tap the static ground water resources. However, caution must be exercised in maintaining the spacing norms.

c) Construction of large diameter dug wells, dug-cum-bore wells and deep tube wells are more suitable in the foot hill region for ground water development.

Percussion or reverse rotary rig can be deployed to construct deep tube wells of 100-150 depth.

d) A considerable area of the district is under water logging condition. To mitigate this problem lowering of water table is very much essential and for this additional number of tube wells should be constructed. Lined irrigation canals should be planned.

e) Various types of water conservation structures can be constructed in the foot-hill regions after conducting a thorough feasibility study. People should be encouraged to construct low cost rainwater harvesting structures especially in the iron-affected areas. In Lakhimpur district, it is generally observed that groundwater in the wat-per logged areas are high in iron.

Figures:

1. Administrative map of Lakhimpur District
2. Hydrogeological map
3. Pre-monsoon depth to water map
4. Post-monsoon depth to water map
5. Water level fluctuation map

DISTRICT GROUND WATER BROCHURE OF LAKHIMPUR DISTRICT, ASSAM.

ANNUAL ACTION PLAN 2012 - 2013

GOVERNMENT OF INDIA
MINISTRY OF WATER RESOURCES
CENTRAL GROUND WATER BOARD

CENTRAL GROUND WATER BOARD
NORTH EASTERN REGION
GUWAHATI

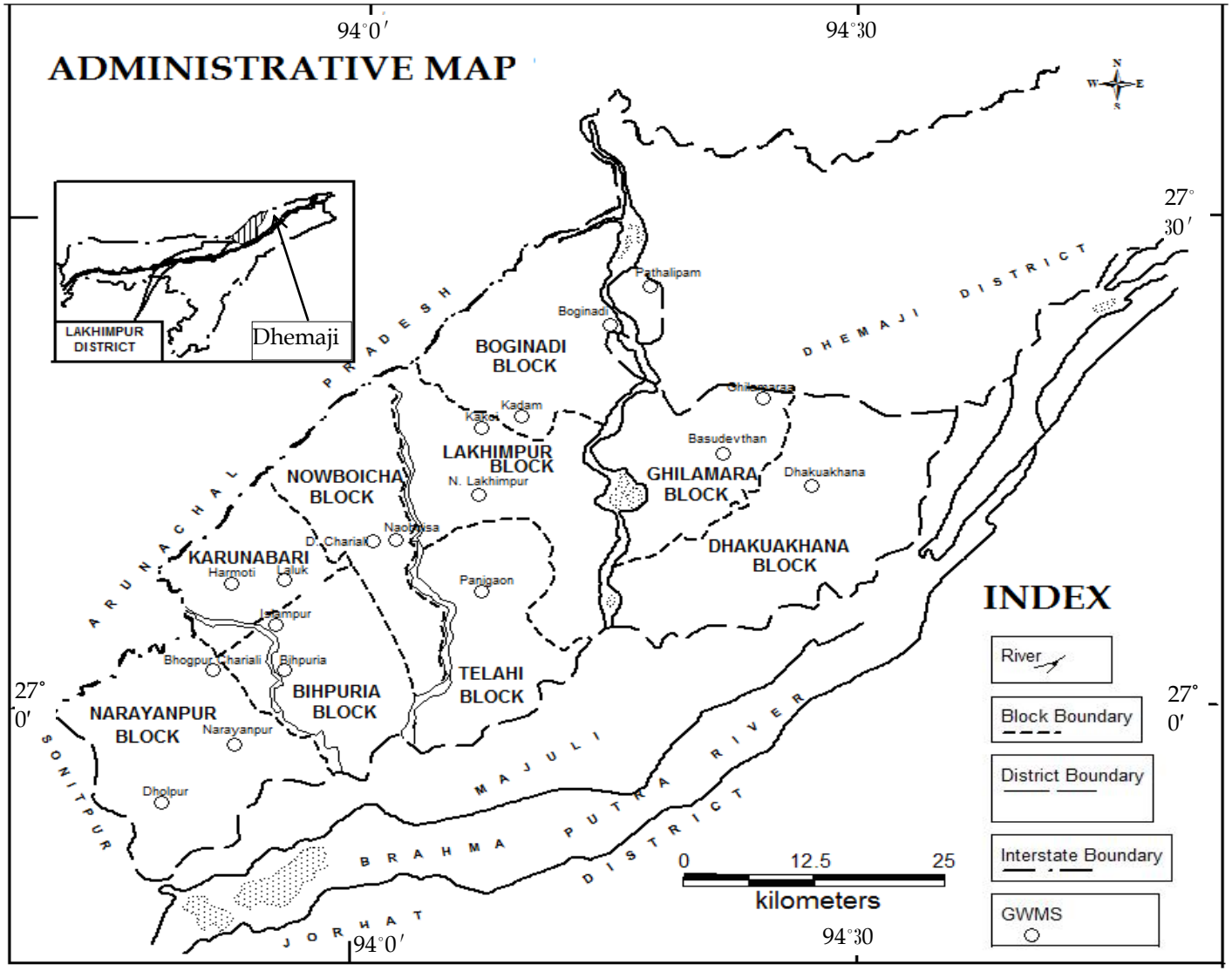


Fig. 1.: Administrative map of Lakhimpur district, Assam

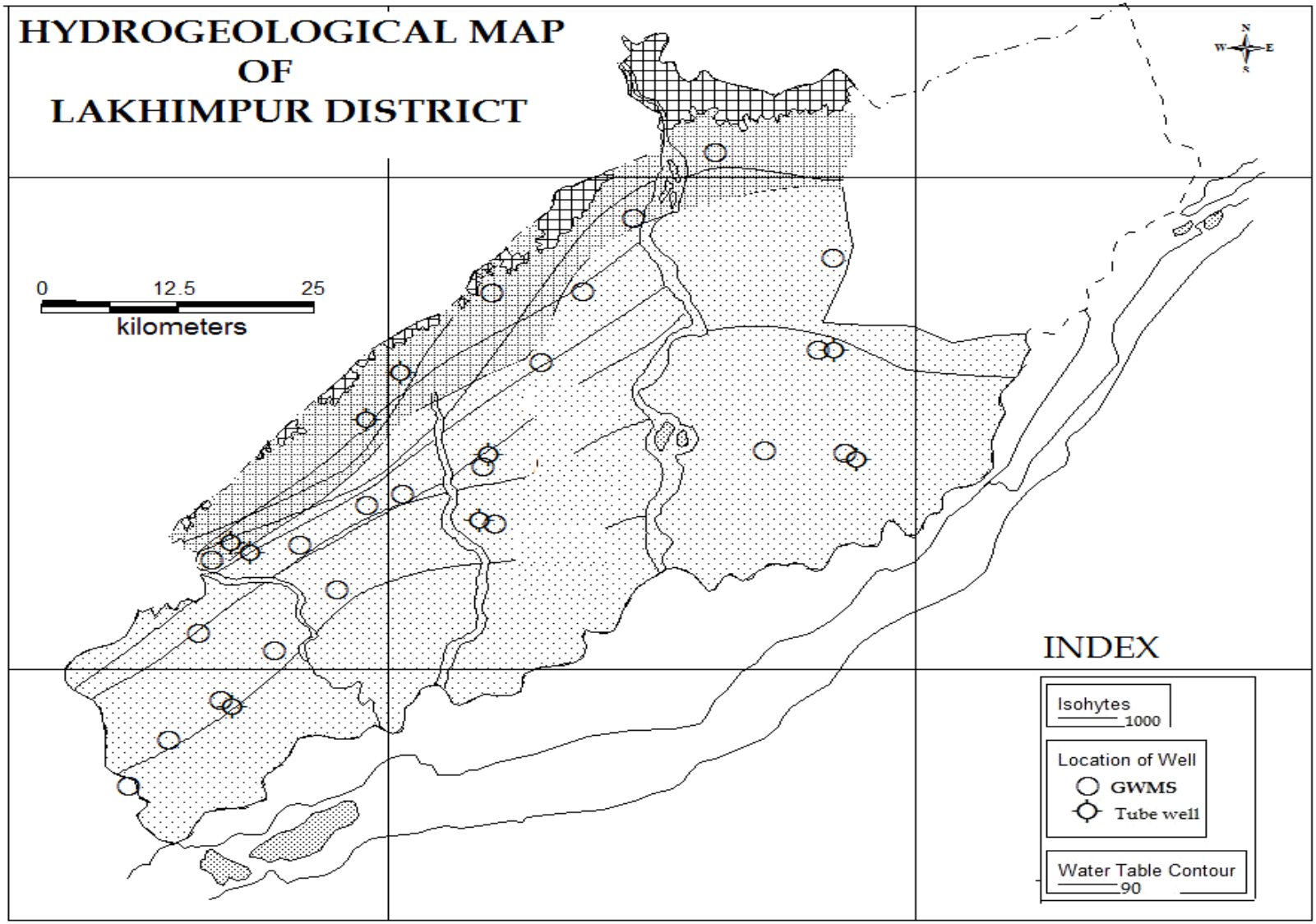


Fig. 2: Hydrogeological Map of Lakhimpur District, Assam

HYDROGEOLOGICAL MAP OF LAKHIMPUR DISTRICT

Sector	Formation	Lithology	Legend	Aquifer Characteristics	Ground Water Potential
I	Younger Alluvium	Sand, clay and gravel		Fairly thick, regionally extensive, unconfined/semi- confined aquifers to 150-200mbgl	Area feasible for shallow tube wells down 30-40m depth with 35-40 m^3/hr. Area feasible for deep tube wells 100- 200m depth with yield capacity 60-250m^3/hr.
II	Younger and older alluvium	Sand, pebbles, boulders with little clay		Aquifer materials consists of highly permeable pebbles, boulders	Not suitable for shallow tube wells. Area feasible for deep tube wells down to 120m depth with yield capacity 50-100 m^3/hr.
III	Siwalik Group	Sandstones, siltstone, conglomerates, etc.		Hilly Area	Area not suitable for ground water development.