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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 NIRMAL MANDAL, ADILABAD DISTRICT, TELANGANA STATE

SOUTHERN REGION,
HYDERABAD
AUGUST-2016

PLAN ON
ARTIFICIAL RECHARGE TO GROUNDWATER AND WATER CONSERVATION IN NIRMAL MANDAL, ADILABAD DISTRICT, TELANGANA STATE

CONTENTS

AT A GLANCE

Name of the Mandal	NIRMAL
District	ADILABAD
State	TELANGANA
Total Area(sq. km)	206
Area suitable for Artificial Recharge (Sq.kms)	175
Latitude and Longitude	18.922200 to 19.184220 and 78.261740 to 78.420870.
Average Annual Rainfall (mm)	1182
Geology	BGC
Average Depth To Water Level (Decadal) (Pre Monsoon)	4.67
Average Depth To Water Level (Decadal) (Post Monsoon)	1.39
Ground Water Resources (2011)	
Annual Replenishable Ground Water Resources (MCM/yr)	24.15
Net Annual Ground Water Availability(MCM)/yr	22.60
Net Annual Ground Water Draft(MCM)/yr	25.47
Projected Demand for Domestic and Industrial Use(MCM)/yr	2.15
Stage of Ground Water Development (%)	113
Runoff Yield in MCM/yr.	69.0
Total Storage Created in the Mandal by Various Agencies (MCM)/yr	0.2
Artificial Recharge/Conservation Measures	
Recharge Structures Proposed (No.s)	Percolation Tanks-4 Check Dams-73 Farm Ponds - 680, Recharge Shafts- 16
Improving Water use Efficiency	Micro Irrigation – 3400 ha
Tentative Total Cost in Lakhs (Rs.)	2,797
Expected Recharge/Savings (MCM)/yr	12.297

1. INTRODUCTION

Nirmal Mandal is one of the over-exploited Mandal in Adilabad district, Telangana State, which is economically backward and chronically drought affected. The Mandal has 34 inhabited villages, 7 uninhabited villages and with 25 gram Panchayats.

2. LOCATION

The Mandal lies between north latitudes 18.922200 to 19.184220 and between east longitudes 78.261740 to 78.420870. The Mandal occupies the South-West part of the Adilabad district and is bounded on the north by Sarangapur mandal, on the east by Laxmanchanda mandal, on the south by Nizamabad district and west by Dilawarpur mandal. (Fig.1) The geographical area of the Mandal is 206 sq.km.

3. PHYSIOGRAPHY AND DRAINAGE:

The area is drained by streams, falling in Middle Godavari basin. 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 1182 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 206 sq.km, the area covered by forest is 20.70 sq.km and the net area sown is 98.41 sq.km. Barren and uncultivable land is 5.0 sq.km. The land for non agricultural use accounts for 52.08 sq.km. (Fig.3)

6. HYDROGEOLOGY

The area is underlain by 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 20 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 granites down to depth of 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 pre and post-monsoon varies from 5 to 10 m bgl. The Decadal mean water levels and trends during post monsoon is depicted in the Fig.5.

8. DYNAMIC GROUND WATER RESOURCES

The Ground water availability, Utilization and stage of Development in Nirmal Mandal, Adilabad District is given in the Table-1.

Table-1 Ground water resources of Nirmal Mandal, Adilabad District.

Annual Replenishable Ground water resources (MCM)	24.15
Net Annual Ground Water Availability(MCM)/yr	22.60
Net Annual Ground Water Draft(MCM)/yr	25.47
Projected Demand for Domestic and Industrial use up to 2025. (MCM)	2.15
Stage of Ground water development (%).	113
Weather 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 15 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

Nirmal Mandal falls under high stage of ground water development i.e., 113 % 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)	206.0
Hilly Area (Sq.kms)	31.0
Area suitable for Artificial Recharge (sq.km.)	175.0
Runoff Yield in MCM/yr.	69.0
Existing No. of Check Dams	29
Storage created MCM/yr.	0.2
Existing No. of Percolation Tanks	1.0
Total Existing Storage Created	0.2

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 for ground water recharge purpose within the mandal has been assessed as 69 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 1182 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.

A total of 73 Check dams and 4 Percolation tanks are recommended in the mandal.

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 1 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 680 farm ponds in 34 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 3400 ha @ 100 ha per village.

13. TENTATIVE COST ESTIMATES (NIRMAL 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)	73	2.044	5	365	1.533
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)	1	0.011	1	1	0.011
5	Proposed Farm Pond (6 filling) 5*5*1.5 dimension @ 20 farm ponds per each village	680	0.09792	0.25	170	0.088128
6	Proposed Sprinkler/drip/HDPE pipes for 100 ha in each village	3400		0.6	2040	10.2
7	Proposed Piezometers up to 50 mbgl @ one PZ per Village	34	0	0.6	20.4	0
8 (i)	Total (No. of AR Structures)	807	2.72		623.9	2.097
8 (ii)	Total (ha)	3400			2040	10.2
	Total (8(i) + 8 (ii))				**2663.9**	**12.297**
9	Impact Assessment & O & M -5 % of Total cost of the Scheme				**133.195**	
	Grand Total				**2797.095**	

*(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 12.29 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 113% to 73% (40%)
4. It will also help in controlling soil erosion.

Acknowledgements

The inputs with regard to the Utilizable Yield, existing and proposed Artificial Recharge Structures have been provided by the Director, State Ground Water Department, Government of Telangana. The same is duly acknowledged.

EXISTING ARTIFICIAL RECHARGE STRUCTURES (CHECK DAMS)
NIRMAL MANDAL, ADILABAD DISTRICT, TELANGANA.

S.NO.	Lat	Long
1	19.1077	78.304
2	19.1125	78.3043
3	19.1191	78.3012
4	19.1227	78.3062
5	19.123	78.3084
6	19.1258	78.3089
7	19.1268	78.3129
8	19.1378	78.3845
9	19.1369	78.3872
10	19.0564	78.3346
11	19.0717	78.3291
12	19.0731	78.332
13	19.0714	78.3335
14	19.0747	78.3108
15	19.0792	78.3231
16	19.0804	78.3223
17	19.0626	78.3064
18	19.0413	78.309
19	19.0455	78.3124
20	19.0341	78.3167
21	19.0547	78.3164
22	19.0676	78.3135
23	19.0691	78.3114
24	19.0646	78.3262
25	19.069	78.3304
26	19.0839	78.3209
27	19.1275	78.4094
28	19.0429	78.3397
29	19.0417	78.3109

PROPOSED ARTIFICIAL RECHARGE STRUCTURES (CHECK DAMS)
NIRMAL MANDAL, ADILABAD DISTRICT, TELANGANA

S.NO.	Latitude	Longitude
1	19.0965	78.3957
2	19.0994	78.4062
3	19.0974	78.3854
4	19.1008	78.4183
5	19.1054	78.4175
6	19.1251	78.4096
7	19.142	78.4176
8	19.1165	78.3992
9	19.1124	78.3985
10	19.0113	78.3657
11	19.0061	78.37
12	19.013	78.3916
13	19.0254	78.3942
14	19.0197	78.3839
15	19.0355	78.3702
16	19.0465	78.3668
17	19.0476	78.4012
18	19.0507	78.4103
19	19.0531	78.378
20	19.0596	78.3815
21	19.0623	78.3922
22	19.0642	78.4068
23	19.0685	78.3902
24	19.076	78.3899
25	19.0679	78.38
26	19.0682	78.3642
27	19.0885	78.3734
28	19.157	78.3605
29	19.1252	78.3633
30	19.1084	78.3705
31	19.1203	78.3759
32	19.1259	78.3795
33	19.1246	78.3677
34	19.1346	78.3809
35	19.1413	78.381
36	19.1582	78.3705
37	19.1565	78.3875
38	19.155	78.3932
39	19.1573	78.4016
40	19.0639	78.36
41	19.0204	78.338
42	19.022	78.3429
43	19.0182	78.352
44	19.0368	78.3459
45	19.0485	78.3357
46	19.0493	78.3507
47	19.0548	78.3513
48	19.0573	78.3474
49	19.0657	78.3453
50	19.0744	78.3395
51	18.9818	78.349
52	18.9846	78.3501
53	18.993	78.3238
54	19.0042	78.3316
55	19.0094	78.3222
56	19.0675	78.2992
57	19.0699	78.3059
58	19.0923	78.3021
59	19.0984	78.2923
60	19.1012	78.2971
61	19.0987	78.3157
62	19.1112	78.3137
63	19.1137	78.332
64	19.0373	78.3351
65	19.0284	78.3189
66	19.0162	78.3249
67	19.0231	78.3183
68	19.0204	78.3293
69	19.0299	78.3345
70	19.0377	78.3112
71	19.0404	78.3238
72	19.0393	78.3301
73	19.0501	78.3003

PROPOSED PERCOLATION TANKS

S.NO.	Latitude	Longitude
1	19.077	78.3016
2	19.0299	78.3236
3	19.0647	78.3769
4	19.148	78.4118

Fig.1

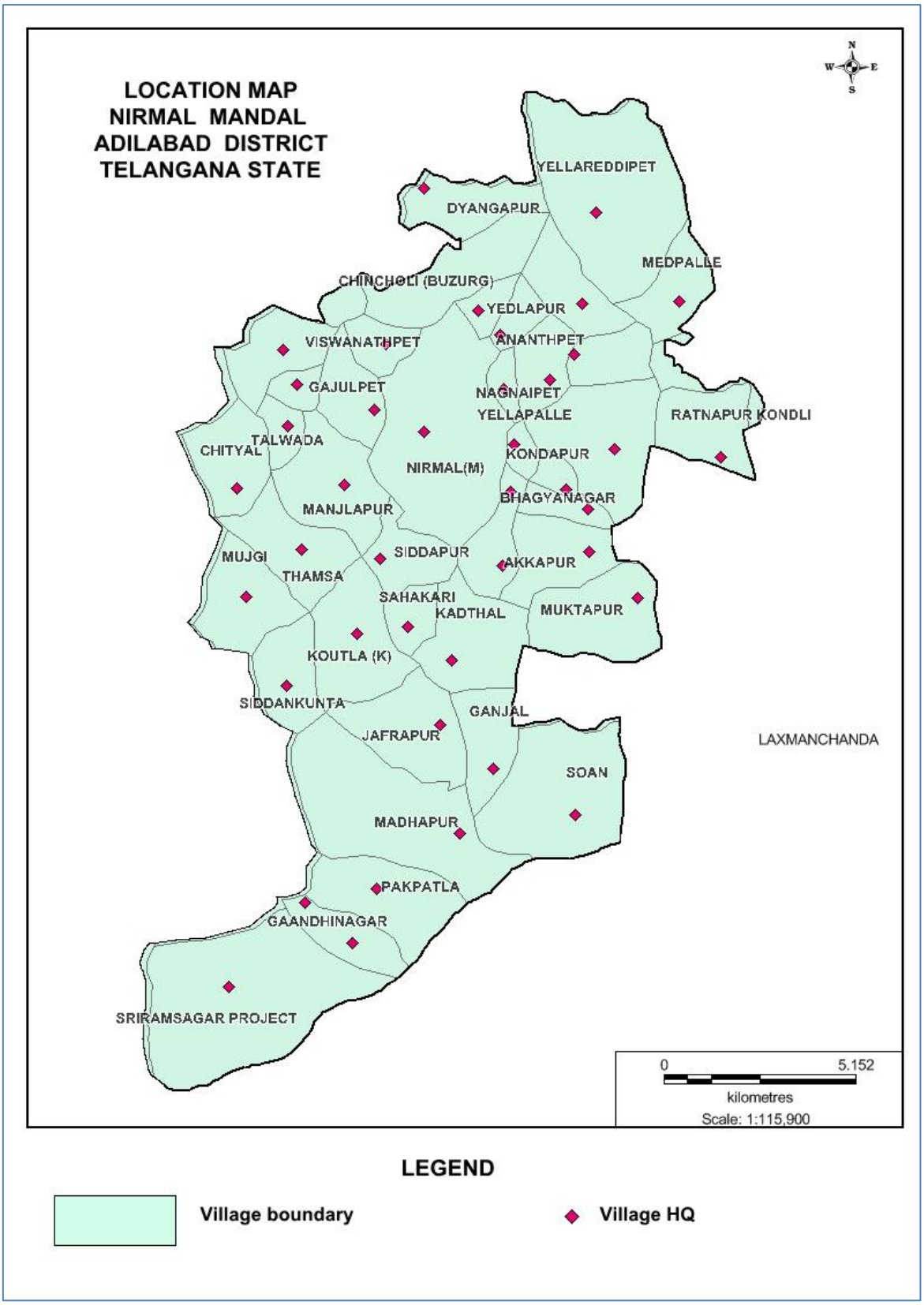

LOCATION MAP
NIRMAL MANDAL
ADILABAD DISTRICT
TELANGANA STATE
N
W
E
S
YELLAREDDIPET
DYANGAPUR
MEDPALLE
CHINCHOLI (BUZURG)
YEDLAPUR
ANANTHPET
VISWANATHPET
GAJULPET
NAGNAIPET
YELLAPALLE
RATNAPUR KONDLI
TALWADA
CHITYAL
KONDAPUR
NIRMAL(M)
BHAGYANAGAR
MANJLAPUR
MUJGI
SIDDAPUR
AKKAPUR
THAMSA
SAHAKARI
KADTHAL
MUKTAPUR
KOUTLA (K)
SIDDANKUNTA
GANJAL
JAFRAPUR
LAXMANCHANDA
SOAN
MADHAPUR
PAKPATLA
GAANDHINAGAR
SRIRAMSAGAR PROJECT
0
5.152
kilometres
Scale: 1:115,900
LEGEND
Village boundary
Village HQ

Fig.2

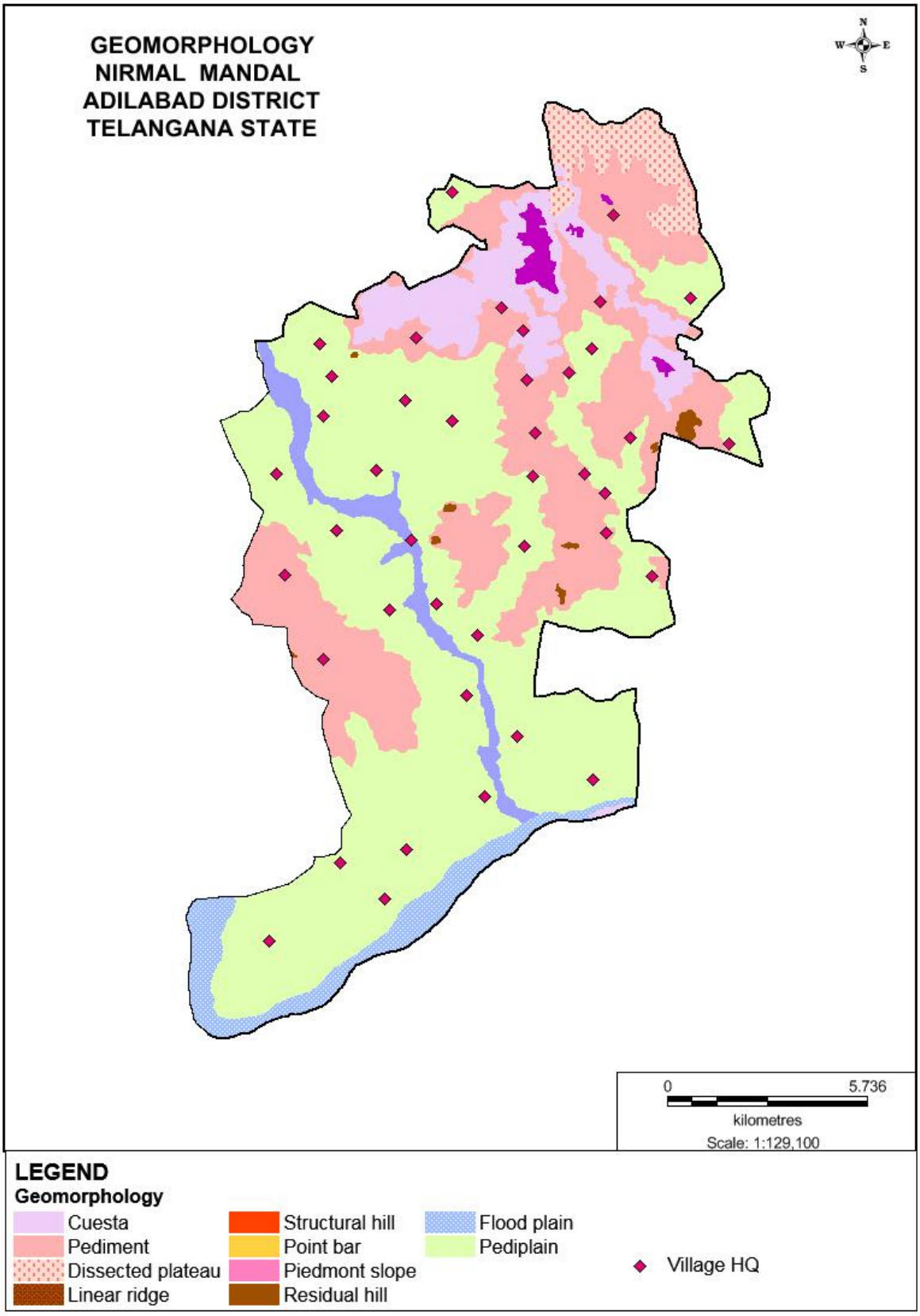

GEOMORPHOLOGY
NIRMAL MANDAL
ADILABAD DISTRICT
TELANGANA STATE
N
W
E
S
0
5.736
kilometres
Scale: 1:129,100
LEGEND
Geomorphology
Cuesta
Pediment
Dissected plateau
Linear ridge
Structural hill
Point bar
Piedmont slope
Residual hill
Flood plain
Pediplain
Village HQ

Fig.3

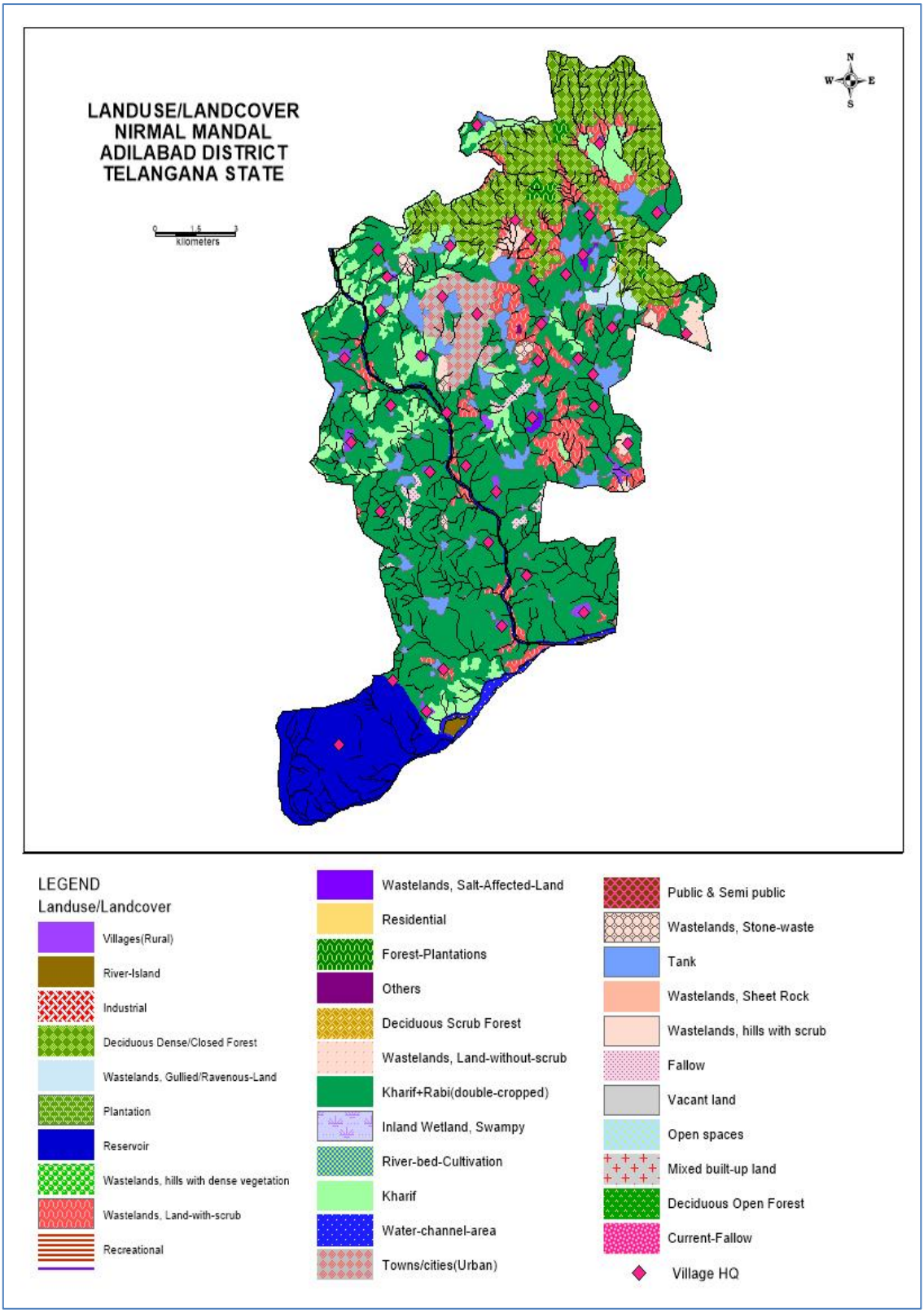

LANDUSE/LANDCOVER
NIRMAL MANDAL
ADILABAD DISTRICT
TELANGANA STATE
0 1.5 3
kilometers
N
W
E
S
LEGEND
Landuse/Landcover
Villages(Rural)
River-Island
Industrial
Deciduous Dense/Closed Forest
Wastelands, Gullied/Ravenous-Land
Plantation
Reservoir
Wastelands, hills with dense vegetation
Wastelands, Land-with-scrub
Recreational
Wastelands, Salt-Affected-Land
Residential
Forest-Plantations
Others
Deciduous Scrub Forest
Wastelands, Land-without-scrub
Kharif+Rabi(double-cropped)
Inland Wetland, Swampy
River-bed-Cultivation
Kharif
Water-channel-area
Towns/cities(Urban)
Public & Semi public
Wastelands, Stone-waste
Tank
Wastelands, Sheet Rock
Wastelands, hills with scrub
Fallow
Vacant land
Open spaces
Mixed built-up land
Deciduous Open Forest
Current-Fallow
Village HQ

Fig.4

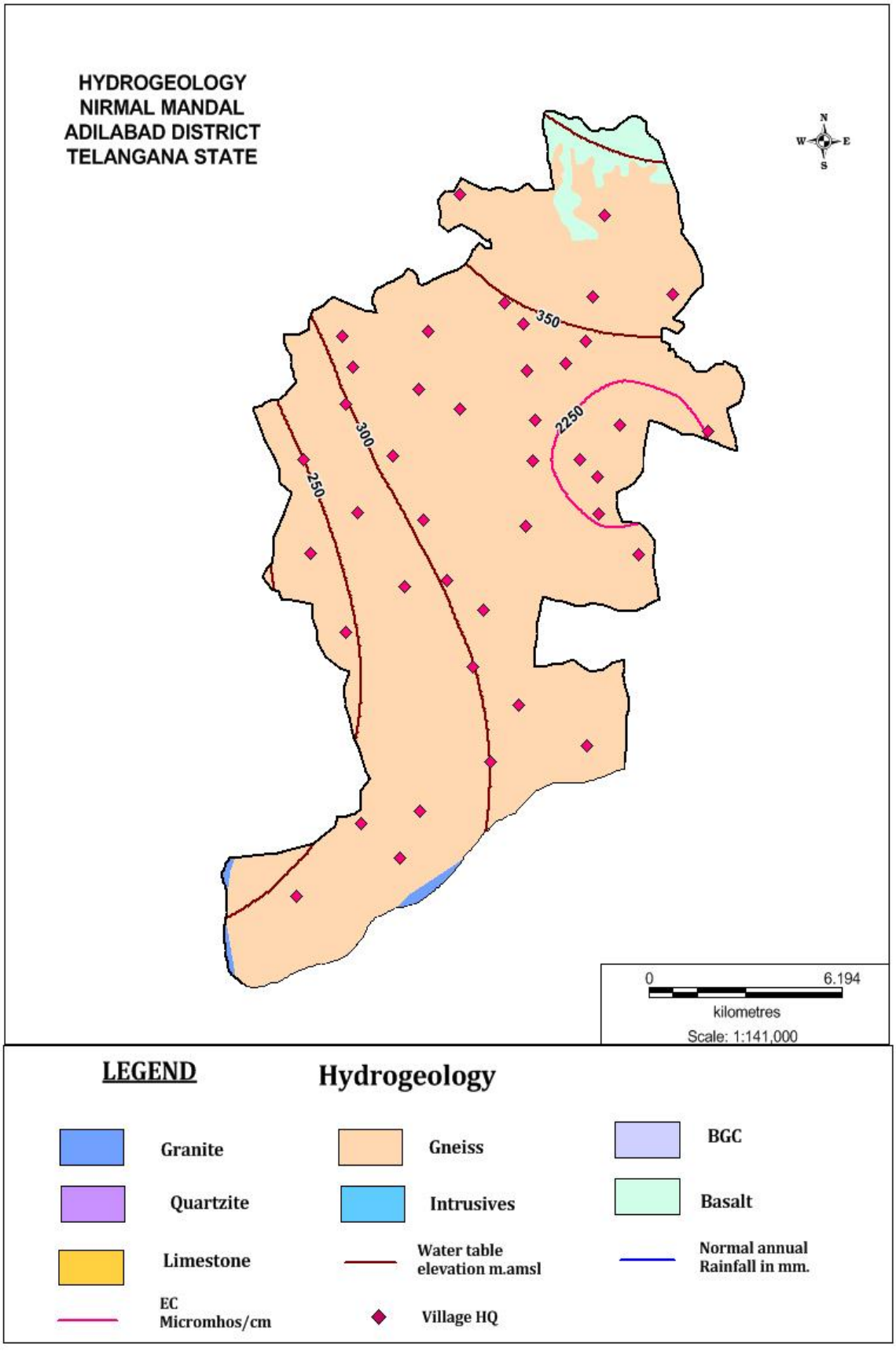
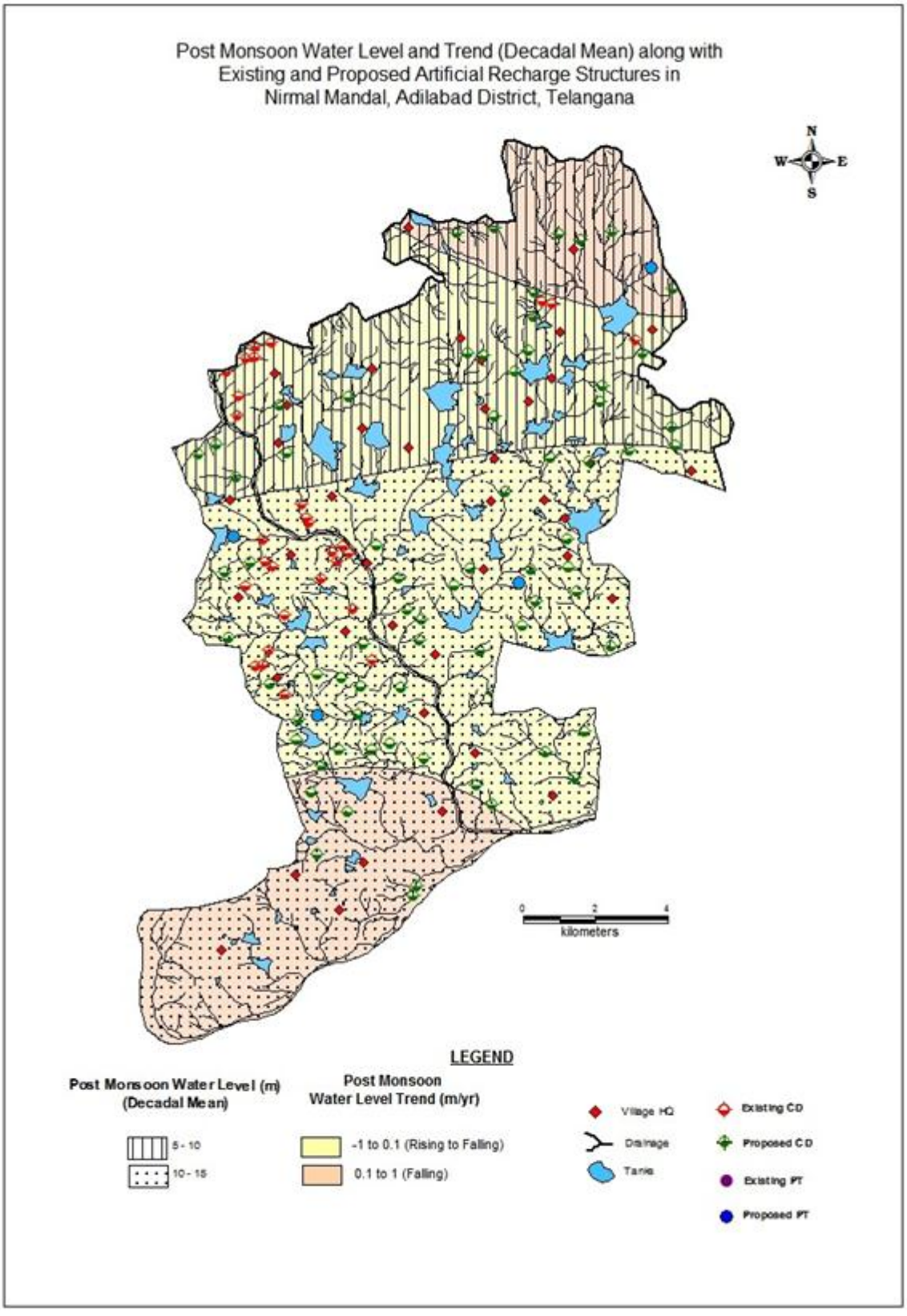

HYDROGEOLOGY
NIRMAL MANDAL
ADILABAD DISTRICT
TELANGANA STATE
N
W
E
S
350
300
250
2250
0
6.194
kilometres
Scale: 1:141,000
LEGEND
Hydrogeology
Granite
Gneiss
BGC
Quartzite
Intrusives
Basalt
Limestone
Water table elevation m.amsl
Normal annual Rainfall in mm.
EC Micromhos/cm
Village HQ

Fig.5


Post Monsoon Water Level and Trend (Decadal Mean) along with
Existing and Proposed Artificial Recharge Structures in
Nirmal Mandal, Adilabad District, Telangana
N
W
E
S
0
2
4
kilometers
LEGEND
Post Monsoon Water Level (m)
(Decadal Mean)
5 - 10
10 - 15
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