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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 PULIVENDULA MANDAL, KADAPA DISTRICT, ANDHRA PRADESH STATE

SOUTHERN REGION
HYDERABAD
AUGUST-2016

PLAN ON
ARTIFICIAL RECHARGE TO GROUNDWATER AND WATER CONSERVATION IN PULIVENDULA MANDAL, KADAPA DISTRICT, ANDHRA PRADESH STATE

CONTENTS

AT A GLANCE

Name of the Mandal	PULIVENDULA
District	KADAPA
State	ANDHRA PRADESH
Total Area sq.km.	163
Area suitable for Artificial Recharge (sq.km.)	152
Latitude and Longitude	14.323350 to 14.493510 and 78.123450 to 78.325840.
Average Annual Rainfall (mm)	620
Geology	Shale, Limestone and Quartzite
Average Depth To Water Level (Decadal) (Pre Monsoon)	12.8
Average Depth To Water Level (Decadal) (Post Monsoon)	11.7
Ground Water Resources (2011)	
Annual Replenishable Ground Water Resources (MCM/yr)	12.11
Net Annual Ground Water Availability(MCM)/yr	11.23
Net Annual Ground Water Draft(MCM)/yr	14.04
Projected Demand for Domestic and Industrial Use(MCM)/yr	1.53
Stage of Ground Water Development (%)	125
Surface runoff available (MCM)/yr	13.76
Total Storage Created in the Mandal by Various Agencies (MCM)/yr	0.319
Artificial Recharge/Conservation Measures	
Recharge Structures Proposed (No.s)	Percolation Tanks: 4, Check Dams: 52 Farm ponds: 400, Recharge Shafts: 23
Improving Water use Efficiency	Micro Irrigation System: 2000 ha
Tentative Total Cost in Lakhs (Rs.)	1729.875
Expected Recharge/Savings (MCM)/yr	7.697

1. INTRODUCTION

Pulivendula Mandal is one of over-exploited mandal in Kadapa district, Andhra Pradesh State, which is economically backward and chronically drought affected. The mandal has 19 inhabited villages and 1un inhabited villages with 13 gram panchayats.

2. LOCATION

The mandal lies between north latitudes 14.323350 to 14.493510 and between east longitudes 78.123450 to 78.325840. The mandal occupies the western part of the Kadapa district and is bounded on the north by Thondur mandal, on the east by Vemula mandal, on the south by Ananthapur district and west by Ananthapur district. (Fig.1) The geographical area of the mandal is 163 sq.km.

3. PHYSIOGRAPHY AND DRAINAGE:

The area is drained by streams which are tributaries of Pennar 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 620 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 163 sq.km, the area covered by forest is 8.2 sq.km and the net area sown is 66.12 sq.km. Barren and uncultivable land is 33.12 sq.km. The land for non agricultural use accounts for 12.45 sq.km.(Fig.3)

6. HYDROGEOLOGY

The area is underlain by Meta Sedimentary formations comprising of Shale, Limestone and Quartzite of Pre-Cambrian 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 40 m. The weathered zone has been extensively tapped by dug and dug cum bore wells up to 20 m depth, which are mostly dry now. Ground water occurs in the fractured rock formations 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 depth to water level during the pre-monsoon and post-monsoon varies from 5 to 20 m. The depth to water levels maps for pre and post monsoon period (2014) are shown in Fig 5 & 6 respectively. The average depth to water level (decadal) during pre and post monsoon is 12.8 and 11.7 m bgl respectively. The decadal mean water level trend during post monsoon is depicted in the Fig.7.

8. DYNAMIC GROUND WATER RESOURCES

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

Table-1 Ground water resources of Pulivendula mandal, Kadapa district.

Annual Replenishable Ground water resources (MCM)	12.11
Net Annual Ground Water Availability(MCM)/yr	11.23
Net Annual Ground Water Draft(MCM)/yr	14.04
Projected Demand for Domestic and Industrial use up to 2025. (MCM)	1.53
Stage of Ground water development (%).	125
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 upto20 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

Pulivendula Mandal falls under high stage of ground water development i.e., 125 % 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)	163
Hilly Area (Sq.kms)	11
Area suitable for Artificial Recharge (sq.km.)	152
Runoff Yield in MCM/yr.	13.76
Existing No. of Check Dams	30
Storage created MCM/yr.	0.21
Existing No. of Percolation Tanks	15
Storage created MCM/yr.	0.106
Total Existing Storage Created	0.319

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 13.44 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 620 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, a total of 52 **Check dams and 4 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 15 and 8 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 400 farm ponds in 20 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 2000 ha @ 100 ha per village.

13. TENTATIVE COST ESTIMATES (PULIVENDULA 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)	52	1.456	5	260	1.092
2	Recharge shaft in Check dam (50% of the existing Check dams)	15	0.165	0.5	7.5	0.165
3	Proposed Percolation Tanks (100*100*2.5)* 4 fillings)	4	0.4	15	60	0.3
4	Renovation Desilting, Repairs and installation of Recharge Shafts in existing PTS (50% of the existing PTS)	8	0.088	1	8	0.088
5	Proposed Farm Pond (6 filling) 5*5*1.5 dimension @ 20 farm ponds per each village	400	0.0576	0.25	100	0.05184
6	Proposed Sprinkler/drip/HDPE pipes for 100 ha in each village	2000	12	0.6	1200	6
7	Proposed Piezometers up to 50 mbgl @ one PZ per Village	20	0	0.6	12	0
8 (i)	Total (No. of AR Structures)	499	2.17		447.5	1.697
8 (ii)	Total (ha)	2000			1200	6
	Total (8(i) + 8 (ii))				**1647.5**	**7.697**
9	Impact Assessment & O & M -5 % of Total cost of the Scheme				**82.375**	
	Grand Total				**1729.875**	

*(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	2nd	3rd	4th	5th	6th	7th	8th
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 7.697 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 125% to 74% (51%)
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
PULIVENDULA MANDAL, KADAPA DISTRICT, AP

S.no	Gram Panchayat	Habitation	Structure Type	Longitude	Latitude	Scheme
1	Konampalli	Konampalle	Check Dam	78.1970	14.3513	NREGS
2	Konampalli	Konampalle	Check Dam	78.2047	14.3450	NREGS
3	Konampalli	Konampalle	Check Dam	78.2065	14.3506	NREGS
4	Konampalli	Konampalle	Check Dam	78.2045	14.3509	NREGS
5	Yerripalli	Yerripalli	Check Dam	78.2836	14.4565	NREGS
6	Yerripalli	Yerripalli	Check Dam	78.2735	14.4480	NREGS
7	Yerripalli	Yerripalli	Check Dam	78.2751	14.4500	NREGS
8	Yerripalli	Yerripalli	Check Dam	78.2844	14.4457	NREGS
9	Yerripalli	Yerripalli	Check Dam	78.2921	14.4420	NREGS
10	Atchavalle	Atchavalle	Check Dam	78.2851	14.4842	NREGS
11	Atchavalle	Atchavalle	Check Dam	78.2873	14.4802	NREGS
12	Atchavalle	Atchavalle	Check Dam	78.2846	14.4735	NREGS
13	Atchavalle	Atchavalle	Check Dam	78.2837	14.4768	NREGS
14	Atchavalle	Atchavalle	Check Dam	78.2853	14.4805	NREGS
15	E.kothapalli	Chandragiri	Check Dam	78.1808	14.3958	NREGS
16	E.kothapalli	Chandragiri	Check Dam	78.1791	14.3936	NREGS
17	E.kothapalli	Motunuthalapalli	Check Dam	78.1865	14.3638	NREGS
18	E.kothapalli	Motunuthalapalli	Check Dam	78.1824	14.3633	NREGS
19	E.kothapalli	Motunuthalapalli	Check Dam	78.1873	14.3595	NREGS
20	E.kothapalli	Motunuthalapalli	Check Dam	78.1949	14.3536	NREGS
21	Ragimanupalle	Ragimanupalle	Check Dam	78.2365	14.4738	NREGS
22	Ragimanupalle	Rayalapuram	Check Dam	78.2246	14.4648	NREGS
23	Yerraballi	Harijanawada	Check Dam	78.1763	14.3880	NREGS
24	Yerraballi	Harijanawada	Check Dam	78.1791	14.3908	NREGS
25	Yerraballi	Mallikarjunapuram	Check Dam	78.1694	14.3876	NREGS
26	Yerraballi	Mallikarjunapuram	Check Dam	78.1732	14.3878	NREGS
27	Yerraballi	Nallapureddipalli	Check Dam	78.1764	14.4013	NREGS
28	Yerraballi	Nallapureddipalli	Check Dam	78.1802	14.3994	NREGS
29	Yerraballi	Nallapureddipalli	Check Dam	78.1567	14.3799	NREGS
30	Yerraballi	Nallapureddipalli	Check Dam	78.2005	14.4018	NREGS
31	Yerripalli	Yerripalli	MPT	78.2909	14.4572	NREGS
32	Yerripalli	Yerripalli	MPT	78.2907	14.4565	NREGS
33	Yerripalli	Yerripalli	MPT	78.2786	14.4482	NREGS
34	Atchavalle	Atchavalle	MPT	78.2772	14.4804	NREGS

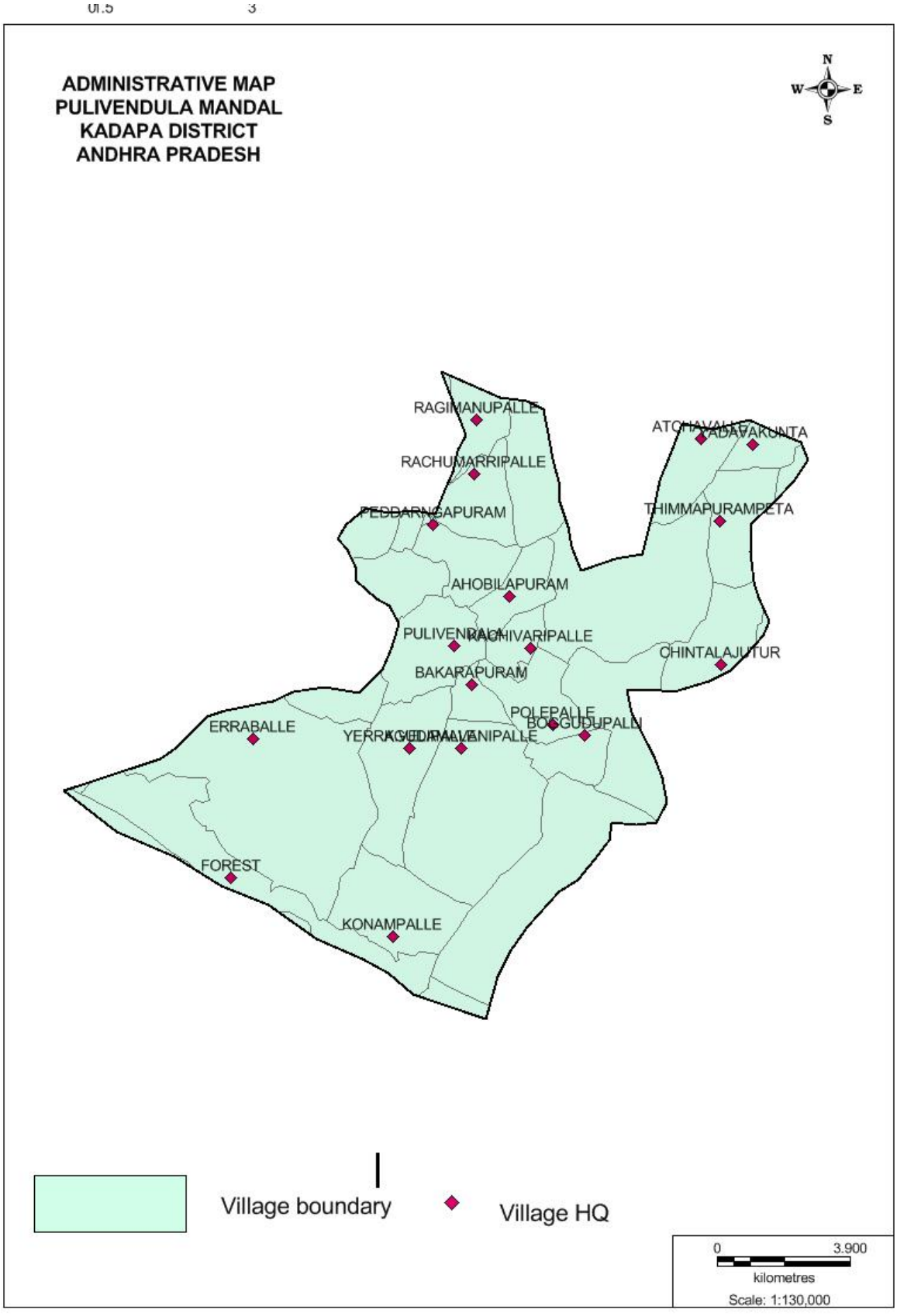
35	Atchavalle	Atchavalle	MPT	78.2832	14.4742	NREGS
36	Atchavalle	Atchavalle	MPT	78.2840	14.4723	NREGS
37	Atchavalle	Atchavalle	MPT	78.2711	14.4617	NREGS
38	Atchavalle	Atchavalle	MPT	78.2672	14.4595	NREGS
39	Atchavalle	PutrayuniPeta	MPT	78.2836	14.4609	NREGS
40	Yerripalli	Yerripalli	PT	78.2743	14.4457	NREGS
41	Atchavalle	Atchavalle	PT	78.2972	14.4710	NREGS
42	Atchavalle	Atchavalle	PT	78.2834	14.4801	NREGS
43	Atchavalle	Atchavalle	PT	78.2769	14.4745	NREGS
44	Ragimanupalle	Rachumarripalle	PT	78.2346	14.4724	NREGS
45	Yerraballi	Nallapureddipalli	PT	78.1686	14.3916	NREGS

PROPOSED ARTIFICIAL RECHARGE STRUCTURES
PULIVENDULA MANDAL, KADAPA DISTRICT, AP

S.No.	Mandal	Lattiutude	Longitude	Structure type
1	Pulivendula	14.3681	78.2041	Checkdam
2	Pulivendula	14.4059	78.2101	Checkdam
3	Pulivendula	14.3816	78.1847	Checkdam
4	Pulivendula	14.3678	78.1689	Checkdam
5	Pulivendula	14.3790	78.1620	Checkdam
6	Pulivendula	14.3784	78.1475	Checkdam
7	Pulivendula	14.3722	78.1904	Checkdam
8	Pulivendula	14.3702	78.1805	Checkdam
9	Pulivendula	14.3754	78.1605	Checkdam
10	Pulivendula	14.4024	78.1641	Checkdam
11	Pulivendula	14.3839	78.1944	Checkdam
12	Pulivendula	14.3599	78.1995	Checkdam
13	Pulivendula	14.3634	78.1756	Checkdam
14	Pulivendula	14.3461	78.2219	Checkdam
15	Pulivendula	14.4185	78.2337	Checkdam
16	Pulivendula	14.3948	78.2319	Checkdam
17	Pulivendula	14.3971	78.2540	Checkdam
18	Pulivendula	14.3945	78.2598	Checkdam
19	Pulivendula	14.3728	78.2401	Checkdam
20	Pulivendula	14.3687	78.2241	Checkdam
21	Pulivendula	14.3801	78.2159	Checkdam
22	Pulivendula	14.3517	78.2119	Checkdam
23	Pulivendula	14.3417	78.2128	Checkdam
24	Pulivendula	14.3989	78.2731	Checkdam
25	Pulivendula	14.3757	78.2673	Checkdam
26	Pulivendula	14.3455	78.2428	Checkdam
27	Pulivendula	14.3314	78.2371	Checkdam
28	Pulivendula	14.3358	78.2259	Checkdam
29	Pulivendula	14.3605	78.2334	Checkdam

30	Pulivendula	14.3883	78.2162	Checkdam
31	Pulivendula	14.3619	78.2174	Checkdam
32	Pulivendula	14.3769	78.2156	Checkdam
33	Pulivendula	14.3526	78.2180	Checkdam
34	Pulivendula	14.4696	78.2401	Checkdam
35	Pulivendula	14.4608	78.2377	Checkdam
36	Pulivendula	14.4643	78.2510	Checkdam
37	Pulivendula	14.4828	78.2462	Checkdam
38	Pulivendula	14.4314	78.2307	Checkdam
39	Pulivendula	14.4385	78.2422	Checkdam
40	Pulivendula	14.4490	78.2540	Checkdam
41	Pulivendula	14.4388	78.2604	Checkdam
42	Pulivendula	14.4332	78.2552	Checkdam
43	Pulivendula	14.4276	78.2455	Checkdam
44	Pulivendula	14.4444	78.3034	Checkdam
45	Pulivendula	14.4631	78.3073	Checkdam
46	Pulivendula	14.4537	78.2098	Checkdam
47	Pulivendula	14.4754	78.2501	Checkdam
48	Pulivendula	14.4769	78.3143	Checkdam
49	Pulivendula	14.4722	78.3221	Checkdam
50	Pulivendula	14.4666	78.2888	Checkdam
51	Pulivendula	14.4171	78.3019	Checkdam
52	Pulivendula	14.4171	78.2867	Checkdam
53	Pulivendula	14.3792	78.1644	Percolation Tank
54	Pulivendula	14.3957	78.2489	Percolation Tank
55	Pulivendula	14.3731	78.2465	Percolation Tank
56	Pulivendula	14.4766	78.2446	Percolation Tank

Fig.1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3
ADMINISTRATIVE MAP
PULIVENDULA MANDAL
KADAPA DISTRICT
ANDHRA PRADESH
N
W
E
S
RAGIMANUPALLE
RACHUMARRIPALLE
PEDDARNGAPURAM
AHOBILAPURAM
PULIVENDALA
RAGHIVARIPALLE
BAKARAPURAM
POLEPALLE
ERRABALLE
FOREST
KONAMPALLE
CHINTALAJUTUR
THIMMAPURAMPETA
Village boundary
Village HQ
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kilometres
Scale: 1:130,000

Fig.2

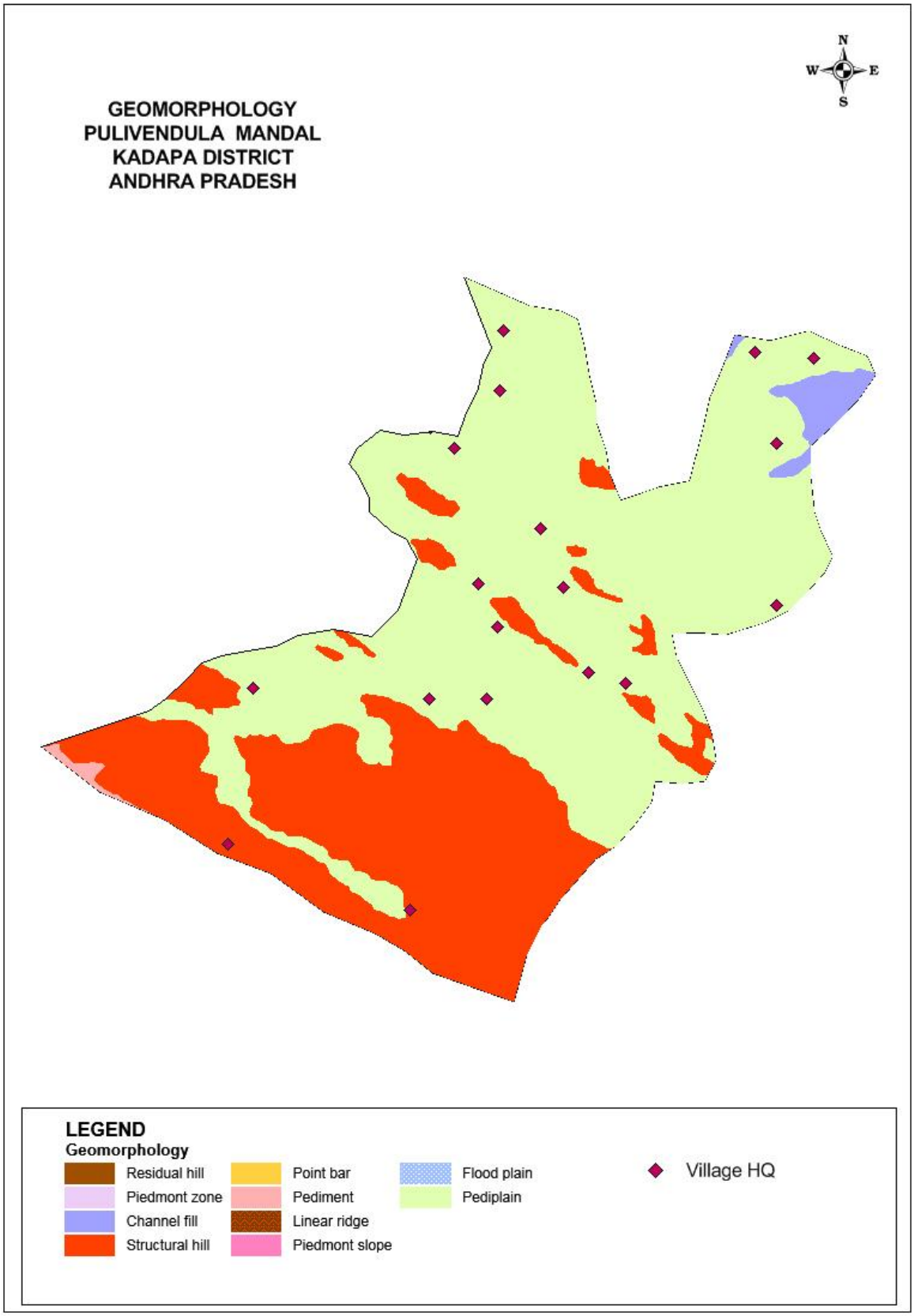

N
W
E
S
GEOMORPHOLOGY
PULIVENDULA MANDAL
KADAPA DISTRICT
ANDHRA PRADESH
LEGEND
Geomorphology
Residual hill
Piedmont zone
Channel fill
Structural hill
Point bar
Pediment
Linear ridge
Piedmont slope
Flood plain
Pediplain
Village HQ

Fig.3

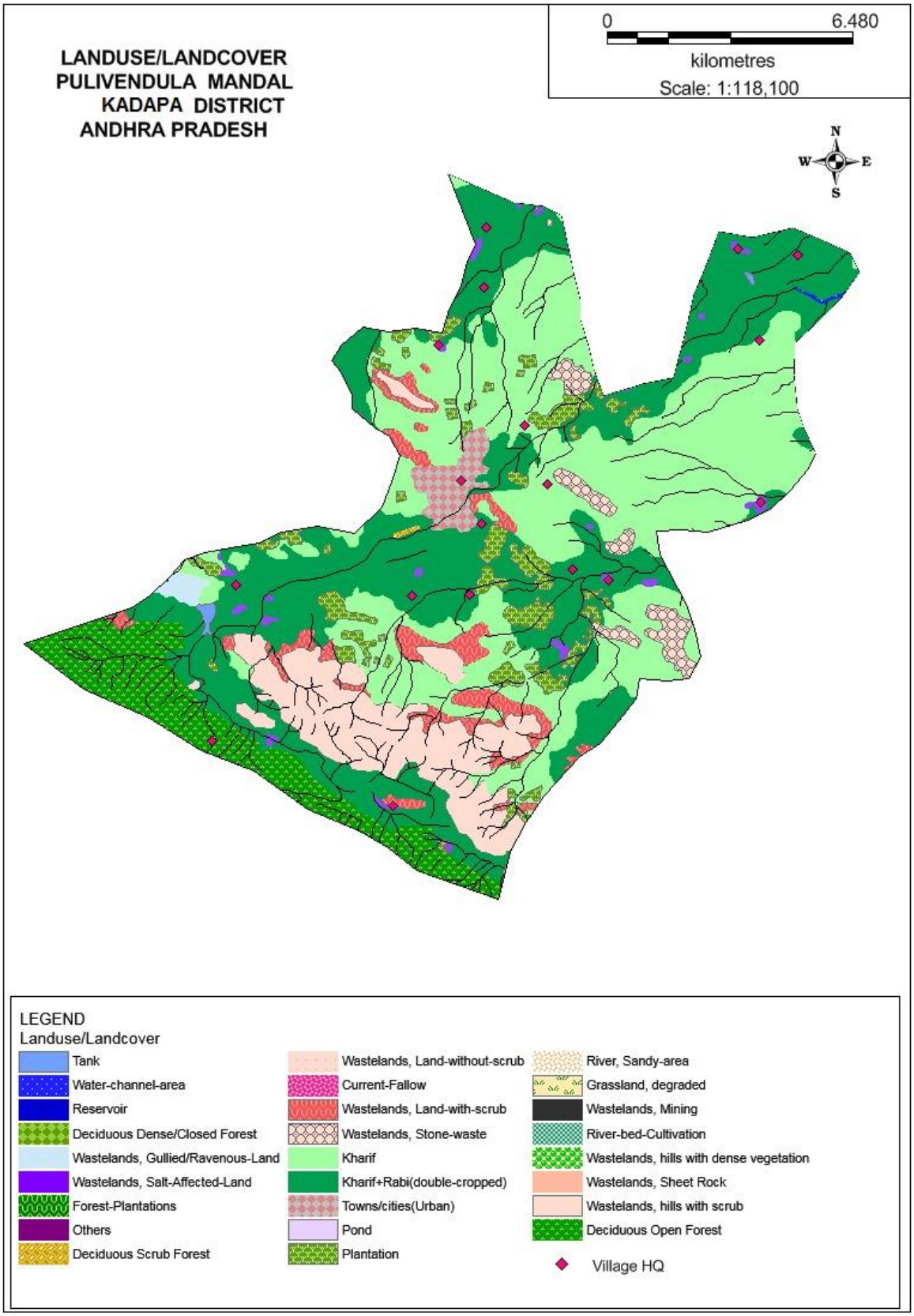

LANDUSE/LANDCOVER
PULIVENDULA MANDAL
KADAPA DISTRICT
ANDHRA PRADESH
0
6.480
kilometres
Scale: 1:118,100
N
W
E
S
LEGEND
Landuse/Landcover
Tank
Water-channel-area
Reservoir
Deciduous Dense/Closed Forest
Wastelands, Gullied/Ravenous-Land
Wastelands, Salt-Affected-Land
Forest-Plantations
Others
Deciduous Scrub Forest
Wastelands, Land-without-scrub
Current-Fallow
Wastelands, Land-with-scrub
Wastelands, Stone-waste
Kharif
Kharif+Rabi(double-cropped)
Towns/cities(Urban)
Pond
Plantation
River, Sandy-area
Grassland, degraded
Wastelands, Mining
River-bed-Cultivation
Wastelands, hills with dense vegetation
Wastelands, Sheet Rock
Wastelands, hills with scrub
Deciduous Open Forest
Village HQ

Fig.4

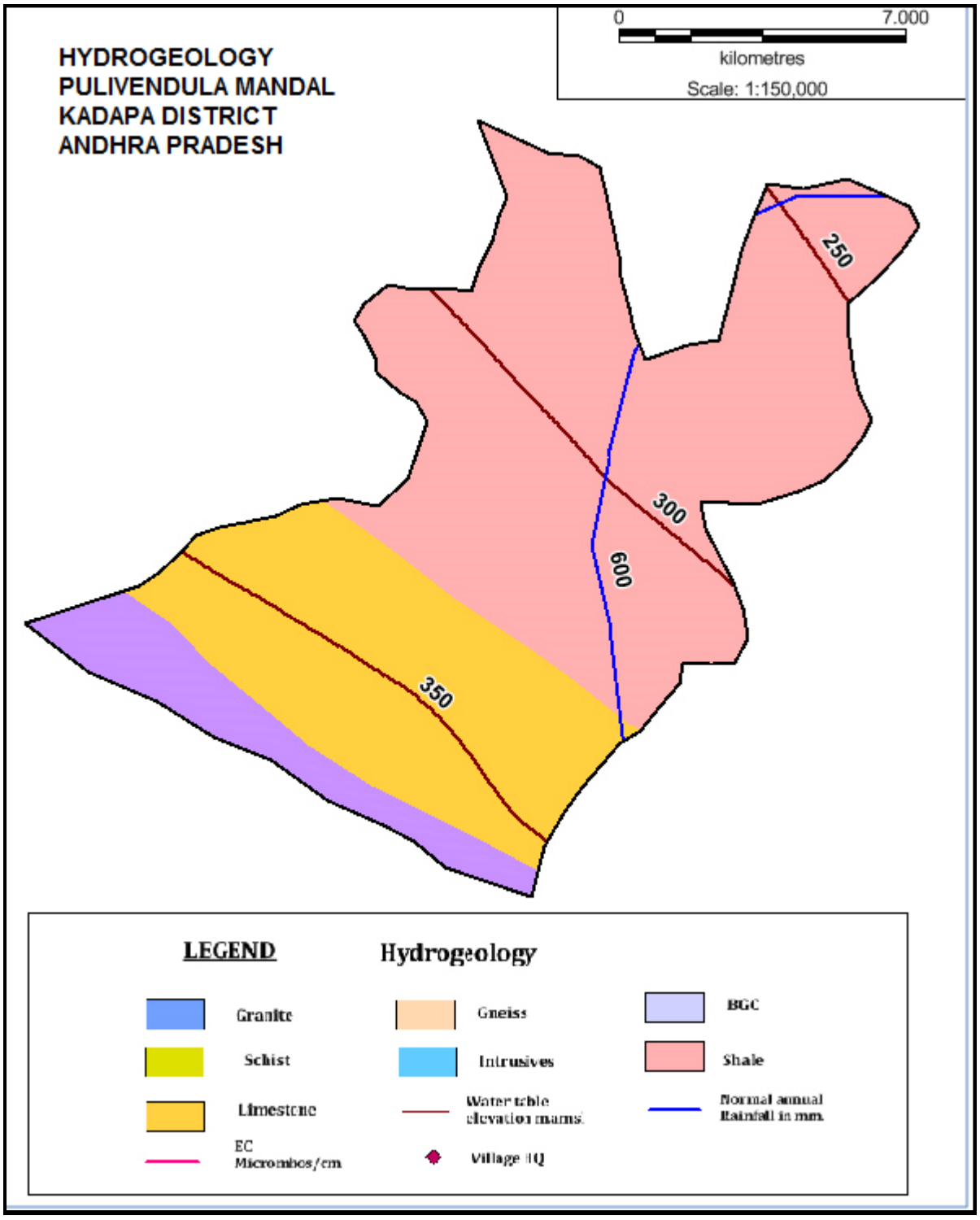

HYDROGEOLOGY
PULIVENDULA MANDAL
KADAPA DISTRICT
ANDHRA PRADESH
0
7.000
kilometres
Scale: 1:150,000
250
300
600
350
LEGEND
Hydrogeology
Granite
Gneiss
BGC
Schist
Intrusives
Shale
Limestone
Water table elevation mams.
Normal annual Rainfall in mm.
EC Micrombos/cm
Village HQ

Fig.5

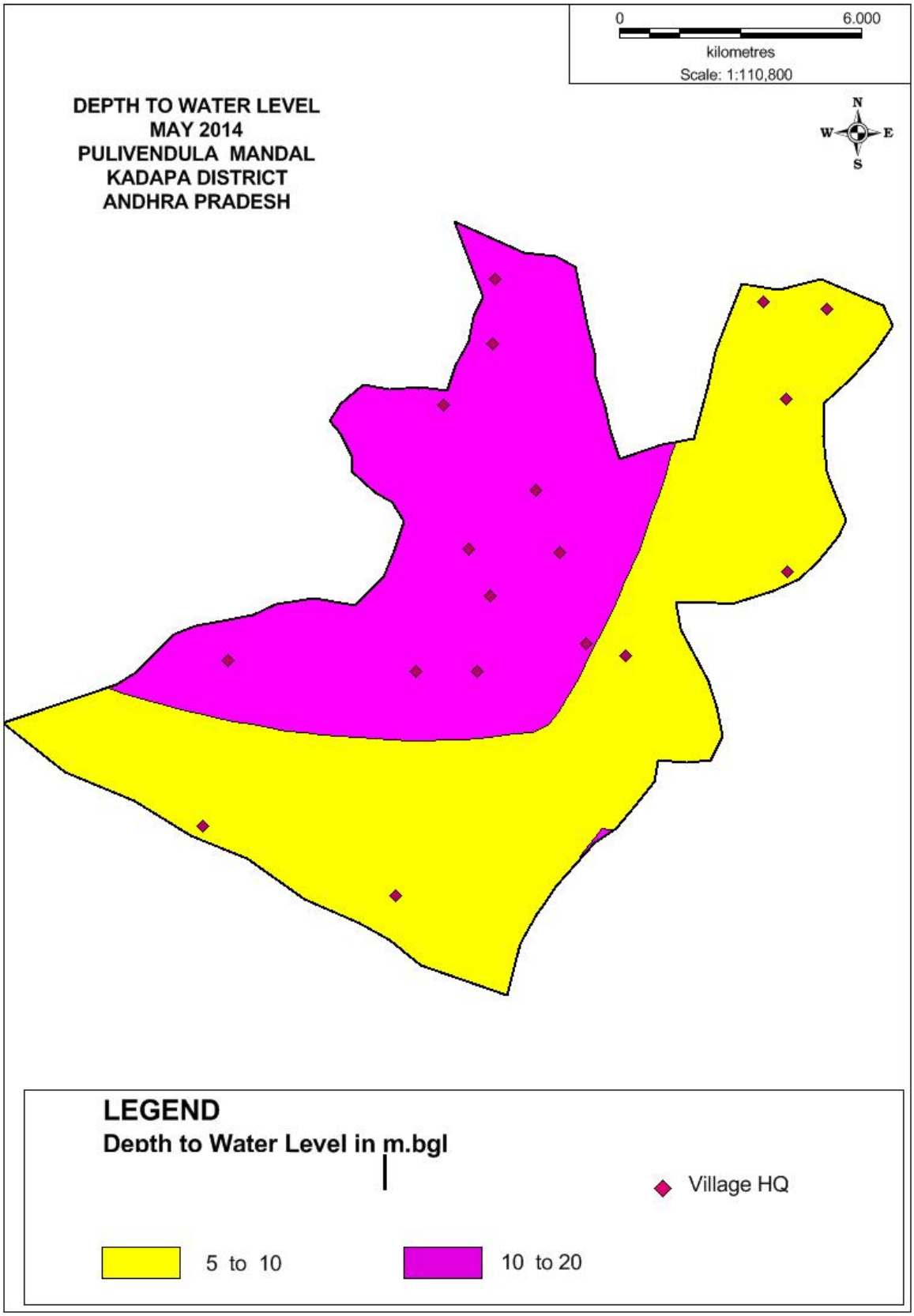

0
6.000
kilometres
Scale: 1:110,800
DEPTH TO WATER LEVEL
MAY 2014
PULIVENDULA MANDAL
KADAPA DISTRICT
ANDHRA PRADESH
N
W
E
S
LEGEND
Depth to Water Level in m.bgl
Village HQ
5 to 10
10 to 20

Fig.6

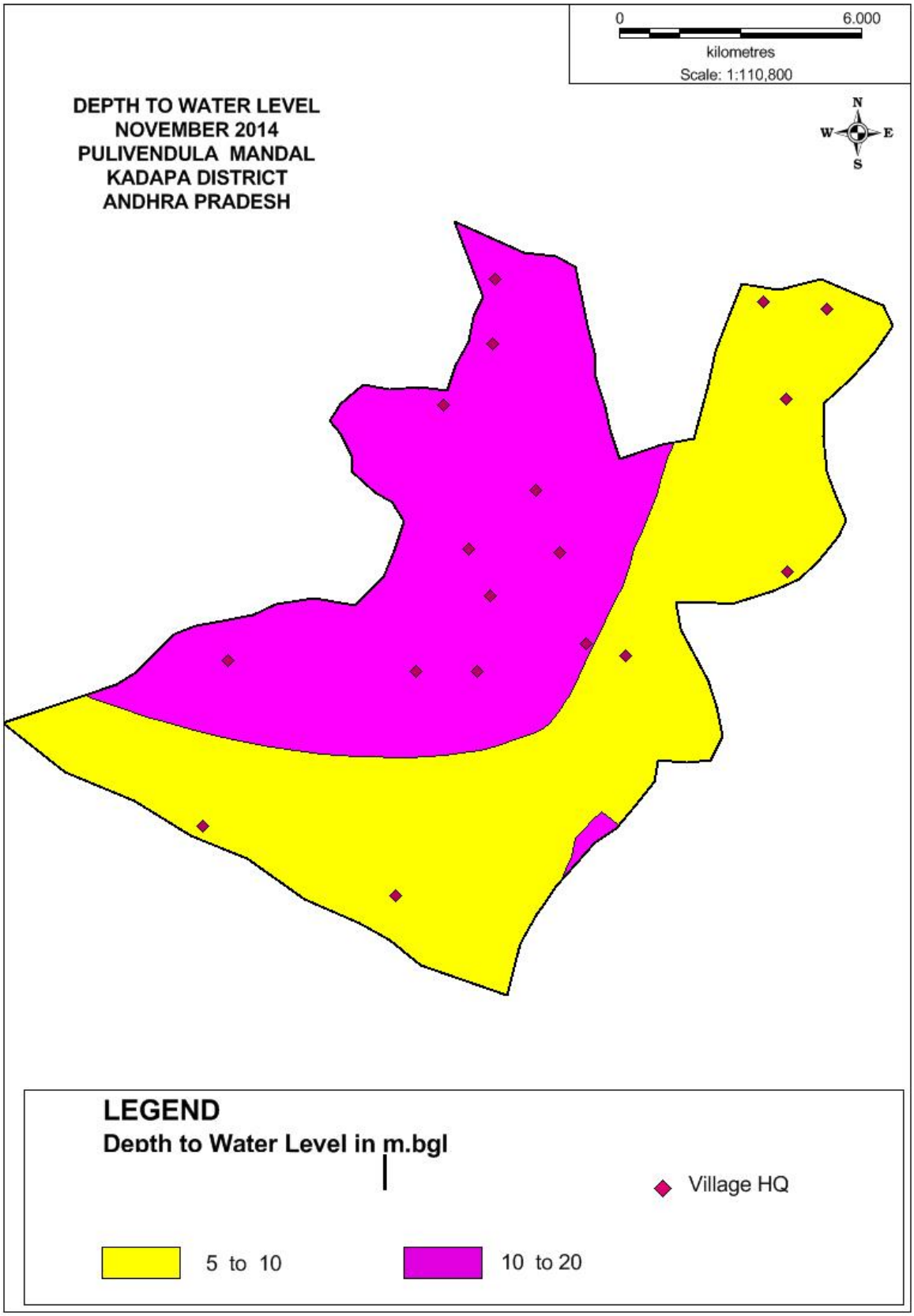
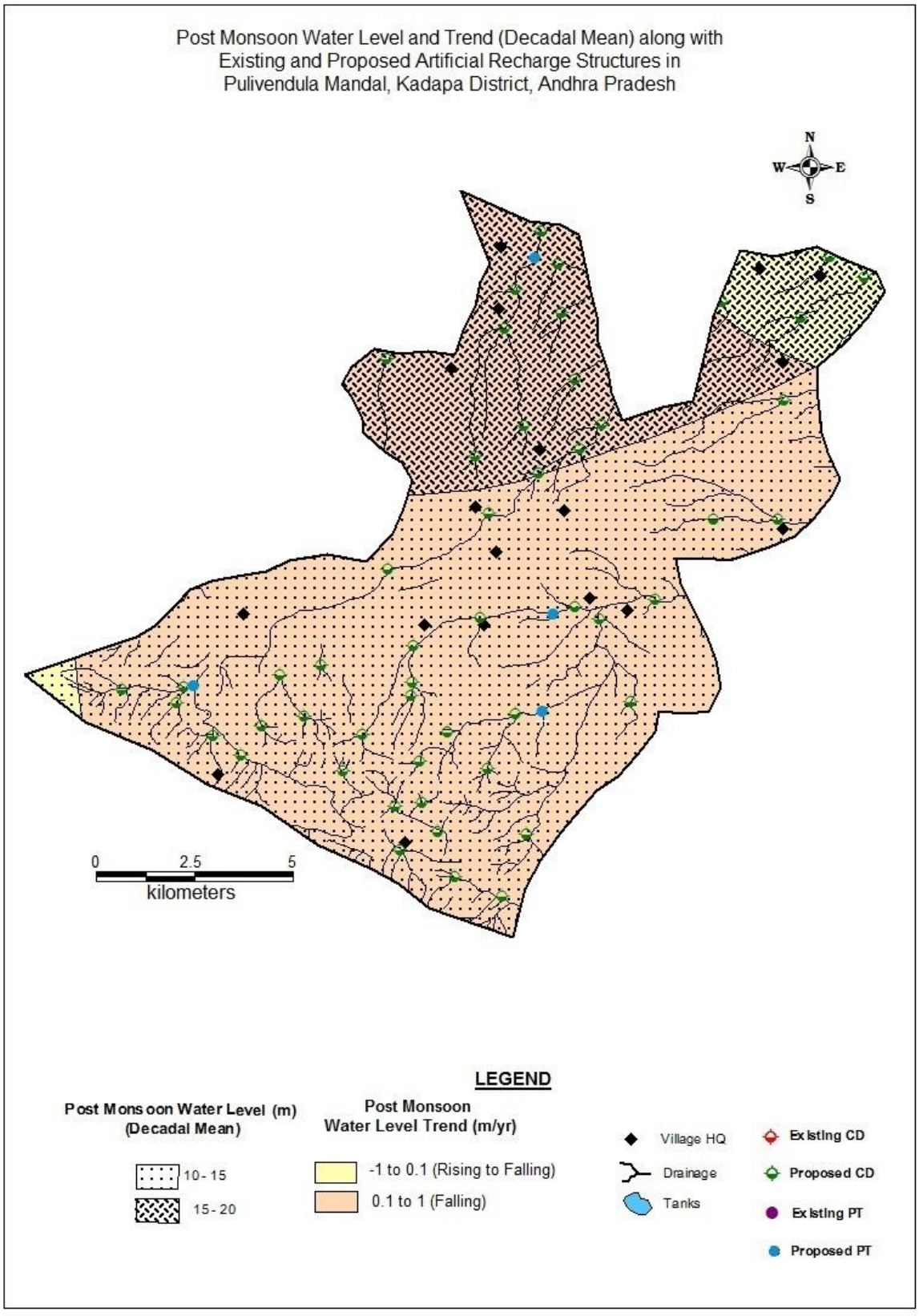

0
6.000
kilometres
Scale: 1:110,800
DEPTH TO WATER LEVEL
NOVEMBER 2014
PULIVENDULA MANDAL
KADAPA DISTRICT
ANDHRA PRADESH
N
W
E
S
LEGEND
Depth to Water Level in m.bgl
Village HQ
5 to 10
10 to 20

Fig.7


Post Monsoon Water Level and Trend (Decadal Mean) along with
Existing and Proposed Artificial Recharge Structures in
Pulivendula Mandal, Kadapa District, Andhra Pradesh
N
W
E
S
0
2.5
5
kilometers
LEGEND
Post Monsoon Water Level (m)
(Decadal Mean)
10 - 15
15 - 20
Post Monsoon
Water Level Trend (m/yr)
-1 to 0.1 (Rising to Falling)
0.1 to 1 (Falling)
Village HQ
Drainage
Tanks
Existing CD
Proposed CD
Existing PT
Proposed PT