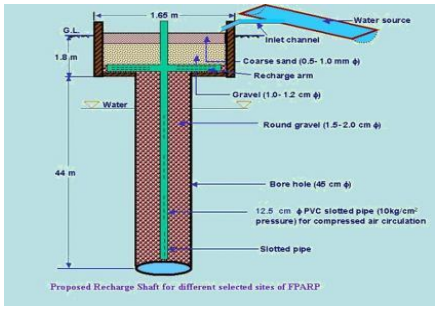
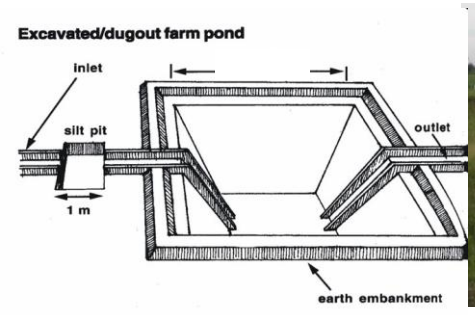
Plan on Artificial Recharge to Groundwater and Water Conservation in Viruveedu Firka, Nilakottai Taluk, Dindigul District, Tamil Nadu





By

Central Ground Water Board
South Eastern Coastal Region
Rajaji Bhawan, Besant Nagar
Chennai

September 2015

Content

AT GLANCE	
Name of Firka	Viruveedu
Taluk	Nilakottai
District	Dindigul
State	Tamil Nadu
Total area	117.66
Total suitable area	68.24
Lat. & Lon.	10°01'07" to 10°09'30" & 77°40'03" to 77°50'08".
Rainfall	814.05 mm
Monsoon	626.02 mm
Non- Mon soon	188.03 mm
Geology	Charnockites and crystalline metamorphic gneisses
WATER LEVEL	
Pre – Monsoon	10 to 15 m bgl.
Post - Monsoon	5 to 12 m bgl.
GROUND WATER RESOURCES ESTIMATION	
Replenish able ground water resources	14.81 MCM
Net ground water available	13.33 MCM
Ground water draft for irrigation	20.47 MCM
Groundwater draft for domestic & industrial water supply	0.55 MCM
Total ground water draft	21.02 MCM
Stage of ground water development (%)	158 %
Uncommitted surface runoff available for the Firka	11.05 MCM
Total volume of weathered zone	1412 MCM
Total volume available for recharge (considering 3 m depth from 3 m bgl	588 MCM
ARTIFICIAL RECHARGE /CONSERVATION MEASURES	
Structures Proposed (tentative) Masonry Check dam Nalla Bund Revival, repair of pond, tanks with recharge shaft	 5 18 8
Improving Water Efficiency Micro irrigation system for 100 ha	7.0 MCM
Excepted groundwater recharge	1.10 MCM
Total excepted groundwater recharge/saving	1.80
Tentative total cost of the project	Rs.3.90 Cr
Expected rise in water level by recharging/saving	1.74 m

Improving Water Efficiency Micro irrigation system for 100 ha	7.0 MCM
Excepted groundwater recharge	1.0916 MCM
Total excepted groundwater recharge/saving	1.7916 MCM
Tentative total cost of the project	Rs:- 3.49 cr
Expected raise in water level by recharging/saving	0.79

Plan on Artificial Recharge to Groundwater and Water Conservation in Viruveedu Firka, Nilakottai Taluk, Dindigul district, Tamil Nadu

1. Introduction

India is the largest user of groundwater in the world. Food grain security of the country is mainly dependent on water resources and groundwater play major role in irrigation sector. Imprints of Over-Exploitation on groundwater resources are being observed as steep deepening of water levels, drying up of shallow groundwater abstraction structures, ingress of salinity in fresh aquifers

etc. which signal towards taking necessity of emergent action for artificial recharge and rainwater harvesting by utilizing surplus runoff and maintaining groundwater resources.

In Tamil Nadu dependency on groundwater has increased many folds during the recent years and the groundwater extraction for irrigation, domestic and industries have resulted in lowering of water levels, long-term water level declining trend and even drying up of wells. In order to regulate the groundwater development, Central Ground Water Board in association with State Ground Water Departments has computed Dynamic Groundwater Resources and categorized firkas as Over Exploited, Critical, Semi Critical and Safe.

Out of 1129 firkas (assessment units) of Tamil Nadu the category of groundwater development is over-exploited in 374 firkas, critical in 48 firkas, semi-critical in 235 firkas, safe in 437 firkas. And the rest 35 firkas are saline. Various measures such as rainwater harvesting, artificial recharge and water use efficiency are successfully practiced by some NGOs, Central and State governments which need replication at larger scale in close coordination with State government agencies and stakeholders, so that capacity building of state implementing agencies and awareness among stakeholders towards artificial recharge and rainwater harvesting can be made.

2. Objectives of the scheme

Objectives of the proposed scheme are

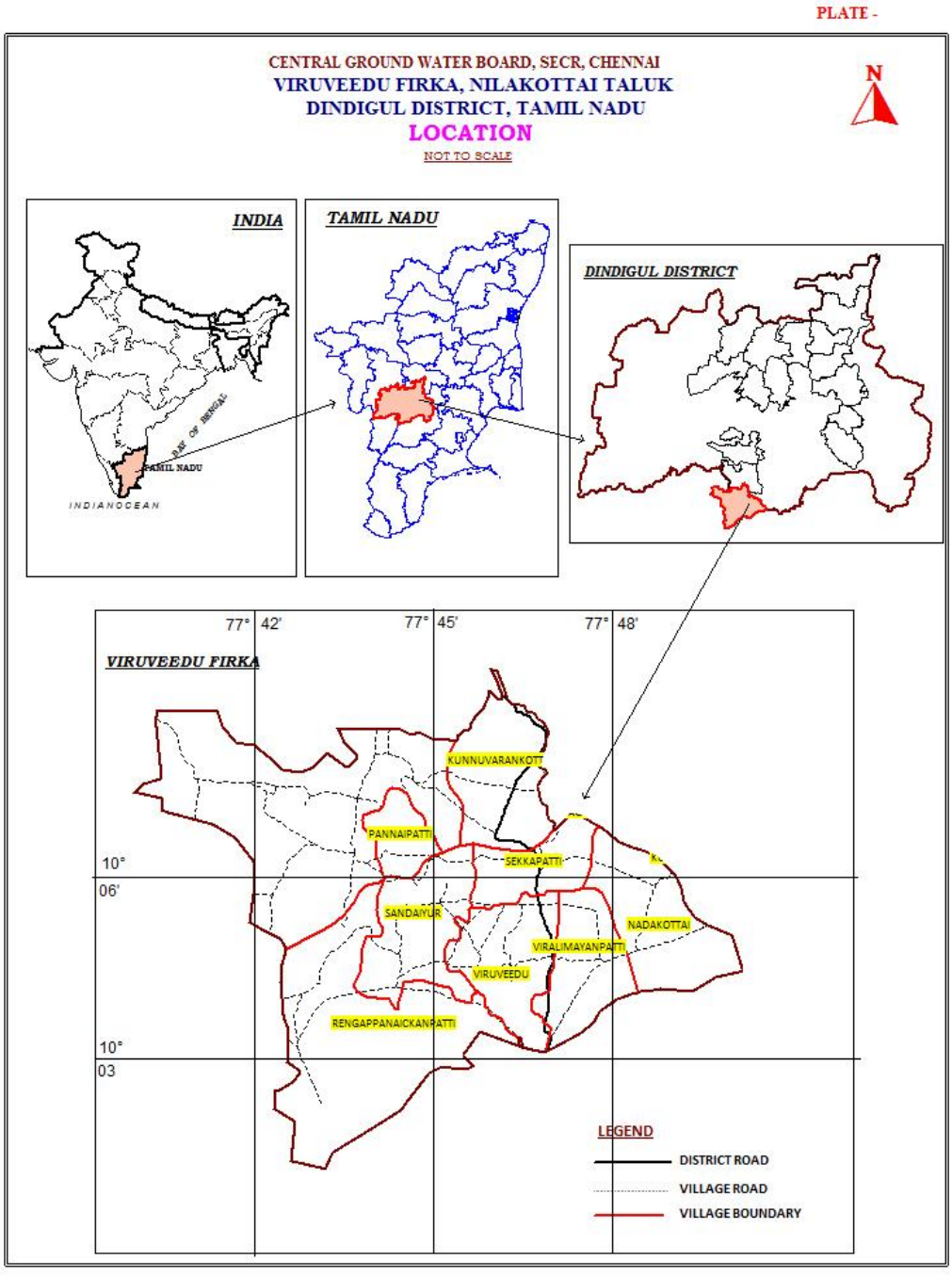
- To upscale recharge activities, supplement additional groundwater resources by harvesting surplus runoff, sustainability of groundwater resources at shallow depths
- Recovery of over-exploited groundwater areas by implementing artificial recharge measures in groundwater stress areas.
- Conservation, development and sustainable management of natural resources including their usage.

3. Study area details

3.1 Location

The total area of Viruveedu firka is 97.58 sq.km and Viruveedu firka lies between North latitudes 10°01'07" to 10°09'30" and east longitudes 77°40'03" to 77°50'08" and falls in Survey of India Toposheet Nos. 58F/12 & 16. Location map of Viruveedu firka is given in Figure 1.

Figure – 1



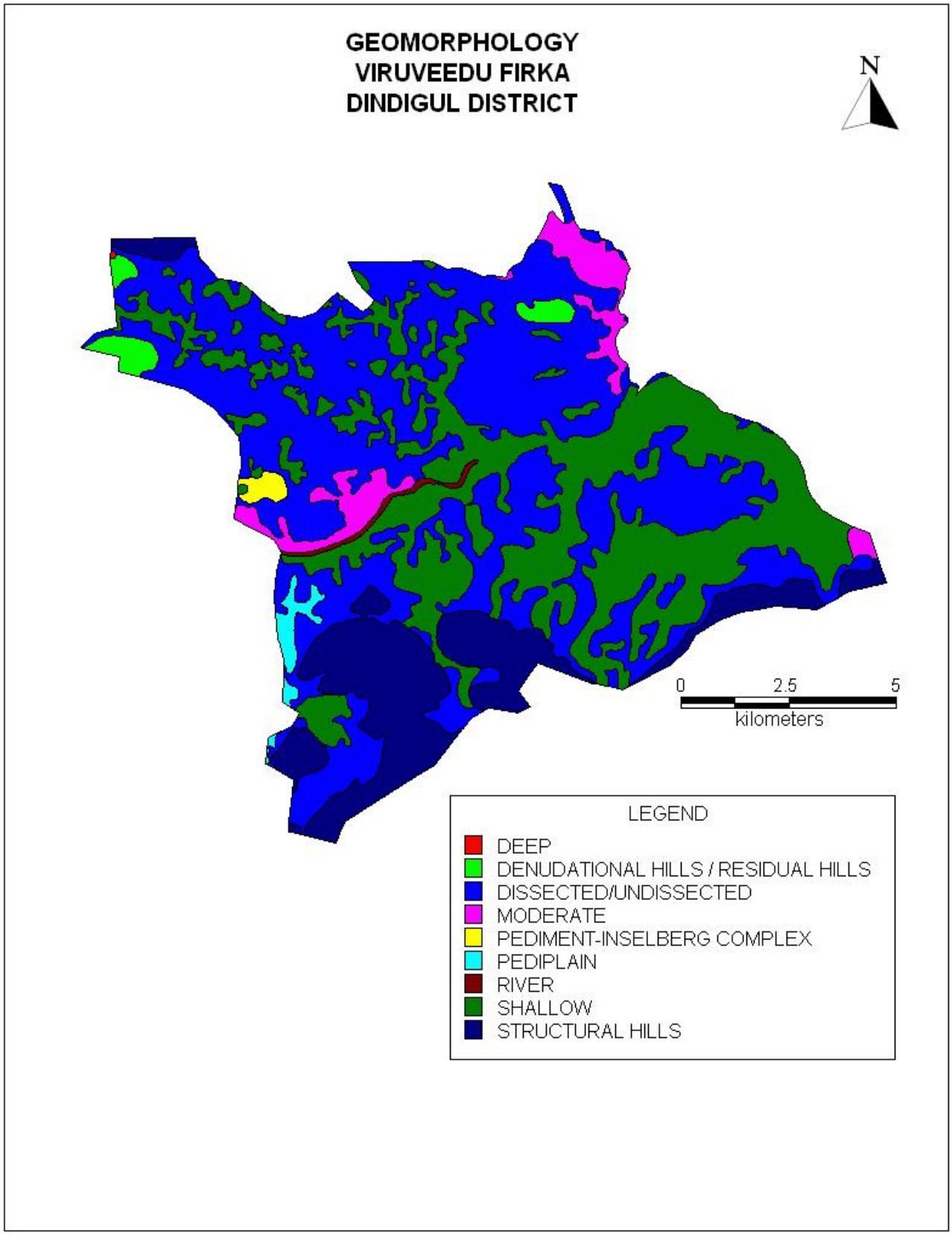
3.2 Geomorphological Set up

Geomorphologically, the firka mainly consists of dissected/ undissected plateau, shallow buried pediment and structural hills. and plain landforms. Shallow buried pediment and dissected plateau are influencing the ground water recharge to some extent. Hill landforms like residual hills, denudation hill and structural hills act as runoff zone. (*Source: IRS, Anna university, Chennai Tamil Nadu). Geomorphological map prepared using IRS- 1D data on 1: 50,000 scale and units are as per NNRMS standard*s.The various geomorphological units with its % of coverage area are given in table 1. and shown in figure 2.

Table 1. Various geomorphological units with its % of coverage area in Viruveedu firka

LANDFORMS	% of Area
DISSECTED/UNDISSECTED	47.72
SHALLOW PEDIMENT	31.22
STRUCTURAL HILLS	13.64
PEDIPLAIN (WEATHERED) MODERATE	4.18
DENUDATIONAL HILLS / RESIDUAL HILLS	1.43
PEDIMENT-INSELBERG COMPLEX	0.47
RIVER	0.44

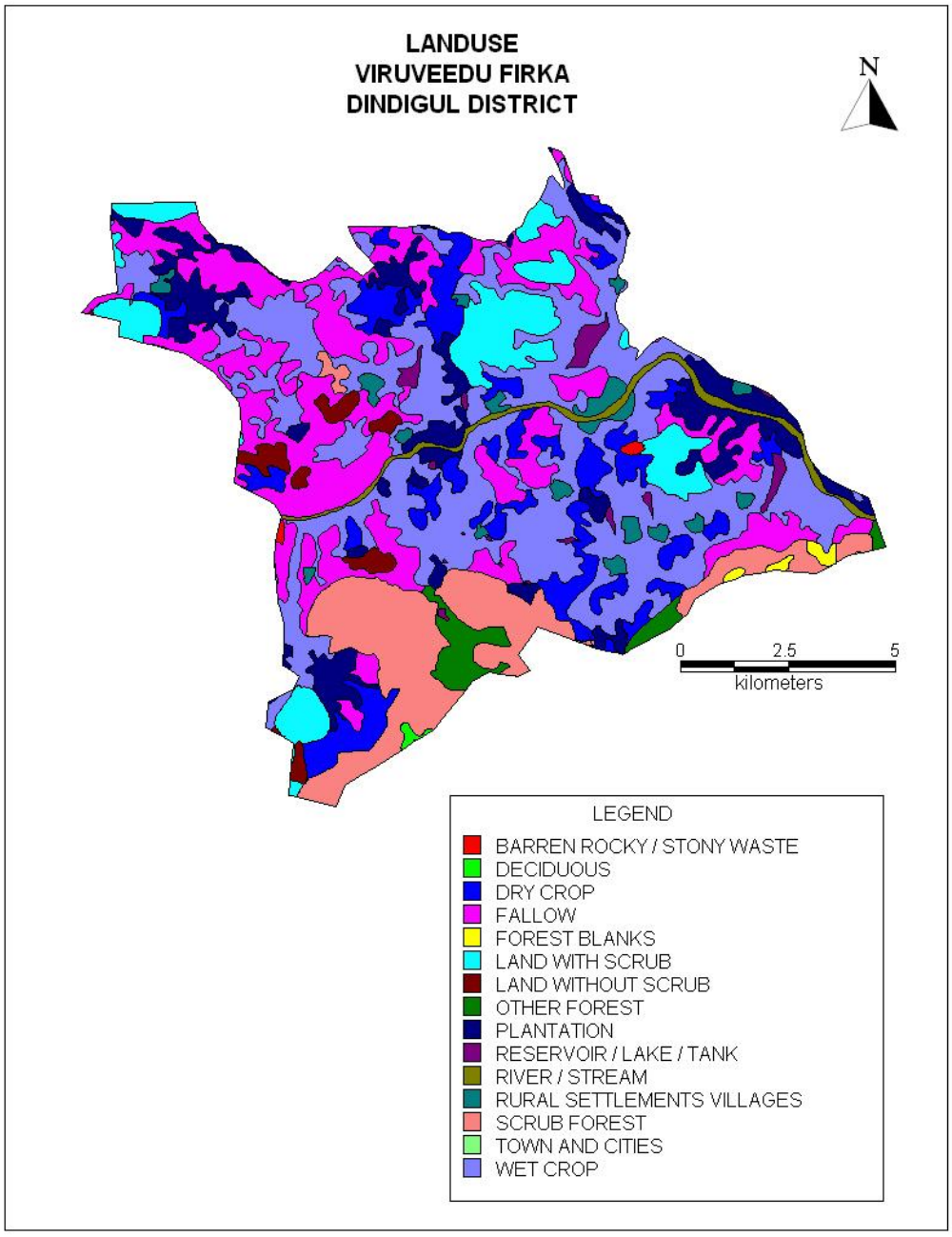
Figure-2


GEOMORPHOLOGY
VIRUVEEDU FIRKA
DINDIGUL DISTRICT
N
0
2.5
5
kilometers
LEGEND
DEEP
DENUDATIONAL HILLS / RESIDUAL HILLS
DISSECTED/UNDISSECTED
MODERATE
PEDIMENT-INSELBERG COMPLEX
PEDIPLAIN
RIVER
SHALLOW
STRUCTURAL HILLS

3.3 Land use and soil

The land use pattern of the Viruveedu Firka is given in figure 3. Predominantly the most of the area is characterised by the wet crop, plantation and dry crop (i.,e agricultural field)and accounts for 50 % of the total area of the firka(Source: IRS, Anna university, Chennai Tamil Nadu). This area is highly suitable for water conservation and recharge. The entire Firka area is occupied by rock outcrops with loamy soil.

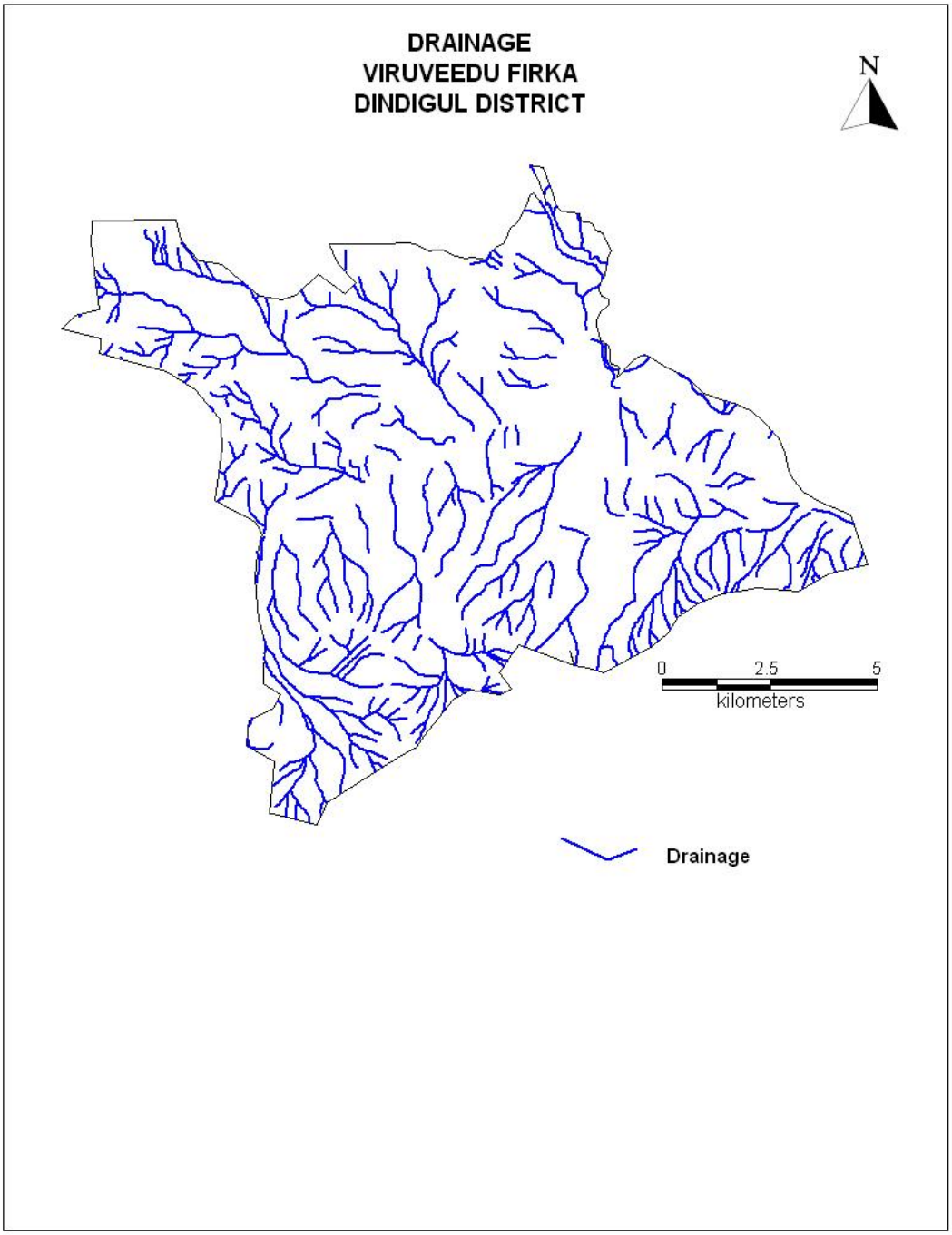
Figure - 3



3.4 Drainage

The entire Firka area is within the Vaigai river basin. Vaigai is flowing across the firka area from WSW to ENE. Tanks and surface water bodies are spread over the entire firka. The drainage pattern is the dendritic and sub- dendritic. The drainage map of Viruveedu firka is given in Fig 4.

Figure – 4



3.5 Rainfall

Viruveedu area falls under tropical climate. The period from April to June is generally hot and dry. The average temperature varies from 26 to 41° C. The humidity is relatively high in the mornings and varies between 65 and 85%. While in the afternoons it varies between 40 and 70%. Viruveedu Firkas receives rainfall from southwest monsoon (June – September), northeast monsoon (October – December) and non-monsoon periods (January – May). The area receives the major rainfall from northeast monsoon and the normal annual rainfall is 814mm.

Taluk	Name of Firkas	Area in sq.km	Monsoon rainfall (Jun to Dec) In mm	Non monsoon rainfall (Jan – May) In mm	Total Rainfall In mm
Nilakottai	Viruveedu	117.66	626.03	188.03	814.05

3.6 Hydrogeology

The entire firka is underlain by the crystalline rocks consisting of Charnockites, Honrblede –Biotite gneiss, Epidote-Hornblede gneiss. Ground water occurs in pheratic condition in weathered and fractured gneiss rock formations. The weathering is highly erratic and the depth of abstraction structures is controlled by the degree of weathering and fracturing. Large diameter dug wells are more common ground water abstraction structures in the area. The diameter of the dug well is in the range of 5 to 10 m and depth of dug wells range from 10 to 18 m bgl. The dug wells yield up to 30-100 cu.m in summer months and few wells remains dry. The yield is adequate for irrigation for one or two crops in monsoon period. In summer it is inadequate as the groundwater storage reduces.

Water levels in observation wells tapping shallow aquifers varied from 10 to 15 m bgl during pre-monsoon and it varies from 5 to 12 bgl during post monsoon. The hydrogeological map of Viruveedu firka is given in Figure 5. Decadal mean water level of pre-monsoon and post monsoon are given as fig 6a & 6b. The decadal maps reveal that, mean water level during pre-monsoon in majority area is more than 10 m bgl likewise during post monsoon majority part is in the range of 5 – 10m bgl.

Figure – 5

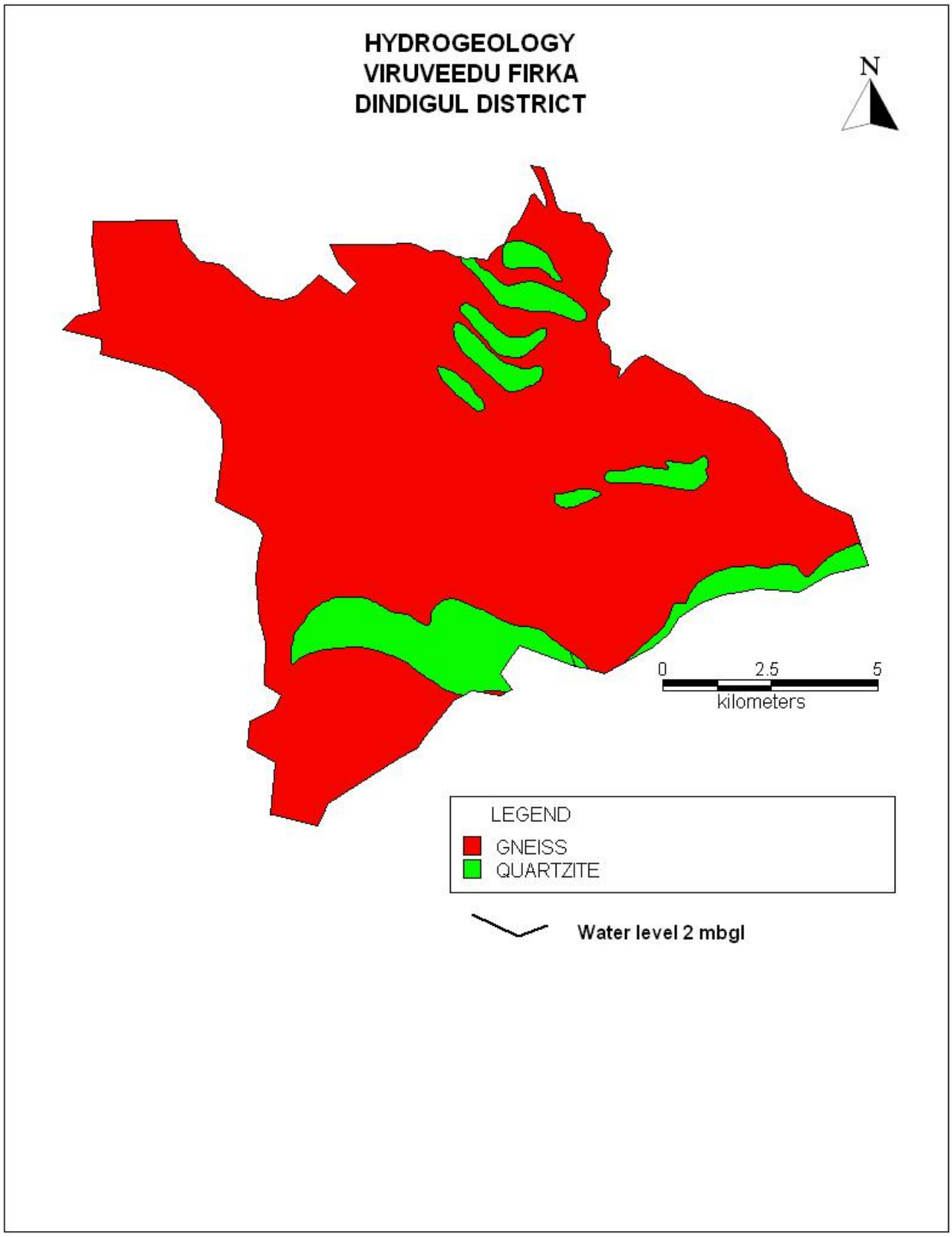

HYDROGEOLOGY
VIRUVEEDU FIRKA
DINDIGUL DISTRICT
N
0
2.5
5
kilometers
LEGEND
GNEISS
QUARTZITE
Water level 2 mbgl

Figure 6A

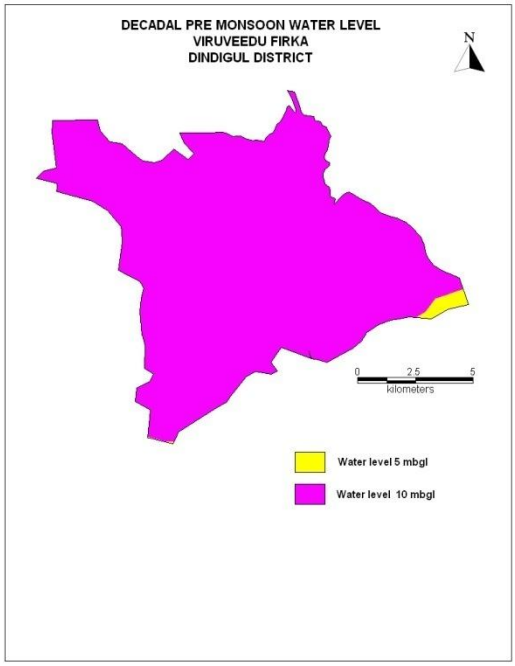
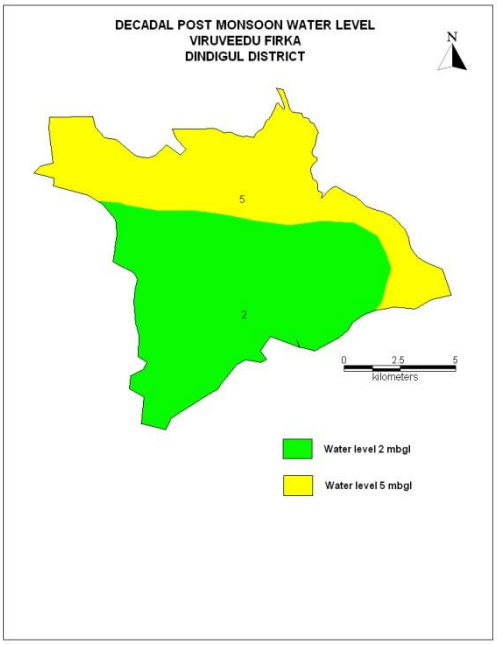


Figure 6B



3.7 Dynamic Ground water Resources

The ground water resources have been computed jointly by Central Ground Water Board and State Ground Water Resources Data Centre (PWD, WRO, Govt. of Tamil Nadu) as on 31st March 2011. The computation has been done using GEC1997 methodology. The salient features of the computations are furnished in table 2.

Table 2. Dynamic Ground water resources estimation of Viruveedu firka

Firka	GW WORTHY AREA	REPLENISH ABLE GROUND WATER RESOURCES	NET GROUND WATER AVAILABLE	GROUND WATER DRAFT FOR IRRIGATION	GROUNDWATER DRAFT FOR DOMESTIC & INDUSTRIAL WATER SUPPLY	TOTAL GROUND WATER DRAFT	STAGE OF GROUND WATER DEVELOPMENT (%)	CATEGORY
	(Sq.Km)	(In MCM)					%	
Viruveedu	117.66	14.81	13.23	20.47	0.55	21.02	158	OVER EXPLOITED

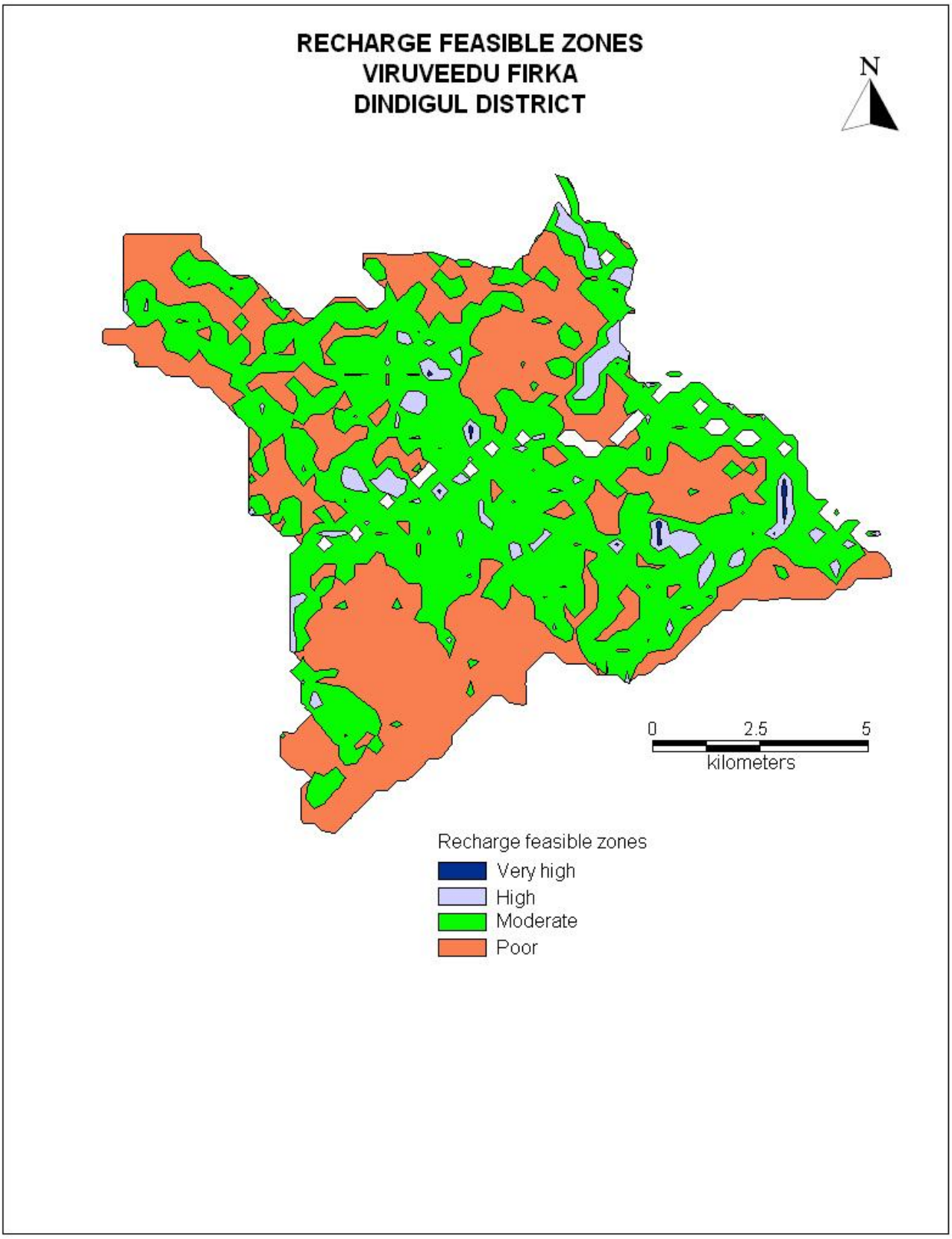
4. Spatial Data Integration

The potential area for groundwater recharge is highly influenced by Geology, Geomorphology, Land use /land cover, Drainage, Surface Water Body, Weathered Thickness and first fractured Depth in the area. In order to ascertain the suitable area for groundwater recharge in firka, spatial data integration of have been attempted using index overlay model in GIS environ. In this model,above seven layers have been integrated byassigning weightage for the theme having scale of 1-100 and sub-classes of the theme between 1 to 10 scales.The resultant map has been reclassified into four classes(High-low integrated values) indicating the suitable area for artificial recharge and given in fig-7 and described below.

ZONE	% OF AREA COVERAGE	SIGNIFICANCE*
Very high	0	Suitable for all major recharge structures like Percolation pond and stop dam, check dam etc.,
High	4	Suitable for all major recharge structures like stop dam, check dam etc.,
Moderate	54	Suitable for all major recharge structures like earthen check dam, Boulder check dam and Nala bund etc.,
Poor	42	Hilly/Forest /Catchment area

*However, the filed verification is required to confirm above potential area for groundwater recharge.

Figure – 7


RECHARGE FEASIBLE ZONES
VIRUVEEDU FIRKA
DINDIGUL DISTRICT
N
0
2.5
5
kilometers
Recharge feasible zones
Very high
High
Moderate
Poor

5. Planning for groundwater recharge /conservation

5.1 Justification of the artificial recharge & conservation measures

- The Viruveedu Firkas is with high stage of groundwater development i.e, 158 % and with sufficient amount of uncommitted surface runoff/flow of 11.05 MCM.
- The total weathered zone available beneath the ground in the firka is 1412 MCM. Out of these total volume available for recharge considering 3.5 m depth from 3 m) is 588 MCM.
- The Viruveedu Firka consists of 16 surface water bodies /lakes (cover almost 10 % of the total area of the firka) which are well connected by the drainage. Revival and Recharge of these ponds will enhance the sustainability of the ground water abstraction structures.
- The water levels in the pre and post season are within range of 10 to 20 m
- However, most of the ground water developments for agricultural purposes are met through dug-cum bore well and bore wells only. Hence, there is sufficient scope of recharge.
- Model generated in the Viruveedu areas reveals that more than 55 % of the firka area is moderately suitable for recharge.
- In Viruveedu firka more than 60 % area is characterised by the agricultural activities, there is sufficient scope for the water conservation measures for enhance the crop production and better ground water development.

5.2 Availability of surplus surface water for artificial recharge or conservation

The uncommitted surface flow for Viruveedu Firka is estimated as per the norms followed by State Ground & Surface Water Resources data centre, PWD, Taramani, Chennai (Aug 2015). The available of surplus surface water for Viruveedu Firka is 11.05 MCM.

5.3 Proposed interventions including tentative location of artificial recharge /conservation measures

On basis of above description the following three type of approach have been made to propose artificial recharge or conservation structures.

a. Artificial recharge
b. Water conservation measure
c. Water Efficiency

5.3.1 Artificial recharge

The details of artificial recharge structure proposed along with justification are given below.

5.3.1.1 Check dam/Nala bund

Viruveedu firka area is covered by the seasonal nallahs/drains which carry heavy discharge during monsoon period along with heavy silt load and this is debauched into the water bodies within a short duration. It is proposed that such seasonal nala rivers will be identified and the rain water will be harnessed through construction of series of check dams, nala bund and gabion structures so as to harness this water thereby increasing the resident period of the water in these channels and to increase the soil moisture content. As per the integrated model prediction around 20 % of the firkas areas are suitable for these structures. It is proposed to construct 5 Check dam and 18 Nala bunds. The tentative location of these 23 ARs are given below and shown in Plate 1. The size and location of these structures are tentative and details field survey is essential to ascertain the exact size and location.

Tentative location of proposed 5 Check dam in Viruveedu firka

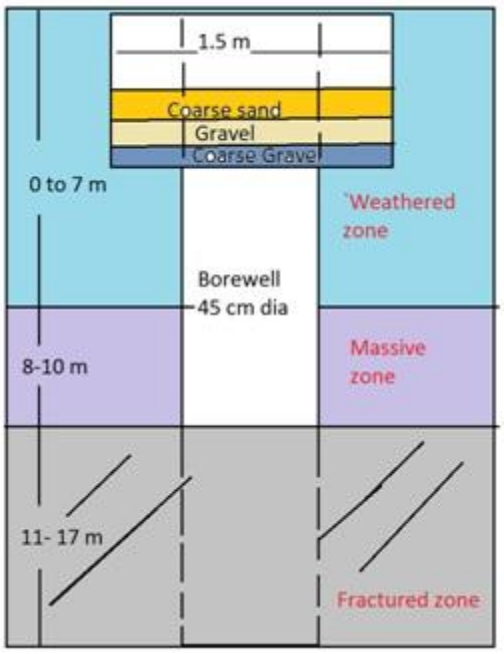
S. NO.	LATITUDE	LONGITUDE	TYPE OF ARS
1	10.0483	77.7147	Check Dam
2	10.0776	77.7975	Check Dam
3	10.102	77.7091	Check Dam
4	10.122	77.6949	Check Dam
5	10.1328	77.6998	Check Dam

Tentative location of proposed 18 Nalla bund in Viruveedu firka

SL.NO	LATITUDE (DD)	LONGITUDE (DD)	TYPE OF ARS
1	10.1244	77.7369	Nala Bund
2	10.1185	77.7296	Nala Bund
3	10.118	77.7033	Nala Bund
4	10.1089	77.7031	Nala Bund
5	10.1081	77.7231	Nala Bund
6	10.119	77.7447	Nala Bund
7	10.0735	77.741	Nala Bund
8	10.0824	77.7633	Nala Bund
9	10.0764	77.7637	Nala Bund
10	10.0682	77.7774	Nala Bund
11	10.0733	77.7876	Nala Bund
12	10.069	77.7935	Nala Bund
13	10.0785	77.8046	Nala Bund
14	10.0811	77.8205	Nala Bund
15	10.1303	77.6794	Nala Bund
16	10.1222	77.6903	Nala Bund
17	10.1197	77.7132	Nala Bund
18	10.1252	77.7453	Nala Bund

5.3.1.2. Revival, repair of water bodies

Figure – 8
Recharge Shaft



The existing ponds and tanks in loose their storage capacity as well as the natural ground water recharge through these water bodies has also become negligible due to siltation and encroachment by farmers for agriculture purposes. There are several such villages where ponds/ tanks are in dilapidated condition. These existing village tanks which are normally silted and damaged can be modified to serve as recharge structure in case these are suitably located to serve as percolation tanks. Through desilting, coupled with providing proper waste weir, the village tanks can be converted into recharge structure. Several such tanks are available in the area which can be modified for enhancing ground water recharge. Studies, however, are needed to ascertain whether the village tanks are suitably located to serve as recharge structures. The locations of about 8 existing ponds/tanks having an area of less than 200 sq.m have been identified with latitude and longitude given below and marked on Plate 1. The 8 tanks/ponds could be taken up for the renovation with recharge shaft on priority. The design of the recharge shaft is shown as Figure – 8. This shaft structure augment groundwater recharge substantially during flood time. Thus total 3 lakh cu. m of rainwater could be harvested by revival of ponds/tanks alone.

Tentative location of proposed de-siltation of pond/tanks with recharge shaft in Viruveedu firka

Sl. No.	LATITUDE	LONGITUDE	STRUCTURE	ACTION
1	10.0594	77.7428	TANK/ RESERVOIR	DESILTTAION AND RECHARGE
2	10.0708	77.7433	TANK/ RESERVOIR	DESILTTAION AND RECHARGE
3	10.0764	77.7471	TANK/ RESERVOIR	DESILTTAION AND RECHARGE
4	10.0756	77.7524	TANK/ RESERVOIR	DESILTTAION AND RECHARGE
5	10.0701	77.7552	TANK/ RESERVOIR	DESILTTAION AND RECHARGE
6	10.066	77.7607	TANK/ RESERVOIR	DESILTTAION AND RECHARGE
7	10.0907	77.7407	TANK/ RESERVOIR	DESILTTAION AND RECHARGE
8	10.1135	77.6947	TANK/ RESERVOIR	DESILTTAION AND RECHARGE

5.3.2 Water conservation measure

5.3.2.1 Farm Pond

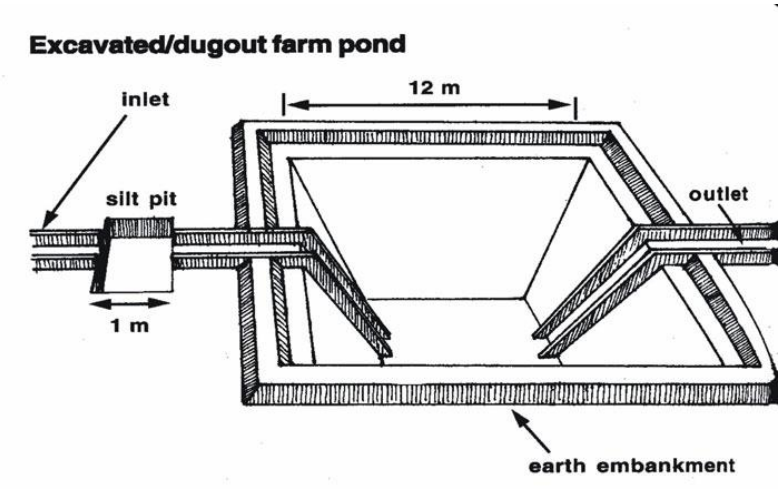
A farm pond is a large dug out in the earth, usually square or rectangular in shape, which harvests rainwater and stores it for future use. It has an inlet to regulate inflow and an outlet to discharge excess water. The pond is surrounded by a small bund, which prevents erosion on the banks of the pond.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

water requirements, the cost of excavation, and the possible uses of the excavated earth. 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 Landuse classification of the firka, majority of the area is covered by the agricultural field. Hence it is proposed to construct 100 farm ponds as per the specification of AED, Govt. of Tamil Nadu (30 x 30 x 1.5 m). These 100 farm ponds can hold/ harvest about 202500 cum of rainfall runoff in Single Filling. Considering 4 filling this can accommodate 0.8 MCM of runoff rainfall.



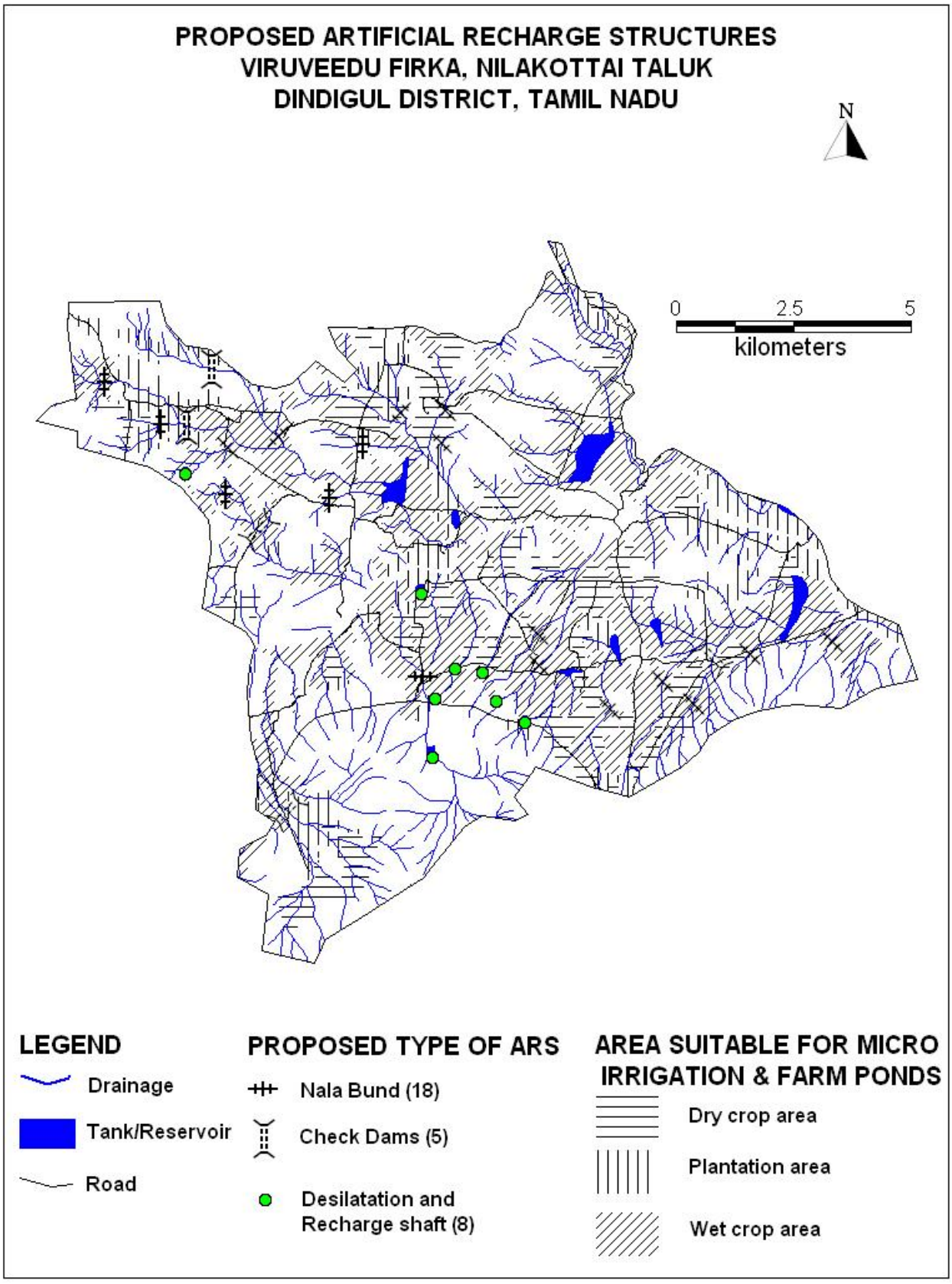
5.3.2.2. Micro Irrigation System (Sprinkler/ drip/ HDPE pipes)

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 wastage 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 100 ha. The cost estimation for this component has been taken from SOR of Agricultural Engineering Department (AED), Govt. of Tamil Nadu.Tentativelocations of proposed micro irrigation are shown in Plate 1.

Plate – 1



. Location map showing the proposed AR Structures in Viruveedu firka

6. Tentative Cost Estimation

The tentative cost for different activities is given in table below. The unit rates are as followed by the PWD, Govt. of Tamil Nadu (Sources the total estimated cost of the project is Rs 5.24 crores. It is expected that annually about 52.37 ham(0.52 MCM) of available monsoon runoff can be recharged to ground water. It is also expected to reduce ground water withdrawal by about 30 ham through best irrigational and on-farm practices. A tentative number of feasible structures and cost is given in the table 7.

Table 7. Showing the Cost Estimation of proposed Artificial Recharge Structures

Feasible Artificial Recharge & Water Conservation structures/ activities	Tentative Design	quantity (in nos. or area in sq. m)	Total volume (cu.m)	Tentative unit cost (in Rs lakh)	Total tentative cost (in Rs lakh)	Expected Annual GW recharge (cu.m)
Recharge Structures/ Activities						
Masonry Check dams (4 Fillings)	Crest- 10 -15 m; Height- 0.5 m to 1 m	5	85000	9	45	68000
Nala bunds/ Gabion (4 Fillings)	Width: 5 to 15 m	18	54000	2.0	36	43200
Revival, repair of water bodies (3 fillings)	(~100mx100mx1m)	8	600000	12	96	480000
Recharge shaft with the pond /tanks	(1.5 m dia. with bore well up to 17 m)	8		2.0	16	
Water Conservation Activities						
Farm Pond (in ha) (4 filling)	(30 m x 30m x 1.5 m) 900 sq.m or 0.1 ha	100 unit	600000	1	100	510000
Sprinkler/ drip/ HDPE pipes for 300 ha select area	For 1 ha with 5 m interval HDPE pipe	100 ha	1000000	0.6 /ha	60	700000
				Sub total	**353**	**1801200**
Impact assessment and O & M						
PiezometersUp to 50 m bgl – 3 nos. @ 0.6 lakh					**1.8**	
O & M - 5 % of total cost of the scheme					**17.74**	
Impact assessment to be carried out by the implementing agencies @5% of total cost					**17.74**	
				TOTAL	**390.28**	

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

7. Implication modalities

The implementation of the scheme will be done by the line department of the state selected by the respective State authority. Further, it is to add that more than 50 % MGNREGA works related to water conservation/sustainable management,accordingly a convergence guideline has been madebetween National Rural Employment Guarantee Act (NREGA) (Ministry of Rural Development) & Programmes of Water Resources (MoWR , RD & GR). The district Dindigul is one among the list of districts identified for Convergence between NREGS and schemes of MoWR. The details of permissible works under convergence are envisaged in the Joint Convergence Guideline.

a.) Time schedule

Steps	1st Quarter	2th Quarter	3rd Quarter	4th Quarter	5th Quarter	6th Quarter	7th Quarter	8th Quarter
❖ Identification of line department /implementing agency and preparation of DPR								
❖ Approval of scheme and release of sanction of funds								
❖ Implementation of ARS								

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

b.) Operation and maintenance

In all projects Impact assessment has to be carried out to ensure that projects 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 a have impact assessment at rate of 5 % of the total cost of the project for 5 years from the completion of artificial recharge.

Prepared under Supervision of

Shri. A. Subburaj, Head of Office, CGWB, SECR, Chennai

Nodal Officer

Dr.S.Subramanian, Senior Hydrogeologist, CGWB, SECR, Chennai

Program – Core Working Committee

Shri. A. Ravi, Sr.Hg (Scientist- D, **CGWB, SECR, Chennai**

Dr. S. Subramanian, Sr.Hg (Scientist- D, **CGWB, SECR, Chennai**

Ms. D. Dhayamalar, Sr.Hg (Scientist- D, **CGWB, SECR, Chennai**

Dr.B. Umapathi, Sr.Hg (Scientist- D, **CGWB, SECR, Chennai**

Shri. R. Arumugam , Scientist D, **CGWB, SECR, Chennai**

Compiled by

Dr.S.Subramanian, Senior Hydrogeologist, **CGWB, SECR, Chennai**

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ई-I,सी-ब्लॉक,राजाजीभवन

बेसंतनगर

Contact for further details

The Regional Director

Central Ground Water Board

South Eastern Coastal Region

E1, C Block, Rajaji Bhawan

Besant Nagar

Chennai –600090