REPORT OF THE EXPERT COMMITTEE SUBMITTED IN COMPLIANCE TO HON'BLE SUPREME COURT OF INDIA, NEW DELHI, ORDERS

CIVIL APPEAL NO. (s) : 10463-10464/2016

MUMBAI METROPOLITAN REGION DEVELOPMENT AUTHORITY Apellant(s)

VERSUS

JALBIRADARI & ORS. Respondent (s)

With

C.A. No. 6064-6065/2017

AS PER ORDERS DATED 16.08.2017 OF HON'BLE SUPREME COURT OF INDIA

13 MARCH, 2018

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Abbreviations

BKC	*Bandra-Kurla Complex*
BOD	*Bio-chemical Oxygen Demand*
COD	*Chemical Oxygen Demand*
CWPRS	*Central Water and Power Research Station*
FFC	*Fact Finding Committe*
FSL	*Full Supply Level*
HTL	*High Tide Level*
IIT B	*Indian Institute of Technology, Bombay*
LULC	*Land Use and Land Cover*
MCGM	*Municipal Corporation of Greater Mumbai*
MIAL	*Mumbai International Airports Limited.*
MMRDA	*Mumbai Metropolitan Region Development Authority*
MPCB	*Maharashtra Pollution Control Board*
MRDPA	*Mithi River Development and Protection Authority*
MSL	*Mean Sea level*
NDZ	*No Development Zone*
NEERI	*National Environmental Engineering Research Institute*
PAP	*Project Affected People*
PIL	*Public Interest Litigation*
R & R	*Relocation and Rehabilitation*
RCC	*Reinforced Cement Concrete*
SEIAA	*State Environment Impact Assessment Authority*
STP	*Sewage Treatment Plants*

Executive Summary

Mumbai, being an island city, most of the part of the city is having low altitude above mean sea level (MSL).Therefore when high intensity of rainfall coincides with high tide, flooding takes place in low lying areas. The suburban part of the city experienced very heavy rains on 26th July 2005 with a record of 944 mm of rainfall in 24 hours with highest rainfall intensity of 190.3 mm in one hour between 15.30 to 16.30 hrs. coinciding with the highest tide of 4.48 m. During this event, severe flooding had taken place in all catchments of suburban rivers and deluge in the catchment of Mithi river was tremendous and thus this river received attention of the entire nation. The deluge resulted in tremendous loss of human and animal lives, and huge economic losses. After this deluge, Govt. of Maharashtra, MMRDA and MCGM appointed number of Expert Committees to understand the causes of flooding and the remedial measures to mitigate it. Various committees post deluge of July 2005 gave several recommendations as mitigating measure for flood control and abatement of pollution.

Hon'ble Supreme Court vide their order dated 16th August 2017, with reference to Civil Appeal NOS 10463-10464 of 2016 and 6064-65 of 2017 (Appeal NOS 7 of 2015 and 8 of 2013), had directed to form a joint team by the Director of IIT, Bombay as well as the Director of National Environmental Engineering Research Institute (NEERI), Nagpur, to look into the matter of flooding and pollution in Mithi River catchment; the steps taken by the State of Maharashtra and authorities under the state government to eliminate the pollution and ensure that an unfortunate tragedy does not recur. Mr. Satish Gavai, Additional Chief Secretary in the department of Environment of the Government of Maharashtra (GoM) and the Secretary of the SEIAA is the Convenor of the committee. Accordingly, The Director of IIT Bombay nominated the expert professors in this field as the member of the committee and also Director NEERI alongwith the expert scientist constituted the team from NEERI and thus a joint team was formed. Further, as per Supreme Court directive, two Civil Society Members were nominated via order dated 29/11/2017 for commenting on report prepared by IITB-NEERI and committee did not

received any comments on report but additional Eco-rejuvenation plan was suggested which according to IITB & NEERI needs more study. The main scope of the committee is to prepare a factual report on what has transpired so far, what is the extent of the damage caused to Mithi river, what steps can be taken to remedy the damage and the short term and long term future course of action to be followed.

Total length of Mithi River is about 17.84 km, out of which 8.23 km downstream part is influenced by the tidal effect of Mahim creek. Upper reach of the river, from Vihar Lake to Andhei-Kurla road has very steep gradient whereas downstream part from Andheri-Kurla road to Mahim causeway there is a flat gradient. As the upper stretches of river are comparatively steeper than that of lower stretches there is a sudden discharge of water in downstream part of the river. Thus downstream catchment of the river is prone to floods. Apart from overflow of two lakes, also 13 major nallas/outfalls discharge their flow into the Mithi River system. At present, what can be seen is encroachment along the banks of the river, no proper effluent and sewage capture and its treatment, continuous dumping of solid waste in the river system which has exacerbated the pollution levels tremendously.

For carrying out various works of the Mithi River and Vakola Nalla (Tributary), administratively for planning as well as for execution of works, these lengths are divided within the authorities MCGM, MMRDA and MIAL (inside airport only) by Gov. of Maharashtra. The MRDPA is the overall coordinating agency between the implementing agencies of MCGM, MMRDA and MIAL. The MPCB is the statutory body related to the pollution issues. The works with respect to project implementation, land acquisition, Rehabilitation of Project affected persons, and others are to be carried out by respective implementing authorities, in their respective jurisdiction.

As per Hon'ble Supreme Court dated 16th Aug, 2017 for further actions.,first review meeting under the chairmanship of Additional Chief secretary, Environment Department, GoM was held on 13th September 2017 and second meeting was held on 22nd September 2017 in presence of the committee members and concerned staff of MRDPA, MMRDA, MCGM and MPCB. In these meetings, the concerned agencies were directed to submit the details of the flooding, action taken till date and also the report on action taken on

various recommendations suggested by various committees through their reports. They were also requested to submit soft copy of the reports of various committees and also the synopsis of work done so far to mitigate flooding and control of pollution in Mithi River system. The meeting was also held with the representatives of Jalbiradari and Vanashakti foundations on 22nd and 23rd October, 2017 respectively to understand their views on the said matter. The main issue raised by various NGOs and other agencies was on the "constructed retaining wall" on both sides of Mithi River by MCGM and MMRDA and forest areas like Aarey has walls construction on both sides thus preventing the interaction of river in the forest itself. The Committee during field visit inspected the entire stretch of Mithi River on 10th November 2017 and saw the nature of the retaining walls already constructed and understanding its impacts on the River Ecology, flooding issues and environmental problems. For more reporting of status quo again a meeting of all concerned agencies was held on 8th December 2017 at IIT Bombay and the government officials were asked to clarify the status of suggested and implemented recommendations of previous studies for mitigating the floods and pollution of river.

Further, to ascertain the present status of the pollution of the Mithi River system, water samples were collected from the river and testing was done for various parameters to ascertain the water quality. It was found that the pollution level in Mithi River has increased as compared to 2015 study done by IIT-NEERI. Lack of proper sewerage network along the banks of the river as well as absence of STPs to treat the effluent entering into the river system are the major reasons of pollution.

The studies done post 2005 for Mithi river, total 10 reports provided by the government officials to the committee were studied to prepare the list /questionnaire for status of compliance or non-compliance. The list was sent to respective authorities for their remarks on the status of recommendations. As per the reports received from MCGM, MMRDA and MRDPA authorities, the report on action taken so far on the recommendations of various committees by these agencies and also impact on the Mithi River system has been prepared on major points such as widening and deepening work, desilting work, encroachment removal, construction of retaining wall, construction of service roads, sewer line laying works, construction of STP works, ecological

conservation work, beautification works, and widening of bridges and setting up of disaster management cell.

The Committee assessed various issues as per directives of the Honb'le Supreme Court and classified various issues into following seven categories and studied the major aspects and provided recommendations.

- Construction of Retaining Walls
- Flood Related Issues
- Environmental Pollution Issues
- River Rejuvenation Issues
- Encroachment Related Issues
- Administration and Coordination Issues
- Social Issues

The major problem of flooding is due to reclamation of land (620 ha) for Bandra-Kurla Complex and due to the bottleneck forming at the confluence of the non- widened bridges at the downstream side of the Mithi River system. Therefore, widening of bridges as per various previous committees suggested widths near the confluence is of utmost importance. Along with setting up of sewage treatment facility as suggested by IIT, NEERI and MPCB in its report is the need of hour. Therefore, to maintain the status of river the present committee proposed the recommendations suitable for riverine hydrology and the modifications in the existing constructed retaining wall. To mitigate avoid future flooding and abatement of as pollution in Mithi River system, Committee also suggests various "Short Term measures" and "Long Term Measures" for addressing all issues mentioned above.

After studying of the earlier committee's reports, recent site visits, interaction with authority staff and NGO's, data received from the authorities about the work done so far and for future plans, the detailed short term and Long term measures are suggested. Committee's some major recommendations in the order of priority are listed below.

1. Provision immediately of a minimum 15mts on both sides of the rivers as buffer zone, along with a 50 mts NDZ reservation on both sides, which will act floodplains during the rains.

2. For the upper reaches, a review of walls should be undertaken with a view to change its configuration height, flood plain connection structure etc. so that natural settings of river hydrology is maintained. For the middle reaches, after airport and upto CST bridge, wherever possible, the constructed retaining walls may be modified with flood plains and service roads on both sides. On the lower reaches, upto Mahim causeway, the present retaining walls may be retained. However, wherever possible, flood plains may be provided with service roads on both sides.

3.Widening of all bridges along the Mithi River system

4.Installation of proper garbage collection system on both banks of Mithi River.

5.Provision of sewerage system on both sides of the banks of the Mithi River so that no sewage can enter into the river system.

6.Setup of decentralized sewage treatment plants (STP) on both sides at various locations. as suggested in this report and also in previous report of MPCB

7.The entry of river mouth at Mahim bay to be widened by removing the obstruction protruding rocks extending towards mouth of river to improve the easy flow of water to sea.

8.Development of a flood warning system to intimate public about any kind of floods during monsoon season. Making website which should have information of flood plains, flood hazard, vulnerability and flood risk maps and can be accessed by citizens.

9.In the catchment of Mithi River, the low lying areas which are presently acting as a natural detention or retention ponds should be earmarked as sustainable flood control ponds in revised Development Plan.

10. Appropriate rehabilitation and resettlements should be provided for the people affected while removing the encroachments from both sides of the Mithi river.

11. Formation of a single authority/ council under MCGM or MMRDA or directly under Maharashtra Govt. to deal with all problems of flooding, environmental pollution, encroachment etc. For better coordination, the Chiefs of MCGM, MMRDA, MIAL etc. should be members of the authority/ council.

This report is based on the study of the various committee reports appointed after the deluge of 26th July 2005, interaction with MMRDA and MCGM officials, meeting with NGOs and other parties and observation and assessment made during the site visits and afterwards.

The committee constituted as per directives of Hon'ble Supreme Court vide their order dated 23rd August 2017, with reference to Civil Appeal NOS 10463-10464 of 2016 and 6064-65 of 2017 (Appeal NOS 7 of 2015 and 8 of 2013) and addition of Civil Society members dated 29th November 2017 for comments on report by IITB and NEERI. Director NEERI and Director IIT B nominated the experts for the preparation of report on the order passed. The civil society members later approved by Hon'ble Supreme Court via order dated 29th November 2017.

(Dr. Rakesh Kumar)	(Dr. Indrani Gupta)	(Dr. Shalini Tandon)	(Mrs. Sunayana)
Director, NEERI-Nagpur.	Principal Scientist, NEERI- Mumbai Zonal Centre	Scientist, NEERI-Mumbai Zonal Centre	Scientist, NEERI-Mumbai Zonal Centre

(Prof. Sanjeev Chaudhari)	(Prof. T.I. Eldho)	(Prof. A.B. Inamdar)
IIT Bombay	IIT Bombay	IIT Bombay

(Dr. A.D. Sawant)	(Mr. P.K.Das)
Civil Society Member	Civil Society Member

CHAPTER 1

INTRODUCTION

1.1.Preamble

Mumbai, being an island city, most of the part of the city is having low altitude above mean sea level (MSL) therefore, when high intensity of rainfall coincides with high tide, flooding takes place in low lying areas. Mumbai city consists of four rivers viz. Mithi, Poisar, Oshiwara, and Dahisar and three major lakes namely Vihar, Tulsi and Powai. These all rivers discharge their flow in Arabian Sea through creeks and thus are influenced by tidal effects. Out of these four rivers, Mithi River is the main, important and largest river with respect to catchment area. Its watershed extends between Latitudes 19^0 0' 15"N and 19^0 15' 0" N as well as Longitudes 72^0 45' 0" E and 73^0 0'0" E. River originates from the overflow of the Vihar lake at an altitude of 246 m and overflow of Powai lake joins subsequently to the river. Catchment area of the Mithi River is 7295 ha and total length of the river is 17.84 kms. Out of the total length, upstream 11.84 km length is under jurisdiction of Municipal Corporation of Grater Mumbai (MCGM) and downstream 6.0 km length under jurisdiction of Mumbai Metropolitan Regional Development Authority (MMRDA).

Mithi River traverses through Powai, Marol, Sakinaka, Andheri and then runs below the runway of international airport and then meanders through Bandra-Kurla complex and finally discharges its flow to Arabian sea through Mahim Creek (Fig.1.1). Along the total length of the river, there are total 15 bridges. Mithi River has one major tributary called Vakola nalla towards downstream of the catchment having length of 3.8 km and catchment area of 907 ha. Out of the total length of 3.8 km, 1.8 km is in MMRDA jurisdiction and balance 2.0 km is in MCGM jurisdiction. A total of 13 major nallas are discharging their flow into the Mithi River. The river has four distinct reaches with different bed gradients as shown in Figure 1.1. Upstream part of the Mithi River contains very little volume during the dry season and hence has been referred as a seasonal river.

MITHI BASIN:

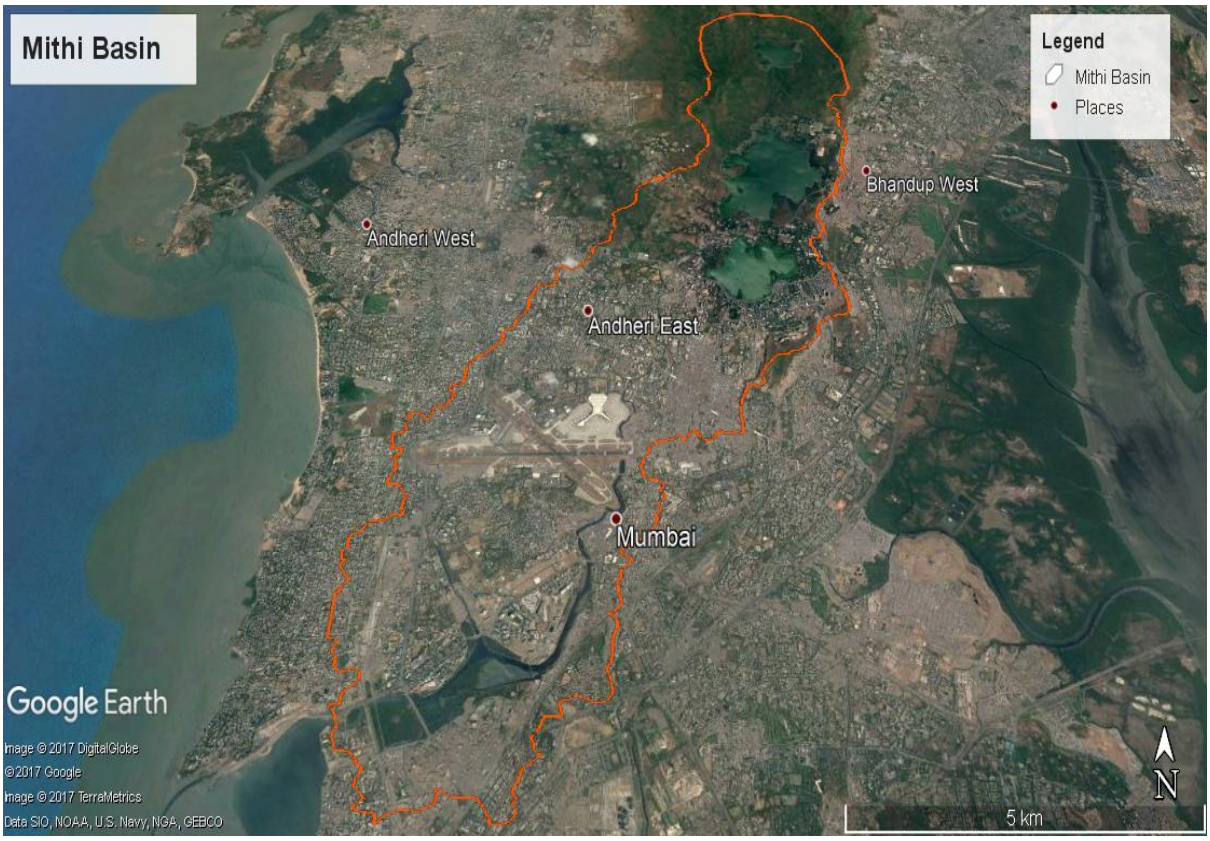


Fig. 1.1. Mithi River Catchment

Total length of Mithi River is about 17.84 km, out of which 8.23 km downstream part is influenced by the tidal effect of Mahim creek. The river has four distinct reaches (Figure 1.1) with very steep bed gradient of 1:200 for about 4.0 Km from its origin up to the crossing near Jogeshwari-Vikhroli Link Road (JVLR), steep bed gradient of 1:450 for about 3.5 km reach between JVLR and MV Road, moderate bed gradient of 1:850 for about 4.5 km reach between MV Road and CST Bridge and flatbed gradient of 1:4000 in 6 km reach between CST Bridge and Mahim Causeway in Bandra Kurla Complex (BKC) area . As the upper stretches of river are comparatively steeper than that of lower stretches there is a sudden discharge of water in downstream part of the river. Thus downstream catchment of the river is prone to floods. Apart from overflow of two lakes, 13 major outfalls discharge their flow into the Mithi River system. Some of the main issues being faced by Mithi river are Encroachment along the banks of the river, no

proper domestic and industrial effluent treatment system, rampant disposal of solid waste into Mithi river. This has exacerbated the pollution levels tremendously in Mithi river.

For carrying out various works on the Mithi River and Vakola Nalla (tributary), for administrative convenience, planning as well as for execution of works, these lengths have been divided within two authorities viz., Municipal Corporation of Greater Mumbai (MCGM) and Mumbai Metropolitan Regional Development Authority (MMRDA). Airports Authority of India i.e. Mumbai International Airport Limited (MIAL) has been assigned for management of length inside airport only by Gov. of Maharashtra. The Mithi River Development and Planning Authority (MRDPA) is the overall coordinating agency between the implementing agencies of MCGM, MMRDA and MIAL. The Maharashtra Pollution Control Board (MPCB) is the statutory body related to the pollution issues. It is expected that the works with respect to project implementation, land acquisition, rehabilitation of project affected persons, and others are to be carried out by respective implementing authorities, in their respective jurisdiction.

1.2. Flood in Mumbai

The suburban part of the city experienced very heavy rains on 26th July 2005 with a record of 944 mm of rainfall in 24 hours with highest rainfall intensity of 190.3 mm in one hour between 15.30 hrs. to 16.30 hrs. coinciding with the highest tide of 4.48m. During this event, severe flooding had taken place in all catchments of suburban parts of Mumbai and deluge in the catchment of Mithi river was tremendous resulting into unprecedented and prolonged flood situation and thus, this river received attention of the entire nation. The deluge resulted into heavy loss of human and animal lives, and huge economic and property loss.

After the flood disaster of 26th July 2005, Govt. of Maharashtra appointed Fact Finding Committee (FFC) under the chairmanship of well-known hydrologist Dr. Madhavrao Chitale in order to look into the causes of floods and also to recommend the short term and long term measures. Also Govt. of Maharashtra vide G.R. No. MRD-3305/Pra. Kra. 109/UD-7 dated 19th August 2005, formed Mithi River Development and Protection Authority (MRDPA) under the chairmanship of Hon'ble Chief Minister to act as a

coordinating agency between the various implementing agencies viz. MMRDA, MCGM, MPCB and also to monitor the progress and achieve the recommendations suggested by various committees. MMRDA and MCGM also appointed number of Expert Committees to understand the causes of flooding and suggest the remedial measures to mitigate and prevent recurrence of such situation. Various committees gave several recommendations as mitigating measures for flood control and abatement of pollution in river to improve quality of Mithi River water.

1.3.Hon'ble Supreme Court Response to PIL

Hon'ble Supreme Court vide their order dated 16th August 2017, with reference to Civil Appeal NOS 10463-10464 of 2016 and 6064-65 of 2017 (Appeal NOS 7 of 2015 and 8 of 2013), had directed to form a Joint Team by the Director of IIT, Bombay as well as the Director of National Environmental Engineering Research Institute (NEERI), Nagpur, to look into the matter of flooding and pollution in Mithi River catchment; to look in the steps taken by the State of Maharashtra and authorities under the state government to eliminate the pollution and ensure that an unfortunate tragedy does not recur.

Mr. Satish Gavai, Additional Chief Secretary in the Department of Environment of the Government of Maharashtra (GoM) and the Secretary of the State Environmental Impact Assessment Authority (SEIAA) has been appointed as the Convenor of the Committee by the Hon'ble Supreme Court. Accordingly, The Director of IIT Bombay nominated the expert Professors in this field as the Members of the Committee and also Director NEERI alongwith the team of expert scientists constituted the team from NEERI and thus a Joint Team was formed. Further, as per the Hon'ble Supreme Court directives, two Civil Society Members were also inducted for comments on the report prepared by IIT-B and NEERI via order dated 29.11.2017.

Accordingly, The Director of IIT Bombay nominated the following experts as member of the committee.

- Prof. Sanjeev Chaudhari, (Head, CESE)
- Prof T.I.Eldho (HOD, Civil Engineering Dept.)
- Prof A.B. Inamdar (CSRE)

Director NEERI Dr. Rakesh Kumar alongwith other experts as mentioned below constitutes the team from NEERI.

- Dr. Indrani Gupta (Senior Principal Scientist)
- Dr. Shalini A Tandon (Scientist)
- Mrs. Sunayana (Scientist)

Two civil society members approved as per Hon'ble Supreme Court order are:

- Prof.(Dr.) Arun Sawant
- Architect P.K. Das

1.4.Scope of the Work of this Committee

The main focus of the present Committee is to prepare a factual report on what has transpired so far, what is the extent of the damage caused to Mithi river, what steps can be taken to remedy the damage and the short term and long term future course of action as stated in the Hon'ble Supreme Court order dated 16/08/2017 given in Annexure-I.

1.4.1. Objectives of the Committee:

The Committee proposed following tasks to be undertaken in order to prepare the factual report for the points mentioned by Hon'ble Supreme Court:

- To study and enlist the major recommendations suggested by the various expert committees through their reports after deluge of year 2005 floods to avoid the future flooding and pollution in the Mithi River system.
- To enlist and ascertain the various steps taken by the State of Maharashtra and authorities such as Municipal Corporation of Greater Mumbai (MCGM), Mumbai Metropolitan Region Development Authority (MMRDA), Mithi River Development and Protection Authority (MRDPA) and Maharashtra Pollution Control Board (MPCB) to mitigate the flooding and pollution problem of Mithi River.
- To obtain the factual reports of actual work done and measures taken to achieve the various recommendations suggested by various committees

through their reports from concerned authorities and state of Maharashtra and submit the factual report on what transpired so far.

- To ascertain the extent of the damage caused to Mithi River based on the reports submitted by the concerned authorities.
- Further steps to be taken to remedy the damage and avoid flooding and pollution in Mithi river.
- To suggest short term and long term measures for future by the committee formed by Hon'ble Supreme and also suggesting guiding principles to implement short term and long term measures.

1.4.2. Meetings and Discussion

In the above context, as per Hon'ble Supreme Court order dated 16th Aug, 2017 for further actions, first review meeting under the chairmanship of Additional Chief secretary, Environment Department, GoM was held on 13th September 2017 and second meeting was held on 22nd September 2017 in presence of the committee members and concerned staff of MRDPA, MMRDA, MCGM and MPCB. In these meetings, the concerned agencies were directed to submit the details of the action taken till date and also the report on action taken on various recommendations suggested by various committees through their reports. They were also requested to submit soft copy of the reports of various committees and also the synopsis of work done so far to mitigate flooding and control of pollution in Mithi River system. The meeting was also held with the representatives of Jalbiradari and Vanashakti foundations on 22nd and 23rd October, 2017 respectively to understand their views on the said matter. The main issue raised by various NGOs and other agencies was on the "constructed retaining wall" on both sides of Mithi River by MCGM and MMRDA and forest areas like Aarey has walls construction on both sides thus preventing the interaction of river in the forest itself.

The Committee during field visit inspected the entire stretch of Mithi River on 10th November 2017 and saw the nature of the retaining walls already constructed and understanding its impacts on the River Ecology, flooding issues and environmental problems. For more reporting of status quo, again a meeting of all concerned agencies

was held on 8th December 2017 at IIT Bombay and the government officials were asked to clarify the status of suggested and implemented recommendations of previous studies for mitigating the floods and pollution of river.

Further, to ascertain the present status of the pollution of the Mithi River system, water samples were collected from the river and testing was done for various parameters to ascertain the water quality. It was found that the pollution level in Mithi River has increased as compared to 2015 study done by IIT-NEERI. Lack of proper sewerage network along the banks of the river as well as absence of STPs to treat the effluent entering into the river system are the major reasons of pollution.

The studies done post 2005 for Mithi river, total 10 reports (Table 1.1) provided by the government officials to the committee was studied to prepare the list /questionnaire for status of compliance or non-compliance. The list was sent to respective authorities for their remarks on the status of recommendations. As per the reports received from MCGM, MMRDA and MRDPA authorities, the report on action taken so far on the recommendations of various committees by these agencies and also impact on the Mithi River system has been prepared on major points such as widening and deepening work, desilting work, encroachment removal, construction of retaining wall, construction of service roads, sewer line laying works, construction of STP works, ecological conservation work, beautification works, remodeling and widening of bridges and setting up of disaster management cell and its functioning work.

Table 1.1 Various Committee's Reports prepared post deluge of 2005 floods

Sr. no.	**Reports**	**Committees/organisations**	**Year**
1.	Fact finding committee on Mumbai floods	FFC-Dr. Madhavrao Chitale committee	2006
2.	Pollution study of Mithi River Basin.	MPCB	2006

3.	1-D Mathematical Model and Desk Studies for Mitigating Floods of Mithi River in Mumbai	CWPRS	2006
4.	Development of action plan for environmental improvement of Mithi river and along its Bank	IIT Bombay	2006
5.	Current status of Mithi River and Possible Solutions	NEERI	2011
6.	Environmental Impact of Rock Blasting activity in the Mithi River region	NEERI	2014
7.	(a) Integrated Impact Assessment of Mithi River- Remote Sensing, GIS and Socio-economic studies of Mithi catchment (b) Integrated impact assessment study for Mithi River	IIT, Bombay NEERI	2014 & 2015
8.	Comprehensive Study/Profiling of Mithi river	MPCB (by Technogreen Environmental Solutions)	2014
9.	Consultancy Services for preparation of Detailed Project Report on Mithi River	MCGM (by Frischmann Prabhu)	2017

This report is based on the study of the various reports as mentioned in Table 1.1, interactions with MMRDA and MCGM officials, meeting with NGOs and other parties and observation and assessments done during the site visit and discussions thereafter. Chapter 2 highlights the previous committees' recommendations and work done by authorities and remarks by the present committee. Chapter 3 enlists the observations

made by the team for different issues. Chapter 4 presents the recommendations made by team after this study and proposed short term and long term plans for future course of action under various parameters to revive the river.

1.5. Status of Mithi River and Impact of flood and pollution

1.5.1. Rapid urbanization and changes in LULC

In Mumbai, the population has increased by 16 folds during the last century. Present population density of the city is 28404 persons per sq. km. As the population density increases, the demand for land and water increases. With this occurred the change in land use land cover (LULC), reduction in infiltration area, encroachment along the path of river took place in major river courses such as Mithi River in Mumbai city area. Thus urbanization has played a major role in altering the process of hydrology, morphology, habitat and ecology of the entire catchment area of Mithi. Mumbai city being surrounded by sea and its creeks by all sides have scarcity of land and also have limitations on discharge capabilities of the drainage system due to tidal effects. There are total 174 outfalls discharging their flows to sea or creeks having tidal effects. Out of these outfalls, 44 outfalls are below Mean Sea Level (MSL) and 124 outfalls are above MSL but below High Tide level (HTL) (Source: Flood preparedness Book, MCGM, 2017). Moreover, large scale developments have taken place in the floodplains of most of the Rivers in Mumbai and particularly in Mithi River Zones. As such when a small intensity of rainfall coincides with high tide, flooding takes place in low lying areas of the city.

Flooding being the natural phenomena cannot be completely avoided, however the rivers which are prone to flooding, preventive measures can be taken to minimize its impacts on the living of the people in the catchment area and around as also to minimize the infrastructural and financial losses and damage to properties in the vicinity. People residing in the vicinity of flood prone areas should have the proper knowledge of impact of flood hazard, vulnerability and risk. Proper short term and long term measures to avoid the flooding are very essential as the part of the preventive measures.

1.5.2. Mithi River Catchment - Causes of Flooding

Mithi River is one of the major and important rivers among all four rivers situated in Mumbai city as it runs through important area such as Bandra- Kurla Complex (BKC) and also sensitive area such as airport. Origin of the Mithi River is from the overflow of the Vihar Lake and subsequently overflow of Powai Lake joins Mithi River (Fig. 1.2). Upper reach of the river, from Vihar Lake to Andhei-Kurla road has very steep gradient whereas at downstream part from Andheri-Kurla road to Mahim causeway there is flat gradient. During monsoon, sudden discharge load comes downstream of the river. Thus, downstream catchment of the river remains flood prone due to combined effects of sudden discharge load and tidal effects. At the origin, only fresh water enters into the river through Vihar and Powai lakes. Ideally, during monsoon period, there should be clean water in the river after overflow from the Vihar and Powai Lake.

Fig. 1.2 Origin of Mithi River from Vihar Lake

However, the course of the river flowing through adjoining areas of the urban sprawls and also encroachment along the path of the river has been modified at many places. There are 13 major nallas discharging their flows to Mithi River system. Due to the encroachment of slums along the banks of the river and also along the banks of these major 13 outfalls, residents living in these slums are discharging their sewage directly into the Mithi River which is one of the major cause of pollution of Mithi River system. Also unauthorized industrial units present along the vicinity of the Mithi River catchment

are discharging their effluents without any treatment into the river system causing the major problem of pollution of the water of the river system. It is well known Dissolved Oxygen Level below 4 mg/ lit which badly affects the aquatic life. Pollution parameters such as Biochemical-Oxygen Demand (BOD) and Chemical Oxygen Demand (COD) are very high as compared to their standards for best designated usages /regulatory standard limits.

1.5.3. Impact of Reclamation

In the vicinity of the Mithi River in Bandra Kurla Complex (BKC) area, out of the original water spread area of 800 ha, as reported in 1930, about 400 ha area was reclaimed by the year 1973 (CWPRS, 2006). Further Mumbai Metropolitan Regional Development Authority) MMRDA) under direction of Govt. of Maharashtra had appointed Central Water and Power Research Station (CWPRS) authority in 1975 to study further possible reclamation in BKC area within the catchment of the Mithi River area. As per the study conducted by CWPRS vide their report of 1976 and note of January 1978 the broad recommendations of CWPRS were:

a. Channelisation of Mithi river in BKC area is essential prior to reclamation.
b. In order to reduce flood levels of Mumbai Agra road corresponding to 10 year return period of rainfall provision of sluice gate at Mahim causeway and channelization is essential.
c. Extent of reclamation possible is a function of the channelization along with widening of existing waterways of bridges, maximum reclamation of 220 ha is possible.
d. Channelization of the Mithi River needs to be undertaken from downstream region to upstream region and the corresponding reclamation of pockets from upstream to downstream.
e. The channelization consists of –
    - Widening of 5 Km stretch of Mithi River BKC area to 175 m at bed and 200 m at top between Dharavi Road Bridge and CST Bridge.

- Widening of 1 Km stretch of Mithi River in BKC area to 60 m between Dharavi Road Bridge and Mahim causeway and further into Mahim Bay with suitable transition.
- Widening of Vakola Nalla to 40 m at Bed and 60 m at top for a stretch of 3 km.

f. Deepening of Mithi River from CST bridge and that of Vakola nalla with bed gradient of 1:1250.

g. A bund of adequate height along the banks of the Mithi River and Vakola Nalla to contain floods.

h. The cross drains which drain into Mithi River should be provided with non-return valve and arrangements of pumping of waters into creek during floods.

Many of the above recommendations were not implemented, severe flooding in the catchment of the Mithi River was witnessed specifically at downstream catchment area, due to the unprecedented rainfall of 944 mm on 26th and 27th July 2005. It caused enormous damage to life and property with deaths and also tremendous financial losses. Then after this deluge of 26th July 2005, MMRDA appointed again CWPRS to examine tidal hydraulics, deepening of region above upstream of BKC upto Powai lake outfall, identifying chainage-wise remedial measures for mitigating flood levels and necessity for creating holding ponds.

From the Toposheet of the year surveyed in 1966 and published in 1976, polygon of the Mithi River course of downstream area was digitized and it has been superimposed on present Google Earth image of 2017 as shown in Fig 1.3. From this figure, it can be observed that muddy area and certain portion of deep water existing in 1966 till 2017 has gone under rapid urbanization and infrastructural growth. This growth has even taken place along the flow path of the river, adding to one of the main cause of flooding.

In hydrology and hydraulic system, catchment area, ponds and lakes acting as detention or retention pond, channelization of the river plays vital role. Water storage activities of Powai lake at full supply level (FSL) is 4.58 ML/ cubicmeter and of Vihar lake at full supply level (FSL) is 18.16 ML/cubicmeter (FFC, 2006). As per the 1923 topographic

sheet, Mithi catchment spatial distribution showed 12 smaller ponds which were acting earlier as the buffer storage. Out of these ponds, ponds at Narayan nagar, NITIE, Padam Talao (airport), north of Kalina cantonment, Talao at Kalina and Marol and Mohili villages were reclaimed for the development activities. Further reclamation of BKC area and other pond is also one of the major reasons for severe flooding in catchment of Mithi River area during the event of 26th July 2005 (IITB, 2006).

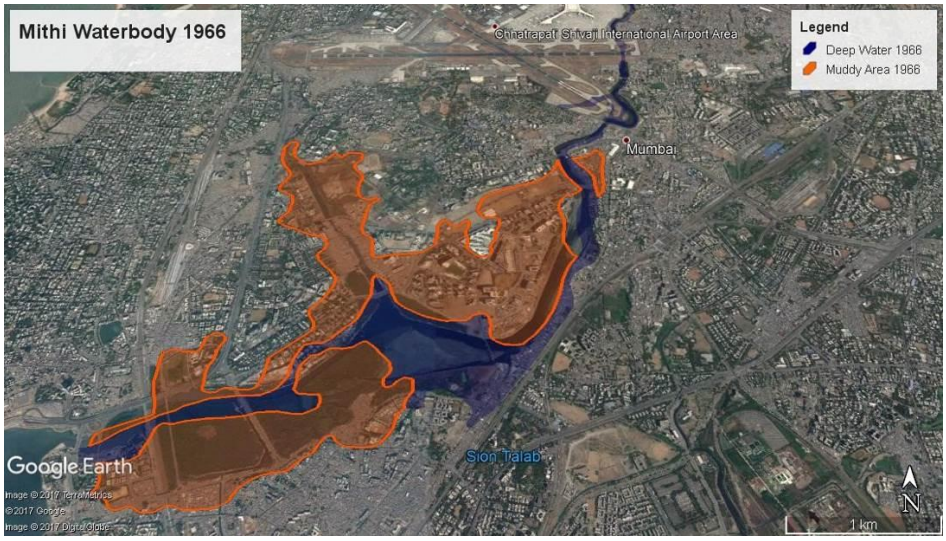


Fig. 1.3 Infrastructural growth along the flow path of the Mithi River (1966- 2017)

Another major cause of flooding during the extreme rainfall event of 26th July 2005 was the change in the Mithi River course near airport area due to the extension of the runway on Mithi river course (FFC report, 2006) shown in Fig. 1.4.

Fig 1.4 Extension of runway on Mithi River Course

1.5.4. Impacts of Encroachment

The encroachment along the banks of the rivers which reduces the flow path of the river is another cause of manmade flood hazards. Before the 2005 floods, the banks of the Mithi river were encroached by hutments and thus the flow path of the river is drastically reduced (Figure 1.5). Beside the bank of the river, there are industrial units, storage facilities, workshop and scrap yards, which discharge untreated sewage and industrial waste water into the river, thus polluting the aquatic system of the entire river (CWPRS, 2006). Discharge of liquid from the industry, sewage from the households, dumping of debris and solid waste from the residents of the slums along the bank of the rivers not only reduce the carrying capacity of the river but also pollute the river drastically. Further, the piers of the bridges are acting as a deposition place for this solid waste and debris. Pinching of the river course is a very common phenomenon in most of the river courses flowing through the urban areas (IITB, 2006). This phenomenon is being observed at the crossing and on upstream and downstream sides. There are about 35 crossings on Mithi River and about 11 crossings on Vakola nalla.

Fig. 1.5 Encroachment along the flow path of the River (before 2005 floods)

Always the downstream width of the river with reference to bridge should be greater than the upstream side otherwise reverse funneling takes place. Such situation was observed at many places before the flood of 26th July 2005 (IITB, 2006).

1.5.5. Pollution Issues in the Mithi River Catchment

For the past few decades, the Mithi River and its catchment is severely polluted with domestic and industrial sewage directly discharged to the River without any treatment, effluent from adjacent industries and also dumping of variety of solid wastes including wet and dry waste from adjacent households, plastic, construction debris, scarp materials and other waste materials (Fig. 1.6). Thus over the years, the pollution has reduced the river to toxic sewer. During the monsoon season, the situation is better as the over flow from Vihar and Powai lakes supply fresh water and the various drains flows the storm water to the River. During the non-monsoon season, the river does not receive any fresh water and the existing flow is only effluent or sewage from various outfalls, slums, industries and nearby households (Fig. 1.7).

The Mithi 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. A survey by MPCB in 2004 itself indicates that the pollution levels had reached an alarming stage (MPCB report, 2004).

Fig. 1.6 – Mithi River Condition in Summer time with solid waste & sewage in summer season

Fig. 1.7 – Mithi River Condition with sewage and effluent for adjacent industrial units (as on 10th November 2017)

Solid wastes disposal takes place along the banks, into the river and the Vakola nalla. There are slums along the river stretch namely in areas such as Filter pada opposite Vihar Lake, Passpouli slum area, from Sion opposite to the BKC bank till Military road in patches and along the Vakola nalla as can be seen in the maps (Annexure-II). In some stretches water quality is extremely poor and requires immediate corrective measures.

Further study by NEERI in 2011 (NEERI, Report 2011) and 2014 (NEERI Report, 2014) showed further increase in all pollution indicators in the water of Mithi River.

As recommended by many reports (MPCB, 2004; IITB, 2006; NEERI, 2011; NEERI, 2014), the Mithi river pollution control needs action urgent consideration of the following aspects:

- Domestic sewage due to residential colonies as well as hutments in the thickly populated area should be collected by sewer lines and treated in decentralized STP to achieve discharging standards before it can be discharged in river.
- Industrial waste generated by authorized as well as unauthorized industries should be treated by setting up ETPs.

- Effluent coming from cowsheds should be treated before it is discharged in Mithi stream or new laws to be made for discharging effluents from cowsheds.

- Garbage dumping by citizens all along its course needs to be controlled by providing proper waste collection system.

- Industrial sludge and rejects discarded by recyclers at various location needs to be covered under waste collection or waste management system.

Therefore, it is required that govt. bodies such as MCGM and MPCB should strive to reduce the discharge of untreated effluents and install and mandate treatment for all polluting activity.

1.5.6 Developments after the Deluge of July 2005 – Perspectives/ Issues

There was tremendous loss of lives as well as damage to property and infrastructure due to the deluge of 26th July 2005 floods. Subsequently, Government of Maharashtra and MCGM appointed various committees (as mentioned in Table 1.1) to study the causes and flooding and to suggest the recommendations to mitigate flooding in future. The status of implementation of these recommendations and its impacts are presented later in this chapter.

After the deluge of 26thJuly 2005, Government of Maharashtra and MCGM appointed a Fact Finding Committee (FFC) under the Chairmanship of Dr. Madahavrao Chitale. The Committee critically studied in details about the deluge happened in Mumbai and its suburbs, its causes, the precautions to be taken, the short term and long term measures to be adopted to avoid such flooding in future and submitted its report in 2006 (FFC, 2006). Chapter 2 delineates the recommendations of various committees, status as of now and remarks of the present committee of NEERI-IITB. Though MCGM, MMRDA and Maharashtra Gov. implemented some of the recommendations of the FFC, many of the key recommendations are not yet implemented, EVEN after 12 years of the deluge.

Fig. 1.8 Flooding at Mithi River catchment on 26th July 2005

Further to study the technical aspects of flooding and to recommend remedial measures, especially in the Mithi River and its catchments, Gov. of Maharashtra and MCGM, appointed Technical Committees from IIT Bombay and CWPRS. The IIT Bombay looked in to various issues related to "Development of action plan for environmental improvement of Mithi river and along its Bank" and submitted its report in 2006 with number of recommendations (IIT Bombay, 2006). The CWPRS Committee mainly looked in to the flooding related issues and conducted various model studies and gave recommendations for mitigating Floods of Mithi River (CWPRS, 2006). As reported in Chapter 2, though MCGM and MMRDA implemented flood related recommendations such as widening and deepening of the River course, it is observed that most of the other recommendation such as pollution abatement, protection of banks, river water quality improvement etc. are not yet implemented.

Further, after the deluge of 26 July 2005, Government of Maharashtra, MCGM and MMRDA have undertaken number of measures as detailed below:

- To prevent such natural disasters in future, Govt. of Maharashtra vide its Govt. Resolution No. MRD- 3305/ Pra. Kra. 109/ UD-7 dated 19th August 2005 formulated Mithi River Development and Protection Authority (MRDPA) under the Chairmanship of Hon'ble Chief Minister. MRDPA is expected to act as a coordinating agency between the implementing agencies i.e., Mumbai

Metropolitan Region Development Authority (MMRDA) and Municipal Corporation of Greater Mumbai (MCGM) for the works related to the Mithi River and Vakola Nalla projects. The MRDPA is not a Statutory Authority and hence, acquisition of land and rehabilitation work cannot be undertaken by the said authority. Therefore, works with respect to project implementation, land acquisition, Rehabilitation of Project affected persons, and others shall be carried out by respective implementing authorities, in their respective jurisdiction.

- Hon. High Court vide its order of August 2005 directed MCGM/MPCB to identify and check the polluting industrial units along its banks and to make sure that no new encroachments or industrial activities on the riverbank are permitted.

- The Hon. High Court vide its order of March 2006 accepted MRDPA's proposal to implement the river development works in two phases. Phase-I included deepening, widening and desilting of Mithi River and resettlement and rehabilitation of PAPs and MRDPA was directed to monitor and oversee the work of deepening, widening and desilting being executed by MMRDA and MCGM. Phase-II works included pitching, construction of Retaining wall, construction of service roads, landscape development, beautification work on either sides of the river along with additional widening works and deepening works.

- Through a letter dated 13th May 2014, MPCB has informed MRDPA that MPCB had submitted a list of 208 units to MCGM to whom closure directions were issued with a request to disconnect water supply and submission of compliance report thereof. MPCB observed that inspite of disconnection of electricity of units within 30 meters from the bank of Mithi River, most of the units were found in operation through unauthorized electricity supply sources.

- Currently, MPCB is not issuing consents to any industries within 30 meters along Mithi River bank. As per the final order by Honorable NGT Principal Bench, in the Appeal No. 7 of 31st May 2015, MPCB and MCGM was directed to take actions against defaulters as per the directions of Hon. High Court via order dated 31st August 2005. MPCB was also directed to ensure that the STP works should

get initiated by MCGM in next six (6) months as per the recommendations. However, till date no progress is informed by the MCGM towards construction of STP to MPCB.

- In the 6th Authority meeting of MRDPA Chaired by Hon. Chief Minister of GoM and Chairman, MRDPA, dated 25th May 2010 (considering the recommendations of Fact Finding Committee (FFC, 2006), CWPRS and IIT Bombay) the widths of the Mithi River were finalized. Status of widening and deepening is given in Chapter 2.

Disclaimer: *The above details are based on information obtained from MRDPA, MMRDA, MCGM and MPCB.*

Chapter 2

Mithi River- Previous Committees Recommendations, Works done and remarks by IIT-NEERI

2.1 Previous Recommendations, Responses and Remarks

The recommendations suggested by various previous committees through their reports are analyzed in five parts viz. Flood related issues, pollution related, rejuvenation of river issues, encroachment related issues and organization and social Related issues. The recommendations which are partially implemented or totally not implemented were enlisted in these five sections on which detailed clarification and report was asked from the respective authorities concerning each point. All responses on these recommendations received from the authorities are given under sections 2.2 to 2.6 of this chapter. The joint committee of this report has given remarks for each recommendation based on the responses given and other documents availed by different government bodies, by making field visits, several meetings and discussions.

2.2. Flood Related Issues

Sr. No	**Recommendations (Ref)**	**Response** **From Authority**	**Remarks of the Committee**
01	Channelization of Mithi River (Widening and deepening of Mithi River) (*FFC,2006; CWPRS,2006*)	**MCGM:** • 95% widening and deepening of Mithi River is completed. Till date, 14319 mtrs. length is completed out of 21588 mtrs. length of retaining wall of Mithi River	As mentioned by MCGM that 95% deepening and 100% by MMRDA has been done.

		MMRDA: • Deepening work is 100% completed as per CWPRS 2006. The removal of outcrop (approximately 1.0 lakh cum) near Mahim causeway is balance due to stay order by Hon'ble NGT. Widening work is 95% completed except in stretch of 300 mtrs. in Vakola Nalla due to stay order by Hon'ble NGT. **Future work plans of MCGM and MMRDA** • *MCGM and MMRDA proposed to complete remaining work of deepening, widening rock excavation, retaining wall and service road. The details of which are presented in Annexure A along with balance work costs.*	
02	Providing modified bed gradients to increase the conveyance capacity of the river which will then be able to	**MCGM:** The gradient of Mithi River is maintained as per the design submitted by IIT-B and CWPRS.	As mentioned by both the authorities gradient is maintained.

	accommodate flood flow of 1 in 100 year probability (*FFC,2006; CWPRS,2006*)	**Year Qty. of Silt in MT.** 2014-15 189200.00 2015-16 116900.00 2016-17 69989.00 2017-18 55,800.00 Desilting of Mithi River is carried out through year but not during monsoon. **MMRDA**: Bed gradient as suggested by CWPRS is achieved.	
03	River basin management- Hill slopes, check dams and contour bunds (*FFC, 2006*)	**MCGM:** Weir wall constructed near Bamandyapada, Sakinaka	It is necessary to study in detail with regard to where these should be constructed and how it will benefit.
04	For effective flood control- Construction of detention basins and infiltration zones (*FFC, 2006; NEERI, 2015*)	**MRDPA** has mentioned for increase in water holding capacity by 2 times and discharging capacity by 3.0 times	There are no detention basins and infiltration zones provided in response by authority. The absence of detention basin and additional interim storages are still not planned.

05	Review of waterways under the bridges- Widening of bridges and restoration or repositioning of ducts of the utilities (*FFC, 2006*)	**There are total 15 Bridges:** • 05 bridges completed by MMRDA • 05 bridges completed by MCGM • 05 bridges Balance (**to be completed by MCGM**)- Mahim Causeway, Tansa Watermain, Vaiterna Watermain, Sion-Dharavi	Under the bridges, there are number of utilities like water pipelines, gas pipeline, cables etc. The bridges should be widened and restoration or repositioning of ducts of the utilities on urgent basis. The railway culverts also should be upgraded.
06	Improvement of Mahul creek and develop the relieving flood sub catchments 500, 501, 502,503, 509 and 510 of Mahul creek system (*FFC, 2006*).	• MAHUL pumping station is proposed • 501 catchment: 40% work completed. • 500 Catchment: 60% work completed. • 504 Catchment: 20% work completed.. • 509 catchment: Tender for Training, widening and deepening is invited.	It seems that till date no proper attention given to execute these works. Also, efficacy and adequacy of these works are not continuously assessed.
07	(i)The retaining wall along the whole river stretch is not desirable and should be avoided. It will result in rapid movement of water thus causing more flooding *(NEERI, 2011).*	**MMRDA** The reasons stated for the necessity of retaining wall as: • To restrict the encroachments in river course. • To channelize the flow	Retaining walls have been built indiscrimately. The purpose of retaining walls to prevent encroachment is fundamentally wrong. In addition these walls are made above ground (even upto 3m in many locations) without giving

		• To protect the embankment (banks) • To control the erosion of river banks. • To increase flow velocity of river Recommendations by: • Hon'ble High court case no.2116 of 2005 pg no. 4. • CWPRS 2006 Page 33 of concluding remarks **MCGM:** • To cater the flow storm water drains are constructed by this department, the storm water is carried out to river through outfalls. Also the weep holes are provided in re**t**aining wall.	any scope for water to flow to and fro from the river during a high rainfall conditions by obstructing the entire river hydrology. This is a factor of flooding in the area adjacent to the retaining wall as proper drainage arrangement is not provided. Weep holes are also not sufficient to discharge the surface flow.
08	De-silting and removal of Debris on regular basis of the	**MCGM:** Desilting of Mithi River is carried	Primarily desilting is done only

	Mithi River Channel (*FFC, 2006*)	out through year but not during monsoon **<u>Response from Chief Engineer Storm Water Drain, MCGM</u>** Desilting of Mithi River is carried out on yearly basis. ***[Refer to Appendix 4, Page-38]*** **<u>Response from Dy. Chief Engineer, Storm Water Drains, Eastern Suburb, MCGM</u>** Depth achieved as recommended by CWPRS, table attached (**Annexure A3**). Desilting of Mithi River is carried out through year but not during monsoon. **Future Plans** MCGM and MMRDA proposed that regular desilting will be carried out before monsoon.	once in a year which is inadequate. It is important that monthly dredging of Mithi stretches should be done as said by NEERI in their 2015 Report.
09	Access ramps into rivers from major roads and at critical locations for proper desilting (*FFC, 2006*)	**MMRDA**: Access for desilting has been provided at 5 locations at Mithi River and 3 locations at Vakola Nalla. **MCGM**: Provision for the access road to the Mithi River for desilting and routine	In MCGM portion there is no such provision of this as observed by committee. This is required to be done on priority basis.

		maintenance work is provided in retaining wall whenever necessary.	
10	Providing River flushing system to initiate rejuvenation of river channel by providing 0.6 m gates at Vihar and Powai spillway dams. 2700 M.L. of volume (Oct to May) (*FFC, 2006*)	**MCGM:** There is no arrangement of providing gates and walls of Vihar and Powai spill way dams. Overflow of both dams flow from the top at dam and gates cannot be provided on existing spillway of dams.	It seems that no efforts have taken By MCGM to study and examine about this possibility of providing gates by some expert agency or institute.
11	Pumping arrangements and tidal gates as suggested by BRIMSTOWAD (*FFC, 2006*)	No response for this point is given by MCGM and MMRDA	Storm water drains discharge rain water directly by gravity through outfalls as floodgates have been provided in only three of the 44 outfalls below MSL. *(Source: Flood Preparedness Guidelines, 2017 by MCGM)* Such gates and mechanism should have been implemented for all 44 outfalls.
12	At least 20 m buffer zone on either side of the bank beyond width as suggested by CWPRS. Provision of service road of sufficient width on either side of banks would be beneficial for reducing flood level (*CWPRS,*	**MMRDA:** 20m buffer was not possible due to paucity of land space on either side of bank since encroachments, permanent building, religious strethces and mangroves,etc. MRDPA in its 6th Authority meeting dated 25th May 2010 has recommended only service road of 6.0 m	In MCGM portion, they have not provided buffer zone or service road. Alternatives have been worked out as detailed in Chapter 4 under Short term and Long term plans.

	2006).	to 12.0 m wide on either side of bank. MMRDA has executed service road accordingly. **MCGM:** 06 meters wide service road will provided after removal of encroachment.	
13	Flood Risk zone maps for different return periods and should be marked on DP sheets. (*FFC, 2006*)	**MMRDA:** The data required for preparation of Flood Risk Zone Maps have been collected such as rainfall data, river cross-section, tidal data, counter maps etc. and same are under preparation.	No proper attention given to prepare the flood risk zone maps even after 12 years of 2005 deluge. Flood risk zone maps for different return periods are not prepared so far.
14	At least one stream gauge close above the tide level or above the confluence of the stream with main river channel. One for 2 lakhs population. (*FFC, 2006*)	No data or information received from Authorities.	No automatic stream gauges are yet provided. It seems that though there is no much cost involved to provide stream gauges, no priority to this work is given by the authorities.
15	Gates at out fall and pumping stations – For larger catchments, gates to a flood flow of 1 in 100 years & for small catchment 1 in 25 years probability. (*FFC, 2006*)	No data or information received from Authorities.	This should be considered seriously and a study to be undertaken to delineate steps for implementation.

16	Up gradation of railway culverts. (*FFC, 2006*)	No data or information received from Authorities.	These works have not been initiated.
17	Providing non return valves for cross drains *(CWPRS, 2006) (Pg. 28)*	No data or information received from Authorities.	These works have not been initiated.
18	Bridge near Mahim bay confluence should be widened.*(IITB, 2006)*	MRDPA has said that tendering procedure in progress by MCGM .	As this bridge is at outlet of the Mithi River system, priority should had been given to this work for smooth flow of the stream
19	Storage loss of existing Powai and Vihar lakes due to sedimentation requires immediate attention – suggested desiltation. *(IITB, 2006; IITB, 2014)*	**MCGM:** As per concept & feasibility report submitted by Consult M/s Frischmann prabhu the total volume of sediment including bulking of powai lake is 5656800 cubic meter. Estimate Cost of dredging Rs. 84.85 cr. Consultant M/s Frischman prabhu has recommended that due to above, along with lack of MCGM land availability in nearby area, & removal of dredged material will require large span of time, desilting of lake cannot be implemented at this stage. MMRDA will take beautification work. Vihar Lake: In case of Vihar lake, ultra survey / **sonar survey was carried out by MERI**,	The response does not give any solution which is possible. Study as suggested in Chapter 4 section 4.9 should be undertaken by reputed institution to address and provide solution.

		Nashik and it was stated by them that sedimentation in Vihar lake is minimum and at present, it is not feasible and advisable to carry out de silting in this lake.	The committee does not have any information regarding MERI survey.
20	A rigorous flood warning system – emanating from Vihar & Powai lakes will have to be in place along with the up gradation of the role of the reservoirs in the management of the Mithi River *(FFC, 2006).*	No information received from authority	This should be have been done to lead to proper management of floods in rivers.
21	The conveyance capacity and the basin capacity to be increased for safe and sufficient 100 year rainfall return period with coinciding of extreme high tide as experienced in 26th July 2005 *(FFC, 2006; CWPRS, 2006).*	**MMRDA, MCGM:** The conveyance capacity of the basin has been increased by 3times and water holding capacity by 2 times as vetted by CWPRS report 11.11.2011(Annexure:IV).	Though CWPRS stated that conveyance capacity and holding capacity of the Mithi River is increased, the work carried out of construction of retaining wall not as per riverine methodology. Also, the proposed width of the River has been reduced in MRDPA meetings due to site problems. So the claim of capacity increase cannot be considered adequate.
22	Sensing by Radars- Installation of Doppler radar & data to be placed on web site *(FFC, 2006).*	No Data received from Authority	No action on this aspect is of high concern.

2.3 Pollution Related Issues

Sr. No	**Recommendations (Ref)**	**Response** **From Authority**	**Remarks of the Committee**
01	Build sewerage system on both the banks of the river *(MPCB, 2006; FFC,2006)*	Sewer line works completed and in progress at following locations. • Wadia Estate to LBS Marg along East side service road. • Sewer line along Marva Road to Ashok nagar Bridge to Sakinaka Sewage pumping station work in progress. • Providing 1200mm dia sewer line from Kurla pumping to Kamani junction along LBS Marg etc. Also MCGM have appointed consultant to prepare Short term and long term solution to curb pollution in Mithi River	For construction of Buffer Zone, Service Road and also sewer line, execution agency is same that is M.C.G.M., however it seems that they have **no coordination between them with internal departments.** The work of sewer lines are initiated in few locations, partially done in few locations and work progress is totally unsatisfactory. Works of Buffer Zone, Service road as well as sewer line work all are lacking in details. Current plan of MCGM largely focuses on interception and diversion at huge cost and which are very time consuming. Recommendations of IIT Bombay, MPCB, NEERI and also Hon'ble

		Future plans of MCGM MCGM proposes laying of sewer lines and major trunk sewers in different areas of Mithi catchment in future. The details of which are given in Annexure-B.	High Court have been ignored.
02	Set up sewage treatment plants wherever needed to prevent pollution of river *(MPCB, 2006; FFC,2006; IITB 2006)* About 14 lakh people (slum population) reside in the river basin, domestic sewage treatment is required *(CSIR-NEERI, 2015).*	• Sewerage treatment plant locations are proposed in Buffer zone. Buffer zone and service road not constructed along Mithi river. • MCGM have proposed to construct 8.0 MLD capacity STP at Water Supply Project (WSP) garage to treat the dry weather flow collected from Filterpada and treated flow will be discharge then in Mithi River. Tender work for this is in Progress and work may start on May 2018. • As regards major ingress point i.e. Bapat nalla and Safed Pool nalla, it is proposed to provide 2.70m dia tunnel from Bapat nalla to Ghatkopar WWTF. The flow from these two nallas will be picked up in this tunnel. The preparation of tender for these works are in progress and works are likely to be started in May-2018. • Other major ingress point such as Ashok	The proposed site for STP is at higher altitude i.e. flow would be pumped from lower level to higher level thus increasing the cost and operation and maintenance. This option is not feasible when MPCB in 2014 on the other site has already marked the locations for installation of STP's. Further it is important to note that MCGM proposed work of intercepting dry weather flow (DWF) at enormous cost does not solve the problem of pollution inputs for almost four months. During these four months huge amount of untreated waste water , silt sludge, plastics and garbage

		Leyland nalla, Kalpna Kamran nalla will be diverted to the ongoing work of 1200mm dia sewer line along LBS marg. The preparation of tender diverting the DWF is in progress and works are likely to be started in May-2018. **Future plans of MCGM** MCGM proposes to build STP at WSP site as recommended by Frischmann Prabhu report. The details of work to be undertaken alongwith timeline of completion of work is given in **Annexure-C**.	will flow into the river. Interception at last point in nallas technically fails as has happened in Aurnagabad and many places in Nashik. MCGM has squarely neglected the plan of treatment of sewage given by IIT and MPCB as was also directed by Hon'ble High Court and now proposes a new plan which is not only highly expensive but technically flawed.
03	Effective implementation of operation and maintenance of ETP/STP in organized and large scale industries including hotels and restaurants *(MPCB, 2014).*	**MPCB:** There are 11 large and Medium scale establishment in the catchment of Mithi River. Out of which 9 no. are Hotels, 1 no. is Hospital and Mumbai Airport. The total generation of domestic and industrial effluent is about 9.82 MLD. All the establishment are provided full fledge STP's and treating the effluent up to the mark. The MPCB also given	Committee has doubt about the functioning of all STPs in working condition. The present status of the running STPs should be verified by the MPCB. MIAL (airport) has a working STP.

		condition to recycle the treating effluent up to 60%. No Large scale industries established in the catchment of Mithi River.	
04	The treatment options shall all be confined mostly to those stretches of river with no tidal influence whereas it shall be applicable to all nallahs and industrial sources irrespective of location *(MPCB, 2014).*	No response given by any authority.	It seems that the present status has not been verified by the authority. It should be verified by the MPCB, action should be initiated against the owners of units are running without permission.
05	Install proper garbage collection system on both banks of Mithi *(MPCB, 2006)* Provision for decentralized and segregated solid waste management in slums. *(NEERI, 2011).* Waste collection from river banks through involvement of local communities and awareness. *(NEERI, 2011).*	<u>Response from MRDPA</u> Solid Waste Management is being carried out by MCGM. SWM Cell of MCGM may respond. Currently, MPCB is not issuing consents to any industries within 30 meters along Mithi River bank. MPCB/MCGM was directed to take actions against defaulters as per the directions of	On this count MCGM has not been able to implement measures to collect garbage from the areas adjoining both banks. Effectiveness of garbage collection is very poor as these quantities discharged in river finally goes in Sea and only a part is recovered when desilting is done once every year.

		Hon. High Court	
06	Any drain carrying industrial effluent, storm water and/or domestic sewerage having values of BOD and COD higher than 3mg/L and 10mg/L should be closed. Similarly all the drains from residential areas should be connected to sewerage system of the city *(IITB, 2006)*	**Response from MPCB** MPCB has carried out survey since 2005 and issued closure directions to 838 units. The policy decision has been taken and not allowing industries establisment upto 30 mtr. along the Mithi River.	At present no proper treatment is existing for industries or drains carrying the industrial waste water.
07	No proper garbage collection and disposal arrangement in the river basin *(MPCB, 2006; IITB, 2006).*	No information received from authority.	Lack of garbage collection plan which can ensure no garbage is thrown into the river.
08	Recyclers of commodities like paper, metal scrap, plastics, glass, etc., need to be shifted out to conforming areas. *(MPCB, 2006)*	No information received from authority	MPCB to give its plan for implementation.
09	Solid waste collection and disposal within 500m on either side to be removed by the corporation.*(MPCB, 2006; IITB, 2006)*	No information received from authority	Plan of garbage collection in 500m on either side is poorly implemented resulting in garbage disposal in nalla/river.
10	Provision for decentralized and segregated solid waste	No information received from authority	Plan of garbage collection in 500m on either side is poorly

	management in slums.*(NEERI, 2011)*		implemented resulting in garbage disposal in nalla/river.
11	MCGM to implement new byelaws for waste generated in cowsheds *(NEERI, 2015).*	No information received from authority	Not yet done. Government of Maharashtra had a policy " River Regulation Zone" policy for protection of rivers, however it has withdrawn the RRZ policy in the year 2015.
12	As per industrial policy on river catchment, as per the Department of Environment (GR No MMV-2000/326/22/TB-3 dt 15/7/200), River is classified in categories viz A-I to A-IV. Mithi River is categorized as A-IV. As per this GR for this category, 500 m on either side of the road- NDZ for any type of industry. Only green & orange industries with pollution control devices are allowed within 500 m to 1000 m.*(IITB, 2006)*	**MPCB:** The Government of Maharashtra has scrapped the Industrial policy on river catchment of 2000.	Committee feels that scrapping of RRZ policy for river protection is against the environment. **Hon'ble Supreme Court should consider to restore this circular with immediate effect.** For robust protection plan of Mithi, red category industries location policy (As per industrial policy on river catchment, as per the Department of Environment (GR No MMV-2000/326/22/TB-3 dt 15/7/200), River is classified in categories viz A-I to A-IV. Mithi River is categorized as A-IV. As per this GR for this category, 500 m on either side of the road- NDZ for any type of industry. Only

			green & orange industries with pollution control devices are allowed within 500 m to 1000 m) which was already specified. The River Regulation Zone policy of Government of Maharashtra should be restored and made more robust which will help in protection of Mithi river

2.4 <u>Rejuvenation of River</u>

Sr. No	Recommendations (Ref)	Present Status (As per reports received from Authority)	Remarks of the Committee
01	Rehabilitation of riverbeds and lakes through phytoremediation and ecological engineering *(FFC, 2006).*	**MMRDA:** During the entire construction work no damages/destruction were done to the existing mangroves. Therefore, the existing mangroves are protected.	In Powai lake and also in Mithi River severe pollution observed. No specific efforts are seen to avoid pollution. This should be implemented immediatly. Recommendation have been given by NEERI (2014), MPCB and also in this report.
02	Providing River flushing system to initiate rejuvenation of river	**MCGM:** There is no arrangement of providing gates and walls of Vihar and Powai	It seems that no efforts have taken By MCGM to study and Examine

	channel by providing 0.6 m gates at Vihar and Powai spillway dams. 2700 M.L. of volume (Oct to May) (*FFC, 2006*)	spill way dams. Overflow of both dams flow from the top at dam and gates cannot be provided on existing spillway of dams.	about this possibility of providing gates by some expert agency or Institute.
03	Declaring the river an eco-zone and the settlements falling under this zone should be evacuated and the structures should be demolished *(IITB, 2006).*	MMRDPA said that MMRDA and MCGM have carried out removal of encroachment and data is already submitted**.**	Eco-rejuvenation plan can be used with more study given in this report.
04	**Construction of retaining wall-** It has to be realized that any little surface flow generated beyond the confines of the channel has now to drain compulsorily through storm water drainage system, and unless this drainage system is of adequate capacity and conditions, may lead to localized flooding of moderately low lying areas, especially at very heavy rainfall conditions. This is evident from the analysis of DEM at fine vertical resolution of 20cm *(IITB, 2014).*	Retaining wall partially done. **Future plans by MCGM** MCGM has proposed to complete remaining work of 25 % at various phases in future. **Future plans by MMRDA** MMRDA has proposed to complete remaining work of 8% in future.	Retaining walls along the river at most places were not necessary and it led to cut off the nerves of river at the bottom as well as at the top. Specific areas retaining walls need to be broken and redesigned as per the recommendations given by this committee.
05	Catchment area of this river must have a green cover to the extent of 33% of the total area. After service road, in a belt not	**MMRDA** Due to paucity of land space buffer zone has not been provided. However, beautification	This should be implemented immediately. A plan of eco-restoration and green

	narrower than 15m, trees, shrubs, and forbs (herbs and shrubs) should be planted in the buffer zone *(IITB, 2006; IITB, 2014)*	along the bank at Ch.1280 m to 2400.0m towards BKC side has been developed and green-coverage has been partially achieved. It can be observed that from Mahim causeway (ch.0.0m) to Mini-confluence ch.3000.0 m towards Dharavi side already suffient green coverage of mangroves and Mahim Nature Park is existing. Further, a strip of about 50.0 m vide and length 2.0 kmtr. at BKC side is reserved for gardening purpose to create further greenway.	buffer zone is given in this report which should be adopted.
06	Slope stabilization: Bioengineered, Biotechnical, Bio- Structural (Construction of Gabion wall) *(NEERI, 2015).*	**MMRDA:** In eco-sentitive zone near mangroves, gabbion wall provided at ch.1300.0m to 2300.0m BKC side & at ch.500.0m to ch.3000.0m. At Dharavi side, already sufficient green patch covered with mangroves is existing. Therefore, natural slope stabilization is persisting.	Stabilization work should be carried out in MMRDA areas, Gabion walls have been used however other places, bio engineered walls should be considered after detailed study.
07	Use of Willow Spilling,Geo-Textiles, Root wads, Fascines, Green Vegetation, Coconut/Jute fibre rolls, Grasscrete, RCC KellenerJettys,Submerged Vanes,Geo- Celletc.and adopt effective measures of bio-remediation and pollution	No information received from authority.	The techno economic feasibility should be studied as given in recommendation of this report.

	treatment (*NEERI, 2015).*		
8	A Strategy to rejuvenate the inert channel environment (*NEERI, 2015).*	**MMRDA:** Anoxic Bio-Remediation Technology is being adopted in the Mithi River channel for rejuvenation. In this methodology Bio-remedial liquid named persnickety-713 product is used.	This technology use of bacteria Persnickety-713 is not suitable for Mithi as it is tidally influenced river. The study carried out earlier as also data given in this report shows that it has no positive impact on water quality of Mithi.
9	Restoration and rehabilitation of mangrove forest areas *(FFC, 2006)*	**MMRDA** The growth of mangroves has been improved between ch.645 m to 1005 m at Vakola Nalla (Dnyaneshwar Nagar side).	While executing widening balance work, precautions should be taken to save mangroves. It is also important to not allow mangroves to grown in areas which are for holding flood water and are providing volume for interim period. Dredging in those areas where silts are accumulating should be carried.
10	The restoration and creation of wetlands along the river can significantly reduce heavy metal, oil and grease loads from water. *(IITB, 2006)*	No information received from authority.	To be studied in detail and should be implemented.

2.5 Encroachment Related Issues

Sr. No	Recommendations (Ref)	Present Status (As per reports received from Authority)	Remarks of the Committee
01	Removal of encroachment along the banks of river- 1st Phase- 0 to 15 m; 2nd Phase – 15 to 30m; 3rd phase – 30 to 45 m *(FFC, 2006; CWPRS, 2006, IITB, 2006; IITB, 2014)*	**MMRDA:** • Phase I: 2600 hutments removed for 30 m widening. • Phase II: 1128 hutment removed for 10 m widening of Vakola Nalla on either side and 5 m for Mithi River. • Balance: 367 due to Hon'ble NGT stay order. **MCGM:** • Mithi River: Phase I and II- Total encroachment 6577 • Removed - 5340 • Balance - 1237 (Retaining wall) **Vakola Nalla:** • Total encroachment - 572 • Removed - Nil	Encroachment removal is not totally satisfactory. Should be implemented immediately.

		• Balance - 575	
02	Removal and rehabilitation of human population from the river bank and flood plain should be completed on priority basis and a maximum buffer between the river and human inhabitation has to be enforced (*IITB, 2014)*	**MMRDA:** Hutment dwellers removed rehabilated as PAPs and service road is provided which acts as buffer zone.	Proper rehabilitation program should be prepared before removal of encroachment.
03	River bank upto 50 m on either side of the river must be cleared. In this zone grasses and shrubs can be planted for optimizing drainage and percolation. *(NEERI, 2014)*	**MMRDA:** There were considerable constraints like permanent structure, religious structures, rehabilitation of PAP's Maximum efforts have been taken for clearing the encroachments and creation of service roads as per the directions of MRDPA	To save Mithi River from further deterioration, this recommendation should be implemented immediately. Recommendation in this report to be implemented.
04	Removal of encroachment for widening of river *(FFC, 2006).*		Incomplete. Should be taken on priority.

2.6 Organization and Social Issues Related

Sr. No	Recommendations (Ref)	Present Status (As per reports received from Authority)	Remarks of the Committee
01	Compilation of seismic data and hydrologic data *(FFC, 2006)*	**MMRDA**: Hydrological study was carried out for Mithi by IIT B and CWPRS; for Dahisar, Oshiware, &Poisar by WAPCOS and Ulhas and Waldhuni rivers by MERI Nashik.	There should be one centralized data center so that all data from different agencies can be accessed by anybody. This data should be placed on website to use for further research works also.
02	Setting up Mumbai Transportation council *(FFC, 2006)*	**MRDPA** Setting up of Unified Mumbai Metropolitan Transport Authority(UMMTA) in process	Not Implemented. Should be implemented immediately at government level.
03	Urban Hydrology Unit for MCGM *(FFC, 2006)*	**MMRDA**: Hydrology Unit was set up in MMRDA	Not Implemented. Though recommendation is given in 2006, till date it is not implemented.
04	As per section 43 of the MR and TP Act, 1966 it is mandatory for any person to obtain permission in writing of the Planning Authority before undertaking and development of land *(IITB, 2006).*	**MCGM** 100% Compliance	Not Followed in the Mithi Zone.

05	A data center/cell exclusively devoted to compiling all the studies/ data relevant to the Mithi catchment needs to be established *(IITB, 2014)*	**MRDPA** mentioned about *Meeting held* in this regard	This should be implemented immediately.
06	A web site on Mithi related information should be designed *(IITB, 2014)*	Link to MRDPA Web page: https://mmrda.maharashtra.gov.in/mithi-river-development-and-protection-authority-mrdpa-	Website should update regular progress and status of the river quality, flood etc.
07	Establish a single advisory body of experts from across the world representing fields like environment, ecology, planning, sociology, geoinformatics, urban drainage/civil engineering, water resources, coastal engineering etc., who will help formulate a time bound action plan based on a shared vision of the river by stake holders of the river. *(IITB, 2014).*	**MRDPA** said that Experts of IIT/ NEERI/ CWPRS etc. are consulted by MMRDA and MCGM	MRDPA does not hold even regular meetings to update members of the committee. Last meeting held of the committee was on 14 November 2013.
08	Set up of Emergency Support Function (ESF). ESF are the essentials of Emergency Management that provide the coordination mechanisms among various agencies *(IITB, 2014)*	**MRDPA** said that Disaster Management Cell of MCGM and MMRDA are established	This should be implemented immediately.

From above table, it is observed that though the recommendations as suggested by various committees suggested time to time from 2006, authorities have not implemented many of them. The various recommendations which are partially implemented or totally not implemented should be taken on priority by the authorities to execute the same as flooding and pollution can be reduced. All recommendations of all committees and based on current situation, a set of short and long term recommendations are given in this report alongwith plan of eco-rejuvenation of the Mithi river.

CHAPTER 3

COMMITTEE'S OBSERVATIONS

3.1. Different aspects of Mithi

The reports received from MCGM, MMRDA and MRDPA authorities, the present committee lists its observations under following different aspects which includes the work done by authorities and committee's observation for same.

- Widening of Mithi River
- Deepening of Mithi River
- Desilting work
- Removal of encroachments
- Rehabilitation of the Project Affected peoples (PAP)
- Construction of retaining wall
- Flood control works
- Creation of Buffer Zone along the Bank of the river
- Construction of service roads along the bank
- Action taken by MIAL within airport area
- Construction of sewage line along the bank area to arrest entry of sewage directly into river
- Construction of Sewerage Treatment Plants (STPs)
- Solid waste management in the River catchment
- Action plan on unauthorized industrial units discharging effluent without treatment into the river.
- Action on major outfall discharging their flow into River without following norms of BOD and COD.
- Rock Excavations
- Mangrove Conservation
- Beautification Work
- Remodeling and Widening of Bridges

- Setting up of disaster management Cell and its functioning

3.2. Administrative Limits of Mithi River and Vakola Nalla

Total length of the Mithi River system is 17.84 km and length of the Vakola Nalla is 3.8 km. For carrying out various works of the Mithi River and Vakola Nalla, administratively for planning as well as for execution of works, these lengths are divided within the authorities MCGM, MMRDA and MIAL (inside airport only) by Gov. of Maharashtra as enlisted below in Table 4.1. The MRDPA is the overall coordinating agency between the implementing agencies of MCGM, MMRDA and MIAL. The MPCB is the statutory body related to the pollution issues.

Table 3.1 Administrative limits of Mithi River and Vakola Nalla

River /Nalla	**Total length** (Km)	**Catchment Area** (ha)	**MCGM** (Limit)		**MMRDA**		**MIAL**
			Length (Km)	**Limit** (Km)	**Length** (Km)	**Limit**	**Length** (Km)
Mithi River	17.84	7295	10.76	Vihar Lake to CST Bridge	6.0	CST Bridge to Mahim Creek	1.08 (airport stretches)
Vakola Nalla	3.8	907	2.0	Airport to Vakola Bridge on SCLR	1.8	Vakola Bridge on SCLR to BKC	NIL

As reported by various agencies to the Committee, different works enlisted in section 3.1 were carried out at various stretches of Mithi River as per the jurisdiction given in Table 3.1.

3.2.1. Committee's Observation

For the improvement of Mithi River system, various agencies such as MMRDA, MCGM, MIAL, MPCB and various Departments of the state government are involved. As observed by FFC (FFC, 2006), it was observed by this committee also, there is no proper coordination between the various agencies involved as well as within the internal Departments of the concerned Agency resulting in delay of works.

3.3. Work Done on the Improvement of Mithi River

As per the status report submitted by MRDPA vide "Status Note on Mithi River Development Works" dated 5th October 2017 and also various submissions received from MCGM authorities, the status report of the actual work done by these on improvement and development of Mithi River and Vakola Nalla system is described below.

Disclaimer: *The details are based on information obtained from MRDPA, MMRDA, MCGM and MPCB.*

3.3.1 Present Status of Physical Progress of Various Works Done

The recommended width and depth of the Mithi River suggested by Chitale committee (FFC, 2006) and CWPRS (CWPRS, 2006) to increase the discharge carrying capacity to avoid floods as experienced during 26th -27th July 2005 and achieved depth as decided by MRDPA are enlisted in Annexure III. Various works executed by MMRDA and MCGM authorities for improvement of the Mithi River and Vakola Nalla with reference to the recommendations suggested by various Committees through their reports are enlisted in Annexure –D

MRDPA has submitted the photographs of the images of the year 2005 and 2017 wherein we can observe the change in width of the Mithi River with respect to the conditions of year 2005 due to widening as shown in Fig. 3.1 and 3.2 (Source: MRDPA).

Fig. 3.1 Mithi River satellite image for the year 2005 and 2017-Ch. 8900 to 10000 m.

Fig. 3.2 Mithi River satellite image for the year 2005 and 2017-Ch 5900 to 7900 m.

During the site visit along with MMRDA and MCGM officials on 10/11/2017, photographs of widened and deepened Mithi River are taken and are shown in Fig 3.3.

Fig. 3.3 Widening and Deepening of Mithi River (as on 10th Nov. 2017)

Fig. 3.4 Obstruction of Mithi River flow due to bottleneck at Bridge

As reported by MRDPA, CWPRS vide letter dated 11th November 2011 (Annexure IV) stated, "The increase in the conveyance capacity is more than 3 times, compared to the conditions in 2005. The basin capacity which is important for holding a part of the floodwaters, has more than doubled."

3.3.1.1 Impacts of Widening and Deepening- Committee's Observation

As suggested by the Chitale committee (FFC, 2006) and CWPRS (CWPRS, 2006), widening and deepening of the Mithi River is carried out as per the widths decided by the MRDPA. However, in some part of the Mithi River as given in Annexure III, proposed width of the River as suggested by CWPRS has been reduced to some extent due to

practical site problems which may cause flooding problems in future. Also the section of Mithi River for widening suggested by CWPRS was as trapezoidal section. However, MRDPA adopted rectangular section. Due to change in section from trapezoidal to rectangular also, proposed carrying capacity of the river has been reduced as shown in Fig 3.5.

Though the widening and deepening of river is carried out to some extent, it is very important to widen the bridges across also. For example, the Mahim Causeway Bridge is a major bottleneck for flood discharge and causes considerable afflux conditions in the upstream river reaches especially for extreme flood conditions (Fig. 3.4). The five bridge structures from Mahim Causeway to Dharavi Bridge would have further adverse effect due to additional afflux conditions especially for extreme events of flooding.

From the physical work progress as reported by MCGM and MMRDA it can be stated that deepening and widening work of the river has been completed to 90% to 95%. Thus as compared to 26th July 2005 conditions, discharge carrying as well as basin capacity of the river has increased.

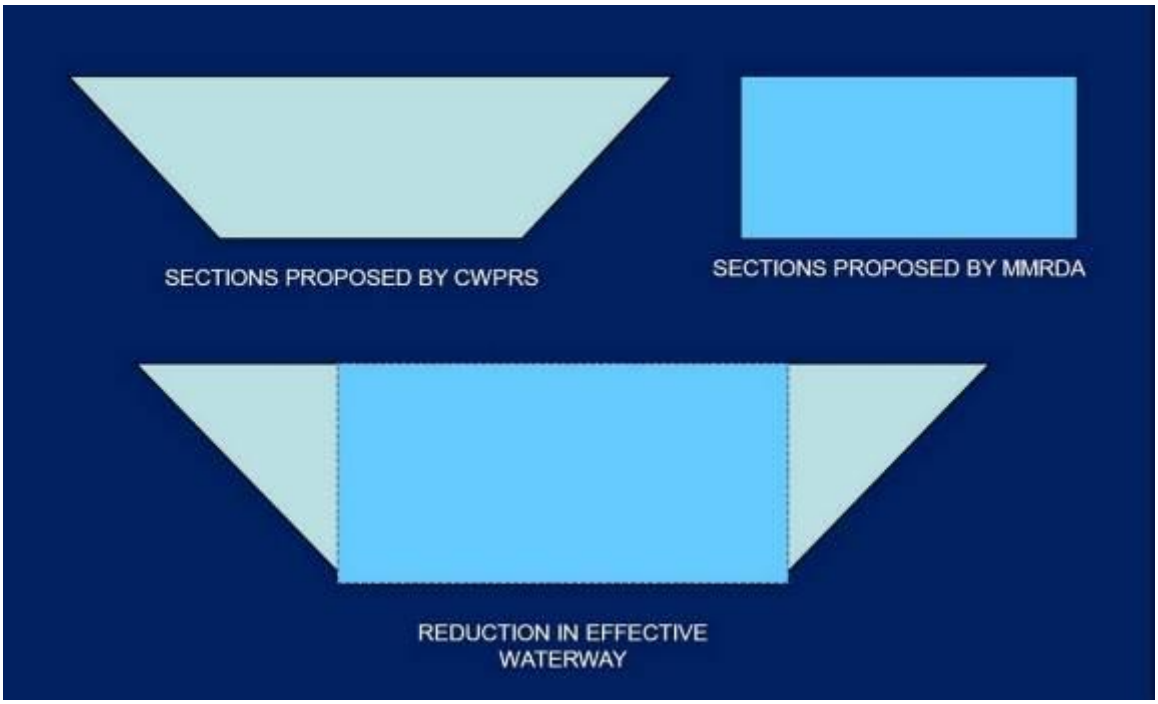


Fig. 3.5 Reduction in waterway due to change in proposed section

3.3.2 Service Road and Buffer Zone – Committee's Observation

The work of service road and beautification work along the banks of the river is carried out at some part of the MMRDA portion only (Fig.3.6). Provision of 20 m buffer zone along the bank of the Mithi River was suggested by CWPRS (CWPRS, 2006) as well as IITB (IITB, 2006) vide their reports by which not only damage to flood plain prone area would have been avoided but pollution due to the encroachers along the banks by dumping solid waste as well as sewage disposal could have been avoided. However, from the reports, it has been realized that no efforts had been taken by the authorities' specifically in MCGM area to provide buffer zone area as well as for provision of service roads. The service road details for Mithi river and Vakolla Nalla is provided in Annexure-V as reported by MMRDA and MCGM. During the site visit on 10th November 2017, it was observed that at many places encroachments are along the bank of the river (Fig. 3.7) and solid waste is being dumped by the scrap yards as well as encroachers directly into the river (Fig. 3.8) and thus blocking the flow of the river as well as polluting the river drastically. Thus, service roads and buffer zones should be provided along the banks of the Mithi River.

Fig. 3.6 Beautification work and service road at BKC area

Fig 3.7 Encroachment along the path of the Mithi River

Fig 3.8 Encroachment along the bank and dumping of Solid waste into the Mithi River

3.3.3 Impact of Construction of Retaining Wall

As per the suggestion given by CWPRS vide their flood modeling study (CWPRS, 2006), trapezoidal section of the river was suggested as shown in Fig.3.5. However, MRDPA in their Empowered committee meetings decided to construct rectangular section with construction of retaining wall on both the banks of the Mithi River. MRDPA vide their *"Brief Note on Mithi River works in Bandra – Kurla Complex"* stated the objectives of the construction of retaining wall as:

- To provide better tidal exchange

- To increase discharging capacity during floods.
- To control the encroachments
- To train the river.
- To restrict filling of debris
- To maintain designed waterway
- To protect the banks from erosion.
- To channelize the flow.

The retaining walls constructed along Mithi River can be classified in to three categories.

1. Upper reaches of Mithi River– uptoSakinaka airport side - retaining walls constructed by MCGM with no tidal effect.
2. Middle reaches of Mithi River – airport side - retaining walls constructed by MIAL- airport authority; further after airport, retaining walls constructed by MCGM upto CST Bridge with tidal effect.
3. Lower reaches of Mithi River – retaining walls constructed by MMRDA from CST bridge side to Mahimcauseway - end of Mithi River with tidal effect.

Fig. 3.9 shows the constructed retaining walls in upper, middle and lower reaches of the Mithi River at various locations. MMRDA in their jurisdiction of lower reach portion have adopted touch piling method for construction of retaining wall. MIAL in their jurisdiction have constructed RCC retaining wall with height above the ground for security and safety purpose of the airport operational area. MCGM in their jurisdiction have constructed RCC retaining wall with about 3.0 m height above the natural ground level.

Fig. 3.9 Retaining wall at Upper Reach, Middle Reach and Lower Reach (as on 10/11/2017)

3.3.3.1 Committee's Observation

The retaining walls are made without considering any riverine hydrology, environmental and flooding aspects. The walls are also made above ground (even upto 3m in many locations) without giving any scope for water to flow to and fro from the river during a high rainfall conditions by obstructing the entire river hydrology. This may lead to flooding (localized) in that area adjacent to the retaining wall. This problem may arise specifically in upper reach portions and middle reach portion of the MCGM area.

In middle reach, in MIAL area, it is understood about the security and safety purpose they raised wall above ground and also they have made proper drainage arrangements in their premises to avoid the flooding. In lower reach area of MMRDA part, as they have adopted touch piling method, the adjacent storm water can enter in river through permeable gaps in between the piles. Also there are major grievances about the construction and rising of retaining wall by NGOs. As such it is necessary to modify the retaining wall portion in upper reach and middle reach area of MCGM.

3.4 Encroachment Removal Status

As per the data provided by MRDPA vide their letter dated 5th October 2017, present status of the encroachment removal and also the balance work of removal of encroachments along the Mithi River and Vakola Nalla in MMRDA and MCGM area is given in Annexure E

As such, total encroachment along the banks of Mithi River and Vakola Nalla is 11248, of which 9069 structures are removed and 2179 structures are to be removed. From Annexure E it can be observed that removal of encroachment along the bank of the Mithi River and Vakola Nalla in MMRDA potion is considered while constructing wall and service road. However, in MCGM part,it seems that they have considered only for construction of retaining wall and no consideration for service road.

As per the letter of DMC (Zone- V) of MCGM dated 17th November, 2017, it has been mentioned that there are about 1277 structures to be removed for construction of retaining wall and service road and MRDPA letter dated 5th October, 2017 says total 1812 encroachments needs to be removed. The numbers are different from different authorities thus it is felt that is no proper coordination between the authorities and also within the various departments of authorities. During the site visit of the committee on 10th November 2017, encroachment was observed along the banks of the river as shown in Fig. 3.10.

Fig 3.10 Encroachment along the path and bank of the Mithi River

3.4.1 Committee's Observation

In both the parts of MMRDA and MCGM along Mithi River, they have not taken removal of encroachment for provision of buffer zone as suggested by various committees. Thus the total number of encroachment as well as to be removed, may increase drastically. Encroachment by slums along the path and banks of the river obstructs the flow of the River and increase the environmental pollution in terms of sewage and solid wastes. During the floods, it is also a threat to the life of people residing in this encroached areas along the banks which is being the part of the flood plain. There is urgent need to remove encroachment along the path, bank also within the proposed buffer zone area.

3.5 Status of Rehabilitation of Eligible Slum Dwellers

As per the data given by MRDPA vide their letter dated 5th October 2017, the rehabilitation of eligible slum dwellers removed from the banks of Mithi River and Vakola Nalla is enlisted in Annexure –F. It is necessary to make the proper planning of rehabilitation program for shifting of the eligible slum dwellers from the encroached area along the path and proposed zone area of the Mithi River system.

3.5.1. Committee's Observation

It was observed that from Mithi catchment there is no much rehabilitation of slum dwellers. The many units mentioned by MRDPA given in Annexure F does not form a part of Mithi zone.

3.6 Desilting work of Mithi River and Vakola Nalla

It has been informed by the authorities that the desilting work is being carried out in three phase that is before onset of monsoon (60 % of the total estimated quantity), during monsoon and after monsoon. As per the data given by the respective authorities, the factual position of removal of desilting is enlisted in Annexure –G.

3.6.1. Committee's observation

During the site visit, it was observed that at many places solid waste was dumped into the river and also silt was lying at some places (Fig. 3.11). As per committees' opinion, desilting work is the very important activity to keep the flow of the river smooth during the entire year period so it is necessary to carry out the desilting work continuously (i.e. on monthly basis), the justification presented by NEERI 2015 report is presented in Annexure-VI and therefore it should not be in only three phases.

Fig. 3.11 Debris, silt and solid waste lying in Mithi River (As on 10th November 2017)

3.7 Remodeling and Widening of Bridges

As per the information received from Executive Engineer (Bridges) E.S. of MCGM vide their letter dated 09th November 2017, out of 12 Nos. of bridges on Mithi River (Fig.1 in Annexure-VII (a)), four bridges namely Krantinagar Bridge, MTNL Bridge, Ashok Nagar Bridge and Bamandaya bridge are remodeled, widened and opened for traffic. It was also informed by MMRDA that the certain works are proposed in near months for 3 bridges named Tansa Bridge, Vaitarana Bridge and Mahim Causeway Bridge. The details are presented in Annexure-VII (b).

The present status of all other bridges as reported by MCGM is enlisted in Annexure - H.

3.7.1. Committee's Observations

Though the widening and deepening of river is carried out to some extent, it is very important to widen the bridges across the. The Mahim Causeway Bridge is a major bottleneck for flood discharge and causes considerable afflux conditions in the upstream river reaches especially for extreme flood conditions (Fig. 3.4). The five bridge structures from Mahim Causeway to Dharavi Bridge would have further adverse effect due to additional afflux conditions especially for extreme events of flooding. As such it is very important to take up the remodeling work of the Bridges on top priority basis for smooth flow of the Mithi River system.

3.8 Construction of Sewer Line Along the River Bank

As per the recommendation of various committees, it was suggested to construct sewer line network along the Mithi River alignment besides the banks of the river and also in catchment so that unauthorized sewage disposal into the river can be arrested and pollution could be reduced. As per the data received from MCGM, the works of the sewer lines are initiated and work is in progress at various stages. Annexure –I (Annexure Set B) enlists the present status of the work done for provision of sewer line so far along the banks of the river which has been done.

3.8.1. Committee's Observation

During the field visit on the banks of Mithi River on 10th November 2017, the Committee observed that the work of sewer lines only initiated in many locations, partially done in few locations and work progress is totally unsatisfactory. To save the Mithi River from the environmental disaster, the MCGM has to complete the sewer lines works on both sides of the River on a priority basis and connect the sewer lines to collect all sewage for appropriate treatment.

3.9. Mithi River Works within Airport Area by MIAL

Total length of the Mithi River along the eastern edge of Chatrapati Shivaji International Airport (CSIA) boundary is 3080 m. Out of this, approximately 400m length of Mithi

River passes through active aeronautical area, under Runway 09/27 and parallel Taxiway N1 via existing culverts. This was one of the main reason of flooding during the floods of 26th July 2005 in the catchment of the Mithi River. As per the recommendations of various committees suggested through their reports about widening and deepening of the Mithi River for increase in discharge carrying capacity, MIAL had appointed committee of IITB to suggest the modifications to existing Mithi River system passing through their premises. The following objectives were decided by MIAL authority for improvement of Mithi River as well as for smooth operation of their activities of runway (*Source: documents submitted by MIAL*).

- Construction of additional Channel
- Construction of Mithi River retaining wall
- Construction of GSE bridge
- Mithi River cleaning-every year

As per the reports of IITB, they had suggested additional channel with two bays having width of 12 m in addition to the existing channel of Mithi River as shown in Fig. 3.12. For the safety of the airport area, MIAL has constructed the retaining wall with larger height adjacent to their boundary as shown in Fig. 3.13. As raising the height adjacent to the airport boundary is for the safety purpose, construction of the retaining wall seems justified.

Fig.3.12 Additional Channel in MIAL area to increase carrying capacity of Mithi River

Fig. 3.13 Retaining wall adjoin to MIAL area of Mithi River

For Access from Terminal 2 apron to GSE facility, a bridge was proposed over Mithi River. As per MIAL, GSE facilities are essential services for aircraft operations and are required to ensure efficiency and safety of aircraft operations. As per the design study conducted by IIT, Bombay and CWPRS, GSE Bridge having 3 spans with 2 piers of 800 mm width was proposed with RCC box section and the same has been constructed at site as shown in Fig. 3.14. The clear waterway is 38.14 m which is more than width proposed by MRDPA i.e. 35 M.

Fig. 3.14 GSE Bridge on Mithi River

3.9.1. Committee's Observation

From the site visit and observations and also as per the works carried out by MIAL for improvement of Mithi River system for increase in discharge capacity, it seems that there should not be any problem of flooding in MIAL area and for the capacity of the river for the designed rainfall return period conditions**.** As per the analysis carried out in sec 3.14 airport has certain accumulation of water on 29 august 2017 but during field visit and discussion with MIAL people no problem of flooding was informed. Also, MIAL is carrying out regular desiltation works in their area of the Mithi River.

3.10 Setting-up of Disaster Management Cell

Floods being the natural disaster, and frequently occurring in Mumbai during the monsoon period especially when rainfall coincides with tides, it was necessary to act on disaster management planning. Also, one of the important suggestions of the Chitale committee (FFC, 2006) was setting up the advanced and efficient Disaster Management Cell for quick response during the flood disaster management and also acting as a coordination unit between various agencies and departments of the government and private organizations.

Accordingly, as per the information received, MCGM has established the disaster management cell at their head office (Fig. 3.15) and individual disaster control room at each ward level. Details of the disaster management cell as reported are as under *(Source: Information from MCGM)*.

- Emergency Operations Centre (EOC) is fully equipped with uninterrupted power supply and various modes of communications.
- Dedicated phone line: 1916 (for complaints)- 10 nos.
- Hot Lines connected with 21 external agencies, 4 Major and 2 peripheral hospitals, 24 ward offices.
- Provision of cyclone centers.
- 60 automatic weather stations with 15 min interval records.
- Ward Level/Dept. Level SOPS
- Dewatering Pumps at low level areas.

- 24 JCBs and 48 dumpers have been procured.
- Six boats and twelve kayaks to enhance disaster preparedness.
- Scaled down versions of fully equipped EOC has been established at all 24 wards of the city along with communication equipment and technical staff with manpower and machinery.
- More than 4500 CCTV cameras are installed in suburb and city area and monitored by Mumbai Police. Feedback of the same is provided to disaster management cell.
- Prepositioning of rescue teams.

Fig. 3.15 Disaster management cell at MCGM head office

3.10.1 Committee's Observation

From the above information, the Committee observed that MCGM has set up the disaster management cell in an appropriate way. However, there is no proper flood warning system design for future projection of flood along the bank of the River. Proper training and awareness to the public residing in the nearby flood prone area of the river should be carried out periodically by setting up separate Centers and Staff at each ward level. Complete details of flood mitigation measures and Relief Centers during the floods should be published in Newspapers and electronic media before onset of monsoon period.

3.11 Physical Model Study of Mithi River (3D)

MRDPA has appointed CWPRS to carry out the physical model study of the Mithi River system and to suggest remedial long term measures for improvement of the River system to avoid flooding for future rainfall projections for different return periods**.**

- Salient Features of the Mithi River model (*Source: MRDPA report*)
    - Mithi river Hangar 80 m x 26.50 m - Construction by CPWD
    - Laying of Model tray inside the Hangar using river cross sections and Bathymetry Chart of Mahim Bay
    - Providing Automatic Tide Generation (ATG) System
    - Providing Discharge Control System for generation of river discharge hydrographs
    - Providing Data Acquisition System (DAS) for measuring water levels and currents
    - Providing water circulations and Pumping System
    - Providing Power Supply and Electrical works

Layout of the physical model prepared by the CWPRS is shown Fig. 3.16 and 3.17.

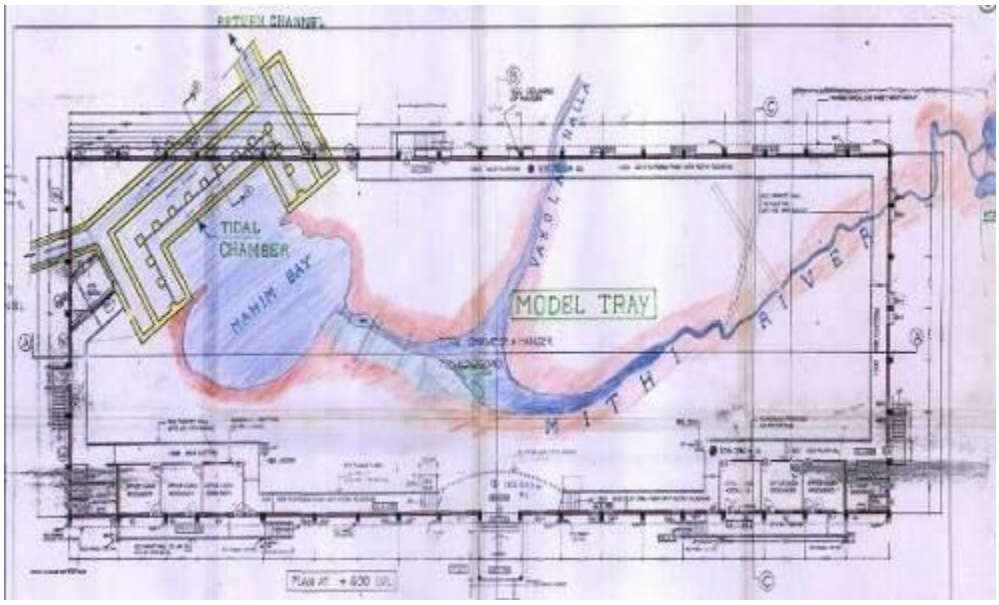


Fig. 3.16 Layout of the physical model of Mithi River at CWPRS (Source: CWPRS)

Fig. 3.17 Physical set up of model of Mithi River at CWPRS (Source: MRDPA)

3.11.1 Committee's Observation

One of the Committee Member visited the physical model site at CWPRS, Pune. However, it is observed that the physical model is still incomplete and not ready for physical run. The MRDPA has to provide sufficient funds to CWPRS to complete the work and make the physical model functional and get the complete picture for various scenarios and the same to be appropriately implemented in the field.

3.12 Ecological Restoration - Mangrove Conservation

Land Use Land Cover LU/LC of 2005 & 2017 (Latest available date) and change detection maps indicating changes in forest areas, especially Mangroves, in Mithi River catchment, especially at outlet at Mahim. Fig. 3.18 shows the glimpses of variations.

Fig. 3.18: Changes in Mangrove forest at Mahim, outlet region of Mithi River (Ref. MRDPA, Report, Oct. 2017)

Due to the partial implementation of different committee's recommendations, the clarity on river rejuvenation plan is lost. The mangroves are affected by the construction of retaining walls. The pollution load entering into river adversely affects the mangrove vegetation. The construction of retaining wall is neither social solution nor sustainable solution. Moreover, this solution adversely impacts the ecology and flora and fauna, as well as the growth of mangroves in that area.

3.12.1 Committee's Observation

Due to excessive siltation mangroves have grown at new places showing that desilting has not been done by authorities. The wrong place of growth of Mangroves i.e at the mouth or river obstructs the path of flow of river as well. It is not seen as a long term solution, but seems to be one taken in a hurry, an impulsive unviable solution. Therefore, a detailed study for protection of mangrove along the Mithi river must be undertaken.

3.13 Water Quality in Mithi River – Present Status

Water sampling was conducted by NEERI during Low Tide period in the Post Monsoon in October 2017. The analyzed data was compared with data obtained in 2015 by NEERI to get an approximate assessment of the extent of further deterioration of the River. There

were 17 sampling points starting from Phule Nagar till Mahim Bay as shown in the maps (Figure 3.19 a and b). The photographs of sampling locations are shown in Annexure - VIII.

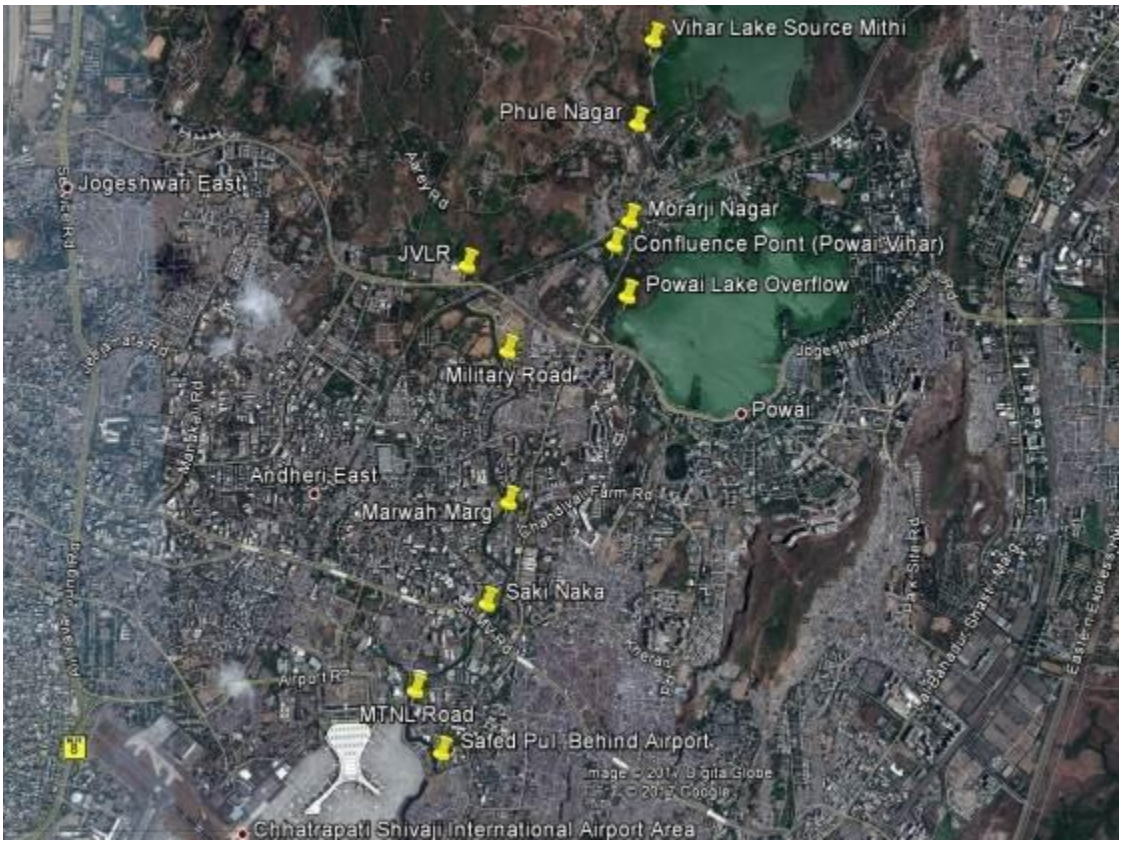


Fig. 3.19a: Sampling Locations in upper reaches

Fig. 3.19b: Sampling Locations in middle & lower reaches

Parameters were assessed to quantify the extent of pollution of a visibly polluted river (Table 1 and 2 in annexure-X). As per the water quality standards for best designated usages the river does not even fall in the A-IV water quality standards (Annexure-IX) prescribed by MPCB at most of the sampling locations.

The **pH** for all the sampling locations ranged from 7.3 to 8.2 (Table 1 in Annexure- X). The pH at the locations meet the A-III and A-IV water quality standards prescribed by MPCB.

The **Biochemical Oxygen Demand** values for the stretch of Mithi River from Phule Nagar to Mahim Bay ranged from 35 mg/L to 175 mg/L. As per the A-IV water quality standards prescribed by MPCB, BOD of river should not exceed 30mg/L. The BOD values at all the sampling locations exceeded the prescribed standards indicating the high pollution levels in the river.

The **Chemical Oxygen Demand** values ranged from 121 to 822 mg/L. As per the A-IV water quality standards prescribed by MPCB, COD of river should not exceed150 mg/L.

Thus, COD values exceeded A-IV water quality standards at most of the sampling locations except at Powai outfall and Morarji Nagar. Highest COD value was observed at Military Road. The COD: BOD ratio ranged from 2.1 to 4.7. The values of COD to BOD ratio upto 2.5 indicate sewage as the major source of pollution, whereas higher ratios indicate industrial pollution. The COD analysis was carried out till the CST Road sampling location beyond which tidal influence is observed and therefore due to high chloride interference the COD was not analyzed for the samples after CST Road to Mahim Bay. The COD values shows both domestic and industrial sources of pollution are responsible for pollution of Mithi River.

The **Total Suspended Solids** at all the sampling locations ranged from 20 to 260 mg/L. Highest TSS concentration was found at Mithi River near Military road area.

Ammonium concentration at all the sampling location ranged from 0.8 to 16.2 mg/L. Generally, the concentration of ammonium in sewage is found to be in the range of 10 to 20 mg/L.

3.13.1 Committees Observation on Comparison between Mithi River water quality in 2015 and 2017

Comparing the water quality of Mithi River in 2015 during post monsoon (Table2 in annexure-X) and 2017 (Table1 in annexure-X),it was found that the river is more polluted in 2017.

In 2015, the **pH** for all the locations ranged from 6.2 to 7.5. However, pH for all the sampling locations ranged from 7.3 to 8.2 in 2017. In both the years, the pH at the locations meet the A-III and A-IV water quality standards prescribed by MPCB (Figure 3.20 a).

In 2015, the **Biochemical Oxygen Demand** values for the stretch of Mithi River from Phule Nagar to Mahim Bay ranged from 21 to 119 mg/L. In 2017, **Biochemical Oxygen Demand** values for the stretch of Mithi River from Phule Nagar to Mahim Bay ranged from 35 mg/L to 175 mg/L. On comparing BOD values of 2015 and 2017 (Figure 3.20 b) it can be observed that at most of the sampling locations, BOD values have increased

except at two locations including Phule Nagar and Morarji Nagar. As per the AIV water quality standards prescribed by MPCB, BOD of river should not exceed 30 mg/L. The BOD values at all the sampling locations exceeded the prescribed standards in both the years and had worsened in 2017.

The **Chemical Oxygen Demand** values ranged from 43 to 320 mg/L in 2015 and 121 to 822 mg/L in 2017(Figure 3.20 c). At all the sampling locations, the COD values in 2017 are higher than that of 2015 values indicating the increased pollution levels. The **Total Suspended Solids** at all the sampling locations ranged from 22 to 220 mg/L in 2015 and 20 to 260 mg/L in 2017 (Figure 3.20 d). Highest TSS concentration was found at Mithi River near Military road area. In 2017, although TSS values are lower the higher BOD values could be due to more of dissolved solids.

Phosphate concentration ranged from 0.3 to 10.4 mg/L in 2015 and 0.1 to 6.2 mg/L in 2017 (Figure 3.20 e). **Ammoniacal nitrogen** concentration at all the sampling location ranged from 1.7 to 14 mg/L in 2015 and 0.8 to 16.2 mg/L in 2017 (Figure 4.20 f). At most of the locations, the values of concentration are higher in 2017 as compared to that in 2015.

As can be observed from the figures, the pollution load in the Mithi River has increased. The Committee observed that appropriate action has not been taken by the concerned authority to contain pollution of the river and hence the River water quality has deteriorated. As suggested by various Committees and observation made by this Committee, various actions need to be adopted on a priority basis to rejuvenate the Mithi River.

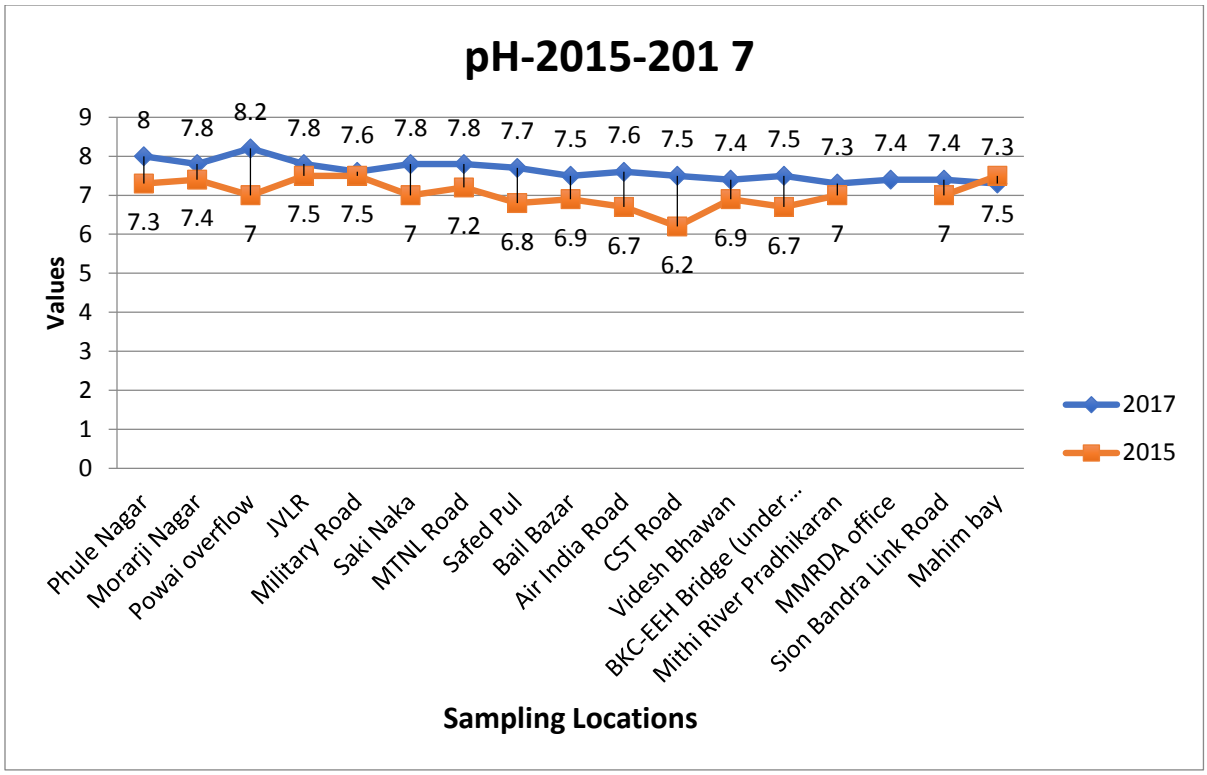


Figure 3.20 a: Mithi River (2015-2017) pH values

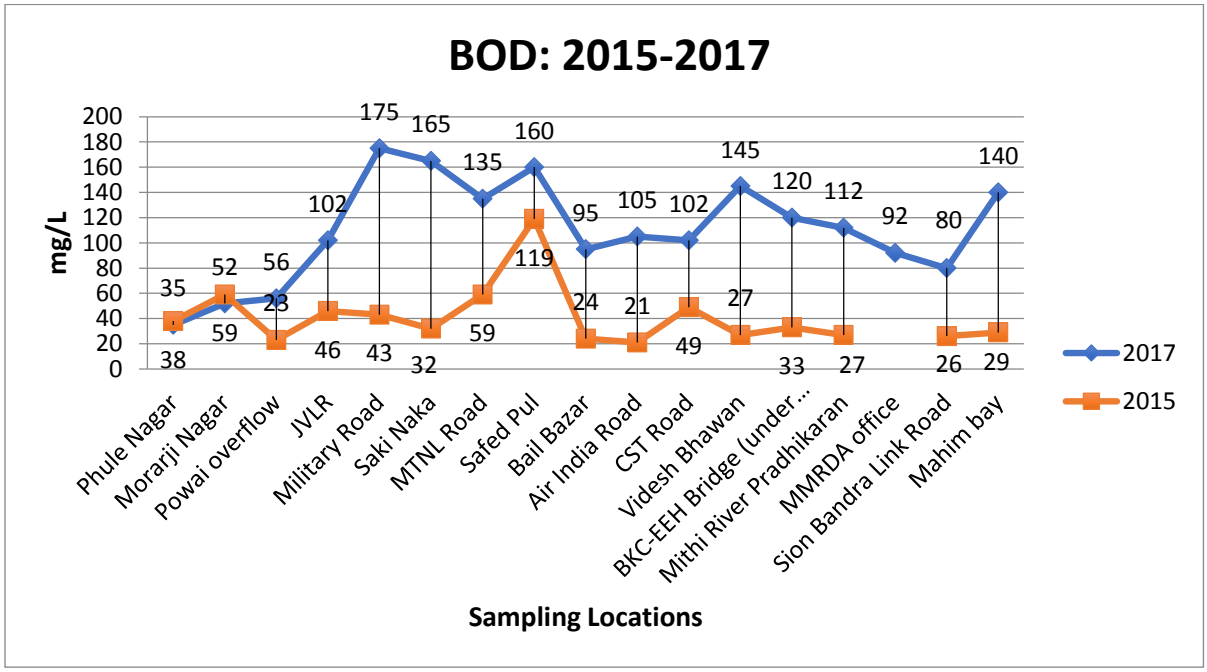


Figure 3.20 b: Mithi River (2015-2017) BOD values

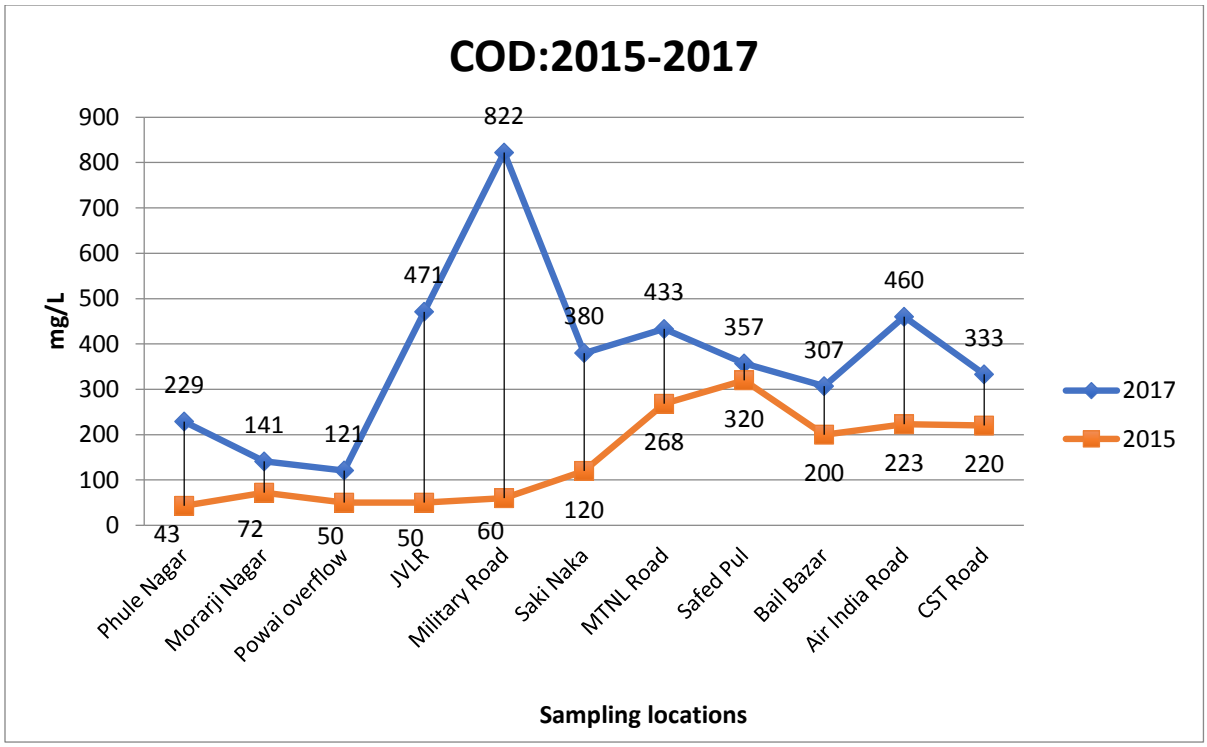


Figure 3.20 c :Mithi river (2015-2017) COD values

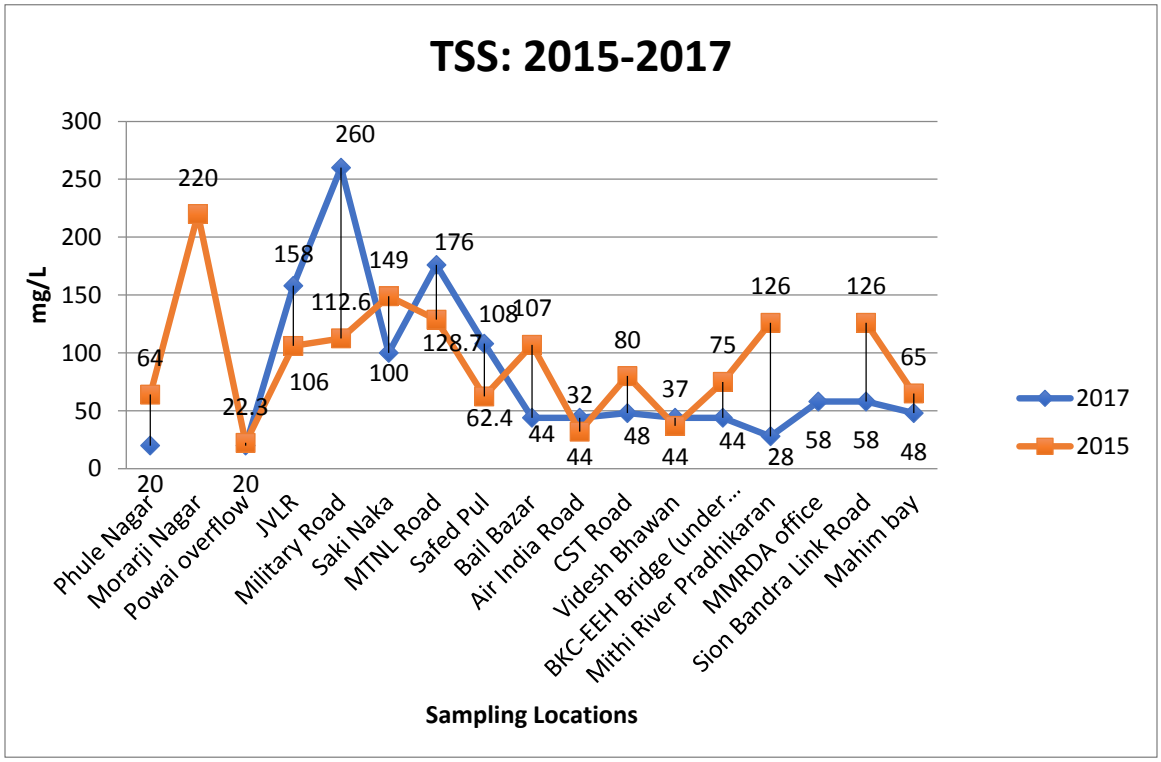


Figure 3.20 d: Mithi river (2015-2017) TSS values

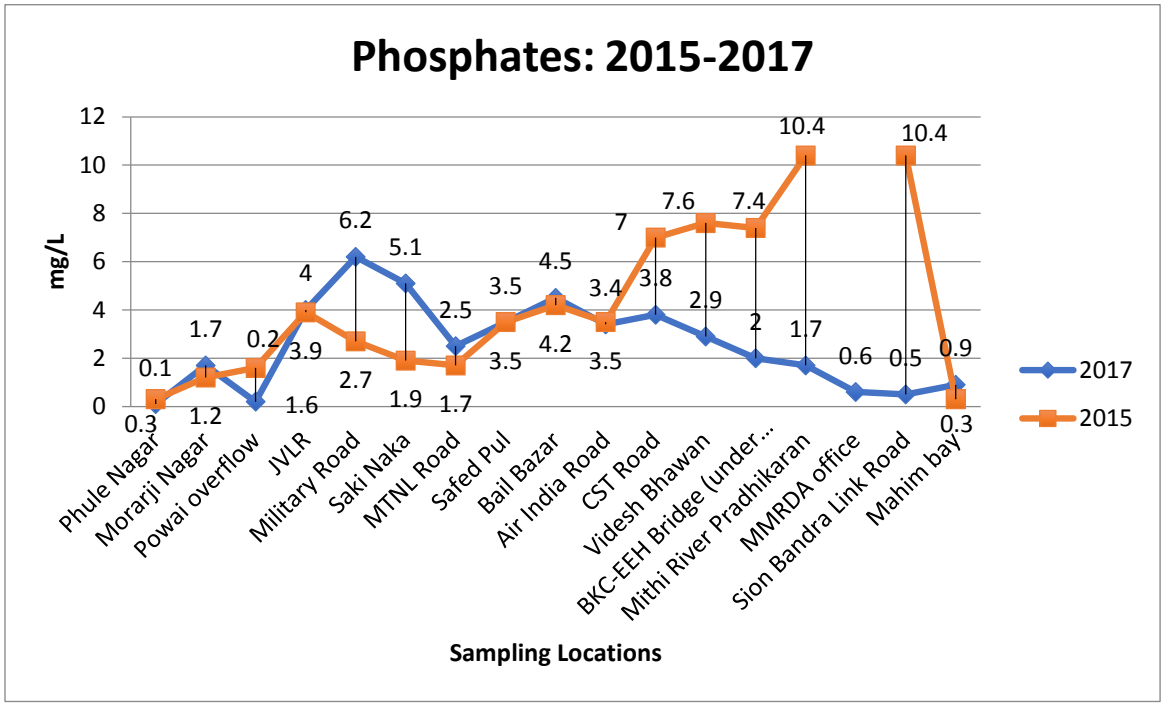


Figure 3.20 e: Mithi river (2015-2017) Phosphates values

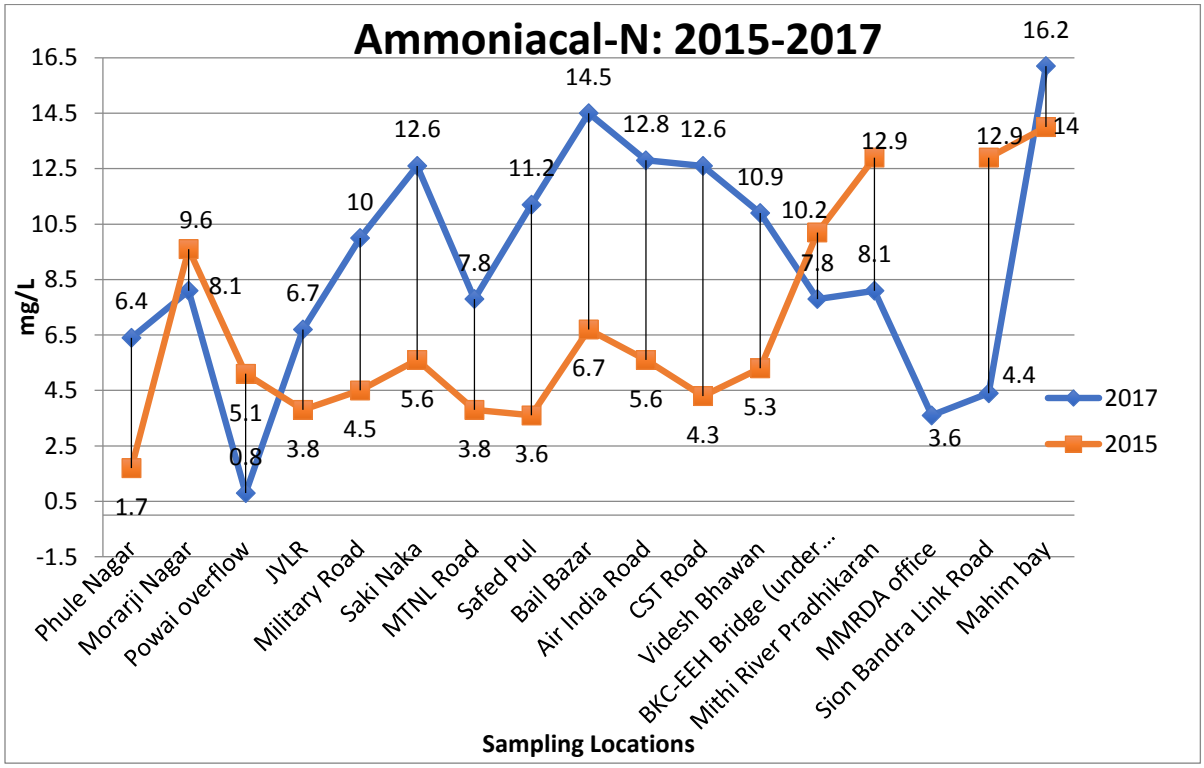


Figure 3.20 f: Mithi river (2015-2017) Ammoniacal-N values

3.14 Latest Flooding Scenario on 29th August 2017

On 29th August 2017, there was heavy rainfall in Mumbai of about 225 mm in 24 hours with coinciding high tide. At many locations, localized flooding was reported and traffic got disrupted. Accordingly, the Committee felt to look into the flooding scenario in the Mithi River catchment. To get a holistic view, satellite picture around noon time was obtained. We used Sentinel 1A satellite Ground Range Detecting (GRD) images of 29th Aug 2017 (when flooding was reported despite hardly 225mm of rains in 24 hours and 'No flooding' claims were made by the Authorities). Sentinel 1A is a European Space Agency's (ESA) microwave remote sensing satellite working with C- Band of wavelength 5.55 cm (Radar frequency is 5405 MHz). The two images are descending pass and right looking images. First we converted amplitude values into σ_0 for both images, then we done coregistration. Finally we subtracted these two images σ_0 values to observe the change.

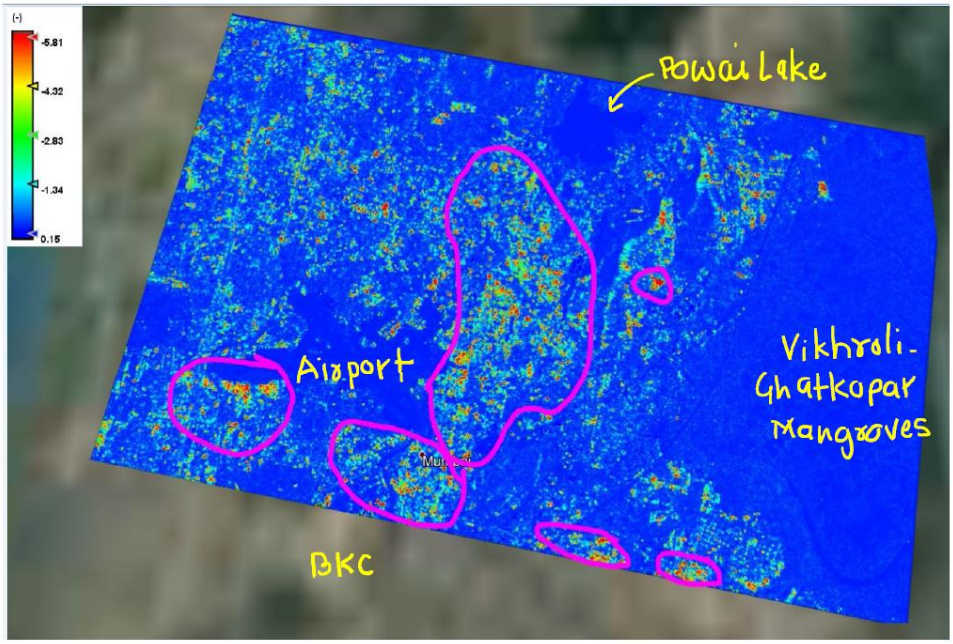


Fig. 3.21 Satellite image analysis of Mithi catchment on 19th August 2017

In the above image in Fig. 3.21, red color portions are high $\sigma_0$difference observed areas. This is due to water present in the location on 29th Aug 2017. This provides a clear

indication of problem areas (rounded off by pink line) that were affected by water logging during the satellite pass time, i.e. around noon time on 29th August, 2017.

3.14.1. Committee's Observation

The committee felt that there is a need to have a reliable mechanism to crosscheck the flooding scenario and claims of 'No flooding in Mithi catchment' likely to be made by some of the agencies looking after the upkeep of the flood control systems. It is felt essential to install cameras at known vulnerable locations to keep a watch on the flooding levels. In support of this, it is also advisable to use either UAVs or Radar satellite coverage of the day, whichever is available, as tried above.

3.15 Extent of damage caused to Mithi

Since 2005 many studies had been done which had highlighted the issues that are deteriorating the river. The issues have been raised from flooding to pollution to river rejuvenation along with social issues but to quantify the extent of damage being done to Mithi requires more study.

To understand the probable damages occurred to the river various perspectives have been discussed and deliberated with NGOs, committee members and authorities.

3.15.1. Committee's Observation

After several meetings, field visits, report readings and discussions among committee members it can be said that construction of retaining wall in upper reaches of river has been done without incorporating the steps to maintain the natural behaviour and flow of river. In upper reaches, there are forest areas like Aarey which can act as a major retention zone but construction of wall in that region has damaged the flood plain and interaction with catchment. For maintaining the flow in a river and increasing the carrying capacity desiltation is required but it has been found that huge volume (~40 cum.) of silt is still in the river bed at the mouth of river as per mail dated 14 Decemeber 2017 of Project Director MRDPA . The analysis of water quality has revealed that pollution in Mithi has increased with more dumping of waste on river banks. The slums

still existing on the banks of river are contributing to the deterioration of Mithi water as waste is directly being discharged into the river. The growth of mangroves due to excessive siltation near the mouth of river is obstructing the free flow of water.

CHAPTER 4

SHORT AND LONG TERM RECOMMENDATION AND ECO-REJUVENATION PLANS

4.1 Introduction

The present Committee assessed various issues as per directives of the Honb'le Supreme Court and classified various issues into following seven categories and studied the major aspects and provided recommendations.

- Construction of Retaining Walls
- Flood Related Issues
- Environmental Pollution Issues
- River Rejuvenation Issues
- Encroachment Related Issues
- Administration and Coordination Issues
- Social Issues

After the deluge of 2005, many works were undertaken by concerned authorities. Major ones which can be classified as achievements are:

- Widening and deepening of the river channel
- Removal of encroachments though not as per expected levels.

However, many other related issues remain unaddressed or partially done.

The present committee has proposed the recommendations suitable for riverine hydrology and modifications in the existing constructed retaining wall. To mitigate future flooding and abatement of pollution in Mithi River system, Committee also suggests various "Short Term measures" and "Long Term Measures" for addressing all issues mentioned above.

After study of the earlier committee's reports, recent site visits, interaction with authority staff and NGO's, data received from the authorities about the work done so far and for future plans, the detailed short term and Long term measures are suggested. An eco-rejuvenation plan has also been delineated which needs to be implemented.

In this chapter, the short term and long term future course of actions expected from concerned authorities have been ascertained. Further, the guiding principles for preparation of short term and long term future course of action plan are elaborated. The "short term measures" – means the activities to be completed within a short time period of THREE Years. The "long term measures" – means the activities to be completed within a time period of THREE to SEVEN Years.

As the retaining walls already constructed is one of the major issues raised, the Committee Comments and suggestions on the "retaining walls" are given in the following section. Various measures recommended are grouped into seven categories viz: 1) Retaining wall related issues 2) Flooding related issues 3) Environmental pollution issues 4) River rejuvenation issues 5) Encroachment issues 6) Administration and Coordination Issues and 7) Social issues.

It may be noted that most of the issues and recommendations are already discussed in details in various available reports. However, as observed earlier, most of the recommendations are "not done" or partially done. Hence in this report, the various measures to be undertaken are put in terms of "Short Term Measures" and "Long Term Measures".

4.2. Retaining Walls related issues

Based on the main issue raised by various NGOs and other agencies on the "constructed retaining wall" on both sides of Mithi River by MCGM and MMRDA, the Committee inspected the entire stretch of Mithi River and studied the nature of the retaining walls already constructed and its impacts on the River ecology, flooding issues and environmental problems. It was also found that as per the reports provided to this committee, retaining walls were not recommended by any of those committees.

The retaining walls constructed along Mithi River can be classified in to three categories.

a. Upper reaches of Mithi River– upto Sakinaka airport side - retaining walls constructed by MCGM
b. Middle reaches of Mithi River – airport side - retaining walls constructed by MIAL- airport authority; further after airport, retaining walls constructed by MCGM upto CST bridge
c. Lower reaches of Mithi River – retaining walls constructed by MMRDA from CST bridge side to Mahim causeway - end of Mithi River.

4.2.1 Committee's Observations on Retaining Walls:

Following are the observation of the Committee:

1. **In the upper reaches** - according to Committee's opinion, **the retaining walls are NOT** constructed the way, that should have been done for an urban River. At many locations, the walls are constructed as a reinforced concrete wall vertically up like a rectangular section without considering any riverine hydrology, environmental and flooding aspects (see Fig. 4.1). The walls are also made above ground (even upto 3m at many locations) without giving any scope for water to flow to and fro from the river during a high rainfall conditions by obstructing the entire river hydrology. Retaining walls in the stretch of Aarey creates a complete barrier for a natural setting of a river. This kind of retaining walls is completely unjustified.
2. **In the middle reaches**- on airport side, due to security reasons, the walls are constructed as vertical rectangular section including above ground, by providing sufficient width (see Fig. 4.2). Due to various security reasons and river channelization issues, which seem reasonably justified due to airport.

   In the middle reaches- after the airport stretches, the retaining walls are to be modified that is suiting the river hydrology and ecology.
3. **In the lower reaches** - from CST bridge to Mahim causeway, the retaining walls are constructed with porous gabion walls suiting the River ecology (see Fig. 4.3).
4. For this stretch, the provided retaining walls are suiting the location and riverine

Hydrology.

Fig. 4.1: Mithi River in Upper reaches

Fig. 4.2: Mithi River in Middle reaches (near airport)

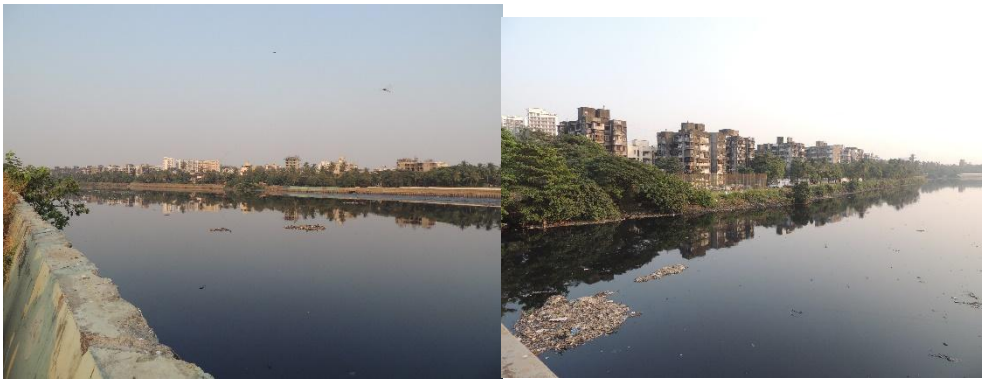


Fig. 4.3: Mithi River in Lower reaches (near Mahim, after CST Bridge)

4.2.2 Recommendation on Retaining wall:

The Committee studied the urban riverine hydrology and various case studies available in cities like Seoul, Singapore etc. (Fig. 4.4).By considering the various issues in Mithi

River catchment, a typical cross section of the river should be trapezoidal with option of a flood plain on both sides. Further to avoid any encroachments, on both sides service road of minimum 6m should be provided. The existing bottom width of river should be maintained and on both sides a flood plain of minimum 9 m wand serice road of 6 m should be provided. Figure 4.5 shows a typical section suggested for Mithi River.

Fig. 4.4 Rejuvenated Urban River - Cheonggyecheon in Seoul, South Korea

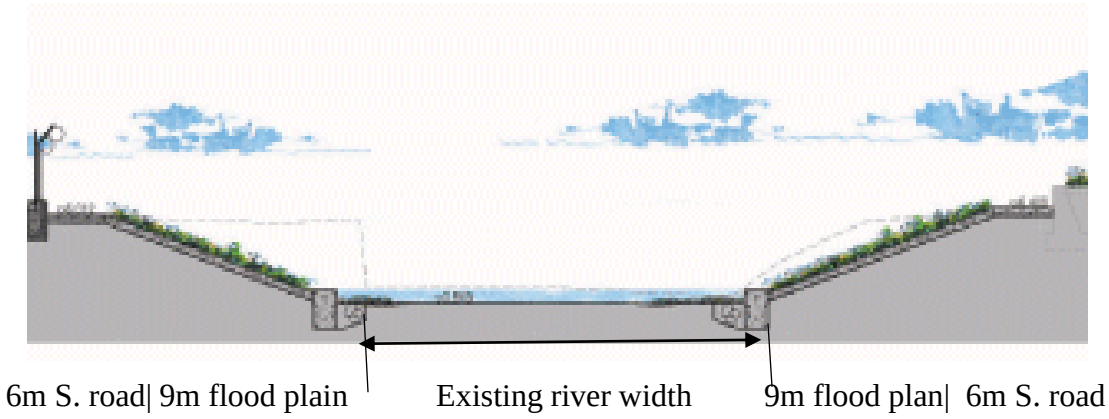


Figure 4.5 – A Typical Cross section suggested for Mithi River

Committee recommends following actions on retaining walls already constructed in different stretches

1. For the upper reaches, a review of walls should be undertaken with a view to change its configuration height, flood plain connection structure etc. so that natural settings of river hydrology is maintained.
2. For the middle reaches, on the airport side, as there is sufficient width for the river, due to security reasons, the existing structure may be retained.
3. For the middle reaches, after airport and upto CST bridge, wherever possible, the constructed retaining walls may be modified with flood plains and service roads on both sides.
4. On the lower reaches, upto Mahim causeway, the present retaining walls may be retained. However, wherever possible, flood plains may be provided with service roads on both sides.

4.3.Flood related Issues

The Mithi River catchment is a heavily flood prone area due to large scale urbanization in its catchment and various developments in its floodplains. There are two aspects of flooding issues for Mithi River. First one is the "high tidal flows" coming to the River up to Airport side (Fig. 4.6). Second one is the high rainfall conditions and high stream flows during heavy monsoon due to large scale urbanization (Fig. 4.7).

Fig. 4.6: High tidal flows to Mithi River during dry period at Mahim causeway (10th November 2017)

Mumbai suburban part of the city has experienced very heavy rains on 26th July 2005 having record of 944 mm of rainfall in 24 hours recorded at Santacruz rain gauge station whereas in Colaba, the total rainfall recorded was 73.4 mm coinciding with the highest high tide of 4.48 m. The maximum of 190.3 mm rainfall in one hour period between the times, 15:30 hrs to 16:30 hrs was recorded on 26th July 2005. During this event, severe flooding had taken place in all catchments of Suburbn Rivers. Mithi being the main river, deluge in the catchment of Mithi River was tremendous (Fig. 4.8). There was tremendous loss of human lives, animal lives, and huge economic loss of properties and infrastructure.

Fig. 4.7: Mithi River flows during Monsoon period

Fig. 4.8: Mithi River during 26th July 2005 deluge

After going through all recommendations by various Committees and studying the present field conditions, the committee recommended following short and long term measures.

Short Term Measures.

- Further channelization (widening and deepening) and modification of bed gradient by providing a trapezoidal type riverine section (see Fig. 4.5) with a minimum of 15 m on both sides with floodplain of 9 m and service road of 6 m.
- Restoration of waterways under the bridges- There are number of bridges across the Mithi River and each has number of utilities like water pipelines, gas pipeline, Cables etc. The bridges should be widened and restoration or repositioning of ducts of the utilities on urgent basis. The railway culverts also should be upgraded.
- De-silting and removal of debris on regular basis of the Mithi river channel as so much of solid waste are dumped at various stretches of Mithi River. The River stretches should be desilted regularly atleast 4 times a year if not every month. All drains should be desilted and cleaned every month.
- Provision of access ramps into rivers from major roads and at critical locations for proper desilting of the River stretches.
- Provision of more Pumping arrangements at critical locations as suggested by BRIMSTOWAD – in critical regions of flooding, especially at lower reaches, more pumping stations are to be installed other than the existing pumping stations at 3 locations.
- Provision of minimum two stream gauges one above the tide level and the other above the confluence of the stream with main river channel so that the level variations can be captured and suitable measures can be undertaken for flood disaster measures.
- Provision of gates at all 44 outfalls and pumping stations – For larger catchments, gates to a flood flow of 1 in 100 years & for small catchment 1 in 25 years probability.
- Provision of no-return valves for cross drains and outfalls. In case of flooding, this will reduce the local flooding issues in lower reaches of the Mithi River due to high tides.

- The bridges near Mahim bay confluence should be widened to have more capacity of outflow.
- The entry of river mouth at Mahim bay to be widened by removing the outcrop extending to the river mouth. This will improve the easy flow of water to the sea.
- At critical flooding spots including Powai and Vihar outlet, Mahim causeway River outlet, a rigorous flood warning system with sensors connected to Disaster Cell and other authorities should be installed. Radar sensing technology should be used further during monsoon season to appropriate warning system to the public.
- Prepare flood zone mapping for various return periods of 5 years, 10years, 20 years, 50 years and 100 years and integrate with the future Development Plans (DP) and restrict the developments in the Mithi River basin, depending on the severity of flooding problems. Based on this, various zonal development plans such as red zone (10 years flood zone), blue zone (50 years flood zone) and green zone (100 years flood zone) can be developed and developmental activities can be restricted.
- Existing website of Disaster Management Cell can be further improved with flood warning system and a system to intimate to the public about possibility of any kind of flooding during monsoon season across the whole region. This system can also be integrated with other rivers of Mumbai located northward of island city.

Long Term Measures.

- River basin management- consider Mithi River as catchment and provide treatment for hill slopes, check dams, contour bunds, plantation of more trees, provision of erosion control measures etc.
- Increase the flood carrying capacity of Vihar lake and Powai lake by raising the existing weir height by at least 1.5m. This will reduce the flood flow to the Mithi River catchment and will serve as permanent source of water to the Mithi River during dry and summer period.
- Desilt the entire Powai lake and increase its flood carrying capacity and provide flood gates for continuous supply of water to Mithi River during dry weather

period after summer. Appropriate embankments shall be constructed on all the sides of Powai lake (including IIT Bombay side) using the dredged silt from the lake and increase its flood carrying capacity.

- In Mithi catchment, the low lying areas which are presently acting as a natural detention or retention ponds should be earmarked as sustainable flood control plans in revised development plan. Provision of further detention basins and infiltration zones may also be explored. For example, in Arey colony region, some areas can be identified for detention basins.
- Improvement of Mahul creek and develop the relieving flood sub catchments 500, 501, 502,503, 509 and 510 of Mahul creek system. This will relieve the larger flooding issues in lower reaches of Mithi River.
- Provision of a minimum of 15 m on both sides of the river for 9 m of floodplain and 6 m of service road. The way it should be incorporated is shown in Fig. 4.5.
- It is proposed to restore certain network of Mithi river with other watercourses that have been severed over time due to unplanned construction and development works. This will help in restoring larger ecology of Mumbai and enable quick outflow of lakes overflow and rain water in east and west directions instead of currently available one directional flow downstream into the Arabian Sea at Mahim.
- Create floodplains wherever possible in the Mithi River catchment. A detailed plan for the same is given in Chapter 5 under Eco-rejuvenation master plan.

4.4.Environmental Pollution Issues

For the Mithi River catchment, the environmental pollution issues are of two kinds. First one is, severe water pollution due to discharge of raw domestic and industrial sewage without any treatment, on the sides of the River (Fig. 4.9). Second one is, issues related to solid waste deposited in the river (Figure 4.10). The dumping of different kinds of solid waste like dry and wet waste for households, industrial wastes, plastics and debris from construction industries creates large scale siltation in the Mithi River reducing its carrying capacity and causing flooding. To deal with this issue, the immediate short term measure is to stop the pollution sources and then regular desilting.

Figure 4.9 – Sewage flowing in the Mithi River – as on 10th November 20**17**

Figure 4.10 – Solid waste dumped in the Mithi River – as on 10th November 2017

After going through all recommendations by various previous Committees and studying the present field conditions, following short term and long term measures are proposed in context of pollution abatement.

Short Term Measures

- Installation of proper garbage collection system on both banks of Mithi River (atleast within the 500m from both sides of the river). This will stop the dumping of wet and dry wastes and other industrial solid waste on the banks and in the River.

- Provision for decentralized and segregated solid waste management in slums.
- Waste collection from river banks through involvement of local communities and awareness.
- MCGM has to implement new byelaws for waste generated in cowsheds and treat in their premises.
- Recyclers of commodities like paper, metal scrap, plastics, glass, etc., need to be shifted out to conforming areas or regulated to collect all wastes by MCGM.
- Effective implementation of operation and maintenance of ETP/STP in organized and large scale industries including hotels and restaurants in the Mithi river catchment.
- The plan of MCGM prepared through Frischmann Prabhu of waste water treatment is not proper as it has ignored all recommendations of IIT, MPCB and NEERI. This plan should be immediately reviewed as it is likely to fail due to flawed concept of interception and diversion (only during 8 months) at a huge costs.
- Any drain carrying industrial effluent, storm water and/or domestic sewerage having values of BOD and COD higher than 10mg/L and 20mg/L should be closed. Similarly all the drains from residential areas should be connected to sewerage system of the city/ specific treatment plants proposed on the banks of Mithi River.
- During the high tide, lot of debris are carried into the Mithi River. Hence, at the marine end, there is need for screening of debris and plastics that entre through the tidal waters. A suitable screening mechanism could be provided at each drain meeting the Mithi river.
- Strictly prohibit entry of sewage to Powai Lake. Now, sewage/ effluent from Heeranandani side and slums enter the Powai lake, polluting it and further polluting Mithi River as Powai lake's discharges to Mithi River.
- Decentralized treatment plants across the length of the river as detailed below in Table 4.1 should be installed at all locations in Phase-I where local slums and other habitations contribute less than 15 MLD. Higher than 15 MLD plants should be taken under long term plans.

Table 4.1 Source based treatment options for Mithi stretch

Sr. No.	Stretch	Source of Wastewater	Proposed Management Plan
1.	Filterpada	Domestic	STP with Capacity of 2MLD
2.	Gautam Nagar	Domestic	STP with Capacity of 3MLD along with ETP for nallah N11
3.	JVLR Bridge	Industrial Mixed with Domestic	STP of Capacity of 3.5MLD at the downstream along with in path ETP for nallah N509
4.	Bamandayapada	Domestic	STP with Capacity of 40MLD at the upstream
5.	KBM Compound	Industrial Mixed with Domestic	STP with Capacity of 10MLD and ETP at source for industries
6.	Marol	Industrial Mixed with Domestic	STP of Capacity of 9MLD at the downstream along with ETP for nallah N512
7.	Sakinaka	Industrial Mixed with Domestic	STP of Capacity of 9MLD at the downstream along with ETP for nallah N515
8.	Domestic Airport	Domestic	STP with Capacity of 10MLD
9.	Safed Pool	Mostly Domestic	STP with Capacity of 15MLD
10.	BMK Compound	Domestic	STP of Capacity of 27MLD at the downstream along with ETP for nallah N35
11.	CST Bridge	Domestic	STP of Capacity of 45MLD at the downstream
12.	MTNL Bridge	Domestic	Under tidal influence

13.	BKC	Domestic	Under tidal influence
14.	Vakola Nallah	Domestic	Under tidal influence
15.	Kalanagar	Domestic	Under tidal influence
16.	Mahim	Domestic	Under tidal influence

*ETP to be installed as per recommended for industrial sources in all the stretches.

Long Term Measures

Following are the long term measures recommended to avoid/ reduce the environmental pollution related issues with respect water pollution and solid waste management and its impacts with some justifications.

- Provision of sewerage system on both the banks of the River so that all the liquid (domestic and industrial) waste can be collected for treatment in the treatment plants.
- Setting up of decentralized sewage treatment plants (STP) on both sides at various locations as proposed by MPCB in 2014.
- Provision of an STP in Aarey colony, as the numerous cattle sheds inside Aarey also discharge organic waste from Diary farming into the river
- After appropriate treatment of the sewage (preliminary, primary and secondary), the effluent can be discharged back to the Mithi River so that continuous flow will be there in the River to meet the minimum required environmental flows.
- As per industrial policy on river catchment, as per the Department of Environment (GR No MMV-2000/326/22/TB-3 dt 15/7/200), River is classified in categories viz A-I to A-IV. Mithi River is categorized as A-IV. As per this GR for this category, 500 m on either side of the road- NDZ for any type of industry. Only green and orange industries with pollution control devices should be allowed within 500 m to 1000 m of Mithi River.

- Proper Resettlements and Rehabilitation of the slum dwellers on both sides of the River so that the it will be an eco-zone and on long term, the River will be rejuvenated.

4.5 River Rejuvenation Issues

Though the Mithi River is originating from Vihar lake in its natural and clean form (Fig. 4.11), as can be seen from the present state of the Mithi River, it cannot be called as River, but has become a drain at its middle stretches and lower stretches. Immediate steps are required to rejuvenate the River.

Figure 4.11 – Mithi River at its origin and as a drain for sewage in the middle stretches – as on 10th November 2017

Short Term Measures

Following are the immediate or short term measure suggested for River rejuvenation.

- Declaring both sides within 50m from the sides of the river as No development zone zone (NDZ) and the settlements should be restricted, no new construction should be allowed.
- Provision of River flushing system to initiate rejuvenation of river channel by providing 0.6 m gates at Vihar and Powai spillway dams.
- Slope stabilization on both sides of the Mithi River: Bioengineered, Biotechnical, Bio- Structural measures should be adopted for slope stabilization.

- Restoration and rehabilitation of mangrove forest areas in the Mithi River catechment.
- Conduct survey the stretch of Mithi River to mark potential holding ponds location and infiltration zones.
- The flood plains and catchment area of Mithi River needs to be clearly defined and protected for ensuring longer duration of supply of fresh water into the river.

Long Term Measures

- Rehabilitation of riverbeds and lakes through phytoremediation and ecological engineering on the River banks.
- During dry weather season and summer, most part of the River, there is no continuous flow. A strategy should be developed to rejuvenate the inner channel environment with minimum environmental flows.
- Greening of the Mithi catchment – throughout the catchment, more trees should be planted so that the riverine ecology will be revived
- Catchment area of this river must have a green cover to the extent of 33% of the total area. After service road, in a belt not narrower than 15m, trees, shrubs, and forbs (herbs and shrubs) should be planted in the buffer zone.
- Latest eco-friendly technologies and materials should be encouraged across the river catchment, thereby supporting an eco-engineering approach of development.
- Provide number of holding ponds along the stretches of the Mithi River, wherever possible with infiltration zone so that River will be rejuvenated in few years time.

Details of many such approaches are given in Chapter 5.

4.6 Encroachment related Issues

As can be seen on both sides of the Mithi River (Fig. 4.12), large scale encroachment has taken place in the last two decades on the flood plains of the Mithi River. Many housing colonies are located in the flood plains of the River. These encroachments mainly in the form of slums has destroyed the River, its ecology and environment. To save the River

and to rejuvenate it back to a natural River, urgent measures are required to remove the encroachments and protect the both banks of the River as an ecological zone.

Fig. 4.12 Encroachments on the sides of Mithi River as on 10th November 2017.

Short Term Measures

- Removal of encroachment along the banks of river- atleast to 15 m in the **first phase** for proper flood management.
- Declare 50m on either side of Mithi River as ecological protected zones ie. NDZ so that NO future construction or developmental activities be permitted in these zones.
- Provide strict vigil and protection and provide fencing on the already cleared areas so that no further encroachment takes place. It is observed that in many of the cleared area, after some time, further encroachment has taken place.
- Buildings and building complexes that fall in 50 m proposed Mithi river NDZ area to be removed and relocated as and when there is redevelopment undertaken in future, but in specified time as would be directed by Hon'ble Supreme Court

or by a proposed quasi- judicial authority. Then they would be accommodated in the balance area with necessary concessions and benefits of redevelopment.

- Part of slums that have come-up onto the river's edge and fall within 50 m Mithi river NDZ area, are proposed to be relocated and rehabilitated in the balance slum land upon slums redevelopment project that would be undertaken.

Long Term Measures

Following are the long term measures suggested for encroachment related issues:

- Removal of encroachment along the banks of river 15 to 30 m in the **Second phase** and 30 to 50m in the **Third phase**.
- River bank upto 50 m on either side of the river must be cleared. In this zone various eco-elements such as eco parks, promenades, plantations, grasses and shrubs can be done for optimizing drainage and percolation.
- Declare Mithi River and its surrounding areas as an ecological protected area so that no future encroachment will takes place.

4.7 Administration and Coordination Issues

As discussed in the previous Chapters, the Mithi River, its developmental issues, flooding, environmental pollution issues and related problems are presently dealt by various agencies from Maharashtra Government such as MMRDA and MRDPA, Mumbai Municipal Corporation and Mumbai International Airport Authority Limited (MIAL). The various Departments in MCGM has the authority in the upper reaches and middle reaches till CST bridge. Near the airport region, MIAL is looking after various issues. In the lower reaches (from CST Bridge to Mahim Causeway), MMRDA is the authority dealing with development and other issues. While dealing with these agencies, the Committee felt that there is poor coordination between these agencies in any of the Mithi River related issues. Though, Govt. of Maharashtra formed the Mithi River Development Project Authority, due to lack of coordination between various agencies, MRDPA is unable to function properly to restore Mithi River and solve related problems.

To deal with all the Mithi River related issues, better coordination of various agencies are required.

Short Term Measures

- Increase efficiency of Storm Water Management - there are mutual and counter complaints by MCGM and local communities. Hence more effective intervention is needed.

- Formation of a single authority/ council under MCGM or MMRDA or directly under Maharashtra Govt. to deal with all problems of flooding, environmental pollution, encroachment etc. It can be under the present MRDPA itself. However, all activities from developmental issues to sewage treatment to drainage should be handled by a single authority.
- For better coordination, the Chiefs of MCGM, MMRDA, MIAL and all members of the empowered committee as was envisaged earlier should meet at least 4 times in a year.
- The authority/ Council should be assisted by an advisory body of experts representing fields like environment, ecology, planning, sociology, geo informatics, urban drainage/civil engineering, water resources, coastal engineering etc., who will help formulate a time bound action plan based on a shared vision of the river by stake holders of the river.
- Development of a Web site on Mithi River related information and all details should be made available to public.
- Set up of Emergency Support Function (ESF). ESF are the essentials of Emergency Management that provide the coordination mechanisms among various agencies.
- Make the existing Disaster Cell of MCGM more effective with all modern facilities and powers, wherein ESF can be part of it.

Long Term Measures

Following are the long term measure suggested for better coordination of various agencies.

- Undertake urban flooding study and create a under/facilities which will help MCGM and MMRDA.
- Establishment of a data center/cell exclusively devoted to compiling all the studies/ data relevant to the Mithi River catchment needs to be established.
- Regulate the developmental activities in Mithi River Catchment. As per section 43 of the MR and TP Act, 1966 it is mandatory for any person to obtain permission in writing of the Planning Authority before undertaking and development of land.

4.8 Social Issues

As discussed in the earlier Chapters, there are large scale encroachments on the flood plains of Mithi River, narrowing the river and its flow conditions. There are so many slums on the sides of the River stretches. To rejuvenate the River to its natural conditions, large scale removal of the encroachments on both side of the River Banks are required. While removing the encroachments, there are so many social issues to be dealt with.

While the efforts of MMRDA, MCGM, and MRDPA are commendable, there are still many tasks to be completed, before flood mitigation and disaster management can advance to a level where risk levels considerably reduce. The comprehensive and efficient relocation and rehabilitation of households and other structures and land uses from the banks of the Mithi River and Vakola Nala is crucial for preventing floods, reducing encroachments, and preventing the river from becoming polluted. The Relocation and Rehabilitation (R&R) process itself has to be of sound design and implemented in a participatory manner so that impoverishment risks are reduced and R&R households are better off.

The R&R programme and peoples' participation in flood mitigation and disaster preparedness have to be integrated with other technical solutions for flood mitigation.

With this view, the following recommendations are made based on data and insights obtained from this study.

Short Term Measures

- Development of Flood shelters during floods and strengthen MCGM flood disaster response team.

- More participatory design and implementation of R&R is recommended so that many concerns of people including jobs, cost of living, design of structures, commuting, transport and choice of relocation site can be addressed.

- Communication and trust building in flood control and disaster mitigation

- Problems of Institutional weakness of R&R need to be addressed by enabling better coordination between MMRDA and MCGM.

- Undertake a study to plan R & R (for all buildings/people coming under 50 m on both sides.

Long Term Measures

Following are the long term measures suggested for dealing with R&R issues.

- Provision of community amenities and facilities (in addition to existing ones); in particular more common spaces (playgrounds, gyms, toilets, washing places etc) are required in R&R sites.

- The R & R implementing agencies need to focus on programmes to create and provide jobs and livelihoods locally, and enhance skill levels, so that their earnings can go up.

- Detailed study on the gap between policy and practice needs to be conducted.

- There is a need to integrate Civic / Urban Planning with R&R, so that problems such as open spaces, community amenities, education and health facilities, transport, solid waste etc. can be better addressed.

4.9 Recommended studies for effective implementation

Based on the committees' discussion on multiple aspects of past work done and recommendations made, it is envisaged that following detailed studies will need to be undertaken for effective implementation of short and long term plans integrating Eco-Rejuvenation plan for the Mithi river.

1. **Retaining wall modification strategy**

   This would involve chainage wise examination of its role and plans of removal of the walls, partial modifications, weep holes, flood management along walls, shapes of the retaining walls if necessary, alternative methods etc.

2. **Encroachment Removal-Relocation and Rehabilitation plan**

   Current implementations have been mixed with many compromises and led to inadequate implementation. This would lead to high risk of flooding leading to loss of life,properties and businesses.

3. **Flood Management through Restoration of Natural channels**

   Detailed scientific and technical studies required with a view to assess feasibility of connecting natural channels in Mithi catchment both on east and west side. Powai and Vihar and flow management, silt removal and storage creation will be part of this study.

4. **Eco-rejuvenation Master Plan**

   Detailing of each aspect as presented earlier needs to be carried out for actual implementation plan.

Chapter 5

Proposed
Mithi River Eco Rejuvenation Plan with Area-wise Recommendations

Approach

1. Introduction
2. Mithi – Through The Years
3. Mumbai's Flood Prone Areas
4. Mithi River Area
5. Observations And Problems
6. Key Objectives
7. Interventions And Solutions
8. Mithi River Eco Rejuvenation Plan
9. Mithi River Zoning
10. Defining Mithi River 50m Ndz
11. Zone 1 – Zone 15
12. Mumbai's Existing Rivers And Water Courses Map
13. Reconnecting Mithi River & Water Courses
14. Achievements
15. Short Term – Long Term Phasing

INTRODUCTION

Our central objective is to prepare a comprehensive Mithi River Eco Rejuvenation Plan.

Firstly, we look at Mithi in the context of the larger eco system of Mumbai and suggest ways by which its relationship with other watercourses that have been severed over time with the city's growth is restored to the extent possible. Secondly, we propose ways by which the restoration of the river eco-system is undertaken through the implementation of various eco-elements, such as developing new flood plains, eco-parks, terraced and trapezoidal edges, construction of gabion walls in many parts by demolishing the existing concrete walls, plantation of various flora and fauna. Also, a series of small or medium scale sewage treatment plants strategically located, are proposed on both sides along the length of the river. The integration of the river with the symbiotic relationship with surrounding forest, hills as well as city and its development plan is crucial for the achievement of long- term sustainable ecology andlend its contribution to thedevelopment of Mumbai. We wish, Mithi river becomes the pride of the city than its liability.

Environmentally sensitive low-cost bio-remedial measures, Gabion walls, aeration of the treated sewage water post STP, plantations, clearing silt that has formed due to obstructions of the flow of water, installation of sleeves for arresting the floating waste, water monitoring stations, set up phytoremediation plants for self cleaning, setting other bio processes and sponge parks for treating the water.

The eco expansion plan essentially proposes a fifty-meter wide MITHI RIVER NDZ (No Development Zone) belt on both sides along its entire river course. It is possible to immediately implement this reservation in large parts, while in other parts it will be gradually undertaken in phases upon the redevelopment of existing slums and buildings. It is this NDZ area that will provide space and opportunity for the implementation of the various eco-elements. Certain areas of these eco-elements would be accessible as public parks, promenades and open spaces. The interaction of people with the river and its natural setting will not only contribute to a better quality of environment, but also promote greater understanding of the significance of the river and its contribution to building a flood-free and sustainable city. Mithi river shall become the pride of the city than its liability.

Further, the plan suggests that the Mithi River Eco-Plan be included in the Development Plan (DP) of the city, including the fifty-meter Mithi River NDZ.

Lastly, the Eco-plan proposes the constitution by the State Government an independent ECO-ZONES PLANNING AND MANAGENT AUTHORITY being responsible for the conservation and protection of the over 150 sq.kms natural areas of Mumbai inclusive of Mithi river and its ecosystem.

Overwhelming thrust over the years by the State Government and the Mumbai Municipal Corporation has been to deal with flood control measures by proposing civil engineering interventions, not many of which have been effective. The case of building high concrete walls on both sides of the river and the blasting of the monolithic rock bed in the ocean are just two of the many unwarranted engineering actions undertaken. The floods have occurred once again post these measures.

Generally the mainstream approach of the authorities concerned is to tame and contain the river and its eco-system. Besides reflecting utter arrogance of power over nature and its forces, in this case the Mithi river, were desired to restrict the eco-system area has been primarily dictated by short term real estate greed-amongst many other interests, one of the major one was maximizing land for construction. Such measures have continued over the years in spite of the devastating impact. The river containment measures and the rampant destruction of the eco-system made Mithi River more prone to flooding. There seems to be no lessons learnt or any attempts made to analyze and analysis that evaluates the larger eco-system and the need to address that instead of short term high cost engineering solutions of containment were implemented that are environmentally unsustainable and destructive in the long term.

There has to be a paradigm shift in the understanding of flood control measures and more importantly the reinvigoration of the river and its eco-system. Our proposed Mithi River Eco Master Plan is an attempt towards the achievement of these objectives.

Mithi River is a part of a larger network of rivers and water courses of the estuary of Mumbai. Surrounded by sea on three sides and having a coastline of 149kms, the city has over 140 sq.kms of natural areas in the form of mangroves(62.94sq.kms), creeks, rivers(13.14sq.kms), wetlands(8.01sq.kms), hills, forests(53.60sq.kms), etc. Over the time, as the city expanded, large parts of the rivers and water courses have been encroached upon, treated as dumping grounds at various locations and at places obstructed and diverted, thus, not only severing their relationship downstream but also causing obstruction to flow of

water. Today, all the water courses have been turned into dirty, stinking, chocked and highly polluted nullahs. Sewage and industrial effluent too are released into these water-courses. Garbage and solid waste are disposed into the nullahs too. As a result, during heavy rains and rise of water levels, floods occur and affect the encroached areas. In the case of Mithi, due to its disconnect from certain other water courses, the flood waters cannot find its way to the sea on to the eastern and western coast.

Our objective is also to revive and restore the natural network of the river as far as possible. This would be a significant way forward in mitigating floods and maintaining a minimum standard of water quality to provide sustainable aquatic life. Besides the restoration of these networks of Mithi and the other three rivers of Mumbai viz., Oshiwara, Dahisar and Poisar, must be reinvigorated in the interest of flood control and improvement of the environment. Mithi river is approx. 18 kms in lenght, Oshiwara 7kms, Dahisar 12kms &Poisar 3kms. Put together, the length of the 4 rivers and major water courses, that are now known today as ‘nullahs’, have a total length of approx. 300kms. The water carrying capacity of these riversis also required to be restored.

Notwithstanding earlier recommendations of various committee's & authorities and their submissions, this Joint Committee as constituted by the Hon'ble Supreme Court recommends the Mithi River Eco Rejuvenation Plan as a way forward Action Plan for developing a sustainable and flood free Mithi river eco system, understood in the larger ecological and urbanization context to safeguard lives and properties. In addition, the river would hold good quality water, good enough for sustainable aquatic life.

MUMBAI LANDFILL THROUGH

THE YEARS

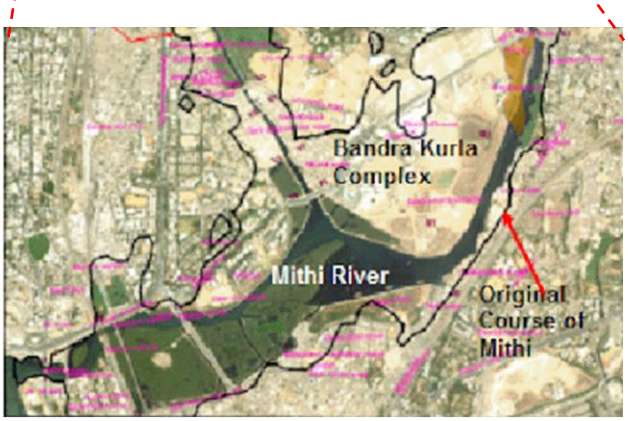
1925 Landfill

1969 Landfill

2000 Landfill

MITHI – THROUGH THE YEARS

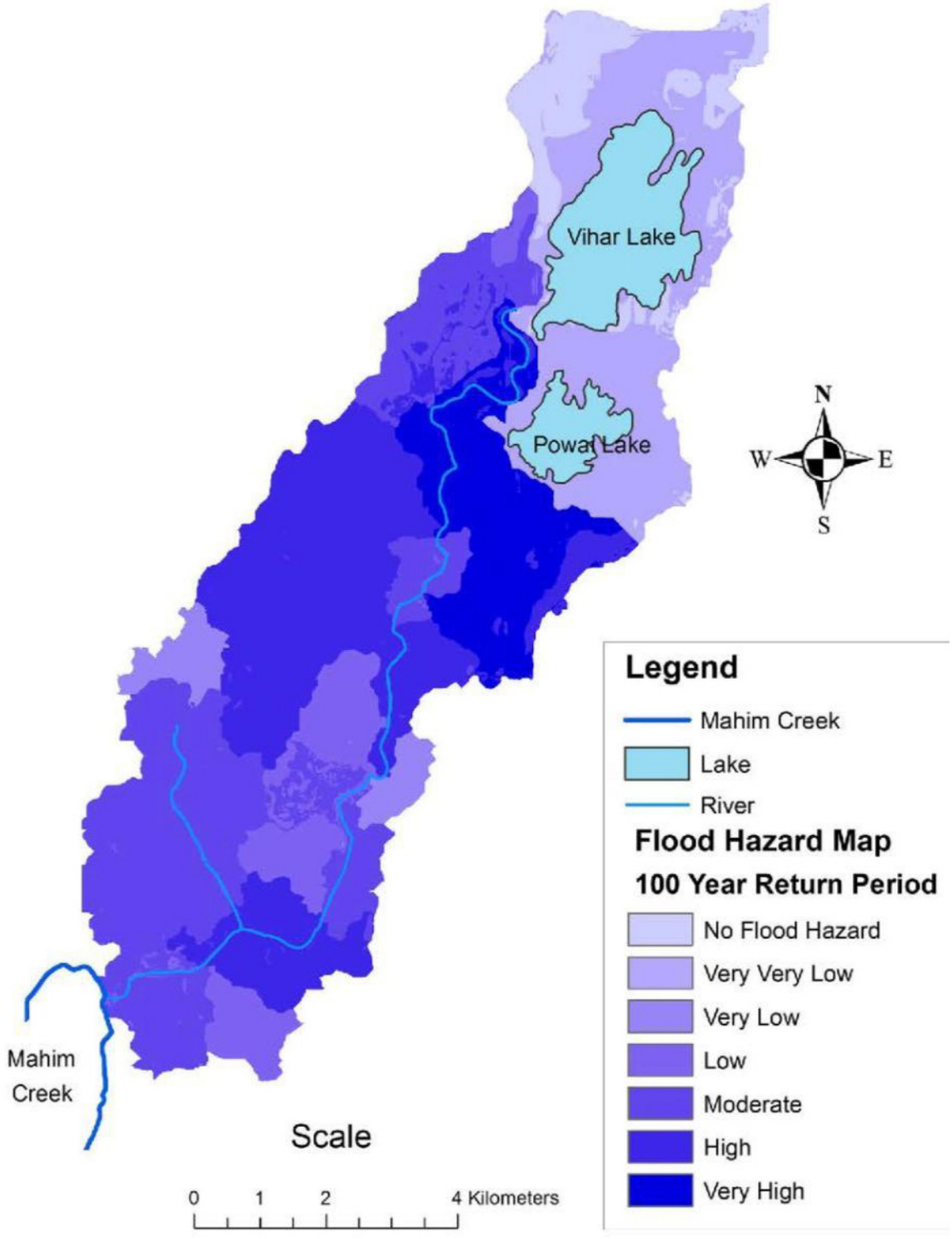
Source: Google Map



Source: disastermanagementmumbai.blogspot.in

BKC RECLAMATION
Land filling – 620 Acres

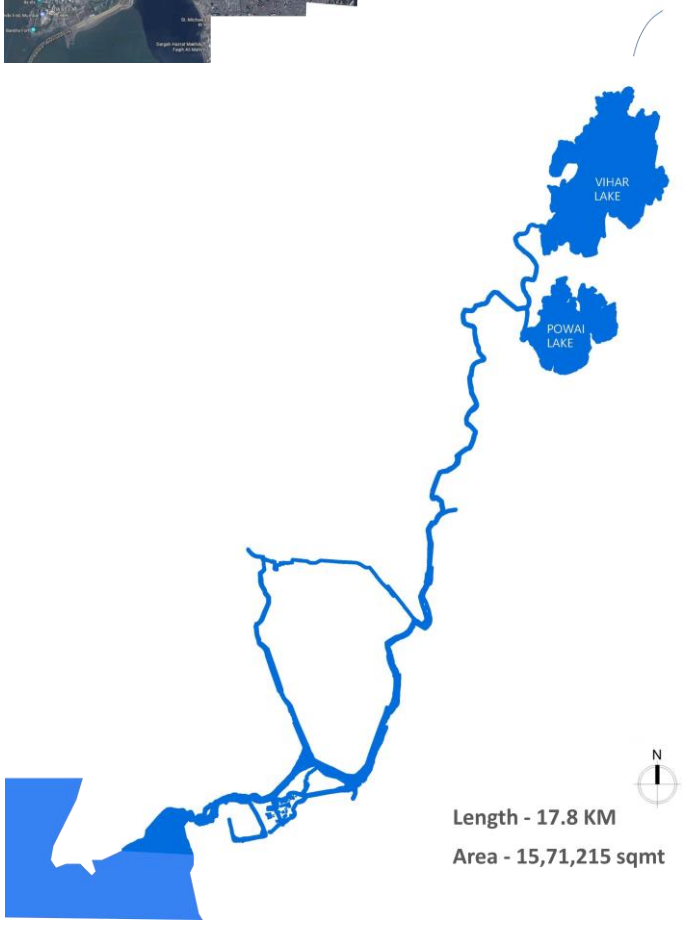
MUMBAI'S FLOOD PRONE AREAS



Source: Impacts of Urbanization on flooding of a coastal urban catchment: a case study of Mumbai city, India, 6 September 2014, P.E.Zope, T.I. Eldho, V. Jothiprakash

Received:

MITHI RIVER AREA



OBSERVATIONS AND PROBLEMS

1. High concrete walls have been built along both edges of the entire length of the river, thus severing the ecological relationship of the river with the surrounding eco-systems- flood plains, wetlands, vegetationetc. At some point, due to objections and protests by environmentalist's citizen's, further construction of the concrete walls was suspended, instead gabion walls were built by MMRDA.

   In this way the visibility of the rising water level during heavy rains by settlements & people in the precinct of the Mithi River is hampered. As a result any over flow over the walls during incessant rains would cause flash flood endangering life and property. Also the drainage of water from the neighborhoods into the river is blocked.

2. In many places, buildings exist abutting the river's edge.

3. In certain other sections, there are slums along the river's edge too.

4. At a number of places road bridges have been built across the river by the Municipal Corporation, resulting in severe constriction of the river width, thereby posing obstruction to flow of the waters.

5. In many instances, land filling along the river has led to either obstructing the flow of the waters or causing critical diversion of the course of the river, resulting in obstruction and silt formation downstream.The other notable activities on the banks of river are operations of several garages, workshops, illegal small manufacturing units, eateries and make shift restaurants, godowns and storages etc which all contribute to dumping of sewage, solid and liquid wastes including burnt/spent oils , all are obstructing the river flow and impair its water quality.

6. At the airport, the natural course of the river has been critically tampered with. Underground pipes have been laid under the runway to allow the flow of the waters. But this has caused a major obstruction during torrential rains that lead to the rise in water level. As a result, the runway and the airport were both inundated in 2005 floods.

7. The next big obstruction of the river has been at Bandra Kurla Complex (BKC). Over 620 acres of land filling into the river and the wetlands and mangroves has been done. All that area was an integral part of the rivers estuary, has been carried out by MMRDA, a state government agency for developing a business hub. Google maps of the period before land filling was undertaken and ones after clearly illustrate this adverse impact. This act has led to the waters overflowing, stagnating and rising in the river inside the wall section, thereby affecting the outflow of the flood waters into the river & upstream areas. The problem is compounded during high tide. This has also resulted in the excessive situation, thereby grossly undermining the river's water carrying capacity.

8. At a number of places, substantial silt formation has taken place due to the changes that have been made to the natural course and flow of the waters. Sharp turns and twists are noticed as a result. Also, in certain places, new mangrove growth is noticed in the river due to excessive silt formation. These have contributed to the free flow of the waters during heavy rains.

9. Finally, the most critical obstruction to the flow of the river into the Arabian Sea is at Mahim, causing build-up of water pressure up-stream during heavy rains. This condition turns even more critical when high tide coincides with heavy rain. Silt formation and growth of mangroves in the rivers bed causes critical obstruction. But the bigger obstruction right at the mouth of the river when it meets the sea at Mahim bay has been due to massive land filling and construction of roads and flyover turn-around. This has resulted in narrowing down of the mouth of the river.

KEY OBJECTIVES

1. Preparing an Ecological Master Plan
2. Defining 50m NDZ (No Development Zone)
3. Developing Eco Parks
4. Developing Public Spaces
5. Achieving Trapezoidal Section
6. Removal of R.C.C walls built as retaining wall
7. Plantation – Flora & Fauna
8. Restoring Mithi river & other water courses linkages
9. Restoring and Expanding Flood Plains
10. Widening & clearing bottle necks
11. Expanding Mithi out flow at Mahim
12. Restructuring Bridges
13. Redeveloping & Rehabilitating of Slums
14. Defining Redevelopment regulation in 50m NDZ
15. Treating Sewage
16. Maintaining river water quality standard
17. De-silting
18. Amending Land use in D.P
19. Setting up of Quasi Judicial Authority of Mumbai's Rivers, Water courses & Water Fronts

PROPOSED SOLUTIONS

1. It is necessary to remove the concrete walls in many parts, particularly in the upstream areas including the National park and Aarey. Waters from the forest and thick vegetation flow into Mithi due to the natural gradients. Today, due to retention walls these waters flood nearby areas, as they do not clear easily. Similarly, in many other parts downstream, the concrete walls are proposed to be demolished to help rainwater's and flood waters for finding an easy outlet into the river. Stagnation of water for long hours during heavy rains has endangered life and property.

   River must be allowed to swell naturally and the process must be left visible to initiate timely evacuation plans. Therefore, any form of channelization way of construction of concrete walls must be avoided. Instead, natural trapezoidal ground section be developed all along the river edges with plantations.

2. A 50-meter wide Mithi River NDZ area is proposed on both sides of the entire length of the river. This area would be developed with various eco elements in order to develop a cohesive and integrated eco-zone
3. Along both sides of the river, in the 50-meter eco-zone, various eco-elements such as flood plains, eco parks, forests, plantations, etc. are proposed.
4. Buildings and building complexes that fall in the 50-meter proposed Mithi River NDZ area are proposed to be removed and relocated as and when their redevelopment is undertaken in the future, but in specified time as would be directed by Hon'ble Supreme court or by a proposed quasi judicial authority. Then they would be accommodated in the balance area with necessary concessions and benefits of redevelopment.
5. Similarly, parts of slums that have come-up onto to the river's edge and fall within the 50-meter Mithi River NDZ area, are proposed to be relocated and rehabilitated in the balance slum land upon slums redevelopment project that would be undertaken.
6. Lengths of those bridges that have constricted the width of the river and its flow have to be rebuilt with bigger lengths covering the full width of the river and the 50 meter wide NDZ on both sides.
7. Bottlenecks, wherever necessary have to be cleared by widening the width of the river, increasing the curvatures of the turns and twists and avoiding sharp turns. Also, in these locations, additional flood plains and recreation zones are proposed to provide space for river swell and overflow during rising water levels.
8. In certain places along the river, accessible public spaces are proposed too. Promenades along the Vakolanullah would effectively inter-weave the habitation and developments along side with the waters and the ecology. In certain other places, proposed eco parks too would function as accessible public spaces.
9. It is proposed that the silt formation areas in the course of the river along with the new mangrove areas that obstruct the width and flow have to be cleared.

10. In places where the concrete walls are proposed to be demolished, the edges of the river on both its sides would be developed into trapezoidal sections with plantations. Part gabion walls as may be necessary to retain the ground may be built.
11. Most importantly, as a flood preventive measure, it is proposed to restore certain network of Mithi River with other watercourses that have been severed over time due to unplanned construction and development works. This way, we would be able to take a step forward in putting Mithiriver back into the larger ecology of Mumbai and enable quick outflow of lakes overflow and rain water in east and west directions instead of the currently available one directional flow downstream into the Arabian Sea at Mahim.
12. Development of a website and flood warning system and a system intimate to the public about possibility of any kind of flooding during Monsoon season especially for the Mithi River catchment. Publish flood plain, flood hazard, Vulnerability and Flood Risk map on the website to provide access to the citizens.
13. In the catchment of Mithi River, the low lying areas which are presently acting as a natural detention or retention ponds should be earmarked as sustainable flood control ponds in revised Development Plan.
14. Formation of a single authority/ council under MCGM or MMRDA or directly under Maharashtra Govt. to deal with all the problems of flooding, environmental pollution, encroachment etc. For better coordination, the Chiefs of MCGM, MMRDA, MIAL etc. should be members of the authority/ council.

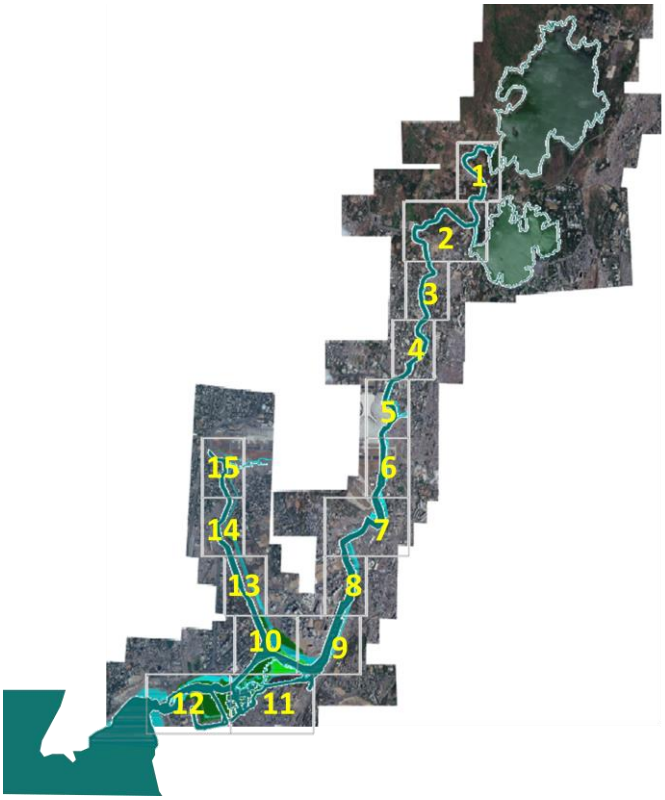
The implementation of all these recommendations will take away the need of yearly desilting of the river at colossal cost incurred every year.

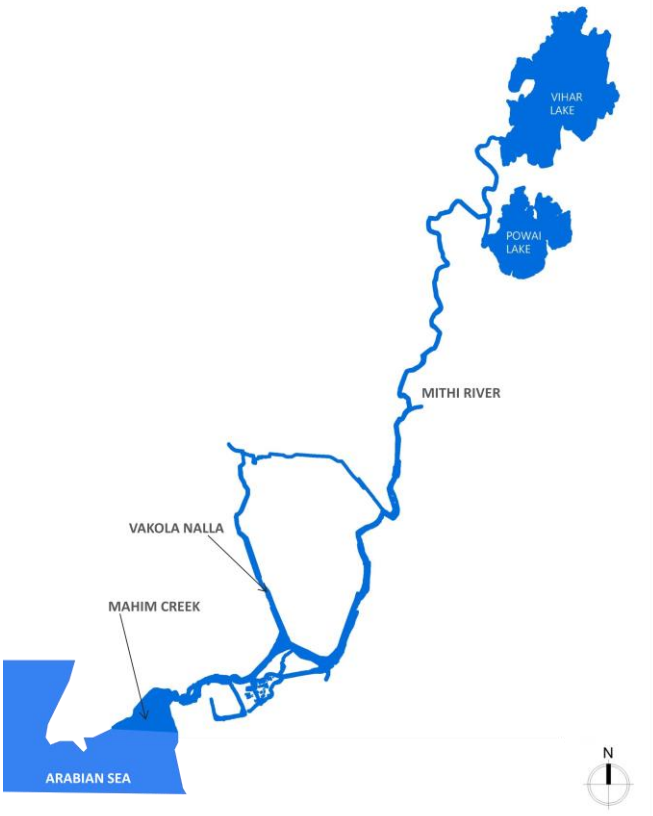
Hopefully, this interconnectivity of the watercourses would be the beginning of awareness and action plans for undertaking the re-invigoration of the over 300 kms. of the watercourses of Mumbai, all of which have been turned into nullahs.

All these measures would contribute significantly towards building a long- term sustainable ecology and the achievement of the re-invigoration of the river, resulting into freeing the flood prone areas of the city due to Mithi overflow and torrential rains. These measures will significantly contribute in increasing the water holding capacity of the river and its faster flow in to the sea.

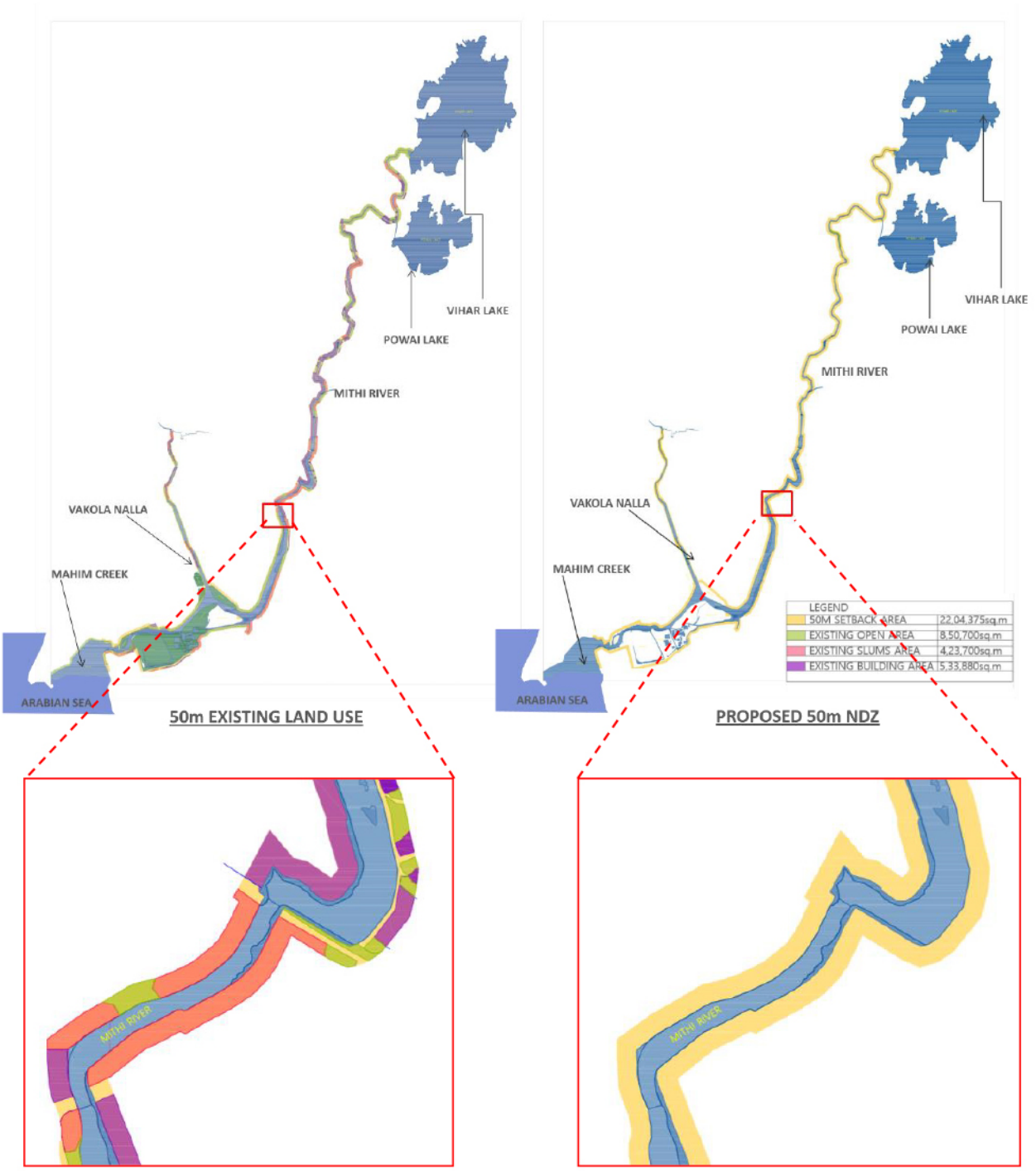
A Mithi River Eco Rejuvenation Plan

MITHI RIVER ZONING



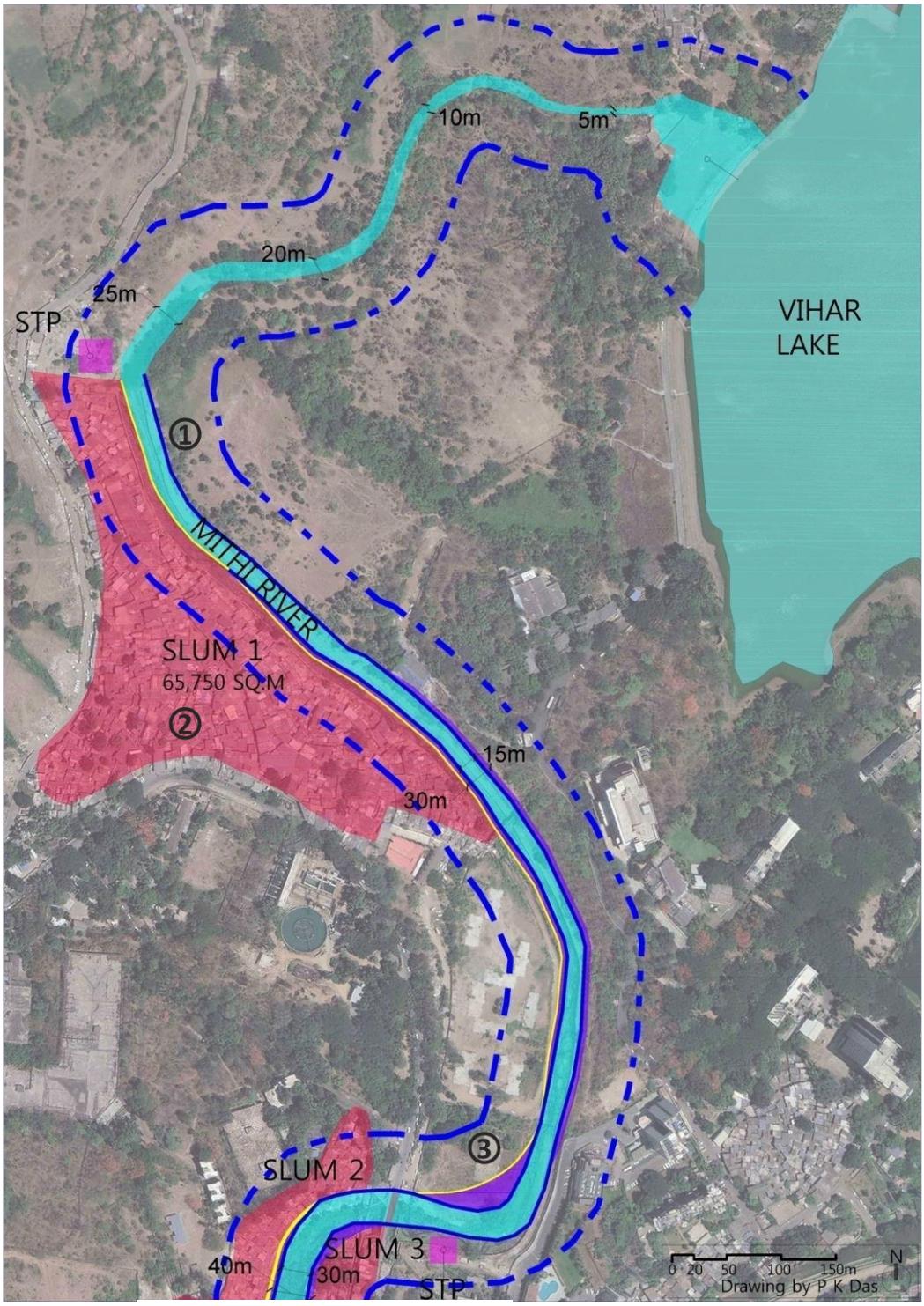


DEFINING 50M MITHI RIVER NDZ



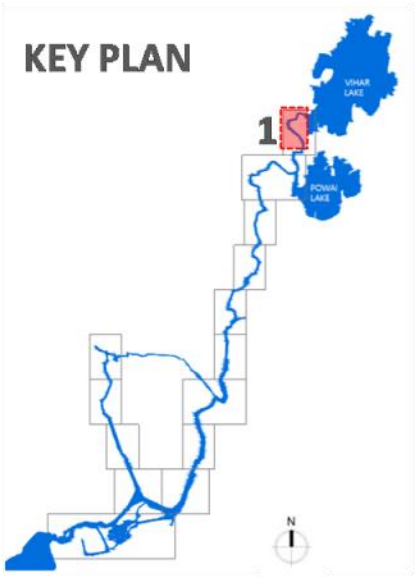
ACCODRING TO , **BEFORE THE NATIONAL GREEN TRIBUNAL**
(WESTERN ZONE) BENCH, PUNE
APPEAL NO.25 OF 2014(WZ)
placed on record Govt.
Resolution (GR) dated 2nd March, 2015.
"Precautionary Principle' : enumerated in Section 20 of the NGT Act, 2010
On basis ofsuch DPR, and further line of each flood prone area/cities, even if, the Irrigation Department has shown tentative 'blue line' as blue line which needs to be finalized, then also no construction shall be permitted/finalized by the authorities which may cause environmental degradation at least within distance of fifty (50) meters from such blue line within NDZ area by the Municipal Corporations/Councils/Panchayats.

Zone 1- VIHAR LAKE to AURUM IT PARK



AURUM IT PARK END

Drawing by P K Das



ZONE 1		
EXISTING		
	Mithi River	41,575sq.m
	Lake	
	River Silting	
	Slum	76,830sq.m
	Pipelines	
	Bridges	
	Streams	
	Mangrove	
	Wetland	
DP - 2034 LANDUSE		
	Proposed Road	
	School	
	Industrial	
	Market	
	NA	
	Open Space	
	SPA	
PROPOSED		
	Flood Plain	
	River Widening	6,935sq.m
	RCC Wall to be removed	2200m
	Trapezoidal Section	2360m
	Proposed Gabion Wall	
	Ecopark	
	Promenade	
	Public Space	
	STP	2nos
	Water Treatment Plant	
	50M NDZ FROM RIVER	
NOTE :-SUBJECT TO DETAILED STUDY & INVESTIGATION		

PROPOSED ACTION PLAN

1. Removal of RCC Wall & Achieving Trapezoidal section

Removal of the concrete embankment wall built on both sides of the river, along its entire length that runs within the National Park. This will facilitate the surface water runoff from the hills and forests into the river. National Park constitutes a vast catchment area that is integral to the river ecology. Upon removal of the concrete walls, both edges be turned into trapezoidal section.

2. Redeveloping & Rehabilitating of Slums

a) Part of Slum-1 falling in the 50 meters Mithi River NDZ area is to be cleared and rehabilitated in the slum redevelopment project to be undertaken on the balance slum land area. The slum clearance area is 65750sq.mts. and the balance slum land is 38590 sq.mts.

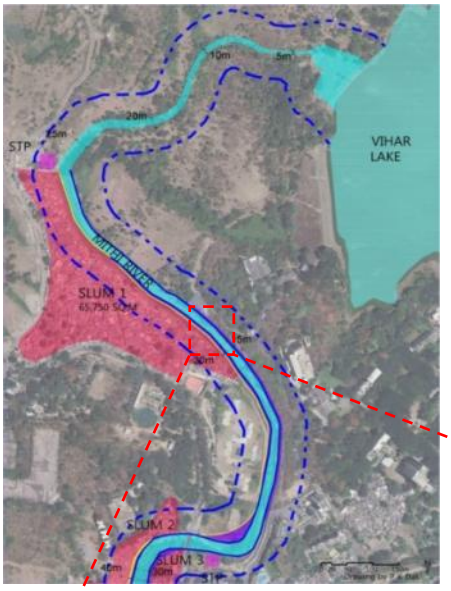
b) Slum-2 & 3 would also be redeveloped to clear areas within the 50 mtrs Mithi River NDZ. The displaced hutments would get accommodated in the slum redevelopment scheme to be undertaken in the balance land area. Displaced slum area 44482 sq.mtrs., balance slum land area doe redevelopment is 25286 sq.mtrs.

3. Widening & clearing bottle necks

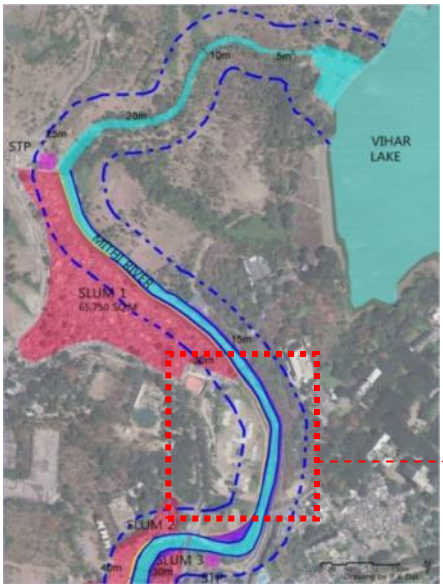
The river would be widened at places as shown in the plan in order to achieve uniform width. This correction would enhance unhindered flow of water, particularly during heavy rains and high over-flows from the lake.

4. Water treatment

Every zone installation of electric deflectors/ screens, sediment traps along with phytorid and self cleaning aerated grade chamber for cleaning the waters – 2 nos.



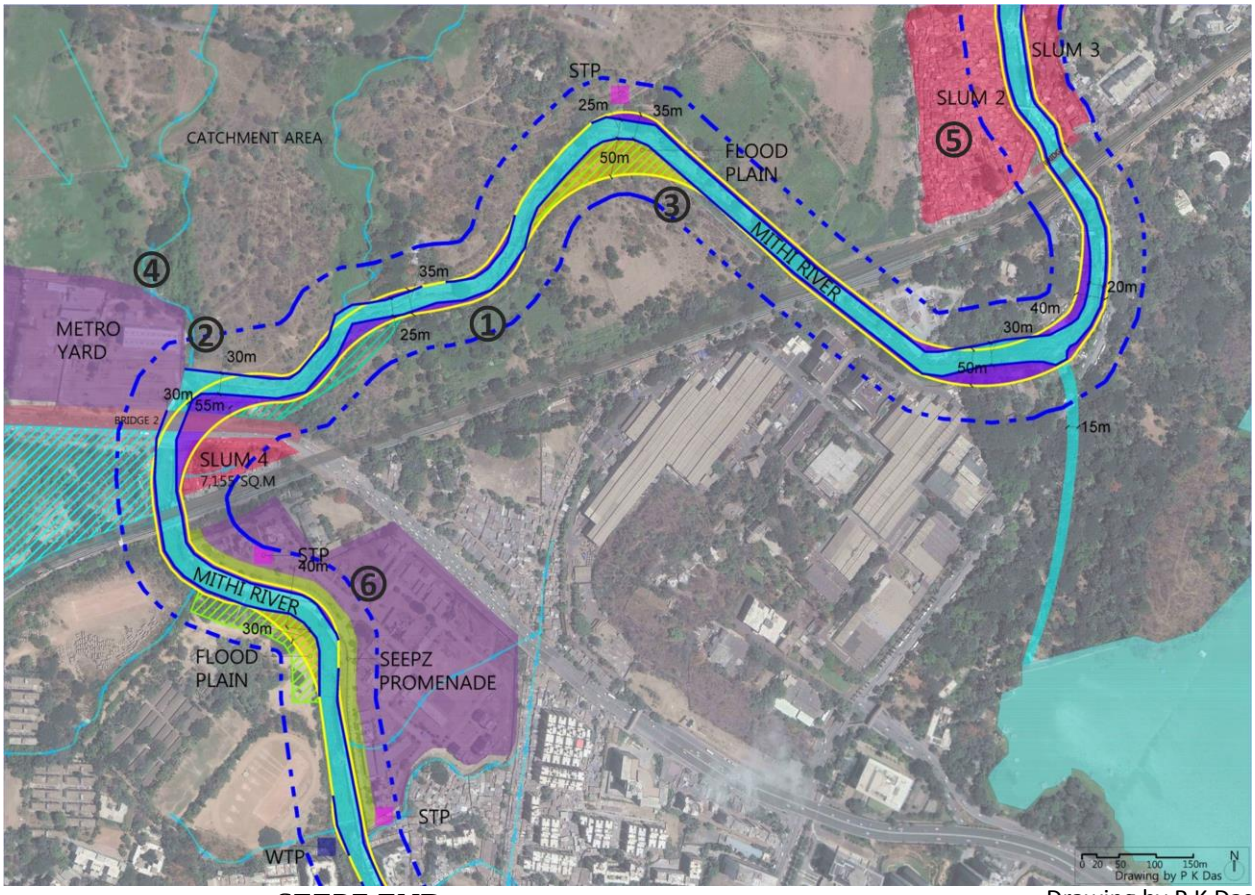
Existing Wall Section



Proposed Trapezoidal Wall Section

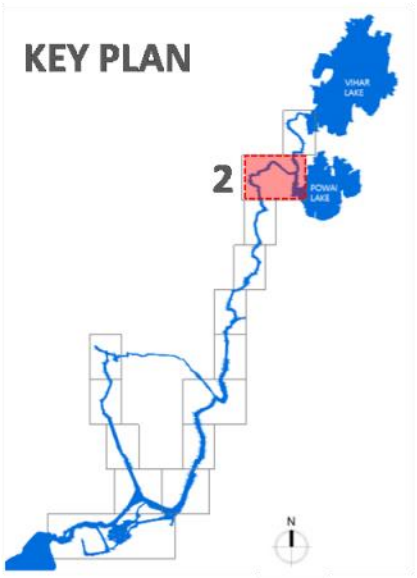
Zone 2- AURUM IT PARK to SEEPZ

AURUM IT PARK



SEEPZ END

Drawing by P K Das



ZONE 2		
EXISTING		
	Mithi River	73,350sq.m
	Lake	
	River Silting	
	Slum	51,635sq.m
	Pipelines	1 nos
	Bridges	
	Streams	
	Mangrove	
	Wetland	
DP - 2034 LANDUSE		
	Proposed Road	
	School	
	Industrial	
	Market	
	NA	
	Open Space	
	SPA	
PROPOSED		
	Flood Plain	9,970sq.m
	River Widening	28,370sq.m
	RCC Wall to be removed	5100m
	Trapezoidal Section	5385m
	Proposed Gabion Wall	
	Ecopark	
	Promenade	04,425sq.m
	Public Space	
	STP	2 nos
	Water Treatment Plant	1 nos
	50M NDZ FROM RIVER	
NOTE :-SUBJECT TO DETAILED STUDY & INVESTIGATION		

PROPOSED ACTION PLAN

1. Removal of RCC Wall & Achieving Trapezoidal section

Concrete embankment walls on both sides of the river within the Aarey area must be removed to create trapezoidal edge section. These trapezoidal areas would be planted with flora and fauna.

2. Widening & clearing bottle necks

The river would be widened at places as shown in the plan in order to achieve uniform width. This correction would enhance unhindered flow of water, particularly during heavy rains and high over-flows from the lake.

3. Expanding flood plains

Additional flood plain areas have been earmarked at locations where the river takes sharp turns. These flood plains would be lowered in its level from the existing ground, thus helping faster flow of water during flood spate situation.

4. Hot Spot-1:

a) **The State Government has land filled a large area in the Aarey eco-sensitive zone for the development of a Metro yard. As a result of this the natural course of the river has been altered, leading to an acute 90° turn at the edge of the Metro yard. Therefore, to compensate the obstruction of the Metro yard it is proposed to alter the course of the river and create a smooth diversion that will help an easy flow of water without any obstruction or back-flow and compensate the obstruction of the Metro Yard.**

b) Certain natural rain water gradients in the Aarey are obstructed due to land filling for the metro yard. Such natural channels must be re-opened or re-routed to ensure that the surface water reaches the river without any obstruction.

5. Redeveloping & Rehabilitating of Slums

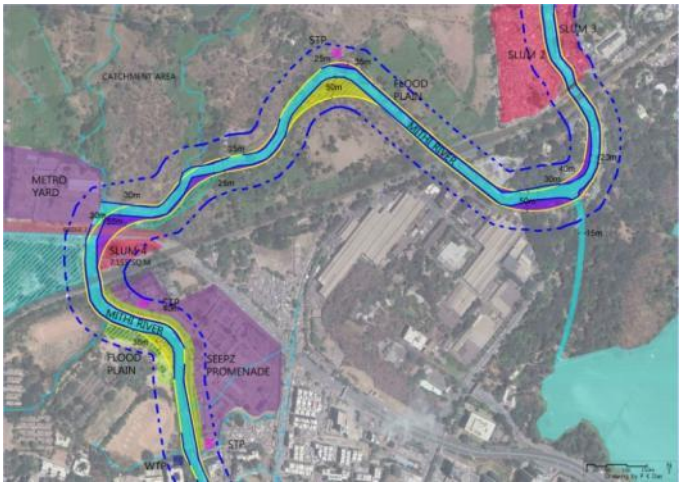
Slum – 4 must be entirely removed from its existing location since it falls not only within the 50 mtrs. Mithi River NDZ area but also must be prone to deluge and must be re-located at an alternate site in the immediate neighbourhood.

6. Developing Public Spaces

All along the edges of the SEEPZ, a promenade with landscape and natural flora and fauna is proposed within the 50 mtrs Mithi River NDZ.

7. Water treatment

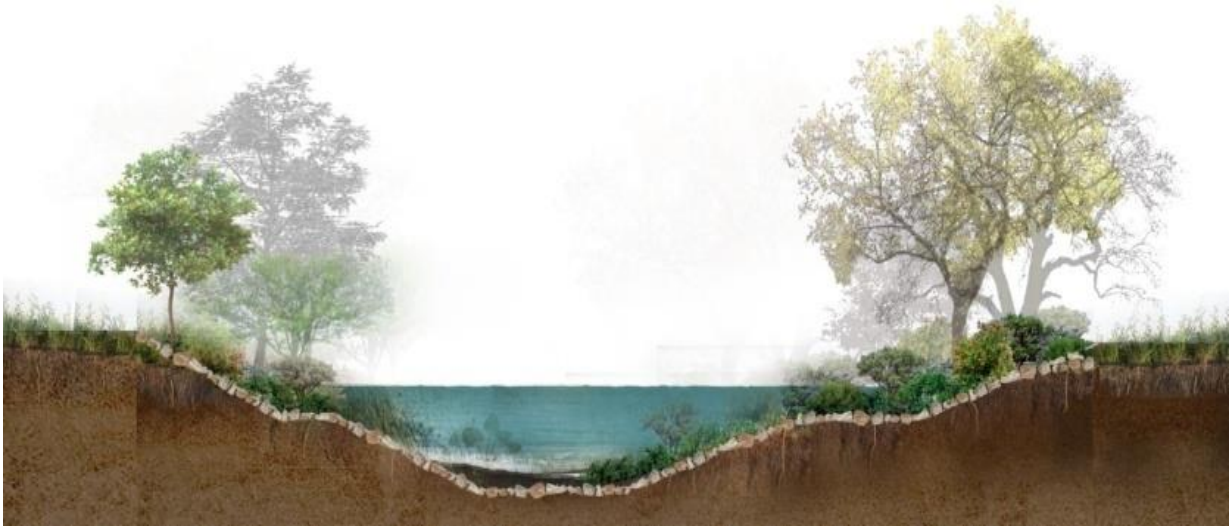
Every zone installation of electric deflectors/ screens, sediment traps along with phytorid and self cleaning aerated grade chamber for cleaning the waters – 2 nos.



The land filling underway by state government for the metro yard causes major obstruction to the passage of rainwater from areas within Aarey from flowing into the Mithi.

Proposed Flood Plain Module

Water Courses That Will Be Obstructed

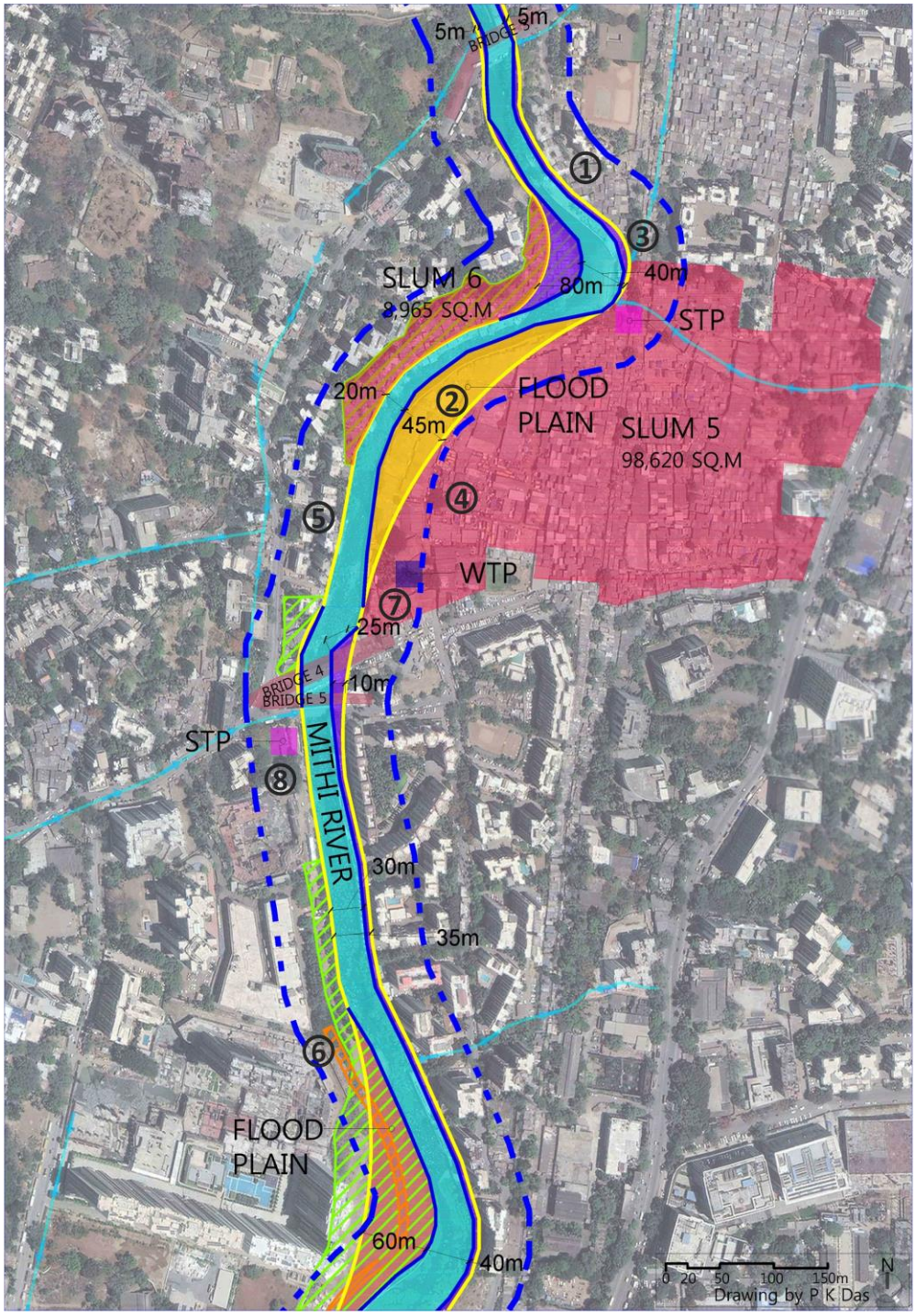


Proposed Flood Plain Section

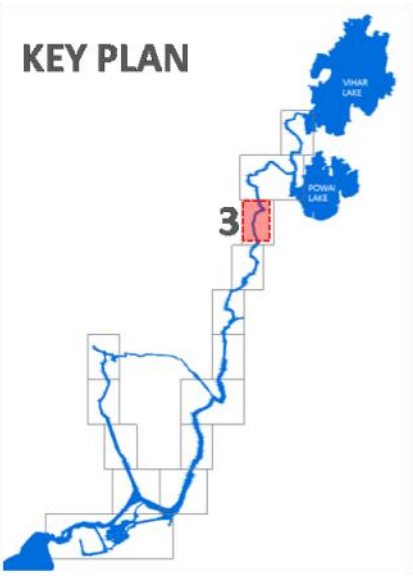
Proposed Promenade At Seepz Within 50m Buffer Zone

Zone 3 - SEEPZ TO CHANDIVALI NAKA

SEEPZ END



Drawing by P K Das



ZONE 3		
EXISTING		
	Mithi River	38,640sq.m
	Lake	
	River Silting	
	Slum	1,07,575sq.m
	Pipelines	
	Bridges	3 nos
	Streams	
	Mangrove	
	Wetland	
DP - 2034 LANDUSE		
	Proposed Road	
	School	
	Industrial	
	Market	
	NA	
	Open Space	
	SPA	
PROPOSED		
	Flood Plain	19,580sq.m
	River Widening	9,080sq.m
	RCC Wall to be Removed	2180m
	Trapezoidal Section	2675m
	Proposed Gabion Wall	
	Ecopark	
	Promenade	
	Public Space	
	STP	2 nos
	Water Treatment Plant	1 nos
	50M NDZ FROM RIVER	
NOTE :-SUBJECT TO DETAILED STUDY & INVESTIGATION		

PROPOSED ACTION PLAN

1. Removal of RCC Wall & Achieving Trapezoidal section

Concrete embankment walls on both sides of the river must be removed to create trapezoidal edge section. These trapezoidal areas would be planted with huge flora and fauna.

2. Expanding flood plains

Since the river in this zone has two sharp bands, additional flood plain area is proposed along the river abutting slum-5 to enable free flow of the river water during high monsoon .The level of this flood plain would be lowered from the existing ground level.

3. Widening & clearing bottle necks

The river would be widened at places as shown in the plan in order to achieve uniform width. This correction would enhance unhindered flow of water, particularly during heavy rains and high over-flows from the lake.

4. Redeveloping & Rehabilitating of Slums

a) Part of Slum-5 that fall within 50 mtrs. Mithi River NDZ would have to be cleared and rehabilitated in the balance slum area by undertaking a slums redevelopment project.

b) Slum-6 would be entirely removed as it falls within the 50 mtrs. Mithi River NDZ area and most susceptible to floods and rehabilitated in the slum-5 redevelopment project.

5. Redevelopment of Buildings & Layouts

Buildings that fall within the 50 mtrs. Mithi River NDZ would be ultimately deleted as and when the existing complex is redeveloped. In the redevelopment project, the 50 mtrs. Mithi River NDZ would have to be maintained and developed as public spaces with necessary landscape.

6. Amending Land use in D.P

A proposed DP Road in the 50 mtrs Mithi River NDZ area would have to be re-routed.

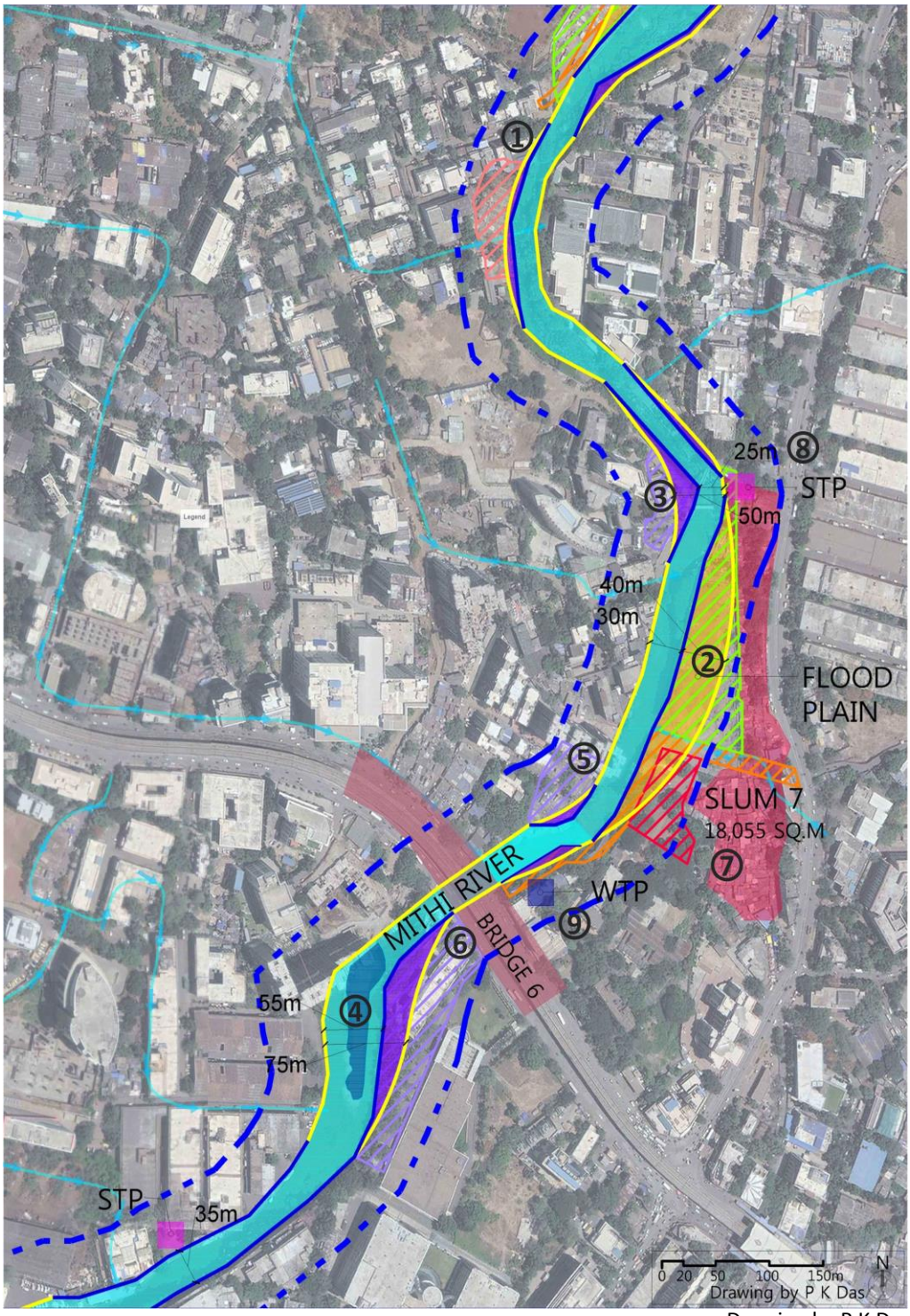
7. Water treatment

Every zone installation of electric deflectors/ screens, sediment traps along with phytorid and self cleaning aerated grade chamber for cleaning the waters – 2 nos.

8. Two STPs are proposed in this zone.

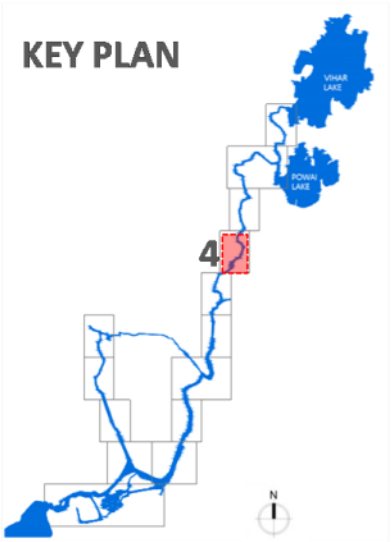
Zone 4 - MAROL TO SAKINAKA

MAROL START



SAKINAKA START

Drawing by P K Das



ZONE 4		
EXISTING		
	Mithi River	46,270sq.m
	Lake	
	River Silting	2,820sq.m
	Slum	18,060sq.m
	Pipelines	
	Bridges	1 nos
	Streams	
	Mangrove	
	Wetland	
DP - 2034 LANDUSE		
	Proposed Road	
	School	
	Industrial	
	Market	
	NA	
	Open Space	
	SPA	
PROPOSED		
	Flood Plain	10,310sq.m
	River Widening	8,780sq.m
	RCC Wall to be Removed	2095m
	Trapezoidal Section	2625m
	Proposed Gabion Wall	
	Ecopark	
	Promenade	
	Public Space	
	STP	2 nos
	Water Treatment Plant	1 nos
	50M NDZ FROM RIVER	
NOTE :-SUBJECT TO DETAILED STUDY & INVESTIGATION		

PROPOSED ACTION PLAN

1. Removal of RCC Wall & Achieving Trapezoidal section

Concrete embankment walls on both sides of the river must be removed to create trapezoidal edge section. These trapezoidal areas would be planted with flora and fauna.

2. Expanding flood plains

Additional flood plain area is proposed where the river takes sharp turns. The level of the flood plain area would be lowered from the current ground level and landscaped with natural flora and fauna.

3. Widening & clearing bottle necks

At 3 locations, the widths of the river have to be broadened to avoid sharp turns which cause obstruction to the flow.

4. De-silting

Due to the sharp turn of the river there are patches of silt. These would have to be excavated & removed.

5. Redevelopment of Buildings & Layouts

Buildings that fall within the 50 mtrs. Mithi River NDZ would be ultimately deleted as and when the existing complex is redeveloped. In the redevelopment project, the 50 mtrs. Mithi River NDZ would have to be maintained and developed as public spaces with necessary landscape.

6. Restructuring bridges

An existing bridge in this zone will require extension on both sides.

7. Amending Land use in D.P

a) Reservation for a school in the development plan (DP) of the city that falls in the 50 mtrs Mithi River NDZ and abutting slum-7 would have to be deleted from here and relocated.

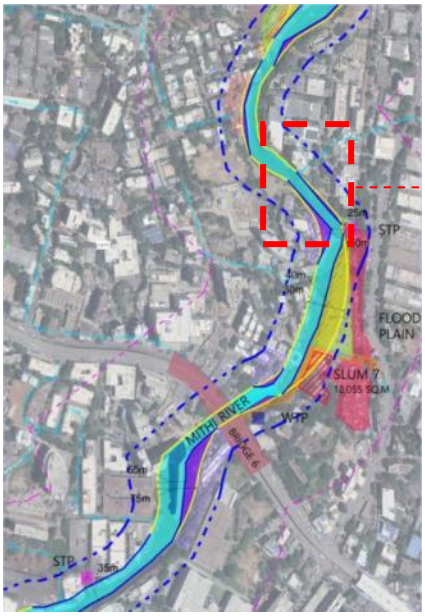
b) Another plot reserved in the D.P. for a market abutting the river and falling within the 50 mtrs Mithi River NDZ would also have to be deleted.

c) Land reserved for industrial purposes as earmarked in the DP plan abutting the river's edge, also falling within the 50 mtrs Mithi River NDZ have to be deleted from here and relocated.

8. Two STPs are proposed in this zone.

9. Water treatment

Every zone installation of electric deflectors/ screens, sediment traps along with phytorid and self cleaning aerated grade chamber for cleaning the waters – 2 nos.

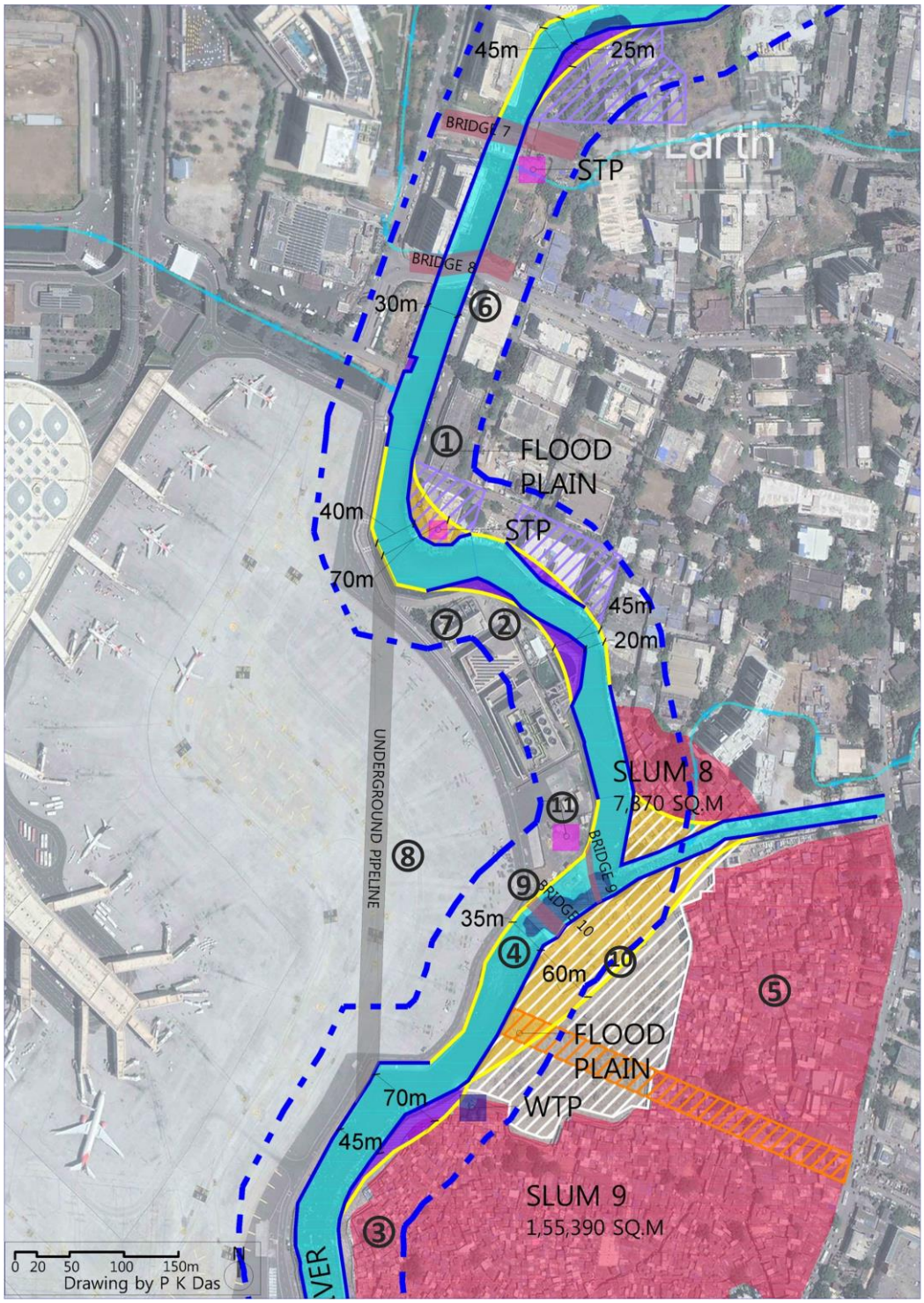


Proposed Neighbourhood Parks Module

Proposed Promenade Within 50m Buffer Zone

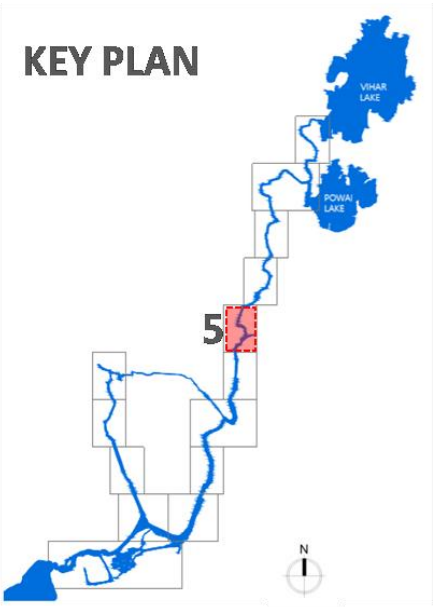
Zone 5 - SAKINAKA TO AIRPORT

SAKI NAKA START



AIRPORT START

Drawing by P K Das



ZONE 5		
EXISTING		
	Mithi River	51,990sq.m
	Lake	
	River Silting	2,290sq.m
	Slum	1,23,385sq.m
	Pipelines	1 nos
	Bridges	4 nos
	Streams	
	Mangrove	
	Wetland	
DP - 2034 LANDUSE		
	Proposed Road	
	School	
	Industrial	
	Market	
	NA	
	Open Space	
	SPA	
PROPOSED		
	Flood Plain	16,035sq.m
	River Widening	5,530sq.m
	RCC Wall to be Removed	2865m
	Trapezoidal Section	1920m
	Proposed Gabion Wall	
	Ecopark	
	Promenade	
	Public Space	
	STP	2 nos
	Water Treatment Plant	1 nos
	50M NDZ FROM RIVER	
NOTE :-SUBJECT TO DETAILED STUDY & INVESTIGATION		

PROPOSED ACTION PLAN

1. Removal of RCC Wall & Achieving Trapezoidal section

Concrete embankment walls on both sides of the river must be removed to create trapezoidal edge section. These trapezoidal areas would be planted with flora and fauna.

2. Widening & clearing bottle necks

a) At a certain locations the width of the river would have to be increased and amended to avoid sharp turns and sharp edges that protrude into the river.

b) River width has been increased at two locations where the river takes a sharp turn. Slum-8 would be entirely cleared and rehabilitated in the slum redevelopment project of slum-9.

3. Developing Public Spaces

In slum-9, the large available open-space is proposed as an additional flood plain and is to be developed as a public park.

4. De-silting: Stilt areas in this zone have to be removed

5. Redeveloping & Rehabilitating of Slums

Parts of slum-9 that fall in the 50 mtrs Mithi River NDZ would have to be cleared and rehabilitated in the slum redevelopment project to be carried-out on the balance slum land.

6. Redevelopment of Buildings & Layouts

Buildings that fall within the 50 mtrs. Mithi River NDZ would be ultimately deleted as and when the existing complex is redeveloped. In the redevelopment project, the 50 mtrs. Mithi River NDZ would have to be maintained and developed as public spaces with necessary landscape.

7. Hot spot-2: Mumbai International Airports Ltd., (MIAL) has built a treatment plant for which the width of the river has been substantially encroached, thereby causing a major bottle neck and obstruct free flow of the river water. The river width at this point would have to be increased. .

8. MIAL would have to also undertake tunneling to lay underground pipes to allow direct flow of the river water to deal with high water pressure during heavy rains.

9. Restructuring bridges

Lengths of the two bridges in this zone have to be extended in their length.

10. Amending Land use in D.P

a) A proposed DP Road that cut across slum-9 must be excluded in the 50 mtrs Mithi River NDZ area.

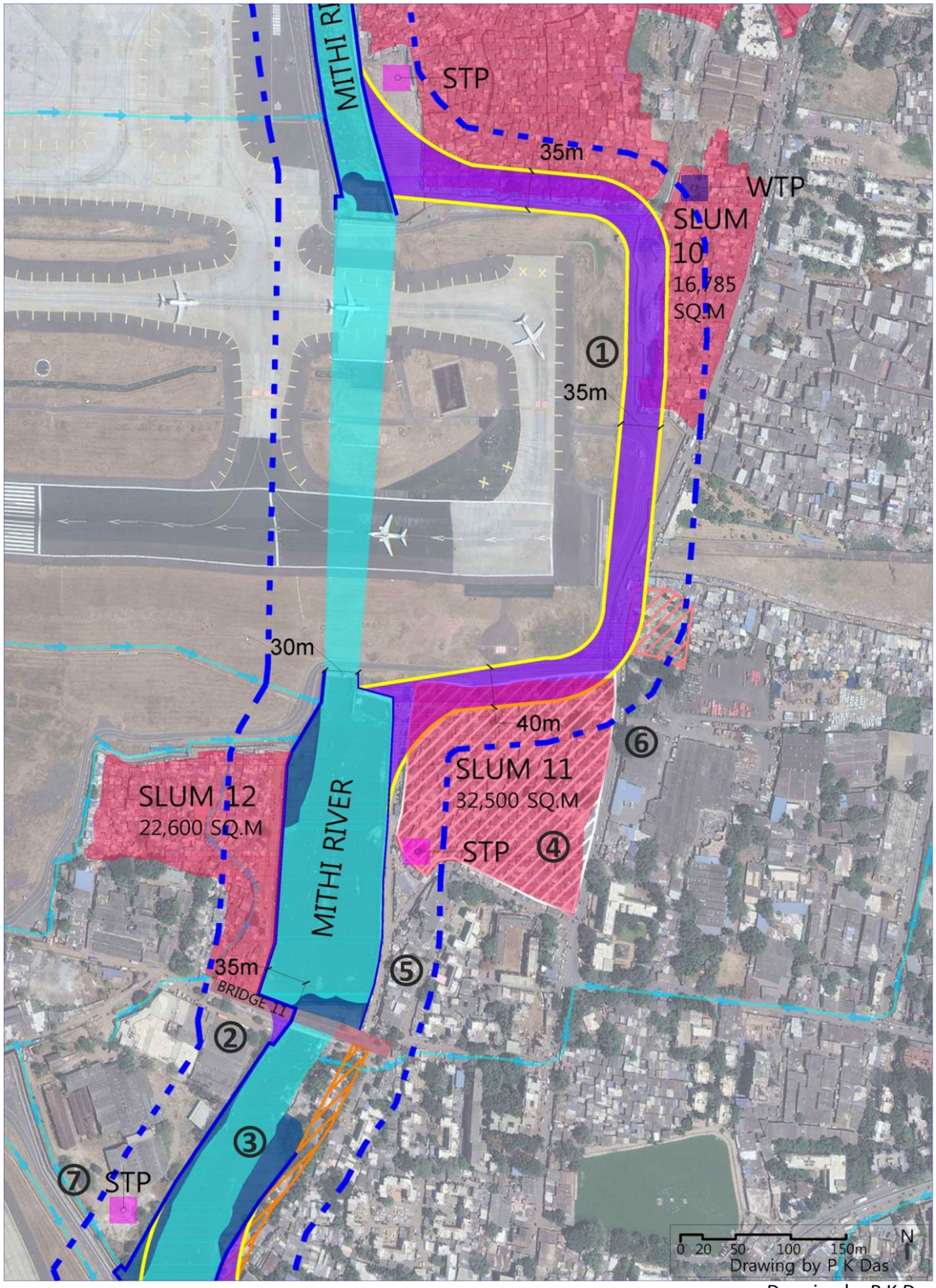
b) Reservation for Industries in the DP plan that falls in the 50 mtrs Mithi River NDZ, at 2 locations, would have to be excluded.

11. Two STP's are proposed in this zone.

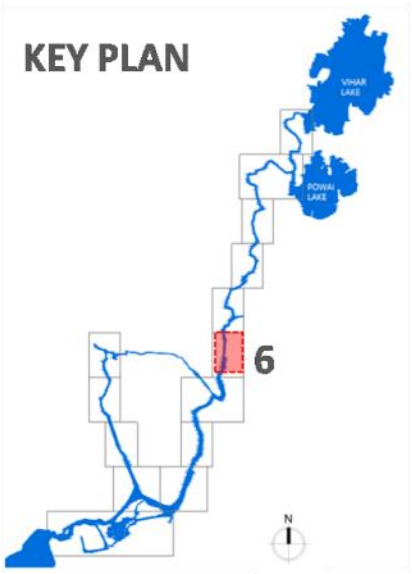
12. Water treatment

Every zone installation of electric deflectors/ screens, sediment traps along with phytorid and self cleaning aerated grade chamber for cleaning the waters – 2 nos.

Zone 6 – AIRPORT



Drawing by P K Das



ZONE 6		
EXISTING		
	Mithi River	63,465sq.m
	Lake	
	River Silting	12,090sq.m
	Slum	1,11,115sq.m
	Pipelines	
	Bridges	1 nos
	Streams	
	Mangrove	
	Wetland	
DP - 2034 LANDUSE		
	Proposed Road	
	School	
	Industrial	
	Market	
	NA	
	Open Space	
	SPA	
PROPOSED		
	Flood Plain	
	River Widening	35,850sq.m
	RCC Wall to be Removed	1570m
	Trapezoidal Section	2040m
	Proposed Gabion Wall	
	Ecopark	
	Promenade	
	Public Space	
	STP	2 nos
	Water Treatment Plant	1 nos
	50M NDZ FROM RIVER	
NOTE :-SUBJECT TO DETAILED STUDY & INVESTIGATION		

PROPOSED ACTION PLAN

1. **Hot Spot 3: due to the construction of the main run way of Mumbai Airport, the original course of the river has been disrupted . Underground pipes have been laid to restore the flow of the river but this poses critical condition during high rains and high outflow from the lakes. This action is completely against the law of nature. Now against this there is no other option but proposing herewith an entirely new route for the river, turning around the run-way. This would take care of the additional pressure of river waters during high rains.**

2. Widening & clearing bottle necks

The width of the river as proposed in the plan should be widened to facilitate free flow of water without any obstruction.

3. De-silting

Various silt areas would have to be removed

4. Redeveloping & Rehabilitating of Slums

a) Parts of slum-10 that fall within the 50 mtrs Mithi River NDZ area would have to be cleared. The rehabilitation of the displaced slum would be accommodated in the redeveloped project to be undertaken for slum-9.

b) Parts of slum-11 that fall within the 50 mtrs Mithi River NDZ would have to be cleared and rehabilitated in the slum redevelopment project to be undertaken on the balance slum land area.

5. Redevelopment of Buildings & Layouts

Buildings that fall within the 50 mtrs. Mithi River NDZ would be ultimately deleted as and when the existing complex is redeveloped. In the redevelopment project, the 50 mtrs. Mithi River NDZ would have to be maintained and developed as public spaces with necessary landscape.

6. Amending Land use in D.P

a) A plot of land reserved in the D.P. for a market that falls within the 50 mtrs Mithi River NDZ would have to be deleted from here and relocated.

b) A proposed DP road that falls within the 50 mtrs Mithi River NDZ area would have to be re-routed.

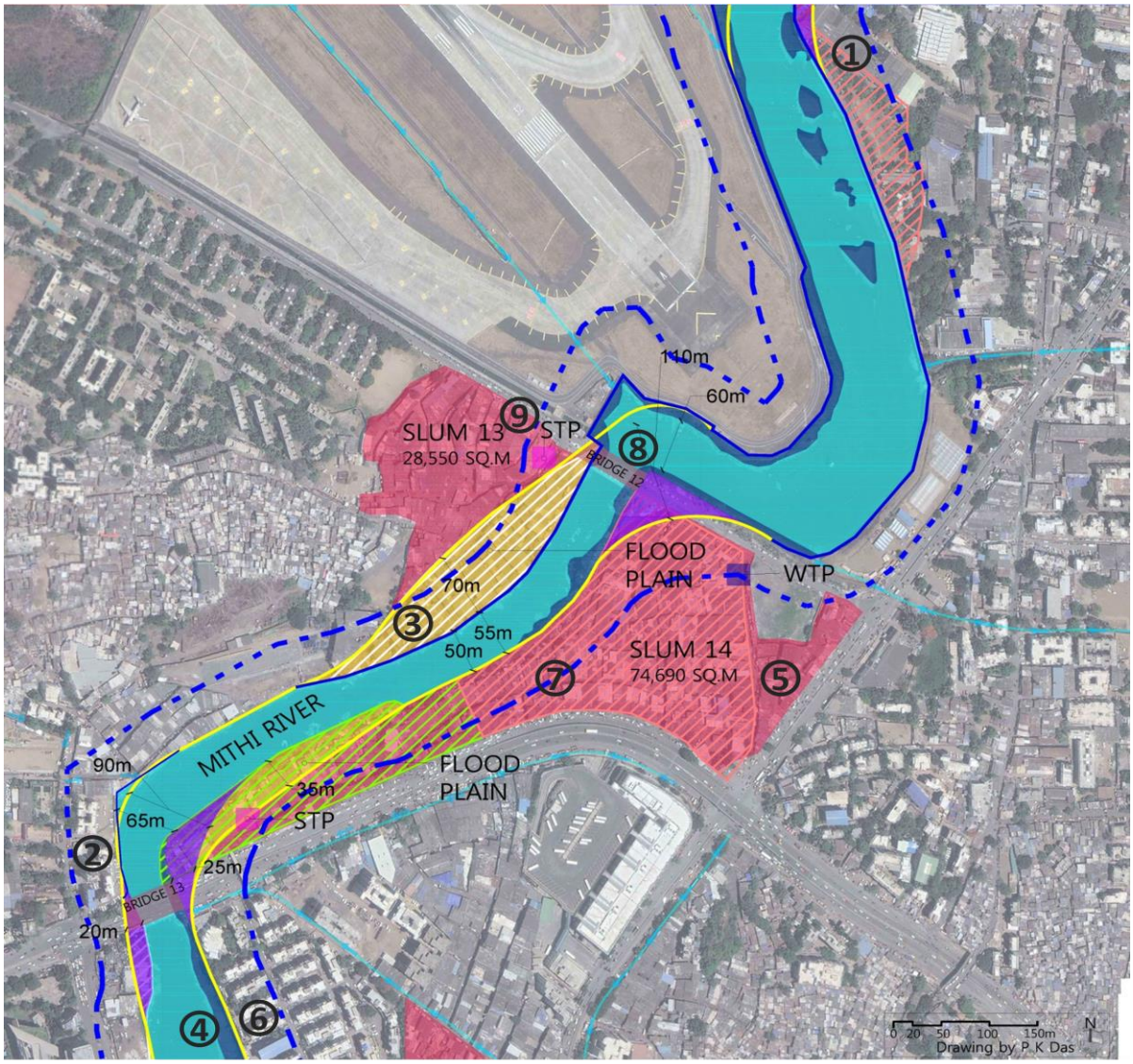
7. Two STP's are proposed in this zone.

8. Water treatment

Every zone installation of electric deflectors/ screens, sediment traps along with phytorid and self cleaning aerated grade chamber for cleaning the waters – 2 nos.

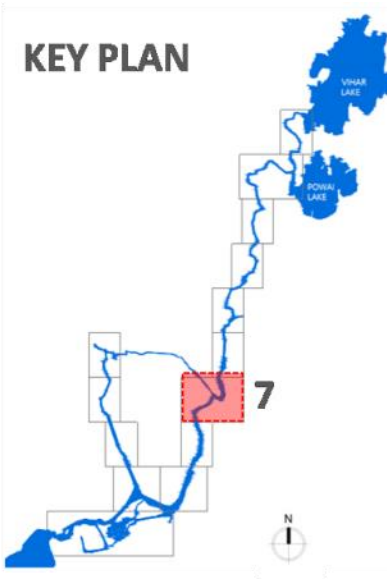
Zone 7 - AIRPORT TO BKC

AIRPORT END



BKC START

Drawing by P K Das



ZONE 7		
EXISTING		
	Mithi River	1,12,450sq.m
	Lake	
	River Silting	20,355sq.m
	Slum	1,06,310sq.m
	Pipelines	
	Bridges	2 nos
	Streams	
	Mangrove	
	Wetland	
DP - 2034 LANDUSE		
	Proposed Road	
	School	
	Industrial	
	Market	
	NA	
	Open Space	
	SPA	
PROPOSED		
	Flood Plain	25,425sq.m
	River Widening	10,550sq.m
	RCC Wall to be Removed	2230m
	Trapezoidal Section	2280m
	Proposed Gabion Wall	
	Ecopark	
	Promenade	
	Public Space	
	STP	2 nos
	Water Treatment Plant	1 nos
	50M NDZ FROM RIVER	
NOTE :-SUBJECT TO DETAILED STUDY & INVESTIGATION		

PROPOSED ACTION PLAN

1. Removal of RCC Wall & Achieving Trapezoidal section

Concrete embankment walls on both sides of the river must be removed to create trapezoidal edge section. These trapezoidal areas would be planted with flora and fauna.

2. Widening & clearing bottle necks

Construction of another run-way further along the downstream of Hot spot-3 is yet another critical area of concern. Sharp turn of the river at this point of the run-way is proposed to be widened for easy flow of Mithi water.

3. Expanding flood plains

Additional flood plains are proposed at two locations. The level of these flood plains will be lowered from the existing level of land.

4. De-silting

A number of silt areas in this zone would have to be removed

5. Redeveloping & Rehabilitating of Slums

Parts of slum-12 & 13 that fall within the50 mtrs Mithi River NDZ would have to be cleared and rehabilitated in the slum redevelopment project to be undertaken on the balance slum land area.

6. Redevelopment of Buildings & Layouts

Buildings that fall within the 50 mtrs. Mithi River NDZ would be ultimately deleted as and when the existing complex is redeveloped. In the redevelopment project, the 50 mtrs. Mithi River NDZ would have to be maintained and developed as public spaces with necessary landscape.

7. Amending Land use in D.P

a) Land for a market as earmarked in the DP plan happens to be on an existing slum-13. This market restoration would have to be deleted and necessary provision for it would be achieved by way of imposing built reservation in the slum redevelopment project.

b) Land marked as open-space in the DP along the Mithi River that falls thin the 50 mtrs Mithi River NDZ be maintained as public open space with landscape.

8. A piece of land abutting into the river, adjoining a bridge in this zone that is reserved for slum rehabilitation would have to be deleted from the DP plan.

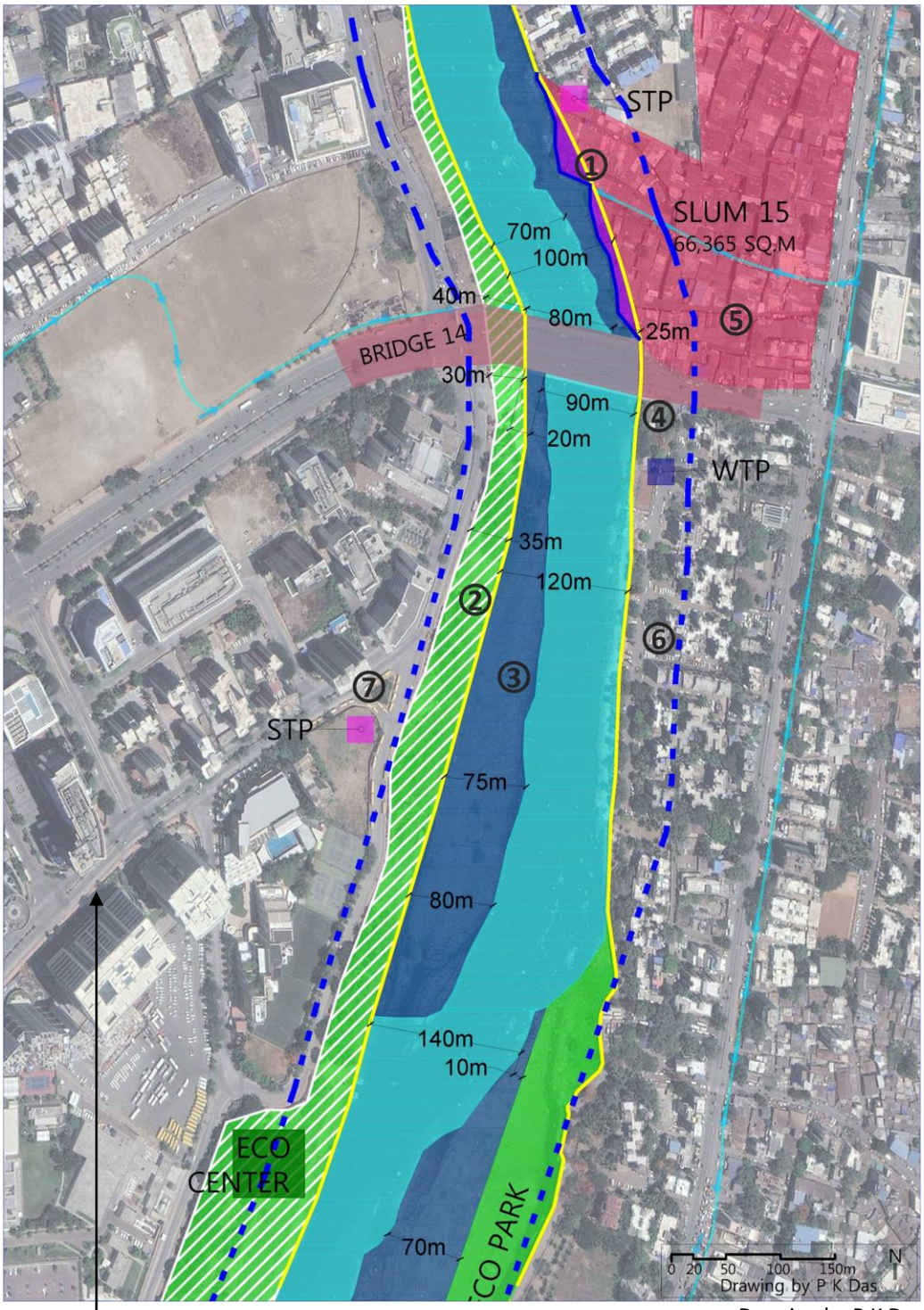
9. Two STPs are proposed in this zone

10. Water treatment

Every zone installation of electric deflectors/ screens, sediment traps along with phytorid and self cleaning aerated grade chamber for cleaning the waters – 2 nos.

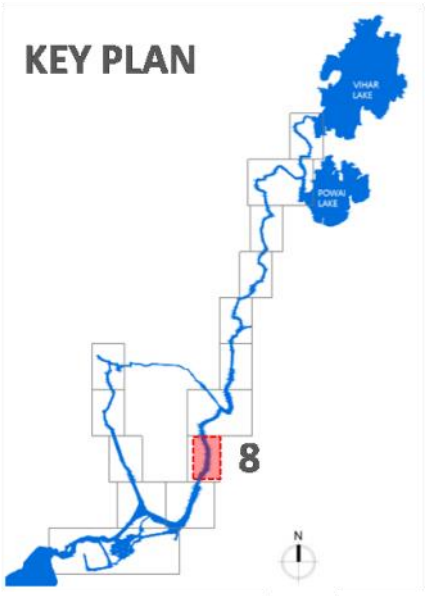
Zone 8 - BKC AREA

BKC START



Drawing by P K Das

BKC REGION



ZONE 8		
EXISTING		
	Mithi River	1,02,700sq.m
	Lake	
	River Silting	54,900sq.m
	Slum	63,290sq.m
	Pipelines	
	Bridges	1 nos
	Streams	
	Mangrove	
	Wetland	
DP - 2034 LANDUSE		
	Proposed Road	
	School	
	Industrial	
	Market	
	NA	
	Open Space	
	SPA	
PROPOSED		
	Flood Plain	
	River Widening	2,765sq.m
	RCC Wall to be Removed	280m
	Trapezoidal Section	2455m
	Proposed Gabion Wall	
	Ecopark	69,840sq.m
	Promenade	
	Public Space	
	STP	2 nos
	Water Treatment Plant	1 nos
	50M NDZ FROM RIVER	
NOTE :-SUBJECT TO DETAILED STUDY & INVESTIGATION		

PROPOSED ACTION PLAN

1. Removal of RCC Wall & Achieving Trapezoidal section

Concrete embankment walls on both sides of the river must be removed to create trapezoidal edge section. These trapezoidal areas would be planted with flora and fauna.

2. Developing Eco-Parks

Eco-Parks are proposed on both sides of the river in this zone that fall under the 50 mtrs Mithi River NDZ.

3. De-silting

Silt areas are required to be cleared

4. Restructuring bridges

An existing bridge in this zone needs to be extended along its length.

5. Redeveloping & Rehabilitating of Slums

Area of slum that falls under the 50 mtrs Mithi River NDZ needs to be cleared and rehabilitated in the slum redevelopment project to be undertaken on the balance slum land.

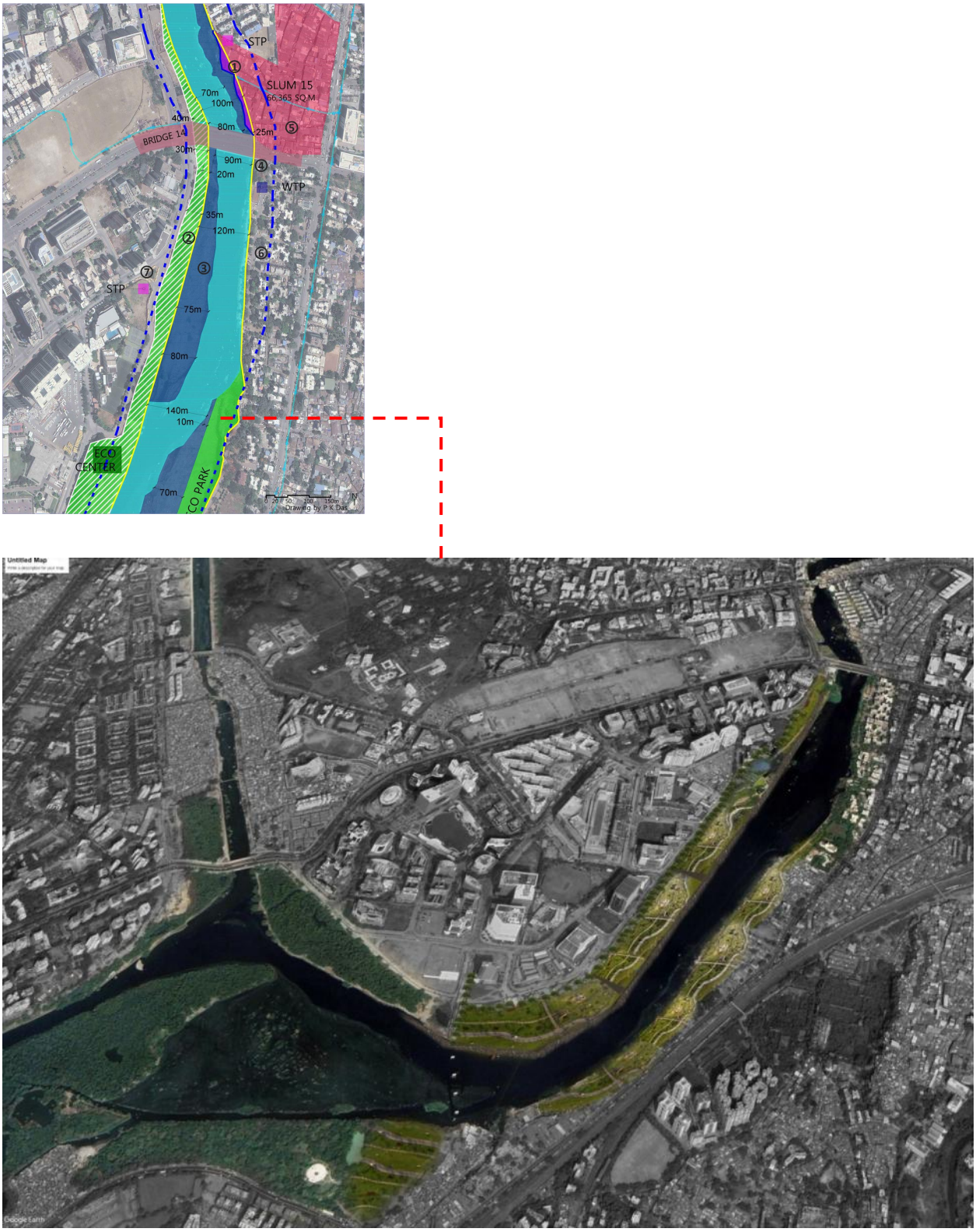
6. Redevelopment of Buildings & Layouts

Buildings that fall within the 50 mtrs. Mithi River NDZ would be ultimately deleted as and when the existing complex is redeveloped. In the redevelopment project, the 50 mtrs. Mithi River NDZ would have to be maintained and developed as public spaces with necessary landscape.

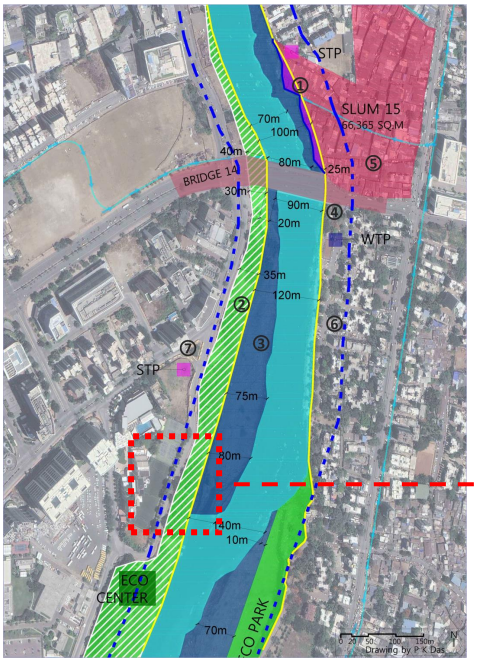
7. Two STP's are provided in this zone.

8. Water treatment

Every zone installation of electric deflectors/ screens, sediment traps along with phytorid and self cleaning aerated grade chamber for cleaning the waters – 2 nos.

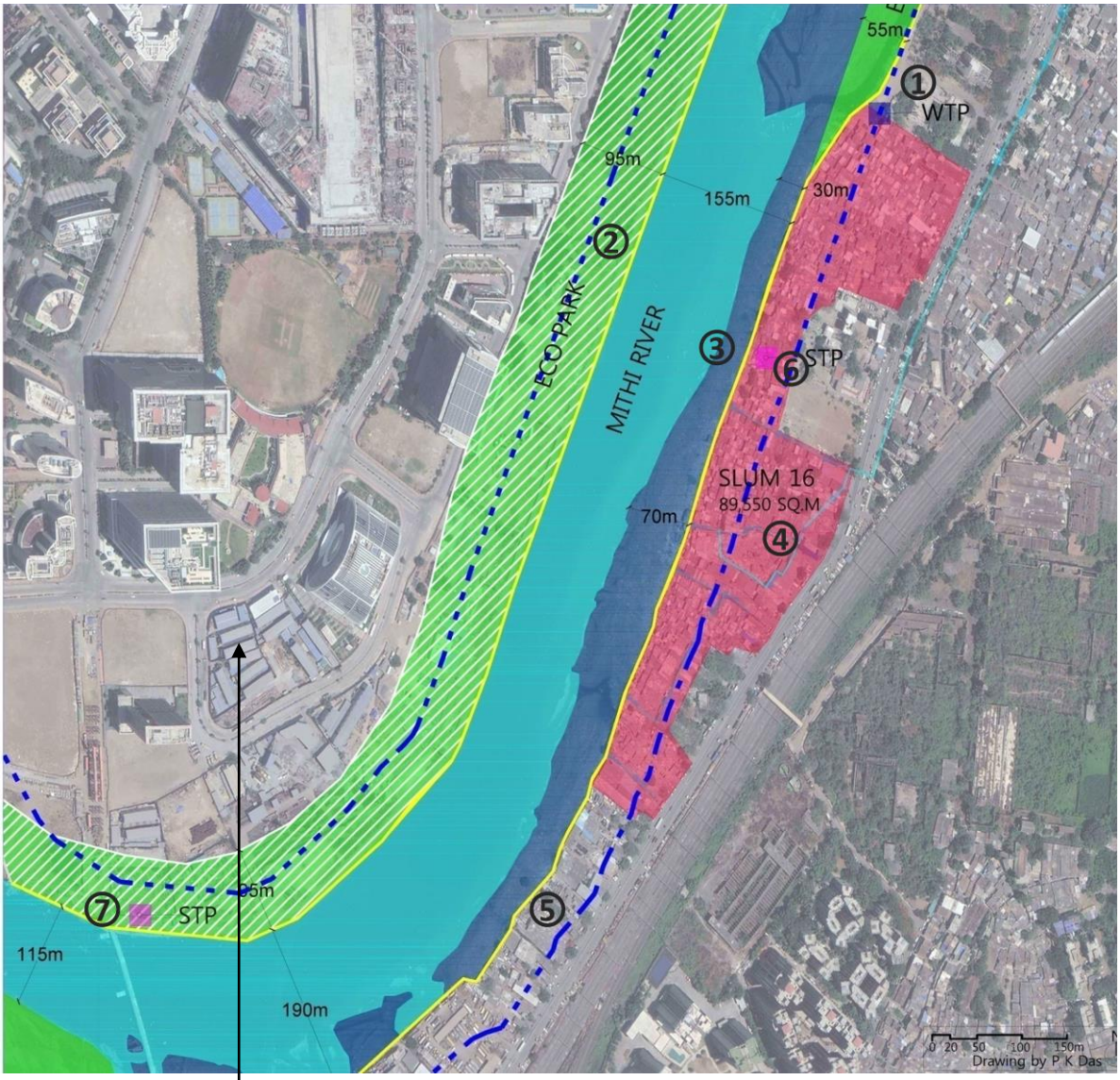


BKC Area – Proposed Sponge Park & Water Treatment



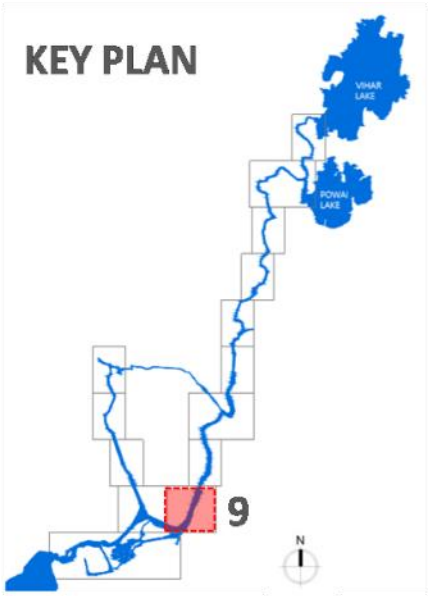
BKC Area – Proposed Ecopark

Zone 9 - BKC AREA



Drawing by P K Das

BKC REGION



ZONE 9		
EXISTING		
	Mithi River	1,95,490sq.m
	Lake	
	River Silting	64,490sq.m
	Slum	89,550sq.m
	Pipelines	
	Bridges	
	Streams	
	Mangrove	
	Wetland	
DP - 2034 LANDUSE		
	Proposed Road	
	School	
	Industrial	
	Market	
	NA	
	Open Space	
	SPA	
PROPOSED		
	Flood Plain	
	River Widening	
	RCC Wall to be Removed	
	Trapezoidal Section	2925m
	Proposed Gabion Wall	
	Ecopark	1,41,220sq.m
	Promenade	
	Public Space	
	STP	2 nos
	Water Treatment Plant	1 nos
	50M NDZ FROM RIVER	
NOTE :-SUBJECT TO DETAILED STUDY & INVESTIGATION		

PROPOSED ACTION PLAN

1. **Achieving Trapezoidal section**

Create trapezoidal edge section. These trapezoidal areas would be planted with flora and fauna.

2. Developing Eco-Parks

An Eco park is also proposed along the river in this zone.

3. De-silting

Silt area needs to be cleared

4. Redeveloping & Rehabilitating of Slums

Parts of slums which fall under the 50 mtrs Mithi River NDZ would have to be cleared and rehabilitated in the slum redevelopment project to be undertaken on balance slum land. The cleared area developed as landscaped public spaces.

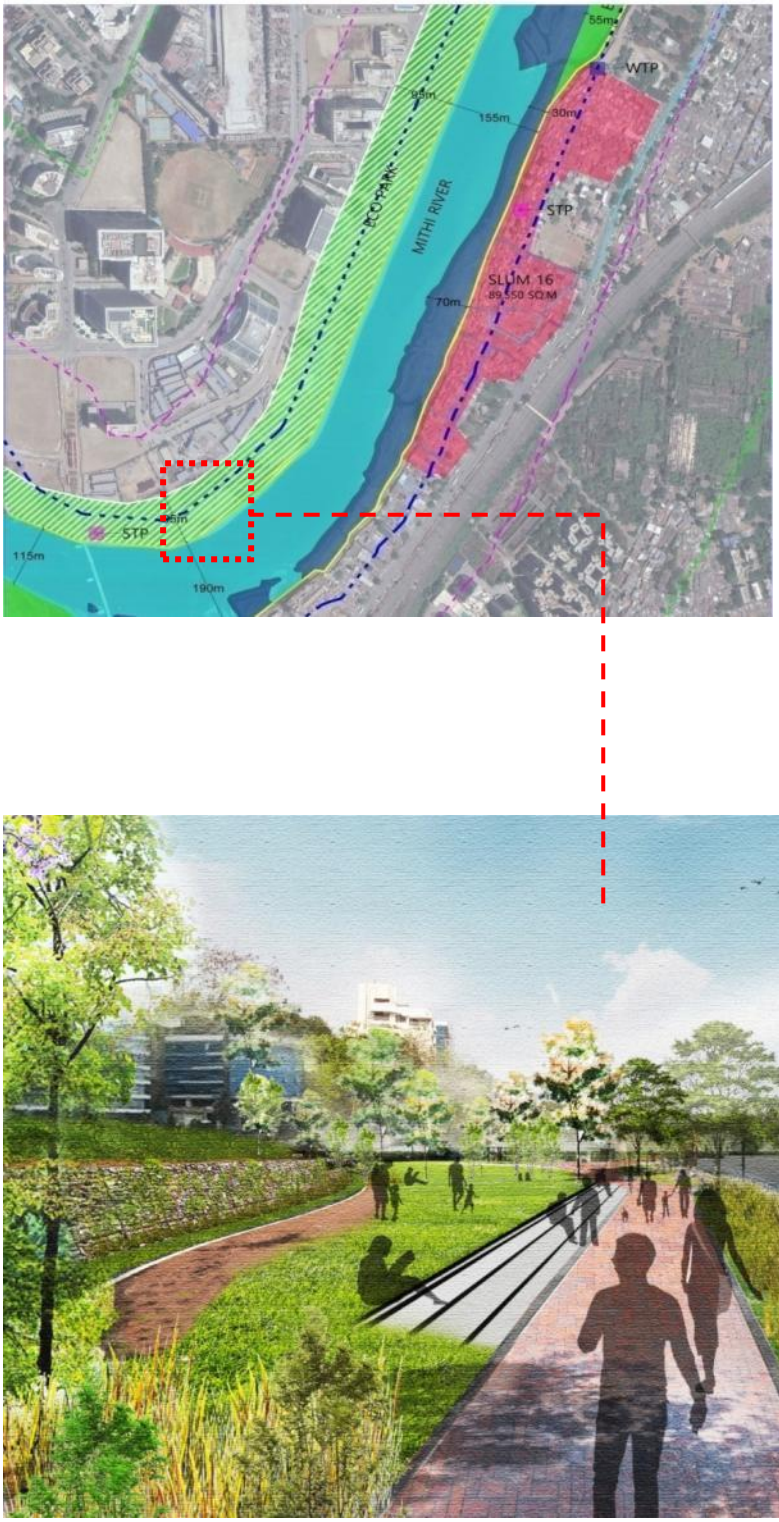
5. Redevelopment of Buildings & Layouts

Buildings that fall within the 50 mtrs. Mithi River NDZ would be ultimately deleted as and when the existing complex is redeveloped. In the redevelopment project, the 50 mtrs. Mithi River NDZ would have to be maintained and developed as public spaces with necessary landscape.

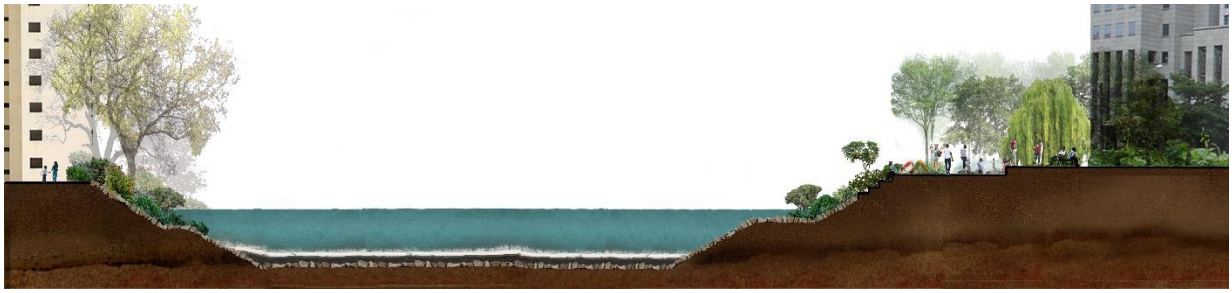
6. Two STP's are provided in this zone.

7. Water treatment

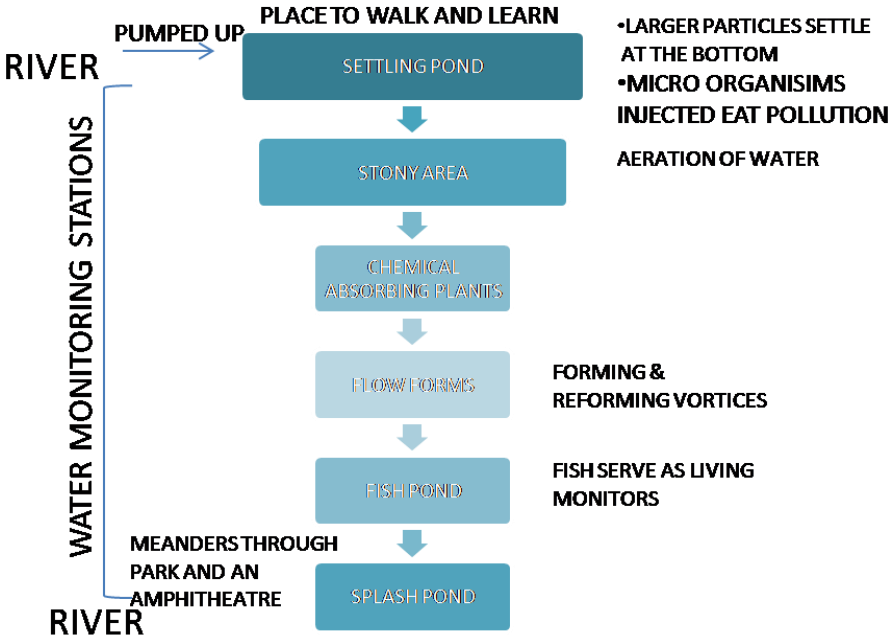
Every zone installation of electric deflectors/ screens, sediment traps along with phytorid and self cleaning aerated grade chamber for cleaning the waters – 2 nos.



BKC Area – Proposed Sponge Park



Proposed Conceptual Section BKC



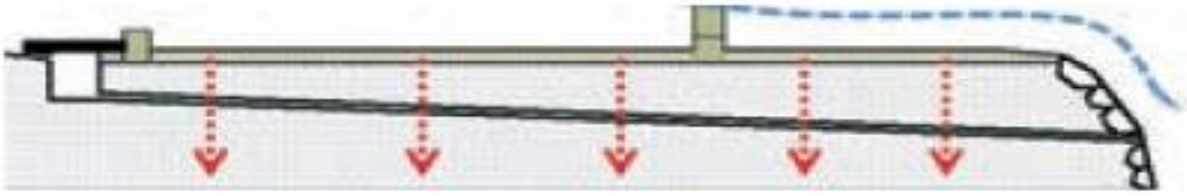
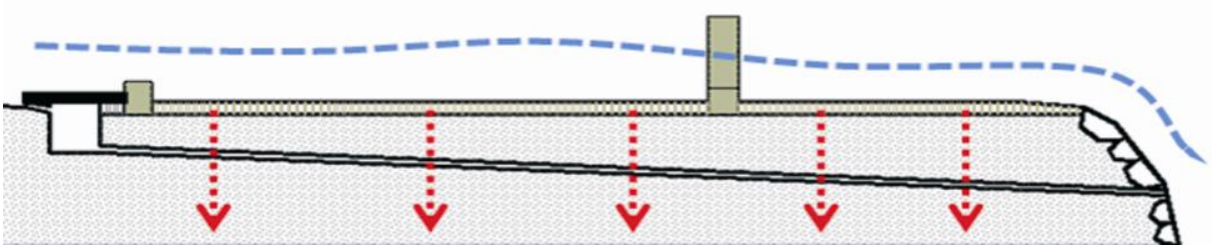
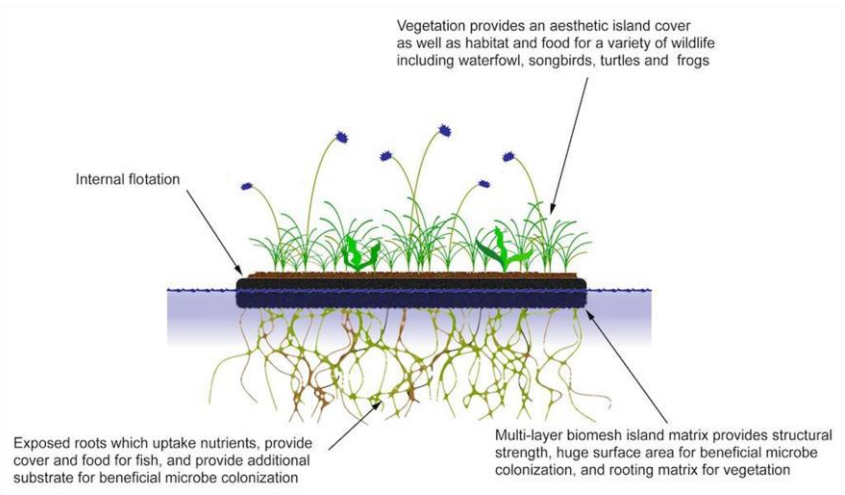


Fig.6. Paved surface will allow permeability

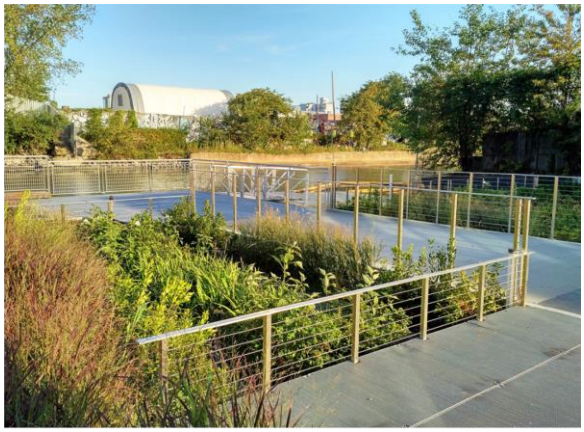


Phytorid



Detail working mechanism of floating bed

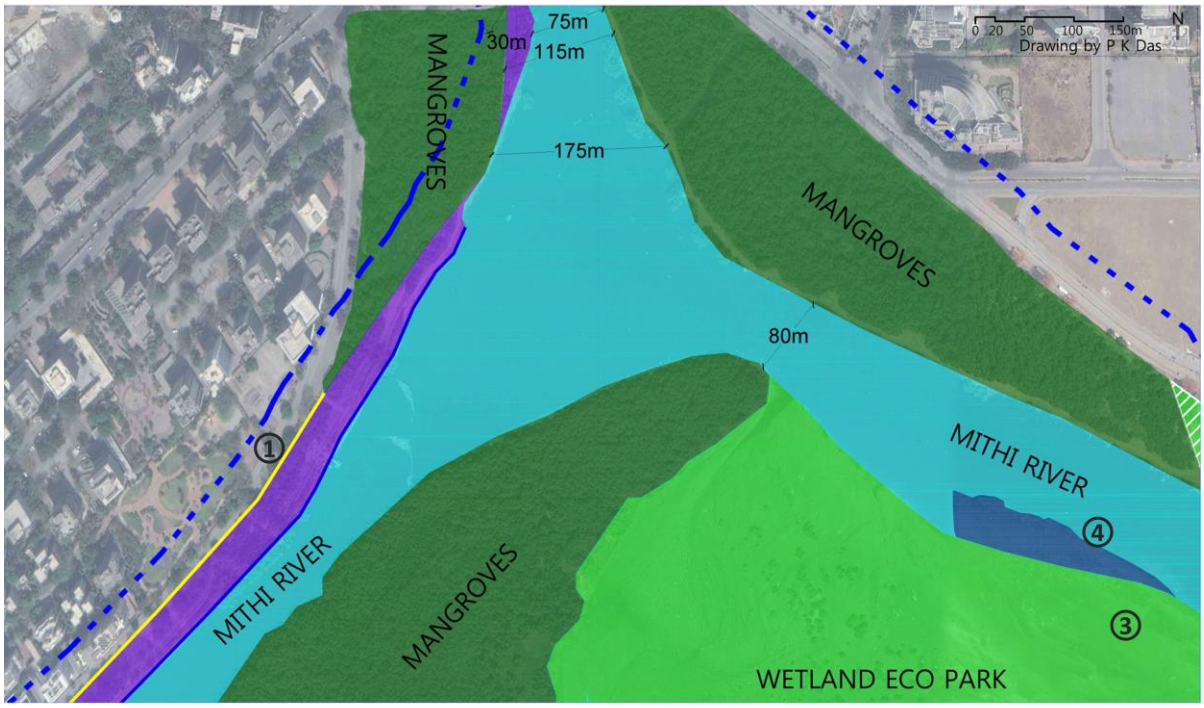
SPONGE PARKS



Source: Gowanus Sponge Park, http://www.dlandstudio.com

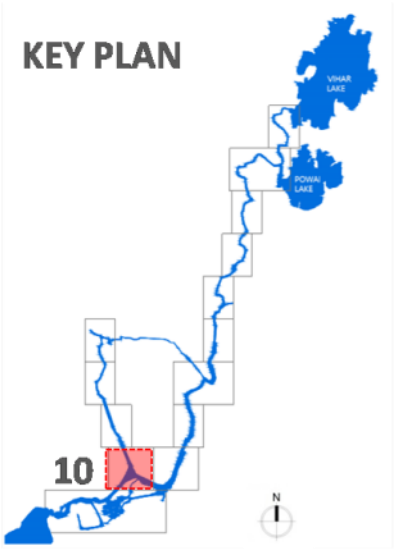
Zone 10 - MITHI – VAKOLA NULLAH JUNCTION

VAKOLA NULLAH



TOWARDS THE MOUTH

Drawing by P K Das



ZONE 10		
EXISTING		
	Mithi River	1,73,475sq.m
	Lake	
	River Silting	7,745sq.m
	Slum	
	Pipelines	
	Bridges	
	Streams	
	Mangrove	2,25,325sq.m
	Wetland	1,26,480sq.m
DP - 2034 LANDUSE		
	Proposed Road	
	School	
	Industrial	
	Market	
	NA	
	Open Space	
	SPA	
PROPOSED		
	Flood Plain	
	River Widening	25,250sq.m
	RCC Wall to be Removed	600m
	Trapezoidal Section	410m
	Proposed Gabion Wall	580m
	Ecopark	1,26,480sq.m
	Promenade	
	Public Space	
	STP	
	Water Treatment Plant	
	50M NDZ FROM RIVER	
NOTE :-SUBJECT TO DETAILED STUDY & INVESTIGATION		

PROPOSED ACTION PLAN

1. Achieving Trapezoidal section - Create trapezoidal edge section. These trapezoidal areas would be planted with flora and fauna.

2. Widening & clearing bottle necks - The river needs to be expanded on one side for easy flow

3. Developing Eco-Parks - An Eco park is also proposed along the river in this zone.

4. De-silting - Silt area needs to be cleared.

5. Developing Public Spaces - Public space area proposed as Wetland Eco-park.

6. Restructuring bridges - The mud flat created due to BKC linkage road from Kalina / Govt. Colony site to be cleared and the existing bridge in this zone needs to be extended along its length.

7. Redevelopment of Buildings & Layouts - Buildings that fall within the 50 mtrs. Mithi River NDZ would be ultimately deleted as and when the existing complex is redeveloped. In the redevelopment project, the 50 mtrs. Mithi River NDZ would have to be maintained and developed as public spaces with necessary landscape.

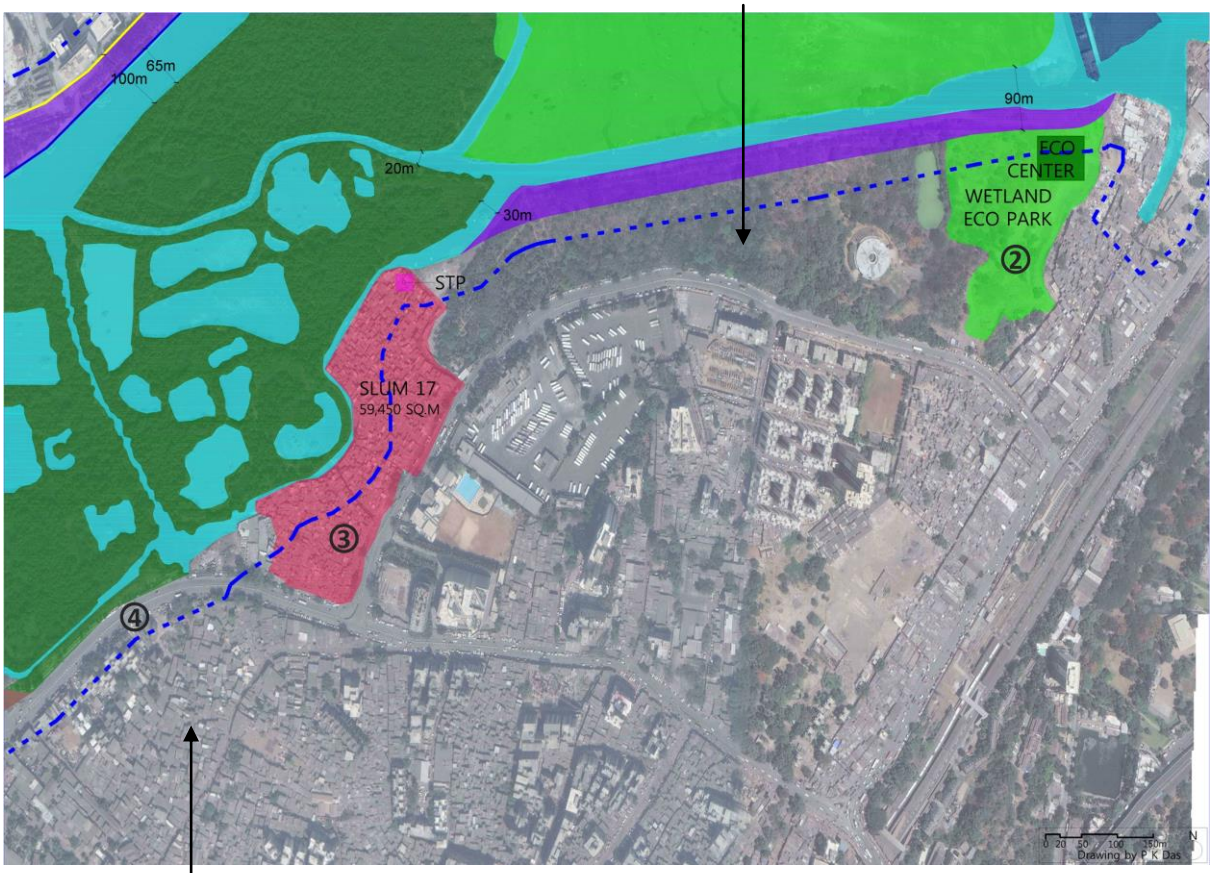
8. Two STP's are provided in this zone.

9. Water treatment

Every zone installation of electric deflectors/ screens, sediment traps along with phytorid and self cleaning aerated grade chamber for cleaning the waters – 2 nos.

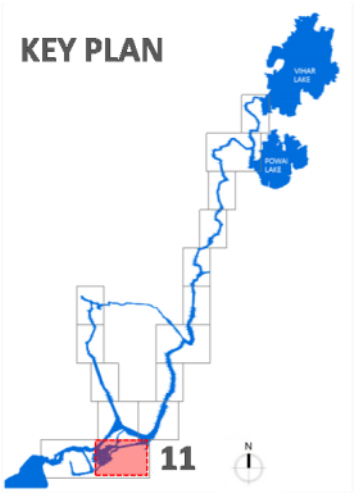
Zone 11 - MAHIM NATURE PARK

MAHIM NATURE PARK



Drawing by P K Das

DHARAVI



ZONE 11		
EXISTING		
	Mithi River	2,01,895sq.m
	Lake	
	River Silting	5,900sq.m
	Slum	59,450sq.m
	Pipelines	
	Bridges	
	Streams	
	Mangrove	2,74,485sq.m
	Wetland	1,55,090sq.m
DP - 2034 LANDUSE		
	Proposed Road	
	School	
	Industrial	
	Market	
	NA	
	Open Space	
	SPA	
PROPOSED		
	Flood Plain	
	River Widening	47,120sq.m
	RCC Wall to be Removed	340m
	Trapezoidal Section	250m
	Proposed Gabion Wall	430m
	Ecopark	1,55,090sq.m
	Promenade	
	Public Space	
	STP	1 nos
	Water Treatment Plant	
	50M NDZ FROM RIVER	
NOTE :-SUBJECT TO DETAILED STUDY & INVESTIGATION		

PROPOSED ACTION PLAN

1. Expanding flood plains - The river needs to be expanded on one as indicated side for easy flow

2. Developing Eco-Parks - Public space area proposed as Wetland Eco Park adjacent to or inclusive of the Mahim Nature Park, along the Mithi river with allowance to be a flood plain in crisis time.

3. Redeveloping & Rehabilitating of Slums

Parts of slum-17 that fall within the 50 mtrs Mithi River NDZ area would have to be cleared. The rehabilitation of the displaced slum would be accommodated in the redeveloped project to be undertaken.

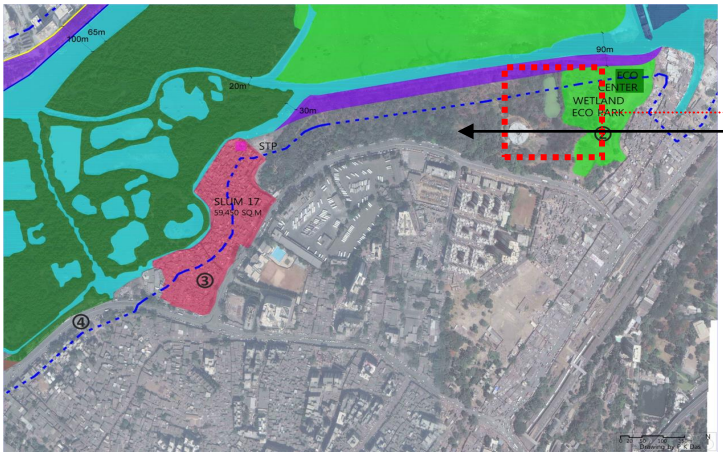
4. Redevelopment of Buildings & Layouts

Buildings that fall within the 50 mtrs. Mithi River NDZ would be ultimately deleted as and when the existing complex is redeveloped. In the redevelopment project, the 50 mtrs. Mithi River NDZ would have to be maintained and developed as public spaces with necessary landscape.

5. Water treatment

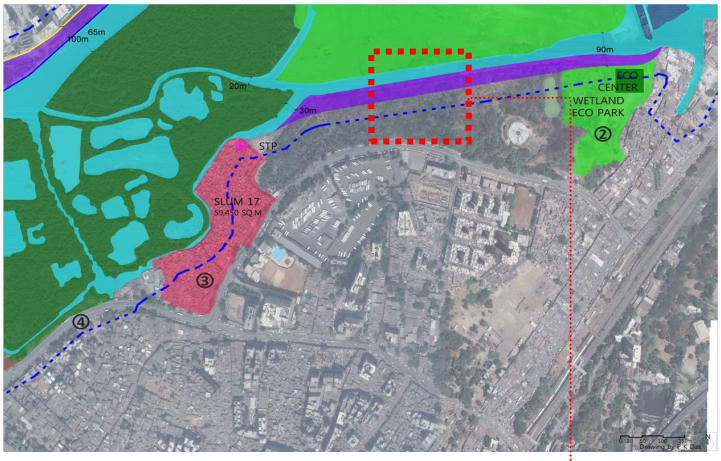
Every zone installation of electric deflectors/ screens, sediment traps along and aerated grade chamber with phytorid and self cleaning systems for cleaning the waters – 2 nos.

6. Two STP's are provided in this zone.



MAHIM NATURE PARK

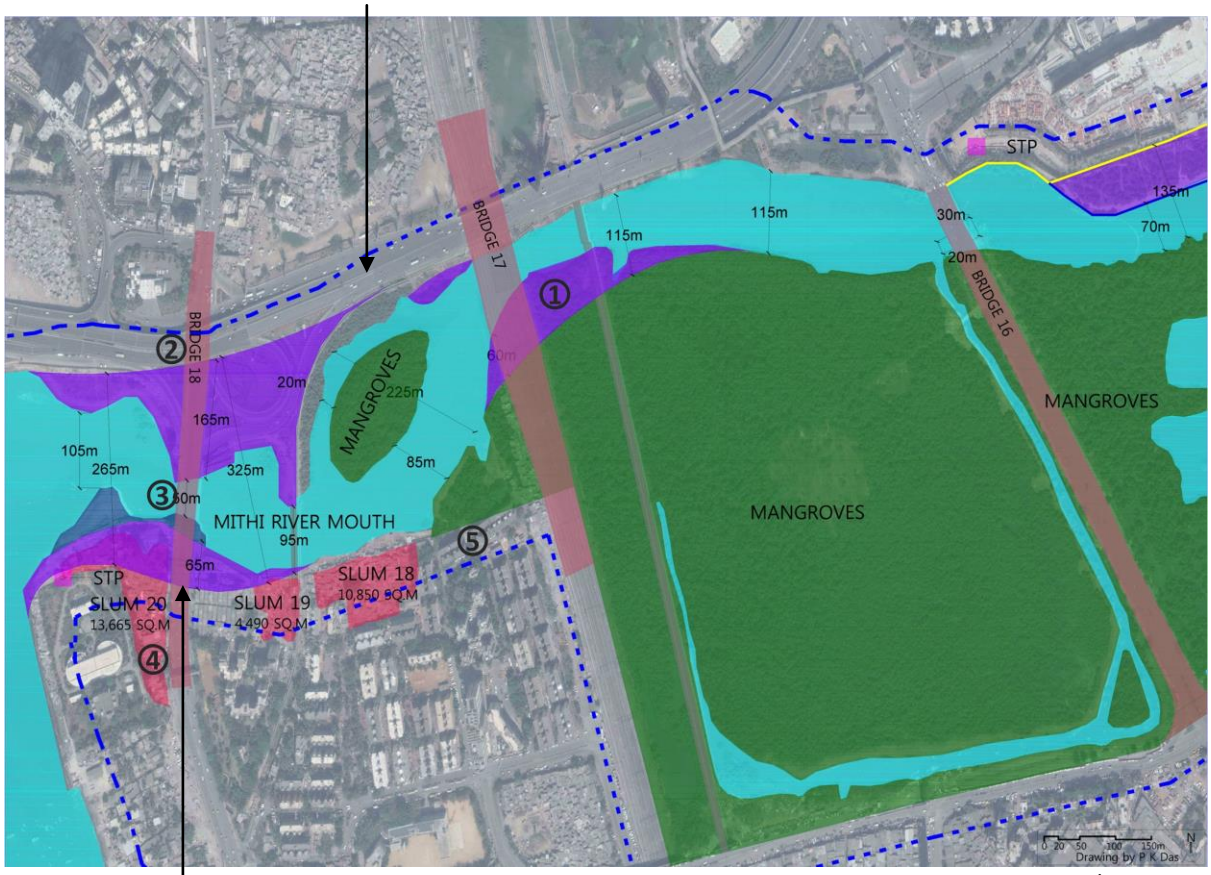
Mahim Nature Park



Proposed Flood Plain Module

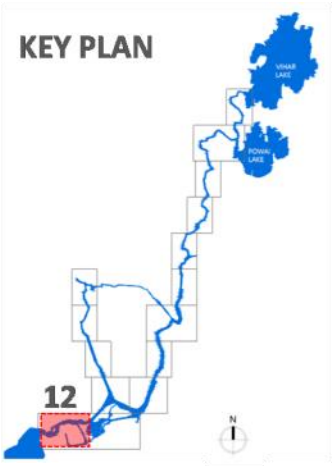
Zone 12- MITHI MEETING THE ARABIAN SEA

WESTERN EXPRESS HIGHWAY



Drawing by P K Das

MAHIM CAUSEWAY



ZONE 12		
EXISTING		
	Mithi River	3,19,020sq.m
	Lake	
	River Silting	5,450sq.m
	Slum	29,000sq.m
	Pipelines	2 nos
	Bridges	3 nos
	Streams	
	Mangrove	6,27,270sq.m
	Wetland	
DP - 2034 LANDUSE		
	Proposed Road	
	School	
	Industrial	
	Market	
	NA	
	Open Space	
	SPA	
PROPOSED		
	Flood Plain	
	River Widening	93,595sq.m
	RCC Wall to be Removed	245m
	Trapezoidal Section	400m
	Proposed Gabion Wall	2450m
	Ecopark	
	Promenade	
	Public Space	
	STP	2 nos
	Water Treatment Plant	
	50M NDZ FROM RIVER	
NOTE :-SUBJECT TO DETAILED STUDY & INVESTIGATION		

PROPOSED ACTION PLAN

1. Widening & clearing bottle necks - Mangroves at 2 places have to be removed, particularly at the point where the bridges are built for the pipe lines and railways, to get rid of the flow obstruction.

2. Restructuring bridges - The course of the river and its out flow to the sea at Mahim has been severely constricted at three places where bridges have been built for pipelines, railway tracks and vehicular road. The length of the three bridges would have to be substantially increased to expand the out-flow passage of water during heavy rains and to ease out the pressures that builds-up stream

3. Expanding Mithi out flow at Mahim - A major obstruction has been caused due to land filling along the flyover for building a road bypass and a circular ramp. Existing roads that are built in this land-filled area must be re-built on columns and the land-fill under the stilted roads them cleared.

4. Redeveloping & Rehabilitating of Slums

Parts of slums which falls under the 50 mtrs Mithi River NDZ would have to be cleared and rehabilitated in the slum redevelopment project to be undertaken on balance slum land. The cleared area developed as landscaped public spaces.

5. Redevelopment of Buildings & Layouts

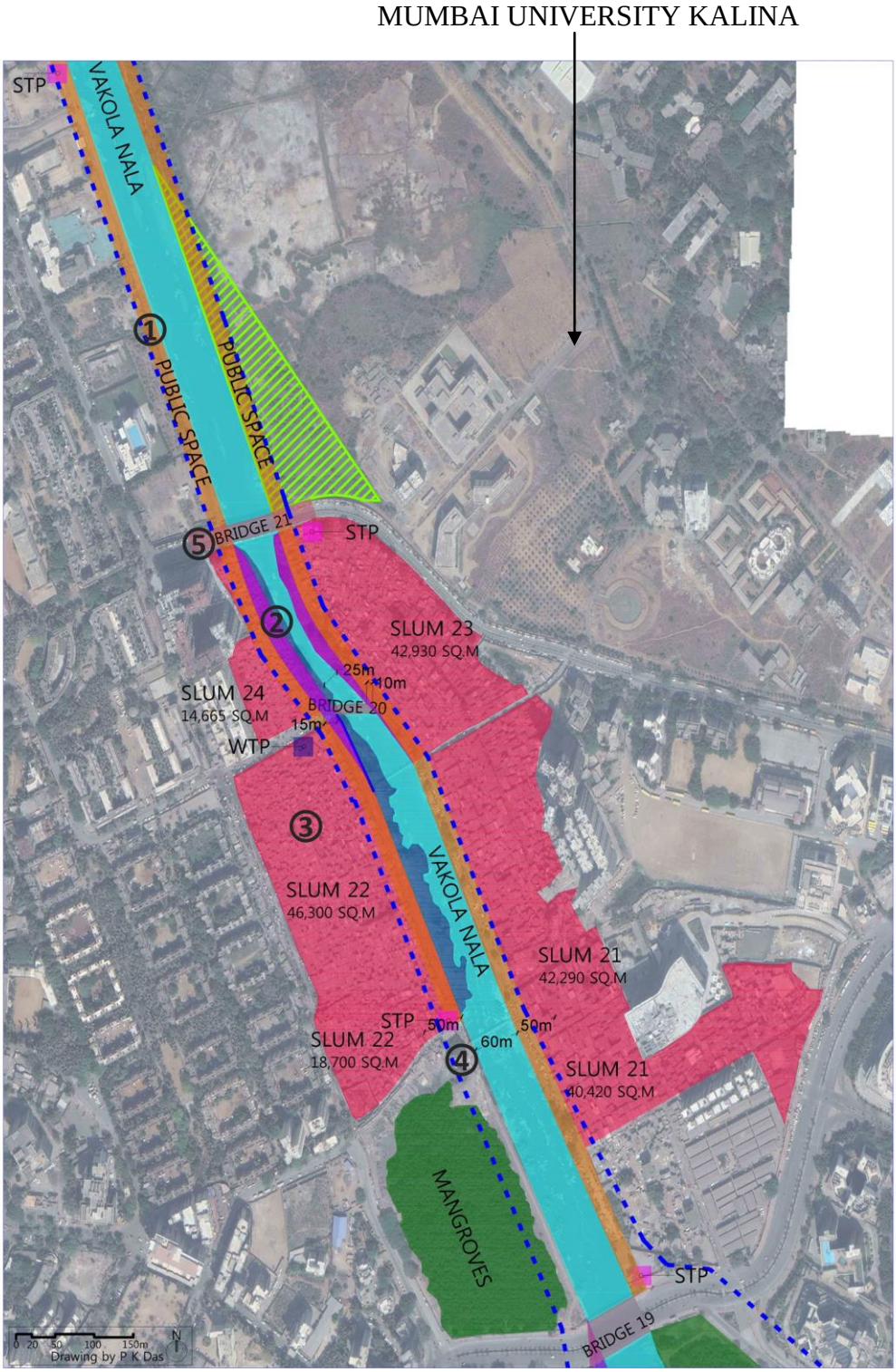
Buildings that fall within the 50 mtrs. Mithi River NDZ would be ultimately deleted as and when the existing complex is redeveloped. In the redevelopment project, the 50 mtrs. Mithi River NDZ would have to be maintained and developed as public spaces with necessary landscape.

6. Water treatment

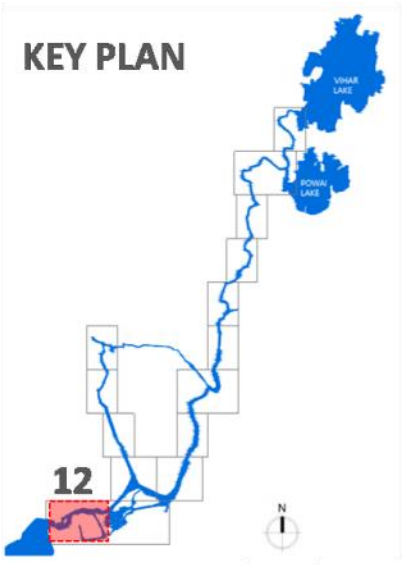
Every zone installation of electric deflectors/ screens, sediment traps along and aerated grade chamber with phytorid and self cleaning systems for cleaning the waters – 2 nos.

7. Two STP's are provided in this zone.

Zone 13- PATTHAR NAGAR



Drawing by P K Das



ZONE 13		
EXISTING		
	Vakola Nullah	93,365sq.m
	Lake	
	River Silting	10,270sq.m
	Slum	2,24,040sq.m
	Pipelines	
	Bridges	3 nos
	Streams	
	Mangrove	
	Wetland	
DP - 2034 LANDUSE		
	Proposed Road	
	School	
	Industrial	
	Market	
	NA	
	Open Space	
	SPA	
PROPOSED		
	Flood Plain	
	River Widening	8,180sq.m
	RCC Wall to be Removed	110m
	Trapezoidal Section	
	Proposed Gabion Wall	3420m
	Ecopark	
	Promenade	
	Public Space	60,360sq.m
	STP	4 nos
	Water Treatment Plant	1 nos
	20M NDZ FROM NALLAH	
NOTE :-SUBJECT TO DETAILED STUDY & INVESTIGATION		

PROPOSED ACTION PLAN

1. Developing Public Spaces

The 20 mtrs Vakola Nullah NDZ area would be developed as a promenade and public space.

2. De-silting

Various silt areas in the Vakola Nullaha is to be cleared

3. Redeveloping & Rehabilitating of Slums

Existing Slum falling in 20 mtrs Vakola Nullah NDZ would have to be cleared and rehabilitated in the slum redeveloped project to be undertaken on the balance slum land area.

4. Redevelopment of Buildings & Layouts

Buildings that fall within the 20 mtrs. Vakola Nullah NDZ would be ultimately deleted as and when the existing complex is redeveloped. In the redevelopment project, the 20 mtrs. Vakola Nullah NDZ would have to be maintained and developed as public spaces with necessary landscape.

5. Restructuring bridges

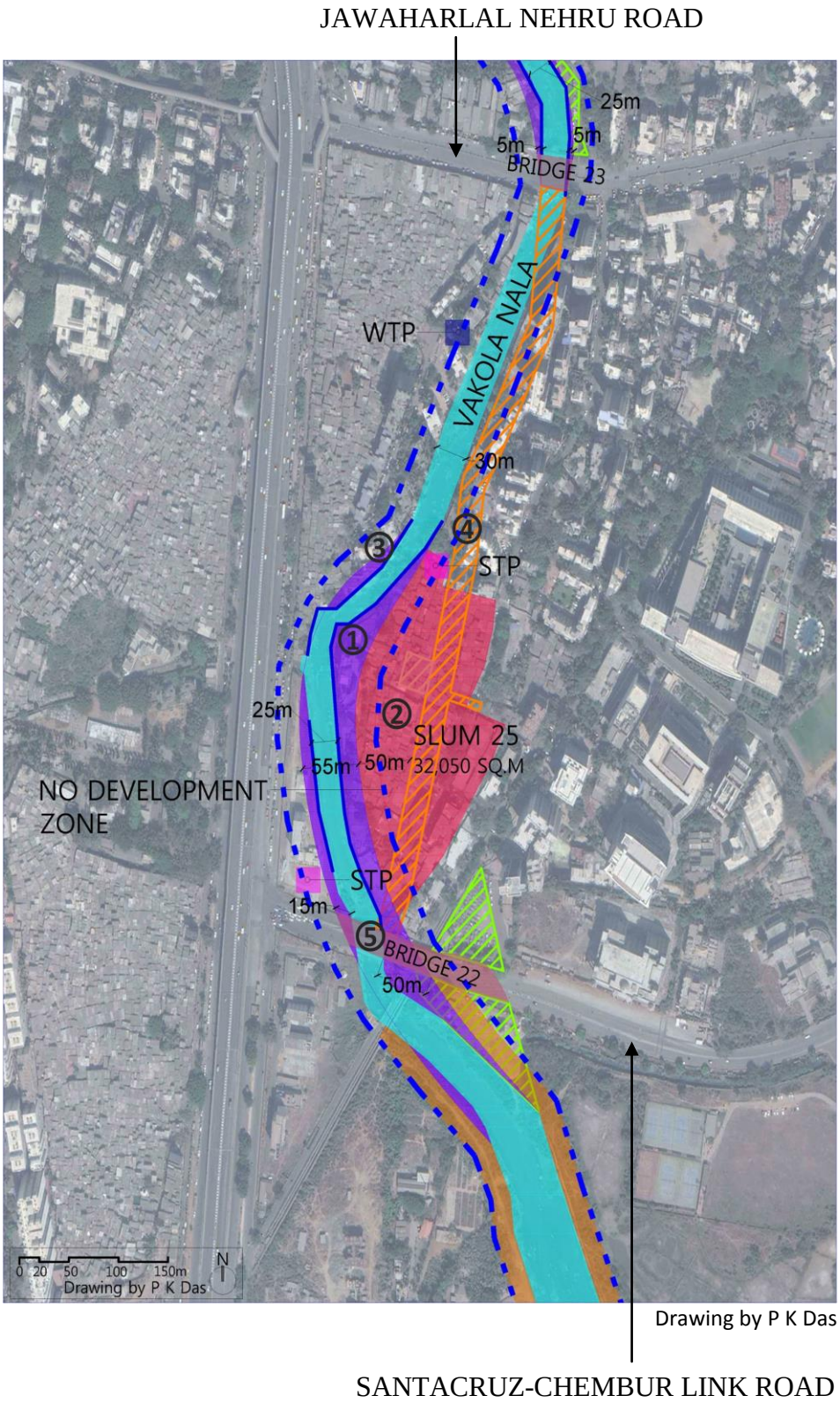
Length of 2 bridges over the nullah in this zone has to increase in their length to avoid land-fill on the 20 mtrs Vakola Nullah NDZ on both sides.

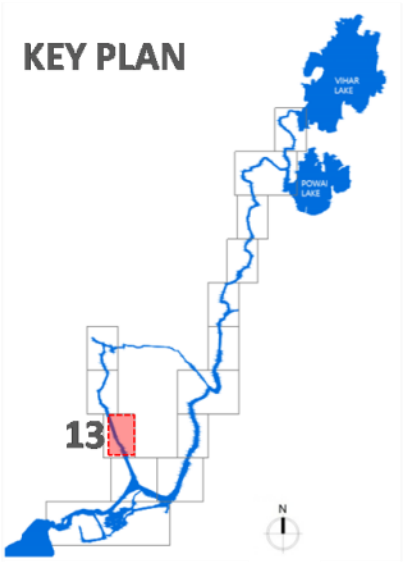
6. Two STP's are provided in this zone.

7. Water treatment

Every zone installation of electric deflectors/ screens, sediment traps along with phytorid and self cleaning aerated grade chamber for cleaning the waters – 2 nos.

Zone 14- SANTACRUZ EAST





ZONE 14		
EXISTING		
	Vakola Nullah	44,370sq.m
	Lake	
	River Silting	
	Slum	95,250sq.m
	Pipelines	
	Bridges	2 nos
	Streams	
	Mangrove	
	Wetland	
DP - 2034 LANDUSE		
	Proposed Road	
	School	
	Industrial	
	Market	
	NA	
	Open Space	
	SPA	
PROPOSED		
	Flood Plain	
	River Widening	17,720sq.m
	RCC Wall to be Removed	1000m
	Trapezoidal Section	
	Proposed Gabion Wall	2625m
	Ecopark	
	Promenade	
	Public Space	13,020sq.m
	STP	2 nos
	Water Treatment Plant	1 nos
	20M NDZ FROM NALLAH	
NOTE :-SUBJECT TO DETAILED STUDY & INVESTIGATION		

PROPOSED ACTION PLAN

1. Widening & clearing bottle necks

Existing nullah width as marked in blue have to be increased to maintain an uniform width and flow.

2. Redeveloping & Rehabilitating of Slums

Parts of slum-25 falling within the 20 mtrs Vakola Nullah NDZ would be cleared and rehabilitated in the slum redevelopment project to be undertaken on the balance slum land.

3. Redevelopment of Buildings & Layouts

Buildings that fall within the 20 mtrs. Vakola Nullah NDZ would be ultimately deleted as and when the existing complex is redeveloped. In the redevelopment project, the 20 mtrs. Vakola Nullah NDZ would have to be maintained and developed as public spaces with necessary landscape.

4. Amending Land use in D.P

A proposed DP Road going over parts of the nullah and the 20 mtrs Vakola Nullah NDZ would have to be deleted & re-routed.

5. Restructuring bridges

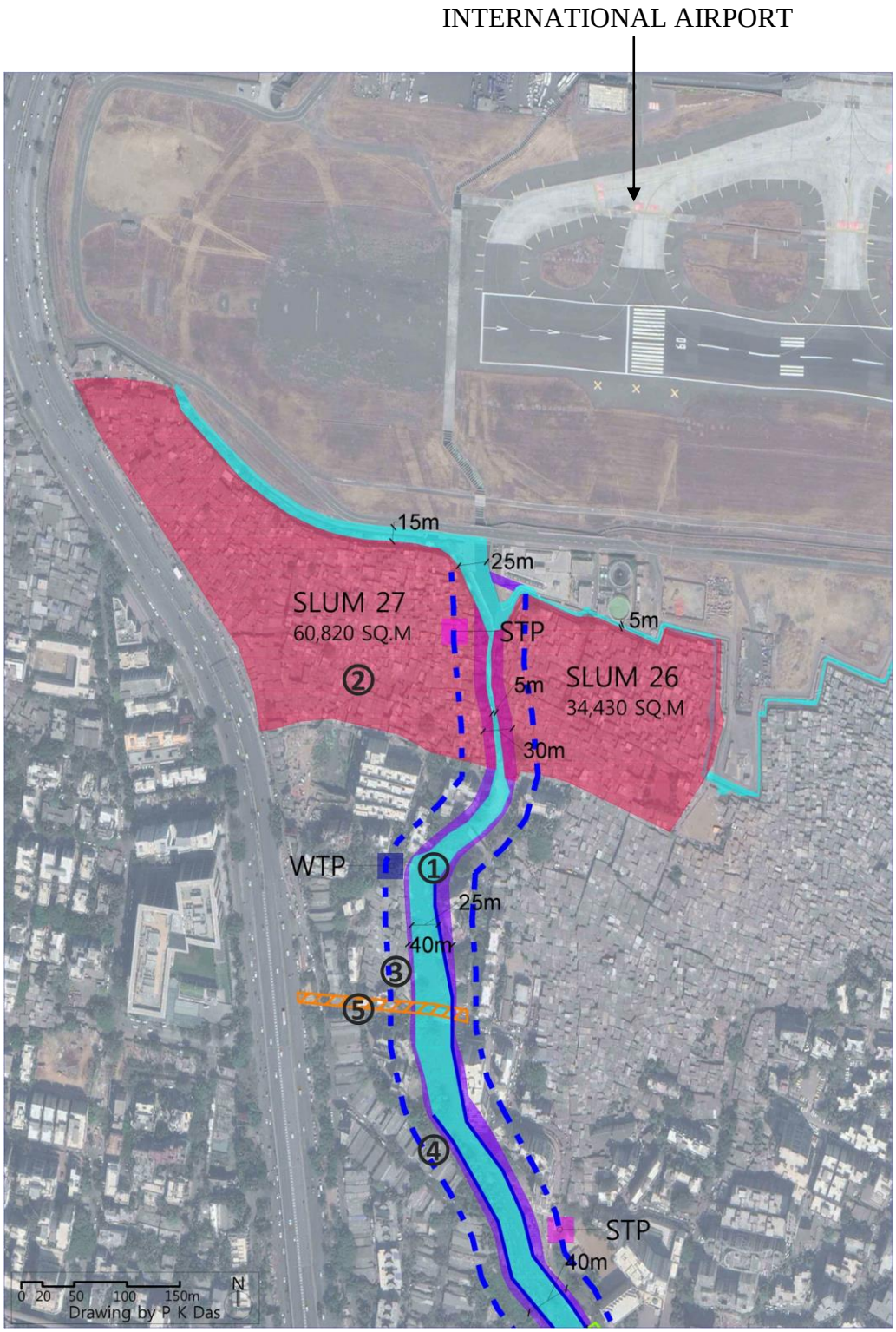
Length of 2 bridges over the nullah in this zone have to increased in their length to avoid land-fill on the 20 mtrs Vakola Nullah NDZ on both sides.

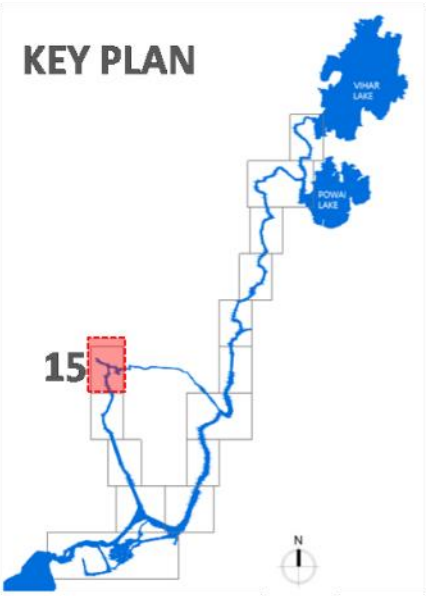
6. Two STP's are provided in this zone.

7. Water treatment

Every zone installation of electric deflectors/ screens, sediment traps along with phytorid and self cleaning aerated grade chamber for cleaning the waters – 2 nos

Zone 15- AIRPORT





ZONE 15		
EXISTING		
	Vakola Nullah	22,130sq.m
	Lake	
	River Silting	
	Slum	95,250sq.m
	Pipelines	
	Bridges	
	Streams	
	Mangrove	
	Wetland	
DP - 2034 LANDUSE		
	Proposed Road	
	School	
	Industrial	
	Market	
	NA	
	Open Space	
	SPA	
PROPOSED		
	Flood Plain	
	River Widening	11,625sq.m
	RCC Wall to be Removed	685m
	Trapezoidal Section	
	Proposed Gabion Wall	1480m
	Ecopark	
	Promenade	
	Public Space	
	STP	2 nos
	Water Treatment Plant	1 nos
	20M NDZ FROM NALLAH	
NOTE :-SUBJECT TO DETAILED STUDY & INVESTIGATION		

PROPOSED ACTION PLAN

1. Widening & clearing bottle necks

Existing nullah width as marked in blue have to be increased to maintain an uniform width and flow.

2. Redeveloping & Rehabilitating of Slums

The width of the river passing through slum-26 and 27 will have to be increased. The displaced huts would be accommodated in the slum redevelopment project to be undertaken on balance slum land.

3. Redevelopment of Buildings & Layouts

Buildings that fall within the 20 mtrs. Vakola Nullah NDZ would be ultimately deleted as and when the existing complex is redeveloped. In the redevelopment project, the 20 mtrs. Vakola Nullah NDZ would have to be maintained and developed as public spaces with necessary landscape.

4. Developing Public Spaces

The 20mtrs Vakola Nullah NDZ would be developed as a public space with necessary plantation & landscape.

5. Amending Land use in D.P

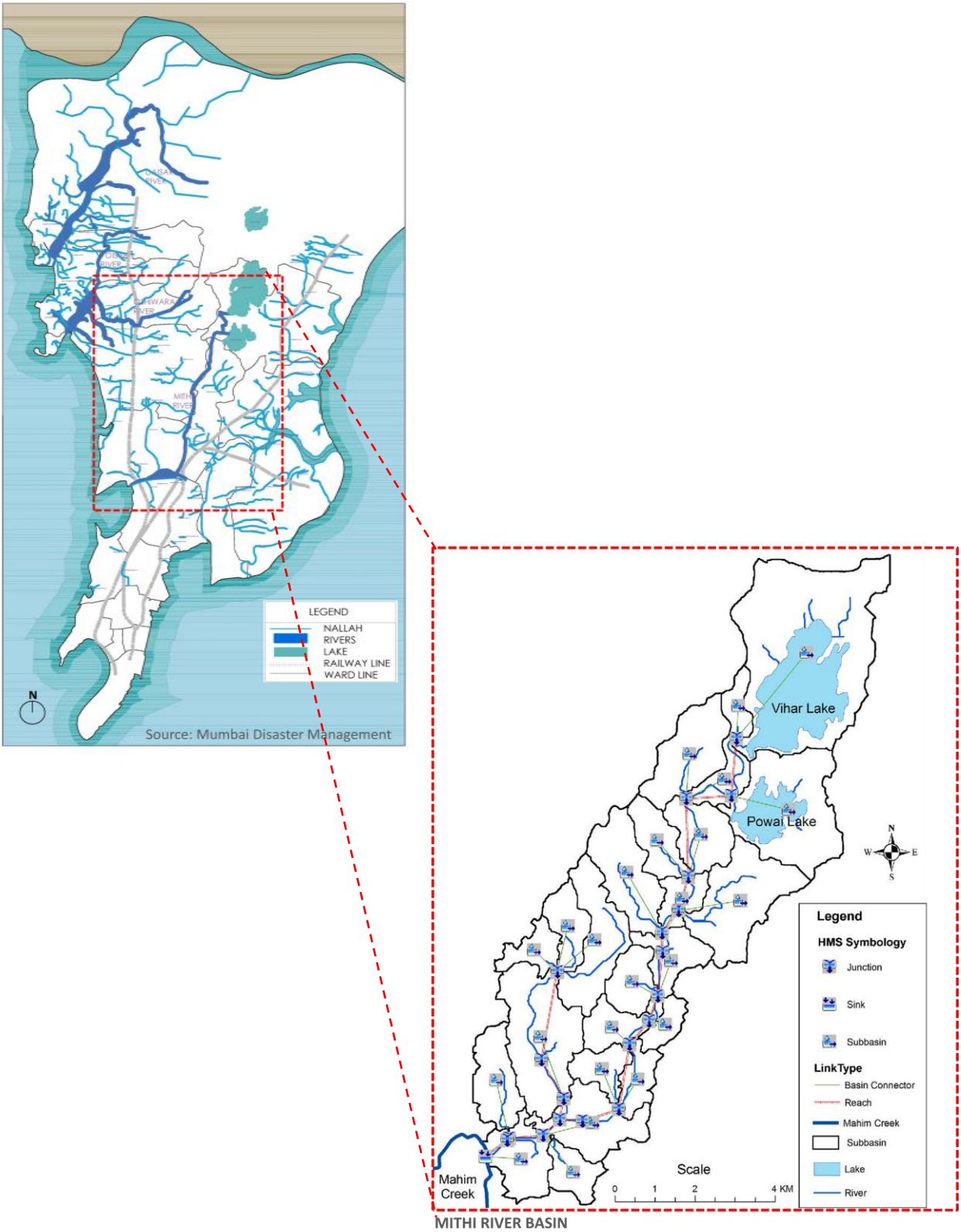
A proposed DP Road in this zone would have to be extended by way of a bridge across the nullah and the 20mtrs Vakola Nullah NDZ area.

6. Two STP's are provided in this zone.

7. Water treatment

Every zone installation of electric deflectors/ screens, sediment traps along with phytorid and self cleaning aerated grade chamber for cleaning the waters – 2 nos

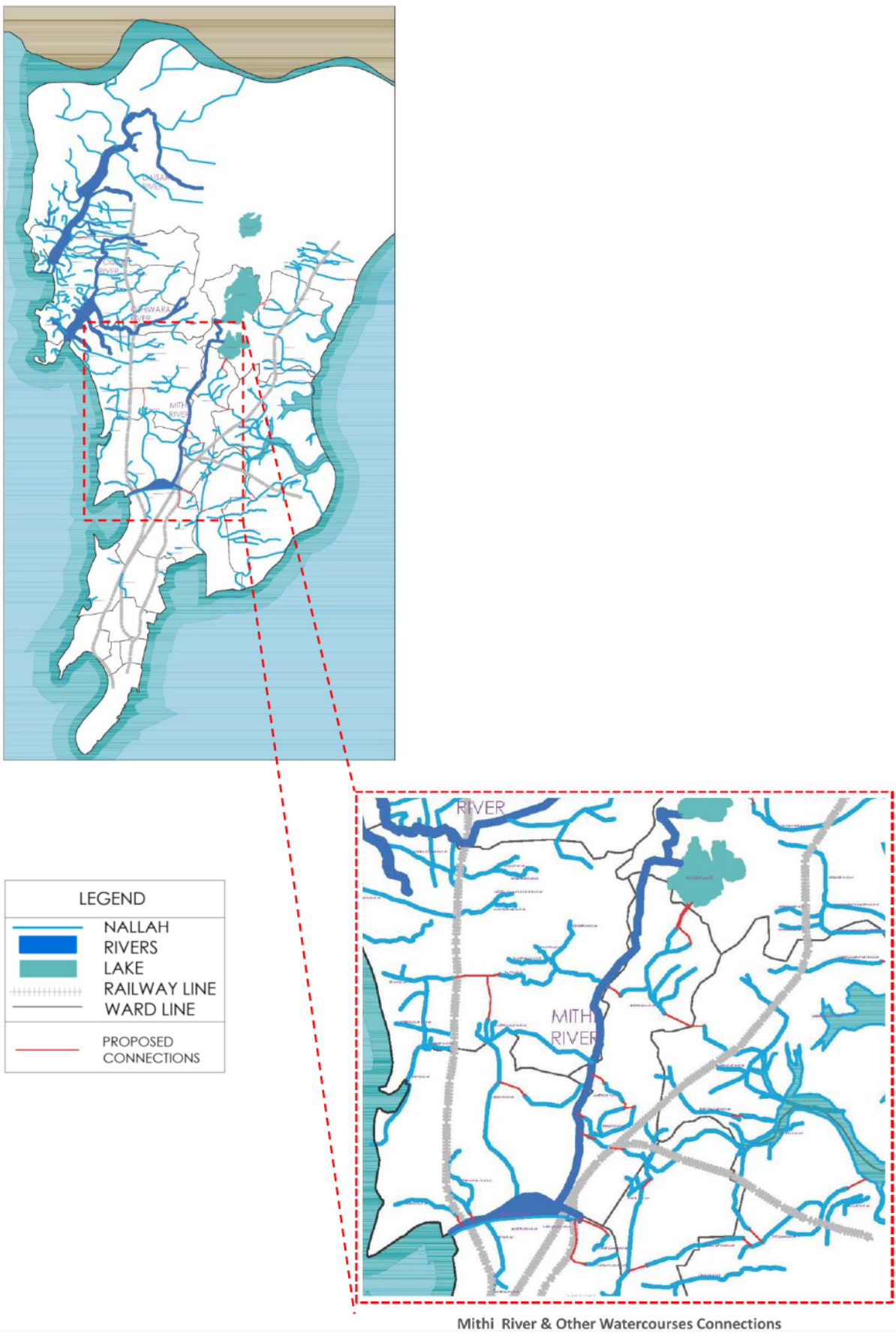
MUMBAI'S EXISTING RIVERS AND WATER COURSES MAP



MITHI RIVER BASIN

Source: Impacts of urbanization on flooding of a coastal urban catchment: a case study of Mumbai City, India, 6 September 2014, P. E. Zope • T. I. Eldho • V. Jothiprakash Received:

RECONNECTING MITHI RIVER & WATER COURSES



Mithi River & Other Watercourses Connections

ACHIEVEMENTS CHART

PROPOSED MITHI RIVER ECO REJUVENATION PLAN

MITHI RIVER

MITHI RIVER	EXISTING	PROPOSED
River	15,71,215sq.m	
Lake	58,36,870sq.m	
River Silting	1,88,110sq.m	
Slum	11,83,990sq.m	8,65,733sq.m
Pipelines	4 nos	
Bridges	22 nos	
Mangrove	11,73,200sq.m	
Wetland	2,81,570sq.m	
River Widening		3,08,560sq.m
Flood Plain		81,320sq.m
RCC Wall to be Demolished		21,495m
Trapezoidal Section		25,720m
Proposed Gabion Wall		8,535m
Ecopark		4,92,630sq.m
Eco Center	2 nos	
Promenade		04,425sq.m
Public Space		73,380sq.m
STP		25 nos
Water Treatment Plant		10 nos
Mithi River NDZ		22,04,375sq.m

VAKOLA NULLAH

VAKOLA NULLAH	EXISTING	PROPOSED
Nullah	1,59,865 sq.m	
Lake		
River Silting	10,270 sq.m	
Slum	3,51,350 sq.m	3,05,670sq.m
Pipelines		
Bridges	5 nos	
Mangrove		
Wetland		
River Widening		37,525 sq.m
Flood Plain		
RCC Wall to be Demolished		1,800 m
Trapezoidal Section		
Proposed Gabion Wall		7,525 m
Ecopark		
Eco Center		
Promenade		
Public Space		73,380sq.m
STP		8 nos
Water Treatment Plant		3 nos
Vakola Nullah 20m NDZ		1,88,275 sq.m

Proposed Total Eco Zone Area - 25,40,475 SQ.M.

Existing Area – 14,11,350 SQ.M.

SHORT TERM – LONG TERM ACTIONS

Action Plan	Short Term (Upto 3yrs)	Long Term (Upto 6yrs)
Desilting	✓	
Slum Rehabilitation	✓	✓
Bridges Expansion	✓	✓
Mangrove Relocation	✓	
River Widening	✓	
Flood Plain	✓	✓
Removal of RCC Wall	✓	
Trapezoidal Section	✓	
Proposed Gabion Wall	✓	
Eco/Sponge park	✓	✓
Promenade	✓	✓
Public Space	✓	✓
STP	✓	
Water Treatment	✓	
River / Nullah NDZ	✓	

CHAPTER 6

CONCLUSIONS

6.1 Summary

As directed by Hon'ble Supreme Court in their order dated 16th August 2017 with reference to Civil Appeal Nos. 10463-10464 of 2016 and 6064-65 of 2017 (Appeal Nos. 7 of 2015 and 8 of 2013), a joint team was set up by the Director of IIT, Powai as well as the Director of National Environmental Engineering Research Institute (NEERI), Nagpur to look into the matter with respect to pollution in Mithi River, the steps taken by the State of Maharashtra and authorities under the State Government to eliminate the pollution and ensure that an unfortunate tragedy does not recur. Accordingly, the main scope of the work was to prepare a factual report on what has transpired so far, what was the extent of the damage caused to Mithi river, what steps could be taken to remedy the damage and the short term and long term future course of actions. The civil society members nominated further via order dated 29th November 2017 were asked to comment on report, the committee did not received any comment rather Mithi River-Ecorejuvenation plan was suggested which according to NEERI and IIT B needs more study.

In this regard, four review meetings under the chairmanship of Additional Chief secretary, Environment Department were held in the presence of the Committee Members and concerned staff of MRDPA, MMRDA, MCGM and MPCB. In these meetings, the concerned agencies were directed to submit the details of the flooding and pollution, action taken till date and also the report on action taken on various recommendations suggested by various committees through their reports. Also the meeting was held with the representatives of petitioners Jalbiradari and Vanashakti foundations on 22nd October 2017 and 23rd October respectively to understand their views on the said matter. Committee members visited the site of Mithi River along the staff of the MRDPA, MMRDA and MCGM on 10th November 2017 to get factual scenarios. Accordingly, this report was made by considering all aspects of Supreme Court directives.

Initially, the Committee studied various issues related to Mithi River, its catchment, flooding and pollutions issues. An analysis of the causes of flooding and pollution are presented in Chapter 1 itself. After the deluge of 26th July 2005, Gov. of Maharashtra, MRDA and MCGM have appointed various committees to study the causes of flooding and pollution and number

of recommendation were submitted. As per the earlier committee's reports, list of major recommendations were enlisted in tabular form along with the status of the work as described in Chapter 2 and these detail list was sent to respective authorities to offer their remarks on the compliance or non- compliance of recommendations. Also, as per the reports received from MCGM, MMRDA and MRDPA authorities, the report on so far action taken on the recommendations of various committees by these agencies and also impact on the Mithi River system has been prepared on major points such as widening and deepening work, desilting work, encroachment removal, construction of retaining wall, construction of service roads, sewer line laying works, construction of STP works, ecological conservation work, beautification works, remodeling and widening of bridges and setting up of disaster management cell as described in detail in Chapter 2. Committee's observation on different works and issues is presented in Chapter 3.

As the main issue raised by various NGOs and other agencies was on the "constructed retaining wall" on both sides of Mithi River by MCGM and MMRDA, the Committee has inspected the accessible stretches of Mithi River and studied the nature of the retaining walls already constructed and its impacts on the River ecology, flooding issues and environmental problems. The Committee suggested various recommendations suitable for riverine hydrology with modifications in the existing constructed retaining wall in Chapter 4. Further in Chapter 4, to avoid future flooding as well as pollution of the Mithi River system, Committee suggested the solutions in terms of "Short Term measures" and "Long Term Measures grouped into 1) Retaining wall related issues 2) Flooding related issues 3) Environmental pollution issues 4) River rejuvenation issues 5) Encroachment issues 6) Administration and Coordination Issues and 7) Social issues. Further the Conclusions and Recommendations are drawn based on the above points enlisted.

6.2 Overall Conclusions and Observations

Following are the major conclusions from the present study.

- The Mithi River was a natural stream carrying overflow from Powai and Vihar lakes and supposed to drain the catchment surface and subsurface flow to Arabian sea through Mahim Creek. However, due to encroachments, discharge of sewage and effluent flows, and solid waste dumping, the Mithi River has become an open drain.

- As large-scale urbanization, encroachment and developments have taken place in the Mithi River basin, future flooding like deluge of July 2005 is inevitable and may occur in future also. To improve the situation, drastic measures as suggested by various committees are to be implemented seriously on top priority basis.

- Earlier Committees through their reports had recommended about the removal of encroachments along the banks of the river with minimum buffer of at least 15 m. However even after 12 years of 2005 deluge, this work is not complete and the issue of removal of encroachment has not being taken seriously by the authorities. As a result, the river becomes the solid waste dumping yard and also gets polluted due to sewage directly entering from the slums on the adjacent sides into the river system.

- As per the recommendations of various Committees, it was suggested to stop immediately the industries discharging their effluents directly into the Mithi River system. Also it was suggested to lay sewer lines and provide STP plants to capture the sewage and sullage discharging by the adjoining slums and encroachers. However, as per the present status of the work reports received from MCGM, it has been observed that no proper planning and execution work was carried out for the said proposed works and at this stage also these works have been done at very minimal level and other works are only at planning stage. Also there are unauthorized industries which discharges industrial sewage effluents in to the river system.

- One of the major recommendation of the committees was provision of service roads along the bank of the river which will serve as pathway for cleaning purpose and avoid encroachments, solid waste dumping and entering unauthorized sewer and effluent into the River system. However, still major work of construction of service roads has not been undertaken.

- For the River rejuvenation, one of the recommendations of the Chitale committee (FFC, 2006) was provision of River flushing system to initiate rejuvenation of river channel by providing 0.6 m gates at Vihar and Powai spillway dams. However, till date administration has not taken it seriously and not even checked the possibilities for implementation of the same.

- Provision of non-return valves to the cross drains and outfalls discharging into the Mithi River system was one of the major recommendations. However, nothing has been done in this regard.

- Though Chitale Committee (FFC) vide their report itself recommended in 2006, for preparation of food zone and flood risk maps for different return period of rainfall events, so far after 11 years, these maps are not prepared by the authorities.

- The retaining walls constructed along the Mithi River **are NOT** constructed the way, that should have been done for an urban River.

- The committee observed that there is no appropriate coordination between different agencies for the various issues on the planning and execution of the Mithi River related works.

6.3. Comments on proposed plans of MCGM

MCGM had appointed Frischmann Prabhu as consultant to prepare a First Report (FR) and DPR (Draft Project Report) to address the affluent pollution to Mithi river. The report is prepared to address pollution in Mithi river and says that for preventing discharge of sewage in Mithi river, Dry weather flows (DWF) should be intercepted and diverted for treatment. It also says that availability of land area to locate Sewage treatment plants (STPs) in Mithi catchment is quite limited so MCGM proposes to upgrade Bandra STP and build a new STP at Dharavi to provide high level sewage treatment by 2021. Under short term works i.e. first phase construction of a 6 MLD STP at MCGM owned WSP site (at Powai) is proposed. All DWF entering Mithi river north of this point will be intercepted and transferred for treatment. It also says that modifications at Saki Naka Pumping stations would be done to transfer 44 MLD DWF via tunnel to WSP site for treatment.

From the above proposed plans the following comments are made by this committee

1) There are feasible locations for installing STP's along Mithi stretch as suggested by MPCB (Comprehensive Study/Profiling of Mithi river) report 2014.
2) No deadline is mentioned for short term works and it should be seen from the map that Saki naka is in upper reach i.e. from low altitude to high altitude the flow would be transferred which is not a feasible option when MPCB already marked the feasible location for installing STPs along the river.

3) The current plan proposed by MCGM which deviates considerably from IIT report of 2006 and the report prepared by MPCB (Comprehensive Study/Profiling of Mithi river), 2014. The major deviation of plan as proposed by MCGM will not address the issue of treatment and Mithi river cleaning.
4) The proposal by consultant mainly plans to divert the flows through tunnel and additional pumping stations away from Mithi at a considerably enormous cost and long period of implementation. The claim of 2021 for diversion and treatment is technically not possible for the entire flow.
5) It is important to note that of the 124MLD which flows in Mithi, only 6-8 MLD is planned for treatment.

Another important flaws in interception/diversion and treatment scheme of MCGM proposal which it is planning to implement are:

a) It intercepts only Dry weather flow (DWF), meaning it will allow Mithi to remain dirty for almost 4 months.
b) Interception at last point of nallas flowing is technically difficult and not sustainable as these suffers from high clogging and overflow due to high solids loading and high scouring velocity

   Examples of failure of drains near or on the banks of river are **Aurangabad and Nashik** in the state of Maharashtra.

Thus it can be said that a great opportunity to revive the river by diverting almost all flows during dry weather may be lost.

6.4 Recommendations

The recommendations for the revival of the Mithi River system in terms of the “long term measures” and “short term measures” are enlisted in detail in Chapter 4. The Committee’s overall recommendations in the order of priority are listed below.

- Providing a minimum of 15 m on both sides of the River for flood plain and service road. This can be done with a 9m flood plain and 6m service road with appropriate protection measures.

- Declare 50m on either side of Mithi River as ecological protected zones i.e NDZ so that NO future construction or developmental activities (i.e. in form of residential and industrial) can be permitted in these zones.

- Constructed retaining walls may be modified as suitable to urban river. A typical cross section is suggested in Section 4.2.2 of Chapter 4. All future construction of retaining wall should be in the natural way suitable to urban River.

- The bridges near Mahim bay confluence should be widened to have more capacity of outflow as suggested by previous committees also. The huge difference in removal of rock blasted volume to rock excavated volume (~ 40 cum.) shows that entire Mahim causeway needs to be desilted as one of the measure for mitigating floods.

- Flood zoning maps with reference to high tide levels and climate change and zoning based on probable risk that can occur because of coincidence of extreme events should be prepared for different return period of rainfall events and appropriate protection measures should be implemented in the flood vulnerable zones. These maps should be able to highlight the flood hazard and risk associated and should be made available to public.

- Upgradation of an existing website and development of flood warning system to give real time information to public about possibility of any kind of flooding during Monsoon season especially for the Mithi River catchment.

- Increase in storage capacity of Vihar and Powai lakes by proper desilting should be done. Powai lake is now silted and it should be properly desilted and made as a possible holding pond during the monsoon and release water to Mithi River during dry weather period. The gated structure can also be made at Vihar lake to increase the storage capacity of water.

- Measures for administratively regulating the crowding in the risky areas and for protecting these developments through modern technological packages like pumping on such lands; ponding, channelisation or gated structures at the mouths of the outfalls to be adopted in keeping with the increasing pressure from land occupation. (FFC pg. 253, 254)

- In the catchment of Mithi River, the low lying areas (Dharavi Slum, Kismat Nagar, Rupa Compound, Kurla BEST Depot, Kalpana Cinema and adjoining areas, Shalimar Hotel, Sheetal Cinema, Dhobi Ghat, Halav Pool, Masarani Estate, Kartika School, Christian Village, Greator Khan Estate, Buddha Colony, LIG, MIG Colony, Hari masjid, Lokmanya Tilak Nagar, Indira Nagar, Lohia Nagar, Shivaji Kutir Mandal, Kapadia Nagar, D'souza Nagar, Kajupada, Jari-Mari, Motilal Nehru Nagar, Kalina, Shastri Nagar, etc. as per FFC pg: 134) which are presently acting as a natural detention or retention ponds should be earmarked as sustainable flood control ponds in revised Development Plan and probable new sites should be explored and marked as holding ponds.

- Provision of sewerage system on both sides of the banks of the Mithi River so that sewage does not enter into the river system.

- Untreated sewage entering into Powai lake must be treated by installing STP's/ or other feasible treatment option before it is discharged.

- Adopting stretch-wise waste management plan based on the observed sources of pollution in each of the stretch as per the table 4.1. Also the treatment options shall all be confined mostly to those stretches of rive with no tidal influence whereas it shall be applicable to all nallahs and industrial source irrespective of its location

- All nallas that represent Orange and Blue colour code (MPCB, 2014 and NEERI, 2015) as per criticality index shall require full-fledged treatment facility to achieve stringent standard of 10mg/l BOD concentration and other MPCB standards for the effluent.

- The sewerage network for untreated sources directly discharging in Mithi is still not designed. Construction of 8 MLD STP (with inlet pumping facility to lift the flow at WSP site at Powai (as per MCGM) is not feasible.

- Installation of proper garbage collection system on both banks of Mithi River.

- Formation of a single authority/ council under MCGM or MMRDA or directly under Maharashtra Govt. to deal with all problems of flooding, environmental pollution,

encroachment etc.For better coordination, the Chiefs of MCGM, MMRDA, MIAL etc. should be members of the authority/ council.

- The authority/ Council should be assisted by an advisory body of experts representing fields like environment, ecology, planning, sociology, geo informatics, urban drainage/civil engineering, water resources, coastal engineering etc., who will help formulate a time bound action plan based on a shared vision of the river by stake holders of the river.

References

1) FFC (2006), Fact finding committee on Mumbai floods final report.
2) MPCB (2006), Pollution study of Mithi River Basin.
3) CWPRS (2006), 1-D Mathematical Model and Desk Studies for Mitigating Floods of Mithi River in Mumbai.
4) IIT Bombay (2006), Development of action plan for environmental improvement of Mithi river and along its Bank.
5) NEERI (2011), Current status of Mithi River and Possible Solutions.
6) NEERI (2014), Environmental Impact of Rock Blasting activity in the Mithi River region.
7) IIT Bombay (2014), Integrated Impact Assessment of Mithi River- Remote Sensing, GIS and Socio-economic studies of Mithi catchment.
8) MPCB (2014), Comprehensive Study/Profiling of Mithi river by Technogreen Environmental Solutions
9) NEERI (2015), Integrated impact assessment study for Mithi River.
10) MCGM (2017),Consultancy Services for preparation of Detailed Project Report on Mithi River by Frischmann Prabhu.
11) Bunch (1 to 6), 7th September 2017, from Office of the Dy. Chief Engineer (Sewerage Project) P&D, Engineering Hub Bldg, 2nd floor, Store Bldg., Dr. E. Moses Road, Worli, Mumbai-400018 with subject as 'To curb pollution of Mithi River and Vakolla Nalla'

Annexures Volume -I

Annexure-I

ITEM NO.4 COURT NO.5 SECTION XVII

S U P R E M E C O U R T O F I N D I A
RECORD OF PROCEEDINGS

Civil Appeal No(s). 10463-10464/2016

MUMBAI METROPOLITAN REGION DEVELOPMENT AUTHORITY Appellant(s)

VERSUS

JALBIRADARI & ORS. Respondent(s)
(FOR CONDONATION OF DELAY IN FILING AND EX-PARTE STAY)
WITH
C.A. No. 6064-6065/2017 (XVII)
(FOR CONDONATION OF DELAY IN FILING APPEAL)

Date : 16-08-2017 These matters were called on for hearing today.

CORAM : HON'BLE MR. JUSTICE MADAN B. LOKUR
HON'BLE MR. JUSTICE DEEPAK GUPTA

For Parties Mr. Colin Gonsalves, Sr. Adv.
Mr. Choudhary Ali Zia Kabir, Adv.
Mr. Zaman Ali, Adv.
Mr. Satya Mitra, AOR
Mr. Shreeji Bhavsar, Adv.

Mr. R.P. Bhatt, Sr. Adv.
Mr. S. Sukumaran, Adv.
Mr. Anand Sukumar, Adv.
Mr. Bhupesh Kumar Pathak, Adv.
Ms. Meera Mathur, AOR

Mr. K.V. Viswanathan, Sr. Adv.
Mr. Prateek Kumar, Adv.
Ms. Anushka Sharda, Adv.
Mr. Suksham Chauhan, Adv.
Mr. Sanjeev K. Kapoor, Adv.
Ms. Jaishree Viswanathan, Adv.
For M/s. Khaitan & Co.

Mr. S. Wasim A. Qadri, Adv.
Mr. R. Bala, Adv.
Mr. Zaid Ali, Adv.
Ms. Aarti Sharma, Adv.
Mr. Gurmeet Singh Makker, AOR
Mr. Mukesh Kumar Maroria, AOR

Mr. Sunil Gupta, Sr. Adv.
Mr. Mukesh Verma, Adv.
Mr. Pawan Kumar Shukla, Adv.
Mr. Yash Pal Dhingra, AOR

Mr. Kunal A. Cheema, Adv.
Mr. Yogesh K. Ahirrao, Adv.
Mr. Nishant Katneshwarkar, Adv.

UPON hearing the counsel the Court made the following

O R D E R

These appeals arise out of the floods in Mumbai on 26th July, 2005. We have been informed that as a result of the floods more than 1000 people had died and perhaps several thousands had fallen ill with various diseases due to the polluted water in Mumbai.

Notwithstanding this tragedy of enormous proportions, no effective steps appear to have been taken by anybody in the State of Maharashtra including some of the statutory authorities to remedy the situation in spite of the fact that a little more than 12 years have gone by.

Under the circumstances, we are constrained to re-examine the issue and after hearing learned counsel for the parties, we are of the view that it will be appropriate if a joint team is set up by the Director of IIT, Powai as well as the Director of National Environmental Engineering Research Institute (NEERI), Nagpur to look into the matter with regard to pollution in Mithi river, the steps taken by the State of Maharashtra and the authorities under the State Government to eliminate the pollution and ensure that such an unfortunate tragedy does not recur. The joint team will

give us a factual report on what has transpired so far, what is the extent of the damage caused to Mithi river, what steps can be taken to remedy the damage and the short term and long term future course of action.

We request the concerned Directors to nominate experts to the team who are in a position to co-ordinate with each other and give us a report within three months.

For the expenses that will be incurred by the committee which will be a joint committee and not separate committees of IIT, Powai and NEERI, we require the State of Maharashtra or the State Environment Impact Assessment Authority (SEIAA) to initially deposit an amount of Rs. 50 Lakhs in the Registry of this Court.

The amount be deposited within two weeks.

Mr. Satish Gavai, Additional Chief Secretary in the Department of Environment of the Government of Maharashtra and the Secretary of the SEIAA will be the Convenor of the Committee.

List the matters for follow up on 10.10.2017.

(MEENAKSHI KOHLI)
COURT MASTER

(MADHU NARULA)
COURT MASTER

Annexure-II

Auto Cad Maps (i.e Mithi stretches)

Mithi stretches

The whole stretch of Mithi River which is 17.84 km long from overflow of Powai and Vihar Lake to the mouth of the river i.e. up to Mahim Bay was surveyed. Map was prepared for whole stretch showing river banks, water flow, slum area, road, buildings, mangroves and retaining wall. The stretch is divided into 5 parts under 5 different Maps of 1:2000 scale are given in table below:

Map No.	Covered stretch
Map 1	This part initiates with Aarey Colony and ends near Mittal Industrial Estate.at Saki Naka
Map 2	From Mittal Industrial Estate (Marol) and ends near MMRDA region (Kalina)
Map 3	From BKC and ends near Mahim Nature Park.
Map 4	From BKC to Mahim bay (Mouth of the river)
Map 5	Vakolla Nallah from Airport area to BKC

Map-1: From Aarey Colony to Andheri-Kurla Road

The initial stretch of the river starts from Mahatma Phule Nagar. A small approach road was observed near the river bank. The human settlement begins (19.142166, 72.894224) with a slum pocket on the right bank of the river which comprises of many small slums in the area. The slums stretch starts with Mahatma Phule nagar, which further extends to Filterpada and Passpoli slum area . The slums are seen in close proximity to the river wall with their wastewater outlet directly connected to the river. The width of the river in this stretch is 24.24 meter at start point of Mahatma phule nagar slums, which gradually increases as we move downwards. The Maximum width achieved in this section was 42.92 meters which is near Tata motor Concorde (Marol) on the left bank near Saki vihar

road. Retention wall can be observed throughout the area. The total height of the wall observed is 15 feet (measurement taken at the ground level) near Filter Pada (Goregaon). . The retention wall starts at the Mahatma Phule nagar slums. The slum area also has a cowshed (19.141883, 72.894260). The drain holes through the walls have been converted to wastewater outlets by the slums where a direct disposal is practiced. Slums are observed to dump waste into the river directly which includes vegetable waste, plastic, metals, cloth material etc. The area also holds commercial complexes like AURUM IT Park, and also has some area under construction buildings. A massive construction project labelled as Vasant oasis (residential complex) near Makhwana road in Marol can be seen. Vasant Oasis is approximately 120 meters away from the right bank of the river. The width of the river becomes 42.92 meters. Retention wall total height is 14.5 feet. The area lying southwards holds numerous companies. On the left bank lies Marwah house which again is an industrial estate holding many companies. Some of the outlets can be seen in this area too. The photos are attached in Annexure-II (Map-1 is for Aarey Colony to Andheri-Kurla Road stretch).

The following table-1 summarizes the features observed in stretch from Aarey Colony to Andheri-Kurla Road.

Table-1: Observations from Aarey Colony to Andheri-Kurla Road

Location /area	**Presence of retaining wall (Left bank/Right bank) and Height of wall**	**Width of river**	**Presence of Buffer Zone/Service Road (Yes/No)**	**Slum/Building**	**Any other observation**
Aarey colony	LB & RB	24.24 m	Service road	Mahatma Phule Nagar	Holds cowshed
Powai	LB & RB	22.33 m	No	Passpoli Slum	-
Powai	LB & RB	27.96 m	No	Morarji nagar slum	Drains can be observed, along Gali no. 2 road and

		27.06 m			Saki vihar road.
Marol	LB & RB	27.93 m 25.83 m 27.73 m	No	Manohar nagar Milind nagar SRA buildings, Residential apartments	-
Marol	LB & RB	28.95 m	Yes	Vasant Oasis Raje shivaji nagar Maharshtra Nagar	Here river experiences change of course. Marwah industrial group is settled in this region.

Map-2 From Mittal Industrial Estate (Marol) and ends near MMRDA region (Kalina)

In this stretch i.e. on right bank lies Mittal Industrial Estate in close proximity to the river which holds certain companies like FedEx courier, Nexgen health Pvt.Ltd., the river widens here to 50.2 meters. The retention wall has a height of 18 feet. At the beginning of Chhatrapati Shivaji Maharaj International Airport, lies a drain and retention wall with height 16.5 feet along IA project road. Over here, the river experience a change of course, width of the river here is about 50 meters. Opposite of this through the left bank lies a huge slum area-Shivaji nagar (Saki naka). Along Shivaji nagar the Safed pool drain can be observed, which is connected to Mithi River. An open area can be observed along MV road in Shivaji nagar and width of the river here narrows down to 40.6 m and near Shivaji Nagar width of the river is 43.8 meters. A bridge is constructed on Mithi River joining Kranti nagar and Sandesh nagar (Saki Naka). However, due to the bridge the width of the river passing under the bridge is considerably reduced which is a bottle neck. Moving further lies Kranti nagar, where the river expands its width to 99.9 meters. Kranti nagar is mix of Industrial Area and slums where the retention wall is 13.5 feet high. Gaps within retention wall is observed here. At Lalbahadur Shashtri Marg, Kurla width of river expands to 96.4 meters and a major change of course of river of about 90^{o} can be seen and the width of the river is reduced. Near Kalina there is another major change of course just before Mumbai Pune Highway (CST Road) which is also about 90^{o}. The photos are attached in Annexure-II (Map-2 is for Marol to Kalina stretch).

The following table-2 summarizes the features observed in stretch from Marol to Kalina.

Table-2: Observations for stretch from Marol to Kalina

Location /area	**Presence of retaining wall (Left bank/Right bank) and Height of wall**	**Width of river**	**Presence of Buffer Zone/Service Road (Yes/No)**	**Slum/Building**	**Any other observation**
Marol	LB & RB	32.39 m 50.20 m	No	Mittal Industrial area Wellington business park Chimatpada slums	Area is a mix of industrial and commercial complexes.
Andheri	LB & RB	49.77 m 40.57 m	No	Chhtrapati Shivaji Maharaj International Airport	Drain can be seen along the IA project road, as well as Safedpul drain can be observed.
Saki Naka	LB & RB	43.82 m 96.36 m	Yes (Industrial private road)	Shivaji nagar slums Sandesh nagar slums Kranti nagar slums Wadia colony	Here river experiences a change of course.
Kalina	No	51.57 m	No	Shastri nagar slums Kolivery village	Kolivery nallah can be observed.
Kurla	No	99.39 m	No	Kismat nagar slums Kapadia nagar	This area is mix of residential, commercial and industrial pockets.

Map-3 From BKC to Mahim Nature Park.

In this stretch, the right bank of the river has structures as MTNL office and some other commercial areas whereas the left bank has a residential area. However, the area is free from slum in the initial part. The height of retention wall here is 10 feet. Moving downwards the river widens and has a width of 163.50 meters. Maharashtra Nagar slum (Kurla West) can be observed, a major slum area in the region. Direct disposal of solid waste can be observed at the location which include cloths, papers waste and scrap waste. Mangrove patches start near the meeting of Vakola drain to Mithi River. A bridge connecting BKC to Eastern Express Highway (BKC-EEH Bridge) is under construction. Mahim Nature Park which is a green zone lies in this stretch and right bank also has mangroves present. In this region, the width of the river is 280.42 meters which also includes mangrove area in between. The photos are attached in Annexure-II (Map-3 is for BKC to Mahim Nature Park).

The following table-3 summarizes the features observed in stretch from BKC to Mahim Nature Park.

Table-3: Observations for stretch from BKC to Mahim Nature Park

Location /area	**Presence of retaining wall (Left bank/Right bank) and Height of wall**	**Width of river**	**Presence of Buffer Zone/Service Road (Yes/No)**	**Slum/Building**	**Any other observation**
BKC	RB & LB	163.50 m	Yes	MTNL exchange Income tax quarters	Vakola- Mithi meeting point.
Kurla	RB &LB		No	Taximens colony Maharashtra nagar slums	Garbage deposition throughout the stretch can be observed in this region.
Dharavi	No	280.42 m	No	Naik nagar slums Dharavi slums	Mahim Nature park is present in this region. Also mangrove population can be seen.

Map 4 From BKC to Mahim bay (Mouth of the river)

In this stretch, on the left bank Dharavi slums can be seen where the width of the river becomes 474.67 m, in this patch large population of mangroves can be observed. Dharavi nallah can be seen flowing along the 60 feet road and the river widens to 692.37 m which includes the mangrove patch. Moving downwards Mahim koliwada slums can be seen and there is no retention wall throughout this patch. Toilet outlet can be seen which is directly released into the river. On the left bank Fisherman's colony can be seen along with slum pockets in the region as well. On the other side i.e. the right bank holds commercial sector such as MMRDA, Income tax office etc. Further, near SV Road again the river narrows down to 70.39 m, slum pockets near western express highway (Bandra) can be observed and finally the mouth of the river opens into the Mahim Bay to 231.26 m. The photos are attached in Annexure- II (Map-4 is for BKC to Mahim bay). The following table-4 summarizes the features observed in stretch from BKC to Mahim bay

Table-4: Observations for BKC to Mahim bay

Location /area	**Presence of retaining wall (Left bank/Right bank) and Height of wall**	**Width of river**	**Presence of Buffer Zone/Service Road (Yes/No)**	**Slum/Building**	**Any other observation**
BKC	RB	474.67 m	Service road	Income tax office MMRDA office	Vakola- Mithi meeting point.
Dharavi	No	692.37 m	No	Dharavi slums	Dharavi nallah can be seen along 60 feet road.
Mahim	No	260.89 m 231.26 m	No	Mahim koliwada slums Fisherman's colony	Solid waste disposal can be seen near the mouth of the river.

Map 5 Vakolla Nallah from Airport area to BKC (Vakola nallah starts from Santacruz passes through Golibar, Khar and meets Mithi river near BKC)

Vakola nallah is considered as the major tributary and contributor to the Mithi river pollution. The total length of the nallah is 3.27 km. It originates from santacruz east (19°05'08.3"N 72°50'54.4"E) downstream of the airport. Flowing downwards, the nallah passes through the slums of Ashok nagar, Anand nagar. Jawaharlal Nehru road crosses over the nallah. Western express highway runs parallel to the vakola nallah, which further connects to Santacruz - chembur link road. On both the banks, industrial and residential complexes, hotels like Grand Hyatt, college like M.P.S.P. Singh College are present. Further the nallah passes through TATA nagar. BKC road passes over the nallah, further the nallah meets Mithi River. Throughout the nallah stretch, slums are settled in close proximity, as well as the outlets from the houses are directly led into the nallah can be observed. The photos are attached in Annexure- II (Map-5 is for Vakolla Nallah from Airport area to BKC). The following table-5 summarizes the features observed in stretch from Airport area to BKC showing Vakolla Nallah

Table-5: Observations for Vakolla Nallah stretch from Airport area to BKC

Location /area	**Presence of retaining wall (Left bank/Right bank) and Height of wall**	**Width of river**	**Presence of Buffer Zone/Service Road (Yes/No)**	**Slum/Building**	**Any other observation**
Santacruz	LB	-	No	Anand nagar slums	Mangrove population be seen.

Jawaharlal Nehru road	RB	-	No	Davri Nagar slums	Garbage deposition can be seen in some part of the stretch.
Kalina		-			Drain can be observed near santacruz-chembur link road.
BKC	RB	260.89 m 70.39 m 231.26 m	Yes	Huge slum population can be seen on both the banks of the nallah.	Solid waste disposal is practiced in this region. As well as mangroves can be observed in the stretch.

Annexure-III

Recommended and achieved width and depth of Mithi River as per Compendium of Empowered Committee Meeting (ECM) –page 75

Agency	Sr.no.	Stretch Details	Chainage	FFC width	CWPRS width	MRDPA width	Width achieved (MRDPA)	NEERI 2017*	CWPRS depth	Achieved Depth
MMRDA	1	Mahim Causeway to Dharavi Bridge	0-1280	100	100	100	96.52	-	2.15	2.10
	2	Dharavi Bridge to Mini Confluence	1280-3300	200	200	200	193.25	114-177	2.65	2.60
	3	Mini Confluence to New Mithi Bridge	3300-5400	200	200	100-160	110-175	110 - 168	2.6	2.70
	4	New Mithi Bridge to CST Bridge	5400-5883	200	200	70-100	70-110	99-110	2	2.20
MCGM	1	CST Bridge to Airport Culvert	5883-7815	60-100	100	100	100	51-99	1.5	1.39
	2	Airport Culvert to Marva FOB	7815-10920	30-60	60-100	30-100	30-60	33-49	1.2	1.21
	3	Marva FOB to JVLR Bridge	10920-13720	20-25	40-60	20-30	25-30	33	1.35	1.46

	4	JVLR Bridge to Pipeline Road	13720-15500	20	40	20-25	25	24	0.95	0.94
	5	Pipeline Road to Natural Valley of Vihar Lake	15500-17040-17840 (Vihar Lake)	20	40	20	20	20	0.95	0.89

Recommended and achieved width and depth –Vakolanala as per Compendium of Empowered Committee Meeting (ECM) –page 75

Agency	Sr.no.	Stretch Details	Chainage	FFC width	CWPRS width	MRDP A width	Width achieved	CWPRS depth	Achieved Depth
MMRDA	1	Mini-confluence-Vakolla and Mithi	0-705						
	2	Vakola Bridge to SCLR Bridge	705-2450	60	60	60	60	2.25	2.5
MCGM	1	SCLR to Airport	2450-3800		60	28-30	28-30	2.25	2.5

(Note: All dimensions are in m)

Note: **NEERI 2017*** is a new column added to the table after Survey conducted by NEERI which is not mentioned in **Compendium of Empowered Committee Meeting (ECM) –page 75**

Annexure-IV

CWPRS vide letter dated 11th November 2011

ANNEXURE - B

BY SPEED POST

Government of India
Ministry of Water Resources
Central Water & Power Research Station
Khadakwasla, Pune – 411 024

Tel 24103200, 24103214
Fax 020 - 24381004
E-mail nagendra_r@cwprs.gov.in
Website www.cwprs.gov.in

No: 101/8/71-PH/2011/ 254 – 2442-51

Dated: 11.11.2011

Shri D U Gajbhiye
Superintending Engineer (Mithi River Works)
MMRDA, Bandra Kurla Complex
Bandra (East),
Mumbai 400 051

(FAX No. 022 - 26595913)

Sub: Channelisation of Mithi River for mitigation of floods – Improvement in Conveyance and Basin capacity - reg

Ref: MMRDA Letter No. SE/MMRDA/MRW/455/2011 dated 19/09/2011

Sir,

This has reference to the discussions held with MMRDA officials on 30/09/2011 regarding the channelisation of Mithi River and the final development plan approved by MRDPA. As decided during the meeting CWPRS has undertaken the model studies using the latest prototype data of Mithi River furnished by MMRDA and after incorporating the possible top widths and bed gradient as executed at site.

Before the deluge of 26th July 2005, the Mithi River had very poor drainage capacity. A number of developments along the Mithi River over the years had diverted the river with number of bends and also reduced the width at a number of places. Mithi river banks have slums and buildings in flood plain areas which are prone to regular flooding. There are also a number of low lying areas which experiences flooding during monsoon. The river has chronic drainage choking sites, which reduce the conveyance capacity. The configuration of Mahim bay bathymetry was also not conducive for rapid draining of flood discharges from Mithi River into the sea. In addition the following factors further aggravated the deteriorating conditions in Mithi River:

1. Narrowing of river basin for housing
2. Reclamation of river bed for Industrial units
3. Reclamation of Airport authority for extension of Runway
4. Diversion of River flow due to dumping of construction debris/ solid waste/ Industrial waste at several locations along the banks
5. Inadequate drainage capacity of Box Culver below Airport runway and bridges along Mithi River

17/11
88 (Hanbur)

Mumbai Metropolitan Region Development Authority (MMRDA) and the Municipal Corporation of Greater Mumbai (MCGM) have taken up the task of implementing flood mitigation measures along the Mithi River and Vakola Nalla. These measures are broadly based on the extensive hydrologic and hydraulic model studies undertaken by the Central Water and Power Research Station (CWPRS), Pune. In order to cater for 100 year probability flood, river Channelisation by means of widening and deepening of the Mithi river and adjoining Vakola Nalla was recommended with suitable bank protection measures, to avoid encroachment and flooding of the low lying areas. While implementing the channelisation proposals a number of constraints were encountered in providing adequate widths in the river cross section due to encroachment by slums and existing legal structures in various reaches of Mithi River and Vakola Nalla. MMRDA, therefore, decided to adopt vertical Reinforced Cement Concrete (RCC) Retaining Walls on either bank of the rivers and have service roads along the banks for periodic desilting operations in the river and adjoining channels. The periodic desilting / dredging of the river is necessary to maintain the required cross section for tidal circulation and improve the conveyance capacity for the safe passage of the floodwaters.

As per the discussions held on 30/09/2011, the preliminary model studies have been completed and an assessment of the conveyance and basin capacity has been made for the channelisation works executed by MMRDA / MCGM, as per the final development plan. The results of model studies in respect of river conveyance capacity and cross sectional area are shown in the Table-1 enclosed at Annexure. The increase in the conveyance capacity is more than 3 times, compared to the conditions in 2005. The basin capacity, which is important for holding a part of the floodwaters, has more than doubled from 3 million cubic meters to 6.5 million cubic meters. The vertical retaining walls along the banks will help to train the river, guide the flow in addition to the control of encroachment and dumping of debris.

A detailed report on the studies will be sent shortly.

Thanking you,

Yours faithfully,

(P.Nagendran)
Joint Director

Encl: As above

Copy to

Ms. Ulisa A., Chief (Planning) and Project Director (MRDPA), C/o MMRDA, Bandra Kurla Complex, Bandra (East), Mumbai 400 051

Service Road detail for Mithi River:

		Service Road left Bank (BKC side)						Service Road right Bank (BKC side)					
				Balance length as on 2013						Balance length as on 2013			
Agency	**Chainage**	**Total length as on 2010**	**To be reexamined**	**Total**	**Completed**	**Yet to be completed**	**Chainage**	**Total length as on 2010**	**To be reexamined**	**Total**	**Completed**	**Yet to be completed**
MMRDA	0-140	140	140	0	0	0						
	140-1280	1140	1140	0	0	0						
							0-480	480	0	480	0	480
							480-1280	800	800	0	0	0
	1280-1650	370	370	0	0	0	1280-3500	2220	2220	0	0	0
	1650-2400	750	-	750	750	0	3500-4100	600	600	0	0	0
	2400-2600	200	200	0	0	0	4100-4700	600	600	0	0	0
	2600-3300	700	700	0	0	0	4700-5100	400	0	400	0	400
	3300-5300	2000	0	2000	2000	0	5100-5400	300	300	0	0	0
	5300-5400	100	100	0	0	0	5400-5883	443	443	0	0	0
	5400-5883	483	483	0	0	0						
	Total-A	**5883**	**3133**	**2750**	**2750**		**Total-C**	**5883**	**4963**	**880**		**880**
		Service Road left Bank (East Side)						**Service Road right Bank (West side)**					
MCGM	5883-7815	1932	728	1204	950	254	5883-7815	1144	868	276	250	26
	8238-10919	2681	2247	434	434	0	8238-10919	1469	704	765	326	439
	10919-13433	2514	2101	413	0	413	10919-13433	2514	1017	1497	0	1497
	13433-15618	2185	0	2185	0	2185	13433-15618	2185	0	2185	0	2185
	15618-17040	1422	990	432	0	432	15618-17040	1422	0	1422	0	1422

	Total-B	**10734**	**6066**	**4668**	**1384**	**3284**	**Total-D**	**8734**	**2589**	**6145**	**576**	**5569**
	Total A+B	**16617**	**9199**	**7418**	**4134**	**3284**	**Total C+D**	**14617**	**7552**	**7025**	**576**	**6449**

(Note: All dimensions are in metres)

Source: Presentation in 9th Meeting of Empowered Committee Meeting on 20th May 2013.

On the basis of above data made available it can be concluded that 3.2 km (on left bank) of Mithi (by MCGM) + 0.8 km (on right bank) of Mithi (by MMRDA) + 5.6 km (on right bank) of Mithi (by MCGM), total right bank 6.4 km(on right bank) of Mithi is left to be constructed as reported on May 2013.

Service Road detail for Vakolla nala

		Left Bank MIG side						**Right Bank Bharatnagar side**				
				Balance length as on 2013						**Balance length as on 2013**		
Agency	**Chainage**	**Total length as on 2010**	**To be reexamined**	**Total**	**Completed**	**Yet to be completed**	**Chainage**	**Total length as on 2010**	**To be reexamined**	**Total**	**Completed**	**Yet to be completed**
MMRDA	705-1345	640	0	640	0	640	705-1345	640	640	0	0	0
	1345-1645	300	300	0	0	0	1345-1645	300	300	0	0	0
	1645-2450	805	0	805	805	0	1645-2450	805	805	0	0	0
	Total-A	**1745**	**300**	**1445**	**805**	**640**	**Total-C**	**1745**	**1745**	**0**	**0**	**0**
		Service Road left Bank (East Side)						**Service Road right Bank (West side)**				
MCGM	0-1450	1450	0	1450	0	1450	0-1450	1450	0	1450	0	1450
	Total-B	**1450**	**0**	**1450**	**0**	**1450**	**Total-B**	**1450**	**0**	**1450**	**0**	**1450**
	Total A+B	**3195**	**300**	**2895**	**805**	**2090**	**Total C+D**	**3195**	**1745**	**1450**	**0**	**1450**

(Note: All dimensions are in metres)

Source: Presentation in 9th Meeting of Empowered Committee Meeting on 20th May 2013

Justification for Monthly Dredging

As per data received from MMRDA, desilting done from Mithi River and VakolaNala from year2006-2012, has been depicted below.

Desilting Done from Mithi River and VakolaNala from year 2006-2012

Year	**Quantity (Cum)**
2006	486155
2007-2010	1805899
2011	361084
2012	145129
Total	2798267

Based on IIT report 2006 and NEERI's monitoring data, the following initial conservative estimates have been made:

An initial conservative estimate shows that about 400 Tons solids are entering the sea per month in addition to plastics and thermocols. This harms severely the sediment and water quality**. This can be prevented, if instead of yearly, monthly dredging is carried out.**

MUNICIPAL CORPORATION OF BRIHANMUMBAI
NO. Ch.E. / 7050 / Bridges dated 09.11.2017

Office of the -
Chief Engineer (Bridges)
Engineering Hub Building,
Zero floor, Dr. E.Moses Road,
Opp. Geeta Talkies, Worli,
Mumbai – 400 018.
24958001, 24958101

To,
Sahilesh Jadhav
Deputy Planner,
MMRDA,
B Wing Old Bdng 5th Floor,
Bandra-Kurla Complex,
Bandra (E)
Mumbai-400051.

Subject:- Various Bridges over Mithi River

.....

Sir,

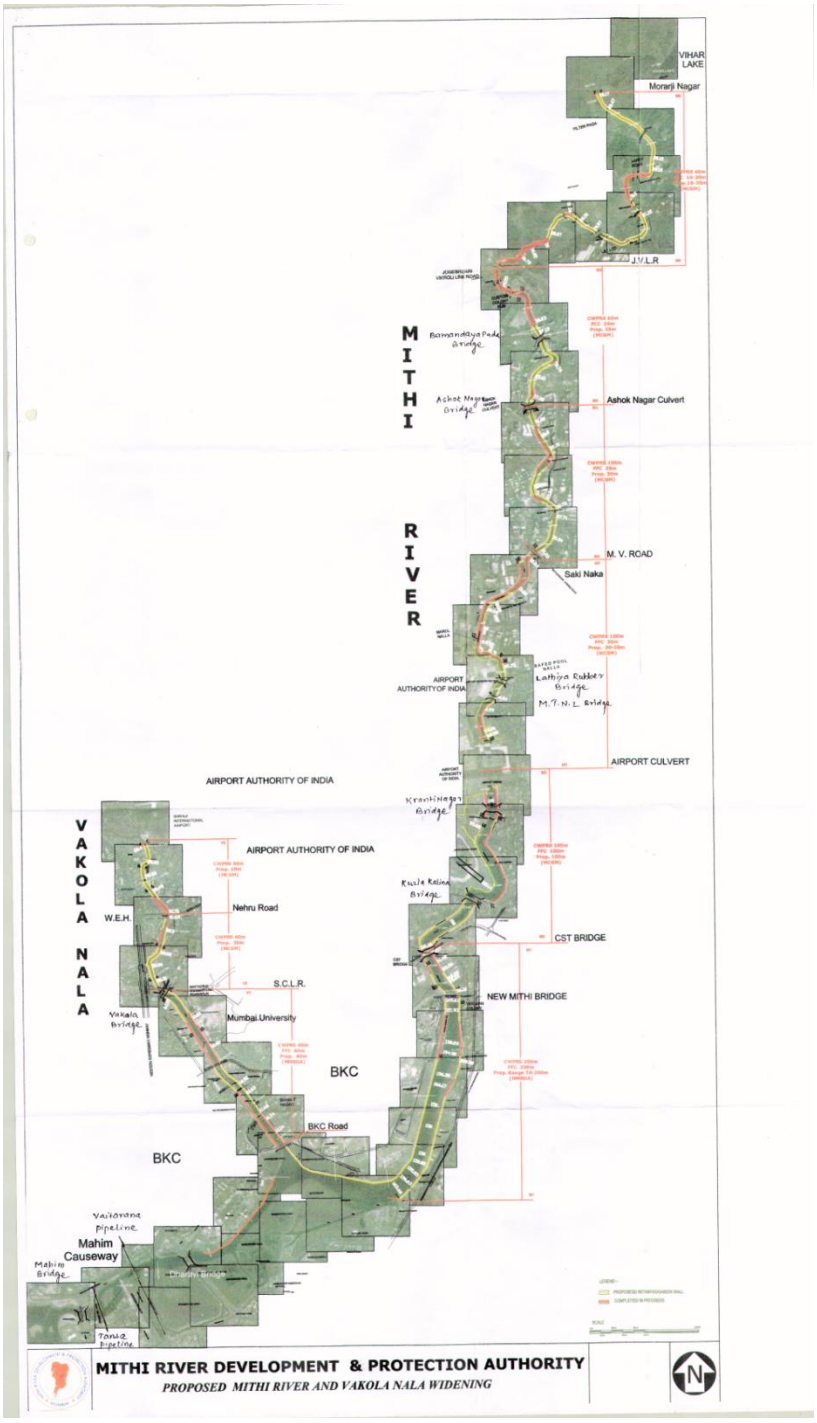
With reference to above, the drawing and status report of the 12 no. of bridges situated at various locations over Mithi River are attached herewith for your reference.

Yours faithfully,

sd/-09.11.2017

Executive Engineer (Bridges)
Eastern Suburbs

Figure-1 All 12 bridges on Mithi River



Annexure-VII (b)

The proposed length for the 3 bridges was provided by MMRDA as follows via e-mail.

Sr.No	Name	Existing length	Proposed length
1.	Tansa Bridge	75.60m	97.20m
2.	Vaitarana Bridge	54.00m	100.00m
3.	Mahim Causeway Bridge	44.10m	104.00m

Annexure-VIII
The photographs of sampling locations conducted by NEERI in 2017

Phule Nagar

Morarji Nagar

Powai Outfall

JVLR

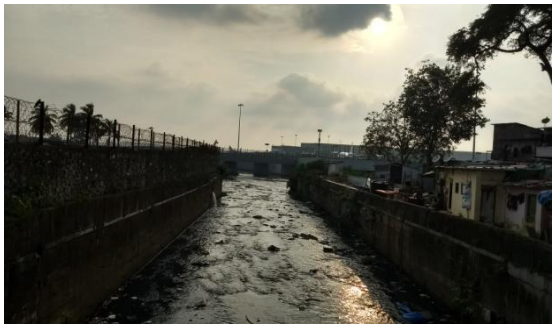
Military Road

Marwah Road

Saki Naka

MTNL Road

Safed Pul (a)



Safed Pul (b)

Safed Pul (c)

Bail Bazar (a)

Bail Bazar (b)

Bail Bazar (c)

Air India Road (a)

Air India Road (b)

Air India Road (c)

CST Road (a)

CST Road (b)

Videsh Bhawan (a)

Videsh Bhawan (b)

BKC-EEH Bridge (a)

BKC-EEH Bridge (b)

Mithi River Pradhikaran (a)

Mithi River Pradhikaran (b)

MMRDA office (a)

MMRDA office (b)

Sion-Bandra Link Road (a)

Sion-Bandra Link Road (b)

Mahim Bay (a)

Mahim Bay (b)

Mahim Bay (c)

Mahim Bay (d)

Mahim Bay (e)

Annexure IX

MPCB Water Quality Standards for Best Designated Usages

(Ref: http://mpcb.gov.in/envtdata/waterquality42.php)

Category of Fresh Water	A - I	A-II	A-III	A-IV
Best Usage	**Unfiltered Public water supply after approved disinfection**	**Public water supply with approved treatment equal to coagulation, sedimen-tation & disinfection.**	**Not fit for human consumption, Fish & Wildlife Propagation.**	**Fit for Agriculture, Industrial cooling & process water.**
Chemical Qualities : Maximum allowable concentration				
Toxic Substances				
Arsenic (As)	0.3 mg/l	0.3 mg/l	1.0 mg/l	0.1 mg/l
Cadmium (Cd)	0.01 mg/l	0.01 mg/l	-	-
Chromium (Cr^{+6})	0.05 mg/l	0.05 mg/l	0.05 mg/l	0.2 mg/l
Cyanide (CN)	0.05 mg/l	0.1 mg/l	0.05 mg/l	0.2 mg/l
Lead (Pb)	0.1 mg/l	0.1 mg/l	-	0.1 mg/l
Boron (B)	-	-	-	2.0 mg/l
Mercury (Hg)	0.001 mg/l	0.001 mg/l	0.001 mg/l	-
Gross alpha activity	3 PCI/l	10-9 uc/ml	3 PCI/l	3 PCI/l
Gross Beta activity	30 PCI/l	10-8 uc/m	30 PCI/l	30 PCI/l
Substances affecting health				
Fluoride (F)	1.5 mg/l	1.5 mg/l	-	1.0 mg/l
Nitrates (NO3)	45 mg/l	45 mg/l	-	-
Substances affecting the potability of water				
pH	6.5 to 8.5	6.0 to 8.5	6.5 to 9.0	6.5 to 9.0
T.D.S.	-	T.D.S.	T.D.S.	-.
Total Solids	1500 mg/l.	1500 mg/l.	-.	-
Total Suspended Solids	25 mg/l	-	-	-
Total Hardness (Caco3)	50 mg/l	-	-	-
Total Residual Chlorine	-	-	-	-
Electrical conduct at 25. C	-	-	1000 x 10-6 mhos	3000 x 10-6 mhos
Free Carbon Di Oxide	-	-	12 mg/l	-
Free Ammonical Nitrogen	-	-	1.2 mg/l	-
Oil & Grease	-	-	0.1 mg/l	-
Pesticides	-	-	0.02 mg/l	-
Biotic Index	-	-	6.0 mg/l	-
Total Ammonical Nitrogen	1.5 mg/l	1.5 mg/l	-	50 mg/l
Chlorides (Cl)	600 mg/l	600 mg/l	-	600 mg/l
Sulphates	400 mg/l	400 mg/l	-	1000 mg/l
Copper (Cu)	1.5 mg/l	1.5 mg/l	-	-
Manganese (Mn)	0.5 mg/l	3.0 mg/l	-	-
Iron (Fe)	1.0 mg/l	5.0 mg/l	-	-
Sodium	-	-	-	-
Zinc (Zn)	15.0 mg/l	1.5 mg/l	5.0 mg/l	5.0 mg/l
Phenolic Compounds	0.002 mg/l	0.002 mg/l	0.05 mg/l	-
Alkyl Benzene sulphates	1.0 mg/l	1.0 mg/l	-	-
Mineral Oil	0.3 mg/l	0.3 mg/l	-	-
Ammonia	1.5 mg/l	1.5 mg/l	-	-
B.O.D. (5 days 20 . C)	2.0 mg/l(Monthly average of atleast 10 samples)	5.0 mg/l(Monthly average of atleast 10 samples)	10 mg/l	30 mg/l
C.O.D.	-	-	-	150 mg/l
D.O.	Not less than 5 mg/l(Monthly average of 100 samples)	4.0 mg/l	Not less than 3 mg/l	Not less than 2 mg/l
Bacteriological Standards :	Coliform Bact. 250	Not greater than 5000		
(MPN/100)				

Table 1: Mithi River Water Quality at various locations during post monsoon period (2017)

Sample no.	**Location**	**pH**	**BOD (mg/l)**	**COD (mg/l)**	**TSS (mg/l)**	**Phosphates (mg/l)**	**Ammoniacal N (mg/l)**
1	Phule Nagar	8	35	229	20	0.1	6.4
2	Morarji Nagar	7.8	52	141	6	1.7	8.1
3	Powai overflow	8.2	56	121	20	0.2	0.8
4	JVLR	7.8	102	471	158	4.0	6.7
5	Military Road	7.6	175	822	260	6.2	10.0
6	Saki Naka	7.8	165	380	100	5.1	12.6
7	MTNL Road	7.8	135	433	176	2.5	7.8
8	SafedPul	7.7	160	357	108	3.5	11.2
9	Bail Bazar	7.5	95	307	44	4.5	14.5
10	Air India Road	7.6	105	460	44	3.4	12.8
11	CST Road	7.5	102	333	48	3.8	12.6
12	VideshBhawan	7.4	145	*	44	2.9	10.9
13	BKC-EEH Bridge (under construction)	7.5	120	*	44	2.0	7.8

14	Mithi River Pradhikaran	7.3	112	*	28	1.7	8.1
15	MMRDA office	7.4	92	*	58	0.6	3.6
16	SionBandra Link Road	7.4	80	*	58	0.5	4.4
17	Mahim bay	7.3	140	*	48	0.9	16.2

* The COD was not analyzed due to interference of high chloride

Table 2: Mithi River Water Quality at various locations during post monsoon period (2015)

Sample no.	**Location**	**pH**	**BOD (mg/l)**	**COD (mg/l)**	**TSS (mg/l)**	**Phosphates (mg/l)**	**Ammoniacal N (mg/l)**
1	Phule Nagar	7.3	38	43	64	0.3	1.7
2	Morarji Nagar	7.4	59	72	220	1.2	9.6
3	Powai Outfall	7.0	23	50	22	1.6	5.1
4	JVLR	7.5	46	50	106	3.9	3.8
5	Military Road	7.5	43	60	112	2.7	4.5
6	Saki Naka	7.0	32	120	149	1.9	5.6
7	MTNL Road	7.2	59	268	128	1.7	3.8
8	SafedPul	6.8	119	320	62	3.5	3.6
9	Bail Bazar	6.9	24	200	107	4.2	6.7
10	Air India Road	6.7	21	223	32	3.5	5.6

11	CST Road	6.2	49	220	80	7.0	4.3
12	Videsh Bhawan	6.9	27	*	37	7.6	5.3
13	BKC-EEH Bridge (under construction)	6.7	33	*	75	7.4	10.2
14	Mithi River Pradhikaran	7.0	27	*	126	10.4	12.9
15	Sion Bandra Link Road	7.0	26	*	126	10.4	12.9
16	Mahim bay	7.5	29	*	65	0.3	14.0

* The COD was not analyzed due to interference of high chloride

Letter of D.M.C. (Z-V) of MCGM showing the details of the affected structures while removal of encroachments

Shri Bharat Marathe
Dy. Municipal Commissioner
(Zone-V)

Municipal Corporation of Greater Mumbai
बृहन्मुंबई महानगरपालिका

Office of the
Dy. Municipal Commissioner (Z-V),
'M'/West Ward Office Building,
1st Road, Near Natraj Cinema,
Chembur, Mumbai - 400 071.
Tel. No. : Office : 2528 5429 (P)
: 2522 5000 (Ext. : 301)
Fax : 2529 9596
E-mail : dmc.z5@mcgm.gov.in

No. : MDM/P/ DMC(Z-V)/29
Date : 17/11/2017

Subject :- Civil Appeal NOS 10463-10464 of 2016 and 6064-65 of 2017 (Appeal NOS 7 of 2015 and 8 of 2013)

Reference :- 1) NGT-2016/CR-52/TC-3 dated 18.08.2017
2) D.No. 7072/2016/XVII of Supreme Court of India , New Delhi dated 23.082017.
3) Meeting on 22nd September, 2017.

Dear ~~Shri~~ Sir,

The Professor S. Chaudhury, Prof A. Inamdar, Prof. Eldho T.I. of I.I.T., Mumbai have requested to submit data of Mithi River as per their list from 1 to 12. I am submitting the information/data about the following two points :-

[1] Short term and long term measures with time line plan to be taken to avoid flooding and pollution problem.

[2] Action plan with time line for removal of encroachments on banks of the river.

With regards,

अ.मु.स. (पर्यावरण)
क्रमांक: 591
दिनांक 5/12/17

Yours Sincerely,

17.11.17
(B.R. Marathe)

To,

Mr. Satish Gavai,
Additional Chief Secretary,
Dept of Environment ad Secretary,
State Environment Impact
Assessment Authority (SEIAA)
Govt. of Maharashtra, Madame Cama Marg,
Hutatma Rajguru Chowk, Mantralaya,
Mumbai-400 032.

बृहन्मुंबई महानगरपालिका

Brihanmumbai Mahanagarpalika

CD/1783 dt 18/11/17

No. DMC/RE/ DT: / /2017

Sub: Action plan with timeline for removal of encroachment on banks of Mithi river.

The meeting was held on 18.11.2017 with DMC Z (V), A.C (K/E), A.C (S), A.C (L), E.E. (H/E) and AC RE (City) i/c. After detailed discussions considering W.P., deadlines for removal of encroachment are finalized as follow.

Sr. No	Ward	Information given by Concerned officer	Instruction given by DMC (RE)	Officers concerned
1	'S' Ward	AC (S) Ward stated that there are total 127 affected structures. Demarcation is given. Eligibility is Finalized 36 structure is eligible. Repairs to the allotted PAP required. It is expected repairs will be done within one month	After giving the keys to eligible PAP holders, take demolition action. Mean while demolition of non eligible structures may be done. Programme of demolition shall be done on 28.11.2017 to 30.11.2017	AC (S) Ward
2	K/E Ward	AC (K/E) Ward stated that there are total 392 affected structures. Demarcation is given. Eligibility is Finalized. PAPs are required the demand for PAP will be sent to AC Estate today.	After giving the keys to eligible PAP holders, take demolition action. Mean while demolition of non eligible structures may be done immediately. Programme of demolition shall be done on 28.11.2017 to 30.11.2017	AC (K/E) Ward
3	L ward	AC (L) Ward stated that there are total 462 affected structures. Eligibility is Finalized by Dy. Collector (Enc). In many cases appeal is filed by the occupants and appeals are pending with Addl. collector (ENC) There are 3 W.P. pending in High Court. The Petitioner had challenged the eviction notice issued by AC L ward.	Start the demolition of non eligible structures may be done immediately. Programme of demolition shall be done on 28.11.2017 to 30.11.2017. In all pending court cases, structure to remain until final orders from court.	AC (L) ward

4	H/E Ward	E.E.(H/E) Ward stated that there are total 296 affected structures. Eligibility is Finalized by Dy. Collector (Enc). All occupants are declared non eligible out of that 91 occupants have filed the appeals and appeals are pending with Addl. collector (ENC).	Identify the structures who have made the appeal before addl. Collector (Enc) and Start the demolition of non eligible structures which are not in appeals may be done immediately. The Programme of demolition shall be done on 28.11.2017 to 30.11.2017	AC (H/E) Ward

DMC RE instructed to all AC's to complete the DPL and take demolition action as scheduled above. Instructions were given to inform DCP (operations) in writing about the scheduled demolition.

DMC (RE)

AC (S) Ward

AC (K/E)ward

AC (L) Ward

AC (H/E) Ward

DMC Z-III V. VI

ANNEXURES VOL-II

Annexure A

Deepening and Widening of Mithi River:

As reported by MMRDA and MCGM in October 2017, the following work given in Table 1 are to be completed and is in progress.

Table 1: Balance of work of River deepening and widening as reported by MRDPA.

Balance Physical Works		
WORKS	**MMRDA**	**MCGM**
Deepening	-	800 m length
Widening	875 m length	800 m length
Rock Excavation	0.97 Lakh Cum	1.925 Lakh Cum
Retaining Wall	0.74 Km length	4.595 Km length
Service Road	1.18 Km length	12.115 Km length
Balance Works Costs	13.85 Cr (Subject to Hon. NGT and Hon. SC Orders)	608.84 Cr (Includes 5 Bridges)

Annexure B

Sewer Line and STP works

As per the letter of Chief Engineer (SP) of MCGM, List of proposed works / under planning and proposed to complete by year 2020 is enlisted in Table 2.

Table. 2 Laying of proposed works / under planning and proposed to completed

Sr. No.	Name of Work	Dia (in mm)	Length (in meter)
1	P/L sewer line along Tanaji Nagar road from Mithi river to Kurla Andheri Road.	300	200
2	P/L sewer line along service road from Airport to Safed Pool Nalla (East Bank)	300	150
3	P/L sewer line along service road from Safed pool to MTNL Bridge (East Bank)	300	150
4	P/L sewer on Chimatpada road & Rubi Coach road leading towards BapatNalla& to be connected to proposed tunnel at Mithi River.	315	1450
5	P/L sewer along service road from Marwah FOB up to Sakinaka Pumping station along (West Bank)	300	300
6	P/L sewer along service road from Ashok Nagar Bridge to J.V.L.R. (West Bank)	400	1500
7	P/L sewer along service road from Ashok Nagar Bridge to J.V.L.R. (East Bank)	400	1300
8	P/L sewer line along C.S.T. Road from Mithi River to L.B.S. junction (East Bank)	800	600
9	P/L sewer line along East & West Bank service road between KurlaKalinaroad to C.S.T. road.	350	1300
10	P/L sewer along service road at Bharat Nagar, Bandra (E).	300	300
11	P/L sewer along service road to Hans Bhugra road, Santacruz(E).	500	250
12	P/L sewer along AnnatKanekar Marg, Bandra (E).	315	185
13	P/L sewer along service road of Vakola nalla at Dhobi Ghat road, Santacruz (E).	300	200
14	P/L sewer (missing link) along east bank service road at Krantinagar.	450	123
15	P/L sewer along LBS Marg MN Road to Kamani Junction	1200	1000

Also as per the letter of Chief Engineer (SP) of MCGM, the time line for laying of Major Trunk Sewers in Mithi Catchment is presented in Table 3

Table 3 Laying of Major Trunk Sewers in the Mithi River catchment (Source:MCGM)

No	Dia-meter (mm)	Sewer Type	Location	Approx Length (km)	Status	Target Completion Date
1	1200	Gravity sewer	Kurla Old PS to M.N Road Junction along LBS Marg	1.5	Under construction	April 2018
2	1200	Gravity sewer	MN Road to Kamani Junction along LBS Marg	1.0 *	In planning	April 2019
3	300 to 800	Gravity sewer	From Ashok Nagar Bridge/Bamandayapada to Saki Naka PS	2.7	Under construction	Feb 2019

* works

Annexure C

Suggestions by Frischmann Prabhu (FR)

Chief Engineer (SP) of MCGM through their letter has submitted theshort term and long term recommendations with time line of completion as suggested by FR vides their draft report submitted to MCGM in Table 4 below:

Table 4 Mithi River DWF Interception and Diversion Project Program (Source: MCGM)

Sr.No	Short Term / Long Term Measures	Description of recommendations	Time line of completion
1	Short Term	DWF interception, transfer, treatment (8MLD STP at the WSP site) and beautification.	2019
2	Long Term	Non Tidal Zone : DWF interception, transfer and treatment at Bandra and Dharavi STPs via existing or proposed sewers including interception of major nallas	2020
3	Long Term	Tidal Zone: DWF interception, transfer and treatment at Bandra and Dharavi STPs via new sewers	2021
4	Long Term	DWF interception, transfer and treatment via a deep 2700 dia tunnel from Bapat and Safed Pul nallas to Ghatkopar STP .	2021

From the above table, it can be revealed that the DWF interception and Diversion of sewer flow project may take three to four years to complete as the works are being carried out as per the given schedule program. However, the feasibility of the project and study conducted by FR may get reviewed and validated by some technical expert agency or institute before execution.

Annexure D

Physical progress for various works as suggested by FFC (2006) and CWPRS (2006) is given in table 5.

Table 5: Physical progress of the work done of Mithi River and Vakola Nalla as on June 2017

Sr. No	Description of work	MMRDA		MCGM		MIAL
		Physical Progress (%)	Financial Progress (%)	Physical Progress (%)	Financial Progress (%)	Physical Progress (%)
01	Deepening	100	95	95	90	100
02	Widening	90	95	95	90	100
03	Rock Excavation	58	95	81	81	100
04	Service Road	73	96	14	10	Not Available
05	Retaining Wall	92	96	75	75	100
06	Beautification Work	100	100	Nil	Nil	Not Available
07	Creation of 20 m wide Buffer Zone as suggested by CWPRS and IITB	Partially Done	Not Available	Not Done	Not Available	Not Available

08	Flood Control Works (such as detention ponds, check dams, infiltration zone, watershed management)	Not Available	Not Available	Partially Done	Not Available	Not Available
09	Construction of STPs	Not Done	Not Available	Not Done	Not Available	Not Available
10	Action on major outfall discharging their flow in Mithi River for pollution control	Not Done	Not Available	Not Done	Not Available	Not Available

(Ref: As per Letter of Project Director and Member Secretary, MRDPA dated 5th Oct 2017)

Annexure E

Table 6: Present **Encroachment Removal** Status (As on June 2017)

Sr. No	**River /Nalla**	**Description**	**MMRDA**	**MCGM**	**Total**
01	Mithi River	Total encroachment as per MRDPA width- Phase I and Phase II	3217	6577	9794
02		Encroachment removed	2876	5340	8216
03		Encroachment to be removed	341 (Service Road, subject to Hon NGT and Hon SC Orders)	1237 (Retaining Wall)	1578
04	Vakola Nalla	Total encroachment as per MRDPA width- Phase I and Phase II	879	575	1454
		Encroachment removed	853	Nil	853
		Encroachment to be removed	26	575	601

(Ref: As per Letter of Project Director and Member Secretary, MRDPA dated 5th Oct 2017)

Annexure F

The present status of rehabilitation is presented in table 7 as reported by MRDPA.

Table 7: Present status of Rehabilitation

Sr. No	**Location of Rehabilitation**	**Units**
01	Nahur, Bhandup	48
02	Borla, Gautam nagar and Govandi	1277
03	Oshiwara	393
04	Poonam Nagar, Jogeshawari	131
05	Motilal Nehru nagar, BKC	136
06	Anik Gaon, Vashinaka, Chembur	479
07	Lallubhai Compound, Tata nagar	454
08	Tungwa gaon, Powai	1850
09	HDIL Complex, Bhandup (West)	03
10	Open Plot at Turbhe mandala	04
11	Sidhara coplex, Borivali	05
12	Bhakti park, Wadala	11
13	Marathon B Wing, and Building P-3, Kanjurmarg	02
14	Harioam nagar, Mudra salt, Mulund (E)	07
Total		4800

(Ref: As per Letter of Project Director and Member Secretary, MRDPA dated 5th Oct 2017)

Annexure -G

Table 8: Present Status of Desilting Work

MMRDA		
Year	Quantity Removed (Cu.m)	Amount in (Crores)
2006	412293	34.5
2007-2010	1804432	125.16
2011	372572	36.37
2012	145129	13.3
2014	92945	3.00
2015-2017	Information not given	Information not given
MCGM		
2017-18	30359 (out of Estimated Qty. 50598)	Information not given

(Ref: As per Letter of Project Director and Member Secretary, MRDPA dated 5th Oct 2017)

Annexure -H

Table 9: Present Statuses of Bridges

Sr. No	**Description**	**Present Status**
01	Bridge near Mahim Causeway	Tendering in process
02	Bridge near Tansa Pipe Line in G North ward	Tendering in process
03	Extension of Bridge for Vaitarna Pipe Line in G/North Ward	Tendering in process
04	Bridge near Drive in Theatre in H/East ward	Pending due to court case
05	Kurla - Kalina Road	Work in progress for Phase II
06	Lathia Rubber Bridge	Bridge work completed Approach road work is held up due to Encroachment
07	Vakola pipe Line Bridge	Bridge work completed partly and balance work will be carried out by MMRDA under their ongoing project of Extension of SCLR Elevated Bridge.
08	CST Road, Kurla	Work in Progress

Annexure I

Table 10: Present Status of laying of Sewer Line along the bank and catchment of the Mithi River completed

Sr. No	Diameter of Sewer (mm)	Sewer type	Location	Approx. length (Km)
01	800/1100	Gravity sewer	From Powai towards Saki Naka along Saki-Vihar Road	2.8
02	800	Gravity sewer	From south to Saki Naka Junction point along Kurla-Andheri road	1.4
03	450-800	Gravity sewer	From East to Saki Naka Junction point along Ghatkopar-Andheri road	1.4
04	1600	Gravity sewer	From Junction point to Saki Naka Police Chowki	0.4
05	Various large Dia	Tunnel	Bandra Tunnel Syatem –linking major sewers on westernside of Mithi River to Bandra and Dharavi sites	5.0
06	1050	Rising main	From Saki naka police Chowki to Church road along Kurla-Andheri road	0.3
07	1600	Gravity sewer	From Church Road to JB Nagar Junction	1.2
08	1800	Gravity sewer	From JB Nagar Junction to shaft at Santacruz	5.0
09	1600	Gravity sewer	Kurla to Dharavi along LBS Marg	2.5
10	450	Gravity sewer	Wadia Estate Kurla (W) to LBS Marg	0.7
Total Sewer Line – 15.7 Km and Tunnel – 5.0 Km				

(Source: Letter of C.E. (SP) of MCGM) and in Bunch 1 pg 336 of High Court of Bombay recordsprovided to this committee.