CHAPTER 4.1.9 GROUND WATER RESOURCES

CUDDALORE DISTRICT

INDEX

GROUND WATER REPORT OF CUDDALORE 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

The geographical extent of Cuddalore District is 3, 67,781 hectares (3, 4860 sq.km.) accounting for 2.7 percent of the geographical area of Tamilnadu State. The district has well laid out roads and railway lines connecting all major towns within and outside the State. For administrative purpose the district has been bifurcated into 6 Taluks,13 Blocks and 32 Firkas. The district capital is Cuddalore which is major city with municipality status for the past 100 years.

Cuddalore District is totally bifurcated into 32 Firkas.

1. Hydrogelogy

(i) Major Geological formations:

Geology

Geologically, the entire district can be broadly classified into hard rock and sedimentary formations.

Hard rock formation

The western part of the district is covered by Granitic gneiss, Hornblende gneiss and of Charnockite with intrusions of Dolelrite dykes and Pegmatites. These rocks are

highly metamorphosed and have been subjected to very sever folding, crushing and faulting.

Sedimentary formation

The Cuddalore sandstones of the Tertiaries are well developed in this district and occur in two discontinuous patches in extensive areas. The formation consists of white clays, sands, sandy clays and unconsolidated sandstones mottled in color with lignite seams.

The Cretaceous formations consist of limestone, white argillaceous sandstone, sandstone with clay and fossiliferous Limestone. The sillakudi formation consists of calcareous sandstone.

The Cuddalore sandstone formations are confined by impervious clay bed which gives rise to several flowing artesian wells. The Sanstone is having good groundwater potential. These tertiary formations are overlain by alluvium.

The river deposits of Vellar, Gadilam, Pennaiyar and Manimuktha rivers are spread over the Cuddalore sandstone. The thickness of the sand ranges between 6m and 12m. This alluvial formation also act as potential aquifers. This alluvium consists of unconsolidated sands, gravels and clays.

The Cuddalore taluk is covered with sedimentary formations namely Cuddalore sandstones and alluvial formations. The northeast and southern parts of this taluk is covered with alluvial deposits, deposited by Pennaiyar and Gadilam River whereas the western part of the taluk is covered with Cuddalore sandstone.

The Kattumannar Koil taluk is covered with alluvium on the Northeast and in the down stream side of Veeranam tank and Cuddalore sandstone deposits on the west and upstream side of Veeranam tank.

In Panruti taluk alluvial deposits occur on the northern side, on either side of the pennaiyar and Gadilam river, Cuddalore sandstone occurs on the southern side of the taluk.

In Vriddhachalam taluk alluvial deposit occurs on either side of Vellar and Manimuktha Rivers. Tertiary formation occurs on the North and Southern parts of the taluk, and gneissic formation occur on the North western part of the taluk.

In Thittagudi taluk more than 80% of the area is covered with Charnockite and Gneissic formations and Alluvial deposit occurs on the south eastern part of the taluk.

Occurrence of Groundwater

Occurrence of artesian aquifer around Neyveli

A series of potential confined occurs below the lignite seams. Lignite occurs in a series of seams between the depth range of 50 and 80 m below ground level whose thickness varies between 10 and 18m.

There is a general decline in piezometric surface ranging form 3.60 m to 17.19 m over a decade. Maximum decline is noticed around Neyveli area due to the overdraft for mine safety, which has resulted in lowering piezometric surface upto 16.77 meter below mean sea level.

All the free flowing wells tapping Cuddalore standstone aquifer have ceased flow. However free flowing wells tapping confined Creataceous aquifer keep free flowing though with lesser discharge rates. The rate of decline in piezometric surface of tertiary aquifer in the Neyveli area due to overdraft for mine safety is in the order of 1.1 to 1.6 m per year and the rate of decline due to groundwater development alone is in the order of 0.36 to 0.56 m per year.

Drilling of Boreholes

The occurrence and movement of groundwater in sedimentary formations depends on the rate of Transmissivity, Permeability and Storage co-efficient and grain size of the particles.

For investigation purposes, the State ground and Surface water Resources Date Centre, has drilled more than 152 bore holes spread over the entire district, out of which

132 bore holes are drilled in sedimentary area and 20 bore holes are drilled in hard rock formations.

The bore holes are spread over the entire district to find out the nature and behaviour of the subsurface formations. There is no much diversity in the nature, in the adjacent area of alluvial and tertiary formations. But there is much variation with in the short distances in hard rock formations. Sand and clay deposits present upto 457.5 m below ground level in the tertiary formation. But the thickness of alluvium is less towards west and covers the entire taluks of Cuddalore, Panruti, Chidambaram, Kattumannarkoil and parts of Vriddhachalam and Thittagudi.

Generally in hard rock regions occurrence and movement of groundwater is restricted to open system of fractures like fissures and joints in unweathered portion and also in the porous zones of weathered formations.

Generally in hard rock regions the occurrence of weathered thickness is discontinuous both in space and depth. Hence the recharge of groundwater is influenced by the intensity of weathering. The subsurface conditions can be ascertained by drilling exploratory bore holes and conducting pump tests.

The maximum thickness of weathering upto 35m is observed at Kilseruvasi and the minimum thickness of weathering upto 12m observed in the locations Vallimarudam and Tholudur.

Aquifer parameters

More or less 80% of Cuddalore district is covered by sedimentary formations of tertiary and alluvial deposits.

The river deposits of Pennaiyar, Gadilam, Manimuktha and Vellar ranges between 6m and 12 m thickness with very good ground potential, consists of sand, gravelly sand, clay and clayey sands. The range of aquifer parameters of Alluvium, Tertiary, Cretaceous and Crystalline formations furnished below:

Range of Aquifer Parameters

	Sp.capacity lpm/m-d	**Sp. Yield %**	**T m^2-d**	**K m/d**	**Yield of Wells lps**
Alluvium	208	7.2	98	19.7	2.5
Tertiary	78.173	1.4-3.5	46-134	16-33	2.5
Cretaceous	33-782	0.3-2.56	33-782	10-66	1.1-3.5
Weathered Crystalline	27-224	0.8-2.5	16-60	5-20	1-2

Drilling of exploratory boreholes

Based on the field studies carried out and interpretations made from aerial photographs and satellite imageries, favourable locations are selected for exploratory drilling. By drilling, subsurface hydrogeological characteristics are determined to evaluate the groundwater potential of the area. From inception this department has drilled 152 bore wells in this district.

(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 Cuddalore 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 Cuddalore District, 205 observation wells and 47 piezometers,totally 252 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 Cuddalore District, during the pre monsoon, the water level generally in declining trend ranges from G.L. to 15m. The depth of well below Ground Level 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 Cuddalore District. The analysis reveals that the water level has gone down in the north, west and central parts of the Cuddalore 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 Cuddalore District.

(iii) Existing network of Monitoring wells:

In Cuddalore District, the existing network of monitoring wells is 252 wells,205 wells are observation wells and 47 wells are piezometers. These wells are observed for every month water level.

Cuddalore District: Observation Wells - Location and Co-ordinates

Well No	District	Tahsil / Taluk	Block / Mandal	Village	Latitude	Longitude
11200	Cuddalore	Viruthachalam		Erumanur	11°32'56"	79°18'25"
11201	Cuddalore	Viruthachalam		Ko.mangalam	11°31'07"	79°17'06"
11202	Cuddalore	Viruthachalam		Thoravalur	11°14'20"	77°21'09"
11203	Cuddalore	Viruthachalam		Vilankattur	-	-
11204	Cuddalore	Viruthachalam		Nallur	11°06'07"	77°23'33"
11205	Cuddalore	Viruthachalam		Thirupayar	-	-
11206	Cuddalore	Thittakudi		Pillur	12°25'52"	77°23'33"
11207	Cuddalore	Thittakudi		A.agaram	11°37'09"	79°41'22"
11208	Cuddalore	Thittakudi		E.keeranur	11°27'31"	79°07'00"
11209	Cuddalore	Thittakudi		Vagaiyur	11°24'16"	79°02'23"
11210	Cuddalore	Thittakudi		Kudikadu	11°41'04"	79°45'23"
11211	Cuddalore	Thittakudi		Vadakarampoondi	11°26'53"	78°55'46"
11212	Cuddalore	Thittakudi		V.chittor	11°32'02"	79°13'00"
11213	Cuddalore	Viruthachalam		T.kopurapuram	11°30'52"	79°19'03"
11214	Cuddalore	Viruthachalam		Veeraddikuppam	12°41'42"	80°23'20"
11215	Cuddalore	Viruthachalam		Manakollai	11°27'28"	79°34'25"

11216	Cuddalore	Viruthachalam		Puliyur	10°38'20"	78°49'57"
11217	Cuddalore	Viruthachalam		Agaram	11°37'07"	79°41'22"
11218	Cuddalore	Viruthachalam		Idaichittoor	-	-
11219	Cuddalore	Viruthachalam		Seppakkam	11°33'37"	79°08'31"
11220	Cuddalore	Viruthachalam		Keelkurichi	11°34'20"	79°07'05"
11221	Cuddalore	Thittakudi		Keel Orathur	11°34'58"	79°02'43"
11222	Cuddalore	Thittakudi		Rettakurichi	11°33'28"	79°01'39"
11223	Cuddalore	Thittakudi		Mangulam	9°46'44"	78°06'48"
11224	Cuddalore	Thittakudi		S.putur	10°19'09"	78°28'20"
11225	Cuddalore	Thittakudi		M.pudaiyur	-	-
11226	Cuddalore	Thittakudi		Pulikarambur	11°27'43"	78°57'58"
11227	Cuddalore	Thittakudi		Kandamathan	78°57'58"	78°57'36"
11321	Cuddalore	Chidambaram	Chidambaram	Kavarapattu	11°22'50"	79°44'47"
11322	Cuddalore	Chidambaram	Chidambaram	Thurinjikollai	11°28'30"	79°31'59"
33021	Cuddalore	Cuddalore		Gingee	12°09'08"	79°25'00"
33075	Cuddalore	Viruthachalam	Vriddhachalam	M.parur	11°34'37"	79°15'25"
33080	Cuddalore	Thittakudi	Mangalore	Panayandur	11°30'50"	78°55'30"
33081	Cuddalore	Thittakudi	Mangalore	Mangalore	11°30'52"	79°00'41"
33082	Cuddalore	Thittakudi	Mangalore	Kaludur	11°30'21"	79°05'41"
33083	Cuddalore	Thittakudi	Nallur	Kandappankurichi	11°32'04"	79°11'20"
33083A	Cuddalore	Viruthachalam	Nallur	Veppur	11°32'08"	79°11'24"

33085	Cuddalore	Thittakudi	Mangalore	Avinankudi	11°53'27"	79°10'21"
33086	Cuddalore	Thittakudi	Mangalore	Edaicheruvai	11°24'15"	79°04'20"
33087	Cuddalore	Thittakudi	Mangalore	Tholudur	11°10'25"	79°15'00"
OW11200	Cuddalore	Viruthachalam	Vridhachalam	Erumanur	11°32'03"	79°17'58"
OW11201	Cuddalore	Viruthachalam	Vridhachalam	Ko.mangalam	11°31'16"	79°16'56"
OW11202	Cuddalore	Viruthachalam	Vridhachalam	Thoravalur	11°31'19"	79°15'46"
OW11203	Cuddalore	Viruthachalam	Vridhachalam	Vilankattur	11°31'38"	79°14'02"
OW11204	Cuddalore	Viruthachalam	Nallur	Nallur	11°33'46"	79°11'16"
OW11205	Cuddalore	Viruthachalam	Nallur	Thirupayar	11°32'03"	79°10'20"
OW11206	Cuddalore	Thittakudi	Mangalore	Pillur	11°30'22"	79°08'21"
OW11207	Cuddalore	Thittakudi	Mangalore	A.agaram	11°29'12"	79°07'12"
OW11208	Cuddalore	Thittakudi	Mangalore	E.keeranur	11°27'49"	79°07'13"
OW11209	Cuddalore	Thittakudi	Mangalore	Vagaiyur	11°24'19"	79°02'27"
OW11210	Cuddalore	Thittakudi	Mangalore	Kudikadu	11°29'42"	78°58'53"
OW11211	Cuddalore	Thittakudi	Mangalore	Vadakarampoondi	11°25'23"	78°56'54"
OW11212	Cuddalore	Thittakudi	Mangalore	V.chittor	11°25'03"	78°57'22"
OW11213	Cuddalore	Viruthachalam	Vridhachalam	T.kopurapuram	11°32'28"	79°20'27"
OW11214	Cuddalore	Viruthachalam	Vridhachalam	Veeraddikuppam	11°32'42"	79°20'35"
OW11215	Cuddalore	Viruthachalam	Vridhachalam	Manakollai	11°36'59"	79°25'40"
OW11216	Cuddalore	Viruthachalam	Vridhachalam	Puliyur	11°36'42"	79°15'08"
OW11217	Cuddalore	Viruthachalam	Vridhachalam	Agaram	11°37'46"	79°16'10"

OW11218	Cuddalore	Viruthachalam	Vridhachalam	Idaichittoor	11°36'33"	79°14'19"
OW11219	Cuddalore	Viruthachalam	Nallur	Seppakkam	11°33'42"	79°08'20"
OW11220	Cuddalore	Viruthachalam	Nallur	Keelkurichi	11°34'39"	79°06'39"
OW11221	Cuddalore	Thittakudi	Mangalore	Keel Orathur	11°34'53"	79°02'45"
OW11222	Cuddalore	Thittakudi	Mangalore	Rettakurichi	11°33'58"	78°59'21"
OW11223	Cuddalore	Thittakudi	Mangalore	Mangulam	11°33'59"	78°59'08"
OW11224	Cuddalore	Thittakudi	Mangalore	S.putur	11°32'34"	78°59'33"
OW11225	Cuddalore	Thittakudi	Mangalore	M.pudaiyur	11°28'53"	79°02'51"
OW11226	Cuddalore	Thittakudi	Mangalore	Pulikarambur	11°27'42"	78°58'01"
OW11227	Cuddalore	Thittakudi	Mangalore	Kandamathan	11°28'04"	78°57'06"
OW11300	Cuddalore	Cuddalore	Cuddalore	Thondamanatham	11°39'22"	79°43'03"
OW11301	Cuddalore	Kattumannarkoil	Kumaratchi	Koothur	11°15'22"	79°35'42"
OW11302	Cuddalore	Kattumannarkoil	Kattumannarkoil	Melakadambur	11°14'14"	79°31'35"
OW11303	Cuddalore	Kattumannarkoil	Keerapalayam	Melpathy	11°22'42"	79°27'23"
OW11304	Cuddalore	Cuddalore	Kurinjipadi	Thanur	11°33'35"	79°41'42"
OW11305	Cuddalore	Cuddalore	Kurinjipadi	Kundiyamallur	11°31'36"	79°39'06"
OW11306	Cuddalore	Cuddalore	Kurinjipadi	Kothavachery	11°31'21"	79°38'19"
OW11307	Cuddalore	Cuddalore	Kurinjipadi	Madhanagopalapuram	11°38'53"	79°36'39"
OW11308	Cuddalore	Cuddalore	Kurinjipadi	Pathirakottai	11°41'26"	79°37'24"
OW11309	Cuddalore	Cuddalore	Kurinjipadi	Ko-chatram	11°38'31"	79°35'56"

OW11310	Cuddalore	Cuddalore	Kurinjipadi	Pacharapalayam	11°35'35"	79°35'05"
OW11311	Cuddalore	Cuddalore	Kurinjipadi	Adoor Agaram	11°31'48"	79°37'49"
OW11312	Cuddalore	Chidambaram	Parangipettai	C.mutlur	11°26'39"	79°43'01"
OW11313	Cuddalore	Chidambaram	Parangipettai	Thatchankadu	11°29'16"	79°41'33"
OW11314	Cuddalore	Chidambaram	Parangipettai	Periyakomati	11°29'22"	79°42'56"
OW11315	Cuddalore	Chidambaram	Parangipettai	Thillaividangan	11°26'00"	79°44'31"
OW11316	Cuddalore	Chidambaram	Keerapalayam	Pannapattu	11°22'28"	79°36'09"
OW11317	Cuddalore	Chidambaram	Keerapalayam	Madhuranthagan allur	11°24'14"	79°35'18"
OW11318	Cuddalore	Chidambaram	Melbhuvanagiri	Maruthur	11°29'35"	79°35'54"
OW11319	Cuddalore	Cuddalore	Cuddalore	Thottapattu	11°46'26"	79°43'16"
OW11320	Cuddalore	Cuddalore	Cuddalore	Nagapanur	11°49'3 "	79°46'20"
OW11400	Cuddalore	Panruti	Kurinjipadi	Vadakkumelur	11°35'50"	79°31'45"
OW11401	Cuddalore	Panruti	Panruti	Semmedu	11°44'35"	79°30'15"
OW11402	Cuddalore	Panruti	Panruti	Silambinathan Pettai	11°41'30"	79°36'55"
OW11403	Cuddalore	Panruti	Panruti	Pathirakottai	11°42'20"	79°37'15"
OW11404	Cuddalore	Panruti	Anna grammam	Karumbur	11°50'20"	79°30'10"
OW11405	Cuddalore	Panruti	Panruti	Manamthavizhhnt haputur	11°48'15"	79°30'10"
OW11406	Cuddalore	Panruti	Anna grammam	Thiruduraiyur	11°49'30"	79°32'20"

OW11407	Cuddalore	Panruti	Anna grammam	Rasapalayam	11°49'05"	79°33'45"
OW11408	Cuddalore	Panruti	Anna grammam	Agaram	11°46'30"	79°37'25"
U33001	Cuddalore	CUDDALORE		KOLIYANUR	11°52'15"	79°31'40"
U33021	Cuddalore	Panruti	Panrutti	Thiruvamur	11°45'45"	79°29'00"
U33021A	Cuddalore	Panruti	Panruti	Thiruvamur	11°46'15"	79°29'50"
U33022	Cuddalore	Panruti	Panrutti	Semakottaii	11°46'30"	79°30'15"
U33023	Cuddalore	Panruti	Panruti	Anguchettipalayam	11°46'45"	79°31'30"
U33023/23A	Cuddalore	Panruti	Panrutti	Anguchettippalayam	11°46'45"	79°31'30"
U33023A	Cuddalore	Panruti	Panrutti	Anguchettippalayam	11°46'45"	79°21'30"
U33024	Cuddalore	Panruti	Panrutti	Poongunam	11°47'15"	79°33'45"
U33025	Cuddalore	Panruti	Panrutti	Kondareddippalayam	11°48'00"	79°34'15"
U33025A	Cuddalore	Panruti	Panruti	Kondareddipalayam	11°48'30"	79°34'50"
U33026	Cuddalore	Panruti	Panrutti	Pulavanur	11°49'30"	79°33'30"
U33026A	Cuddalore	Panruti	Panruti	Pulavanur	11°49'30"	79°33'30"
U33028	Cuddalore	Panruti	Panrutti	Thiruthalur	11°49'15"	79°31'15"
U33028A	Cuddalore	Panruti	Panruti	Thiruthalur	11°49'15"	79°31'15"
U33029	Cuddalore	Panruti	Panrutti	Thiruvathigai	11°46'00"	79°34'45"
U33029A	Cuddalore	Panruti	Panruti	Thiruvathigai	11°41'00"	79°34'45"

U33030	Cuddalore	Cuddalore	Annagramam	Muthukrishnapuram	11°45'45"	79°36'30"
U33030A	Cuddalore	Panruti	Panruti	Muthukkrishnapuram	11°45'48"	79°36'30"
U33031	Cuddalore	Panruti	Panrutti	Thotti	11°44'05"	79°42'10"
U33032	Cuddalore	Panruti	Panruti	Sundaravandi	11°44'45"	79°40'45"
U33033	Cuddalore	Viruthachalam	Kammapuram	Kandiankuppam	11°32'30"	79°20'30"
U33034	Cuddalore	Viruthachalam	Kammapuram	Mohambarikuppam	11°38'30"	79°23'30"
U33035	Cuddalore	Viruthachalam	Kammapuram	Nadiappattu	11°40'00"	79°24'00"
U33036	Cuddalore	Cuddalore	Kurinjippadi	Meenakshipettai	11°34'45"	79°36'00"
U33036A	Cuddalore	Cuddalore	Kurinjipadi	Meenakshipettai	11°34'33"	79°35'53"
U33037	Cuddalore	Panruti	Panrutti	Annadanapettai	11°35'57"	79°36'20"
U33038	Cuddalore	Cuddalore	Kurinjippadi	Krishnankuppam	11°38'25"	79°38'30"
U33039	Cuddalore	Cuddalore	Kurinjippadi	Kullanchavadi	11°37'40"	79°40'20"
U33040	Cuddalore	Panruti	Panrutti	Alagappasamudram	11°40'20"	79°33'30"
U33041	Cuddalore	Cuddalore	Annagramam	Pathrakkottai	11°41'57"	79°37'40"
U33042	Cuddalore	Cuddalore	Cuddalore	Naduveerapattu	11°43'45"	79°37'15"
U33043	Cuddalore	Cuddalore	Cuddalore	Sathankuppam	11°42'22"	79°41'22"
U33044	Cuddalore	Cuddalore	Cuddalore	Ramapuram	11°41'45"	79°41'40"
U33045	Cuddalore	Cuddalore	Cuddalore	Vazhisothanaipalayam	11°41'22"	79°43'40"
U33046	Cuddalore	Cuddalore	Cuddalore	Kannarappettai	11°41'30"	79°44'37"

U33047	Cuddalore	Cuddalore	Kurinjippadi	Vadalur	11°33'05"	79°32'25"
U33047A	Cuddalore	Cuddalore	Cuddalore	Vadalur	11°30'45"	79°33'00"
U33048	Cuddalore	Cuddalore	Kurinjippadi	Abatharanapuram	11°33'40"	79°33'15"
U33050	Cuddalore	Panruti	Annagramam	Sathippattu	11°44'40"	79°34'40"
U33051	Cuddalore	Panruti	Panrutti	Chithankuppam	11°38'45"	79°30'30"
U33052	Cuddalore	Panruti	Panrutti	Muthandikkuppam	11°39'00"	79°28'45"
U33053	Cuddalore	Panruti	Panrutti	Kattugudalur	11°38'15"	79°27'00"
U33055	Cuddalore	Viruthachalam	Kammapuram	Mudanai	11°34'15"	79°24'15"
U33055A	Cuddalore	Viruthachalam	Kammapuram	Mudanai	11°34'15"	79°24'15"
U33056	Cuddalore	Viruthachalam	Kammapuram	Edaikkuppam	11°32'45"	79°24'00"
U33058	Cuddalore	Viruthachalam	Kammapuram	Melakuppam	11°34'15"	79°26'15"
U33059	Cuddalore	Viruthachalam	Kammapuram	Sathamangalam	11°21'25"	79°22'55"
U33060	Cuddalore	Viruthachalam	Vriddhachalam	Vriddhachalam	11°31'10"	79°20'00"
U33060A	Cuddalore	Viruthachalam	Vriddhachalam	Vriddhachalam	11°31'10"	79°20'00"
U33061	Cuddalore	Viruthachalam	Vriddhachalam	Kuppanatham	11°32'45"	79°21'10"
U33061A	Cuddalore	Viruthachalam	Vriddhachalam	Kuppanatham	11°32'45"	79°21'10"
U33062	Cuddalore	Viruthachalam	Vriddhachalam	Irulakkurichi	11°38'30"	79°23'00"
U33063	Cuddalore	Viruthachalam	Vriddhachalam	Palakollai	11°40'30"	79°23'20"
U33065	Cuddalore	Thittakudi	Mangalore	Perumulai	11°12'15"	79°08'00"
U33068	Cuddalore	Thittakudi	Nallur	Maligaikottam	11°24'15"	79°15'30"
U33069	Cuddalore	Viruthachalam	Vriddhachalam	Karaiyur	11°25'45"	79°16'45"

U33070	Cuddalore	Viruthachalam	Vriddhachalam	Karuveppilankurichi	11°28'00"	79°19'30"
U33072	Cuddalore	Viruthachalam	Vriddhachalam	Karkudal	11°29'30"	79°21'00"
U33073A	Cuddalore	Viruthachalam	Kammapuram	Kumaramangalam	11°28'30"	79°23'00"
U33074	Cuddalore	Viruthachalam	Kammapuram	Melpalayur	11°28'00"	79°23'00"
U33075	Cuddalore	Kattumannarkoil	Kattumanarkoil	Gunamangalam	11°26'00"	79°23'00"
U33075A	Cuddalore	Kattumannarkoil	Kattumanarkoil	Gunamangalam	11°26'00"	79°23'00"
U33076	Cuddalore	Viruthachalam	Kammapuram	Kilpalayur	11°28'30"	79°25'30"
U33077	Cuddalore	Kattumannarkoil	Keerappalayam	Kanur	11°24'00"	79°28'15"
U33078	Cuddalore	Chidambaram	Bhuvanagiri	Erumbur	11°28'00"	79°31'00"
U33078A	Cuddalore	Chidambaram	Bhuvanagiri	Erumbur	11°28'30"	79°31'30"
U33079	Cuddalore	Chidambaram	Keerappalayam	Veeramudayanatham	11°26'00"	79°31'00"
U33080	Cuddalore	Chidambaram	Keerappalayam	Vattathur	11°23'00"	79°31'30"
U33080A	Cuddalore	Chidambaram	Keerappalayam	Vattathur	11°23'00"	79°31'30"
U33081	Cuddalore	Chidambaram	Bhuvanagiri	Sethiathope	11°26'00"	79°32'45"
U33082	Cuddalore	Chidambaram	Bhuvanagiri	Miralur	11°27'15"	79°34'00"
U33082A	Cuddalore	Chidambaram	Bhuvanagiri	Pinnalur	11°28'09"	79°33'14"
U33083	Cuddalore	Kattumannarkoil	Keerappalayam	Sathamangalam	11°25'00"	79°33'45"
U33083A	Cuddalore	Chidambaram	Keerappalayam	Sathamangalam	11°25'30"	79°34'00"

U33084	Cuddalore	Chidambaram	Keerappalayam	Orathur	11°25'30"	79°35'30"
U33085	Cuddalore	Chidambaram	Bhuvanagiri	Odaiyur	11°27'15"	79°35'45"
U33085A	Cuddalore	Chidambaram	Bhuvanagiri	Odaiyur	11°27'30"	79°36'00"
U33086	Cuddalore	Chidambaram	Keerappalayam	Keerappalayam	11°26'00"	79°39'00"
U33087	Cuddalore	Chidambaram	Bhuvanagiri	Lalpuram	11°25'00"	79°41'00"
U33088	Cuddalore	Chidambaram	Parangippettai	Portonovo	11°29'20"	79°45'30"
U33089	Cuddalore	Chidambaram	Parangippettai	Puduchatram	11°31'10"	79°43'55"
U33089A	Cuddalore	Chidambaram	Parangippettai	Puduchathiram	11°31'40"	79°44'00"
U33090	Cuddalore	Kattumannarkoil	Kumaratchi	Alkondanatham	11°21'00"	79°34'50"
U33091	Cuddalore	Kattumannarkoil	Kumaratchi	Kuduvelichavadi	11°21'30"	79°38'10"
U33091A	Cuddalore	Kattumannarkoil	Kumaratchi	Kuduvelichavadi	11°22'00"	79°38'50"
U33092	Cuddalore	Kattumannarkoil	Kumaratchi	Kumaratchi	11°18'30"	79°37'45"
U33093	Cuddalore	Chidambaram	Kumaratchi	Thandeswaranallur	11°23'00"	79°40'35"
U33093A	Cuddalore	Chidambaram	Kumaratchi	Thandeswaranallur	11°23'30"	79°41'00"
U33094	Cuddalore	Kattumannarkoil	Kumaratchi	Thirunaraiyur	11°17'45"	79°35'00"
U33095	Cuddalore	Chidambaram	Keerappalayam	Vakkur	11°24'00"	79°34'30"
U33095A	Cuddalore	Chidambaram	Keerappalayam	Vakkur	11°24'40"	79°35'00"
U33096	Cuddalore	Kattumannarkoil	Kattumannarkoil	Reddippalayam	11°24'00"	79°25'30"
U33097	Cuddalore	Kattumannarkoil	Kattumannarkoil	Adhivarahanallur	11°25'00"	79°29'30"
U33097A	Cuddalore	Kattumannarkoil	Kattumannarkoil	Athivaraganallur	11°22'30"	79°25'30"

U33098	Cuddalore	Kattumannarkoil	Kattumannarkoil	Kozhai	11°22'00"	79°27'00"
U33099	Cuddalore	Kattumannarkoil	Kattumannarkoil	Ramapuram	11°20'30"	79°26'30"
U33100	Cuddalore	Kattumannarkoil	Kattumannarkoil	Palayamkottai	11°22'00"	79°28'30"
U33100A	Cuddalore	Kattumannarkoil	Kattumannarkoil	Palayamkottai	11°22'40"	79°28'50"
U33101	Cuddalore	Kattumannarkoil	Kattumannarkoil	Agaram	11°22'00"	79°30'00"

Cuddalore District - Piezometers - Location and Co-ordinates

Well no	District	Taluk/Tashil	Block/Mandal	Village	Latitude	Longitude
HP 31572	Cuddalore	Cuddalore	Cuddalore	Periakattuppalayam	11.853889	79.790000
HP31515	Cuddalore	Thittakudi	Mangalore	Vallimarudham	11.508889	78.944722
HP31516A	Cuddalore	Thittakudi	Mangalore	Kaludur	11.506111	79.093056
HP31538	Cuddalore	Vriddhachalam	Vriddhachalam	T.mavadandal	11.628056	79.218611
HP31539	Cuddalore	Vriddhachalam	Vriddhachalam	M.Parur	11.580833	79.254722
HP31540	Cuddalore	Vriddhachalam	Nallur	Vilambavur	11.543889	79.075278
HP31542	Cuddalore	Thittakudi	Mangalore	Eluthur	11.438333	79.012500
HP31543A	Cuddalore	Vriddhachalam	Nallur	Veppur	11.528333	79.123056
HP31544	Cuddalore	Vriddhachalam	Vriddhachalam	Keelpalaiyur	11.466111	79.422500
HP31545	Cuddalore	Vriddhachalam	Kammapuram	Kammapuram	11.478333	79.421667
HP31546	Cuddalore	Chidambaram	Parangippettai	Puduchathiram	11.542222	79.722778
HP31547	Cuddalore	Kattumannarkoil	Kumaratchi	Kumaratchi	11.310556	79.629167
HP31548	Cuddalore	Kattumannarkoil	Kattumannarkoil	Lalpet	11.298611	79.549167
HP31549	Cuddalore	Cuddalore	Cuddalore	Thiruvandipuram	11.750556	79.711944
HP31551	Cuddalore	Panruti	Annagramam	Anna Grammam	11.788056	79.601944
HP31552	Cuddalore	Cuddalore	Cuddalore	Cuddalore - OT	11.722222	79.774722
HP31553A	Cuddalore	Vriddhachalam	Kammapuram	V.Kumaramangalam	11.491667	79.385556
HP31554	Cuddalore	Panruti	Annagramam	Palur	11.758333	79.628889
HP31558	Cuddalore	Kattumannarkoil	Kattumannarkoil	Eyyalur	11.188056	79.515833
HP31559	Cuddalore	Chidambaram	Keerapalayam	Palayamkottai . I.	11.358611	79.473889
HP31560A	Cuddalore	Kattumannarkoil	Kattumannarkoil	Kondasamuthram	11.337222	79.474722
HP31575	Cuddalore	Chidambaram	Kumaratchi	Chidambaram	11.393056	79.692500
HP31577	Cuddalore	Cuddalore	Cuddalore	Thukkanampakkam	11.841667	79.706944
HP31578	Cuddalore	Kurinjipadi	Kurinjipadi	Ramanathankuppam	11.623889	79.693056
HP31580	Cuddalore	Kurinjipadi	Kurinjipadi	Vadalur	11.554444	79.546389
HP31581	Cuddalore	Vriddhachalam	Vriddhachalam	Ko-poovanur	11.610833	79.306389
INV 11228	Cuddalore	Thittakudi	Mangalore	Lekkur	11.465833	79.018611

INV 31436	Cuddalore	Cuddalore	Cuddalore	Cuddalore N.T	11.756667	79.761111
INV 31445	Cuddalore	Vriddhachalam	Vriddhachalam	Vriddhachalam	11.506944	79.327500
INV 31446	Cuddalore	Thittakudi	Nallur	Pennadam	11.404167	79.250556
INV 31461	Cuddalore	Vriddhachalam	Kammapuram	Melakuppam	11.570833	79.439722
INV31434	Cuddalore	Panruti	Panruti	Poongunam	11.788889	79.797222
INV31435	Cuddalore	Cuddalore	Cuddalore	Vandarasankuppam	11.722222	79.634722
INV31446	Cuddalore	Chidambaram	Kumaratchi	Keerapalayam	11.431944	79.653333
INV31447	Cuddalore	Chidambaram	Melbhuvanagiri	Krishnapuram	11.484722	79.616667
INV31448	Cuddalore	Chidambaram	Keerapalayam	Mazhavarayanallur	11.4175	79.520556
INV31449	Cuddalore	Kattumannarkoil	Kattumannarkoil	Parivilagam	11.3425	79.603611
INV31452	Cuddalore	Kurinjipadi	Kurinjipadi	Pethanaickenkuppam	11.584167	79.615833
INV31453	Cuddalore	Kurinjipadi	Kurinjipadi	Kattiyankuppam	11.637222	79.633056
INV31454	Cuddalore	Chidambaram	Keerapalayam	Pudaiyur	11.361667	79.515556
INV31455	Cuddalore	Chidambaram	Keerapalayam	Koodalaiyathur	11.415278	79.470278
INV31456	Cuddalore	Chidambaram	Kumaratchi	Thuniseramedu	11.376389	79.655278
INV31457	Cuddalore	Chidambaram	Melbhuvanagiri	Kiliyanur	11.424722	79.590278
INV31462	Cuddalore	Thittakudi	Mangalore	Alambadi	11.459444	79.061389
INV31463	Cuddalore	Thittakudi	Mangalore	Vinayaganandal	11.518056	79.040000
MWS 31582	Cuddalore	Panruti	Panruti	Marungur	11.655	79.535278
MWS 31585	Cuddalore	Panruti	Panruti	Thiruvamur	11.768056	79.478333

(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 Cuddalore 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

$$\text{Stage of Ground water Development (\%)} = \frac{\text{Existing Gross Ground water Draft for all uses}}{\text{Net annual Ground Water Availability}} \times 100$$

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 TamilNadu As on March 2013

District Summary

(in ha.m)

CUDDALORE DISTRICT							
Sl.No (District)	District	Net Annual Ground Water Availability	Existing Gross Ground Water Draft for Irrigation	Existing Gross Ground Water Draft for domestic and industrial water supply	Existing Gross Ground Water Draft for All uses (4+5)	Stage of Ground Water Development {(6/3)*100} %	No of Over Exploited Firkas
1	**2**	**3**	**4**	**5**	**6**	**7**	**8**
1	CUDDALORE	128,495.06	51,766.31	34,160.25	85,926.56	67	6

Firka Wise Summary

(in ha.m)

CUDDALORE DISTRICT							
Sl.No	**Assessment Unit (Firka)**	**Net Annual Ground Water Availability**	**Existing Gross Ground Water Draft for Irrigation**	**Existing Gross Ground Water Draft for domestic and industrial water supply**	**Existing Gross Ground Water Draft for All uses (4+5)**	**Stage of Ground Water Development {(6/3)*100} %**	**Category of the Firka**
1	BHUVANAGIRI	4,652.30	397.50	1,700.02	2,097.52	45	SAFE
2	CHIDAMBARAM	4,837.54	762.30	181.03	943.33	20	SAFE
3	KADAMPULIYUR	4,984.71	2,530.50	186.27	2,716.77	55	SAFE
4	KAMMAPURAM(E)	3,442.10	1,871.25	1,810.92	3,682.17	107	OVER EXPLOITED
5	KAMMAPURAM(W)	4,212.32	2,613.30	4,356.60	6,969.90	165	OVER EXPLOITED
6	KATTUMANNARKOIL	4,691.20	846.40	71.46	917.86	20	SAFE
7	KULLANCHAVADI	6,931.49	1,223.70	169.73	1,393.43	20	SAFE

CUDDALORE DISTRICT							
Sl.No	**Assessment Unit (Firka)**	**Net Annual Ground Water Availability**	**Existing Gross Ground Water Draft for Irrigation**	**Existing Gross Ground Water Draft for domestic and industrial water supply**	**Existing Gross Ground Water Draft for All uses (4+5)**	**Stage of Ground Water Development {(6/3)*100} %**	**Category of the Firka**
8	KUMARACHI	4,202.97	447.20	47.59	494.79	12	SAFE
9	KURINJIPADI	5,604.40	1,486.80	123.09	1,609.89	29	SAFE
10	MANJAKKUPPAM	3,300.13	1,057.00	1,697.04	2,754.04	83	SEMI CRITICAL
11	MARUNGUR	1,901.89	163.80	1,141.30	1,305.10	69	SAFE
12	NALLUR	2,516.92	996.30	128.82	1,125.12	45	SAFE
13	NELLIKUPPAM	4,309.09	2,695.83	1,522.45	4,218.27	98	CRITICAL
14	ORATHUR	5,624.02	665.70	7.72	673.42	12	SAFE
15	PANRUTI	5,224.74	3,489.90	1,092.47	4,582.37	88	SEMI CRITICAL
16	PARANGIPETTAI	-	-	-	-	--	SALINE
17	PENNADAM	5,316.26	4,865.60	250.69	5,116.29	96	CRITICAL
18	PUTHUR	3,097.75	445.00	52.52	497.52	16	SAFE
19	RETTY CHAVADI	5,055.25	3,618.98	4,586.93	8,205.91	162	OVER EXPLOITED
20	SETHIYATHOPE	6,215.75	2,630.80	2,886.38	5,517.18	89	SEMI CRITICAL
21	SIRUPAKKAM	1,905.57	1,593.80	55.79	1,649.59	87	SEMI CRITICAL
22	SRIMUSHNUM	8,712.28	2,132.20	638.85	2,771.05	32	SAFE
23	THIRUVAKULAM	5,456.22	219.60	29.14	248.74	5	SAFE
24	THIRUVANTHIPURAM	4,493.91	3,222.00	5,767.43	8,989.43	200	OVER EXPLOITED
25	THOZHUDUR	1,825.50	1,215.60	52.77	1,268.37	69	SAFE
26	TITTAGUDI (E)	2,035.55	1,309.60	238.58	1,548.18	76	SEMI CRITICAL
27	TITTAGUDI (W)	1,450.40	818.20	55.67	873.87	60	SAFE
28	UDAIYARKUDI	3,909.82	1,859.70	77.05	1,936.75	50	SAFE
29	UMANGALAM	3,518.54	836.25	2,761.01	3,597.26	102	OVER EXPLOITED

30	VEPPUR	2,548.93	1,664.10	59.54	1,723.64	68	SAFE
31	VIRUDHACHALAM (N)	3,513.35	992.40	1,302.73	2,295.13	65	SAFE
32	VIRUDHACHALAM (S)	3,004.17	3,095.00	1,108.65	4,203.65	140	OVER EXPLOITED
TOTAL		**128,495.06**	**51,766.31**	**34,160.25**	**85,926.56**	**67**	

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 Cuddalore 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 13 blocks in Cuddalore District, 2 blocks are categorized as Over Exploited and Critical blocks and remaining 11 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 Cuddalore District, totally 32 Firkas, 10 Firkas are categorized as Over Exploited and remaining 22 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 15.38%, but, the total percentage of over exploited and critical Firkas as on March 2011 Assessment is 31.25%, in the Cuddalore 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 32 Firkas, the total percentage of over exploited and critical Firkas is 31.25%, but, In 2013 assessment, out of 32 Firkas, it has been come down marginally to 25%, in the Cuddalore 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 32 Firkas in the District, 6 Firkas are categorized as “Over Exploited Firkas”, 2 Firkas are categorized as “Critical Firkas”, 5 Firkas are categorized as “Semi Critical Firkas”, 18 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 District, 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” and 1 Firkas are categorized as “Saline”.

When compared to last assessment as on March 2011, the “Over Exploited Firkas” comes down from 7 to 6 Firkas, the “Critical Firkas” decreased from 3 to 2 Firkas, the “Semi Critical Firkas” increased marginally from 6 to 5 Firkas, the “Safe Firkas” decreased from 16 to 18 and the “Saline Firkas” increased from Nil to 1. 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	7	6
2	Critical	3	2
3	Semi Critical	6	5

4	Safe	16	18
5	Saline	Nil	1
TOTAL		32	32

(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.