CHAPTER 4.1.9 GROUND WATER RESOURCES

VILLUPURAM DISTRICT

INDEX

GROUND WATER REPORT OF VILLUPURAM DISTRICT

INRODUCTION :

In Tamil Nadu, the surface water resources are fully utilized by various stake holders. The demand of water is increasing day by day. So, groundwater resources play a vital role for additional demand by farmers and Industries and domestic usage leads to rapid development of groundwater. About 63% of available groundwater resources are now being used. However, the development is not uniform all over the State, and in certain districts of Tamil Nadu, intensive groundwater development had led to declining water levels, increasing trend of Over Exploited and Critical Firkas, saline water intrusion, etc.

ADMINISTRATIVE SET UP

Villupuram District was formed on 30th September 1993 by bifurcating the erstwhile composite South Arcot District.It is the fourth largest district in Tamil Nadu. Geographical extent of this district is 7, 22,203 hectares which works out to 5.5percent of the total geographical area of Tamil Nadu.This District is bound by Bay of Bengal and the Union Territory of Pondicherry in the east,Kancheepuram and Thiruvannamalai district in the north,Cuddalore and Tiruchi district in the south and Dharmapuri and salem district in the west. Villupuram is the District headquaters with Municipality status. There are eight taluks with twenty two blocks and 1483 revenue villages, in this district as listed in Table.

1. hydrogelogy

(i) Major Geological formations:

Villupuram District is underlain by crystalline metamorphic complex in the western parts of district and sedimentary tract in eastern side. An area of 4551 Sq.km is covered by crystalline rocks (63%)and 2671 Sq.km is covered by sediments(37%). The general geological sequence of formation is given below:

Quaternary	-	Laterites, Sands and Clays
Tertiary	-	Sandstone, Gravels and Clays
Cretaceous	-	Limestone, Calcareous Sandstone and Clay unconformity.

Archaean - Charnockites, Gneisses, Granites, Dolerites and Pegmatite

- The major part of the area is covered by metamorphic crystalline rocks of charnockite, granitic gneiss of Archaean age intruded by dolerite dykes and pegmatite veins. These rocks are highly metamorphosed and have been subjected to very severe folding, crushing and faulting.
- Ground Water occurs under the phreatic condition and wherever there are deep seated fractures, it occurs under semi-confined to confined conditions.
- Occurrence of Ground Water in hard rock depends upon the intensity and depth of weathering, fractures and fissures present in the rocks.
- Granites and gneisses yield moderately compared to the yield in Charnockites.
- Depth of well in hard rock generally ranges between 8 and 15m below ground level.
- Generally yield in open wells ranges from 30 to 250m^3/day and in bore well between 260 and 430 m^3/day.The weathered thickness varies from 2.5 m to 42m in general there are 3 to 5 fracture zones within 100 m and 1 to 4 fracture zones between 100 and 200 m.

The **Cretaceous formation** is represented by Arenaceous Lime stone, Calcareous sand - stone and marl.

The **Tertiary formation** is argillaceous comprising of Silty clay stones, argillaceous Lime stone.

The **Quaternary deposits** represented by the river deposits of Ponnaiyar and Varahanadhi spread over as patches in Villupuram District. The alluvium consists of unconsolidated sands, gravelly sands, clays and clayey sands. The thickness of the sands ranges between 15 and 25 m in the alluvial formation which also form potential aquifers. In some areas, sand stone of tertiary formation are the potential groundwater reservoirs.

(ii) Aquifer Systems:

Occurrence and storage of groundwater depend upon three factors viz., Geology, Topography and rainfall in the form of precipitation. Apart from

Geology, wide variation in topographic profile and intensity of rainfall constitutes the prime factors of groundwater recharge. Aquifers are part of the more complex hydro geological system and the behaviour of the entire system cannot be interpreted easily. In hard rock terrain the occurrence of Ground Water is limited to top weathered, fissured and fractured zone which extends to maximum 30 m on an average it is about 10-15 m in Villupuram District.

In Sedimentary formations, the presence of primary inter granular porosity enhances the transmitting capacity of groundwater where the yield will be appreciable. The sedimentary area which occupies the eastern part of the District along the coastal tract is more favourable for groundwater recharge. Ground Water occurs both in semi confined and confined conditions. A brief description of occurrence of groundwater in each formation is furnished below.

Alluvial Formations

In the river alluvium groundwater occurs under water table condition. The maximum thickness is 37 m and the average thickness of the aquifer is approximately 12 m. These formations are porous and permeable which have good water bearing zones.

Tertiary Cuddalore sandstone

Tertiary formations are represented by Cuddalore Sandstone and characterised as fluvial to brakish marine deposits. Predominantly this formation is divided into Lower and Upper Cuddalore formations. In the Upper Cuddalore formations the groundwater occurs in semi confined conditions, whereas in the Lower Cuddalore the groundwater occurs in confined condition with good groundwater potential.

Cretaceous Formations

Groundwater occurring in the lens shape in the sandy clay lenses and fine sand is underlain by white and black clay beds which constitute phreatic aquifer depth which ranges 10m to 15m below ground level. Phreatic aquifer in Limestone is potential due to the presence of Oolitic Limestone.

Hard Rock Formations

Groundwater occurs under water table conditions but the intensity of weathering, joint, fracture and its development is much less in other type of rocks when compared to gneissic formation. The groundwater potential is low, when compared with the gneissic formations.

- **Granitic Gneiss**

Groundwater occurs under water table conditions in weathered, jointed and fractural formations. The pore space developed in the weathered mantle acts as shallow granular aquifers and forms the potential water bearing and yielding zones water table is shallow in canal and tank irrigation regions and it is somewhat deeper in other regions.

- **Charnockite**

Groundwater occurs under water table conditions but the intensity of weathering, joint, fracture and its development is much less when compared to gneissic formations. The groundwater potential is low, when compared with the gneissic formations.

Aquifer Parameters

The thickness of aquifer in this district is highly erratic and varies between 15 m to 40 m below ground level. The inter granular Porosity is essentially dependent on the intensity and degree of weathering and fracture development in the bed rock. As discussed earlier deep weathering has developed in Gneissic formations and moderate weathering in charnockite formations. The range of aquifer parameters in hard rock and sedimentary formations are give below:

Table - 11 Range of aquifer parameters

Name	Sp. Capacity (lpm/d)	Specific Yield (%)	T (m^2/d)	K (m/day)	Yield of wells (lps)
Alluvium	2.08	7.2	98	19.7	2.5
Tertiary	78-173	1.4-3.5	46-134	16-33	2-3.3
Cretaceous	33-782	0.3-2.56	33-782	10-66	1.1-3.5

Name	Sp. Capacity (lpm/d)	Specific Yield (%)	T (m^2/d)	K (m/day)	Yield of wells (lps)
Crystalline	27-224	0.8-2.5	16-60	5-20	1-2

(iii) Drilling:

The drilling types are different according to the formation of the terrain. In general, DTH rigs are used in Hard rock formations for drilling a borewell at a depth ranges from 30m to 200m, according to the extension of joints, fractures, lineaments, etc in an area. In Sedimentary formations, rotary rigs with different rotors used according to the Tube well's diameter. The Bento novate clay is used in rotary rigs to avoid the collapse of the Tube well. The sedimentary tube wells are drilled up to a depth of 30m to 300m depending on the area, yield,etc. In alluvial formations, the hand rotary used for drilling tube wells ranges from 10m to 15m.In river beds, infiltration tube wells used for extraction of groundwater.

In Hard rock, the well designing is simple. The upper top soil and highly weathered zone is cased with PVC pipe and the remaining weathered, Fissured, Jointed portion is left as it is. In Villupuram District, the weathered zone ranges from 1.0m to 12.0m. In Granitic gneiss area, the highly weathered portion will be more up to 15m but in charnockite area, the weathered zone will extend up to 8.0m to 10.m only. In Sedimentary area, the well construction depends on the occurrence of sand thickness in the referred area. The logger is also used in the construction to identify the area of good quality of water.

2. GROUNDWATER REGIME MONITORING:

(i) Notes on existing water level scenario:

The water level is being monitored by State Ground & Surface Water Resources Data Centre from 1971 onwards from a network of 1746 observation wells (shallow open wells) located all over the State. The water level readings are observed in the first week of every month by the field officers. In Villupuram District,118 observation wells and 111 piezometers,totally 229 wells are monitoring on Monthly basis. The Central Ground Water Board also monitors the water level from 900 numbers of wells spread all over the State. They observe water level four times in a year. (i.e January, May, August and November). The collected water level data are uploaded in GWDES software and database is maintained regularly for analysing the water level trend with rainfall. From the Monitoring network of wells,

the selected representative wells are taken for Resource Estimation computations.

In Villupuram District, during the pre monsoon, the water level generally in declining trend ranges from G.L. to 15m. The depth of well below GroundLevel 12.0m are become dry during hot season like May, June, July. In the post monsoon, the water level generally in upward trend due to rainfall and it may reach the Ground Level also. The water level trend maps for pre and post monsoons are included as Annexure- I & II.

(ii) Long term trend of water level:

The long term fluctuations of water levels range from G.L. to 14.0m in many parts of the Villupuram District. The analysis reveals that the water level has gone down in the north, west and central parts of the Villupuram District. The inference taken from the annual fluctuation is due to lack of rainfall which in turn affects the groundwater levels in phreatic aquifer. The seasonal fluctuation study reveals that due to necessity for development of ground water for different sectored needs and due to failure of monsoons, the water level has gone down. The hydrograph of observation wells water level trend from 2005 to 2017 enclosed as Annexure – III and water level trend from 2000 to 2017 of Piezometers enclosed as Annexure – IV for Villupuram District.

(iii) Existing network of Monitoring wells:

In Villupuram District, the existing network of monitoring wells is 229 wells, 118 wells are observation wells and 111 wells are piezometers. These wells are observed for every month water level.

Villupuram District: Observation Wells - Location and Co-ordinates

Well No	District	Tahsil / Taluk	Block / Mandal	Village	Latitude	Longitude
00001	Villupuram	Sankarapuram	Rishivendhiyam	Kadambur		
00002	Villupuram	Sankarapuram	Sankarapuram	Nedumanur		
00003	Villupuram	Sankarapuram	Sankarapuram	S.Sellamppattu		
00004	Villupuram	Sankarapuram	Sankarapuram	Mukkaiyur		
00005	Villupuram	Sankarapuram	Sankarapuram	Rangappanur		

00006	Villupuram	Sankarapuram	Sankarapuram	Manalur		
00007	Villupuram	Sankarapuram	Sankarapuram	Erudaiyan pattu		
00008	Villupuram	Sankarapuram	Rishivendiyam	Thiruvaran gam		
00009	Villupuram	Sankarapuram	Sankarapuram	Alathur		
0W11418	Villupuram	Ulundurpet	Thirunavalur	Pillaiyarku ppam	11°49'45"	79°27'50"
33001	Villupuram	Chenji	Melmalaiyanur	Edayappat tu	12°25'10"	79°14'56"
33002	Villupuram	Chenji	Melmalaiyanur	Chinnanol ambai	12°25'43"	79°20'02"
33003	Villupuram	Chenji	Melmalaiyanur	Peruvalur	12°24'18"	79°23'35"
33004	Villupuram	Chenji	Melmalaiyanur	Avalurpet	12°20'15"	79°14'25"
33005	Villupuram	Chenji	Melmalaiyanur	Melmalay anur	12°20'22"	79°19'38"
33005A	Villupuram	Villupuram	Melmaliayanur	Melmalaiy anur		
33006	Villupuram	Chenji	Melmalaiyanur	Annaman galam	12°20'00"	79°23'44"
33007	Villupuram	Chenji	Vallam	Melolakku r	12°20'06"	79°29'11"
33008	Villupuram	Tindivanam	Olakkur	Vadasiruv alur	12°19'39"	79°35'08"
33009	Villupuram	Tindivanam	Olakkur	Vairapura m	12°18'54"	79°39'39"
33010	Villupuram	Tindivanam	Olakkur	Padiri	12°19'01"	79°45'51"
33010 A	Villupuram	Tindivanam	Olakkur	Padhiri	12°19'01"	79°45'51"
33011	Villupuram	Tindivanam	Marakkanam	Nagar	12°14'38"	79°50'31"
33012	Villupuram	Tindivanam	Marakkanam	Kilsevur	12°14'40"	79°45'26"
33013	Villupuram	Tindivanam	Olakkur	Salavathy	12°15'03"	79°40'23"
33014	Villupuram	Tindivanam	Mailam	Salai	12°15'03"	79°34'46"
33015	Villupuram	Chenji	Vallam	Nattarman galam	12°15'22"	79°30'14"
33016	Villupuram	Chenji	Gingee	Gingee	12°15'29"	79°25'00"
33017	Villupuram	Chenji	Gingee	Alampundi	12°14'49"	79°20'14"
33018	Villupuram	Chenji	Melmalaiyanur	Melpappa mpadi	12°16'57"	79°15'13"
33019	Villupuram	Chenji	Gingee	Nallanpilla ipetral	12°11'37"	79°15'13"
33019A	Villupuram	Chenji	Gingee	Nallanpilla ipetral	12°11'37"	79°15'13"
33020	Villupuram	Chenji	Gingee	Devadana mpettai	12°11'10"	79°20'25"
33021	Villupuram	Chenji	Gingee	Karai	12°09'15"	79°24'50"
33021A	Villupuram	Chenji	Gingee	Karai		

33022	Villupuram	Chenji	Vallam	Kalladikuppam	12°10'15"	79°29'29"
33023	Villupuram	Tindivanam	Mailam	Alagramam	12°09'55"	79°34'18"
33023A	Villupuram	Tindivanam	Mailam	Alagiramam		
33024	Villupuram	Tindivanam	Marakkanam	Omandur	12°09'46"	79°41'39"
33025	Villupuram	Vanoor	Vanur	Peravur	12°09'26"	79°44'55"
33026	Villupuram	Tindivanam	Marakkanam	Munnur	12°10'45"	79°48'52"
33027	Villupuram	Tindivanam	Marakkanam	Urani	12°09'43"	79°55'29"
33028	Villupuram	Tindivanam	Marakkanam	Kunimedu	12°05'10"	79°53'48"
33028A	Villupuram	Tindivanam	Marakkanam	Kunimedu	12°05'10"	79°53'48"
33029	Villupuram	Vanoor	Vanur	Kiliyanur	12°06'28"	79°44'40"
33030	Villupuram	Vanoor	Vanur	Perumpakkam	12°05'41"	79°39'29"
33031	Villupuram	Tindivanam	Mailam	Padirappuliyur	12°05'43"	79°35'29"
33032	Villupuram	Villupuram	Vikkiravandi	Tenper	12°05'10"	79°29'50"
33033	Villupuram	Villupuram	Kanai	Kalyanampundi	12°05'21"	79°25'23"
33034	Villupuram	Villupuram	Kanai	Pudukaruvatchi	12°05'29"	79°20'30"
33035	Villupuram	Sankarapuram	Sankarapuram	Vadaponparappi	11°59'54"	78°57'42"
33036	Villupuram	Sankarapuram	Rishivandhiyam	Vadamamandur	12°00'00"	79°00'00"
33037	Villupuram	Sankarapuram	Rishivandhiyam	Kallippadi	12°00'30"	79°04'40"
33038	Villupuram	Tirukkoilur	Mugaiyur	Kuchippalayam	11°58'48"	79°10'50"
33039	Villupuram	Tirukkoilur	Mugaiyur	Vadakaraithayanur	11°59'48"	79°14'56"
33040	Villupuram	Tirukkoilur	Mugaiyur	Karanai	11°59'34"	79°20'08"
33040A	Villupuram	Tirukkoilur	Mugaiyur	Karanai	11°59'29"	79°20'31"
33041	Villupuram	Villupuram	Kanai	Kedar	12°00'31"	79°24'25"
33042	Villupuram	Villupuram	Vikkiravandi	Orathur	12°00'16"	79°29'59"
33043	Villupuram	Villupuram	Vikkiravandi	Vettukkadu	12°00'10"	79°36'02"
33044	Villupuram	Vanur	Vanur	Vanur	12°01'12"	79°43'39"
33044A	Villupuram	Vanoor	Vanur	Vanur	12°01'55"	79°44'28"
33045	Villupuram	Vanur	Vanur	Bommayapalayam	11°59'37"	79°51'02"
33045A	Villupuram	Vanoor	Vanur	Bommayapalayam	11°59'35"	79°50'51"
33047	Villupuram	Villupuram	Koliyanur	Salamedu	12°54'23"	79°29'29"
33048	Villupuram	Villupuram	Kolianur	Kappur	12°54'35"	79°25'21"
33049	Villupuram	Tirukkoilur	Mugaiyur	Arulavadi	11°55'36"	79°20'02"

33050	Villupuram	Tirukkoilur	Thirukkoilur	Elrampattu	11°54'49"	79°14'47"
33051	Villupuram	Tirukkoilur	Thirukkoilur	Thanaganandal	11°54'49"	79°10'36"
33052	Villupuram	Tirukkoilur	Thirukkoilur	Madampoondi	11°55'54"	79°05'22"
33053	Villupuram	Sankarapuram	Rishivandhiyam	Ariyalur	11°55'30"	79°00'00"
33054	Villupuram	Sankarapuram	Sankarapuram	Sankarapuram	11°53'30"	78°55'00"
33056	Villupuram	Sankarapuram	Sankarapuram	Murarpalayam	11°49'30"	78°57'00"
33057	Villupuram	Sankarapuram	Rishivandhiyam	Palayasiruvangur	11°50'00"	79°00'00"
33058	Villupuram	Sankarapuram	Rishivandhiyam	Rishivandhiyam	11°48'50"	79°06'00"
33059	Villupuram	Ulundurpet	Ulundurpet	Kattusellur	11°50'43"	79°10'26"
33059A	Villupuram	Ulundurpet	Ulundurpet	Kattusellur	11°50'43"	79°10'26"
33060	Villupuram	Ulundurpet	Ulundurpet	Nattamur	11°50'18"	79°14'13"
33061	Villupuram	Ulundurpet	Ulundurpet	Tholangampattu	11°50'16"	79°19'48"
33062	Villupuram	Ulundurpet	Ulundurpet	Padurcolony	11°44'07"	79°20'58"
33062A	Villupuram	Ulundurpet	Ulundurpet	Padurcolony	11°44'07"	79°20'58"
33063	Villupuram	Ulundurpet	Ulundurpet	Neyvanai Colony	11°46'07"	79°14'26"
33063A	Villupuram	Ulundurpet	Ulundurpet	Neyvanai Colony	11°46'07"	79°14'26"
33064	Villupuram	Ulundurpet	Ulundurpet	Tottikunjaram	11°45'52"	79°10'59"
33064A	Villupuram	Ulundurpet	Ulundurpet	Thottikunjaram	11°45'52"	79°10'59"
33065	Villupuram	Kallakurichi	Thiyagadurgam	Thiyagadurgam	11°44'30"	79°04'45"
33065A	Villupuram	Kallakurichi	Thiyagadurugam	Thiyagadurugam	11°44'34"	79°04'23"
33066	Villupuram	Kallakurichi	Kallakurichi	Kallakurichi	11°44'00"	78°57'30"
33066A	Villupuram	Kallakurichi	Kallakurichi	Kallakurichi	11°44'44"	78°57'48"
33067 A	Villupuram	Kallakurichi	Chinnasalem	Mattigaikurichi	11°44'30"	78°55'00"
33068	Villupuram	Kallakurichi	Chinnasalem	Kachirappalayam	11°46'30"	78°52'00"
33070	Villupuram	Kallakurichi	Kallakurichi	Kaniamur	11°39'30"	78°54'30"
33070A	Villupuram	Kallakurichi	Kallakurichi	Kaniyamur	11°39'34"	78°54'01"

33071	Villupuram	Kallakurichi	Thiyagadurgam	Virugaavur	11°41'30"	79°02'30"
33071A	Villupuram	Kallakurichi	Thiyagadurgam	Virugavur	11°41'08"	78°02'53"
33072 A	Villupuram	Kallakurichi	Thiyagadurgam	Nagalur	11°39'45"	79°04'46"
33073	Villupuram	Ulundurpet	Ulundurpet	Parindal	11°40'19"	79°10'54"
33074	Villupuram	Ulundurpet	Ulundurpet	Pullur	11°39'14"	79°15'58"
33076	Villupuram	Kallakurichi	Thiyagadurgam	Erangi	11°36'00"	79°10'30"
33077	Villupuram	Kallakurichi	Thiyagadurgam	Asakalathur	11°36'45"	79°04'00"
33078	Villupuram	Kallakurichi	Chinnasalem	Nainarpalayam	11°34'30"	78°55'00"
33079	Villupuram	Kallakurichi	Kallakurichi	Madur	11°44'06"	79°01'24"
33080	Villupuram	Ulundurpet	Ulundurpet	Pu. Konalavadi	11°44'11"	79°16'00"
33088	Villupuram	Sankarapuram	Sankarapuram	Viriyur	12°53'45"	78°57'58"
33089	Villupuram	Sankarapuram	Rishivandhiyam	Tholuvanthangal	11°56'40"	78°58'32"
33090	Villupuram	Tirukkoilur	Thiruvennainallur	Thiruvennainallur	11°52'17"	79°21'39"
33091	Villupuram	Ulundurpet	Thiruvennainallur	Gramam	11°51'07"	79°24'03"
INV31444A	Villupuram	Ulundurpet	Ulundurpet	Pu. Konalavadi	11°44'11"	79°16'00"
OW11100	Villupuram	Villupuram	Koliyanur	Panampattu	11°55'35"	79°31'05"
OW11101	Villupuram	Villupuram	Kanai	Agaramsithamur	11°58'50"	79°24'54"
OW11102	Villupuram	Villupuram	Koliyanur	Thennamadevi	11°59'13"	79°28'58"
OW11103	Villupuram	Villupuram	Vikkravandi	Poondi	12°03'20"	79°28'05"
OW11104	Villupuram	Villupuram	Vikkravandi	Muttathur	12°06'45"	79°26'45"
OW11105	Villupuram	Villupuram	Vikkravandi	Melakondhai	12°03'33"	79°31'48"
OW11106	Villupuram	Villupuram	Koliyanur	Kappiyampuliyur	11°58'38"	79°32'04"
OW11107	Villupuram	Villupuram	Kanai	Pagandai	11°58'38"	79°35'13"
OW11108	Villupuram	Chenji	Melmaliyanur	Eyyil	12°05'07"	79°16'50"
OW11109	Villupuram	Chenji	Gingee	Jambothi	12°08'55"	79°20'00"
OW11110	Villupuram	Chenji	Vallam	Kambandhur	12°21'20"	79°25'48"

OW11111	Villupuram	Chenji	Vallam	Solakunnam	12°13'10"	79°30'00"
OW11112	Villupuram	Chenji	Gingee	Kanakankuppam	12°12'54"	79°26'48"
OW11113	Villupuram	Chenji	Gingee	Mazhavanthangal	12°24'15"	79°19'45"
OW11114	Villupuram	Tindivanam	Marakkanam	Earaiyanur	12°12'00"	79°40'00"
OW11115	Villupuram	Tindivanam	Mailam	Manampoondi	12°17'06"	79°33'32"
OW11116	Villupuram	Tindivanam	Mailam	Peramandur	12°12'40"	79°35'24"
OW11117	Villupuram	Tindivanam	Mailam	Thenkalavai	12°10'42"	79°39'00"
OW11118	Villupuram	Vanoor	Vanoor	Siruvai	12°03'08"	79°36'22"
OW11119	Villupuram	Vanoor	Vanoor	Nallavur	12°08'28"	79°45'02"
OW11120	Villupuram	Vanoor	Vanoor	V.parangani	12°03'08"	79°47'00"
OW11228	Villupuram	Sankarapuram	Rishivandhiyam	Kadambur	11°53'18"	79°04'13"
OW11229	Villupuram	Sankarapuram	Sankarapuram	Nedumanur	11°50'42"	78°54'32"
OW11230	Villupuram	Sankarapuram	Sankarapuram	S.Sellamppattu	11°51'11"	78°51'20"
OW11231	Villupuram	Sankarapuram	Sankarapuram	Mukkaiyur	11°56'55"	78°55'37"
OW11232	Villupuram	Sankarapuram	Sankarapuram	Rangappanur	11°58'47"	78°53'51"
OW11233	Villupuram	Sankarapuram	Sankarapuram	Manalur	12°01'08"	78°55'58"
OW11234	Villupuram	Sankarapuram	Sankarapuram	Erudaiyanpattu	12°00'39"	78°58'27"
OW11235	Villupuram	Sankarapuram	Rishivendiyam	Thiruvarangam	11°59'52"	79°03'41"
OW11236	Villupuram	Sankarapuram	Sankarapuram	Alathur	11°47'55"	78°58'52"
OW11409	Villupuram	Kallakurichi	Kallakurichi	Emaper	11°42'47"	78°57'02"
OW11410	Villupuram	Kallakurichi	Kallakurichi	Indhili	11°41'08"	78°55'30"
OW11411	Villupuram	Kallakurichi	Chinnasalem	Rayappanur	11°36'30"	78°48'49"
OW11412	Villupuram	Kallakurichi	Kallakurichi	Melur	11°40'47"	78°55'54"

OW11413	Villupuram	Kallakurichi	Kallakurichi	Sembadakurichi	11°47'05"	78°54'22"
OW11414	Villupuram	Kallakurichi	Chinnasalem	Eliayathur	11°42'46"	78°52'49"
OW11415	Villupuram	Kallakurichi	Chinnasalem	Karundalakurichi	11°33'04"	78°54'52"
OW11416	Villupuram	Kallakurichi	Chinnasalem	Veerapayangaram	11°32'41"	78°52'23"
OW11417	Villupuram	Kallakurichi	Kallakurichi	Tenthoras alur	11°39'17"	78°58'38"
OW11418	Villupuram	Ulundurpet	Thirunavalur	Pillaiyarkuppam	11°49'45"	79°27'50"
OW11419	Villupuram	Ulundurpet	Thirunavalur	Parikkal	11°47'30"	79°21'59"
OW11421	Villupuram	Kallakurichi	Chinnasalem	Komuki Dam	11°46'45"	78°50'15"
OW11422	Villupuram	Thirukkoilur	Mugaiyur	Manalurpettai	12°00'30"	79°05'20"
OW11423	Villupuram	Thirukkoilur	Thiruvennainallur	Sithilingamadam	11°55'06"	79°17'31"
OW11424	Villupuram	Thirukkoilur	Thiruvennainallur	Siruvanur	11°53'50"	79°22'55"
OW11425	Villupuram	Tindivanam	Olakkur	Endiyur	12°12'40"	79°41'59"
OW11426	Villupuram	Tindivanam	Marakkanam	Alathur	12°13'29"	79°52'38"
OW11427	Villupuram	Tindivanam	Marakkanam	Kurumbaram	12°12'52"	79°52'53"
OW11428	Villupuram	Tindivanam	Mailam	Kodima	12°10'11"	79°35'55"
OW11429	Villupuram	Vanur	Vanur	Karasanur	12°04'11"	79°40'15"
U33001	Villupuram	Villupuram	Kolianur	Serndhanur	11°52'15"	79°31'40"
U33002	Villupuram	Villupuram	Kandamangalam	Panchamadevi	11°52'20"	79°33'30"
U33003	Villupuram	Villupuram	Kandamangalam	Siruvandadu	11°52'00"	79°35'00"
U33005A	Villupuram	Villupuram	Kandamangalam	Pallippudu ppattu	11°52'58"	79°39'29"
U33006	Villupuram	Villupuram	Kandamangalam	Pakkam	11°52'02"	79°40'33"
U33006A	Villupuram	Villupuram	Kandamangalam	Pakkam	11°52'00"	79°40'45"
U33007	Villupuram	Villupuram	Kandamangalam	Mandagappattu	11°52'56"	79°40'03"
U33007A	Villupuram	Villupuram	Kandamangalam	Mandagappattu	11°52'50"	79°40'20"

U33008	Villupuram	Villupuram	Kandamangalam	Navammalkapper	11°54'15"	79°42'45"
U33009	Villupuram	Villupuram	Kandamangalam	Pakkirippalayam	11°58'39"	79°41'18"
U33009A	Villupuram	Villupuram	Kandamangalam	Pakkiripalayam	11°58'30"	79°41'30"
U33010	Villupuram	Villupuram	Kandamangalam	Kumulam	11°57'14"	79°37'47"
U33012	Villupuram	Villupuram	Kolianur	Valavanur	11°55'15"	79°34'20"
U33013	Villupuram	Villupuram	Koliyanur	Kilperumpakkam	11°56'47"	79°30'46"
U33014	Villupuram	Villupuram	Vikkiravandi	Vakkur	11°58'50"	79°34'15"
U33015	Villupuram	Villupuram	Vikkiravandi	Radhapuram	11°59'30"	79°35'30"
U33015A	Villupuram	Villupuram	Vikkiravandi	Radhapuram	12°00'01"	79°35'25"
U33016	Villupuram	Villupuram	Vikkiravandi	Kayathur	12°01'00"	79°34'41"
U33017	Villupuram	Villupuram	Kolianur	Panayapuram	12°01'00"	79°31'45"
U33018	Villupuram	Villupuram	Kolianur	Muthalupettai	11°57'45"	79°29'10"
U33019	Villupuram	Villupuram	Koliyanur	Orukodi	11°55'42"	79°26'16"
U33020	Villupuram	Villupuram	Kolianur	Kolathur	11°53'45"	79°29'10"
U33032	Villupuram	Villupuram	Vikkiravandi	Tenper	12°05'05"	79°29'50"
U33064	Villupuram	Ulundurpet	Thirunavalur	Sendanadu	11°42'40"	79°25'10"
U33064A	Villupuram	Ulundurpet	Thirunavalur	Serndanadu	11°42'40"	79°25'10"

Villupuram District: 111 - Piezometers - Location and Co-ordinates

Well No	District	Tahsil / Taluk	Block / Mandal	Village	Latitude	Longitude
HP 31541A	Villupuram	Sankarapuram	Rishivandhiyam	Rishivandhiyam	11.813333	79.096389
HP-31524A	Villupuram	Villupuram	Kanai	Sangeethamangalam	12.108333	79.399444
HP31329	Villupuram	Villupuram	Kandamangalam	Navammalkapper	11.901667	79.712222
HP31372	Villupuram	Tindivanam	Marakkanam	Keeladayalam	12.167222	79.620278
HP31501	Villupuram	Sankarapuram	Sankarapuram	Murar Palayam	11.822778	78.946667
HP31502	Villupuram	Kallakurichi	Kallakurichi	M.vannanjur	11.769444	78.922222
HP31503	Villupuram	Sankarapuram	Sankarapuram	Thimmanendal	11.889167	78.953611

HP31504	Villupuram	Sankarapuram	Rishivandhiyam	Ariyalur	11.9275	78.998889
HP31505	Villupuram	Kallakurichi	Thiyagadurgam	Vadapoondi	11.671667	79.083889
HP31506	Villupuram	Kallakurichi	Thiyagadurgam	Chitheri	11.650556	79.030278
HP31507A	Villupuram	Thirukkoilur	Thirukkoilur	Madampoondi	11.935278	79.089167
HP31508	Villupuram	Ulundurpet	Ulundurpet	Athaiyur	11.789444	79.155833
HP31510	Villupuram	Kallakurichi	Thiyagadurgam	Kurur	11.702222	79.031111
HP31511	Villupuram	Ulundurpet	Ulundurpet	Vadakurumbur	11.766667	79.219167
HP31512A	Villupuram	Ulundurpet	Ulundurpet	Kanaiyar	11.698889	79.2275
HP31513A	Villupuram	Thirukkoilur	Thirukkoilur	Kilthayanur	11.924167	79.190833
HP31514A	Villupuram	Kallakurichi	Chinnasalem	Sembakurichi	11.580833	78.945
HP31517A	Villupuram	Villupuram	Kanai	Mambalapattu	11.956944	79.376111
HP31518	Villupuram	Gingee	Vallam	Kilmampattu	12.180556	79.481667
HP31519A	Villupuram	Tindivanam	Olakkur	Vairapuram	12.311111	79.664444
HP31520	Villupuram	Gingee	Gingee	Alampoondi	12.2475	79.334444
HP31523	Villupuram	Tindivanam	Marakkanam	Omandur	12.165	79.695
HP31526	Villupuram	Gingee	Melmalaiyanur	Sathampadi	12.373611	79.358611
HP31527	Villupuram	Gingee	Gingee	Thiruvathikunnam	12.155278	79.441944
HP31528	Villupuram	Tindivanam	Olakkur	Avanipur	12.276389	79.8175
HP31529	Villupuram	Tindivanam	Olakkur	Saram	12.279444	79.701389
HP31530	Villupuram	Vanur	Vanur	Kiliyanur	12.105833	79.743889
HP31531	Villupuram	Villupuram	Vikkravandi	Esalam	12.111389	79.503611
HP31532	Villupuram	Villupuram	Koliyanur	Kilperumpakkam	11.943056	79.5075
HP31533	Villupuram	Villupuram	Kanai	Athanurvinayagapuram	12.005833	79.4525
HP31534	Villupuram	Thirukkoilur	Mugaiyur	A.Gudalur	11.954444	79.336667
HP31535	Villupuram	Ulundurpet	Thirunavalur	Mettathur	11.796944	79.298889
HP31536	Villupuram	Ulundurpet	Thiruvennainallur	Periya Sevalai	11.845278	79.346389
HP31537A	Villupuram	Ulundurpet	Thirunavalur	Nagar	11.703889	79.318611
HP31556	Villupuram	Villupuram	Kandamangalam	Kandamangalam	11.9175	79.684167
HP31557	Villupuram	Ulundurpet	Thiruvennainallur	T.kumaramangalam	11.8275	79.449444
HP31561	Villupuram	Villupuram	Kandamangalam	Arpisampalayam	11.898333	79.584167
HP31562	Villupuram	Villupuram	Kandamangalam	Sornavur	11.824167	79.625833
HP31566	Villupuram	Tindivanam	Marakkanam	Nadukkuppam	12.181667	79.882222
HP31568	Villupuram	Villupuram	Koliyanur	Valavanur	11.921944	79.586111
HP31569	Villupuram	Vanur	Vanur	Thiruchitrambalam	12.003333	79.774722
HP31570	Villupuram	Vanur	Vanur	Kottakkarai	12.011389	79.798611

HP31571	Villupuram	Tindivanam	Marakkanam	Nesal	12.058056	79.812222
HP31573	Villupuram	Vanur	Vanur	Koluvari	12.066944	79.831944
HP31575	Villupuram	Ulundurpet	Ulundurpet	Pugaipatti	11.742778	79.205556
HP31576	Villupuram	Ulundurpet	Ulundurpet	Ravutharrayankuppam	11.686111	79.263889
HP31577	Villupuram	Ulundurpet	Ulundurpet	Asanur	11.626389	79.19
HP31578	Villupuram	Ulundurpet	Ulundurpet	Kattuedayar	11.850278	79.143611
HP31579	Villupuram	Ulundurpet	Thiruvennainallur	Ottanandal	11.851389	79.308333
HP31580	Villupuram	Tindivanam	Olakkur	Mambakkam	12.362222	79.529722
HP31581	Villupuram	Tindivanam	Olakkur	Olakkur melpathi	12.308889	79.716389
HP31582	Villupuram	Tindivanam	Olakkur	Pattanam	12.259722	79.1925
HP31583	Villupuram	Vanur	Vanur	Athanapattu	12.117222	79.688056
HP31584	Villupuram	Tindivanam	Marakkanam	Kiledayalam	12.167222	79.620278
HP31585	Villupuram	Vanur	Vanur	Kondamur	12.137222	79.719722
HP31586	Villupuram	Villupuram	Koliyanur	Villupuram	11.938889	79.487778
HP31587	Villupuram	Thirukkoilur	Thirukkoilur	Thirukkoilur	11.918056	79.1925
HP31588	Villupuram	Villupuram	Kandamangalam	Pakkiripalayam	11.965278	79.695556
HP33050A	Villupuram	Thirukkoilur	Thirukkoilur	T.Elrampattu	11.911667	79.243889
INV - 31346	Villupuram	Villupuram	Kandamangalam	Purushanur	11.886667	79.537222
INV - 31347	Villupuram	Villupuram	Kandamangalam	Rampakkam	11.841667	79.613056
INV - 31440	Villupuram	Ulundurpet	Ulundurpet	Thirupaiyur	11.652778	79.203889
INV - 31441	Villupuram	Ulundurpet	Ulundurpet	Pallavadi	11.821389	79.173611
INV - 31443	Villupuram	Ulundurpet	Ulundurpet	Pinnalavadi	11.748611	79.154444
INV - 31458	Villupuram	Villupuram	Vikkravandi	Kayathur	12.016667	79.575278
INV - 31459	Villupuram	Ulundurpet	Thirunavalur	Velur	11.811111	79.323611
INV - 31460	Villupuram	Ulundurpet	Ulundurpet	Nedumanur	11.683056	79.178889
INV - 31464	Villupuram	Kallakurichi	Chinnasalem	Pakkampadi	11.554167	78.834722
INV - 31465	Villupuram	Kallakurichi	Chinnasalem	V.Mamandur	11.522222	78.9
INV - 31466	Villupuram	Kallakurichi	Kallakurichi	Karadichitthur	11.829167	78.877778
MWS - 31596	Villupuram	Villupuram	Kanai	Viramur	12.016389	79.418056
MWS - 31597	Villupuram	Villupuram	Vikkravandi	Kottiyampundi	12.032778	79.498611
MWS - 31598	Villupuram	Gingee	Gingee	Sirunampundi	12.208333	79.407778
MWS - 31599	Villupuram	Gingee	Vallam	Mel Kalavay	12.279722	79.436389
MWS - 31600	Villupuram	Gingee	Vallam	Aviyur	12.305	79.485556
MWS - 31601	Villupuram	Villupuram	Kanai	Perumgalampundi	12.081111	79.401389

MWS - 31602	Villupuram	Villupuram	Kanai	Hanumanathapuram	12.051111	79.379722
MWS - 31604	Villupuram	Gingee	Gingee	Semmedu	12.241111	79.2825
MWS - 31606	Villupuram	Gingee	Gingee	Periyamur	12.201667	79.343333
MWS - 31608	Villupuram	Thirukkoilur	Mugaiyur	V.puthur	11.966111	79.262222
MWS - 31609	Villupuram	Thirukkoilur	Mugaiyur	Kodukkappattu	12.005278	79.187778
MWS - 31610	Villupuram	Gingee	Melmalaiyanur	Kappalambadi	12.372778	79.274722
MWS - 31611	Villupuram	Gingee	Melmalaiyanur	Sevalapurai	12.288056	79.357778
MWS - 31612	Villupuram	Gingee	Vallam	Illodu	12.317222	79.424167
MWS - 31613	Villupuram	Tindivanam	Mailam	Kollar	12.246389	79.595
MWS - 31614	Villupuram	Tindivanam	Mailam	Veliyanur	12.122222	79.650556
MWS - 31615	Villupuram	Tindivanam	Marakkanam	Vada Alapakkam	12.230833	79.67
MWS - 31616	Villupuram	Thirukkoilur	Thirukkoilur	Periyamur	11.901111	79.216111
MWS - 31617	Villupuram	Thirukkoilur	Mugaiyur	Tevadiyarkuppam	12.031389	79.084722
MWS - 31618	Villupuram	Thirukkoilur	Mugaiyur	Appanandal	12.012222	79.266667
MWS - 31619	Villupuram	Thirukkoilur	Thirukkoilur	Thagadi	11.960278	79.125833
MWS - 31620	Villupuram	Thirukkoilur	Thirukkoilur	G.ariyur	11.880278	79.174444
MWS - 31623	Villupuram	Tindivanam	Olakkur	Andappattu	12.258056	79.76
MWS - 31624	Villupuram	Tindivanam	Olakkur	Kambur	12.308889	79.771667
MWS - 31626	Villupuram	Tindivanam	Olakkur	Vadampundi	12.305	79.614722
MWS - 31627	Villupuram	Gingee	Melmalaiyanur	Mel Karanai	12.390833	79.384444
MWS - 31586	Villupuram	Kallakurichi	Chinnasalem	Namasivayapuram	11.684444	78.890556
MWS - 31587	Villupuram	Kallakurichi	Chinnasalem	Illavadi	11.641111	78.824444
MWS - 31588	Villupuram	Kallakurichi	Chinnasalem	Olagiyanaluur	11.618611	78.968889

MWS - 31589	Villupuram	Kallakurichi	Chinnasalem	Dadathripuram	11.580278	78.864722
MWS - 31590	Villupuram	Kallakurichi	Kallakurichi	Palrambattu	11.803611	78.868889
MWS - 31591	Villupuram	Kallakurichi	Kallakurichi	Eravar	11.655278	78.940556
MWS - 31592	Villupuram	Kallakurichi	Kallakurichi	Thandalai	11.756111	78.999722
MWS - 31593	Villupuram	Kallakurichi	Kallakurichi	Nallathur	11.734167	78.903889
MWS - 31594	Villupuram	Kallakurichi	Thiyagadurgam	Chithathur	12.184167	79.790556
MWS - 31628	Villupuram	Sankarapuram	Rishivandhiyam	Kilpadi	11.843056	79.060278
MWS - 31629	Villupuram	Sankarapuram	Rishivandhiyam	Pallipattu	11.806389	79.017222
MWS - 31631	Villupuram	Sankarapuram	Sankarapuram	Poikunam	11.872778	78.886667
MWS - 31633	Villupuram	Sankarapuram	Sankarapuram	Arulambadi	12.006667	78.976111
MWS - 31634	Villupuram	Kallakurichi	Thiyagadurgam	Vilakkur	11.714722	79.085278
MWS - 31635	Villupuram	Ulundurpet	Thirunavalur	Arinatham	11.699444	79.365

(iv) Data Constraints:

The following are constraints in collecting the water level data in the field and validating the data are:

1) The water level data are collected on the monthly basis in the referred observation wells and piezometers. The collected data is not sufficient quantity for analyzing purpose due to drying of wells, Wells abounded by various reasons, lack of selecting the alternate wells, lack of open wells available for monitoring purpose due to increased usage of bore wells in the villages, Panchayats, etc. In many villages, the water supply schemes implemented by overhead tank supply or mini energised pumps and the existing open wells are not used generally by the villagers and moreover, they filled with garbage.
2) The number of bore wells should be increased for monitoring purpose.
3) The site selection of new bore wells should be based on the Geological methods.

4) Strengthening the network of monitoring wells by closing the gaps in the network.
5) Maintenance cost should be allotted to maintain the bore wells on the periodical basis to maintain the quality as well as yield.
6) Installation of Automatic water level recorders in the sensitive and more water level fluctuation in the bore wells will helpful to monitor the extensive depletion of groundwater areas.
7) Upgrading the measuring instruments will helpful to take accurate reading of water levels in the field.
8) Upgrading the soft ware will helpful to minimize the errors and increasing the accuracy of data.
9) Erecting the Telemetric water level recorders in the over exploited Firkas will helpful to monitor the over extraction of groundwater.

10)Lack of manpower and transporting vehicles are also major problems for data collection in the field in proper time.

3. DYNAMIC GROUND WATER RESOURCES:

The State Ground and Surface Water Resources Data Centre has estimated the ground water resources of Tamil Nadu periodically in co-ordination with the Central Ground Water Board, Government of India , Ministry of Water Resources, Chennai, based on the Methodology evolved by the Ground Water Resources Estimation Committee, 1997 (GEC 97).

Groundwater potential assessment is a dynamic one and not static. While assessing an area, the following factors can be considered such as Geology, Total Irrigated Area, Total Number of Wells used for Irrigation, Water Level Data for the past five years, Average Rainfall, Total Recharge, Irrigation methods adopted in the area, Cropping pattern details, Seepage factor, Specific yield, Geological conditions prevailing in that area, Recharge through Artificial recharge structures, etc.

Groundwater potential assessment proposal should be presented for approval in the Central and State Level Working Group Committees and then,

presented for final approval in the Central Level Committee as well as State Level Committees.

The Ground Water Potential Assessments as on January 1992 and January 1997 were done in the State, taking the Panchayat Union Block as an Assessment Unit and the entire State **was categorized as Dark, Grey and White areas**. The Blocks with more than 85% to 100% ground water development (extraction) were categorized as “Dark Blocks” and the blocks with ground water development between 65% to 85% were categorized as “Grey Blocks” and blocks with less than 65% ground water development were categorized as “White Blocks”.

Subsequently, the **Ground Water Potential Assessment was done as on March 2003 and as on March 2009.** In these assessments, the Panchayat Union Blocks in Tamil Nadu were **categorized as Over-Exploited, Critical, Semi-Critical, Safe and Saline instead of Dark, Grey and White blocks.** The Blocks with more than 100% extraction were categorized as “Over Exploited Blocks”, the blocks with 90% to 100% extraction as “Critical Blocks”, the blocks with 65% to 90% extraction as “Semi Critical Blocks”, the blocks with less than 65% extraction as “Safe Blocks” and the bad quality blocks were categorized as “Saline Blocks”. No schemes should be formulated in over exploited and critical blocks - “Notified Blocks – A category – (Stage of Groundwater extraction is 90% and above)”.

The re-estimation of groundwater resources in the State as on March 2011 and as on March 2013 can be assessed in Micro Level basis. In these assessments, the assessing unit is Firka (Unit of Taluk) and **categorized as Over-Exploited, Critical, Semi-Critical, Safe, and Saline Firkas.** As on March 2013 assessment, in the Villupuram District

Based on the Estimation of Ground Water Resources of Tamil Nadu State as on March 2013, Out of 1139 Firkas in the State, 358 Firkas are categorized as “Over Exploited Firkas”, 105 Firkas are categorized as “Critical Firkas”, 212 Firkas are categorized as “Semi Critical Firkas”, 429 Firkas are categorized as “Safe Firkas” and 35 Firkas are categorized as “Saline Firkas”.

When compared to last assessment as on March 2011, the “Over Exploited Firkas” comes down from 374 to 358 Firkas, the “Critical Firkas” increased from 48 to 105 Firkas, the “Semi Critical Firkas” comes down marginally from 235 to 212 Firkas, the “Safe Firkas” comes down marginally from 437 to 429 Firkas and the “Saline Firkas” remains same as 35 Firkas. The alteration of Firkas are due to the construction of Artificial Recharge structures such as Check Dams, Recharge Wells, Recharge shafts, percolation ponds; etc was constructed in the “Over Exploited Firkas” by various departments.

Methodology adopted for Estimation of Ground Water Potential :

The present methodology used for resources assessment is known as Ground Water Resource Estimation Methodology - 1997 (GEC'97) .In GEC'97, two approaches are recommended - **water level fluctuation method and norms of rainfall infiltration method**. The water level fluctuation method is based on the concept of storage change due to differences between various input and output components. Input refers to recharge from rainfall and other sources and subsurface inflow into the unit of assessment. Output refers to ground water draft, ground water evapotranspiration, base flow to streams and subsurface outflow from the unit. Since the data on subsurface inflow / outflow are not readily available, it is advantageous to adopt the unit for ground water assessment as basin / sub basin / watershed, as the inflow / outflow across these boundaries may be taken as negligible.

In each assessment unit, hilly areas having slope more than 20% are deleted from the total area to get the area suitable for recharge. Further, areas where the quality of ground water is beyond the usable limits should be identified and handled separately. The remaining area after deleting the hilly area and separating the area with poor ground water quality is to be delineated into command and non-command areas. Ground water assessment in command and non-command areas are done separately for monsoon and non-monsoon seasons.

The rainfall recharge during monsoon season computed by Water Level Fluctuation (WLF) method is compared with recharge figures from Rainfall Infiltration Factor (RIF) method. In case the difference between the two sets of data are more than 20% then RIF figure is considered, otherwise monsoon recharge from WLF is adopted. While adopting the rainfall recharge figures, weight age is to be given to WLF method over adhoc norms method of RIF. Hence, wherever the difference

between RIF & WLF is more than 20%, data have to be scrutinized and corrected accordingly.

During non-Monsoon season, rainfall recharge is computed by using Rainfall infiltration Factor (RIF) method. Recharge from other sources is then added to get total non-Monsoon recharge. In case of areas receiving less than 10% of the annual rainfall during non-monsoon season, the rainfall recharge is ignored.

The total annual ground water recharge of the area is the sum-total of monsoon and non-monsoon recharge. An allowance is kept for natural discharge in the non-monsoon season by deducting 5 to 10 % of total annual ground water recharge.

The balance ground water available accounts for existing ground water withdrawal for various uses and potential for future development. This quantity is termed as Net Ground Water Availability.

Net Ground Water Availability = Annual Ground Water Recharge - Natural discharge during non-monsoon season.

GEC'97 methodology has recommended norms for various parameters being used in ground water recharge estimation. These norms vary depending upon water bearing formations and agroclimatic conditions. While norms for specific yield and recharge from rainfall values are to be adopted within the guidelines of GEC'97, in case of other parameters like seepage from canals, return flow from irrigation, recharge from tanks & ponds, water conservation structures, results of specific case studies may replace the adhoc norms.

The Gross yearly ground water draft is to be calculated for Irrigation, Domestic and Industrial uses. The gross ground water draft would include the ground water extraction from all existing ground water structures during monsoon as well as during non-monsoon period. While the number of ground water structures should preferably be based on latest well census, the average unit draft from different types of structures should be based on specific studies or adhoc norms given in GEC'97 report.

The stage of Ground water Development is defined by

Stage of Ground water Development (%) = Existing Gross Ground water Draft for all uses / Net annual Ground Water Availability X 100

The units of assessment are categorized for ground water development based on two criteria – a) stage of ground water development and b) long-term trend of pre and post monsoon water levels. Four categories are - Safe areas which have ground water potential for development; Semi-critical areas where cautious ground water development
is recommended; Critical areas; Over -exploited areas where there should be intensive monitoring and evaluation and future ground water development be linked with water conservation measures.

The criteria for categorization of assessment units are as follows:

S. No.	Stage of Groundwater Development	Significant Long term Decline		Categorization
		Pre-monsoon	Post -monsoon	
1.	<=70%	No	No	SAFE
		Yes / No	No / Yes	To be re-assessed
		Yes	Yes	To be re-assessed
2.	>70% and <=90%	No	No	To be re-assessed
		Yes / No	No / Yes	SEMI – CRITICAL
		Yes	Yes	SEMI – CRITICAL
3.	>90 and <=100%	No	No	To be re-assessed
		Yes / No	No / Yes	CRITICAL
		Yes	Yes	CRITICAL

4.	>100%	No	No	To be re-assessed
		Yes / No	No / Yes	OVER- EXPLOITED
		Yes	Yes	OVER- EXPLOITED

Note:' *To be re-assessed' means that data is to be checked and reviewed. If the ground water resources assessment and the trend of long term water levels contradict each other. This anomalous situations requires a review of the ground water resource computations, as well as the reliability of water level data.*

The long term ground water level data should preferably be for a period of 10 years. The significant water level decline may be taken in consideration between 10 to 20 cm/ year depending upon the local hydro geological conditions.

Dynamic Ground Water Resources Estimation of Tamil Nadu As on March 2013

District Summary

(in ha.m)

VILLUPURAM DISTRICT

Sl.No	District	Net Annual Ground Water Availability	Existing Draft for Irrigation	Existing Draft for domestic and industrial use	Total Draft (5+6)	Stage of Ground Water Development {(6/3)*100} %	No of Over Exploited Firkas
1	2	3	4	5	6	7	8
1	VILLUPURAM	148,771.00	141,402.85	5,010.48	146,413.34	98%	30

Firkawise Summary

(in ha.m)

VILLUPURAM DISTRICT

Sl.No	Assessment Unit (Firka)	Net Annual Ground Water Availability	Existing Draft for Irrigation	Existing Draft for domestic and industrial use	Total Draft (5+6)	Stage of Ground Water Development {(6/3)*100} %	Category of the Firka
1	2	3	4	5	6	7	8
1	ALATHAUR	3777.32	2043.36	98.75	2142.11	57	SAFE
2	ANNIYUR	2798.25	3541.35	77.17	3618.52	129	OVER EXPLOITED
3	ARAKANDANALLUR	2366.39	1569.60	109.08	1678.68	71	SEMI CRITICAL
4	ARASUR	2618.43	2651.40	76.71	2728.11	104	OVER EXPLOITED
5	ARIYALUR	3692.67	587.48	70.88	658.36	18	SAFE
6	AVALURPETTAI	2986.39	3144.35	66.31	3210.66	108	OVER EXPLOITED
7	BRAMMADESAM	2075.68	2532.70	107.77	2640.47	127	OVER EXPLOITED

VILLUPURAM DISTRICT

S.No	Assessment Unit (Firka)	Net Annual Ground Water Availability	Existing Draft for Irrigation	Existing Draft for domestic and industrial use	Total Draft (5+6)	Stage of Ground Water Development {(6/3)*100}	Category of the Firka
8	CHINNASELAM	2664.65	2327.20	107.69	2434.89	91%	CRITICAL
9	CHITHALINGAMADAM	2688.39	2658.30	73.27	2731.57	102%	OVER EXPLOITED
10	DEEVANUR	2090.60	1051.20	61.69	1112.89	53%	SAFE
11	ELAVANA SURKOTTAI	2475.06	3028.00	37.70	3065.70	124%	OVER EXPLOITED
12	ERAIYUR	2963.28	3525.00	71.53	3596.53	121%	OVER EXPLOITED
13	GINGEE	3279.20	4024.80	109.71	4134.51	126%	OVER EXPLOITED
14	INDILI	2928.69	3972.83	83.34	4056.17	138%	OVER EXPLOITED
15	KALAMARUDUR	2684.07	2924.04	81.18	3005.21	112%	OVER EXPLOITED

16	KALLAKURICHI	2174.74	1657.22	66.56	1723.78	79%	SEMI CRITICAL
17	KALVARAYAN MALAI	705.90	566.30	13.66	579.96	82%	SEMI CRITICAL
18	KANAI	3196.41	2664.77	126.57	2791.34	87%	SEMI CRITICAL
19	KANDAMANGALAM	4357.54	3299.63	117.45	3417.08	78%	SEMI CRITICAL
20	KANJANUR	3299.53	3148.40	97.83	3246.23	98%	CRITICAL
21	KILIYANUR	1829.92	2352.64	54.65	2407.28	132%	OVER EXPLOITED
22	MAILAM	1247.69	915.26	97.86	1013.12	81%	SEMI CRITICAL
23	MANALURPETTAI	2418.08	1762.66	81.23	1843.89	76%	SEMI CRITICAL
24	MARAKANAM	1572.03	1898.95	46.96	1945.91	124%	OVER EXPLOITED
25	MELMALAYANUR	2528.37	3034.80	75.16	3109.96	123%	OVER EXPLOITED
26	MELOLAKKUR	3720.26	4678.20	73.16	4751.36	128%	OVER EXPLOITED
27	MUGAIYUR	2976.32	1988.95	110.41	2099.35	71%	SEMI CRITICAL
28	NAGALUR	2969.74	4342.40	114.74	4457.14	150%	OVER EXPLOITED
29	NAINARPALAYAM	2437.95	3081.44	57.39	3138.83	129%	OVER EXPLOITED
30	NEMILI	1460.52	1948.10	52.71	2000.81	137%	OVER EXPLOITED
31	OLAKKUR	2094.87	1908.40	230.73	2139.13	102%	OVER EXPLOITED
32	RETTANAI	1900.67	1095.88	88.00	1183.88	62%	SAFE
33	RISHIVANDHIYAM	3897.84	2547.32	107.44	2654.76	68%	SAFE
34	**SANKARAPURAM**	3319.71	2111.22	127.84	2239.06	67%	SAFE
35	SATHAMPATI	2290.28	2335.60	53.72	2389.32	104%	OVER EXPLOITED
36	SATHIYA MANGALAM	3918.66	5238.00	130.49	5368.49	137%	OVER EXPLOITED
37	SENGURICHI	1942.82	1611.03	47.76	1658.79	85%	SEMI CRITICAL
38	SIRUVADI	1987.32	2640.15	95.17	2735.32	138%	OVER EXPLOITED
54	SITHALAMPATTU	3772.09	5905.45	128.45	6033.90	160%	OVER EXPLOITED
39	T.V.NALLUR	2936.24	3630.11	71.36	3701.47	126%	OVER EXPLOITED
40	THIRUKOILUR	2601.20	1956.69	92.58	2049.26	79%	SEMI CRITICAL
41	THIRUNAVALLUR	2588.98	1458.83	71.23	1530.06	59%	SAFE

42	THIRUPPALA PANDAL	2804.06	1380.82	72.81	1453.63	52%	SAFE
43	THIYAGADURGAM	3256.85	3629.60	96.59	3726.19	114%	OVER EXPLOITED
44	TINDIVANAM	1749.38	2022.05	125.24	2147.29	123%	OVER EXPLOITED
45	ULUNDURPETTAI	2059.57	2477.80	65.33	2543.13	123%	OVER EXPLOITED
46	UPPUVELUR	1986.41	2302.17	42.71	2344.87	118%	OVER EXPLOITED
47	VADAKANANDAL	3297.98	2565.60	88.16	2653.76	80%	SEMI CRITICAL
48	VADAPONPARAPI	4022.67	1436.20	146.04	1582.24	39%	SAFE
49	VADASIRUVALUR	2514.14	2741.20	126.98	2868.18	114%	OVER EXPLOITED
50	VALAVANUR	3588.75	2143.70	125.01	2268.71	63%	SAFE
51	VALLAM	3350.19	4137.85	101.74	4239.59	127%	OVER EXPLOITED
52	VANUR	1756.51	1590.55	81.83	1672.38	95%	CRITICAL
53	VELLIMALAI	965.80	611.60	57.66	669.26	69%	SAFE
55	VIKKIRAVANDI	2869.69	2975.40	104.87	3080.27	107%	**OVER EXPLOITED**
56	VILLUPURAM	2314.23	2028.35	111.59	2139.94	92%	CRITICAL
TOTAL		**148771.0**	**141402.85**	**5010.48**	**146413.34**	**98%**	

4. Groundwater quality issues:

The rainfall is the main source for the availability of water both in surface and sub surface. The quantum of rainfall varies every year depending upon the monsoon. However, the extraction of surface and sub surface water is increasing year by year. It leads to environmental impact on the water sources like depletion of water level, deterioration of water quality. It makes the demand for the quantification of available water and also its quality for various purposes like agriculture, industries, drinking and domestic purposes.

For the present assessment, the value of Total Dissolved Solids (TDS) have been considered for demarcation of good / bad quality areas. For this purpose, the TDS value of less than or equal to 2000 mg/l have been considered as good quality and the value more than 2000 mg/l have been considered as bad quality areas.

The presence of fluoride in natural Ground Water is having its merits and demerits depending upon the concentration. Presence of fluoride <1.0 mg/l in drinking water reduces dental diseases whereas higher level > 1.50 mg/l will affect

the health and causes dental fluoridise. Nitrate is noted significantly in Ground Water due to use of chemical fertilizer for agriculture and other local pollution rocks and soils are also contributing nitrate to Ground Water. Arsenic is another poisonous heavy metal in Ground Water. The allowable limits for drinking purposes are 0.05 mg/l.

In Villupuram District, the quality of Ground Water generally ranges from moderate to good quality both in the shallow dug well and bore wells except in & around the Kazhuveli tank, where the water quality is poor due to seawater intrusion in the lagoons during high tide seasons, the production of salt and Aquaculture farming.

5. Groundwater issues and challenges:

The groundwater quantity and quality are to be highlighted and may be analyzed in terms of :

(i)Problems posed by nature:

In terms of Quantitative aspects, nowadays, rainfall may more within the short period of duration. Due to this aspect, recharge is less and runoff will be more. The availability of groundwater is less due to over extraction than recharge. The Percentage of OE/Critical Firkas increased due to this reason. Increasing the artificial recharge structures in the proper areas may avoid the depletion of groundwater especially in OE/Critical Firkas.

(ii) Problems caused by anthropogenic activities:

The problems caused due to intensive groundwater extraction, intensive surface water irrigation, intensive mining activities, growing urban complexes and industrial establishments will lead to drastic depletion in groundwater resources only. Proper alternative recharge structures must be established.

(iii) Problems caused by socio-economic condition:

The land holdings of farmers may be different from another. One farmer having more than 5 Acres has less expense than a farmer having one acre. The free electric supply to all farmers have chance to extract more groundwater. To avoid this, proper guidance will be given to the farmers for the usage of groundwater.

(iv) Administrative issues:

To control, regulate and manage the Ground Water Resources in the State, there is no groundwater act, now in force. But, the **Chennai Metropolitan**

Area Ground Water (Regulation) Act, 1987 is in force and it extends to Chennai City and notified 302 revenue villages in Kanchipuram and Thiruvallur Districts, only.

The rest of Tamilnadu, **G.O.(Ms).No.142, Public Works (R2) Department, dated: 23.07.2014** and **G.O.(Ms).No.113, Public Works (R2) Dept , Dt:09.06.2016** are regulate and manage the groundwater resources. The Government of Tamil Nadu had enacted the **Tamil Nadu Ground Water (Development and Management) Act, 2003**. However, this **Act was repealed on 14.09.2013**, in order to enact a comprehensive law to develop and manage the groundwater in the changed scenario in the State.

The pricing policy for groundwater users is also an important strategy in controlling the illegal extraction of groundwater by taking from lorries,etc. The unused dug wells and bore wells can be used as artificial recharge structures will be good concept in recharging the ground water.

6. Groundwater Management and Regulations:

(i) <u>Statute/Law/Policy/Regulations if any</u>:

The Central Ground Water Authority has been constituted to regulate, control, development and management of ground water resources for whole country based on overall situation prevailing in India. But, the ground water conditions are varying from State to State. **Ground Water is a State subject and the State Government has every right to protect and regulate their own precious ground water resources according to the prevailing conditions in the State.**

The Tamil Nadu Government had enacted **"The Tamil Nadu Ground Water (Development and Management) Act, 2003"** which was subsequently **repealed in 2013**, so as to bring out an effective management Act considering the present scenario. **As an interim measure, for regulating the exploitation of ground water, the Government have issued G.O. (Ms) No.142,PWD dated 23.07.2014 for regulations for management of ground water for safe guarding the scarce groundwater resources in Tamil Nadu State.** In the absence of an Act, the Government executes this Government order to control,

regulate and manage the Ground Water Resources while taking into consideration of the future of the State and its people.

The State Ground and Surface Water Resources Data Centre has estimated the Ground Water resources of Tamil Nadu State periodically in co-ordination with the Central Ground Water Board, Government of India, SECR, Chennai, based on the Methodology evolved by Ground Water Resources Estimation Committee, 1997 (GEC 97).

Accordingly, **the Ground Water Potential Assessment done as on January 1992 and as on January 1997 on the basis of Panchayat Union Blocks as assessment units** in Tamil Nadu and **categorized as Dark, Grey and White areas.** The Blocks with more than 85% to 100% ground water development were categorized as “Dark Blocks” and the blocks with ground water development between 65% to 85% were categorized as “Grey Blocks” and less than 65% ground water development were categorized as “White Blocks” and the Government approved the categorisation and released as Government order and G.O.No:326, PW (R2) Dept, dated: 23.11.1993. It was in effect up to the next assessment done as on March 2003.

Subsequently, **the Ground Water Potential Assessment done as on March 2003**, **categorized the blocks as Over Exploited, Critical, Semi Critical, Safe, Saline instead of Dark, Grey and White blocks**. The Blocks with more than 100% were categorized as “Over Exploited Blocks”, the blocks in between 90% to 100% as “Critical Blocks”, the blocks in between 65% to 90% as “Semi Critical Blocks” and less than 65% as “Safe Blocks” and the bad quality blocks were categorized as “Saline Blocks” and the same was approved by the Government and released as G.O.No:51, PW (R2) Dept, dated: 11.02.2004. It was in effect up to the next assessment done as on March 2009.

The Next **Ground Water Potential Assessment done as on March 2009**, and the same was approved by the Government and **released as G.O.No:52,PW(R2) Dept, dated: 02.03.2012.**

As per G.O.No.52,PW(R2) Dept, dated: 02.03.2012 and G.O. (Ms) No.142,PW(R2)Dept dated 23.07.2014, the State Government have

authorized and empowered the Chief Engineer, State Ground and Surface Water Resources Data Centre, Chennai for issuing permission or license or No Objection Certificate/renewal for drawal and transportation of Ground Water based on the hydro geological conditions to the New Industries, Packaged Drinking Water Companies, Infrastructures and Mining projects, etc except the areas to which the Chennai Metropolitan Area Ground Water (Regulation) Act,1987 extends.

Subsequently, the next **Ground Water Resources Assessment of the State was completed as on March 2011** and taking **Firka as an assessment unit** in the State of Tamil Nadu. Based on the above assessment, **the Government had approved and issued G.O.(Ms).No.113, Public Works (R2) Dept , Dt:09.06.2016** for categorisation of the Firkas in the State as Over Exploited, Critical, Semi-Critical and Safe Firkas. All the Over Exploited and Critical Firkas are notified as **"A" Category** (where the stage of ground water extraction is 90% and Above) and all the Semi Critical and Safe Firkas are notified as **"B" Category** (where the stage of ground water extraction is below 89%). In this Government Order, the Government had directed that **no Schemes should be formulated in the "A" Category Firkas and in "B" Category Firkas, all the Schemes should be formulated through State Ground and Surface Water Resources Data Centre by issuing No Objection Certificate for Ground Water Clearance.**

The term "Schemes" excludes Energisation of Agricultural pump sets by the Tamil Nadu Electricity Board. The present order may also exclude the Ground Water drawal for a). Domestic purpose by individual household, b). Domestic Infrastructure project (Housing), c).Government's Drinking Water Supply Schemes and d). non water based industries, (i.e.- the industries which do not require and use water, either as raw material or for other processing). However, the domestic use of water by this non water based industries will be permitted by the Chief Engineer / State Ground and Surface Water Resources Data Centre based on hydro geological conditions. (i.e. NOC from Chief Engineer, State Ground and Surface Water Resources Data Centre, Water Resources Department, Chennai). The list of non water based industries will be issued by the Industries Department of Government of Tamil Nadu separately.

Appropriate rain water harvesting and Artificial recharge schemes should be carried out in the categories viz , Over exploited , Critical , Semi Critical and Safe blocks of Tamil Nadu. While carrying out the above schemes, priority should be given to marginal quality and bad quality areas so as to avoid further deterioration.

All the schemes and proposals based on Ground Water will have to adhere to the Government orders and conditions. The Chief Engineer, State Ground and Surface Water Resources Data Centre had received the Government approval on Groundwater Assessment as on March 2011.

Regarding granting permission/ License for transportation of ground water for water suppliers/ private water tankers for selling the water on commercial basis, the State Ground and Surface Water Resources Data Centre, Public Works Department is not issuing any No Objection Certificate.

The Chief Engineer, SG&SWRDC have empowered to issue the NOC for drawal of Ground Water is up to 1 Million Gallons per day. Beyond this, the firms should get an approval in Water Utilisation Committee for drawal of both Surface and Ground Water resources in Tamil Nadu.

(ii) <u>Suggestions for improvement of groundwater governance</u>.

Groundwater is recognized as a common pool resource. The use of groundwater by anybody should in no way cause adverse impacts on realization of other person's fundamental right to safe water for life. Access to groundwater without any discrimination, equitable distribution, and sustainable use considering the needs of future generations are considered. Right to water for life is the first priority and then to agriculture, and eco system needs. The precautionary principle and the polluter pay principle only to conserve and recharge groundwater.

The responsibility of the State for ensuring every person's right to safe water even when water service is delegated to a private agency. Groundwater is not amenable to ownership by the State, communities or persons and the State is the public trustee of groundwater. It also deals elaborately on groundwater protection and groundwater security plans.

The Groundwater Act should incorporate legal pronouncement on groundwater such as the public, trust doctrine and recognition of the right to groundwater. It addresses the deficiencies in the present legal frame work in dealing with over exploitation and includes the improvements to the control mechanism to ensure the qualitative and quantitative sustainability of groundwater resources. It proposes to strengthen the regulating powers of Panchayat and Municipal bodies related to Ground water in line with articles 243G and 243W of the constitution.

The Pricing of Ground Water for irrigation, Industrial and domestic purposes and collecting fees by water users association should be left to the State decision.

(iii) <u>Institutions governing/managing/monitoring the resources and Institutional structure, gaps if any</u> :

While framing the Groundwater Act, the recommendation for the constitution of (1) Gram Panchayat Groundwater Sub-Committee, (2) Block Panchayat Groundwater Management, (3) Ward Groundwater Committee, (4) Municipal Water Management Committee, (5) District Ground Water Council and (6) State Ground Water Advisory Council to control and manage Ground water should be considered.

- The constitution of aforesaid committees is completely based on administrative boundaries such as village, block, ward, municipality, district etc. But, with respect to water resources control and management issues and conflicts, the boundary should be based on river basins to have efficient monitoring and management of water resources. The Government of India, in all issues related to water resources considered only the basin boundary concept. Hence, the institutional frame work has to be revised so as to have the jurisdiction of the committees with respect to basin / watershed concept. Further, Government of India, MoWR, RD &GR advocates time and again integrated water resources management. The above institutional frame work separately for groundwater is not in line with that.
- Further, it has also provided for many committees, viz., Gram Panchayat Groundwater Sub-Committee, Village Water and Sanitation Committee, Ward

Committee, Municipal Committee, Block level Committee, District level Committee and State level Committee. For managing surface water resource water users association already exists. Too many committees at village / ward level would jeopardize the very purpose of managing the Groundwater resources efficiently and may invite lot of conflicts.

(iv) <u>Areas of people/private participation if any</u>:

The participation of people or private parties in the groundwater management is not suggestible, acceptable one and more chances of making litigations in the society and has unnecessary law and order problems may arise.

7. Tools and Methods

(i) Water Level and quality measurements through wells, piezometers, DWLR with telemetry, ground water elevation.

In general, water levels in the observation wells and piezometers can be taken manually by measuring tape. This is the simple, cost effective, good accuracy and less maintenance method. Water Levels are observed above the Measuring point.

Monitoring water level in DWLR with telemetry is costly, high maintenance, good accuracy, get the data immediately on desktop, easy to analysis purpose.

The water quality generally is analysed in the Chemical Lab only by collecting water samples in Pre Monsoon and post Monsoon period in the field. Sometimes, instant kits are used for analyzing the TDS and Ph level in the water.

(ii) Metering water supply to confirm contribution from groundwater.

Metering the water supply is essential one to monitor the overall usage of groundwater by different sectors. Flow meter must be fixed in every extraction structure and it has to be monitored periodically by Government officials.

8. Performance Indicators:

(i) Bench Marks/ Norms/ Standards and deviation from the norms/bench marks/ standards currently.

The Ground Water resources of State periodically estimated in co-ordination with the Central Ground Water Board, Government of India, SECR,

Chennai, based on the Norms evolved by Ground Water Resources Estimation Committee, 1997 (GEC 97).

The ground water potential assessment can be assessed based on the bench marks such as Average Rainfall, Total recharged Area, Monthly Water Level Data, Total no of wells in the area, Irrigation methods adopted, Cropping pattern details, Geological conditions prevailing in that area, Specific yield, Seepage factor, Constructed Artificial recharge structures, etc and various calculations methods, etc, have to be considered.

Status of various Performance Indicators

(ii) Percentage of over exploited ,critical, Semi critical , Safe and Saline/Poor quality Firkas/area units

- Trend of over exploited and critical Firkas to total Firkas as per pervious assessment. (2009 Assessment Vs 2011 Assessment)

  The Ground Water Potential Assessment as on March 2009, Out of 22 blocks in Villupuram District, 10 blocks are categorized as Over Exploited and Critical blocks and remaining 12 blocks are categorized as Semi Critical and Safe blocks.

  The next Ground Water Resources Assessment of the State was done as on March 2011 and taking Firka as an assessment unit. In Villupuram District, totally 55 Firkas, 34 Firkas are categorized as Over Exploited and remaining 21 Firkas are categorized as Semi Critical and Safe blocks.

  Instead of taking Block as an assessment, Firka can be taken as assessment unit is to concentrate the assessment in micro level. For Eg, a block contains more than three to four Firkas. In this block, two Firkas may have good groundwater potential than other two Firkas but it may to categorize as Over Exploited. To avoid this, assessment done on the basis of Firkas for the benefit of farmers to the implementation of schemes related to Irrigation.

  The percentage of over exploited and critical Firkas has been increased by changing the concept from Block to Firka assessment. The total percentage of over exploited and critical Blocks for 2009 Assessment is

45.45%, but, the total percentage of over exploited and critical Firkas as on March 2011 Assessment is 61.81%, in the Villupuram District.

- Trend of over exploited and critical Firkas to total Firkas as per latest assessment

  The percentage of over exploited and critical Firkas has been decreased in 2013 latest assessment when compared to 2011 assessment. In 2011 assessment, out of 55 Firkas, the total percentage of over exploited and critical Firkas is 61.81%, but, In 2011 assessment, out of 56 Firkas, it has been come down marginally to 60.71%, in the Villupuram District.

- Existing state of groundwater resources as compared to previous assessment (2013 Vs 2011 assessment).

  Based on the Estimation of Ground Water Resources of Tamil Nadu State as on March 2013, Out of 56 Firkas in the State, 30 Firkas are categorized as “Over Exploited Firkas”, 4 Firkas are categorized as “Critical Firkas”, 11 Firkas are categorized as “Semi Critical Firkas”, 11 Firkas are categorized as “Safe Firkas”.

  Based on the Estimation of Ground Water Resources of Tamil Nadu State as on March 2011, Out of 55 Firkas in the State, 32 Firkas are categorized as “Over Exploited Firkas”, 2 Firkas are categorized as “Critical Firkas”, 10 Firkas are categorized as “Semi Critical Firkas”, 11 Firkas are categorized as “Safe Firkas”.

  When compared to last assessment as on March 2011, the “Over Exploited Firkas” comes down from 32 to 30 Firkas, the “Critical Firkas” increased from 2 to 4 Firkas, the “Semi Critical Firkas” increased marginally from 10 to 11 Firkas, the “Safe Firkas” maintains the same as 11 Firkas and the “Saline Firkas” remains Nil Firkas. The alteration of Firkas are due to the construction of Artificial Recharge structures such as Check Dams, Recharge Wells, Recharge shafts, percolation ponds; etc was constructed in the “Over Exploited Firkas” by various departments.

S.No	Categorisation	No of Firkas	
		2011	2013
1	Over Exploited	32	30
2	Critical	2	4
3	Semi Critical	10	11
4	Safe	11	11
5	Saline	Nil	Nil
TOTAL		55	56

(iii) Water Level(Well hydrographs and water level trends – pre and post monsoon such as declining trend/rising trend,etc).

(iv) Comparison of area irrigated from groundwater resources (Current assessment 2013 to previous assessment 2011).

S.No	Description	2011 Assessment	2013 Assessment
1	Area Irrigated from ground water resources(In hm)	6538.07	6505.06

(v) No. of groundwater abstraction structures (existing no. over the year and trends).

S.No	Description	2011 Assessment	2013 Assessment
1	No of groundwater abstraction structures for Irrigation	1,71,071 Wells	1,70,983 Wells

(vi) Trend in water quality (no of habitations affected with groundwater contamination like As, F, Salinity etc. Change in contamination level over the years.

(vii) Source augmentation (Groundwater)

- Area covered with infrastructure for recharging groundwater:

  The proper artificial recharge structures has to be constructed based on local geological conditions in the areas of existing infrastructure for recharging groundwater according to their extraction needs.
- GW recharge plan to combat adversaries:

Groundwater recharge plans has to be strictly followed by with of implementing the groundwater laws to combat adversaries.

9. Reforms undertaken/being undertaken/proposed if any.

10. Road Map of activities/tasks proposed for better governance with timelines and agencies responsible for each task/activity.