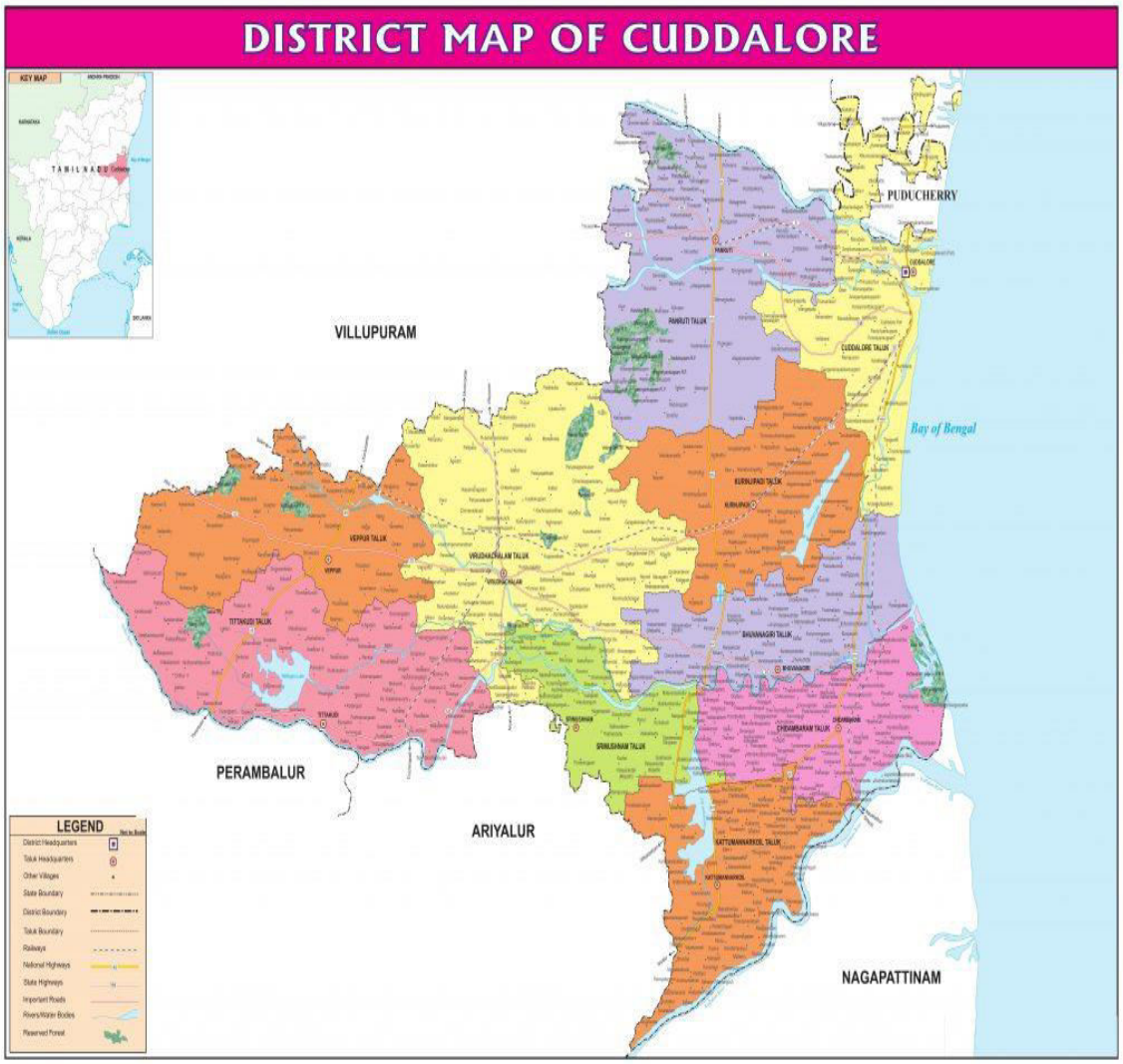
DISTRICT SURVEY REPORT FOR SAND
CUDDALORE DISTRICT



(Prepared as per the Gazette Notification S.O.3611 (E) dated 25.07.2018 of Ministry of Environment, Forest and Climatic Change)

2019

DISTRICT ENVIRONMENT IMPACT ASSESSMENT AUTHORITY (DEIAA), CUDDALORE DISTRICT

INDEX

DISTRICT SURVEY REPORT FOR SAND CUDDALORE DISTRICT

1. Introduction:

The Ministry of Environment, Forest and Climate Change, **Government of India in its notification S.O. No.3611 (E) dated: 25.07.2018 has issued amendments to the** procedure and format for the preparation of District Survey Report of minor minerals including sand mining or river bed mining. The main purpose of preparation of District Survey Report is to identify the mineral resources and developing the mining activities along with other relevant data of the District.

2. Overview of Mining Activity:

Tamil Nadu Public Works Department, pioneer in all branch of engineering, is the custodian of Odai, Canal, Rivers and Water bodies in the State. Public Works Department creates, Maintains and protects all irrigation systems including the rivers. Periodical maintenance including desilting of the drains/river is carried out to maintain the functional efficiency including the carrying capacity of the river. But in rivers flood protection works are carried out by increasing top level of bund and protecting the sides of bund with revetment. The desilting was never carried out in river due to the cost constraints. Therefore, prolonged siltation for decades and more, the level of the floor of riverbed has increased and reduced the carrying capacity.

Whenever floods and consequent damages occurred, it was resorted to increase the bund level to restore the carrying capacity of river. It was never thought of desilting the river due to the enormous cost, it require and the problem of ways and means to dispose the desilted sand. Consequence of this change in river regime and reduction in carrying capacity of the Thenpennaiyar River, the shoals in the rivers, divert the flow of water resulting in bund erosion and consequent breaches, which lead to loss of property and lives.

Solution to the above problem is to desilt the shoals in the Thenpennaiyar River by expending huge amount. Alternatively, the economical solution to this problem is to mine the sand to remove the shoals. This option would yield net revenue to the state exchequer apart from making available the important construction material for infrastructure development at a reasonable price to the common people.

The quarrying of sand in Government Poramboke lands and private patta lands had been entrusted to private agencies by the Revenue Department after concluding a lease agreement with them. The process was in practice up to August 2002.

As per G.O.No. 46/Industries (MMC.1) Department, dated 25.09.2002, a high level committee had been constituted to conduct a survey of rivers and river beds in the state with reference to sand quarry. The high level committee concluded that,

a) Even through several rules on sand mining exist, illegal quarrying of sand in out of control. Authority for regulating sand mining is vested with different organization such as, State Geology and Mining Department, Revenue Department and Public Works Departments. Hence, implementation and monitoring of rules and regulation regarding sand quarrying are not effective. The important task of sand mining therefore, should be entrusted to a SINGLE AGENCY.

The Government issued an order vide G.O. Ms.No. 95, Industries (MMC.1) Department , dated. 01.10.2003 to operate sand quarries in Tamil Nadu by Public Works Department. Accordingly, Sand quarrying operations are being carried out from October 2003 in District of the Tamil Nadu.

Based on the above instructions, the concerned Executive Engineers with their field staff will identify the quarry site considering the availability of sand deposits and sand humps,

approach to the site, existing infrastructures, water head works, cross masonry works etc. After selecting the site, proposals will be sent to the concerned District Collectors.

The sand mining activity carried out by the Public Works Department for the past two years in the district are as follows:-

Sl. No	Name of Quarry	Taluk	Name of River	Sand Quarry approval Details		Lease period	Remarks
				DEIAA	SEIAA		
1	Kamatchipettai	Panruti	Gadilam	-	Lr.No.SEIAA-TN/F.No. 3518/EC/1(a)/1908/2014/ Dated:27.03.2015	2 years	Commenced on 27.04.2017 completed on 28.03.2018
2	Otteri	Panruti	Gadilam	-	Lr.No.SEIAA-TN/F.No. 3465/EC/1(a)/1897/2015/ Dated:30.03.2015	2 years	Commenced on 14.05.2015. completed on 28.03.2018
3	Azhagiyanatham	Cuddalore	Then pennaiyar (Ponnaiyar)	Lr.No.DIA/TN/MIN/9746/2017/DEIAA-15/2017, Ec.No.15, Date:27.11.2017.	-	2 years	Commenced on 19.06.2018. completed on 05.10.2018
4	Vanpakkam	Panruti	Thenpennaiyar (Ponnaiyar)	Lr.No.DIA/TN/MIN/9745/ 2017/DEIAA-14/2017, Ec.No.14, Date:27.11.2017	-	2 years	Commenced on 17.05.2018. completed on 03.07.2018
5	Thirukandeswaram	Panruti	Thenpennaiyar (Ponnaiyar)	Lr.No.DIA/TN/MIN/9747/2017/DEIAA-16/2017, Ec.No.16, Date:27.11.2017.	-	2 years	Commenced on 01.06.2018 and in progress
6	Enathirimangalam	Panruti	Thenpennaiyar (Ponnaiyar)	Lr.No.DIA/TN/MIN/15178/ 2018/DEIAA-24/2018, Ec.No.24, Date:15.05.2018.	-	1 year	Commenced on 09.11.2018 and in progress

7	Kunjamedu	Kattumannarkoil	Coleroon	-	Lr. No. SEIAA TN/ F.No. 6453 / EC/ 1 (a)/ 3967/ 2017 dated 28.02.2018.	2 years	Commenced on 27.04.2018 and in progress
8	C.Arasur	Chidhambaram	Coleroon	-	Lr. No. SEIAA TN/ F.No. 4077 / EC/ 1 (a)/ 2293(A)/ 2015-2 dated 27.10.2015.	3 years	Commenced on 03.03.2016 completed on 18.05.2018
9	Azhangathan	Chidhambaram	Coleroon	-	Lr. No. SEIAA TN/ F.No. 4078/ EC/ 1 (a)/ 2298(A)/ 2014 dated 27.10.2015.	3 years	Commenced on 03.03.2016 completed on 25.01.2018
10	Kallipadi	Srimushnam	Vellar	-	Lr. No. SEIAA TN/ F.No. 3521 / EC/ 1 (a)/ 2299/ 2014 dated 27.10.2015.	2 years	completed on 27.04.2018
11	Koodalaiyahtur	Srimushnam	Vellar	-	Lr. No. SEIAA TN/ F.No. 3369 / EC/ 1 (a)/ 1930/ 2015 dated 30.03.2015.	3 Years	Lorry loading started 07.08.17 completed on 29.10.2017
12	Madhagalirmanickam	Srimushnam	Vellar	-	Lr. No. SEIAA TN/ F.No. 3519 / EC/ 1 (a)/ 1826/ 2014 dated 27.03.2015.	3 Years	Completed on 13.09.2017
13	T.Ellamangalam	Tittagudi	Vellar	-	Lr. No. SEIAA TN/ F.No. 6457 / EC/ 1 (a)/ 3968/ 2017 dated 28.02.2018.	2 years	Commenced on 07.08.2018 and in progress
14	Manavalanallur	Virudhachalam	Manimuktha	Lr.No.DIA/TN/MIN/15177/ 2018/DEIAA-23/2018, Ec.No.23, Date:15.05.2018.	-	1 year	Commenced on 17.07.2018 and in progress
15	Miralur	Bhuvanagiri	Vellar	Lr.No.DIA/TN/MIN/14969/ 2018/DEIAA-20/2018, Ec.No.20, Date:15.05.2018.	-	1 year	Commenced on 28.09.2018 completed on 30.03.2019

16	Ayipettai	Chidhambaram	Vellar	Lr.No.DIA/TN/MIN/14980/2018/DEIAA-22/2018, Ec.No.22, Date:20.06.2018.	-	1 year	Commenced on 10.09.2018 and in progress

3.List of Sand Mining Leases in the District.

Sl. No.	Taluk / Division	Village	S.F.No. & Extent in Hects.	River Name	Collector's Proceedings No. & Date	Lease Period	Bullock Cart / Lorry
1.	Cuddalore	Azhagiyanatham	225 - over an extent of 4.75.0 / 107.11.5 hect.	Thenpennai	Rc.No.385/Mines/2017, dated 07.04.2018	07.04.2018 to 06.04.2020	Non-Operation
2.	Kattumannarkoil	Kunjamedu	68 - over an extent of 19.50.0 /100.40.0 hect.	Coleroon river bed	Rc.No. 335/Mines/2017, dated. 07.04.2018	07.04.2018 to 06.04.2020	Operation
3.	Thittakudi	T.Elamangalam	150 - over an extent of 9.00.0 / 26.00.0hect	Vellar River	Rc.No. 332/Mines/2017, dt.07.04.2018.	07.04.2018 to 06.04.2020	Operation
4.	Panruti	Thirukandeswaram	Ward-A, Block-1, T.S No.2 - over an extent of 4.95.0 / 16.78.0 hect.	Thenpennai	Rc.No. 383/Mines/2017, dt.07.04.2018.	07.04.2018 to 06.04.2020	Non-Operation
5.	Panruti	Akkadavalli	S.F.No. 1/1 (P) - over an extent of 4.90.0 / 99.56.0 hect.	Thenpennai	Rc.No.106/Mines/2018, dt. 13.06.2018	13.06.2018 to 12.06.2019	Non-Operation
6.	Panruti	Enathirimangalam	S.F.No. 1/3 (P) - over an extent of 4.80.0 / 150.88.0 hect.	Thenpennai	Rc.No.100/Mines/2018, dt. 20.06.2018	20.06.2018 to 19.06.2020	Operation
7.	Vridhachalam	Manavalanallur	S.F.No. 3 (P) - over an extent of 4.96.0 / 36.72.5 hect.	Manimuttar	Rc.No.103/Mines/2018, dt. 13.06.2018	13.06.2018 to 12.06.2019	Operation
8.	Bhuvanagiri Taluk	Miralur	S.F.No. 196(P) - over an extent of 4.96.0 / 32.05.0 hect.	Vellar	Rc.No.104/Mines/2018, dt. 13.06.2018	13.06.2018 to 12.06.2019	Operation
9.	Chidambaram	Kiliyanur	S.F.No. 93 (P) – Over an extent of 4.90.0 / 48.51.5 Hects	Vellar	Rc.No.102/Mines/2018, dt. 14.08.2018	14.08.2018 to 13.08.2019	Non-operation
10.	Chidambaram	Ayipettai	S.F.No. 2 (P) – Over an extent of 3.60.0 / 45.62.5 Hects	Vellar	Rc.No.101/Mines/2018, dt. 14.08.2018	14.08.2018 to 13.08.2019	Operation

4.Details of Revenue received in last three years.

Sl.No	Name of Quarry	Quantity of Sand Quarried in Loads (2unit)	Rate/Per Load in Rupees	Total Royalty/Revenue in Rupees
For the year 2016-17				
1	Otteri	3215	840	2700600
2	Azhangathan	48644	1080	52535520
	Sub Total	**51859**		**55236120**
For the year 2017-18				
1	Kamatchipettai	3607.20	840	3030048
2	Otteri	8622	840	7242480
3	Kallipadi	26351.60	1080	28459728
4	Koodalaiyahtur	34817.98	1080	37603418.4
5	Madhagalirmanickam	31799.50	1080	34343460
6	C.Arasur	73274	1080	79135920
7	Azhangathan	37063.55	1080	40028634
	Sub Total	**215535.83**		**229843688.4**
For the year 2018-19				
1	Kallipadi	213.60	1080	230688
2	C.Arasur	20630.00	1080	22280400
3	Azhagiyanatham	8231.25	2660	21895125
4	Vanpakkam	8716.00	2660	23184560
5	Thirukandeswaram	8150.88	2660	21681328
6	Enathirimangalam	7208.00	2660	19173280
7	Miralur	8772.50	2660	23334850
8	Ayipettai	1665.00	840	1398600
9	Kunjamedu	25251.98	2660	67170267
10	T.Ellamangalam	4208.00	840	3534720
11	Manavalanallur	4620.00	840	3880800
Sub Total		**97667.21**		**207764618.00**
Total				**492844426.40**

5.Details of Production of Sand in last three years.

Sl. No	Name of Sand Quarry	Taluk	Name of River	Peroid of Product	Quantity of Sand Quarried in Loads
1	Kamatchipettai	Panruti	Gadilam	27.04.2017 to 28.03.2018 (12 Months)	20417 M^3 (or) 3607.20 Loads (2 units)
2	Otteri	Panruti	Gadilam	14.05.2015 to 28.03.2018 (Months)	82047 M^3 (or) 14496 Loads (2 Units)
3	Azhagiyanatham	Cuddalore	Then pennaiyar (Ponnaiyar)	19.06.2018 to 05.10.2018 (closed)	46589 M^3 (or) 8231.25 Loads
4	Vanpakkam	Panruti	Thenpennaiyar (Ponnaiyar)	17.05.2018 to 03.07.2018 (closed)	49333 M^3 (or) 8716 Loads
5	Thirukandeswaram	Panruti	Thenpennaiyar (Ponnaiyar)	01.06.2018 to 03.10.2018 (Still running)	46134 M^3 (or) 8150.88 Loads
6	Enathirimangalam	Panruti	Thenpennaiyar (Ponnaiyar)	09.11.2018 to 05.04.2019 (Still running)	40797 M^3 (or) 7208 Loads
7	Kunjamedu	Kattumanarkoil	Coleroon	27.04.2018 to 31.03.2019 (Still running)	25251.98 M^3 (or) 4461.48Loads
8	C.Arasur	Chidhambaram	Coleroon	03.03.2016 to 18.05.2018 (Closed)	512966 M^3 (or) 90630 Loads
9	Azhangathan	Chidhambaram	Coleroon	03.03.2016 to 25.01.2018 (Closed)	487363 M^3 (or) 86106.55 Loads
10	Kallipadi	Srimushnam	Vellar	Completed on 27.04.2018	150359 M^3 (or) 26565.20 Loads
11	Koodalaiyahtur	Srimushnam	Vellar	Completed on 29.10.2017	197070 M^3 (or) 34817.98 Loads
12	Madhagalirmanickam	Srimushnam	Vellar	Completed on 13.09.2017	179985 M^3 (or) 31799.50 Loads

13	T.Ellamangalam	Tittagudi	Vellar	07.08.2018 to 31.03.2019 (Still running)	23817 M^3 (or) 4208 Loads
14	Manavalanallur	Virudhachalam	Manimuktha	17.07.2018 to 31.03.2019 (Still running)	26149 M^3 (or) 4620 Loads
15	Miralur	Bhuvanagiri	Vellar	16.10.2018 to 30.03.2019 (closed)	49652 M^3 (or) 8772.50 Loads
16	Ayipettai	Chidhambaram	Vellar	07.08.2018 to 31.03.2019 (Still running)	9424 M^3 (or) 1665 Loads

6.Process of Deposition of Sediments in the rivers of the District

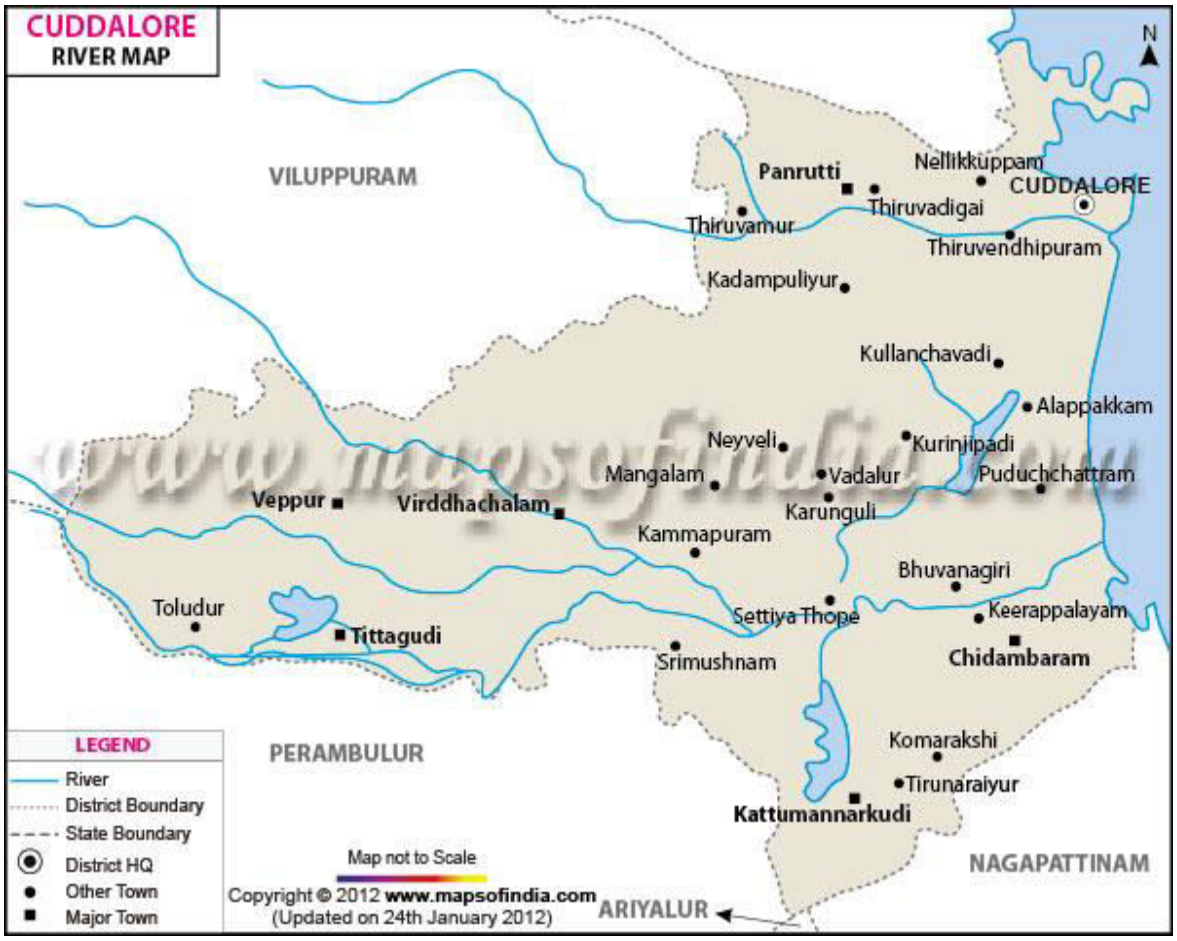
River sediment refers to the mixture of mineral matters which are derived from the weathering and erosion of rocks present in the river bed. Breaking down of rocks by a geological agent, here it is a river (flow of water), is called erosion. The erosion of rocks occurs in many ways. Weathering is described as disintegration and decomposition of rocks due to change in physical and chemical conditions of the rock. Sediments are derived by these natural processes. Sediments are subsequently transported by water and/or by the force of gravity acting on the sediments. Sediments become the river's load and the river transport this loads through its course. Transportation of the sediments depends on the energy of the river. Boulders are transported by traction and are rolled along the bed of the river. Slightly smaller particles, such as pebbles and gravel are transported by saltation. This is where the load bounces along the bed of the river because the river has enough energy to lift the particles off the bed but the particles are too heavy to travel by suspension. Fine particles like clay and silt are transported in suspension; they are suspended in the water. Most of a river's load is transported by suspension. Solution is a special method of

transportation. This is where particles are dissolved into the water so only rocks that are soluble, such as limestone or chalk, can be transported in solution. Deposition occurs when forces responsible for sediment transportation are no longer sufficient to overcome the forces of gravity and friction which are creating a resistance to motion. To transport load, a river needs to have energy at the same time when a river loses energy, it is forced to deposit its load. One of the following ways, a river could lose its energy:

1. Reduction in the discharge: Reduction in discharge may be due to lack of precipitation and evaporation and abstraction by human activity.
2. Change in the river gradient: If the gradient of the river's course flattens out, the river will deposit its load because it will be travelling a lot slower. When a river meets the sea a river will deposit its load because the gradient is generally reduced at sea level and the sea will absorb a lot of energy.

Much of the material will be carried in suspension and loads in suspension erode the river banks by abrasion. When rivers flow over flatter land, they form large bends called meanders. As a river goes around a bend, most of the water is pushed towards the outside causing increased erosion. The river is now eroding sideways into its banks rather than downwards into its bed, a process called lateral erosion (Plate 1. A & B). On the inside of the bend, in contrast, there is much less water. The river will therefore be shallow and slow flowing. It cannot carry as much material and so sand and gravels will be deposited. This is called a point bar or slip off slope. Due to erosion on the outside of a bend and deposition on the inside, the shape of a meander will change over a period of time. Eventually deposition will block off the old meander to leave an oxbow lake. The oxbow lake will slowly dry up, only refilling after heavy rain or during a flood.

In Cuddalore District Then Pennaiyar River ,Gadilam Rive,r Manimuktha River, Vellar River, Coleroon River, Gomukhi River and Mayuranathi River and their tributaries are draining and passing through the District. These rivers are perennial in nature.

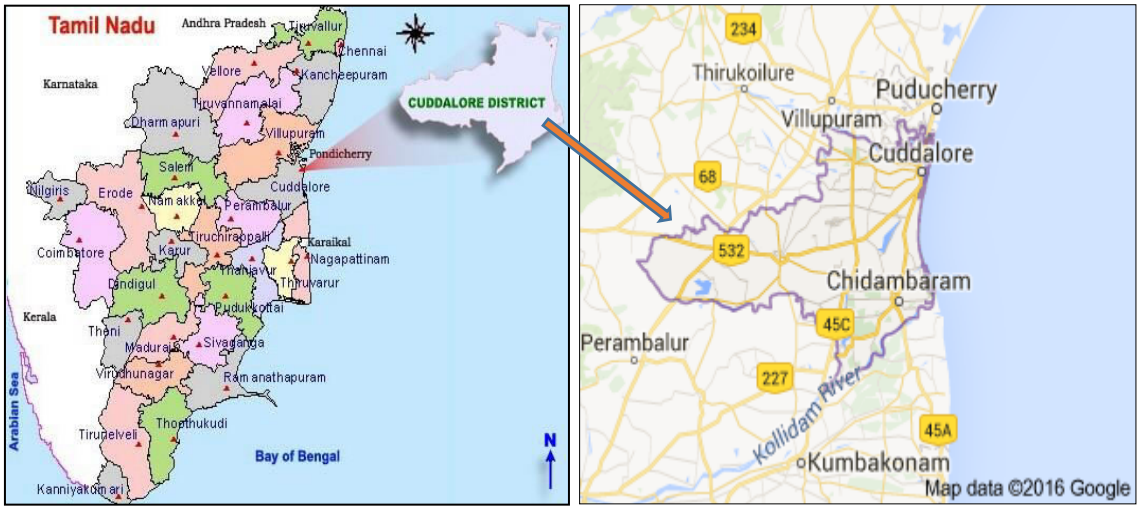


7. General Profile of the District:

The Cuddalore district is bounded in Latitude 11°11” and 12° 5”N Longitude78° 38” and 80° 00” E covered in an area of 3678 Sq.kms . It is bounded on the north by Viluppuram District, on the east by the Bay of Bengal, on the south by Nagapattinam District, and on the west by Perambalur District. The headquarters of the Cuddalore district is Cuddalore (11°44' 45" N and 79°45'56" E), a large industrial town which has experienced coastal development at a rapid rate. Cuddalore is situated about 160 kms south of Chennai, the state capital. The district is drained by Gadilam and Pennaiyar rivers in the north, Vellar and Kollidam River (Coleroon) in south.

Cuddalore District consists of three Revenue Divisions viz., Cuddalore, Chidambaram and Vridhachalam, 10 Taluks viz., 1. Cuddalore, 2. Chidambaram 3. Kattumannarkoil 4.Virudhachalam 5.Thittakudi 6.Bhuvanagiri 7.Panruti 8.Veppur 9.Srimushnam and 10. Kurchipadi. There are 5 Municipalities viz. Cuddalore, Nellikuppam , Panruti, Chidhambaram and Virudhachlam. The Cuddalore District has 13 Blocks and 16 Town Panchayats.

The coastal stretch of Cuddalore extends from Gadilam estuary in the north to Pichavaram mangroves in the south, a total length of 42 km along the Bay of Bengal. The Bay of Bengal experiences severe tropical cyclones during the northeast monsoon (October through December), and nearly 60 cyclonic storms and SCS have been reported in the past century (Indian Meteorology Department (IMD) Atlas 2011). An added risk factor is that large parts of this coastal zone are low-lying with a gentle slope, resulting in wide inundation areas, thus increasing the vulnerability of the region.



(Fig.7) Cuddalore District Map

From ancient times the old town has been a seaport. For two centuries, Cuddalore had been subject to a number of foreign powers including the Netherlands, Portugal, France and more recently, the British. In the early 17th century, the Dutch obtained

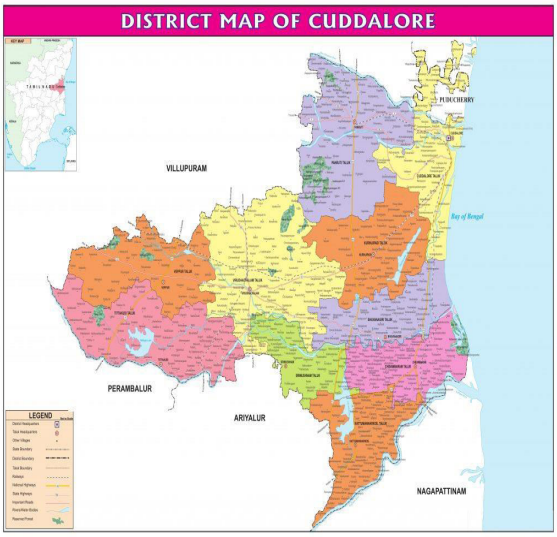
permission from the ruler of Cuddalore to build a fort there, but political pressure from their Portuguese rivals forced them to abandon it. Later, the French and English came to Cuddalore for trade and business. The French established a settlement 10 miles up the coast at Pondicherry in 1674, followed in 1690 by the British settlement of Fort St. David at Cuddalore.

During the 18th century various wars between the European powers spilled over to their colonial empires and to their allies, including those in the Indian sub-continent. During this period the French and British fought several times in the area. In 1746, during First Carnatic War, part of the War of the Austrian Succession, French forces besieged the British at Fort St. David for several months before being driven off in 1747. In 1758, during the Seven Years' War, the Fort was taken by the French, and there was an inconclusive naval action, the Battle of Cuddalore, off the coast. The fort was later abandoned, in 1760, when the British attacked Pondicherry. In 1782, during the Second Anglo-Mysore War, at the time of the American War of Independence, the French again took Cuddalore and were besieged there in 1783 by the British. During the siege French and British naval forces again clashed off the Cuddalore coast. The siege failed, but the fort was returned to the British in 1795. In all there were five different naval actions off the coast during this period, all of which were indecisive.

Some streets in Cuddalore retain their British names, such as Clive Street, Wellington Street, Sloper Street, Canning Street, Rope Street (Rope Street, Wellington Street, Sloper Street and Canning Street jointly known as Salangukara Village), Lawrence Road and Imperial Road. The Cuddalore Central Prison, opened in 1865, is a historically important landmark. Subramania Bharati and other political leaders served prison terms there.

7.1 Land utilization:

It is a predominately agricultural district with the coastline stretching from the Puducherry Union Territory in the north to the mouth of the River Coleroon in the south. The total geographical area of the district is 3706 sq.kms. with a coast line of about 54 kms. It is 19th largest district in Tamil Nadu and ranked 332 in India in terms of total area. The district is 11th most populous district out of 32 districts in Tamil Nadu and it is 158th most populous district in India. It is 7th most densely populated district in Tamil Nadu and 168th most densely populated district out of total 640 districts in India. Cuddalore District comprises 10 taluks, 13 Blocks, 5 Municipalities and 16 Town Panchayats shown in Fig3.2.



7.1. Showing Taluk and Blocks of Cuddalore District:

Cuddalore District - Taluks

7.2 Population:

According to 2011 census, Cuddalore district had a population of 26,05,914 with a sex-ratio of 987 females for every 1,000 males, much above the national average of 929. A total of 2,79,950 were under the age of six, constituting 1,47,644 males and 1,32,306 females. Scheduled Castes and Scheduled Tribes accounted for

29.32% and 0.6% of the population respectively. The average literacy of the district was 69.66%, compared to the national average of 72.99%.

Table 7.2 .Population details of Cuddalore district

Item	India	Tamil Nadu	Cuddalore
Population (No.)	121,01,93,422	7,21,38,958	26,00,880
Male (No.)	62,37,24,248	3,61,58,871	13,11,151
Female (No.)	58,64,69,174	3,59,80,087	12,89,729
Sex Ratio (per 1000)	940	995	984
Density (No./km2)	382	555	702
Area	3,287,240 Km2	1,30,058 Km2	3706 Km2
Literacy (%)	74.04	80.33	79.06

The Cuddalore district had a total of 635,578 households. There were a total of 11,69,880 workers, comprising 1,36,035 cultivators, 3,25,599 main agricultural labourers, 19,151 in house hold industries, 3,56,486 other workers, 3,32,609 marginal workers, 29,135 marginal cultivators, 2,13,813 marginal agricultural labourers, 12,876 marginal workers in household industries and 76,785 other marginal workers.[4] The district has a population density of 702 inhabitants per square kilometre (1,820/sq mi).

8. Land utilisation pattern in the district: Forest, Agricultural Horticultural and Mining etc.

Dunal areas are utilised mostly for raising casuarina and cashew plantations. Some of the dunal flat areas are used for cultivating groundnut crop once a year. Besides these, there are natural

vegetations like wild saline shrubs and palm trees. It is evident that the smaller dunal ridges and mounds have been flattened and landscape has been altered to suit agricultural activity. On the otherhand old dunes are getting stabilised and small new dunal mounds are getting created by the extensive cashew plantations going on this area. The cashew plantation has a thick or bushy canopy due to its lateral growth which facilitates the arrest of sand migration. The beach zone has a sparse cover of saline creepers and shrubs which also contribute to stabilising the sand.

The land use pattern of the district is provided as Table 2

Sl.No	Classification	Area(Ha)
1.	Forests	1414.525
2.	Barren & Uncultivable Lands	14622.745
3.	Land put to non agricultural uses	58942.735
4.	Cultivable Waste	6033.690
5.	Permanent Pastures and other grazing lands	603.730
6.	Land under miscellaneous tree crops and graces not included in net area sown	13734.260
7.	Current Fallows	24554.120
8.	Other fallow lands	27213.215
9.	Net area sown	220661.980
10.	Geographical area according to village papers	367781.000
11.	Total cropped area	332220.165
12.	Area sown more than once	111558.185

Source: District hand book (2015-16) Pg No:13

9. Physiography of the District:

The district has an area of 3,564 km². It is bounded on the north by Viluppuram District, on the east by the Bay of Bengal, on the south by Nagapattinam District, and on the west by Perambalur

District. The district is drained by Gadilam and Pennaiyar rivers in the north, Vellar and Kollidam River(Coleroon) in south.

10. Climate and Rainfall of the District

The climate in general is moderately hot and humid tropical. The Mean Maximum temperature from January to June varies from 28øC to 34øC. It has hot summer and insignificant to mild winter with moderate to heavy rainfall. The area is affected mainly by NE monsoon with some evening showers during SW monsoon. The average rainfall details are shown in figure.

S.No	Year	South West (mm)	North East (mm)	Total
1	2003	434.0	915.7	1349.7
2	2004	437.9	908.5	1346.4
3	2005	340.3	1346.1	1686.4
4	2006	246.5	1007.3	1253.8
5	2007	330.5	837.7	1168.2
6	2008	280.8	1136.5	1417.3
7	2009	278.0	960.5	1238.5
8	2010	362.9	1043.7	1406.6
9	2011	424.6	873.4	1298.0
10	2012	245.5	587.8	833.3

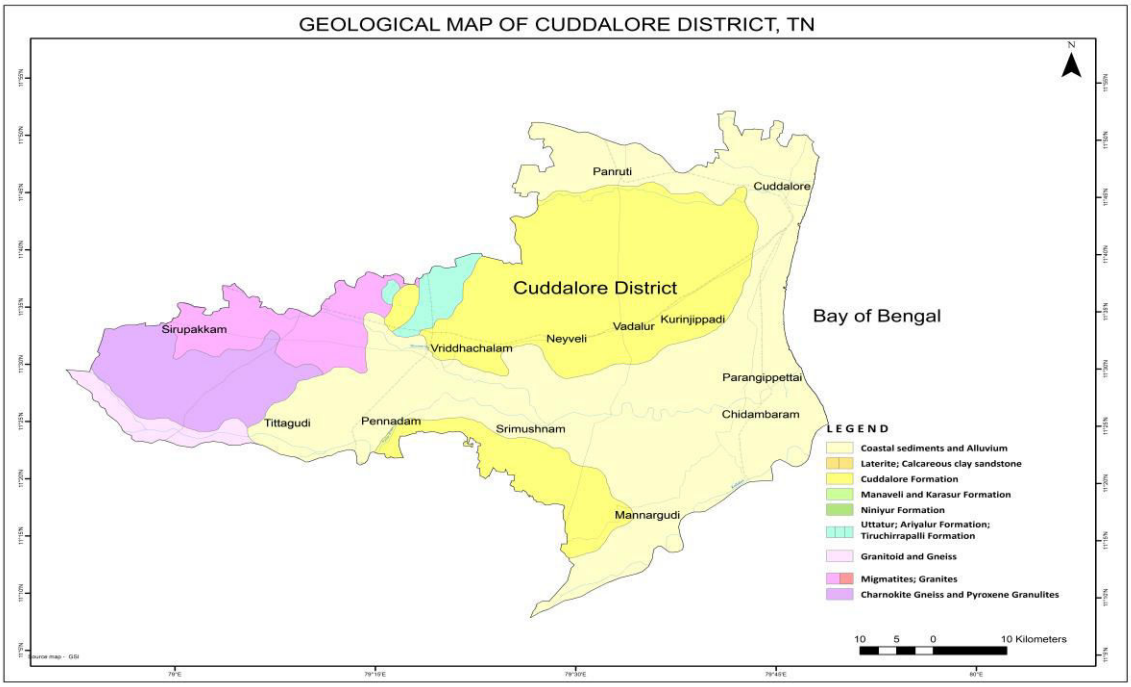
Table 10.1: Rain fall Data of Cuddalore district:

Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year
Average high °C (°F)	28.1 (82.6)	29.2 (84.6)	31.1 (88)	33.2 (91.8)	36.1 (97)	37.0 (98.6)	35.5 (95.9)	34.6 (94.3)	34.0 (93.2)	31.7 (89.1)	29.1 (84.4)	28.0 (82.4)	32.3 (90.16)
Average low °C (°F)	20.8 (69.4)	21.2 (70.2)	23.0 (73.4)	25.8 (78.4)	27.1 (80.8)	27.0 (80.6)	26.1 (79)	25.4 (77.7)	25.1 (77.2)	24.3 (75.7)	22.8 (73)	21.5 (70.7)	24.18 (75.51)
Average rainfall mm (inches)	30 (1.18)	36.8 (1.449)	11 (0.43)	21.5 (0.846)	71 (2.8)	70 (2.76)	85 (3.35)	144 (5.67)	129 (5.08)	247 (9.72)	330 (12.99)	216 (8.5)	1,391.3 (54.775)

Figure 10.2 Showing Average rain fall data of Cuddalore district

11. Geology & Mineral wealth of the Cuddalore District:

The area is occupied by Tertiary and Quaternary Formations and the generalised stratigraphy is shown in the figure 4.1 District resource map of Cuddalore district.



11.1 General Stratigraphic Sequence of Cuddalore district is given below:

Era	Period	Stage	Lithology
Cainozoic	Quaternary	Pleistocene to Recent	Alluvial clay & sand, laterite with reddish brown ferruginous clayey soil
	Tertiary	**Cuddalore Formation -Mio-Pliocene (Early Neogene)**	Mottled, fine to coarse grained yellowish to brownish grey argillaceous, brownish ferruginous sandstone, pebbly sandstone, hard compact clay stone, greenish grey clay with bands of limestones,
		Neyveli Formation - Eocene	Argillaceous sandstone, sandy clay, clay, carbonaceous clay, lignite beds, aquifer sand & clay
		Niniyur Formation – Paleocene (Palaeogene)	Limestone, calcareous shale/mud, clay and sandstone
Mesozoic	Cretaceous	Ariyalur Group	Argillaceous and micaceous sandstone with bands and lenses of limestones, clay sandy clay and siltstone with fine grained argillaceous sandstone
Paleozoic	Lower Permian	Lower Gondwana	Boulder bed, conglomerates, olive green to khaki coloured shale with pink sandstones
Achaean	---	Gneissic Group	Pink migmatitic granitoid gneiss

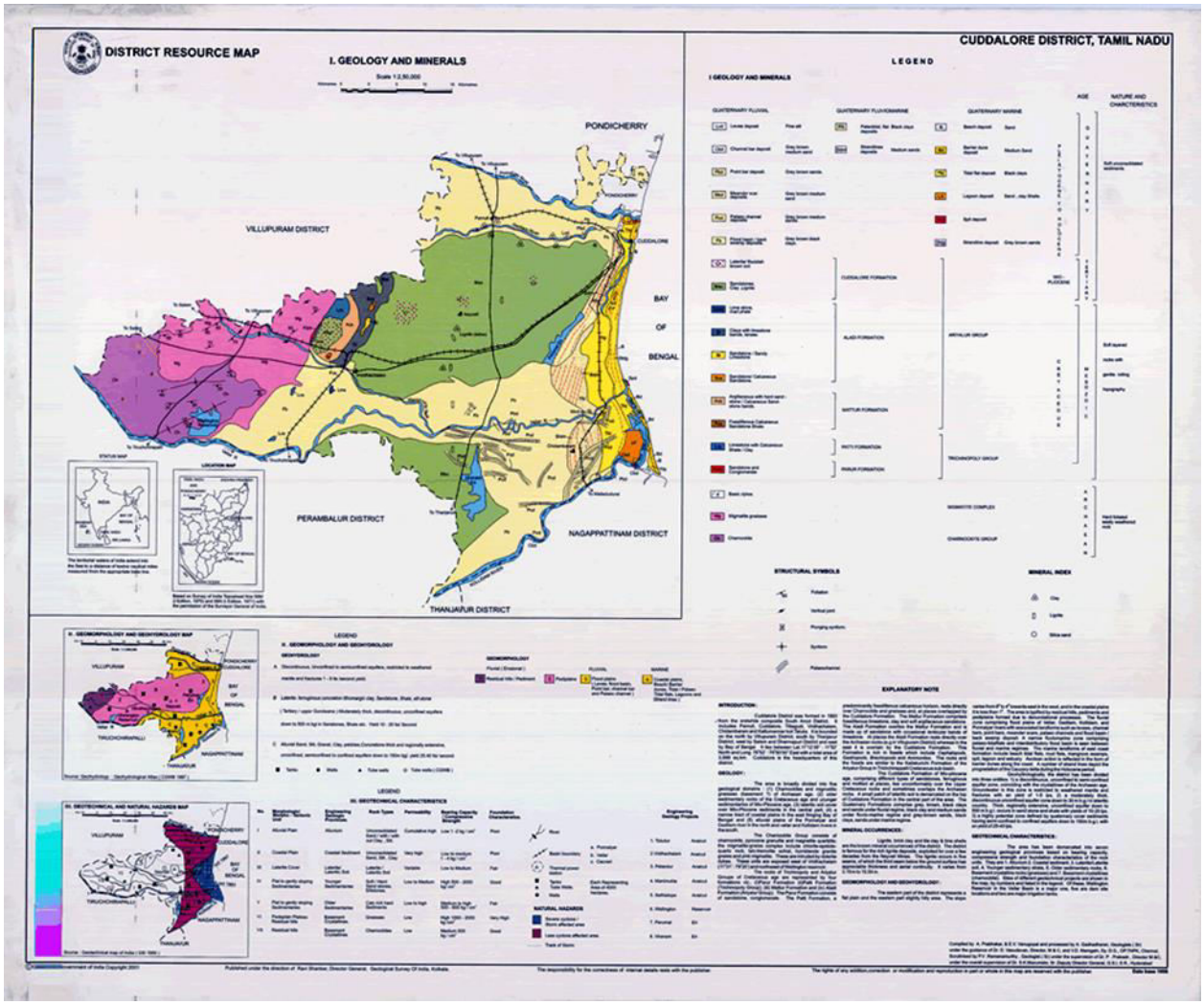


Figure 11.1. Showing District Resource map of Cuddalore District

The general geological formation of the district is simple with metamorphic rocks belonging to the gneiss family. Resting on these are the three great groups of sedimentary rocks belonging to different geological periods and overlaying each other in regular succession from the coast on the east to the hills on the west. The lowest of these groups is the fossil-bearing cretaceous limestone around Pondicherry and Vridhachalam. Above this comes a younger form the Red hills near Pondicherry and the Mount Capper hills south-west of Cuddalore. Uppermost are the alluvial beds of the deltas of rivers. There is every reason to believe that this order of the strata has existed unaltered through a long geological period; that in fact, since the beginning of the time when the oldest of the sedimentary beds, these of cretaceous age, were deposited.

Cuddalore sandstones and there are a number of flowing wells in this area. Gneiss, trap and sandstone are the main minerals of the district.

Gneiss is used for building purposes with excellent results especially in the temples. Its susceptibility to fine carving is exemplified in the chains cut from it which may be seen in the shrine at Srimushnam and the great temple at Chidambaram. Trap is scarcely used for building purposes because of its intractable hardness and inherent moisture absorbing quality. Sandstone is used for building purposes as well as for making mortars, troughs, etc. Besides these minerals, laterite occurs over a wide belt of country between Pondicherry and Vridhachalam (notably on Mount Capper), in the red soil tract around Srimushnam and to the east of Vridhachalam. It is largely used for building purposes and road making.

There are a large number of clay deposits in the district. White clay occurs in many places. It is exposed in the deep ravines below an overburden of 35 feet of sandstones and grits at Pannikappam, south of Panruti and just south of the Gadilam River. It burns to a pale grey colour, it is refractory and its shrinkage is high, being 40 percent.

11.2. Archaeans:

The Archaean rocks are exposed in the north-western and western part of the District or more precisely a passing roughly west of Virdhachalam and Ulundurpettai. The basement rocks (i.e. Archaean) constitute granitoid gneisses with pegmatite and dolerite intrusive in Neyveli Basin. The Archaean rocks form the basement in the area over which the later sediments were deposited. Outcrops of granitoid gneisses (i.e. Archaean) can be seen around Mangalam and Ulundurpettai. The well section shows coarse, weathered and pale coloured gneisses up to a depth of 2 to 4m passing into fresh bluish rocks below. The coarse granite gneisses chiefly consist of quartz, feldspar, biotite and hornblende Pegmatite and quartz veins intruding the granitoid gneisses. Charnockites are very common in the adjoining area and less frequently in the study area. The pegmatite predominantly consists of quartz and feldspar. The dolerites are the youngest intrusive rocks in the area. They cut across the geinesses in NNE-SSW or NE-SW direction between Mangalam and Ulundurpettai. Ground water prospect in these hard rock terrain are

meager because of compact nature of granitoid geinesses and chamockites.

11.3 Cretaceous:

11.3.1 Ariyalur Group:

In the western section of the study area, marine fossiliferous limestone, calcarious sandstones and marlstones succeed the Archaean crystalline basement rocks. They were deposited in shallow marine environment and have been classified as Ariyalur group of rocks (i.e. upper cretaceous). The rocks of Ariyalur group are exposed in a narrow NE-SW trending belt of about 3-8 Km wide between Ulundurpettai in the west and Palakkollai in the east. The marine cretaceous rocks are bounded in the west and east by Archaean crystaUine rocks and Cuddalore sandstone (Tertiaiy Age) respectively. On the east the fossihferous limestone are exposed at:

i. Around Patti, about 8 Km North West of Vridhachalam and 1.60Kms, SSW of Parur.
ii. About 400 to 600 m. south of Puvanur and west of Vridhachalam- Ulundurpettai road and
iii. About 1.6Kms SSW of Pelandurai anicut on the southern bank of Vellar, near a temple.

The limestones near patti are massive and fossiliferous having abandons of Trigonia semiculata and various species of pecten. The low area in the east of Puvanur is covered by kankar and saline black soils and devoid of outcrops. The Cretaceous rocks in the study area are overlained by the younger Tertiary rocks. Between Vridhachalam and Mangalam, the Cretaceous rocks are exposed in a few places in and around Puruver due to the erosion of the overlying Cuddalore Formation.

11.4. Tertiary:

The Tertiary geology is represented by the sediments of Mio-Pliocene periods. No basement rocks have been encountered even in the few deep bore holes drilled by the Neyveli Lignite Corporation. But sediments

probably representing Cretaceous period such as Siliceous limestone, calcareous sandstone, black silts and clay with thin bands of lignite have been encountered in the bore hole recently drilled by Neyveli Lignite Corporation near Palliodai village on the eastern banks of PerumalEri (Personal communication). These Cretaceous formations are overlain by the yellowish white to dirty white sandstone, grey siltstone, pebbly gravelly coarse grained sandstones with minor clays which form the Mio-Pliocene Cuddalore sediments. They are prominently seen as raised mounds around Pudur Sedapallayam, Samatikuppam areas in the northwestern part and these are only the continuation of large Tiruvendipuram sandstone plateau occurring south of Gadilam River.

Pebbly, gravelly, ferri-crete, concretionary soils with reddish brown sands (Lateritised, weathered gully eroded outcrops) occur as veneer over the sandstone. This lateritic cover of sandstone slowly disappears towards east as they are covered by thick alluvium and dunal sands. But the slopes of the sandstone plateau have thin soil cover and form a gently sloping pediplain in the areas of Kothandaramapuram, Palliodai, Puvanikuppam and Kullanchavadi.

11.4.1. Neyveli Formation

The Neyveli Formation represents the lower most tertiary group of rocks. They are essentially argillaceous and occur as a narrow belt overlying the Ariyalur group. It also occurs as inlires and outliers surrounded by Cuddalore Formation and Ariyalur Formation respectively. The Neyveli Formation is composed of silty claystones; black clays /shells, argillaceous sandstones, calcareous sandstones, fossiliferous limestones, algal limestones, etc. The algal limestones and argillaceous sandstones of the Neyveli Formation can be correlated to that of the Niniyur Formation of Ariyular area. It is occurring around Gopurapuram village near Vridhachalam and is assigned to Paleocene to Oligocene in age.

11.4.2. Cuddalore Formation:

The Cuddalore sandstones occur intermittently along the eastern coast of south India and represent the upper most Tertiary Formation. The

Cuddalore Formation occupies the major part of the study area. The rocks of this Formation consist of argillaceous sandstone, pebble-bearing sandstones, mottled sandstone, ferruginous sandstone, grits and clay beds and lignite seams which occupied more than half of the study area. The presence of the pebble and cobbles, mottled appearance, general impoverishment in micas and absence of garnet grains help to distinguish them from the older group of rocks.

The sandstones of the Cuddalore Formation are whitish, pinkish or mottled in colour and are chiefly argillaceous. The sandstone generally consists of rounded pebbles (pebbles and fragments) of quartz. The Cuddalore sandstones were altered and covered by either Laterite capping or by thick alluvium of Gadilam and Ponnaiyar rivers in the north and in the south by Vellar and Manimukta rivers. The Cuddalore Formation in the southern coastal parts of southern India is exposed in detached patches. The central patch extends between Vriddhachalam and Cuddalore, which are about 56.00Kms long, and 26.00Kms wide, trending ENE-WSW direction.The chief occurrence of Cuddalore sandstone is south west of Cuddalore taluk and south of Panruti taluk. The "Mount of Copper west" of Cuddalore comprises mainly fragments of rounded quartz bounded by the ferruginous contact. There is another patch of the Cuddalore sandstone occurs to the south of Vellar River around Srimushnam.

11.4.3. Quaternary formation:

The quaternary formation in the study area comprises sediments of fluvial, fluvio-marine and marine regime. The sediments includes fine to coarse-grained sands, silts, clays, laterites and lateritic gravels. The fluvial sediments are confined in the flood plains of the Ponniyar, Gadilam, Manimuktha , Vellar and Kollidam rivers which consist of mostly of sands and sandy or clay loams. The thickness of Vellar alluvium was recorded about 35m at Vridhachalam and 40mts at Satiatope. Laterites and Lateritic gravels derived from the gravel bearing Cuddalore sandstone are occupied large parts of the area. The laterites were generally ferruginous, yellowish dark brown, metallic luster, hard and with fairly extensive occurrence in the area are underlained by Cuddalore sandstones. In the far east of the

study area between Cuddalore and Portnovo, over a width of 1.50 to 3Kms from the coast occurs a low flat sand dune below sands except where they are interrupted by the outlets of the rivers. The most striking sand dunes occur near Cuddalore and Port Novo, where they formed irregular mounds of 10 to 50m heights by wind action.

The predominant part of study area is occupied by the unconsolidated and semi-consolidated Quaternary sediments which are mostly coastal dunal sands and river alluvium. No dating has been done so far to fix the absolute age of formation of these sediments. Hence only a relative age of Pleistocene and Holocene can be assigned. A.Prabhakar(1986) during the Quaternary geological mapping of this area has classified the area geologically into fluvial, fluviomarine and marine formations such as Auroville formations, Villiyanur formations, Ponnaiyar formations, Kallapettai formations and Marakkanam formations based on the various geomorphic surfaces.

Quaternary Sub recent White to grey silica sands Brown sand, Clayey sand Upper Pleistocene Sandy clay and clay. Tertiary Mio-Pliocene Cuddalore sandstone. The area in between the Perumal Eri and coastal dunal complex and the areas adjacent to Manambattan channel and Uppanar river bed are occupied by the medium to darkgrey coloured clay, silt and sandy clay materials forming the recent alluvial materials. The over flow from Perumal Eri and multiple tributaries of Uppanar riverhave contributed the sediment load in recent time over which intense agricultural activities are going on. The two to three meter thick clay and silt is underlain by weathered Cuddalore sandstone in the west and coastal sands in the east. Since Uppanar is a tidal stream the alluvium on either side has tidal clay or marine sediments at its subsurface.

11.5. Structure:

The Archaean-Cretaceous boundary in the west of the study area showed fault contact near patti . Whereas, evidences of faulted contact between the Cretaceous and Tertiary Cuddalore Formation is more

pronounced than Archaean-Cretaceous contact. The down thrown on the eastern side of the contact are visible about 1 Km to the south of the Pelandurai anicut in Cuddalore Sandstones, where faults can be traced not less than 400m and the change of dip amount in Cuddalore Formation may further strengthen the fault contact between them. During 1954-55, Varaprasada and Raja mapped the part of Cuddalore sandstone of the area recorded dips ranges from 5° to 8° ESE or SE and occasionally as much as 20° towards ESE or SE. The dip of the Cuddalore Formation in a quarries situated about 1.5 Km to the ENE of Pudupattai showing 20° to 25° towards ESE or SE direction.

The change in the direction and magnitude of dip close to Cretaceous-Tertiary contact, it may be a probable fault of post- Cuddalore age as was observed near Penundurai. There are also evidences of a fault parallel to the Gadilam river course, about 1.6 Km south of Panruti i.e. south of the Gadilam River. In the west of Panruti-vadular road, Cuddalore sandstone was disturbed and steep diping. The presences of conspicuous knolls of the Cuddalore rocks are found on the southern bank of the Gadilam River in between Panruti and Cuddalore town. The absence of these physiographic features to the north of the Gadilam river suggest a possible fault along this river course. On the other hand Cuddalore outcrop, south of the Vellar River do not show any major structural feature like folding, faulting, etc

Dunal ridges are aligned more or less parallelly in conformity with the coastline configuration. As there is considerable human interference in the dunal areas it is difficult to delineate the exact number of ridges (beach ridges or strand lines) formed in the study area. But the dunal areas are narrow in the north and more wide spread longitudinally in the south. Few dunes are oriented in an oblique way perpendicular to coast due to change in prevailing wind direction. Cross bedding is seen in the dunal sections along the river course and in some places on the walls of the pits dug for irrigation. The beds are inclined to the principal surface of accumulation. Their thickness is 15cm to 20cm. Dunal surfaces exposed to wind action

develop the ripple marks due to land to sea breeze and vice versa. The asymmetrical and sub parallel crests are either continuous or discontinuous and commonly transverse to the wind direction. The predominant direction noted is E-W. Mud cracks are noticed in a few areas of clayey terrain adjoining Uppanar River and on the dry bed of Perumal Eri. They indicate dessication and compaction of water saturated muddy sediments which produces shrinkage cracks of polygonal nature.

11.6. Pediment and Pediplain :

In the North-western part of the area weathered, laterised reddish and yellowish brown coloured outcrops of cuddalore sandstone occur as flat table land or plateau landform. They are pebbly and gritty and in many place with rill and gully erosion. Due to constant erosion and weathering the intercalated clay has been washed away leaving the loose quartz pebble on the surface. This dissected plateau near Pudur and east of Samanthakuppam has elevation of 34m above M.S.L.

The area between this plateau land and the coastal plain just north and west of Perumal Eri (Kullanchavadi, Anukkumpattu villages) has a flat undulating topography. This pediplain has thick brownish soil cover overlying deeply weathered sandstone. But no outcrops are seen and the area gently slopes in the eastern direction towards the sea. A few small streams drain this pediplain diverting leaving into Perumal Eri and coastal sands. The average elevation of this area is 15m to 20m which has high ground water potential.

This Erosion surface might have been formed during Pleistocene to Holocene age and probably during one of the Glacial period when the sea level was lowered exposing the area for fluvial erosion and natural weathering resulting in a sediplain with a gentle slope.

11.7. Geomorphology:

The Cuddalore district, for the most part, is a flat plain, sloping gently from north to south and from west to east, towards the sea. The only hill in the district is the Mount Capper hill near Cuddalore. The Mount

Capper plateau, just west of south-south-westwards to near Shrimushnam. Mount Capper is the only part which can be termed as a prominent feature in the landscape and even this is only about a hundred feet above mean sea level. For the rest, the course of the formation, where it has not been cut away by the rivers which pass through it, may be traced by the red soil to which it gives rise and which is some of the most unfertile in the district. The geomorphology of the Cuddalore coastal stretch includes the coastal plain with an average width of 6 km. Its coastal landforms include strand-lines, raised beaches, sand dunes, mangrove swamps and tidal flats with predominantly sandy beaches on the northern side and mangrove swamps to the south. The coastal towns of Cuddalore in the North and Porto Novo (Parangipettai) in the South are the most densely populated along this region.

The Cuddalore area mainly attained its present morphological configuration due to the action of Uppanar River, wave action of Bay of Bengal, wind and other erosional or weathering activities. The area broadly can be divided into coastal plain and undulating elevated plateau regions. This inland high region bound the coastal plain occurring on its eastern side. The drainage pattern of Uppanar is sub dendritic in the southern side (north flowing river) and most of them have been converted as irrigational channels (Yazoo pattern). The tidal limit of Uppanar is significantly long and sea waters reach upto Gopalapuram during high tide times. Otherwise it is a Euphemeral stream with fresh water flowing only during monsoon season due to erosion and depositional activity of various natural agents.

12. Drainage System with description of main rivers:

Sl.No.	Name of the River	Area drained (Sq.km)	% Area drained in the District
1	Then Pennaiyar	15101	9.72

2	Gadilam	1628	38.82
3	Manimuktha	747.57	42
4	Vellar	7504.35	69
5	Coleroon	36000	60
6	Gomukhi	1147.23	14
7	Mayuranathi	652	16

13. Salient Features of Important Rivers and Streams:

Sl.No.	Name of the River (or) Stream	Total Length in the District (in Km)	Place of Origin	Altitude at Origin
1	Then Pennaiyar River	42	Nandhidhurka Hills, Karnataka state	1000 m above MSL
2	Gadilam River	52	Mayanur Hills, Villupuram District	167 m above MSL
3	Manimuktha River	47	Northern part of the eastern slopes of Kalrayan Hills,Villupuram District	1004 m
4	Vellar River	103	Chitteri Hills, Dharmapuri District & Jallattu Reserve Forest, Salem District.	1122 m
5	Coleroon River	60	Upper Dam across cauvery, Trichy District	73 m

6	Gomukhi River	9	Eastern slopes of the Kalrayan Hills,Villupuram District	1298 m
7	Mayuranathi	6.25	Southern slopes of the Kalrayan Hills,Villupuram District	200m

Sl. No.	**Portion of the River or Stream Recommended for Mineral Concession**	**Length of Area Recommended for Mineral Concession (in Kilometer)**	**Average width of Area Recommended for Mineral Concession (in meters)**	**Area Recommended for Mineral Concession (in square meter)**	**Mineable mineral potential (in metric tonne) (60% of total mineral potential)**
1	Vanpakkam Village in Then Pennaiyar River	0.475	105.00	49875	158400
2	Kamatchipettai Village in Gadilam River	0.400	120.00	48000	152400
3	Elanthampattu Village in Gadilam River	0.250	120.00	30000	95400
	Elanthampattu Village in Gadilam River	0.325	60.00	19500	61800
4	Sanniyasipettai Village in Gadilam River	0.700	45.00	31500	100200
5	Vilangalpattu Village in Gadilam River	0.900	55.00	49500	157200
6	Vanamadevi Village in Gadilam River	0.300	160.00	48000	152400

7	Koodalaiyathur Village in Vellar River	0.800	200	160000	381600
8	Ambujavallipettai Village in Vellar River	0.500	50	25000	39600
9	Omampuliyur Village in Coleroon River	0.260	190	49400	149400
10	Karupperi Village in Coleroon River	0.450	300	135000	214800
11	Gunavasal Village in Coleroon River	0.600	200	120000	343200
12	Athiyur Village in Gomukhi River	0.350	40	14000	22200
13	A.Kolapakkam Village in Mayuranadhi	0.500	35	17500	27600
14	V.Kumaramangalam (Gopalapuram) in Manimuktha River	0.450	65	29250	46800
		0.300	65	19500	31200

14. Sand Mineral Potential:

Boulder (MT)	Bajari (MT)	Sand (MT)	Total Mineable Mineral Potential (MT)
-	-	264000	264000
-	-	254000	254000
-	-	159000	159000
-	-	103000	103000
-	-	167000	167000
-	-	262000	262000

-	-	254000	254000
-	-	636000	636000
-	-	66000	66000
-	-	249000	249000
-	-	358000	358000
-	-	572000	572000
-	-	37000	37000
-	-	46000	46000
-	-	78000	78000
-	-	52000	52000

Sl. No	River or Stream	Portion of the River or Stream Recommended for Mineral Concession	Length of Area Recommended for Mineral Concession (in Kilometer)	Average width of Area Recommended for Mineral Concession (in meters)	Area Recommended for Mineral Concession (in square meter)	Mineable mineral potential (in metric tonne) (60% of total mineral potential)
1	Pennaiyar	Vanpakkam	0.475	105	49875	158400
2	Gadilam	Kamatchipettai	0.400	120	48000	152400
3	Gadilam	Elanthampattu	0.250	120	30000	95400
	Gadilam	Elanthampattu	0.325	60	19500	61800
4	Gadilam	Sanniyasipettai	0.700	45	31500	100200
5	Gadilam	Vilangalpattu	0.900	55	49500	157200
6	Gadilam	Vanamadevi	0.300	160	48000	152400

7	Vellar	Koodalaiyathur	0.800	200	160000	381600
8	Vellar	Ambujavallipettai	0.500	50	25000	39600
9	Coleroon	Omampuliyur	0.260	190	49400	149400
10	Coleroon	Karupperi	0.450	300	135000	214800
11	Coleroon	Gunavasal	0.600	200	120000	343200
12	Gomukhi	Athiyur	0.350	40	14000	22200
13	Mayuranadhi	A.Kolapakkam	0.500	35	17500	27600
14	Manimuktha	V.Kumaramangalam (Gopalapuram)	0.450	65	29250	46800
			0.300	65	19500	31200
Total for the District			**7.56**	**1810**	**846025**	**2134200**

DEPUTY DIRECTOR,
GEOLOGY AND MINING,
CUDDALORE

Collector,
Cuddalore District,
Cuddalore.