

For official use only
CGWB/SR/AR/2015-16/17



GOVERNMENT OF INDIA
MINISTRY OF WATER RESOURCES,
RIVER DEVELOPMENT & GANGA REJUVENATION
CENTRAL GROUND WATER BOARD

PLAN ON
ARTIFICIAL RECHARGE TO GROUNDWATER AND
WATER CONSERVATION IN
ROLLA MANDAL, ANANTAPUR DISTRICT,
ANDHRA PRADESH

SOUTHERN REGION
HYDERABAD
AUGUST-2016

PLAN ON
ARTIFICIAL RECHARGE TO GROUNDWATER AND
WATER CONSERVATION IN
ROLLA MANDAL, ANANTAPUR DISTRICT,
ANDHRA PRADESH

CONTENTS

S.NO	TOPIC
1	INTRODUCTION
2	LOCATION
3	PHYSIOGRAPHY AND DRAINAGE
4	RAINFALL
5	LAND USE PATTERN
6	HYDROGEOLOGY
7	GROUND WATER LEVEL SCENARIO
8	DYNAMIC GROUND WATER RESOURCES
9	NEED FOR ARTIFICIAL RECHARGE AND CONSERVATION METHODS
10	JUSTIFICATION OF THE ARTIFICIAL RECHARGE PROJECT
11	AVAILABILITY OF SURPLUS, SURFACE WATER FOR ARTIFICIAL RECHARGE OR CONSERVATION
12	FEASIBLE ARTIFICIAL RECHARGE STRUCTURES
13	TENTATIVE COST ESTIMATES
14	TIME SCHEDULE

AT A GLANCE

Name of the Mandal	ROLLA
District	ANANTAPUR
State	ANDHRA PRADESH
Total Area (Sq.kms)	164
Area suitable for Artificial Recharge (Sq.kms)	145.2
Latitude and Longitude	13.757780 to 13.952890 and 77.013640 to 77.181050
Average Annual Rainfall (mm)	618
Geology	Granites, Gneisses
Average Depth To Water Level (Decadal) (Pre Monsoon)	73
Average Depth To Water Level (Decadal) (Post Monsoon)	71.5
Ground Water Resources (2011)	
Annual Replenishable Ground Water Resources (MCM/yr)	12.48
Net Annual Ground Water Availability(MCM)/yr	11.23
Net Annual Ground Water Draft (MCM)/yr	21.35
Projected Demand for Domestic and Industrial Use (MCM)/yr	1.34
Stage of Ground Water Development (%)	190
Surface runoff available (MCM)/yr	13.14
Total Storage Created in the Mandal by Various Agencies (MCM)/yr	2.14
Artificial Recharge/Conservation Measures	
Recharge Structures Proposed (No.s)	Percolation Tanks: 5, Check Dams: 10 Farm ponds: 140, Recharge Shafts: 151
Improving Water use Efficiency	Micro Irrigation System: 700 ha
Tentative Total Cost in Lakhs (Rs.)	699.51
Expected Recharge/Savings (MCM)/yr	4.36

1. INTRODUCTION

Rolla Mandal is one of over-exploited mandal in Anantapur district, Andhra Pradesh State, which is economically backward and chronically drought affected. The mandal has 7 inhabited villages and with 7 gram panchayats.

2. LOCATION

The mandal lies between north latitudes 13.757780 to 13.952890 and between east longitudes 77.013640 to 77.181050. The mandal occupies the Southwest part of the Anantapur district and is bounded on the north by Gudibanda Mandal, on the east by Karnataka State, on the south by Karnataka State and west by Agali mandal. (Fig.1) The geographical area of the mandal is 164 sq.km.

3. PHYSIOGRAPHY AND DRAINAGE:

The area is drained by streams which are tributaries of Lower Thungabhadra River. The streams are mostly ephemeral in nature. The drainage pattern is dendritic, rectangular to sub rectangular due to the influence of geological structures. (Fig.2)

4. RAINFALL

The average rainfall in the mandal is 618 mm. The rainfall during the South-west monsoon season i.e., June-September accounts for about 85% of the total rainfall.

5. LAND USE PATTERN

Out of the total geographical area of 164 sq.km, the area covered by forest is 23.84 sq.km and the net area sown is 102.94 sq.km. Barren and uncultivable land is 5.02 sq.km. The land for non agricultural use accounts for 12.17 sq.km.(Fig.3)

6. HYDROGEOLOGY

The area is underlain by granites and granitic gneisses of Archaean age (Fig.4). Ground water occurs in weathered and fractured zones under water table and semi- confined conditions. The weathered zone thickness as per the GEC report is 10 m. The weathered zone has been extensively tapped by dug and dug cum bore wells upto 20 m depth, which are mostly dry now. Ground water occurs in the fractured granites up to 200 m bgl. However, the potential fractures are encountered between 50-100 m bgl. The cumulative yield varies from 2-5 lps.

7. GROUND WATER LEVEL SCENARIO

The average depth to water level (decadal) during pre and post monsoon is 73 and 71.5 m bgl respectively. The depth to water levels map (2014) is shown in Fig 5. The Decadal mean water level trend during post monsoon is depicted in the Fig.-6.

8. DYNAMIC GROUND WATER RESOURCES

The Ground water availability, Utilization and stage of Development in Rolla Mandal, Anantapur District is given in Table-1.

Table-1: Ground water resources of Rolla Mandal, Anantapur District.

Annual Replenishable Ground water resources (MCM)	12.48
Net Annual Ground Water Availability(MCM)/yr	11.23
Net Annual Ground Water Draft(MCM)/yr	21.35
Projected Demand for Domestic and Industrial use up to 2025. (MCM)	1.34
Stage of Ground water development (%).	190
Whether notified or not with year of notification.	No

9. NEED FOR ARTIFICIAL RECHARGE AND CONSERVATION METHODS

The ground water withdrawal is more than the recharge with a stage of development above hundred percent. The long term water level trend mostly shows a declining trend and the water levels are very deep ranging up to 50 m. The sustainability of bore wells has become questionable as many bore wells are either drying up or have recorded reduced yields. There is no surface water irrigation facility in the area. All these factors indicate that there is an urgent need for artificial recharge and water conservation in the Mandal.

10. JUSTIFICATION OF THE ARTIFICIAL RECHARGE PROJECT

Rolla Mandal falls under high stage of ground water development i.e., 190 % and with sufficient amount of uncommitted surface runoff. The area is completely dependent on ground water for domestic, industrial and irrigation purposes. During the monsoons runoff quickly flows out of the area without natural recharge to ground water. It is necessary to apply artificial recharge techniques to allow more and more recharge through check dams, PTs, MPTs, farm ponds, recharge shafts to cope up with the withdrawal pattern and also to improve ground water situation through various interventions including on farm activities and micro irrigation systems (Sprinkler-Drip-HDPE).

11. AVAILABILITY OF SURPLUS, SURFACE WATER FOR ARTIFICIAL RECAHRGE OR CONSERVATION

The runoff was calculated by taking into account of normal rainfall of the mandal and corresponding runoff yield from Strangers table. The existing storage created by various artificial recharge structures constructed by the State Government, if any, was deducted for calculating the runoff yield to recommend new AR structures.

Total Geographical area (Sq.kms)	164
Hilly Area (Sq.kms)	18.81
Area suitable for Artificial Recharge (sq.km.)	145.2
Runoff Yield in MCM/yr.	13.14
Existing No. of Check Dams	276
Storage created MCM/yr.	1.96
Existing No. of Percolation Tanks	26
Storage created MCM/yr.	0.18
Total Existing Storage Created	2.14

12. FEASIBLE ARTIFICIAL RECHARGE STRUCTURES

Since the mandal is categorized as over exploited, there is an immediate need for improving ground water scenario and to ensure sustainability of ground water sources. It is also suggested to create additional storage capacity of surface water bodies which would result in supplementing irrigation thereby reducing the ground water draft. The run off available in the mandal has been assessed as 11 MCM/yr, which could be considered for further planning of artificial recharge. However, the number of artificial recharge structures feasible has been recommended in areas, by considering the utilizable yield, number of existing structures, land use, drainage pattern and also where the post monsoon water levels (decadal mean) are more than 5 m bgl, and or decadal trends are either falling or showing insignificant raising trend.

A) Check dams and Percolation Tanks

The area is covered by seasonal nalas – drains, which carry discharge during monsoon period debauched into the water bodies within a short duration. It is proposed to identify such nalas for construction of check dams/Percolation tank with recharge shafts, so as to harness ground water and to increase soil moisture content.

- The site selected for check dam/Percolation Tank should have sufficient thickness of permeable soils or weathered material to facilitate recharge of stored water within a short span of time. The water stored in these structures is mostly confined to the stream course and height is normally less than 2m.
- These are designed based on stream width and excess water is allowed to flow over the crest wall. In order to avoid scouring from excess runoff water cushions are provided on the downstream side. To harness maximum runoff in the stream, a series of such check dams can be constructed to have recharge on a regional scale.
- Considering the annual monsoon rainfall of 618 mm, sufficient rain water can be harnessed. This will improve ground water regime as well as delaying the instant flow into the main river.
- The flow in these seasonal rivers can be sustained up to about 2 to 3 months after monsoon.

- Recharge trenches can also be constructed along upstream side of the check dam/Percolation Tank in the impoundment area for enhancing the ground water recharge rate.

Thus, **10 Check dams and 5 Percolation tanks** are recommended.

B). Recharge Shafts

The existing check dams and percolation tanks lose their storage capacity as well as recharge capacity due to siltation. Hence, Recharge shafts are recommended in the existing Check dams and Percolation tanks to enhance the ground water recharge. During the heavy downpours, there will be sufficient accumulation of runoff, which can also effectively be utilized for recharge by constructing recharge shafts. Hence, it is proposed to construct 138 and 13 recharge shafts of 165 mm dia with 30 m depth in the existing check dams and percolation tanks respectively.

C). Farm Ponds

A farm pond is a large dug out in the earth, usually square or rectangular in shape, which harvests rain water and stores it for future use. It has an inlet to regulate inflow and an outlet to discharge excess water. The pond is surrounded by a small bund, which prevents erosion on the banks of the pond. The size and depth depend on the amount of land available; the type of soil water from the farm pond is conveyed to the fields manually, by pumping, or by both methods.

Advantages of Farm Ponds

- They provide water to start growing crops, without waiting for rain to fall.
- They provide irrigation water during dry spells between rainfalls. This increases the yield, the number of crops in one year, and the diversity of crops that can be grown.
- Bunds can be used to raise vegetables and fruit trees, thus supplying the farm household with an additional source of income and of nutritious food.
- Farmers are able to apply adequate farm inputs and perform farming operations at the appropriate time, thus increasing their productivity and their confidence in farming.
- They check soil erosion and minimize siltation of waterways and reservoirs.
- They supplies water for domestic purposes and livestock.
- They promote fish rearing.
- They recharge the ground water.
- They improve drainage.

- The excavated earth has a very high value and can be used to enrich soil in the fields, levelling land, and constructing farm roads.

As per the Land use classification, majority of the area is covered by the agricultural field. Hence, it is proposed to construct 140 farm ponds in 7 villages of the Mandal @ 20 farm ponds in each village.

D).Micro Irrigation System (Sprinkler /drip/HDPE pipes)

Micro irrigation is defined as the frequent application of small quantities of water directly above and below the soil surface; usually as discrete drops, continuous drops or tiny streams through emitters placed along a water delivery line. In flood/furrow irrigation method more than 50% of applied water is wasted through seepage to deeper level, localized inundation causes loss through evaporation and it leaches out the nutrients from the plant. While through drip & sprinkler irrigation wastages of irrigational water could be minimized. The studies on different crops, has revealed that irrigation water is saved drastically. The conveyance losses (mainly seepage & evaporation) can be saved up to 25 to 40% through utilization of HDPE pipes. Initially the scheme is proposed to be implemented in worst affected areas showing deepest water levels and significant declining trends. It is proposed to take up micro irrigation system in 700 ha @ 100 ha per village.

13. TENTATIVE COST ESTIMATES (ROLLA MANDAL)

S.No.	Feasible Artificial Recharge & Water Conservation structures/	No. of Structures/ Quantity	Total Volume (MCM)	Tentative unit cost (in Rs lakh)	Total tentative cost (in Rs Lakh)	Expected Annual GW recharge/savings (MCM)
1	Proposed Masonry Check dams Crest Length -10-15 m, Height-1-2 m) (0.007 MCM*4 fillings)	10	0.28	5	50	0.21
2	Recharge shaft in Check dam (50% of the existing Check dams)	138	1.518	0.5	69	1.518
3	Proposed Percolation Tanks (100*100*2.5)* 4 fillings)	5	0.5	15	75	0.375
4	Renovation Desilting, Repairs and installation of Recharge Shafts in existing PTS (50% of the existing PTS)	13	0.143	1	13	0.143
5	Proposed Farm Pond (6 filling) 5*5*1.5 dimension @ 20 farm ponds per each village	140	0.02016	0.25	35	0.018144
6	Proposed Sprinkler/drip/HDPE pipes for 100 ha in each village	700	4.2	0.6	420	2.1
7	Proposed Piezometers up to 50 mbgl @ one PZ per Village	7	0	0.6	4.2	0
8 (i)	Total (No. of AR Structures)	313	2.46		246.2	2.264
8 (ii)	Total (ha)	700			420	2.1
	Total (8(i) + 8 (ii))				666.2	4.364
9	Impact Assessment & O & M -5 % of Total cost of the Scheme				33.31	
	Grand Total				699.51	

*(Expected annual GW Recharge/Savings MCM - CDS& PTS: 75%, Farm ponds - 90%, Sprinklers-50%, Recharge shafts in existing CDS and PTS-100%)

Note: The type, number and cost of structure may vary according to site, after the ground truth verification.

14. TIME SCHEDULE

Steps	Quarters							
	1st	2 nd	3 rd	4 th	5 th	6 th	7 th	8 th
Identification of line department/implementing agency and preparation of DPR								
Approval of Scheme and releases of sanction of funds								
Implementation of ARS								

Phase = one quarter or 3 months or equivalent to financial quarter

A). Operation and Maintenance

In all projects impact assessment has to be carried out to ensure that project is economically viable, socially equitable and environmentally sustainable by inter-related socio-economic, cultural and human-health impacts, both beneficial and adverse. Accordingly it is proposed to have impact assessment as well as operation & Maintenance at the rate of 5% of the total cost of the project for 5 years from the completion of artificial recharge project.

B). Expected Benefits

The benefits of the project are:

1. The implementation of the project would result in additional recharge/Ground water savings to the tune of 4.364 MCM.
2. Ground water recharge will help in arresting the rapid decline in ground water resources and will also ensure improvement in quality of ground water by dilution.
3. Proposed structures and measures will also enhance the ground water potential and would ensure sustainability of ground water resources. It is estimated that the stage of ground water development may likely to be reduced from the present 190% to 136% (54%)
4. It will also help in controlling soil erosion.

Acknowledgements

The data received from the Director Ground Water Department Andhra Pradesh in respect of the basic inputs is duly acknowledged. The information on existing Artificial Recharge Structures have been taken from the EMUSTER, Department of Rural Development, Government of AP.

EXISTING ARTIFICIAL RECHARGE STRUCTURES
ROLLA MANDAL, ANANTAPUR DISTRICT, AP

S.no	Gram Panchayat	Habitation	Structure Type	Longitude	Latitude	Scheme
1	Kaki	AppnaHalli	Check Dam	77.1330	13.7903	NREGS
2	Kaki	Byadaigira	Check Dam	77.1175	13.7693	NREGS
3	Kaki	Byadaigira	Check Dam	77.1202	13.7662	NREGS
4	Kaki	Byadaigira	Check Dam	77.1336	13.7617	NREGS
5	Kaki	Byadaigira	Check Dam	77.1080	13.7715	NREGS
6	Kaki	Byadaigira	Check Dam	77.1356	13.7628	NREGS
7	Kaki	Byadaigira	Check Dam	77.1302	13.7630	NREGS
8	Kaki	Byadaigira	Check Dam	77.1302	13.7628	NREGS
9	Kaki	Kaki	Check Dam	77.1119	13.7849	NREGS
10	Kaki	Kaki	Check Dam	77.1077	13.7871	NREGS
11	Kaki	Kaki	Check Dam	77.1052	13.7880	NREGS
12	Kaki	Kaki	Check Dam	77.1074	13.7927	NREGS
13	Kaki	Kaki	Check Dam	77.1126	13.7954	NREGS
14	Kaki	Kaki	Check Dam	77.1158	13.7914	NREGS
15	Ratnagiri	Alupanahalli	Check Dam	77.1443	13.7875	NREGS
16	Ratnagiri	Alupanahalli	Check Dam	77.1461	13.7902	NREGS
17	Ratnagiri	Alupanahalli	Check Dam	77.1444	13.7962	NREGS
18	Ratnagiri	Alupanahalli	Check Dam	77.1533	13.7982	NREGS
19	Ratnagiri	Alupanahalli	Check Dam	77.1479	13.7918	NREGS
20	Ratnagiri	Alupanahalli	Check Dam	77.1499	13.7936	NREGS
21	Ratnagiri	Alupanahalli	Check Dam	77.1479	13.7918	NREGS
22	Ratnagiri	Bajjarahpalem	Check Dam	77.1230	13.8199	NREGS
23	Ratnagiri	Bajjarahpalem	Check Dam	77.1213	13.8252	NREGS
24	Ratnagiri	Bajjarahpalem	Check Dam	77.0987	13.8199	NREGS
25	Ratnagiri	Bajjarahpalem	Check Dam	77.0996	13.8152	NREGS
26	Ratnagiri	G.Gollahatti	Check Dam	77.1129	13.8112	NREGS
27	Ratnagiri	G.Gollahatti	Check Dam	77.1095	13.8113	NREGS
28	Ratnagiri	G.Gollahatti	Check Dam	77.1097	13.8102	NREGS
29	Ratnagiri	G.Gollahatti	Check Dam	77.1190	13.8114	NREGS
30	Ratnagiri	G.Gollahatti	Check Dam	77.1141	13.8134	NREGS
31	Ratnagiri	G.Gollahatti	Check Dam	77.1117	13.8130	NREGS
32	Ratnagiri	G.Gollahatti	Check Dam	77.1097	13.8136	NREGS
33	Ratnagiri	Rangapuram	Check Dam	77.1352	13.7922	NREGS
34	Ratnagiri	Ratnagiri	Check Dam	77.1137	13.8048	NREGS
35	Ratnagiri	Ratnagiri	Check Dam	77.1087	13.8025	NREGS
36	Ratnagiri	Ratnagiri	Check Dam	77.1119	13.8022	NREGS
37	Ratnagiri	Ratnagiri	Check Dam	77.1081	13.8040	NREGS
38	Ratnagiri	Ratnagiri	Check Dam	77.1185	13.8069	NREGS
39	Ratnagiri	Ratnagiri	Check Dam	77.1196	13.8073	NREGS
40	Ratnagiri	Ratnagiri	Check Dam	77.1219	13.8039	NREGS
41	Ratnagiri	Ratnagiri	Check Dam	77.1189	13.7956	NREGS

42	Ratnagiri	Ratnagiri	Check Dam	77.1303	13.7984	NREGS
43	Ratnagiri	Ratnagiri	Check Dam	77.1357	13.7999	NREGS
44	Dodderi	Dodderi	Check Dam	77.1468	13.7849	NREGS
45	Dodderi	P.Gollahatti	Check Dam	77.1661	13.7819	NREGS
46	Dodderi	P.Gollahatti	Check Dam	77.1646	13.7825	NREGS
47	Dodderi	P.Gollahatti	Check Dam	77.1673	13.7817	NREGS
48	Dodderi	P.Gollahatti	Check Dam	77.1698	13.7818	NREGS
49	Dodderi	Pilligundlu	Check Dam	77.1730	13.7779	NREGS
50	Dodderi	Pilligundlu	Check Dam	77.1742	13.7737	NREGS
51	Dodderi	Ranganahalli	Check Dam	77.1600	13.7860	NREGS
52	Dodderi	Ranganahalli	Check Dam	77.1606	13.7856	NREGS
53	Dodderi	Venkatampalli	Check Dam	77.1494	13.7862	NREGS
54	Guddugurlu	Girenayakanapalyam	Check Dam	77.1458	13.8098	NREGS
55	Guddugurlu	Girenayakanapalyam	Check Dam	77.1532	13.8037	NREGS
56	Guddugurlu	Gottiguniki	Check Dam	77.1399	13.8355	NREGS
57	Guddugurlu	Gottiguniki	Check Dam	77.1401	13.8384	NREGS
58	Guddugurlu	Gottiguniki	Check Dam	77.1472	13.8392	NREGS
59	Guddugurlu	Gottiguniki	Check Dam	77.1449	13.8438	NREGS
60	Guddugurlu	Gottiguniki	Check Dam	77.1328	13.8405	NREGS
61	Guddugurlu	Gottiguniki	Check Dam	77.1402	13.8439	NREGS
62	Guddugurlu	Gottiguniki	Check Dam	77.1402	13.8439	NREGS
63	Guddugurlu	Gottuguriki	Check Dam	77.1619	13.8245	NREGS
64	Guddugurlu	Gottuguriki	Check Dam	77.1602	13.8214	NREGS
65	Guddugurlu	Gottuguriki	Check Dam	77.1603	13.8213	NREGS
66	Guddugurlu	Gottuguriki	Check Dam	77.1500	13.8291	NREGS
67	Guddugurlu	Gottuguriki	Check Dam	77.1586	13.8252	NREGS
68	Guddugurlu	Honnappalyam	Check Dam	77.1389	13.8268	NREGS
69	M.rayapuram	Bandrepalli	Check Dam	77.0310	13.8578	NREGS
70	M.rayapuram	Bandrepalli	Check Dam	77.0281	13.8559	NREGS
71	M.rayapuram	Bandrepalli	Check Dam	77.0244	13.8557	NREGS
72	M.rayapuram	Bandrepalli	Check Dam	77.0235	13.8563	NREGS
73	M.rayapuram	Bandrepalli	Check Dam	77.0217	13.8586	NREGS
74	M.rayapuram	Bandrepalli	Check Dam	77.0194	13.8601	NREGS
75	M.rayapuram	Bandrepalli	Check Dam	77.0172	13.8616	NREGS
76	M.rayapuram	Bandrepalli	Check Dam	77.0152	13.8647	NREGS
77	M.rayapuram	Bandrepalli	Check Dam	77.0163	13.8700	NREGS
78	M.rayapuram	Cherlopalli	Check Dam	77.0445	13.8965	NREGS
79	M.rayapuram	Chigamattigattu	Check Dam	77.0375	13.8538	NREGS
80	M.rayapuram	Chigamattigattu	Check Dam	77.0398	13.8530	NREGS
81	M.rayapuram	Chigamattigattu	Check Dam	77.0396	13.8551	NREGS
82	M.rayapuram	Chigamattigattu	Check Dam	77.0348	13.8592	NREGS
83	M.rayapuram	Chigamattigattu	Check Dam	77.0375	13.8589	NREGS
84	M.rayapuram	Chigamattigattu	Check Dam	77.0361	13.8619	NREGS
85	M.rayapuram	Hunisekunta	Check Dam	77.0689	13.8727	NREGS

86	M.rayapuram	Hunisekunta	Check Dam	77.0702	13.8704	NREGS
87	M.rayapuram	Hunisekunta	Check Dam	77.0537	13.8883	NREGS
88	M.rayapuram	Hunisekunta	Check Dam	77.0581	13.8922	NREGS
89	M.rayapuram	M.R.Gollahatti	Check Dam	77.0221	13.8898	NREGS
90	M.rayapuram	M.R.Gollahatti	Check Dam	77.0224	13.8947	NREGS
91	M.rayapuram	M.R.Gollahatti	Check Dam	77.0251	13.8956	NREGS
92	M.rayapuram	M.R.Gollahatti	Check Dam	77.0254	13.9002	NREGS
93	M.rayapuram	M.Rayapuram	Check Dam	77.0213	13.8861	NREGS
94	M.rayapuram	M.Rayapuram	Check Dam	77.0198	13.8866	NREGS
95	M.rayapuram	M.Rayapuram	Check Dam	77.0215	13.8874	NREGS
96	M.rayapuram	Somaghatta	Check Dam	77.0200	13.8736	NREGS
97	M.rayapuram	Somaghatta	Check Dam	77.0189	13.8819	NREGS
98	M.rayapuram	Somaghatta	Check Dam	77.0226	13.8818	NREGS
99	M.rayapuram	Somaghatta	Check Dam	77.0266	13.8829	NREGS
100	Bommagondanahatti	Agraharam	Check Dam	77.0881	13.8929	NREGS
101	Bommagondanahatti	Agraharam	Check Dam	77.0925	13.8844	NREGS
102	Bommagondanahatti	Agraharam	Check Dam	77.0937	13.8806	NREGS
103	Bommagondanahatti	Agraharam	Check Dam	77.0859	13.8872	NREGS
104	Bommagondanahatti	Bommagondanahalli	Check Dam	77.0773	13.8980	NREGS
105	Bommagondanahatti	Bommagondanahalli	Check Dam	77.0792	13.9014	NREGS
106	Bommagondanahatti	Bommagondanahalli	Check Dam	77.0709	13.9020	NREGS
107	Bommagondanahatti	Bommagondanahalli	Check Dam	77.0688	13.9014	NREGS
108	Bommagondanahatti	Bommagondanahalli	Check Dam	77.0755	13.9012	NREGS
109	Bommagondanahatti	Bommagondanahalli	Check Dam	77.0752	13.8947	NREGS
110	Bommagondanahatti	Bommagondanahalli	Check Dam	77.0783	13.8920	NREGS
111	Bommagondanahatti	G.Gollahatti	Check Dam	77.1080	13.8846	NREGS
112	Bommagondanahatti	G.Gollahatti	Check Dam	77.1067	13.8846	NREGS
113	Bommagondanahatti	G.Gollahatti	Check Dam	77.1009	13.8822	NREGS
114	Bommagondanahatti	G.Gollahatti	Check Dam	77.1022	13.8860	NREGS
115	Bommagondanahatti	JiriginaHalli	Check Dam	77.0628	13.9113	NREGS
116	Bommagondanahatti	JiriginaHalli	Check Dam	77.0649	13.9026	NREGS
117	Bommagondanahatti	Malasamudram	Check Dam	77.0718	13.8761	NREGS
118	Bommagondanahatti	Malasamudram	Check Dam	77.0777	13.8868	NREGS
119	Bommagondanahatti	Malasamudram	Check Dam	77.0694	13.8818	NREGS
120	Bommagondanahatti	Mallinamadugu	Check Dam	77.0801	13.9149	NREGS
121	Bommagondanahatti	Mallinamadugu	Check Dam	77.0717	13.9046	NREGS
122	Bommagondanahatti	Mallinamadugu	Check Dam	77.0771	13.9123	NREGS
123	Bommagondanahatti	Mallinamadugu	Check Dam	77.0778	13.9176	NREGS
124	Bommagondanahatti	Mallinamadugu	Check Dam	77.0723	13.9151	NREGS
125	Bommagondanahatti	Mallinamadugu	Check Dam	77.0715	13.9163	NREGS
126	Bommagondanahatti	Mallinamadugu	Check Dam	77.0692	13.9199	NREGS
127	Bommagondanahatti	Mallinamadugu	Check Dam	77.0700	13.9182	NREGS
128	Bommagondanahatti	Timmanahalli	Check Dam	77.0528	13.9242	NREGS
129	Bommagondanahatti	Timmanahalli	Check Dam	77.0516	13.9250	NREGS

130	Bommagondanahatti	Timmanahalli	Check Dam	77.0469	13.9196	NREGS
131	Bommagondanahatti	Timmanahalli	Check Dam	77.0516	13.9179	NREGS
132	Bommagondanahatti	Timmanahalli	Check Dam	77.0509	13.9139	NREGS
133	Bommagondanahatti	Timmanahalli	Check Dam	77.0438	13.9288	NREGS
134	Bommagondanahatti	Timmanahalli	Check Dam	77.0570	13.9198	NREGS
135	Bommagondanahatti	Timmanahalli	Check Dam	77.0592	13.9324	NREGS
136	Bommagondanahatti	Timmanahalli	Check Dam	77.0592	13.9275	NREGS
137	Bommagondanahatti	Timmanahalli	Check Dam	77.0603	13.9135	NREGS
138	Bommagondanahatti	Tirumaladevarahalli	Check Dam	77.1117	13.8912	NREGS
139	Bommagondanahatti	Tirumaladevarahalli	Check Dam	77.1111	13.8902	NREGS
140	Bommagondanahatti	Tirumaladevarahalli	Check Dam	77.1148	13.8910	NREGS
141	Bommagondanahatti	Tirumaladevarahalli	Check Dam	77.1196	13.8889	NREGS
142	Bommagondanahatti	Tirumaladevarahalli	Check Dam	77.1252	13.8869	NREGS
143	Rolla	AvinakuntaTanda	Check Dam	77.0855	13.8375	NREGS
144	Rolla	AvinakuntaTanda	Check Dam	77.0885	13.8374	NREGS
145	Rolla	AvinakuntaTanda	Check Dam	77.0812	13.8445	NREGS
146	Rolla	Dommarahatti	Check Dam	77.0892	13.8119	NREGS
147	Rolla	Dommarahatti	Check Dam	77.0943	13.8136	NREGS
148	Rolla	Dommarahatti	Check Dam	77.0988	13.8202	NREGS
149	Rolla	Dommarahatti	Check Dam	77.0993	13.8276	NREGS
150	Rolla	H.B.Halligollahatti	Check Dam	77.1161	13.8291	NREGS
151	Rolla	Hanumanthanahalli	Check Dam	77.0828	13.8676	NREGS
152	Rolla	Hanumanthanahalli	Check Dam	77.0777	13.8672	NREGS
153	Rolla	Hanumanthanahalli	Check Dam	77.0763	13.8661	NREGS
154	Rolla	Hanumanthanahalli	Check Dam	77.0764	13.8533	NREGS
155	Rolla	Hanumanthanahalli	Check Dam	77.0969	13.8510	NREGS
156	Rolla	Hottebetta	Check Dam	77.1661	13.8735	NREGS
157	Rolla	Hulikunta	Check Dam	77.0866	13.8285	NREGS
158	Rolla	Hulikunta	Check Dam	77.0773	13.8253	NREGS
159	Rolla	Hulikunta	Check Dam	77.0778	13.8283	NREGS
160	Rolla	Hulikunta	Check Dam	77.0801	13.8304	NREGS
161	Rolla	Hulikunta	Check Dam	77.0821	13.8332	NREGS
162	Rolla	Hulikunta	Check Dam	77.0876	13.8166	NREGS
163	Rolla	Kalluoppam	Check Dam	77.1524	13.8754	NREGS
164	Rolla	Kotagarlagutta	Check Dam	77.1353	13.8697	NREGS
165	Rolla	Kotagarlagutta	Check Dam	77.1355	13.8687	NREGS
166	Rolla	Kotagarlagutta	Check Dam	77.1341	13.8693	NREGS
167	Rolla	Kotagarlagutta	Check Dam	77.1335	13.8680	NREGS
168	Rolla	Kotagarlagutta	Check Dam	77.1364	13.8612	NREGS
169	Rolla	Kotagarlagutta	Check Dam	77.1316	13.8686	NREGS
170	Rolla	Kotagarlagutta	Check Dam	77.1282	13.8719	NREGS
171	Rolla	Kotagarlagutta	Check Dam	77.1263	13.8715	NREGS
172	Rolla	Kotagarlagutta	Check Dam	77.1257	13.8713	NREGS
173	Rolla	Kotagarlagutta	Check Dam	77.1315	13.8730	NREGS

174	Rolla	Kothapalyam	Check Dam	77.1441	13.8806	NREGS
175	Rolla	Kothapalyam	Check Dam	77.1475	13.8713	NREGS
176	Rolla	Kothapalyam	Check Dam	77.1490	13.8701	NREGS
177	Rolla	Nasehalli	Check Dam	77.1115	13.8415	NREGS
178	Rolla	Nasepalligollahalli	Check Dam	77.1047	13.8470	NREGS
179	Rolla	Palagollahatti	Check Dam	77.1001	13.8552	NREGS
180	Rolla	Palagollahatti	Check Dam	77.1051	13.8511	NREGS
181	Rolla	Palagollahatti	Check Dam	77.1060	13.8528	NREGS
182	Rolla	Palagollahatti	Check Dam	77.1062	13.8538	NREGS
183	Rolla	Palagollahatti	Check Dam	77.1076	13.8563	NREGS
184	Rolla	Palagollahatti	Check Dam	77.1050	13.8539	NREGS
185	Rolla	Palagollahatti	Check Dam	77.1051	13.8543	NREGS
186	Rolla	Palagollahatti	Check Dam	77.1042	13.8524	NREGS
187	Rolla	Palagollahatti	Check Dam	77.1061	13.8486	NREGS
188	Rolla	Rolla	Check Dam	77.0922	13.8411	NREGS
189	Rolla	Rolla	Check Dam	77.1226	13.8542	NREGS
190	Rolla	Rollakonda	Check Dam	77.1097	13.8503	NREGS
191	Rolla	Tubinakunta	Check Dam	77.0690	13.8484	NREGS
192	Rolla	VaddeHatti	Check Dam	77.0870	13.8481	NREGS
193	Rolla	VaddeHatti	Check Dam	77.0837	13.8603	NREGS
194	Kaki	AppnaHalli	Check Dam	77.1330	13.7903	IWMP
195	Kaki	Byadaigira	Check Dam	77.1175	13.7693	IWMP
196	Kaki	Byadaigira	Check Dam	77.1202	13.7662	IWMP
197	Kaki	Byadaigira	Check Dam	77.1336	13.7617	IWMP
198	Kaki	Byadaigira	Check Dam	77.1356	13.7628	IWMP
199	Kaki	Byadaigira	Check Dam	77.1302	13.7630	IWMP
200	Kaki	Byadaigira	Check Dam	77.1302	13.7628	IWMP
201	Kaki	Byadaigira	Check Dam	77.1080	13.7715	IWMP
202	Kaki	Kaki	Check Dam	77.1119	13.7849	IWMP
203	Kaki	Kaki	Check Dam	77.1077	13.7871	IWMP
204	Kaki	Kaki	Check Dam	77.1052	13.7880	IWMP
205	Kaki	Kaki	Check Dam	77.1074	13.7927	IWMP
206	Kaki	Kaki	Check Dam	77.1126	13.7954	IWMP
207	Kaki	Kaki	Check Dam	77.1158	13.7914	IWMP
208	Ratnagiri	Alupanahalli	Check Dam	77.1443	13.7875	IWMP
209	Ratnagiri	Alupanahalli	Check Dam	77.1461	13.7902	IWMP
210	Ratnagiri	Alupanahalli	Check Dam	77.1444	13.7962	IWMP
211	Ratnagiri	Alupanahalli	Check Dam	77.1533	13.7982	IWMP
212	Ratnagiri	Alupanahalli	Check Dam	77.1479	13.7918	IWMP
213	Ratnagiri	Alupanahalli	Check Dam	77.1499	13.7936	IWMP
214	Ratnagiri	Bajjarahpalem	Check Dam	77.0987	13.8199	IWMP
215	Ratnagiri	Bajjarahpalem	Check Dam	77.0996	13.8152	IWMP
216	Ratnagiri	Bajjarahpalem	Check Dam	77.1131	13.8200	IWMP
217	Ratnagiri	Bajjarahpalem	Check Dam	77.1230	13.8199	IWMP

218	Ratnagiri	Bajjarahpalem	Check Dam	77.1213	13.8252	IWMP
219	Ratnagiri	G.Gollahatti	Check Dam	77.1190	13.8114	IWMP
220	Ratnagiri	G.Gollahatti	Check Dam	77.1141	13.8134	IWMP
221	Ratnagiri	G.Gollahatti	Check Dam	77.1117	13.8130	IWMP
222	Ratnagiri	G.Gollahatti	Check Dam	77.1097	13.8136	IWMP
223	Ratnagiri	G.Gollahatti	Check Dam	77.1129	13.8112	IWMP
224	Ratnagiri	G.Gollahatti	Check Dam	77.1095	13.8113	IWMP
225	Ratnagiri	G.Gollahatti	Check Dam	77.1097	13.8102	IWMP
226	Ratnagiri	Rangapuram	Check Dam	77.1352	13.7922	IWMP
227	Ratnagiri	Ratnagiri	Check Dam	77.1137	13.8048	IWMP
228	Ratnagiri	Ratnagiri	Check Dam	77.1087	13.8025	IWMP
229	Ratnagiri	Ratnagiri	Check Dam	77.1119	13.8022	IWMP
230	Ratnagiri	Ratnagiri	Check Dam	77.1081	13.8040	IWMP
231	Ratnagiri	Ratnagiri	Check Dam	77.1185	13.8069	IWMP
232	Ratnagiri	Ratnagiri	Check Dam	77.1196	13.8073	IWMP
233	Ratnagiri	Ratnagiri	Check Dam	77.1219	13.8039	IWMP
234	Ratnagiri	Ratnagiri	Check Dam	77.1189	13.7956	IWMP
235	Ratnagiri	Ratnagiri	Check Dam	77.1303	13.7984	IWMP
236	Ratnagiri	Ratnagiri	Check Dam	77.1357	13.7999	IWMP
237	Dodderi	Dodderi	Check Dam	77.1468	13.7849	IWMP
238	Dodderi	P.Gollahatti	Check Dam	77.1661	13.7819	IWMP
239	Dodderi	P.Gollahatti	Check Dam	77.1646	13.7825	IWMP
240	Dodderi	P.Gollahatti	Check Dam	77.1673	13.7817	IWMP
241	Dodderi	P.Gollahatti	Check Dam	77.1698	13.7818	IWMP
242	Dodderi	Pilligundlu	Check Dam	77.1730	13.7779	IWMP
243	Dodderi	Pilligundlu	Check Dam	77.1742	13.7737	IWMP
244	Dodderi	Ranganahalli	Check Dam	77.1600	13.7860	IWMP
245	Dodderi	Ranganahalli	Check Dam	77.1606	13.7856	IWMP
246	Dodderi	Venkatampalli	Check Dam	77.1494	13.7862	IWMP
247	Guddugurlu	Girenayakanapalyam	Check Dam	77.1458	13.8098	IWMP
248	Guddugurlu	Girenayakanapalyam	Check Dam	77.1532	13.8037	IWMP
249	Guddugurlu	Gottiguniki	Check Dam	77.1402	13.8439	IWMP
250	Guddugurlu	Gottiguniki	Check Dam	77.1402	13.8439	IWMP
251	Guddugurlu	Gottiguniki	Check Dam	77.1399	13.8355	IWMP
252	Guddugurlu	Gottiguniki	Check Dam	77.1401	13.8384	IWMP
253	Guddugurlu	Gottiguniki	Check Dam	77.1472	13.8392	IWMP
254	Guddugurlu	Gottiguniki	Check Dam	77.1449	13.8438	IWMP
255	Guddugurlu	Gottiguniki	Check Dam	77.1328	13.8405	IWMP
256	Guddugurlu	Gottuguriki	Check Dam	77.1500	13.8291	IWMP
257	Guddugurlu	Gottuguriki	Check Dam	77.1586	13.8252	IWMP
258	Guddugurlu	Gottuguriki	Check Dam	77.1619	13.8245	IWMP
259	Guddugurlu	Gottuguriki	Check Dam	77.1602	13.8214	IWMP
260	Guddugurlu	Gottuguriki	Check Dam	77.1603	13.8213	IWMP
261	Bommagondanahatti	G.Gollahatti	Check Dam	77.1080	13.8846	IWMP

262	Bommagondanahatti	G.Gollahatti	Check Dam	77.1067	13.8846	IWMP
263	Bommagondanahatti	G.Gollahatti	Check Dam	77.1009	13.8822	IWMP
264	Bommagondanahatti	G.Gollahatti	Check Dam	77.1022	13.8860	IWMP
265	Guddugurlu	Gottuguriki	Check Wall	77.1647	13.8275	NREGS
266	Guddugurlu	Honnappalyam	Check Wall	77.1388	13.8316	NREGS
267	M.rayapuram	Cherlopalli	Check Wall	77.0453	13.8924	NREGS
268	M.rayapuram	Cherlopalli	Check Wall	77.0430	13.8910	NREGS
269	Bommagondanahatti	Agraharam	Check Wall	77.0901	13.8802	NREGS
270	Bommagondanahatti	Agraharam	Check Wall	77.0904	13.8735	NREGS
271	Bommagondanahatti	Timmanahalli	Check Wall	77.0604	13.9194	NREGS
272	Bommagondanahatti	Timmanahalli	Check Wall	77.0537	13.9307	NREGS
273	Rolla	Nasehalli	Check Wall	77.1311	13.8423	NREGS
274	Rolla	Palagollahatti	Check Wall	77.0998	13.8586	NREGS
275	Rolla	Rolla	Check Wall	77.1213	13.8534	NREGS
276	Guddugurlu	Gottuguriki	Check Wall	77.1647	13.8275	IWMP
277	Guddugurlu	Gottuguriki	MPT	77.1643	13.8268	NREGS
278	M.rayapuram	Hunisekunta	MPT	77.0589	13.8868	NREGS
279	Guddugurlu	Gottuguriki	MPT	77.1643	13.8268	IWMP
280	Ratnagiri	Alupanahalli	PT	77.1526	13.7964	NREGS
281	Ratnagiri	Bajjarahpalem	PT	77.1090	13.8211	NREGS
282	Ratnagiri	Bajjarahpalem	PT	77.0983	13.8168	NREGS
283	Ratnagiri	Bajjarahpalem	PT	77.0962	13.8191	NREGS
284	Ratnagiri	Ratnagiri	PT	77.1158	13.8085	NREGS
285	Guddugurlu	Gottiguniki	PT	77.1382	13.8384	NREGS
286	Guddugurlu	Gottiguniki	PT	77.1436	13.8328	NREGS
287	Guddugurlu	Gottuguriki	PT	77.1627	13.8311	NREGS
288	Guddugurlu	Gottuguriki	PT	77.1621	13.8202	NREGS
289	Guddugurlu	Gottuguriki	PT	77.1594	13.8263	NREGS
290	Guddugurlu	Gottuguriki	PT	77.1612	13.8328	NREGS
291	Bommagondanahatti	Timmanahalli	PT	77.0478	13.9096	NREGS
292	Ratnagiri	Alupanahalli	PT	77.1526	13.7964	IWMP
293	Ratnagiri	Bajjarahpalem	PT	77.0983	13.8168	IWMP
294	Ratnagiri	Bajjarahpalem	PT	77.0962	13.8191	IWMP
295	Ratnagiri	Bajjarahpalem	PT	77.1090	13.8211	IWMP
296	Ratnagiri	Ratnagiri	PT	77.1158	13.8085	IWMP
297	Guddugurlu	Gottiguniki	PT	77.1382	13.8384	IWMP
298	Guddugurlu	Gottiguniki	PT	77.1436	13.8328	IWMP
299	Guddugurlu	Gottuguriki	PT	77.1627	13.8311	IWMP
300	Guddugurlu	Gottuguriki	PT	77.1621	13.8202	IWMP
301	Guddugurlu	Gottuguriki	PT	77.1594	13.8263	IWMP
302	Guddugurlu	Gottuguriki	PT	77.1612	13.8328	IWMP

PROPOSED ARTIFICIAL RECHARGE STRUCTURES
ROLLA MANDAL, ANANTAPUR DISTRICT, AP

S.No.	Mandal	Lattitude	Longitude	Structure_Type
1	Rolla	13.9083	77.1492	CheckDam
2	Rolla	13.9110	77.1183	CheckDam
3	Rolla	13.9119	77.0973	CheckDam
4	Rolla	13.9305	77.1010	CheckDam
5	Rolla	13.9290	77.1424	CheckDam
6	Rolla	13.9461	77.1169	CheckDam
7	Rolla	13.9223	77.1534	CheckDam
8	Rolla	13.9405	77.1690	CheckDam
9	Rolla	13.9149	77.1599	CheckDam
10	Rolla	13.8972	77.1534	CheckDam
11	Rolla	13.8384	77.1196	Percolation Tank
12	Rolla	13.8246	77.1512	Percolation Tank
13	Rolla	13.7789	77.1349	Percolation Tank
14	Rolla	13.7974	77.1463	Percolation Tank
15	Rolla	13.8741	77.1023	Percolation Tank

Fig.1

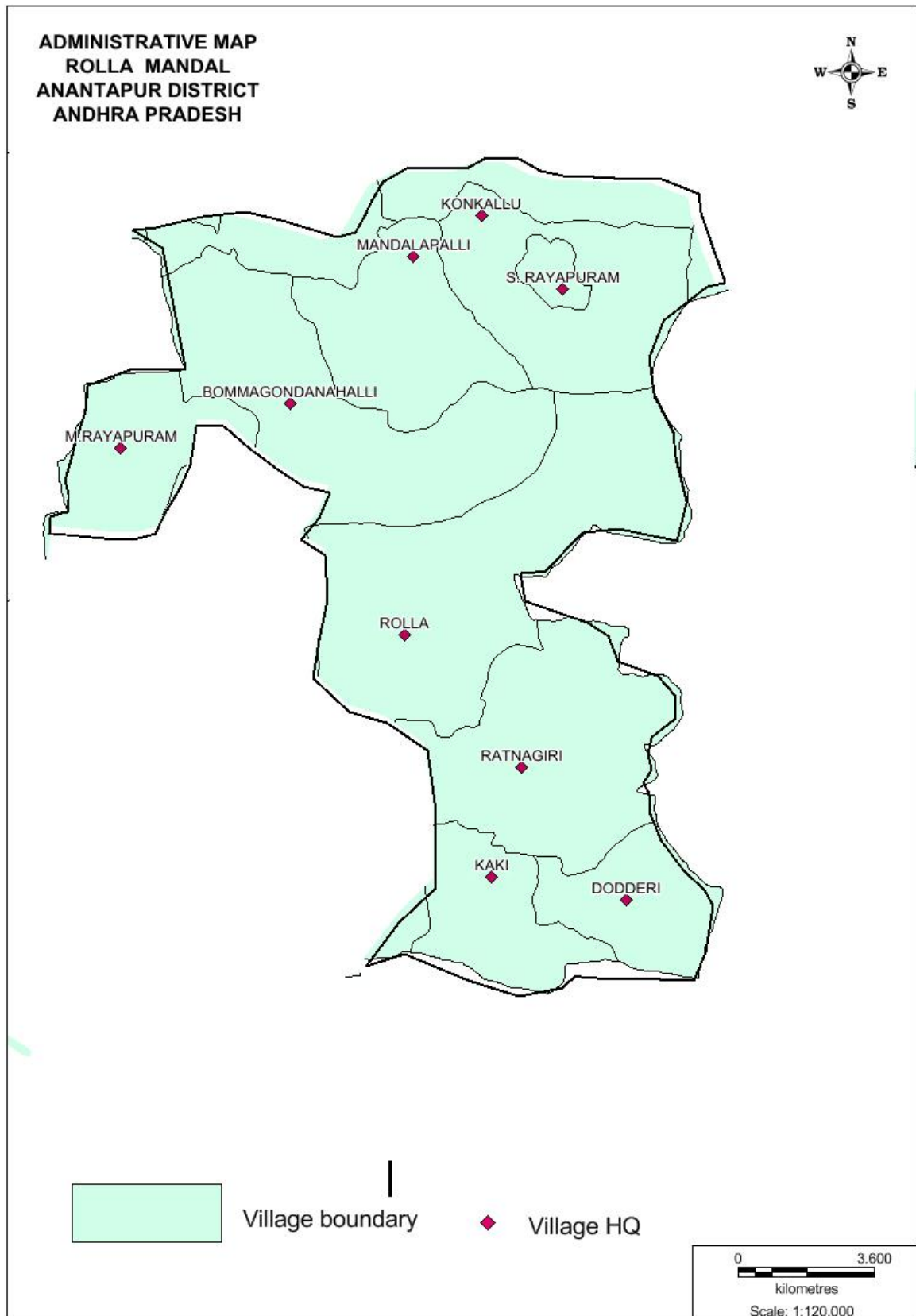


Fig.2

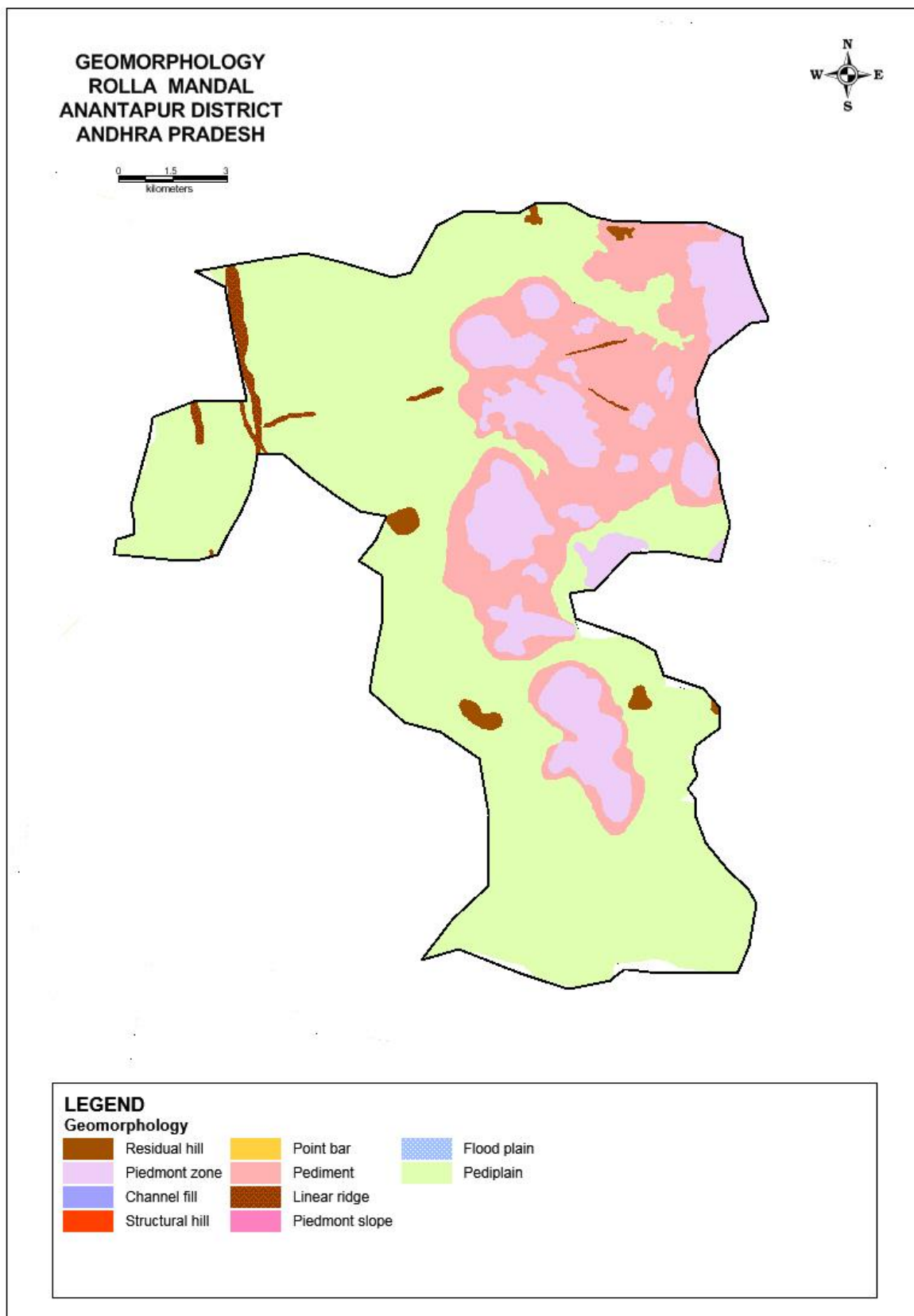


Fig.3

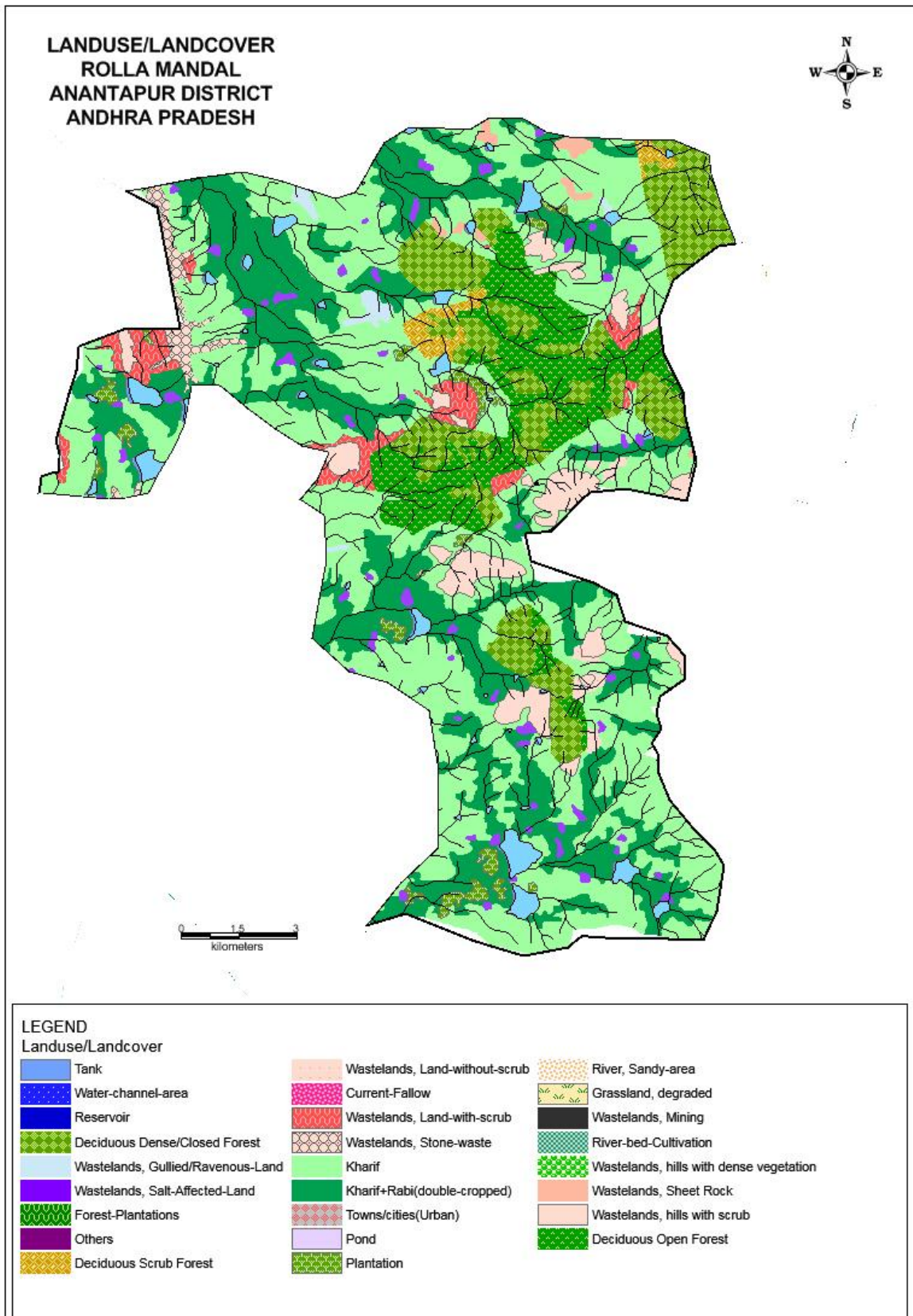


Fig.4

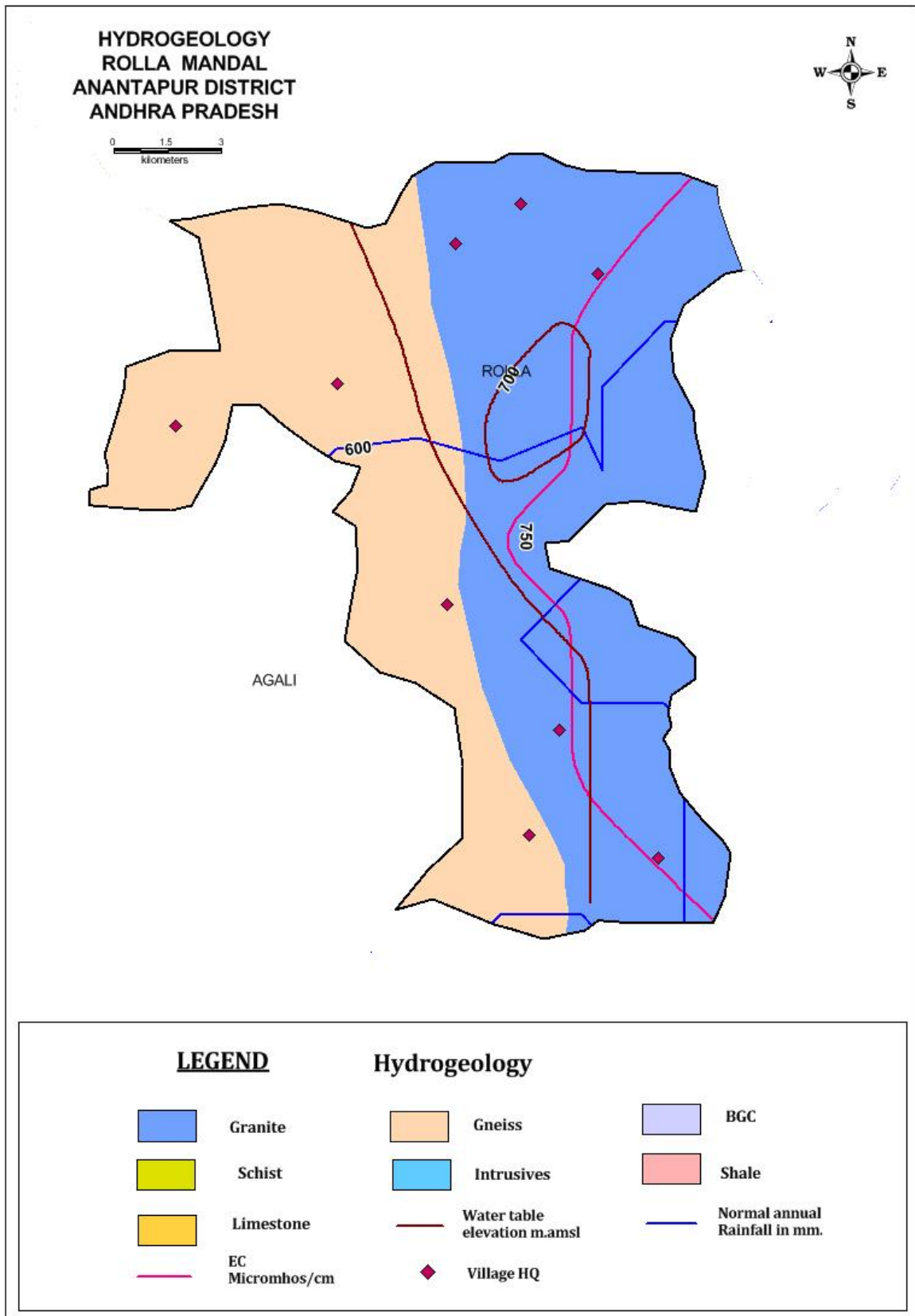


Fig.5

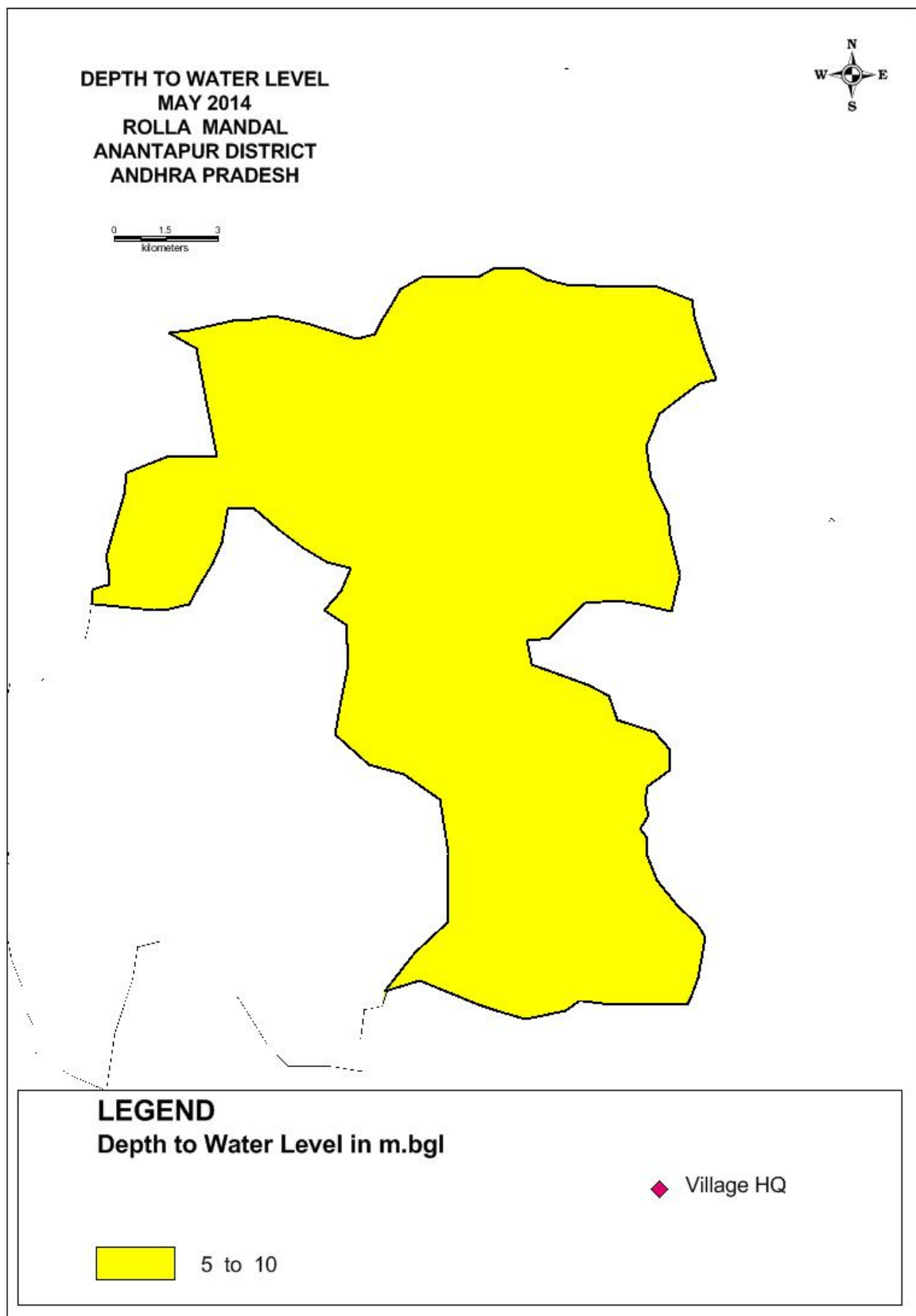


Fig.6

