



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

**GROUND WATER INFORMATION**  
**KHAMMAM DISTRICT, ANDHRA PRADESH**

SOUTHERN REGION  
HYDERABAD  
AUGUST, 2007



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KHAMMAM DISTRICT, ANDHRA PRADESH**

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# GROUND WATER INFORMATION KHAMMAM DISTRICT, ANDHRA PRADESH

BY

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## KHAMMAM DISTRICT AT A GLANCE

### 1. GENERAL

Location	North Latitude	16 <sup>0</sup> 45' : 18 <sup>0</sup> 35'
	East Longitude	79 <sup>0</sup> 47' : 81 <sup>0</sup> 47'
Geographical area (sq.km)		16,069
Headquarters		<b>Khammam</b>
No. of revenue mandals		46
No. of revenue villages		1,242
Population (2001)	Urban	5,10,860
	Rural	20,68,066
Population density (persons/ sq.km)		161
Major rivers		Godavari, Kinnerasani, Sabari, Munneru, Wyra
Soils		Chalaka, Dubba and black soils
Agroclimatic zone		South eastern plateau & hill zone

### 2. RAINFALL

Normal annual rainfall (mm)	Total	1124
	Southwest monsoon	890
	Northeast monsoon	130
Cumulative departure from normal rainfall for the last 5 years		-30%

### 3. LAND USE (2004-'05) (Area in ha.)

Forest	7,43,798
Barren and uncultivated	90,127
Cultivable waste	20,545
Current fallows	75,414
Net area sown	4,37,582

### 4. IRRIGATION (2004-'05) (Area in ha.)

Source of irrigation	
Canals	28,762
Tanks	49,551

Dug wells	44,979
Bore / Tube wells	28,288
Others	21,684
Net area irrigated	1,73,244
Gross area irrigated	2,05,416
Major irrigation projects	Nagarjunasagar Left bank canal
Medium irrigation projects	Wyra, Lanka sagar, Pedavagu, Mookamamidi and Bayyaram Tank

## 5. GEOLOGY

Major rock types	Granites & gneisses, shales, phyllites and dolomites, sandstones etc.
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## 6. GROUND WATER

### Well census (2000-'01)

Dug wells	38,972
Shallow tube / bore wells	7,732
Deep tube / bore wells	1,113

### Exploration by CGWB

No. of wells drilled	96
Major aquifer zones	Hard rocks 40 - 70 m
	Soft rocks 50 - 220 m

### Aquifer parametres

Transmissivity (sq.m/day)	Hard rock	7.8 - 257
	Soft rock	37 - 954
Storage Co-efficient	Hard rock	$8.4 \times 10^{-6}$ - $8.19 \times 10^{-3}$
	Soft rock	$2 \times 10^{-4}$ - $4.64 \times 10^{-4}$

### Monitoring

No. of observation wells	
Dug wells	42
Piezometers	Manual 14 (including DWLR installed)
	Digital recording 7

Range of water levels (May 2005)

Minimum (m below ground level)	2.68
Maximum ( m bgl)	14.27
General range ( m bgl)	5 to 10

**7. GROUND WATER RESOURCES (MCM)**

Net annual ground water availability	1859
Net annual draft	366
Balance resource	1493
Stage of ground water development	20

**8. GROUND WATER DEVELOPMENT CATEGORY**

No. of mandals categorised as

Safe (<70 % of net available resource)	44
Semi Critical (70 - 90 %)	1
Critical (90 - 100 %)	0
Over exploited (> 100 %)	1

No. of villages notified for restricted development 62

(by State Ground Water Authority)

**9. CHEMICAL QUALITY**

Electrical Conductivity (micro Siemens / cm at 25 deg. C)	400 - 2000
Chloride (mg/l)	50 - 225
Fluoride (mg/l)	0.2 - 0.6
Nitrate (mg/l)	50 - 100

## **GROUND WATER INFORMATION**

### **KHAMMAM DISTRICT, ANDHRA PRADESH**

#### **1.0 INTRODUCTION**

Since the day a coal boulder was found by chance by a pilgrim, who was on his way to the abode of Sri Rama at Bhadrachalam, the Khammam district entered into the mineral map of India and attained distinct place in coal mining. The district enjoys a unique place in the state with the presence of extensive green forests and by rivers with lyrical names like Godavari, Kinnerasani, Sabari etc. The district also abounds in mineral wealth backed by many power projects and notable industries.

The district lies between  $16^{\circ}45'$  and  $18^{\circ}35'$  of the north latitude and  $79^{\circ}47'$  to  $81^{\circ}47'$  of the east longitudes. The district is bounded on the north by Chattisgarh and Orissa states and on the other three sides by different districts of the state. The district has geographical area of 16,029 sq.km with a total population of 25,78,927 (2001). The district is divided into four revenue divisions with headquarters at Khammam, Kottagudem, Bhadrachalam and Palwancha. The district comprises 46 revenue mandals (**Fig-1**). There are nine towns including four municipalities with a population of 5.08 lakhs. There are 1,242 revenue villages of which 1,093 are inhabited. The density of population is 161 per sq.km that is increased by 23 per sq.km from 1991 census. Tekulapalli, Chinturu, Gundala, Dummugudem, Velairpad, V R Puram, Mulkalapalli, Kunavaram and Singareni are main tribal mandals. The district has largest forest area of 8.4 lakh hechares and it plays an important role in the economy of the district.

Khammam district is one among the 16 farmer distress hot spot districts identified in Andhra Pradesh. So far, 72 farmer suicides have been reported. Crop failure due to lack of water availability is one of the causes of distress among the farmer community in addition to the vagaries of market fluctuations for agricultural produce and shortage of financial resources to invest till crop harvesting. It is also observed that the farmers committed suicides were cultivating the leased lands, which was an additional burden to pay lease



FIG. - 1  
**INDEX MAP**  
**KHAMMAM DISTRICT**  
**ANDHRA PRADESH**



amount to the landowners. However, efficient water management will console the distress among farmers and the farmers also should resort to economically viable and low water requirement crops.

The district is drained by Godavari and Krishna river systems. Except about less than one fourth of the district on southwestern portion, the district forms part of Godavari river basin. The district as a whole is relatively backward in agriculture compared to other districts of the state however it is the main occupation. The main crops of the district are rice, jowar, bajra, cotton and chillies. The total cropped area in the district is 4,79,305 ha. which forms about 30 percent of the total geographical area. Of the total cropped area 36 percent area is irrigated and groundwater irrigation accounts for 42 percent of the total irrigated area (73,267 ha). Canal, tank and lift irrigation accounts for the rest of 58 percent. The source wise net irrigation for the year 2004-05 is presented in **Table - 1**.

Central Groundwater Board carried out groundwater exploration, systematic and reappraisal hydrogeological studies in parts of the district. The studies inferred the water bearing properties of rocks and the depth of occurrence of water bearing zones in different rock units.

## **2.0 RAINFALL**

The annual normal rainfall of Khammam district is 1124 mm, which ranges from 970 mm at Madhira mandal to 1592 mm at Venkatapuram mandal. The annual rainfall for the years 2000-01 to 2004-05, mandalwise, is given in Table-2 along with its departure from normal. The mean annual rainfall of the district is depicted graphically along with its departure from normal in Figure-2. During 2000-01 and 2003-04 the rainfall was 12 percent above normal (1264 mm) and during 2001-02, 20002-03 and 20004-05 the rainfall was 17 %, 32% and 6 % below normal respectively (962 mm, 768 mm and 1061 mm). Scanty rainfall (drought conditions) recorded in 13 madals viz., Bonakal, Tirumalayapalem, Mudigonda, Aswaraopeta, Bayyaram, Vemsoor, , Chintakani, Kusumanchi, Khammam (urban), Konijerla, Venkatapuram and Cherla. On an average, the district rainfall was 30% below normal (Deficit) considering the cumulative departure from normal.

Table 1.

Table - 1

## NET AREA IRRIGATED SOURCE WISE, MANDAL WISE, 2004-05 IN KHAMMAM DISTRICT

(Area in Hectares)

Sl.No	Mandal	Canals	Tanks	Tube Wells	Other Wells	Lift Irrigation	Other Sources	Total	Percentage of net GW Irrigation to total Irrigation	Area Irrigated more than once
[1]	[2]	[3]	[4]	[5]	[6]	[7]	[8]	[9]	[10]	[11]
1	Nelakondapalli	0	356	374	3034	0	373	4137	82	5642
2	Mudigonda	1380	496	570	4268	173	0	6887	70	850
3	Khammam Urban	0	373	2223	1409	223	0	4228	86	459
4	Konijerla	758	800	0	1580	71	0	3209	49	0
5	Chintakani	0	1129	165	3831	125	0	5250	76	1137
6	Kusumanchi	1993	19	1489	3997	263	30	7791	70	1213
7	Khammam Rural	372	104	11	3914	319	42	4762	82	374
8	Tirumalaipalem	0	0	1045	5333	0	0	6378	100	78
9	Yerrupalem	998	632	1340	661	146	0	3777	53	143
10	Madhira	2	802	649	655	1276	0	3384	39	775
11	Bonakal	571	1106	125	1260	245	0	3307	42	0
12	Wyra	5622	143	0	394	456	0	6615	6	179
13	Thallada	745	939	18	974	2000	122	4798	21	2265
14	Kalluru	4002	1990	26	381	131	0	6530	6	2208
15	Penuballi	1886	2560	1112	765	231	32	6586	28	1923
16	Vemsoor	855	3361	884	53	19	0	5172	18	912
17	Sathupalli	1469	2210	2171	0	0	0	5850	37	2423
18	Yellandu	0	1147	0	222	0	0	1369	16	0
19	Singareni	0	1563	0	1589	34	147	3333	48	296
20	Kamepalli	0	1407	0	2822	772	0	5001	56	105
21	Garla	0	2643	0	1976	207	0	4826	41	0
22	Bayyaram	0	3426	0	1139	52	0	4617	25	214
23	Gundala	0	630	0	128	0	0	758	17	0
24	Tekulapalli	210	696	0	238	0	0	1144	21	0
25	Kothagudem	800	780	496	167	734	0	2977	22	463
26	Julurupadu	0	561	1158	650	0	40	2409	75	614
27	Chandrugonda	0	2098	998	588	0	126	3810	42	199
28	Enkoor	0	134	603	2209	102	0	3048	92	1152
29	Dammapeta	0	1978	4729	0	0	0	6707	71	1364
30	Aswaraopeta	322	1454	1860	0	0	0	3636	51	1984
31	Mulkalapalli	352	1021	275	668	549	29	2894	33	718
32	Palwancha	0	1313	134	0	832	0	2279	6	626
33	Burgampadu	394	507	258	0	1376	0	2535	10	477
34	Kukkunoor	93	349	104	0	1102	0	1648	6	21
35	Velairpadu	716	38	0	0	541	0	1295	0	0
36	Manuguru	0	2223	0	0	339	0	2562	0	891
37	Aswapuram	0	2224	27	62	425	121	2859	3	243
38	Pinapaka	0	3269	2056	0	0	0	5325	39	520
39	Dummugudem	2752	349	0	2	829	0	3932	0	41
40	Bhadrachalam	0	459	0	0	1912	0	2371	0	0
41	Kunavaram	0	189	0	0	1137	0	1326	0	0
42	V.R.Puram	0	105	0	0	1136	0	1241	0	0
43	Chintoor	0	132	0	10	94	0	236	4	0
44	Wazeedu	0	698	1181	0	1330	0	3209	37	0
45	Venkatapuram	0	553	1494	0	1032	0	3079	49	0
46	Cherla	2470	585	713	0	389	0	4157	17	1663
	<b>District Total</b>	<b>28762</b>	<b>49551</b>	<b>28288</b>	<b>44979</b>	<b>20602</b>	<b>1062</b>	<b>173244</b>	<b>42</b>	<b>32172</b>

**Table 2.**

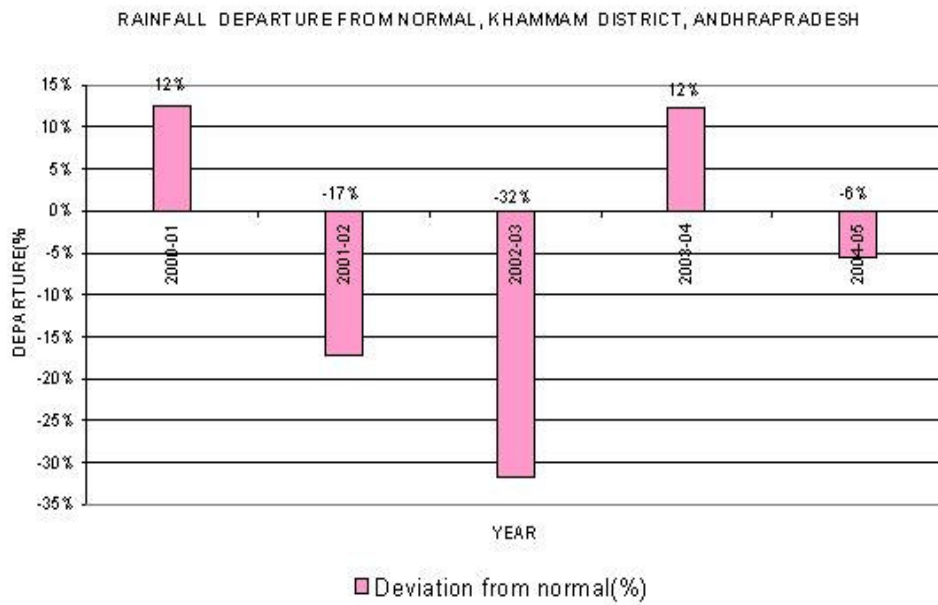
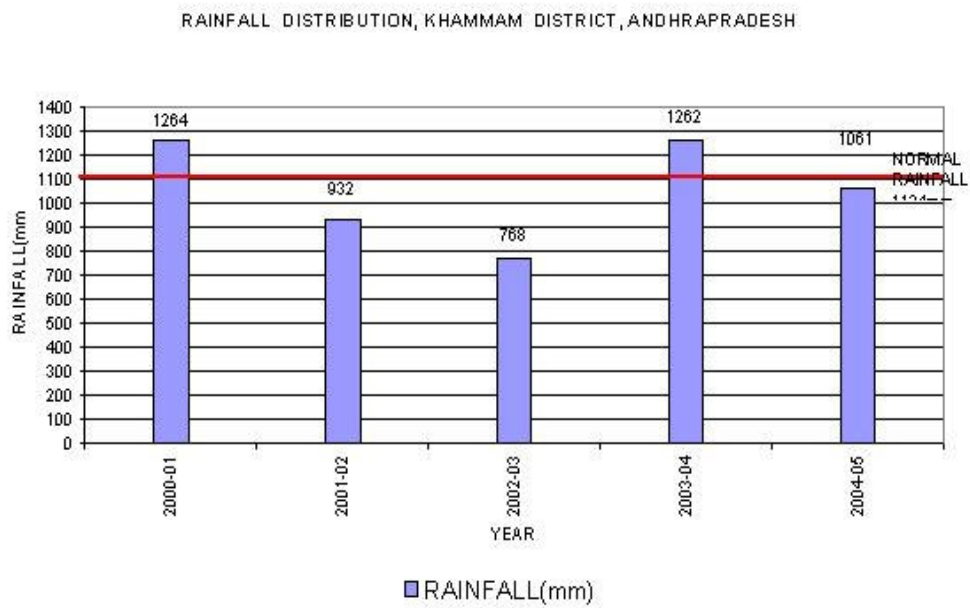
**MANDAL-WISE ANNUAL RAINFALL AND ITS DEPARTURE FROM NORMAL  
KHAMMAM DISTRICT**

Sl.No.	Stations	Rainfall(mm)					Departure from Normal					CUMMULATIVE DEPARTURE	REMARKS	
		Normal	2000-2001	2001-2002	2002-2003	2003-2004	2004-05	2000-2001	2001-2002	2002-2003	2003-2004			2004-05
1	Aswapuram	1141	1121	1058	852	1610	1270	-2%	-7%	-25%	41%	11%	18%	Normal
2	Aswaraopeta	1163	1245	798	721	1072	860	7%	-31%	-38%	-8%	-26%	-96%	Scanty
3	Bayyaram	1212	1155	965	712	1274	951	-5%	-20%	-41%	5%	-22%	-83%	Scanty
4	Bhadrachalam	1159	1347	1093	905	1599	1184	16%	-6%	-22%	38%	2%	29%	Excess
5	Bonakal	990	1101	608	495	892	769	11%	-39%	-50%	-10%	-22%	-110%	Scanty
6	Burgampadu	1201	1386	1139	900	1629	1381	15%	-5%	-25%	36%	15%	36%	Excess
7	Chandrugonda	1058	1521	882	770	1107	1127	44%	-17%	-27%	5%	7%	11%	Normal
8	Cherla	1438	1365	819	752	1935	1237	-5%	-43%	-48%	35%	-14%	-75%	Scanty
9	Chinthakani	988	937	644	694	1006	871	-5%	-35%	-30%	2%	-12%	-80%	Scanty
10	Chintoor	1314	1886	1029	917	1476	1267	44%	-22%	-30%	12%	-4%	0%	Normal
11	Dammapeta	1214	2228	973	877	1321	996	84%	-20%	-28%	9%	-18%	27%	Excess
12	Dummugudem	1356	1406	1109	930	1553	1270	4%	-18%	-31%	15%	-6%	-38%	Deficit
13	Enkoor	1160	1336	954	767	1253	1255	15%	-18%	-34%	8%	8%	-20%	Deficit
14	Garla	1006	1016	951	797	1084	1001	1%	-5%	-21%	8%	0%	-18%	Normal
15	Gundala	987	1170	941	674	1198	875	19%	-5%	-32%	21%	-11%	-8%	Normal
16	Julurupadu	1013	1360	1013	782	1183	1165	34%	0%	-23%	17%	15%	43%	Excess
17	Kalluru	1025	1072	946	673	1070	963	5%	-8%	-34%	4%	-6%	-39%	Deficit
18	Kamepalli	1035	996	901	730	1298	993	-4%	-13%	-29%	25%	-4%	-25%	Deficit
19	Khammam Rural	988	1022	889	800	918	818	3%	-10%	-19%	-7%	-17%	-50%	Deficit
20	Khammam Urban	1060	1022	996	714	918	808	-4%	-6%	-33%	-13%	-24%	-79%	Scanty
21	Konijerla	1059	1239	920	609	843	874	17%	-13%	-42%	-20%	-17%	-76%	Scanty
22	Kothagudem	1049	1062	1042	818	1391	1523	1%	-1%	-22%	33%	45%	56%	Excess

23	Kukkunoor	1101	1318	846	853	1230	1093	20%	-23%	-23%	12%	-1%	-15%	Normal
24	Kunavaram	1145	1844	1162	886	1358	1151	61%	2%	-23%	19%	0%	59%	Excess
25	Kusumanchi	978	1131	841	546	998	791	16%	-14%	-44%	2%	-19%	-60%	Scanty
26	Madhira	970	1032	679	648	1073	987	6%	-30%	-33%	11%	2%	-44%	Deficit
27	Manuguru	1232	1499	1158	694	1616	1280	22%	-6%	-44%	31%	4%	7%	Normal
28	Mudigonda	990	1062	684	536	904	798	7%	-31%	-46%	-9%	-19%	-98%	Scanty
29	Mulkalapalli	1209	1384	1102	847	1279	1107	14%	-9%	-30%	6%	-8%	-27%	Deficit
30	Nelakondapalli	992	1070	760	611	939	894	8%	-23%	-38%	-5%	-10%	-69%	Scanty
31	Palwancha	1134	1024	897	675	1519	1183	-10%	-21%	-40%	34%	4%	-33%	Deficit
32	Penuballi	1046	1059	864	742	1328	1060	1%	-17%	-29%	27%	1%	-17%	Normal
33	Pinapaka	1214	1487	959	898	1536	945	22%	-21%	-26%	26%	-22%	-20%	Deficit
34	Sathupalli	1155	1126	900	800	1211	1111	-3%	-22%	-31%	5%	-4%	-54%	Deficit
35	Singareni	1068	866	961	887	1343	1026	-19%	-10%	-17%	26%	-4%	-24%	Deficit
36	Tekulapalli	1006	1036	906	978	1239	1213	3%	-10%	-3%	23%	21%	34%	Excess
37	Thallada	1091	1145	915	723	1038	999	5%	-16%	-34%	-5%	-8%	-58%	Deficit
38	Tirumalaipalem	1010	995	772	561	992	717	-1%	-24%	-44%	-2%	-29%	-100%	Scanty
39	V.R.Puram	1308	1548	982	780	1309	1423	18%	-25%	-40%	0%	9%	-38%	Deficit
40	Velairpadu	1209	1454	1122	725	1197	1201	20%	-7%	-40%	-1%	-1%	-29%	Deficit
41	Vemsoor	1059	1003	751	607	1241	848	-5%	-29%	-43%	17%	-20%	-80%	Scanty
42	Venkatapuram	1592	2004	985	1064	1658	1008	26%	-38%	-33%	4%	-37%	-78%	Scanty
43	Wazeedu	1441	1646	1001	1021	1827	1228	14%	-31%	-29%	27%	-15%	-34%	Deficit
44	Wyra	1086	1263	1027	653	906	1022	16%	-5%	-40%	-17%	-6%	-52%	Deficit
45	Yellandu	1067	989	1099	1003	1672	1299	-7%	3%	-6%	57%	22%	68%	Surplus
46	Yerrupalem	980	1166	819	677	1017	964	19%	-16%	-31%	4%	-2%	-26%	Deficit
	<b>Dist. Average</b>	<b>1124</b>	<b>1264</b>	<b>932</b>	<b>768</b>	<b>1262</b>	<b>1061</b>	<b>12%</b>	<b>-17%</b>	<b>-32%</b>	<b>12%</b>	<b>-6%</b>	<b>-30%</b>	<b>Deficit</b>

Source: Directorate of Economics and Statistics, Andhra Pradesh

Fig 2.



### 3.0 GROUND WATER SCENARIO

Groundwater is an important source of irrigation contributing 42% to the net area irrigated in the district. But in some mandals like Tirumalayapalem, Enkur, Nelakondapalli, Khammam (Rural & Urban), Mudigonda, Kusumanchi, Julurpad etc., groundwater is the main source of irrigation and accounts for more than 75% of irrigation. The groundwater occurrence is mainly dependent on the rock type of the area and the depth of weathering down below the surface and the extension of weak zones like fractures, fissures and joints. Dug well irrigation is more extensive in the district compared to bore well/tube well irrigation.

### 3.1 HYDROGEOLOGY

Hydrogeology is the study of rocks in relation to groundwater occurrence. Hydrogeologically the rock units of the district may be broadly divided into three distinct groups viz.; i. Consolidated formations, comprising granites and gneisses of Archaean group and schists, phyllites and limestones of Pakhal Series; ii. Semi-consolidated formations, comprising conglomerates, shales and sandstones of Lower and Upper Gondwana Supergroup; iii. Unconsolidated formations comprising river alluvium along riverbanks. The hydrogeological conditions of the district is presented in **Fig.3**.

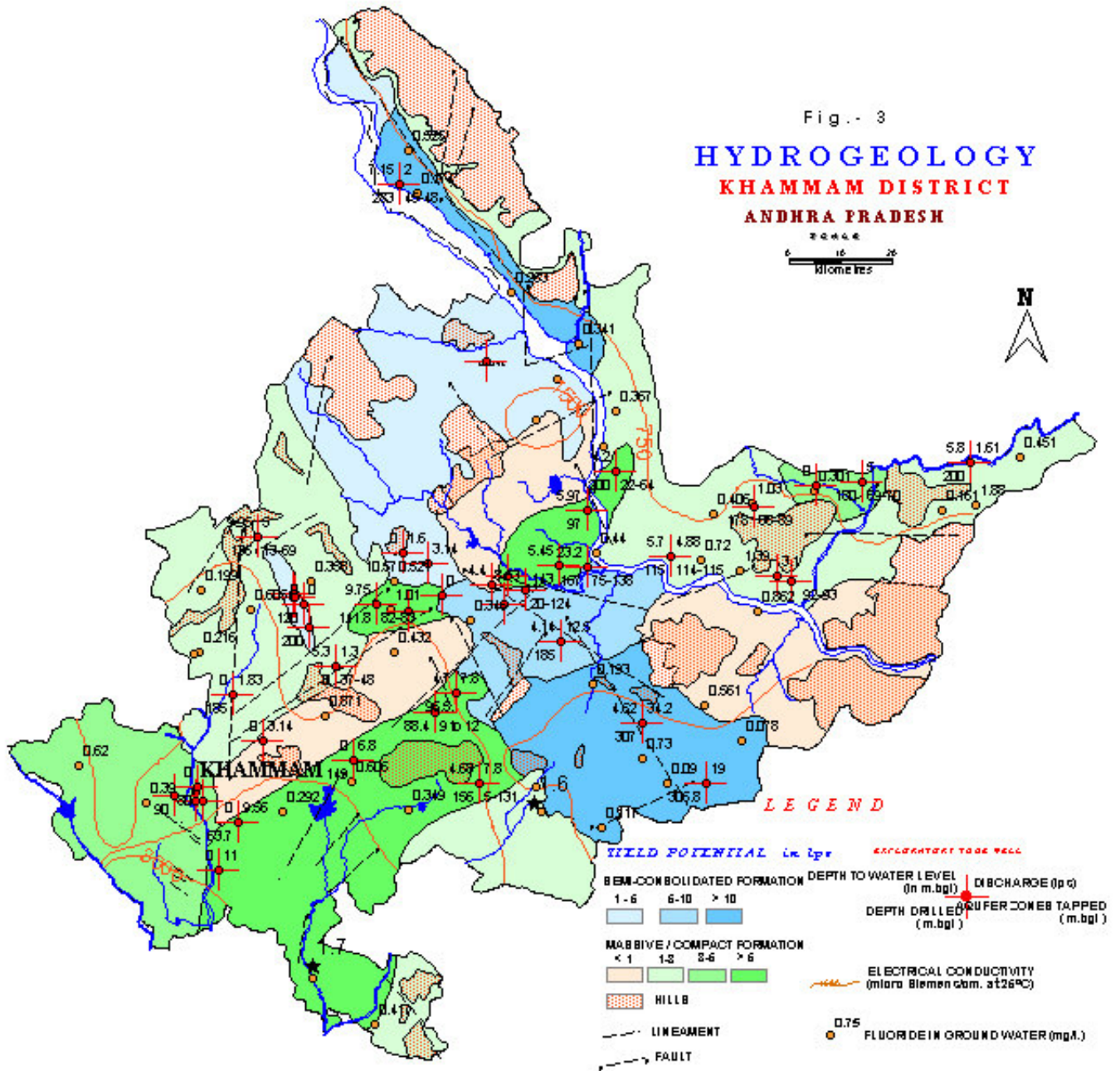
#### i. Consolidated formations:

Aquifers in these rocks are not extensive in space. But these form good aquifer system depending on the depth of weathering, granularity of the rock and the intensity of weak zones.

a) **Archaean crystallines**: These rocks occur on southern, southwestern and eastern parts of the district and occupy more than 50% of the district. Weathered and fractured granites and gneisses form aquifer system; the depth of weathering varies between 10 and 15m below ground level (bgl) and fractures extend from 30 to 60m bgl. Beyond 60m depth the possibility of encountering fracture zones is rare but not uncommon. Ground water is generally tapped from shallow weathered zones through large diameter open wells located in granitic terrain ranging in depth from 5 to 16m with depths to water levels range from 4 to 15.75m bgl. The average yield of these dug

Fig. - 3

## HYDROGEOLOGY KHAMMAM DISTRICT ANDHRA PRADESH





wells range between 10 and 30 m<sup>3</sup>/day. A number of bore wells come up in the recent five years, tapping the fractured zones in the depth range of 30 to 75m bgl, with yields of 1-3 lps.

b) **Pakhals:** These rocks comprising shales, phyllites and silicious limestones occur in parts of Bayyaram, Yellandu and Gundala mandals on western part of the district and in parts of Manuguru, Paloncha, Kothagudem and Aswapuram mandals in central northeastern part and in Wazeed and Venkatapuram mandals in northern part of the district. Ground water occurs under water table conditions in the intergranular secondary pores of weathered rocks. In shales and phyllites the depth of weathered zone varies between 3 and 15m bgl and the well depths range between 4 to 17m bgl and the depth to water levels range between 2 to 16m bgl. The yields in these wells are generally less than 30 m<sup>3</sup>/day. In the limestone formations bore wells have been constructed in the depth range of 15 to 105 m bgl and the depth to water levels are shallow ranging between <1 and 6m bgl, with yields up to 5 lps.

Central Ground Water Board explored formations of the district in tribal and non-tribal mandals during 1989-97 in Chintur, Bhadrachalam, Dummugudem, Cherla, Kukunoor, Aswapuram, Chandrugonda, Penuballi, Enkur, Garla, Tallada, Singareni, Chintakani and Paloncha mandals. A total number of 75 exploratory wells were constructed, out of which, 55 were constructed under tribal sub-plan during 1989-95.

The exploration revealed the availability of fracture system between 80 and 165 m bgl with yields ranging from <1 to 12.75 lps. The exploratory bore wells drilled at Murumuru, Kodumuru, Chidumurum and Garlaroddu given high yields of 5 – 10 lps. The general range of specific capacity of the exploratory wells range between 6 and 87 lpm/ mdd; transmissivity (T) between 7.8 and 257 sq.m/day; and Storage co-efficient between  $8.4 \times 10^{-6}$  and  $8.19 \times 10^{-3}$ .

## **ii. Semi-consolidated formations:**

This group consists of mainly conglomerates, sandstones and shales of Lower and Upper Gondwana members. Groundwater occurs in unconfined and confined conditions in these formations. The sandstones of Upper Gondwana group are very good aquifers and tube wells constructed in this formation at Naravarigudem, Dammapeta and Rudrakshpalli villages yield in the range of 10 – 30 lps. The lower Gondwana members are also productive but not as that of Upper members. The yields in Lower members of Barakars are in the range of 4 – 10 lps. These formations occur in central part of the district falling in Sathupalli, Dammapeta, Aswaraopet, Pinapaka, Manuguru, Aswapuram, Kottagudem, Paloncha and Mulkalapalli mandals, occupying about 30 percent of the district area. These formations form very good aquifer systems and ground water occur under water table conditions as well as confined conditions in these aquifer units. The water table aquifers occur down to 15m bgl whereas the confined aquifers occur at different depths ranging from 40 to 300m.

Central Ground Water Board (CGWB) commenced ground water exploration in these formations in 1972 itself and constructed 8 exploratory tube wells in the erstwhile taluks of Sathupalli and Aswaraopet. In the next phase during 1980-89 another 13 exploratory wells were constructed during 1985-97. All these 21 exploratory tube wells range in depth from 45 – 400 m bgl with discharges of 2.4 – 27 lps for draw downs of <1 – 25 m. The Specific Capacity of the wells range between 10 and 367 lpm/mdd. The Transmissivity (T) and Storage co-efficient ranges between  $2 \times 10^{-4}$  and  $4.64 \times 10^{-4}$  respectively.

## **iii. Unconsolidated formations:**

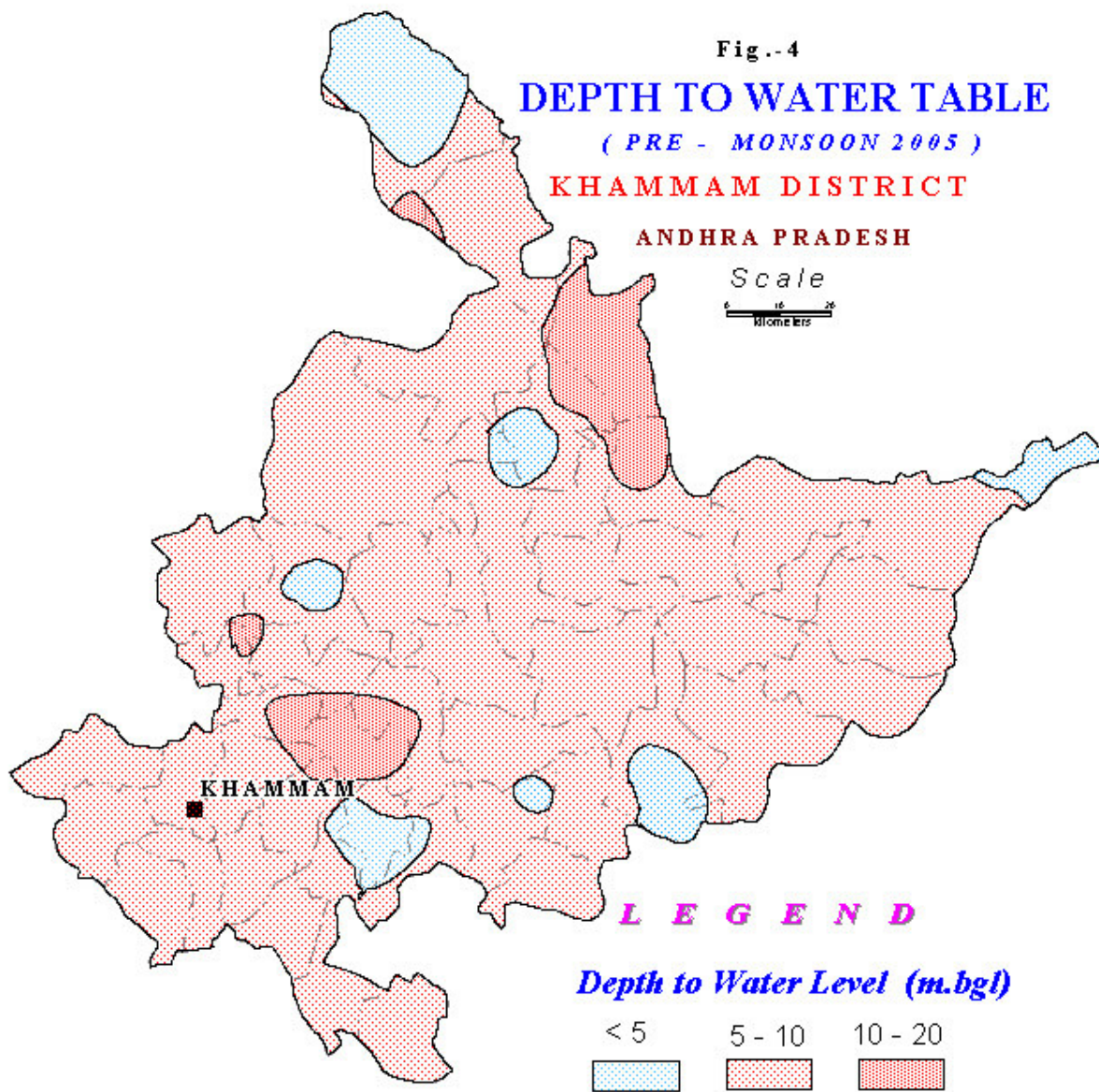
The river alluvium deposited along the major river banks of Godavari and Kinnerasani constitute unconsolidated aquifer system with alternate clay, silt, sand, gravel and kankar.

Productivity of the wells depend on the thickness of sand and gravel layers. The major unit of this formation is along eastern bank of Godavari river on northern part of the district in Wazeed, Venkatapur and Cherla mandals. The width of this bed vary from <1km to 6km from the river bank with a thickness of 3 to 20m down below ground level. The other units along Kinnerasani, Sabari and Munneru river banks are isolated and of limited width and thickness. Filter points are the common groundwater extraction structures in this unit. The depth of these filter points vary from few meters to 25m. The yields range between 3 to 15 lps.

### **Depth to Water levels:**

To understand the dynamic changes of groundwater storage conditions in the aquifers of the district, depth to water levels are monitored four times every year from 56 ground water monitoring wells including 14 piezometer wells. Seven piezometer wells are installed with digital water level recorders and water levels from these wells are recorded daily. State ground water department is monitoring about 80 wells and the past ten years water level data of the state department has been analysed to draw decadal trends of pre and post monsoon seasons. During 2005 the behaviour of water levels are as follows.

**Pre monsoon water levels:** During the pre monsoon season the depth to water level in the district ranges between 2.68 to 14.27m bgl. The analysis of these water levels reveal that more than 67% of the monitoring wells recorded 5 – 10m bgl stating the general water level in the district range between 5 and 10 m bgl (**Fig-4**). Shallow water levels (<5 m) are observed in nine wells and on the other hand, deep water levels (>10 m) are monitored in seven wells. Shallow water table conditions prevailed in parts of Wyra and Kallur on south and in parts of Wazeed and Venkatapur on the north. Deep water levels exist in parts of Enkur and Julurpad mandals on SW and in Cherla and Dummugudem mandals on NE.



**Post monsoon water levels:** During November 2005 (post monsoon), more than 80 % of the monitoring wells show depth to water levels <5 m bgl (**Fig-5**). Relatively deep water levels are recorded in 8 wells, out of the 47 monitored, in parts of Enkur and Julurpad on west and in parts of Cherla and Dummugudem.

**Water level Fluctuation:** Water level fluctuation map has been prepared based on pre and post monsoon water levels (**Fig-6**). Out of the 47 wells considered for preparation of map, 31 wells have shown a rise of >4m. Very little rise (<2m) is shown by 6 nos. of wells, located in the proximity of coal mining at Manuguru and Ellandu. Rest of the 10 wells has shown a rise of 2 – 4 m.

**Long term water level trends :** Long term water level data of regular observation wells of CGWB and State Ground Water Department are analysed for the period of 1996 – 2005 and decadal trends have been generated for pre and post monsoon seasons. The pre-monsoon trends in 42 % of the observation wells showing a declining trend of 0.2 m/ year and 18 % of the observation wells show less than 0.2 m/ year. During post monsoon season only 22 % of the wells are showing declining trend of < 0.2 m/ year. Falling trend of about 0.4m/year prevail in parts of Tirumalayapalem, Sathupalli, Kallur, Chintakani, Kunavaram, Khammam (Rural), Dammapeta, Aswaraopeta and Penuballi mandals in both pre and post monsoon seasons (**Fig-7**).

### **3.2 GROUND WATER RESOURCES**

Based on the Groundwater Estimation Committee recommendations, groundwater assessment of the district was done latest in 2004. The entire district has been divided into 70 micro-basins and assessment has been done micro-basin wise and apportioned to revenue mandal wise for presentation purpose (Table-3). The total availability of the ground water resource of the district is of order of 1859 MCM of which 493 MCM is available in command areas and the rest 1366 MCM in non-command areas.

Fig.-5

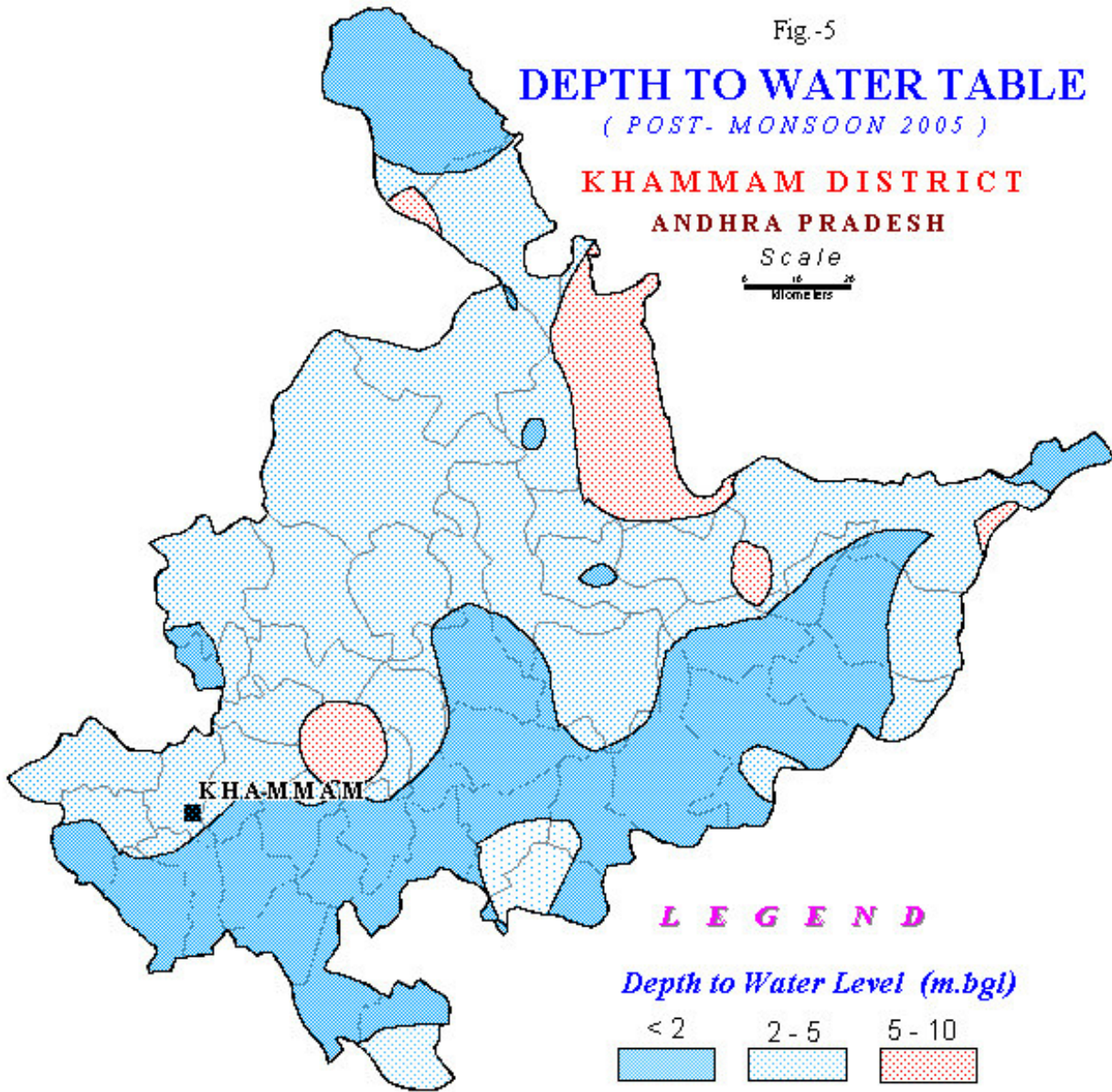
# DEPTH TO WATER TABLE

( POST- MONSOON 2005 )

**KHAMMAM DISTRICT**

**ANDHRA PRADESH**

Scale



## LEGEND

*Depth to Water Level (m.bgl)*

<math>< 2</math>



2 - 5



5 - 10



Fig.-6

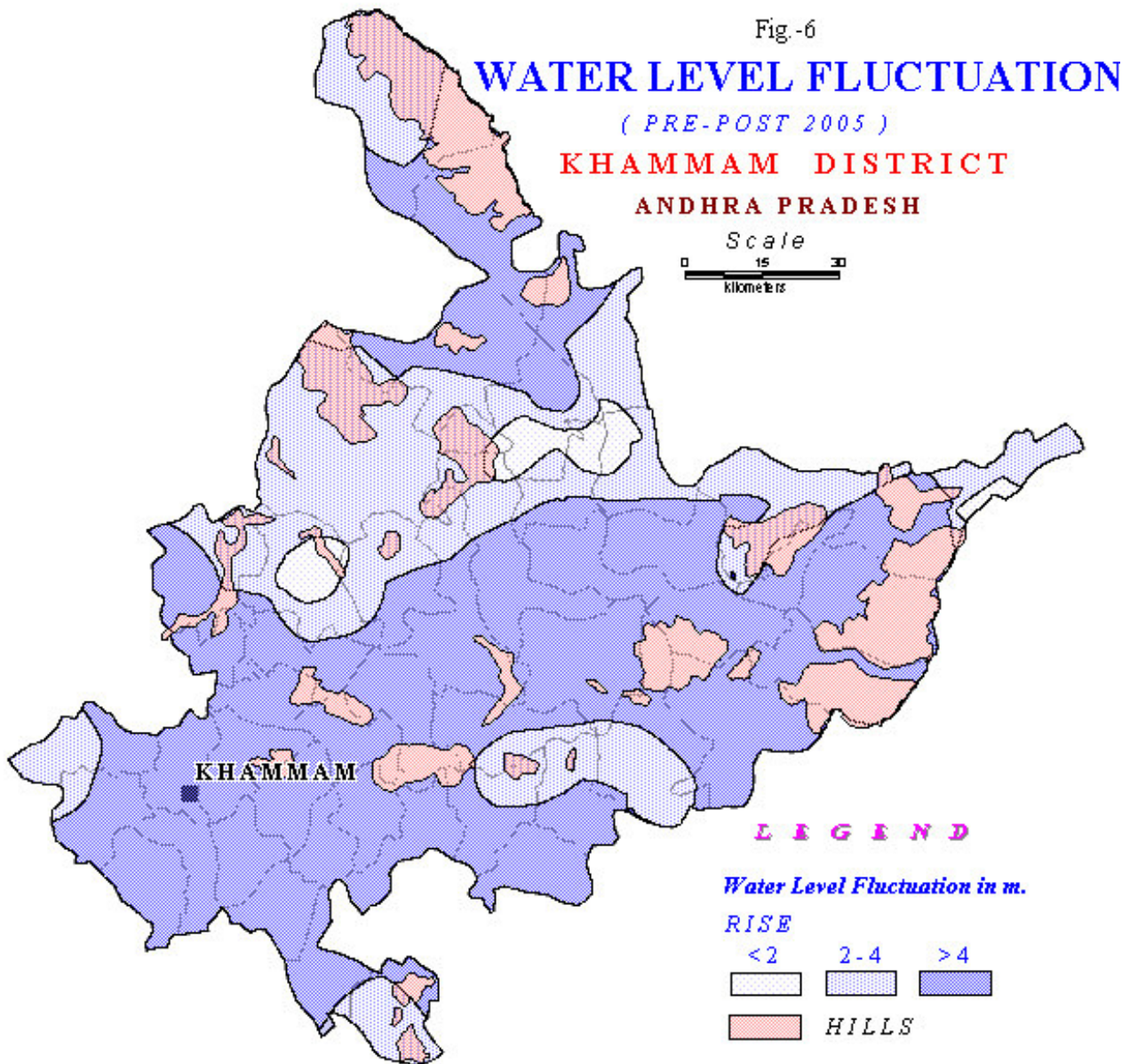


Figure - 7

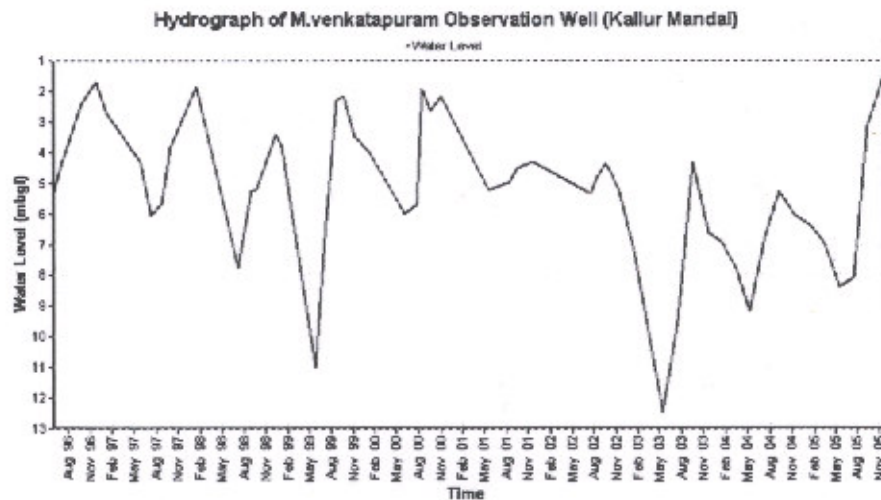
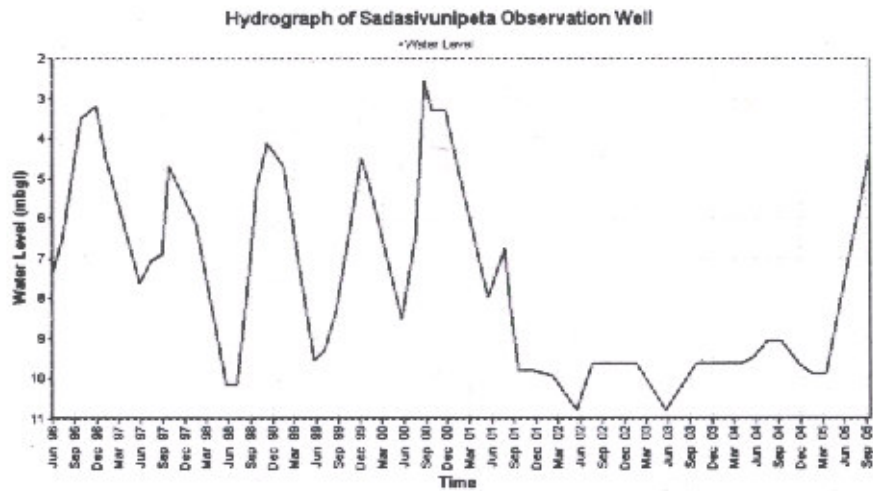
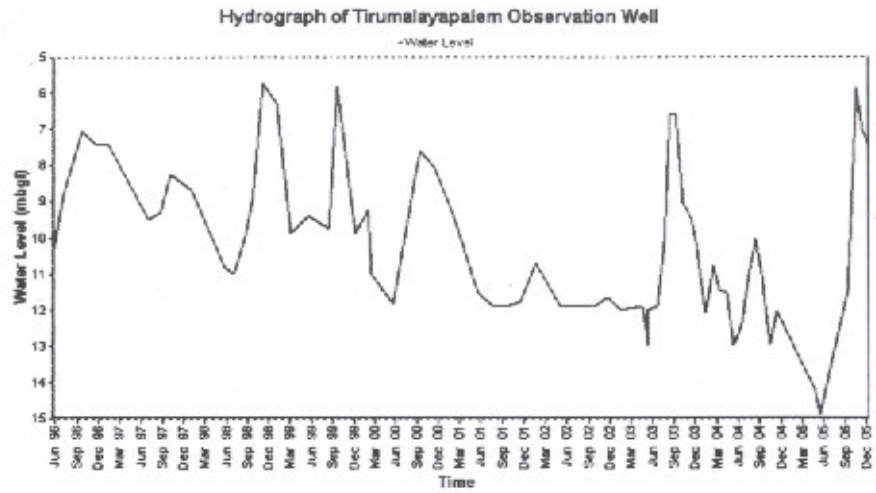
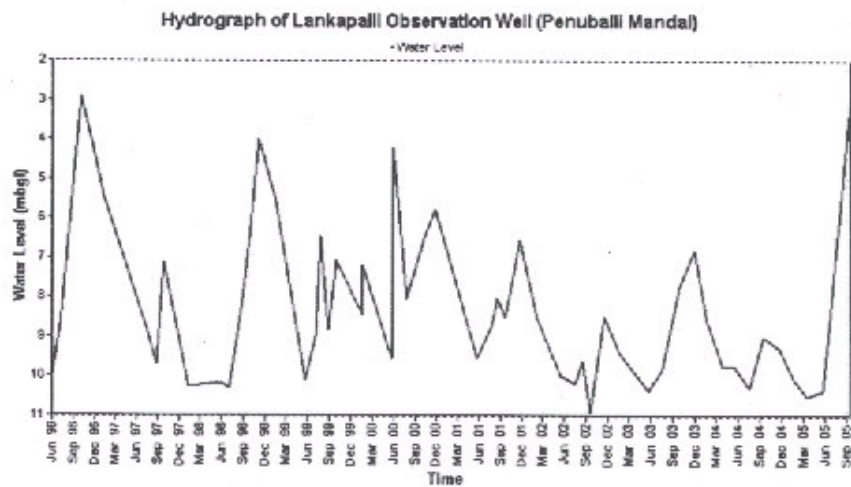
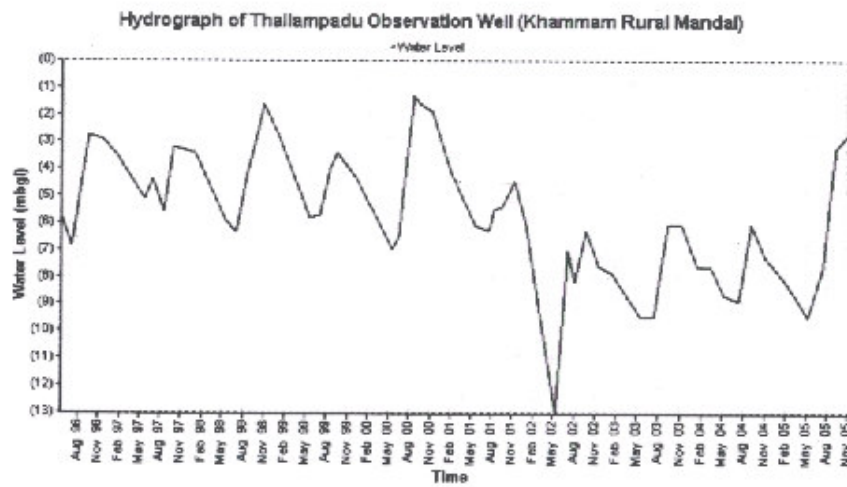
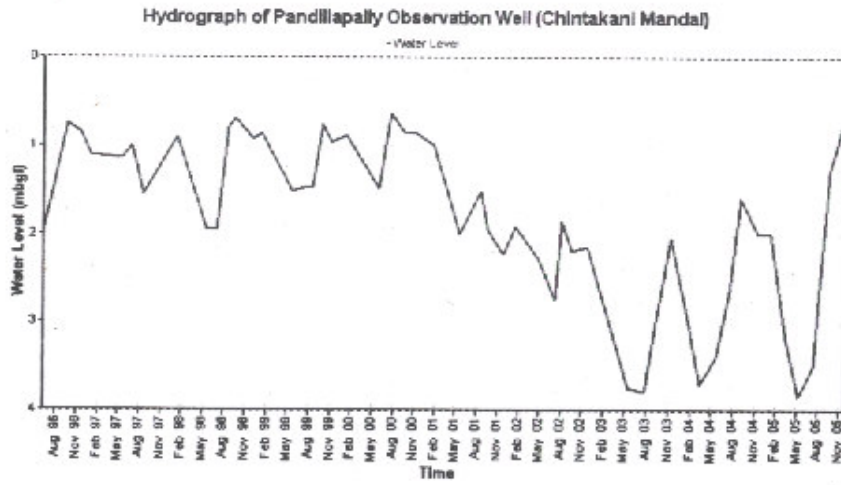




Figure - 7a



**Table 3.**  
**MANDAL WISE GROUNDWATER RESOURCE 2004**  
**KHAMMAM DISTRICT, ANDHRA PRADESH**

S.No	Mandal	Groundwater availability ha.m			Groundwater utilisation ha.m			Groundwater balance ha.m			Stage of development %			Category		
		C	NC	Total	C	NC	Total	C	NC	Total	C	NC	Total	C	NC	Total
1	2	3			4			5 = (3-4)			6 = {(4/3) * 100}			7		
1	Aswapuram	0	2255	2255	0	119	119	0	2135	2135	NA	5	5	NA	Safe	Safe
2	Aswaraopeta	0	6781	6781	0	1582	1582	0	5199	5199	NA	23	23	NA	Safe	Safe
3	Bayyaram	0	1556	1556	0	270	270	0	1286	1286	NA	17	17	NA	Safe	Safe
4	Bhadrachelam	0	2798	2798	0	239	239	0	2560	2560	NA	9	9	NA	Safe	Safe
5	Bonakal	4867	402	5270	532	97	629	4335	305	4641	11	24	12	Safe	Safe	Safe
6	Burgampadu	0	2894	2894	0	254	254	0	2640	2640	NA	9	9	NA	Safe	Safe
7	Chandrugonda	0	3678	3678	0	528	528	0	3150	3150	NA	14	14	NA	Safe	Safe
8	Cherla	0	5543	5543	0	138	138	0	5405	5405	NA	2	2	NA	Safe	Safe
9	Chintakani	3147	773	3920	763	348	1111	2384	425	2809	24	45	28	Safe	Safe	Safe
10	Chintur	0	4568	4568	0	175	175	0	4393	4393	NA	4	4	NA	Safe	Safe
11	Dammamet	0	5691	5691	0	2229	2229	0	3462	3462	NA	39	39	NA	Safe	Safe
12	Dummugudem	0	5729	5729	0	143	143	0	5586	5586	NA	2	2	NA	Safe	Safe
13	Enkur	2467	46	2513	823	185	1007	1644	-139	1505	33	403	40	Safe	OE	Safe
14	Garla	0	944	944	0	453	453	0	491	491	NA	48	48	NA	Safe	Safe
15	Gundala	0	9563	9563	0	102	102	0	9461	9461	NA	1	1	NA	Safe	Safe
16	Julurpadu	668	2407	3075	76	168	244	592	2239	2831	11	7	8	Safe	Safe	Safe
17	Kallur	3599	354	3954	574	94	668	3026	260	3286	16	27	17	Safe	Safe	Safe
18	Kamepalli	0	1125	1125	0	902	902	0	223	223	NA	80	80	NA	SC	SC
19	Khammam ( U )	1056	2011	3067	88	1217	1305	968	794	1762	8	61	43	Safe	Safe	Safe
20	Khammam (Rural)	2500	1828	4328	863	1830	2693	1637	-2	1635	35	100	62	Safe	OE	Safe
21	Konijerla	3625	116	3741	838	57	894	2787	59	2847	23	49	24	Safe	Safe	Safe
22	Kothagudem	0	5843	5843	0	430	430	0	5413	5413	NA	7	7	NA	Safe	Safe
23	Kuknoor	0	3985	3985	0	214	214	0	3771	3771	NA	5	5	NA	Safe	Safe
24	Kunavaram	0	1939	1939	0	144	144	0	1795	1795	NA	7	7	NA	Safe	Safe
25	Kusumanchi	3957	2637	6594	507	2234	2741	3450	403	3853	13	85	42	Safe	SC	Safe
26	Madhira	5816	29	5845	852	18	869	4964	11	4976	15	60	15	Safe	Safe	Safe
27	Manuguru	0	3527	3527	0	108	108	0	3419	3419	NA	3	3	NA	Safe	Safe

28	Mudigonda	3987	103	4090	1869	23	1892	2118	80	2199	47	22	46	Safe	Safe	Safe
29	Mulkalapally	0	6438	6438	0	1090	1090	0	5349	5349	NA	17	17	NA	Safe	Safe
30	Nelakondapalli	4822	0	4822	1041	0	1041	3781	0	3781	22	NA	22	Safe	NA	Safe
31	Palvancha	0	5619	5619	0	472	472	0	5147	5147	NA	8	8	NA	Safe	Safe
32	Penuballi	0	3427	3427	0	1012	1012	0	2415	2415	NA	30	30	NA	Safe	Safe
33	Pinapaka	0	3330	3330	0	179	179	0	3151	3151	NA	5	5	NA	Safe	Safe
34	Sathupalli	0	3710	3710	0	856	856	0	2854	2854	NA	23	23	NA	Safe	Safe
35	Singareni	0	1370	1370	0	563	563	0	807	807	NA	41	41	NA	Safe	Safe
36	Tekulapalli	0	2556	2556	0	320	320	0	2235	2235	NA	13	13	NA	Safe	Safe
37	Thallada	2932	0	2932	556	0	556	2376	0	2376	19	NA	19	Safe	NA	Safe
38	Tirumalayapalem	0	3344	3344	0	5352	5352	0	-2008	-2008	NA	160	160	NA	OE	OE
39	V R Puram	0	7463	7463	0	55	55	0	7408	7408	NA	1	1	NA	Safe	Safe
40	Velairpadu	0	1507	1507	0	81	81	0	1427	1427	NA	5	5	NA	Safe	Safe
41	Vemsur	0	1897	1897	0	914	914	0	983	983	NA	48	48	NA	Safe	Safe
42	Venkatapuram	0	4281	4281	0	77	77	0	4204	4204	NA	2	2	NA	Safe	Safe
43	Wazeedu	0	8977	8977	0	135	135	0	8842	8842	NA	2	2	NA	Safe	Safe
44	Wyra	2838	0	2838	486	0	486	2352	0	2352	17	NA	17	Safe	NA	Safe
45	Yellandu	0	2602	2602	0	208	208	0	2395	2395	NA	8	8	NA	Safe	Safe
46	Yerrupalem	3020	957	3977	738	355	1093	2281	602	2884	24	37	27	Safe	Safe	Safe
	<b>Total</b>	<b>49300</b>	<b>136605</b>	<b>185905</b>	<b>10603</b>	<b>25968</b>	<b>36571</b>	<b>38697</b>	<b>110637</b>	<b>149334</b>	<b>22</b>	<b>19</b>	<b>20</b>	<b>Safe</b>	<b>Safe</b>	<b>Safe</b>

Note: OE = Over exploited; SC = Semi critical; C = Command; NC = Non command; NA = Not applicable

The ground water utilisation is computed based on draft calculations and estimated to be 366 MCM, of which 29% is utilised in command areas and the rest 71% in non-command areas. Tirumalayapalem mandal alone utilises 15% (53 MCM) of the available resource of the district. The other mandals Kusumanchi, Khammam (Rural) and Dammapeta are next in order in utilisation of the available ground water resources. In non-command areas of Tirumalayapalem and Enkur utilisation much exceeds the available resource causing over draft and in Khammam (Rural), Nelakondapalli, Madhira, Tallada and Wyra the entire available resource is being utilised and there is no balance left for future utilisation.

Based on the utilisation rate of the available resources (stage of development denoted in percentage) as well as considering the long term water level trends, mandals are categorised into 4 groups viz., Safe, Semi-critical, Critical and Over exploited. Villages are also categorised in the same manner based on the stage of development of the village.

Mandal-wise resource estimation shows that Tirumalayapalem is the only mandal under Over exploited (OE) category, while Kamepalli is the only mandal under Semi-critical category as a whole (**Fig- 8**). Exclusively non-command areas are concerned Enkur and Khammam (Rural) fall under OE category; and Kusumanch mandal falls in Semi-critical in addition to Kamepalli.

Village level categorisation indicates that 62 villages spreading over 14 mandals are of **OE** category with an average stage of development of 170% (**Table-4**). A maximum of 18 villages are under OE category in Tirumalayapalem mandal itself. The other mandals having more number of villages under OE category are Khammam (Rural), Dammapeta and Kamepalli. The stage of development is more than 400% at Gandepalli, Kesupalli and Tallacheruvu villages of Kamepalli, Enkur and Tirumalayapalem mandals respectively. Nine villages of the district fall under **Critical** category out of which four in command areas of Nelakondapalli and chintakani, the other five villages in non-command areas mainly located on western part of the district. Ten villages, distributed in command areas of seven western mandals, and 50



**Table - 4****MANDALWISE OE VILLAGES AND AVERAGE STAGE OF DEVELOPMENT OF OE MANDALS**

<b>Sl.No.</b>	<b>MANDAL</b>	<b>No. of OE Villages</b>	<b>Average Stage of Development in OE villages (%)</b>
1	Aswaraopeta	4	182
2	Chintakani	2	154
3	Dammapeta	7	139
4	Enkur	2	341
5	Kallur	1	101
6	Kamepalli	6	171
7	Khammam (U)	3	120
8	Khammam ®	8	135
9	Kusumanchi	3	143
10	Mudigonda	3	128
11	Singareni	1	160
12	Thirumalayapalem	18	211
13	Vemsur	2	145
14	Garla	2	101
	<b>Totals</b>	<b>62</b>	<b>170</b>

villages, in non-command areas of 22 mandals of the district, falling under Semi-critical category are mainly located on southern and western parts of the district.

### **3.3 GROUND WATER QUALITY**

The groundwater quality in the district in general is suitable for both domestic and irrigation purposes. The electrical conductivity ranges between 330 and 3490 micro Siemens/ cm at 25<sup>0</sup>C. The nitrate content in the ground water is beyond permissible limits in some pockets of canal command areas. The total population affected is 2,44,763. High fluoride content beyond the permissible limit of 1.5 mg/l exists in ground waters of 131 villages, distributed among 9 mandals (Table-6), affecting a total population of 2,44,763.

### **3.4 STATUS OF GROUND WATER DEVELOPMENT**

The groundwater development in the district is not as per the availability. Majority of the ground water potential areas lack agricultural practices because of backwardness among public.

The densely populated mandals on the western part of the district, where groundwater extraction is more for domestic and irrigation purposes, are underlain by hard rocks with low groundwater potential and low normal rainfall.

Ground water development in the district is mostly through dug/ bore wells in consolidated formations (**Table-5**) and through dug/ shallow tube wells in semi-consolidated formations and through dug/ filter points in unconsolidated formations. Small diameter dug wells with lining are used for household domestic purposes in almost all parts of the district irrespective of the type of formation. Bore wells constructed by Panchayatiraj department in the depth range of 50 – 100m bgl with 152mm diameter are common in hard rock areas to support drinking water supply of villages. High yielding bore wells of these are fitted with submersible pumps and are being used for drinking water supplies through a net work of overhead tanks and pipes. In semi-consolidated and

Table 5.

Table - 5

## MANDALWISE GROUNDWATER STRUCTURES (WELLS) AND WELL DENSITY

Sl.No.	Name of the Mandal	Area of the Mandal (hectares)	Dug wells	Tube/bore wells	Deep TWs	Total no. of wells	Well density (wells/sq.km)
1	2	3	4	5	6	7	8
1	Aswapuram	27456	198	89	1	288	1
2	Aswaraopeta	46199	254	159	222	635	1
3	Bayyaram	35175	1226	31	0	1257	4
4	Bhadrachalam	37269	135	27	0	162	0.4
5	Bonakal	16172	624	22	0	646	4
6	Burgampahad	27390	176	37	0	213	1
7	Chandrugonda	31776	420	57	59	536	2
8	Cherla	54337	44	192	0	236	0.4
9	Chinthakani	16363	1160	0	0	1160	7
10	Chintur	95529	63	0	0	63	0.1
11	Dammapeta	39168	66	740	458	1264	3
12	Dummugudem	43849	88	0	0	88	0.2
13	Enkuru	18453	860	249	0	1109	6
14	Garla	21864	1787	0	0	1787	8
15	Gundala	144602	114	0	0	114	0.1
16	Julurpad	23491	1181	77	53	1311	6
17	Kallur	26184	453	27	0	480	2
18	Kamepalle	21985	1429	84	0	1513	7
19	Khammam (Rural)	20476	3406	48	0	3454	17
20	Khammam (Urbarn)	23606	3067	65	0	3132	13
21	Konijerla	23286	1298	6	0	1304	6
22	Kothagudem	50000	897	167	0	1064	2
23	Kukunoor	28681	172	51	0	223	1
24	Kunavaram	20382	28	0	0	28	0.1
25	Kusumanchi	22138	3766	925	1	4692	21
26	Madhira	21009	813	237	0	1050	5
27	Manuguru	23235	0	152	0	152	1
28	Mudigonda	18435	2368	194	0	2562	14
29	Mulkalapalle	49829	335	44	0	379	1
30	Nelakondapalle	18403	1153	51	0	1204	7
31	Palwancha	37582	217	228	0	445	1
32	Penuballi	27713	709	401	0	1110	4
33	Pinapaka	43620	29	912	0	941	2
34	Sathupalle	26802	392	338	317	1047	4
35	Singareni	27332	1346	0	0	1346	5
36	Tallada	40865	153	32	0	185	0.5
37	Tekulapalle	20693	539	14	1	554	3
38	Thirumalayapalem	22433	5615	536	0	6151	27
39	V.R.Puram	47473	74	0	0	74	0.2
40	Velairpadu	41544	18	0	0	18	0.04
41	Vemsoor	18443	421	834	0	1255	7
42	Venkatapuram	57887	6	69	0	75	0.1
43	Wazeed	45655	4	150	0	154	0.3
44	Wyra	14555	213	32	0	245	2
45	Yellandu	34882	685	0	0	685	2
46	Yerrupalem	26713	970	455	0	1425	5
<b>Total</b>		<b>1580935</b>	<b>38972</b>	<b>7732</b>	<b>1112</b>	<b>47816</b>	<b>3</b>



unconsolidated formations tube wells of 40 – 150m bgl are constructed by Panchayatiraj department for drinking water supplies to villages. As on 2004-05 Panchayatiraj (RWS) has a strength of 19,273 bore wells fitted hand pumps, 1,343 bore/ tube wells fitted with submersible pump sets to support protected water supply and 1,905 dug wells to mitigate the drinking water requirements of the district. Status of mandal wise drinking water wells is shown in **Table-6**.

On the other hand, 42% of the net irrigation in the district is through ground water sources. There are a total number of 38,972 dug wells, 7,732 shallow tube wells and 1,112 deep tube wells (**Table-5**) creating irrigation potentials of 55,102 ha, 15,953 ha and 3,595 ha respectively.

The irrigation dug wells are mostly circular and occasionally rectangular with 4-6m diameter/ 4 x 8m. The depths of these wells range between 5 and 12m.

Majority of the wells sustain 2 – 4 hrs of pumping with 3/ 5 HP pump sets with yields ranging from 20 – 120 cu.m/day. Higher yields exist in the wells situated in semi- consolidated sedimentary terrains of Sathupalli, Dammapeta, Aswaraopeta and Chandrugonda mandals. The dug well density is more in Tirumalayapalem (25/sq.km), followed by Kusumanchi & Khammam (Rural) (17/sq.km), Khammam (Urban) and Mudigonda (13/sq.km); and is low (<1 – 2/sq.km) in almost all the mandals on eastern part of the district dwelled by tribal population.

The irrigation bore wells with 152 mm diameter are common in hard rock terrains with in a depth range of 40 – 80m, fitted with submersible pump sets of 5/ 7 HP capacity with average yields of 2 –4 lps. Higher yields of more than 5 lps prevail in some pockets depending upon the development of fracture/ lineament planes. The high yielding wells are around 5 – 10% among the total wells in these terrains.

Table 6.

Table -6

## DRINKING WATER FACILITIES IN THE VILLAGES - 2004-2005

Sl.No	Name of the Mandal	Total Inhabited Villages (No.)	Villages having adequate Drinking Water Facility (No)				Problematic Villages		
			PWS	Bore wells	Open wells	Others	Floride Villages	Brakish Water	Not having drinking water Facility
1	2	3	4	5	6	7	8	9	10
1	Wazeed	70	14	238	77	0	0	0	0
2	Venkatapuram	84	16	230	0	0	0	0	0
3	Cherla	88	31	321	0	8	0	0	0
4	Pinapaka	100	28	227	212	21	0	0	0
5	Gundala	88	9	245	124	12	0	0	0
6	Manuguru	42	26	157	21	0	0	0	0
7	Aswapuram	67	13	322	50	1	0	0	0
8	Dummugudem	103	17	689	40	1	0	0	0
9	Bhadrachalam	102	27	811	56	0	0	0	0
10	Kunavaram	57	11	427	33	3	0	0	0
11	Chintoor	101	14	694	39	0	0	0	0
12	V.R.Puram	73	17	361	23	5	0	0	0
13	Velairpadu	64	14	262	12	14	0	0	0
14	Kukkunoor	74	12	427	0	5	0	0	0
15	Burgampadu	52	11	499	94	3	0	0	0
16	Palwancha	61	22	390	60	4	0	0	0
17	Kothagudem	146	36	777	142	1	0	0	0
18	Tekulapally	139	14	502	0	2	0	0	0
19	Yellandu	123	30	449	39	8	0	0	0
20	Singareni	102	29	533	0	8	8	0	0
21	Bayyaram	83	38	354	34	1	0	0	0
22	Garla	93	66	243	0	3	0	0	0
23	Kamepally	53	26	318	53	7	8	0	0
24	Julurupadu	63	22	337	64	36	0	0	0
25	Chandrugonda	63	31	494	66	0	0	0	0
26	Mulkalapally	96	15	362	11	3	0	0	0
27	Aswaraopeta	86	62	316	0	5	0	0	0
28	Dammapeta	92	74	332	0	8	0	0	0
29	Sathupally	38	34	262	0	1	0	0	0
30	Vemsoor	35	35	540	35	0	0	0	0
31	Penubally	56	51	679	56	0	0	0	0
32	Kalluru	48	43	540	106	1	0	0	0
33	Thallada	41	23	521	64	4	0	0	0
34	Enkoor	42	18	357	42	1	9	0	0
35	Konijeria	53	34	582	11	0	31	0	0
36	Khammam (U)	74	40	654	12	13	3	0	0
37	Khammam (R)	67	29	452	21	15	22	0	39
38	Tirumalayapalem	79	57	349	79	6	16	0	0
39	Kusumanchi	83	65	356	7	2	25	0	0
40	Nelakondapally	37	30	357	0	0	2	0	0
41	Mudigonda	33	25	286	0	2	7	0	0
42	Chintakani	25	19	395	26	13	0	0	0
43	Wyra	29	29	372	0	0	0	0	0
44	Bonakal	22	15	324	22	8	0	0	0
45	Madhira	34	34	500	138	15	0	0	0
46	Yerrupalem	38	37	430	36	3	0	0	0
	<b>Total</b>	<b>3199</b>	<b>1343</b>	<b>19273</b>	<b>1905</b>	<b>243</b>	<b>131</b>	<b>0</b>	<b>39</b>

Source: Chief Planning Office, Khammam

Shallow/ deep tube wells with in a depth range of 35 – 120m are common in semi consolidated Gondwana Formations in Dammapeta, Aswaraopeta, Sathupalli, Mulkalapalli and Chandrugonda mandals. Deep tube wells of more than 100m depth are many in Dammapeta and Aswaraopet mandals, where relatively thick and more granular zones of Upper Gondwana beds encounter at higher depths. The yields of these wells range between 4 and 10 lps and sustain even 24 hrs/day pumping provided power supplies are assured. Mandal wise irrigation well details are presented in Table-5. Bore well density is maximum at Vemsur mandal (5/sq.km) followed by Kusumanchi, Dammapeta and Pinapaka (4, 3, and 2/sq.km respectively).

The AP State Irrigation Development corporation (APSIDC) has constructed about 95 deep community tube wells in Gondwana soft rocks covering Dammapeta, Aswaraopeta, Sathupalli and Chandrugonda mandals, with in a depth range of 100 – 220m bgl. In the initial stage, the construction programme was supported by scientific advise and supervision from CGWB. The average yields range between 5000 and 10000 GPH and maximum yields upto 35 lps are recorded in parts of Dammapeta mandal. Presently these wells are not in operation due to maintenance problems aroused after handing over to beneficiaries by the APSIDC.

The failure percentage of the attempted bore/ tube wells is more in hard rock formations in comparison to soft rock formations.

#### **4.0 GROUND WATER MANAGEMENT STRATEGY**

Though ground water is a replenishable resource, proper management of the resource is warranted due to its unequal distribution over space and time. The distribution over space is controlled by nature of aquifers, their extent - laterally and vertically below ground surface. Ground water being dynamic resource, it migrates with respect to time towards low altitudes due to gravity flow. Ultimately after having good aquifer material of sufficient volume, the rainfall precipitation and its infiltration into the groundwater system plays a key role in building up the potentiality of the aquifer system. Hence, the strategy of groundwater management starts with the precipitation of the rainfall at the higher

reaches of surface basins, through arresting the surface water and allowing it to percolate into ground in order to recharge the ground water system by means of constructing suitable artificial recharge structures. Once ground water is artificially recharged, its optimal management is the important issue where public should be educated about the importance of the precious mineral – ‘WATER’. In the water scarce areas the government authorities should offer planning and management techniques to the common public and cultivators to seek for low water required crops. Quality of ground water is also the major concern in recent days. Many command areas are in the threat of polluting ground waters due to excess irrigation practices, application of more pesticides and improper drainage facilities. Economic alleviation plans should be framed by integrating the technical expertise of different departments of district and mandal level authorities, like horticulture, sericulture, small scale industries, agro based industries etc., in order to lower the pressure on water / ground water utilisation.

#### **4.1 GROUND WATER DEVELOPMENT**

There is large scope for ground water development in the district as the level of ground water utilisation is only 20% out of the available resources. While water levels are depleting much beyond the safe limits in other districts, Khammam district is meeting water demands for irrigation through dug wells. It is a positive sign as per the level of development of the resource is concern.

In addition to the existing dug wells, bore wells can be attempted in all most all parts of consolidated rock formations after thorough scientific investigations. The depth of the bore wells should be restricted to 60 – 70m bgl, as there is limited scope for encountering potential aquifer zones further below 70m bgl. Depending on the overburden casing of the well can be constructed and pumps can be selected depending on the yield, depth to water level and specific capacity of the wells. **Further dug well construction in the OE mandal of Tirumalayapalem and in other OE, Critical and Semi-critical villages of western mandals may be regulated or even stopped and shallow bore well construction may be encouraged in lieu of dug well construction.** This helps in harnessing the semi confined aquifer zones in the hard rocks. But the detailed studies through hydrogeological/ geophysical

studies are inevitable for pin pointing the bore well sites as the occurrence of aquifer zones in hard rocks is erratic.

In semi consolidated soft rock terrain ground water development is in progress through construction of tube wells of 40 – 120m depth range with 152mm diameter. However, the well construction is not being done with scientific approach. The proper placement of slotted pipe exactly against the aquifer zones and their optimal size and usage of gravel of suitable size and volume should be taken care while constructing tube wells.

Sl. No	Situation	Spacing between any two wells (m)			
		Piccota wells	Dug wells	Filter point or shallow wells	Bore wells / Tube wells
1	Non-Ayacut	60	160	120	250-300
2	Ayacut	40	100	160	150-200
3	Near perennial source like river of tank (within 200m)	40	100	160	200-300
4	Non-perennial streams	50	150	180	200-500

#### Spacing norms for different ground water abstraction structures

**(Source: NABARD)**

While developing the ground water through construction of different groundwater structures, the following spacing norms may be followed as recommended by NABARD.

**Well Design:** In hard rock terrains the bore wells should be drilled down to a depth of 50 to 75 m bgl by casing the overburden. The optimal diameter of the bore well is 165 mm. Dug well construction also may be taken up in parts of the district where the dug well density is less than 8 wells/ sq.km. (**Table-5**). In hard rock terrains lining of the dug well may be limited to overburden, which is in the range of 2 to 5 m bgl. Where as in soft rock formations, ring wells are most suitable. In semi-consolidated formations shallow and deep tube wells are most feasible ground water structures. Tube wells down to a depth of 45 to 120 m with a diameter of 152 mm/ 178 mm may be constructed with slotted pipes

against the granular zones. Proper gravel packing is necessary for the tube well to minimize the well losses.

**Unit cost of wells:** As the district possesses varied hydrogeological conditions and rock types, different types of ground water extraction structures are feasible. The unit cost of different type of wells was worked out based on NABARD norms and approved by the State Unit Cost Committee for financing the ground water abstraction structures for irrigation and cost of pump sets. The details are furnished in the following table.

Geology	Type of well	Dimensions of DWs			Dimensions of bore wells		Existing unit cost (Rs)
		Diameter (m)	Depth (m)	Staining depth (m)	Diameter (mm)	Depth (m)	
Granites and Gneisses	a. DW	6	10	4	-	-	21,000
	b. DW	6	12	4	-	-	27,200
	c. DW	5	16	4	-	-	44,500
	d. BW	-	-	-	165	50	14,500
Sandstones	a. TW	-	-	-	165	<=70	53,000
	b. TW	-	-	-	165	100-120	1,02,000

Source : NABARD

DW: Dug well; BW: Bore well; TW: Tube well;

## 4.2 WATER CONSERVATION & ARTIFICIAL RECHARGE

Ground water conservation and artificial recharge works have been taken up District Ground Water Management Agency (DWMA) on a large scale in the district under different programmes and schemes like DPAP, IWDP and RIDF and a total number of 3991 different types of recharge structures such as percolation tanks, check dams, rock fill dams etc., have been constructed in parts of 25 revenue mandals (**Table-7**). As per the DWMA records the total irrigation potential created with the construction of these structures is in the order of 11,733 ha. More number of artificial recharge structures have come up

in Tirumalayapalem (636 nos.), Enkur (556), Kottagudem (441), Kusumanchi (232), Chandrugonda (194) etc., where ground water utilisation is high.

Table 7

Table - 7

NUMBER OF ARTIFICIAL RECHARGE STRUCTURES CONSTRUCTED AND IRRIGATION POTENTIAL CREATED UNDER DIFFERENT PROGRAMMES THROUGH DWMA, KHAMMAM														
Name of the Mandal	Type of Artificial Recharge Structure													Total Irrigation potential created (ha)
	CCT	Check dams	Check walls	Doug. Ponds	Farm ponds	Gabion structures	GC works	Mini P.Ts	P.Tanks	RCWells	RFD	Sunken ponds	Grand Total	
Bhadrachalam		18			17				22				57	205
Chandrugonda		74			37				20		63		194	244
Chintakani	1	2			6		1		1				11	17
Chittoor		64			50	32		13	298				457	2285
Dammapeta		4			22				17				43	142
Enkoor		70			31		145		24		286		556	467
Gara		8							2				10	38
Gundala					7				24				31	56
Julupad		38	7		14				15		25		99	232
Karrepalli		7							6				13	53
Khammam ( R )		100			56		33		38				227	631
Konijerla	7	1							1				9	7
Kotlagudem		93	41		175	4	3		125				441	1344
Kusumanchi		130	23		35	1			43				232	984
Machira		4		1	9		1		2				17	24
Mudgonda		8			9				1				18	42
N.K. Palli		8			2				1				11	36
Palvoncha		103	7		58		57		37		102		364	519
Penuballi		58			1								59	604
Singareni		11							2				13	53
Tekulapalli		17			22				114				153	326
Tirumalayapalem		163			107				207	111	47	1	636	1787
V.R.Puram		18							253				271	1509
Yellandu									20				20	0
Yerrupalem	2	25			12		7		3				49	127
<b>Grand Total</b>	<b>10</b>	<b>1024</b>	<b>78</b>	<b>1</b>	<b>670</b>	<b>37</b>	<b>247</b>	<b>13</b>	<b>1276</b>	<b>111</b>	<b>523</b>	<b>1</b>	<b>3991</b>	<b>11733</b>

Source: DWMA, Khammam

CCT: Continuous Contour Trench; RFD: Rock Fill Dam; PT: Percolation Tank;



DWMA is encouraging water conservation by promoting micro irrigation practices like drip and sprinkler irrigation by giving subsidies to the farmers. So far 4466 number of drip units and 1630 number of sprinkler units are installed in the district mainly for horticulture practices and sugar cane irrigation. (**Table-8**)

Central Ground Water Board organised a training programme during 2004 on ground water conservation and artificial recharge to ground water at Khammam in order to educate district level offices, NGOs, etc., regarding basic hydrogeological concepts, types of suitable structures, designs and to inculcate the need and necessity of protection, conservation, recharge to ground water and rain water harvesting.

## **5.0 RECOMMENDATIONS**

The distress situation among farmers in the district is more on western parts of the district, mostly in the canal command area of Nagarjunasagar left bank canal. By and large distress situation leading to suicides has little or no bearing on the stage of ground water development. The reasons for suicides are many, like escalating input costs, non-availability of institutional funds during crop growing stage, market fluctuations for farm produce etc. Majority of the farmers committed suicide were cultivating leased lands from private landowners and the lease amount was almost equal to the crop input costs, and finally the farm produce did not give the returns as expected. It is also observed that out of over enthusiasm, some farmers having very smallholdings of less than one hectare land are venturing to take about 4 to 5 hectares on lease and ultimately landing them in great debts. So, it is recommended to frame some rules for possession of land on lease by the small farmers, which in turn may avert the present distress situation.

Most of the distress mandals of the district, viz., Mudigonda, Chintakani, Madhira and Bonakal are at the tail end of Nagarjunasagar left bank canal and the quantity of water reaching to the end farmlands is insufficient and resulting to crop failure. In order to revert the situation the leakages in the canal must be

arrested through taking up repairs. Proper management measures may be practiced by involving farmer societies for delivery of water at the tail ends as

**Table 8.**

Table - 8

MANDALWISE DRIP AND OTHER MINOR IRRIGATION UNITS DISTRIBUTED IN KHAMMAM DISTRICT AND THE AREA IRRIGATED

Sl.No.	Mandal	Drip		Raingun		Sprinkler		Total	
		No. of MI Systems	Area in Ha.	No. of MI Systems	Area in Ha.	No. of MI Systems	Area in Ha.	No. of MI Systems	Area in Ha.
1	Aswapuram	2	5			17	26	19	31
2	Aswaraopeta	254	476			28	47	282	523
3	Bayyaram	108	75			29	59	137	134
4	Bhadrachalem	1	1			67	128	68	129
5	Bonakal	3	6			25	92	28	98
6	Burgampadu	9	15			28	61	37	76
7	Chandrugonda	396	418			20	32	416	450
8	Cherla	1	1			4	16	5	17
9	Chintakani	50	58			13	38	63	96
10	Dammapeta	710	1186			162	359	872	1545
11	Dummugudem	2	3			10	23	12	26
12	Enkoor	279	205			38	63	317	268
13	Garla	268	167			10	24	278	191
14	Julurupadu	200	155			50	60	250	215
15	Kallur	129	229			100	381	229	610
16	Kamepalli	175	142			10	10	185	152
17	Khammam Rural	16	27	1	2	83	94	100	123
18	Khammam Urban	10	17			38	55	48	72
19	Konijerla	9	10			31	95	40	105
20	Koonavaram	1	1			30	55	31	56
21	Kothagudem	213	176	2	4	32	43	247	223
22	Kukkunoor	2	4			39	97	41	101
23	Kusumanchi	28	46			8	12	36	58
24	Madhira	30	40			34	102	64	142
25	Manuguru	2	5			9	9	11	14
26	Mudhigonda	22	42			24	43	46	85
27	Mulakalapalli	267	366			25	31	292	397
28	Nelakondapalli	10	12			12	37	22	49
29	Paloncha	75	72			24	34	99	106
30	Penuballi	270	454			47	97	317	551
31	Pinapaka	3	6			29	35	32	41
32	Sathupalli	355	482			80	144	435	626
33	Singareni	76	52			3	6	79	58
34	Tekulapalli	25	63			10	11	35	74
35	Thallada	17	33			15	23	32	56
36	Thirumalayapalem	20	46			21	23	41	69
37	V.R.Puram					4	6	4	6
38	Velairpad	2	3			5	6	7	9
39	Vemsoor	236	402			123	205	359	607
40	Venkatapuram					64	68	64	68
41	Wyra	75	56			24	79	99	135
42	Yellandu	37	48			9	10	46	58
43	Yerrupalem	78	135			96	176	174	311
	<b>Grand Total</b>	<b>4466</b>	<b>5742</b>	<b>3</b>	<b>6</b>	<b>1530</b>	<b>3014</b>	<b>5999</b>	<b>8763</b>

Source: DWMA, Khammam