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**Results of Yield Testing  
of Wells in  
Marakkanam Block  
South Arcot District  
Tamil Nadu**

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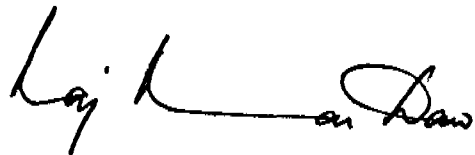
The field work of yield testing was supervised by K. Rajan, supported by the Unit's crew in the field and by J. P. Abraham in logistical and technical matters. Data processing has been done by S. Ranganathane and Ms. Stella Thomas helped in compilation of the report.

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Cuddalore, July 1995



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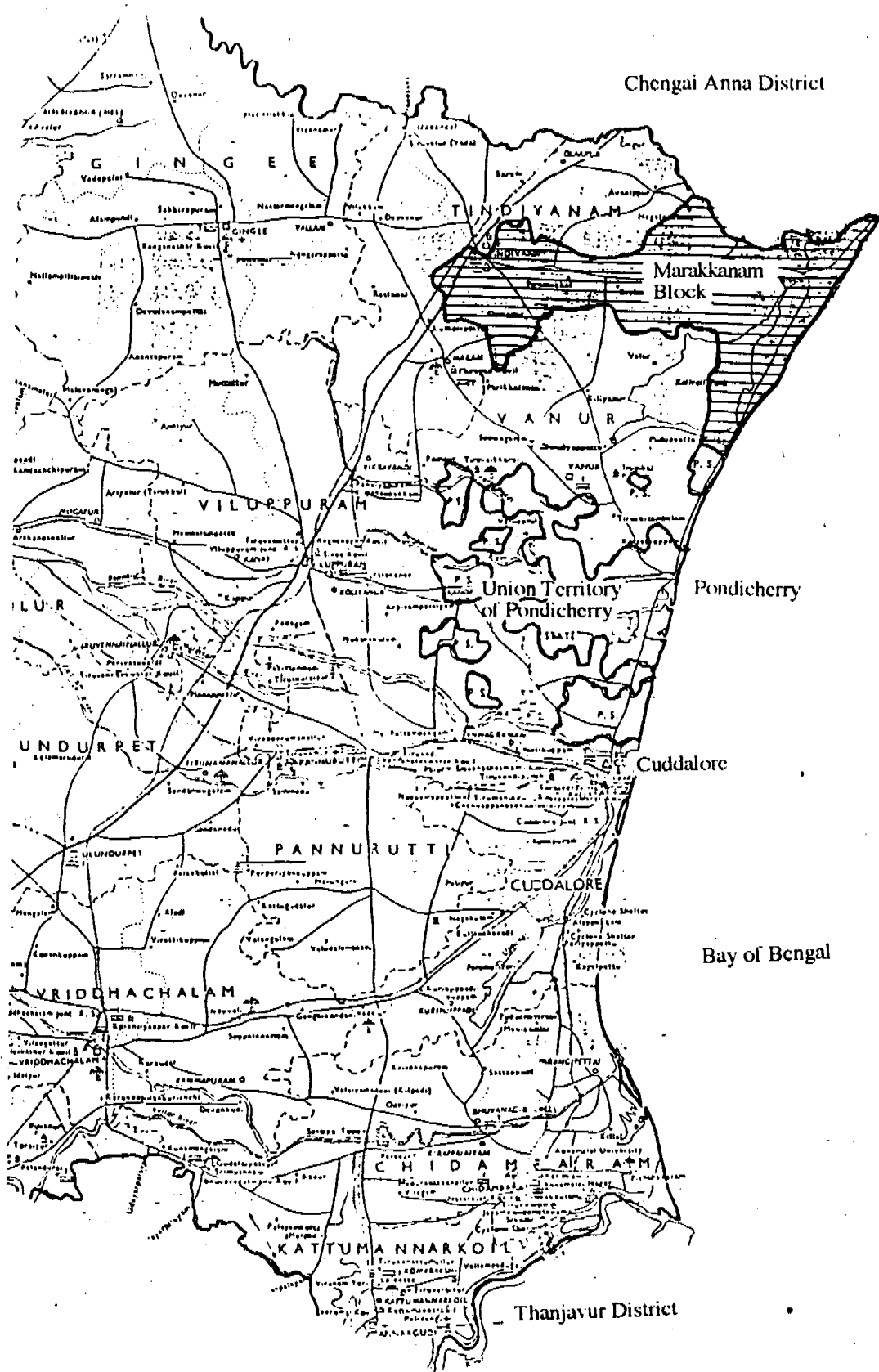


Fig. 1 : Map of Coastal Tamil Nadu showing Marakkanam Block

## **Results of Yield Testing of Wells in Marakkanam Block**

### **Summary :**

In early 1993, following persistent reports of malfunction and break down of hand pumps, yields of a number of wells with hand pumps were tested with a Pumping Test Unit- PTU, and indicated the possibility of a significant occurrence of wells with low and intermittent yields with an areal pattern.

On the basis of these conclusions, a systematic yield testing programme was started with the intention of testing most of the existing wells fitted with hand pumps in villages in the central part of Marakkanam Block.

By mid-1995, a total of 224 tube wells had been tested for their yields. This report deals with yield testing data of 182 wells that represent wells with hand pumps in villages of Marakkanam Block, and then examines the yield data of the central part of the Block in detail.

The conclusions that emerge are not very favourable.

No territorial or hydrogeomorphological patterns of well yields are apparent. Failure wells and Poor yielding wells occurred persistently throughout the Block, with 30% of the pumps falling in these two groups. On the other hand, the occurrence of high yielding wells throughout the Block was almost 50% of the wells tested, indicating that existing sources were under-utilised with hand pumps. These high occurrences of Failed wells and High yielding wells are seen in the central part of the Block also.

These results can be interpreted both favourably, such as good well siting in poor ground water potential areas, and unfavourably, since well yields are inconsistent with hydrogeomorphological categorisation. It raises questions on the quality of hydrogeological siting, of the field practices of source construction, reliability of field data on well construction.

At a minimum, the yield test data indicates that about 21 % of the hand pumps in the Block are on unsustainable wells, and a further 9% pumps are nearly so. Hence, any maintenance system for this Block is faced with a very heavy disadvantage right from its inception, since this group of pumps are virtually unmaintainable in the long run.

The high occurrence of High yielding wells in hand pump installations indicates that present yield estimation techniques (blow test at the time of drilling) are totally inadequate. This conclusion has special significance since water sources for power pump schemes are also subject to the same estimation technique and source failure of such schemes is not uncommon.

Hydrofracturing information on Marakkanam Block indicates that this technique of reclamation of low yielding and failed wells met with very limited success.

The above conclusions, when considered together, raise serious doubts regarding the viability of basing a rural water supply programme solely on groundwater. These doubts are further reinforced by the fact that more than half the wells tested for water quality show non-potable water.

The resultant strategic implications emerging from the data, therefore, warrant some reflection. Since it is now clear that a significant number of drinking water sources are not qualitatively and quantitatively sustainable, it is necessary for the IRS & WS Project to consider the following :

- to have the unsustainable sources de-listed from the official list of drinking water sources of Marakkanam Block;
- to conduct systematic yield testing in the Western Side of Marakkanam, where similar indications of unsustainable sources is evident but the number of tests done so far are insufficient;
- to formulate a long term yield testing programme as a monitoring tool, for quantitative assessment of the sustainability of an exclusively groundwater based water supply strategy, given the organisation cultures and expediencies of the institutions involved;
- to consider water quality monitoring as a similar monitoring tool for gauging sustainability of sources;
- to consider the need for such yield and water quality monitoring in the forthcoming project expansion being contemplated.

### **Background :**

Marakkanam Block is on the north eastern border of Villupuram District. The Bay of Bengal forms the eastern boundary of the Block, with a coastal strip of about 15 Km. The Block has a total of 83 revenue villages, comprising of 188 habitations. The population of the Block, according to the Census of 1991 was 1,29,573 persons. By March 1995, the Block had a total of 653 India Mark II hand pumps, 62 suction hand pumps and 68 water supply schemes based on power pumps. Approximately 460 hand pumps in the Block were constructed by the IRS & WS Project, during 1991-94.

In early 1993, there were persistent reports of malfunction and break down of hand pumps and low and intermittent yields from wells from a group of villages in the middle-northern part of Marakkanam Block. In order to identify the exact nature of the problem, a Pumping Test Unit - PTU was deployed in mid-1993 to test the yields and assess the condition of the hand pumps on these wells.

At an early stage of this programme, the analysis of yield data of 20 wells indicated that:

- there was only 1 (5%) high yielding well;
- only 3 wells (15%) had yields adequate for an IM II hand pump (12 lpm);
- the remaining 16 wells (80%) were poor yielding to failures (less than 8 lpm).

All the above wells had IM II hand pumps fitted on them and all these wells were located in four adjoining villages, Vaidapakkam, Vadanerkunam, Nagar and Nagalpakkam.

The results of these yield tests indicated that not only was there a high occurrence of low yielding wells in the 4 villages but that there was probably a larger areal extent of this phenomenon.

Under the circumstances, it was agreed that :

- most existing wells in the middle-northern villages of Marakkanam Block would be tested for their yields to verify if there was a geographical pattern of failure or low yielding wells;
- if such a pattern existed, the search for alternative water supply technology in this area should be a serious consideration;
- hydrogeological information with TWAD on this area should be reviewed.

By May 1995, 224 tube wells in Marakkanam Block had been tested for their yields by the PTU. Out of these, 205 wells were fitted with India Mark II hand pumps. 23 of these hand pumps were within Marakkanam Town Panchayat and the remaining 182 wells with hand pumps were located in 54 villages. The remaining 19 water sources were tested for Power pump or Alternative Energy (Wind mill and Solar powered pump) applications.

Chemical tests of water quality were done on a number of wells and were categorised as Potable or Not Potable as per standards defined by the Bureau of Indian Standards. This information is summarised in Table 1 below:

Table 1 : Summary of Yield Testing Programme, July 93- April 95

Type of Water Source	Villages	Habitations	Hand Pumps		Water Quality		
			Total	Tested	Tested	Potable	Not Potabl
Hand pumps	Marakkanam Town P			23	23	6	17
	54	78	359	182	66	28	38
AE & PP Sites	12	16		19	9	5	4
Totals			359	224	98	39	59

In order to arrive at a territorial basis for analysis of the yield results, the list of test sites was classified into 3 broad geographical regions of the Block - Western Side, Middle Area and Coastal Area, as shown in Fig. 2.

This report examines yield testing data of the 182 wells in territorial and hydrogeological contexts and then focuses on the Middle Area of Marakkanam Block, which was the original territory of interest, attempting to asses the implications of the results.

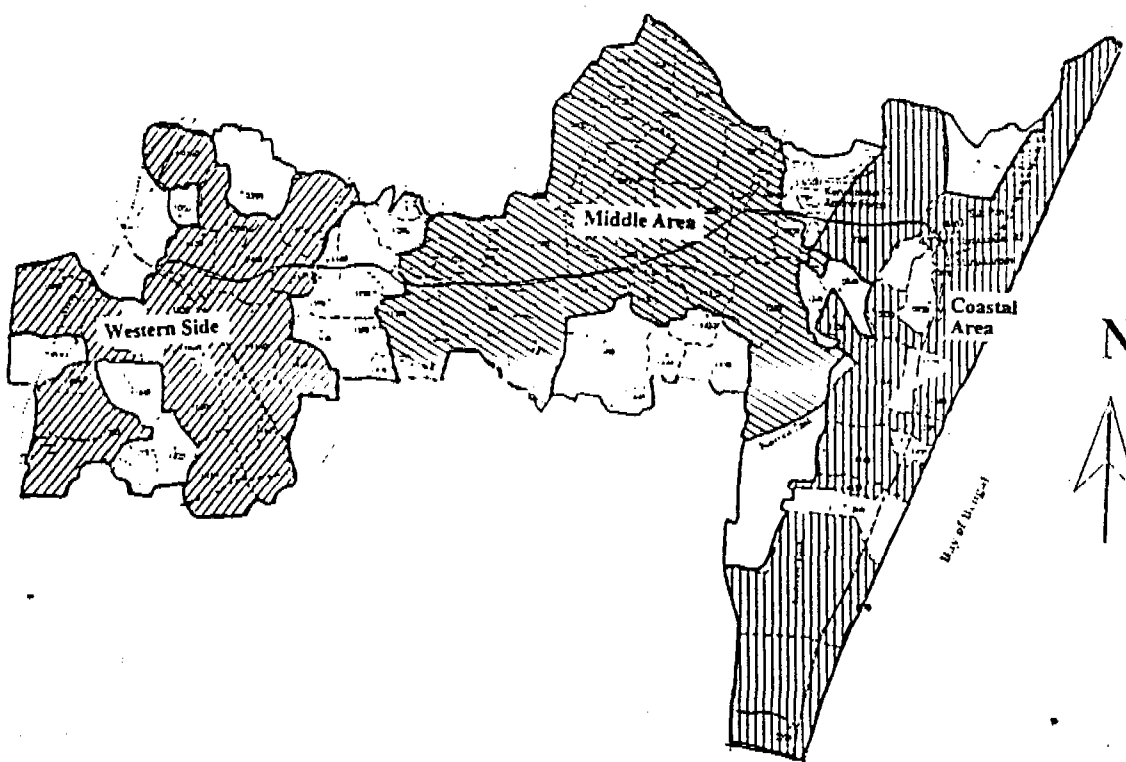


Fig. 2 : Map of Marakkanam Block, showing Villages (shaded areas) where Yield Tests were conducted

### Yield Testing Equipment & Procedure :

The equipment used for conducting yield tests was a truck-mounted hydraulic swivel crane to lower submersible pumps in tube wells. The pump was powered by an electric generator mounted on the same truck. Fig. 3 shows a schematic layout of a typical pumping test or yield test.

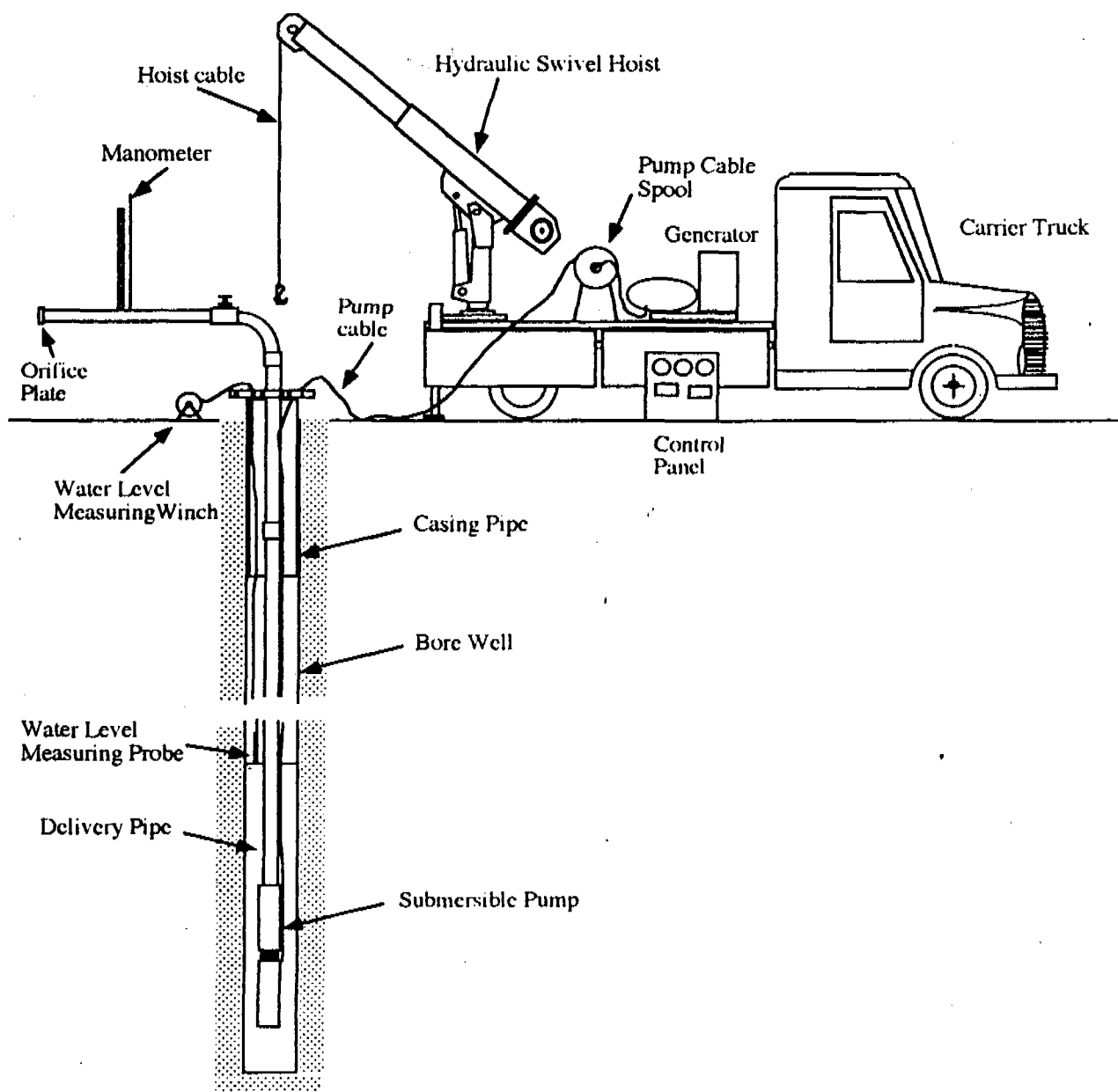


Fig. 3 : Layout of a typical Pumping Test

Most tests were step draw-down tests. A manometer, an orifice plate and a control valve were used to set the yield steps in each test. Draw-down was measured with an electrical water level recorder. Recovery rates in each well were also measured with the water level recorder. Annexure 1 shows the equipment that was actually used for this programme.



### Methodology for Data Analysis :

The results of the yield test at each of the 224 test sites are presented in Annexure 5. All yield values are in litres per minute - lpm. In case of Medium and High yielding wells, the yield values are approximate steady-state yields for a given draw-down, estimated at the time of the test. Accurate calculations of optimal yields for such wells were made separately by TWAD Board, Cuddalore, using accepted methods for such computations, but this data has not been presented in this report. In the case of Low yielding and Failure wells rapid lowering of water level in the well without reaching a steady pumping level were sufficient indicators.

In Annexure 5, two sets of Code numbers, LC and TWAD Codes have been used for numerical identification of villages and habitations. LC Codes - Location Codes, are standard numerical codes for villages used in the Census of India and follow an uniform system throughout the country, with corresponding numerical codes for States, Districts, Talukas, Blocks and Villages. TWAD Codes are an identification method used by Tamil Nadu Water Supply & Drainage Board - TWAD Board, to identify each habitation in Tamil Nadu. Unfortunately, these are independent methods of identification and so both are used in this report. Each test site is listed in the order of LC Codes, i.e. villages and habitations.

In a number of wells, at the end of a yield test, water samples were drawn for water quality tests. These water quality tests were done by the TWAD Water Quality Laboratory at Cuddalore. Detailed data of the results of these water quality tests are available, and have been summarised in terms of Potable and Not Potable, using current Indian Standards for this classification. This water quality categorisation has also been indicated in Annexure 5. However, no detailed analysis has been attempted in this report to interpret the water quality test results separately or in conjunction with yield test results.

Annexure 4 is the summary of the results of tests on of 205 sites (out of a total of 224 sites) with hand pumps, arranged by LC Code. The total number of hand pumps in each habitation has also been shown to give an impression about the proportion of sites tested in each habitation. The results of yield tests in a habitation have then been classified into four groups - Failure, Poor, Medium and High. The basis for this categorisation is given below :

**Failure :** Wells yielding 8 lpm or less were categorised as failures. This limit was chosen since the India Mark II hand pump has a designed yield of 12 lpm (operated optimally at 40 strokes per minute) and the pump is usually considered as operating with an "acceptable" yield if it delivers at least 8 lpm.

**Poor :** Poor yielding wells were those that had yields in the range of 9 lpm to 15 lpm, i.e., just adequate to support an India Mark II hand pump.

**Medium :** Wells in this range were those yielding 16 lpm to 50 lpm, since 50 lpm is a generally accepted yield below which TWAD do not use power pumps.

**High :** Wells yielding above 50 lpm were classified in this category since they would be suited for power pump applications by TWAD standards.

The separation of the data of 182 wells with hand pumps in 54 revenue villages of Marakkanam Block allowed treatment of the data in smaller segments. It also helped segregate the data of the Middle Area, where it was originally the intention to concentrate the testing activities. To that extent, this classification was somewhat convenient.

However, it would be incorrect to interpret well yields on territorial convenience alone. Hence, an attempt has been made to correlate the yield data to hydrogeomorphology of the Block, especially since such detailed information was also available. Annexure 7 is a note on the Geology and Geomorphology of the Block and includes a Hydrogeomorphological Map of the Block prepared by TWAD. In Annexure 2 the villagewise summary of yield testing data has been categorised into geographical groups and further into the appropriate hydrogeomorphological groups.

Villagewise yield classification of wells into categories of Failure, Poor, Medium and High, in Annexure 4, forms the basis of further interpretation of the data on Geographical and Hydrogeomorphological considerations.

### Results of Data Analysis :

The territorial distribution of wells on the basis of yield classification is summarised in Table 2.

Table 2 : Geographical Distribution of Yield Tested Wells

Geographic Area	Total Wells	Tested	
		Nos .	Percent
Coastal Area	71	19	27%
Middle Area	180	135	75%
Western Side	108	28	26%
Totals	359	182	51%

From Table 2, it can be seen that a relatively small fraction of the hand pumps in the Coastal Area (19 out of 71 wells, 27%) and Western Side (28 out of 108 wells, 26%) were tested. As compared to this, a high proportion of wells (135 out of 180 wells, 75%) in the Middle Area were tested. This would make conclusion from the tests fairly representative of the Middle Area and not so representative of the Coastal Area and Western Side.

### Geographical Classification of Yield data :

Table 3, below, is a classification of tested wells in yield categories. It shows that in the Coastal Area, the percentage of High yielding wells was high (74%) and proportion of Failure wells were low (5%). The overall picture was quite unfavourable in the Western Side with 21% Failures and 32% Low yielding wells. However, since only 27% wells of the Coastal Area and 26% of the Western Area were tested (refer Table 2), these conclusions might not be truly representative.

Table 3: Geographical Distribution & Yield Classification

Geographic Area	Wells Tested		Yield Classification			
	Nos.	%	Failure	Low	Med.	High
Coastal Area	19	100%	5%	11%	11%	74%
Middle Area	135	100%	24%	4%	24%	48%
Western Side	28	100%	21%	32%	21%	25%
Totals	182	100%	21%	9%	23%	47%

### Hydrogeomorphological Classification of Yield data :

Similarly, Table 4, below, is the summary of the distribution of tested wells by hydrogeomorphological categorisation.

Table 4: Hydrogeomorphological Distribution of Yield Tested Wells

Hydrogeomorphology		Wells Total	Nos. Tested	% Tested
Geomorphology	Groundwater Potential			
Buried Pediment	Good	207	114	55%
Low land/Valley fill	Good	41	11	27%
Shallow Pediment	Moderate	27	11	41%
Shallow Pediment	Moderate/Poor	23	8	35%
S Pediment/Upland	Poor	61	38	62%
Totals : Numbers		359	182	51%

From Table 4, above, it is seen that 55% of the wells tested were in Buried Pediment category and 62% of the wells in Shallow Pediment & Upland category. This would make conclusions for these two groups, more reliable than the remaining groups with lower proportions of wells tested - Low Land and Valley Fill areas with 27% wells tested and in Shallow Pediment areas with Moderate and Moderate to Poor potential, with 41% and 35% wells tested, respectively.

Table 5, below, is a Hydrogeomorphological categorisation of wells yields into the yield classifications.

Table 5: Hydrogeomorphological Distribution & Yield Classification

Hydrogeomorphology		Wells Tested		Yield Classifications			
Geomorphology	Groundwater Potential	Nos.	%	Failure	Low	Med.	High
Buried Pediment	Good	114	100%	22%	8%	21%	49%
Low land/Valley fill	Good	11	100%	9%	9%	9%	73%
Shallow Pediment	Moderate	11	100%	18%	9%	45%	27%
Shallow Pediment	Moderate/Poor	8	100%	25%	25%	13%	38%
S Pediment/Upland	Poor	38	100%	24%	8%	26%	42%
Totals : Numbers		182	100%	21%	9%	23%	47%

It is seen that Buried Pediment and Shallow Pediment/Upland areas (with high proportion of wells tested, 55% and 62%) show similar fractions of Failure wells (22% and 25%) and of High yielding wells (49% and 42%). Other figures of interest are the consistent rate of Failure wells in all hydrogeomorphological categories (except in Low Lands and Valley Fills) ranging from 18% to 25% and averaging 21% and the high overall average of 47% for High yielding wells.

**Hydrogeomorphology & Well Yields of the Middle Area :**

The Middle Area of Marakkanam was the main area of interest from the start of the yield testing programme. Except for 4 villages in the southern part of this area, yield tests were done in all other 28 villages. Out of the 180 wells with hand pumps in these 28 villages, 135 wells (75%) were tested for their yields.

Annexure 3 shows the Geomorphological map of the Middle Area of Marakkanam and has the villagewise yield test data categorised by Hydrogeomorphology and yield classification. This analysis is summarised in numbers and percentages, in Table 6 Table 7, below:

**Table 6: Hydrogeomorphology & Yield Classification of the Middle Area in Numbers**

Geomorphology	Groundwater Potential	Nos. Villages	Hand Pumps		Yield Classification			
			Total	Tested	Failed	Low	Med.	High
Buried Pediment	Good	19	122	93	21	3	19	50
Shallow Pediment	Moderate, Mod./Poor	3	19	10	2		4	4
Upland, S. Pediment, Pediment	Poor	6	39	32	9	2	10	11
Total Nos.		28	180	135	32	5	33	65
Total Percentages			100%	75%				
				100%	24%	4%	24%	48%

**Table 7: Hydrogeomorphology & Yield Classification of the Middle Area in Percentages**

Geomorphology	Groundwater Potential	Tested Nos.	Yield Classification			
			Failed	Low	Med.	High
Buried Pediment	Good	93	23%	3%	20%	54%
Shallow Pediment	Mod., Mod./Poor	10	20%		40%	40%
Uplands, S. Ped., Ped.	Poor	32	28%	6%	31%	34%

Table 6 shows, and as mentioned earlier, 75 % of the wells (135 wells out of 180) were tested in the Middle Area, making any conclusions fairly representative. Table 6 also shows that as overall averages, 24% of the wells were rated in the Failure category, 4% in the Low yielding category, 24% in the Medium and 48 % in the High yielding categories.

Three main Hydrogeomorphological groups are found in the Middle Area. These are Buried Pediment with Good groundwater potential; Shallow Pediments with Moderate and Moderate/Poor groundwater potential; and Upland, Shallow Pediments, and Pediments with Poor groundwater potential. In Table 7, all these three broad groups show high rates of Failure wells - 20% to 28%; even higher rates of High yielding wells and wide variations in Low and Medium yielding wells.

In terms of consistency of yield test results with hydrogeomorphology of the Middle Area:

- The relatively high rate of Failure and Low yielding wells, 28% and 6%, for Upland, Shallow Pediments, and Pediments might be explained by Poor groundwater potential of these areas.
- The relatively high rate of High yielding wells, 54%, for areas with Buried Pediments might be explained by Good groundwater potential of these areas.

- The relatively high rate of Failure wells, 23% and 20%, for areas with Buried Pediments and Shallow Pediments with Good, Moderate and Moderate/ Poor groundwater potential, is not easy to explain.
- The relatively high rate of Medium to High yielding wells, 40% and 34%, for areas with Shallow Pediments; Upland, Shallow Pediments, and Pediments with Moderate and Moderate/ Poor and Poor groundwater potential, is not easy to explain.
- There was no discernible pattern of well yields and hydrogeomorphology. When data of the Middle Area is compared with the Western Side (Table 3), it is seen that the occurrence of Failure wells in both areas are roughly the same (24% and 21%, respectively) and the occurrence of High yielding wells is quite significant (48% and 25%, respectively) and these figures can not be explained easily.

### **Hydrofracturing of Failure & Low Yielding Wells :**

A discussion on Hydrofracturing of failed and low yielding wells is relevant at this stage since hydrofracturing is now an accepted practice for improving the yields of such wells and since data on hydrofracturing work done in Marakkanam was available for Marakkanam Block from TWAD. The results of this work is presented in Annexure 6.

A total of 31 wells underwent hydrofracturing during 1993-94. The sites have been classed by whether they fall in the Coastal Area (one site), Middle Area (18 sites) and Western Side (12 sites). Yield test results prior to and after hydrofracturing are shown against each site. It is seen that there was no improvement in 13% sites, a slight improvement in 61% sites and 26% sites showed clear improvement. Yields of 20 wells (65%) remained with yields of 8 lpm or less, i.e. remained Failures.

The above results indicate that hydrofracturing met with little success in Marakkanam.

### **Specific Conclusions:**

#### **Well Yields :**

The territorial distribution of well yield tested can be summarised as :

- 27% of the wells were tested in the Coastal Area and 26% were tested in the Western Side. These are relatively small fractions of the wells in these area, making conclusions about the Coastal Area and Western Side not so representative.
- 75% of the wells of the Middle Area were tested. This would make conclusions from the tests fairly representative for the Middle Area.

The territorial distribution of well yields indicate:

- In the Middle Area, where a high proportion of wells were tested:
  - 24% wells were categorised as Failure wells, less than 8 lpm;
  - 4% wells were categorised as Low yielding, between 9 and 15 lpm;
  - 24% wells were in the Medium yield range, between 16 to 50 lpm;
  - 48% wells were High yielding, above 50 lpm.
- In the Coastal Area, the percentage of High yielding wells was high (74%) and proportion of Failure wells were low (5%).
- The picture was quite unfavourable in the Western Side with 21% Failure wells and 32% Low yielding wells.

On the basis of Hydrogeomorphology, it is seen that the percentages of wells tested were :

- 55% of wells Buried Pediments with Good groundwater potential;
- 27% of wells Low Lands & Valley Fill areas with Good groundwater potential;
- 41% of wells Shallow Pediment with Moderate groundwater potential;
- 35% of wells Shallow Pediment with Moderate/ Poor groundwater potential;
- 62% of wells in Shallow Pediments and Uplands with Poor groundwater potential.

This would make conclusions regarding Buried Pediments and Shallow Pediments and Uplands more reliable than the remaining hydrogeomorphological groups.

A hydrogeomorphological categorisation of the wells tested into the yield classifications reveals that:

- Buried Pediment and Shallow Pediment/Upland areas show similar fractions of Failure wells (22% and 25%) and of High yielding wells (49% and 42%). These results, however, can be only partly explained on the basis of hydrogeomorphology. Buried Pediments could be expected to show high occurrence of High yielding wells and Shallow Pediment/Upland could be expected to show high occurrence of Failure wells, but the rest of the results are inconsistent.
- Except in Low Lands and Valley Fills, the occurrence of Failure wells was noticeably high in all other hydrogeomorphological categories, ranging from 18% to 25%, averaging 21%. This phenomenon does not have an easy explanation.
- Similarly, the occurrence of High yielding wells was significant in all hydrogeomorphological categories, ranging from 73% to 27%, averaging 47%, which, again, is not easy to explain for areas assessed with Poor groundwater potential.

Three main hydrogeomorphological groups are found in the Middle Area of the Block. The categorisation of yields of the Middle Area by these groups show no patterns. The data indicates that:

- the relatively high rate of Failure and Low yielding wells, 28% and 6% for Upland, Shallow Pediments, and Pediments is consistent with the Poor groundwater potential of these areas.
- the relatively high rate of High yielding wells, 54% for areas with Buried Pediments is consistent with the Good groundwater potential of these areas.
- the relatively high rate of Failure wells, 23% and 20% for areas with Buried Pediments and Shallow Pediments with Good, Moderate and Moderate/ Poor groundwater potential is not easy to explain.
- the relatively high rate of Medium to High yielding wells, 40% and 34%, for areas with Shallow Pediments, Upland, and Pediments with Moderate and Poor groundwater potential is not easy to explain.

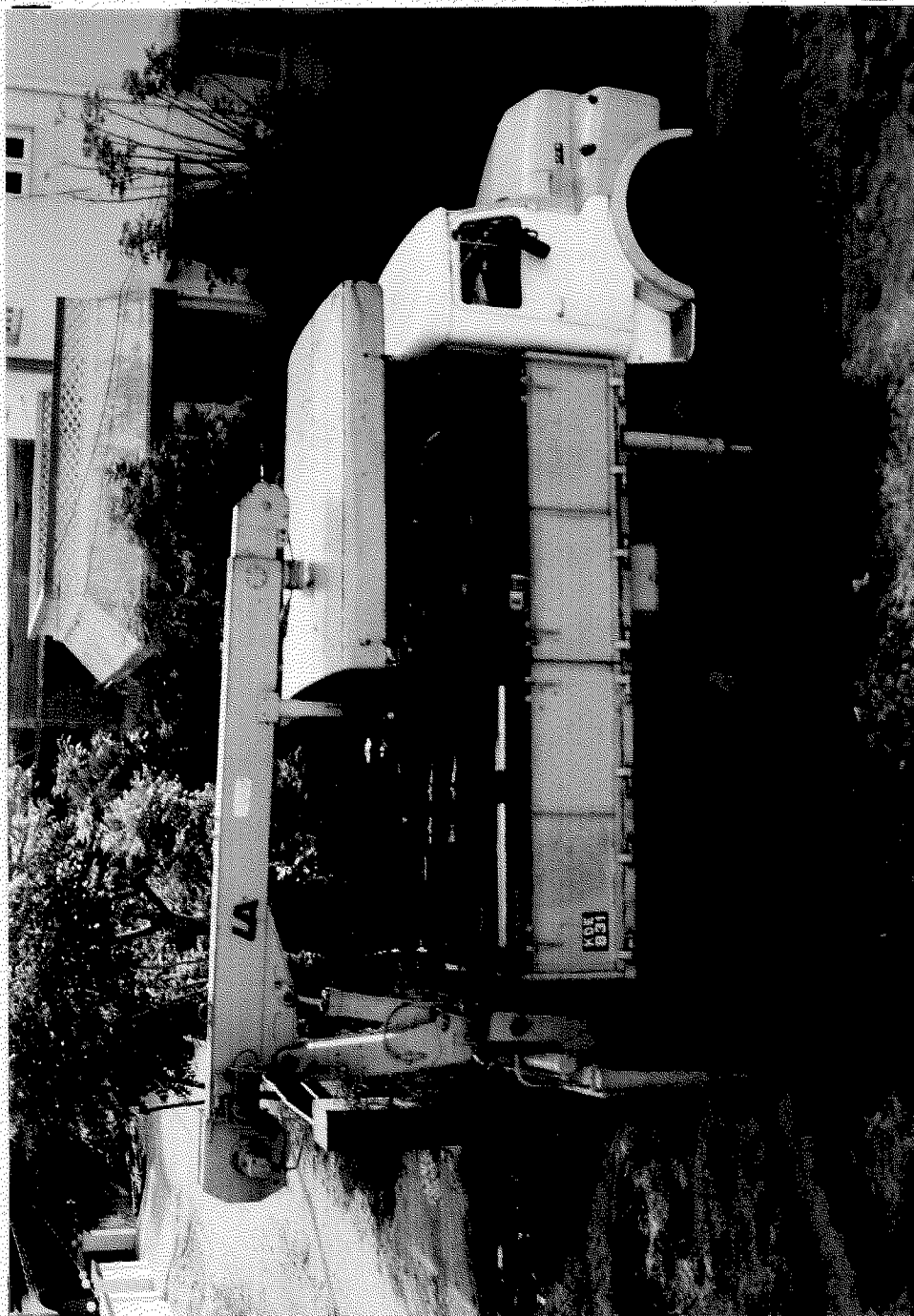
### **Water Quality:**

Chemical tests for water quality were done on 98 wells and were classified as Potable or Not Potable according to Indian Standards. Marakkanam Block has a significant number of sources delivering non-potable water and has a serious water quality problem, as detailed below:

- In Marakkanam Town Panchayat, water quality tests were done for all 23 wells that were yield tested. 74% of these wells showed Not Potable water quality.
- Out of 182 wells with hand pumps that were yield tested in villages in the Block, water quality tests were done for 66 wells. 58% of these wells showed Not Potable water quality.

**Reclamation of Well Yields by Hydrofracturing:**

Data on 31 wells of Marakkanam Block, which underwent hydrofracturing during 1993-94 was available from TWAD. This information indicates that there was no improvement in 13% sites, a slight improvement in 61% sites and 26% sites showed clear improvement. Yields of 20 wells (65%) remained at levels of 8 lpm or less, i.e. remained Failures after hydrofracturing. These results indicate that hydrofracturing met with little success in Marakkanam.



Annexure 1 : Truck-mounted Yield Testing Unit



## Annexure 2 : Geographical &amp; Hydrogeomorphological Categorisation of Yield Test Results

Table 1 : Geographical &amp; Hydrogeomorphological Categorisation of Yield Test Results - Coastal Area

LC Code	Village	Geomorphology	Groundwater Potential	Hand Pumps		Yield Classification			
				Total	Tested	Failed	Low	Med.	High
790	Kandadu	Valley Fill	Good	16	3			1	2
830	Vadagaram	Buried Pediment	Good	1	1			1	
840	M. Pudupakkam	Valley Fill	Good	4	1				1
1350	Thirukanur	Valley Fill	Good	9	3	1	1		1
1380	Atchikadu	Pediment	Poor	4	1				1
1390	Panichamedu	Low land, Rechr. Zone	Good	6	1				1
1410	Anumandai	Buried Pediment	Good	7	1				1
1850	Cheyyankuppam	Pediment	Poor	3	1				1
1870	Koonimedu	Low land, Rechr. Zone	Good	6	3				3
2090	Kilpudupattu	Tertiary Upland	Poor	15	4		1		3
Totals - Nos.				71	19	1	2	2	14
Total -Percentage				100%	27%				
Percentage of Wells Tested					100%	5%	11%	11%	74%
800	Marakkanam TP	Shallow Pediment	Poor		23	5	3	4	11

Table 2 : Geographical &amp; Hydrogeomorphological Categorisation of Yield Test Results - Middle Area

LC Code	Village	Geomorphology	Groundwater Potential	Hand Pumps		Yield Classification			
				Total	Tested	Failed	Low	Med.	High
720	Nallur	Buried Pediment	Good	8	7			1	6
730	Pandadu	Pediment	Poor	6	6			3	3
740	Nagalpakkam	Buried Pediment	Good	3	2	2			
750	Rayanallur	Buried Pediment	Good	7	5	1		2	2
760	Nagar	Buried Pediment	Good	16	13	7	1	2	3
770	Asappur	Buried Pediment	Good	7	6	2		2	2
850	Kurumbaram	Tertiary Upland	Poor	8	5			3	2
860	Alathur	Buried Pediment	Good	10	10	1	1	3	5
870	Vadakottipakkam	Shallow Pediment	Moderate/Poor	2	2			1	1
880	Siruvadi	Shallow Pediment	Poor	8	8			2	6
890	Vaidapakkam	Pediment	Poor	13	13	7	2	2	2
900	Vadanerkunam	Buried Pediment	Good	10	7	2		3	2
1270	Madavanthangal	Buried Pediment	Good	1	1	1			
1280	Endur	Buried Pediment	Good	11	9	1		1	7
1290	Kurur	Buried Pediment	Good	2	2				2
1300	Vepperi	Buried Pediment	Good	5	5	2			3
1310	Murukkeri	Buried Pediment	Good	6	4		1		3
1320	Kolathur	Pediment	Poor	2	2			1	1
1330	Nadukuppam	Buried Pediment	Good	9	2			1	1
1450	Sathamangalam	Pediment	Poor	4	2	2			
1460	Singanandal	Pediment	Poor	2	2				2
1470	Alanguppam	Buried Pediment	Good	13	11	2		4	5
1490	Vanniper	Buried Pediment	Good	6	1	1			
1500	Biramadesam	Buried Pediment	Good	3	1	1			
1510	Ariyanthangal	Buried Pediment	Good	5	5				5
1520	Sokkanthangal	Buried Pediment	Good	2	1				1
1550	T Nallalam	Buried Pediment	Good	7	1				1
1560	Kilsiviri	Pediment	Poor	4	2			2	
Totals - Nos.				180	135	32	5	33	65
Total -Percentage				100%	75%				
Percentage of Wells Tested					100%	24%	4%	24%	48%

Table 2 : Geographical &amp; Hydrogeomorphological Categorisation of Yield Test Results - Western Side

LC Code	Village	Geomorphology	Groundwater Potential	Hand Pumps		Yield Classification			
				Total	Tested	Failed	Low	Med.	High
560	Salavadi	Buried Pediment	Good	7	1				1
970	Kattalai	Buried Pediment	Good	7	4		2		2
980	Endiyur	Buried Pediment	Good	12	1			1	
990	Athur	Shallow Pediment	Moderate	3	2			2	
1150	Manur	Buried Pediment	Good	12	3	1	1		1
1160	Molasur	Buried Pediment	Good	5	1			1	
1170	Kuruvampettai	Buried Pediment	Good	8	3		1	1	1
1610	Kovadi	Buried Pediment	Good	13	1	1			
1620	Omandur	Shallow Pediment	Moderate	7	1		1		
1630	Annamputhur	Shallow Pediment	Moderate/Poor	3	1		1		
1650	Erayanur	Buried Pediment	Good	4	2		2		
1670	Jaggampettai	Buried Pediment	Good	3	2	2			
1680	Singanur	Buried Pediment	Good	6	1			1	
1800	Avanampettu	Shallow Pediment	Moderate/Poor	4	1	1			
1820	Vengai	Shallow Pediment	Moderate/Poor	6	2				2
1830	Kilsithamur	Shallow Pediment	Moderate/Poor	4	1		1		
1920	Kiledayalam	Shallow Pediment	Moderate/Poor	4	1	1			
Totals - Nos.				108	28	6	9	6	7
Total -Percentage				100%	26%				
Percentage of Wells Tested					100%	21%	32%	21%	25%

Annexure 4 : Summary of Yield Test Results on Hand pumps in Marakkanam by May 95

TWAD Code	LC Code	Village	Habitation	Hand Pumps		Yield Classification			Water Quality		
				Total	Tested	Failed	Low	Med.	High	Potable	Not Potbl.
44.01	560	Salavadi	Salavadi	7	1				1		1
36.01	720	Nallur	Nallur	5	4				4		
36.02	720	Nallur	Nallur Col H	3	3			1	2		
36.03	730	Pandadu	Pandadu	4	4			3	1		
36.04	730	Pandadu	Pandadu Col. H	2	2				2		
35.01	740	Nagalpakkam	Nagalpakkam	3	2	2					
35.02	750	Rayanallur	Rayanallur	5	4	1		1	2		
35.03	750	Rayanallur	Rayanallur Col	2	1			1			
34.01	760	Nagar	Nagar	10	8	2	1	2	3		
34.02	760	Nagar	Nagar Col H	6	5	5					
8.01	770	Asappur	Asappur	4	3	1		1	1		
8.02	770	Asappur	Odderkudisai	2	2	1		1			1
8.03	770	Asappur	Thakkamedu	1	1				1		1
17.01	790	Kandadu	Kandadu	7	1				1		
17.03	790	Kandadu	Kanimedu	4	1			1			
17.05	790	Kandadu	New Old Col H	5	1				1		
50.05	830	Vadagaram	Vadagaram	1	1			1			
42.01	840	M. Pudupakkam	M. Pudupakkam	4	1				1		1
17.06	850	Kurumbaram	Kurumbaram	2	1			1			1
17.09	850	Kurumbaram	Mudaliyar Pettai	3	3			1	2		2
17.08	850	Kurumbaram	Pachapaithankollai H	3	1			1			
5.01	860	Alathur	Alathur	10	10	1	1	3	5	2	6
52.01	870	Vadakottipakkam	Vadakottipakkam	2	2			1	1	1	
46.03	880	Siruvadi	Kamatchi Nagar New	1	1				1		
46.01	880	Siruvadi	Siruvadi	7	7			2	5	4	1
54.03	890	Vaidapakkam	Settikulam	3	3		1		2		
54.01	890	Vaidapakkam	Vaidapakkam	10	10	7	1	2			
53.01	900	Vadanerkunam	Vadanerkunam	8	6	2		3	1		
53.03	900	Vadanerkunam	Vadanerkunam Col	2	1				1		
19.01	970	Kattalai	Kattalai	4	1				1		
19.02	970	Kattalai	Mariyamangalam	3	3		2		1		
13.01	980	Endiyur	Endiyur	12	1			1			
9.02	990	Athur	Athur Col.	3	2			2			
29.04	1150	Manur	Mannar Samy Koil	8	2		1		1		
29.01	1150	Manur	Manur	4	1	1					
31.01	1160	Molasur	Molasur	5	1			1			
13.02	1170	Kuruvammapettai	Kuruvammapettai	6	2		1		1		
13.03	1170	Kuruvammapettai	Kuruvammapettai Col	2	1			1			
14.03	1270	Madavauthangal	Madavanthangal	1	1	1					
14.01	1280	Endur	Endur	7	5			1	4	2	1
14.04	1280	Endur	Endur New Col	4	4	1			3	3	1
28.01	1290	Kurur	Kurur	2	2				2		
28.02	1300	Vepperi	Vepperi	5	5	2			3	2	2
46.02	1310	Murukkeri	Murukkeri	6	4		1		3	1	3
25.01	1320	Kolathur	Kolathur Road Col.	2	2			1	1	1	
33.01	1330	Nadukuppam	Nadukuppam	9	2			1	1		
42.04	1350	Thirukanur	Thirukanur	3	1				1		
42.03	1350	Thirukanur	Thirukanurpalayam	6	2	1	1				2
4.02	1380	Atchikadu	Atchikadu	4	1				1	1	
41.01	1390	Panichamedu	Panichamedu	6	1				1		1
7.01	1410	Anumandai	Anumandai	7	1				1		
25.08	1450	Sathamangalam	Kallumetu Col	1	1	1					
25.03	1450	Sathamangalam	Sathamangalam	3	1	1					

## Annexure 4 : Summary of Yield Test Results on Hand pumps in Marakkanam by May 95

TWAD Code	LC Code	Village	Habitation	Hand Pumps		Yield Classification				Water Quality	
				Total	Tested	Failed	Low	Med.	High	Potable	Not Potabl.
25.04	1460	Singanandal	Singanandal Col H	2	2				2		
3.01	1470	Alanguppam	Alanguppam	11	9	2		4	3	7	1
3.02	1470	Alanguppam	Pillayar Kulam New	2	2				2	1	
55.02	1490	Vanniper	T. Pudupakkam	6	1	1					1
10.02	1500	Biramadesam	Biramadesam Col.	3	1	1					
14.02	1510	Ariyanthangal	Ariyanthangal	5	5				5		
18.03	1520	Sokkanthangal	Sokkanthangal	2	1				1		
38.01	1550	T Nallalam	T Nallalam	7	1				1	1	
24.01	1560	Kilsiviri	Kilsiviri	4	2			2			1
26.01	1610	Kovadi	Kovadi	13	1	1					
39.01	1620	Omandur	Omandur	7	1		1				
6.01	1630	Annamputhur	Annamputhur	3	1		1				1
15.01	1650	Erayanur	Erayanur	4	2		2				1
16.03	1670	Jaggampettai	Moorthypettai	2	1	1					
16.04	1670	Jaggampettai	Seethapuram	1	1	1					
45.01	1680	Singanur	Singanur	6	1			1			1
49.02	1800	Avanampettu	Avanampettu	4	1	1					1
56.01	1820	Vengai	Vengai	6	2				2	2	
23.01	1830	Kilsithamur	Kilsithamur	4	1		1				1
12.01	1850	Cheyyankuppam	Cheyyankuppam	3	1				1		
27.03	1870	Koonimedu	Koonimedukuppam	6	3				3		
20.01	1920	Kiledayalam	Kiledayalam	4	1	1					1
22.01	2090	Kilpudupattu	Kilpudupattu	5	2				2		
22.07	2090	Kilpudupattu	Monniyanpettai	4	1				1		
22.05	2090	Kilpudupattu	Pudupattu Chavadi	6	1		1				1
Sub-Total Numbers				359	182	39	16	41	86	28	34
Sub-Total Percentages				100%	51%						
Percentage of Wells tested				100%	21%	9%	23%	47%			
800	Marakkanam TP			23	5	3	4	11	6	17	

## Annexure 5 : List of Sites Yield tested in Marakkanam Block by May 95

LC Code	Village	TWAD Code	Habitation	Nos. HPs	Site Tested	Pump Type	Date of Test	Yield lpm	WQ Test	Remarks
560	Salavadi	44.01	Salavadi	7	Nr. Mariamman Temple	HP	20 Aug 94	97	NP	Head assembly damage., pipes rusted
720	Nallur	36.01	Nallur		Opp. TV Room	HP	5 Apr 94	60		HP N fitted. Rejuv.. needed
720	Nallur	36.01	Nallur		Nr. Muniappan house	HP	7 Apr 94	60		HP working, refitted 8 pipes. Pipes damage.
720	Nallur	36.01	Nallur		Nr. School	HP	9 Apr 94	113		HP working, refitted
720	Nallur	36.01	Nallur	5	Nr. Devaraj House	HP	10 Apr 94	102		HP working, refitted
720	Nallur	36.02	Nallur Col H		Nr. Iruvan House	HP	11 Apr 94	120		HP working, pipes & rod to be changed
720	Nallur	36.02	Nallur Col H		Nr. Elumalai House	HP	19 Apr 94	60		HP refitted, one pipe to be changed
720	Nallur	36.02	Nallur Col H	3	Nr. Ponnusamy Agri. land	HP	20 Apr 94	30		HP refitted
730	Pandadu	36.03	Pandadu		Nr. Patchappan House	HP	21 Jan 94	17		HP working, refitted
730	Pandadu	36.03	Pandadu		Opp. Pillathamman Temple	HP	22 Jan 94	24		HP working, refitted
730	Pandadu	36.03	Pandadu		Nr. Sekar House	HP	26 Jan 94	120		HP working, refitted
730	Pandadu	36.03	Pandadu	4	Nr. Govindaraj Naidu House	HP	27 Jan 94	40		HP working, refitted
730	Pandadu	36.04	Pandadu Col. H		Nr. Nagappan House	HP	28 Jan 94	120		HP working, refitted
730	Pandadu	36.04	Pandadu Col. H	2	Nr. Kathvarayan House	HP	4 Feb 94	60		HP working, refitted
740	Nagalpakkam	35.01	Nagalpakkam		Nr. Ramachandran House	HP	18 Sep 93	2		HP refitted
740	Nagalpakkam	35.01	Nagalpakkam	3	Nr. Kali House	HP	21 Dec 93	3		HP working refitted
750	Rayanallur	35.02	Rayanallur		Nr. Gopal House	HP	1 Dec 93	40		HP working, refitted
750	Rayanallur	35.02	Rayanallur		Nr. Sundaramoorthy House	HP	2 Dec 93	120		HP working, refitted
750	Rayanallur	35.02	Rayanallur		Opp. School	HP	19 Jan 94	113		New Well New HP to be fitted
750	Rayanallur	35.02	Rayanallur	5	Nr. Jayabal House	HP	20 Jan 94	6		HP working refitted
750	Rayanallur	35.03	Rayanallur Col	2	Nr. Perumal House	HP	15 Dec 93	38		HP working refitted
760	Nagar	34.01	Nagar		Nr. Boominathan Gounder's House	HP	12 Oct 93	1		HP was N refitted, cylinder missing
760	Nagar	34.01	Nagar		Nr. Bus stop, Kurur Rd.	HP	13 Oct 93	1		HP refitted
760	Nagar	34.01	Nagar		Opp. Perumal Temple	HP	14 Oct 93	15		HP refitted
760	Nagar	34.01	Nagar		Nr. Mani House	HP	16 Oct 93	100		HP refitted
760	Nagar	34.01	Nagar		Nr. Samikannu House	HP	18 Oct 93	106		HP refitted, Sub P obstru. at 28 m. Saline
760	Nagar	34.01	Nagar		Nr. School	HP	19 Oct 93	24		HP refitted
760	Nagar	34.01	Nagar		Villiyar Col. Opp. Tank	HP	20 Oct 93	100		HP refitted
760	Nagar	34.01	Nagar		Nr. Mangalammal House	HP	21 Oct 93	24		HP refitted
760	Nagar	34.01	Nagar	10	Kulakurai, Regular PP Scheme	PP	23 Aug 94	97	P	New well

## Annexure 5 : List of Sites Yield tested in Marakkanam Block by May 95

LC Code	Village	TWAD Code	Habitation	Nos. HPs	Site Tested	Pump Type	Date of Test	Yield lpm	WQ Test	Remarks
760	Nagar	34.02	Nagar Col H		Nr. Tank, Gangaianman Temple	HP	24 Sep 93	4		HP NW, not refitted
760	Nagar	34.02	Nagar Col H		Nr. Iyyanar House	HP	25 Sep 93	3		HP refitted
760	Nagar	34.02	Nagar Col H		Nr. Rajagopal house	HP	27 Sep 93	3		HP NW, not refitted, parts needed
760	Nagar	34.02	Nagar Col H		Nr. Prakash House	HP	28 Sep 93	5		HP refitted
760	Nagar	34.02	Nagar Col H	6	Nr. Samikannu House	HP	29 Sep 93	5		HP NW, refitted 9 pipes
770	Asappur	8.01	Asappur		Opp. Manjini gounder House (Rayanallur Rd.)	HP	6 Dec 93	127		
770	Asappur	8.01	Asappur		Nr. Ramadoss House	HP	24 Dec 93	20		New BW
770	Asappur	8.01	Asappur	4	Opp. Raju House (Col.)	HP	25 Jan 94	3		HP working refitted
770	Asappur	8.02	Odderkudisai		Opp. Varadhappan chettiyar House	HP	9 Feb 95	2	NP	HP working, refitted
770	Asappur	8.02	Odderkudisai	2	Nr. Vedhagiri pillai Agri. land	HP	20 Feb 95	33	NP	HP working, refitted
770	Asappur	8.03	Thakkamedu	1	Opp. Gangaianman Temple	HP	21 Feb 95	60	NP	HP working, refitted
790	Kandadu	17.01	Kandadu	7	Nr. Kothandaraman House	HP	10 Mar 94	113		HP working, refitted, Rejuv. needed
790	Kandadu	17.03	Kanimedu	4	Nr. Manicka gounder House	HP	9 Mar 94	30		HP parts missing
790	Kandadu	17.05	New Old Col H		Nr. Selva Raj House	HP	7 Feb 94	120		HP working, refitted
790	Kandadu	17.05	New Old Col H	5	Nr. Ganapathi House	PP	27 Oct 94	8	NP	Rejuv. needed
800	Vasavankuppam		Marakkanam TP	1	Nr. Ponniamma koil	HP	28 Sep 94	107	P	HP was working, refitted
800	Vasavankuppam		Marakkanam TP	2	Kizhkku thervu	HP	30 Sep 94	107	P	HP was working, refitted
800	Marakkanam TP		Marakkanam TP	3	BDO office	PP	4 Aug 93	120		
800	Marakkanam TP		Marakkanam TP	4	Villiyar Col.	HP	24 Aug 94	60	NP	HP working, refitted
800	Marakkanam TP		Marakkanam TP	5	Ramanathan Gounder House	HP	25 Aug 94	15	NP	Rejuv.. needed, no pipe rods
800	Marakkanam TP		Marakkanam TP	6	Col. Nr. MLA House	HP	29 Aug 94	30	NP	HP refitted, pipes are change
800	Marakkanam TP		Marakkanam TP	7	Nr. Mariamman Koil	HP	31 Aug 94	2	NP	HP NW, One pipe damaged
800	Marakkanam TP		Marakkanam TP	8	Mariamman Koil thervu	HP	5 Sep 94	30	NP	HP working, refitted
800	Marakkanam TP		Marakkanam TP	9	Azhaganpallam St.	HP	6 Sep 94	2	NP	HP working, refitted
800	Marakkanam TP		Marakkanam TP	10	PHC Qutrs.	HP	7 Sep 94	107	NP	HP NW, pcd. base damage., refitted
800	Marakkanam TP		Marakkanam TP	11	Nr. Bus Stand	HP	8 Sep 94	1	NP	HP NW, N refitted
800	Marakkanam TP		Marakkanam TP	12	Mettu thervu	HP	20 Sep 94	20	NP	HP NW, refitted, one pipe damage & reply.
800	Marakkanam TP		Marakkanam TP	13	Naravakam	HP	21 Sep 94	102	NP	HP removed
800	Marakkanam TP		Marakkanam TP	14	Sannathi thervu, Nr. Azhamuthumariamman koil	HP	3 Oct 94	60	P	HP working, refitted
800	Marakkanam TP		Marakkanam TP	15	Evening market	HP	5 Oct 94	107	P	HP NW, head & one pipe damage., refitted
800	Kattayan Col.		Marakkanam TP	16	Nr. Vellachi House	HP	1 Sep 94	1	NP	HP NW, refitted
800	Karipalayam		Marakkanam TP	17	North St. Nr. Shanmugam House	HP	26 Aug 94	15	NP	Only Head assembly fitted
800	Karipalayam		Marakkanam TP	18	Nr. Sudalaimani House	HP	27 Aug 94	60	NP	All pipes rusted

## Annexure 5 : List of Sites Yield tested in Marakkanam Block by May 95

LC Code	Village	TWAD Code	Habitation	Nos. HPs	Site Tested	Pump Type	Date of Test	Yield lpm	WQ Test	Remarks
800	Karipalayam		Marakkanam TP	19	Nr. Balakrishan House	HP	28 Aug 94	60	NP	Cylinder, NW
800	Karipalayam		Marakkanam TP	20	Nr. School	HP	3 Sep 94	30	NP	HP NW, N refitted, all parts damage
800	Karipalayam		Marakkanam TP	21	Nattamai thervu	HP	4 Sep 94	10	NP	HP working, refitted
800	Kaipanikuppam		Marakkanam TP	22	Kizhakku thervu	HP	22 Sep 94	102	P	HP NW, refitted
800	Kaipanikuppam		Marakkanam TP	23	Vadaku thervu	HP	23 Sep 94	102	P	HP working, refitted
800	Kaipanikuppam		Marakkanam TP	24	Village	HP	24 Sep 94	1	NP	HP NW, N refitted
830	Vadagaram	50.05	Vadagaram	1	Opp. Balwadi	HP	23 Mar 94	40		New HP to be fitted
840	M. Pudupakkam	42.01	M. Pudupakkam	4	Nr. Health sub centre	HP	6 Jul 94	89	NP	HP working, refitted
850	Kurumbaram	17.06	Kurumbaram	2	Nr. Rajendran House	HP	23 Nov 94	30	NP	HP working, refitted
850	Kurumbaram	17.09	Mudaliyar Pettai		Nr. Vasantha House	HP	20 Nov 94	93	NP	
850	Kurumbaram	17.09	Mudaliyar Pettai		Nr. Raju House	HP	21 Nov 94	93	NP	
850	Kurumbaram	17.09	Mudaliyar Pettai	3	Nr. Elumalai House	HP	22 Nov 94	30	NP	
850	Kurumbaram	17.08	Pachapaithankollai H	3	Nr. Duraiswamy House	HP	8 Feb 94	40		HP working, refitted
860	Alathur	5.01	Alathur		Nr. Health sub centre	HP	7 Oct 94	10	NP	HP working, refitted
860	Alathur	5.01	Alathur		Opp. Dhrowpathiamman Temple	HP	5 Jan 95	60		HP working, refitted
860	Alathur	5.01	Alathur		Opp. Gandiappan House	HP	6 Jan 95	170	P	HP working, refitted
860	Alathur	5.01	Alathur		Opp. Lakshminarayanan House	HP	7 Jan 95	2	NP	HP working, refitted
860	Alathur	5.01	Alathur		Opp. Raju House	HP	9 Jan 95	75	NP	HP working, refitted
860	Alathur	5.01	Alathur		Opp. Perianna gounder House	HP	10 Jan 95	20		HP working, refitted
860	Alathur	5.01	Alathur		Opp. Raju Petty shop	HP	18 Jan 95	93	NP	HP working, refitted
860	Alathur	5.01	Alathur		Opp. Kulanthai House	HP	23 Jan 95	17	NP	HP working, refitted
860	Alathur	5.01	Alathur		Nr. Pump Room	HP	31 Jan 95	170	NP	HP working, refitted
860	Alathur	5.01	Alathur	10	Marakkanam main Rd. -Alathur Kootu Rd.	HP	2 Feb 95	30	P	HP working, refitted
870	Vadakottipakkam	52.01	Vadakottipakkam		Nr. Veerasamythambiran House(Opp. School)	HP	7 Dec 93	36		New well with out HP
870	Vadakottipakkam	52.01	Vadakottipakkam	2	Nr. Vengatekrisha reddyar House	HP	8 Feb 95	60	P	HP working, refitted
880	Siruvadi	46.03	Kamatchi Nagar New	1	Nr. Elumalai House	HP	5 Dec 94	60		HP working, refitted
880	Siruvadi	46.01	Siruvadi		Nr. School compus	PP	5 Aug 93	374		
880	Siruvadi	46.01	Siruvadi		Nr. Annamalai House	HP	17 Dec 93	36		HP working, refitted. Saline
880	Siruvadi	46.01	Siruvadi		Nr. Subramani House	HP	7 Dec 94	60	P	HP working refitted
880	Siruvadi	46.01	Siruvadi		Nr. Subramni House,col (Condenmed)	HP	8 Dec 94	20	NP	HP removed, Saline water. No Cyl., pipes

Annexure 5 : List of Sites Yield tested in Marakkanam Block by May 95

LC Code	Village	TWAD Code	Habitation	Nos. HPs	Site Tested	Pump Type	Date of Test	Yield lpm	WQ Test	Remarks
880	Siruvadi	46.01	Siruvadi		Nr. Kuppasamy House(Droupathiamman Temple)	HP	9 Dec 94	170	P	HP working, refitted
880	Siruvadi	46.01	Siruvadi		Opp. Balwadi	HP	10 Dec 94	170	P	HP working, refitted
880	Siruvadi	46.01	Siruvadi		Nr. Health sub centre	HP	11 Dec 94	60	P	HP working, refitted
880	Siruvadi	46.01	Siruvadi	7	Nr. Pattammal House	HP	12 Dec 94	78	NP	HP working, refitted
890	Vaidapakkam	54.03	Settikulam		Opp. Singarampillai House	HP	8 Nov 93	10		HP fitted, pipe needed
890	Vaidapakkam	54.03	Settikulam		Opp. Mariamman Temple	HP	27 Nov 93	113		HP refitted, One pipe needed
890	Vaidapakkam	54.03	Settikulam	3	Opp. Packrisamy House	HP	29 Nov 93	107		HP refitted
890	Vaidapakkam	54.01	Vaidapakkam		Nr. Lake	HP	18 Aug 93	1		HP N fitted for hydrofracturing
890	Vaidapakkam	54.01	Vaidapakkam		Opp. Parasuraman House	HP	19 Aug 93	3		HP refitted
890	Vaidapakkam	54.01	Vaidapakkam		Opp. Muthupillai House	HP	23 Aug 93	3		HP NW, reinstalled 7 pipes
890	Vaidapakkam	54.01	Vaidapakkam		Nr. Ajeskan House	HP	24 Aug 93	4		
890	Vaidapakkam	54.01	Vaidapakkam		Nr. Elumalai Pillai House	HP	7 Sep 93	3		HP refitted, pipes bad.
890	Vaidapakkam	54.01	Vaidapakkam		Nr. Devraj pillai House	HP	10 Sep 93	5		HP refitted
890	Vaidapakkam	54.01	Vaidapakkam		Nr. Health sub centre	HP	3 Nov 93	20		HP refitted, Repeat
890	Vaidapakkam	54.01	Vaidapakkam		Opp. Mari House(Col.)	HP	4 Nov 93	15		HP refitted
890	Vaidapakkam	54.01	Vaidapakkam		Backside Mariamman Temple(Col.)	HP	5 Nov 93	17		HP refitted
890	Vaidapakkam	54.01	Vaidapakkam	10	Opp. Farukannu House	HP	6 Nov 93	2		HP refitted
900	Vadanerkunam	53.01	Vadanerkunam		Nr. Munusamy House	HP	30 Dec 93	120		HP working refitted
900	Vadanerkunam	53.01	Vadanerkunam		Nr. Vengatesan gounder House	HP	6 Jan 94	17		HP working refitted
900	Vadanerkunam	53.01	Vadanerkunam		Opp. Chinnathal gounder House	HP	11 Jan 94	8		HP working refitted
900	Vadanerkunam	53.01	Vadanerkunam		Nr. Murugesan House	HP	12 Jan 94	8		HP working refitted
900	Vadanerkunam	53.01	Vadanerkunam		Nr. Arumugam Assari Tea stall	HP	13 Jan 94	25		HP working refitted
900	Vadanerkunam	53.01	Vadanerkunam	8	Nr. Alamelu House	HP	5 Feb 94	40		HP working refitted
900	Vadanerkunam	53.03	Vadanerkunam Col	2	Opp. Muthumariamman Temple	HP	13 Sep 93	100		HP removed, Rejuv. needed
970	Kattalai	19.01	Kattalai	4	Nr. Kuppan House	HP	25 Feb 94	60		HP working, refitted
970	Kattalai	19.02	Mariyamangalam		Opp. Purshothaman House	HP	3 Jun 94	11		HP working, refitted
970	Kattalai	19.02	Mariyamangalam		Nr. Vinayagar Temple, Pond	HP	4 Jun 94	9		HP working, refitted ,Insp. cover damage.
970	Kattalai	19.02	Mariyamangalam	3	Nr. Kalidoss House	HP	6 Jun 94	170		HP working, refitted
980	Endiyur	13.01	Endiyur	12	Nr. Iyyanar House	HP	6 Mar 94	30		HP NW. Rejuv. needed
990	Athur	9.02	Athur Col.		Nr. Chinnapaian House	HP	21 Sep 93	30		
990	Athur	9.02	Athur Col.	3	Opp. Mthusamy House	HP	21 Sep 93	20		



## Annexure 5 : List of Sites Yield tested in Marakkanam Block by May 95

LC Code	Village	TWAD Code	Habitation	Nos. HPs	Site Tested	Pump Type	Date of Test	Yield lpm	WQ Test	Remarks
1150	Manur	29.04	Mannar Samy Koil		Nr. Mummy Daddy Tailoring House	HP	26 Nov 93	113		HP refitted, Saline, Sf.Yld.60 lpm/8hr/3m dd
1150	Manur	29.04	Mannar Samy Koil		Opp. Iyyannar Temple	HP	11 Sep 93	10		HP refitted. needs rejuv.
1150	Manur	29.04	Mannar Samy Koil		Marakkanam-Tindivanam Rd. I st BW Repeat	PP	1 Nov 93	63		PP Scheme 2nd visit(1st on 6-Aug-93)
1150	Manur	29.04	Mannar Samy Koil		Marakkanam-Tindivanam Rd. IInd BW	PP	18 May 94	93		New well
1150	Manur	29.04	Mannar Samy Koil	8	Marakkanam-Tindivanam Rd. IInd BW Repeat	PP	29 Jun 94	157		Repeat test. New well
1150	Manur	29.01	Manur	4	Nr. Health sub centre	HP	7 Mar 94	2		HP NW
1150	Manur	29.02	Manur Col	4	Nr. Devraj Agr. land	PP	20 Oct 94	30	NP	PP I Sch. ,HP N refitted, 3HP Jet instl.
1160	Molasur	31.01	Molasur	5	Opp. President House	HP	9 Jun 94	30		HP working, refitted
1170	Kuruvammapettai	13.02	Kuruvammapettai		Nr. Open Well, end of the village	HP	7 Jul 94	15		HP N fitted
1170	Kuruvammapettai	13.02	Kuruvammapettai	6	Opp. School	HP	12 Nov 94	102		
1170	Kuruvammapettai	13.03	Kuruvammapettai Col	2	Nr. Sambooranam House	HP	26 Feb 94	30		HP NW, refitted, pipes needed
1270	Madavauthangal	14.03	Madavanthangal	1	Opp. Varadhapillai House	HP	18 Apr 95	2		HP NW
1280	Endur	14.01	Endur		Opp. Bashinga reddyar House	HP	11 Oct 94	30	NP	HP working, refitted
1280	Endur	14.01	Endur		Nr. Iyyannar Temple	HP	4 Apr 95	157	P	HP working, refitted
1280	Endur	14.01	Endur		Opp. Muthukrishan House	HP	5 Apr 95	157	P	HP working, refitted
1280	Endur	14.01	Endur		Opp. Health sub centre	HP	12 Apr 95	157		HP working, refitted
1280	Endur	14.01	Endur	7	Opp. Natarajan House	HP	17 Apr 95	60		HP working, refitted
1280	Endur	14.04	Endur New Col		Opp. Egambaram House	HP	8 Apr 94	82	P	HP working, refitted
1280	Endur	14.04	Endur New Col		Opp. Amavasai House	HP	6 Apr 95	2	NP	HP working, refitted
1280	Endur	14.04	Endur New Col		Opp. Kannan House	HP	7 Apr 95	60	P	HP working, refitted
1280	Endur	14.04	Endur New Col	4	Opp. Natarajan House	HP	10 Apr 95	82	P	HP working, refitted
1290	Kurur	28.01	Kurur		Nr. Pump Room	PP	23 May 94	60		HP working, refitted( conv. to PP )
1290	Kurur	28.01	Kurur		Opp. Velu House	HP	24 May 94	185		HP working, refitted
1290	Kurur	28.01	Kurur	2	Nr. Balwadi	HP	25 May 94	60		HP working, refitted
1300	Vepperi	28.02	Vepperi		Nr. Parasuraman House	HP	22 Feb 95	1	NP	HP working, refitted
1300	Vepperi	28.02	Vepperi		Primary School Campus	HP	24 Feb 95	6	NP	HP working, refitted
1300	Vepperi	28.02	Vepperi		High School Compus	HP	25 Feb 95	60	P	HP working, refitted
1300	Vepperi	28.02	Vepperi		Opp. Periyasamy House	HP	27 Feb 95	157	P	HP working, refitted
1300	Vepperi	28.02	Vepperi	5	Nr. Jagathambal House	HP	28 Feb 95	157	NP	HP working, refitted

## Annexure 5 : List of Sites Yield tested in Marakkanam Block by May 95

LC Code	Village	TWAD Code	Habitation	Nos. HPs	Site Tested	Pump Type	Date of Test	Yield lpm	WQ Test	Remarks
1310	Murukkeri	46.02	Murukkeri		Opp. Rice mill	HP	15 Dec 94	170	P	HP working, refitted
1310	Murukkeri	46.02	Murukkeri		Nr. Murali Hosiptal	HP	17 Dec 94	93	NP	HP NW, N refitted
1310	Murukkeri	46.02	Murukkeri		Nr. Ravi chettiyar House, Main Rd.	HP	18 Dec 94	60	NP	HP working, refitted
1310	Murukkeri	46.02	Murukkeri	6	Nr. Natarajamudaliar House	HP	30 Dec 94	13	NP	HP working, refitted
1320	Kolathur	25.01	Kolathur Road Col		Nr. Pillaiyar Temple	HP	24 Feb 94	40		HP working, refitted, pipes need change
1320	Kolathur	25.01	Kolathur Road Col.	2	Nr. Manickam House	HP	19 Oct 94	85	P	
1330	Nadukuppam	33.01	Nadukuppam		Opp. Elumalai House (Pudu nagar)	HP	27 Feb 94	40		HP working, refitted
1330	Nadukuppam	33.01	Nadukuppam	9	Opp. School	HP	13 Jun 94	170		HP working, refitted
1350	Thirukanur	42.04	Thirukanur	3	Nr. Perumalgounder House	HP	8 Mar 94	120		HP NW, N refitted , Rejuv.. needed
1350	Thirukanur	42.03	Thirukanurpalayam		Opp. Ramachandran Ex-president House	HP	5 Jul 94	8	NP	HP working, refitted
1350	Thirukanur	42.03	Thirukanurpalayam	6	Nr. Murugan Temple	HP	15 Jul 94	10	NP	HP working, refitted
1380	Atchikadu	4.02	Atchikadu	4	Nr. Muthu mariamman Temple	HP	9 Oct 94	102	P	Cyl. washer replaced
1390	Panichamedu	41.01	Panichamedu	6	Nr. Grursamy House	HP	13 Dec 94	170	NP	New well. Solar scheme
1390	Panichamedu	41.02	Panichamedu Kuppam	7	Nr. OHT	Sol	3 Aug 94	10	NP	
1410	Anumandai	7.01	Anumandai		Nr. Exsiting Old OHT, South side	OW	26 Mar 94	120		Site for Sol Pump
1410	Anumandai	7.01	Anumandai	7	Opp. P.H. Centre	HP	6 Apr 94	120		HP working, refitted
1410	Anumandai	7.02	Kalyankuppam	2	Opp. Seetharaman House	PP	25 Mar 94	120		
1420	Omiper	40.02	Omiper Col	2	Nr. Tank	PP	29 Oct 94	60	P	
1450	Sathamangalam	25.08	Kallumetu Col	1	Nr. Gopalakrishan House	HP	14 Sep 93	3		HP working, refitted
1450	Sathamangalam	25.03	Sathamangalam	3	Nr. Jaganathan House	HP	20 Sep 93	8		HP removed. Rejuv.. needed
1460	Singanandal	25.04	Singanandal Col H		Nr. Muthu House	HP	29 Mar 95	157		HP working, refitted
1460	Singanandal	25.04	Singanandal Col H	2	Nr. Burial ground	HP	1 Apr 95	157		HP working, refitted
1470	Alanguppam	3.01	Alanguppam		Nr. Balwadi	HP	17 Mar 95	4	P	HP working, refitted
1470	Alanguppam	3.01	Alanguppam		Opp. Co-orprative Society	HP	18 Mar 95	93	P	HP working, refitted
1470	Alanguppam	3.01	Alanguppam		Opp. Krishnan House, Munnur Rd.	HP	20 Mar 95	30	NP	HP working, refitted
1470	Alanguppam	3.01	Alanguppam		Oxlai	HP	21 Mar 95	3	P	HP NW
1470	Alanguppam	3.01	Alanguppam		Opp. Soali House	HP	22 Mar 95	30		HP working, refitted

## Annexure 5 : List of Sites Yield tested in Marakkanam Block by May 95

LC Code	Village	TWAD Code	Habitation	Nos. HPs	Site Tested	Pump Type	Date of Test	Yield lpm	WQ Test	Remarks
1470	Alanguppam	3.01	Alanguppam		Opp. Mohanakrishan House	HP	23 Mar 95	30	P	HP working, refitted
1470	Alanguppam	3.01	Alanguppam		Opp. Pump Room, Nr. Neejalan House	HP	24 Mar 95	60	P	HP working, refitted
1470	Alanguppam	3.01	Alanguppam		Nr. Munusamy House, Col.	HP	25 Mar 95	30	P	HP working, refitted
1470	Alanguppam	3.01	Alanguppam	11	Tindivanam Rd., Inside Agri land	HP	28 Mar 95	157	P	HP working, refitted
1470	Alanguppam	3.02	Pillayar Kulam New		Opp. Mariamman Temple	HP	27 Mar 93	157		HP working, refitted
1470	Alanguppam	3.02	Pillayar Kulam New	2	Nr. Mariamman Temple	HP	1 Mar 95	60	P	HP working, refitted
1490	Vanniper	55.02	T. Pudupakkam	6	Opp. School	HP	10 Oct 94	6	NP	One coupling & pipe broken
1500	Biramadesam	10.02	Biramadesam Col.	3	Nr. Gopal House	HP	26 Aug 93	5		
1510	Ariyanthangal	14.02	Ariyanthangal		Opp. Suban House	HP	21 Apr 95	60		
1510	Ariyanthangal	14.02	Ariyanthangal		Nr. Raju House	HP	7 May 95	60		HP working, refitted
1510	Ariyanthangal	14.02	Ariyanthangal		Opp. Dharman House	HP	8 May 95	140		HP working, refitted
1510	Ariyanthangal	14.02	Ariyanthangal		Opp. School	HP	9 May 95	146		HP working, refitted
1510	Ariyanthangal	14.02	Ariyanthangal	5	Opp. Kannappa gounder House	HP	10 May 95	60		HP working, refitted
1520	Sokkanthangal	18.03	Sokkanthangal	2	Nr. Kannan naidu House	HP	10 Nov 94	102		One pipe rusted, coupling damage
1550	T Nallalam	38.01	T Nallalam	7	Nr. Kadharmaiden House	HP	18 Jul 94	89	P	HP working, refitted
1560	Kilsiviri	24.01	Kilsiviri		Opp. Mariamman Temple(Mandavelli)	HP	22 Feb 94	20		New well HP to be fitted, saline water
1560	Kilsiviri	24.01	Kilsiviri	4	Opp. Balwadi, Nr. Narayanasamy chettiyar House	HP	16 Nov 94	20	NP	One pipe disconnected
1610	Kovadi	26.01	Kovadi	13	Nr. Ettiyappan House(Periya thoppu)	HP	8 Jun 94	6		HP removed
1620	Omandur	39.01	Omandur	7	Opp. Lakshminarayana reddyar House	HP	10 Jun 94	11		Tank assembly broken
1630	Annamputhur	6.01	Annamputhur	3	Opp. Dhrowpathiamman Temple	HP	18 Aug 94	10	NP	
1650	Erayanur	15.01	Erayanur		Opp. Velayutham House	HP	14 Jun 94	10		HP working, refitted
1650	Erayanur	15.01	Erayanur	4	Backside Ponnathal Temple	HP	21 Oct 94	10	NP	Pedestal rusted, rod cut., one pipe damage.
1670	Jaggampettai	16.03	Moorthypettai	2	Nr. Open well, Nr. Ragupathi House	HP	23 Sep 93	8		HP refitted, 8 pipes repl.
1670	Jaggampettai	16.04	Seethapuram	1	Nr. Sengani House	HP	22 Sep 93	8		HP refitted, 8 pipes repl.
1680	Singanur	45.01	Singanur	6	Nr. Health Sub centre	HP	17 Nov 94	30	NP	One pipe needed

## Annexure 5 : List of Sites Yield tested in Marakkanam Block by May 95

LC Code	Village	TWAD Code	Habitation	Nos. HPs	Site Tested	Pump Type	Date of Test	Yield lpm	WQ Test	Remarks
1800	Avanampettu	49.02	Avanampettu	4	Opp. School	HP	25 Jul 94	8	NP	
1820	Vengai	56.01	Vengai		Nr. Iyyanar House	HP	27 Jul 94	60	P	HP working, refitted
1820	Vengai	56.01	Vengai	6	Nr. Mariamman Temple	HP	28 Jul 94	93	P	HP working, refitted, Cyl.. washer damage.
1830	Kilsithamur	23.01	Kilsithamur	4	Very close to School	HP	19 Aug 94	15	NP	HP working, refitted, saline water
1850	Cheyankuppam	12.01	Cheyankuppam		Nr. Dhanappan House	HP	4 Mar 94	120		HP working, refitted
1850	Cheyankuppam	12.01	Cheyankuppam	3	Nr. Parthiban House	PP	22 Oct 94	102	P	
1850	Cheyankuppam	12.02	Kattu Kollai	3	Nr. Gopal chettiyar Agri. land	PP	25 Oct 94	20	NP	
1870	Koonimedu	27.03	Koonimedukuppam		Nr. School	HP	26 Oct 93	132		HP working, refitted
1870	Koonimedu	27.03	Koonimedukuppam		Nr. Kathavarayan House	HP	27 Oct 93	110		HP working, refitted
1870	Koonimedu	27.03	Koonimedukuppam		Nr. OHT	PP	28 Oct 93	400		Jet pump, NW
1870	Koonimedu	27.03	Koonimedukuppam		Opp. Subramani House	HP	30 Oct 93	120		HP working, refitted
1870	Koonimedu	27.03	Koonimedukuppam		South end of fisherman col.	WM	10 Feb 94	127	P	New well (step draw test), WM Sch.
1870	Koonimedu	27.03	Koonimedukuppam		South end of fisherman col. (I st Repetition)	WM	11 Feb 94	93		Repeat test. Const. discharge
1870	Koonimedu	27.03	Koonimedukuppam		North end of Qtrs.	WM	12 Feb 94	107		New well (step draw test), WM Sch.
1870	Koonimedu	27.03	Koonimedukuppam	6	South end of fisherman col. (II nd Repetition)	WM	24 Jan 95	102		Repeat test
1920	Kiledayalam	20.01	Kiledayalam	4	Nr. School	HP	2 Sep 94	2	NP	HP NW, N refitted, cylinder inside well
2090	Kilpudupattu	22.03	Anichakuppam	3	North side	WM	5 Jan 94	120		Windmill Sch.
2090	Kilpudupattu	22.01	Kilpudupattu		Opp. Panduregan House	HP	11 Mar 94	60		HP NW, N fitted. Rejuv.. needed
2090	Kilpudupattu	22.01	Kilpudupattu	5	Nr. Kannapiran House	HP	7 Jun 94	60		HP N fitted
2090	Kilpudupattu	22.07	Monniyanpettai	4	Nr. Jayabal House	HP	28 Feb 94	120		HP working, refitted
2090	Kilpudupattu	22.02	Mudaliyar Kuppam		South side	WM	23 Jun 94	157	P	
2090	Kilpudupattu	22.02	Mudaliyar Kuppam	3	South side, Repetition	WM	20 Jan 95	160		Repeat test
2090	Kilpudupattu	22.05	Pudupattu Chavadi	6	Nr. Iyyanar Temple	HP	1 Nov 94	15	NP	

## Annexure 6 : Results of Hydrofracturing in Marakkanam Block

SL. No.	LC Code	Geog. Area	Habitation	Location	Date	Geology	Yield before lpm/draw dn.	Yield after lpm/draw-dn.	Yield Classification* & Change	Result Classification			Conclusion/ Proposed Action	
										No Impr.	Slight Impr.	Improved		
1	790	Coast	Kandadu	Kollumedu, Nr. Manman Koil	18/19.10.93	Contact area	5.20 m d-d	7/20 m d-d	Failure		1		Write off	
1	720	Middle	Vadnerkunam	Nr. Droupathyamman koil	28/29.9.93	Gneiss, Charnokite	7/20 m d-d	7/20 m. d-d	Failure	1			Write off	
2	760	Middle	Nagar Col. H II bore	Nr. Vairapor house		Charnokite	4	7	Failure		1		Write off	
3	760	Middle	Nagar Col. H I bore	Nr. temple		Charnokite	10	10	Poor	1			Hand pump	
4	860	Middle	Alathur III		21&24.1.94	Gneiss, Charnokite	4/10 m d-d	5/10 m d-d	Failure		1		Write off	
5	890	Middle	Vaidapakkam IV		19/20.1.94	Gneiss, Charnokite	6/10 m d-d	7/10 m d-d	Failure		1		Write off	
6	890	Middle	Vaidapakkam VII bore	Behind School		Charnokite	7	8	Failure		1		Write off	
7	890	Middle	Vaidapakkam III bore	Mosque St.		Charnokite	3	4	Failure		1		Write off	
8	1270	Middle	Madavanthangal			Charnokite	8	9	Failure- Poor		1		Write off	
9	1310	Middle	Murukkkeri I	South of PHC	14/15.2.94	Biotite, Gneiss, Charnokite	2	3	Failure		1		Write off	
10	1440	Middle	Adavallikuthan		8/9.2.94	Charnokite & contact area	3.5/10 m d-d	4/10 m d-d	Failure		1		Write off	
11	1470	Middle	Alanguppam	In HC	22/23.1.94	Gneiss, Charnokite	29/10 m d-d	47/10 m d-d	Medium			1	Hand pump	
12	1470	Middle	Alanguppam III			Charnokite		2	Failure		1		Write off	
13	1490	Middle	Vanniper	T. Pudupakkam IV	12/13.01.94	Charnokite	6/10 m d-d	6/10 m d-d	Failure	1			Write off	
14	1490	Middle	Vanniper	T. Pudupakkam V	4/5.2.94	Charnokite	17/10 m d-d	24/10 m d-d	Medium			1	Hand pump	
15	1500	Middle	Biramadesam IV		14/15.9.93	Gneiss, Charnokite	6/19 m d-d	8/19 m d-d	Failure- Poor		1		Write off	
16	1500	Middle	Biramadesam III		16/17.9.93	Gneiss, Charnokite	5/18m d-d	9/18 m d-d	Failure- Poor		1		Hand pump	
17	1500	Middle	Biramadesam	Vellakulam Mettu Col.	12&14.2.94	Biotite, Gneiss, Charnokite	4	19	Poor- Medium			1	Hand pump	
18	1550	Middle	T Nallalam		7.2.92	Gneiss, Charnokite	4	6	Failure		1		Write off	
							Total Numbers			18	3	12	3	
							Total Percentages			100%	17%	67%	17%	
1	970	West	Kattalai	Post Office road	3-4.11.93	Gneiss, Charnokite	4.5/20 m d-d	5/20 m d-d	Failure		1		Write off	
2	1000	West	Vadapakkam	School	15/16.2.94	Charnokite	92/10 m d-d	113/10 m d-d	High			1	High Yield	
3	1150	West	Munur	Nr Muthumarianman Koil St	19&28.10.93	Gneiss, Charnokite	6/20 m d-d	16/20 m d-d	Failure-Medium			1	Hand pump	
4	1170	West	Kuruvampettai Col.		8/9.2.92	Biotite, Gneiss, Charnokite	7.5/20 m d-d	19/20 m d-d	Poor- Medium			1	Hand pump	
5	1170	West	Kuruvampettai II bore	Nr School		Charnokite	5	5	Failure	1			Write off	
6	1190	West	Perumukkal III		25&27.1.94	Gneiss, Charnokite	65/10 m d-d	72/10 m d-d	High			1	High Yield	
7	1190	West	Perumukkal	Road village	11/12.2.94	Biotite, Gneiss, Charnokite	107	119	High			1	High Yield	
8	1610	West	Kovadi V		28/29.1.94	Charnokite	4/10 m d-d	5/10 m d-d	Failure		1		Write off	
9	1610	West	Kovadi X		2/3/02.94	Charnokite	2/10 m d-d	3/10 m d-d	Failure		1		Write off	
10	1670	West	Jaggampettai I		5/6.11.93	Gneiss, Charnokite	6/20 m d-d	10/20 m d-d	Failure- Poor		1		Hand pump	
11	1670	West	Jaggampettai II		10/11.1.94	Charnokite	1.5/10 m d-d	2/10 m d-d	Failure		1		Write off	
12	1800	West	Sorapattu		10/11.2.94	Charnokite & contact area	2.5/10 m d-d	4/10 m d-d	Failure		1		Write off	
							Total Numbers			12	1	6	5	
							Total Percentages			100%	8%	50%	42%	
							Grand Total Numbers			31	4	19	8	
							Grand Total Percentages			100%	13%	61%	26%	

\* Yield Classifications : Failure : 0-8 lpm; Low : 9-15 lpm; Medium : 16-50 lpm; High : &gt; 50 lpm.

## Annexure 7 : Geology and Geomorphology of Marakkanam Block\*

### Geology :

Marakkanam block is underlain by various geological formations from the Archeans to semi consolidated formations of Mesozoic and Tertiary ages to the unclassified alluvial formation of Quaternary age. A generalised geological succession is presented in the table below and the various formations are also described briefly below :

Geological Succession in Marakkanam Block

	Era	Age	Formation	Lithology
	Quaternary	Recent	Alluvium laterites,	Alluvial coastal sand, clay and laterites
	---	---	Nonconformity	—
Ceno- zoic	Tertiary	Mioplio- cene	Cuddalore sandstone	Sandstone, argillaceous pebbles bearing sandstone, grit sand with clay.
—	---	---	Nonconformity	—
Meso- zoic	Upper cretaceous	—	—	Fossiliferous siliceous lime stone, calcareous sandstone & marls.
—	---	---	Nonconformity	—
Azoic	Archacan	—	—	Gneiss, granites Charnockites and intrusive Dolerite, Pegmatite and Quartz veins.

**Archean Formations :** This forms the basement over which the later sediments were deposited. A greater part of the block is covered with metamorphic crystalline rocks or Charnockite belonging to Archean age consisting of acid type of rock. Some times, cofolded with the enclosed bands of Magnetite, Quartzite and Granite. The Charnockites are medium to coarse grained and may be banded. The general foliation trends vary from NNE to NE with dips to ESE and SE. On weathering, the Charnockites give rise to rounded blocks due to exfoliation.

**Granites in the block** are medium to coarse grained and are pink to light gray in colour. Dark coloured dykes of varying dimensions form the youngest basic intrusive and are also wide spread. Pegmatite and Quartz veins are seen traversing the country rocks. There are mostly small and sporadic in distribution.

**Cretaceous Formations :** The Cretaceous formations are represented by a fossiliferous group of siliceous lime stone, calcareous sandstone and marls trending roughly NNE-SSW to the south of Marakkanam. Exposures of fossiliferous lime stone occur south of Marakkanam on the Pondicherry Road. These rocks are of shallow marine origin and are

\* This note has been prepared from documentation available in the Project Advisory Group of the IRS & WS Project, and had provided guidelines for the preparation of a Hydrogeomorphological map of Marakkanam Block by the Hydrogeological Section of TWAD Board Madras, under the supervision of an Adviser to the Project. This map is presented along with this note and has been used for analysis of Yield Testing data.

classified under the Ariyalur stage of the Cretaceous system. The Cretaceous formations occupies the low places giving rise to lakes and ponds. The Cretaceous formations are overlain by the younger tertiary rocks. The formations are overlapped by alluvium in some places.

**Tertiary Formations :** Overlying the Cretaceous rocks are the Cuddalore formations of Miopliocene age. The Cuddalore sandstones are often ferruginous and consist of pebble beds, sands and clays. The Cuddalores have been altered and covered either by lateritic formation or by alluvium. Good exposures of Cuddalores are seen at and around Kandadu, and Nadukkuppam.

These sand stones are whitish, pinkish and reddish or mottled in colour and are chiefly argillaceous. Particular beds of white or mottled clay are observed occasionally in association with sandstones.

**Quaternary Formations :** Along with the coast of Marakkanam, blown sands of 1.5 to 3 Km width are common and occur mainly in the form of low and flat topped sand dunes.

**Structures :** No major or minor structures have been traced in this block. The gravimetric and seismic surveys carried out by the ONGC in the coastal sedimentary tract have revealed a main fault along the line where the sedimentary series meets with the crystalline rock to the western part of the block. The Cretaceous and Tertiary sediments are of general strike NE to SW to ENE to WSE with low dips.

The density of current bedding marks in Cuddalore sandstones are suggestive of rapid pulsational, depositional environment. The soft nature of sandstone and their tendency to weather easily appear to have led to the development of the characteristic bad-land topography.

Well developed joints more or less parallel to the strike of foliation are noted in the gneiss strike joints, dip joints and oblique joints are seen well developed in the crystalline rocks that normally extend down to a depth of 30 m. sheet joints are common in massive rocks like charnockites. The joints are well developed close to the surface.

The crystalline rocks are weathered and the degree of weathering is highly variable depending on the structure, mineralogical composition of the rocks, topography, drainage, etc. Gneisses generally are less resistant to weathering than charnockites and granites. Spheroidal weathering in Charnockites is common. Thickness of weathering varies from place to place and with rock type from less than a metre to as much as of 20 m.

### Geomorphology :

Geomorphology can be defined as the science studying the genesis and development of land forms. It reveals the geomorphic representation of forms and its extent, the origin of relief, the quantitative aspects of the land forms and chronological sequence of land form development. For groundwater exploration the information about the geomorphic units is very essential to demarcate the potential zones of groundwater, such as pediment, valley fills, etc. Spot Imagery with an Anglepoise lamp with magnifier is of immense help to delineate the land forms.

Marakkanam block consist of pediments of different classifications and valley fills as follows:

**Denuded Hill:** There is a denuded hill where the weathering process is still active since Archaean times. It has a symmetric top with escarpment with moderate dip slope. This is of Charnockite/Gneisses. The Perumukkal Malai is a denudational hill. It acts as a run-off zone.

**Pediment:** These are fresh cut rock surfaces with a thin veneer of soil cover. Land use is very poor. Groundwater potential is also very poor. Any intrusions or lineaments occurring in this unit gives it a good potential for groundwater exploration. Different classifications have been made considering the land use and vegetative cover.

**Buried Pediment:** This unit can be divided into Deep buried pediment, Buried pediment and Shallow buried pediment of different weathering thickness.

**Shallow Buried Pediment-SP1:** This is interpreted on the basis of the sparse vegetation and minimal land use where the weathered thickness may be in the range of 2 m to 10 m or less.

**Shallow Buried Pediment-SP2:** This is also delineated on the basis of land use and vegetative cover. Land use is not regular or dense. The weathering thickness may be of greater than 10 m.

**Buried Pediment:** This is the place where vegetation cover is moderate and land use is better and the weathering thickness may range from more than 10 m and upto 50 to 70 m.

**Deep Buried Pediment:** This area is of a high groundwater order, where the land use is good and the land cover is denser than for buried pediment.

**Valley Fills:** Valley fills are formation comprises of medium to coarse grained materials deposited along the linear depressions. A well cutting may show embedding of well rounded pebbles. Intensive cultivation is present and the ground water potential is very good.

**Lineaments:** These are surface manifestations of the linear fractures like faults, joints and fractures. Groundwater potential of high order is indicated where lineament run along and across the weathered rock deposit and intersect one another.

Lineaments can not be verified in the field because of poor field expression. However lineaments can be identified by:

- Abrupt displacement of rock unit boundaries.
- Abrupt changes of direction in drainage, forming repetitive patterns.
- Unaccountable change of river direction.
- Junction line between two adjacent blocks of different drainage patterns, physiography and tone.

Apart from the above, geological units such as alluvium like fine sand to loamy sand characterised by fine texture with white yellowish tone in the project area.

The geology of the project consists of two different formations, viz., the Hard Rock and Porous or sedimentary formation. Though these are of different genesis and disposition, the units can be interpreted and delineated based on the photo and geotechnical elements. Hence separate classification has not been given for Porous units which are having a good thickness of porous beds. However, the area devoid of any intensive land use and the poor stand of vegetation, has been brought this under the unit pediment. Wherever land use and vegetation is better, those areas have been brought under other classifications, as done in general.



### Hydrogeomorphological Map:

A study was undertaken during 1991-93, by the Hydrogeology Wing, TWAD, with the objective of identifying various units of Geology, Geomorphology and Hydrogeology using different photo elements and geotechnical elements for quick exploration, exploitation and assessment of groundwater resources potential. Planning of water supply investigation, selection of likely areas of ground water exploration and Hydrogeological mapping were to be carried out using the SPOT Geo-coded imagery.

**Study Area :** The study area formed parts of South Arcot District of Tamil Nadu, a separate union of unique geographical and geological disposition. The total area falls in survey of India Topo sheet 57P/11 and 57 P/16. The main towns in the project area are Marakkanam T.P., Tindivanam (MC).

### Products Used:

SPOT Geo-coded FCC Satellite imagery, Scale -1:50,000

Topo sheet used 57P/11, 57 P/16, Scale - 1:50,000.

Aerial photographs with TWAD Board, to complete the interpretation of gaps between adjacent imageries, Task No.1009A Run No. 41 Photo

The general quality of the SPOT FCC and its resolution was very good. However a little Planimetric inaccuracy was expected and they were to be rectified while preparing final map.

**Methodology:** Remote sensing is the science and art of obtaining information about an object, area, or phenomena through the analysis of data acquired by a device that is not in contact with the object, area or phenomenon under investigation. Electromagnetic sensors operated from airborne and space-borne sensors acquire data of the various earth surface features which emit and reflect electromagnetic energy.

When electromagnetic energy is incident on any given earth features three fundamental energy interactions with the feature are possible. Various fractions of the energy incident on the element are reflected absorbed and/or transmitted. This proportion of energy reflected, absorbed and transmitted will vary for different earth features depending on their material type and condition. These differences permit us to distinguish different features on an imagery.

Visual interpretation was carried out by following standard image interpretation techniques which are based up on the photo elements such as tone, pattern, location, association, shape and texture.

The resultant Hydro-geomorphological Map of Marakkanam Block is attached.