



CENTRAL POLLUTION CONTROL BOARD

Zonal Office (South)

Nisarga Bhavan, Thimmaiah Road

Shivanagar, Bengaluru - 560 010

INSPECTION REPORT OF VARTHUR LAKE, BENGALURU

1.0 Background

The sudden foam formation and its overflow from Varthur Lake into the adjoining roads and surrounding areas in Varthur town attracted the attention of print and electronic media and caused nuisance among local public. The foaming from lake started overflowing on 27th April 2015 and still continuing as on date. The localities and by passers made complaints to the concerned authorities and it drew the attention of all throughout the country. In response to this incident, the Member Secretary, CPCB vide letter No. MSCB/04/2015 dated May 1, 2015 directed south zonal office to inspect the lake on May 2, 2015 and to report the status.

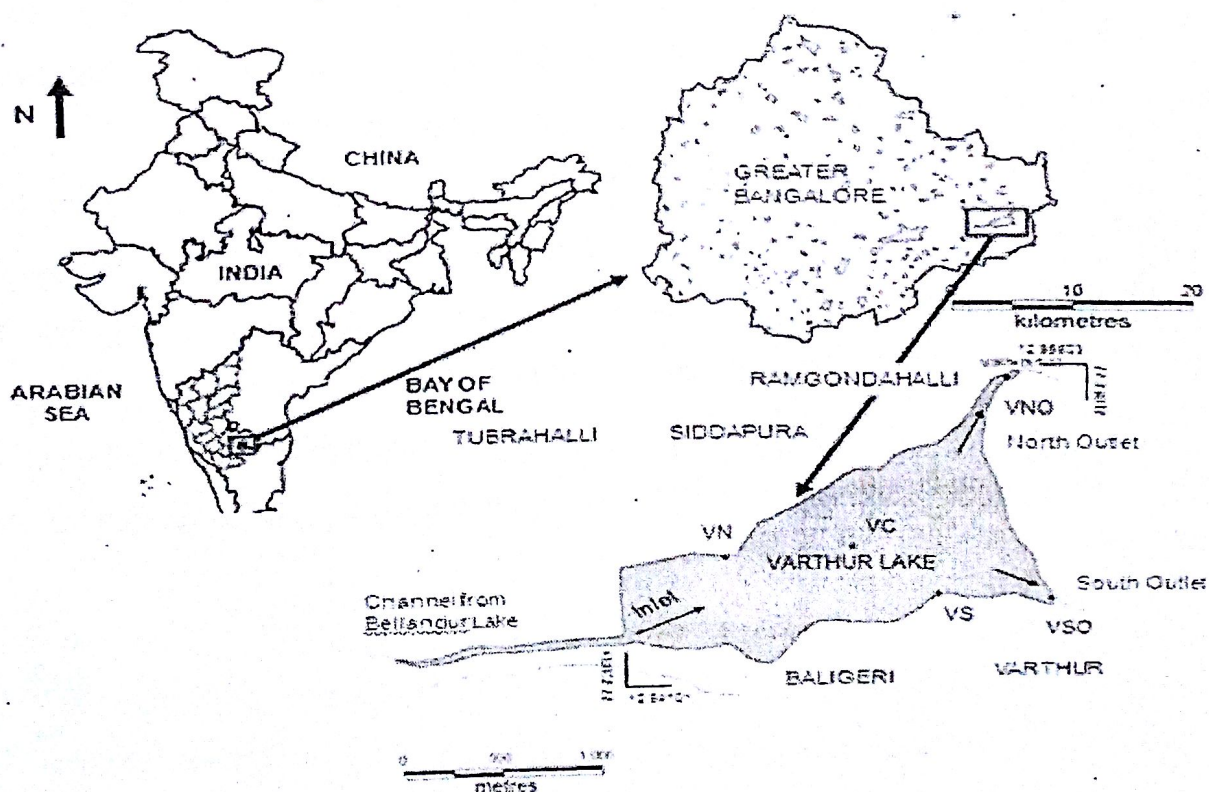


Figure 1: Location of Varthur Lake in greater Bengaluru city

2.0 Approach

Immediately, on receipt of the complaint, a team of officials comprising of Sh. S. Suresh, Zonal Officer, Dr. V. Pattusamy, Sc-E, Sh. Radheshyam Balaji, Sc-C and Sh. Deepesh, SSA visited the Varthurlake and surrounding area and collected grab samples from certain critical points along the lake. The team also interacted with residents, NGO's and other representatives present at the spot. The prima-facie of the issue is "due to continuous discharge of untreated sewage into the lake, it has become completely eutrofied, deposited with silt and self-purification is retarded and lake water is not much useful for domestic/irrigation purpose. The uncontrolled discharges due to rapid urbanization have made the lake losing its socio economic value and are generating foam and causing panic among public".

Sh. P. C. Mohan, Hon'ble MP, Bengaluru (Central) and Sh. Arvind Limbavali, Hon'ble MLA from Mahadevapura constituency, Senior officials from Karnataka State Pollution Control Board and residents from Varthur town, By-passers and press reporters were present during the inspection.

3.0 About Varthur Lake

Varthur Lake ($12^{\circ}57'24.98''$ - $12^{\circ}56'31.24''$ N, $77^{\circ}43'03.02''$ - $77^{\circ}44'51.1''$ E) is an shallow artificial lake, or *tank*, located in the South taluk of Bengaluru district which was built by the Ganga Kings few thousand years ago for domestic and agricultural uses. The lake occupies around 147.8 hectares with a mean depth of 1 meter. The lake is surrounded by villages and small farms and is estimated to irrigate around 625 hectares. Varthur lake is interconnected to Bellandur and other tanks present in Bengaluru South region and finally joins the Dakshina pinakini river (Thenpennai river) which is drinking water source in Hosur, Tamilnadu. It has a catchment area of 1.8 KM^2 but due to rapid urbanization the entire catchment area of varthur lake contains substantially huge population and full of huge residential & office complexes.

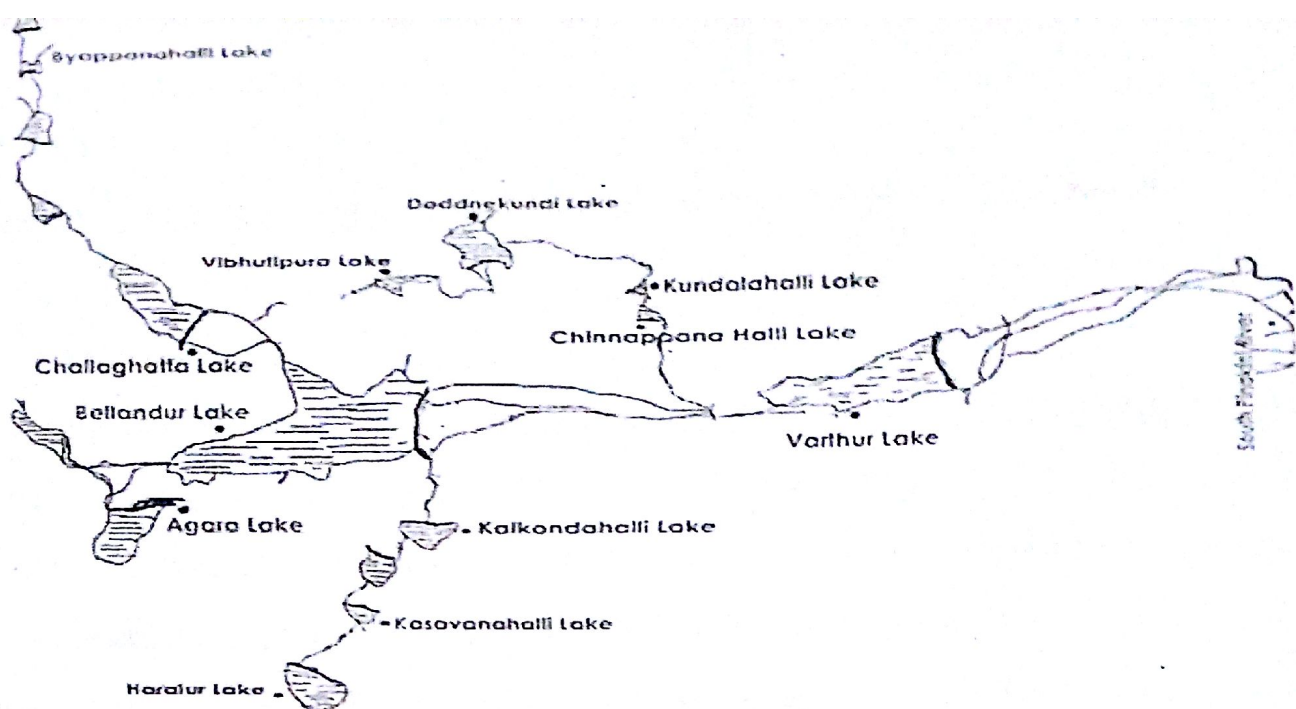


Figure 2: Interconnection of Lakes showing the linkage of Varthur with other lakes

4.0 Observations

The team made following salient observations:

- i. **Accumulation of foam and odour nuisance due to discharge of untreated sewage**
 - The domestic sewage generated in Koramangala-Challaghatta valley of Bengaluru South district is around 600 MLD while the total capacity of the wastewater treatment plants is approximately 300 MLD. Only 50% of the wastewater generated in the catchment is currently being treated and the remaining untreated sewage is discharged into various lakes. Varthur Lake is part of interconnected system of tanks and canals that receive virtually all the surface runoff, wastewater, and sewage from this catchment area as shown in the figure 2.
 - The overflow of the treated domestic effluents are reaching Bellandur tank and from there it is flowing to Varthur lake.
 - The Karnataka State Pollution Control Board (KSPCB) mandates that apartments with more than 50 units shall have its own STP and to utilize the entire treated sewage in its premises. However, there are numerous dwellings with less than 50 units are discharging sewage directly into UGD wherever it is connected or directly into lake wherever UGD does not exist. The sewerage network caters only 50% of the total area and remaining portion is yet to be connected. The majority of the untreated sewage and effluents from other activities are reaching directly into the lakes

adding more pollution load on the lakes thus impairing the self-purification capacity.

- The lake was found completely filled & eutrophied and water is in anoxic-anaerobic condition.
- There was heavy rainfall in Bengaluru during April, 2015 (around 80mm). Since, most of the storm water drains/ Rajakaluves are being encroached, the surface runoff is reaching into the lakes from catchment area. The lake is observed to be completely filled and overflowing. The outfall of Varthur weir is very rocky & sloppy and the effluents containing high surfactants, sodium and potassium hydroxides flowing over it leads to foam formation due to rigorous agitation.

ii. Silting of lake

- It is learnt that the de-silting operations are not carried out since long time; the lake is likely to fill with large quantity of silt of which composition is not known. Due to the silt deposition, the effective depth of the lake and bed porosity has been reduced. Thus the capacity of the lake is reduced recharging of ground water is also likely to be affected.

iii. Eutrophication in varthur lake

- The varthur lake is completely covered by water hyacinth which may be due to the excessive presence of nitrates and phosphates. This may be attributed to agricultural runoff and discharge of untreated sewage from both point and non-point sources. The dissolved oxygen (DO) content is very low in the morning hours itself. The enhanced algal activities in the night time are likely to have much impact on the DO.
- The management of wetlands in poor condition is not helping the outflow of lake effluent in any manner.

iv. Human interventions

- It is visible that the lake bed area is getting reduced due to cropping of unauthorised structures, dumping of garbage, debris and construction waste. The peripheral bunds

along the lake have been vanished. The washing of vehicles, cattle etc. near the lake was also noticed.

v. Poor Co-ordination among Civic agencies

- It is learnt that Bangalore Development Authority (BDA) is mainly responsible for the maintenance of the Varthur lake. From the physical observation, it was clear that, not much due attention has been given to the development and maintenance of Varthur lake in healthy status by the agency. It is also understood that a proposal for construction of STP of 90 MLD capacity is under consideration. The estimate and DPAR has to be prepared by minor irrigation for execution of the proposal. The lack of co-ordination among various departments is posing problems in development of Varthur Lake.
- There is plethora of departments responsible for each lake in the city; it includes BDA, Bruhat Bengaluru Mahanagara Palike (BBMP), Karnataka Forest Department, Lake Development Authority, Minor irrigation etc. The policy and attitude of each department varies in conserving the lakes. It is felt that, identifying a single agency for conservation of lakes will be more appropriate and meaningful.

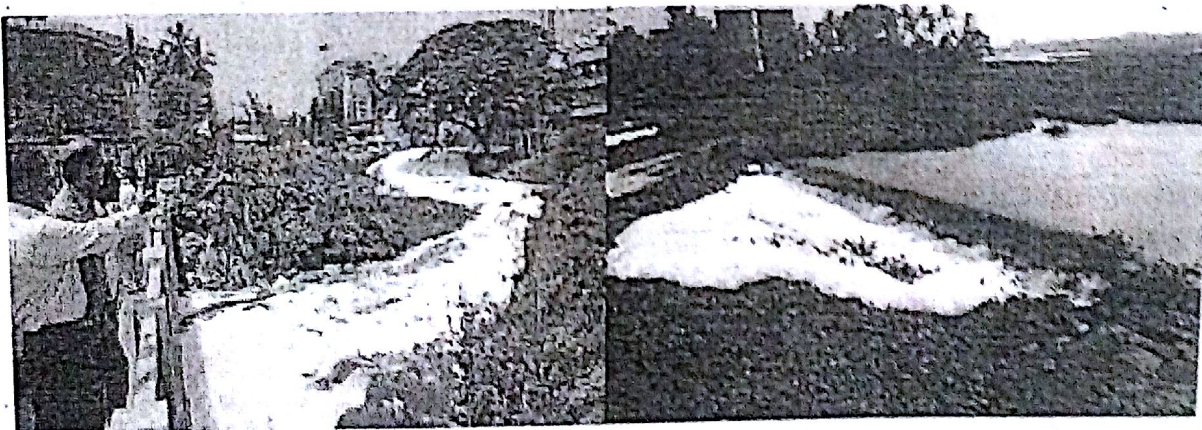


Photo: Foaming in Varthur lake

5.0 Results and Discussions

The team collected grab samples at three critical points: varthur lake outlet- whitefield, varthur lake outlet channel- varthur kodi and outlet of Bellandur lake and results are depicted in table 1 given below.

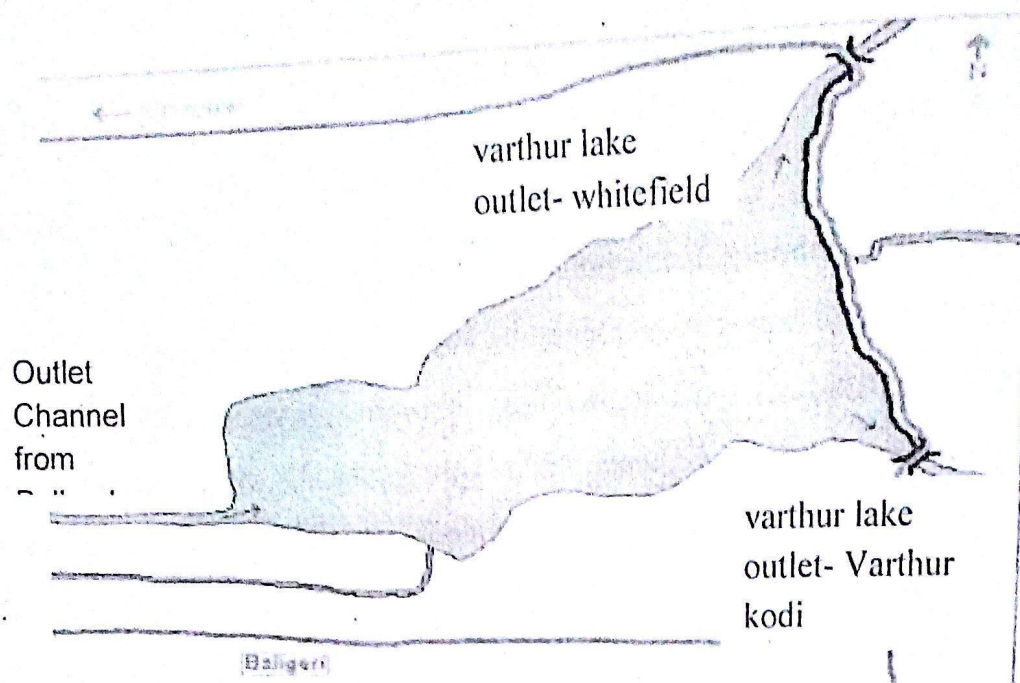


Figure 3: sampling locations

Table1: Physicochemical analysis of water samples collected from Varthur lake, Bengaluru.

Parameters	Varthur lake outlet channel: Whitefield 12°57'23.4"N 77°44'42.1"E	Varthur lake outlet channel: Varthur Kodi 12°56'42.1"N 77°44'49.9"E	Bellandur lake outlet, Yemalur (Inlet to Varthur lake) 12°56'38.1"N 77°40'48.9"E
pH	7.06	7.19	7.14
Conductivity (μS)	795	806	779
Dissolved oxygen (mg/L)	0.7	0.4	1.61
COD (mg/L)	27	41.9	29.7
Ortho Phosphate (mg/L)	2.1	2.3	2.6
Ammonia-N (mg/L)	168	252	112
Chloride (mg/L)	85.5	90.2	80.7
Total hardness (mg/L)	333.2	254.8	274.4
Calcium hardness (mg/L)	196	196	176.4
Total alkalinity (mg/L)	256.3	287	353.5

- It is envisaged from the analysis results that the dissolved oxygen is varying between 0.7 to 1.61 mg/l. which clearly indicates that the lake is in hypoxic condition posing threat for the sustenance of aquatic life. Hypoxic and anoxic conditions can be correlated with a higher demand for oxygen for bacterial decomposition, which results in higher decomposition rates of organic matter, and consequently creates an anaerobic environment.

- Dissolved oxygen decides the prevailing conditions of the water. Dissolved oxygen (DO) at inlet of Varthur lake is more compared to other two locations. This shows that water in the lake is stagnated, due to inflow of raw sewage and other effluents.
- Ammonical N (112 mg/l – 252 mg/l during April) substantiates hypoxic and anoxic conditions prevailing in the lake which is very toxic to biotic components. Varthur lake behaves like a highly anoxic system mostly at the outlet.
- Phosphorus an essential part of the biological system is present mostly in the form of inorganic phosphates and also constitutes a major factor to eutrophication. The values varied between 2.1 to 2.6 mg/L.
- Total alkalinity ranged from 256.3 - 353.5 mg/l. Total alkalinity is higher at inlet which may be due to high concentration of carbon-based mineral molecules.
- The water quality of sewage-fed Varthur Lake has been measured at three different locations. The analyses for the remaining parameters are under progress. The quality of the lake water could be exactly concluded once the results are available for all parameters and also by carrying out integrated sampling. The growth and spread of macrophytes (water hyacinth) is rendering the lake anaerobic and reducing its treatment capacity.
- The runoff from Bellandur, chalaghatta, Agara and Varthur lake joins the Dakshina Pinakini/ Thenpennai river which is a drinking water source at Hosur, Tamilnadu. CPCB is monitoring river Thenpennai at Mugular bridge on quarterly under interstate river monitoring programme. The concentration of few core parameters is given in table 2.

Table 2:Thenpennai river at Mugular bridge monitoring results

S.N	Parameter	Concentration range in mg/l
1	BOD	10-32
2	COD	24-55
3	Phosphate	0.5-6.5
4	Nitrate	21-28

Based on the preliminary investigation, the following short-term and long-term plans are recommended.

A. Short-term plans:

- The state Government shall directed
 - To restore Varthur Lake by adopting in situ measures such as de-silting, de-weeding, bioremediation, aeration, bio-manipulation, nutrient reduction, withdrawal of anoxic hypolimnion, constructed wetland approach or any other successfully tested eco-technologies etc. depending upon the site conditions.
 - To earmark the boundary of the lake, and establish bunds along the periphery of the lake.
 - To instruct the concerned agency to identify all sewage inlet points, divert the sewage entering varthur lake to the Koramangala-Challaghatta valley STP for treatment. The entire catchment area needs to be connected with proper sewerage network.
 - To install silt traps & biological treatment, develop green belt to prevent silt deposition.
 - To restrict human interventions by strengthening of bund, lake fencing, shoreline development etc.
 - To earmark particular area in the lake for immersion of idols and exhibit sign boards.
 - To propagate the utilization of treated sewage for industrial or other domestic activities and avoid discharging into lakes
 - To explore the techno-economic feasibility solutions for removal of phosphorus, nitrates causing eutrophication
- The Karnataka State Pollution Control Board (KSPCB) shall be directed
 - To immediately stop the discharge of untreated sewage from the apartments in the surrounding area. Further, KSPCB shall ensure that all apartments with more than 50 units shall treat the sewage in their own STP's and reuse the treated sewage within its premises.

- To ensure that apartments with less than 50 units to compulsorily connect to UGD system and not to discharge directly into lake at any cost.
- To conduct surprise inspection of all residential & office complexes, industrial units and all other such units to ensure their effluents are connected to UGD and taken to STP for treatment.
- To cross- verify the adequacy of STP's existing in the catchment area by forming different committee involving local public. This drive should be given wide publicity in public media
- To increase the frequency of monitoring and analysing related parameters and correlating with the standards. The data should be analysed in Scientific manner and root cause analysis should be done to know the reason for not meeting the standards.
- To upload entire monitoring data of Varthur lake in KSPCB website and inform the public about the progress made in achieving the improvement.
- To invite public opinion to provide for innovative ideas for rejuvenation and restoration of Varthur lake.
- To involve R & D institutions to conduct various studies on lake to come out with exact vision for overall improvement.
- To adopt similar strategy for remaining lakes in the state.

B. Long-term plans

- **The State Government shall be instructed**
 - To monitor the deterioration in the quality of water and discharges and to maintain the wetlands as per Conservation and Management of Wetlands Rules under the provisions of Environment (Protection) Act, 1986 and the wetlands (Management & Conservation) Rules, 2010.
 - To expedite the construction of STP of adequate capacity at Varthur lake.
 - To assign development and maintenance of lakes to a single agency like Lake Development Authority (LDA)
 - to undertake Catchment area treatment which may include afforestation, storm water drainage, silt traps etc.
 - To direct concerned agency to ensure tertiary treatment of sewage before discharge into lakes

- To prepare an Action Plan and to devise suitable policy for rejuvenation of Varthur lake involving all stake holders.
- To inform the public about the development made towards the compliance of all above points in Government of Karnataka website
- To conduct the mass balance study of the lake to assess the exact situation of the quality of water

C. Immediate Action

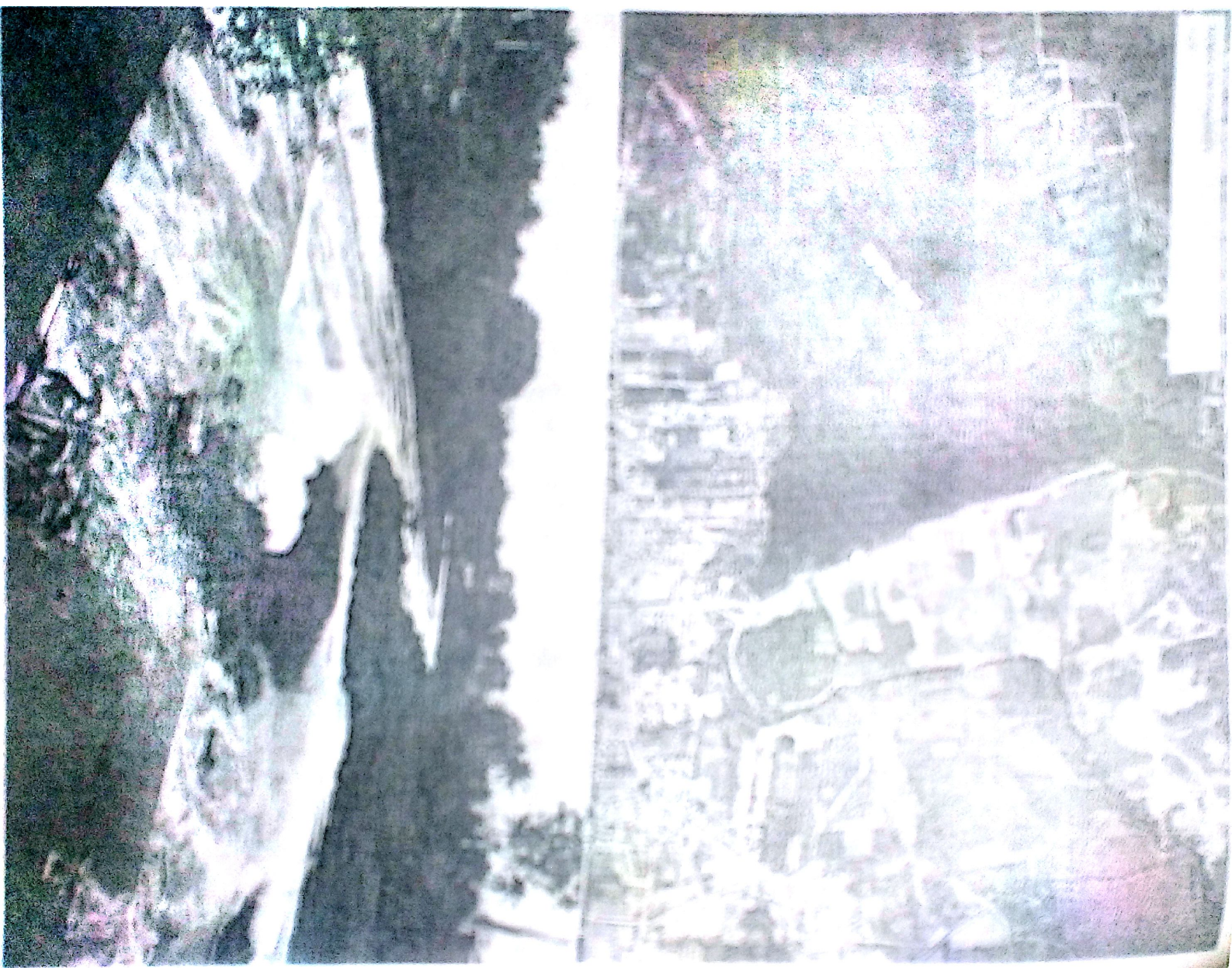
A committee comprising of CiSTUP-IISc, Central Pollution Control Board, Karnataka State Pollution Control Board, Lake Development Authority, Bengaluru Water Supply and Sewerage Board, BDA and BBMP shall be constituted to be headed by Dr. T. V. Ramachandra, Expert on lakes, CiSTUP, IISc, Bengaluru to carry out a detailed study about status of Varthur lake and remedial measures for restoration of Varthur lake and submit the report within a month.

12°56'36.1"N 77°40'48.9"E

Traffic



Photo 2: Sampling location: Balandur lake outlet, Yemalur (Inlet to Varthur lake) 12°56'38.1"N 77°40'48.9"E



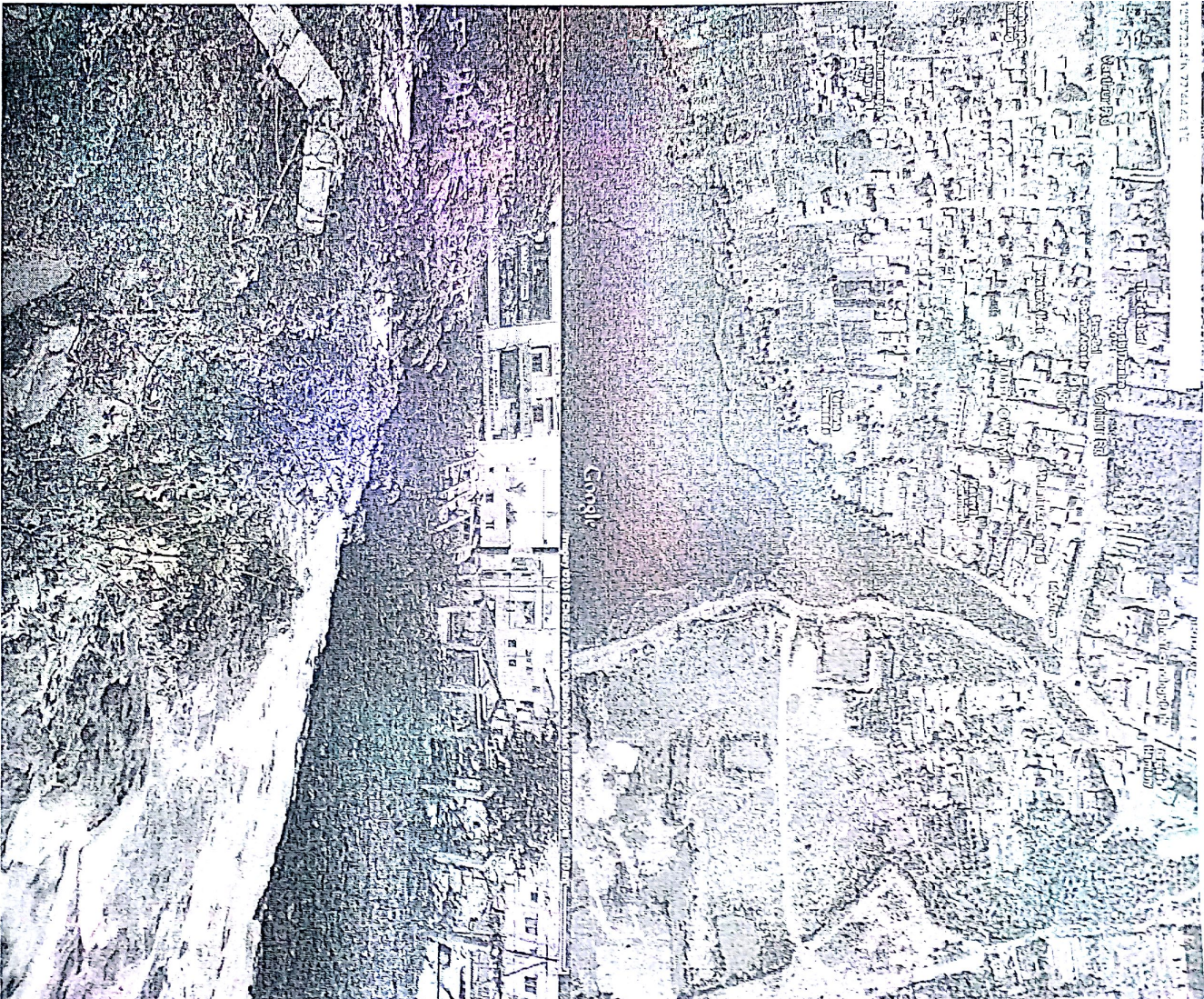


Photo 4: Sampling location: Varthur lake outlet channel, Whitefield (12°57'23.4"N 77°44'42.1"E)