CHAPTER 4.1.9 GROUND WATER RESOURCES

NILGRIS DISTRICT

INDEX

GROUND WATER REPORT OF NILGRIS 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

Nilgiris the name in Sanskrit means Blue mountain and in Neelamalai. The Nilgiris district is situated on the Northwestern part of Tamil Nadu. The entire district area is a mountainous terrain and situated in Western Ghats. The district is a celebrated summer resort for the tourist from all over India. Udagamandalam popularly Known as Ooty is the Queen of hill Stations in India. Udagamandalam is the capital of Nilgiris District.

The Nilgiris District is a mountainous district in Tamilnadu. The district has an aerial extent of 2,545sq.km. Or 2,54,485 hectares accounting 1.92% of the total geographical area of the Tamil Nadu.

The district lies between North Latitude, 11°12’00” and 11°43’ 00” and East Longitude 76°14’00” and 77°01’ 00” forming part of Survey of India Topographical sheet No:58 A and it is bounded by Erode district in the East ,Coimbatore District in the South, Karnataka and Kerala State in the North and Kerala State in the West.

For Administrative purpose this district had been divided into four Revenue Taluks and four Panchayat unions (Blocks) up to 1998. From the district has been divided into six Taluks and four Blocks and 15 Firkas. Totally 55 Revenue villages are there in this District.

Udagamandalam,Coonoor,Kotagiri,and Gudalur are the import Townships in the District. The special grade Town Panchayat Wellington is the only Cantonement in this District. The meter gauge Railway line of Southern railway connecting Ooty with Mettupalayam is the only railway link in the district. Coimbatore-Ooty, Gudalur-Calicut, Gudalur and Gundlepet are the important State highways in this District.

Nilgris District is totally bifurcated into 15 Firkas.

1. HYDROGELOGY

(i) Major Geological formations:

Geology:

Nilgirs District is fully comprises of the Crystalline Metamorphic rocks of Archaen age. The main rock types include Charnockite, Biotite gneiss, Magnetite, Quartzite, Granite, Syenite, Hornblende granulites, Dolerits, Pegmtites, Quartz veins, and Laterite cappings. The district forms part of the Western Ghats and hence fully hilly area with steep slopes. Charnockite forms the bulk of the rock units in the district, which forms the basement in the high grade metamorphic terrain. Most of the peaks are Charnockite. Biotite gnessic rock is found at lower level of the district. Further the gneiss occurs as lenses within the charnockite. The generalized stratigraphic succession of the geological formation met with in this district is as follows.

Recent to Sub-Recent	:	Alluvium, Colluvium, Laterite
Archaean	:	Charnockite, Biotite Gneiss, Quartzite, Hornblende Granulite, Pyroxonite, Schist, Dolerites, Pegmatile, Magnetile and Pyroxene Granulites.

A brief description of the various rock types existing in the district is presented below.

Alluvium and colluvium

The alluvium is generally restricted to narrow belts along the banks of rivers. In the course of river and adjacent area Colluvial materials consists of gravel, sand, silt, and clay are seen. The thickness of the alluvium is meager.

Biotite Gneiss

Biotite gneissic rock is found at the lower levels north of Mettupalayam, bordering the Nilgiris hills. Lenses of biotite gneiss are found in charnockite.

Hornblende granulite

This is invariably associated with Magnetite quartzite in the Wynad part of the Nilgris ranges. Fibrous Amphibole, Hornblende, Garnet, Quartz and Magnetite are the minerals making up the rocks.

Quartz veins

While granular quartz reefs occur in profusion with maximum width of 5m and maximum length of 100m. They are conformable with basement rock or cut across them. Many of the quartz veins are deformed. A few are gold bearing in Gudalur Taluks.

Talc bearing Schist

Talc chlorite schist is found as small lenses, possibly as a meta sedimentary sequence. The composition of schist varies from talcose to Quartzitic. Quartz-muscovite-biotite schist and Sericite Quartzite occur near Nedugani.

Pegmatite

Pink and white pegmatite occurs as conformable bodies in Charnockite and Biotite gneiss. The Pegmatite are generally homogenous in composition. Quartz and Feldspar are the main constituents with Muscovite and Biotite as other accessory minerals.

Magnetite Quartzite

The band of Magnetite Quartzite occur as resistant linear ridges disposed along the longer axis of the Hills. Banding and contortions are noticeable. Variation in composition is noticeable along the strike. Intrusion of Magnetite Quartzite in Biotite gneisses are reported in the Northwest of Vychannanpakuyam.

Charnockite

Charnockite faorms the bulk of the rock units and forms the basement in the high grade metamorphic terrain. Most of the area in Udagamandalam, Coonoor and kotagiri Taluks Charnockite forms the basement. Most of the peaks and high points in the district are Charnockite massives. The Charnockite has granulitic texture and carrier the minerals Quartz, Feldspar, Hypersthene, Garnet, Apatite and Zircon are present in accessory amounts.

Laterite

Laterite is prevalent extensively in Nilgiris occurring as mantle over the country rock forming an irregular sol horizon. It is a hard material mainly composed of silicates of Alumina with or without enrichment of Iron. Laterite is formed as an alternation product of Charnockite in the Nilgiris district. Detrital Laterite is wide spread on the sloope of the hills like Rangasamy betta, Yedapalli, Math orai, Carion hill, Parson's valley etc.,

Dolerite

Dykes of Dolerite composition cut across the country rocks, Biotite gneiss and Charnockites. The dykes are emplaced parallel to the country rocks with varying width of 15 to 40m.

Occurrence of Ground Water

The study of ground water is concerned with evaluating the occurrence, distribution, availability and quality of ground water. In Nilgiris District the ground water occurs in all type of rocks of the oldest Archaen to Recent Alluvium under water table or Phreatic condtionns.

The district being a highly terrain with narrow valleys and undulating plains, the hydrogeological scenario of the district is controlled by the configuration of morphological, structural, geological features and distribution of rainfall. In this district rainfall, tanks, reservoirs, rivers and streams and return flow seepage from irrigated areas are the important sources of ground water recharge. Generally in relation to the mode of occurrence of ground water, the hydrological frame work met with in the district

has been divided in to two categories namely fissured and fractured formation and porous formation.

Ground water in Fissured and Fractured hard rock formation

The major part of the district is underlain by the crystalline rocks like mixed Gneisses, Charnockite and other associated rocks. The water bearing properties of the crystalline rocks in the district depend upon the extent of weathering, fractures and joints and which imparts Secondary porosity and permeability of the rocks. The weathered zone of the crystalline basement and the fractured rocks from the aquifers. Ground water occurs in these weathered zone under water table or Phreatic condition. As the thickness of weathered mantle is limited varying from less than a m to as much as 15m. The water stored in the weathered zones also limited. The weathered granular zone extends to a maximum depth of 15-20 m below ground level, in gneissic and 10-15m in charnockite rocks constitute the shallow water table aquifer and it occurs in the major part of the district with in the depth of 20-25m in general. The water table aquifer in favorable locations like low lying areas, and along the stream course are generally developed by means of open dug wells.

Since the district is highly undulating and rugged, occupied by numerous hills and deep valleys, development of ground water by means of bore wells for Agriculture purpose is very low. Ground water extraction is mainly by open wells existing in valley areas and low lying plains. Generally groundwater condition in the fissured and fractured crystalline rocks is heterogeneous in nature as indicated by the variation in lithology, weathering and structure with in short distance.

Since the district is mostly covered by Charnockite which is massive, the development of fissures and fractures are much less compared to other rock types. As a result charnockite is not a potential water bearing formation, except in a region where the intensity of Weathering in the charnockite increases the possibility and occurrence of groundwater.

Ground Water in the Porous Formations

The porous formations in the district are represented by the river alluvium and colluvium. The alluvial deposit comprisisng sand with admixture of silt and clay are confined to the major river and stream courses only. The colluvial materials comprisisng

the sands and gravels are seen in the valley portions. Ground water is developed by dug wells and occur under phreatic condition. The thickness of the saturated aquifer depends upon the topographic condition.

In general, in these formations water table is shallow during the post monsoon period whereas it is somewhat deep during the pre monsoon period. It has been reported that wells remain dry during the drought years and in the years of less rainfall. In valley fill sediment near the foot of the hills, the groundwater occurs under semi confined condition. The valley fill sediments are highly porous and permeable. The sandy material facilitates vertical infiltration and good ground water storage.

Drilling of Bore Holes.

Since the occurrence and movement of ground water in hard rock formations are restricted to porous zones of weathered formations and depending upon the intensity of fractures, fissures and joints, the recharge of ground water in deeper depth is very limited in this district. Hence drilling of bore wells in this district is limited. Due to highly elevated and mountainous area, the Ground water wing of PWD during the course of ground water investigation drilled no exploratory bore holes in this district. However under hyrodology project three bore holes had been drilled in this district of find out the nature and behaviors of the sub surface and aquifer Characteristics. Digital water level recorders (DWLR) have been fitted in these bore hole for water level monitoring.

The forest department have drilled a few bore holes with the depth ranging from 45 to 100m in the Mudumalai Wild life sanctuary areas to provide drinking water to the animals. The bore hole lithology revealed the presence of potential fractures at shallow depths. Ground water occurs under semi confined and confined conditions. The reported yield of these boreholes piercing the jointed and partly weathered formations ranges between 60 and 70 LPM. The yield was very poor in the bore well piercing through the hard and impervious rocks.

Aquifer Parameters

The thickness of the weathered, jointed zone in this district varies from place to place. It ranges form 6 to 30m, below ground level. The inter granular porosity is essentially depending upon the intensity and degree of weathering and fracture development in the hard rock and control the occurrence and storage of groundwater.

The resulting porosity, permeability, transmissivity etc., decides the well yield. As discussed earlier it is noted that the thickness of weathering is more in gneissic formation and moderate in charnockite formations and accordingly the well yield and the aquifier parameters vary and are estimated through pump test.

Drilling of exploratory bore wells

Based on the field studies and interpretations made from aerial photographs and satellite imageries, favorable locations are being selected for exploratory drilling, By drilling, sub surface hydrogeological aquifer characteristics such as aquifer thickness, yield, transmissivity, permeability, specific capacity, storage co-efficient, water quality etc., are being studied to evaluate the groundwater conditions of the area. Since entire Nilgiris district is mountainous terrain so far no exploratory bore wells are drilled in this district. But under Hyrdrology Project, 3 numbers of peizometer have been drilled in this district for water level monitoring purpose.

(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 Nilgris District,37 observation wells and 03 piezometers,totally 40 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 Nilgris 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 Nilgris District. The analysis reveals that the water level has gone down in the north, west and central parts of the Nilgris 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 Nilgris District.

(iii) Existing network of Monitoring wells:

In Nilgris District, the existing network of monitoring wells is 40

wells, 37 wells are observation wells and 3 wells are piezometers. These wells are observed for every month water level.

Nilgiris District: Observation Wells - Location and Co-ordinates

Well No	District	Tahsil / Taluk	Block / Mandal	Village	Latitude	Longitude
62758	Nilgiris	Gudalur	Gudalur	Padanthurai	11°31'53"	76°27'49"
63057	Nilgiris	Gudalur	Gudalur	1 St Mail - gudalur	11°30'41"	76°28'47"
63356	Nilgiris	Gudalur	Gudalur	Nelakkottai-(poova Sola)	11°33'12"	76°25'17"
63655	Nilgiris	Gudalur	Gudalua	Devala	11°28'23"	76°23'05"
63901	Nilgiris	Udagamandalam	Udagamandalam	Thalayattumandu	11°23'50"	76°43'15"
63902	Nilgiris	Udagamandalam	Udagamandalam	Ooty (Near Lake)	11°24'25"	76°41'25"
63904	Nilgiris	Udagamandalam	Udagamandalam	Indu Nagar	11°25'10"	76°40'15"
63905	Nilgiris	Udagamandalam	Udagamandalam	M.Palada	11°22'20"	76°40'10"
63906	Nilgiris	Udagamandalam	Udagamandalam	Kallatti	11°27'30"	76°41'00"
63907	Nilgiris	Udagamandalam	Udagamandalam	Iduhatti	11°27'50"	76°46'30"
63908	Nilgiris	Ootacamund	Ooty	Batwear-kakkathoppu	11°25'15"	76°40'30"
63909	Nilgiris	Ootacamund	Ooty	Kappathorai	11°22'11"	76°39'26"
63910	Nilgiris	Ootacamund	Ooty	Thummanati	11°25'36"	76°45'15"
63911	Nilgiris	Ootacamund	Udagamandalam	Tr.bazar-naduvattam	11°27'49"	76°33'22"
63912	Nilgiris	Ootacamund	Ooty	Thalakundha	11°26'44"	76°40'44"
63921	Nilgiris	Coonoor	Coonoor	Karumpalam	11°20'00"	76°45'43"
63922	Nilgiris	Coonoor	Coonoor	Kulakkombai	11°17'14"	76°44'08"
63923	Nilgiris	Coonoor	Coonoor	Ketty	11°29'00"	76°43'56"
63924	Nilgiris	Coonoor	Coonoor	Jakathala	11°22'15"	76°45'43"

63925	Nilgiris	Coonoor	Coonoor	Naduhatti	11°24'22"	76°48'57"
63926	Nilgiris	Coonoor	Coonoor	Manthada	11°23'22"	76°43'43"
63927	Nilgiris	Coonoor	Coonoor	Katteri	11°20'25"	76°44'20"
63929	Nilgiris	Coonoor	Coonoor	Kilinjada	11°18'45"	76°44'45"
63931	Nilgiris	Coonoor	Coonoor	Yedapalli	11°22'30"	76°48'40"
63932	Nilgiris	Kotagiri	Kotagiri	Kotagiri	76°51'50"	11°25'15"
63932A	Nilgiris	Kothagiri	Kothagiri	Kothagiri	11°25'15"	76°51'50"
63935	Nilgiris	Kothagiri	Kothagiri	Aravenu	11°24'10"	76°52'25"
63936	Nilgiris	Kothagiri	Kothagiri	Konavakkarai	11°24'29"	76°53'34"
63937	Nilgiris	Kothagiri	Kothagiri	Nedugula	11°28'37"	76°53'25"
63938	Nilgiris	Kothagiri	Kothagiri	S.kaikatti	11°27'08"	76°53'32"
63939	Nilgiris	Kothagiri	Kothagiri	Denad	11°26'56"	76°56'59"
63940	Nilgiris	Kothagiri	Kothagiri	Kunjapanai	11°21'37"	76°55'50"
63951	Nilgiris	Gudalur	Gudalur	Gudalur	11°29'35"	76°30'00"
63953	Nilgiris	Gudalur	Gudalur	Thorapalli	11°32'00"	76°31'30"
63954	Nilgiris	Gudalur	Gudalur	Nanthatti	11°29'41"	76°28'12"
63959	Nilgiris	Gudalur	Gudalur	Panthalur	11°29'10"	76°20'29"
63960	Nilgiris	Ootacamund	Ooty	Itlar	11°35'21"	77°04'20"

Nilgris District: Piezometers - Location and Co-ordinates

Well no	District	Tashil/Taluk	Block/Mandal	Village	Latitude	Longitude
HP2NIL01	Nilgiri	Ooty	Ooty	Sholur	11.483333	76.658333
HP2NIL02	Nilgiri	Ooty	Ooty	Masinangudi	11.562500	76.633333
HP2NIL03	Nilgiri	Coonoor	Coonoor	Coonoor	11.358333	76.804167

(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 Nilgris 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 TamilNadu As on March 2013

District Summary

(in ha.m)

NILGRIS 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	NILGIRIS	13,063.02	602.00	533.38	1,135.38	9	NIL

Firka Wise Summary

(in ha.m)

NILGRIS 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	CHERAMBADI	2,387.80	-	49.90	49.90	2	SAFE
2	COONOOR	471.60	3.50	16.75	20.25	4	SAFE
3	DEVARSHOLA	714.33	56.00	1.60	57.60	8	SAFE
4	GUDALUR	1,336.20	-	109.42	109.42	8	SAFE
5	ITHALAR	481.73	44.10	8.32	52.42	11	SAFE
6	KETTI	555.98	65.80	44.98	110.78	20	SAFE
7	KILKOTAGIRI	626.83	2.10	17.10	19.20	3	SAFE
NILGRIS 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	KOTAGIRI	679.10	8.40	52.58	60.98	9	SAFE
9	KUNDAH	457.66	37.10	17.96	55.06	12	SAFE
10	MELUR	912.57	17.50	25.89	43.39	5	SAFE
11	NEDUGULA	419.74	91.70	7.38	99.08	24	SAFE
12	PANDALUR	1,373.10	-	36.53	36.53	3	SAFE
13	SHOLUR	1,546.23	104.30	15.75	120.05	8	SAFE

14	THUNERI	699.05	124.60	27.14	151.74	22	SAFE
15	UDHAGA MANDALAM	401.09	46.90	102.08	148.98	37	SAFE
TOTAL		**13,063.02**	**602.00**	**533.38**	**1,135.38**	**9**	

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 Nilgris 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 4 blocks in Nilgris District, 4 blocks are categorized as 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 Nilgris District, totally 15 Firkas, 15 Firkas are categorized as 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 Nil, but, the total percentage of over exploited and critical Firkas as on March 2011 Assessment is Nil, in the Nilgris 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 15 Firkas, the total percentage of over exploited and critical Firkas is Nil, but, In 2013 assessment, out of 15 Firkas, it has been come down marginally to Nil, in the Nilgris 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 15 Firkas in the District, 15 Firkas are categorized as “Safe Firkas”.

Based on the Estimation of Ground Water Resources of Tamil Nadu State as on March 2011, Out of 15 Firkas in the District, 15 Firkas are categorized as “Safe Firkas”.

When compared to last assessment as on March 2011, the “Safe Firkas” maintains the same as 15 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	Nil	Nil
2	Critical	Nil	Nil
3	Semi Critical	Nil	Nil
4	Safe	15	15
5	Saline	Nil	Nil
TOTAL		15	15

(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.