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Final Report
on
Water Harvesting and Water Conservation in Imphal East I Block, Imphal East District, Manipur

Submitted to:

The Member Secretary
Indian National Committee on Hydrology
INCOH Secretariat, Jalvigyan
Bhawan, Roorkee -247667, Uttranchal.

Submitted by:

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Project at a glance

Project Title	:	Water Harvesting and Water Conservation in Imphal East I Block, Imphal East District, Manipur.
Principal Investigator	:	Dr.L.Dinachandra Singh Senior Scientific Officer, Manipur Science & Technology Council, Central Jail Road Imphal-795001
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Thrust Area of R&D	:	Hydrology and Drought Management.
Duration	:	2 (two) years.
Date of Start	:	December 24, 2004.
Date of Completion	:	March 31, 2007
Financial Details	:	

i) Sanctioned Amount	: Rs. 10,48,000/-
ii) Amount Released	: Rs. 6, 38,000/-
iii) Expenditure (31/3/2007)	: Rs. 6, 29,081/-
iv) Balance	: Rs. 8,919/-

MAP OF IMPHAL EAST- I BLOCK MANIPUR

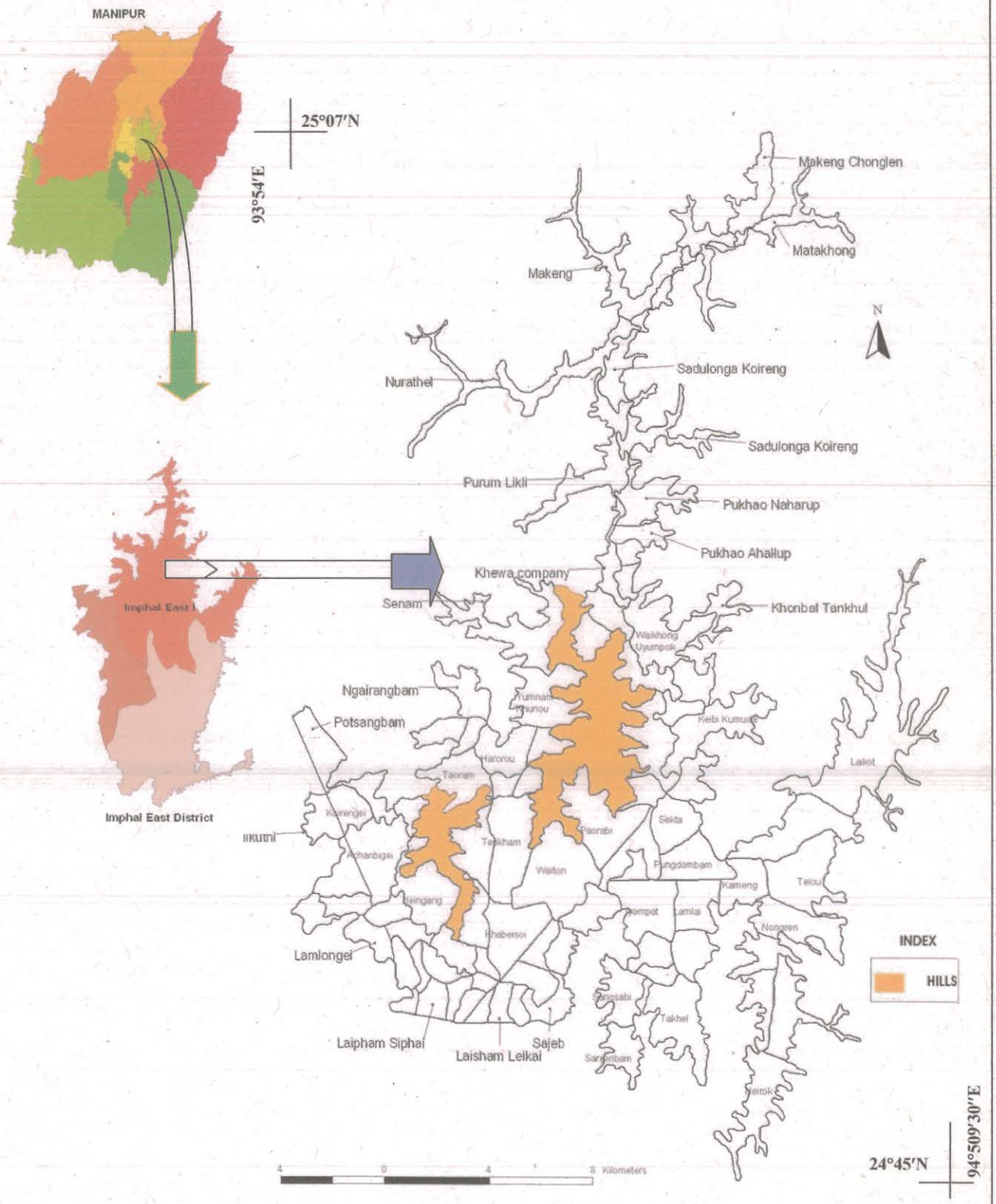


Plate 1

Introduction:

Water, the most vital element for the survival on earth, has become one of the emerging environmental issues our ecosystems are facing today. Issues of water quantity; quality and availability are the three major concerns and are vital to the quality of the life on earth. The assessment of the global water resources can alarm us for its future consequences. Water crises are the challenges to the global environment communities, as water issues have been included under the agenda 21 of the United Nations Environment Programme (UNEP).

The water resources of India are very unevenly distributed within the basins, National Commission for Integrated Water Development has shown that the per capita availability of water varies widely from around 300 cubic meters per person per year in basin like Sabarmati to very large quantities in Brahmaputra, with a National average of about 2,000 cubic meters per person per year. India is among the countries projected to fall into the water shortage category before 2025.

Manipur is a small mountainous state in the north-east of the country bounded by Nagaland on the north, Mizoram on the south-west, Myanmar on the east and south-east and Assam on the west. Out of 22,327 sq.km. about 90% is hills and the remaining 10% consists of central oval shaped valley surrounded by hills on all sides. The state has a total population of 23, 88.634 (Census 2001) and out of which rural population is 17, 91,875 and urban is 5, 97,159. Manipur receives a very good amount of rainfall. The state is confined with two major river basins. Barak river basin and Manipur river basin. The surface and ground water potentials of the state have been assessed by various departments like Irrigation and Flood Control Department (IFCD), Minor Irrigation Department (MID) and Public Health Engineering Department (PHED) in consultation with other agencies like CWC, CEA, CGWB etc. The total surface water and ground water potential are estimated as 18,487 million cu m and 44 million cu m respectively.

Manipur valley has four districts and Imphal East is one of them. Imphal East district has four blocks/ sub-divisions. They are Imphal East I, Keirao Bitra, Porompat and Jiribam. Geographically, Jiribam sub-division is located separately at a distance of about 220km in the western part of the state bordering Assam state.

Water Demand:

Urban Water Supply: It is estimated that water demand for Imphal city including the Greater Imphal area is 109 MLD by 2010 A.D. whereas the actual production of water is around 65 MLD against the installed capacity of 82 MLD Water Treatment Plants in Imphal. Hence, there is a gap of 44 MLD.

SL.No	Name of Plants		Installed capacity in MLD.
1.	Kangchup Water Supply Scheme (old)	---	14.53
2.	Kangchup Extention (French Assistance)	---	9.08
3.	Singda Water Supply Scheme	---	18.16
4.	Porompat Water Supply Scheme	---	2.27
5.	Aug. of Porompat Water Supply Scheme Ph-I	---	6.81
6.	Aug. of Porompat Water Supply Scheme Ph-II	---	6.81
7.	Ningthempukhri Water Supply Scheme	---	4.54
8.	Koirengei Water Supply Scheme	---	2.27
9.	Potsangbam Water Supply Scheme	---	6.81
10.	Khuman Lampak Water Supply Scheme	---	1.30
11.	Ghinga Water Supply Scheme	---	2.27
12.	Canchipur Water Supply Scheme	---	1.14
13.	Aug. of Canchipur Water Supply Scheme	---	4.54
14.	Tube Wells	---	1.36.

Imphal East I Block is situated in the northern part of the capital city. The project area comprises an area of about 280 sq. km with a total population of 1, 46,787 of which 1, 42,702 (95 village) in rural and 4085 in Urban. The geographical co-ordinates are 24°45′N - 25°7′N. and 93°54′E -94°9′30″E. The project area is crossed by three main rivers, the rivers are Imphal river, Iril river and Kongba river. The average annual rainfall for last 24 years is 1400mm. The maximum rainfall is observed in the month of June and minimum is in the month of January. The minimum annual temperature is 3°C and maximum annual temperature is about 34°C. The average height is 780 msl in the valley. The general gradient is from north to south with a very small angle slope. The actual source of water supply system in the area is from surface (more than 95%). However, Drought and flood are frequently occurred in the block during lean and monsoon seasons. The villages in the block suffer scarcity of water for drinking, domestic and irrigation purposes in most of the seasons

except during peak monsoon months caused due to lack of proper water conservation and management practices. Physiographically, the area is plain with gently sloping southwards.

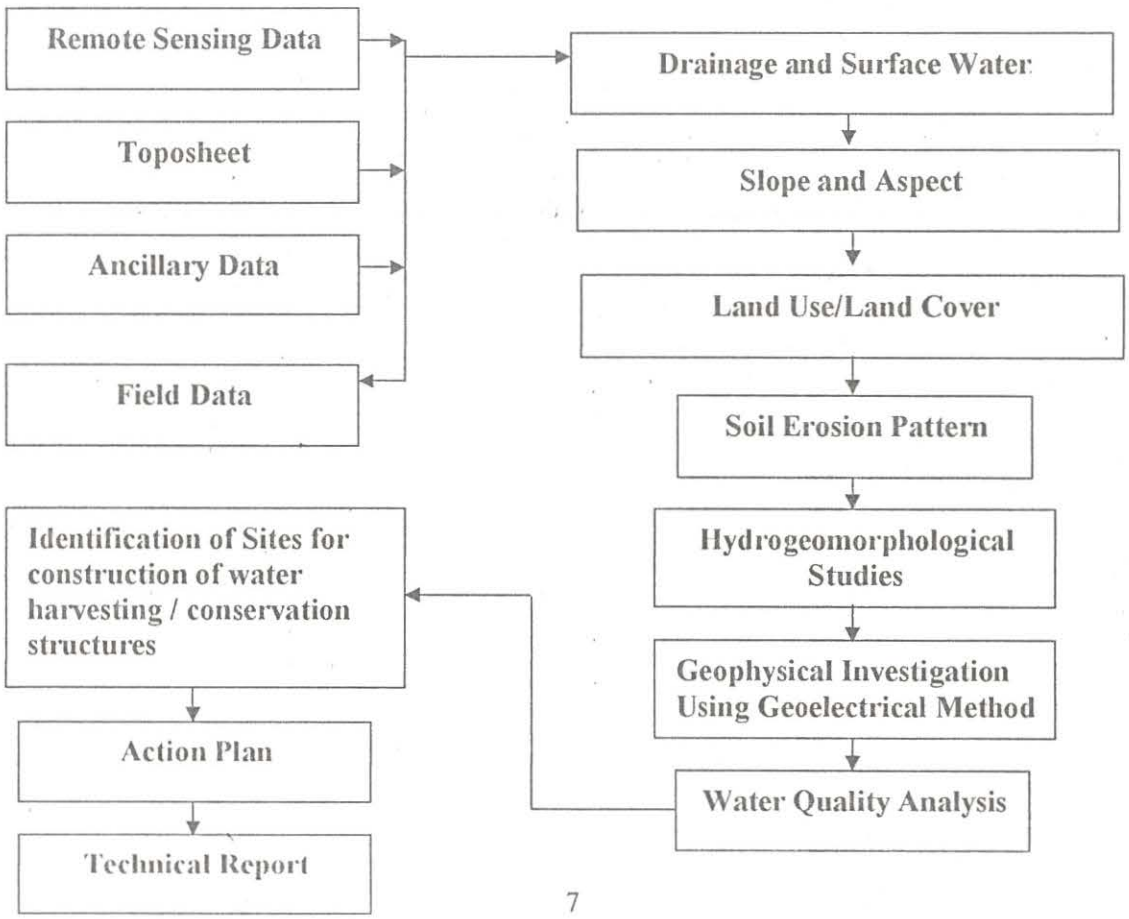
The evolution of geomorphology, hydrology, groundwater condition and water quality of the area has been considered as an important step/ pre-requisite step that can help in the management of water resources in the area for sustainable development since the occurrence and movement of surface and ground water in any terrain is controlled by its geology, topography, land use, soil, geomorphology, geological structure etc. It has become necessary to gather information about these parameters for proper investigation and utilisation of surface and ground water resources.

Objectives:

1. To identify surface and ground water resources.
2. To investigate ground water potentiality.
3. To asses the quality of surface and ground water for domestic and irrigation purposes.
4. To carry out the management practises for deterioted water.
5. To construct suitable water harvesting and water conservation structures

Methodology:

Flow Chart



PROFILE OF IMPHAL EAST I BLOCK

TOTAL POPULATION	**: 1, 46,787**
TOTAL RURAL POPULATION	**: 1, 42,702 (96 Village)**
TOTAL URBAN POPULATION	**: 4085**
AREA	**: 223 sq. km.**
TOTAL HOUSE HOLDS	**: 26,645.**

BASIC AMENITIES:

1) Total no. of Primary School	**: 165**
2) Total no. of Middle School	**: 71**
3) Total no. of Secondary School	**: 29**
4) Total no. of Senior Secondary	**: 6**
5) Total no. of College	**: 4**
6) Total no. of Hospital	**: 11**

DRINKING WATER FACILITIES:

a) Total no. of Well	**: 5**
b) Total no. of Tank	**: 62**
c) Total no. of Tube Well	**: 124**
d) Spring	**: 4**
e) Tap water facilities	**: 32 Villages**

OTHER SOURCE OF WATER:

River, Pond, lake, Canal etc.

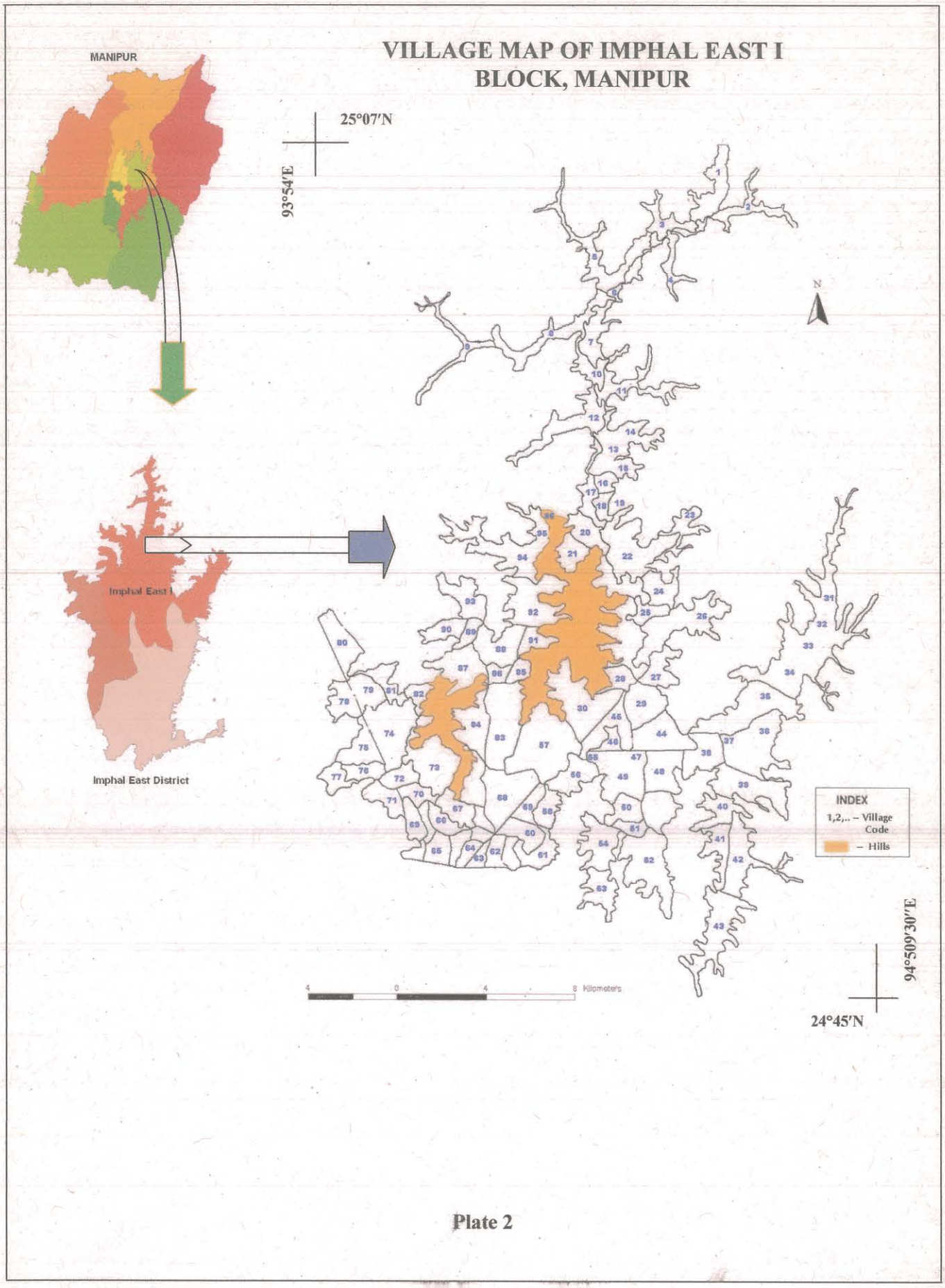

VILLAGE MAP OF IMPHAL EAST I BLOCK, MANIPUR
MANIPUR
Imphal East I
Imphal East District
25°07'N
93°54'E
94°50'30"E
24°45'N
N
INDEX
1,2,.. – Village Code
– Hills
4 0 4 8 Kilometers

Plate 2

Code	Village Name	Code	Village Name
1.	Makeng Chonglen	49.	Iyampat
2.	Matakhong	50.	Kharasom
3.	Makeng Nunglen	51.	Salakhul
4.	Khongjil Khongjai	52.	Takhel
5.	Mekheng	53.	Sanjenbam
6.	Leitanpokpi	54.	Sangsabi
7.	Sadu Koireng	55.	Phaknung
8.	Thangal Surung	56.	Sawombung
9.	Nurathel	57.	Waiton
10.	Pukhoa Terapur	58.	Kangla Siphai
11.	Sadu Longa Koireng	59.	Kangla Sangomsang
12.	Purum Likli	60.	Angom Leikai
13.	Pukhoa Naharup	61.	Sanjeb
14.	Pikhoa Santipur	62.	Laishram Leikai
15.	Pukhao Ahallup	63.	Khuari Angom Leikai
16.	Pukhao Khabam	64.	Khurai Thangjam Leikai
17.	Khewa Company	65.	Laipham Siphai
18.	Pukhao Laipham	66.	Kairang
19.	Waikhong	67.	Khomidok
20.	Sagolamng	68.	Khabeisoi
21.	Yumnam Patlou	69.	Mantripukhri
22.	Uyumpok	70.	Kontha Ahallup
23.	Khongbal Thangkhul	71.	Lamloigei
24.	Lamboi Khul	72.	Khabam
25.	Taret Khul	73.	Heigang
26.	Keibi Kamuda	74.	Achanbeigei
27.	Keibi Lousangkhong	75.	Luwansangbam
28.	Heikak Mapal	76.	Matai
29.	Sekta	77.	Ashi Loklen
30.	Pourabi	78.	Nilakhuthi
31.	Sanasabi	79.	Koirengei
32.	Yaingangpokpi	80.	Potsangbam Khunou
33.	Thamnapokpi	81.	Mongjam
34.	Laikot	82.	Maibakhul
35.	Sabungkhok	83.	Tangkham
36	Tellou	84.	Pangei
37.	Nongada	85.	Chingkhu
38.	Kameng	86.	Khundrakpam
39.	Nongren	87.	Taorem
40.	Kakching	88.	Haraorou
41.	Nongdam	89.	Sorouthel
42.	Oksu	90.	Morok Ingkhol
43.	Heirok	91.	Sambei
44.	Pungdombam	92.	Yumnam Khunou
45.	Nungoi	93.	Ngairangbam
46.	Itam	94.	Senam
47.	Yourabung	95.	Isingthembi
48.	Lamlai	96.	Isikha

Summary of Progress:

Imphal East I (Manipur) receives heavy rainfall from the SW and NE monsoon. The average annual rainfall received by the area is 1400mm. This amount of richness of surface water resource and saving it from being drained out due to peculiar drainage pattern over the rugged terrains of the state have been assessed by various departments like the Irrigation and Flood Control Department (I.F.C.D), Minor Irrigation Department (MIDI) and Public Health Engineering Department (P.H.E.D) in consultation with other agencies like CWC, CEA and CGWB etc.

5.1 Collection and analysis of rainfall data:

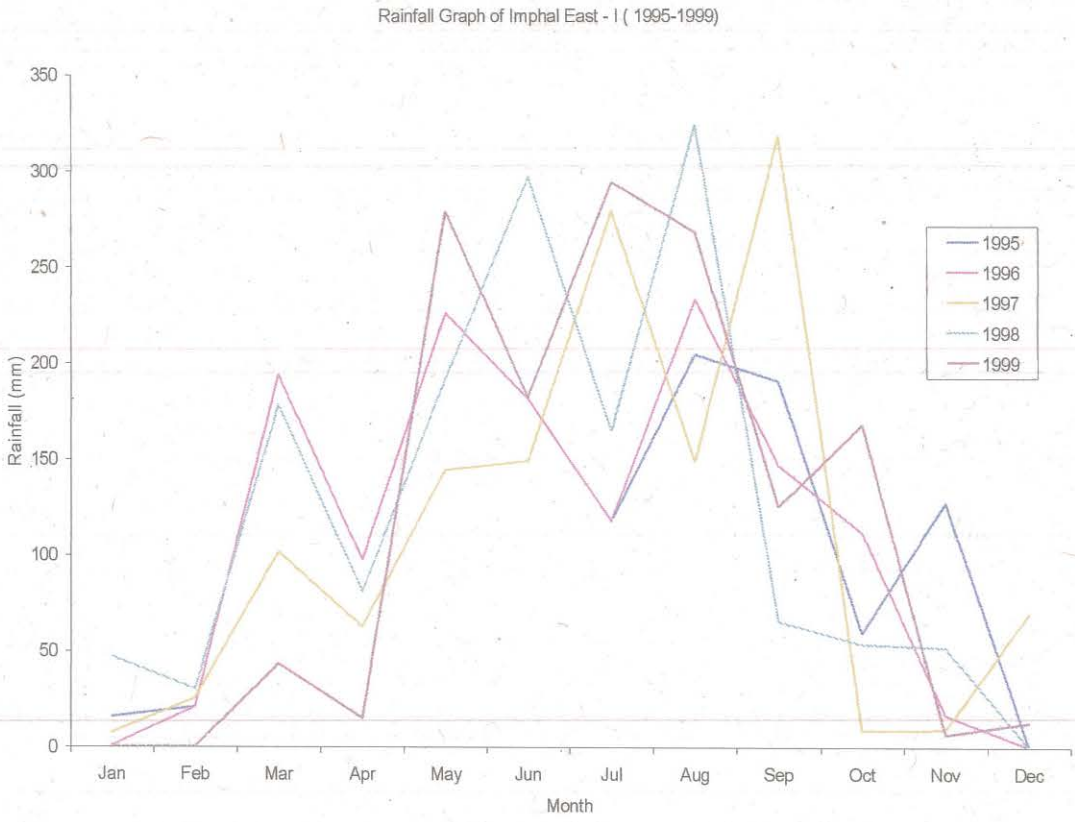
In project area the rainfall data were collected for the period of 1995 to 2006. For the period of 1995 to 1999 were collected from the airport meteorological station. and for the period of 2000 to 2006 were collected from ICAR Research Complex for NEH Region, Manipur Centre, Lamphelpat, Imphal. Rainfall in the study area starts from May and extend upto October. Highest monthly rainfall was recorded in the month of August 2002 with an intensity of 490.7mm and minimum was recorded in the month of January 1996 with 0.5 mm. Monthly rainfall data from 1995 to 2006 have been analysis, the table and graph are as below:

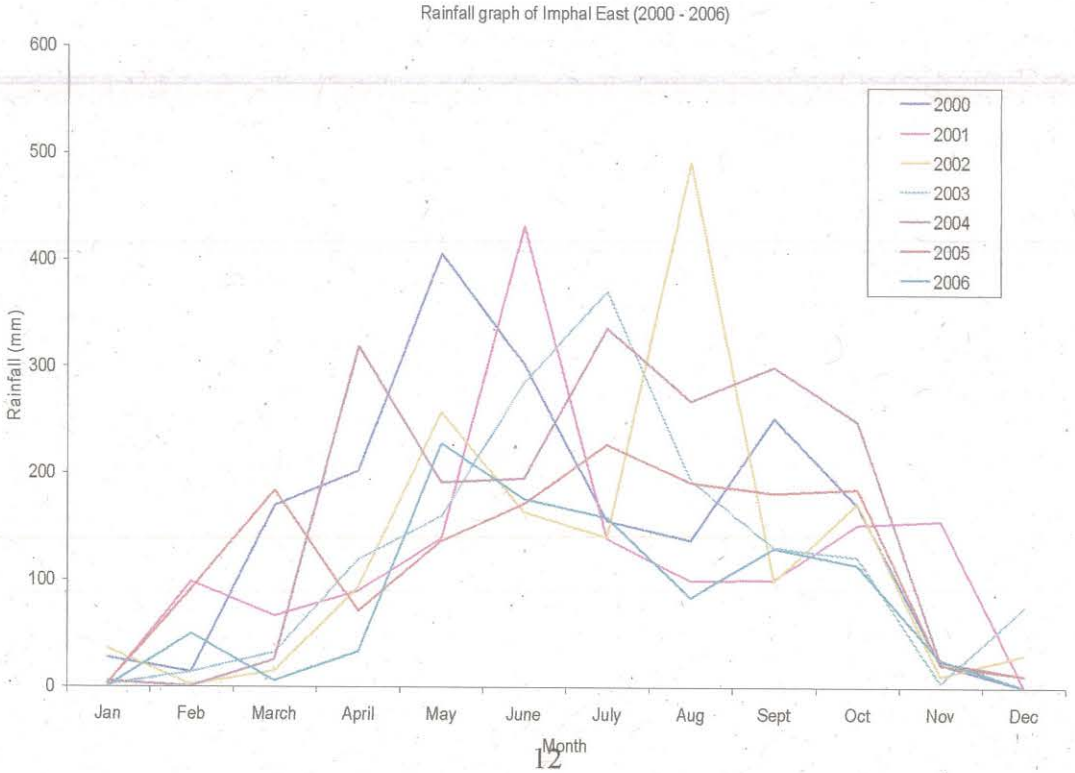
Rainfall Data from 1995- 1999

	1995	1996	1997	1998	1999
Month					
January	15.8	0.5	7.2	47.1	0
February	20.8	20.8	25.3	30	0
March	193.5	193.5	101.5	177.9	43.2
April	97.5	97.5	62.6	81	15
May	225.5	225.5	144.1	191.3	278.6
June	181.2	181.2	148.7	296.5	181.9
July	117.6	117.6	278.7	164.2	293.8
August	204.3	232.9	148.4	323.6	267.8
September	190.3	146.7	317.8	65.4	125.1
October	59.4	111.6	8.7	53.5	167.5
November	127	16.8	9	51.7	6.5
December	0	0	69.4	0	12.8

Rainfall Data from 2000 to 2006

	2000	2001	2002	2003	2004	2005	2006
Month							
January	27	2.2	35.3	1.5	4.8	2.8	0
February	13.6	98	1.5	13.3	0	91	49.40
March	169.4	66	14.4	32	24.9	183.6	5.20
April	202	89.5	92.7	118.9	318.5	71	32.80
May	405.3	138.5	256.8	159.7	191	136.2	227.2
June	302	430.9	163.5	284.6	195	171.2	175.9
July	155.3	138.8	140.1	370.4	335.6	226.6	158.4
August	137.2	99.3	490.7	193.6	267.4	191	83.60
September	251.4	100.2	98.8	130.6	299.4	181.4	129.80
October	169.8	152	172	121.5	248	185.2	114.0
November	21.7	155.4	10.4	4.1	24	20.8	25.6
December	0	0	30.1	74.8	10.6	10.8	0.0


Rainfall Graph of Imphal East - I (1995-1999)
Rainfall (mm)
350
300
250
200
150
100
50
0
Jan
Feb
Mar
Apr
May
Jun
Jul
Aug
Sep
Oct
Nov
Dec
Month
1995
1996
1997
1998
1999


Rainfall graph of Imphal East (2000 - 2006)
Rainfall (mm)
600
500
400
300
200
100
0
Jan
Feb
March
April
May
June
July
Aug
Sept
Oct
Nov
Dec
Month
2000
2001
2002
2003
2004
2005
2006

5.2 Surface water:

The total water discharge from the two river basins viz The Barak River Basin draining the western part and the Manipur River Basin draining the eastern half of the state including the Manipur valley has been estimated to be 1.8545 M hectare metre (15.04 M acre ft.) Our project area falls within the Manipur River Basin.

Manipur River Basin accounts for 0.5192 m hectare metre annual run off against a total catchments area of 6332 sq.km.

Drainage System:

The general trends of all the drainage of Imphal are N-S. They have high degree of base level erosion. Three major rivers crossed the study area. They are

(i) Iril river

(ii) Imphal river and

(iii) Kongba river

The Iril river is one of the largest rivers in Imphal (Manipur River System). It originats from Chingai area of Ukhrul district and joins the Imphal river at Lilong. It covers a catchment area of 1260 Sq.km with discharge of 0.0794Mham.The Imphal river which drains from Kangpopkpi areas and running north to south direction. It covers a catchment area of 560sq.km with accounts for 0.0863Mham. The confluence area of Iril and Imphal has many swamps which are now dried up. The Kongba river is also a tributary of Imphal river which joins Imphal river before Iril.

Tap/Tanks/Pond

Pipe lines are installed in many villages of the area under State Water Supply Scheme. However, the water supply through pipe is very very less because of water availability, harvesting and conservation problems.

A number of tanks are also observed in the study area, they are found adjacent to the built up lands. The water in the tank stored mostly in the rainy seasons and they are found dried sometimes during winter.

Ponds are also seen in some part of the study area.viz Sanjengbam Awang Leikai, Sanasabi village, Laikot village, Paorabi, Lamlai, Sawombung and some part of Khurai.

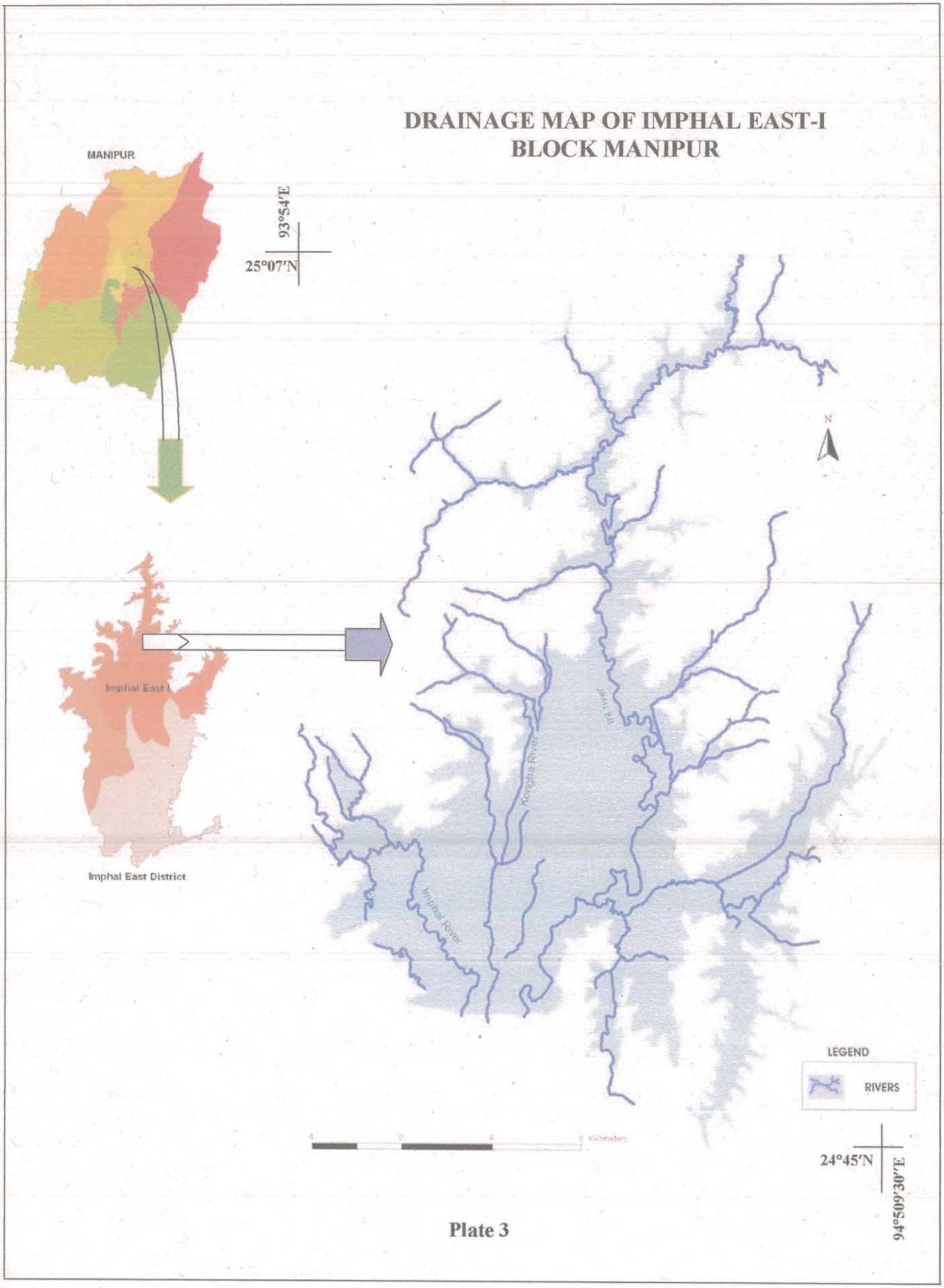

DRAINAGE MAP OF IMPHAL EAST-I
BLOCK MANIPUR
MANIPUR
93°54'E
25°07'N
Imphal East I
Imphal East District
N
Kongba River
Imphal River
LEGEND
RIVERS
24°45'N
94°09'30"E

Plate 3

5.3 Land use/ Land Cover:

Land is non-renewable resources and hence assessment of land use/land cover is essential for planning and development of land and water resources. The project area falls within the meridians N24° 45′ to N25° 7′ and parallel E93° 54′ to 94° 9′ 30″. Land use/land cover mapping of the area has been done using IRS-LISS III data. The major categories of land use/land cover in the area are:

SL.No.	Category	Area(Sq.Km)	Percentage
1	Agricultural land.	187.6	67%
2.	Built-up land.	33.6	12%
3.	Degraded Forest.	30.8	11%
4.	Forest Plantation.	6.16	2.2%
5.	Water Body.	4.76	1.7%
6.	Waterlogged area.	16.24	5.8%

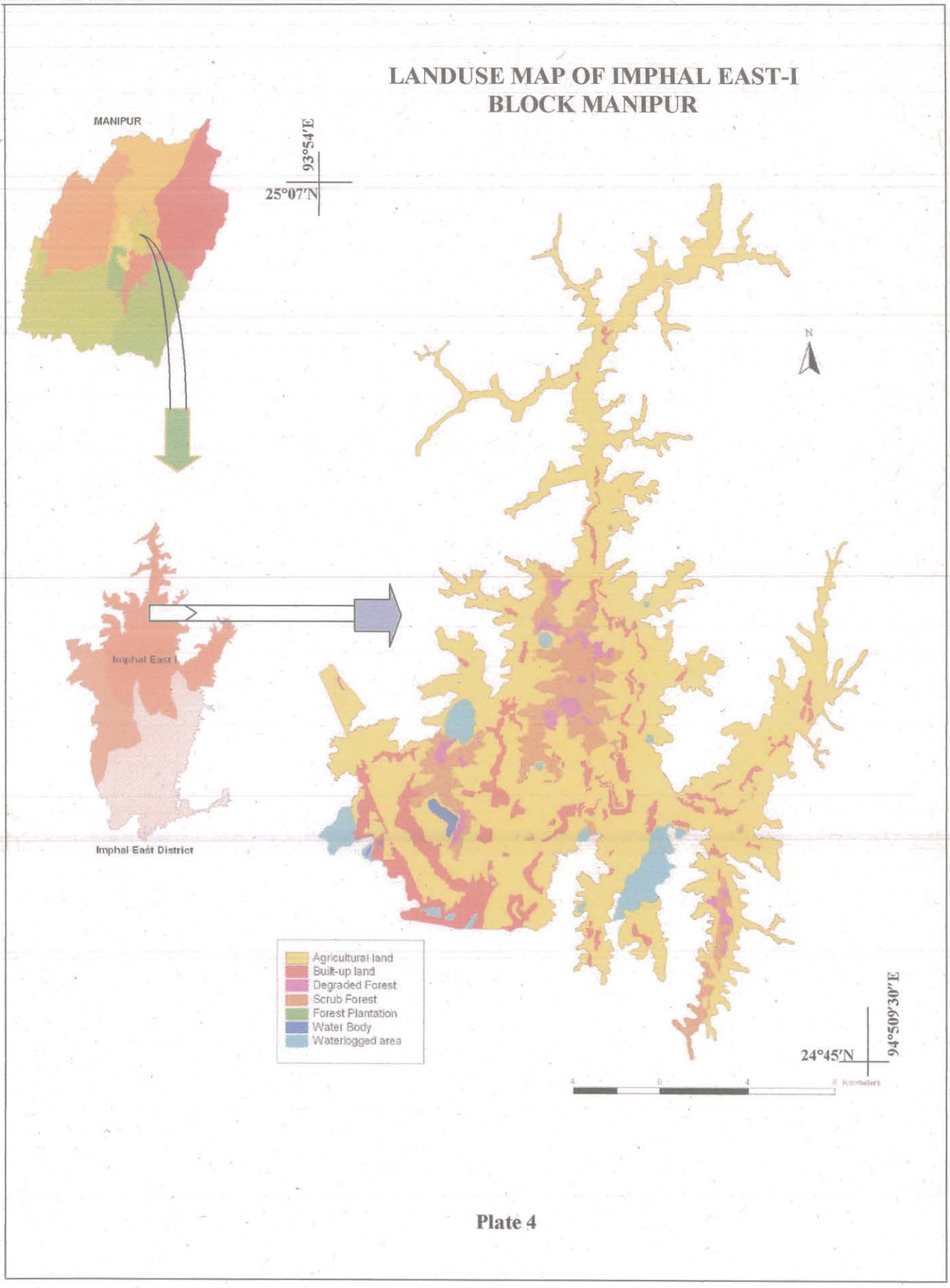

LANDUSE MAP OF IMPHAL EAST-I
BLOCK MANIPUR
MANIPUR
93°54'E
25°07'N
N
Imphal East I
Imphal East District
Agricultural land
Built-up land
Degraded Forest
Scrub Forest
Forest Plantation
Water Body
Waterlogged area
24°45'N
94°09'30"E

Plate 4

5.4 Slope and Relief:

Slope and Relief play role for land utilisation and geo-environment assessment. Main factors that control led the evolution of slope are structure, litho logy, geologic processes and time. Slope and Relief of the project area are studied and mapped.

So far seven classes of slope have been identified in the study area:

(1) Nearly level (0-1%)

The slope class is observed in the south central part of the area These areas are basically plain which are adjacent to the wetlands, agricultural lands and settlements.

(2) Very Gently Sloping (1-3%)

This class of slope is observed mainly on the eastern and north eastern part of the study area. Important land use categories found in this area are agricultural land (terrain for cultivation and horticulture) and settlements.

(3) Gently Sloping (3-5%)

This class of slope is mainly on the northern, eastern and some western part of the study area. Important land use categories found in this area are agricultural land and settlement.

(4) Moderate Sloping (5-10%)

This class of slope is mainly found in northern, eastern and central part of the area. Agriculture land scrub forest and water body are important land use categories.

(5) Strong Sloping (10-15%)

This class is observed in the central and southern part of the area, the main land use pattern are agricultural land, scrubland and settlement.

(6) Strong to Steep Slope (15-25%)

This slope is mainly observed in all sides surrounding the area. This area is dominated with forest, scrubland, settlement and agricultural land.

(7) Very Steep Slope (>25%)

Very steep slope occupies the central portion of the area. The area is dominated with forest cover, scrub land and shifting cultivation.

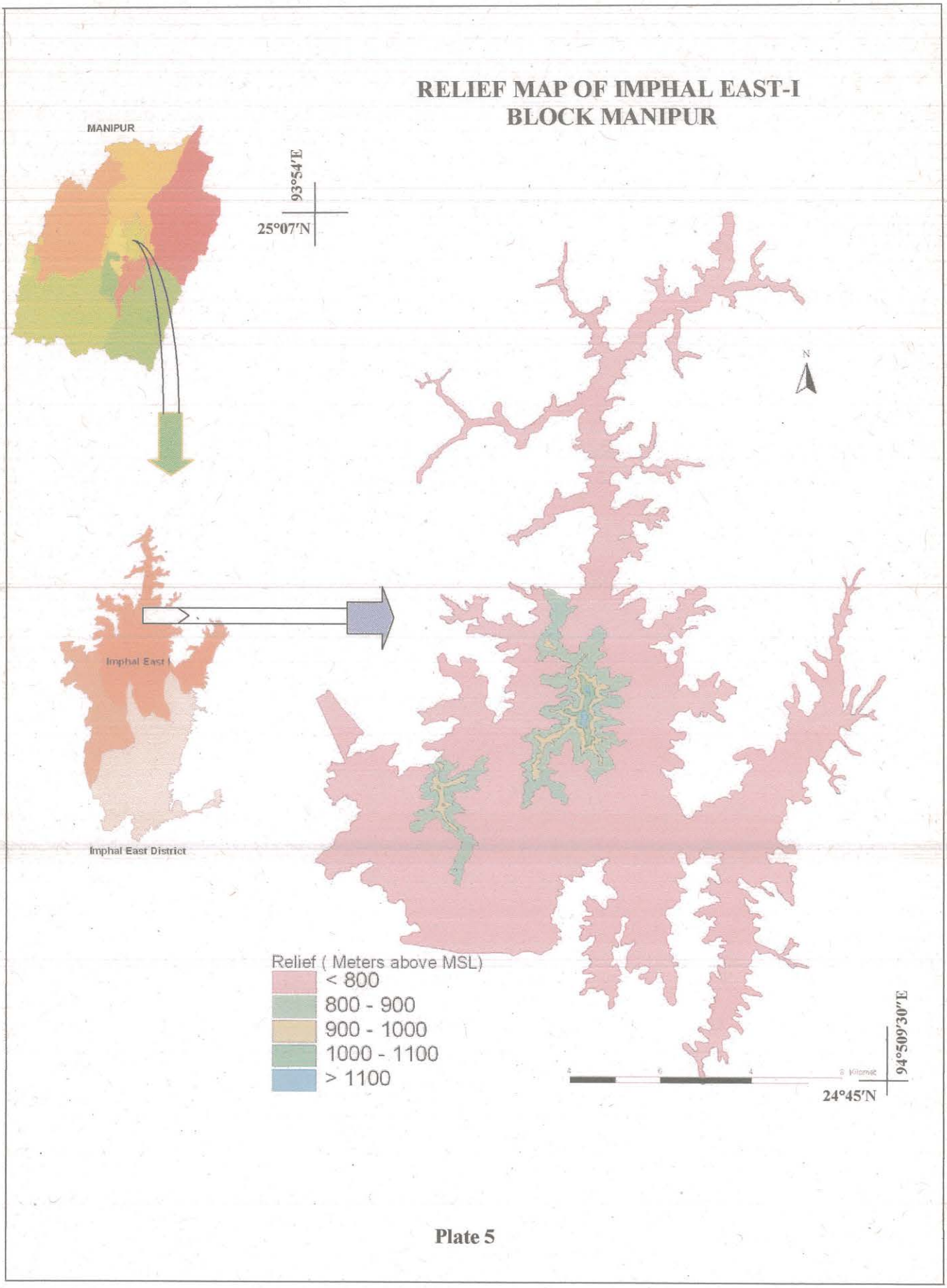

RELIEF MAP OF IMPHAL EAST-I
BLOCK MANIPUR
MANIPUR
93°54'E
25°07'N
N
Imphal East I
Imphal East District
Relief (Meters above MSL)
< 800
800 - 900
900 - 1000
1000 - 1100
> 1100
94°09'30"E
24°45'N

Plate 5

5.5 Geomorphology and Hydrogeomorphology units observed in the area:

(I) Alluvium plain (younger).

(II) Alluvium plain (older).

(III) Flood plain.

(IV) Structural hill.

(V) In filled valley.

(VI) Piedmont.

Alluvium plain (younger & older):

Alluvium covers the widest aerial extent in the study area. They are mainly dark grey to black carbonaceous clay silt and sand which clay forms the main sediments while silt and sand are subordinate. Major part of the area is further divided into older alluvium and younger alluvium due to change in the lithology. The large alluvial plain forms the potential source of ground water. The various geomorphic landforms constitute these types of aquifers. The nature of aquifer material is from unconsolidated to semi consolidated (Sand, gravel, pebbles, gravel mixed with sand).

Flood Plain:

Flood plains are observed in most part of the study area which are deposited along the major river courses. Along the Imphal river flood plains are extended more than 300 meters e.g. Nilakuthi, Khabam etc These deposits are prominent along the Imphal river at many places e.g. Pukhoa, Sawombung, Kangla Siphai etc. Flood plain deposits are the recharge zones of ground water and also form good aquifer. In general, flood plain consists of loose to moderately compact coarse to fine sand with little amount of silt and

Older Flood Plain area

Hand pump at Older Flood Plain area at Pukhoa Terapur Village

clay acts as high recharge zone, the groundwater occurs at shallow depth in semi-confined conditions. They are filled with fine sand and silt.

Structural hill:

Structural hill ranges are observed in the central portion of the study area which is formed due to different erosional and weathering processes. Shale and sandstone constitute the structural hills, where shale is dominated. They belong to Disang group. Occurrence of spring along the foot hill zones of Yaingangpokpi hills is the indication of structural weakness and appeared to be lithologically and structurally controlled. They are good to excellent ground water potential.

Spring at Sanasabi Village, along the foot hill zoneof Yaingangpokpi hill

In- filled valley:

In- filled valleys are seen in the upper reaches of the major rivers. The unconsolidated materials like gravel, pebble and loose sand are particularly favourable position to receive the water of the hills stream and transmit it to all parts of the valley fill. They are filled with sand, gravel pebbles etc. In filled valleys filled are exposed at Yaingangpokpi Bazar, Sanasabi, Sadu Dolaithabi etc, The ground water potential is good to excellent.

A handpump at valley fill deposit at Ningthemcha Khul

Piedmont:

Piedmont zone is gentle sloping area situated in between the hills and plain which are found in the central and southern side of the area. This zone consists of coarse sand, gravel, pebble and boulders. Because of coarse texture of deposit, they recharge the ground water from influent stream. Ground water potential at this region is good to moderate.

A dug well at Peidmont zone at Nongren

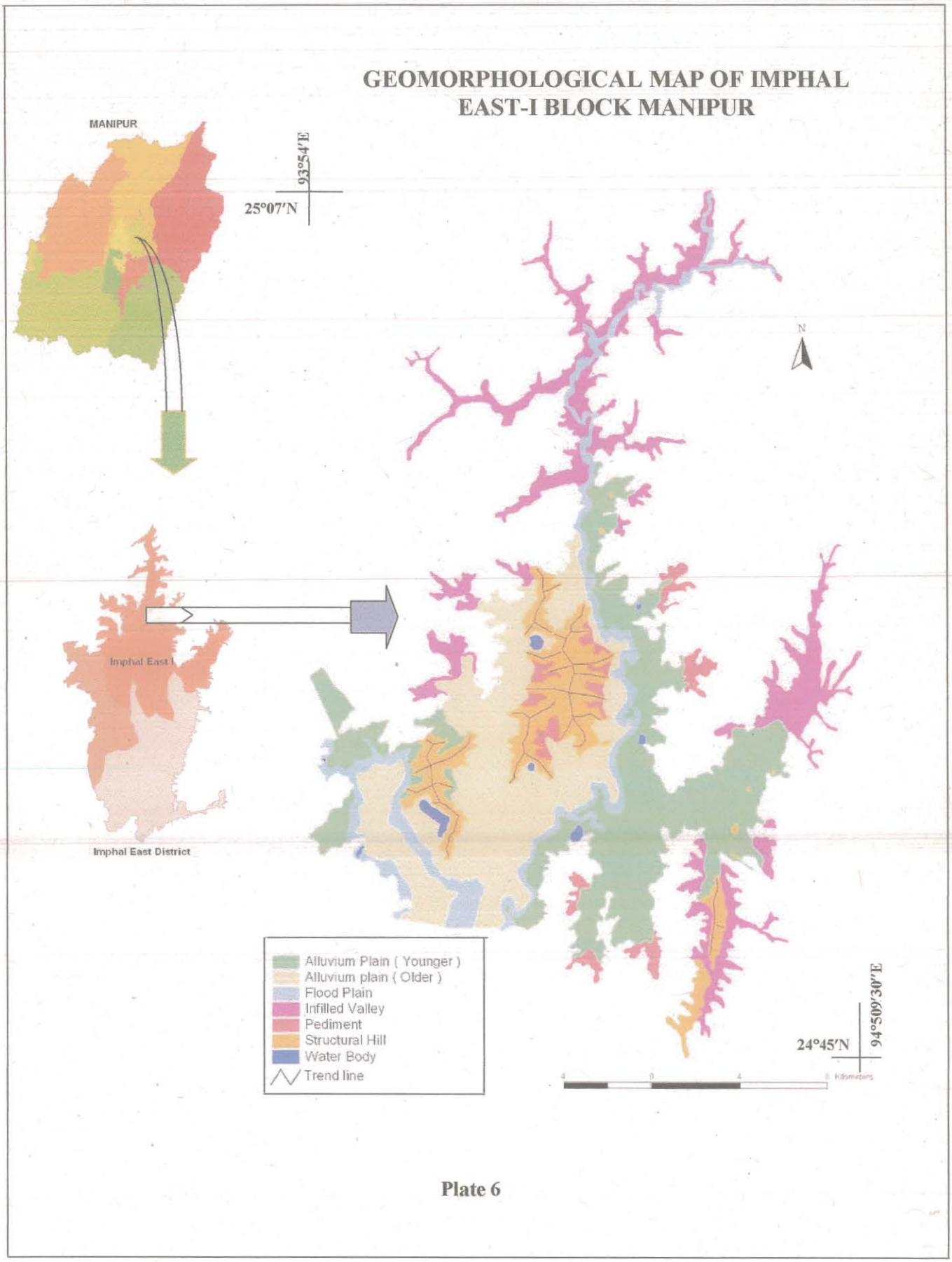

GEOMORPHOLOGICAL MAP OF IMPHAL EAST-I BLOCK MANIPUR
MANIPUR
93°54'E
25°07'N
N
Imphal East I
Imphal East District
Alluvium Plain (Younger)
Alluvium plain (Older)
Flood Plain
Infilled Valley
Pediment
Structural Hill
Water Body
Trend line
24°45'N
94°09'30"E
Kilometers

Plate 6

HYDROGEOMORPHOLOGICAL MAP OF IMPHAL EAST- I BLOCK MANIPUR

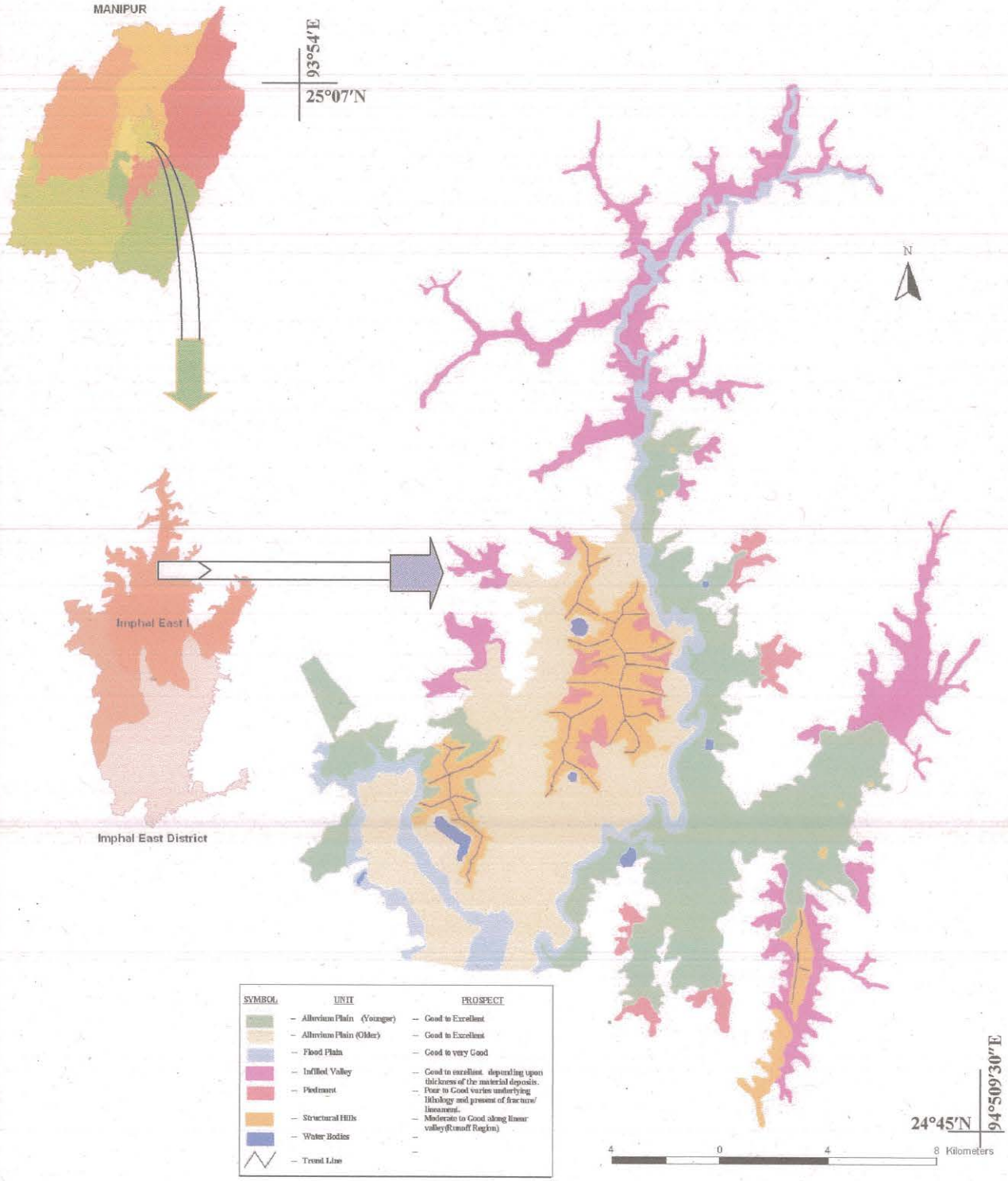


Plate 7

5.6 Geological Setup of Manipur:

Sedimentary, metasedimentary rocks with ophiolite suites belonging to tertiary in age constitute the geology of the Manipur. The flysch dominates the region approximately 70%. On the other side of the state is occupied by ophiolite melange and deep sea pelagic sediments and some metamorphic rocks. Limestones in the form of lensoids are exposed in the region. The metamorphic complex lies on the eastern side of Naga-Chin-Arakan Yoma suture zone. It is an allocthonous mass overthrusted the ophiolite and its sedimentary envelope. It occurs as a klippe overlying the melange zones. The Disangs are exposed on the eastern side of the state. The lithostratigraphic status of Disang is still a controversy. Some workers treated it as a formation and others as a group. It is mainly composed of dark grey to black splintery shale and intercalated by sandstone. These rocks are highly deformed. Regionally, rocks are folded into antiforms and synforms running in NNE - SSW direction. They also show the significant polyphase deformation. The sand pebbles are found in shale beds and shale pebbles are also present in sand beds.

Barials are exposed on western side of Manipur. Barials are predominantly made up of areneceous sandstone, interbedded with shale. The carbonaceous matter is abundant in the form of coal bands. They are characterised by intense folding and faulting. The Barials are deformed into a number of regionally extended folds and faults. The major folds and severe faults follow the regional trend of N – S to NE – SW.

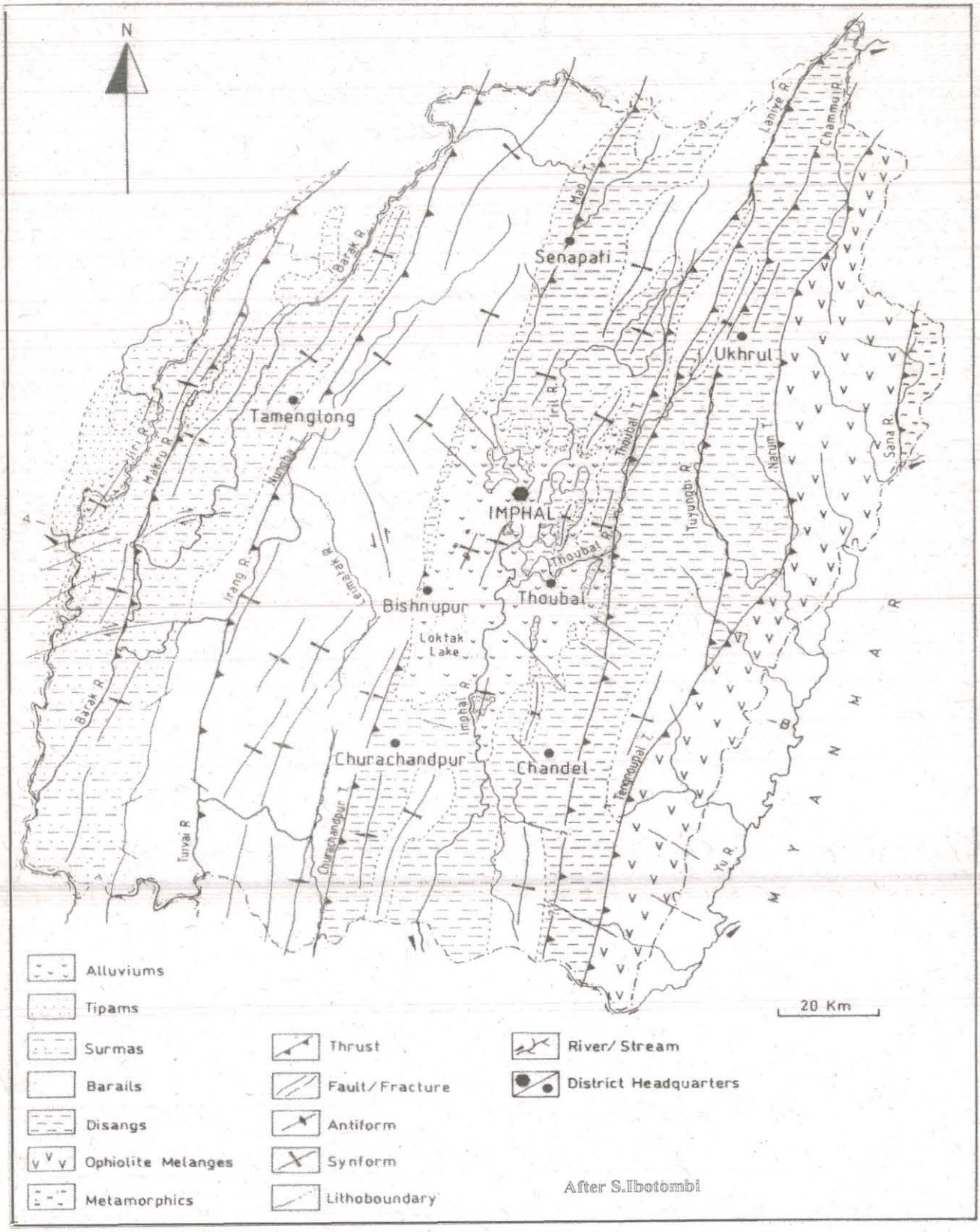
The sediments of Disang and Barial are flysch in characters. Disang is mainly argillaceous while Barial is arenaceous. They show the turbidite nature. Hence, they form a major flysch basin in the lithostratigraphy of the Indo-Burma Ranges.

The Surma and the younger Tipam lie unconformably above the Barials. They occupy the western part of the state. They are most prominent represented in neighbouring Mizoram and Tripura state.

The rocks of Surma Group are mainly grey to brownish grey in colour. In this Group arenaceous with shale bands are prominent conglomerate horizons are also observed. Usually shales are less sandy and sandstone are less argillaceous.

Tipams are observed only a small patches on the western part of the state. The Tipam sandstones are predominantly made up of coarse gritty ferruginous sandstone having blue to green.

The Surma and the younger Tipams have considerably argillaceous at the lower part predominantly composed of areneceous sediments in the upper part. So, they are sometimes also known as molasses deposits of the Surma basin and treated as a separate tectonic province of the north east India.



Geological Map of Manipur

5.7 Geology of the Imphal Valley with reference to groundwater prospects in the area:

Imphal Valley is surrounded by the high slope hills in all sides. The area is extended from Motbung to north of the Kakching to south. The total area is more than 1400 sq.km. The geographical co ordinate is 24°28′ N to 24°59′ N and 93° 46′ E to 94° 07′E. The Valley is crossed by many rivers, the main rivers are Imphal river, Iril river, Thoubal river and Nambul river. The average annual rainfall for the last 24 years is 1400mm. The maximum rainfall observed in the month of June and minimum in the month of January are 243.6mm and 11.1mm.

The average height is 780msl in the valley. The general gradient is from north to south with a very small angle slope (in average less than 30m. of fall in elevation between north and south). The actual source of water supply system in the Imphal valley is from surface water (more than 95%)

Geology:

In valley area we observed three main geological formations, two belongs to upper cretaceous- tertiary and one to qautenery.These formations were studied in detail by many organisations. Their detailed hydrogeological characteristics are as follows

Disang Group formation

The substratum of the Imphal valley is involves essentially shale and silt stone of the Disang Gp. This unit becomes gradually more sandy and possible carbonated upward in the Upper Disang.The Disang shale is deeply weathered, particularly at the periphery of the inselbergs or ridges and all around the present or former ponds, giving several meter to several tens meters of red clay with paleosoils. Silt and clay Disang feed in abundance the lacustrine sedimentation. They are in part of local origin by denudation, weathering and leaching of the emerging paleo-hills.However, hydrogeological point of view, pebbles and gravel continue to be provided by sandy and shally parts of this formation.

Barial Group Formation

This formation is essentially composed of sandstone. Barials are usually light to brownish gray, fine to medium grain sandstone often interbedded with shales. They are mainly brownish in colour after alteration. They were formed in flysh which has the turbidite character. In spite of the conformable strtigraphic boundary between Disang and Barial, the contact between the two units more often tectonic, on the western edge of the valley, due to competency of the compact sandstone in the Barial, with faults and overthrusts. The width of the overlap of Barial by Disang in the SW. The Barial Group forms the crests of the water divide in the NW of the area. In the SW it can be observed near Bishnupur where it presents classical thickening up turbidite sequences (laishong Formation).The sandstone is always

compact but often highly fracture along a direction of opening EW and subsidiary joints in between. Strike slip or transverse faults are associated with the main stress direction and generally oriented NW- SE as shown by the river direction and more obvious in the sandstone deposits of the Barial Group.

Plio- Quaternary valley fill

Plio- Quaternary valley fill are mainly composed of gravel, sand and clay. The more recent infill is due to black clay rich in organic matter covering almost the whole area, except the far NW. The present older fluvial deposits is continuous from NW to downstream of the present Imphal river. They are probably fluvio-lacustrine deposits of confined and low energy environment. Sections across this formation can be seen on several meters in the drainage troughs of the paddy fields. The contact between Disang ridges and Quaternary sediments is steep, without transitions between tectonised silty shale or paleosoils of weathered shale and quaternary clays. On the western edge of the valley, alluvial fans of limited extent occur in Bishenpur or north of the Leimakhong river.

5.8 Geology of the Study area:

Basically, the area is made up of alluvium of fluvio-lacusrine origin. They are usually dark grey to black in colour .The principal constituents are clay, silt and sand whereas sand ,gravel, pebbles and boulders are found in the foothill regions. The hillocks inside the project area are basically composed of Disang shales but some have sandstone capping. Alluvium covers the widest aerial extent in the area. They are mainly dark grey to black carbonaceous clay, silt and sand of which clay forms the main sediments while silt and sand are subordinate. Major parts of the area belong to alluvium which is further divided into older and younger alluviums due to change in lithology. Based on lithology and structure the region is broadly divided into two types of aquifer-weathered rock aquifer and alluvium aquifer. Average thickness of the alluvium is about 100-150 m.

Two types of Aquifer are:

(i) **Weathered rock Aquifer**

Moderately thick weathered shales are responsible for this type of aquifer. The water yielding properties are highly variable depending upon nature of the weathered material and surface cover.

(ii) **Alluvium Aquifer**

The various geomorphic landforms constitute this type of aquifers. The nature of aquifer material is from unconsolidated to semi consolidated (sand, gravel, pebbles, gravel mixed with sand.). Large alluvial plain form the potential source of ground water.

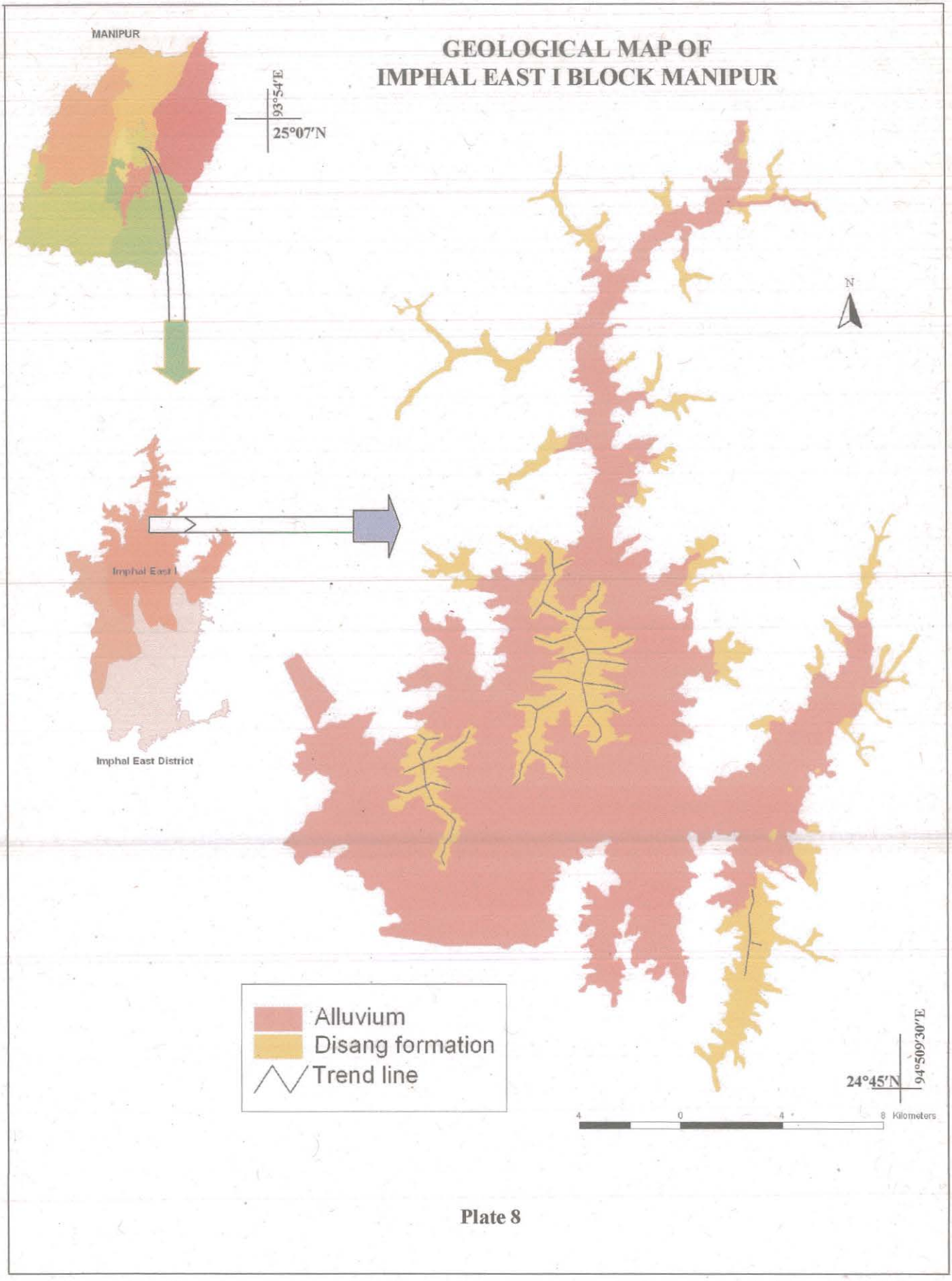

MANIPUR
GEOLOGICAL MAP OF
IMPHAL EAST I BLOCK MANIPUR
93°54'E
25°07'N
N
Imphal East I
Imphal East District
Alluvium
Disang formation
Trend line
94°09'30"E
24°45'N
4 0 4 8 Kilometers

Plate 8

5.9 Soil:

Soil is one of the important resources on earth and is formed under varying topographic and climatic conditions by physical, chemical and biological processes. Soils of the project area are developed on shale and sandstone rocks of Tertiary age. The temperate climate with high rainfall is responsible for very deep weathering of the rocks. The soils are formed in situ or the hill area and as alluvium on the valley areas. Seven soil types have been found and mapped in the area.

Soil Type:

Mapping Unit	Description
1.	Deep, well drained, fine soils on gently to moderately sloping side of hillocks having clayey surface with moderate erosion.
2.	Deep, excessively drained, clayey skeletal soils with moderate to severe erosion.
3.	Deep, well drained, fine silty soils having loamy surface with severe erosion.
4.	Deep, poorly drained, fine silty soils gently sloping with slight erosion.
5.	Deep, very poorly drained, very fine soils on nearly level valleys having clayey surface with very slight erosion.
6.	Deep, excessively drained, fine soils on steeply sloping sides of hillocks having clayey surface with moderate to severe erosion.
7.	Deep, poorly drained very fine soils on valleys having loamy soils surface with very slight erosion.

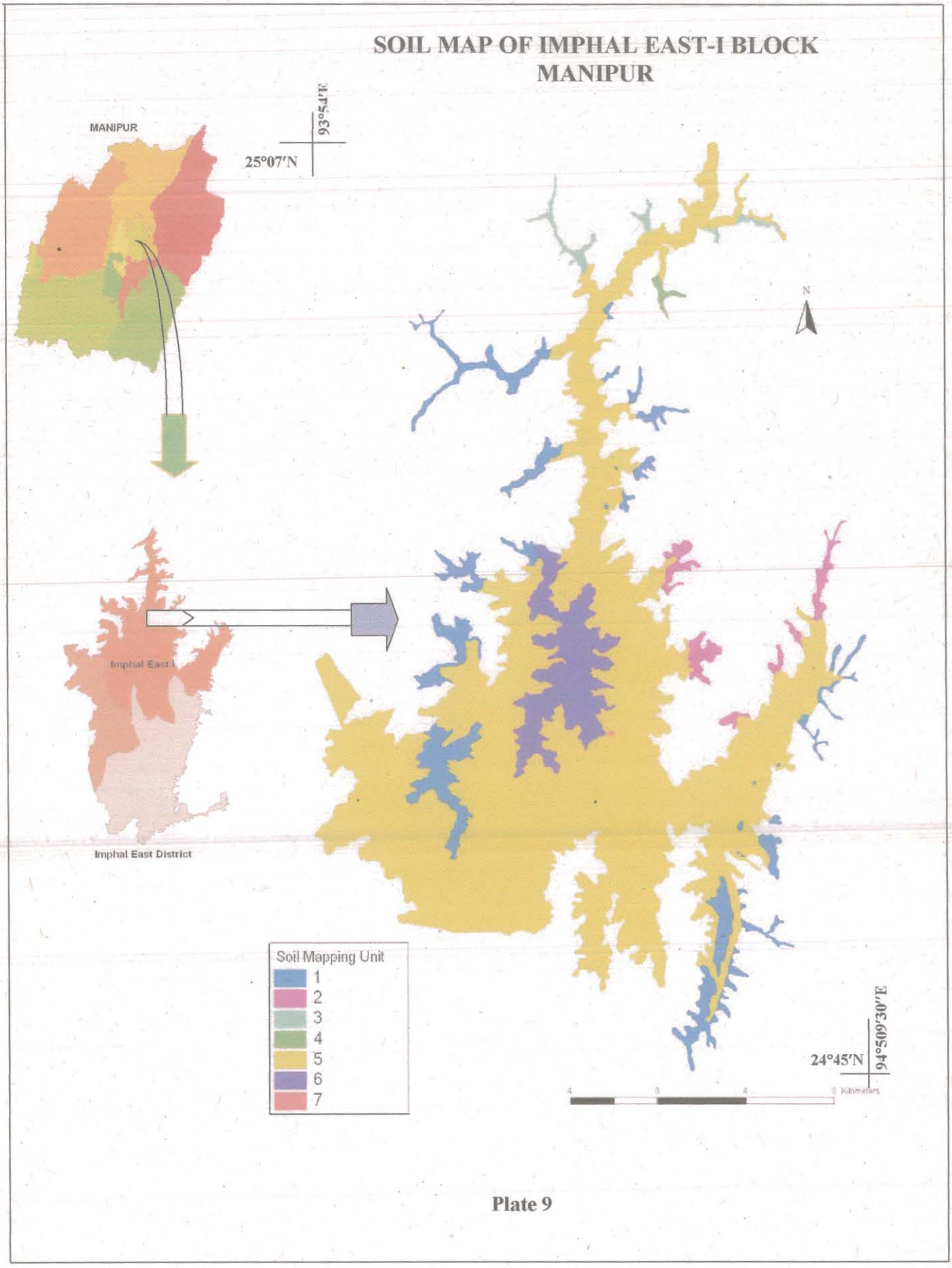

SOIL MAP OF IMPHAL EAST-I BLOCK
MANIPUR
MANIPUR
93°54′E
25°07′N
N
Imphal East I
Imphal East District
Soil Mapping Unit
1
2
3
4
5
6
7
24°45′N
94°09′30″E

Plate 9

5.10 Groundwater condition:

The area covered by the valley that can be investigated for groundwater potential in the Manipur is about 1800 sq.km. forming roughly 8% of the total geographic area. Our study area (Imphal East I Block) comprises of about 280 sq.km which is included in Manipur Central Valley. The Central Ground Water Board (CGWB) surveyed the hydro geological condition in 29.5 per cent of the state area. The valleys have superficial alluviums which are underlined by Tertiary rocks of Barial Series in Imphal. Ground water in top sandy and clayey formation occurs underwater table conditions with the depth of water varying from 3 to 4 metres bgl. Groundwater in the deeper aquifer occurs under sub-artesian and artesian conditions. The groundwater in the shallow aquifers is unconfined and the static water level is 3 to 5 m.b.g.l. Groundwater in deeper layers is semi-confined to confined with static water level from 7m.b.g.l. to 1.5 m.a.g.l. Granular zones are encountered at depth of about 150m in Imphal valley. Tube wells have been installed at various places of the valley area with the yields ranging from 0.6 to 4 cum/hr. On the basis of the monitoring of water level in key/dug wells network stations in the area, an annual recharge of 44 M.cu.m 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 or water supply. However, it can be exploited by open well, dug –cum-bore wells and tube wells.

Ground water condition in the study area are considerably influenced by various geological formation and unconsolidated to semi consolidated alluvial sediments of Recent to Sub Recent age comprising of fine to medium grained nature inliers of highly weathered ferrugeneous sandstone .

With respect to occurrence of ground water the area is divided into following parts:

(i) Northern part with weathered rock to the aquifers consisting of shale and sandstone.

(ii) Central and southern part with alluvial aquifers

The ground water potential map of the area has been prepared

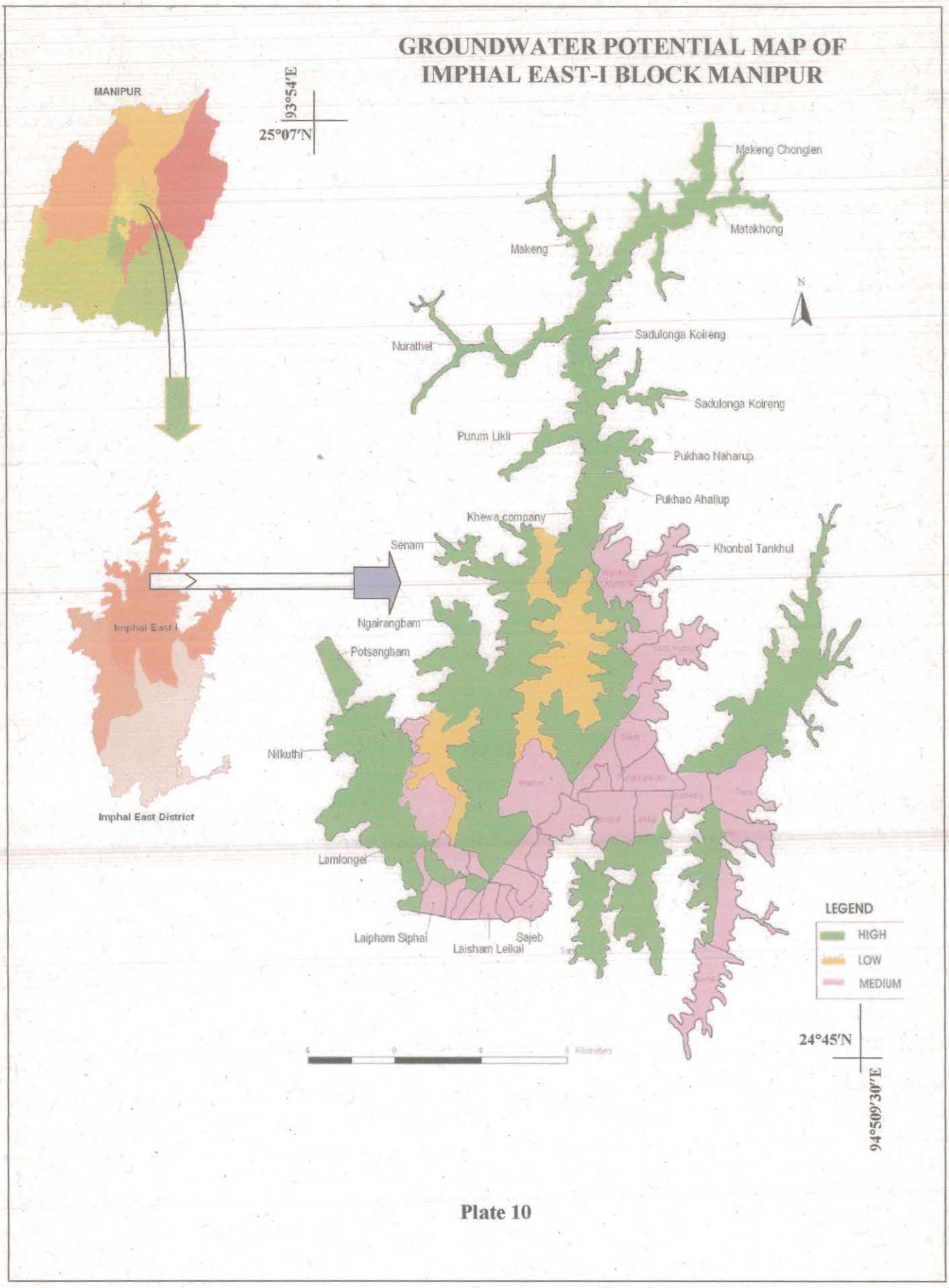

GROUNDWATER POTENTIAL MAP OF
IMPHAL EAST-I BLOCK MANIPUR
MANIPUR
93°54'E
25°07'N
Makeng Chonglen
Matakhong
Makeng
N
Nurathel
Sadulonga Koireng
Sadulonga Koireng
Purum Likli
Pukhao Naharup
Pukhao Ahallup
Khewa company
Senam
Khonbal Tankhul
Ngairangbam
Potsangbam
Imphal East I
Nilkuthi
Imphal East District
Lamlongei
Laipham Siphai
Laisham Leikai
Sajeb
LEGEND
HIGH
LOW
MEDIUM
24°45'N
94°50'30"E

Plate 10

5.11 Drinking Water Amenities/Water Supply Scheme

Water Supply Scheme of the area depends on the following source of water.

(i) Stream/ River

(ii) Tank/ Pond

(iii) Tube well

The attempt is made in present study to provide the ground water prospect in the area. The drinking water amenities are collected from census hand bk. of 2001 and field survey. The demographic data and existing drinking water amenities are compared to asses the future needs of drinking water. Data on basic amenities and village level water resources are given at Appendix I and a drinking water amenities map of the area has also been prepared

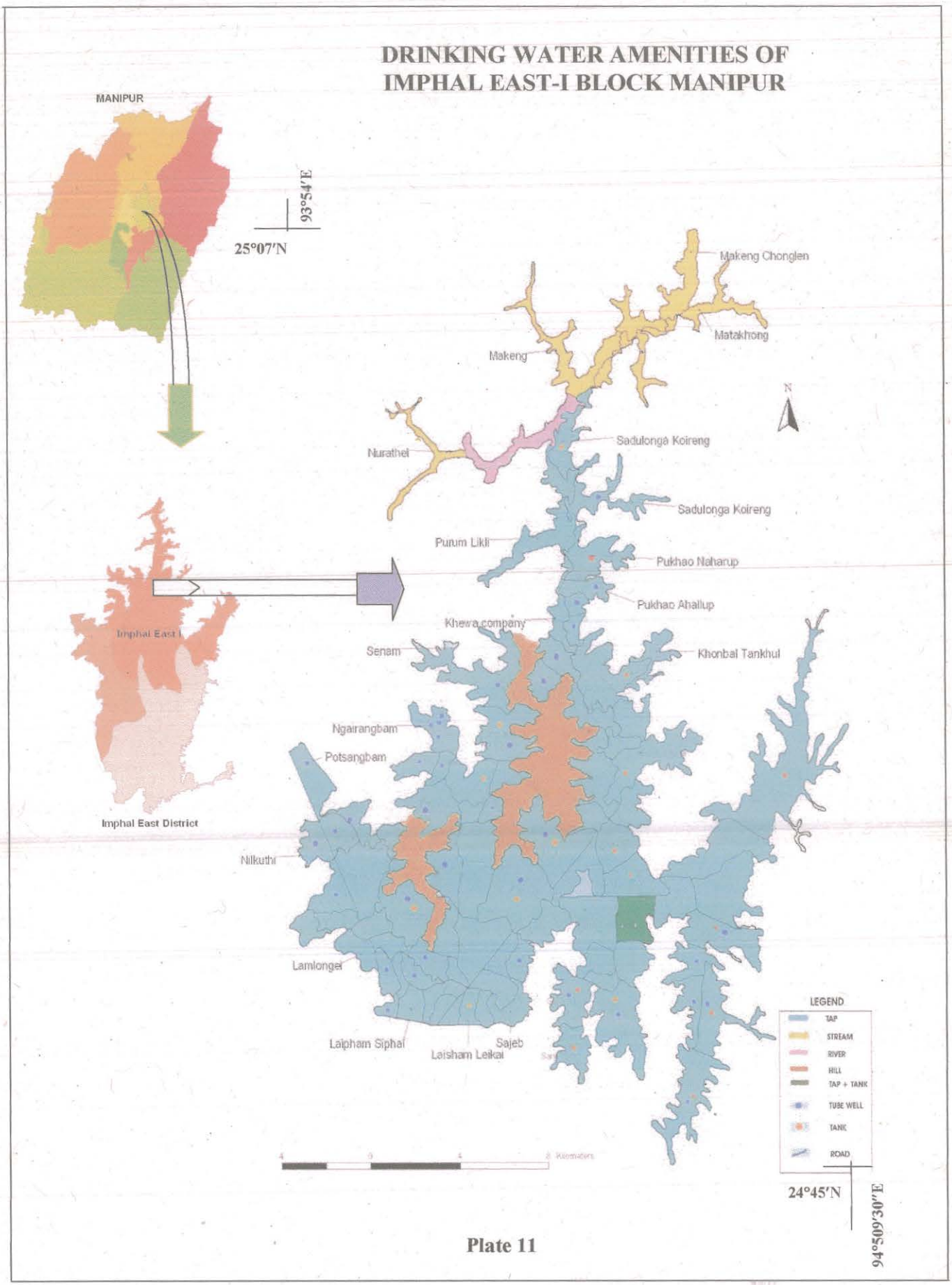

DRINKING WATER AMENITIES OF
IMPHAL EAST-I BLOCK MANIPUR
MANIPUR
93°54'E
25°07'N
Makeng Chonglen
Matakhong
Makeng
N
Nurathel
Sadulonga Koireng
Sadulonga Koireng
Purum Likli
Pukhao Naharup
Pukhao Ahallup
Khewa company
Senam
Khonbai Tankhul
Imphal East I
Ngairangbam
Potsangbam
Imphal East District
Nilkuthi
Lamlongei
Laipham Siphai
Laisham Leikai
Sajeb
LEGEND
TAP
STREAM
RIVER
HILL
TAP + TANK
TUBE WELL
TANK
ROAD
24°45'N
94°50'30"E

Plate 11

5.12 Water Quality:

Study of water resources cannot be considered to be completed without any knowledge about its chemical character and quality, as quality determines its suitability and usability, or otherwise for such specific uses as irrigation, industry and drinking purposes. The Public Health Engineering Department and Environmental Monitoring Research & Development Laboratory, Environment and Ecology Wing, Govt of Manipur are involved to analyse the water samples from various places of the study area. As per the analysed parameters, water samples are potable but after conventional treatment. pH at Sample No. 5 (Maibakhul) groundwater is above the desirable limit; Conductivity at Sample No.12 (Sambei) and pH at Sample No.7 (Achanbeigei) are high in concentration but low in nitrate, sulphate & fluoride concentration at all the water samples, hardness of Sample No.3, (Mantripukhri) of second table is high, iron at Sample No.4 (Khurai, Ningthoubung), Sample No. 5 (Takhel), Sample No.6 (Sangsabi) is above the permissible limit.

Table I

Sample No.	Place	Source of Sample	pH	TDS (mg/l)	Conductivity in ms/m	Hardness as $CaCo_3$ (mg/l)	Calcium	Magnesium (Mg) (mg/l)	Chloride (Cl) (mg/l)	Nitrogen as Nitrate	Sulphate	Iron (Fe) (mg/ l)	Fluoride
1.	Potsangbam	Hand Pump	7.02	90	300	90	11.24	14.13	11.97	0.174	8.40	0.854	0.603
2.	Potsangbam	Hand Pump	7.85	60	210	82	10.42	12.54	12.78	0.116	4.80	0.098	0.603
3.	Keikol	Hand Pump	7.75	90	320	92	10.42	16.08	11.97	0.145	2.40	0.098	0.639
4.	Keikol	Pond	7.63	40	160	80	7.21	15.00	12.78	0.174	3.60	0.042	0.603
5.	Maibakhul	Hand Pump	8.72	200	660	194	32.26	18.03	15.62	0.116	1.20	0.028	0.648
6.	Luwangsangbam	Community Pond	8.35	70	240	84	4.81	17.54	14.20	0.174	7.20	0.798	0.621
7.	Achanbeigei	Hand Pump	8.39	140	450	98.00	12.03	16.55	11.97	0.087	2.40	1.484	0.594
8.	Kundarkpam	Community Pond	7.61	210	700	140	24.85	19.00	31.24	0.145	6.00	0.182	0.603
9.	Isingthembi	Canal	7.94	80	290	120	10.73	19.98	12.78	0.058	5.80	0.084	0.630
10.	Yumnam Khunou	Community Pond	7.96	50	190	96	6.41	4.87	12.78	0.174	3.60	0.084	0.603
11.	Haraorou	Hand Pump	7.56	220	720	208	33.07	30.69	9.14	0.116	2.40	0.112	0.603
12.	Sambei	Hand Pump	7.85	310	1030	144	14.44	21.44	12.78	0.145	3.60	0.056	0.630
13.	Chingkhu	Hand Pump	7.87	250	810.00	132.00	11.26	20.46	8.52	0.087	6.00	0.132	0.630

Test conducted at Environment & Ecology Wing Govt. of Manipur

Table II

Sample .No	Place	Source of Sample	pH	Turbidity	Conductivity In ms/m	TDS (mg/l)	T-alkanity as $CaCo_3$(mg/l)	Hardness as $CaCo_3$ (mg/l)	Iron (Fe) (mg/l)	Chloride (Cl) (mg/l)	Magnesium (Mg) (mg/l)	Potassium	Sodium (Na) (mg/l)
1.	Potsangbam	Water Supply	7.15	0.10	30.00	24	100	500	0.50	--	--	--	--
2.	Koirengei	Water Supply	7.40	0.10	10	11	50	400	0.50	--	--	--	--
3.	Mantripukhri	Hand Pump	7.60	1.00	50.00	39	300	900	1.00	--	--	--	--
4.	Khurai Ningthoubung	Tube Well	6.51	3.20	12.8	12.8	76.8	80	3.50	15.00	100	--	--
5.	Takhel	Tube Well	6.35	6.00	51.40	308	240	260	1.18	60	--	--	--
6.	Sangsabi	Tube Well	6.28	25	30.40	182	160	155	4.50	40	--	--	--
7.	Sanasabi (North)	Spring	7.11	--	310	80	--	90	--	18.46	16.07	13	25
8.	Sanasabi (South)	Spring	6.63	--	130	30	--	84	--	19.88	17.53	9	17
9.	Laikot	Spring	6.61	--	220	70	--	100	--	18.46	19.48	12	21
10.	Nongpok Heirok	Hand Pump	7.45	--	810	270	--	336	--	17.04	52.60	28	50

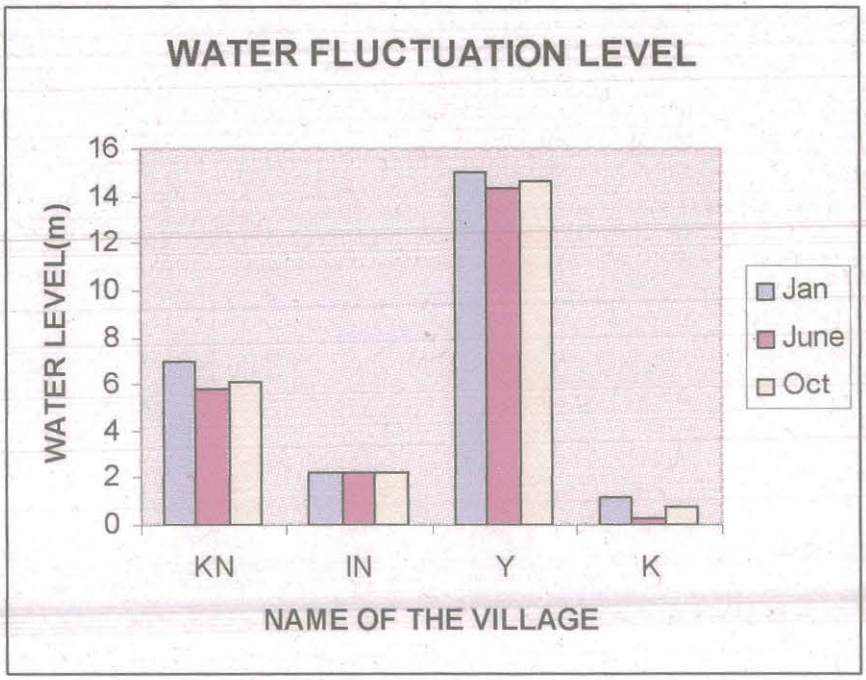
Test conducted at PHED,Imphal

5.13 Water Fluctuation Report: (SWL) in bgl

SL. No.	Name of the Villages	Source	Jan (m)	June (m)	Oct (m)	Fluctuation(m)	Year
1	Khurai Ningthoubung (KN)	Tube Well	6.99	5.79	6.12	1.20, 0.33	2006
2	Itam Nungoi (IN)	Tube Well	2.26	2.19	2.21	0.07, 0.02	2006
3.	Yaingangpokpi (Y)	Tube Well	15.03	14.38	14.65	0.65, 0.27	2006
4.	Kharasom (K)	Tube Well	1.20	0.33	0.79	0.87, 0.46	2006

Source: PHED, Imphal

Note: SWL –Static Water Level, bgl- below ground level



5.14 Traditional Water Management Practices: Ponds/Pukhris are the most prevalent

Community Pond

traditional water harvesting structures. Till a few decades ago, one pond was shared by two or three households. Community Ponds are also commonly found in the settlements. Three are generally larger in size and better maintained than Private ponds. The water supply situation in the state in terms of coverage and adequacy continues to be pathetic in most settlements. Hence even today, a large majority of the population depends on ponds to meet their water requirement.

Residents of Yaingangpokpi dug hole to fetch water on the river bed of Leimakhong rivers

Dug hole in the river bed is also a traditional type of water collection, during the dry/lean season in households where house ponds or wells are dried or not available at all, the children normally sent out to fetch water from dugout hole on the dry stream/riverbeds.

6.00 Geoelectrical Exploration

Introduction:

There are many methods of electrical surveying. Various types of configurations are used in the ground water exploration. Schlumberger's configuration is used in present studies. Schlumberger's methods provides both vertical electrical sounding (VES) and profiling, which is most successful in the exploration of ground water as well as estimating the aquifer parameter (eg Zohdy,1969, Henrict,1976, Verma et-al 1980,Kosinski and Kelly,1981, Sri Niwas and Singhal 1981,1985; Kwader, 1985. The thickness and depth of the various geoeletrical layers are obtained by interpreting the field curve either manually using master curves or analytically by using computer.

Ohm's law

The potential difference across a conductor is directly proportional to the current flowing in it, when other physical condition like temperature remains constant. When an artificially generated current is introduced into the ground, and the resulting potential differences are measured at each surface. The method is based on Ohm's law.

$$V \propto I$$
$$V = IR$$

Where R = a constant of proportionality and is known as resistance.

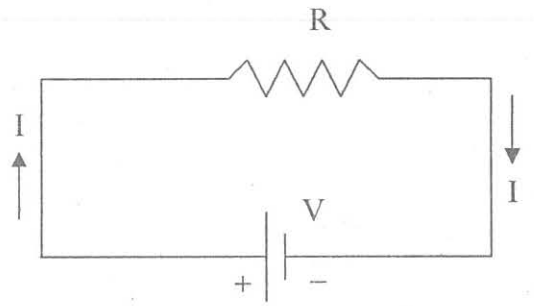


Fig: Ohm's law electrical circuit.

The resistance of a conductor is directly proportional to the length of the conductor and inversely proportional to the area of the cross section

$$R \propto I \text{ and } R \propto I/A$$
$$\text{or } R \propto I/A$$

therefore, $R = \varsigma\, I/A$,

where ς = a constant of proportionality and is known as resistivity.

If I = 1, ampere and A=1m2 then, $R = \varsigma$.

Therefore resistivity of a conductor can be defined as the resistance across a cylinder of unit cross sectional area having a unit length. It's unit is ohm-m or ohm-cm.

The resistivity may be expressed as

$$\varsigma = A/1 \,.R$$
$$\varsigma = K.\ R, \text{ where K= geometric factor}$$
$$\text{or } \varsigma = K.\ V/I$$

The above formula is used to determine the electrical resistivity of the earth by introducing two current electrodes into the ground. Potential difference, due to the current is measured using two another electrodes known as potential electrodes. The geometric factor K depends on the mutual distances between the four electrodes.

Methodology:

In resistivity method five electrode configurations were used as follows:

I. Schlumberger's Configuration
II. Three- electrode Schlumberger's configuration
III. Wenner's configuration
IV. Three – electrode Wenner's configuration and
V. Azimuthal dipole configuration.

The configurations of these methods are shown in Fig 1 of these Schlumberger's method adopted in the present investigation. It has many advantages in the field such as less sensitive to unknown laterally inhomogeneties and more rapid survey.

Schlumberger's Configuration:

In this method, all the four electrodes are placed collinear, but the potential electrodes are kept very close to the central point of the arrays, as compared to the current electrodes. Current (I) is sent to the ground through the outer electrodes, A and B and potential difference (V) is measured across the inner electrodes M and N. If 2L is current separation, 2L is potential electrode separation, the apparent resistivity (ς) for schlumberger's configuration is

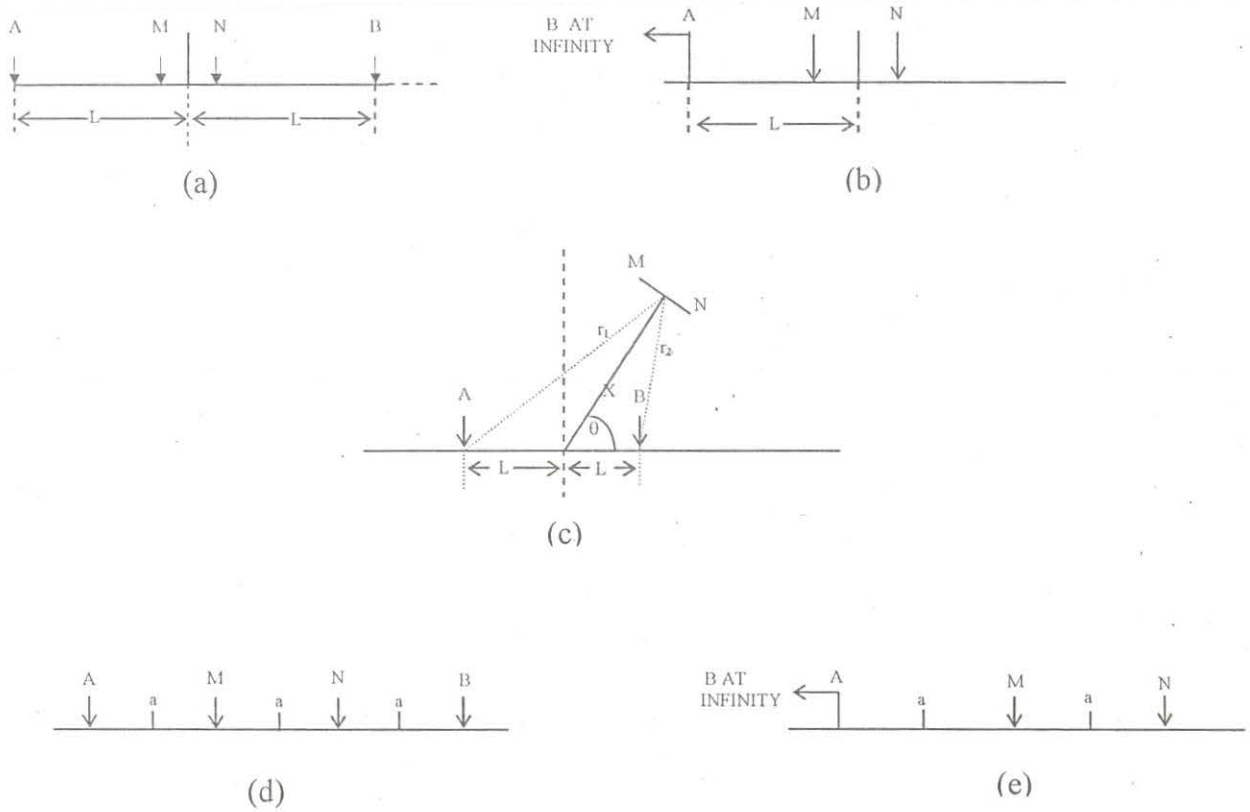


Fig 1 Principal electrode arrangements

(a) Schlumberger Configuration
(b) Three – electrode Schlumberger Configuration
(c) Azimuthal dipole Configuration
(d) Wenner Configuration
(e) Three – electrode Wenner Configuration.

$$\varsigma a = \pi/2 \left[\frac{L^2 - l^2}{l} \right] \frac{V}{I}$$

therefore, $\varsigma a = K.R$ (since, $R = \frac{V}{I}$)

Geoelectrical Sections:

The vertical distribution of resistivities within a particular volume of earth is known as geoelectrical section. The sub-surface data can often be approximately determined by a geoelectrical section. Vertical electrical sounding procedure is best for this type of section.

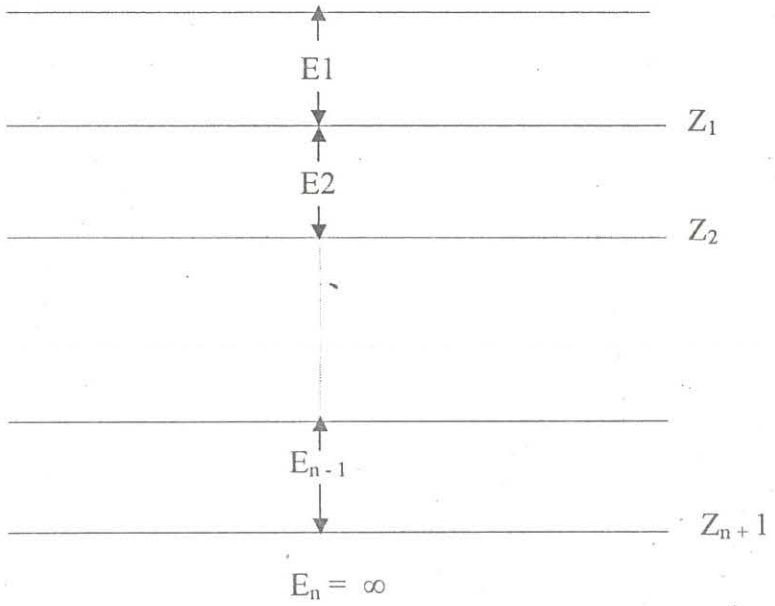


Fig.2 An n-layer geoelectrical section.

The above two figures represent two dimensional sections E1, E2 ..... En-1 are the thickness Z1 = E1, Z2 = E1+E2 .... Zn-1 = E1 + ...+ En-1 are the depth of the bottom of successive layers and are the true resistivities of the respective layers. The last nth layer is taken to have a great thickness i.e. En =∞.

Geoelectrical sections can be classified depending on the number of layers n. For two layers n = 2: three layers, n=3 : four layers, n =4 and so on. Each category is classified according to the pattern of resistivity variation with depth.

Two types of two layer sections are possible i.e., P1>P2 and P1<P2 as shown in the figure below:

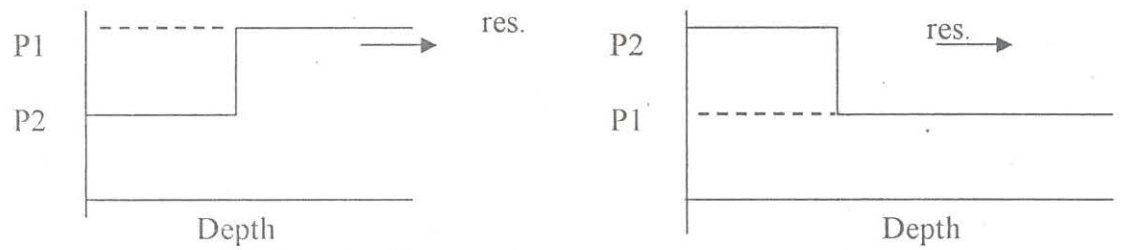


Fig 3 Two layer sections

For three layers sections there are four possibilities

(a) Type H : P1>P2>P3
(b) Type K : P1<P2>P3
(c) Type A : P1<P2<P3
(d) Type Q : P1>P2>P3

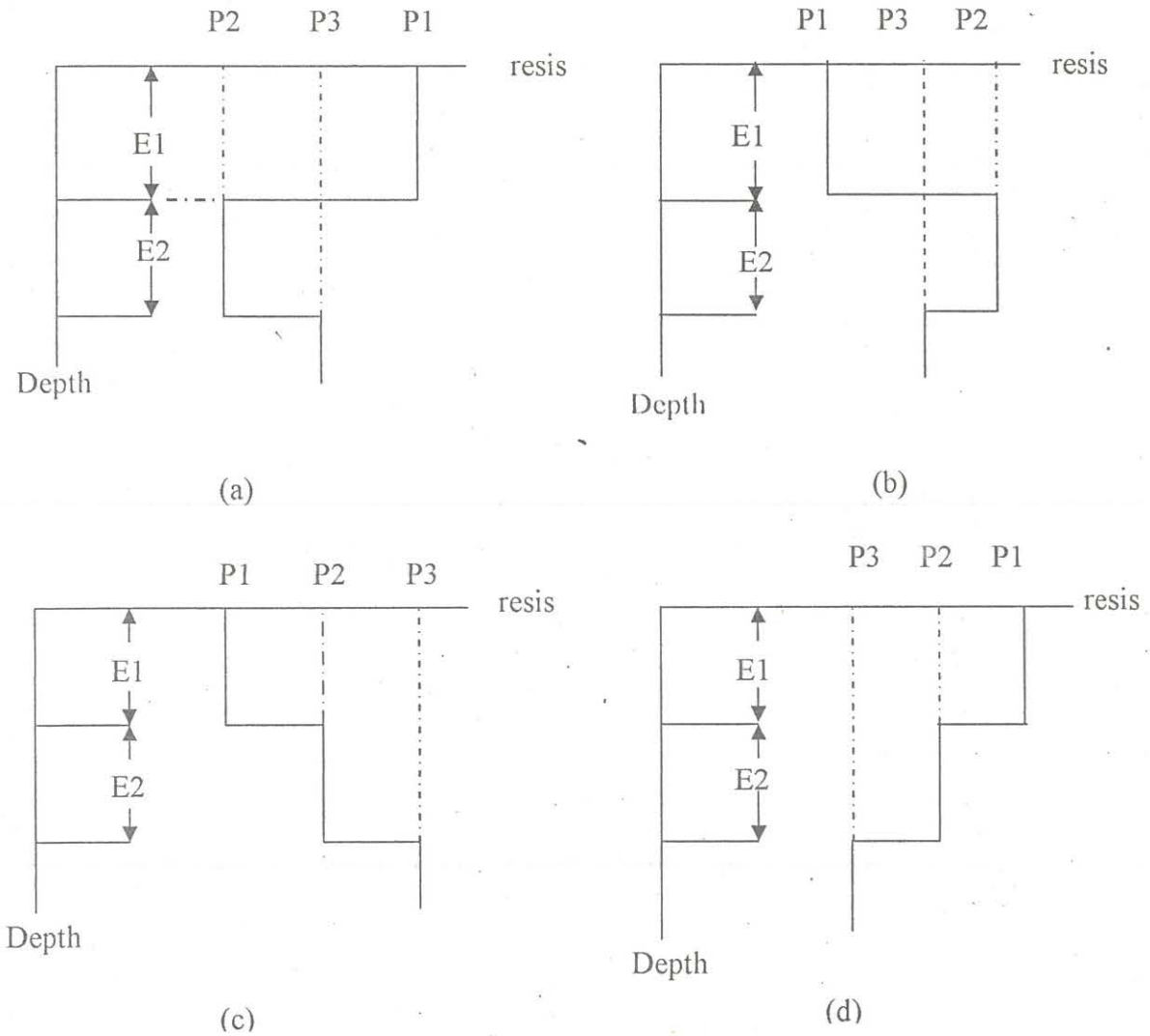


Fig. 4 Three layer sections

For four layers sections, there are eight possibilities. The section may be identified by combination of three layer designation as AA will correspond to P1<P2<P3<P4. Similarly HK will correspond to P1>P2<P3>P4. In the present studies the type sections encountered as H and K type. In Most cases, the electrode separation is 100 meters only. It cannot penetrate greater depth. In the present investigation the H and the K type could be interpretated as:

H Type
Top soil
Water saturated clay
Shale / Sand

K Type
Top soil
Water saturated clay
Clay with carbonaceous clay.

Ranges of the most common resistivities of rock formation in the area compared with normal resistivities areas given below:

Rock Formation	Imphal District (Ohm.m)	Standard (Ohm.m)
Sand with fresh water	30 – 200	50 – 500
Weathered shale	70 – 120	60- 100
Fracture fresh shale	100 - ∞	100 – 200
Clay with silt	11 – 15	2- 20
Sandstone	30 - 1000	50 - 1000

Instrument

DDR-3 Resistivity meter (Integrated Geoinstruments and Services Pvt. Ltd.) is used for collecting field data.

Interpretation

The apparent resistivities measured in a VES are plotted against the electrode distance L in graph of logarithmic coordination of the same modulus as used in the master curves. The master curves used, are potted on a modulus of 62.5 mm cycle.

Depending on the type of the field curve appropriate master curves are used. If accurate curve fitting are not possible, auxiliary point methods are used.

Results

The resistivity surveys were conducted at different places of the project area to understand the nature of sub-surface formation, thickness of aquifer etc. Type- H and type- K were commonly encountered in the present studies. Type-H section are most suitable for ground water exploration as the third layer is of weathered shale or sand. Resistivity varies for sand from 30 to 200 Ohm-metre and for shale, from 70 to ∞ Ohm-metres depending upon the degree of fracture and alteration to clay. The resistivity increases suddenly in shale with joints and fracture. Such H –type are observed at Laikot VES-2, Tellou VES-5, Nongren VES – 6, Kameng VES -7, Khabeisoi VES- 18, Achanbeigei VES -25, Luwangsangbam VES – 26, Koirengei VES-31, Potsangbam VES – 32, Uyumpok VES -39, and Leitangpokpi VES -42, Pukhoa VES- 43etc. In the area, large quantity of water is exploited from shale at the foothill zones which are highly weathered
jointed and fractured. Water exploited from weathered rock aquifer (shale) is relatively poor in quality compared to the alluvial aquifer (sand).

Survey at Heingang VES-24 and lithologs taken in drilling are correlated with the lithologs given in the reports of PHED and CGWB. It is found that a clay bed of 50m

Installed Hand Pump at Heingang Mayai Leikai, Imphal East –I, Block, Manipur

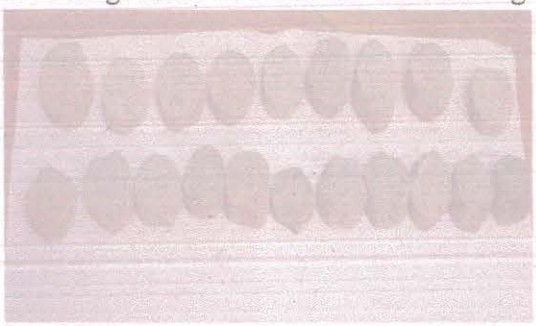
depth from the land surface, within this clay bed, a layer of sand lenses (3 to 4m) thick constitutes the alluvial aquifer. A sand horizon of 4m in thickness occurs at the depth of 25.75m to 28.78m and other at 42.42m to 45.45m from Heingang Mayai Leikai. Impervious clay layers constitute the aquifer extent. A Hand Pump has been installed in the area at the depth of 48.48m with yield of 86 l/m. The static water level is 4.5m from ground level. Ground water is good.

Survey at Pukhoa VES-43. Lithologs from drilling are correlated with lithologs data from PHED, Imphal, it is found that a clay bed of 30.30m depth has been encountered

Installed Hand Pump at Pukhoa Terapur, Imphal East

from land surface, within this clay bed, sand bed (3 to 4m) thick constitute the flood plain aquifer. A sand horizon of 4 m in thickness (fine sand) occurs at the depth of 19.6m to 23.63m and other of 3.6m in thickness (coarse sand) at the depth of 25.75m to 29.39m from Pukhoa Terapur Leikai. A Hand Pump has been installed in the area from the depth of 30.30m with yield of 98 m/l. The static water level is 10.6 m from ground level. The ground water in this area is good.

Survey at Khundrakpam VES-17 and lithologs taken from two different drilling



Hand drilling at Noarem Birahari College, Kundrakpam and Lithologs taken from drilling

sites and lithologs data from P.H.E.D. have been carefully observed. It is found that thick formation of clay have been encountered upto the depth of 70 m from the land surfaces, within this clay bed, carbonaceous matter (gas pocket) have been encountered at the depth of 34m and other at the depth of 61m from ground level. Silty clay, carbonaceous clay and very fine dry sand have also been encountered. These area are not suitable for ground water exploration as the underlying shale are not encountered yet upto even upto 167m from ground level. Ground water in this area is relatively poor.

The location map of the geophysical work and resistivity data collected during investigation are as given below:

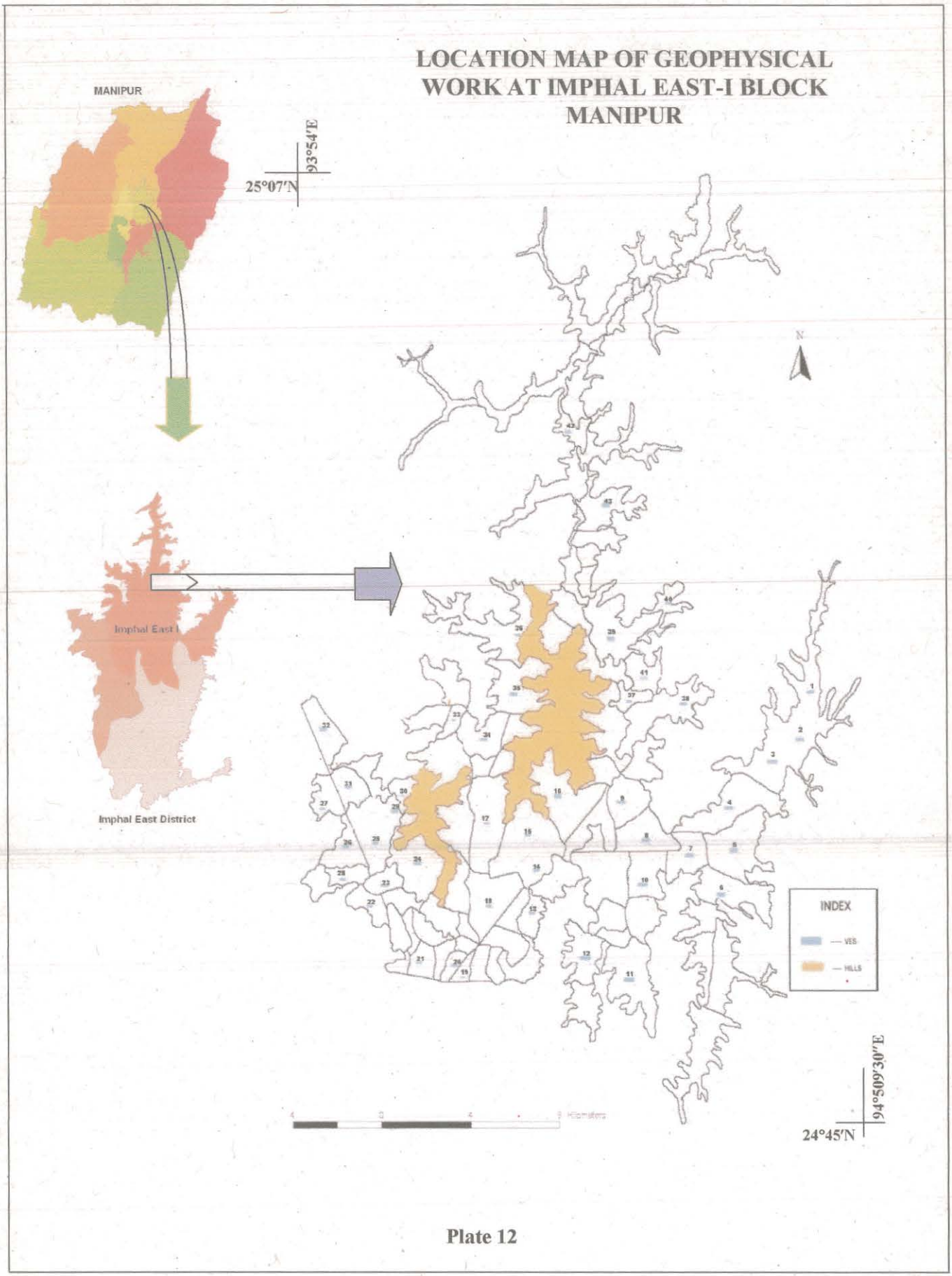

LOCATION MAP OF GEOPHYSICAL WORK AT IMPHAL EAST-I BLOCK MANIPUR
MANIPUR
93°54'E
25°07'N
Imphal East I
Imphal East District
N
INDEX
VES
HILLS
94°59'30"E
24°45'N

Plate 12

SL.NO./VES NO.	NAME OF THE VILLAGE
1.	SANASABI
2.	LAIKOT
3.	SHABUNGKHOK
4.	SHEIJANG
5.	TELLOU
6.	NONGREN
7.	KAMENG
8.	PUNDONGBAM
9.	SEKTA
10.	LAMLAI
11.	TAKHEL
12.	SANGSABI
13.	SAWOMBUNG
14.	CHINGKHU
15.	WAITON
16.	POARABI
17.	KHUNDRAKPAM
18.	KHABEISOI
19.	KHURAI ANGOM LEIKAI
20.	KHURAI THANGJAM LEIKAI
21.	LAIPHAM SIPHAI
22.	LAMLONGEI
23.	KHABAM LAMKHAI
24.	HEINGANG
25.	ACHANBEGEI
26.	LUWANG SANGBAM
27.	NILAKUTHI
28.	MATAI
29.	MAIBAKHUL
30.	MONGJAM
31.	KOIRENGEI
32.	POTSANGBAM KHUNOU
33.	MAIBUNG
34.	TANGKHAM
35.	YUMNAM KHUNOU.
36.	SANSENBAM
37.	TARET KHUL
38.	KEIBI
39.	UYUMPOK
40.	KONGBAL TANGKHUL
41.	LAMBOIKHUL
42.	LEITANPOKPI
43.	PUKHOA

Photograph showing Geophysical Investigation in the project area

Resistivity Survey Data (VES):

	SANASABI	LAIKOT	SHABUNGKHOK	SHEIJANG	TELLOU	NONGREN	KAMENG
AB/2	Resistivity	Resistivity	Resistivity	Resistivity	Resistivity	Resistivity	Resistivity
1.5	128	29.5	27	27.9	34	20	19
2	79	28	26.4	25.6	31	19.8	18.5
3	41	24.5	28	24.9	29.5	18	18
4	30.1	23	28.3	23.8	27	17.8	17.5
5	24.5	19	27.8	22.1	23	18	17
6	22.2	18	27.1	20.7	21.5	17.8	16.5
8	19.4	16.8	24.8	18.6	18	18	15
10	17.7	16.3	22.7	17.2	16.4	19.3	14
12	17	16.3	20.8	16.5	16	19.7	13.8
10	17	15.8	22.6	16.6	16.5	19.2	13.5
12	16.2	15.8	20.6	15.8	16.1	19.6	13.3
15	16.2	15.8	18.7	15.3	15	20	13.5
20	16.1	16	16.2	14.8	14.9	20	13.5
25	16.4	15.9	14.7	14.6	15	19.9	13.6
30	16.9	15.9	13.9	14.4	15.2	19	13.8
40	17.9	16	13.3	13.6	15	17.9	14
50	18.6	16	13.1	13.8	16.2	17.6	14.1
60	19.3	16	13.3	13.8	17.1	17.5	14.1
50	18.2	16	13.4	13.5	16.1	17.7	14
60	18.8	16.1	13.6	13.5	17	17.6	14
80	19.9	17	14.5	14.3	18	17.7	14
100	20.9	18	15.2	15.2	19.5	18.8	15
120	21.3	19	16	16.3	21	19	16
150	22.1	20	17.6	18.1	25	20.5	17

	PUNGDOM BAM	SEKTA	LAMLAI	TAKHEL	SANGSABI	SAWOMBUNG	CHINGKHU	WAITON
AB/2	Resistivity	Resistivity	Resistivity	Resistivity	Resistivity	Resistivity	Resistivity	Resistivity
1.5	27.5	29.5	28.4	24	41	28	36	19
2	23	28.8	27	25	41.5	26	30	18
3	19	28.2	23	24.5	39	28	29	20
4	18	27.8	21	23.6	35	28	26	21
5	17	26	18	22	29	28.5	23	20
6	16.5	25	17	21	26	28	22	20
8	16	24	15	19	22.5	26.5	19	19.5
10	15	22	14.1	18	19.5	25	18	18.5
12	14.8	20	13.8	17	19.5	24	17.5	18
10	--	21	13.9	17.8	19	--	17.3	18
12	--	19.5	13.7	17	19	23	17.2	17.5
15	14.5	17.5	13	16	18.7	21	17	16
20	14	17	12.7	15	17.5	18	16	15.5
25	14.1	17	12.1	14.8	17.5	17	16	15
30	14.3	17	12	14.8	17.5	16.5	16.5	14.5
40	14.4	17.8	12	14.8	17.5	16	16.4	15
50	14.5	17.8	12	14.8	17.5	16	16	16
60	15	18	12.2	14.8	18	16.2	16	16.5
50	14	17.7	13	14.9	--	15.8	15.5	15.5
60	14.5	17.9	13.1	14.9	--	16	15.5	16
80	14	17.8	13.2	15	18.6	17	16.5	15.5
100	15	18	13.2	16	21	18	17	16.5
120	15.5	18.2	13.2	16.8	23	19	17.5	17
150	17	19	14	17.8	27.5	22	--	18

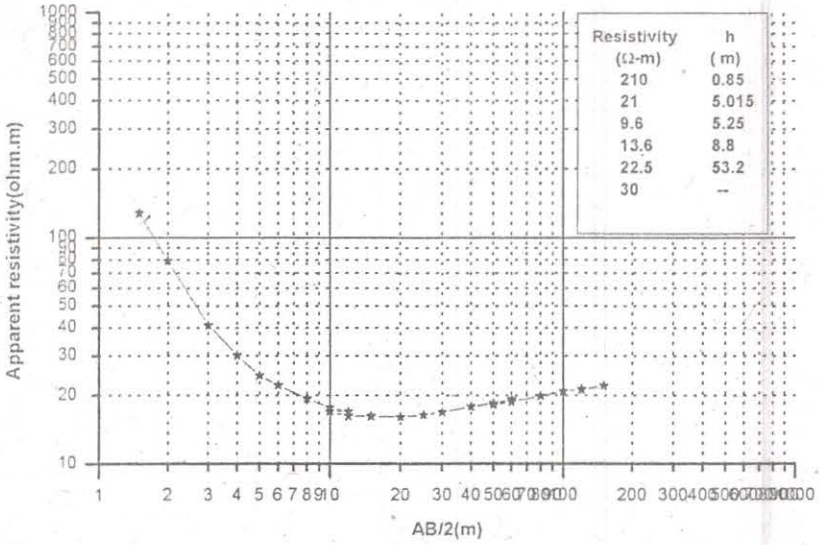
AB/2	POARABI Resistivity	KHUNDRAKPAM Resistivity	KHABEISOI Resistivity	KHURAI ANGOM LEIKAI Resistivity	KHURAI THANGJAM LEIKAI Resistivity	LAIPHAM SIPHAI Resistivity	LAMLONGEI Resistivity
1.5	21	18	21	31	28.5	33	36
2	20	15.5	20	29	27.5	32	37.2
3	20	14.5	20	27	27	32	35
4	19.5	14.5	19	26	25	31	32
5	19	15	19	25	23	32	32.5
6	19	15	19	24	20.5	30	29.5
8	19	15.5	19	23.5	19	28.5	28
10	19	16	19	23	18	27	25.5
12	19	16	19	23	17.5	25	23.5
10	18.5	15	18	22	17	--	-
12	18.5	15.5	18	22	16.8	--	-
15	17.5	16	18	22	16.6	23	21
20	17	16	18.5	20.5	16.5	20	19
25	16.5	16	19.5	20	16.3	19.5	17.5
30	15	16	19	19	16	19.5	17
40	14.5	16	20	18.5	16.5	19.5	17.6
50	14	17	18.5	18	16.5	20	19.1
60	14	17.5	18.5	17.5	17	20	19.5
50	13.5	--	--	18	16.3	--	18.2
60	13.5	--	--	17	16.6	--	19
80	13.5	18	18.5	16.5	17.5	20	20
100	14	18.5	18.5	16	19	20	21
120	14.5	19	18.5	16	21	20	22
150	15.5	18	21	16	23.5	--	24

AB/2	KHABAM LAMKHAI Resistivity	HEINGANG Resistivity	ACHANBIGEI Resistivity	LUWANG SANGBAM Resistivity	NILAKUTHI Resistivity	MATAI Resistivity	MAIBAKHUL Resistivity
1.5	36	70	38.5	35	30.5	29	40
2	35	80	36	33	29.5	27.5	38
3	27	86.9	32	31	30	24.5	39
4	26.5	87.1	30	31	29	21.5	40
5	25	82	30	32	29	20	40
6	24.5	77	30	31.5	28.5	19	39
8	23.5	69	28	32.5	28.5	18	40
10	22.5	60.1	27.5	33	28	18	40
12	21	54	27	34	27.5	17.5	43
10	23	58.9	27	30	27	17.5	40
12	22	54	26.5	30	26	17	42
15	19.5	44	25	32	25	16	42
20	18.5	24	23.5	33	23.5	15.5	39
25	18	28	24	34	22	14.5	37
30	18	26	24.5	35.5	22	14	36
40	18.5	24	26.5	35	23.5	14	35
50	19	23	28	34.5	25	14	36
60	19.5	24	28.5	34.5	26	14.5	39
50	18.5	22.85	26.5	--	24	--	35
60	19	23.9	27.5	--	25	--	38
80	20	24	31	35	26	15	40
100	21	25	32	38	27	16	42
120	21.5	--	32.5	41	28	18	42
150	22	--	--	48	30.5	--	40

AB/2	MONGJAM Resistivity	KORENGEI Resistivity	POTSANGBAM KHUNOU Resistivity	MAIBUNG Resistivity	TANGKHAM Resistivity	YUMNAM KHUNOU Resistivity	SANSENBAM Resistivity
1.5	37.5	51	46	24	26.5	31	45
2	37.5	49	51	23.5	28	29	39.5
3	36	50	55	26.5	29	29	34
4	34	51.5	58	26.5	30	28	31
5	33	54	58	26	30	27.5	28.5
6	32	56	59.5	25	29	27.5	28
8	30	60	60.5	23	28	26.5	26
10	30	61	65	22	26.5	25	25
12	28	65	70	21	24	24	24.5
10	32	60	63.5	21.5	23.5	24	24.5
12	30	64	64	20	22	23	22
15	28	68	70	19	20	21	21
20	24	69	78.5	18.5	18.5	19.5	19.5
25	23	69	81.5	18	17.5	18.5	19
30	20	65	85	17.5	17	17.5	18
40	19	59.5	90	17.5	16	17	18
50	19	53	90	17	15.5	17	17.5
60	19	53	92	17	15.5	17	17.5
50	19.5	52	89	16.5	15	17	17
60	19	52	90	16.5	15	16.5	17
80	20	54	97	17	15	17	17.5
100	22	58.5	98	17.5	16	18	18.5
120	23.5	60	95	18	17	18.5	20
150	27	51	46	20.5	26.5	31	22

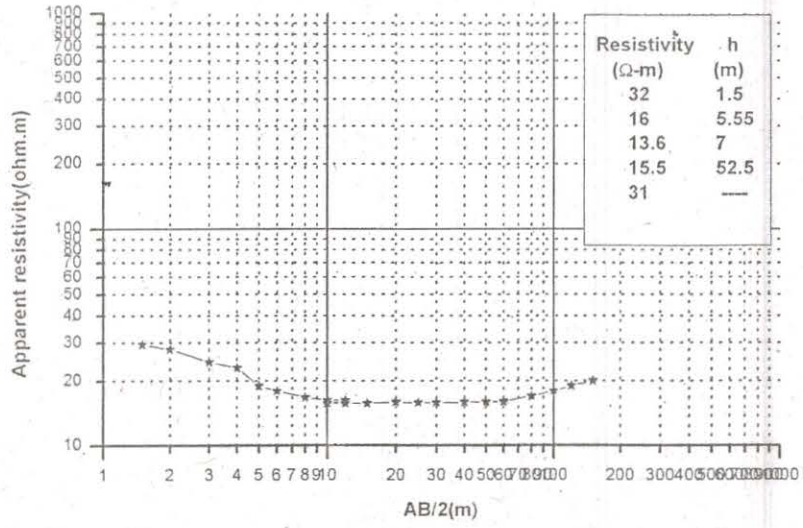
AB/2	TARET KHUL Resistivity	KEIBI Resistivity	UYUMPOK Resistivity	KONGBAL TANKHUL Resistivity	LAMBOI KHUL Resistivity	LEITANG POKPI Resistivity	PUKHAO Resistivity
1.5	28	29.9	23	27	32	47	29.5
2	24	29	18.8	17.5	30	40.5	29
3	19	25	17.8	15	26.5	39	28
4	17	22	16.8	15	23	35	26.5
5	16	19.5	16.7	15.5	20	32.5	25.5
6	14	17.8	16.8	16	18	31.5	25
8	13	15	16.8	16.5	17.5	30	24.5
10	12.5	14	16.9	17	17.5	30.5	23.5
12	11	14.1	16.9	17	18	31	23
10	11	14.1	17.8	16.5	17	29.5	22.5
12	12	14.1	17.9	16.5	17.5	29.5	22
15	12.5	14	18.6	16.5	18	30	21.5
20	13.5	14.8	20	17	20.5	31.5	20
25	14.5	15	21	17.5	23.5	34	19
30	15.5	16.8	22	18.5	25	37	18.5
40	17.5	17.8	24	21	27.5	39	19
50	19	19	25.6	22.5	28.5	41	19.5
60	21	20	26	23	30	41.5	22
50	18.5	--	--	22.5	--		19.5
60	20.5	--	--	23	--	40	20
80	24	21	29	26.5	31.5	42	24
100	27.5	22	30	28	34	43	25
120	30	24	31.6	30	36	44	27.5
150	35	24	34.5	34.5	38.5	46	29

VES1-SANASABI



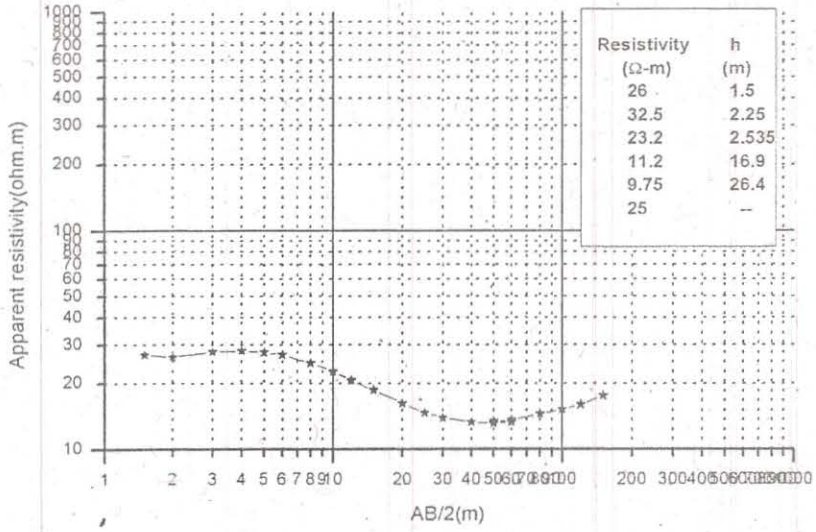
Resistivity (Ω-m)	h (m)
210	0.85
21	5.015
9.6	5.25
13.6	8.8
22.5	53.2
30	--

VES2-LAIKOT



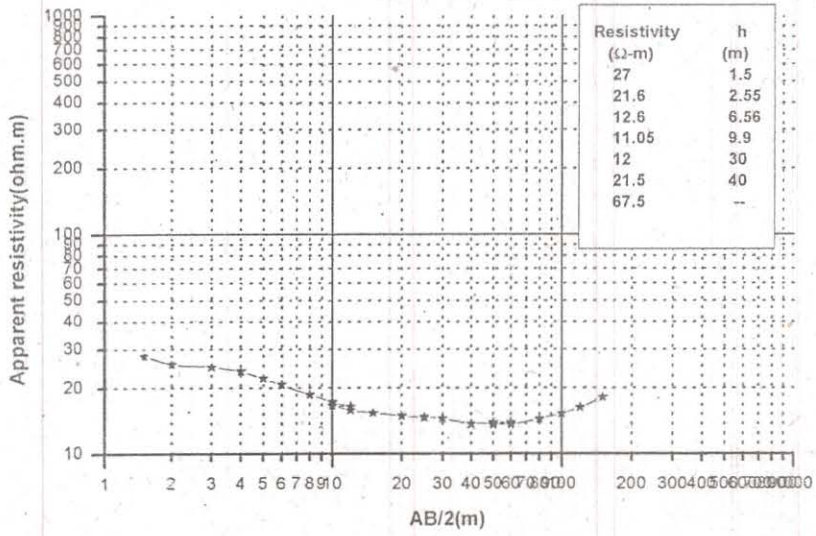
Resistivity (Ω-m)	h (m)
32	1.5
16	5.55
13.6	7
15.5	52.5
31	----

VES3-SHABUNGKHOK

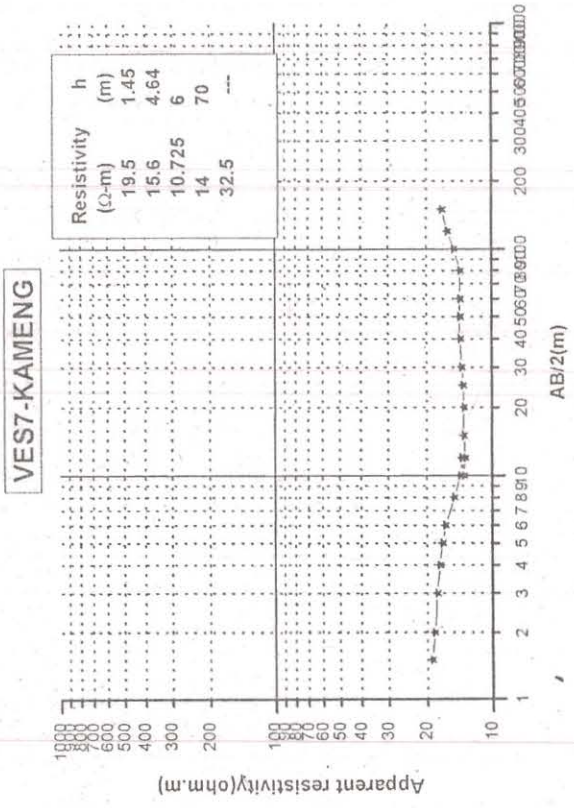


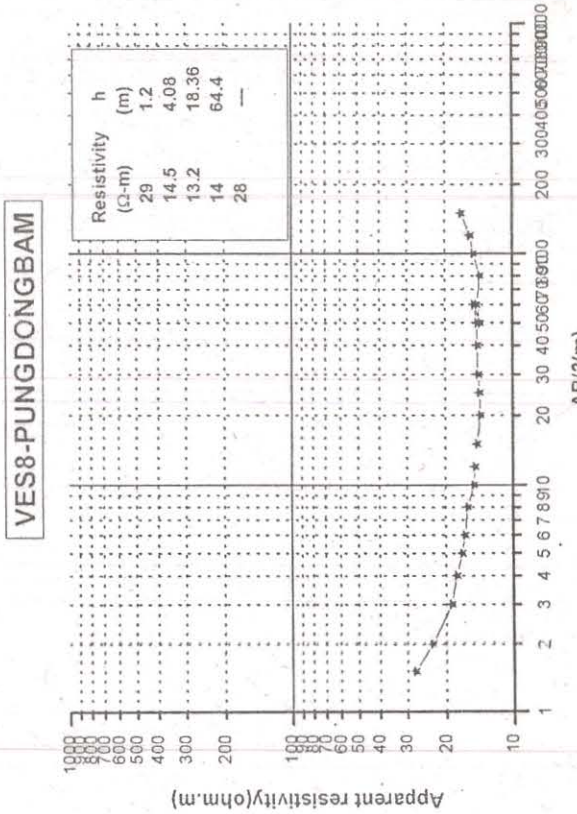
Resistivity (Ω-m)	h (m)
26	1.5
32.5	2.25
23.2	2.535
11.2	16.9
9.75	26.4
25	--

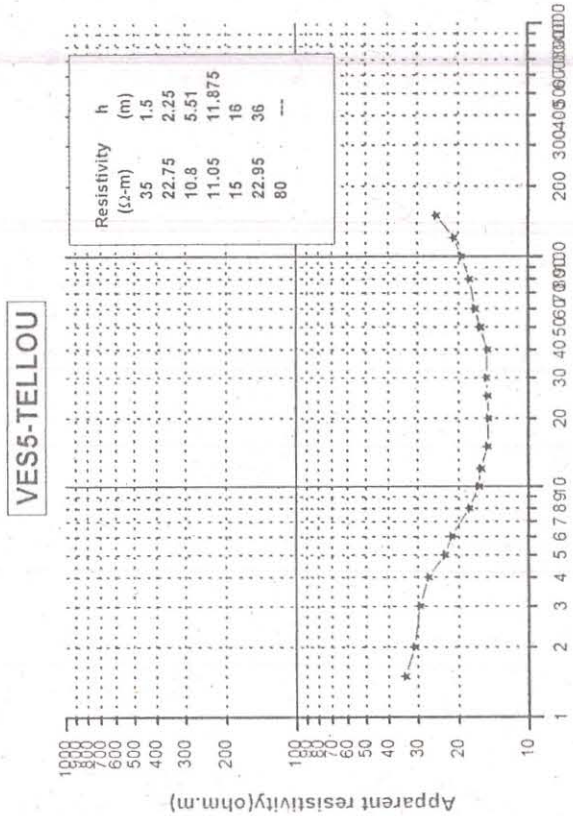
VES4-SHEIJANG

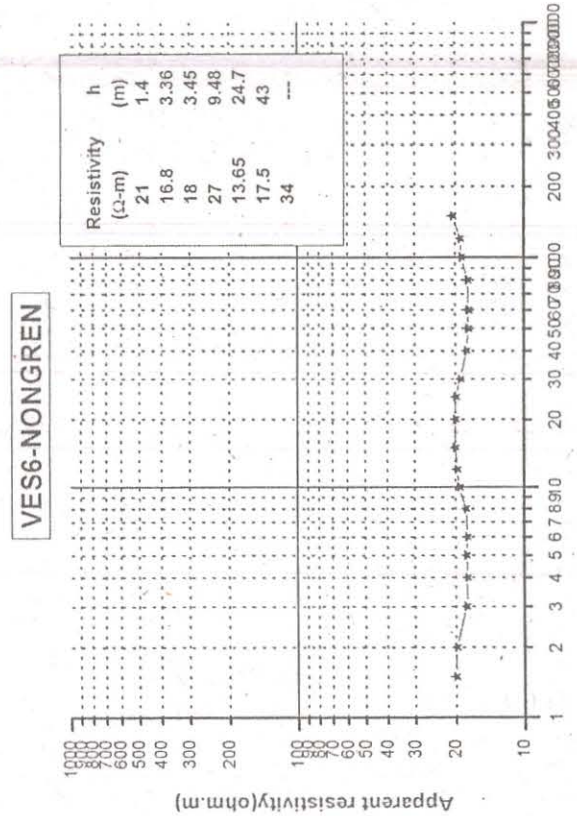


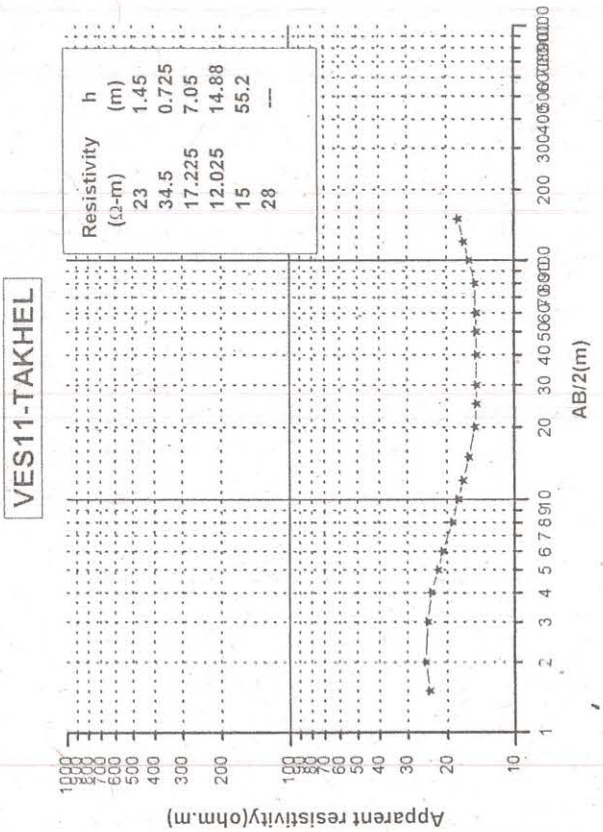
Resistivity (Ω-m)	h (m)
27	1.5
21.6	2.55
12.6	6.56
11.05	9.9
12	30
21.5	40
67.5	--

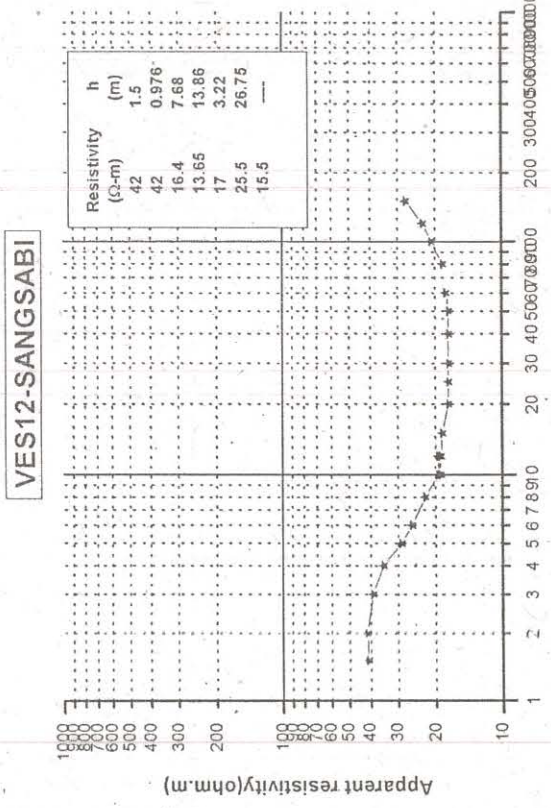

VES7-KAMENG
Resistivity (Ω-m) h (m)
19.5 1.45
15.6 4.64
10.725 6
14 70
32.5 ---
Apparent resistivity(ohm.m)
AB/2(m)

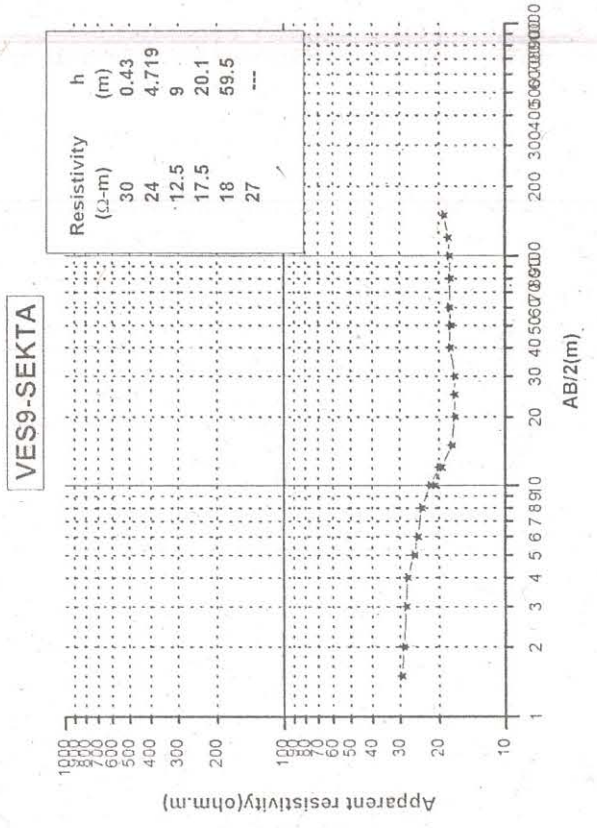

VES8-PUNGDONGBAM
Resistivity (Ω-m) h (m)
29 1.2
14.5 4.08
13.2 18.36
14 64.4
28 ---
Apparent resistivity(ohm.m)
AB/2(m)

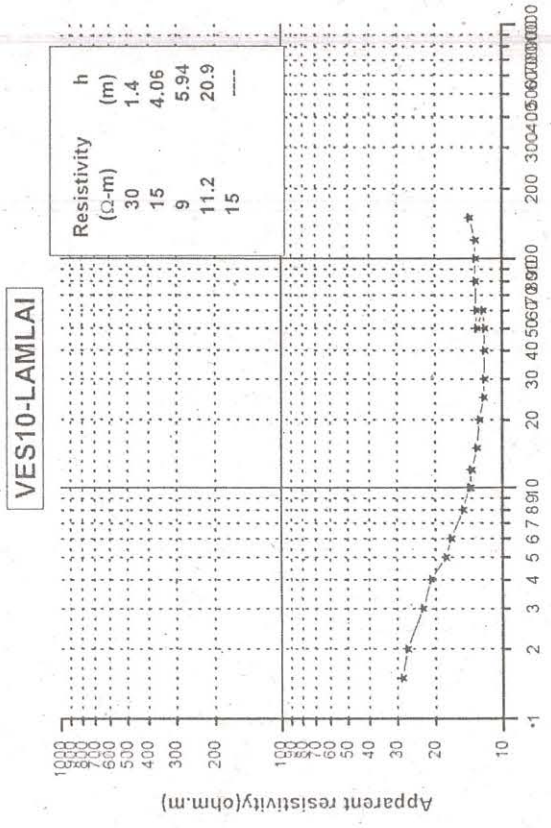

VES5-TELLOU
Resistivity (Ω-m) h (m)
35 1.5
22.75 2.25
10.8 5.51
11.05 11.875
15 16
22.95 36
80 ---
Apparent resistivity(ohm.m)
AB/2(m)


VES6-NONGREN
Resistivity (Ω-m) h (m)
21 1.4
16.8 3.36
18 3.45
27 9.48
13.65 24.7
17.5 43
34 ---
Apparent resistivity(ohm.m)
AB/2(m)

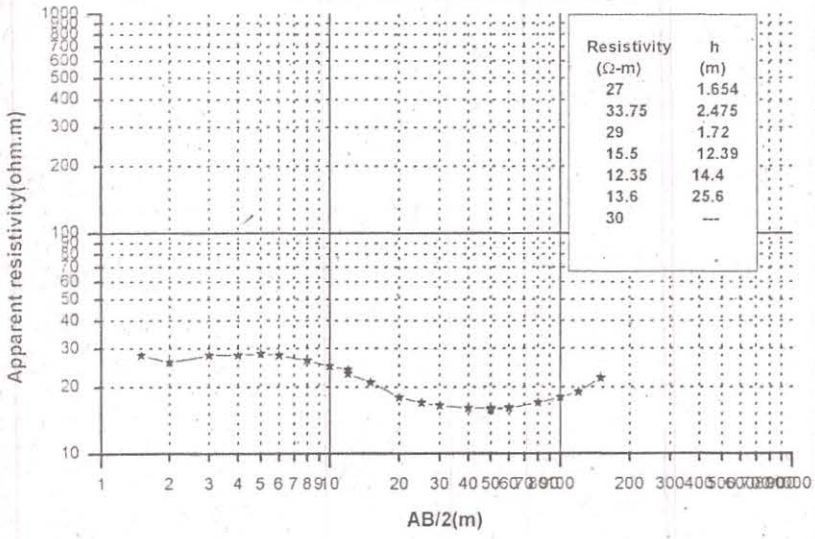

VES11-TAKHEL
Resistivity (Ω-m) h (m)
23 1.45
34.5 0.725
17.225 7.05
12.025 14.88
15 55.2
28 —
Apparent resistivity(ohm.m)
AB/2(m)


VES12-SANGSABI
Resistivity (Ω-m) h (m)
42 1.5
42 0.976
16.4 7.68
13.65 13.86
17 3.22
25.5 26.75
15.5 —
Apparent resistivity(ohm.m)
AB/2(m)


VES9-SEKTA
Resistivity (Ω-m) h (m)
30 0.43
24 4.719
12.5 9
17.5 20.1
18 59.5
27 —
Apparent resistivity(ohm.m)
AB/2(m)

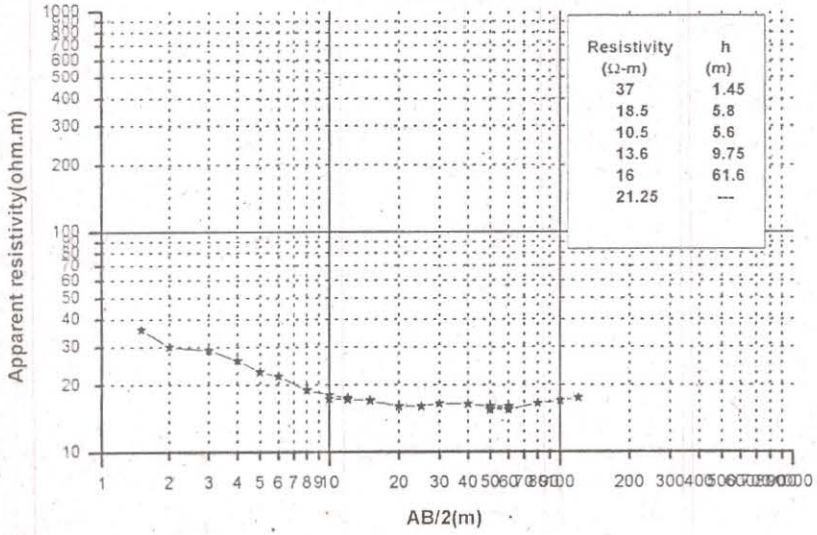

VES10-LAMLAI
Resistivity (Ω-m) h (m)
30 1.4
15 4.06
9 5.94
11.2 20.9
15 —
Apparent resistivity(ohm.m)
AB/2(m)

VES13-SAWOMBUNG



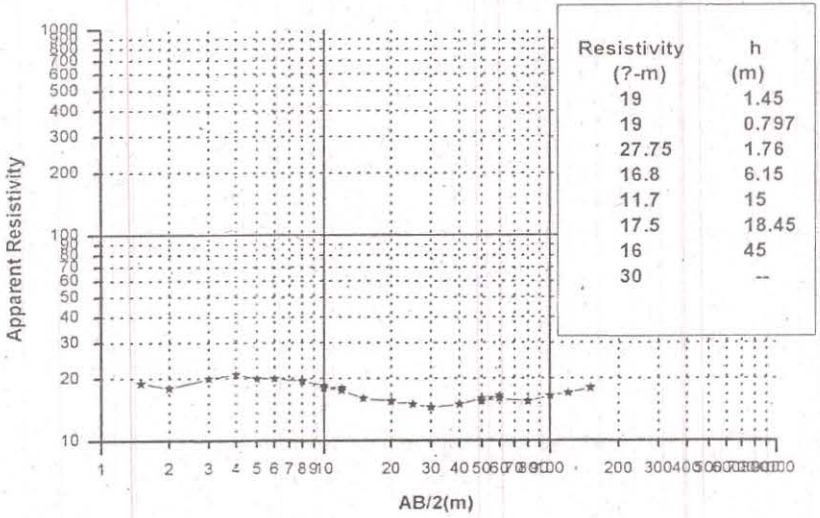
Resistivity (Ω-m)	h (m)
27	1.654
33.75	2.475
29	1.72
15.5	12.39
12.35	14.4
13.6	25.6
30	---

VES14-CHINGKHU



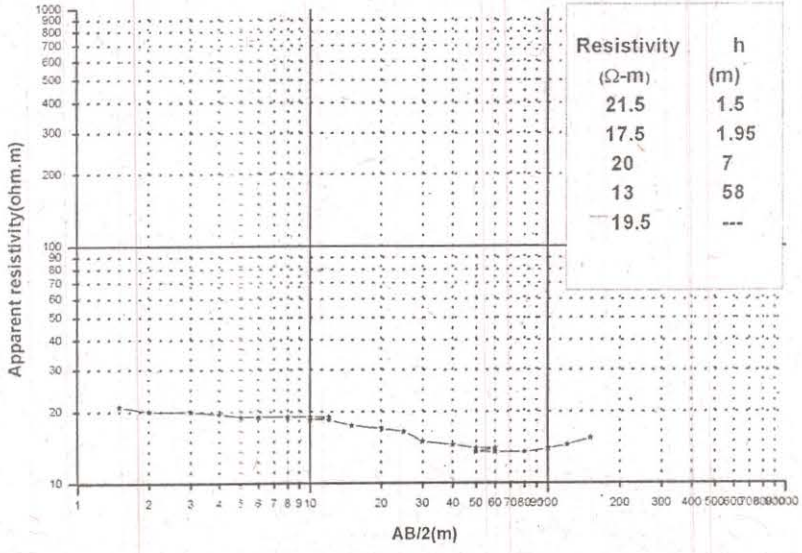
Resistivity (Ω-m)	h (m)
37	1.45
18.5	5.8
10.5	5.6
13.6	9.75
16	61.6
21.25	---

VES15-WAITON



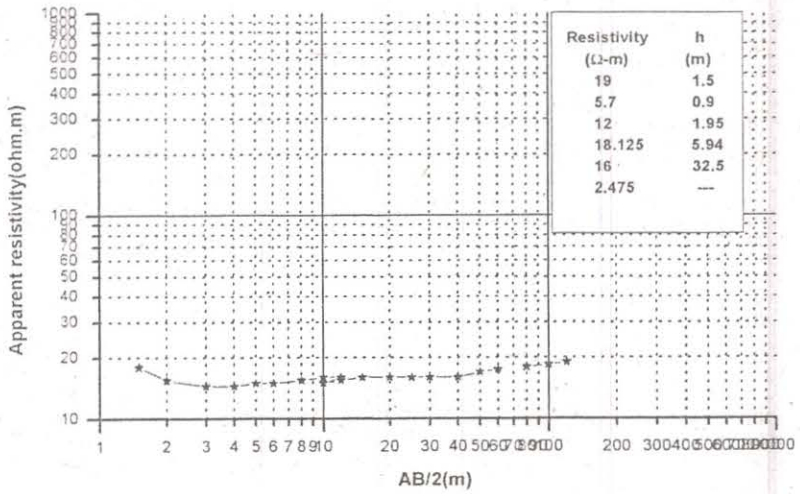
Resistivity (?-m)	h (m)
19	1.45
19	0.797
27.75	1.76
16.8	6.15
11.7	15
17.5	18.45
16	45
30	--

VES16 PAORABI

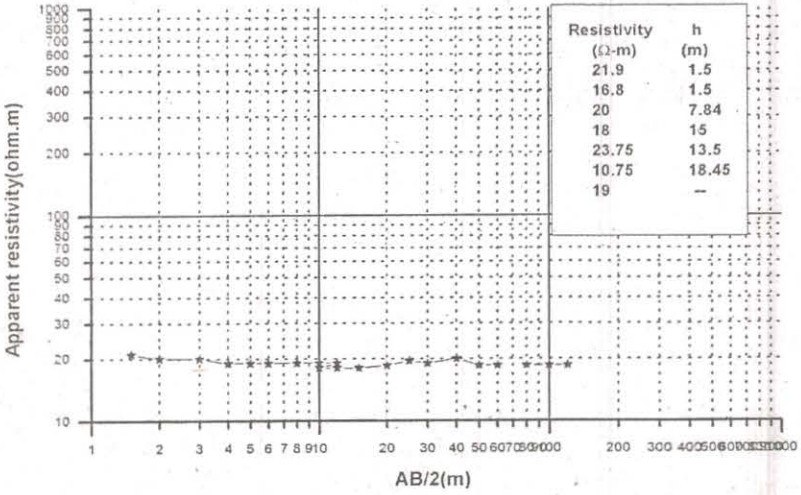


Resistivity (Ω-m)	h (m)
21.5	1.5
17.5	1.95
20	7
13	58
19.5	---

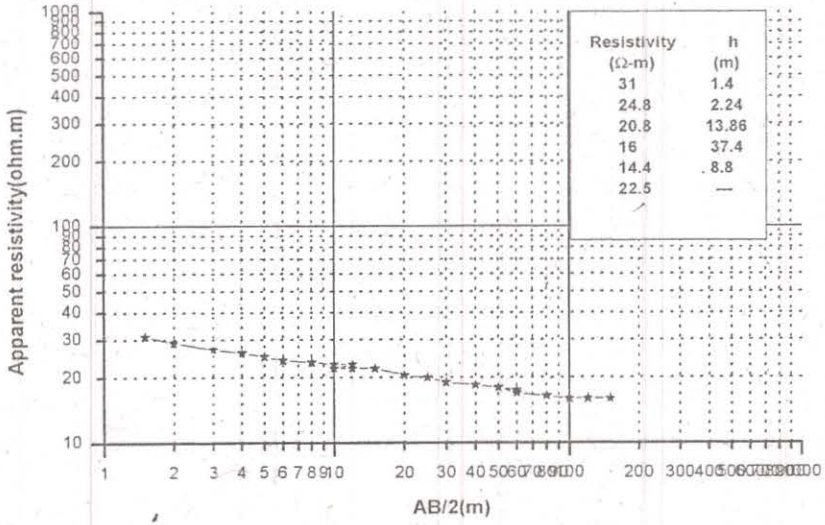
VES17-KHUNDRAKPHAM



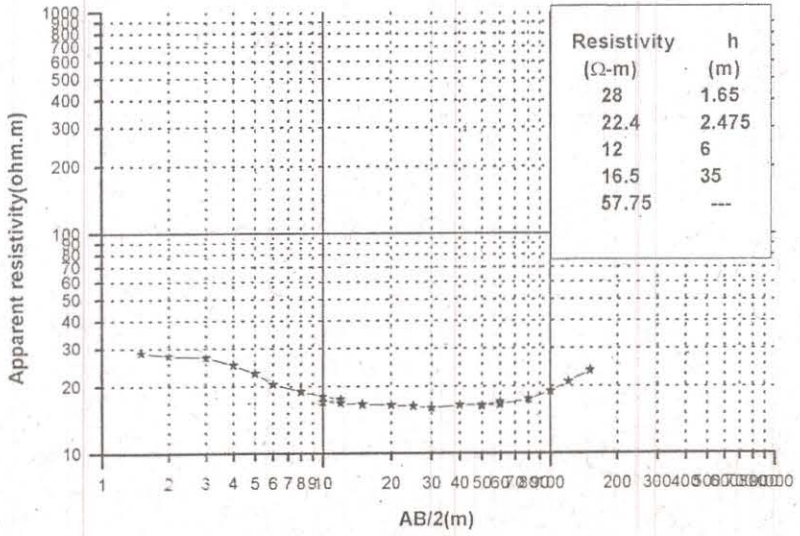
VES18-KHABEISOI



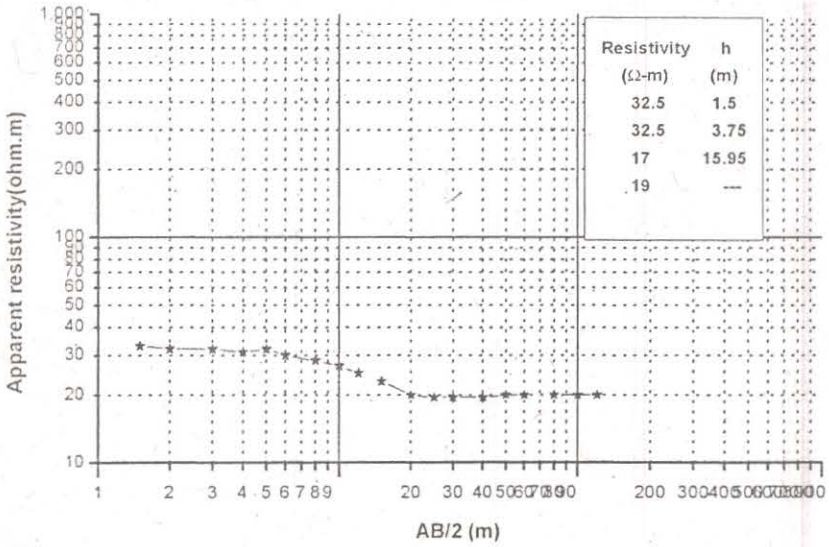
VES19-KHURAI ANGOM LEIKAI



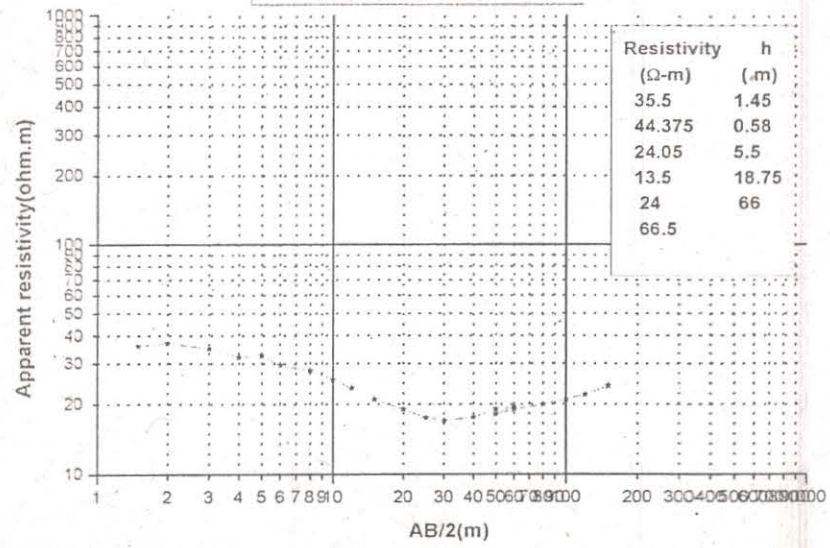
VES20-KHURAI THANGJAM LEIKAI



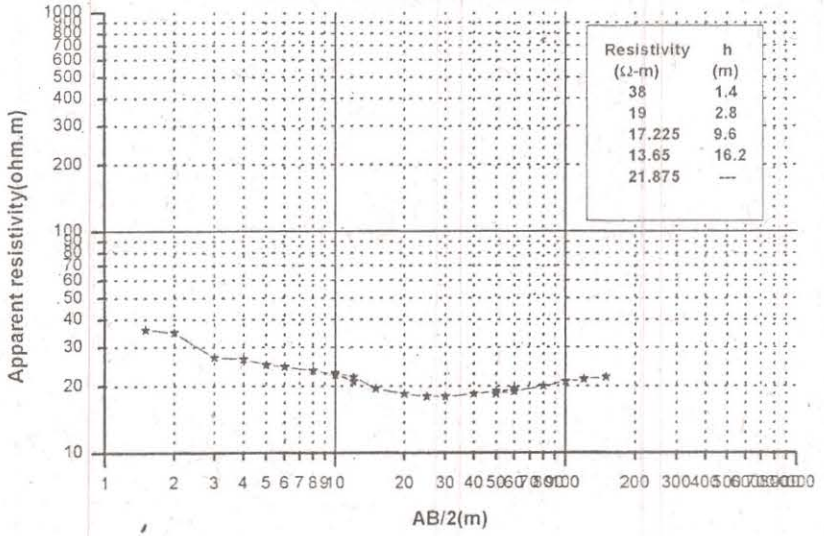
VES21-LAIPHAM SIPHAI



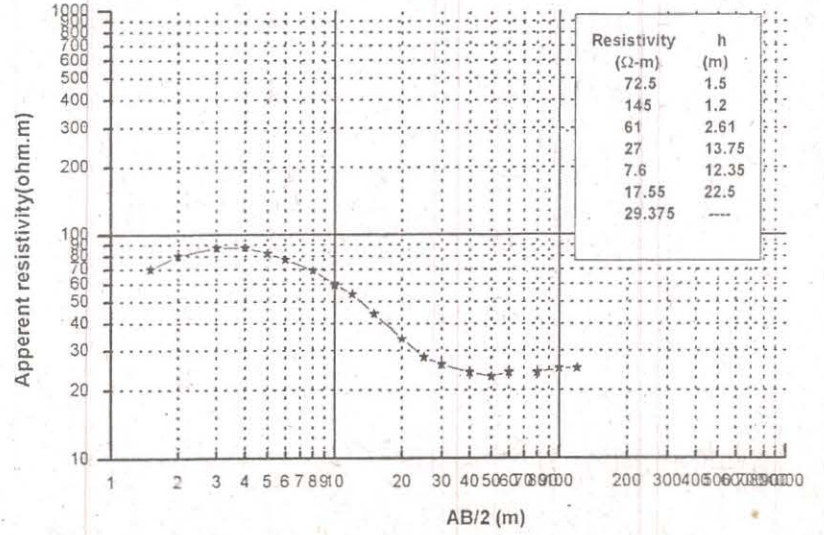
VES22 LAMLONGEI



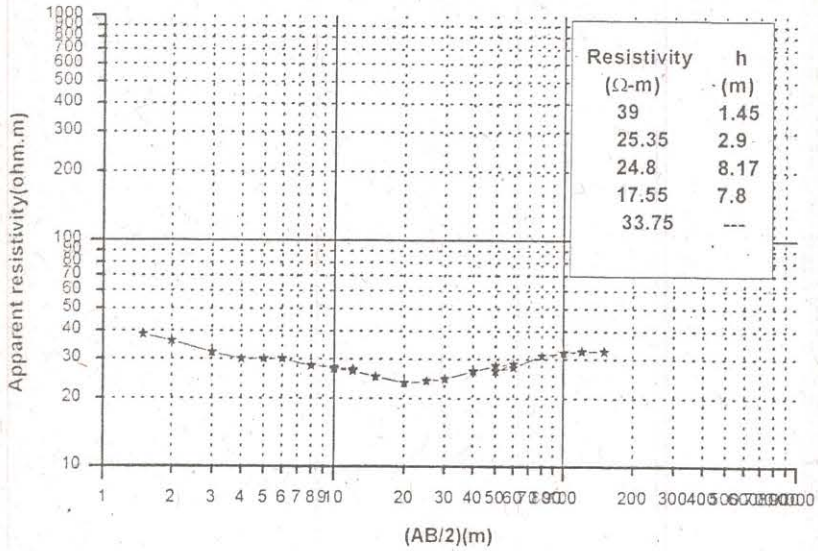
VES23-KHABAM LAMKAI



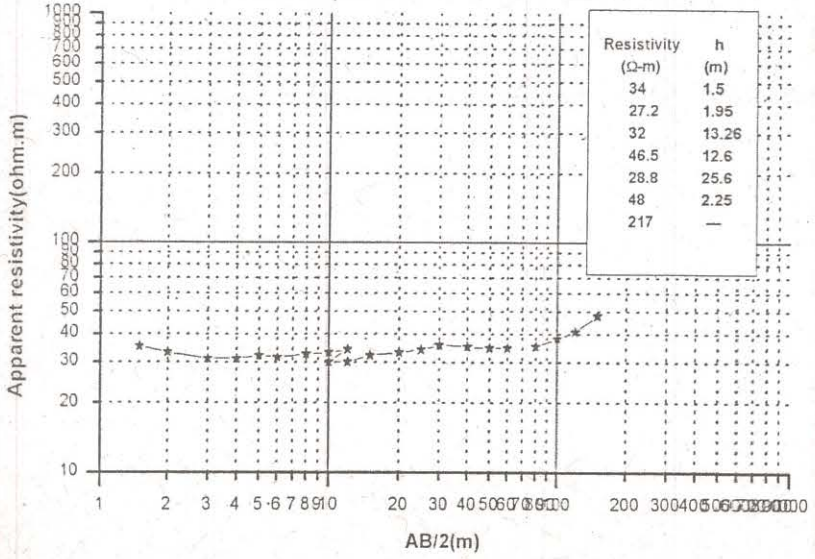
VES24-HEINGANG



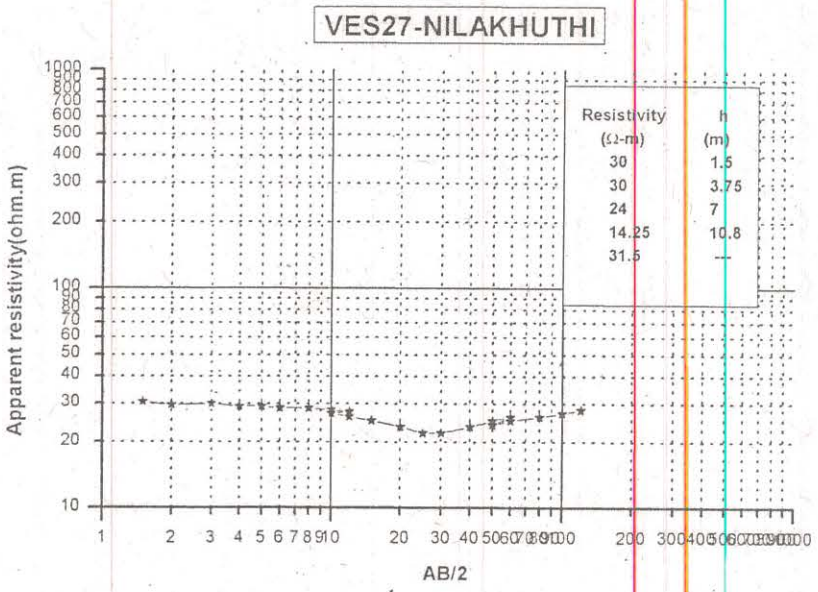
VES25-ACHANBIGEI



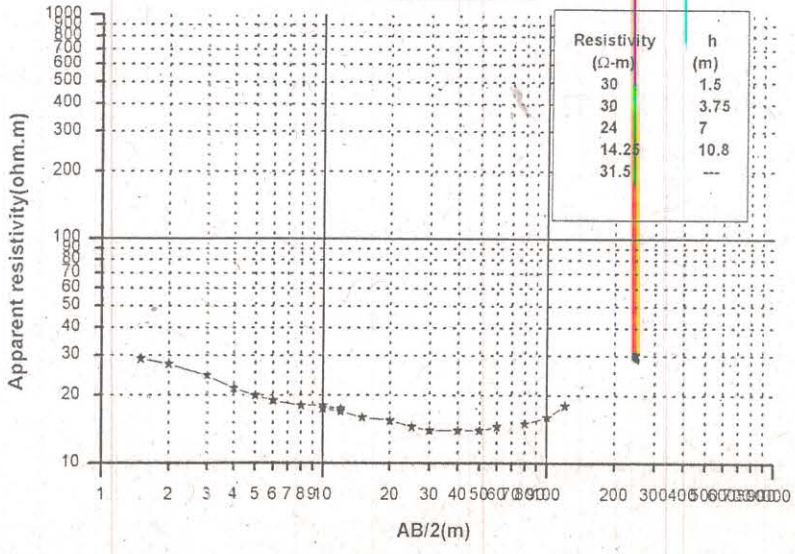
VES26-LUWANG SANGBAM



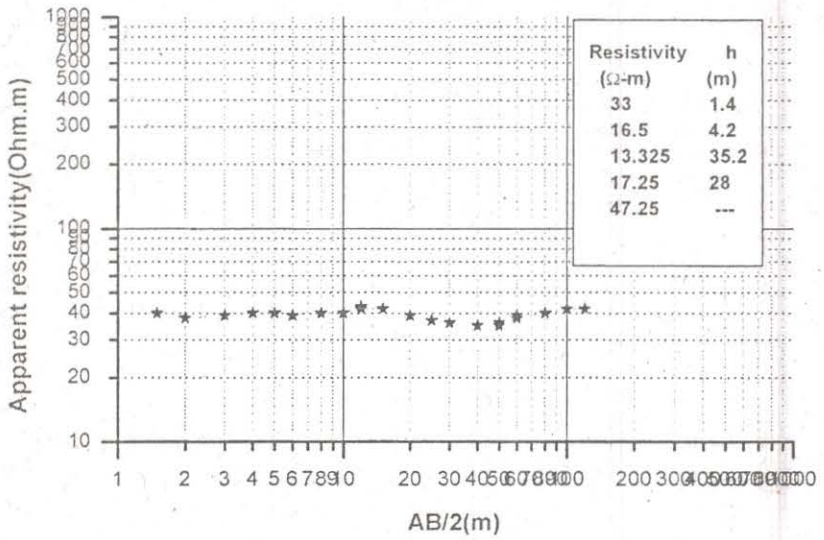
VES27-NILAKHUTHI



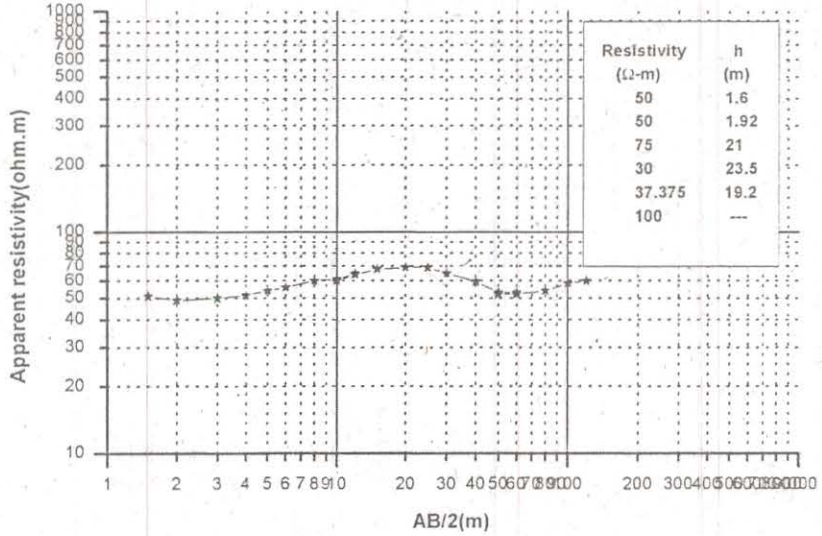
VES28-MATAI



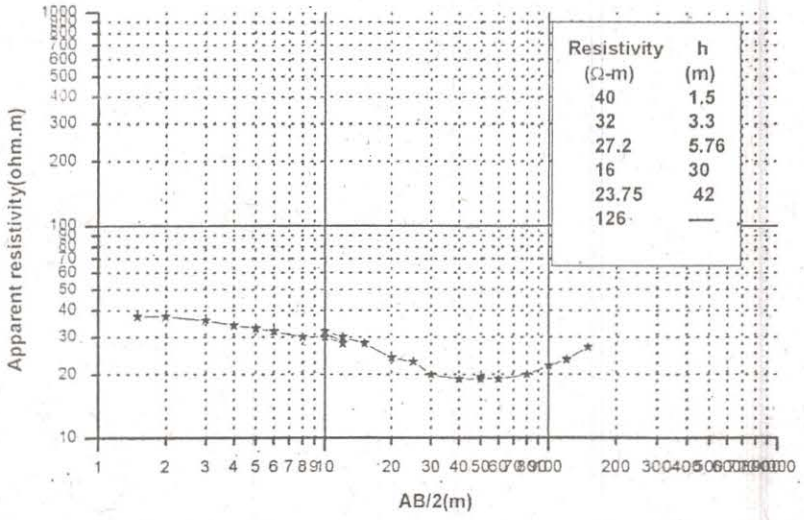
VES 29-MAIBAKHUL



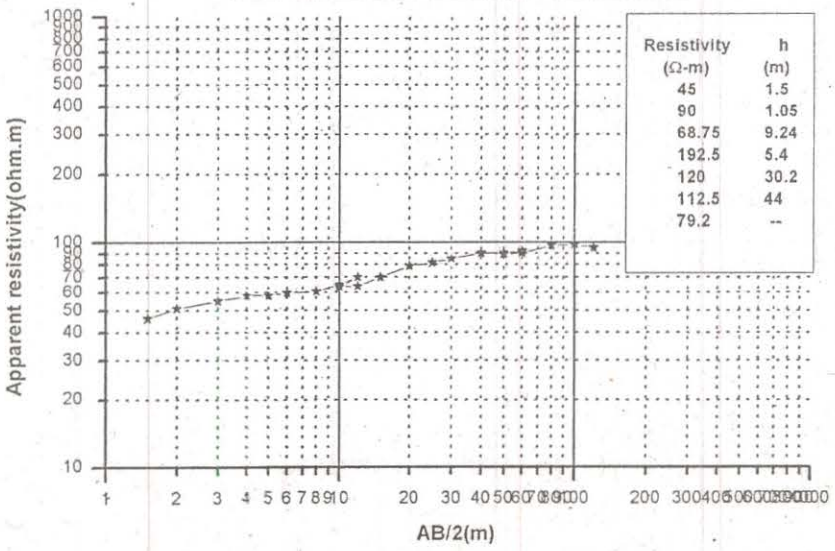
VES31-KOIRENGEI



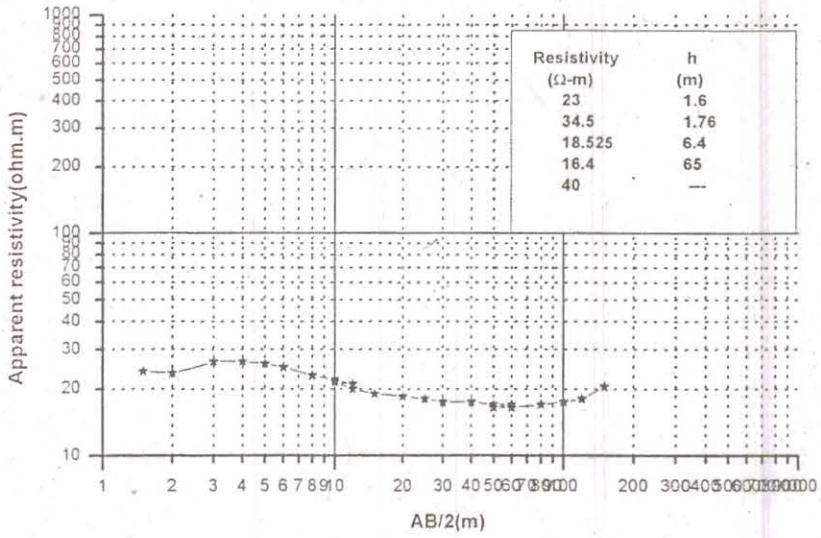
VES30-MONJAM



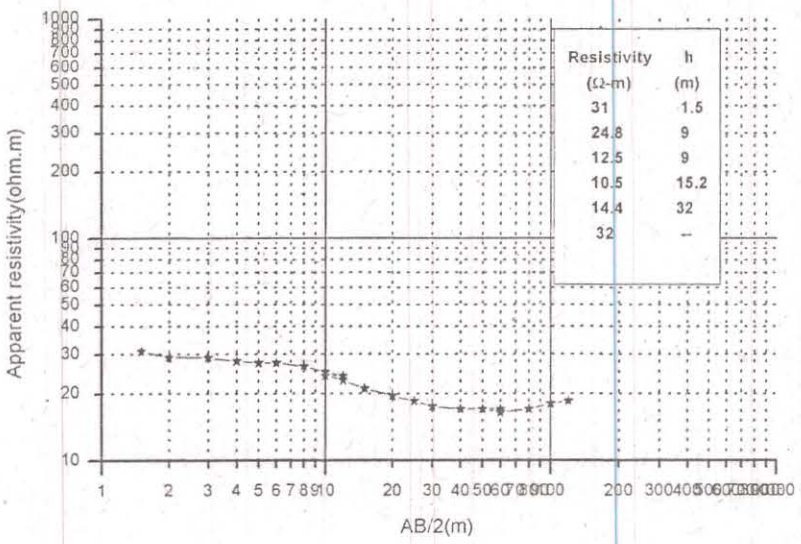
VES32-POTSANGBAM KHUNOU



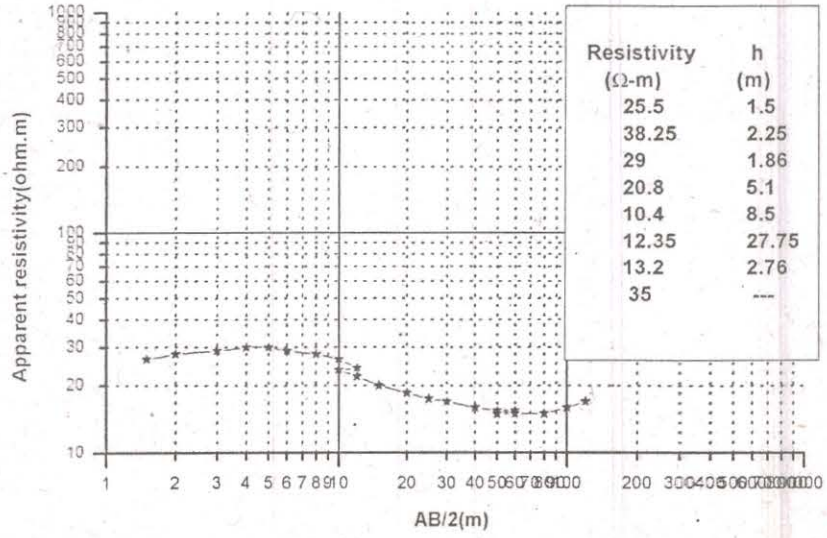
VES33-MAIBUNG



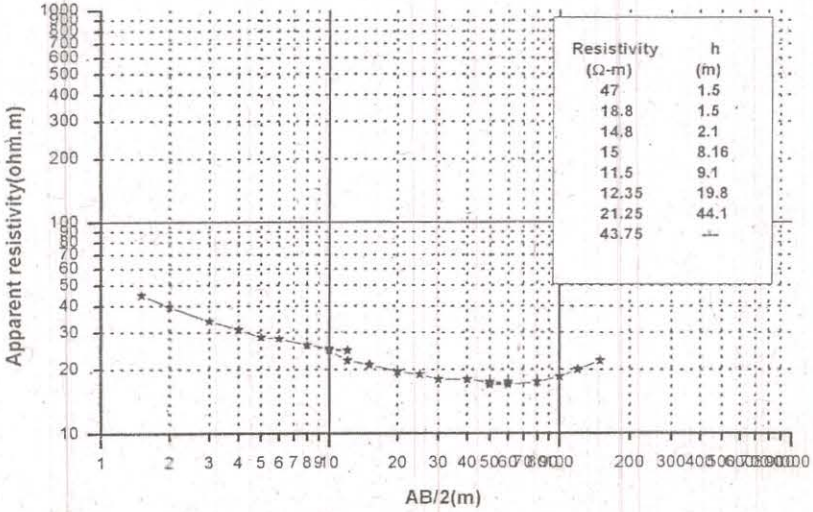
VES35-YUMNAM KHUNOU



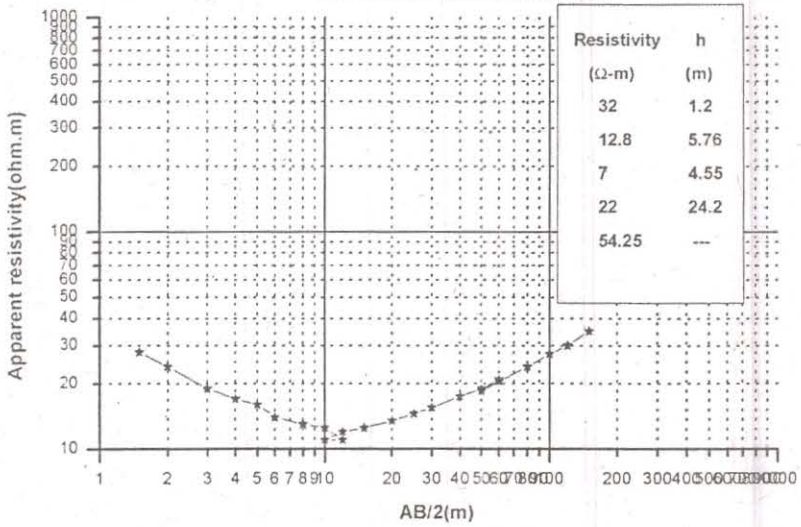
VES34-TANKHAM



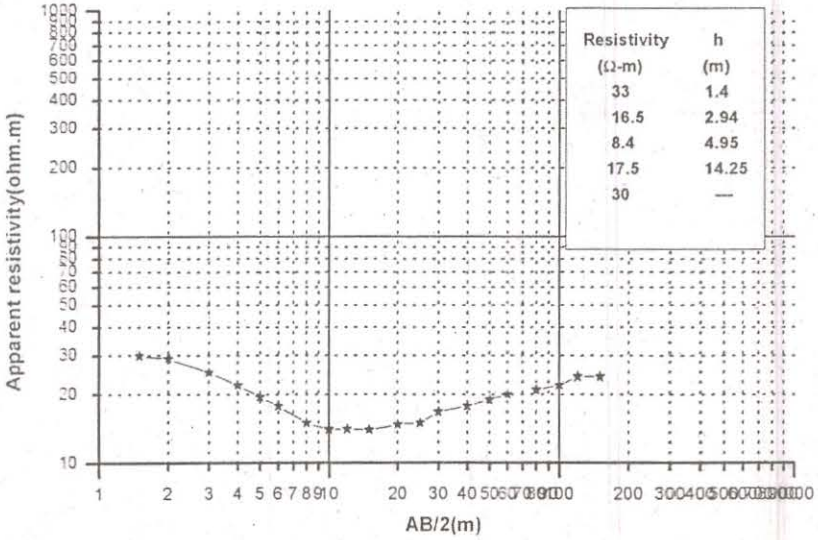
VES36-SANSENBAM



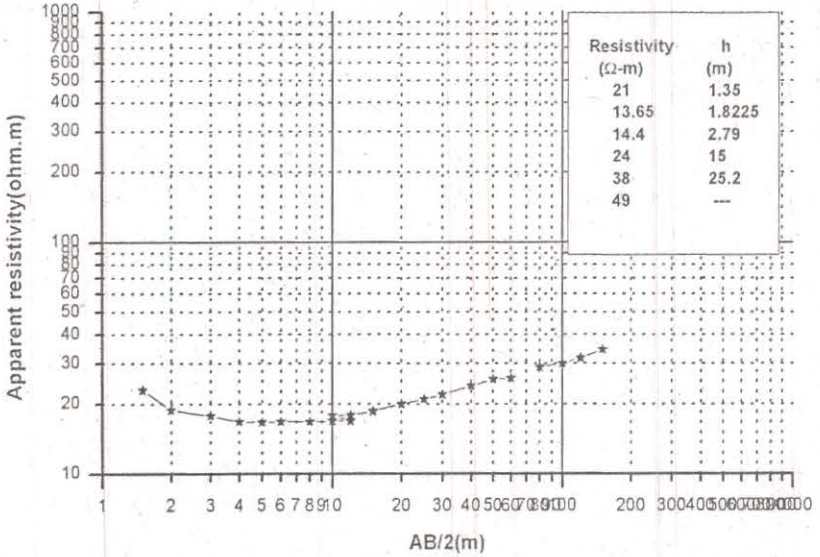
VES37-TARETKHUL



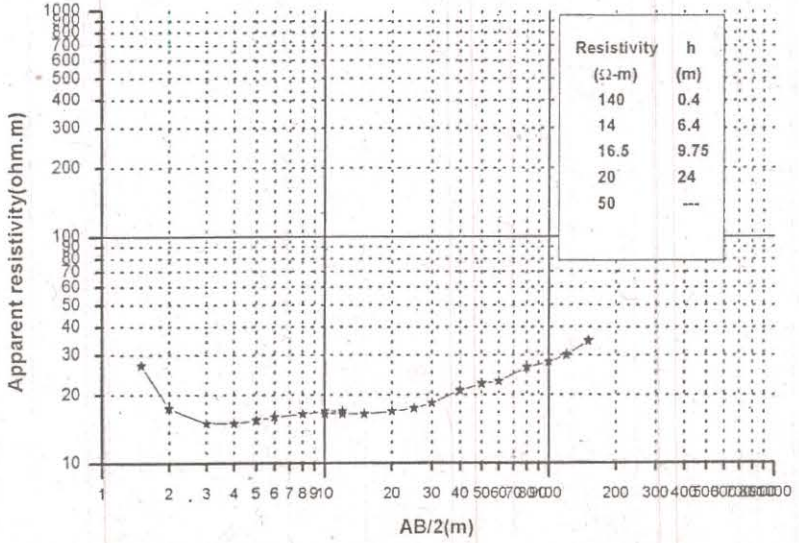
VES38-KEIBI

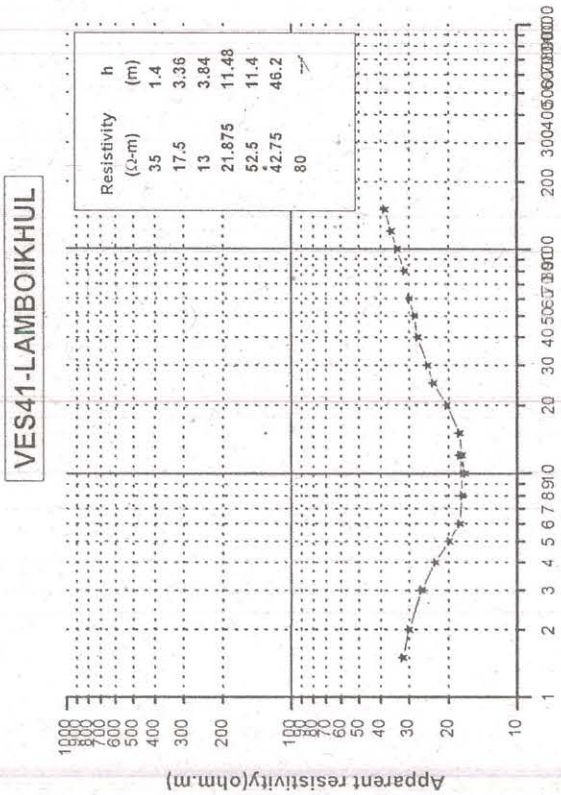


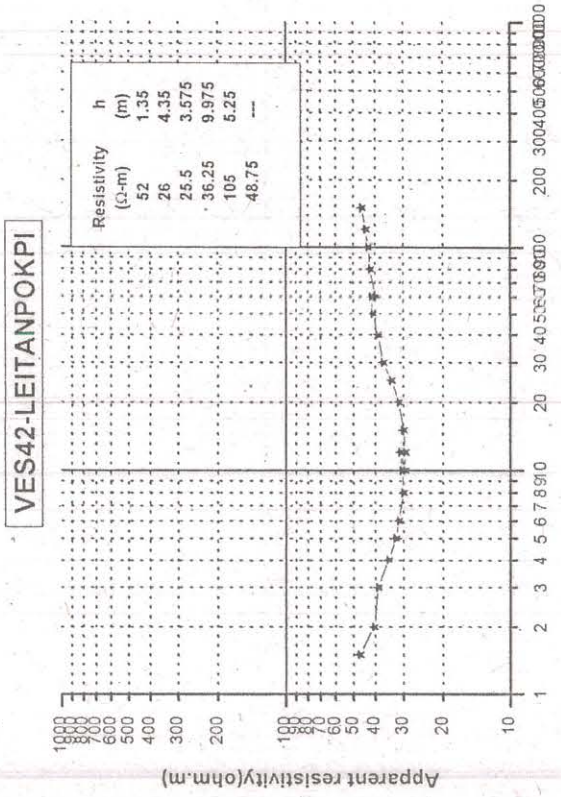
VES39-UYUMPOK



VES40-KHONGBAL THANGKHUL




VES41-LAMBOIKHUL
Resistivity (Ω-m) h (m)
35 1.4
17.5 3.36
13 3.84
21.875 11.48
52.5 11.4
42.75 46.2
80 ---
Apparent resistivity(ohm.m)
AB/2(m)


VES42-LEITANPOKPI
Resistivity (Ω-m) h (m)
52 1.35
26 4.35
25.5 3.575
36.25 9.975
105 5.25
48.75 ---
Apparent resistivity(ohm.m)
AB/2(m)

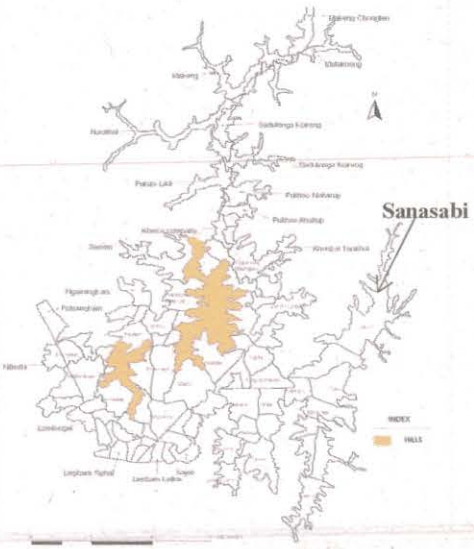
7. Water Harvesting and Conservation Structures:

Spring Water

Spring Water used by the villagers of Sanasabi Village, Imphal East

Location

Sanasabi village is located on the eastern side of Imphal East along Imphal Ukhrul road. The geographical co-ordinates is 24°55′25″N and 94°6′46″E. It is about 26 km from Imphal city and 3km from Yangengpokpi Bazaar.



Profile of the village:

Total No. of Population : 300
Total No. of Household : 55
River and spring are the major sources of drinking water,domestic and other irrigation purposes.
Villagers depend mainly on spring for drinking water.
Scarcity of water experienced by the villagers during the lean season, due to lack of proper water conservation
2 (two) spring water conservation structures have been constructed for drinking.

Spring Water Conservation at Sanasabi Village, Imphal East.

Hand Pump

Hand Pumps are used primarily in developing nations as a manually powered means of bringing water to the surface from borehole, rainwater tank or well. Two hand pumps have been installed at Heingang Mayai Leikai and Pukhoa Terapur Village of block.

Installed Hand Pump at Heingang Mayai Leikai

Location:

The Site of the installed hand pump at Heingang village is located on the eastern side of Imphal river. The geographical coordination is 24°51′ 23″N and 93°57′28″E. It is about 10 km from Imphal city.

Profile:

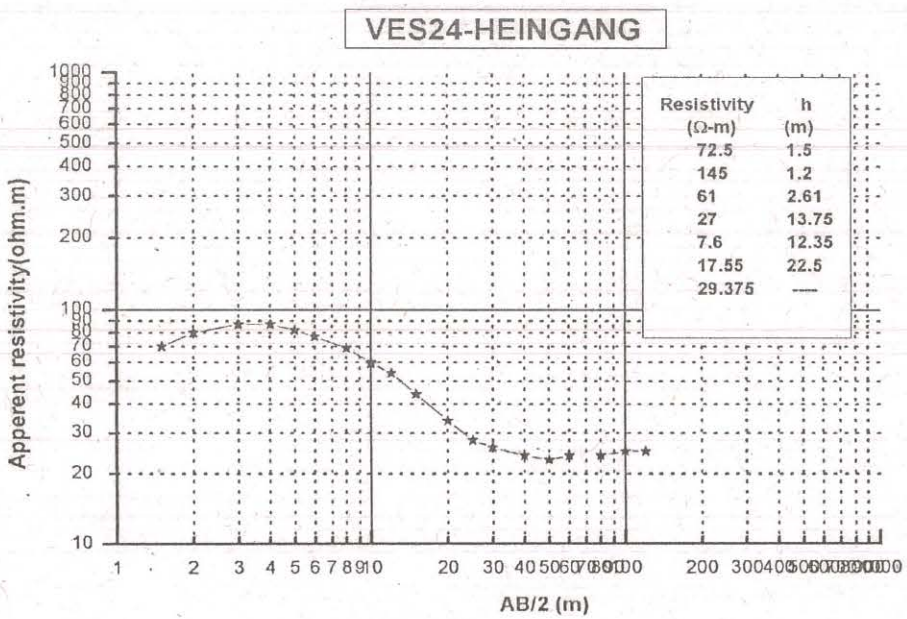
Total No. of Population : 5364
Total No. of Household : 980

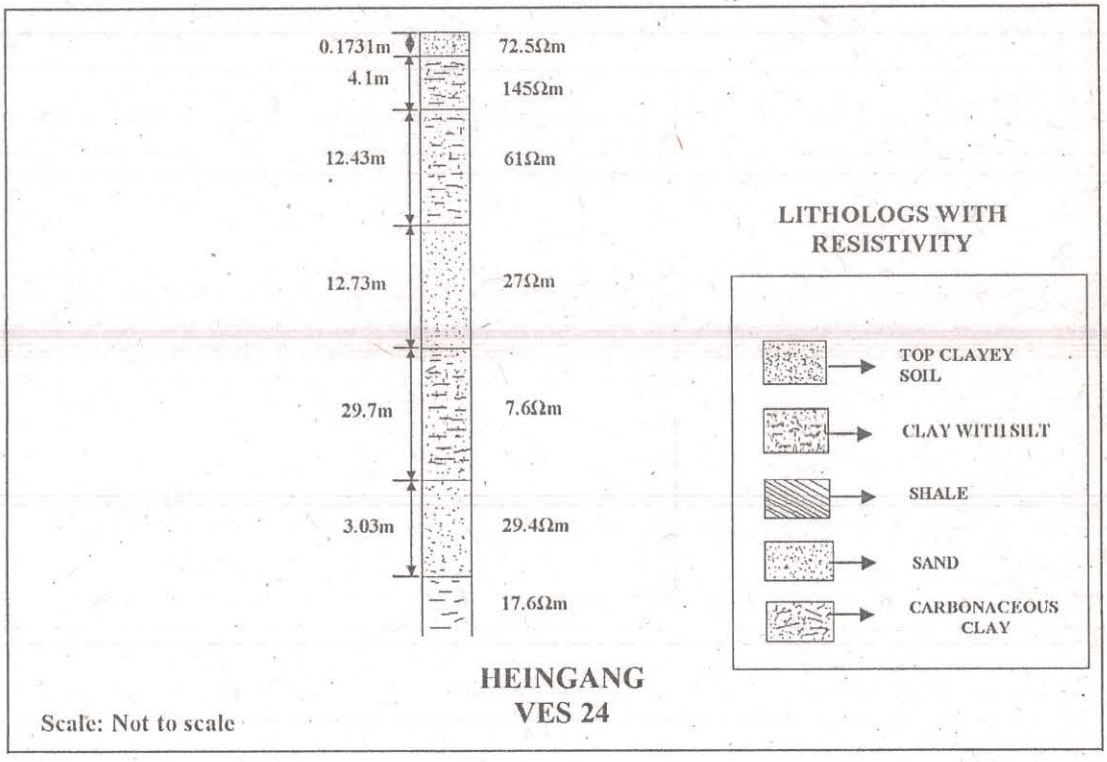
River and hand pump are the major sources of drinking water, domestic and other irrigation work.

Scarcity of water experience during lean season every year

Hand Pump has been installed to meet the water requirement throughout the year.

Resistivity Survey (VES):

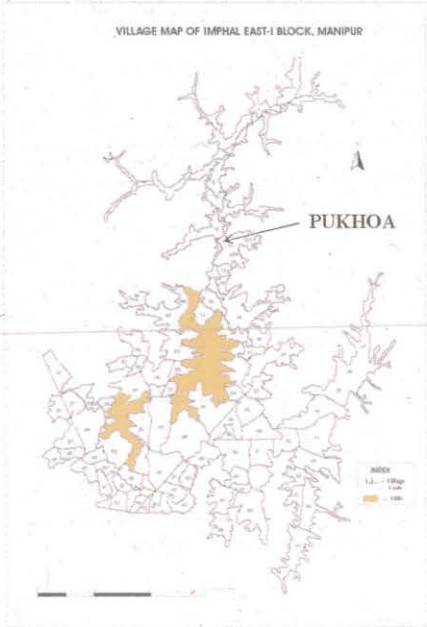




Installed Hand Pump at Pukhoa Terapur Village, Imphal East.

Location:

Pukhoa Terapur Village is located at the eastern side of Iril river. The geographical coordination is 24°57′ 46″N and 94°1′25″E. It is about 28 km from Imphal city.

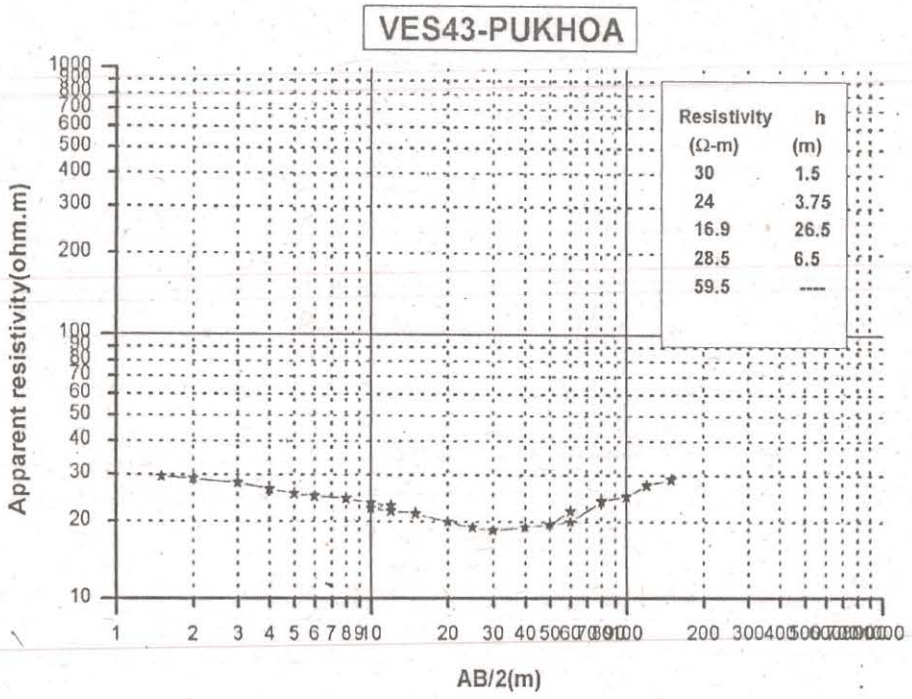


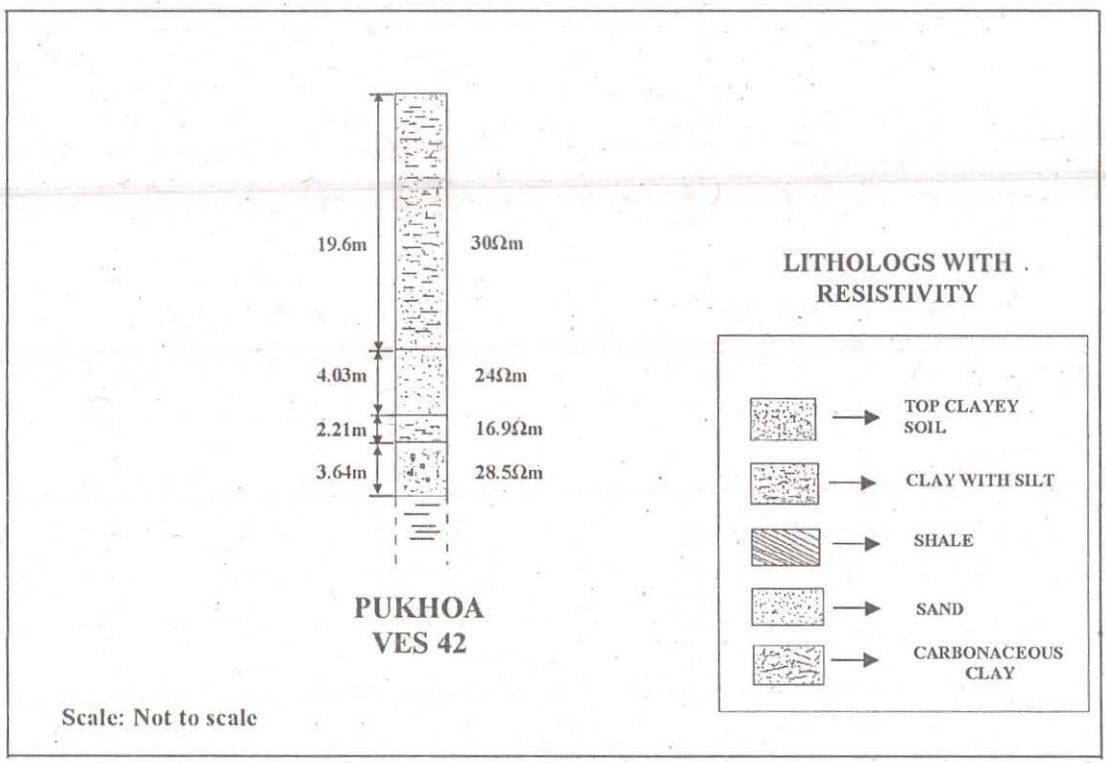
Profile:

Total number of Population : 600
Total number of Household : 120

Tube well and river are the major source of drinking water, Irrigation and other domestic purposes. Acute shortage of water experience by the villagers during summer every year. The hand pump have been installed at Older Flood Plain area at Pukhoa Terapur Village

Resistivity Survey:





Rainwater Harvesting Structure:

Rainwater may be harvested in areas, having rainfall of considerable intensity, spread over the larger part of the year. This is an ideal solution of water problem where there is inadequate groundwater supply and surface water sources are either lacking or insignificant. Rainwater is bacteriologically pure, free from organic matter and soft in nature.

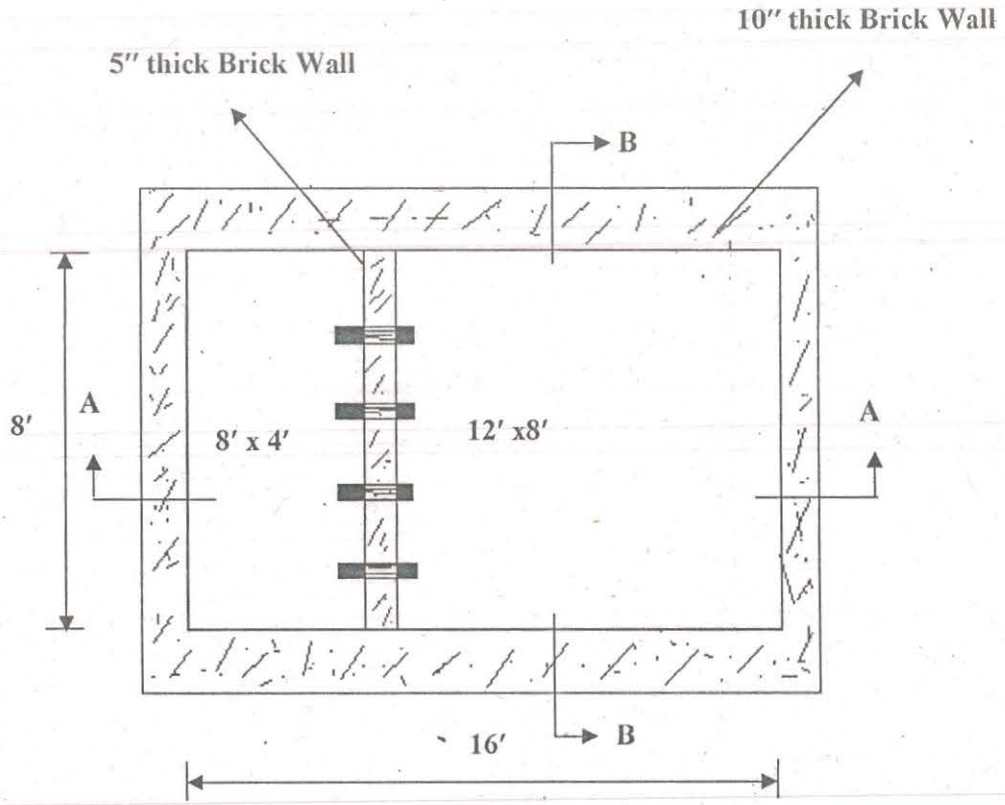
Rainwater harvesting is a technology used for collecting and storing rainwater from rooftops in a storage vessel or tank and to be used during the period of scarcity. In this system, only roof top is the catchment. The roofing should be of galvanised iron sheets aluminium, clay tiles, asbestos or concrete. For collection of water, a drain is provided (gutter) along the edge of the roof. It is fixed with a gentle slope towards down pipe, which is meant for free flow of water to the storage tank.

Components of a rainwater harvesting system:

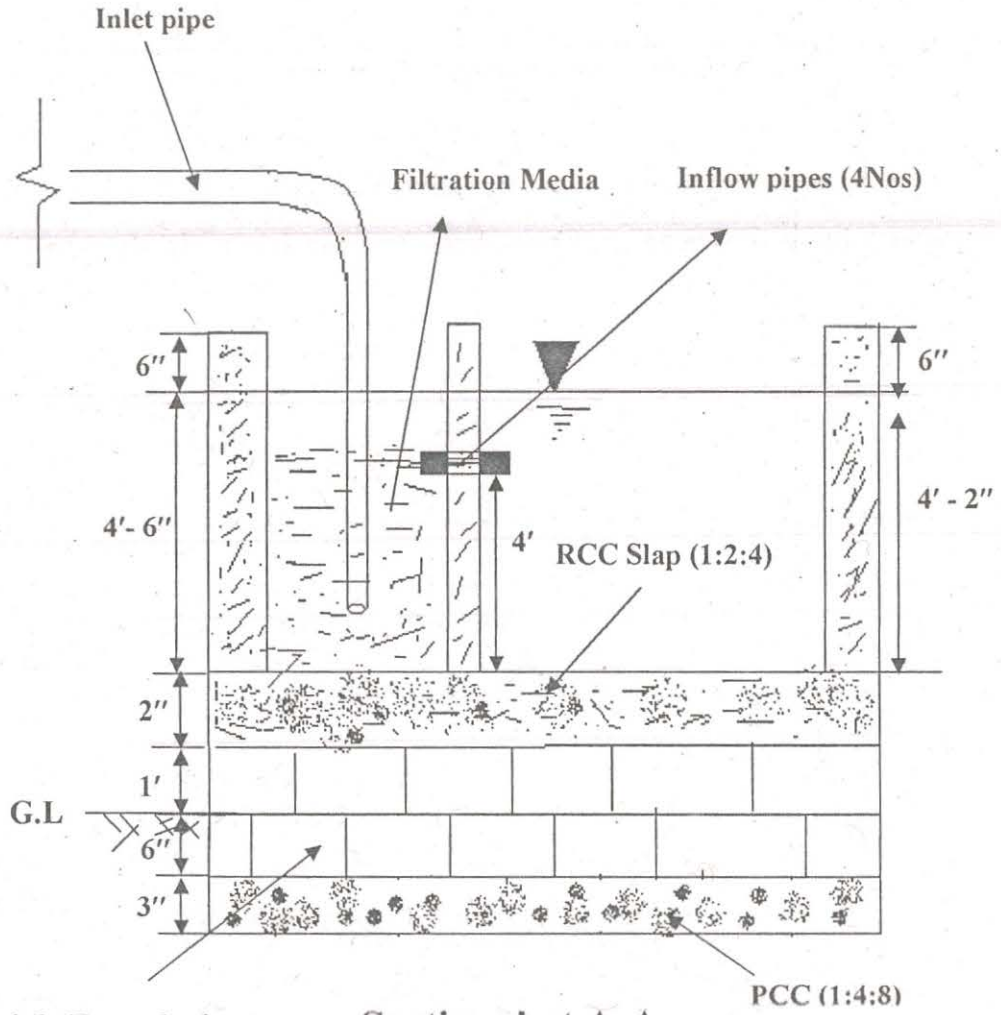
A rainwater harvesting set-up is composed of a water- collection system, a storage cistern and a water distribution system. It mainly needs:

- Rain, and plenty of it preferably
- A catchment area
- Gutter or pipes
- Storage Tank or Reservoir
- Filter (Simple slow sand filter)

A rainwater harvesting structure with slow sand filter facility has been constructed at Emanuel English Academy, Yaingangpokpi, Imphal East, with about 300square meter of roof span. The rainwater of about 100sq.meter roof area is harnessed. The water is filtered and stored in storage tank, the total capacity is about 12,000 litres.

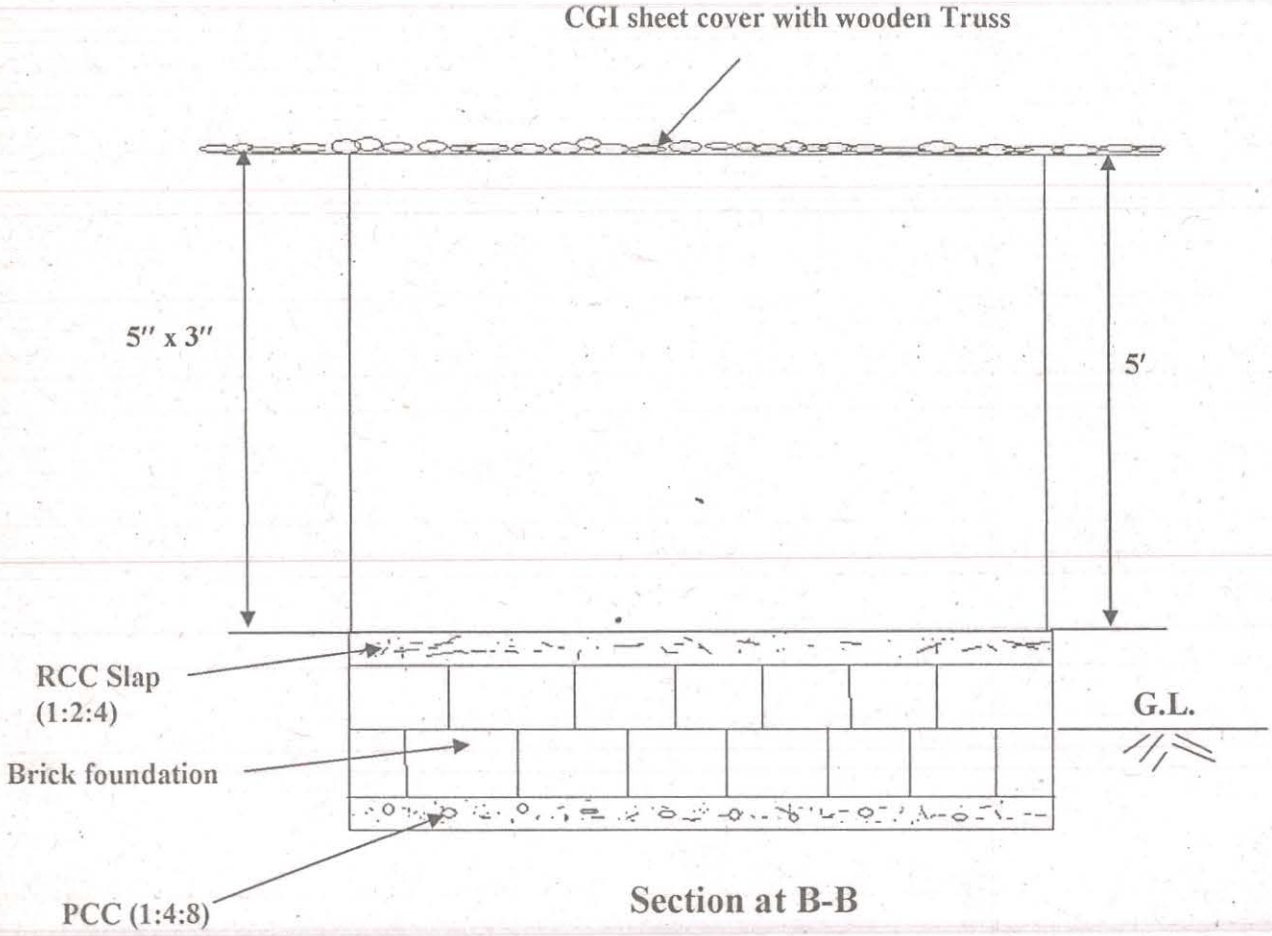


Layout Plan



Brick Foundation

Sectional at A-A



Section at B-B

Scale: Not to Scale

Layout Plan of Rainwater harvesting Structure at Yaingangpokpi

PHOTOGRAPH SHOWING RAINWATER HARVESTING STRUCTURE AT EMANUEL ENGLISH ACADEMY, YAINGANGPOKPI VILLAGE, IMPHAL EAST

Rainwater harvesting is simple and cost effective. If such measures to "Catch Water it Fall" is taken by individuals most of the Water Management problem in our state can be solved. Every drop of rainwater saves and preserved today will be precious wealth of tomorrow.

8.0 Conclusion:

The ground water exploration is an ancient task as revealed from the excavations of Mohenjodaro during the Indus Valley Civilisation. The need of dug wells came into the systematic hydrogeological task was taken during 1970 by Central Groundwater Board and concerned state agencies in the country to tackle the need of drinking water supply. Besides, National Project on "Technology Mission on Drinking Water and Related Water Management" was launched during 1986-88 to provide the potable water supply to the villagers.

State Public Health Engineering Department, Govt. of Manipur is a leading agency to tackle the task of drinking water supply in urban and rural areas in the state. Due to lack of hydrogeological knowledge, availability of gas pockets during drilling, high iron content in the groundwater and slow recharge in the alluvial aquifer, occurrence of drought and flood during lean and monsoon ,the state agency is far behind to achieve the task. Therefore, Imphal East I Block has been selected for present studies for both surface and subsurface investigation to provide a scientific source of finding at village level to help state lead agency.

Imphal East I Block is situated in northern part of the city (Imphal) fall under meridian N 24 ° 45′ to N 25 ° 7 ′ and parallels E 93° 54′ to E 94° 9′ 30″. It comprises an area of about 280 sq.km. The average height is 780msl in the valley. The area received an annual rainfall for the last 24 years is 1400 mm. Surface water of the area falls within the Manipur River basin which account for 0.5192hectare metre annual run off against a total catchments area of 6332 sq.km. General trending of all drainage in the area is N-S direction. Three major river crossed the area i.e., Imphal, Iril and Kongba rivers. Iril river is one of the largest river in the area.. State PHED had installed pipe line in many villages of the area but water supply through the pipe is very very less because water availability, harvesting and conservation problems. The actual source of water supply in the area is from surface (more than 95%).However, Drought and flood are frequently occurred in the study area during lean and monsoon seasons. The villages in the block suffer scarcity of water for drinking, domestic and irrigation purposes in most of the season except during peak monsoon month due to lack of proper water conservation and management practices.

Seismotectonically, the region is an active one and requires the attention. Therefore, the construction of tube wells/ hand pumps are more recommended than the construction of large reservoir to avoid the future reservoir induced seismicity.

Stratigraphically, two distinct groups of rocks constitute the area, viz Disang Group (Tertiary), and Alluvium (Quaternary). The Disangs found as the structural and isolated hills in central part of the area. They are highly weathered. Shale and sandstone constitute the structural hills where shale is dominant. Major part of the area belongs to Alluvium, which is further divided into Older Alluvium and Younger Alluvium due to change in lithology. Based on lithology and structure, the region is broadly divided into two types of aquifers viz. weathered rock aquifer and alluvial aquifers.

Geomorphologially, the area is divided into several land form units. The structural hills are the oldest members and constitute the run off regions. The coalescing alluvial fan zone and piedmont zone constitute a prospective aquifer region due to high recharge. A number of hand pumps are installed to feed the domestic consumption. The alluvial plains constitute the large part of the area. The aquifer is found in the form of sand lenses. The thickness of the alluvial plains varies from few metres to few hundred metres. The gas pockets are available which frequently disrupt the drilling operations at places. The alluvial plains provide a prospective region. The various land use patterns are identified in the area. The agriculture lands constitutes a large part which is followed by settlement, degraded forest, forest plantations etc.

Ground water occurs both under confined and unconfined conditions. Water table is met within a depth of about 1 to 4 metres below ground level as measured in tube well in depth from 0.33m to 15.03metres.The water table is in conformity with topography. The water table rises during rainy season and lowers gradually, being the minimum in May with fluctuation of about 1-3 metres. Th shallow alluvial aquifer consists of ill-sorted pebbles and cobbles, below the depth of 1.5mts. The aquifer in central part of the district is coarse grained sand, dark grey in the form of sand lenses.

The confined conditions occur within a depth of about 60mts.below the ground level as indicated by the flowing tube wells in western side and occurrence of springs along the foot hill zone of structural hills in Yaingangpokpi area in eastern side of the study area. Most of the springs occur in silty shale which suggests the combined lithological and structural control.

The source of the ground water recharge varies for shallow and deeper aquifers. It may be inferred that it is mainly from the top soil cover in the weathered rock aquifer while in alluvial plains the top soil is clayey, therefore infiltration and recharge are relatively less. The general slope of the area is from north to south, hence the gradient is 2.2meter/km.

Results of geophysical electricity sounding indicate the H-type and K-type curve at various locations. All the success tube wells are observed carefully and its lithology is found to be consisting of top soil, hard shale, clay, sand and sandy gravel. The curve of success tube wells are of H-type. Unsuccess tubewell are due to thick formation of top clayey soil with loose shingles. Unsuccess tubewell are correlated with K-type.

Weathered shale is the aquifer, however it is essential to determine the depth of the formation. This is manifested by the sharp increase in resistivities of the formation (H-type curve). The highest yield in the shale at Wari (Sawombung) is 375 l/m. All the aquifers of sand (sandy gravel) yield very low as 10 l/m approximately, except in some cases of Awang Potsangbam, Nilakuthi, and Sangsabi etc. After considering with the result obtained from electrical survey and correlation with the existing lithologs, the following points are given below:

i. K-type section should be avoided for groundwater exploration, chances of gas problem is very high.
ii. Western side of Imphal river and eastern side of the Iril river such as, Pangei, Kundrakpham, etc are not recommended for drilling, due to gas pockets.
iii. H-type curves are favourable for further groundwater exploration in Imphal East District.

The analysis of water quality indicates that the water sample is within the permissible limits for use in domestic, irrigation and industrial purpose.

Village level data on drinking water amenities has been analysed and mapped with reference from State PHED, Census hand Book of 1991, 2001 and field survey.

In the project area 5(five) structures for surface and sub-surface water harvesting and water conservation have been constructed.

9.0 Suggestions:

From the above facts and figures it may be suggested that.

1. More rainwater harvesting methods may be suggested in the area.
2. Agriculture in the block depends mainly on rainfall and irrigation facilities through river, tube wells etc. are needed
3. Isolated hills are highly degraded and hydrological cycle in the area is disturbed- afforestration programme may be taken up.
4. Safe drinking water facility is inadequate and more water supply scheme are needed in the area.
5. Awareness for water conservation and management is also needed.
6. Lithology of the area is complex in nature and a detailed sub-surface investigation may be required for further ground water development.
7. The lakes and other water bodies available in the area should be conserved for maintaining the drought and flood.

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Appendix I

BASIC AMENITIES AND VILLAGE LEVEL WATER RESOURCES DATA

Table No. 1 NONGREN CHINGNUNGKHOK (GRAM SABHA)

Name of the Village	Area (in hectares)	Population	No. of Primary School	No. of Middle School	No. of Secondary/ Senior Secondary School	No. of College	Medical Facilities	Water Supply Scheme Status	No. of Tube Well	Source of Water					Other Source of Water
										Tap	Tank	Hand Pump	Canal	River	
Nongren	349.66	1533	1	1			Primary Health Sub Centre	Fully Covered	3 Success	Yes	Yes	Yes			Tank & Hand Pump
Kameng	173.46	1957	1	1					1. Success	Yes	Yes			Yes	River and Tank Water
Nondam	132.95	716	1						2. Success	yes	Yes	Yes			Hand Pump and Tank
Kameng Heirok	417.48	405	1					Fully Covered	1. Success	Yes	Yes				Tank
Oksu	437.2	410	1					Partly covered	3. Success		Yes				Spring and Hand pump

Table No. 2 TAKHEL(GRAM SABHA)

Name of the Village	Area (in hectares)	Population	No. of Primary School	No. of Middle School	No. of Secondary/Senior Secondary School	No. of College	Medical Facilities	Water Supply Scheme Status	No. of Tube Well	Source of Water					Other Source of Water
										Tap	Tank	Hand Pump	Canal	River	
Takhel	596.33	2039	2	1	1			Partly Covered	2. Success			Yes			Hand Pump and Pond Water
Sanjengbam	237.4	1312	3	1			Primary Health Sub Centre	Fully Covered	1. Success		Yes	Yes			Hand Pump, Tank and Pond water
Sangsabi	313.81	489	1					Partly Covered	2. Success		Yes	Yes			Hand Pump and Tank
Karasom	125.7	434	1					Partly Covered	2. Success			Yes			Hand Pump and Tube Well
Salakhul	0	5						Partly Covered	1.Success		Yes	Yes			Hand Pump and Tank

Table No.3 MOIRANG KAMPU(GRAM SABHA)

Name of the Village	Area (in hectares)	Population	No. of Primary School	No. of Middle School	No. of Secondary/Senior Secondary School	No. of College	Medical Facilities	Water Supply Scheme Status	No. of Tube Well	Source of Water					Other Source of Water
										Tap	Tank	Hand Pump	Canal	River	
Moirangkampu Khewa Mapal	109.51	1121	4	1			Primary Health Sub Centre	Partly Covered			Yes			Yes	Tank and River
Top Dusara	0	1700	2	1	1			Partly Covered		Yes				Yes	Lake & River
Top Dusara	0	2274	2	1	1			Partly Covered						Yes	River
Khurai Ninthoubung	63.74	1409	1	1				Partly Covered			Yes	Yes		Yes	Tank and River

Table No.4 SAWAMBUNG (GRAM SABHA)

Name of the Village	Area (in hectares)	Population	No. of Primary School	No. of Middle School	No. of Secondary/ Senior Secondary School	No. of College	Medical Facilities	Water Supply Scheme Status	No. of Tube Well	Source of Water					Other Source of Water
										Tap	Tank	Hand Pump	Canal	River	
Sawambung		74143						Partly Covered	2. Success		Yes	Yes			Hand Pump and Tank
Itam	96.23	1035	2	1				Partly Covered	1 .Success			Yes		Yes	Hand Pump and River
Nungoi	309.53	2808	2	1		1		Partly Covered	2. Success					Yes	River
Iyampal	382.63	1955	1					Partly Covered						Yes	River

Table No.5 PUNGDONGBAM (GRAM SABHA)

Name of the Village	Area (in hectares)	Population	No. of Primary School	No. of Middle School	No. of Secondary/ Senior Secondary School	No. of College	Medical Facilities	Water Supply Scheme Status	No. of Tube Well	Source of Water					Other Source of Water
										Tap	Tank	Hand Pump	Canal	River	
Pungdongbam	216.01	2251	3	2				Fully Covered			Yes			Yes	Tank and Lake
Sekta	270.04	1908	3	1			Primary Health Sub Centre	Fully Covered			Yes			Yes	River and Tank
Kebi Leisshangkhong	229.84	485	2					Fully Covered			Yes			Yes	Tank and River

Table No.6 TELLOU CHANA SHEIJANG (GRAM SABHA)

Name of the Village	Area (in hectares)	Population	No. of Primary School	No. of Middle School	No. of Secondary/ Senior Secondary School	No. of College	Medical Facilities	Water Supply Scheme Status	No. of Tube Well	Source of Water					Other Source of Water
										Tap	Tank	Hand Pump	Canal	River	
Thamnapokpi		950						Partly Covered			Yes				Tank
Sanasabi		501						Partly Covered						Yes	River and Spring
Yaingangpokpi															
Sabungkhok Khonou		500						Partly Covered							
Loyalum thangkhul															
Laikot (Torophai Sheijang)	1254.16	3456	1	1			Primary Health Sub Centre	Partly Covered			Yes				Tank and Spring
Chonthabakhul	491.86	833	1	1			Primary Health Sub Centre				Yes				Tank and Well
Tellou	721.79	2285	1	1			Primary Health Sub Centre	Partly Covered			Yes	Yes			Tank and Hand Pump

Table No.7 KANGLA (GRAM SABHA)

Name of the Village	Area (in hectares)	Population	No. of Primary School	No. of Middle School	No. of Secondary/ Senior Secondary School	No. of College	Medical Facilities	Water Supply Scheme Status	No. of Tube Well	Source of Water					Other Source of Water
										Tap	Tank	Hand Pump	Canal	River	
Phaknung	243.12	1100	2	1				Fully Covered		Yes	Yes			Yes	Tank and Tap water
Kangla Siphai	156.37	762	1	1			Primary Health Sub Centre	Partly Covered	1 Success			Yes	Yes		Hand Pump and Canal
Kangla Sangomsang	165.82	1495	1					Partly Covered				Yes			Hand Pump

Table No.8 UYUMPOK (GRAM SABHA)

Name of the Village	Area (in hectares)	Population	No. of Primary School	No. of Middle School	No. of Secondary /Senior Secondary School	No. of College	Medical Facilities	Water Supply Scheme Status	No. of Tube Well	Source of Water					Other Source of Water
										Tap	Tank	Hand Pump	Canal	River	
Uyumpok	542.24	2366	2	1				Fully Covered		Yes				Yes	Tap Water and River
Khongbal Tangkhul	228.17	211	1					Partly Covered						Yes	River
Lamboikhul	230.03	1113	1					Partly Covered	1. Success		Yes		Yes		Tank and Canal
Kebi Khullen & Khunou	295.73	1176	1	1			Primary Health Sub Centre	Partly Covered		Yes	Yes			Yes	Tap Tank and River
Kebi Leishangkhong	229.84	485	2					Partly Covered	1. Success		Yes			Yes	Tank and River
Kebi Khumuda	551	793	1					Partly Covered	1.Success		Yes			Yes	Tank Well and River
Kebi Heikak Mapal	173.9	587	1					Partly Covered	1. Success	Yes	Yes				Tank and Tap water
Taret Khul	134.93	446	2				Primary Health Sub Centre	Partly Covered	1. Success		Yes				Tank

Table No. 9 MAKHENG DOLAITHABI (GRAM SABHA)

Name of the Village	Area (in hectares)	Population	No. of Primary School	No. of Middle School	No. of Secondary/ Senior Secondary School	No. of College	Medical Facilities	Water Supply Scheme Status	No. of Tube Well	Source of Water					Other Source of Water
										Tap	Tank	Hand Pump	Canal	River	
Matakhong	93.39	204	1					Partly Covered			Yes			Yes	River
Makheng Chongleu	281.9	505	1	1			Primary Health Sub Centre	Fully Covered			Yes			Yes	Tank and River
Makheng Ngunglou	0	489	1					Partly Covered			Yes			Yes	Tank and River
Khonjil Khonjal	236.54	230						Partly Covered	1. Success		Yes			Yes	Tank and River
Makeng	306.75	181	1	1				Partly Covered				Yes		Yes	Tubewater and River
Sadu Koireng	0	474	1					Fully Covered			Yes			Yes	Tank River and Spring
Thangal Surung	353.35	340	1	1				Partly Covered					Yes	Yes	Canal and River
Sadu Longa Koireng	267.67	169	1					Fully Covered			Yes	Yes	Yes	Yes	Tank and Hand Pump
Purum Khunou	107.89	175	1					Fully Covered				Yes		Yes	Hand Pump and River
Purum Likli (Leitanpokpi)	298.05	995	1	1										Yes	River

Table No.10 PUKHOU (GRAM SABHA)

Name of the Village	Area (in hectares)	Population	No. of Primary School	No. of Middle School	No. of Secondary /Senior Secondary School	No. of College	Medical Facilities	Water Supply Scheme Status	No. of Tube Well	Source of Water					Other Source of Water
										Tap	Tank	Hand Pump	Canal	River	
Pukhoa Naharup	391.67	1271	1					Fully Covered			Yes			Yes	Tank and River
Pukhoa Ahallup	150	389	1	1				Fully Covered	1.Success					Yes	River
Pukhoa Khabam	70.96	446	2					Fully Covered	1.Success					Yes	River
Pukhoa Laipham	75.87	499	2					Fully Covered	1.Success		Yes	Yes	Yes		Tank Hand Pump and River
Khewa Company	162.35	711	1					Fully Covered						Yes	River
Sangolmang	179.28	649	1					Fully Covered	2.Success	Yes				Yes	Tap water and River
Yumnam Patlou	153.29	764	3	1				Fully Covered	1.Success			Yes			Well and Hand Pump

Table No. 11: KHUNDARKPAM (GRAM SABHA)

Name of the Village	Area (in hectares)	Population	No. of Primary School	No. of Middle School	No. of Secondary/Senior Secondary School	No. of College	Medical Facilities	Water Supply Scheme Status	No. of Tube Well	Source of Water					Other Source of Water
										Tap	Tank	Hand Pump	Canal	River	
Khundarkpam	531.98	4128	5	3	2/1			Fully Covered	1.Success	Yes	Yes				Tap water and Tank
Taorem and Khuningthek	345.23	82	1						1.Success			Yes			Hand Pump

Table No. 12 HARAOROU (GRAM SABHA)

Name of the Village	Area (in hectares)	Population	No. of Primary School	No. of Middle School	No. of Secondary /Senior Secondary School	No. of College	Medical Facilities	Water Supply Scheme Statu	No. of Tube Well	Source of Water					Other Source of Water
										Tap	Tank	Hand Pump	Canal	River	
Yumnam Khunou	484.61	1595	1	1			Primary Health Sub Centre	Fully Covered	3. Success		Yes	Yes		Yes	Tank Hand Pump and River
Thangjam Khunou	180.59	1150	1	1	1			Partly Covered			Yes			Yes	Tank and River
Sinam	540.48	673	1					Fully Covered			Yes	Yes			Well Tank and Hand Pump
Tangkham	111.29	1073	1					Fully Covered	2.Success		Yes	Yes			Tank and Hand Pump
Haraorou	235.48	1034	1					Partly Covered				Yes		Yes	Hand Pump and River
Ngairangbam	294.41	259	1					Fully Covered	1.Success		Yes	Yes			Tank and Hand Pump
Morok Inkhol	142.03	87	1					Partly Covered	1.Success		Yes	Yes			Tank and Hand Pump
Sarouthel	66.58	113	1					Partly Covered	1.Success		Yes	Yes			Tank and Hand Pump
Chingkhou	80.75	458	1	1			Primary Health Sub Centre	Fully Covered	2.Success		Yes	Yes	Yes		Tank Hand Pump and River
Sambei	130.95	537	1					Fully Covered				Yes			Hand Pump

Table No. 13 WAITON (GRAM SABHA)

Name of the Village	Area (in hectares)	Population	No. of Primary School	No. of Middle School	No. of Secondary /Senior Secondary School	No. of College	Medical Facilities	Water Supply Scheme Status	No. of Tube Well	Source of Water					Other Source of Water
										Tap	Tank	Hand Pump	Canal	River	
Pangei	313.97	3162	4	2	2/1	0	0		1.Success		Yes	Yes	Yes	0	Tank &Hand Pump
Waiton	649.01	2350	2	1	1	0	Primary Health Sub Centre	Partly Covered	1. Success		Yes	Yes	0	0	Tank and Hand Pump
Chiga Tejpur															
Sawambung Lamkhai															
Mani Yaiskul															
Poarabi	533.09	1382	3	1	0	0		Partly Covered	3. Success	0	Yes	Yes	0	0	Tank and Hand Pump
Wairi															

Table No.14: KONTHA KAHBAM (GRAM SABHA)

Name of the Village	Area (in hectares)	Population	No. of Primary School	No. of Middle School	No. of Secondary /Senior Secondary School	No. of College	Medical Facilities	Water Supply Scheme Status	No. of Tube Well	Source of Water					Other Source of Water
										Tap	Tank	Hand Pump	Canal	River	
Kontha Khabam	206.37	3125	2	2	1/1			Fully Covered	3.Success	Yes	Yes	Yes		Yes	Tank Hand Pump and River
Achanbeighei	496.23	2640	2	1	0/1			Fully Covered		Yes	Yes	Yes		Yes	Tank Hand Pump and River

Table No.15 LUWANGSANGBAM (GRAM SABHA)

Name of the Village	Area (in hectares)	Population	No. of Primary School	No. of Middle School	No. of Secondary /Senior Secondary School	No. of College	Medical Facilities	Water Supply Scheme Status	No. of Tube Well	Source of Water					Other Source of Water
										Tap	Tank	Hand Pump	Canal	River	
Luwang sangbam	256.2	4285	2	1	1		Allopathic Hospital	Fully Covered	1.Success		Yes	Yes			Tank and Hand Pump
Koirengei	189.69	1098	2				Allopathic & Allopathic Dispensary	Fully Covered	6.Success			Yes		Yes	Hand Pump and River
Matai Basti	183.06	4285	3	1				Partly Covered		Yes	Yes	Yes			Tap water Tank and Hand Pump
Asei Loklen															
Lamlongei	125	1279	2	1							Yes				Tank

Table No.16 LIRIKYEMBAM (GRAM SABHA)

Name of the Village	Area (in hectares)	Population	No. of Primary School	No. of Middle School	No. of Secondary/Senior Secondary School	No. of College	Medical Facilities	Water Supply Scheme Status	No. of Tube Well	Source of Water					Other Source of Water
										Tap	Tank	Hand Pump	Canal	River	
Lirikyembam leikai	122.89	4006	5	2	1			Fully Covered		Yes		Yes		Yes	Tank and River

Table No.17 KAIRANG KHOMIDOK (GRAM SABHA)

Name of the Village	Area (in hectares)	Population	No. of Primary School	No. of Middle School	No. of Secondary /Senior Secondary School	No. of College	Medical Facilities	Water Supply Scheme Status	No. of Tube Well	Source of Water					Other Source of Water
										Tap	Tank	Hand Pump	Canal	River	
Komidok	256.2	4285	4	1				Fully Covered	1.Success		Yes	Yes			Tank and Hand Pump
Khabeisoi	414.6	3040	2	1				Partly covered		Yes	Yes				Tap water and Tank
Kairang Muslim	126.37	2868	4	1				Partly covered	1.Success	Yes		Yes			Tap water and Tank
Kairang Meitei	136.89	1140	2					Partly covered	2.Success	Yes	Yes			Yes	River and Tank

Table No. 18 HEINGANG (GRAM SABHA)

Name of the Village	Area (in hectares)	Population	No. of Primary School	No. of Middle School	No. of Secondary /Senior Secondary School	No. of College	Medical Facilities	Water Supply Scheme Status	No. of Tube Well	Source of Water					Other Source of Water
										Tap	Tank	Hand Pump	Canal	River	
Heingang	446.79	5364	5	4	2/1		Primary Health Sub Centre	Fully Covered	13. Success	Yes	Yes	Yes		Yes	Hand Pump and River

Table No.19 NILAKUTHI (GRAM SABHA)

Name of the Village	Area (in hectares)	Population	No. of Primary School	No. of Middle School	No. of Secondary/Senior Secondary School	No. of College	Medical Facilities	Water Supply Scheme Status	No. of Tube Well	Source of Water					Other Source of Water
										Tap	Tank	Hand Pump	Canal	River	
Potsangbam		1097						Fully Covered	28. Success			Yes		Yes	Hand Pump and River
Nilakhuti	170.73	1346	2	1				Partly covered	4.Success			Yes		Yes	Hand Pump and River
Maibakhul	143.56	612	1	1				Partly covered	5.Success	Yes		Yes		Yes	Hand Pump and River
Monjam	95.26	578	1	1				Partly covered	1. Success			Yes		Yes	Hand Pump and River

Table No. 20 KHURAI CHINGANGBAM LEIKAI (GRAM SABHA)

Name of the Village	Area (in hectares)	Population	No. of Primary School	No. of Middle School	No. of Secondary /Senior Secondary School	No. of College	Medical Facilities	Water Supply Scheme Status	No. of Tube Well	Source of Water					Other Source of Water
										Tap	Tank	Hand Pump	Canal	River	
Khurai Chingangam Leikai	0	4433	1					Partly covered		Yes	Yes	Yes	Yes		Hand pump and Tank
Khorei Kongkham leikai	122.49	3210	2	1				Partly covered		Yes	Yes				Tap water and Tank

Table No.21 KHURAI KHAIDEM LEIKAI(GRAM SABHA)

Name of the Village	Area (in hectares)	Population	No. of Primary School	No. of Middle School	No. of Secondary/Senior Secondary School	No. of College	Medical Facilities	Water Supply Scheme Status	No. of Tube Well	Source of Water					Other Source of Water
										Tap	Tank	Hand Pump	Canal	River	
Khurai Khaidem leikai	40.08	1753	2	1				Partly covered		Yes	Yes				Tap water and Tank
Khurai Khangnang khong	16.62	1814	2	1	1			Partly Covered						Yes	River
Khurai Moirangkhampu	109.51	1121	4	1	1		Primary Health Sub Centre	Partly covered			Yes			Yes	Tank and River

Table No. 22 NANDEIBAM LEIKAI(GRAM SABHA)

Name of the Village	Area (in hectares)	Population	No. of Primary School	No. of Middle School	No. of Secondary /Senior Secondary School	No. of College	Medical Facilities	Water Supply Scheme Statu	No. of Tube Wel	Source of Water					Other Source of Water
										Tap	Tank	Hand Pump	Canal	River	
Nandeibam Leikai							Primary Health Sub Centre	Partly covered		Yes					Tap and Pond
Thoidingjam Leikai							Primary Health Sub Centre	Partly covered		Yes					Tap and Pond
Puthem Leikai							Primary Health Sub Centre	Partly covered		Yes					Tap and Pond
Sorokhaibam Leikai							Primary Health Sub Centre	Partly covered		Yes					Tap and Pond

Table No.23 LAISHRAM LEIKAI(GRAM SABHA)

Name of the Village	Area (in hectares)	Population	No. of Primary School	No. of Middle School	No. of Secondary /Senior Secondary School	No. of College	Medical Facilities	Water Supply Scheme Status	No. of Tube Well	Source of Water					Other Source of Water
										Tap	Tank	Hand Pump	Canal	River	
Laishram Leikai	96.78	1872	2	2	1			Partly covered		Yes	Yes	Yes			Hand Pump and Tank
Thanjam Leikai	0	1222	1	1	1			Partly covered		Yes	Yes				Tap water and Tank
Sajor Leikai	98.93	7239	3	2	2		Primary Health Sub Centre	Partly covered		Yes	Yes	Yes		Yes	Hand Pump and Tank