Govt. of India

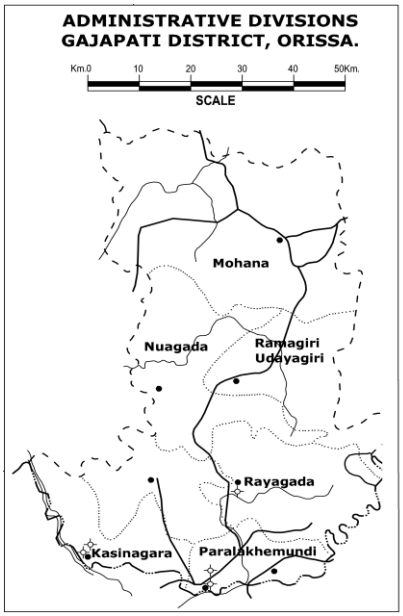
MINISTRY OF WATER RESOURCES

# CENTRAL GROUND WATER BOARD

# GROUND WATER INFORMATION BOOKLET

## OF

## GAJAPATI DISTRICT




## SOUTH EASTERN REGION,

## BHUBANESWAR

## APRIL-2013

# DISTRICT GROUND WATER BROUCHER OF GAJAPATI DISTRICT

## 1.0 INTRODUCTION :

The Gajapati district has a total geographical area of about 4325 sq.km with 7 administrative blocks, one sub division and 3 tahasils. The total population of the district as per 2001 census is 518448. The rural population constitutes about 89.82% of the total population. Geographically, Gajapati district is located in the West-South west part of Orissa state. The district is situated between $18^0$45' and $19^0$38' North latitude and $83^0$56' and $84^0$29' East and longitude respectively. The district Head Quarters at Parlakhemundi is connected with the block head quarters by all weather roads.

Part of the district is underlain by Pre-cambrian crystalline rocks of Eastern Ghat group. Which constitude hilly rugged mountains with narrow valleys. The Vansadhara River along with its tributanies controls the overall drainage of the district. Which displays a dendritic pattern. The important tributaries of Vansadhara are Harbhangi, badanadi, Mahendra Tanaya etc are mostly seasonal in nature.

The district has limited irrigation facilities. There is no major or medium irrigation project command area in the district. Minor Irrigation Projects (Flow), lift irrigation projects & GW are the main source of irrigation which caters to about 47% of the net sown area and total irrigation potential created is about 30507 Ha in the district.

Systematic Hydrogeological Surveys have been conducted in different parts of the district by CGWB on 1:50,000 scale in the year 1978 & 1984. Scientific source finding work under Technology Mission for Drinking water has been carried out by CGWB. Only 4 nos of exploratory wells & 2nos of observation wells hae been drilled by GW Exploration Programme of CGWB to delineate

ground water potential of deeper aquifers. The exploration programmes were restricted the southern part of district.

## 2.0 RAINFALL & CLIMATE :

Southwest monsoon is the Principal source of precipitation is the district. The normal annual rainfall of the district is 1925.6mm, out of which 85% to 90% is received during monsoon period (mid June to mid October). Monthly rainfall data for the period from 1982 to 2004 along with the monthly normal Rainfall data and average monthly rainfall data have been studied. It shows that the district received the minimum rainfall of 988.5mm during the year 1996 and the maximum precipitation of 2253.5mm during 1990. The rainfall is highly erratic both in space and time. The rainfall pattern over the years also shows variations. Under the period of observation, both mild and normal droughts have occurred during different periods in different blocks of the district.

The maximum temperature rises upto $42^0$C during summer months (May & June) and the minimum temperature comes down to $15^0$C during winter period i.e. in December. The climate of the district is tropical with hot and dry summer, cold winter and erratic rainfall in monsoon. Humidity of the air is high during monsoon season & decreases due to cold wave from the end of November. The mean monthly potential evapo-tranopiration values rangers from 45mm (in December) to 470mm (in May). Wind is generally light to moderate. The southern part of the district is prone cyclonic storms.

## 3.0 GEOMORPHOLOGY & SOIL TYPES :

The most part of Gajapati district is covered with rugged forest and mountainous terrain of Eastern Ghats rocks with narrow intermontane valleys.

The average elevation of hills ranges from 500 to 1200m above mean sea level. The important hills in the district are Dandamera Parbat (1103m), Tangiri Parbat (1155m) and Mahendra Giri (1499m). the area in and around Mohana, Chandragiri, Chandiput and Parlakhemundi constitute the pediment of undulating plains which have undergone intense weathering.

The Vansadhara river along with its tributaries e.g. Harbahangi, Badanadi & Mahendra Tanaya etc controls the overall drainage of the district which displays a dendritic patter.

The soil characteristics of the district show wide variation according to their physical and chemical properties, mode of orgin & occurrences. Soils are having average to good fertility status. The following soil types are available in the district.

**(A)** Alfisols or Red soil include red sandy soils and red loamy soils of which red sandy soils are conspicuously available is almost all blocks except in Parlakhemundi block which is characterized by red loamy soils. Alfisols are neutral to slightly alkaline in nature having light texture porous & friable structure devoid of lime Kankars. These are deficient in nitrogen, phosphate, organic matter and lime and are good for paddy crops.

**(B)** Entisols or Alluvial soil are younger in origin deficient in nitrogen, phosphoric acid and comparatively rich in potash, lime and ore, alkaline is nature. These are the most fertile soils in the district.

## 4.0 GROUND WATER SCENARIO :

### 4.1 Hydrogeology :

The contrasting water bearing properties of different geological formations usually play an important role in the occurrence and movement of groundwater.

Depending upon geology, water bearing and water yielding properties, two major Hydro geological units have been identified in the district.

**(i)** Consolidated formations

**(ii)** Unconsolidated formations

**(i) Consolidated Formations :**

Almost the entire district is covered with the consolidated formations comprising granites, gneisses, Khondalites & Charnockite. These rocks are devoid of primary porosity and are usually very hard and compact in nature. The secondary porosity in the consolidated formations developed as a result of weathering and fracturing form the conducts for movement as well as reservoir of ground water. These fracture & joints when interconnected from potential aquifers, which sustain limited to moderate yield. Ground water occurs under water table conditions is the weathered residuum while it occurs under semi confined to confined conditions in the deeper fractured and jointed rocks. Generally two to four water bearing fracture zones occur down to a depth of 100 mbgl.

**Water Bearing properties of Major Litho Units :**

**Granite and Granite Gneisses :** The most prevalent rock types occurring in the district covering undulating terrain and low-lying areas and form the most potential aquifer in the hard rock terrain. These rocks reduce to loose Kaolinised granular material on weathering. Porphyritic granite gneisses have comparatively thicker weathered mantle than the garnetiferous gneissies. The thickness of weathered mantle ranger from 5m to 15m. the weathered mantle and the fractures zones in these rocks form the main source of ground water and can be developed through dug wells & bore wells. The depth to water

level ranges from 4.90m to 11.90m below ground level during premonsoon season and during postmonsoon season it varies from 1.70m to 7.0m below ground level. The yield of dug wells in this formation generally range upto 3lps and that of dug-cum bore wells ranges upto 5 lps. In general these rocks can sustain yield from 2 to 10lps depending on topography, thickness of weathered mantle and number of inter connected satmated fractured zones encountered etc.

**Charnockite and Khondalite :** There crystalline rocks are of very hard and compact nature occupying high bills and do not have significant ground water storage capacity owing to lack of joints & fractures. The weathering is now & the zone of weathering ranges from 5to 10 meters. Khondalite general occupy the hills and have limited ground water potentials. The thickness of weathered zones ranges from 10 to 30m. The depth to water level in there formations ranges from 1.46 to 6.06m below ground level during post monsoon period and from 1.93 to 10.35 mbsl during summer season. The yield of dug wells & in low tying valley areas ranges upto 3lps and upto 5 lps is dug-cum bore wells. The vein quarter form good aquifers when fractured & friable.

**(ii) Unconsolidated Formations :**

Laterite and alluvium of sub recent to Recent age constitute the unconsolidated formation laterites occurring as capping over older formations are highly porous is nature and thus the aquifers formed are tapped through dug wells. The alluvial deposits of recent within it age constitute the most potential aquifers in the disteict due to high degree of porosity and permeability. Occurring in the flood plains of Vansadhara River and in other tributary channels as this discontinuous patches. These deposits mainly consist of silt. Sand with gravel and attain a thickness of

about 10 to 26m in the flood plains. The yield of the shallow tube well is upto LPS.

**Depth to Water Level :** The occurrence and movement of ground water and seasonal water table fluctuation were studied through hydrograph network stations monetarily data collected in pre and post monsoon period of 2011. Based on monitoring data depth to water level zone maps for pre-monsoon and post-monsoon periods have been prepared. The depth to water level during pre-monsoon (April-06) ranges from 4.5 to 11.9m below ground level and from 1.3 to 6.97m below ground level during post-monsoon period (Nov,06).

**Seasonal Fluctuation :** The study of the water table fluctuation data shows that in the major part, fluctuation of the water table is in the range of (1.5 to 2.3m and 2.5 to 4m). The seasonal fluctuation of water table (Pre and Post-monsoon monitoring data for the year - 2011) has been depicted in plate ?

**Trend of Ground Water Level :** The Long term trend of water level in 19 nos open wells (NHS) have been computed. The decadal water level trends during pre-monsoon period (April 97 to April,06) indicate that 47% station showing rising trend of water level, the maximum being 0.23 m/yr (at Kaftaiakanita) & 0.22 m/yr (at Gumma). In most of the cases the rise is less than 0.1 m/yr which indicates no such significant change in water level. The falling trend of water level is shown by about 52% of the stations of which maximum fall recorded is 0.29 m/yr (at Kasinagar) and 0.20 m/yr (at Nuagarh) may be due to over exploitation or rugged terrain. Majority of falling trends are within 0.1 m/yr.

The decadal water level trend of post-monsoon period (November,97 to November,06) indicate that there is a rising trend of water level in 79% stations and falling trend in 21%. The maximum rise recorded is 0.35 m/yr (at Chandigarh) and 0.33 m/yr (at R.Udaygiri). The maximum fall is 0.39 m/yr (at Ramagiri). From the long-term water level trend data is is observed that no such significant variation evident over the decade. The data for rise and fall of hydrograph station are presented in table ?

## 4.2 GROUND WATER RESOURCES :

Blockwise ground water resource estimation has been based on norms recommended by Ground Water Estimation Committee (G.E.C 1997) and presented in Table – 1. The total ground water resource of the district is assessed to be 22670 hectare meter (HM). The annual draft for irrigation use by all structures is 4468 hectare meter and the gross annual draft for all uses is 5588 hectare meter. Thus a net balance of ground water resource of 16906 HM is available for future irrigation development in the district. The present stage of ground water development has been estimated to be 24.65%. Kashinagar block shows the highest development of (37.12%) than the other blocks in the district.

### Ground water Resource Potential of Gajapati District As on 31.03.2009

Figures in hectare metre

| Sl. No. | Assessment unit/block | Net Annual Ground Water Availability | Existing gross ground water draft for irrigation | Existing gross ground water draft for domestic and industrial water supply | Existing gross ground water draft for all uses | Allocation for domestic and industrial requirement supply up to next 25 years | Net ground water availability for future irrigation development | Stage of ground water development (%) |
|---|---|---|---|---|---|---|---|---|
| 1 | Gosani | 4381 | 1187 | 138.08 | 1325 | 138 | 3056 | 30.24 |
| 2 | Gumma | 3163 | 629 | 185 | 814 | 188 | 2346 | 25.74 |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| 3 | Kashinagar | 3109 | 1003 | 151 | 1154 | 184 | 1922 | 37.12 |
| 4 | Mohana | 4436 | 374 | 256 | 630 | 318 | 3744 | 14.20 |
| 5 | Nuagada | 2234 | 324 | 110 | 434 | 136 | 1774 | 19.43 |
| 6 | R.Udayagiri | 2888 | 466 | 131 | 597 | 149 | 2273 | 20.67 |
| 7 | Rayagad | 2459 | 485 | 149 | 634 | 183 | 1791 | 25.78 |
| 8 | **District Total** | 22670 | 4468 | 1121 | 5588 | 1296 | 16906 | 24.65 |

### 4.3 GROUND WATER QUALITY :

Ground water quality depends upon the lithological and chemical composition of the aquifer, climate condition, quantum of recharge made and its movement, micro organisms activity and presence of contaminants in the environment etc. The water samples collected from the national hydrograph stations during ground water monitoring work hydrogeological surveys are analyzed in the chemical laboratory of CGWB for assessing ground water quality. The formation wise ranges of the different water quality parameters are presented in Table (2) and the complete chemical analysis results of water samples during monitoring work are presented in Annexure – 2,

As per the standards of the ISI mostly ground water of Gajapati district is suitable for drinking purpose except for a few places in granitic & Khondalitic terrain where $NO_3$ and Fe connection exceed the permissible limits which may be attributed due to local pollution.

The suitability of ground water for irrigation use depends on the degree of tis mineralization and the effects of the dissolved constituents on plants and the soil. High Sodium concentration reflects reducing permeability of the soil as for as the suitability for irrigation purpose is concerned. The sodium absorption ration (SAR) is

important for studying the suitability of ground water for irrigation purpose. From chemical analysis data, it is observed that ground water can be used for irrigation with moderate teaching and moderate salt tolerant crops. It is also suitable for forest product industries, broiler feed and livestock use. The ground water from deeper aquifers, of few exploratory wells mainly restricted in the southern part of the district also reveals that the water is suitable for drinking and irrigation use.

## 4.4 STATUS OF GROUND WATER DEVELOPMENT :

Ground water development in the district is mainly through dug wells, Dug-cum-bore wells, bore wells & shallow tube wells. Ground water is mainly used for domestic and irrigation purpose and in a few small industrial purpose.

**Dug wells** are most common ground water abstraction structure in the district. Specially in shallow water table area with a thick cover of weathered mantle. The dug wells of 9 to 12m depth, diameter 4.5 to 6m in such suitable pumps. The yield may be upto 2 lps. Such dug wells may irrigate upto 4 ha area of land. Approximately a total of 19323 additional dug wells for irrigation use are feasible in the district.

**Bore wells** few exploratory bore wells constructed southern parts of the district especially in Parlakhemundi & Kashipur area are encouraging (Annexure-1), Bore wells are suitable structure, even in the areas of deeper water level and hard rocks are encountered at diameter of 150mm. (Depending upon the discharge and draw down of the bore wells suitable 2 HP submerisible pumps may lift yield upto 10 lps in some cases). The block wise ground water structures feasible as per study group report (2001) are presented in table below :-

| Block | Lift irrigation (Ha) Kharif | Rab | Nos of additional GW structures feasible for irrigation use Dug wells (Nos.) | Additional irrigation potentials to be created (Ha) |
|---|---|---|---|---|
| Gosani | 86 | 40 | 1166 | 1539 |
| Gumma | | | 2297 | 3032 |
| Kshinagar | 562 | 372 | 2702 | 3567 |
| Mohana | 100 | 18 | | |
| Nuagad | 18 | | 5047 | 6662 |
| R.Udaigiri | 22 | 24 | 3192 | 4213 |
| Rayagada | 191 | 50 | 978 | 1291 |
| Paralakhemundi | 845 | 448 | | |
| District total | 1824 | 952 | 19323 | 25506 |

**URBAN & RURAL WATER SUPPLY**:

PHED & RWS & S have installed pipe water supply scheme for domestic purpose in Pralakhemundi Municipality & Kashinagar NAC. RWS & S has also constructed hand pump fitted bore wells at different places to provide safe drinking water in rural areas

**GROUND WATER FOR IRRIGATION**:

The ground water resource available for irrigation is the district is 26552 HM. The present draft is 3085 HM through ground water structures in t he irrigation sector fix by 6962 dug wells & 71 shallow tube wells. The balance resource for irrigation is 23467 HM. (Table – 6.1).

## 5.0 GROUND WATER MANAGEMENT STRATEGY :

### 5.1 : Ground Water Development

Shallow tube wells, fitter point tube well upto 30m depth with 100-150mm diameter fitted with 3 to 4HP submersible pump may be constructed along flood plain deposits of the Bansadhara river in parts of Kashinagar blocks. The Yield of such structure may be 12 to 15 lps.

Dug wells 10-12m depth, 4 to 6m diameter to be fitted with 2-3 HP centrifugal pump and dug-cum bore wells (15m depth) with vertical bore well 25-30m below ground level may be fitted with 2-3 HP submersible pump giving yield less than 5 Lps in the area is granitic & Khondalitic Terrain. The areas in and around Parlakhemundi town, Mohana town, Gosani are suitable for development through dug wells & dug-cum- bore wells. Limited ground water exploration data revealed that high yielding wells may be constructed with an average depth of 60 to 80 meters below ground level in Parlakhemundi, Gosani & Kashinagar blocks after proper hydrogeological investing actions of the area. These wells may encounter 2 to 3 saturated fracture zones.

The yield of existing dug wells may be increased by converting into dug-cum bore wells wherever feasible. The existing dug wells may be deepened further to tap the entire thickness of the saturated zones with brick lining if necessary increasing yield.

### 5.2 Water Conservation & Artificial Recharge

Major parts of the district is covered by rugged topographic conditions which facilitates flow of ground water through nalas, rivers & streams as base flows, resulting deeper water level condition during post-monsoon period. Artificial recharge techniques and rain water harvesting method after proper hydrogeological

investigation at suitable sites will help in effecting additional recharge to the ground water reservoir. The most suitable structures adopted are percolation tanks, nala/contour bunding small check dams/weirs, renovation of old tanks to percolation tanks, gully plugging.

## 6.0 GROUND WATER RELATED PROBLEMS :

The quality of ground water from the shallow as well as deeper aquifers is potable for drinking & irrigation purposes. However, in a few patches higher occurrences of nitrate, iron, high total hardness, total dissolved solids have been observed where suitable precaution in their use & management are needed.

The analysis of water level trend over the years (last 10 years) for both pre-monsoon and post monsoon periods indicates t hat there is no appreciable change in water levels, i.e. depletion has not taken place in the district.

No water logging problems has been identified in the area of restricted command areas (Seasonal) covering hard rock terrain.

## RECOMMENDATIONS :

1. The large scale ground water development programmes in the district may be carried out by demarcating hydrogeologically favourable area suitable for various ground water abstraction structures. Exploratory drilling aided by hydrogeological surveys, remote sensing & resistivity sounding may be carried, through out. The district for getting high potential aquifers in the depth range between 80 and 100 mtr below ground level.
2. The yield of existing dug well may be increased by converting into dug-cum wells wherever formation permits. The deepening of dug wells may be bring about increase in discharge of the well by tapping entire saturated zones.

3. Detailed surface geophysical surveys and remote sensing studies etc should be taken up in rugged Terrain of the district for demarcating thickness of weathered zones and occurrence and extent of lineaments which form potential aquifers.
4. The energisation of the wells which are having potential discharge may be taken into consideration for optimum utilization of ground water.

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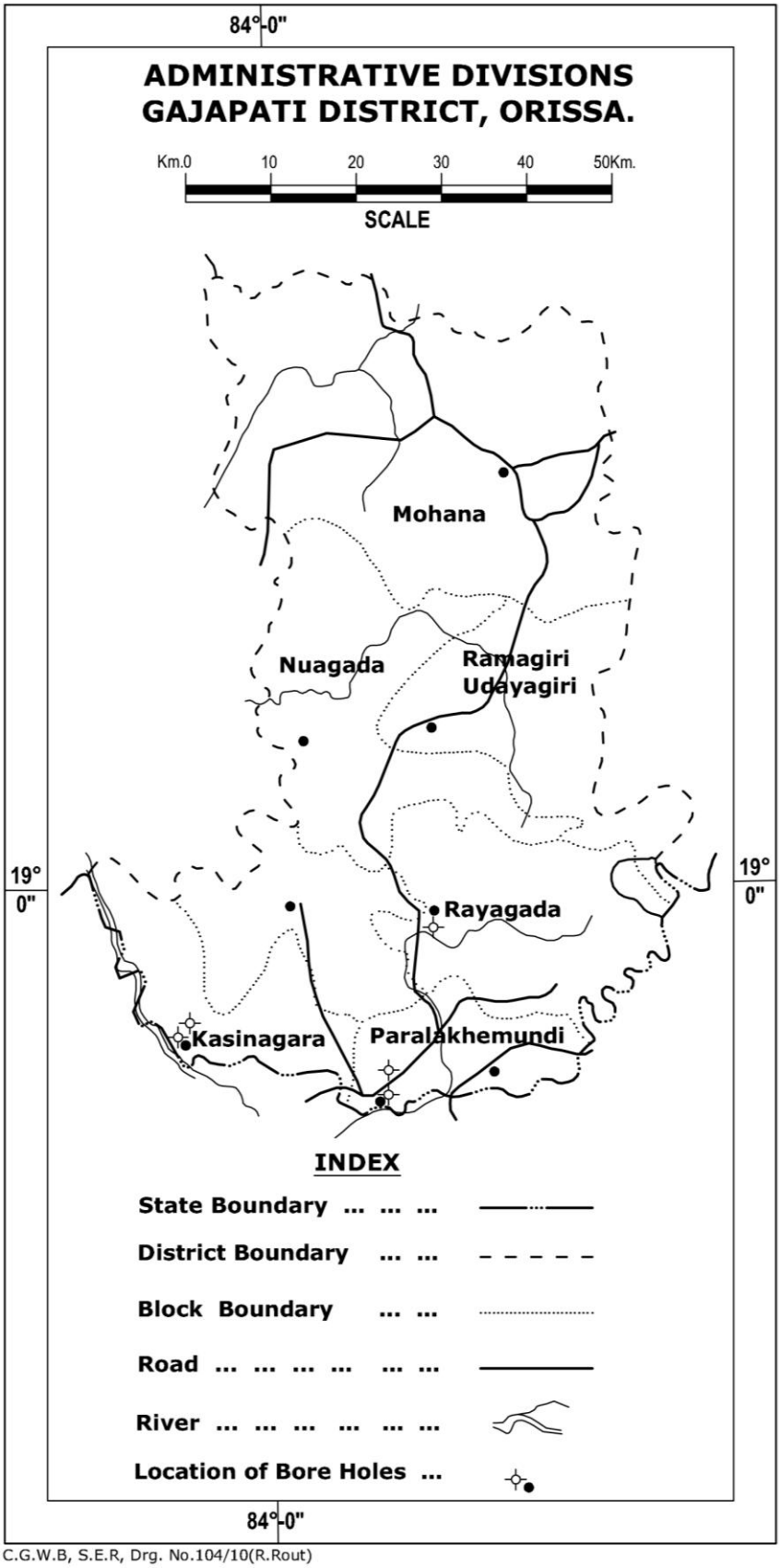
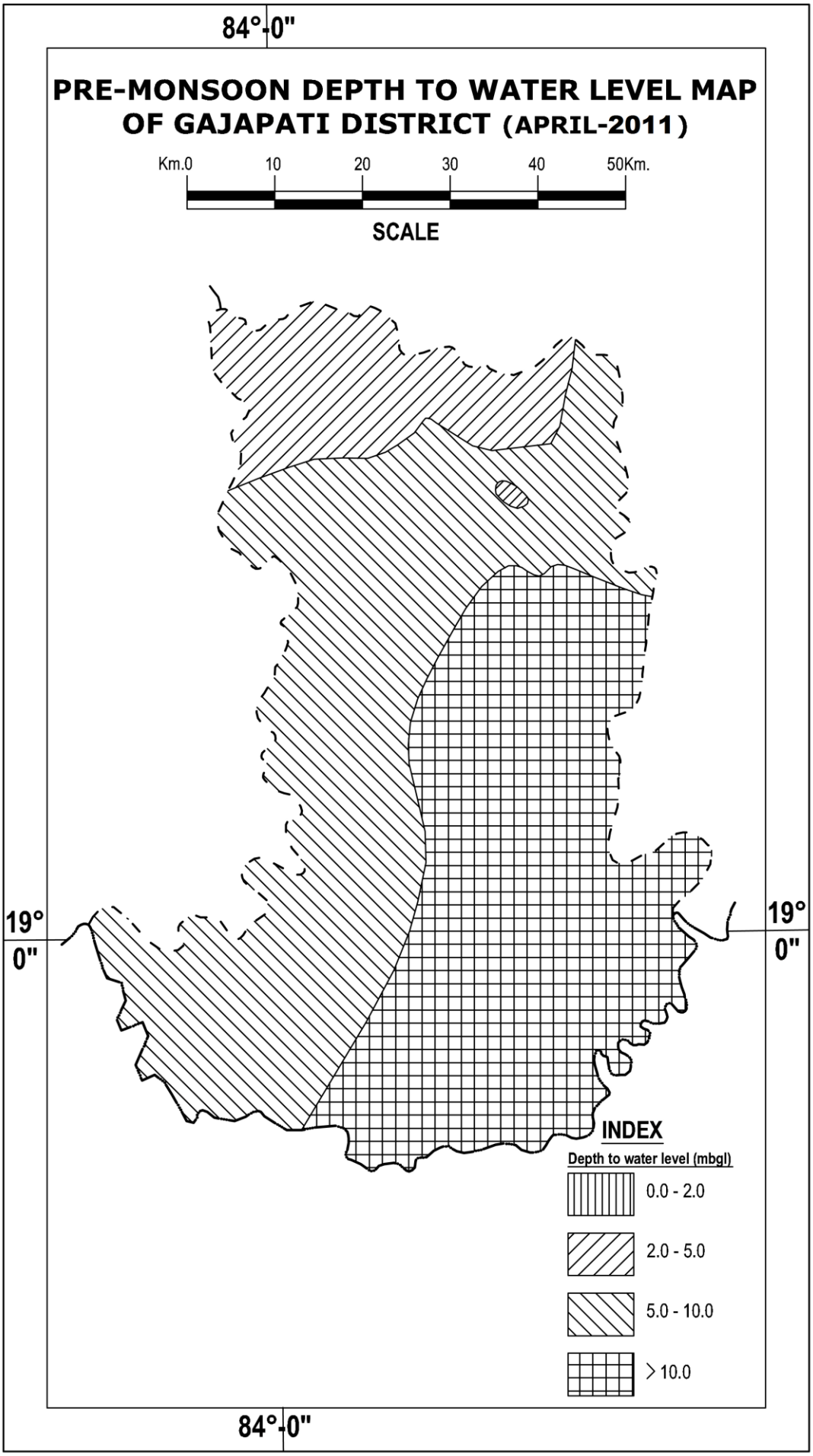



C.G.W.B, S.E.R, Drg. No.104/10(R.Rout)

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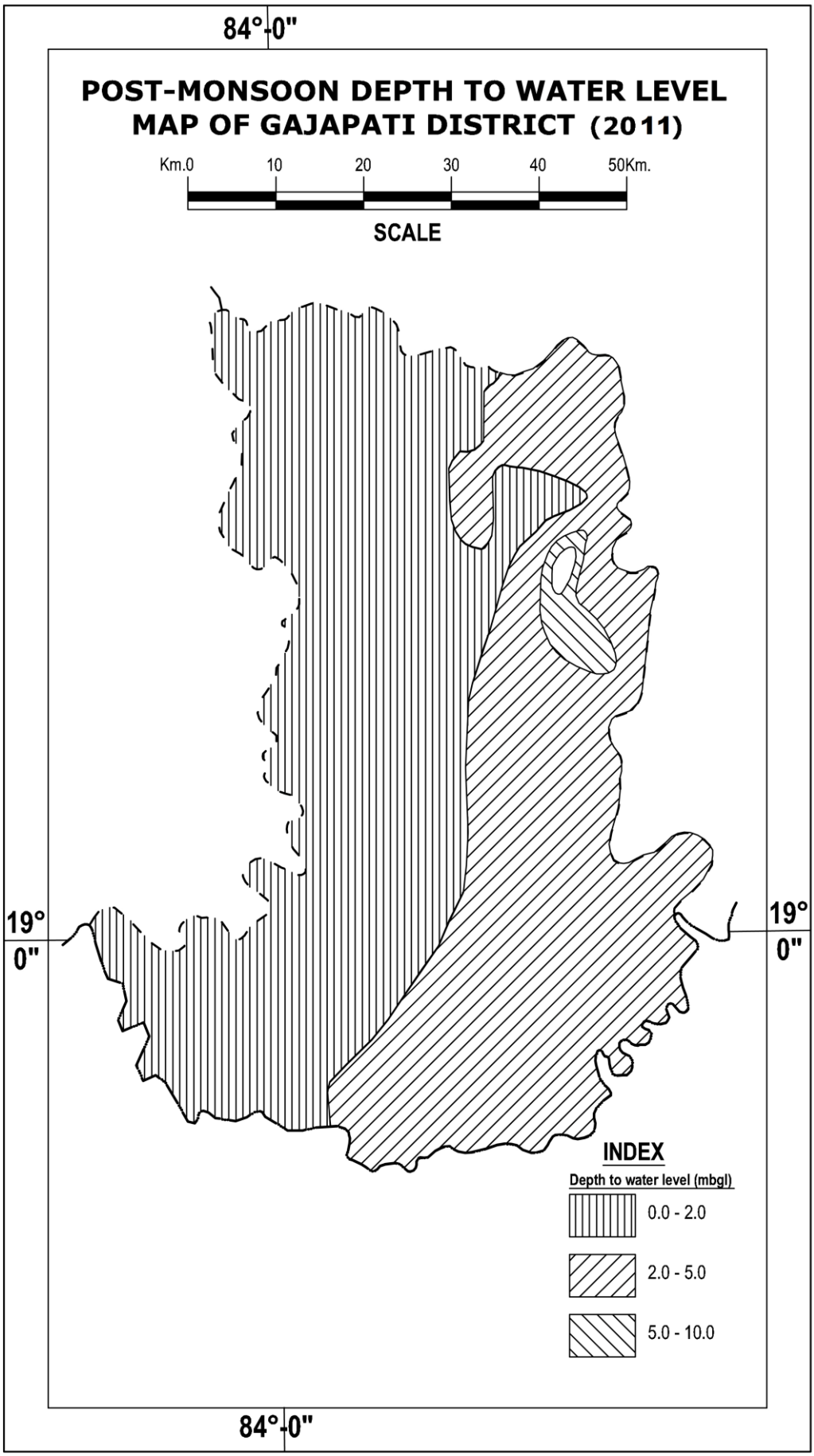


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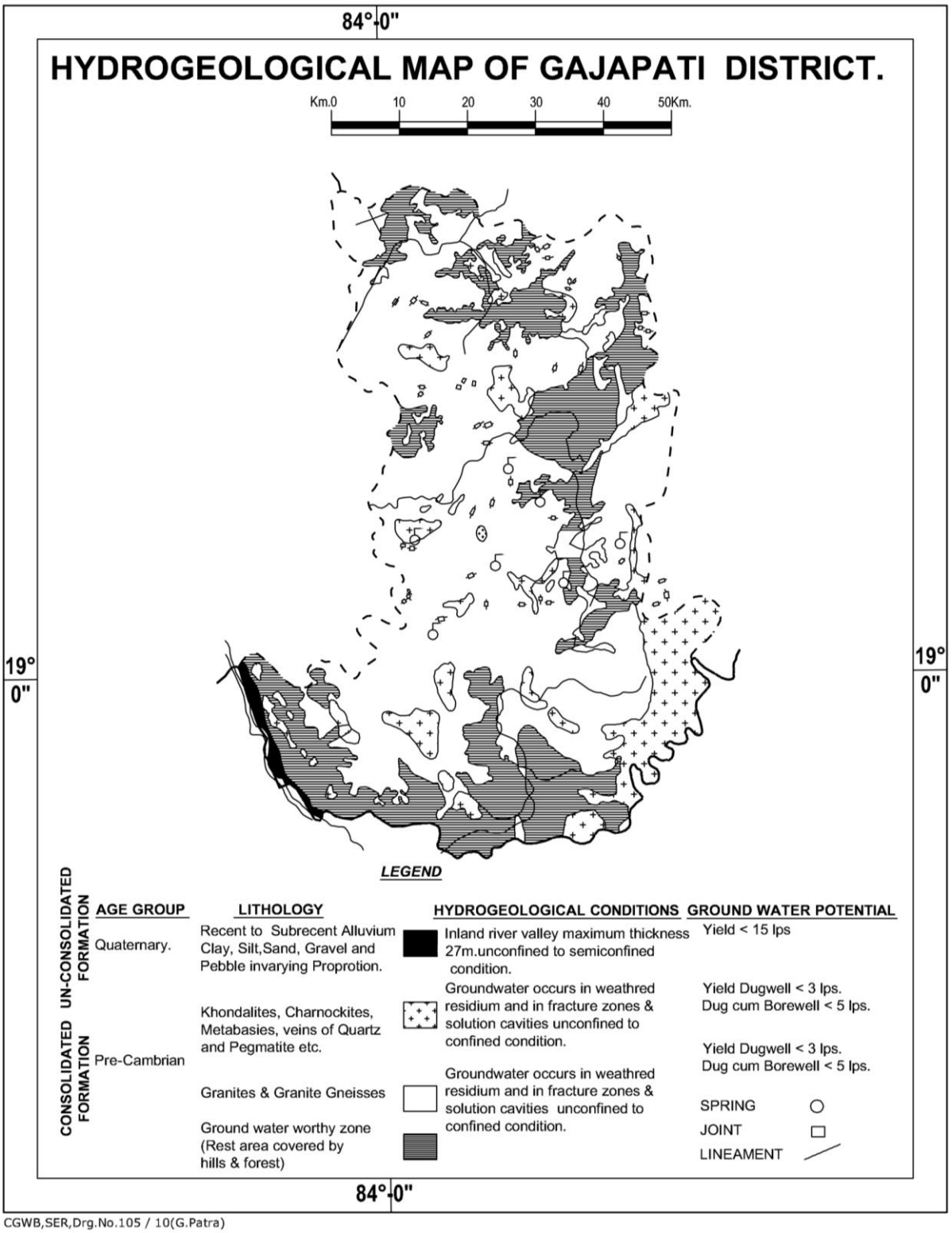
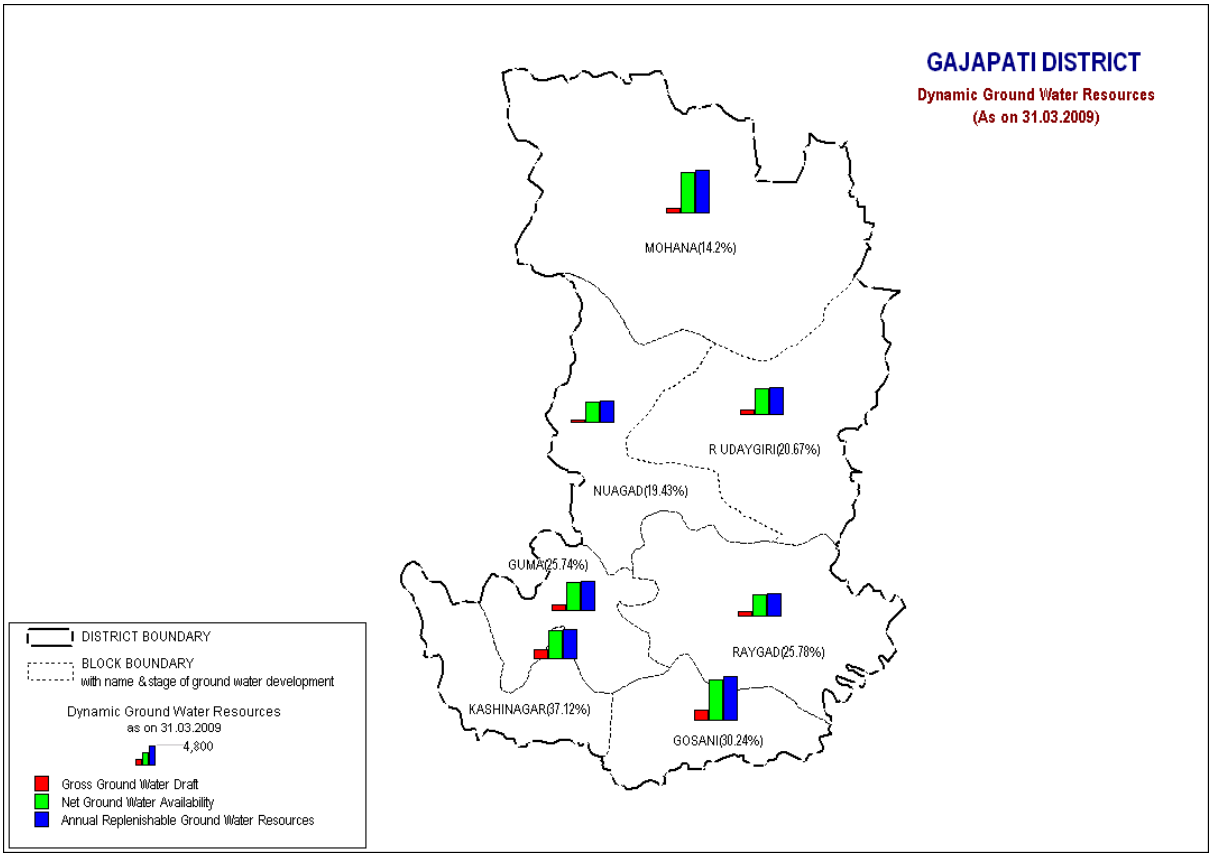
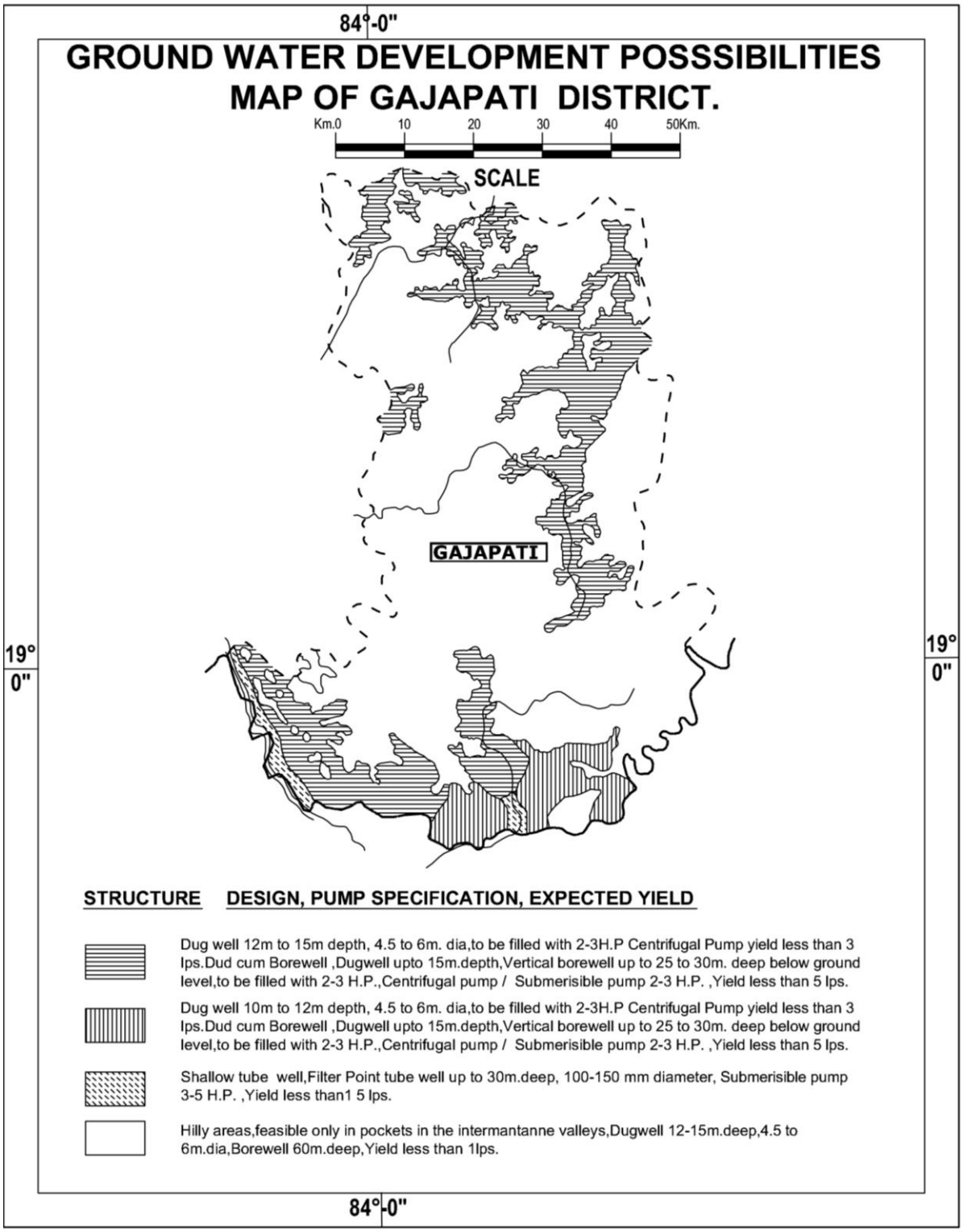
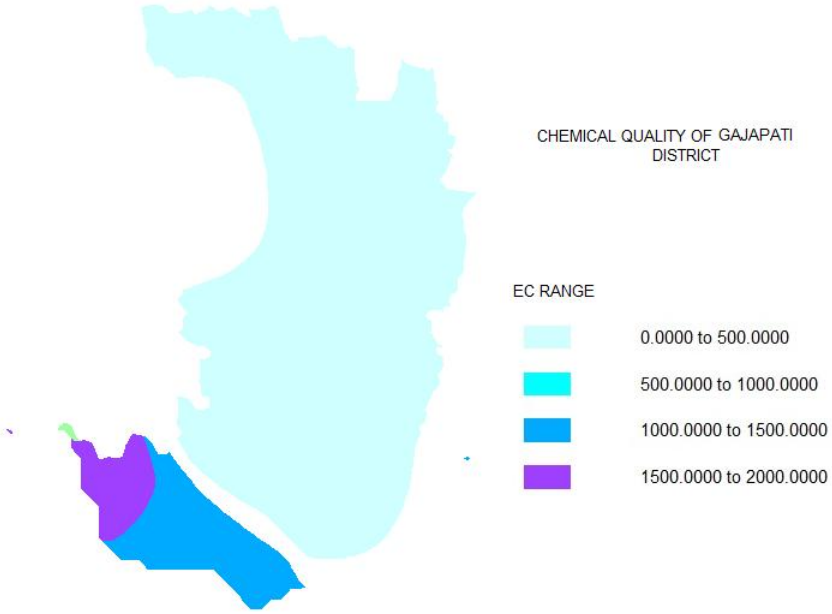



CGWB,SER,Drg.No.105 / 10(G.Patra)


GAJAPATI DISTRICT
Dynamic Ground Water Resources
(As on 31.03.2009)
MOHANA(14.2%)
R UDAYGIRI(20.67%)
NUAGAD(19.43%)
GUMA(25.74%)
RAYGAD(25.78%)
KASHINAGAR(37.12%)
GOSANI(30.24%)
DISTRICT BOUNDARY
BLOCK BOUNDARY
with name & stage of ground water development
Dynamic Ground Water Resources
as on 31.03.2009
4,800
Gross Ground Water Draft
Net Ground Water Availability
Annual Replenishable Ground Water Resources




CGWB,SER,Drg.No.106 / 10(G.Patra)


CHEMICAL QUALITY OF GAJAPATI DISTRICT
EC RANGE
0.0000 to 500.0000
500.0000 to 1000.0000
1000.0000 to 1500.0000
1500.0000 to 2000.0000