REPORT ON

MITHI RIVER WATER POLLUTION

AND

RECOMMENDATIONS FOR ITS CONTROL

AS SUBMITTED TO

MAHARASHTRA POLLUTION CONTROL BOARD

KLEAN

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I N D E X

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REPORT ON
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1.0 INTRODUCTION:

MITHI river in Mumbai city, is a confluence of tail water discharges of Powai and Vihar lakes. Mithi river originates at Powai and meets Arabian sea at Mahim Creek flowing through residential and industrial complexes of Powai, Saki Naka, Kurla and Mahim over a distance of about 15 km (Ref. Annex-I). This river is treated like an open drain by the citizens who discharge raw sewage, industrial waste and garbage unchecked. Besides this, illegal activities of washing of oily drums, discharge of unauthorized hazardous waste are also carried out along the course of this river. The organic waste, sludge and garbage dumping has reduced carrying capacity of the Mithi river. The water with mixture of sewage and Industrial waste is a threat to marine life and the river is showing sign of total loss of such support system. Preliminary survey indicates that the pollution levels have reached an alarming stage.

Mahim bay area, where Mithi river meets Arabian sea, is a nominated bird sanctuary called “Salim Ali Bird Sanctuary” where migratory birds come for nesting. This part is full of mangroves and this fragile eco system requires considerations from pollution point of view, so that it is not destroyed.

Govt. of India intends to get an action plan for control of pollution in Mithi river and bring back the quality to its best uses. To assess probable load of pollution in the Mithi river and plan to improve the quality of water in the river as well as its carrying capacity, a reconnaissance survey is proposed by Maharashtra Pollution Control Board (MPCB). For this purpose, MPCB appointed M/s. Klean Environmental Consultants (P) Ltd. Mumbai to submit their report by carrying out survey and sampling of Mithi river (vide letter No.MPCB/MS/TB/B-747 dated 14th May 2004).

The terms of reference for such study were as follows,

1. To fix 20 monitoring points along the stretch of Mithi river.

2. Four (4) sets of samples to be collected and analyzed at these points.

3. Simultaneously two (2) sets of sludge samples to be collected and analyzed at these 20 stations.

4. Sources of pollution points be identified and samples collected for assessing the quality.

   Note : Entire sampling work to be completed before the first week of June 2004, to avoid monsoon dilution.

5. Based on above findings, the report shall provide following,

   1. Mithi river water quality,

   2. Sludge quality and quantity,

   3. Short term and Long term measures to control pollution of Mithi river.

Accordingly sampling and survey for river water and sediments at 20 locations was carried out from 18th May '04 to 29th May '04 (both days inclusive) and based on this data we are pleased to submit our report.

2.0 SURVEY TO DETERMINE MITHI RIVER WATER QUALITY

2.1 Topography of Mithi River

Originating at Powai, Mithi river flows through Saki Naka, Safed Pool, around Santacruz airstrip, passing through thickly populated and industrial area like Jarimari, Bail Bazar, old airport road, Kalina (CST road), Vakola, Bandra Kurla complex, Dharavi and ends at Mahim creek. It serves as combined sewer for the area carrying sewage as well as storm water to sea. River bed is narrow in the initial stretch and is about 10 meters wide but at Bandra Kurla complex it is much wider.

The river passes through congested residential colonies including hutments, which let out raw sewage in the river and also throw garbage in it. Due to this reason, the river bed is full of sludge, garbage and vegetation growth like Hyacinth in many parts as can be seen from photographs enclosed for various locations. Cattle sheds in areas like Bail bazar, Jarimari, Andheri Kurla road etc. contribute animal waste.

At CST road junction and on the road from Lal Bahadur Shastri Marg (LBS Marg) to Santacruz airport there are many unauthorized industries like Oil refiners, Barrel cleaners, scrap dealers etc who dump sludge, oil, effluent and garbage in the river.

In order to assess water quality of Mithi river, the topography of area through which river flows was studied (Please refer Map attached). Sampling points were selected at a distance of about 800 meters to 1 km and wherever convenient for water and sediment sampling. As there are many road bridges crossing the river, these locations were used for convenience.

2.2 Sampling Points:

Mithi river is subject to tidal variation, in order to get proper idea of population load in high and low tide, sampling schedule was spread over 12 day's period. Twenty (20) sampling points were selected starting from origin i.e. overflows of Vihar and Powai lakes, and ending at Mahim creek, where Mithi river meets the sea. Sediment samples were collected from the river bed at the same locations. Sediments were collected during low tide with the help of scoop, as the river bed is shallow due to sludge accumulation. Based on above considerations, sampling points on the Mithi were selected at following locations.

Sampling Point No.	Location
1.	Under Mahim Creek bridge where river meets Arabian sea.
2.	Under Western Express(W.E.) highway
3.	Bridge near Kalanagar on junction of Bandra Kurla road with Dharavi road.
4.	Bandra Kurla complex main road bridge (Near Wochardt office)
5.	Bridge on branch road from BK complex to Vakola
6.	On road from WE highway to Kalina, near Hyatt Hotel.
7.	Over the bridge at Kalina leading to LBS road
8.	Upstream of bridge on Bandra Kurla Complex road which leads to LBS road.
9.	Down stream of bridge on Bandra Kurla Complex road which leads to LBS road.
10.	Near taxi-men's colony on Bandra Kurla Complex road which leads to LBS road
11.	Bridge on the Road from LBS marg to old airport
12.	Bail bazar area at Sarvodayanagar bridge
13.	Jari-Mari area colony, on Bail bazar - saki naka road, after airport.
14.	Behind Samhita complex (Safed pool -Saki naka road).
15.	Bridge on Andheri- Kurla road near Saki naka.
16.	Near Marvel Industrial Estate on Saki-Vihar road.
17.	On Jogeshwari -Vikhroli Link road.
18.	Vihar Lake overflow near BMC gate
19.	Origin of Mithi river (meeting point of Powai and Vihar lake overflows) behind BMC office.
20.	Powai lake overflow (Ambedkar Garden)

2.3 Sampling Schedule :

	DATE OF SAMPLING	SAMPLE OF
First set	Tuesday 18th May 2004	Water
Second set	Saturday 22nd May 04	Water and sediment
Third set	Tuesday 25th May 04	Water
Fourth set	Saturday 29th May 04.	Water and sediment

2.4 Sample Collection Procedure :

All samples were analyzed in our laboratory and at each location three sets of samples were collected and conditioned to determine various parameters, as specified in "Standard Methods". All the samples were transferred to the laboratory within four hours of collection.

Sr.No.	Sample for	Preservation method
1	Dissolved Oxygen (DO)	D.O. fixed at site using a) $MnSO_4$, and b) Alkali Iodide Azide
2	BOD, COD, Solids etc	Preservation in ice
3	Metal radicals	Acidification with Sulfuric Acid.

2.5 Method Of Sample Analysis

Sample analysis was carried out using following methods.

Sr. No.	Parameter	Method used
1	pH	APHA-4500-H
2	Alkalinity	IS: 3025.1964
3	Dissolved oxygen	APHA-4500-0.C
4	Chlorides	APHA-4500Cl- B
5	Suspended solids	IS: 3025-1964
6	Total dissolved solids	IS: 3025-1964
7	3 days 27^0C BOD	IS: 3025 (PART 44):1964
8	C.O.D.	COD reactor model 45600
9	Sulfates	APHA-4500-so_4 E
10	Phosphates	APHA-4500-PD
11	Hexavalent Chromium (Cr^6)	APHA-3500-Cr B
12	Copper	APHA-3500- Cu B
13	Zinc	APHA-3111-B
14	Lead	APHA-3111-B
15	Phenols	APHA-5530-D

2.6 Flow Measurement of Mithi River:

As Mithi river is subject to tidal flows, river water level changes substantially due to tidal variation. As the specific gravity of sea water is high, at the time of high tide, river water swells upstream and at low tide, water level at some points reduces to few feet. This variation makes it difficult to estimate flow of water in such short duration of time. Hence no effort was made to estimate water discharge in Mithi river at this juncture.

2.7 Mithi River water Quality : Review of results.

Enclosed please find 4 sets of analysis reports for Mithi river water (Annex-II). The samples were anlaysed to determine,

a. Whether river water contains any industrial pollution, and

b. If this water can be treated further and used as a secondary water source for the city.

Accordingly 15 (Fifteen) major parameters were selected to determine quality of river water.

2.7.1 Review of Results:

Based on sample analysis results, river water quality shows two distinct groups. First group is water having high salinity and second group with low salinity.

Group (A): Waters with high salinity include locations near Mahim creek i.e.

1) Under Mahim Creek bridge
2) Under Western Express highway
3) Bridge near Kalanagar on junction of Bandra Kurla road with Dharavi road.

These samples has very high dissolved solids, chlorides etc. indicating sea water influx.

Group (B) : Waters with low salinity.

This includes all remaining 17 locations, spanning from Bandra Kurla complex to origin of Mithi river at Powai.

Following is the summary of analysis Parameters Group wise.

Group (A) : Waters with high salinity,

	Parameter	Range of values
1.	pH	6.75 to 8.17.
2.	Alkalinity as $CaCO_3$	182 to 325 mg/L
3.	Dissolved oxygen	0 to 2.5 mg/L,
4.	Chlorides	372 to 21238 mg/L
5.	Suspended solids	100 to 191 mg/L
6.	Total dissolved solids	943 to 35252 mg/L
7.	3 days 27^0C BOD	14 to 51 mg/L
8.	C.O.D.	92 to 358 mg/L
9.	Sulfates as SO_4	54 to 4114 mg/L
10.	Phosphates as PO_4	0.23 to 2.9 mg/L.
11.	Hexavalent Chromium (Cr^{6+})	Nil
12.	Copper as Cu	Nil to 0.64 mg/L
13.	Zinc as Zn	0.123 mg/L to 1.2 mg/L
14.	Lead as Pb	0.009 mg/L to 0.249 mg/L.
15.	Phenols	absent

Group (B) : Waters with low salinity.

	Parameter	Range of values	*Inland Surface water standards.
1.	pH	6.9 to 7.25.	5.5 to 9.0
2.	Alkalinity	33 to 278 mg/L	---
3	Dissolved oxygen	Nil to 2.1 mg/L,	---
4.	Chlorides	37 to 212 mg/L.	---
5.	Suspended solids	100 to 1500 mg/L	< 100
6.	Total dissolved solids	48 to 965 mg/L	< 2100
7.	3 days 27^0C BOD	11 to 81 mg/L	< 30
8.	C.O.D.	100 to 512 mg/L	< 250
9.	Sulfates	7 to 55 mg/L	---
10.	Phosphates	0.3 to 1.7 mg/L.	< 5.0
11.	Hexavalent Chromium (Cr^6)	Nil	< 0.1
12.	Copper	Nil to 0.68 mg/L	<3.0
13.	Zinc	0.123 to 2.3 mg/L	< 5.0
14.	Lead	0.009 to 0.249 mg/L.	< 0.1
15.	Phenols	absent	< 1.0

* The Environment (Protection) Rules 1986.

2.8 **Mithi River Quality:** Discussion based on results of chemical analysis.

Parameterwise discussion on water analysis is as follows,

1) pH

There is no significant change in pH as pH varied from 6.7 to 8.1.

This also implies that there was no Alkaline / Acidic discharge at the time of sampling.

2) Dissolved Oxygen:

Dissolved oxygen was present at origin as well as near

Mahim creek. However samples between these locations had very low or Nil Dissolved Oxygen probably due to high organic load contributed by sewage or decomposed garbage.

3) Alkalinity:

The Alkalinity of water ranges between 100 to 300 mg/L indicating presence of fresh water.

4) Chlorides

Chlorides were high for 3 sampling stations near the sea and were as high as 21000 mg/L. However for remaining 17 stations the chloride levels was low in the range of 50 to 400 ppm indicating that sea influx is limited to last 3 stations.

5) Total Dissolved Solids:

Similar to chloride, TDS level was high at last 3 to 4 stations and thereafter TDS level varied between 100 to 500 mg/L. TDS at Bandra Kurla road and Samhita Industrial complex, was noted high probably due to discharge of some chemicals.

6) B.O.D.

BOD values varied significantly wherever Mithi river flows through thickly populated areas like Jarimari area, Vihar Lake overflow, Vakola bridge, Bail Bazar etc.High BOD all along the river course indicates presence of domestic sewage as well as decomposed organic matter in the form of garbage, animal waste etc.

7) C.O.D.

If this parameter is considered as indicator of industrial pollution then COD, BOD, Oil and Grease exceeded tolerance figures at following sampling point locations.

- ✦ Jarimari area on Andheri-Kurla Road
- ✦ Vihar lake overflow,
- ✦ Bandra Kurla road near Wockhardt
- ✦ Taximen's colony
- ✦ CST road, Kalina

This shows presence of industrial activity, either authorized or unauthorized. taking place in these areas.

8) Oil & Grease

The oil & grease levels were very high (more than 10 mg/L) at most of the locations starting from Powai lake overflow to Mahim creek These were observed during low tide sampling of 22nd May 2004 and could be related to industrial activity.

9) Sulphates

Like Chlorides and TDS, sulphate levels were noted high at 3 sampling points at Mahim creek and up-stream. However, other streams had sulphate contents less than 50 mg/L.

10) Phosphates

Possibly because of domestic sewage phosphate occurred between 1 to 2 mg/L.

11) Cyanide

The Cyanide was found at Andheri-Kurla location as well as at Bail bazaar and Jarimari area, though the values were significantly low, it points to industrial activity.

12) Hex. Chromium

No sample showed presence of Hex. Chromium.

13) Copper, Zinc and Lead

Most of samples indicated presence of copper, zinc and lead though the figures are well within the specified limit. However they indicate industrial activity in these areas.

14) Phenols

No sample indicated any Phenols including sample at CST road.

Mithi River is formed due to overflows of Vihar and Powai lakes. Hence it s expected to have very good quality water at least at the origin. However due to direct discharge of sewage from residential colonies around the two lakes this river is polluted right from its source. Vihar lake overflow sample indicated a BOD range of 40 - 600 mg/L and this situation continued down stream over a 15 Km length. As the river flows through thickly populated area cumulative discharge of sewage has converted this river into the biggest combined sewer of Mumbai as it carries storm drain from its catchment area.

Water analysis of Mithi river was done for Physico-Chemical and Biological parameters in order to identify the pollution in the river. As Mithi river passes through an area with lot of industrial activity and high density of population, it was expected to detect typical pollution parameters like Oil and Grease, COD or Heavy Metals etc. where-ever such industrial activities are taking place. Though analysis indicated such heavy metals, their levels were not alarming to call it chemical pollution. This may be due to cumulative discharge of domestic sewage (including animal waste from cow sheds) in the river right from origin at Powai to its meeting Mahim creek. Domestic sewage volume from this area is much more than industrial effluent discharged and hence may offer dilution.

Above comparison clearly indicates that due to high volume of domestic sewage, industrial pollution is not noticeable except some isolated values like lead etc. Considering the inlet surface water standards as stipulated in Environment Rules 1986, Mithi river waters in Group (B) need to be treated for Suspended solids, B.O.D. and C.O.D. removal. Thus the treatment to be provided is only biological in order to achieve standards for all the three parameters.

2.9 Sludge Quality and Quantity : (A discussion)

(Ref. Annexure - III)

Parameters	Remarks
1) pH	pH of the sediments noted were between 6.5 to 8.5
2) Sulphates	Sulphates were high in most of the sludge samples in the range of 1500 to 4000 mg/L
3) Chromium & Cyanide	Cyanide was detected on CST road and Bandra Kurla road sampling stations indicating some industrial activities up-stream.
4) Zinc	Zinc occurred at a few of the stations like CST Road, Vakola Junction, Bandra Kurla Road near Wockhardt Office (where BMC drain meet the river) as well as at Samhita complex.
5) LOI & LOD	In order to establish quality of sludge, "Loss on Ignition" and "Loss on Drying" tests were conducted. The high values for both these tests clearly indicate high presence of organic matter which is degradable upto 72% to 80%.

Sediments at all the 20 points were collected to check their pollution levels. Since the river has substantial quantity of garbage, sediment sample is a mixture of decomposed garbage, sewage sludge and industrial sludge (at some locations). However as explained earlier due to very high load of organic sludge, sediment analysis does not realistically reflect presence of Industrial sludge or its pollution load.

Analysis of sediments for metals, like Hexavalent Chromium(C^{r6}) , Cyanide (CN), Zinc (Zn) etc. does not show significant contribution indicating that the sludge may not have any such Heavy metals. At the same time high values of Loss on Drying (LOD) and Loss on Ignition (LOI) indicate that the river bed is full of organic sludge due to domestic sewage and decomposed garbage.

It is very difficult to estimate sludge volume in the river, since we have not carried any sludge gauging tests. However observed sludge removal operation carried out by Brihan Mumbai Mumnicipal Corporation for their annual storm drain activity and judging from the volume of sludge and garbage removed by them, it may be realized that this is a massive work.

As an approximation, river length is about 15 km and has average width of 10 meters. With average depth of sludge of 1 meter, volume of sludge per meter depth is 150,000 cum or equivalent to 15,000 truck loads.

3.0 MEASURES TO CONTROL POLLUTION OF MITHI RIVER.

Mithi river water is polluted right from its origin at Powai due to discharge of sewage from residential colonies. At various locations our sampling indicated presence of industrial waste due to high values of COD, Oil & Grease, etc. and contribution of industrial waste cannot be ignored. The salient pollution contributing locations noticed during our survey were as follows (Refer map of Mithi River enclosed),

S. No.	Location	Description
1)	Powai Lake Overflow	The Powai lake overflow sampling point is in Ambedkar udyan adjoining Powai road.
2)	Mithi River origin	The location of origin of Mithi river is behind BMC water works office. The river is accessible and is full of hyacinth indicating sewage coming to the river from Vihar lake overflow.
3)	Vihar Lake Overflow	This point is already upstream of Mithi river origin but shows very high values of BOD, Suspended solids etc., indicating discharge of domestic sewage.
4)	Jogeshwari - Vikhroli Link Road	The first point on the down stream of river is surrounded by residential areas. The river at this point is being trailed under the newly constructed Jogeshwari - Vikhroli link road.
5)	Marvel Industrial Estate	The additional discharge to the river may be done to industrial effluent as indicated by COD load as well as oil & grease values.
6)	Andheri-Kurla Road	This is a busy junction and surrounded by residential, industrial estates and other activities. There are few stables in this area which might have given us higher suspended solids and other values.
7)	Behind Samhita Complex Safed Pool.	This spot was surrounded by industrial are which has organized industries with probably small quantity discharge.

8)	Jari Mari after Airport	Jari Mari area has thick residential area and has many small scale industries including scrap dealers. There may be some chemical activity as indicated by consistent high COD and Oil & grease found at this station. We also got one sample indicating presence of Cyanide.
9)	Sarvodaya Nagar (Bail Bazar)	This has high density residential areas which include hutments, stables etc. The discharge indicated high COD, BOD, Suspended solids etc. and indicate provision of local clean-up. We also got a sample indicating presence of Cyanide.
10)	L.B.S. Marg before Airport	This sampling point has maximum industrial activity indicating 40 to 50 Oil Refiners and other recyclers.
11)	Taximen's Colony	Here river has a substantial width and the bed is full of sludge, so that during low tide there is almost no flow. This spot has many residential colonies like Taximen's colony etc.
12)	Down stream under the bridge at Bandra Kurla Road.	The samples collected under the bridge shows unauthorized industrial activities upstream and also at this point river is full of garbage which is removed by BMC as storm drain clean-up operation.
13)	Up-stream under the bridge at Bandra Kurla Road.	The samples collected under the bridge shows unauthorized industrial activities upstream and also at this point river is full of garbage which is removed by BMC as storm drain clean-up operation.
14)	CST Road, Kalina	This sampling point is surrounded by many small scale industries including Recyclers, Barrel cleaners, workshops and other units. This area has thick density of population.

15)	Near Hyatt Hotel	This area is surrounded by properly designed residential complexes and apparently river carries no liquid effluent. The hyacinth grown in the bed is noticeable and water is used by resident for secondary purposes. No industrial activity in this sector.
16)	Bandra Kurla Road to Vakola	This part of the river is a dumping ground for garbage as can be seen from the photograph and it is reflected in higher values of Suspended solids, BOD, COD etc.
17)	Near Worckardt office Bandra Kurla Road	A 2m x 2m RCC drain discharges at this point into the river under the bridge. Due to this discharge the values of all the Parameters like Suspended solids, chlorides COD, BOD etc. shot-up.
18)	Kalanagar Junction	Here river carries with discharges of various colonies, residential area of Dharavi etc. The effluent mixing of river water into sea is noticed at this point.
19)	Western Express Highway	The sample point under the Western Railway track indicated septic sewage by bad stink and at the same time since the sewage is mixed with sea water the odour of effluent increases due to chlorides.
20)	Mahim Creek	This area is surrounded by residential areas of Police colony, Fisherman colony and many slums surrounded the river. The span from Mahim creek to Dharavi has a very thick mangroves and area includes Salim Ali Bird sanctuary.

The Mithi river pollution control needs consideration of the following aspects for clean-up.

1) Domestic sewage due to residential colonies as well as hutments in the thickly populated area.

2) Industrial waste generated by authorized as well as unauthorized industries.

3) Animal waste due to cow sheds in various areas.

4) Garbage dump by citizens all along its course.

5) Industrial sludge and rejects discarded by recyclers at Kalina and CST Road.

The clean-up operation is thus a comprehensive effort by Brihan Mumbai Municipal Corporation, Citizens, Maharashtra Pollution Control Board as well as NGOs, as the complex nature of land use suggests. The steps to be taken to minimize pollution are as follows,

1) Provide sewerage system on both the banks of the river so that the sewage is collected and treated at various locations. This includes existing sewage discharge drains provided by BMC

2) Immediately stop all the unauthorized industries which includes scrap dealers, scrap recyclers, waste oil recyclers etc. These industries contribute industrial waste, hazardous waste as well as sludge.

3) Provide proper garbage collection system on both banks of the river, so that garbage is not dumped in the river.

4) To improve flow pattern, it is essential to clean the bed of Mithi river right from Powai to Mahim. This will improve its carrying capacity.

5) To improve the quality of water, sewage treatment plants are essential at various locations. The analysis report clearly indicates that the water after treatment can be reused in industry or for gardening. Both the banks of Mithi river can be planted with proper vegetation for beautification. In fact this will work as a natural eco-system to improve the quality of water and save cost of providing expensive treatment plants.

6) If the sludge is removed from the bed of Mithi river, it may be possible to use this river for internal navigation purpose, using some barriers down stream, as the width of the river at many places is more than 10 metres.

In conclusion though the cost of clean-up and utilization as detailed above will be astronomical, some step taken in these directions will definitely benefit the city in the long run. These steps include,

(a) Providing sewer lines and sanitation arrangement on both banks of the river.

(b) Proper garbage collection and disposal arrangement

(c) Closure of unauthorized industries in these areas.

Mithi river water is polluted right from its origin at Powai due to discharge of sewage from residential colonies. Hence total length of the river should be considered for any clean up operation. As observed during our survey, properly constructed sewer drains discharge into the river and hence total quantity of river water need be treated to meet Inland surface standards.

Before taking any treatment works in hand it is essential to remove garbage from the river and also prevent practice of garbage disposal in the river. All the unauthorized industrial activities in the Kurla - Kalina area must be stopped which is handling chemicals of unidentified variety. As these industries are scavenger industries-barrel leaning, container cleaning etc they pose a threat to the river environment as they handle any chemicals without knowing their nature or their pollution potential. Similarly unauthorized Oil refiners in Kalina area are hazardous and also add to the water pollution. These industries need be closed immediately.

Thus the pollution control is divided in two parts viz short term measures and long term measures.

3.1 Short Term Measures:

These include following,

(1) Immediate closure of all the unauthorized activities which discharge industrial effluents, sludge, oil and chemicals.

(2) Provide proper garbage collection system to prevent citizens from dumping the same into the river.

3.2 Long Term Measures

Long term measures to minimize pollution in Mithi river include the following,

1. Plan for sewers on both the banks of Mithi river and provide Sewage treatment plants at various locations. Such plants can be provided wherever proper drainage lines exist today.
2. Dredge the entire length of Mithi river bed to improve its carrying capacity.
3. Provide proper garbage collection stations for the benefit of hutment dwellers

4.0 Acknowledgement :

While preparing this report, we received excellent co-operation from Maharashtra Pollution Control Board (MPCB) and we wish to mention the encouragement given by Mr. R. M. Kulkarni, Regional Officer - Mumbai. We were able to complete our report in short time because of specific guidelines given by Dr. D. B. Boralkar, Member Secretary, MPCB, who constantly supported our activity. We also wish to thank Mr. G. N. Mohite, Sub-gional Officer - Mumbai, MPCB for valueable help rendered to complete our assignment.

We wish to acknowledge the valueable suggestions made by Dr. A. D. Patwardhan, who is a well-known consultant in Environmental Engineering field. We wish to thank them all for their help in making this report possible in short time.

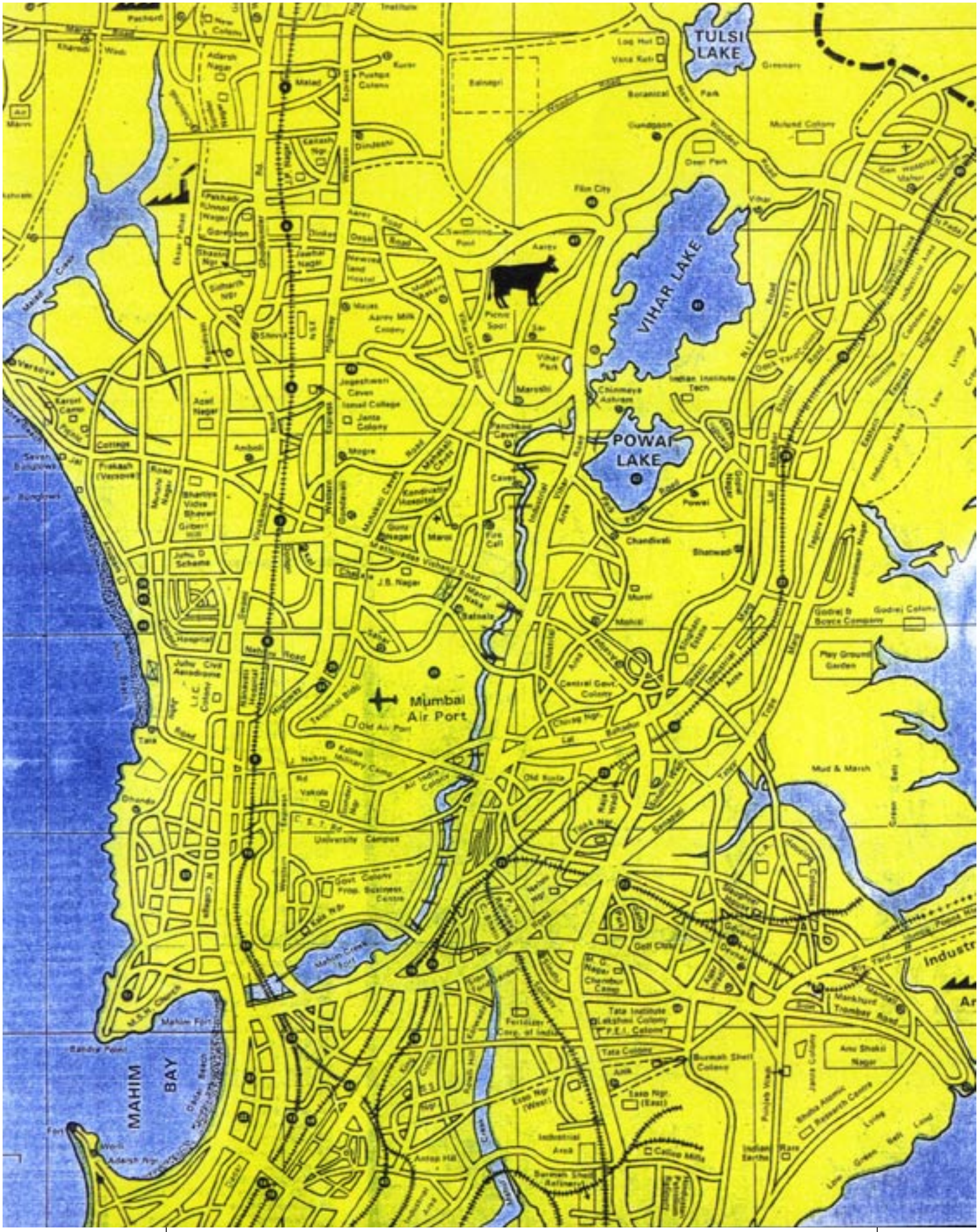
FOR KLEAN ENVIRONMENTAL CONSULTANTS PVT. LTD.,

V. W. KALE

MANAGING DIRECTOR

ANNEXURE - I

MITHI RIVER MAP


TULSI LAKE
VIHAR LAKE
POWAI LAKE
Mumbai Air Port
MAHIM BAY

ANNEXURE - II

WATER SAMPLE ANALYSIS

ANALYSIS REPORT

Name of the client : MPCB
Nature of the sample : Mith River Water
No. of sample : Twenty
Date Of Collection : 18.05.2004
Report No. : KL/W/0405/42

Parameter / Name of sample	pH	D.O	Alka-linity	Chlo-rides	SS	TDS	B.O.D	C.O.D.	O & G	Sulp-hates	Phosp-hates	Cya-nide	Hex. Chr.	Copp-er	Zinc	Lead	Phenol
Mahim creek	7.47	0.4	216	15867	100	26263	18	128	2	158	0.82	Nil	Nil	Nil	0.312	0.167	Nil
West Exp. Highway	7.31	1.9	188	21238	150	35252	16	293	Nil	2202	2.9	Nil	Nil	0.08	0.505	0.24	Nil
Kalanagar Jn.	7.21	2.5	182	19168	152	34050	14	244	1	4114	2.4	Nil	Nil	Nil	0.293	0.249	Nil
Near Wokhardt Office	7.37	1	237	374	116	995	135	118	Nil	61	2.1	Nil	Nil	Nil	0.123	0.025	Nil
BK rd to Vakola	7.07	3.9	135	136	103	463	37	143	7	56	1.5	Nil	Nil	Nil	0.124	0.022	Nil
Near Hyatt Hotel	7.07	1.6	124	61	123	365	45	138	Nil	57	1.5	Nil	Nil	0.24	0.158	0.003	Nil
CST Rd. Kalina	6.79	1.1	140	81	149	155	13	143	8	82	1	Nil	Nil	0.28	0.224	0.034	Nil
U/S Bridge on BK Rd.	7.1	Nil	164	91	135	431	30	101	Nil	84	0.86	Nil	Nil	0.32	0.251	0.036	Nil
D/S Bridge on BK Rd.	7.01	2.3	176	96	147	428	34	109	2	92	1.5	Nil	Nil	0.44	0.319	0.031	Nil
Taxi mens colony	7.1	3.8	274	186	112	615	39	141	6	90	2.4	Nil	Nil	0.04	0.241	0.047	Nil
LBS Rd. to Airport	7.01	0.8	190	96	152	550	11	130	Nil	75	1.7	Nil	Nil	0.28	0.36	0.081	Nil
Sarvodayanagar Bail Bazar	7.05	Nil	195	106	264	427	29	240	6	83	2.2	Nil	Nil	0.8	0.685	0.097	Nil
Jari Mari area (after airport)	7.27	Nil	43.2	119	1510	470	290	1248	37	11	1.2	Nil	Nil	8	2.347	0.143	Nil
Behind Samhita complex	7.18	Nil	223	88	144	442	24	128	3	57	0.79	Nil	Nil	0.36	0.568	0.057	Nil
Andheri Kurla Rd.	7.21	Nil	232	88	241	442	21	288	13	51	2.4	Nil	Nil	0.84	0.55	0.089	Nil
Marvel Ind.Estate	7.21	Nil	225	81	223	230	36	244	23	57	0.652	Nil	Nil	0.44	0.894	0.075	Nil
Jogeshwari-Vikhroli Link Rd.	7.11	1.8	166	68	80	398	21	98	16	57	1.7	Nil	Nil	0.08	0.13	Nil	Nil
Vihar Lake overflow	7.04	Nil	33	73	710	188	149	781	28	28	1.2	Nil	Nil	1.8	0.367	0.007	Nil
Mithi River origin	7	Nil	50	73	480	198	96	366	35	12	0.82	Nil	Nil	0.88	0.353	0.065	Nil
Powai Lake overflow	7.14	3.5	137	45	12	238	2	49	21	7	0.32	Nil	Nil	0.16	0.074	0.016	Nil

(All values except pH are expressed in mg/L.)

ANALYSIS REPORT

Name of the client : MPCB
Nature of the sample : Mith River Water
No. of sample : Eighteen
Date Of Collection : 22.05.2004
Report No. : KL/W/0405/49

Parameter / Name of sample	pH	D.O	Alka-linity	Chlo-rides	SS	TDS	B.O.D	C.O.D.	O & G	Sulp-hates	Phosp-hates	Cya-nide	Hex. Chr.	Copp-er	Zinc	Lead	Phenol
Mahim creek	7.41	0.7	251	1879	191	4023	25	128	5	242	0.82	Nil	Nil	0.08	0.481	0.055	Nil
West Exp. Highway	7.4	0.7	325	1898	177	3858	33	92	2	219	0.14	Nil	Nil	0.04	1.247	0.02	Nil
Kalanagar Jn.	7.17	Nil	285	1115	133	2265	34	102	12	73	0.37	Nil	Nil	Nil	0.428	0.009	Nil
Near Wokhardt Office	7.37	Nil	415	680	1510	1638	8.2	410	14	27	0.45	Nil	Nil	3.52	1.476	0.091	Nil
BK rd to Vakola	7.13	0.5	240	213	74	633	68	179	Nil	37	1.3	Nil	Nil	Nil	0.178	0.031	Nil
Near Hyatt Hotel	7.1	Nil	258	72	141	362	89	159	20	26	1.2	Nil	Nil	0.08	0.29	0.024	Nil
CST Rd. Kalina	6.89	Nil	251	125	261	477	88	184	16	51	0.79	Nil	Nil	0.72	0.845	0.093	Nil
U/S Bridge on BK Rd.	7.05	Nil	524	249	940	685	81	532	19	13	0.5	Nil	Nil	2.64	2.431	0.377	Nil
D/S Bridge on BK Rd.	Sample not available																
Taxi mens colony	7.08	Nil	221	111	165	447	63	148	7	13	1.4	Nil	Nil	0.28	0.987	0.057	Nil
LBS Rd. to Airport	7.14	Nil	261	105	184	400	82	154	15	25	2.1	Nil	Nil	0.48	0.356	0.033	Nil
Sarvodayanagar Bail Bazar	7.21	0.8	248	143	251	472	96	179	10	34	2.4	0.01	Nil	0.92	1.413	0.164	Nil
Jari Mari area (after airport)	7.34	1.6	239	104	87	435	38	133	10	22	2.5	0.01	Nil	0.16	0.34	0.065	Nil
Behind Samhita complex	7.5	1.5	259	94	74	437	56	250	9	66	1.9	Nil	Nil	0.08	0.227	0.038	Nil
Andheri Kurla Rd.	7.01	Nil	237	92	77	287	55	117	11	26	2.8	Nil	Nil	0.16	0.312	0.014	Nil
Marvel Ind.Estate	6.94	0.7	177	57	32	262	16	107	17	16	1.6	Nil	Nil	Nil	0.08	0.047	Nil
Jogeshwari-Vikhroli Link Rd.	6.96	Nil	114	29	99	142	11	128	13	15	1	Nil	Nil	0.04	1.951	0.056	Nil
Vihar Lake overflow	6.89	2	105	27	83	142	14	87	15	14	0.56	Nil	Nil	0.04	0.159	0.032	Nil
Mithi River origin	7.07	0.5	154	52	9	267	7	56	7	1	0.62	Nil	Nil	Nil	0.08	0.006	Nil
Powai Lake overflow	Sample not available																

(All values except pH are expressed in mg/L.)

ANALYSIS REPORT

Name of the client : MPCB
Nature of the sample : Mith River Water
No. of sample : Twenty
Date Of Collection : 26.05.2004
Report No. : KL/W/0405/62

Parameter / Name of sample	pH	D.O	Alka-linity	Chlo-rides	SS	TDS	B.O.D	C.O.D.	O & G	Sulp-hates	Phosp-hates	Cya-nide	Hex. Chr.	Copp-er	Zinc	Lead	Phenol
Mahim creek	7.27	Nil	296	602	177	1507	50	131	12	68	0.64	Nil	Nil	0.2	0.316	0.028	Nil
West Exp. Highway	7.14	Nil	265	372	93	934	51	116	2	49	1	Nil	Nil	Nil	0.17	0.04	Nil
Kalanagar Jn.	7.3	Nil	311	421	181	1105	47	106	4	54	1.3	Nil	Nil	0.64	0.116	0.009	Nil
Near Wokhardt Office	7.15	Nil	261	264	284	468	92	339	14	31	0.66	Nil	Nil	5.68	0.273	0.036	Nil
BK rd to Vakola	7.15	1.5	210	55	140	335	69	135	8	32	1.4	Nil	Nil	0.12	0.173	0.029	Nil
Near Hyatt Hotel	7.03	0.5	223	55	132	342	70	339	17	28	1.4	Nil	Nil	0.12	0.133	0.012	Nil
CST Rd. Kalina	7.01	Nil	247	92	194	415	39	205	7	30	1.4	Nil	Nil	0.4	0.434	0.056	Nil
U/S Bridge on BK Rd.	Sample not available																
D/S Bridge on BK Rd.	7.03	Nil	245	90	262	330	35	133	22	29	1	Nil	Nil	0.6	0.589	0.0122	Nil
Taxi mens colony	7.07	Nil	278	184	382	617	61	461	23	38	0.98	Nil	Nil	1.36	0.956	0.18	Nil
LBS Rd. to Airport	7.27	Nil	265	102	127	465	31	143	16	25	1.1	Nil	Nil	Nil	0.246	0.052	Nil
Sarvodayanagar Bail Bazar	7.01	Nil	248	90	194	795	51	154	8	30	0.81	Nil	Nil	Nil	0.53	0.1	Nil
Jari Mari area (after airport)	7.1	Nil	267	106	299	455	86	358	20	2	0.99	Nil	Nil	0.44	0.835	0.129	Nil
Behind Samhita complex	7.1	Nil	252	86	70	868	220	133	8	17	0.93	Nil	Nil	0.12	0.464	0.03	Nil
Andheri Kurla Rd.	7.21	Nil	241	78	62	546	13	92	7	17	1	Nil	Nil	Nil	0.165	0.37	Nil
Marvel Ind.Estate	Sample not available																
Jogeshwari-Vikhroli Link Rd.	7	0.4	180	37	49	290	13	97	Nil	24	0.13	Nil	Nil	Nil	0.81	0.023	Nil
Vihar Lake overflow	6.93	Nil	269	61	821	275	212	683	40	10	0.35	Nil	Nil	Nil	0.429	0.133	Nil
Mithi River origin	7.09	Nil	199	41	164	355	45	143	7	50	0.47	Nil	Nil	Nil	0.096	0.015	Nil
Powai Lake overflow	7.37	3.1	145	37	48	257	18	36	5	6	0.1	Nil	Nil	Nil	0.103	Nil	Nil

(All values except pH are expressed in mg/L.)

ANALYSIS REPORT

Name of the client : MPCB
Nature of the sample : Mith River Water
No. of sample : Twenty
Date of Collection : 29.05.2004
Report No. : KL/W/0405/63

Parameter / Name of sample	pH	D.O	Alka-linity	Chlo-rides	SS	TDS	B.O.D	C.O.D.	O & G	Sulp-hates	Phosp-hates	Cya-nide	Hex. Chr.	Copp-er	Zinc	Lead	Phenol
Mahim creek	7.14	0.6	245	10,127	101	15085	29	128	17	845	0.23	Nil	Nil	0.28	0.298	0.117	Nil
West Exp. Highway	7.23	0.7	256	5968	95	7450	25	118	7	410	0.32	Nil	Nil	Nil	0.216	0.086	Nil
Kalanagar Jn.	7.31	3	315	2348	500	2825	46	358	11	125	0.28	Nil	Nil	0.52	0.358	0.069	Nil
Near Wokhardt Office	7.21	Nil	315	240	445	422	98	307	11	22	0.3	Nil	Nil	Nil	0.561	0.068	Nil
BK rd to Vakola	7.12	Nil	247	92	108	340	64	143	10	45	1.1	Nil	Nil	Nil	0.224	0.021	Nil
Near Hyatt Hotel	7.06	1	247	76	117	338	77	148	21	16	1.5	Nil	Nil	Nil	0.191	0.049	Nil
CST Rd. Kalina	6.97	Nil	236	115	238	465	97	293	5	32	0.252	Nil	Nil	0.24	0.624	0.113	Nil
U/S Bridge on BK Rd.	8.17	2.1	310	299	119	897	73	154	10	55	1.68	Nil	Nil	0.72	0.493	0.077	Nil
D/S Bridge on BK Rd.*	7	Nil	239	115	244	512	88	205	19	45	0.61	Nil	Nil	Nil	0.699	0.102	Nil
Taxi mens colony	7.14	Nil	289	219	708	630	126	512	17	25	0.55	Nil	Nil	4.7	1.296	0.196	Nil
LBS Rd. to Airport	7.16	Nil	251	109	206	469	62	225	5	25	1.7	Nil	Nil	0.68	0.447	0.042	Nil
Sarvodayanagar Bail Bazar	7.27	Nil	281	108	151	482	81	147	6	22	0.43	Nil	Nil	0.2	0.381	0.076	Nil
Jari Mari area (after airport)	7.12	Nil	289	181	240	518	172	350	16	20	1.1	Nil	Nil	0.16	0.664	0.129	Nil
Behind Samhita complex	7.15	Nil	251	98	123	287	44	128	5	18	2	Nil	Nil	0.08	0.278	0.006	Nil
Andheri Kurla Rd.	7.2	1.6	234	102	68	430	45	81	2	23	0.252	0.048	Nil	Nil	0.313	0.01	Nil
Marvel Ind.Estate	6.99	Nil	230	96	77	422	60	108	12	18	0.532	Nil	Nil	0.6	0.368	0.024	Nil
Jogeshwari-Vikhroli Link Rd.	7.01	1.2	156	63	32	256	11	61	Nil	21	1.7	Nil	Nil	Nil	0.104	0.017	Nil
Vihar Lake overflow	7.11	1	106	35	65	176	17	107	6	13	0.81	Nil	Nil	Nil	0.115	0.024	Nil
Mithi River origin	6.97	2.9	91	33	90	142	15	97	6	7	1.62	Nil	Nil	Nil	0.146	0.025	Nil
Powai Lake overflow	7.21	3.6	144	61	30	246	8	66	Nil	6	0.79	Nil	Nil	Nil	0.034	0.027	Nil

(All values except pH are expressed in mg/L.)

ANNEXURE - III

SLUDGE SAMPLE ANALYSIS

ANALYSIS REPORT

Name of the client : MPCB
Nature of the sample : Mith River Sludge
No. of sample : Fifteen
Date of Collection : 22.05.2004
Report No. : KL/W/0405/50

Parameter → / Name of sample ↓	pH	Sulphate as SO4--	Chloride as Cl -	Chromium as Cr+6	Cyanide as CN -	Zinc	LOD @ 105oC (%)	LOI @ 550oC (%)
Mahim creek	7.97	8918	10124	Nil	Nil	Nil	52.08	59.05
West Exp. Highway	8.09	3830	6653	Nil	Nil	Nil	52.49	59.75
Kalanagar Jn.	7.67	5338	15910	Nil	Nil	Nil	63.62	71.24
Near Wokhardt Office	8.17	1835	15090	Nil	Nil	3.1	81.45	86.7
BK rd to Vakola	7.74	1012	1977	Nil	Nil	4.4	87.18	93.8
Near Hyatt Hotel	7.58	3289	193	Nil	Nil	Nil	40.56	45.85
CST Rd. Kalina	6.27	3008	366	Nil	Nil	4.1	67.22	80.84
U/S Bridge on BK Rd.	8.21	1289	2661	Nil	Nil	3	31.71	40.54
D/S Bridge on BK Rd.*	Sample not available							
Taxi mens colony	1.81	35390	915	Nil	Nil	4	40.54	88.25
LBS Rd. to Airport	6.47	2919	274	Nil	Nil	Nil	66.29	73.94
Sarvodayanagar Bail Bazar	Sample not available							
Jari Mari area (after airport)	7.61	926	274	Nil	Nil	Nil	48.95	55.63
Behind Samhita complex	Sample not available							
Andheri Kurla Rd.	7.71	861	434	Nil	Nil	1.4	82.53	89.39
Marvel Ind.Estate	8.07	400	183	Nil	Nil	Nil	32.34	37.59
Jogeshwari-Vikhroli Link Rd.	7.91	502	165	Nil	Nil	Nil	58.85	64.68

Note : 1) All values except LOD & LOI expressed in mg/kg
2) LOD & LOI are expressed as Percentage

ANALYSIS REPORT

Name of the client : MPCB
Nature of the sample : Mith River Sludge
No. of sample : Fifteen
Date of Collection : 29.05.2004
Report No. : KL/W/0405/64

Parameter → / Name of sample ↓	pH	Sulphate as SO4--	Chloride as Cl -	Chromium as Cr+6	Cyanide as CN -	Zinc	LOD @ 105oC (%)	LOI @ 550oC (%)
Mahim creek	8.48	2153	8048	Nil	Nil	Nil	71.49	77.23
West Exp. Highway	8.31	3996	8323	Nil	Nil	Nil	66.25	74.29
Kalanagar Jn.	7.87	8622	16371	Nil	Nil	4.02	65.54	73.5
Near Wokhardt Office	8.1	3193	5213	Nil	Nil	Nil	80.11	85.57
BK rd to Vakola	7.32	3654	1445	Nil	Nil	Nil	82.01	90.88
Near Hyatt Hotel	7.73	1947	366	Nil	Nil	Nil	78.46	83.9
CST Rd. Kalina	8.2	1212	2835	Nil	0.17	0.27	36.07	46.56
U/S Bridge on BK Rd.	7.21	3498	2912	Nil	0.078	3.13	55.06	66.57
D/S Bridge on BK Rd.*	Sample not available							
Taxi mens colony	7.36	4177	429	Nil	Nil	Nil	63.87	75.18
LBS Rd. to Airport	7.07	1804	322	Nil	Nil	Nil	71.9	84.63
Sarvodayanagar Bail Bazar	8.51	408	161	Nil	Nil	1.35	34.21	38.51
Jari Mari area (after airport)	Sample not available							
Behind Samhita complex	7.57	2692	268	Nil	Nil	3.72	52.8	57.91
Andheri Kurla Rd.	7.81	1917	536	Nil	Nil	Nil	77.85	85.69
Marvel Ind.Estate	6.71	7052	304	Nil	Nil	Nil	69.47	80.93
Jogeshwari-Vikhroli Link Rd.	Sample not available							
Vihar Origin-Water Dept. BMC Gate	7.11	471	143	Nil	Nil	Nil	48.7	54.38

Note : 1) All values except LOD & LOI expressed in mg/kg
2) LOD & LOI are expressed as Percentage

ANNEXURE - IV

PHOTOGRAPHS AT MAJOR LOCATIONS ALONG MITHI RIVER

Annex - IV

PHOTOS OF SAMPLING POINTS IN MITHI RIVER.

Sr. No.	Description
01	Mahim Bay, before Mithi river meets sea.
02	Under Western Express highway showing septic nature of Mithi River by it's black colour
03	Mahim Creek from Dharavi side
04	Mangrove at Mahim creek
05	Kalanagar Junction showing mangroves of "Salim Ali Bird Sanctuary"
06	Sewer outlet near Wockhardt office
07	Bridge after taking left turn from HP Petrol Pump - Note the width of river.
08	Vokala Pipeline near Hyatt Hotel - Buffaloes enjoying swim.
09	CST Road, Kalina - This is highly polluted area and a heaven for recyclers.
10	Mithi River near Airport - I
11	Mithi River near Airport - II
12	Oil Industry at Old Airport Road
13	Oil Industry at Old Airport Road -1
14	Unauthorized oil refineries at Old Airport Road
15	Samhita Complex, Andheri Kurla Road, Safed Pool - Note growth of Hyacinth and other vegetation.
16	Vikhroli - Jogeshwari Link Road - River is reconstructed under new road.
17	Saki-Vihar Cross Road, Opp. Marve Industrial Estate - Indicating dumping of scrap materials and growth of vegetation.
18	Powai Lake Overflow near Ambedkar Garden.

1. Mahim Bay, before Mithi river meets sea.

2. Under Western Express highway showing septic nature of Mithi River by it's black colour

03 Mahim Creek from Dharavi side

04 Mangrove at Mahim creek

05 Kalanagar Junction showing mangroves of "Salim Ali Bird Sanctuary"

06 Sewer outlet near Wockhardt office

07 Bridge after taking left turn from HP Petrol Pump - Note the width of river.

08 Vokala Pipeline near Hyatt Hotel - Buffaloes enjoying swim.

09 CST Road, Kalina - This is a highly polluted area and a heaven for recyclers.

10 Mithi River near Airport - I

11 Mithi River near Airport - II

12 Oil Industry at Old Airport Road

13 Oil Industry at Old Airport Road -1

14 Unauthorized oil refineries at Old Airport Road

15 Samhita Complex, Andheri Kurla Road, Safed Pool - Note growth of Hyacinth and other vegetation.

16 Vikhroli - Jogeshwari Link Road - River is reconstructed under new road.

17 Saki-Vihar Cross Road, Opp. Marve Industrial Estate - Indicating dumping of scrap materials and growth of vegetation.

18 Powai Lake Overflow near Ambedkar Garden.