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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 THIRUMALAYAPALEM MANDAL, KHAMMAM DISTRICT, TELANGANA STATE

SOUTHERN REGION
HYDERABAD
AUGUST-2016

PLAN ON
ARTIFICIAL RECHARGE TO GROUNDWATER
AND WATER CONSERVATION IN
THIRUMALAYAPALEM MANDAL, KHAMMAM DISTRICT,
TELANGANA STATE

CONTENTS

AT A GLANCE

Name of the Mandal	THIRUMALAYAPALEM
District	KHAMMAM
State	TELANGANA
Total Area(sq. km)	234
Area suitable for Artificial Recharge (sq.km.)	231.00
Latitude and Longitude	17.261690 to 17.410310 and 79.805380 to 80.087070.
Average Annual Rainfall (mm)	1005
Geology	BGC
Average Depth To Water Level (Decadal) (Pre Monsoon)	4.12
Average Depth To Water Level (Decadal) (Post Monsoon)	2.85
Ground Water Resources (2011)	
Annual Replenishable Ground Water Resources (MCM/yr)	40.15
Net Annual Ground Water Availability(MCM)/yr	36.89
Net Annual Ground Water Draft(MCM)/yr	37.19
Projected Demand for Domestic and Industrial Use(MCM)/yr	1.19
Stage of Ground Water Development (%)	101
Surface Runoff (MCM/yr)	63.42
Total Storage Created in the Mandal by Various Agencies (MCM)/yr	0.74
Artificial Recharge/Conservation Measures	
Recharge Structures Proposed (No.s)	Percolation Tanks: 69, Check dams: 70 Farm Ponds: 640, Recharge Shafts: 52
Improving Water use Efficiency	Micro Irrigation – 2800ha
Tentative Total Cost in Lakhs (Rs.)	3415.44
Expected Recharge(MCM)/yr	15.690

1. INTRODUCTION

Thirumalayapalem Mandal is one of the over-exploited Mandals in Khammam district, Telangana State, which is economically backward and chronically drought affected. The Mandal has 25 inhabited villages and with 28 gram Panchayats.

2. LOCATION

The Mandal lies between north latitudes 17.261690 to 17.410310 and between east longitudes 79.805380 to 80.087070. The Mandal occupies the western part of the Khammam district and is bounded on the north by Warangal district, on the east by Khammam-Ruralmandal, on the south by Kusumanchi mandal and west by Nalgonda district. (Fig.1) The geographical area of the Mandal is 234 sq.km.

3. PHYSIOGRAPHY AND DRAINAGE:

The area is drained by low order streams which are tributaries of Lower Krishna 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 1005 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 234 sq.km, the net area sown is 133.42 sq.km. Barren and uncultivable land is 17.55 sq.km. The land for non agricultural use accounts for 16.89 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 30 m.The weathered zone has been extensively tapped by dug and dug cum bore wells up to 30 m bgl depth, which are mostly dry now. Ground water occurs in the fractured granites down to a depth of 200 m bgl. However, the potential fractures are encountered between 50-100mbgl. 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 2 to 10 m bgl. The decadal mean water level trend during post monsoon is depicted in the Fig-5.

8. DYNAMIC GROUND WATER RESOURCES

The Ground water availability, Utilization and stage of Development in Thirumalayapalem Mandal, Khammam district is given in theTable-1.

Table-1 Ground water resources of Thirumalayapalem Mandal, Khammam District.

Annual Replenishable Ground water resources (MCM)	40.15
Net Annual Ground Water Availability(MCM)/yr	36.89
Net Annual Ground Water Draft(MCM)/yr	37.19
Projected Demand for Domestic and Industrial use up to 2025. (MCM)	1.19
Stage of Ground water development (%).	101
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 upto10mbgl. 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

Thirumalayapalem Mandal falls under high stage of ground water development i.e., 101 % 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)	234
Hilly Area (Sq.kms)	3
Area suitable for Artificial Recharge (sq.km.)	231
Runoff Yield in MCM/yr.	63.42
Existing No. of Check Dams	84.00
Storage created MCM/yr.	0.60
Existing No. of Percolation Tanks	20.00
Storage created MCM/yr.	0.14
Total Existing Storage Created	0.74

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 62.68 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 along with silt load and 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 1005 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 70 Check dams and 69 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 42 and 10 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 560 farm ponds in 28 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 2800 ha @ 100 ha per village.

13. TENTATIVE COST ESTIMATES (THIRUMALAYAPALEM 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)	70	1.96	5	350	1.47
2	Recharge shaft in Check dam (50% of the existing Check dams)	42	0.462	0.5	21	0.462
3	Proposed Percolation Tanks (100*100*2.5)* 4 fillings)	69	6.9	15	1035	5.175
4	Renovation Desilting, Repairs and installation of Recharge Shafts in existing PTS (50% of the existing PTS)	10	0.11	1	10	0.11
5	Proposed Farm Pond (6 filling) 5*5*1.5 dimension @ 20 farm ponds per each village	560	0.08064	0.25	140	0.072576
6	Proposed Sprinkler/drip/HDPE pipes for 100 ha in each village	2800		0.6	1680	8.4
7	Proposed Piezometers up to 50 mbgl @ one PZ per Village	28	0	0.6	16.8	0
8 (i)	Total (No. of AR Structures)	779	9.51		1572.8	7.290
8 (ii)	Total (ha)	2800			1680	8.4
	Total (8(i) + 8 (ii))				**3252.8**	**15.690**
9	Impact Assessment & O & M -5 % of Total cost of the Scheme				**162.64**	
	Grand Total				**3415.44**	

*(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 15.690 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 101% to 70% (31%)
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.

PROPOSED ARTIFICIAL RECHARGE STRUCTURES
THIRUMALAYAPALEM MANDAL, KHAMMAM DISTRICT, TELANGANA

SNO.	MANDAL	LATTITUDE	LONGITUDE	STRUCTURE TYPE
1	TIRUMALAYAPALEM	17.32	79.8685	CHECKDAM
2	TIRUMALAYAPALEM	17.3128	79.8585	CHECKDAM
3	TIRUMALAYAPALEM	17.3222	79.8541	CHECKDAM
4	TIRUMALAYAPALEM	17.3153	79.8627	CHECKDAM
5	TIRUMALAYAPALEM	17.3091	79.8625	CHECKDAM
6	TIRUMALAYAPALEM	17.306	79.8772	CHECKDAM
7	TIRUMALAYAPALEM	17.3056	79.8723	CHECKDAM
8	TIRUMALAYAPALEM	17.3001	79.8795	CHECKDAM
9	TIRUMALAYAPALEM	17.3203	79.8798	CHECKDAM
10	TIRUMALAYAPALEM	17.3036	79.8679	CHECKDAM
11	TIRUMALAYAPALEM	17.3283	79.8662	CHECKDAM
12	TIRUMALAYAPALEM	17.325	79.8779	CHECKDAM
13	TIRUMALAYAPALEM	17.2754	79.8711	CHECKDAM
14	TIRUMALAYAPALEM	17.2682	79.8716	CHECKDAM
15	TIRUMALAYAPALEM	17.2735	79.8781	CHECKDAM
16	TIRUMALAYAPALEM	17.2829	79.859	CHECKDAM
17	TIRUMALAYAPALEM	17.2826	79.8713	CHECKDAM
18	TIRUMALAYAPALEM	17.2904	79.8655	CHECKDAM
19	TIRUMALAYAPALEM	17.3474	79.886	CHECKDAM
20	TIRUMALAYAPALEM	17.3177	79.8835	CHECKDAM
21	TIRUMALAYAPALEM	17.3172	79.8905	CHECKDAM
22	TIRUMALAYAPALEM	17.3205	79.8884	CHECKDAM
23	TIRUMALAYAPALEM	17.3155	79.8905	CHECKDAM
24	TIRUMALAYAPALEM	17.3156	79.887	CHECKDAM
25	TIRUMALAYAPALEM	17.3096	79.8872	CHECKDAM
26	TIRUMALAYAPALEM	17.3359	79.8865	CHECKDAM
27	TIRUMALAYAPALEM	17.3394	79.912	CHECKDAM
28	TIRUMALAYAPALEM	17.3425	79.912	CHECKDAM
29	TIRUMALAYAPALEM	17.3384	79.884	CHECKDAM
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33	TIRUMALAYAPALEM	17.3032	79.8107	CHECKDAM
34	TIRUMALAYAPALEM	17.3074	79.8184	CHECKDAM
35	TIRUMALAYAPALEM	17.3064	79.8128	CHECKDAM
36	TIRUMALAYAPALEM	17.307	79.8072	CHECKDAM
37	TIRUMALAYAPALEM	17.3097	79.8112	CHECKDAM
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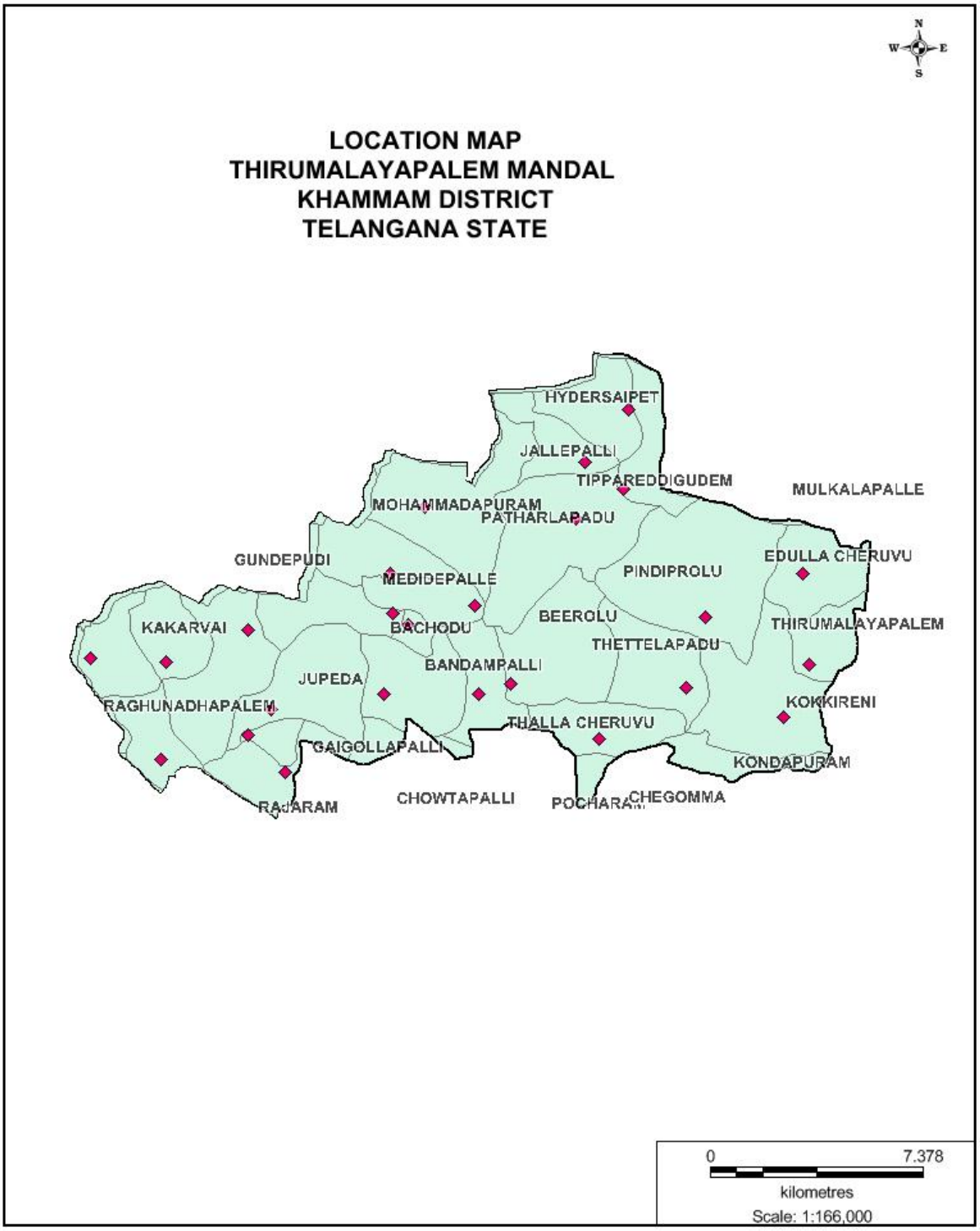
Fig.1

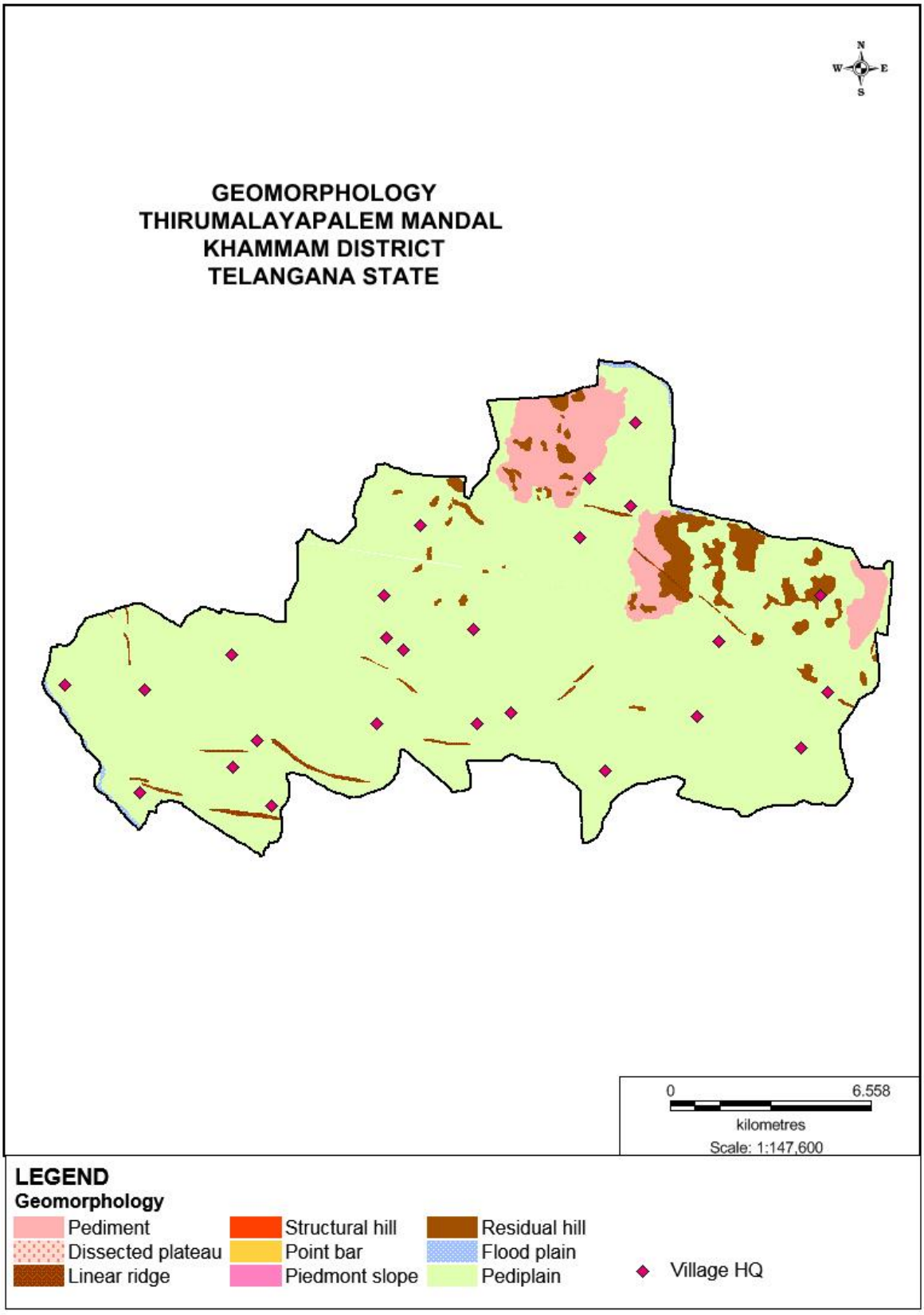


LEGEND

Village boundary

Village HQ

Fig.2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E
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GEOMORPHOLOGY
THIRUMALAYAPALEM MANDAL
KHAMMAM DISTRICT
TELANGANA STATE
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kilometres
Scale: 1:147,600
LEGEND
Geomorphology
Pediment
Dissected plateau
Linear ridge
Structural hill
Point bar
Piedmont slope
Residual hill
Flood plain
Pediplain
Village HQ

Fig.3

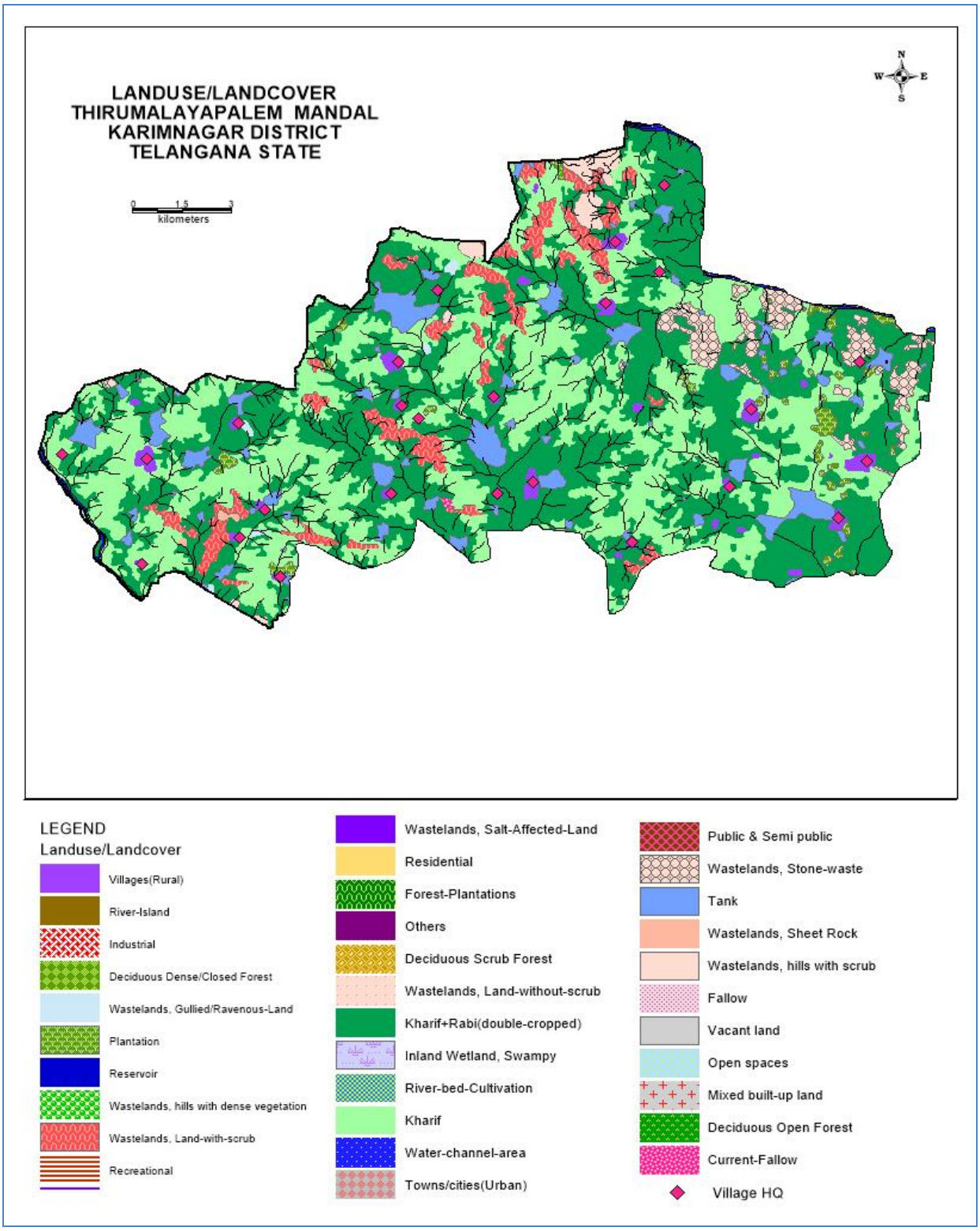

LANDUSE/LANDCOVER
THIRUMALAYAPALEM MANDAL
KARIMNAGAR DISTRICT
TELANGANA STATE
0 1.5 3
kilometers
N
W
E
S
LEGEND
Landuse/Landcover
Villages(Rural)
River-Island
Industrial
Deciduous Dense/Closed Forest
Wastelands, Gullied/Ravenous-Land
Plantation
Reservoir
Wastelands, hills with dense vegetation
Wastelands, 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

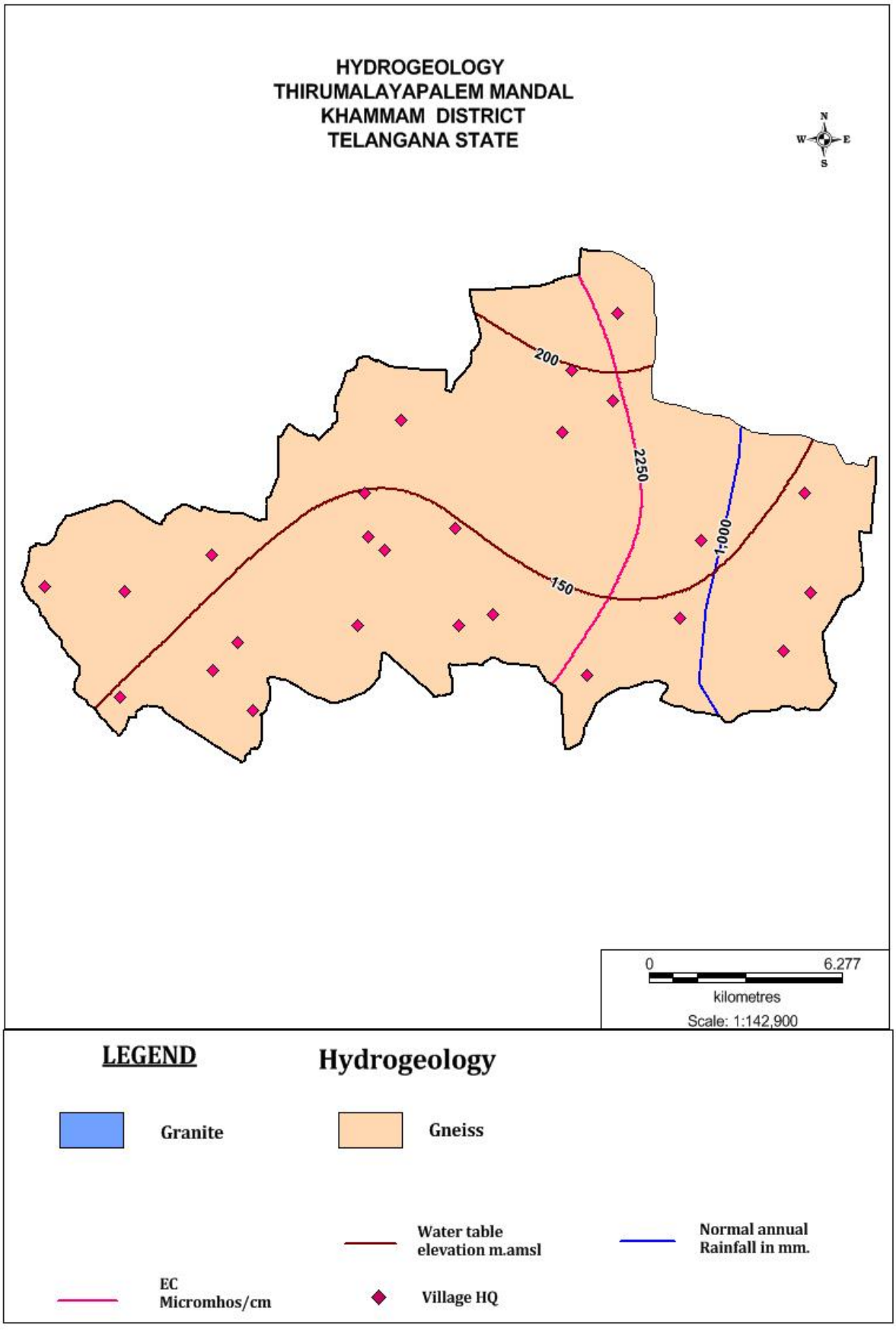
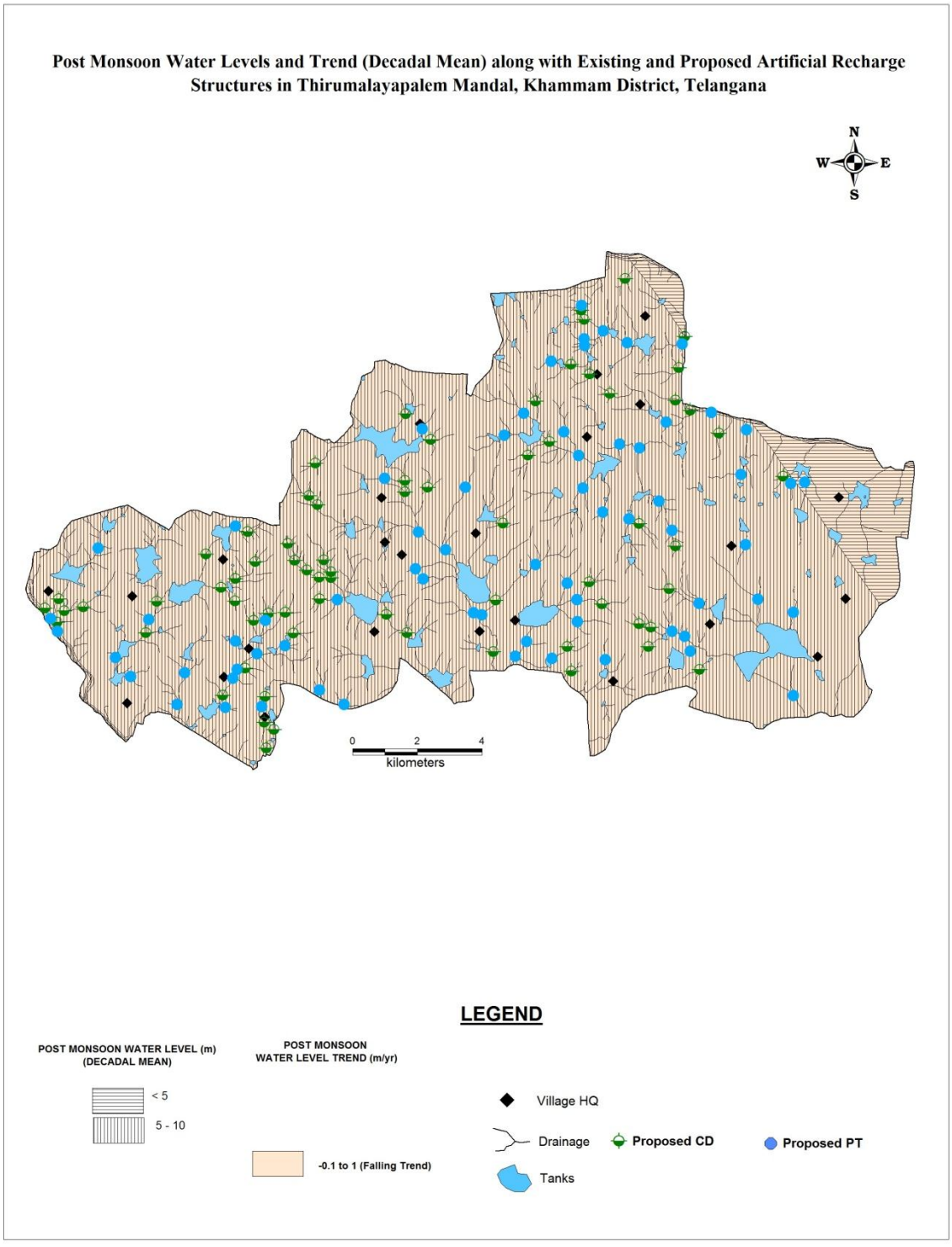

HYDROGEOLOGY
THIRUMALAYAPALEM MANDAL
KHAMMAM DISTRICT
TELANGANA STATE
N
W
E
S
200
2250
1000
150
0
6.277
kilometres
Scale: 1:142,900
LEGEND
Hydrogeology
Granite
Gneiss
Water table elevation m.amsl
Normal annual Rainfall in mm.
EC Micromhos/cm
Village HQ

Fig.5


Post Monsoon Water Levels and Trend (Decadal Mean) along with Existing and Proposed Artificial Recharge Structures in Thirumalayapalem Mandal, Khammam District, Telangana
N
W
E
S
0
2
4
kilometers
LEGEND
POST MONSOON WATER LEVEL (m) (DECADAL MEAN)
< 5
5 - 10
POST MONSOON WATER LEVEL TREND (m/yr)
-0.1 to 1 (Falling Trend)
Village HQ
Drainage
Proposed CD
Proposed PT
Tanks