



For official use

Technical Report Series

**DISTRICT GROUNDWATER BROCHURE
NAGAPATTINAM DISTRICT
TAMIL NADU**

By

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**Government of India
Ministry of Water Resources
Central Ground Water Board
South Eastern Coastal Region
Chennai**

November 2008

DISTRICT AT A GLANCE (NAGAPATTINAM DISTRICT)

S. No.	ITEMS	STATISTICS
1.	GENERAL INFORMATION	
	i. Geographical area (Sq. km)	2715.83
	ii. Administrative Divisions as on 31-3-2007	
	Number of Taluks	5
	Number of Blocks	11
	Number of Panchayats	434
	Number of Villages	523
	iii. Population (Census 2001)	
	Total Population	14,88,839
	Male	73,9074
	Female	74,9765
	iv. Normal Annual Rainfall (mm) (1901-1970)	1230
2.	GEOMORPHOLOGY	
	i. Major physiographic Units	Coastal plain under marine influences. Flood plain of fluvial regime with an intermixing section of both fluvial and marine influence.
	ii. Major Drainages	Kollidam, Cauvery & Vennar and their tributaries
3.	LAND USE (Sq. km) (2005-06)	
	i. Forest area	46.33
	ii. Net area sown	1485.42
	iii. Cultivable waste	38.37
4.	MAJOR SOIL TYPES	Black clay, brown clay and arenacious soils
5.	AREA UNDER PRINCIPAL CROPS (2005-2006) (The figures given in bracket are % of total geographical area)	1. Paddy – 158100 Ha (58.2%) 2. Pulses – 64969 Ha (24%) 3. Others – 42930 Ha (16%)

6.	IRRIGATION BY DIFFERENT SOURCES (2005-06)	Number	Area irrigated (Ha)
	i. Dug wells	49197	-
	ii. Tube wells	13164	-
	iii. Tanks	Nil	
	iv. Canals	9	100%
	v. Other Sources	-	-
	vi. Net irrigated area (Ha)	125014	
	vii. Gross irrigated area (Ha)	152127	
7.	NUMBERS OF GROUND WATER MONITORING WELLS OF CGWB (As on 31.03.2007)		
	i. No. of dug wells		11
	ii. No. of piezometers		3
8.	PREDOMINANT GEOLOGICAL FORMATIONS	Pliocene to Recent	
9.	HYDROGEOLOGY		
	i. Major water bearing formations	Lower Miocene deeper aquifers and Pliocene quaternary shallow aquifers	
	ii. Pre- monsoon depth to water level (May 2006)	2.0 – 9.45 m bgl	
	iii. Post- monsoon depth to water level (Jan'2007)	GL -2.641 m bgl	
	iv. Long term water level trend in 10 years (1998-2007) (m/yr)	Annual	
		Rise	Fall
		Min: Nil Max :0. 31	Min :0. 022 Max :0. 29
10.	GROUND WATER EXPLORATION BY CGWB (As on 31-03-2007)		
	i. Number of Exploratory wells	37	
	ii. Number of Observation wells	6	
	iii. Number of Piezometers under Hydrology Project.	2	
	iv. Depth range (m bgl)	76.0 – 711.0	
	v. Discharge (lps)	<1 - 63	
	vi. Storativity (S)	4.81X10 ⁻¹ to 4.40 x 10 ⁻¹⁰	
	vii. Transmissivity (m ² /day)	1 to 1200	
11.	GROUND WATER QUALITY (As on MAY 2006)		
	i. Presence of chemical constituents more than permissible limit	TH as CaCO ₃ and NO ₃	
	ii. Type of water	NaCl, Mg HCO ₃ and NaHCO ₃	

12.	DYNAMIC GROUND WATER RESOURCES (As on 31.03.2004) (M Cum)	
	i. Annual Replenishable Ground Water Resources	181.71
	ii. Total Annual Ground Water Draft for all purposes	231.81
	iii. Projected demand for Domestic and Industrial Uses up to 2025	20.27
	iv. Stage of Ground Water Development	126.2
13.	GROUND WATER CONTROL AND REGULATION	
	i. Number of OE Blocks	4
	ii. Number of Critical Blocks/Semi-critical	Nil / 1
	iii. Number of Blocks Notified	Nil
14.	MAJOR GROUND WATER PROBLEMS AND ISSUES	The mushrooming growth of aquaculture has lead to the pollution of ground water in the coastal part of the district. The quality of ground water in eastern and southeastern parts is poor. The natural hydrodynamic conditions, is being disturbed every year due to natural or some man made causes, results the lowering of water levels below mean sea level. The chloride-bicarbonate ratio indicates that the flushing is insufficient.

1.0. INTRODUCTION

1.1. Administrative Details

Nagapattinam district is having administrative division of 5 taluks, 11 blocks, 434 village panchayats, 8 town panchayats, 4 municipality and 523 revenue villages (Plate-I).

Blocks	No. of Panchayats
Nagapattinam	29
Thirumarugal	39
Kilvelur	38
Keelaiyur	27
Vedaranyam	36
Thalanayar	24
Mayiladuthurai	54
Kuthalam	51
Sembanarkoil	57
Sirkali	37
Kollidam	42
Total	434

1.2. Basin and sub-basin

The district is part of the composite east flowing river basin having Cauvery and Vennar sub basin.

1.3. Drainage

The district is drained by Kollidam and Cauvery in the north, Virasolanar, Uppanar in the central part and Arasalar, TirumalairajanAr, Vettar, Kedurai AR, Pandavai Ar, Vedaranyam canal and Harichandra Nadi in the southern part of the district.

1.4. Irrigation Practices

The nine-fold land use classification (2005-06) for the district is given below.

S. No.	Classification	Area (Ha)
1	Forests	4633
2	Barren & Uncultivable Lands	33419
3	Land put to non agricultural uses	47655
4	Cultivable Waste	3837
5	Permanent Pastures & other grazing lands	964
6	Groves not included in the area sown	10554
7	Current Fallows	2747
8	Other Fallow Lands	19232
9	Net Area sown	148542
	Total	271583

(Source: Department of Economics & Statistics, Govt. of Tamil Nadu)

The block-wise and source wise net area irrigated in Ha is given below (2005-06).

S. No.	Block	Canals (Ha)
1	Nagapattinam	6915
2	Thirumarugal	122139
3	Kilvelur	12062
4	Keelaiyur	10178
5	Vedaranyam	545
6	Thalanayar	12208
7	Mayiladuthurai	15236
8	Kuthalam	13966
9	Sembanarkoil	17275
10	Sirkali	13003
11	Kollidam	11487
	Total	125014

(Source: Department of Economics & Statistics, Govt. of Tamil Nadu)

1.5. Studies/Activities carried out by CGWB

The erstwhile exploratory tube well organisation had undertaken the ground water exploration by drilling since 1956 in phases to identify the vertical and aerial extent of aquifers. Also, the ground water exploration was carried out by CGWB in Nagapattinam district during 1969 to 1972, 1990 to 1994 and 2000 to 2007. In all, exploratory bore holes (24 Nos.), observation wells (2 Nos.) and slim hole (1No.) were drilled. The maximum depth drilled is 711 m bgl. From the results of exploration, ground water potential areas were identified near Valmangalam, Kohur and T. Manalmedu areas during 2000-01.

Systematic surveys and Ground Water Management studies were carried out under various phases.

2.0. RAINFALL AND CLIMATE

The district receives rainfall under the influence of both southwest and northeast monsoon. A good part of the rainfall occurs as very intensive storms resulting mainly from cyclones generated in the Bay of Bengal especially during northeast monsoon. The district receives rainfall almost throughout the year. Rainfall data analysed (period 1901-70) shows the normal annual rainfall of the district is 1230 mm.

The rainfall pattern in the district shows interesting features. Annual rainfall, which is 1500 mm at Vedaranyam, the southeast corner of the district, rapidly decreases to about 1100 mm towards west of the district. The district enjoys humid and tropical climate with hot summers, significant to mild winters and moderate to heavy rainfall.

The temperatures varies from 40.6 to 19.3° C with sharp fall in night temperatures during monsoon period. The relative humidity ranges from 70 – 77% and it is high during the period of October to November.

3.0. GEOMORPHOLOGY AND SOIL TYPES

The present geomorphic set up in the district is the result of action of the major rivers with their distinct tributaries, oscillations in the sea level, tidal effects of Bay of Bengal and forces of wind. The landforms are delineated under erosional and depositional regime. The depositional regime comprises of a coastal plain under marine influence, a flood plain of fluvial regime with an intermixing section of both fluvial and marine influence. The entire area is a peneplained terrain with a gentle slope towards east and southeast. The maximum elevation is about 21 m above mean sea level in the west.

3.1. Soils

The major part of the district is covered by black clay and isolated patches of brown clay loam in the area bordering the NE boundary of Karaikal Region is seen. Some patches of Arenacious soils are also found along the coastal line.

4.0. GROUND WATER SCENARIO

4.1. Hydrogeology

The entire district covered by semi-consolidated formations consisting of sand, silt and clays (Plate-II). Ground water occurs under water table, semi-confined and confined conditions. The important aquifer systems in the district are i) Lower Miocene deeper aquifers and ii) Pliocene – Quaternary shallow aquifers.

i) Lower Miocene Deeper Aquifers : These are the deeper aquifer system which can be divided into two hydraulically interconnected aquifers namely a) Lower Orathanadu aquifer zone b) the upper or Main flowing aquifer zone.

- a) Orathanadu Aquifer: These aquifers occur through out the entire Cauvery delta area. The aquifers of “Primordial delta” grade laterally into fine facies both towards northeast in the Cauvery sub basin and southeast in the Vennar sub basin of the district. The facies changes are effected due to presence of sub stratum ridges in the basement. The thickness of the aquifer ranges between 30 and 70 m. Ground water occurs under confined conditions in these aquifers.
- b) Main flowing zone: The main flowing zone consisting of the coarse grained sands lies over the “Primordial delta” of the Cauvery basin. The aquifers occurring east of the line Okkanadu-Kilaiyur and Ottangadu in the new delta area and in the Vennar sub basin comprising fine-grained sand with clay. The thickness of the aquifer is around 35 m. Ground water occurs under confined conditions in these aquifers. Tube wells tapping these aquifers range in depth between 100 m bgl in the west and about 250 m bgl in the east. It was established that the ground water from the Lower Miocene Orathanadu aquifer flows upward to this overlying main flowing

zone, which in turn recharges the shallow aquifer system by upward leakage through the semi-confined upper and middle Miocene formations.

- ii) Pliocene – Quaternary Aquifer: Shallow aquifer system can be classified as Pliocene and Quaternary. These aquifers occur over the entire area of the district.
- a.) Pliocene Shallow Aquifers: The Pliocene shallow aquifers are represented by sands, gravels, sandy clays and variegated clays. Heterogeneity in lithology is noticed. The aquifer is more clayey in east and south-eastern parts of the district. The formation materials are deposited under fluvial and marine environment. The marine aquifers are in the east towards coast of Cauvery sub basin and entire Vennar sub basin of the district except the northeast corner of the district. The thickness of the aquifer ranges from 10 to 35 m. Ground water occurs under water table as well as confined conditions and is developed by means of shallow tube wells and dug cum bore wells. The depth of tube wells ranges from 30 to 100 m bgl.
- b.) Quaternary Shallow Aquifers: The delta shows wide variations in the positions of sands clays and silts both laterally and depth-wise resulting in wide variation of permeability values and consequently in the yields of wells from depth to depth in the same location. The aquifer of this group occurs at about 2 to 3 m bgl in major part of Cauvery sub basin, which are partly confined by sandy silty formations overlying these aquifers. Ground water occurs in these aquifers under water table, semi-confined and confined conditions. The thickness of the aquifer ranges between 5 to 25 m within the depth of 45 m bgl. The aquifer at shallow depth ranges are tapped by filter point wells, whose depth ranges between 8 to 12 m bgl and also by dug wells. The aquifer also developed by means of shallow tube wells whose depth ranges mostly between 20 and 50 m bgl.

4.1 Long term Fluctuation (1998-2007)

The long-term water level fluctuation for the period 1998-2007 indicates rise in water level in the area in the order of max. 0.31 m/year. The fall in the water level ranges from 0.022 to 0.29 m/year. The pre monsoon and post monsoon water levels are presented in Plate-III & IV.

4.2 Aquifer Parameters

In the porous formation the depth of the tube wells ranges from 76 to 711 m bgl. The Sp. Capacity value ranges from 13.43 to 870 lpm/m of drawdown and the transmissivity value ranges from 11 to 1202 m²/day. The storativity is in the order of 4.81 x 10⁻¹ to 4.40 x 10⁻¹⁰.

4.3 Ground Water Resources

The ground water resources have been computed jointly by Central Ground Water Board and State Ground and Surface Water Resources Data Centre (PWD, WRO, Govt. of Tamil Nadu) as on 31st March 2004. The salient features of the computations are furnished in Table-1.

(in Ham)									
S.No	Name of Groundwater Assessment Unit: Block	Net Groundwater Availability	Existing Gross Draft for Irrigation	Existing Gross Draft for Domestic and industrial water supply	Existing Gross Draft for all uses	Allocation for Domestic and Industrial Requirement supply upto next 25 years (2029)	Net groundwater Availability for future Irrigation Development	Stage of Groundwater Development	Categorization for Future groundwater development (Safe/Semi Critical/Critical/Over Exploited)
1	2	4	5	6	7= 5+6	8	9 = 4-(6+8)	10 = (7/4)*100	11
1	KEELAIYUR*								
2	KILVELUR*								
3	KOLLIDAM	3239.28	3708.12	437.22	4145.34	451.70	-920.53	128	Over Exploited
4	KUTHALAM	4167.34	6679.84	876.89	7556.73	905.92	-3418.42	181	Over Exploited
5	MYLADUTHURAI	3943.26	3125.26	318.04	3443.30	328.57	489.43	87	Semi Critical
6	NAGAPATTINAM*								
7	SEMBANARKOIL	3681.62	4265.44	201.44	4466.88	208.11	-791.93	121	Over Exploited
8	SIRKALI	3140.50	3402.29	193.29	3595.59	199.69	-461.48	114	Over Exploited
9	THALANAYAR*								
10	THIRUMARUGAL*								
11	VEDARANYAM*								

Note : * - Denotes the Complete Saline Blocks

4.4 Ground water Quality

Ground water in phreatic aquifers, in general, is colourless, odourless and predominantly alkaline in nature. In more than 50% of the samples, pH value is >8.00. The specific electrical conductance of groundwater in the phreatic zone during May 2006 was in the range of 714 to 3640 micro Siemens at 25° C, in the district. Conductance below 750 has been observed only in select pockets of the district. Saline ground waters (EC>10,000) are observed at southern part of the district.

It is observed that the ground water is suitable for drinking and domestic uses in respect of all the constituents except total hardness and nitrate in about 83% of samples. The hardness as CaCO₃ as well as nitrate is observed to be in excess of permissible limits of drinking water standard of BIS, in about 17% of samples. The incidence of high total hardness is attributed to the composition of litho units constituting the aquifers in the district, whereas nitrate pollution is most likely due to the use of fertilizers for agriculture and other improper waste disposal practices.

With regard to irrigation suitability based on specific electrical conductance and Sodium Adsorption Ration (SAR), it is observed that ground water in the phreatic zone may cause high to very high Salinity hazard and medium to very high alkali hazard when used for irrigation. Proper soil management strategies are to be adopted in the major part of the district while using ground water for irrigation.

4.5 Status of Ground Water Development

The estimation of ground water resources for the district has shown that 4 blocks are over exploited and one block is semi-critical (Plate-V).

In Nagapattinam district, the bulk of rural water supply is from ground water by means of dug wells, hand pumps (filter point) and tube wells owned by individuals. The TWAD Board, an apex body for the rural and urban water supply in Tamil Nadu has provided water supply in rural and urban sectors from the ground water sources through the implementation of various schemes with the assistance of Govt. of India and with funds of State Govt. Drinking water is being supplied to Nagapattinam Municipality from a bore well at Odachcheri village, situated 15 km away from the town.

5.0 GROUND WATER MANAGEMENT STRATEGY

5.1. Ground Water Development

In view of the comparatively high level of ground water development in the major part of the district and the quality problems due to geo-genic and anthropogenic factors, it is necessary to exercise caution while planning further development of available ground water resources in the district.

5.2. Water Conservation and Artificial Recharge

As per the detailed studies, it is clear that the artificial recharge of ground water in Nagapattinam district is not an easy task. For recharging deeper aquifers and to prevent seawater intrusion, recharge wells in the favourable tanks of coastal areas is recommended (Plate-VI). The implementation of the schemes may be taken up in phases, giving priority to blocks where the development of ground water resources is comparatively high. Central Ground Water Board is also providing technical guidance for implementation of rainwater harvesting schemes.

6.0 GROUND WATER RELATED ISSUES AND PROBLEMS

The hydrogeological environment in the Nagapattinam district has been subjected to pollution considerably. The eastern part of the district being tail end of the canal system, and due to inferior quality of ground water, the agricultural prosperity in the eastern part attained a set back. The agricultural lands are brought under aquaculture use. The mushrooming and unregulated growth of aquaculture may lead to an alarming magnitude of pollution.

In the eastern part of the district near the coast, a ground water is saline. The fresh water pocket in the sand dune areas are used for drinking purposes. The discharge of untreated wastewaters of aquaculture farms and chemicals used for the growing prawns will also affect the shallow fresh water pockets.

Agriculture, which is the mainstay of the populace of the district, forms the chief socio economic base. The environmental hazards may arise in two kinds. (1) Due to the infiltration of irrigation water saturated with chemicals, insecticides, pesticides, fertilisers (2) the water of Cauvery is highly polluted with industrial effluents. The river water is reported to be polluted by the effluents discharged into the river by several textile-processing industries in the up stream.

6.1 Area Notified by CGWB/SGWA

Central Ground Water Authority has not notified any area in the district. The over exploited blocks in this district are earmarked by SGWA where new irrigation schemes are not permitted. The regulatory measures coupled with long term water management practices are needed in following over exploited blocks;

1. Kollidam
2. Kuthalam
3. Sembanarkoil
4. Sirkali

7.0 RECOMMENDATIONS

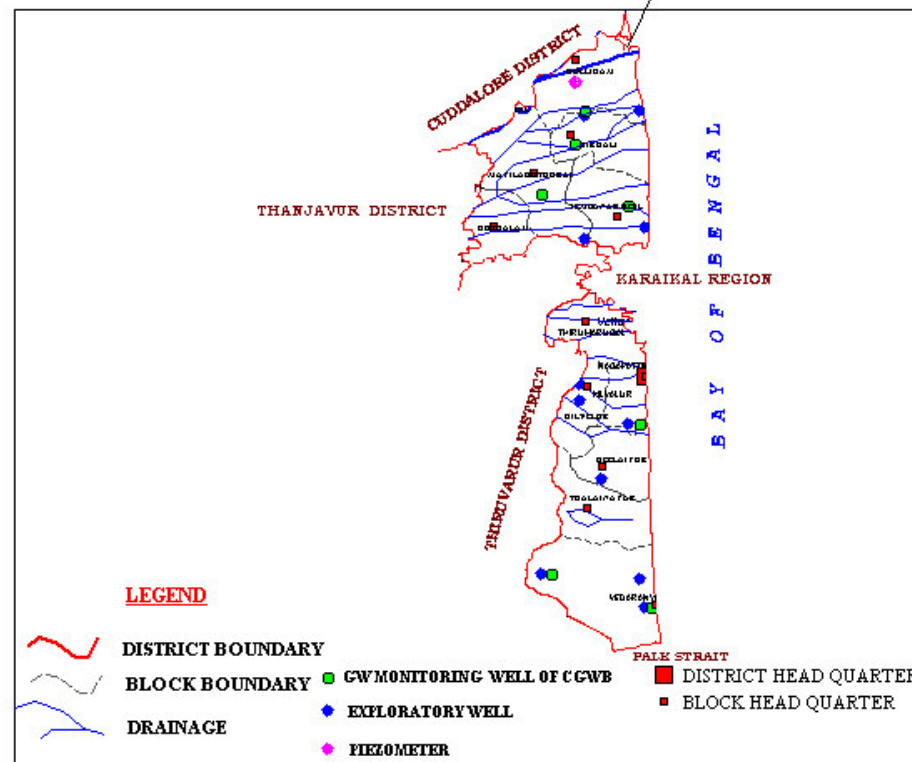
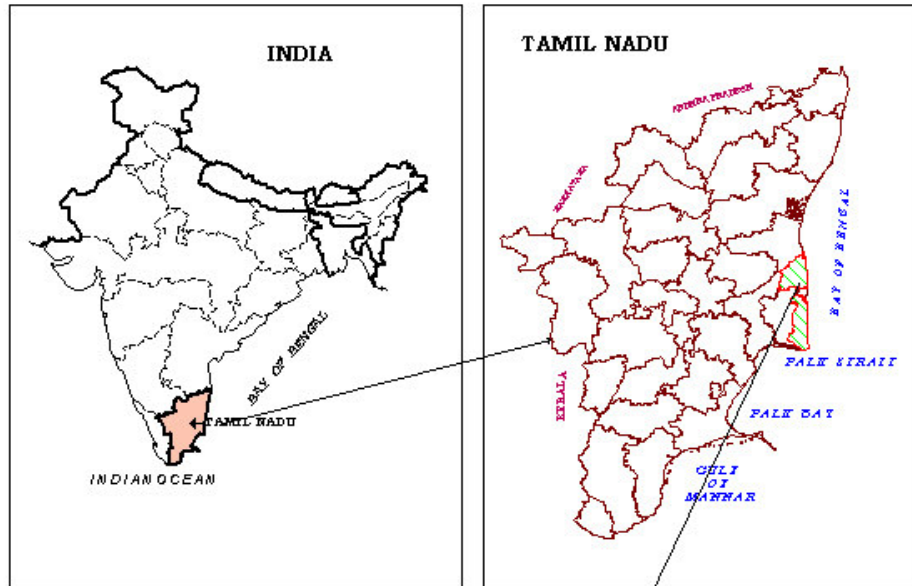
As the development of ground water has already reached an alarming stage in many blocks of the district, further development of ground water for creation of additional irrigation potential has to be carried out with extreme caution.

In the eastern part of the district near the coast ground water is saline. The fresh water pocket in the sand dune areas are used for drinking purposes. However, caution has to be taken while discharging the untreated wastewaters of agriculture farms and chemicals used in the prawns culture. For recharging deeper aquifers and to prevent seawater intrusion, recharge wells are recommended in the favourable tanks and ponds.

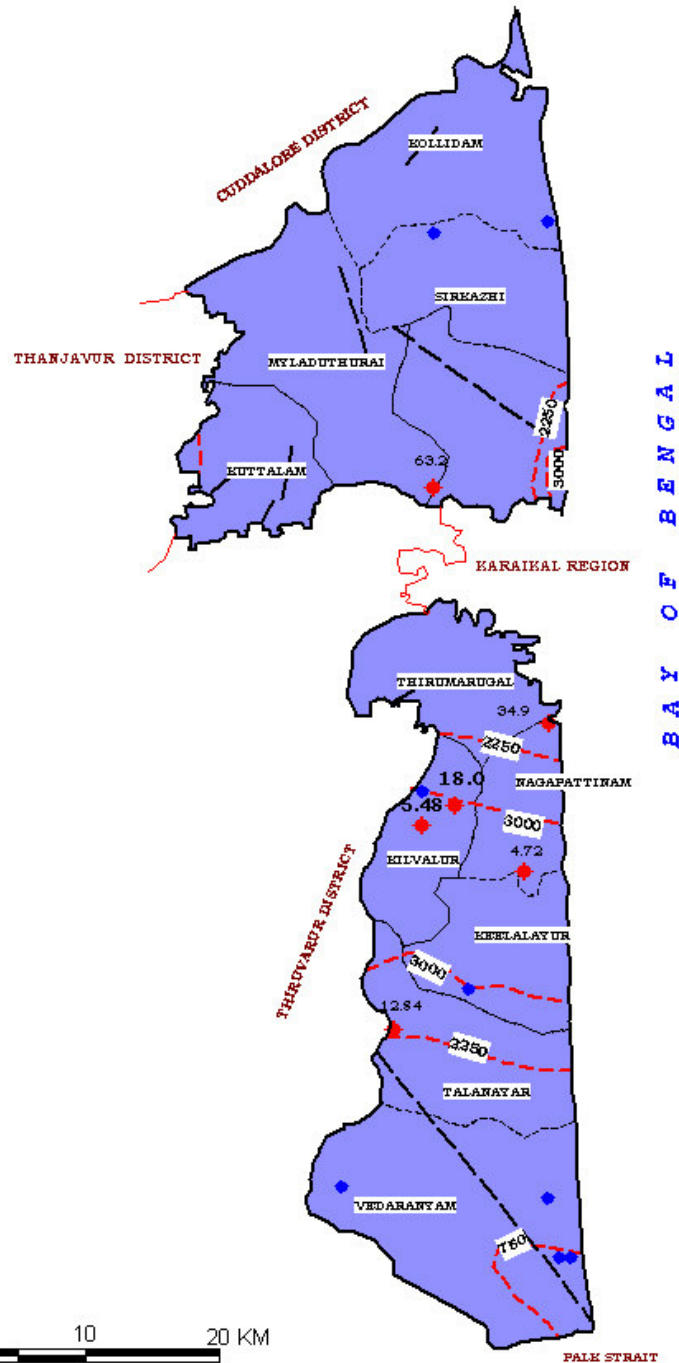
Engineering measures (hydraulic) to improve the flow of flood water into the sea, maintain water quality levels in coastal lakes, revival of traditional water harvesting to meet drinking water requirements are recommended.

CENTRAL GROUND WATER BOARD, SECR, CHENNAI
NAGAPATTINAM DISTRICT, TAMIL NADU
LOCATION

(NOT TO SCALE)



CENTRAL GROUND WATER BOARD, SECR, CHENNAI
NAGAPATTINAM DISTRICT, TAMIL NADU
HYDROGEOLOGY



LEGEND OVER LEAF

LEGEND FOR PLATE - II


ADMINISTRATIVE SETUP

———— DISTRICT BOUNDARY
 - - - - - BLOCK BOUNDARY

GROUND WATER HYDROLOGY


◆ EXPLORATORY BORE WELL [CGWB]
 ● HIGH YIELDING BORE WELL [CGWB]

HYDROCHEMISTRY

750
 ISOCONS [Sp ELECTRICAL CONDUCTANCE [$\mu S / Cm$ at 25° C]

STRUCTURE

—— TRACE OF LINEAMENT

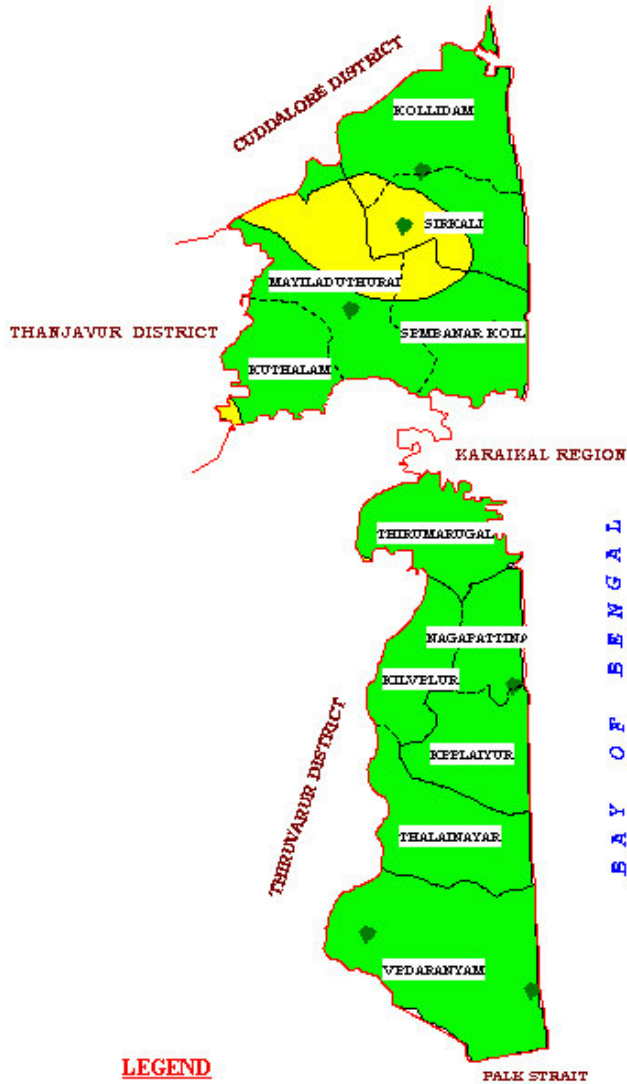
<u>AQUIFER</u>	<u>AGE</u>	<u>LITHOLOGY</u>	<u>GROUND WATER CONDITIONS</u>	<u>YIELD PROSPECTS (lpm)</u>	<u>GROUND WATER DEVELOPMENT STRATEGIES</u>
 SEMI-CONSOLIDATED	QUATERNARY	SAND & SILT FORMATION	WATER TABLE SEMI-CONFINED AND CONFINED CONDITIONS THICKNESS 5 TO 25 M	300 TO 1700	SUITABLE FOR DUG WELLS, FILTER POINT WELLS AND SHALLOW TUBEWELLS.
	PLIOCENE TO MIOCENE	FINE GRAINED WITH CLAY SAND AND SILT AND COARSE GRAINED SAND	SEMI-CONFINED CONDITION IN THE UPPER AND MIDDLE MIOCENE FORMATIONS (ENTIRE CAUVERY DELTA REGION) THICKNESS 25 TO 450 m	300 TO 3000	SUITABLE FOR DUG WELLS, FILTER POINT WELLS, SHALLOW AND DEEP TUBEWELLS.

CENTRAL GROUND WATER BOARD, SECR, CHENNAI
NAGAPATTINAM DISTRICT, TAMIL NADU


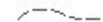



DEPTH TO WATER LEVEL

PRE MONSOON (MAY -2006)





LEGEND

-  DISTRICT BOUNDARY
-  BLOCK BOUNDARY
-  GROUND WATER MONITORING WELL OF CGWB

0 10 20 KM

DEPTH TO WATER LEVEL (m.bgl.)

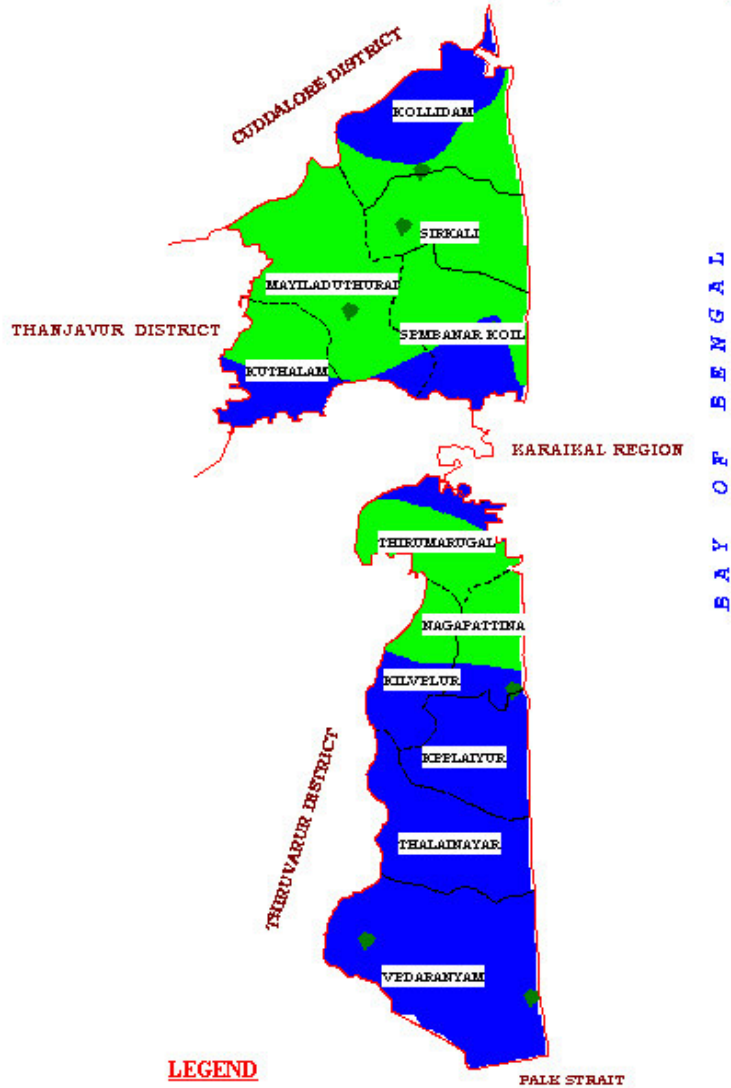
-  2-5
-  5-10

CENTRAL GROUND WATER BOARD, SECR, CHENNAI
NAGAPATTINAM DISTRICT, TAMIL NADU






DEPTH TO WATER LEVEL



POST MONSOON (JANUARY -2007)



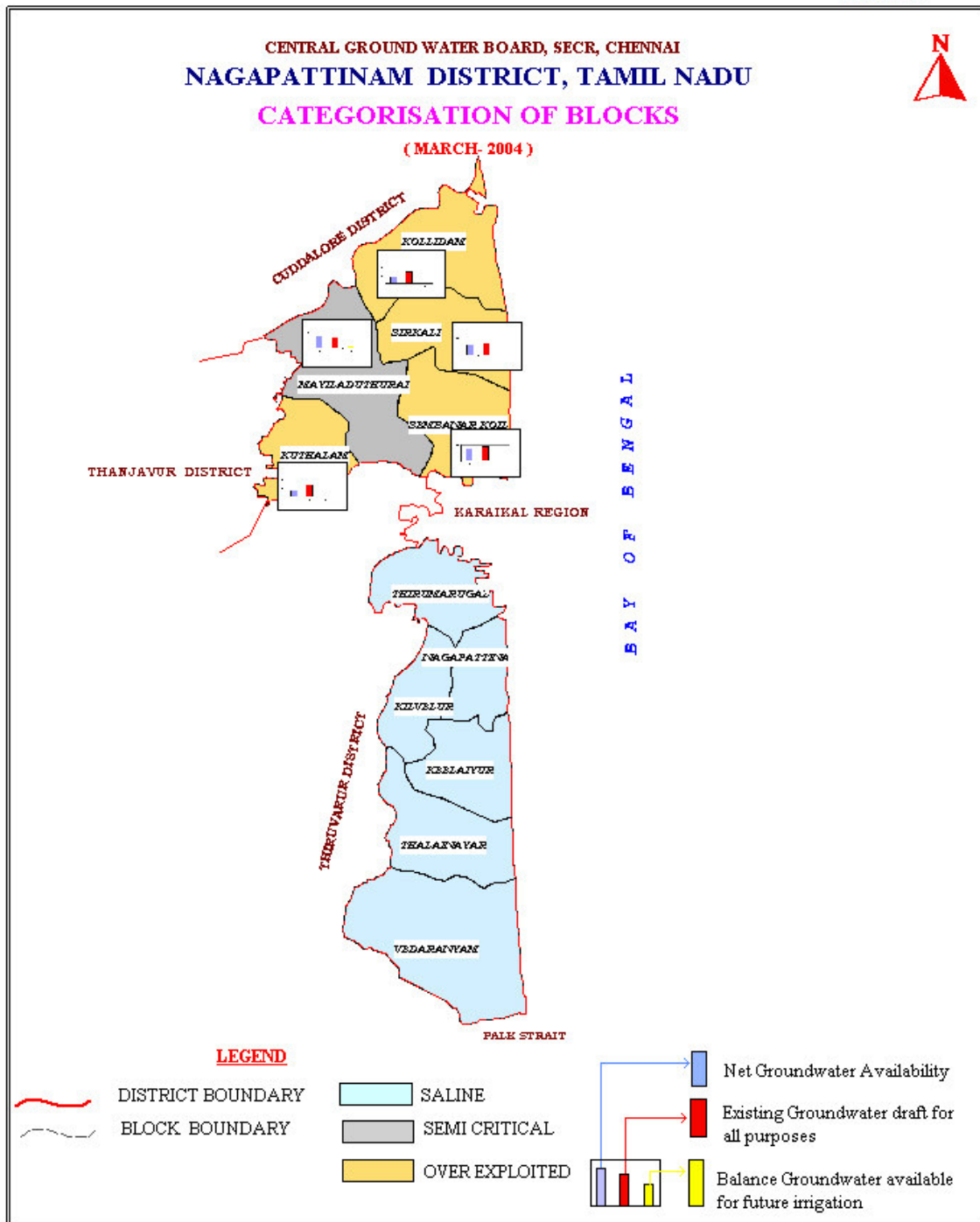
LEGEND

-  DISTRICT BOUNDARY
-  BLOCK BOUNDARY
-  GROUND WATER MONITORING WELL OF CGWB

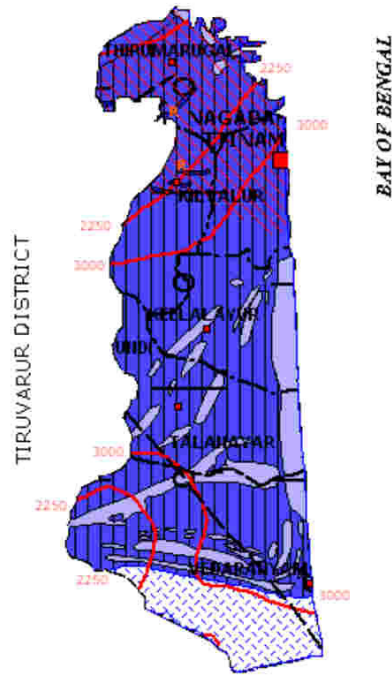
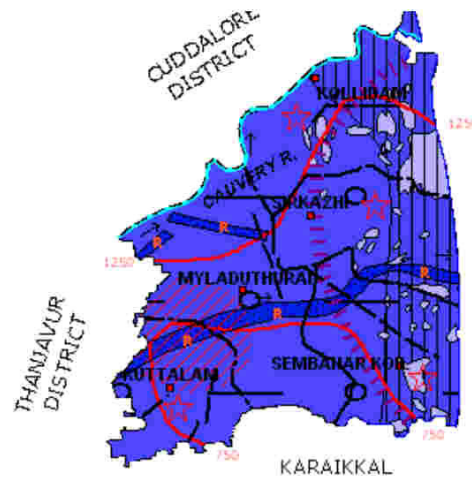
DEPTH TO WATER LEVEL (m.bgl.)

-  0-2
-  >2-5



















CENTRAL GROUND WATER BOARD, SECR, CHENNAI
**GROUND WATER DEVELOPMENT POTENTIAL AND
ARTIFICIAL RECHARGE PROSPECTS**
NAGAPATTINAM DISTRICT, TAMIL NADU



LEGEND OVER LEAF

LEGEND FOR PLATE -VI

DISTRICT – NAGAPATTINAM

	Wells Feasible	Rigs Suitable	Depth of Well (mbgl)	Discharge (lpm)	Suitable Artificial Recharge Structures
 Soft Rock shallow aquifer	Dug Well Filter Point	Manual Hand Bore	5 – 10	Less Than 300	Rain Water Harvesting/ Surface & Sub surface Storage Tanks
 Soft Rock pliocene Quaternary Aquifer	Dug Well Filter Point Tube Well	Manual Hand Bore Direct Rotary	8 – 12 10 – 15 100 – 450	400 – 1700	Rain Water Harvesting / Percolation Pond
 Soft Rock Orthanadu Aquifer	Filter Point Tube Well	Hand Bore Direct Rotary	10 – 20 40 – 450	300 – 1000 1000 – 3000	Rain Water Harvesting Percolation Pond/ Gabion Structures
	District Boundary				
	Block Boundary			Swamp	
	District Headquarter			Block Headquarter	
	River			EC (Micro Siemens / Cm at 25°C)	
	Fluoride Greater than Maximum Permissible Limit (1.5 mg/l)			Nitrate Greater than the maximum Permissible Limit (45 mg/l)	
	Palaeo Channal			Saline Zone	

OTHER INFORMATION



Geographical Area	2715.83 Sq km
Number of Blocks	11
Major Drainage	Kollidam, Cauvery
Population (2001)	14,88,839
Average Annual Rainfall	1230 mm
Annual Range of Temperature	19.3 – 40.6° C
Regional Geology	Soft Rocks: Alluvium and Orthanadu formation
Net Ground Water Availability For Future Irrigation	Nil
Stage of Ground Water Development (As on March 2004)	126.2 %
Name of Blocks Showing Intensive Ground Water Development	★ Over-Exploited: Kollidam, Kuthalam, Sembanarkoil & Sirkali


SAVE WATER

AND

CONSERVE WATER

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