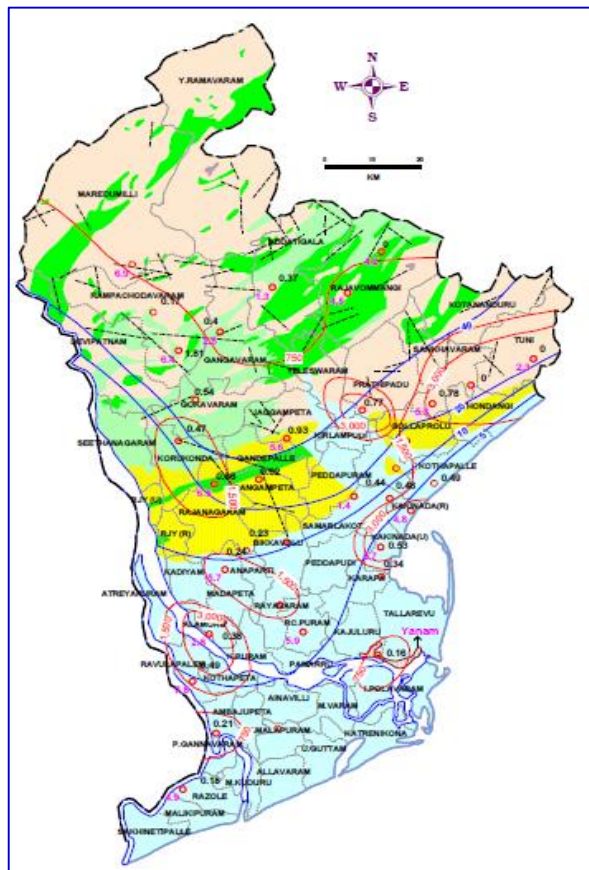


GROUND WATER BROCHURE

EAST GODAVARI DISTRICT, ANDHRA PRADESH



**SOUTHERN REGION
HYDERABAD
September 2013**



**CENTRAL GROUND WATER BOARD
MINISTRY OF WATER RESOURCES
GOVERNMENT OF INDIA**

**GROUND WATER BROCHURE
EAST GODAVARI DISTRICT, ANDHRA PRADESH
(AAP-2012-13)**

BY

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EAST GODAVARI DISTRICT AT A GLANCE

1. GENERAL INFORMATION

Geographical Areas	:	10,818 sq. km
Administrative Divisions		
District HQ	:	Kakinada
Mandals	:	57
Towns	:	22
Villages	:	1348
Population	:	51,51,549
Average Annual Rainfall	:	1100 mm
Annual Rainfall (2012)	:	1497 mm

2. GEOMORPHOLOGY

Major Physiographic Units	:	Deltaic Plain Upland Region Hilly Region
Major Drainage	:	Godavari

3. LAND USE (Area in Ha.)

Forest Area	:	3,23,244
Net Area Sown	:	419433
Cultivable waste	:	16886

4. SOIL TYPE

:	Clayey Soil Deltaic Alluvial Soil Coastal Sandy Soil Lateritic Soil
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5. IRRIGATION BY DIFFERENT SOURCES (Area in Ha.)

Dug Wells/Tube wells/ Bore wells	:	62540
Tanks	:	23871
Canals	:	181165
Other Sources	:	16016
Net Irrigated Area	:	283592

6. GROUND WATER MONITORING WELLS

Dug Wells	:	36
Piezometers	:	12

7. GEOLOGICAL FORMATIONS

Recent	:	Alluvium
Sub-recent	:	Laterite
Miocene	:	Rajahmundry Sandstones
Eocene	:	Deccan Traps
Jurassic	:	Tirupati Sandstones
Archaean	:	Migmatites Charnockites Khondalites

8. HYDROGEOLOGY

Water Bearing Formations	:	
Hard Rock	:	Granitic gneisses, Charnockites, Khondalites & Basalt
Soft Rock	:	Sandstones, Alluvium
Pre-monsoon	:	1.02 to 20.55 m bgl
Depth to Water Level (May, 2012)	:	
Post-monsoon	:	0.28 to 6.28 m bgl
Depth to Water Level (Nov., 2012)	:	

9. GROUND WATER EXPLORATION

Wells Drilled	:	EW=65, OW=09,PZ=21
Depth Range	:	20 to 750 m
Discharge	:	<1 to 40 lps
Transmissivity	:	17 to 3446 m ² /day
Storativity	:	1.0x10 ⁻⁴ to 16.68x10 ⁻³

10. GROUND WATER QUALITY

In general good and suitable for drinking and irrigation purposes except in the coastal aquifers.

11. DYNAMIC GROUND WATER RESOURCES (in Ha.m)

Annual Replenishable GW Resources	:	1,47,982
Total Draft	:	33129
Projected Demand (2025) for Domestic & Industrial Uses	:	12700
Stage of GW development	:	22 %

12. AWARENESS AND TRAINING ACTIVITY

Mass Awareness Programme		
Date	:	22.03.2002
Place	:	Rajanagaram
No. of Participants	:	250
Water Management Training Programme:		Nil

13. GROUND WATER CONTROL & REGULATION

Over Exploited Mandals	:	Nil
Critical Mandals	:	2
Notified Mandals	:	Nil

14. MAJOR GROUND WATER PROBLEMS AND ISSUES

Water logging and salinity are the major considerable problems in the coastal aquifers.

GROUND WATER BROCHURE

EAST GODAVARI DISTRICT, ANDHRA PRADESH

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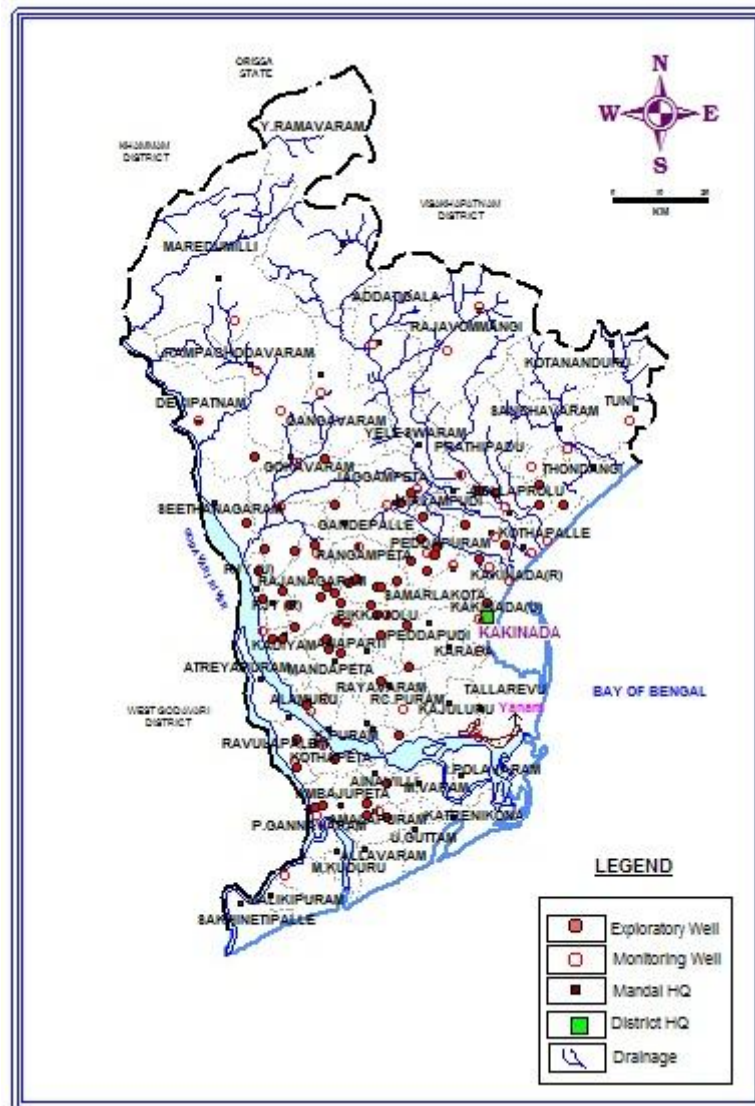
GROUND WATER BROCHURE

EAST GODAVARI DISTRICT, ANDHRA PRADESH

1.0 Introduction

East Godavari district is one of the nine coastal districts of Andhra Pradesh and is known for its historical importance. The district enjoys a unique place and is known as “*rice bowl*” of Andhra Pradesh. The district forms part of the Godavari delta region and is endowed by a vast potential of surface water resources.

Fig.1: Administrative Divisions of East Godavari District, A.P.



The district lies between north latitude $16^{\circ}30'$ and $18^{\circ}00'$ and east longitude $81^{\circ}30'$ and $82^{\circ}30'$ spreading over an area of 10,807 Sq.km. The district is bounded in the North by Visakhapatnam district and Orissa state in

the East and South by Bay of Bengal and west by West Godavari district. Yanam, one of the regions in the Union Territory of Pondicherry is embedded in the south eastern part of the district. The district is well connected by a good network of road and rail communication facilities.

The district headquarters is located at Kakinada town. The district is divided into five revenue divisions viz., Kakinada, Peddapuram, Amalapuram, Rajahmundry and Rampachodavaram. Further these revenue divisions are divided into 60 revenue mandals (**Fig. 1**). There are 22 towns 1344 villages in the district. As per the 2001 census the population of the district is 49,01,420 out of which urban population is 23.50% and the rural population is 76.50% and the density of population is 453 persons per sq. km. The decennial growth rate from 1991 to 2001 is 7.93 percent.

1.1 Drainage

The Godavari river is the major river drain the district, which is perennial and flows along the western boundary of the district. South of Rajahmundry the river bifurcates into two viz., Gautami Godavari in the East and Vasista Godavari in the West. The Godavari River further splits into smaller arms before it debouches into the Bay of Bengal. The other important rivers and tributaries of Godavari flowing in the district are Gondiyeru, Pamuleru, Polavaram vagu, Sileru river, Suddagedda, Yeleru, Madeyeru and Tandava. The general drainage pattern is dendritic to sub-dendritic. The drainage density varies from less than 0.4 km/sq.km in poorly drained alluvial areas which covers the entire southern parts of the district to 0.6 km/sq.km in the Northern parts occupied by crystalline rocks.

1.2 Irrigation

The East Godavari district is having both surface and ground water irrigation sources. The chief sources of surface irrigation are through canals & tanks, and are harnessed by major, medium and minor irrigation schemes. Ground water is developed by means of dug wells, bore wells, tube wells and filter point wells in the district. The total net area irrigated is 280412 ha. by means of all sources of irrigation available in the district. The net area irrigated through the surface water irrigation projects is of 1665 ha. in the district. The ayacut under Godavari central delta irrigation project is around 81,673 ha. whereas under Godavari eastern division comes an area of 99286 hectares and an area of 21456 ha. comes under Yeleru canal system. An area of 15208 ha. is being irrigated by Torrigedda pumping scheme and Sri Satyanarayana Swami Sagar project scheme. The net area irrigated through canals, tanks is 163820 and 2194 ha. respectively, and irrigation through lift and other sources is 644ha. The net area irrigated through tube wells and filter point wells is 35631 ha. and thus constituting 12.70 percent through ground water irrigation in the district.

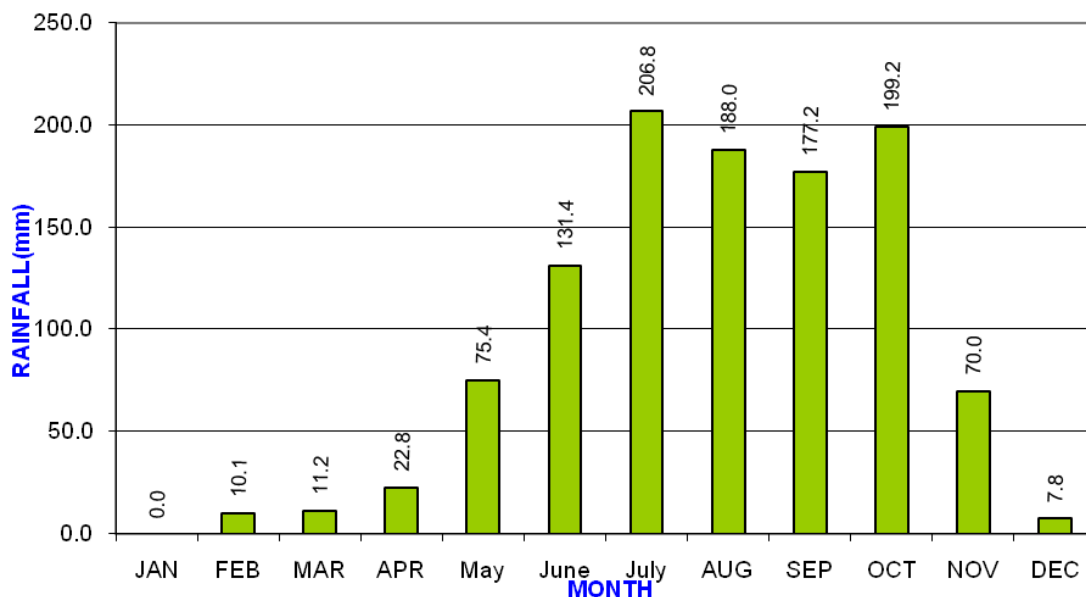
1.3 CGWB Activities

The Central Ground Water Board took up long term hydrogeological studies since 1969 with the establishment of Network Hydrograph Stations in various hydrogeological environments as a part of the all India programme and presently there are 48 (36 dug wells, 12 piezometers) such hydrograph stations in the district. The systematic hydrogeological surveys were carried out during 1959 – 1990. Ground water management surveys and Geophysical surveys were carried out in various parts of the district during 1997-2002. Under the ground water exploratory drilling programme 65 exploratory bore/tube wells and 09 observation wells were constructed in the district. Under Hydrology Project 21 piezometers were constructed. Exploratory drilling was also taken up by CGWB during AAP2005-06, 2007-08, 2008-09, 2009-10 at Kakinada, Amalapuram, Munganda, and Cheyyeru respectively. Ground water management studies were carried out in Coastal areas of the district during AAP2008-09, 2009-10, 2010-11 by Shri AVSS Anand, Scientist of CGWB. Hydro geological and Hydro chemical studies were taken up in Kakinada Urban area by Dr. VSR Krishna, Scientist of CGWB, during AAP 2011-12

2.0 Climate &Rainfall

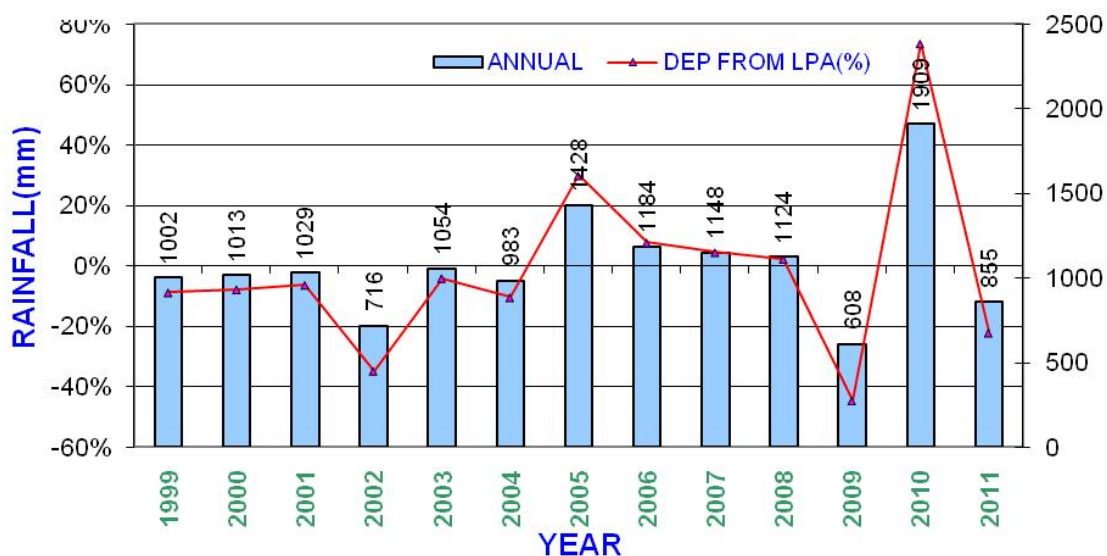
The climate of the district is hot subtropical with very hot summer. The average annual rainfall of the district is 1100 mm, which ranges between nil rainfall in January and 207 mm in July. July and October are the wettest months of the year. The mean seasonal rainfall distribution is 704 mm in southwest monsoon (June-September), 277 mm in northeast monsoon (Oct-Dec), 10 mm rainfall in Winter (Jan-Feb) and 109 mm in summer (March – May). The percentage distribution of rainfall, season-wise, is 64% in southwest monsoon, 25 % in northeast monsoon, 1.0 percentage in winter and 10 % in summer. The mean monthly rainfall distribution is given in Fig. 2.

Fig. 2: Mean Monthly Rainfall Distribution



The annual rainfall ranges from 608 mm in 2009 to 1909 mm in 2010. The annual rainfall departure ranges from -45 % in 2009 to 74 % in 2010. The southwest monsoon rainfall contributes about 64 % of annual rainfall. It ranges from 411 mm in 2002 to 945 mm in 2005. The year 2002 and 2009 experienced drought conditions in the district as the annual rainfall recorded in these two years is 35 % and 45% less than the long period average (LPA) respectively. The cumulative departure of annual rainfall from LPA is presented in **Fig.3**. It indicates that, the rainfall departure as on 2011 is negative i.e., -23 %, showing rainfall deficit.

Fig.3 : Annual Rainfall and Rainfall Departure from LPA



December is the coldest month with normal mean maximum temperature of about 27.1°C and mean minimum temperature of 19.2°C. Temperature begins to raise after February. May is the hottest month with mean daily maximum temperature of about 36.1°C and the mean daily minimum temperature of about 27.7°C. During May and early June the maximum temperature rises occasionally to 46°C and with the on set of SW monsoon by about second week of June, temperature begins to drop rapidly. The relative humidity is generally high throughout the year and is of the order of 80% in the morning and 75% in the evening. During summer season particularly in the month of May the relative humidity is 71% in the morning and 64% in the evening hours. The wind speed in the district is generally light to moderate throughout the year. The special weather phenomenon prevails in the district viz., during post monsoon season wide spread heavy rain and strong winds occur when depressions in the Bay of Bengal move Northwesterly direction. Thunderstorms occur during March to November with high frequency in the months of May, June, August and through October.

The interior parts of the district experience more thunderstorms than the coastal areas.

3.0 Geomorphology & Soil Types

Geomorphologically the district can be broadly divided into 3 regions, viz., Hilly region in the northern parts of the district, the upland region in the central part and the deltaic plain in the south. The hilly region in the northern area comprises several denudational, residual hills, inselbergs, pediments, buried pediments and structural hills. The general trend of the hill ranges is NE-SW and parallel to the east coast. The upland plain (plateau) of Rajahmundry sandstone raises to a height of 45m to 70m comprises erosional land forms consisting of structural and residual hills, pediment, pediplain and narrow corridor of piedmont zone. The deltaic region in the south comprises low-lying deltaic and coastal plains having a gentle easterly slope and are characterised by landforms of both fluvial and marine origin. Among the fluvial landforms are active channel of Gautami, Vasista Godavari and associated braided channel bars and levees. The flood plain is predominantly seen between vasista and Gautami channels. The marine landforms include palaeo beach ridges, palaeotidal flats, active beach and spit. The deltaic plain shows a relief between 15 m at its apex to 2 m near the coast.

The predominant soils in the district are red clayey soil, deltaic alluvial soil, coastal sandy soil and lateritic soil. Red clayey soils with sandy loam to clayey loam in texture and occur around Rampachodavaram, Yeleshwaram, Prathipadu, Peddapuram, Rangampeta, Kakinada, Rajahmundry, Tuni, Korukonda, Pithapuram and Tallarevu areas. The deltaic alluvium which is grey brown to black in colour with fine to medium texture, moderate to poorly permeable and are prevalent in the canal irrigated areas as seen around Kothapeta, P.Gannavaram, Ramachandrapuram, Rajahmundry, Amalapuram, Razole and Pithapuram areas. The coastal sandy soils occur all along the coast with a width of about 6 to 10 kms and is highly porous and lack of binding material. Lateritic soils, deep reddish in colour, but differ from red soils in composition and are characterised by free drainage condition and acidic in reaction. These soils are mostly confined to parts of Rajahmundry and Peddapuram areas of the district.

4.0 Ground Water Scenario

4.1 Hydrogeology

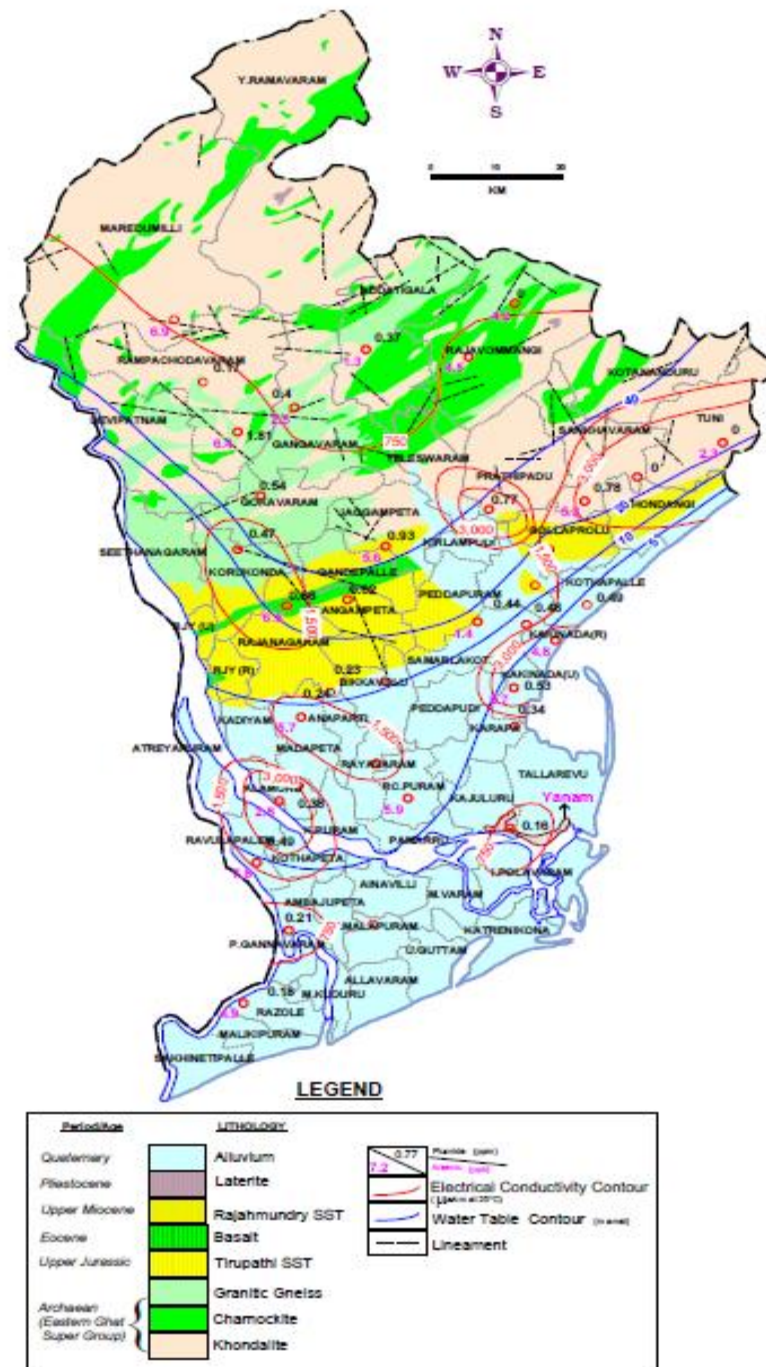
The district is underlain by different geological formations comprising oldest Archaeans to Recent Alluvium. The rock types are classified as consolidated, semi-consolidated and unconsolidated formations. The consolidated formations include khondalites, charnockites & granitic gneisses of Archaean group, deccan traps of Tertiary period. The semi consolidated formations are represented by tertiary and upper gondwana formations like Rajahmundry & Tirupati sandstones and unconsolidated formations comprise deltaic and river alluvial deposits of Quaternary period. Prominent lineaments

are trending in NE-SW, NW-SE and NNW-SSE (**Fig.4**). Ground water occurs in all most all geological formations and its potential depends upon the nature of geological formations, geographical setup, incidence of rainfall, recharge and other hydrogeological characters of the aquifer. Ground water occurs under unconfined to semi-confined conditions in the consolidated formations, while it occurs under unconfined to confined conditions in semi-consolidated & unconsolidated formations. In the consolidated formations, the depth of weathering ranges from 3.0 to 14.0 m bgl and fractured zones occurs within the maximum depth of 51.0 m bgl as revealed from the available bore well data. Generally, dug wells range in depth between 3.0 and 17.0 m bgl. The unit area specific capacity of dug wells are estimated to be in the range between 3.36 lpm/m/m² and 4.42 lpm/m/m² and the bore wells range in depth between 17.0 and 51.0 m bgl and the yield of bore wells in crystalline rocks generally vary from 1.0 to 2.8 lps and the yield of irrigation dug wells generally vary from 0.6 to 3.6 lps.

In the semi-consolidated formations comprising Tirupati sandstone of upper Gondwana formation the dug wells range in depth from 4 to 20 m bgl. Dug-cum-bore wells and tube wells tap confined aquifers between 27 and 80 m bgl. Dug-cum-borewells yield 6 lps on an average for a draw down of about 4.0 m. The aquifer zones in tube wells occur generally in the range of 30 to 136 m bgl with yields ranging from 5.3 lps to 14.5 lps. The Rajahmundry sandstone of tertiary formation in which the dug wells range in depth between 4.0 and 21.0 m bgl. The most important confined aquifers between Kadiyam and Bikkavolu occur below 105 meters. Granular zones occur down to a maximum depth of 250 m bgl. The dug-cum-bore wells yield 10.5 to 19.72 lps. The yield of deep tubewells vary from 10 to 45 lps for a draw down of 0.8 to 30.25 m. The transmissivity value of the aquifer in the semi consolidated formations varies from 17.27 to 2843 m²/day and the specific capacity value ranges from 8.851 lpm/m/day to 3446.42 lpm/m/day and the storage co-efficient varies from 1.0×10^{-4} and 16.68×10^{-3} indicating the confined conditions of the aquifer.

In the unconsolidated formations comprising coastal alluvium, deltaic river alluvium and wind blown sand deposits, the depth of the dug wells tapping these formation ranges from 3.0 to 11.0 m bgl. In the different tube wells drilled in alluvial formations continuous sequence of sand, silt with clay have been encountered at various depths down to a maximum drilling depth of 200 m bgl and the depth of fresh water aquifers varies considerably from place to place, in general brackish to saline water occurs below 30 m depth. The yield of the tube wells tapping fresh water zones in the area varies from <1 lps to 13 lps for a draw down ranging from 0.07 to 7.0 meters. The depth of filter point wells which are being used for irrigation varies from 10 to 20 m bgl with yield varies in between 8 and 25 lps. In unconsolidated formations the transmissivity of the aquifer ranges from 208.8 to 592.5 m²/day, specific capacity of the wells varies from 112.92 lpm/m/day to 857.14 lpm/m/day and the storage co-efficient value is 3.14×10^{-3} to 5.5×10^{-4} indicating the confining conditions of aquifer.

Fig. 4 HYDROGEOLOGY - EAST GODAVARI DISTRICT

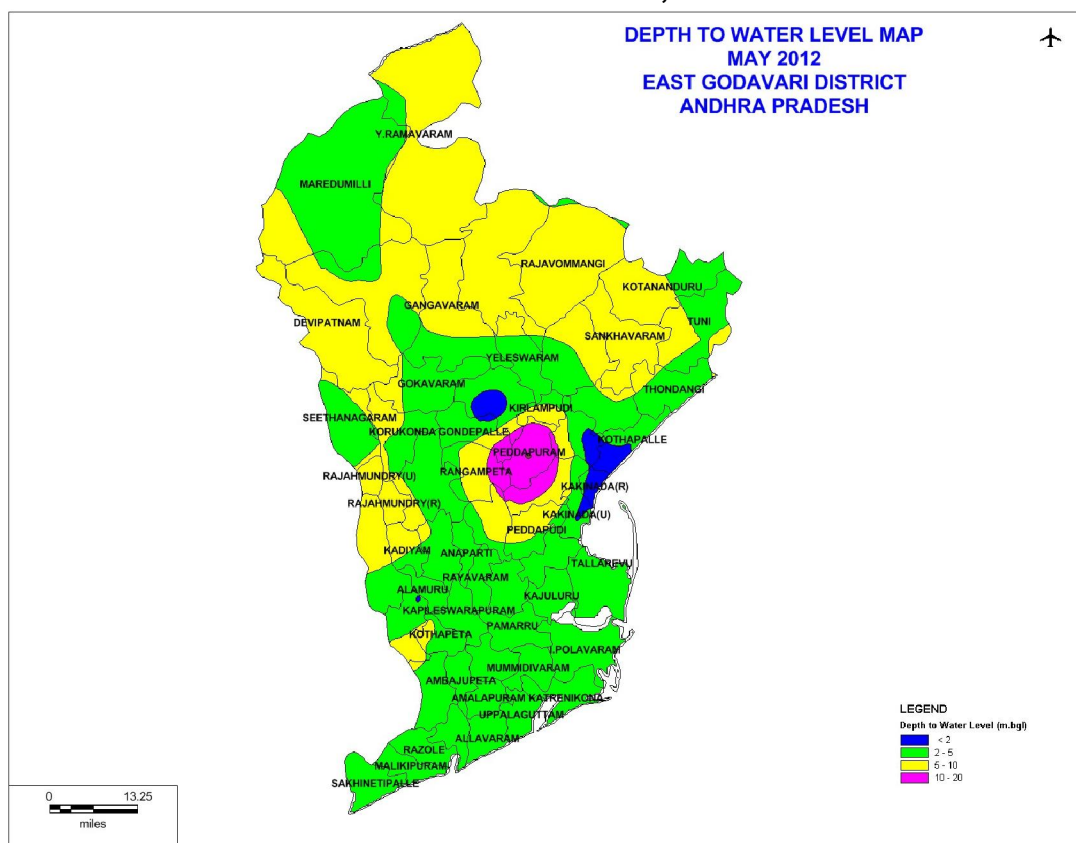


Water Level Scenario

The depth to water level during pre monsoon season (May, 2012) generally ranges between 2 and 5 m bgl (**Fig. 5**). Shallow water levels less than 2 m bgl occur in the southern parts of the district i.e. in parts of Kothpalle, Kakinada mandals. Whereas water levels more than 5 m bgl are occur in central and northern parts of the district i.e. in parts of Rampachodavaram, Gangavaram, Addathegala, Rajavommangi, Korukonda, Rajahmundry and

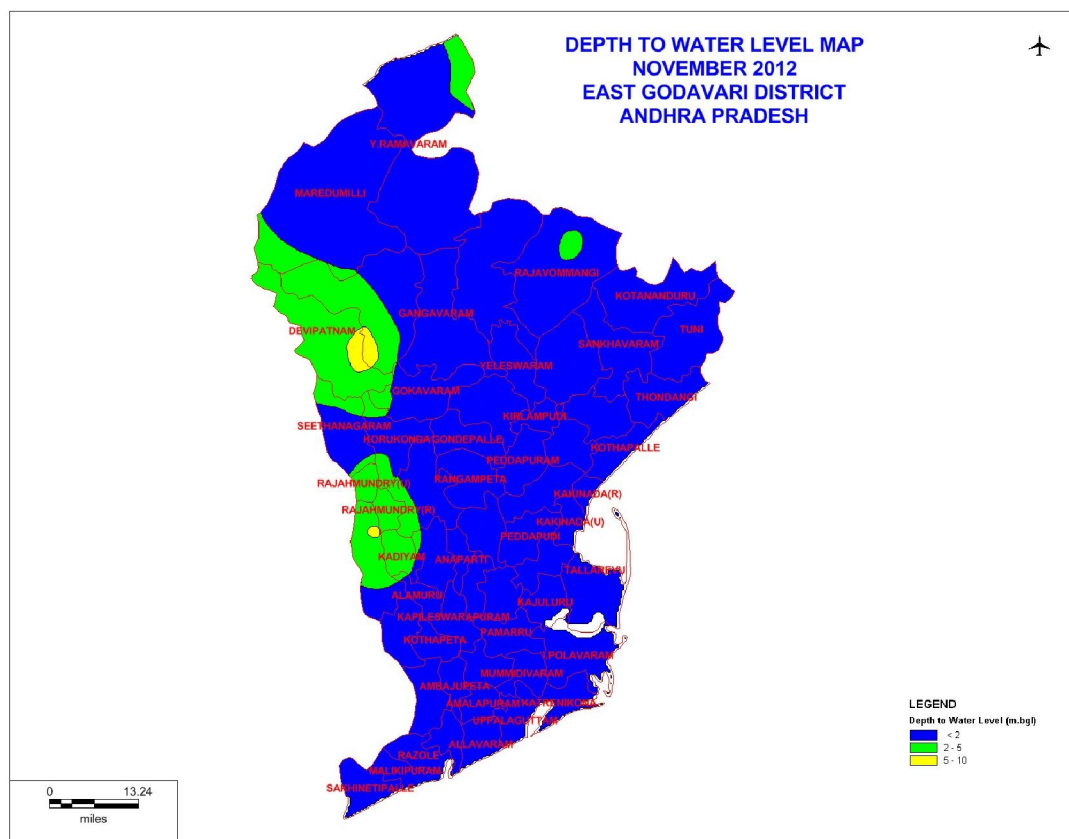
Rajanagaram mandals. The depth to water level during post monsoon season (Nov, 2012) (**Fig.6**) in the district generally less than 2 mbgl. Whereas water levels in the range of 2 to 5 m bgl occur in northern, northwestern and western parts of the district.

Fig.5: Depth to Water Level Map – Pre monsoon (May 2012) – East Godavari District, A.P.



Ground water levels fluctuate considerably in response to the recharge and draft conditions of ground water reservoir. Rise in water levels from pre-monsoon to post-monsoon in the range of 0.05 to 4.11 m observed in the district. Long-term trend of water level (2002 to 2011) indicates during pre-monsoon rise in the range of 0.0102 to 0.4803 m/yr where as fall in the range of 0.0048 to 0.1424 m/yr exist in the district. During post monsoon period overall raise exists in the district, it varies from 0.0024 to 0.287 m/yr except at few areas, where fall recorded in the range of 0.0003 to 0.3324 m/yr. The water table elevation ranges between <1 m amsl (Delta Gannavaram) and 341 m amsl (Maredumilli). The water table contours are almost parallel to the topographic contours and general ground water flow direction is towards south and SE directing towards the sea.

Fig.6: Depth to Water Level Map – Post monsoon (Nov 2012) – East Godavari District, A.P.



4.2 Ground Water Resources

Net annual ground water availability is 114398 ha.m in the command area and 33584 ha.m in non-command area with a total of 147982 ha.m in the entire district. The gross ground water draft for all uses in the command area is in the order of 28807 ha.m whereas it is 4322 ha.m in non-command area and the total gross ground water draft for all uses in the district is 33129 ha.m. Out of this Resource 10138 ha.m in Command area and 2562 ha.m in non-command area with the total of 12700 ha.m in the entire district allocated to cater the domestic and industrial needs of the population in the district as on 2025. Net ground water availability for future irrigation use is 78716 ha.m in the command, 27395 ha.m in non-command area and 106111 ha.m in the entire district. All the mandals in the district are categorised as safe except Rajanagaram and Gandepalli which falls in Semi-Critical category. The entire district is categorized as safe. Ground water resources for each mandal are presented as Table – 1.

4.3 Ground Water Quality

The quality of ground water is as important as quantity. The quality of ground water is good in both shallow and deeper aquifers of crystalline formations, Rajahmundry & Tirupati sandstones of the district. Shallow alluvial aquifers exhibit wide range of quality variations, due to deltaic nature of the deposits and drainage conditions. In alluvial aquifers the deeper aquifers are invariably saline. The electrical conductivity varies from 372 to 7625 $\mu\text{s}/\text{cm}$ at 25°C. In major portion of the district EC ranges from <750 to 1500 $\mu\text{s}/\text{cm}$ at 25°C except in the eastern part of the district and along the coast i.e. at Yuni, Kattipudi, Kakinada, Jonnada and Vakalpudi, Prathipadu where EC values are recorded more than 3000 $\mu\text{s}/\text{cm}$ at 25°C. Whereas in the central part of the deltaic area EC ranges in between 1500 and 3000 $\mu\text{s}/\text{cm}$ at 25°C.

Table – 1 GROUND WATER RESOURCES – EAST GODAVARI DISTRICT

(ham)

Sl. No.	Administrative Unit	Sub-Unit	Total Annual Ground Water Recharge	Provision for Natural Discharges	Net Annual Ground Water Availability	Existing gross ground water draft for all uses	Provision for domestic and industrial requirement supply to 2025	Net ground water availability for future irrigation development	Stage of ground water development	Category
1	2	3	4	5	6	7	8	9	10	11
1	Addateegala	Command	0	0	0	0	0	0	0	
		Non-command	3127	282	2846	34	136	2688	1	Safe
		Poor Quality				0	0	0		
		Total (without PQ)	3127	282	2846	34	136	2688	1	Safe
2	Anaparthi	Command	2639	264	2375	347	149	2007	15	Safe
		Non-command				0	0	0	0	
		Poor Quality				0	0	0		
		Total (without PQ)	2639	264	2375	347	149	2007	15	Safe
3	Biccavole	Command	4469	447	4022	1224	285	2797	30	Safe
		Non-command	86	9	78	90	3	0	114	Over Exploited
		Poor Quality				0	0	0		
		Total (without PQ)	4555	455	4100	1314	288	2786	32	Safe
4	Devipatna	Command	0	0	0	0	0	0	0	
		Non-command	1820	182	1638	145	77	1479	9	Safe
		Poor Quality				0	0	0		
		Total (without PQ)	1820	182	1638	145	77	1479	9	Safe
5	Eleswaram	Command	2396	240	2156	58	259	1896	3	Safe
		Non-command	1095	109	986	8	32	954	1	Safe
		Poor Quality				0	0	0		
		Total (without PQ)	3491	349	3142	66	291	2850	2	Safe

1	2	3	4	5	6	7	8	9	10	11
6	Gandepalli	Command	3946	395	3551	3489	76	0	98	Semi-Critical
		Non-command				0	0	0	0	
		Poor Quality				0	0	0		
		Total (without PQ)	3946	395	3551	3489	76	0	98	Semi-Critical
7	Gangavaram	Command	0	0	0	0	0	0	0	
		Non-command	4020.68	234.56	3786.12	136.00	129	3651	4	Safe
		Poor Quality				0	0	0		
		Total (without PQ)	4020.68	234.56	3786.12	136	129	3651	4	Safe
8	Gokavaram	Command	0	0	0	0	0	0	0	
		Non-command	2016.26	134.00	1882.26	509.00	242.00	1200	27	Safe
		Poor Quality				0.00	0.00	0		
		Total (without PQ)	2016.26	134.00	1882.26	509	242	1200	27	Safe
9	Gollaprolu	Command	2077	208	1869	64	164	1641	3	Safe
		Non-command	969.30	96.97	872.32	201	120.00	570	23	Safe
		Poor Quality				0.00	0.00	0		
		Total (without PQ)	3045.86	304.59	2741.26	265	284	2211	10	Safe
10	Jaggampet	Command	2961	296	2665	332	224	2108	12	Safe
		Non-command	718	36	682	90	52	540	13	Safe
		Poor Quality				0	0	0		
		Total (without PQ)	3679	332	3347	422	276	2648	13	Safe
11	Kadiam	Command	3937	394	3543	1400	227	2018	40	Safe
		Non-command				0	0	0	0	
		Poor Quality				0	0	0		
		Total (without PQ)	3937	394	3543	1400	227	2018	40	Safe
12	Kakinada	Command	2642	264	2378	122	1810	529	5	Safe
		Non-command				0	0	0	0	
		Poor Quality				0	0	0		
		Total (without PQ)	2642	264	2378	122	1810	529	5	Safe
13	Kirlampudi	Command	2401	240	2161	522	271	1421	24	Safe
		Non-command				0	0	0	0	
		Poor Quality				0	0	0		
		Total (without PQ)	2401	240	2161	522	271	1421	24	Safe
14	Korukonda	Command	3812	381	3431	335	144	2999	10	Safe
		Non-command	739	66	673	144	98	458	21	Safe
		Poor Quality				0	0	0		
		Total (without PQ)	4551	447	4104	479	242	3457	12	Safe
15	Kotananduru	Command	2010	201	1809	477	103	1260	26	Safe
		Non-command				0	0	0	0	
		Poor Quality				0	0	0		
		Total (without PQ)	2010	201	1809	477	103	1260	26	Safe
16	Mandapet	Command	4769	477	4292	744	294	3363	17	Safe
		Non-command	124	12	111	6	18	88	5	Safe
		Poor Quality				0	0	0		
		Total (without PQ)	4893	489	4404	750	312	3451	17	Safe

1	2	3	4	5	6	7	8	9	10	11
17	Maredumilli	Command	0	0	0	0	0	0	0	
		Non-command	2601	260	2341	17	63	2272	1	Safe
		Poor Quality				0	0	0		
		Total (without PQ)	2601	260	2341	17	63	2272	1	Safe
18	Pedapudi	Command	4109	224	3885	248	184	3536	6	Safe
		Non-command				0	0	0	0	
		Poor Quality				0	0	0		
		Total (without PQ)	4109	224	3885	248	184	3536	6	Safe
19	Peddapuram	Command	3506	351	3156	510	423	2222	16	Safe
		Non-command	39	4	35	0	2	33	0	Safe
		Poor Quality				0	0	0		
		Total (without PQ)	3545	354	3191	510	425	2255	16	Safe
20	Pithapuram	Command	3492	349	3143	977	461	1721	31	Safe
		Non-command				0	0	0	0	
		Poor Quality				0	0	0		
		Total (without PQ)	3492	349	3143	977	461	1721	31	Safe
21	Prathipadu	Command	1997	200	1798	310	92	1395	17	Safe
		Non-command	2095	210	1886	227	197	1548	12	Safe
		Poor Quality				0	0	0		
		Total (without PQ)	4092	409	3683	537	289	2943	15	Safe
22	R.Chodavaram	Command	0	0	0	0	0	0	0	
		Non-command	2403	222	2181	116	135	2046	5	Safe
		Poor Quality				0	0	0		
		Total (without PQ)	2403	222	2181	116	135	2046	5	Safe
23	Rajahmundry	Command	1656	166	1491	156	163	1171	10	Safe
		Non-command	587	59	528	193	334	0	37	Safe
		Poor Quality				0	0	0		
		Total (without PQ)	2243	224	2019	349	497	1171	17	Safe
24	Rajanagaram	Command	4487	449	4039	4049	22	0	100	Over Exploited
		Non-command	881	88	793	539	66	191	68	Safe
		Poor Quality				0	0	0		
		Total (without PQ)	5368	537	4832	4588	88	191	95	Semi-Critical
25	Rajvommangi	Command	0	0	0	0	0	0	0	
		Non-command	3175	318	2857	137	139	2690	5	Safe
		Poor Quality				0	0	0		
		Total (without PQ)	3175	318	2857	137	139	2690	5	Safe
26	Rangampet	Command	2724	272	2452	1915	112	426	78	Safe
		Non-command	665	66	598	312	30	256	52	Safe
		Poor Quality				0	0	0		
		Total (without PQ)	3389	339	3050	2227	142	682	73	Safe
27	Rowtulapudi	Command	0	0	0	0	0	0	0	
		Non-command	3235	324	2912	694	266	1956	24	Safe
		Poor Quality				0	0	0		
		Total (without PQ)	3235	324	2912	694	266	1956	24	Safe

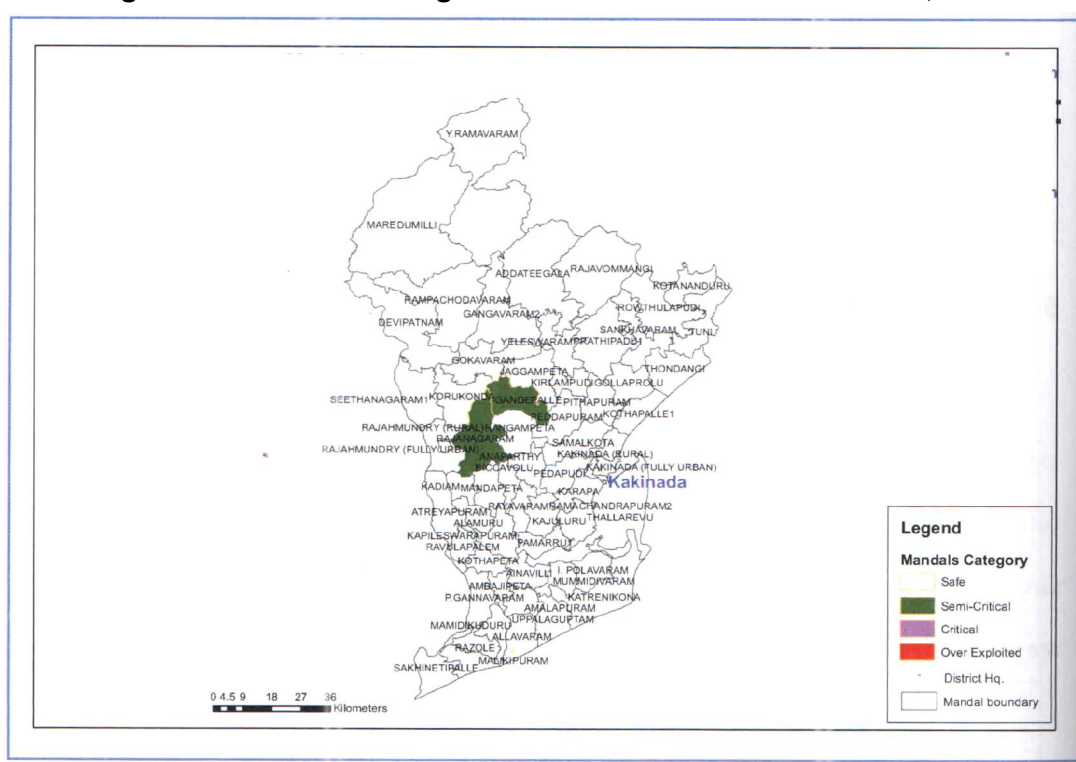
1	2	3	4	5	6	7	8	9	10	11
28	Samalkota	Command	3184	318	2865	774	474	1640	27	Safe
		Non-command				0	0	0	0	
		Poor Quality				0	0	0		
		Total (without PQ)	3184	318	2865	774	474	1640	27	Safe
29	Sankavaram	Command	0	0	0	0	0	0	0	
		Non-command	2904	290	2613	331	198	2088	13	Safe
		Poor Quality				0	0	0		
		Total (without PQ)	2904	290	2613	331	198	2088	13	Safe
30	Sithanagaram	Command	5115	512	4603	1055	238	3346	23	Safe
		Non-command	59	6	53	2	6	48	4	Safe
		Poor Quality				0	0	0		
		Total (without PQ)	5174	517	4656	1057	244	3394	23	Safe
31	Thondangi	Command	3491	349	3142	16	304	2834	1	Safe
		Non-command				0	0	0	0	
		Poor Quality				0	0	0		
		Total (without PQ)	3491	349	3142	16	304	2834	1	Safe
32	Tuni	Command	2295	229	2065	607	230	1235	29	Safe
		Non-command	1222	122	1100	378	135	606	34	Safe
		Poor Quality				0	0	0		
		Total (without PQ)	3517	352	3165	985	365	1841	31	Safe
33	U.Kothapalli	Command	3051	305	2746	25	270	2451	1	Safe
		Non-command				0	0	0	0	
		Poor Quality				0	0	0		
		Total (without PQ)	3051	305	2746	25	270	2451	1	Safe
34	Y.Ramavaram	Command	0	0	0	0	0	0	0	
		Non-command	2367	237	2130	13	84	2033		
		Poor Quality				0	0	0	1	Safe
		Total (without PQ)	2367	237	2130	13	84	2033	1	Safe
35	Ainavilli	Command	3571	357	3214	939	164	2249	29	Safe
		Non-command				0	0	0	0	
		Poor Quality				0	0	0		
		Total (without PQ)	3571	357	3214	939	164	2249	29	Safe
36	Aalamuru	Command	3137	314	2823	814	180	1985	29	Safe
		Non-command				0	0	0	0	
		Poor Quality				0	0	0		
		Total (without PQ)	3137	314	2823	814	180	1985	29	Safe
37	Amalapuram	Command	2117	212	1905	408	339	1159	21	Safe
		Non-command				0	0	0	0	
		Poor Quality				0	0	0		
		Total (without PQ)	2117	212	1905	408	339	1159	21	Safe
38	Ambajipet	Command	1929	190	1740	1030	163	547	59	Safe
		Non-command				0	0	0	0	
		Poor Quality				0	0	0		
		Total (without PQ)	1929	190	1740	1030	163	547	59	Safe

1	2	3	4	5	6	7	8	9	10	11
39	Atreyapuram	Command	4092	387	3705	1297	159	2393	35	Safe
		Non-command				0	0	0	0	
		Poor Quality				0	0	0		
		Total (without PQ)	4092	387	3705	1297	159	2393	35	Safe
40	K.Gangavaram	Command	2865	286	2578	490	257	2089	19	Safe
		Non-command				0	0	0	0	
		Poor Quality				0	0	0		
		Total (without PQ)	2865	286	2578	490	257	2089	19	Safe
41	Kothapet	Command	3673	367	3305	1120	238	2186	34	Safe
		Non-command				0	0	0	0	
		Poor Quality				0	0	0		
		Total (without PQ)	3673	367	3305	1120	238	2186	34	Safe
42	Kpuram	Command	4735	474	4262	725	167	3466	17	Safe
		Non-command				0	0	0	0	
		Poor Quality				0	0	0		
		Total (without PQ)	4735	474	4262	725	167	3466	17	Safe
43	Mummidivaram	Command	4861	486	4374	749	256	3625	17	Safe
		Non-command				0	0	0	0	
		Poor Quality				0	0	0		
		Total (without PQ)	4861	486	4374	749	256	3625	17	Safe
44	P.Gannavaram	Command	3515	351	3163	1011	390	2153	32	Safe
		Non-command				0	0	0	0	
		Poor Quality				0	0	0		
		Total (without PQ)	3515	351	3163	1011	390	2153	32	Safe
45	Ravulapalem	Command	4111	411	3700	135	193	3507	4	Safe
		Non-command				0	0	0	0	
		Poor Quality				0	0	0		
		Total (without PQ)	4111	411	3700	135	193	3507	4	Safe
46	Rayavaram	Command	2992	299	2693	22	166	2527	1	Safe
		Non-command				0	0	0	0	
		Poor Quality				0	0	0		
		Total (without PQ)	2992	299	2693	22	166	2527	1	Safe
47	Razole	Command	2574	257	2316	143	206	2112	6	Safe
		Non-command				0	0	0	0	
		Poor Quality				0	0	0		
		Total (without PQ)	2574	257	2316	143	206	2112	6	Safe
48	RCPuram	Command	5245	262	4983	168	281	4702	3	Safe
		Non-command				0	0	0	0	
		Poor Quality				0	0	0		
		Total (without PQ)	5245	262	4983	168	281	4702	3	Safe
49	Allavaram	Command				0	0	0	0	
		Non-command				0	0	0	0	
		Poor Quality	3591	349	3241	452	0	2790	14	Safe
		Total (without PQ)				0	0	0	0	

1	2	3	4	5	6	7	8	9	10	11
50	I.Polavaram	Command				0	0	0	0	
		Non-command				0	0	0		
		Poor Quality	3795	379	3415	16	16	3399	0	Safe
		Total (without PQ)				0	0	0	0	
51	Kajuluru	Command				0	0	0	0	
		Non-command				0	0	0		
		Poor Quality	5422	271	5151	425	42	4726	8	Safe
		Total (without PQ)				0	0	0	0	
52	Karapa	Command				0	0	0	0	
		Non-command				0	0	0		
		Poor Quality	3549	355	3195	88	35	3107	3	Safe
		Total (without PQ)				0	0	0	0	
53	Katernikona	Command				0	0	0	0	
		Non-command				0	0	0		
		Poor Quality	4474	447	4027	141	141	3885	4	Safe
		Total (without PQ)				0	0	0	0	
54	Mamidikuduru	Command				0	0	0	0	
		Non-command				0	0	0		
		Poor Quality	2664	133	2531	509	310	2022	20	Safe
		Total (without PQ)				0	0	0	0	
55	Sakhinetipalli	Command				0	0	0	0	
		Non-command				0	0	0		
		Poor Quality	3033	303	2729	36	36	2692	1	Safe
		Total (without PQ)				0	0	0	0	
56	Tallarevu	Command				0	0	0	0	
		Non-command				0	0	0		
		Poor Quality	4236	424	3813	12	12	3800	0	Safe
		Total (without PQ)				0	0	0	0	
57	Uppalaguptam	Command				0	0	0	0	
		Non-command				0	0	0		
		Poor Quality	4416	221	4196	92	92	4104	2	Safe
		Total (without PQ)				0	0	0	0	
58	Malkipuram	Command				0	0	0	0	
		Non-command				0	0	0		
		Poor Quality	2508	251	2257	812	131	1446	36	Safe
		Total (without PQ)				0	0	0		
East Godavari		Command	126581	12183	114399	28807	10138	78716		
		Non-command	36949	3367	33582	4322	2562	27395		
		Poor Quality	37689	3134	34555	2583	815	31971		
		Total (without PQ)	163530	15549	147981	33129	12700	106111		

In general the quality of ground water in shallow aquifers of crystalline formations, Rajahmundry & Tirupati sandstones is good and suitable for domestic, industrial and irrigation purposes except at few localities in isolated places, which is due to localised pollution. In majority of the alluvial areas the quality of ground water down to a maximum depth of 25 m bgl is suitable for domestic, industrial and irrigation purpose except in the area immediately adjoining the coast where major chemical constituents are above the maximum permissible limits and unsuitable for domestic, industrial and irrigation purposes. In alluvial aquifers the deeper aquifers are invariably saline. The mandal-wise categorization in East Godavari District is given in Plate-7.

Fig. 7 :Mandal-wise Categorization of East Godavari District, A.P



4.4 Status of Ground Water Development

The development of ground water in the district is through dug wells, dug-cum-bore wells and bore wells in the northern part of the district i.e. in crystalline rock formation. The dug wells generally range in depth between 3.0 and 17.0 m bgl. with 2.0 to 6.50m dia. and the yield of the irrigation dug wells vary from 0.6 to 3.6 LPS with a command area of 1.0 to 2.5 hectares. The bore wells of 150 mm to 250 mm dia. range in depth between 17.0 and 51.0 m bgl. and the depth of bore wells end in fractured rocks. The yield of these bore wells generally vary from 1.5 to 3 LPS with a daily pumpage of 4 to 5 hrs. Generally in well bores from the bottom of dug wells pierced through the entire thickness of the weathered zone in order to increase the yield of the wells.

In the semi-consolidated rocks comprising Tirupathi and Rajahmundry sandstone formation the dug wells range in depth from 4.0 to 20.0 m bgl with 2.50 to 8.0 m dia. Most of the dug wells for irrigational purposes tap deeper confined aquifers by means of bores from the bottom of the wells. Dug-cum-bore wells and tube wells in confined aquifers range in depth between 27 and 80 m bgl. The dug-cum-bore wells yield 6.0 lps on an average for a draw down of about 4.0 m. The deep tube wells range in depth from 92 to 225 m bgl with yields varying from 6 to 30 lps for a draw down of 2.0 to 30 m. The confined aquifers occurring between 25 and 60 m and below were tapped in many tube wells in the area south of Kondaguntur, west of the district between Punyakshetram, Chintada, Annavaram and between Kadiyam and Dwarapudi and the most important confined aquifers occur between Kadiyam and Bikkavolu below 105 m bgl.

In the unconsolidated formation comprising coastal and deltaic river alluvium and wind blow sand deposits the ground water is developed mostly through dug wells ranging in depth from 3.0 to 11.0 m bgl. with 1.00 to 3.50 m bgl and the dia. of irrigation dug wells varies from 4.50 to 8.50 meters with 1.5 to 5.0 lps. However, the depth of fresh water aquifers varies considerably from place to place. In the different boreholes drilled in alluvium formation continuous sequence of sand silt with clay have been encountered at various depth down to a maximum drilling depth of 200 m bgl. and depth of fresh water aquifers varies considerably from place to place. Exploratory drilling at Vanampalli, Devarapally, Ambajipeta, Magam, P.Gannavaram and Jonnada have revealed the occurrence of brackish to saline water below 30 m depth at many places. In the area bordering the coast the brackish water is encountered at shallow depths.

Ground water irrigation in the district is not extensive. The net area irrigated through tube wells and filter point wells is 35631 ha. and thus constituting 12.70 percent through ground water irrigation in the district.

The district has urban and rural water supply schemes to provide drinking water to the people under rural water supply schemes. Villages in the district are provided with adequate drinking water facilities through 684 Piped water supply schemes, 789 bore wells and 377 dug wells, and 172 other sources.

5.0 Ground Water Management Strategy

5.1 Ground Water Development

The scope for further development of ground water in the district varies widely from place to place and from mandal to mandal. Hence scientific and judicious development and management of available water resource will contribute to the over all planned development in improving the economy of the district. In the deltaic area the ground water is supplementary source for irrigation requirements in limited mandals, while it is the prominent source for drinking water requirements.

The ground water development along the coast is to be carried out judiciously by installing low capacity pumps as the thickness of fresh water aquifer is limited and also due to high tidal effects the areas adjacent to the coastal streams are affected by salinity problems. Therefore, only shallow wells have to be constructed away from the coastal streams, so that they can supply fresh water in summer. In the soft rock areas by using direct mud rotary shallow tube wells of depth range between 30 – 50 m bgl. and deep tube wells of 100 – 200 m bgl range with discharge of less than 300 lpm are feasible in the areas around Kirlampudi, Pithapuram, Kothapalli, Peddapuram, Rangampeta, Biccavolu, Peddapudi, Karapa, Kakinada, Kajula, I.Polavaram, Mummadvaram, Katrenikona, Amalapuram and Tallarevu in the south-eastern parts of the district. Similarly shallow tube wells of depth range 10-60 m bgl with 300-900 lpm discharge are feasible in the south and south western parts of the areas around Kadiyam, Anaparthi, Rayavaram, Alamuru, Kapileshwarapuram, Kothapeta, Ainavilli, Razole, Malikipuram and Sakinetipalli. Whereas in the south central parts of the district in the sedimentary area deep tube wells tapping Gondwana formation below trap rock in the area. Where Rajamundry and Trap rock is exposed, shallow tube wells of depth range 30-50 m bgl and deep tube wells of 100 – 200 m bgl are feasible. Further, deep tube wells may be constructed around Punyakshetram, Balavaram, Srikrishnapatnam and Dowleshwaram to bring large command area under such wells. In order to monitor the movement of fresh water/saline water interface advancing towards inland in due course of movement with rapid ground water development along the coast if it is necessary for construction of piezometers perpendicular to the coast line to monitor the water level and chemical quality of waters.

In the hard rock areas of the district in the North and North eastern parts viz., Y.Ramavaram, Marredumulli, Devipatnam, Gangavaram, Seethanagaram, Gokavaram, Gandepalli, Addateegala, Rajavomangi, Yeleshwaram, Prathipadu, Sankhavaram, Kotanadanuru, Tuni and Thondangi mandal areas dug wells of depth range 10-20 m bgl with 60 to 180 lpm and 150 mm to 250 mm dia, bore wells by DTH drilling in the depth range of 50-150 m bgl. with 60-300 lpm yield are feasible. Based on the yield potential of the aquifers of the hard formation of the district is classified as low (1 to 3 lps) & Low to Moderate (1 to 5 lps) and, the soft formation as Low (1 to 3 lps), Low to Moderate (1 to 5 lps) & high (> 5 lps) yield potential areas.

5.2 Water Conservation and Artificial Recharge

Construction of artificial recharge structures like check-dams, contour trenches, percolation tanks and water conservation structures like sub-surface dykes are feasible in the areas where water levels are declining and over exploitation of ground water resources is taking place viz. Rajanagram, Rangampeta, Peddapuram, Gandepalli, Rajahmundry and Korukonda Mandals. Roof top Rainwater Harvesting is to be implemented in the Urban areas wherever deepening of water levels are taking place.

6.0 Ground Water Related Issues and Problems

Water logging and salinity are the major problems in the delta and coastal area of the district. Due to intensive irrigation there is an excess recharge over discharge of ground water leading to a rise in the water table. The most of the command area is either water logged or seasonally water logged. The district has a water logged area of about 500 sq.km and area prone to water logging is about 2200 sq.km. The intensive irrigation, near flat topography, low ground water development, poor drainage and clayey soils are the factors responsible for the water logging. In the deltaic area and coastal area the brackish/ saline ground water occurs in hydraulic contact with fresh ground water. The quality of ground water varies widely from place to place even within short distances and the deeper aquifers are invariably saline. The salinity of ground water is caused due to geomorphic landform, water logging conditions, sluggish nature in ground water movement and excess use of fertilizers and unregulated growth of aquaculture in the coastal area.

7.0 Awareness and Training Activity

The Mass Awareness programme on ground water conservation and protection was organized in the district on 22nd March, 2002 at Rajanagaram. About 250 persons representing state government officials, NGO's and farmers participated in the campaign. The importance of groundwater management, conservation, protection, recharges practices and chemical qualities were discussed and interaction on these themes was held. Posters and maps related to ground water were displayed and explained to the participants.

8.0 Areas Notified by CGWA/ SGWA

No area/mandal has been notified.

9.0 Recommendations

1. Ground water should be judiciously exploited in the shallow fresh water aquifers of deltaic area without disturbing the fresh/saline water interface. There is a need for proper monitoring of the saline water – fresh water interface in the area by establishing purpose built piezometers with predefined monitoring parameters of level and quality with reference to depth. There is an urgent need for special studies for estimating the status of sea water ingress on a regular basis.
2. In the area along the coast, it is very much essential to demarcate the dynamic boundary of saline and fresh water interface and proper measures should be taken up to restrict the interface below the maximum pumping water level.

3. There is a need for proper planning for utilizing the ground water resources during the water stress periods without allowing the fresh water – saline water interface intersecting the pumping water levels.
4. In the limited ground water potential areas, modern irrigation methods like drip and sprinkler irrigation should be adopted to increase the command area of the well.
5. The aqua culture development should be restricted to areas close to the coast only. The practice of converting agricultural lands in the inland areas should be stopped to avoid the pollution of fresh water aquifers.
6. Conjunctive use of surface and ground water need to be planned in the command area, particularly in the deltaic area, to prevent the adverse effects of the water logging conditions.
7. Artificial recharge measures should be adopted in the urban and Semi-critical and poor quality areas for improving the ground water situation.
8. A multi-sectoral approach is needed to study the ground water development, augmentation and management perspective. Therefore, all the aspects related to ground water legislation, involvement of NGOs and mass awareness campaign will play an important role in conserving and developing the precious water resources.