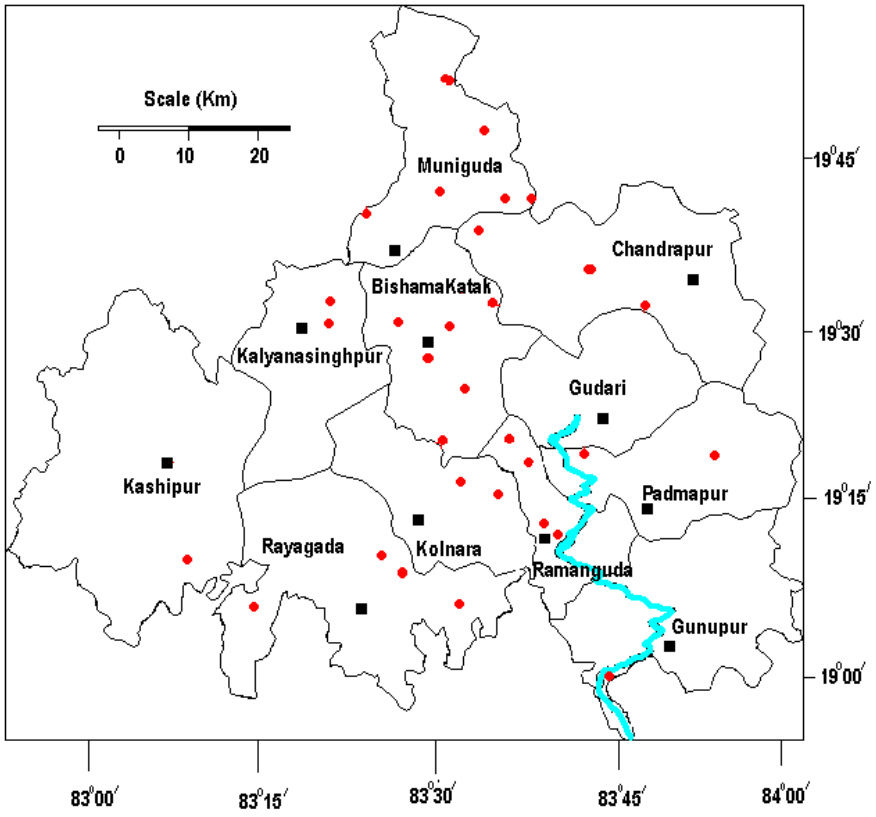
GROUND WATER INFORMATION BOOKLET

RAYGADA DISTRICT, ORISSA



Ministry of Water Resources
Central Ground Water Board,SER
Bhubaneswar
March, 2013

DISTRICT AT A GLANCE

Sr. No.	Items	Statistics
1	**GENERAL INFORMATION**	
	(i) Geographical Area (Sq. km) (ii) Number of Blocks (iii) Number of Panchayat (iv) Number of Villages (v) Population as on 2011 Census (vi) Average annual rainfall (mm)	7073 11 171 2667 961,959 1521.5
2	**GEOMORPHOLOGY** 1.Major Physiographic Units	(i)Undulating plains dotted with residual hills (ii)Scattered hill with high relief
	2.Major Drainages	Vamsadhara & Nagavalli
3	**LAND USE (SQ KM)** a) Forest Area b) Net Area Sown	10000.0 14000.0
4	**MAJOR SOIL TYPE**	Alfisol, Entisols
5	**AREA UNDER PRINCIPAL CROPS**	1. Autumn – 126166 Ha 2. Winter – 1449577 Ha 3. Summer – 53586 Ha
6	**IRRIGATION BY DIFFERENT SOURCES (Area and nos of structures)** 1. Canals	(i) Major & Minor Irrigation Project – 9800 Ha. (ii) Minor Irrigation Project (Flow) – 23260 Ha(Kharif); 5420(Rabi) (iii) Lift Irrigation Project – 17033 (Kharif); 9714(Rabi)
	2. Net Irrigated Area	30006 Ha (Kharif) 5924 Ha(Rabi)

7	**NUMBER OF GROUN WATER MONITORING WELLS OF CGWB (as on 31.3.2011)** 1. No of BoreWells 2. Nos of Piezometers	 39 Nil
8	**PREDOMINANT GEOLOGICAL FORMATIONS**	(i) Eastern Ghat Supergroup of Rocks (Precambrian Crystalline Rocks) (ii) Quternaries
9	**HYDROGEOLOGY** • Major Water Bearing Formations • Pre-Monsoon Depth to Water Level during 2006 • Post-Monsoon Depth to Water Level during 2006 • Long Term water level trend in 10 yrs (1997-2006) in m/yr	 Weathered & Fractured Crystalline Rocks 1.05 mbgl to 12.99 mbgl 1.14 mbgl to 11.62 mbgl 53.8% of wells show rise from 0-2m, 7.7% wells show rise from 2-4 m (Pre-monsoon). 58.8% of wells show rise in 0-2 m, 11.8% of wells show rise from 2-4 m (Post monsoon).
10	**GROUND WATER EXPLORATION BY CGWB (As on 31.3.2011)** No of wells drilled (EW,OW,Pz,SH,Total) Depth Range (m) Discharge (lps) Transmissivity(m ²/day)	 E/W - 15 (Departmental) O/W – 4 (do) E/W-18 (Outsourcing) Total – 34. 90 – 200m Negligible to 25 0.5 to 116
11	**GROUND WATER QUALITY** Presence of Chemical constituents more than permissible limit (e.g. EC ,F,AS, Fe) Type of water	 EC and F value higher in limited patches. Normal(pH 7.12 to 8.19 mg/ltr)

12	**DYNAMIC GROUND WATER RESOURCES (2009 in mcm)** 1. Annual replenishable Ground Water Resources 2. Net Annual Ground Water Draft 3. Projected demand for domestic and industrial uses up to 25 years 4. Stage of Ground Water Development	 656.81 94.85 27.99 14.44%
13	**AWARENESS AND TRAINING ACTIVITY** Mass Awareness Programmes organized Data Place No of Participiants	 Nil
	Water Management and Training Programmes Organised Data Place No of Participiants	Nil
14	**EFFORTS OF ARTIFICIAL RECHARGE & RAIN WATER HARVESTING** Projects compiled by CGWB (No & Amont spent) Projects under technical guidance of CGWB (numbers)	 Nil Nil
15	**GROUND WATER CONTROL AND REGULATION** No of OE Blocks No of Critical Blocks No of Blocks Notified	 Nil Nil Nil
16	**MAJOR GROUND WATER PROBLEMS AND ISSUES**	Groundwater pollution & depletion in parts of blocks

GROUNDWATER BROCHURE OF RAYGADA DISTRICT, ORISSA

C O N T E N T S

1.0 INTRODUCTION

Raygada was conferred the status of district in the early part of 1992, when erstwhile Koraput district was divided into four new districts. About 94% of the population of the district live in the rural areas and depend for their livelihood largely on agriculture. However, the irrigation facilities existing in the district are limited, leaving agriculture to the mercy of the monsoon. Hence necessity for optimal utilisation of the existing water resources in the district is rather compelling while terrain conditions restrict the scope of surface water development. Raygada districts situated in the south western part of Orissa lying between the north latitudes 18^0 $54^/$ and 20^0 $00^/$ N and east longitudes 82^0 $54^/$ and $82^0$$02^{'}$ E, falling in Survey of India degree sheet Nos. 65 I, M,N and 74A and I. It is bordered by Kalahandi Phulbani district of Orissa in North and Gajapati district of Orissa in the South. The district covers an area of 7073 sq. km. and is divided into 10 administrative blocks (Plate I). The district headquarters at Nawrangpur approachable by National Highway 43 which passes through southern border of the district and connects the headquarters Vishakhapatnam port. The major towns of the district are connected to the district headquarters by road.

The Vamsadhara and Nagavally rivers river is the most prominent river in the district. It is a tributary of the Godavari and sustains perennial flow. It originates in the Kalahandi district flows through Nawarangpur and Koraput districts and enters in Bastar district of Madhya Pradesh. The Tel and Bhaskel are the other rivers flowing through the district.

The district has limited irrigation facilities as per available data. The net irrigated area from different sources is 30006 ha and 5924 Ha for Kharif and Ravi resp.

Sl.No.	**Source**	**Irrigated area (Ha)**	
		Kharif	**Rabi**
1	Major / Medium Irrigation Projects	9824	2633
2	Minor Irrigation Projects	16960	1048
3	River lift Projects	3222	2243
4	Other sources (Tanks, Nala, etc.)		
5	Groundwater Source		
	Total :-	**30006**	**5924**

The area has been covered by Systematic Geological Mapping by Officers of G.S.I. The Systematic Hydrogeological Surveys were carried out by Sh. M.V.Rao (1977-78), Sh. S.N.Sar (1978-79), Sh. B.B.Basak(1979-80) and Sh. R.N.Sharma (1979 – 80) of CGWB.. The Reappraisal hydrogeological surveys were conducted on 1:50,000 scale by Sh. N. Vinaychandran(1989-90), Sh. D.P.Pati and Sh S. Brahma (1994-95),

Ground water exploration by deep drilling upto 200m has been taken up in the district and 29 nos. exploratory wells so far has been drilled to delineate the deeper potential water saturated fracture zones. The location of the wells are depicted in Plate –I Ground water monitoring is being done through 21 hydrograph network stations four times in a year.

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2.0 RAINFALL & CLIMATE

The climate of the district is typically tropical to subtropical with three distinct seasons e.g. summer, winter, and monsoon. December is the coldest month with mean daily average temperature of 20^{o} C which reaches a maximum of 42^{0} C in May. The rain fall in the area is mostly from the south west monsoon lasts from middle of June to October. The average annual rainfall varies from 1030.21 mm to 1569.50 mm.

3.0 GEOMORPHOLOGY & SOIL TYPES

The district has varied geomorphological features. The geomorphic units are (i) Lateritic Upland, (ii) Pediplane, (iii) Denudational Hills, (iv) Flood Plain, (v) Structural Hills, (vi) Inselberg, (vii) Mesa & Butte, (viii) Residual Hills, (ix) Intermontane Valleys, (x) Bazada (Plate-V).

The distribution of different soil types in the district depends much on its physiographic and lithologic variations. Based on the physical and chemical characteristics, mode of origin and occurrence, soils of the district may be classified into two groups namely Alfisols and Entisols.

Alfisols : It includes red sandy soils and red loamy soils. The red loamy and sandy soils are occurring in throughout the district. The characteristic features of red soils are (1) light texture, porous and friable structure, (2) absence of lime Kankar and free carbonates and (3) soluble salts in a small quantity usually not exceeding 0.05%. These are usually deficient in nitrogen, phosphate, organic matter and lime. These soils are suitable for cultivation of paddy and other crops.

Entisols : These are restricted to the flood plains of Vamsadhara and Nagavalli rivers in the blocks of Ramanguda, Gudari, Padampur, Raygada and Kolnara and consists of sand, silt and clay. This type of soil is alkaline in nature and deficient in nitrogen and humus material. The district belongs to the North Eastern Ghat agro climatic zone.

4.0 GROUNDWATER SCENARIO

4.1 Hydrogeology

The hydrogeological conditions vary from place to place depending upon the aquifer characteristics of the litho units, sources of groundwater recharge and the structural setting of the area. The hydrogeological units of the area are broadly categorized into three groups namely:

A. Consolidated formations.
B. Semi Consolidated formations
C. Unconsolidated formations

Consolidated Formations:- The weathered and fractured granites, granite gneisses and their variants, khondalites, charnockites etc. are the most predominant rock types in the district. These are characterized by development of secondary porosity. The secondary porosity in the consolidated formations developed as a result of weathering and fracturing due to major and minor tectonic movements from the conduits for movement of groundwater as also act as reservoir of groundwater. Generally the secondary porosity in the consolidated formations developed as a result of weathering and fracturing due to major and minor tectonic movements form conduits for movement of groundwater as also act as reservoir of ground water. Generally the secondary porosity developed in the crystallines is non uniform in distribution. This fractured and jointed rocks when interconnected form potential aquifers, which sustain limited to moderate yield.

Semi-consolidated formations:- Porous laterites occurring as discontinuous capping over older formations. These posses both primary and secondary porosities.

Unconsolidated formations:- Recent alluvium occurring as valley fills of the rivers, Vamsadhara & Nagavalli are characterized by primary porosity. Recent alluvial deposits formed in the river valleys of Vamsadhara and Nagavalli, are the most potential. The occurrence and movement of ground water in the alluvium are characerised by more or less homogenous hydrogeological properties.

Water bearing properties of the Consolidated formations:

Granites and Granite Gneisses: The granite and granite gneisses with leaching out of kaolinised clay these rocks on weathering reduce to porous granular materials. The thickness of weathered mantle is an average 10 m. The weathered as also fractured and fissures intersecting system of granite gneisses in topographic lows form potential aquifers. It is in these hydrogeologically favourable locales that groundwater structures are successful and well yields are relatively high. The yield of the wells depends upon the thickness of the saturated zone as also number of fractures tapped. The open wells generally range from 7.3m to 8.5m. The depth to water table during premonsoon season is between 1.72 m to 11.70 m below ground level and during post monsoon season between 0.50 m to 9.80 m below ground level. The seasonal fluctuation of water level is between 0.67 m to 7.28 m. Specific capacity index of wells in this formation ranges from 1 lpm/m/m^2 to 14 lpm/m/m^2 , the transmissivity values of the formation range from 0.5 m^2/day to 116 m^2/day. The yield

of the open wells in Granitic Gneissic terrain is generally upto 3 lps. However generally the bore wells in this formation yield upto 10 lps.

Khondalites : Khondalites are actually metasediments and occupy mainly ridges and hills, covered with thick forests and profuse vegetation. Khondalites have undergone high degree of weathering down to a depth of more than 20 meters. Although the interlacing joints and sheared surfaces, from potential receptacles of groundwater, preponderance of clayey material reduces the permeability of the formation. The depth of open wells in this formation generally varies between 7 m to 8 m. The depth to water level during premonsoon period varies between 2.62 to 9.13 m below ground level and during post monsoon period between 0.86 m to 6.96 m below ground level. The seasonal water table fluctuation is between 1.20 m to 4.14m.The pumping test analysis in the open wells indicate that specific capacity index of the formation varies between 1.00 to 13 lpm/m/m^2 . The yield of the dugwells is upto 3 lps.

Charnockites: The Charnockitic rocks in the area are generally devoid of significant ground water storage due to lack of well connected joints and fractures. Very few wells exist in this formation. The average depth of open wells vary between 4 to 20m. The depth to water level during premonsoon period varies between 3.34 to 16.39 m below ground level and during post monsoon period it ranges between 0.64 to 16.39 m below ground level. The water level fluctuation between premonsoon and post monsoon period varies from 0.07 to 3.09 m. The aquifer characteristics of the formatuion could not be ascertained for want of facilities for conducting hydraulic tests on wells tapping charnockites.

Semi-Consolidated Formation:

Laterites : Porous laterites are formed as capping over the crystalline hardrocks in the upland areas like the Raygada-Kolnara uplands, Kailashkota, Ramanguda, Gudari section etc. Due to restricted areal extent these rocks do not contribute as potential aquifers.

Unconsolidated Formation:

Alluvium: The alluvial deposits in the flood plains of the Vamsadhara and Nagavali rivers form the most potential aquifer system of the district. The borehole data reveals that there is a sub surface disposition of aquifers in parts of the Vamsadhara basin. The colluvium in the intermontane valleys also form rich aquifers. The alluvium comprises an admixture of gravel, sand and clay derived from eroded and weathered country rocks. Groundwater occurs in these deposits under both unconfined as well as semi confined conditions. A number of openwells and shallow tubewells vary between 0.90m to 13.05 m below ground level with an average depth of 5.5 m to 7.5 m below ground level.

Aquifer Characteristics of Crystalline: In the hard crystalline rock recharge of ground water from precipitation or seepage from surface water bodies percolate into the weathered (saprolite) zone. In case the underlying basement rocks (both weathered and fresh) are incised by open fractures, the downward movement of the water from the upper regolith zone (comprising the top soil and saprolite horizon) is facilitated. In the saprolite/regolith horizon ground water generally occurs under unconfined condition where as is the fractured bedrock aquifers it occurs under semi-confined to confined conditions. The ground water potentials of various zones i.e.

saprolite (tapped by dug wells), weathered basement rock and shallow fractured basement rock horizon (tapped by the hand pumps) and deeper fractured basement rock (tapped by the deep boreholes by CGWB) vary considerably depending upon their lithological and structural characteristics. Perusal of all result indicates that granite gneiss forms the most potential aquifer both in shallow and deeper horizons followed by Khondalite.
In Lateites the specific capacity Index of dug wells vary from 2.32-to 10.27-lpm/m/m^2.
In limited extant the alluvium forms potential shallow aquifers.

Groundwater Exploration
Exploratory drilling has been taken up by the Central Ground Water Board in Raygada district with the objective to delineate deeper water bearing fractures in the consolidated formation and their yield potentiality within a maximum depth of 200m. Till March 2011, 33exploratory and 4 observation wells were drilled in hard crystalline and semiconsolidated formations and 1 EW and 1 OW drilled in unconsolidated formation in the district under Normal Ground Water Exploration Programme and Accelerated Exploration Drilling Programme. The depth range of these wells varies from 32m to 200 m below ground level. The thickness of the overburden ranges from 5.5 to 35.5m. The yield of exploratory wells vary from negligible to 25 LPS. Formation wise yield range of the wells is given in the table 4.1.

Table 4.1 Details of Exploration (Litho unit wise)

Lithological Unit	No. of Wells	Depth range of wells (mbgl)	No. of wells with yield (LPS)		
			<2	2-5	>5
Granite and granite gneisses	25	82.1-200	8	4	2
Khondalites, Charnokites and Calc silicate rocks	12	141-193	2	3	1
Sandstone and shale	2	125-200	3	2	2

Depth to Water Level (Pre-monsoon and Post-monsoon, 2006)

The depth to water level is measured from the 14 National Hydrograph Staions situated in different blocks of the Raygada District. The Pre monsoon, 2011 water level data varies from 1.05 mbgl to 12.99 mbgl. The shallow water level was measured from Padampur and the deepest water level was measured at Kashipur. The depth to water level map of pre -monsoon, 2011 is displayed in Plate II.

The depth to water level data of Post-monsoon, 2011 represents 1.14 mbgl to 11.62 mbgl. The Gunupur shows deepest water level and Raygada shows shallowest one. Plate III represents depth to water level map of post –monsoon, 2011.

Seasonal Fluctuation

The fluctuation of depth to water level in 2011 shows rise in water level from 2.95 to 7.37mbgl in all the NHS wells.

Long Term Water Level Trend in Last 10 years in Ground Water Monitoring wells

The long term trend (10 years) in water level for the **pre-monsoon** shows rise of 0-2m in 53.8% of wells and 2-4 m rise in 7.7% of wells in Raygada district. It represents 30.7% of wells fall between 0-2 m and 7.7% fall between 2-4 m.
The long term trend of (10 years) in water level for **post monsoon** season shows rise in water level for 0-2m in 58.8% of wells and 2-4 m rise in 11.8% wells in the district Only 29.4 % wells show fall between 0-2 m..

4.1 Ground Water Resources

The Ground Water Resources of the district has been assessed adopting the methodology recommended by the Groundwater Estimation Committee (1997), constituted by Govt. of India. The task was jointly carried out by the Central Ground Water Board and Ground water Survey & Investigation, Department of Water Resources, Govt. of Orissa. The block wise computation of ground water resources in the district has been presented in Table 4.3. The Annual replenishable ground water resources in the district are computed as 628.83 MCM, out of which the existing Ground Water Draft for irrigation is 46.9 MCM. The ground water draft for irrigation is through dug wells and shallow tube wells. A large number of hand pumps fitted in PHED bore wells and tube wells also cater to the rural and urban water supply needs. On the basis of the estimated ground water potentials a detailed scheme for ground water development may be launched in the district. So far ground water development in the district has been meager, and all the blocks fall under the safe category. The stage of ground water development varies from 8.57% to 25.78% in different blocks. The overall Stage of Groundwater development of the district is 14.44%. There is ample scope for stepping up ground water development in the district. The ground water budget of the district is presented in Plate No. IV.

Table 4.3 : Stage of Ground Water Development Of Raygada District, Blockwise as on 31st March , 2009

Sl No	Block	Net Annual Ground Water Availability	Existing Gross Ground Water Draft for Irrigation	Existing Gross Ground Water Draft for domestic & Industrial Supply	Existing Gross Ground Water Draft for all uses	Provision for domestic & industrial requirement supply for next 25 years	Net Ground Water Availability for future irrigation development	Stage of Ground Water Development
		(ham)	(ham)	(ham)	(ham)	(ham)	(ham)	(%)
1	2	3	4	5	6	7	8	9
1	Bisamcuttack	5110.00	325.00	263.06	588.00	303.00	4481.00	11.51
2	Chandrapur	3886.00	208.00	96.00	304.00	118.00	3560.00	7.82
3	Gudari	7113.00	945.00	116.97	1062.00	127.00	6042.00	14.93
4	Gunupur	6361.00	1430.00	209.39	1640.00	212.00	4718.00	25.78
5	Kalyansinghpur	4922.00	212.00	210.10	422.00	313.00	4396.00	8.57
6	Kashipur	5626.00	213.00	334.00	547.00	443.00	4970.00	9.72
7	Kolnara	4707.00	318.00	235.46	554.00	254.00	4135.00	11.77
8	Muniguda	6937.00	435.00	316.01	751.00	278.00	6224.00	10.83
9	Padmapur	7773.00	835.00	205.46	1040.00	183.00	6755.00	13.38
10	Ramanaguda	7146.00	1285.00	165.01	1450.00	165.00	5696.00	20.29
11	Rayagada	6100.00	543.00	583.41	1127.00	403.00	5154.00	18.48
	District Total	65681.00	6749.00	2735.00	9485.00	2799.00	56131.00	14.44

Ground Water Quality

The chemical quality of ground water in the district has been assessed on the basis of ground water samples collected during ground water monitoring, hydrogeological surveys and ground water exploration.

The ground water quality is slightly alkaline type (pH ranging from 7.16 to 8.25). The electrical conductance varies from 162 μS/cm to 1103 μS/cm except at Kumudwali of Muniguda block of Raygada district where the EC value is found to be 2200 μS/cm The chloride value at Kumudwali also shows high value of 550 mg/l.The fluoride content of the ground water is generally low except in case of Raygada where value of 1.4 mg/l has been observed. The iron content of water exceeded the maximum permissible limit of 1.0 mg/l at Raygagada (1.6 mg/l), Kalyansinghpur (1.2 mg/l), Kutraguda (1.9mg/l) and Muniguda (1.57 mg/l).

The ground water in deeper aquifers in the districts in general is suitable for drinking purposes as such values are within permissible limit of drinking water standard except in very rare cases.
The ground water suitable for irrigation purposes for all the soil type and crops. The most common class of irrigation water is C_2S_1 class.

It may be noted that about 100% of the groundwater samples collected from the phreatic and deeper aquifers are good for irrigation purposes.

Table 4.4 The chemical analysis data of few NHS.

Location	District	pH	E.C µ S/cm *at 25 ^0C*	Cl	NO_3	F	Fe
				<----------mg/L---------->			
GORAKHPUR	RAYAGADA	8.20	140	10.6	3.0	0.07	0.46
KASHIPUR	RAYAGADA	7.98	297	14.2	21.0	0.24	0.50
RAYAGADA	RAYAGADA	8.18	506	35.5	25.0	0.35	0.00
MUKUNDPUR	RAYAGADA	8.12	236	17.7	7.6	0.24	0.07
SHIRIKONA	RAYAGADA	8.14	602	24.8	13.0	0.45	0.01
DURGI	RAYAGADA	8.22	995	102.8	30.0	0.49	0.08
THERABALI	RAYAGADA	8.17	847	99.3	8.6	0.34	0.00
NARAINPUR	RAYAGADA	8.23	218	17.7	5.6	0.20	0.44
PADAMPUR	RAYAGADA	8.25	629	67.4	26.0	0.27	0.01
GUMDA	RAYAGADA	8.24	1117	106.4	12.0	0.75	0.03
GUMMA	RAYAGADA	8.19	437	14.2	0.8	0.54	0.10
KUTRAGUDA	RAYAGADA	8.28	185	7.0	1.0	0.41	1.90
DONGASURDA	RAYAGADA	8.17	361	14.0	25.0	0.52	
MUNIGUDA	RAYAGADA	8.27	185	7.0	1.0	0.46	1.57

4.4 Status of Ground Water Development

Ground water development in the district is mainly through dug wells, Dug-cum-bore wells and bore wells. Ground water is mainly used for domestic and irrigation purpose and in limited scale for industrial purposes. The stage of development of Ground Water in the district is low. So far only 12.74% of its resources has been exploited. Hence a strategy for detailed ground water development is required. The hydrogeological, remote sensing studies and ground water exploration so far carried out in the district depict the tentative possibilities of ground water development through suitable ground water abstraction structures in various hydrogeological settings (Plate –VI).

Dugwells : The wells may be sited in the topographic lows and should tap the maximum saturated thickness of the weathered zone. The depth of the dugwells may vary from 9 to 12m with 4.5m to 6m diameter. The wells may be fitted with 1.5 to 2 H.P. centrifugal pumps. The wells may sustain yield maximum up to 3 lps.

Dug-cum-borewells : Dug-cum-borewells may drilled down to a depth of 25 to 30m below ground level, tapping the saturated shallow fracture below the regolith and in

top portion of the hard basement. The wells should be fitted with 2 H.P. centrifugal / submersible pumps may sustain yield up to 3 lps.

Borewells : Borewells may tap the deeper saturated fractures found to occur in the depth range of 100 to 120m. The borewells should be 100 to 150mm. diameter and may be flitted with submersible pumps of 2 to 2.5H.P. capacities. The wells drilled in the vicinity of NNW-SSE and NE-SW trending lineaments are likely to be successful which has been established based on exploratory drilling by CGWB in the Western and Southern tracts of the district. The suitable sites for drilling may be selected in the district with the aid of Remote Sensing studies, Surface Geological, hydrogeological and Geophysical surveys.

Shallow tube well: These structures are feasible in the blocks of Gudari, Gunupur, Padampur, Kolnara, Ramanguda and Rayagada in the flood plain deposits of the Vamsadhara and Nagavalli rivers. The depth of the tube well will be within 50 m.

Since the surface water resources are inadequate and the district often comes under the grip of drought, development of ground water resources may help in expanding irrigated agriculture in the district. An optimal utilisation of ground water in the district requires adoption of a suitable cropping pattern and energisation of the wells. The ground water structures feasible as per Study Group Report (March, 2004) has been given in Table below.

District	No. of additional GW structures feasible for irrigation use			
	MDTW	SDTW	FPTW	DW
Raygada	0	228	387	35715

5.0 Ground Water Management Strategy

Ground water development: The existing irrigation facilities of t he district are inadequate to meet the requirement of agricultural production. There is large scope for groundwater development by sinking open wells, dug cum bore wells, bore wells and tube wells as hydrogeologically feasible areas.

Artificial Recharge & Rainwater Harvesting: Although Raygada district does not represents drastic fall of depth to water level then also there are scope for implementating artificial recharge structure and rainwater harvesting structures here. The district shows rugged terrain where there is high surface run off in comparison to the rate of infiltration. The ground water resource can be augmented through adoption of artificial recharge techniques like construction of sub surface dykes, percolation tank, gully plugging etc.

6.0 Ground Water related issues & Problems

Ground Water Problems : There is no significant ground water problems. There are water quality problems in very few locales of the district.

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Ground Water Quality Problem : Based on the chemical analyses of water samples collected from different aquifers, it is observed that there is a very limited Ground water Quaity problem in limited locatons. The electrical conductance varies from 162 μS/cm to 1103 μS/cm except at Kumudwali of Muniguda block of Raygada district where the EC value is found to be 2200 μS/cm The chloride value at Kumudwali also shows high value of 550 mg/l.The fluoride content of the ground water is generally low except in case of Raygada where value of 1.4 mg/l has been observed. The iron content of water exceeded the maximum permissible limit of 1.0 mg/l at Raygada (1.6 mg/l), Kalyansinghpur (1.2 mg/l), Kutraguda (1.9mg/l) and Muniguda (1.57 mg/l).

7.0 Awareness & Training Activity

There was no Mass Awareness & Training Activity in the district of Raygada.

8.0 Areas Notified by CGWA

The stage of Groundwater development is well within Safe Category and there is no overexploitation and major threat of Groundwater pollution and depletion. Hence no area has been notified by CGWA.

9.0 Recommendations

1. Large scale planning for Ground Water Resources development should be preceded by intensive hydrogeological and geophysical survey aided by Remote Sensing studies and ground truth data.

2. Bore wells/dug wells should be located in the vicinity of NNW-SSE and NE-SW trending lineaments which have been proved to be high yielding & productive and in thickly buried pediment areas.

3. Existing dug wells should be deepened to tap the maximum saturated thickness of the weathered mantle or vertical bores maybe drilled to enhance the yield of the well where normally the dug wells get dried up.

4. Energisation of wells should be stepped up to ensure optimal utilisation of the ground water resources to create additional irrigation potential.

5. The State Ground Water Organization should render expert guidance for siting ground water structures in favourable hydrogeological settings.

6. The farmers should be educated through agricultural extension services, Mass Awareness and water management training programme to adopt suitable

cropping pattern, conservation of ground water and irrigation practices especially for drought tolerant crops for optimal utilisation of available ground water resources.

7. Programme for artificial recharge may also be taken up in areas where deeper water table condition coupled with high fluctuation is observed for augmentation of ground water resources through construction of percolation tanks, subsurface dykes, check dams, nala bunding and contour bunding and other site specific favourable artificial recharge structures.
In areas of shallow water table lying with in 0 to 5 m bgl during post monsoon period, surface water bodies like local ponds, farm ponds and small earthen dam along small streams may be constructed to hold water for long duration and for replenishment of soil moisture.

8. For augmentation of drinking water supply to the major towns and villages near the major rivers, infiltration galleries or collector wells may be constructed in suitable locales to fruitfully harness the base flow /subsurface flow which otherwise goes as waste.

Growing of sugarcane and cash crops may be encouraged along the thin linear alluvial patches lying adjacent to major rivers where prolific ground water is available throughout the year.

Plate - I

INDEX MAP OF RAYGADA MAP

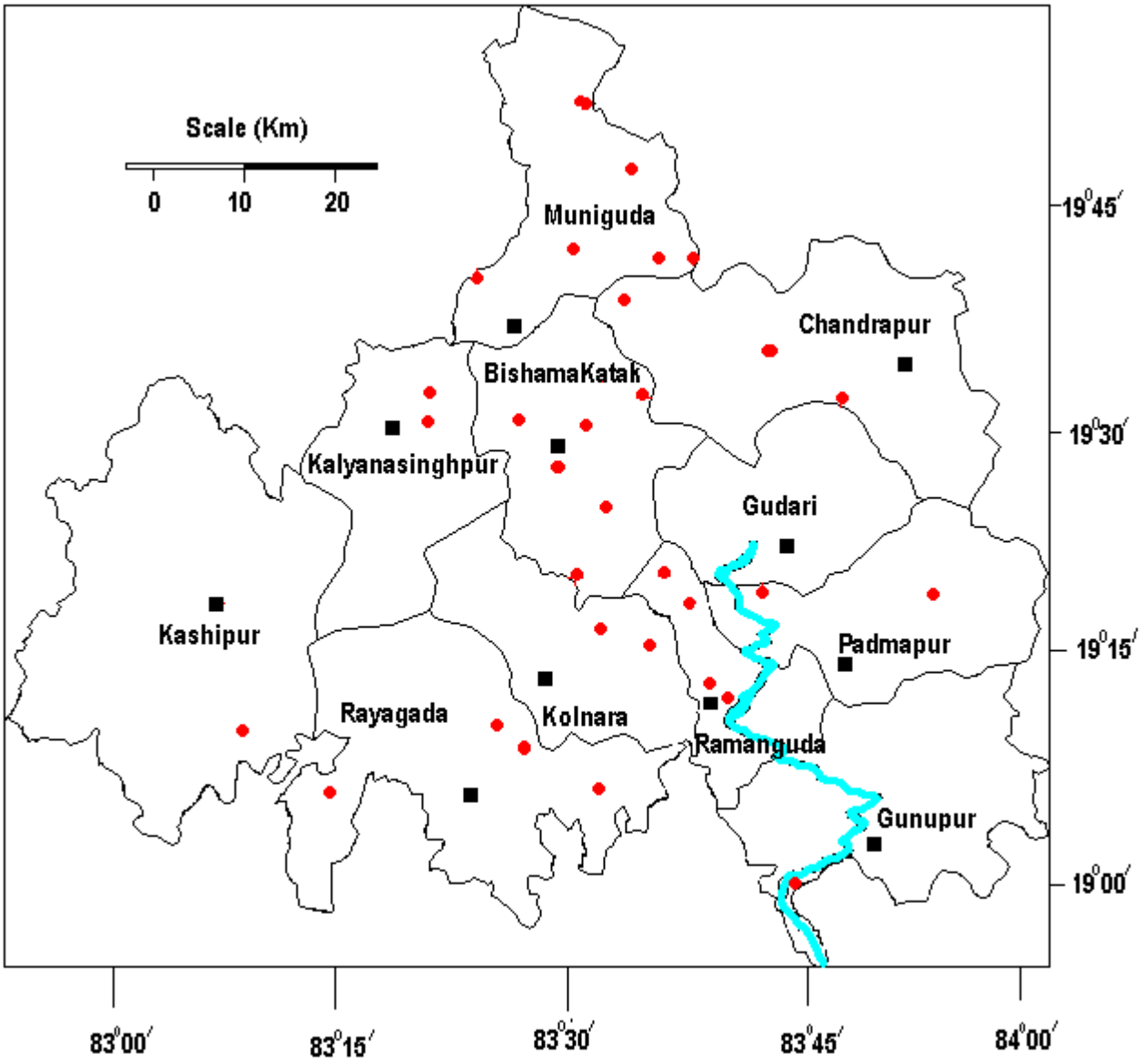


Plate -II

PRE MONSOON DEPTH TO WATER LEVEL MAP

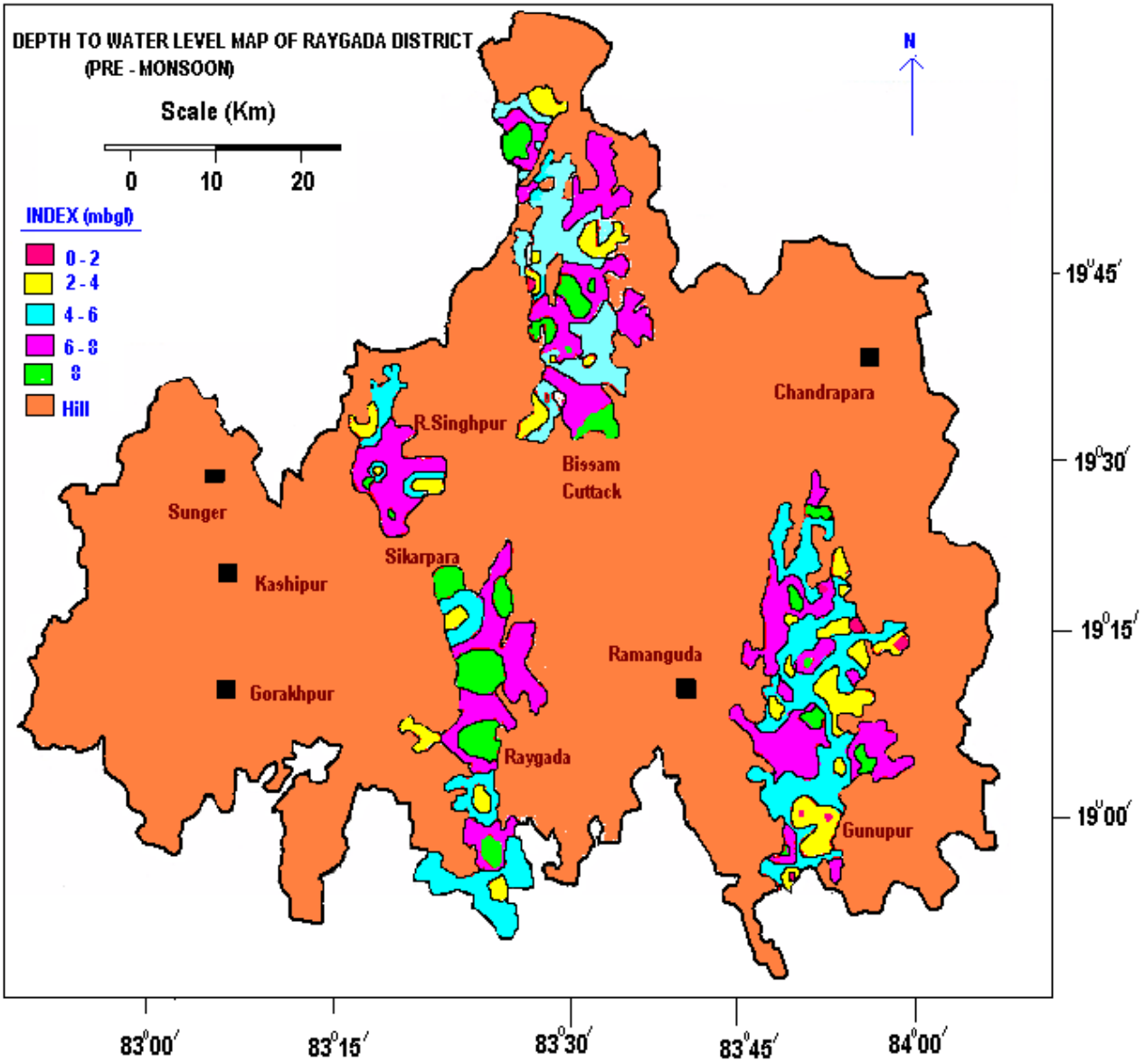


Plate III

POST MONSOON DEPTH TO WATER LEVEL MAP

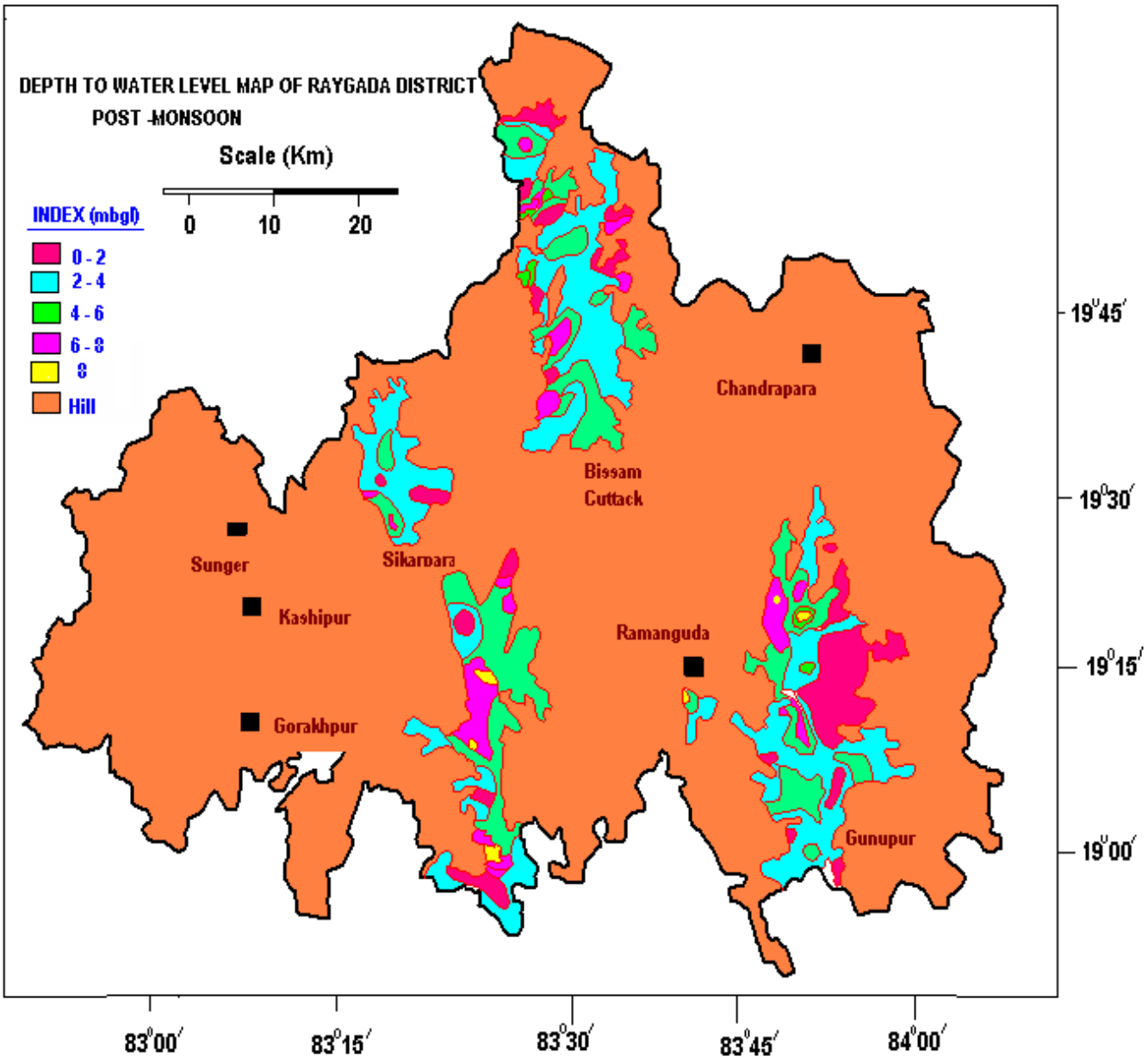
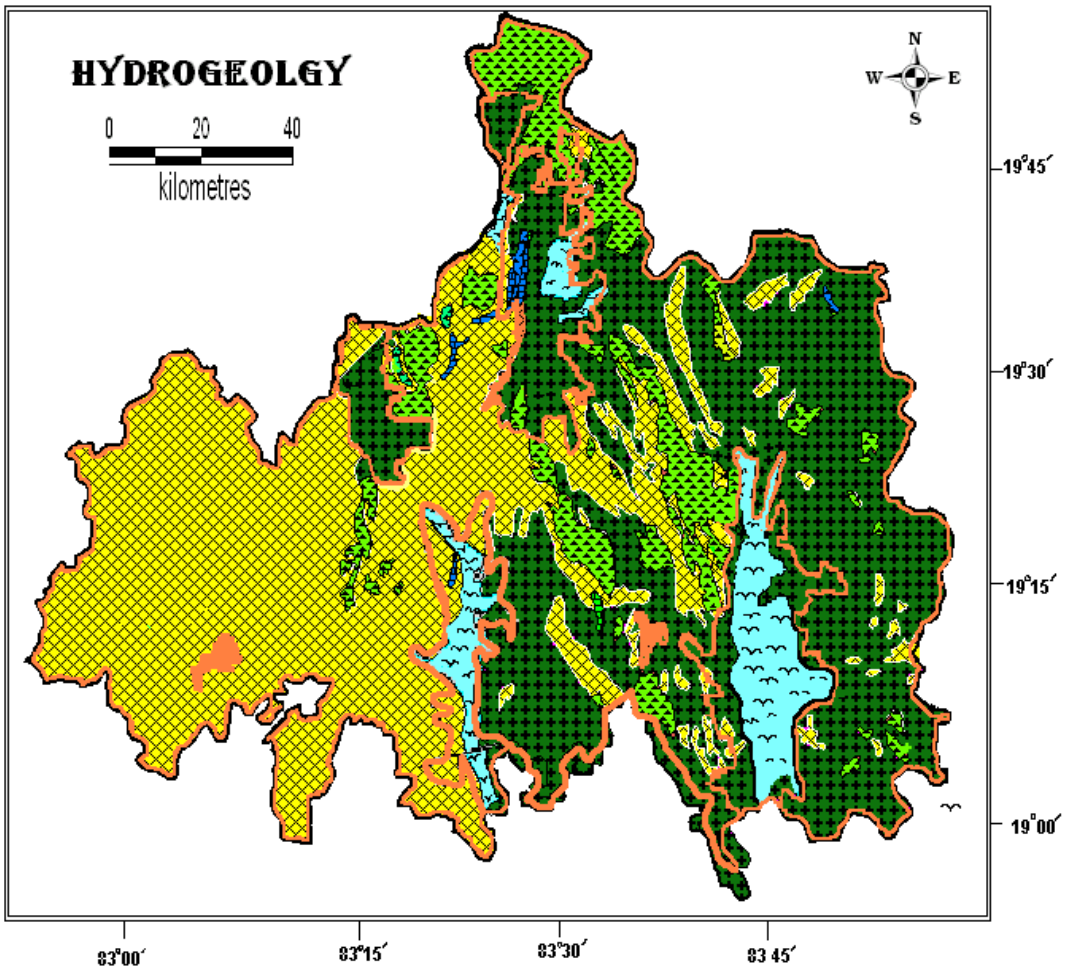


Plate IV



LEGEND

Lithology	Hydrogeological Condition	Ground Water Potential
Alluvium	Groundwater occurs in primary porosities;maximum depth range 40 to 45 m.b.gl; pre-monsoon depth to water level ranges between 1.27 to 10.22 m.b.g.l and seasonal fluctuation ranges between 0.05 to 3.54 m.b.g.l.	Yield : 9.5 to 24.0 lps (tubewell) 0.95 to 3.17 lps(dugwell)
Laterite	Groundwater occurs in porous secondary capping on parent rock viz. khondalite restricted in areal extent when associated with khondalite hydrogeology similar to later	Yield : 3 lps
Charnokite	Groundwater occurs in secondary joints and fractures; which are generally sparse and not inter connected, relatively not good aquifercompared to other formations, pre-monsoon DTW rages between 7.02 to 14.37 m.b.g.l.	Yield : 3 lps
Khondalite	Groundwater occurs in weathered residuum secondary joints and fractures, pre-monsoon DTW ranges between 0.65 to 13.54 m.b.g.l, seasonal fluctuation from 0.40 to 8.16 m.b.g.l	Yield upto 6 lps
Granite gneiss/ granite	Groundwater occurs in weathered residuum, secondary joints and fractures, pre-monsoon DTW ranges between 0.40 to 11.33 m.b.gl, season fluctuation from 0.27 to 7.17 m.b.g.l.	Yield upto 20 lps (Borewell) upto 3 lps (Dugwell)
Hills		

Plate - V

GROUND WATER RESOURCE POTENTIAL OF RAYGADA DISTRICT

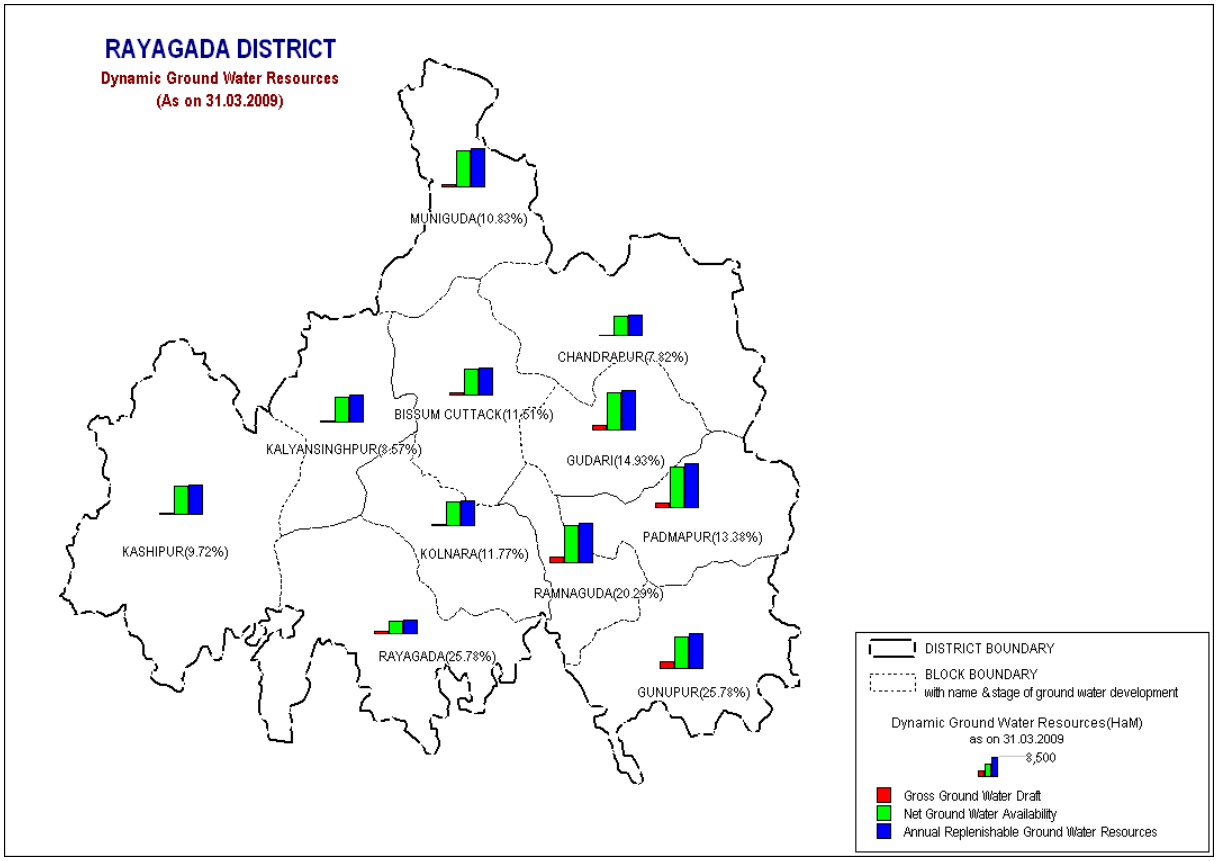
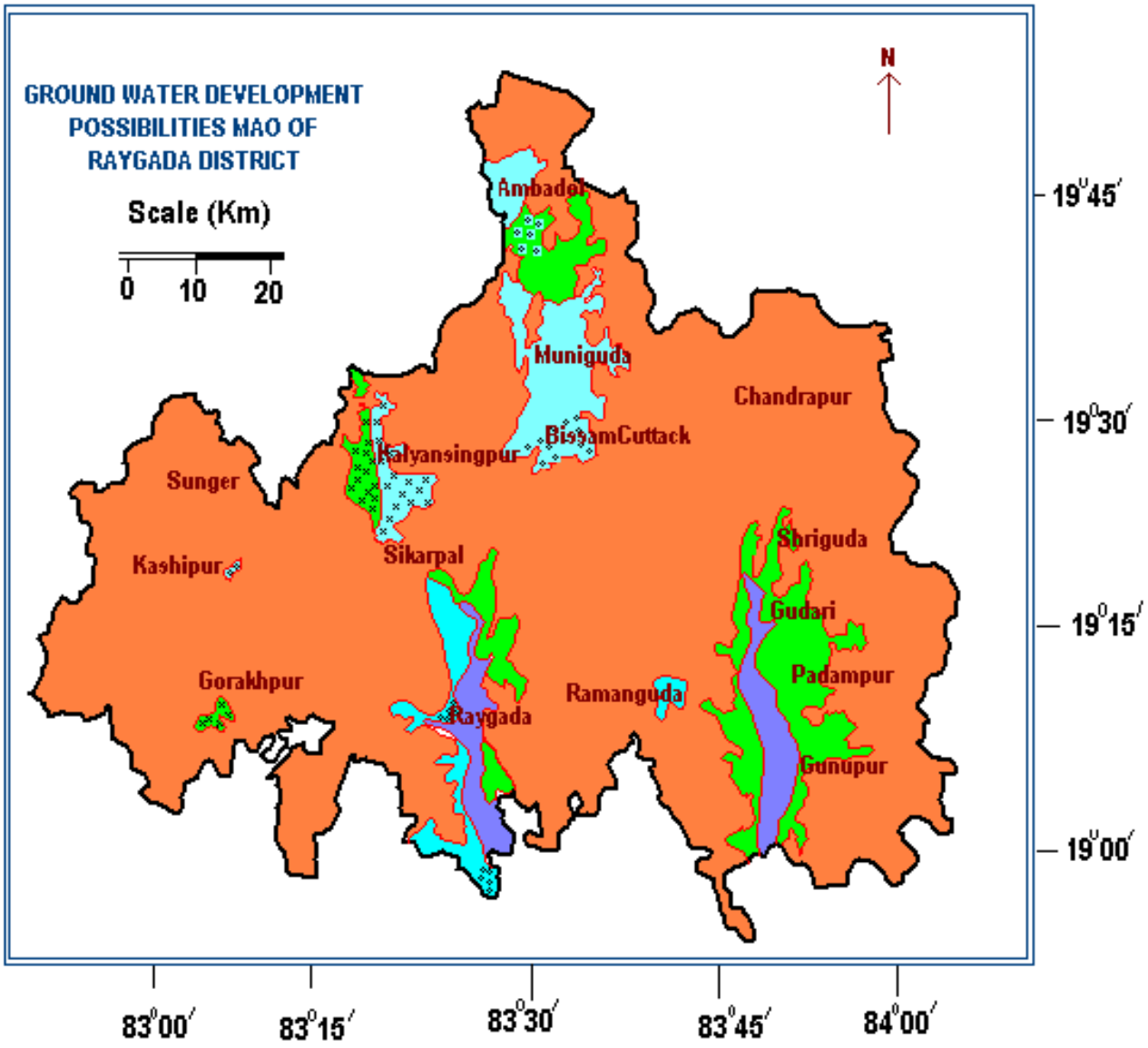


Plate -VI



LEGEND

Dugwell ; 10-12m Deep, 4.5-6.0m dia , Centrifugal Pump 2H.P.Yield < 3 lps

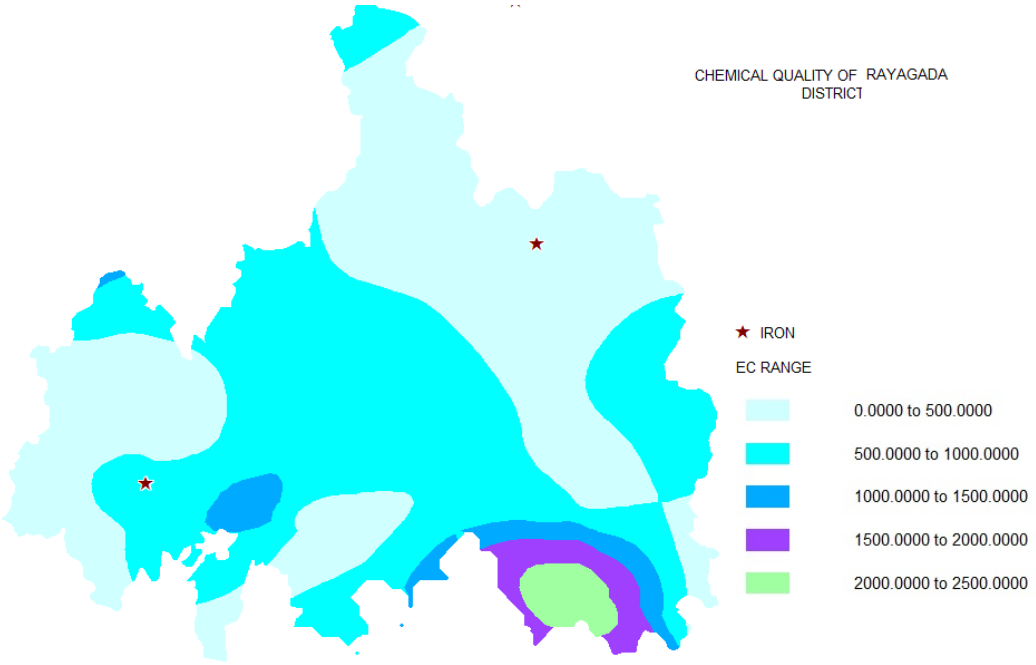
Dugwell ; 12 -15mDeep, 4.5-6.0m dia , Centrifugal Pump 2H.P.Yield < 3 lps
Dug cum borewell, Dugwell upto 15m, vertical bore upto 30m, deep below ground level, yield <5 lps

Shallow/Filter Point tube well, less than 50 m deep, Submersible Pump 3-10 H.P., Yield <20 lps

Bore well ; 100-150 m deep, 150mm dia submersible pump 3 H.P., Yield <5 lps

Borewell; 50-100m deep, 150mm dia submersible pump 2-3 H.P.,Yield <10 lps

Hilly area dugwell ; 12 -1 5 m deep 4.5 - 6.0 m dia; Borewell ; 80 - 100 m deep feasible in pockets in intermontane valley yields <1 lps (dugwell)/ <3 lps (Bore well)


CHEMICAL QUALITY OF RAYAGADA DISTRICT
IRON
EC RANGE
0.0000 to 500.0000
500.0000 to 1000.0000
1000.0000 to 1500.0000
1500.0000 to 2000.0000
2000.0000 to 2500.0000