OBSERVER RESEARCH FOUNDATION MUMBAI
Ideas and Action for a Better India

MAKING THE SEWER... A RIVER AGAIN

WHY MUMBAI MUST RECLAIM ITS MITHI

A study by Gautam Kirtane

Sudheendra Kulkarni
Chairman
Observer Research Foundation Mumbai

Mumbai, the City of Dreams, carries an equal measure of curse and blessing. For its slumdwellers, who constitute more than half of its population, living conditions are anything but pleasurable. Denied the basic civic needs of adequate living space, sufficient water and sanitation, clean surroundings, comfortable mass transportation, etc., their lives are a study in grit and resilience in the face of extreme deprivation. However, strangely, when poor people's basic needs are counted, access to natural beauty, tranquillity and open spaces are neither a matter of consideration nor a matter of concern. It is somehow presumed that they have no use for these higher necessities of life, which provide colour and canvas for human beings to dream.

The presumption here cannot be that Mumbai is deprived of natural beauty and has no scope for creating open and public spaces for its teeming citizens. Indeed, there is no Indian city that is as blessed by nature as is Mumbai. Just look at its natural endowments – a scenic ocean on all three sides, the world's largest natural park within the limits of a city, ancient caves in the vicinity, beaches, bays, creeks, lakes, and, let's not forget, a river flowing through the middle of the city.
Sadly, it is a river that has become a sewer.

The river Mithi bears a name that is suggestive of both sugar and salt, an apt metaphor for its origin and its end. But its waters were not meant to carry toxic pollutants and garbage as they do today. Its banks were not meant to be pavilions for exhibiting the unspeakable squalor of slums. In short, the river was not meant to become so hazardously inhospitable to fish, birds, butterflies and human beings.

This ORF study is about how the Mithi river has been turned into a gutter. It is about how its degradation became a curse for Mumbai during the deluge of July 26, 2005 (which claimed the lives of nearly a thousand people). And, more importantly, it is about how the Mithi can be transformed back into a beautiful blessing for the city. This study affirms that reclaiming the Mithi can be a good context for a forward-looking urban renewal project in which slumdwellers can be humanely rehabilitated; the river can regain its pure flow; migratory birds can return to its rejuvenated ecology; and the riverfront can become a vibrant place for arts, culture, recreation and sports open to the poor and rich alike.

The purpose of this study is three-fold. Firstly, rivers have been the cradles of civilizations all over the world. Indeed, no civilization has regarded rivers to be as sacred as the Indian civilization has. However, as exemplified by Mumbai's molestation of the Mithi, the treatment of rivers and other sacred water bodies since India's independence is a shameful testimony of our inability to match practice with precept. Therefore, in taking corrective action for the restoration of the Mithi, the nation's commercial capital has a responsibility and an opportunity to reconnect the city to the sacred.

Secondly, in addition to serving as a much-needed flood control measure, Mithi's transformation, as we have envisioned it all along its nearly 18-km stretch, can bring a lot of beauty and joy into the lives of the common citizens of Mumbai. We believe that easy and free access to natural beauty, and to regenerative open spaces, is the birthright of every Indian citizen. Beauty in the outer space has a way of spurring man's inner development. Contrary to the presumption of the elite sections of society, common people hunger for beauty, as much as they do for food and shelter. Isn't it obvious, for example, when we see thousands of them thronging on Marine Drive on Sunday evenings just for that magical and much-anticipated hour of the sunset?

Today, natural beauty can be experienced largely by those who can afford to travel to secluded holiday resorts or have a weekend home in Alibagh or Khandala; this cannot continue to be the case. ORF believes that the current trend of privatisation and commercialisation of natural beauty must give way to redesigned cities of the future, in which people can create, and experience, beauty wherever they live and work. This is the message of the Project for Public Spaces (PPS), a New York-based organisation campaigning for a new paradigm of urbanization around the world, whose vision has considerably influenced our study. We would like Mumbai to be redeveloped as one of the most beautiful waterfront cities in the world. Rejuvenation of the Mithi is one of the necessary components of remaking, and in some sense rediscovering Mumbai. Another is the redevelopment of the extensive waterfront that stretches along the city's eastern coast (right from Gateway of India to Thane), which is today mostly inaccessible to its citizens. Here, sadly, central, state and local authorities have made a complete mess of the large and precious landmass that the Mumbai Port Trust currently occupies. Renaissance of Mumbai's eastern waterfront will form the subject of a separate study by ORF.

Thirdly, the message of the Mithi's restoration is not limited to Mumbai alone. Many Indian cities are blessed with magnificent waterfronts – Delhi on the Yamuna, Guwahati on the Brahmaputra, Patna and Banaras on the Ganga, to name a few. However, independent India has turned a blind eye to these bountiful blessings and allowed these waterfronts to become eyesores. Actually, our country can boast of very few successful waterfront redevelopment projects, the recent transformation of the Sabarmati waterfront in Ahmedabad being a hope-giving exception. De-polluting India's sacred water bodies and enabling our people to enjoy the beauty of waterfronts in cities as well as villages must become a part of our vision and mission to build a New India.

This study is the outcome of the extraordinary concern, commitment and zeal of my young colleague Gautam Kirtane, who conceptualized it and wrote most parts of this report. He was assisted by Dhaval Desai who has conducted similarly important urban renewal studies at ORF. The credit for the aesthetic and imaginative design of this booklet, and also for many of the telling photographs of the Mithi in it, goes to my other young colleague, Riddhi Chokhawala. The trio has also produced a gripping documentary film on the Mithi river, which is enclosed with this report. I am really proud of these colleagues, who exemplify a confluence of the objectivity of good researchers and the sensitivity of dedicated social activists actualizing the meaning of ORF Mumbai's motto: IDEAS AND ACTION FOR A BETTER INDIA.

I do hope that the people of Mumbai, and the authorities in the central, state and local governments, will take serious note of this report.

"Our rivers are dying. We, the educated ones, still remain ignorant of the repercussions of their death on our health and quality of life. Today there is not a single river in all of India whose waters may be considered fit for drinking. They have all been reduced to dirty nalahs...

I have no desire to curse the people of Mumbai, but it appears as if the people of Mumbai are dead. There is no life left in their hearts and minds. They do not feel the pain of the Mithi River, in which the abyss between life and lifeless is plain to see. Mumbaiites do not dare to question their politicians. So long as we continue to glorify them without holding them accountable, our rivers will continue to die."

-Rajendra Singh

Waterman of India and recipient of the Ramon Magsaysay Award for community leadership

Figure 1.1- 'An elevated view of the Islands of Bombay and Salsette' by J. S. Barth, published by R Cribb, London, 1803

May this sublime harmony last forever

It was a cold November morning when the sun pierced through the mist and lit up a lush green patch of grass in a clearing on the forest floor. A monk in saffron arose from his hour-long meditation and headed to the hills where his people had been chiselling the rock for several seasons. He came to the same spot each day before dawn and followed the same ritual till just after sunrise - a quick bath in my flowing waters followed by meditation on my banks.

The sunlight slowly warmed the earth as the fog began to lift revealing a large herd of cheetal deer grazing on the dew-laden blades of fresh grass. A month-old fawn strayed from its mother and sniffed the intoxicating air that filled the clearing. The Karvi bushes were in full blossom and their mauve and purple-pink flowers filled the air with a musky fragrance. Only the elders in the herd had seen the Karvi's burst of flowering seven monsoons ago when it seemed to carpet the hill slopes. And here it was abloom again.

Behind the bushes on the west of the clearing, a tigress crouched ready to charge and bring down the straying fawn. The mist had still not lifted completely and a large boulder and a thick shrub blocked the bright orange of her coat from being visible to her prey. Inching towards her meal, she was thankful that the pesky monkeys were not nearby to give her away.

Out of her line of sight, a flamingo, a migratory bird that had flown to this idyllic spot from a far part of the planet, was perched atop a large Kadamba tree. He was amused to see a tigress for the first time in his life. Yet, he knew her intent and cried out a loud and long shriek which broke the morning's silence. The deer were alerted and bolted from the scene. The tigress's bid was foiled and she stepped into the clearing scorning and growling at the strange red bird that exhibited a thin curvy neck and thin long legs that had denied her a chance to feed.

Figure 1.2 - A monk in meditation

Figure 1.3- Karvi flower at Sanjay Gandhi National Park. Photo courtesy: *Sameer Sampat*

The flamingo flapped his wings and without so much as a glance in the tigress's direction took off south to rejoin his flock. He followed me as I descended through the green hills, my crystal clear waters swelling as rivulets merged into me before slowing and broadening as I approached the sea. Here, I meandered into a dense mangrove forest teeming with life as my waters hit against the warm tides of the Arabian Sea. He perched next to a flock of flamingos on a thick branch that was inches off the water.

Surveying the landscape beyond the mangroves, I saw smoke rising from small huts on hill slopes which stood on a group of tiny islands with golden sands and green forests. Small wooden boats emerged with the sun, the boatmen said a small prayer before hitting my waters, and made their way into the sea.

Meditating on the morning's sights, I couldn't help feeling blessed and thanked God for His benevolence. There was perfect harmony between me, the sea, the sky, the birds, the animals and that most wondrous of God's creations ~ Man. Indeed, the monk with his sacred chants and the boatmen with their sturdy bodies enhanced the harmony, giving it the feel of permanence.

I have only one prayer: May this sublime harmony last forever, even as all must change in the Tide of Time.

~Mithi River, 3 BCE

Figure 1.4- Tulsi Lake, just below Kanheri Caves.
Photo courtesy: *Dr. Sangeeta Dahanukar*

Figure 1.5- A flamingo near Mumbai
Photo courtesy: *Dr. Sangeeta Dahanukar*

MITHI THROUGH THE AGES

Mumbai, India's commercial capital situated on the shores of the Arabian Sea, is built on what was once an archipelago of seven islands - Apollo Bunder, Malabar, Cumbala, Mazgaon, Worli, Mahim, and Parel-Dharavi-Sion. Reclamation has greatly influenced the geography and topography of Mumbai. While the city has gained space as a result of the reclamation; unplanned, myopic and greed-driven development has cost Mumbai dearly with not only the loss of natural beauty but also the increased vulnerability to devastating floods and the erosive effects of tidal action. It has also affected the quality of life of its teeming millions. Taking a closer look at the transformation of Mumbai over the years, we see unnatural contortions of the local environment as a result of reclamation and rapid, haphazard urbanization.

Figure 2.1- : Old maps of Mumbai from the years 1740, 1782, 1844 , show the Mahim estuary which was subjected to reclamation over the years and today is an extension of the Mithi River. Extreme right - a Google Earth imagery shows the extent of reclamation which has sealed one end of the Mahim estuary.

In 1728, Britain's colonial rulers established a Mayor's Court in Bombay[1] and the first reclamation was started as a temporary measure in Mahalaxmi, on the creek separating erstwhile Bombay from Worli. The first major reclamation efforts to join all seven islands into one landmass began under the British, in 1782. Then, in 1803, Bombay was connected with Salsette, a large island landmass (that has now become the Mumbai Metropolitan Region), by a causeway at Sion. By 1838, all seven islands were linked. The major reclaimed areas were Wadi Bunder, Chinch Bunder, Curnac Bunder, Mint Road, Elphinstone Road, Tank Bunder, Clerk Road, Mahalaxmi, Sewree and Frere Estate. Subsequently, a causeway was constructed at Mahim to connect Mahim and Mount Mary.

1. Bombay was renamed Mumbai in 1996.

The area of present-day Dharavi was predominantly mudflats and mangrove forest. Towards the end of the 19th century it was still inhabited largely by *Koli* fisher folk. However, continuous reclamation and dumping of solid waste in this area caused fishing to dwindle and also severed the contiguity of the Mahim and Mahul estuaries that adjoined Dharavi. Until this loss of contiguity, Bombay was an island in the truest sense. By this time, land had begun to command a premium and reclamation was providing thousands with living space in an overcrowded city. Overnight, Mumbai forgot about the Mithi. This is clear from the 1944-map of Survey of India that does not even mention the 'Mithi', but shows Mahim river as an extension of the Mahim Estuary.

Figure 2.2- Old photograph of Mahim Fort without encroachments and a spotless Mahim beach in the foreground

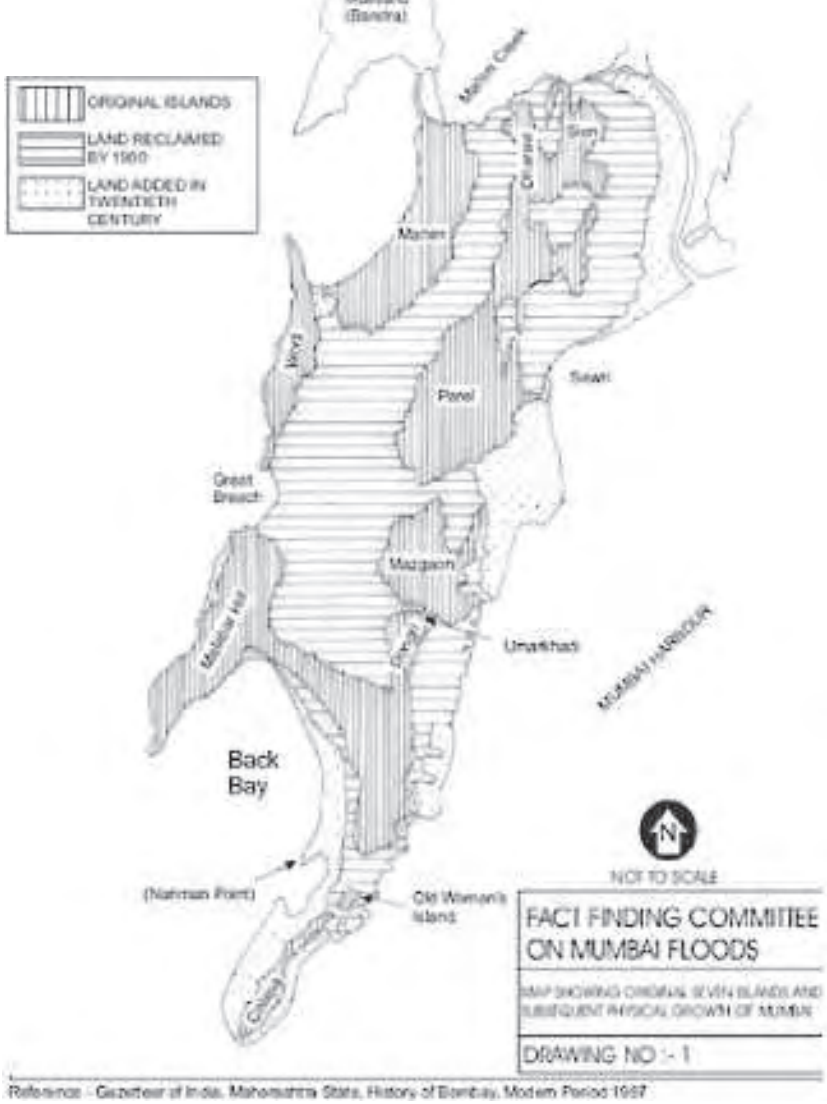


Figure 2.3- Map showing the original seven islands and subsequent physical growth of Mumbai. - Final Report of the Fact Finding Committe on Mumbai Floods, March 2006

Development of Salsette Island

While the reclamation juggernaut had remoulded the island city to accommodate the future millions, Salsette Island to its north with its large tracts of thick forests set amid the hills remained relatively untouched for a much longer period of time. But Bombay soon spread to the Salsette Island, a precursor to its unstoppable expansion that has now covered the entire Mumbai Metropolitan Region. It is estimated that between 1924 and 1994 alone, a staggering 75km^2 of mangroves were lost in the Mumbai Metropolitan Region (Samant, 1996). Development on Salsette Island was punctuated with the construction of the airport in 1920. The airport came up on the estuarine reach of the Mithi River and its tributary known as the Vakola Nala, thus putting Mumbai on the world map.

The Mahim estuary which separated Mumbai from Salsette Island has witnessed many battles between the natives (Marathas and Gujaratis) and foreign forces (Portuguese and British). Four important forts were built around the Mahim estuary which divided the islands of Mumbai and Salsette. The forts were built and occupied by different rulers over time. The Mahim Fort has been in existence since 1516 when the Portuguese invaders captured it. The fort was later ceded to the British who strengthened it as a strategic watchtower against possible attacks by the Portuguese and the Marathas. The Portuguese had also built the Castella de Aguada in 1640, a fort at the mouth of the estuary at Bandra, to keep watch over the Arabian Sea and the island of Mumbai. It was subsequently surrendered to the British and later occupied by the Marathas, marking the end of Portuguese domination of Salsette Island. Other important forts along the estuary include the Sion Hillock Fort, built between 1667 and 1675 and the Riwa Fort, locally known as *Kala Killa* (meaning Black Fort in Marathi) built in 1737. The former commanded a panoramic view of the region and was an ideal watch tower and the latter used to touch the waters of the estuary before reclamation pushed the estuary further away. These forts were built by the British to secure their hold over the erstwhile island of Mumbai from Portuguese marauders as well as from patriotic Maratha and Gujarati warriors. Many of these warriors were tribals, who now live in pitiful conditions of insecurity and exploitation. All the forts lie in a dilapidated condition today, and all have been encroached upon and surrounded by slums, a sad testimony to Mumbaikars' apathy towards their own history.

It was in Salsette Island that the Mithi River originated. It is not clear if the river ever had its own source, such as an underground spring, but its large catchment captured rainwater during the monsoon and it must have flowed for some months after the rains had stopped.

Figure 2.4- An 18th Century map of Bombay showing the forts of Mahim, Riwa, Sion and Worli.

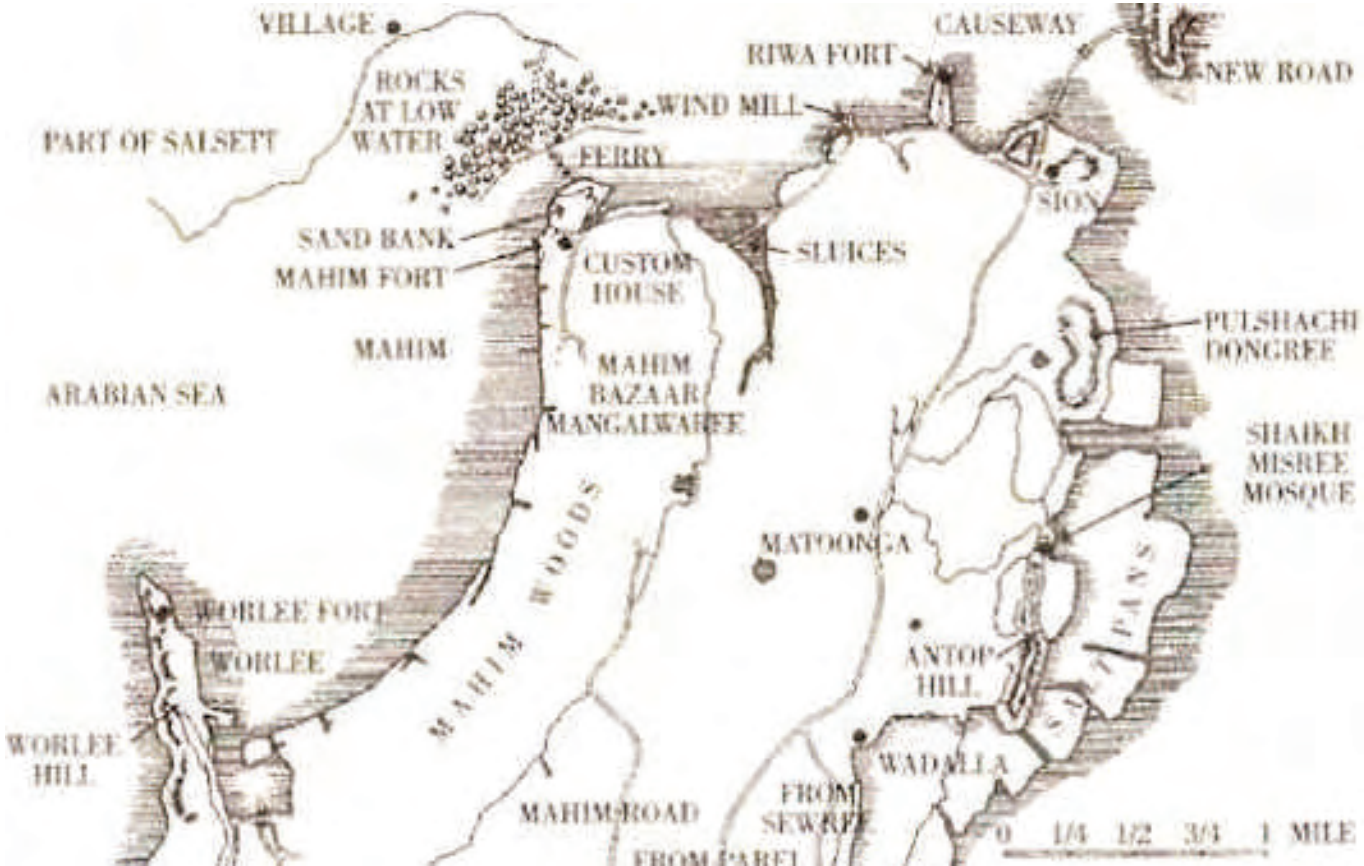


Figure 2.5-'*The Church and River at Mahim, Bombay*'. One of a series of illustrations in *India and in the vicinity of Bombay*. Lithographed by *Major Pouget (*1850)

Reservoirs on the Mithi River

In the past, Mumbai's ever-growing population drew water from wells and tanks but this limited supply failed to keep up with the rapid increase in demand. In the absence of perennial rivers, harnessing of surface water became inevitable. In 1845, a suitable site was identified to capture the substantial monsoon run-off and Tulsi, Vihar and Powai lakes were created by impounding the Mithi River, constructing masonry dams across hillocks in the forests south of the Kanheri Caves.[2] Commissioned in 1860, Vihar Lake became the source of Mumbai's first piped water supply system. At the time, it was located 20km away from the city. Such has been the frenetic pace of Mumbai's growth that today the city practically surrounds the lake.

To augment the water supply, Tulsi Lake was created by building a dam further upstream on the Mithi River in 1873. Tulsi was designed to allow its overflow into Vihar Lake located to its south. Like Vihar Lake, Tulsi Lake too, is surrounded by hillocks on all sides. The vegetation on the hill slopes is thick, lush and largely undisturbed. Today, both the lakes and surrounding areas are managed and protected by the Municipal Corporation of Greater Mumbai (MCGM) and the Sanjay Gandhi National Park (SGNP) authority.

To mitigate the anticipated drought of 1891, the Powai valley scheme was taken up in 1890 on a tributary of the Mithi River as an emergency measure. Until then, this tributary had served all of Powai village's water supply needs. Unlike Vihar and Tulsi Reservoirs, Powai Lake lies outside SGNP and its surroundings and therefore has no protection from encroachments and the perils of urbanization.

The prestigious Indian Institute of Technology Bombay (IIT-Bombay) was established in 1958 on the lush green banks of Powai Lake. Sadly, the environs of its campus were allowed to be encroached by slums and the once-beautiful lake itself has got considerably degraded due to water hyacinth, weeds, untreated sewage and large silt and debris deposits. Not surprisingly, the objective to supply drinking water from the lake was abandoned in the early 1990s in light of the poor quality of its water. It is predominantly the overflows of Vihar and Powai lakes that feed the Mithi River of today.

Figure 2.6- Tail waters from Powai Lake joining the Mithi River. Photo courtesy: *ORF Mumbai*

Figure 2.7- Sunrise at Powai Lake
Photo courtesy: *IIT Bombay*

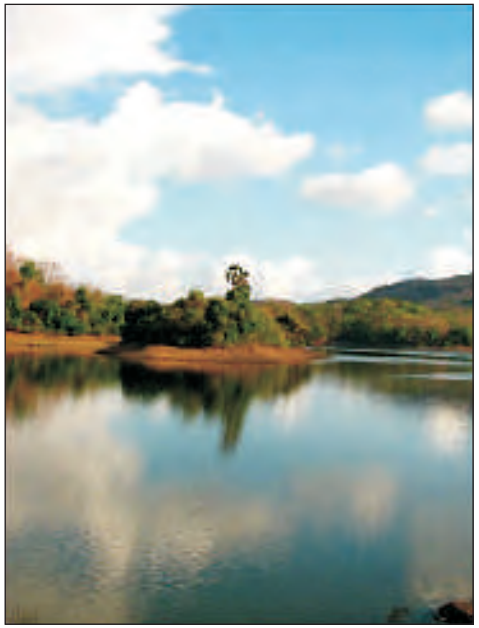


Figure 2.8- Tulsi Lake
Photo courtesy: *Dr. Sangeeta Dahanukar*

2. Kanheri Caves in the Sanjay Gandhi National Park, with their magnificent stone carvings from 3rd century BCE to 9th century AD, show the influence of a Buddhist Vihara. These carvings are the inspiration for the monk who appears in the fictional reflections of the Mithi River in the first chapter.

Developments in Independent India

Reclamation of land continued post Independence, extending to the Back Bay reclamation project on which Marine Drive and Nariman Point currently stand. In 1978, the Mumbai Metropolitan Regional Development Authority (MMRDA), which was established in 1975, reclaimed 370 hectares of land to create the Bandra Kurla Complex (BKC) - a first in the series of new business districts that were planned in Greater Mumbai to help arrest further concentration of offices and commercial activities in South Mumbai. Of this, 220 hectares were reclaimed from the estuarine reach of the Mithi River, which resulted in it being reduced to a canal and gave it a completely new course and shape. Up until this point, the Mithi drained into a large low lying area made up of mud flats and mangroves in the Mahim Creek.

Following the reclamation of the BKC, the Mithi River became longer, adding about 5 km to its course, which consisted of that area of the Mahim Creek that had escaped reclamation. The area between Salsette Island and Mahim has undergone considerable topographical modification and is barely recognizable from its pristine estuarine grandeur which existed for millennia before the reclamations. Systematic reclamation by the MMRDA in this region eased after the completion of the BKC. However, a far greater threat not only to the purity but to the very existence of the Mithi River came from mushrooming slums on mangroves patches between the reclaimed land and the river course. These slums, which first appeared in the late 1800s, have since grown at an alarming pace on both sides of the river and the Vakola Nala destroying mangroves in large numbers. Further damage has been caused by the highly polluting small-scale industries that have been allowed to flourish along the river banks.

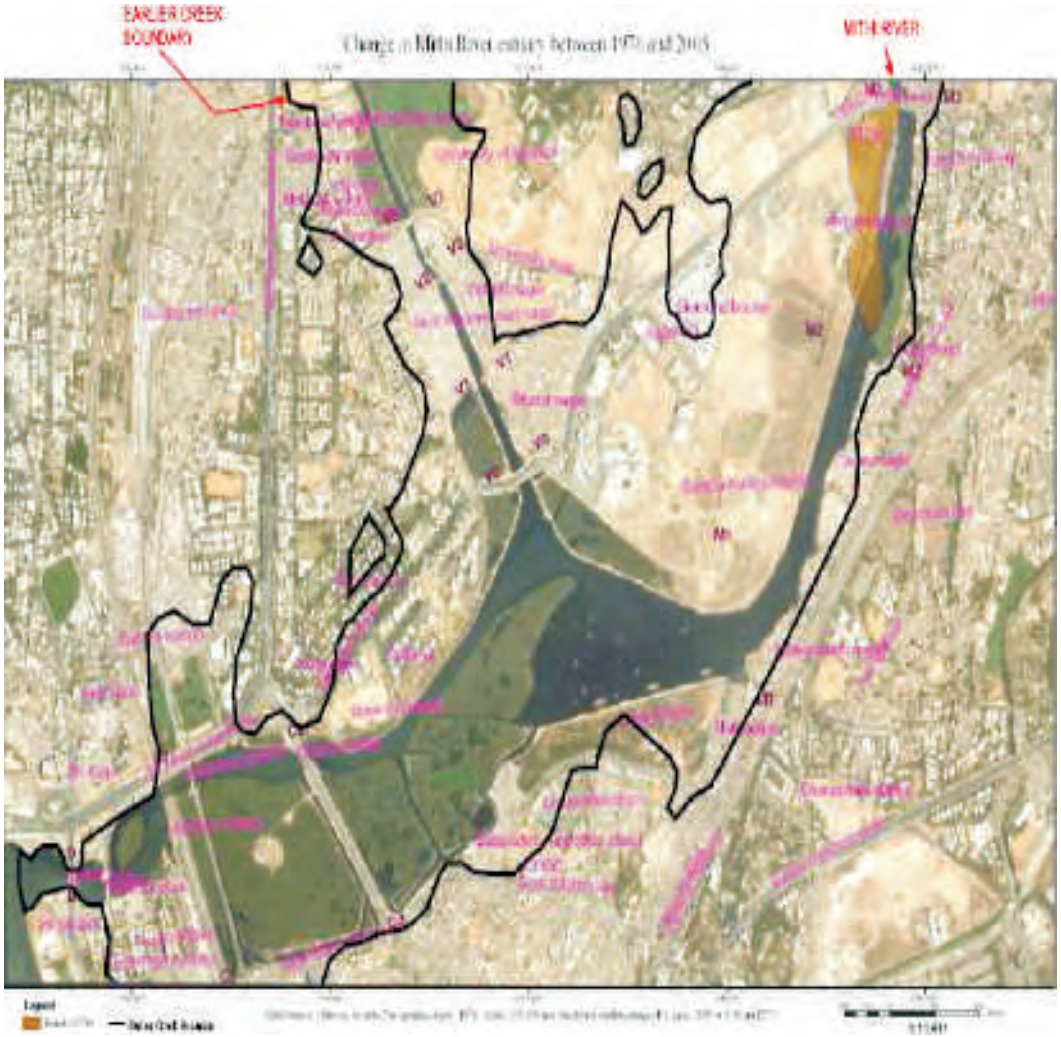


Figure 2.9- Change in the Mithi River Estuary between 1976 and 2005. Final Report of the Fact Finding Committe on Mumbai Floods, March 2006

Results of a recent study by the National Remote Sensing Agency (NRSA) using GIS techniques, point to the adverse human-induced influences on the Mithi River and its catchment. Between 1966 and 2005, there has been almost 50% reduction in river width and 70% decrease in mudflats and open spaces. The simultaneous upward trend in concretisation of the catchment area from 29% to 70% in the same period has reduced the porosity and infiltration capacity of the ground, which in turn, has increased the run-off of rainwater and also adversely affected the ground water table (J. Kamini, 2006). Worse, this has increased the risk of flooding in the city.

Figure 2.10- Bandra Kurla Complex, Mumbai's newest business district (in the background), has been reclaimed from the estuarine reaches of the Mithi River. Photo Courtesy: *ORF Mumbai*

Thus, the Mithi River that once ran pure and unpolluted for millennia was moulded, remoulded, polluted, abused and reduced to a toxic sewer within half a century. While our need to reclaim land was justified in some cases, in hindsight, it is obvious that it would have made a huge difference to plan the reclamation with the geography and environment of the city in mind. Mumbai's Mithi amnesia could last only until the deadly deluge of 26th July, 2005. Mumbai created the Mithi of today and the folly of destroying the Mithi drowned Mumbai on that fateful day. Overnight, Mumbai, India and the world came to know of the Mithi as the River of Death, which sunk a city of 13 million people. The media took her to the sword and all fingers of blame pointed her way. Yet, no historical evaluation and no sincere introspection were made to see why the river had not been able to cope with the flood waters.

It is the aim of this paper to reconstruct a picture of the Mithi in its purest form; trace the effects of urbanization and reclamation on the geography, environment and health of the river and its catchment; detail and scrutinize the works done on the river after the deluge; instil in the people of Mumbai curiosity, respect and a sense of ownership towards the river; and, most importantly, present a vision of how Mumbai, by reclaiming its Mithi, can indeed make its riverfront development the centrepiece of a world-class urban renewal project in the 21st century.

Figure 2.11- Slums along the Mithi River - 2010
Photo Courtesy: *ORF Mumbai*

At an altitude of 246m above sea level, the Mithi River originates in the hills located in the east of the SGNP, gathers water from the streams and spillway discharges of the Tulsi, Vihar, and Powai Lakes, and travels 17.84km to the Mahim bay.

Runoff from the Mithi's catchment, which is a staggering 7295 hectares (Chitale, 2006) and covers over 16% of Mumbai's area, is added along its course. The tidal reach of the river is about 7km from the Mahim Bay up to Air India employees' housing colony, located to the east of Santacruz Airport, renamed in 1995 as Chhatrapati Shivaji International Airport.

From its point of origin, the Mithi flows through the SGNP, Royal Palms (Aarey Colony), Filter Pada, Larsen & Toubro Junction near IIT Powai, Jogeshwari-Vikhroli Link Road (JVLR), Saki Naka, Kranti Nagar, Bail Bazaar, Chhatrapati Shivaji International Airport, Air India Colony, S.G. Barve Marg, BKC, Bandra (East), then under the Bandra-Mahim Railway Line, Mahim Creek, and Bandra Reclamation, before emptying into the Arabian Sea.

Figure 3.1- Catchment of the Mithi River. Derived from CWPRS Technical Report, 2005. Graphic courtesy: *ORF Mumbai*

Like most rivers, the Mithi's bed is narrow in the initial stretch and wider at the mouth near BKC. Mahim Estuary acts as a filter for the ingress of seawater, as well as a drain for the river. Because of the very steep gradient in the upper reaches, the flow of the Mithi is generally swift. In the lower reaches, the bed gradient becomes moderate and the river becomes more sluggish as it approaches the bay. Based on the gradient, the river may be divided into four distinct reaches with steep bed gradients of 1:200 from its Vihar Lake to JVLR, gradient of 1:450 downstream up to Mathurdas Vasanji (MV) Road, moderate bed gradient of 1:850 further downstream up to S.G. Barve Marg Bridge, and a flatter bed gradient of 1:4000 up to Mahim Causeway (Chitale, 2006). Throughout the length of the river, the bed is composed of different materials, which could be mud, silt or rock.

Mahim estuary, where the river meets the Arabian Sea, was once the site of a designated bird sanctuary attracting a large number of local and migratory birds, some of them coming from as far as Siberia. Looking at the unedifying sight of the estuary today, it is not difficult to see why the population of birds, and the number of migratory birds in particular, has sharply dwindled over the years.[3]

Figure 3.2- Flow of the Mithi River through Aarey Colony. Photo courtesy: *Dr. Kirit Somaiya*

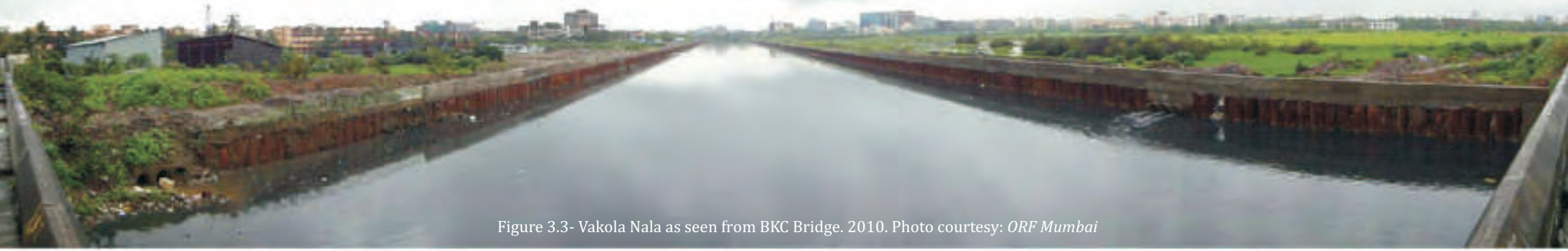


Figure 3.3- Vakola Nala as seen from BKC Bridge. 2010. Photo courtesy: *ORF Mumbai*

Vakola Nala and Other Feeders:

The Vakola Nala is a major tributary of the Mithi River and experiences tidal action for most of its course. It flows in the areas of Vile Parle (East), Santacruz (East), Khar and a part of Bandra (East). It originates north of Santacruz downstream of the airport, passes through the airport to Prabhat Colony and then continues to flow south across S.G. Barve Marg and through Kole Kalyan and the Mumbai University campus at Kalina, to join the Mithi River. With a length of 3.8 km, it has an average bed level of (+) 3.0m and a catchment of 907 hectares (Chitale, 2006). The Vakola Nala is so called as it has been canalised and walled-in to such a great extent that not a single inch of natural river bank is left. As recently as in 1976, it was a part of the Mahim Estuary and was as wide as 900m in places where it is only 60m wide today. It is surrounded by large slum settlements on both sides which stand on what was once thick mangrove forest. The water in the *nala* is pitch black, thanks to the enormous amount of pollutants that it carries, all of which it discharges into the Mithi.

Other than the Vakola Nala, there are about 11 additional *nalas* that discharge into the Mithi including the highly polluted *nala* coming from the Bandra Terminus via Bandra station (east) and emptying into the estuarine reaches of the river.

3. A 2010 report of Birdlife International stated that 11 % of the migratory birds coming to India are threatened. All large migratory birds require wetlands of the kind that the Mithi once supported. According to Dr. Asad R. Rahmani, Director of the Bombay Natural History Society (BNHS), "India falls on the South-Asia migratory route and being the largest country in the region, for some migratory species India is very important during their winter sojourn." Significantly, 2010 is also the International Year of Bio-diversity. Activities of BNHS, like the annual Flamingo Festival, have been helpful in creating awareness about migratory birds.

Ponds and Streams in the Mithi Catchment:

Water bodies including ponds account for 1106 hectares of Mithi's watershed. However, if we exclude Tulsi, Vihar, and Powai lakes, the remaining 10-12 ponds account for only 22.5 hectares (Chitale, 2006). Some of the major ponds in the Mithi's catchment are the Sheetal Talao, Chandivali Lake, Padam Talao and Kole Kalyan Talao (Mumbai University Campus, Kalina), the latter being the largest. The number and size of ponds in the Mithi's catchment have been declining steadily over the years as a result of reclamation and fast-paced urbanisation and infrastructure development. Studies show that as many as half of the ponds and tanks that existed in 1966 in Mithi's catchment have vanished and those that survived have shrunk in size. These are the ideal sinks for[4] rainwater and are also responsible for groundwater recharging. Alarmingly, about two-thirds of the streams and drainage channels in the Mithi's catchment have also fallen prey to land reclamation and urbanisation in the same period of time (J. Kamini, 2006). This is a worrying development as ponds play a vital role in the context of flood protection in their micro-catchments besides providing an opportunity for recreation, fishing, and siltation. The decrease in ponds and tanks is directly proportional to the increase in built-up area around the Mithi; the impervious urban surface increased from 46% in 1966 to 85% in 2005. This increase has drastically reduced the percolation of rain water, thereby accelerating the run-off.

Figure 3.4- Old photograph of Gowalia Tank, which was used for bathing cattle. The tank was later filled-in with earth and its grounds were chosen to launch the 'Quit India' movement in August 1942. It was subsequently renamed August Kranti Maidan.

Figure 3.5- Sheetal Talao. One of the few surviving ponds in the Mithi River's catchment. Photo courtesy: *ORF Mumbai*

4. Bombay once had many water tanks within its city limits. Before piped water came to the city in 1860, they were the only source of water to the city. Some of the tanks that became major landmarks in the city are: Cowasji Rustamji Patel Tank (CP Tank), Gowalia Tank (the Indian National Congress was born in its vicinity in 1885: the historic Quit India resolution was passed at the AICC session held here in August, 1942) Khara Tank, Do Taki, Babula Tank, Nawab Tank, Framjee Cowasji Tank, Mumbadevi Tank, Banganga Tank and Bandra Tank. Out of these, only the Banganga Tank and the Bandra Tank are still in existence today.

The Airport and the River

The establishment of Mumbai's airport and subsequent growth have had a significant impact on the Mithi River and its catchment. The process of land acquisition for enlarging the airport facilities ate into the river's estuarine reach and destroyed surrounding mudflats. It is evident from satellite imageries that the entire area south of the airport boundary wall was situated on the periphery of a low-lying reclaimed pond area. A survey record from 1925 confirms that this area was a portion of the water-logged wetland system of the Mithi Estuary (then named as Mahim River Estuary). Reclamation of ponds seems to have aggravated flooding in this area due to loss of natural drainage. Between 1976 and 2004, airport works forced the river to deviate unnaturally, making it bend at 90 degree angles four times in rapid succession thus, rearranging its erstwhile linear flow. The river was made to pass through a channelised culvert beneath the runway, and bound with walls and embankments on both sides.

Behind the Fauzia nursing home in Kurla West, the river was first bifurcated and then reunited forming a small island near Nasibullah compound in Mumbai's H-ward, as shown in the Development Plans. This area was subsequently reclaimed by the Airports Authority of India and was used for the extension of the runway in late 1980's.There is no doubt that the airport expansion has adversely affected the course of the Mithi River, leading to its rapid environmental degradation and reducing its ability to effectively drain this densely populated low lying region.

Figure 3.6- International airport at Santacruz, Mumbai. Built in 1948

Figure 3.7- Temporary diversion of Mithi River's course for construction of a box culvert under proposed taxi-bay extension (April 2005)
Photo Courtesy: Google Earth Imagery

Figure 3.8- Slums downstream of the airport runway (Seen at the top of the image). Photo courtesy: *ORF Mumbai*

Mumbai's domestic and international airport together is India's most important aviation hub, handling more than 25 million passengers and 533,593 tonnes of cargo. It has five operating terminals spread over an operational area of 1,450 acres (5.9km^2), much of which is in the Mithi's erstwhile estuarine reach. Heavy rainfall can cause the airport grounds to get flooded and affect operations. Flooding along the river also has a direct or indirect impact on five important transport corridors, including Central Railway (Main Line), Central Railway (Harbour Line), Western Railway (Main Line), Western Express Highway and the Eastern Express Highway.

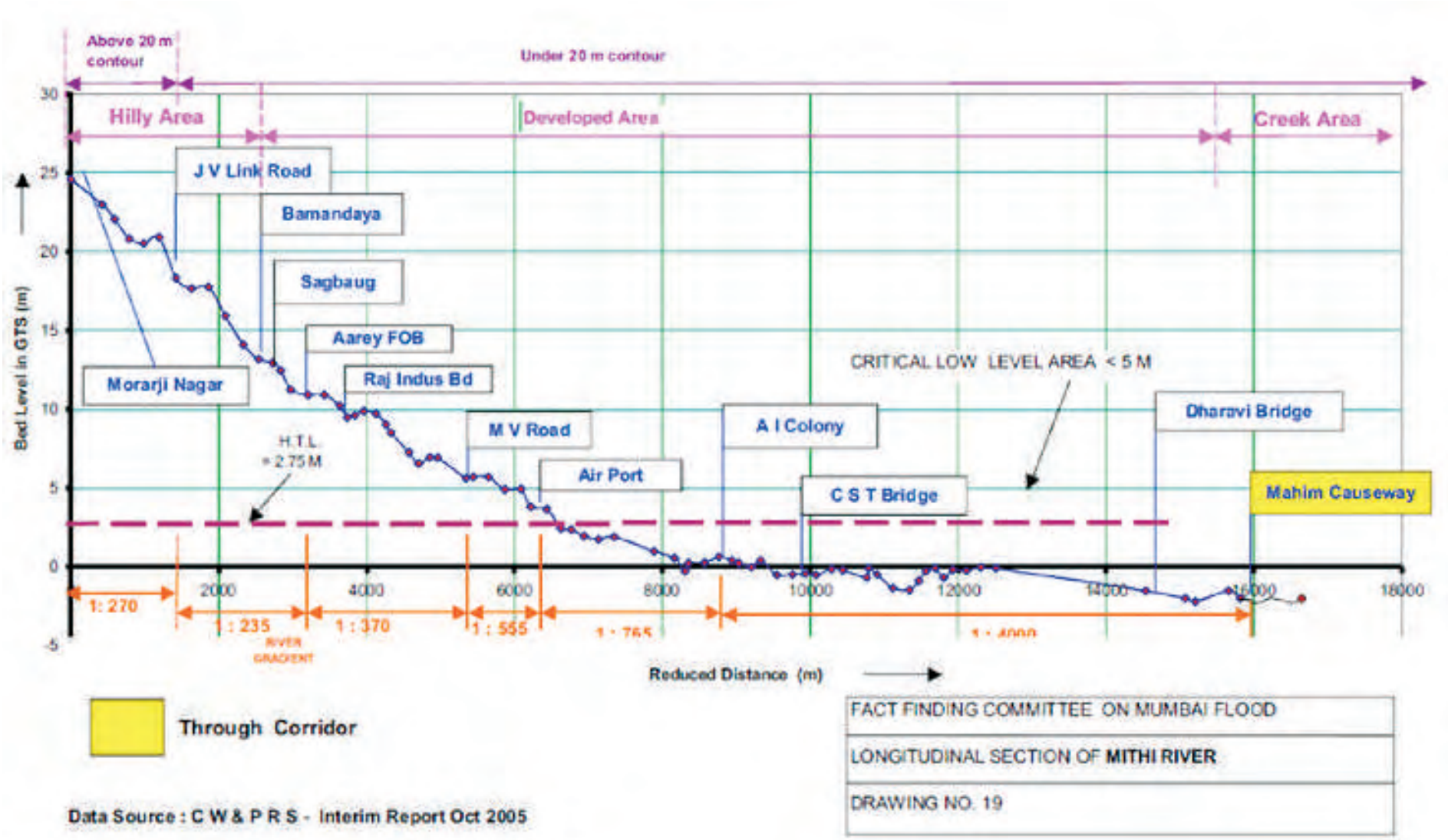


Figure 3.9- Longitudinal Section of Mithi River. Fact Finding Committee on Mumbai Flood, March 2006

Sanjay Gandhi National Park: Mumbai's Threatened Treasure

With the changes in characteristics of slope, carrying capacity and flow rate, the river's environment and ecosystems also change. Significant impacts on any of the components of these ecosystems[5] can eventually have repercussions for the entire river system. It is vital to understand the various ecosystems that the Mithi supports and interacts with within different sections of its course.

Let's begin with the river's origin. Until recently, not many people in Mumbai knew that the Mithi existed, and fewer still knew that it originates in the SGNP. Part of the reason for this amnesia is the general ignorance about, and apathy towards, the park itself. It is a large protected area on the north end of the city covering an area of 104km^2 and is the world's largest national park within the boundary of a city. It boasts 59 species of mammals, 155 species of butterflies, 52 species of reptiles, 250 species of birds, 13 species of amphibians, and more than 1,000 species of plants. Yet, even this proud natural endowment that Mumbai is blessed with has been allowed to be encroached upon by slum settlements with the patronage of local politicians, for whom the slum dwellers are a safe vote bank. The encroachments include more than 57 settlements, with 3,00,000 people inhabiting over 61 thousand hutments and occupying an area of 300 hectares of land. Of this, less than 10% is local tribal population (Krishna Tiwari, 2010). Land-grabbers in collusion with builders and corrupt politicians have been denuding the forest at an alarming rate.

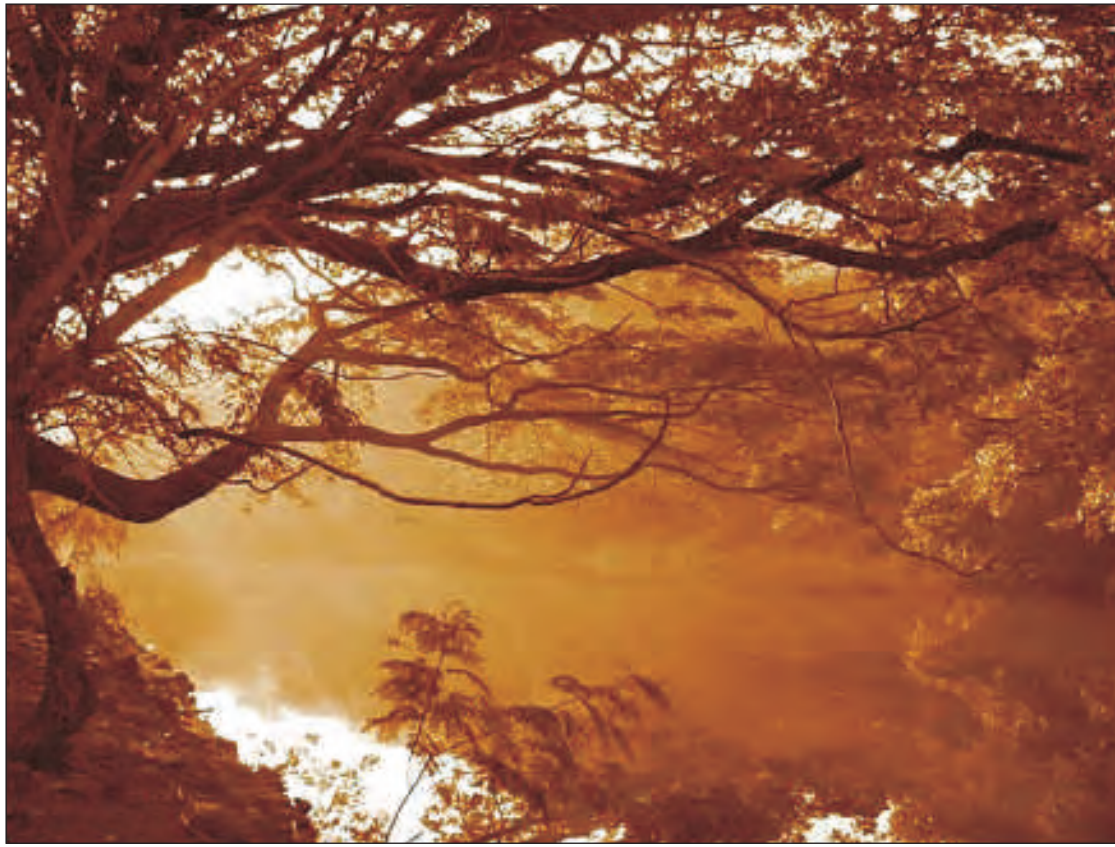


Figure 4.1- Early morning at Sanjay Gandhi National Park.
Photo courtesy: *Dr. Sangeeta Dahanukar*

They manipulate ownership of such cleared land parcels in the *benami*[6] (proxy) names of illiterate tribals, misusing the legal protection that forest-dwelling tribals possess. Their hope is that some day the land would turn gold when it is denotified for construction purposes and they would be able to make a killing. Encroachment is not the only criminal activity that threatens the Park's future. Nature's precious gift to Mumbai is also plagued by quarrying, poaching, wood smuggling, grazing and dumping of solid wastes and chemicals.

5. An ecosystem is a biological environment consisting of all the organisms living in a particular area, as well as all the nonliving, physical components of the environment with which the organisms interact, such as air, soil, water, and sunlight
6. *Benami* transaction means any transaction in which property is unlawfully transferred to one person for a consideration paid or provided by another person

Region of Urban Interaction

In its hilly origin, the Mithi has a steep gradient and flows fast in the rainy season, getting larger with streams merging into the tail waters of Vihar Lake. This is where one can still experience the Mithi in a relatively pure state. A large volume of tail water from Powai Lake augments the river further downstream. From this point on, the gradient becomes gentler.

It is after exiting Powai Lake that the river begins its perilous journey through the urban jungle that is Mumbai. The river is walled-in at several locations from here on and gets subjected to unchecked abuse by citizens dumping raw sewage, industrial and municipal wastes. Besides this, illegal activities like washing vessels, animals and oily drums, discharge of unauthorised hazardous waste etc., are also carried out along the river course. Cattle sheds in some areas contribute animal waste. Barrel cleaners, *bhangarwalas* (scrap dealers) and others dump sludge oil, effluent and garbage in the river. The relentless dumping has piled up and reduced the carrying capacity of the river. The water with a mixture of sewage and industrial waste is a serious threat to marine life.

Figure 4.2- Rejects from the recycling industry lie scattered around the Mithi River. Photo courtesy: *ORF Mumbai*

In this region of urban interaction, the river has been narrowed at several locations including Fauzia Hospital at Kurla, South of the Saki Naka Bridge, Wadia Estate, in front of Kalpana Theatre (Kurla), and near the runway extension of the domestic airport. Over the years, the land mafia has surreptitiously used debris and construction wastes to fill up the riverbed, ponds, streams and wetlands for illegal reclamation in this region. The river is riddled with open, dangling cables and pipes crossings on the sides of the bridges and culverts which appear to bind the river in an urban straightjacket.

The topography of the river and its catchment has been altered multiple times and its overall health has degraded to such an extent that there is no semblance to the landscape that prevailed even 50 years ago. The pollution carrying contaminates either flow into the Arabian Sea or settle on the river bed and in the sediments of the mangrove forest in the estuary and the bay.

Figure 4.3- Illustration showing a typical river exploitation in Urban India post independence. Illustration by Mr. K. Sivarama Reddy - taken from *'Building Regulations for happy and healthy living'* by Mr. G. Venkatarama Reddy for the Director of Town Planning, Government of Andhra Pradesh. (Published in 1972)

Proliferation of Slums: A Curse on the Mithi and a Blot on Mumbai

Mumbai's slums squeeze in 60% of the city's population into 12% of its total area. These slums are the face of India's urban poverty and are characterized by unsteady homes, severely curtailed access to basic urban services including water supply, sanitation, storm water drainage, healthcare, education, roads, fire fighting etc., coupled with insecurity of land tenure. Over the years the health and quality of life of Mumbai's slum dwellers has further deteriorated with increasing social trauma and visible inequity. Some of the major slums along the course of the Mithi and its tributary, the Vakola Nala, are — Dharavi (the largest slum in Asia), Dyaneshwar Nagar, Bharat Nagar, Valmiki Nagar, Maharashtra Nagar, Sandesh Nagar, Jari Mari, Davri Nagar, Shivaji Nagar, Agripada, and Morarji Nagar. Because these slums had no legal status when they were established, the civic body made no provision for adequate water supply, sewerage, storm water drainage and solid waste management. As the unmanaged and unplanned slums grew larger in size, the Mithi River provided a single window 'solution' to several basic civic needs. The river became a universal dump for all solid and liquid wastes. Moreover, untreated effluents from illegal industries that flourish in these slums also make their way into the river.

Mumbai produces a staggering 6,500[7] metric tons of municipal solid waste (MSW) each day (MCGM). This excludes a large amount of material that would have been disposed of as solid waste in other cities but gets recycled in Mumbai's slums. Mumbai is home to a large informal recycling industry and a significant amount of this waste salvaging takes place along the banks of the Mithi in recycling units run by *Bhangarwalas*.[8] An assessment of this industry must necessarily invite two contradictory comments. On the one hand, it deserves kudos for recycling a significant amount of urban waste and bringing it back into productive use — an ethos of conservation that Indian society has always encouraged. This industry also provides livelihood to tens of thousands of the poorest residents of the city, many of them women. However, on the negative side, the owners of this industry follow no rules and regulations, and are completely apathetic towards the disposal of "value-less" components of the waste they handle. Unlike a formal regulated system, rejects, including those containing toxic chemicals, are often disposed directly into the river without a second thought. Islands of waste can be seen at places where the river is shallower than two feet. This irresponsible and criminal dumping of urban solid wastes in and on the banks of the river causes unnatural sedimentation on the river's bed and this is further aggravated by grossly inadequate annual desilting efforts on the part of city authorities.

Other than recycling, this region, and particularly the area around S.G. Barve Marg Bridge, houses several small industrial units that have been discharging chemicals, oils and other untreated effluents directly into the river and its banks for years together. This hazardous practice has sucked the life out of this once productive riparian zone, stripping it of all vegetation. The problem is particularly severe in the vicinity of Habbibullah compound and Air India Colony. In January 2011, authorities discovered large scale oil and fuel adulteration operations that had been running unchecked along the banks of the Mithi River in the Kurla - Kalina belt by Mumbai's oil mafia. There are several tanneries towards the lower reaches of this section which discharge, heavy metals and other contaminants as part of their effluents. As highlighted by a study conducted by IIT Bombay in 2005, the entire river is contaminated by heavy metals and other toxic contaminants.

The river has an overpowering stench for most of this section and when the waters run shallow, the exposed riverbed creates a nauseating environment all around. It is difficult to believe that the Mithi was once used for recreational activities including boating and fishing.

7. In addition to the 6,500 metric tons of Municipal Solid Waste produced each day, Mumbai produces an additional 2500 metric tons of construction and demolition waste per day.
8. *Bhangarwalas* small scale scrap dealers in urban centers in India. They collect wastes from doorsteps of citizens besides receiving waste from the streets which is collected by rag pickers.

Figure 4.3- Mixed land use consisting of slums, commercial and small industrial units typify this region. Photo courtesy: *ORF Mumbai*

Figure 4.4- A toilet constructed outside a *pucca* slum designed to directly dispose sewage into the *nala* below. Photo courtesy: *ORF Mumbai*

A River Dies

A river dies choked to gills
expiring upon industrial waste

sadly as the river dies the fish die also
oxygen starved extinguished

life was a web of light upon the water
life web torn broken discarded

water breathed life into river flowing
man breathed in death river choking

oxygen rich river was flush with fish
smell taste drink putrid pollution

-Terence George Craddock

Estuarine Region:

In its last leg, the river broadens further as it enters the estuarine region and meets with the waters of the Arabian Sea, which come in with the high tide. The term estuary is used to describe a dynamic ecosystem with a connection to the open sea, through which the seawater enters according to the rhythm of the tides. The seawater entering the estuary is diluted by the freshwater flowing from rivers and streams.

While the estuarine part of the Mithi is also plagued by slums, it is far more sensitive from an environmental perspective and critical for flood mitigation. It is well known that rivers sustain life and that several civilizations and large contemporary metropolises were settled along rivers. But it is less known that 22 of the 32 largest cities in the world are located on estuaries (Ross, 1995). Mumbai had the best of both, yet acknowledged the importance of neither.

The estuarine segment of the Mithi has perhaps been the greatest victim of Mumbai's reclamation and chaotic urbanisation. The Mahim estuary, a once open water mass that was connected to the eastern sea through the Mahul estuary, is now reduced to a mere extension of the Mithi River.

Prior to reclamation, this region was made up of mudflats and mangrove forests. The area under mudflats in the Mahim Creek has decreased from 4.47km^2 in 1966 to 3km^2 in 1987 and finally to 1.5km^2 in 2005. Nearly 75% of the area under mudflats has been reclaimed and transformed (J. Kamini, 2006). Although the reclamation of BKC ate into a large part of the mangroves, there still is abundant mangrove vegetation surviving in this region. Bordering this green lung, in stark contrast to each other, lie the sprawling Dharavi slum and the Mahim Nature Park (MNP), the latter spread over an area of 37 idyllic acres covered with forest and a designated bird sanctuary. Both the MNP and large parts of Dharavi have come up on what was once wetlands subsequently converted into a garbage dump for Mumbai as recently as 1976 (MMRDA). Behind the MNP and separated from the river by the Dharavi Bus Depot lies the Riwa Fort built by the British to ward off the Maratha warriors from Salsette Island. The estuary waters once touched the walls of this fort.

"As a child, I would wait for the day when the estuary in Dharavi would be full of brightly coloured fishing boats which had all been freshly painted. Large flags, unique to each family, would be hoisted on the boats to celebrate Narali Poornima, the first day of the new fishing season", recalls Mahesh Haldankar, 45, who spent his childhood in Dharavi.

Figure 4.5- The estuarine reach of the Mithi River. Photo courtesy: *ORF Mumbai*

Figure 4.6- A bird in the garbage floating in the Mahim Estuary
Photo courtesy: *ORF Mumbai*

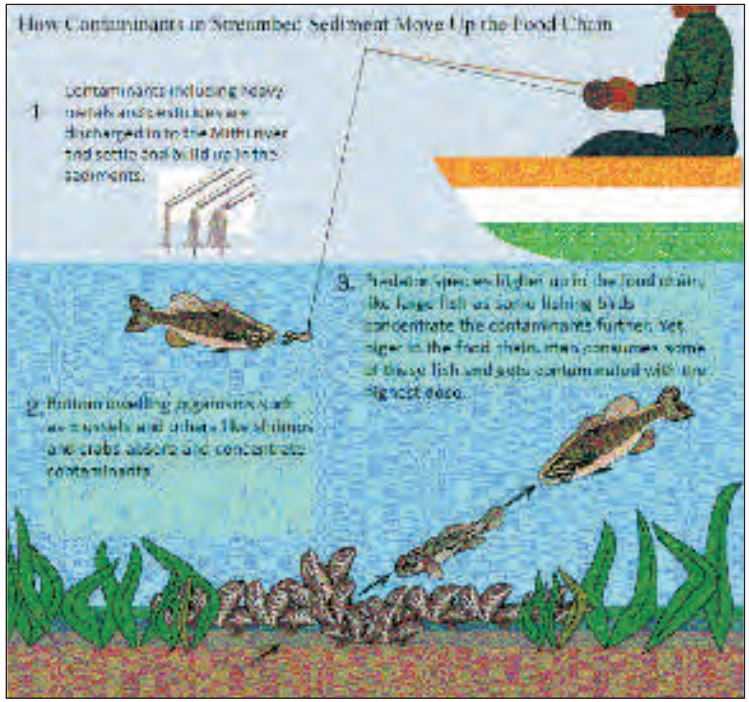


Figure 4.7- Diagram showing bioaccumulation and biomagnification in an estuarine ecosystem

The MNP plays host to about 38 species of butterflies, more than 80 species of birds and as many as 200 species of trees (MMRDA). It is a haven for numerous insects, amphibians and reptiles along with the many species of fungi that thrive in this woodland. The estuarine vegetation and the surrounding mudflats are home for migratory and aquatic birds that winter in the Indian subcontinent. Hence, the park has become a particularly popular spot for birdwatchers from mid-October all the way to February-March. When people come today to the MNP they find it difficult to believe that, the forest they see now was a garbage dump just 20 years ago. The northern boundary of the park borders the Mithi River. Despite its location in the heart of the city, the MNP attracts a meagre 100,000 visitors on average each year, an overwhelming majority of whom are school children visiting as part of an organized tour by their school. In spite of being located in the heart of the city, the park fails to attract visitors because the road leading to it is very dirty and the entrance is uninviting. Neither the management of MNP, nor the MMRDA, have done anything to attract more visitors to the park. As a result, the park still remains relatively unknown to the Mumbaikar and perhaps, unheard of, by tourists. At the other end of the river, the Sanjay Gandhi National Park attracts nearly 2,000,000 visitors each year and is one of Asia's most visited parks.

More than the freshwater sections of the river upstream, the estuarine section is under greater threat from the high levels of pollution from effluent and sewage discharge, ingress of settlements and land reclamation. The estuary is sensitive and gets affected by events far upstream, and concentrates heavy metals in its sediments. Many of the contaminants including plastics, pesticides, furans, dioxins, phenols and heavy metals, that enter the river upstream, do not disintegrate rapidly in the marine environment. These pollutants may flow into the estuary and onward into the sea where they accumulate in the tissues of fish and other species of aquatic life, in a process called bioaccumulation.[9] These contaminated fish are then consumed by the humans, who suffer as a consequence. While it may appear that we have rid ourselves of pollutants by disposing them into the river, they come right back into our lives and the lives of our families and neighbours. The highest concentrations of these contaminants reach our babies through human breast milk. Pollutants that don't flow out to the sea accumulate and embed in the estuary and bay mud in sediments.

9. Bioaccumulation refers to the accumulation of substances, such as pesticides, or other organic chemicals in an organism, that forms part of the food-chain in an ecosystem.

Mangroves – Why they matter

The mangroves in the Mahim estuary may have survived the city's onslaught thus far, but their existence is now threatened on several fronts. Let us understand the mangroves a little better.

Mangroves are unique trees and shrubs that have the ability to grow in saline habitats. The saline conditions tolerated by various species range from brackish water, through pure seawater . They form a characteristic saline woodland or shrubland habitat, called mangrove swamp or mangrove forest. Mangroves are able to exploit the intertidal zone by developing physiological adaptations to overcome the problems of high salinity and frequent tidal inundation. The area of the estuary which is submerged in the high tide but gets exposed during the low tide is called the intertidal zone and is the most productive part of the estuary. The base of the mangroves in the Mahim estuary gets submerged twice a day with the incoming tide.

Fine sediments under mangroves act as sinks for a variety of heavy metals. Mangrove removal disturbs these underlying sediments, often creating problems of trace metal contamination of seawater and biota and could lead to rapid bioaccumulation and biomagnification.[10]

Mangroves protect coastal areas from erosion, storms, and tsunamis, all of which are real threats for Mumbai today. Their massive root system is efficient at dissipating wave energy. Likewise, they slow down tidal water enough that its sediment is deposited as the tide comes in, leaving all, except fine particles, when the tide ebbs. In this way, mangroves in the Mahim estuary have patiently built their own environment. The predominant species of mangrove in the Mahim estuary is *Avicennia Marina*, commonly known as grey or white mangrove.

The destruction of mangroves by felling, inundation and cutting off of access to water is a common practice in Mumbai. For many decades, the mangroves in Mahim have been a safe haven for bootleggers. They are known to unlawfully chop down trees, for firewood, used to produce alcohol by a crude method of distillation. The thick mangroves provide a perfect cover for thier illegal operations. Due to the uniqueness of this mangrove ecosystem and the protection against erosion that it provides, it is vital that we fiercely protect the remaining patches and restore whatever we can. This reach of the river is Mumbai's biggest ally against flooding. Its ability to soak rainwater and drain the city is critical and must be treated with respect.

Figure 4.8- Mangrove surviving in highly polluted water. Retaining wall has cut off thick mangrove patch from the water. Photo courtesy: *ORF Mumbai*

Figure 4.9- Mangroves near BKC —Choked by plastics. Photo courtesy: *ORF Mumbai*

10. Biomagnification, or bioamplification, is the increase in concentration of a harmful substance, such as the pesticide DDT, that occurs in a food chain.

Banks of the Mithi River

Other than the abuse from dumping of solid wastes, sewage and industrial effluent, the banks of the Mithi River have suffered the greatest damage from government actions. Silently the banks have been squeezed and eliminated in places. Under the pretext of flood control, the banks have been walled-in with concrete, which has been strongly objected to by environmentalists as serving no purpose whatsoever and draining the public exchequer in terms of expensive contracts. What were once natural sloping banks open for public access have now become vertical inaccessible walls further cutting any human interaction and re-establishing the image of the river as a drain.

Figure 4.10- Abused banks of the river. Photo courtesy: *ORF Mumbai*

Figure 4.11- Concrete retaining walls have robbed the river of its banks. Photo courtesy: *ORF Mumbai*

Figure 5.1- Clay embankment built to create fish farms inside the mangrove forest trapping estuarine waters during high tide. In this image, the difference in water levels on either sides of the banks is clearly visible. Photo courtesy: *ORF Mumbai*

Observations

As part of ORF's research for this project, we made several visits between April and November 2010 to the Mithi River and surrounding areas including the estuarine region, the region of urban interaction and the hilly region through which the river flows. Our team also visited the Riwa Fort (*Kala Killa*) and the Mahim Fort, both of which are inseparable from the history of Mumbai and the Mithi.

A boat ride from Mahim Bay to BKC, where the Vakola Nala meets the river, presented us with a wonderful opportunity to study the river at close quarters and experience both its splendour and squalor. The remainder of the river's course was experienced largely from the bridges that cross over it at several locations from Mahim to Powai. Our observations tell us that despite the extreme pollution that the river is subjected to, it is very beautiful and welcoming in the estuarine region and at the hilly region where it runs relatively pure. Everything in between is a huge mess.

Figure 5.2- The incoming tide brings all sorts of garbage into the mangrove forests. This garbage then gets trapped and does not float away with the receding tide
Photo courtesy: *ORF Mumbai*

Figure 5.3- Inundation in the enclosed water bodies has caused the destruction of mangroves. Photo courtesy: *ORF Mumbai*

Figure 5.4- Panoramic view of a manmade water body enclosed in the mangroves between Mahim and Dharavi. Photo courtesy: *ORF*

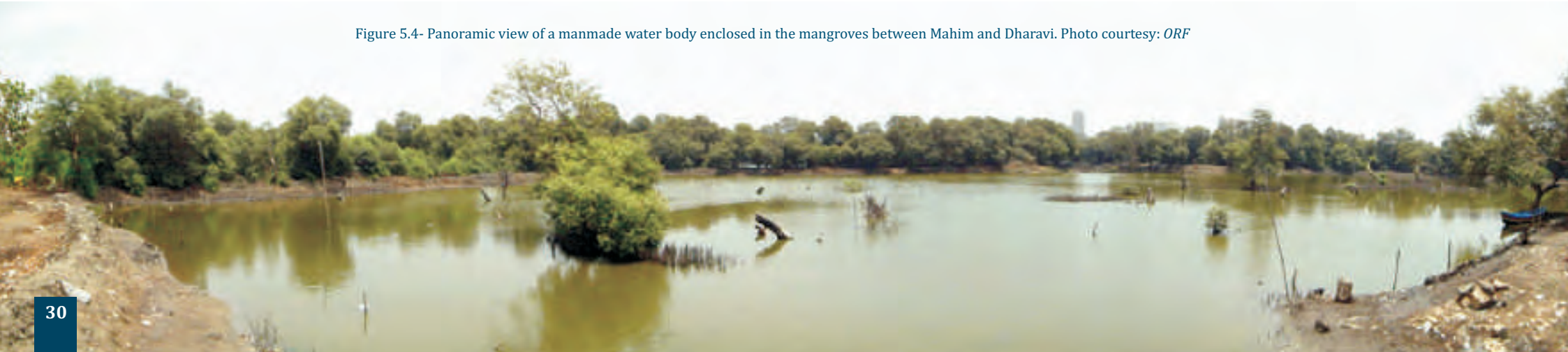


Figure 5.5- Pathetic condition of river bank and bridge near Dharavi.
Photo courtesy: *ORF Mumbai*

Figure 5.6- Gone to the dogs. Piles of garbage and rejects from informal recyclers, openly dumped on the S.G. Barve Marg flyover . Photo courtesy: *ORF Mumbai*

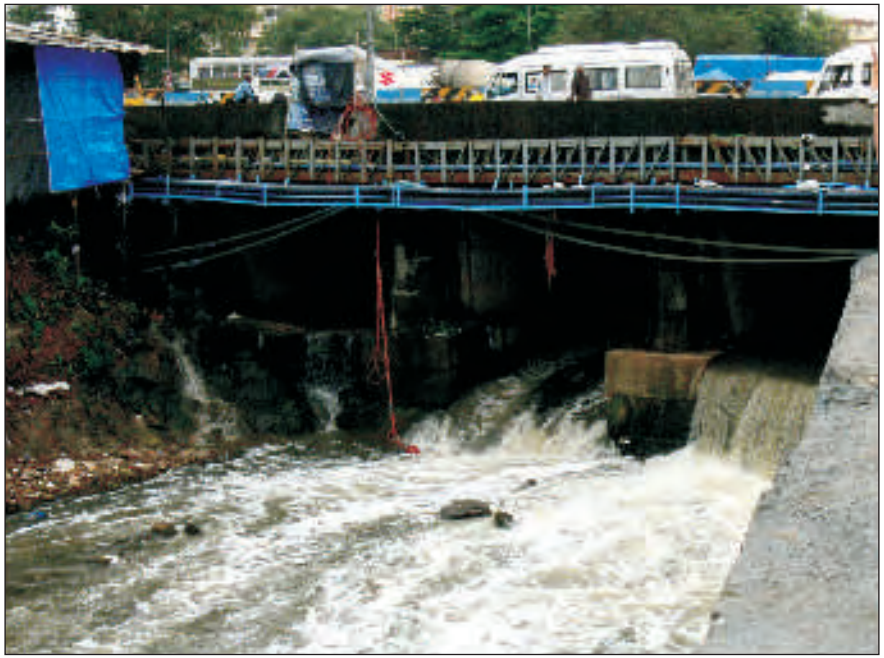


Figure 5.7-Dangling cables and concrete walls appear to imprison the river near Andheri-Kurla road. Photo courtesy: *ORF Mumbai*

Figure 5.8- Pathetic living conditions around the Vakola Nala. Photo courtesy: *ORF Mumbai*

We opted to study the estuarine region on a boat ride up the river. The estuarine region is easily the most beautiful and yet least accessed part of the river. We got off the fisherman's boat and walked into a mangrove forest at Mahim and discovered a large water body, invisible from the outside. There are many more of these water bodies inside mangrove forests in Mahim that were illegally created decades ago by *Koli* fisher-folk to harvest fish and prawns. These water bodies are also rich hunting grounds for a variety of fishing birds which we witnessed in large numbers. The beauty of this area is best experienced first hand. We also noticed that foul odour which emanates mostly from the river bed rather than the water, in the estuarine region is a low tide phenomenon.

One of the depressing aspects of all our visits was the appearance of bridges and other structures across the river. Without exception, they were all very ugly and unpleasant. This reflects a complete omission of aesthetic considerations on the part of the authorities concerned while constructing these road, rail and utility bridges.

Figure 5.9- The gabion wall with palm trees on the promenade adjacent to BKC. Photo courtesy: *ORF Mumbai*

Figure 5.10- Promenade constructed on top of the gabion wall cutting off the natural access of the mangroves (extreme right of the photo) to the water. Thick mangroves in contrast on the opposite banks of the Mithi. Photo courtesy: *ORF Mumbai*

The four-meter high concrete retaining walls constructed by the MCGM from the airport to Saki Naka have been built on the edge of the river without leaving any space for a river bank. In areas where the river is completely walled in on both sides, it appears as a drain. The retaining walls built by the MMRDA are slightly lower and employ a completely different construction method. These walls appear even uglier than those built by the MCGM and have already begun crumbling in places. These too have been built on the edge of the river leaving no room for a natural bank. In many places, the MMRDA has constructed these walls to separate the mangroves from the river. In addition, a 900m-long gabion wall has been constructed by the MMRDA in similar fashion dividing more mangroves from the water. Unlike the retaining walls, the gabion wall is porous and designed to allow water to enter and exit the mangroves behind it in rhythm with the movement of the tide. Its functionality and ability to allow movement of water as required to sustain mangroves, needs to be studied further.

Figure 5.11- Open defecation is a common sight near the slums along the Mithi River. Photo courtesy: *ORF Mumbai*

Figure 5.12- Retaining walls constructed by the MMRDA - S.G. Barve Marg Flyover - Vakola Nala. Photo courtesy: *ORF Mumbai*

Figure 5.13- Large retaining walls built by the MCGM - View from Andheri Kurla Road. Photo courtesy: *ORF Mumbai*

We also noticed the massive extent of encroachments along the river. In many places, slums, scrap dealers and industrial units are built touching the water's edge. The water quality is very poor and sewage and solid waste are continuously being disposed indiscriminately into the river. Recycling by *bhangarwalas* is the predominant commercial activity along the Mithi River. Sadly, wherever the river banks are present, they are sites for open defecation throughout the day. We also visited the Sheetal Talao, an important pond in the Mithi's catchment. This lake is used for immersion of idols during the popular Ganesh Festival. Its waters too appeared polluted.

Both Riwa and Mahim forts are in a dilapidated condition. The Riwa Fort, however, has been spared the horror of encroachment in its premises unlike the much larger Mahim Fort which is plagued by slums that have grown inside and over it like a festering wound. Open defecation is seen all along the length of Mahim beach right up to the entrance of Mahim Fort. A lot of old wooden boats lie unused on the beach – a clear sign that fish in the bay area are not as plentiful as they used to be. Harishchandra Vitthal Vaidya, a fisherman in Mahim for 50 years, told us, "The fish have reduced in number over the years and now we have to go further out into the sea. The taste and nutrition from the fish has also reduced." The Riwa Fort was built on mudflats in the erstwhile Mahim Creek that was then connected to the eastern sea. The waters of the creek would lash against the fort walls at high tide, recalls Prabhakar Zanke, 60, a local guide. He remembers a time when the vegetation here was so dense that only the brave and adventurous came to the Riwa Fort for a picnic enjoying a commanding view of the Arabian Sea, and the

Figure 5.14- Although the historic Riwa Fort is in a dilapidated condition, it has been spared the horrors of large-scale encroachments. Photo courtesy: *ORF Mumbai*

Figure 5.15- Prabhakar Zanke (Left) and his brother Laxman have protected the Riwa Fort from encroachments. Photo courtesy: *ORF Mumbai*

Figure 5.16- Riwa Fort, now covered by wild grass overlooking the Dharavi bus depot which was reclaimed from the Mithi River. Photo courtesy: *ORF Mumbai*

Figure 5.17- Harishchandra Vitthal Vaidya - He once fished in the unpolluted Mithi
Photo courtesy: *ORF Mumbai*

thrill of walking through the thick mangroves and the forested hills of Salsette Island. He recalls swimming in the waters of the creek up to Bandra and sometimes up to Kurla. “We would swim there (site where Kurla Court stands today) in the mornings .This is where the creek ended. We would find crabs and roast them over a small fire. The area was forested and hilly and we could hear the calls of foxes in the distance. Sometimes, when the water receded we could see a small river no wider than 20 feet and wondered where it came from.” Both Prabahakar Zanke and his brother Laxman, have fought for the protection of the fort against encroachments. Says Prabhakar, “I fear for the future of the Riwa Fort. I pray that the authorities stop repeating the mistakes of the past. They should restore this crumbling fort, protect it from encroachments, and build a garden on it so that people can come and enjoy the fort and learn about its history.” He was most happy when we told him about the purpose of our visit and refused to charge us for his services as a guide. “You are working for the realisation of my life's wish,” he said.

Figure 5.18- Garbage on Mahim Beach. Photo courtesy: *ORF Mumbai*

Figure 5.19- Heaviliy encroached Mahim Fort. Photo courtesy: *ORF Mumbai*

Figure 5.20- Sorry state of Mahim Beach
Photo courtesy: *ORF Mumbai*

Figure 5.21- Cancerous encroachment has ruined a proud Mumbai landmark (Mahim Fort). Photo courtesy: *ORF Mumbai*



Fig 5.22- They still come from near and far: Clockwise from top - Fiddler crabs, Black-winged Stilts, Median Egret and Little Egret, Great Cormorant and Indian Pond Heron. Photograph courtesy: *ORF Mumbai*


Our most recent site visit came when most of the report had been completed. ORF took it upon itself to present a completely unseen and unexplored facet of the Mithi to the city of Mumbai with the help of print and television media. A group of 20 participants were invited to join ORF on a boat ride on the Mithi River and a walk in to the Mangrove forests of Mahim and Dharavi. The list included Shri. Anish Andheria, India's leading conservationist and wildlife photographer, Shri. Janak Daftary and Shri. Jagdish Gandhi – activists from the Mithi Nadi Sansad, Smt. Roshni Udyavar who heads the Rachana Sansad Institute of Environmental Architecture and friends from print and television media. Despite having worked extensively with the Mithi before, none of the participants were prepared for what they witnessed that day. Although we chose a period of high tide, our boat got trapped in the thick black sediment on the riverbed opposite the Bandra Kurla Complex giving us an insight and evidence of the ineffectiveness and uselessness of dredging operations conducted by the MMRDA in this region. After freeing our vessel from water that was hardly two feet deep, we climbed up onto the mangrove forests. Seeing and experiencing the amazing setting with a series of beautiful lakes surrounded by a thick forest in the middle of the city left the new visitors spellbound. The rescue of a little egret further enhanced the magical feeling of being in a virgin oasis of beauty surrounded by a desert of slums. The sentiments of the visitors were amply reflected in the newspapers and news channels that generously covered the story over the next few days.

"When you see the pollutants in the Mithi river your heart sinks. Yet, you feel that there is hope when you see birds like sandpipers, godwits and kingfishers doing what they have been doing for millions of years even before humans set foot on the planet. I was pleasantly surprised to see so many beautiful life forms in the visually filthiest place that you can think of. The onus of cleaning up the river and protecting these life forms squarely falls on the Government of Maharashtra, the city municipal corporation and the people of Mumbai."

Dr. Anish Andheria

Director (Science, Natural History and Photography), *Sanctuary Asia*

Fig 5.23- Compassion in a cruel environment: Fisherman Suresh Tandel rescues a Little Egret trapped in a nylon net; (pics 3 and 4); plastics litter the estuarine sediment covered with black putrefying organic matter.

Fig 5.24- Experiencing the Mithi first hand. Gautam Kirtane, Dhaval Desai and Riddhi Chokhawala, of ORF Mumbai, lead a team of activists, urban planners and media persons on a guided tour of Mithi's estuarine region. L-R - Dr. Anish Andheria, Mr. Gautam Kirtane, Mr. Viju B, Mr. Jagdish Gandhi, Mr. Sandeep, Mr. Kunal Purohit, Mr. Suresh Tandel, Mr. Janak Daftary, Ms. Roshni Udyavar , Ms. Lahar Mehta, Ms. Devashree Sharma, Mr. Dhaval Desai, Ms. Kavitha Iyer and Mr. Vinayak Parab. Photographed by Riddhi Chokhawala

MEDIA COVERAGE FOR ORF'S WORK ON MITHI

Green warriors see red over retaining walls

Researchers look to revive Mithi, give residents river experience

Save mangroves on Mithi

DYING GREENERY Activists loot funds built for fish farming at Bandra Kala Complex are destroying mangroves

Five years, ₹900 crore later, Mithi still a stretch of stench

Greens see red over vanishing mangroves

06 ADC CITY

Report on Mithi calls for urgent policy change

Massive environmental degradation making river toxic

કારવાઇના આદેશ દેનારે મુખ્યમંત્રી હટલે, ઝોપડ્યા માત્ર તશાવા

રૂા.૯૦૦ કરોડ ખર્ચ્યા બાદ પણ મીઠી નદીનું શુધ્ધિકરણ થયું નથી

WE HAD BEEN FOREWARNED

Heavy monsoon and flooding are not a recent phenomenon in Mumbai. In fact, flooding has been a chronic issue affecting many parts of the city each year since decades. Well before the deluge on 26th July 2005, the MCGM and MMRDA had appointed several committees and consultants to study the problems of flooding. Some of these were specific to the Mithi River, and suggested several sound measures. These include the following:

- Natu Committee Report,1975
- Report on Model Studies on the effect of proposed Reclamation in Mahim Creek (Bandra-Kurla Complex) by the Central Water and Power Research Station (CWPRS), 1978
- Dharavi Storm Water Drainage System — Detailed Project Report by Shah Technical Consultants (STC), 1988
- Paranjape Committee for development of a gated barrage across the mouth of the Mithi River in 1988.
- Brihanmumbai Storm Water Drainage Project (BRIMSTOWAD) Report, 1993
- The Mithi River Water Pollution and Recommendations for its Control – Klean Environment Consultants, 2004

The Natu Committee Report (1975)

Key Observations and Recommendations:

- Due to increase in the impervious area, the amount of rainwater runoff has increased significantly.
- To provide by-pass sluice and a pumping station at Mahim Causeway outfall.
- To reduce the bed invert of rocky outcrop under the Mahim Causeway (this was subsequently executed).
- To provide electrically operated sluice gates.
- To eliminate bypasses of sewage into storm water drains.

Report on model studies on the effect of proposed reclamation in Mahim Creek (Bandra-Kurla Complex) — (CWPRS), (1978)

CWPRS was appointed by the MMRDA to study the requirements of the storm water system for development of BKC. The maximum permissible reclamation in the estuarine reach of the Mithi River and Mahim estuary was capped at 220 hectares. The MMRDA reclaimed all of the 220 hectares. This amount of land reclamation, however, had specific follow-up actions clearly mentioned in the CWPRS report. Only some of these follow-up actions were carried out.

Key Recommendations:

- Maintaining of minimum widths of the Mithi River in its lower section where the BKC reclamation was to take place.
- Follow a 3-year maintenance dredging cycle.
- The cross drains which empty into Mithi River should be provided with non-return valves and a facility to pump waters into the creek during floods. (Neither was provided.)
- Provision of sluice gate at Mahim Causeway. The idea of the sluice gate structure is to shut the gates before high tide occurrence so that the empty reservoir created by dredging upstream absorbs the floodwater which can then be discharged into sea by opening the gates during the low tide.

The following table compares the recommended widths of the Mithi River at various stages to the reported widths just after the deluge of 2005.

Segment of the River (m)	Recommended minimum width in CWPRS report of 1978 (m)	Reported width following the floods of July 2005 (m)
From Bay 0 to 1280	60	50-90
1280 to 5930	200 at top & 175 at bottom	85-115
Vakola Nala	60 at top & 40 at bottom	20-40

This clearly shows that the minimum prescribed widths had been compromised by upto 50% in several places

Dharavi Storm Water Drainage System Report by Shah Technical Consultants (1988)

Key Observation:

- Chronic flooding in Dharavi occurs when the High Flood Waters in Mahim Creek basin reduce the discharging capacity of Dharavi's drainage system.

Key Recommendations:

- Raise the average ground level in Dharavi. (This was deemed impractical.)
- Pump out the internal storm water mechanically. (The pumping station has not been installed.)

BRIMSTOWAD Report (1993)

Key Observations:

- When high intensity rain fall and high tides occur simultaneously, flooding is severe. Such events occur on average six times each year in the island city, and four times each year in the suburbs.
- National revenue losses for one flooding day are estimated at Rs. 37 Crores in the island city and Rs. 12.5 Crores in the suburbs (at 1991 prices). Thus, the nation incurred an annual loss of about Rs. 254 Crores at (1991 prices) due to flooding in Mumbai in 1991.
- It was specifically mentioned in the report that the Mithi River and its tributary, the Vakola Nala, were among the major water courses carrying storm water from the suburbs. However, these were encroached upon at many places and their water ways had been drastically reduced.

Key Recommendations:

- To remove encroachments and structures in or above the *nalas* and the storm water drains.
- Provide pumping stations to discharge storm flow from low lying areas and widening and deepening of the open storm water channels.

Minutes of the 195th Meeting of the Executive Committee of the MMRDA dated 8th December, 2001.

This meeting, chaired by the then Chief Secretary of the Government of Maharashtra, clearly demonstrates that the MMRDA was well aware of the problems of excessive siltation, unauthorized slum settlements, municipal waste dumping, illegal industrial units and industrial waste dumping along the Mithi. Other senior members of the committee present at this meeting included the Municipal Commissioner of Mumbai, Principal Secretary (Urban Development), Principal Secretary (Housing & Special Assistance), and the Metropolitan Commissioner, who heads MMRDA. The following extract from the minutes demonstrates that the problem with the government is not its ignorance about the nature of the problem and the solutions thereto, but the total lack of political will to implement the solutions:

"The Chairman observed that after desilting the river a lot of debris or waste material was being dumped directly on the banks of Mithi River and Vakola Nala that led to heavy sedimentation and shallowing of the basin. Hence, one or two attempts of desilting at this stage might not serve the purpose. He said encroachers reclaimed part of the river progressively resulting in further reduction of available section of the river. It was, therefore, necessary to take long term measure to discourage the encroachments and unauthorised industries along the banks instead of going for temporary measures."

The Mithi River Water Pollution and Recommendations for its Control –

Klean Environment Consultants, Submitted to Maharashtra Pollution Control Board in July, 2004

Key Observations:

- Organic waste, sludge and garbage dumping have reduced the carrying capacity of the Mithi River. The water with a mixture of sewage and industrial waste is a threat to marine life and the river is showing signs of total loss of such support system. Preliminary survey indicates that the pollution levels have reached an alarming stage.
- High Biological Oxygen Demand (B.O.D.) values all along the river indicate presence of sewage as well as decomposed organic matter in the form of garbage, animal wastes etc.
- Values for Chemical Oxygen Demand (C.O.D.), an indicator of industrial pollution, exceeded tolerance figures at several sites along the river course.
- Oil and grease levels were very high at most of the locations starting from Powai Lake to Mahim Bay.
- Direct discharge of sewage from residential colonies around Powai and Vihar lakes has resulted in the river being polluted right from its source.
- Tests indicate that the river bed is full of organic sludge due to domestic sewage and decomposed garbage.

Key Recommendations:

- Provide sewerage system on both the banks of the river so that the sewage is collected and treated at various locations all along the river.
- Immediately stop all the unauthorised industries which include scrap dealers, scrap recyclers, waste oil recyclers etc.
- Provide a proper garbage collection system on both banks of the river so that garbage is not dumped in the river.
- The analysis indicated that the river water after treatment can be reused in industry or for gardening. Both the banks of the Mtih can be planted with proper vegetation for beautification. In fact, this will work as a natural ecosystem to improve the quality of water and save cost of providing expensive treatment plants.
- Dredging the entire river is suggested as a long-term measure.

Figure 6.1- Illustration of a flood as seen in the streets of Bombay. Source: *Illustrated London News*, 1868

COST OF NOT HEEDING THE WARNING

- Total Rainfall in 24 Hours: 944mm
- Human Deaths: 914
- Cattle Deaths: about 20,000
- Houses damdaged: 250,000
- Small Vehicles damaged: 20,000
- BEST Buses damaged: 2,500
- Trains damaged: 25%
- Roads Railways and Airport Submerged -Transportation came to a grinding halt
- Millions stranded and many had to wade through neck deep water
- Landslides claimed several lives and electricity supply was cut off
- Estimated loss: Rs. 450,00,00,000

(Chitale 2006)

The Mithi River was in the eye of the storm of the media blame game that ensued. Its inability to drain the adjacent low lying areas was highlighted as one of the main causes of the floods. The term July 26, 2005 is now, in context, always used to refer to the day the Mithi breached its banks and the city of Mumbai came to a standstill. The river in 2005 had been reduced to a sewer and in places its flow was negligible. We know today, that even if the Mithi had been in better health that day, the amount of rainfall would still have been too much for it to contain, given the simultaneous occurrence of high tides on that day. However, a cleaner and healthier Mithi on 26 July, 2005 would have undoubtedly drained the flood waters faster and more effectively giving Mumbai precious extra time to manage the situation more appropriately and minimize damage to life and property. What if the river and the creek had been completely reclaimed and encroached upon by then? Imagine the devastation that Mumbai would have suffered particularly on 16% of its total area that forms the catchment of the Mithi. There are many different ways to look at the Mithi in the context of Mumbai. This paper prefers to look at it as Mumbai's greatest ally in combating extreme monsoons events like July 26, 2005. Rainfall of this magnitude was a black swan in Mumbai's history. It may not occur again for centuries to come, but its horror will remain etched in Mumbai's memory forever.

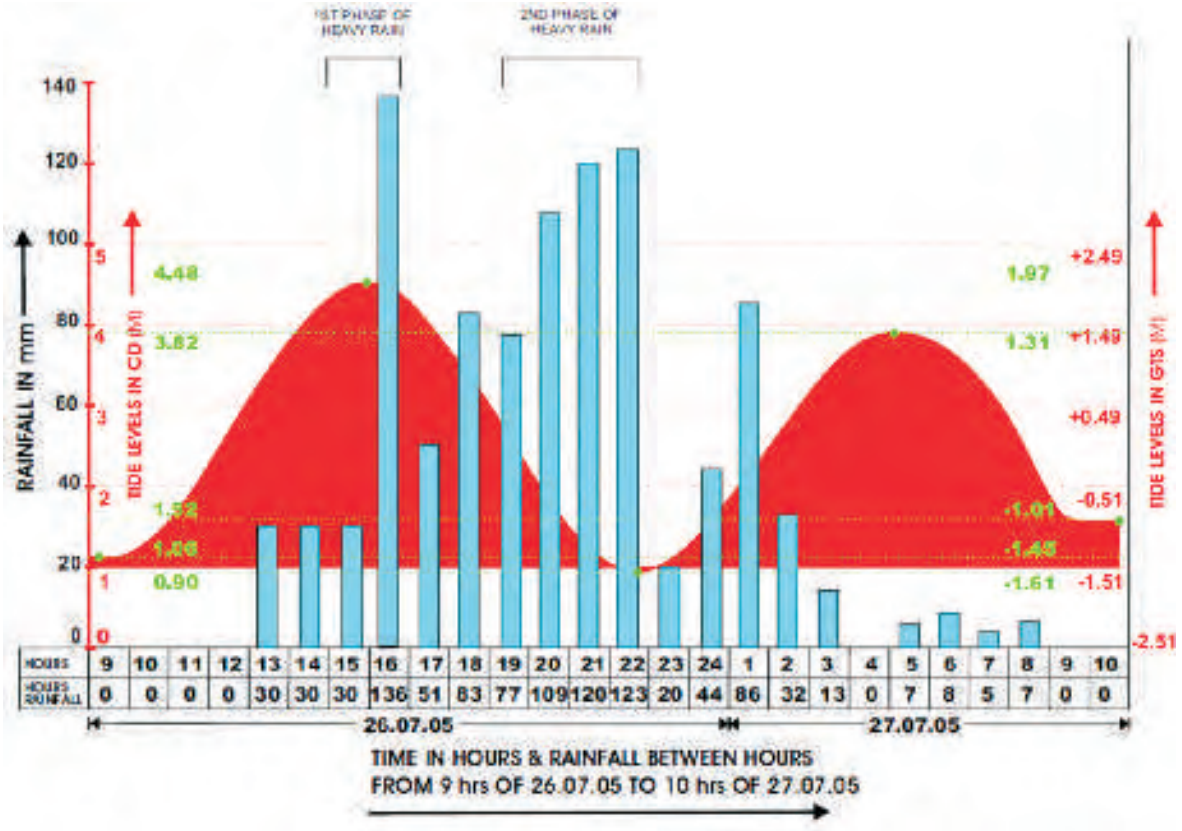


Figure 7.1- Rainfall graph of Vihar on 26-27 July 2005 & Tide positions—Fact Finding Committee on Mumbai Floods, March 2006

Studies after July 2005 – Warnings have again gone unheeded

In response to the deluge of 26th July 2005, the MMRDA sprung into action and commissioned the following studies:

- 1-D Mathematical Model & Desk Studies for Mitigating floods of the Mithi River– by the Central Water and Power Research Station (CWPRS), Pune
- Development of an Action Plan for Environmental Improvement of the Mithi River and along its Banks – by the Centre for Environmental Science and Engineering (CESE), IIT Bombay.
- Baseline Socio-Economic Survey for the entire width of the Mithi River spanning 200m on either side of the river – IIT Bombay.
- Fact Finding Committee (FFC) on Mumbai Floods, headed by Dr. Madhavrao Chitale, an International Expert in Water Resources and Management to conduct an exhaustive analysis of factors responsible for the flooding of July 26, 2005 and to provide solutions for improvement of the same.

" The absence of an institutional system of communication within the community and stakeholders is becoming more and more hurtful to the society. There is an urgent need to connect academic institutions, research and development establishments and other interested groups to the decision makers in the government comprising bureaucrats and politicians."

Dr. Rakesh Kumar

Scientist & Head, Mumbai Zonal Centre, National Environmental Engineering Research Institute (NEERI)

Some of the highlights of the studies are mentioned below.

1-D Mathematical Model & Desk Studies for Mitigating floods of Mithi River in Mumbai – Interim Technical report January 2006 by the CWPRS, Pune

The scope of this study was to examine the tidal hydraulics of Mithi River and the Vakola Nala corresponding to rainfall intensities that occur once every 50 years and every 100 years and identify remedial measures to tackle the excess flood levels. For the estuarine reach of the river, an additional rainfall intensity corresponding to that of July 26, 2005 was added to the study.

Its recommendations included widening of waterway for the entire river and modification of the river bed slope to increase the carrying capacity of the river and the Vakola Nala to accommodate a once-in-a-100-year rainfall event which occurs simultaneously with a spring tide.

Key Recommendations:

a) Widening:

1. BKC Area
    1. Providing a dredged channel, 60m wide and 3m deep in Mahim Bay by removing existing rock outcrops.
    2. Widening the waterway from Mahim Causeway to Dharavi Bridge to 100 m.
    3. Widening from 175m to 200m between Dharavi Bridge and SG Barve Marg Bridge.
    4. Widening of the Vakola Nala from 40 m to 60m.

2. Upstream of BKC Area
    1. Widening reach from SG Barve Marg Bridge to MV Road to 100m.
    2. Widening reach from MV Road to JVLR to 60m.
    3. Widening reach from JVLR to Morarji Nagar to 40m.

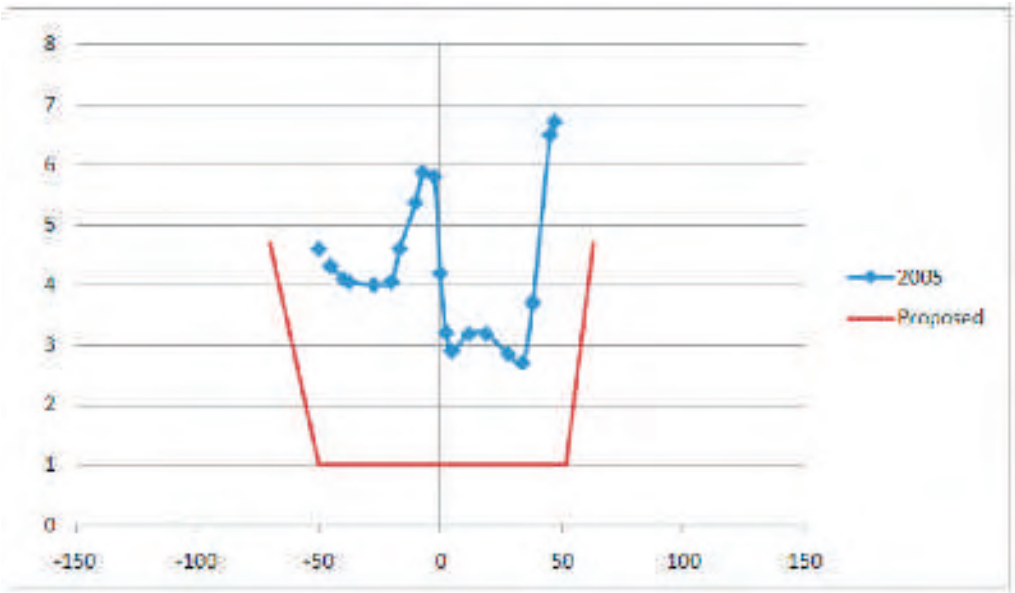


Figure 8.1- Existing cross section and proposed widening of Mithi River at Air India Colony – Derived from CWPRS 1-D Mathematical Model and Desk Studies for Mitigating Floods of Mithi River in Mumbai, 2005

b) Deepening of existing bed levels

1. Mahim Causeway (0.0km) from (+) 0.5m to (-) 1 m.
2. SG Barve Marg bridge (5.88km) from 2.0m to 0.67m.
3. Air India Colony (7.05) from 3.11 m to 1.0 m.
4. Airport (9.38km) from 6.15m to 4.0m.
5. MV Road (10.47km) from 8.12m to 6.35m.
6. Aarey Dairy Foot Over Bridge (12.18km) from 12.75m to 10m.
7. JVLR (14km) from 20.25m to 18m.

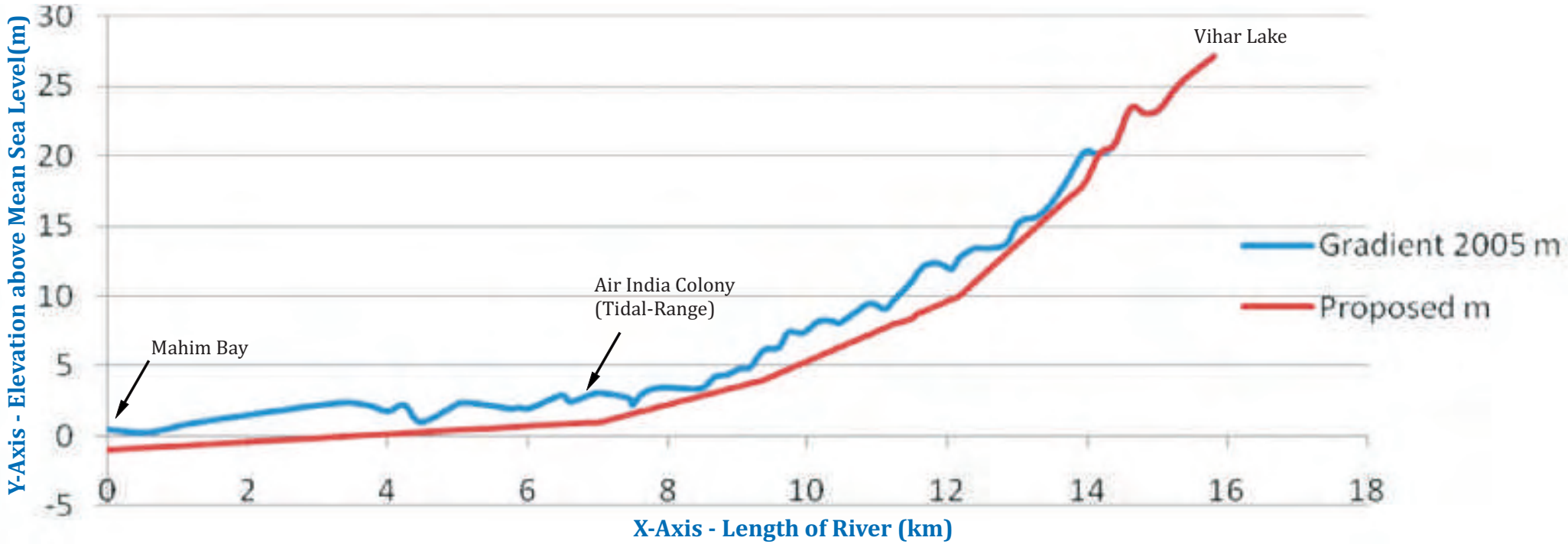


Figure 8.2- Existing (2006) and proposed bed levels along Mithi River derived from data in CWPRS 1-D Mathematical Model and Desk Studies for Mitigating Floods of Mithi River in Mumbai, 2005

For the first 10.5km from Mahim bay to MV Road, a side slope of 1:5 is recommended and for remainder of the upstream section, a side slope of 1:2 is recommended.

The new recommendations are designed to allow the river to carry a discharge as high as 900 cubic metres per second (cumecs), i.e. 90 full water tankers each second. However, in some locations, the height of the river banks was found to be inadequate to safely hold the discharge. The report, therefore, recommended raising the bank levels along certain reaches of the river.

Location	**Distance from Mahim Bay (km)**	**Existing Bank Level (+m)**	**Proposed Bank Level (+m)**
Mini Confluence at BKC	3.50	4.99	6.00
Air India Colony	7.05	4.78	6.78
Air Port	9.38	7.70	10.70
MV Road	10.48	8.87	10.85
JVLR	13.95	21.05	22.50

C) Additional recommendations for reducing flood levels:

1. Moderating the river course by replacing existing sharp bends by longer bends.
2. Removal of temporary bridges with small waterways across the Mithi River and Vakola Nala.
3. Providing non-return valves for cross drains.
4. Providing regular maintenance of cross sections of river by dredging and provision of service road of sufficient width on either side of the river.
5. Providing smooth transition for waterways near bridges.

D) The report suggested that as the carrying capacity of the river would be sufficiently enhanced, there was no need for provision of additional holding ponds in this region.

Development of an Action Plan for Environmental Improvement of the Mithi River and its Banks – Final Interim Report (February 2006) by the Centre for Environmental Science and Engineering (CESE), IIT Bombay

The objective was to study of various aspects of the river, its environment and its banks up to 200m on either side and provide recommendations for its improvement. The study also aimed to determine the pollution loads entering the river along with an assessment of water quality. Forty-three polluting point sources were identified and marked along the river.

Key Observations:

- The entire stretch of the river is very polluted and contaminated by heavy metals. The concentrations of mercury and chromium were found to be 20 times the permissible limit.
- Acid from repair of car batteries was directly disposed in the river.
- Raw sewage from slums in adjacent 50m, and in places up to 100m, was directly discharged into the river. These areas were found to be without access to the municipal sewerage network.
- Among other findings, several lakes and ponds had disappeared since 1923, including a large lake at Juhu. The river had no flow in some regions as recently as 2005.

Key Recommendations:

- Creation of a buffer zone of 20m to 50m on either side free of any construction (short term).
- Restoration of the hydrological continuity between east and west i.e. Mithi River, Mahul Creek and Reti Bunder by providing structures for adequate passage of water.
- Removal of hutments on either side of the Mithi River and Vakola Nala in phases of 15m and 30m.
- Industries within first 15m to be removed and those within next 30m to be permitted with zero discharge or after adequate treatment.

The IIT Bombay report envisioned a beautiful precinct for the entire river where one could walk from the origin near Vihar Lake to the confluence at Mahim on an uninterrupted promenade. It also proposed the development of a marine park that included the mangroves in the estuarine region. Other parks and open areas were proposed all along the course where Mumbaikars could interact with the river and have access to much-needed open spaces for recreation.

Chitale Committee on Mumbai Floods – March 2006

The observations and recommendations of the Chitale Committee have been, by far, the most comprehensive. These have been summarised below:

- Reclamation of land for the BKC was subject to widening and deepening of the Mithi River as per the recommendations in the CWPRS study of 1978. This was reiterated in the report submitted by the Merani Committee in 1996. These pending works should be undertaken and completed immediately.
- Flood risk zones should be demarcated along the entire course of the river for a 1 in 10 year probability (high risk), a 1 in 25 year probability (medium risk) and a 1 in 100 year probability (requiring insurance cover). The zones should be illustrated in the development plan sheets for the city. The citizens need to be made aware of the risk posed by the river so that they have the option of adequate disaster preparedness.
- Immediately provide minimum buffer strips of 15m on both sides of the Mithi channel for access, for maintenance and for management. A 12m carriageway on either side of the prohibitive zone may be able to accommodate 1 in 25 year probability flood. 1 in 100 year probability may be applied only to the tidal creek portion (estuarine length), which is also subjected to reclamation activities. The report suggests immediate evacuation of 1:10 year rainfall probability flood zone on both banks of the rivers and regulation of 1:25 year rainfall probability flood zone on both banks of the rivers on priority basis.
- Restore the existing degraded rivers and river-banks to initiate recovery of the urban ecosystem. The first step should be to reinstate each river, nala, and lake or pond in its rightful place into the respective development plan sheets at once, followed by restoration of river channel and riverbank.
- Restoration will have to begin with identifying polluters and encroachers and removing them immediately. Identify risk zones along the river course and providing access ramps to facilitate desilting.
- The implementation of the proposed plan for restoration may be undertaken by encouraging adoption of portions/stretches of the rivers and coast by NGOs and citizens' groups on the lines of Advance Locality Management (ALM) groups.

- After adequate study, an additional 2,700 million litres water may be sourced from Powai and Vihar lakes and used to flush the Mithi River and rejuvenate river channels in the dry season (October to May). A flowing river channel is an environmental asset for the city. Flushing of the river channel will help in minimizing anaerobic spots in the river.
- Rejuvenate degraded urban ecosystems including lakes/ ponds, rivers, creeks, and costal zones. Given the amount of land that is being developed, it is essential to replant urban parks and even backyards, with native species. Use the renaturalized areas to provide an opportunity for children to learn about the natural heritage of our area.
- Restore the mangrove-ecosystem and rejuvenate the coastal zones.
- Improve Municipal Solid Waste management.
- Upgrade the sewage treatment plants, sewerage networks and storm water drains. The events of July 26, 2005 have clearly demonstrated shortcomings in Mumbai's sewerage network's ability to isolate sewage and prevent it from mixing with surface runoff. Separation of sewage and storm water, and their appropriate safe disposal is absolutely necessary.
- Recommendation for Airport Authority's actions:
  - The waterway below the taxi bay will be effective and useful only when the existing 27m wide waterway (culvert) below the runway is also widened at least to 40m. The original proposal of the consultants for the airport was for a total width of 60m.
  - Proper accesses to the section below the runway will have to be provided for the purpose of silt removal. Design of the taxiway bridge and the runway bridge will have to make suitable provisions for the same.

- Construct detention basins and infiltration zones for flood control and provide spaces for people to escape in case of disasters and calamities.
- Remove encroachments and strictly adhere to the Development Plan. Coastal areas, salt pan lands, mill lands, and all vacant lands due to relocation of industries need to be reserved for public use in the new DP – especially for gardens, wetlands, detention basins, public parks, play grounds, recreation areas, and vegetation. It is important that all the encroachments of buildings and slums from the floodplains and risk zones of the Mithi are removed on a priority basis. The prevailing legal framework of environmental laws in India must be effectively used to address the encroachments in flood plains and Coastal Regulatory Zones (CRZ).
- Adoption of "polluter pays principle" should be integrated into the planning and decision making process because it promotes internalisation of the environmental costs.
- It is necessary that the aquatic ecosystem rejuvenation program addresses the issue of “accumulated contaminated sediments” in the ecosystem and systematically dredges them out so that a newer healthy ecosystem can be instituted.

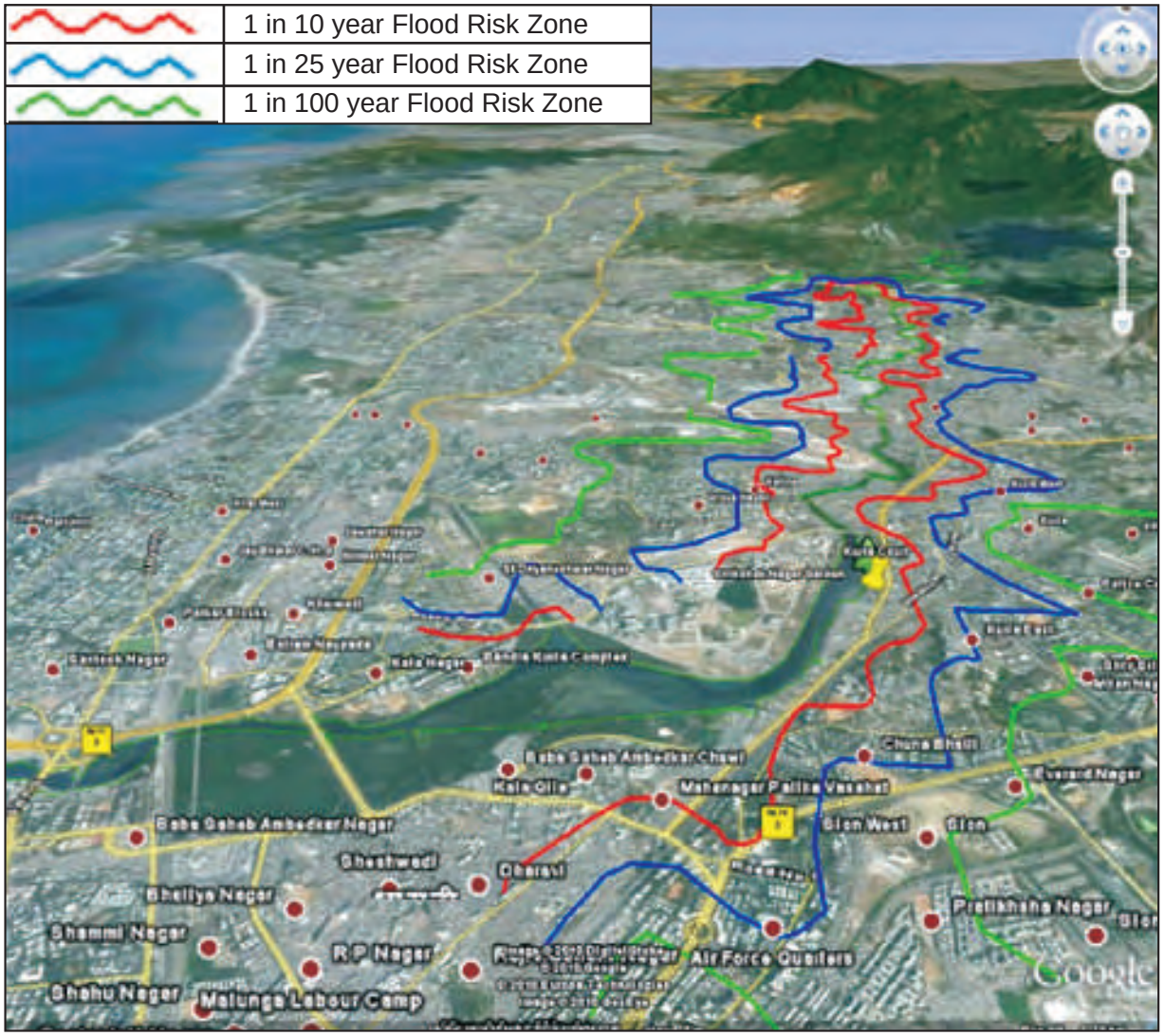


Figure 8.3- A representative sketch showing the perceived flood plains for frequencies of 1 in 10, 25 and 100 years rainfall intensities derived from the report of Fact Finding Committee on Mumbai Flood. Graphic courtesy: *ORF Mumbai*

The Chitale Committee also recommended the following comprehensive studies to be conducted:

- Study of the Mithi River ecosystem in the context of flood proofing measures.
- Study of the environmental impacts of Mumbai Urban Infrastructure Project (MUIP) or Mumbai Urban Transport Project (MUTP) reclamation and building projects in Mumbai including all the developmental projects undertaken by MMRDA and MCGM.
- Role of lakes and ponds in Mumbai in the context of beautification and flood protection, provision for detention or silt accumulation in conjunction with the management of the rivers and environmental upgradation of the aquatic ecosystems.

Other Notable Contributions

Many public-spirited individuals have made noteworthy contributions to the cause of the Mithi River. Chief among them is Dr. Kirit Somaiya, a well-known political personality who has consistently campaigned for the protection and restoration of the Mithi since 2003 — that is, even before the deluge of 2005. Mention should also be made of other dedicated environmental activists: Magsaysay Award winner Rajendra Singh, Janak Daftari, Jagdish Gandhi and Girish Raut. Their combined efforts resulted in the organization of a Mithi Yatra and formation of the Mithi Nadi Sansad, a multi-stakeholder platform aimed at protecting the river and connecting the people along its banks. Dilip Dacunha and Anuradha Mathur, both architect planners and faculty members at the University of Pennsylvania, worked on a project titled SOAK, which highlighted the need to revitalize the entire river-sea ecosystem in the Mumbai.

Based on the recommendations of the government-funded studies after July 26, 2005 and some of the recommendations of the BRIMSTOWAD report of 1993, the Mithi River Redevelopment plan was drafted. The Mithi River Development and Protection Agency (MRDPA), a non-statutory body, was created by a government resolution to coordinate activities allotted to various related organisations; MCGM, MMRDA, Collector (Mumbai Suburban District), Maharashtra Pollution Control Board (MPCB), CWPRS, IIT Bombay, Mumbai International Airport Limited (MIAL), Airports Authority of India and National Environmental Engineering Research Institute (NEERI). The MRDPA is completely dependent on the MMRDA for financial and logistical support.

On acceptance of recommendations in the redevelopment plan, the MRDPA agreed to implement the desilting and widening works in two phases before monsoon 2006. Tata Consulting Engineers Ltd. was appointed as Project Management Consultants in May 2006 for this project to design and prepare cost estimates and supervise the works. The works were executed by the MMRDA in the estuarine regions from Mahim Bay to S.G. Barve Marg Bridge (6km) and by MCGM for the remainder of the river up to Vihar Lake (11.84km)

The work to be done included widening, deepening, rock removal, construction of retaining walls and gabion walls along river and *nalas*, and beautification. The works also included relocation and rehabilitation of people affected by the project.

A **River Course (2005-2006)**
B **Actual widening achieved (till 2010)**
C **Shortfall in widening work**

Figure 9.1- Google Earth image showing the extent of widening of Mithi River at S.G. Barve Marg bridge — recommended and achieved. Graphic courtesy: *ORF Mumbai*

Mithi River Development Project Phase I (MMRDA)

Sr.	Description	Target volume to be removed (m^3)	Achievement (m^3)	Remarks
1	Deepening	4,15,293	4,86,155	• **Completed during March-June 2006** • **Total expenditure done – Rs. 25.76 Cr.**
2	Widening	3,04,514	3,22,449	
3	Rock Excavation	21,157	24,660	
	Total	**7,40,964**	**8,33,264**	**100% Target achieved**

Figure 9.2- Mithi River at S.G Barve Marg (before widening)
Photo courtesy: *Dr. Kirit Somaiya*

Mithi River Development Project Phase II (River) (MMRDA)

Sr.	Description	Target volume to be removed (m^3)	Achievement up to 30.11.09 (m^3)	Remarks
1	Deepening	17,26,773	18,46,226	
2	Widening	6,10,340	1,00,923	
3	Rock Excavation	3,14,110	90,000	
4	Construction of Retaining Wall	8km.	1.9km. completed	Remaining 6.1km will be completed by Dec. 2010
	Total	**26,51,223**	**20,37,149**	

Figure 9.3- Mithi River at S.G Barve Marg (after widening)
Photo courtesy: *ORF Mumbai*

Mithi River Development Project Phase III (Vakola Nala) (MMRDA)

Sr.	Description	Target volume to be removed (m^3)	Achievement up to 30.11.09 (m^3)	Remarks
1	Deepening	2,27,964	2,20,433	
2	Widening	1,91,500	1,51,048	
3	Rock Excavation	6,140	0	
4	Construction of Retaining Wall	3.60km.	2.70km. completed	Balance will be completed by Oct.2010
	Total	**4,25,604**	**2,00,347**	

The MMRDA claims to have relocated 5,000 out of 7,000 units required to be shifted for the project by August 2010. This figure includes residential, commercial and industrial units. Relocation is only required for those units which are located on the proposed river course.

As of August 2010, the MMRDA has shown a total expense of Rs. 300 crore while the MCGM's expense stands at Rs. 600 crore. The MIAL had not commenced any work by this time, but their estimated expenses for works in and around the airport are Rs. 150 Crore. Additionally, Rs. 1,300 Crore is sought from the central government for completion of the project. The total project cost estimated by MRDPA is to the tune of Rs. 1,650 crore, excluding the cost of rehabilitating project affected people. Like so many other large infrastructure projects in the city, this cost may also increase with each passing year. Despite the high cost, it is clear that the redevelopment plan is almost exclusively focused on flood mitigation and has completely ignored aesthetic considerations and Mumbai's desperate need for world class waterfront development. While the MMRDA on its part has constructed gabion walls that separate mangroves from the estuary, the MCGM has constructed large retaining walls at the edge of the river without sparing any area for the river banks. The retaining walls have actually canalised the river, giving it the look of a massive storm water drain, rather than a river. Upon closer inspection, it is evident that the plan drafted by the MRDPA has selectively taken those suggestions from the various reports that require the minimum amount of area to be given to the river and to the city, while completely ignoring those suggestions that would have greatly benefited the citizens of Mumbai.

What's more, the plan does not address issues of encroachments on the river banks. Therefore, its successful implementation would not necessitate removal of encroachments from the water's edge. Alarmingly, the plan also does not provide a solution for the multiple sources of pollution including sewage and industrial effluent. The MRDPA has conveniently left this important task to the MCGM to be addressed by their Mumbai Sewerage Disposal Plan (MSDP) which will take at least another seven years to execute.

Even the task of deepening and widening of the river for flood mitigation, has not been carried out satisfactorily as can be seen from the Audit Report (Floods in Maharashtra) for the year ended March 31, 2006, by the Comptroller and Auditor General (CAG) of India which states the following:

"Till 26 June 2006, MMRDA and MCGM had claimed to have excavated about 12.96 lac m^3 of silt / debris / rocks from the river. The excavated material of 7.57 lac m^3 was transported at dumping sites at, Turbhe, Mandale and Dahisar in Thane District by MMRDA at a cost of Rs 5.55 crore as the dumping sites were not provided by MCGM or by Collector, MSD, Bandra. Neither the records of stack measurement taken at dumping sites nor proof of transportation in the form of toll receipts, number of trips, number of trucks engaged, lorry numbers, dates of transportation etc. was on record though MMRDA was required to maintain all these records, as per decision of the Executive Committee. Since there were no records on the basis of which payment were made, the matter requires detailed investigation."

The MCGM budget for 2011-12 states the following: 11.8 km of the Mithi River is under the jurisdiction of the MCGM, that has undertaken development work in phase II which includes the work of widening and work of construction of RCC retaining wall on both sides of the river for river maintenance. In these works, 334000 cu.m. of rock has been excavated up to October 31, 2010. Out of a targeted 20km of retaining wall, 7.6km is completed. The MCGM claims to have completed 85% of the work of deepening as recommended by the CWPRS. For the widening and training works of the Mithi River and associated nalas, and for the construction of retaining walls, a provision of Rs. 71 crores has been proposed in MCGM budget estimates for the year 2011-12. Construction of 4 out of 11 proposed bridges across the Mithi River is underway. All 11 are expected to be complete by May, 2012 at a cost of Rs. 18.26 Crores.

In this information age, the citizens of Mumbai and other stakeholders have no consistent access to information about the Mithi River Redevelopment Plan and the status of its implementation in terms of physical and financial progress. Five years after the plan was drafted and work began, the MRDPA is still to create a website for information dissemination. Furthermore, none of the studies and their findings have been made available in the public domain. Public consultation may not be the modus operandi of the MRDPA but it cannot continue to ignore its responsibility to disseminate information consistently and in a transparent manner to all stakeholders. It is shocking that over four years after it was drafted, the MRDPA is yet to share the complete development plan of the Mithi River with the citizens of Mumbai.

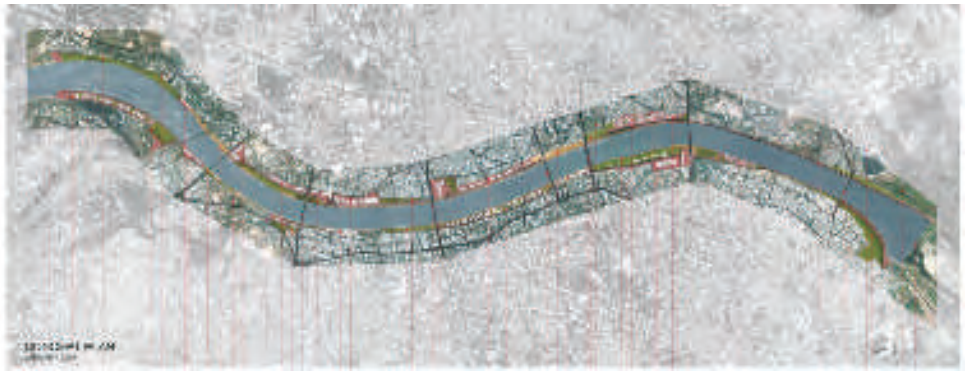
Based on this, one could conclude that the MMRDA and the MCGM, who form the backbone of MRDPA and are the largest implementation agencies, have been myopic in their approach. They clearly lack vision and strong leadership required to seize a golden opportunity to showcase a truly world-class urban renewal project, as presented by the Mithi River. Its plan, which focuses exclusively on flood mitigation, will rob the city of a beautiful river which in time will again be reduced to a drain.

"We are not hapless beings caught in the grip of forces we can do little about, and wholesale damnation of our society only lend a further mystique to organization. Organization has been made by man; it can be changed by man."

-William H. Whyte
American urbanist

Besides flood control measures, the riverfront restoration of the Mithi should aspire to make its corridor a new and proud landmark of Mumbai, an aesthetic haven for its citizens and a major attraction for tourists. To help plan the restoration, there are four relevant best practices – two international and two national – available for study and emulation. The two international success stories, the Cheonggyecheon River in Seoul (South Korea) and the Besòs River in Barcelona (Spain), resemble the Mithi in many ways and provide great inspiration and hope for the renaissance of the Mithi and for Mumbai. Closer to home, in the neighbouring state of Gujarat is the single largest inspiration in the form of the Sabarmati River Redevelopment Project. The Osho Teerth in Pune is an example of a non-government initiative resulting in the restoration of a highly polluted stream.

CHEONGGYECHEON RIVER, SEOUL,SOUTH KOREA



SABARMATI RIVER, AHEMDABAD, GUJARAT, INDIA

BESOS RIVER, BARCELONA, SPAIN

OSHO TEERTH, PUNE,INDIA

Chonggyecheon

Seoul, South Korea

Seoul is one of the world's largest cities with a population of over 10 million people and about 24.5 million in the larger metropolitan area. It is also one of the densest, with over 17,000 people per square kilometre. The 6-km-long Cheonggyecheon Stream in South Korea's capital is the site of a massive urban renewal project involving the river's restoration. The project opened up a congested, overpopulated and polluted neighbourhood, and transformed the riverfront into an enchanting tourist attraction. It is an important stream in the history of Seoul and Korea across several dynasties that ruled the nation. The downturn for the stream started after the Korean War (1950~1953) when millions migrated into Seoul and settled along the banks in slums. Not surprisingly, garbage and sewage were released into the waters and deteriorating conditions resulted in an eyesore in the city. The stream was gradually covered up since 1958. This included an elevated highway built above the stream which had been reduced to a sewer by then. Completed in 1976, the bridge was 5.6km long and 16m wide. This is very similar to the case of the slums that came up along the Mithi River and Mahim Estuary.

In July 2003, a project was initiated by the then Seoul Mayor Lee Myung Bak to demolish the elevated highway and restore the stream. Removing the busy highway was a major obstacle. However, a combination of political will and people's demand ensured that Seoul embarked on a daring movement to re-introduce nature to the city and to promote a more eco-friendly urban design. By the time the restoration started, the stream had lost its flow and gone totally dry as a result of urbanisation and neglect. To overcome this, 12,00,000 cubic meters of water had to be pumped in each day. The restoration also brought back the lost history and culture of this region. It led to the restoration of bridges and created a whole new vibrant precinct at the heart of the city. The project was completed in 2005 at a cost of 900 million USD and has become very popular with locals and tourists alike. The restoration has given Seoul a new landmark. Rather than being criticized for its very high cost, the project is being studied and copied by cities all over the world simply because the citizens love the reclaimed space. While the project has received some criticism for its high costs, the city of Seoul has been applauded for its efforts on sustainable urban regeneration and rehabilitation as epitomized by the restoration of the Cheonggyecheon stream

Figure 10.1- Slums along the Cheonggyecheon were built by Korean refugees in the 1950s

Figure 10.2- Elevated Flyover built over the Cheonggyecheon

Figure 10.3- Elevated flyover demolished to reclaim Cheonggyecheon

The large-scale greening and environmental restoration along Cheonggyecheon has resulted in several benefits. The fish species have increased from 4 to 25, birds from 6 to 36 and insect species from 15 to 192. The removal of the highway has also reduced air pollution and particulate matter significantly. The greening and reduction in refractive concrete surface reduces summer temperatures by up to 5 degrees in the corridor as compared to adjacent localities effectively using the river as a natural air conditioner for this area of Seoul. A 2005 public survey showed that respondents overwhelmingly noticed improvements in air and water quality, noise and smells. Since the end of the project, property prices along the stream have risen at double the rate of the remaining city.

The restored stream corridor is divided from start to end into three zones of History, Urban Culture, and Nature. National and imperial motifs highlight the first zone's emphasis on history. The middle zone has recreation areas, waterfront decks, and stepping stones that bridge the two banks. Its design focuses on using environmentally friendly materials. Other features include fountains and waterfalls. During the summer months, people often cool off by swimming in the shallows. Maps are embedded into the embankment walls at regular intervals, and prominent signage links nearby streets with the stream.

The stream widens as it enters the final zone, which was designed to look overgrown and untamed. The wetlands at their meeting point are designated as an ecological conservation area. The north and south sides are connected at street level by 22 bridges, each reflecting the theme of its respective zone. Some of these bridges were constructed based on designs submitted by citizens. Public participation and green construction were highlights of the project which has marked a shift in the city's approach from car-oriented to human-oriented mobility. Between 65,000 to 90,000 pedestrians visit the stream each day. (Seoul Metropolitan Government, 2008)

The lion's share of credit for restoration of the Cheonggyecheon goes to Lee Myung-Bak, the erstwhile mayor of Seoul city, who went on to become president of South Korea and still holds that office today. It was his brand of leadership that made possible the most ostensible projects that include the restoration of Cheonggyecheon, the creation of Seoul Forest, the opening of Seoul Forest Park, the construction of a grassy field in front of Seoul City Hall, and the addition of rapid transit buses to the city's transportation system. It is been a very long time since Mumbai has had such a leader.

Figure 10.4- Cheonggyecheon River transformation - a spectacular sight by night.

Figure 10.5- Citizens and tourists enjoy a walk by the Cheonggyecheon River

Besos River

Bacelona, Spain

The Besos restoration project in Spain gives us an opportunity to evaluate how landscape and restoration ideas are implemented given social, political and financial constraints.

The Besos River borders the northern periphery of Barcelona. Its runs through the Barcelona Metropolitan Region, one of the wealthiest regions in Spain, both in terms of per capita income as well as its citizens' access to basic infrastructure, services and technology. Its immediate surroundings, however, housed mostly low or middle income migrant workers. The river is not perennial and it empties into the Mediterranean Sea.

During the 1950's the Besos still had enough water to sustain aquatic life, fishing and recreational activities such as swimming. But extraction of water for industrial and urban uses severely diminished the quantity and quality of river water. City officials did not invest in the lower Besos until 1962 when a flash flood caused severe material damage and loss of life. This led to a standard engineered response to the flooding threat. A large floodplain of 300m was barricaded off by concrete walls on either side of the riverbed to avoid additional flooding. The massive cement walls gave a sense of security. Development along the river, including large infrastructure projects, mushroomed. However, the quality of the water and the health of the river continued to be ignored. Contamination was severe due to industrial sources, treated and untreated wastewater effluent and urban storm water runoff. By 1980, the Besos had the dubious honour of being the most contaminated river in Europe.

Since the mid-1990s, recovery and restoration of the river began in earnest to shed the reputation of being polluted and to move towards a cleaner future. The agency Barcelona Regional managed the restoration project. The agency has a unique legal and operational structure which merits comment. Barcelona Regional calls itself a Metropolitan Urban Development and Infrastructure Agency. It is formed by an alliance of public agencies that include the City of Barcelona. This is akin to the MMRDA in Mumbai, a crucial difference being the high level of inter-agency coordination in Barcelona, which is completely missing in Mumbai.

The Besos River Consortium was formed to spearhead the restoration efforts. Rather than looking at the project as a one-time fix, the restoration was considered to be a central predecessor, perhaps even a pre-condition, for motivating other redevelopments in this formerly dilapidated area (This is so very different from the way the authorities in Mumbai are currently planning flood-control measures in the Mithi, as a standalone initiative with very little focus on the entire riverfront redevelopment).

Figure 10.6- Cycle paths along the Besos River

Figure 10.7- Entry and exit ramps on the Besos River Park.

Moving beyond the old concrete walls, the river got recognized as a critical biological corridor for the metropolitan area, vital to sustain migratory birds and local fauna. Restoration was done largely on the last 9 km of the river where it was found to be most polluted and had maximum urban interaction.

The first phase consisting of 6km was undertaken in 1996 at a cost of 20 million USD and completed in 2000 (Honey-Rosés, 2007). During this phase, a constructed wetland was built to improve the quality of water via tertiary treatment. This resulted in an 85% reduction in BOD and significant reductions in phosphates, nitrates, ammonia and faecal coliform. This phase also developed the famous Besos River Park that attracts millions of people. It opened to the public on April 1, 1999 and was the result of a strong public demand for more open space. The Besos River Park consists of green space and a bicycle path on both banks of the river. Access ramps have been constructed on both sides to reach down into the new floodplain park. The bicycle path hugs the tall cement walls and the space between the bicycle paths to the river has been filled with grass. The new park has greatly transformed the northern segment of Barcelona and neighbouring towns.

The second phase restored and beautified the remaining 3km up to the Mediterranean Sea and was completed at a cost of 53 million USD (Honey-Rosés, 2007). The major expense was incurred in removal and relocation of high tension power lines along the river. This large-scale urban change project was successfully completed in 2004. This is what the book The Besos Planning Reform (published by Ajuntament de Barcelona in 2007) says about it: “One of the greatest achievements in Barcelona in recent years is the restoration as a public space of the lower River Besos, formerly an area of pollution and foreboding. The redevelopment has transformed this area into a park of pleasure, with clean water and an artificial reef at the river mouth. Where once were noxious gases emanating from the incinerator, frolicking Catalans now sing of their civic pride.”

Figure 10.8- Besos river with no development zone on either side

Figure 10.9- Another Pride of Spain: The iconic Guggenheim Museum on the redeveloped waterfront along Nervion River in Bilbao

Sabarmati Riverfront Development Project and Kankaria Lakefront Development

Ahmedabad

When will Maharashtra Learn from Gujarat?

The Sabarmati Ashram is a well-known national monument due to its association with Mahatma Gandhi and India's Freedom Movement. It was from this Ashram, on the banks of the Sabarmati River in Ahmedabad, Gujarat, that Gandhiji undertook the historic Dandi March in 1930, walking 241kms along with 78 companions in protest of the British Salt Law. This mass awakening filled the British jails with 60,000 freedom fighters and provided unstoppable momentum to the freedom struggle.

Today, 80 years later, a great movement is once again churning along the banks of the Sabarmati River.

The Sabarmati Riverfront Development Project is an ambitious initiative by the Ahmedabad Municipal Corporation (AMC), with the full backing of the Government of Gujarat, to develop a world-class riverfront. Gujarat's dynamic Chief Minister, Narendra Modi, has taken personal interest in the project. As such, it is expected to be implemented expeditiously and become a model for the entire nation.

Figure 10.10- Planned perspective view of the Sabarmati Riverfront Development Project. Graphic courtesy: *Sabarmati Riverfront Development Corporation Limited (AMC)*

The project's primary objective is three-fold: environmental improvement, urban beautification and provision of housing for the poor who currently live in life-threatening conditions along the river. It has been planned as a self-financing project. Covering 20km of the river's course, the project is currently underway at a cost of Rs. 1,200 crore. The critical process of obtaining over 200 hectares of land for the development through clearance and reclamation has been substantially completed. AMC plans to sell 21% of the land for residential and commercial purposes, and use the rest of the land to set up promenades, informal markets, gardens and to extend the road network. A portion of ten per cent has been reserved for the rehabilitation of all the slum-dwellers who will be displaced by the project. The project assures slum-dwellers secure tenure to good houses, access to roads, infrastructure services such as schooling and healthcare, and a 23km proximity to their present location to safeguard their livelihood sources. As many as 4,000 brand new houses are being built for slum rehabilitation. The relocation of riverbank slum dwellers is being monitored by the High Court of Gujarat.

The proposal boasts of a walkway and a road along the river, an amusement park, golf course, water-sports, and marinas. All these are certain to boost tourism and recreational activities in a big way.

Currently, surplus water in the Narmada main canal is diverted to ensure that the Sabarmati River flows perennially. However, the AMC also has plans in place to maintain the river's perennial status by releasing 140 million litres of water each day into the river from the Dharoi dam between October and June, should the supply from the Narmada canal be unavailable in the future.

Figure 10.11- Planned perspective view of the Sabarmati Riverfront Development Project
Graphic courtesy: *Sabarmati Riverfront Development Corporation Limited (AMC)*

Figure 10.12- Planned perspective view of the Sabarmati Riverfront Development Project
Graphic courtesy: *Sabarmati Riverfront Development Corporation Limited (AMC)*

The riverfront development also includes major interceptor sewer lines on both banks of the river, capturing more than 38 sewage discharge points and routing sewage to newly-commissioned treatment plants. Both banks of the river have diaphragm walls built into the riverbed at a depth of more than 10m, and retaining walls which protect low-lying areas from periodic flooding. The project thus has ensured protection from flooding during very heavy rainfall without compromising aesthetic values.

A key feature of this project is a two-level, continuous promenade on both sides of the river. The lower promenade has an average width of 10.3m. It is built just above the water level to serve only pedestrians and cyclists and to provide access to the water. The upper promenade is being built to host a variety of public features: cultural and educational institutions, leisure activities, large public parks and plazas, and a few areas for commercial and retail development.

The Sabarmati Riverfront project sets new standards for public projects in India. The project is designed to maximize the use of reclaimed land for public purposes. The Riverfront will upgrade 18 precincts, revitalizing the heart of Ahmedabad and leading the city's future growth. The Sabarmati Riverfront is re-shaping Ahmedabad's future as a city oriented towards residents' needs and poised for responsible, inclusive, and culturally vibrant growth. As a usable central artery, the river will likely revolutionise the development of Ahmedabad as an urban centre and raise the threshold for city planning in India.

When will Maharashtra learn to be as ambitious as Gujarat in urban renewal?

Figure 10.13- Narendra Modi, Chief Minister of Gujarat

Historic engraving of the Sabarmati River by a Dutch artist

The Sabarmati River, polluted and encroached with slum dwellings

The first phase of the Sabarmati Riverfront Development

Kankaria Lakefront Development

Kankaria Lake in Ahmedabad is a historical icon for the capital of Gujarat. An artificial water body spanning 76 acres, it has 34 equal sides of 190 feet each. A large quantity of pebbles *(Kankario)* was excavated while constructing the lake and so it was named as Kankaria. In the middle of the lake, there is *'Naginawadi'* or a beautiful garden, an island connected to the bank of the lake with a bridge. The lake is surrounded by important public places and recreational facilities. The perimeter of the lake is used for walking, jogging, yoga and informal gatherings by local residents as well as a food plaza serving up authentic *Amdavadi* street food.

However, the joy of this once proud urban precinct had all but vanished a few years ago. The lakefront was riddled with constantly disturbing traffic and the precinct had become dangerous for pedestrians. It had become isolated from its surroundings and a lot of land around it was grossly underutilized. Hawking and illegal parking on footpaths had gone out of control.

Then, in 2008, the Kankaria Lakefront Development project was taken up by the Ahmedabad Municipal Corporation with a vision to create an aesthetic and world-class public space that acts as an anchor point for the city and is suitable to Indian culture and lifestyle. The makeover of Kankaria Lake has given it a beautiful, vintage, narrow-gauge train called the Atal Express, named after former Prime Minister Atal Bihari Vajpayee. In addition, it boasts of India's first helium balloon ride, a kids' city and a zoo.

As in the case of the Sabarmati riverfront redevelopment, this project also could be implemented only because of the political will and vision shown by the Gujarat Chief Minister, Narendra Modi. Kankaria Lake has set the benchmark as the best developed lakefront in the country.

Figure 10.14- Ariel photograph of Kankaria Lakefront after redevelopment. Photo courtesy: *Dr. Manek Patel*

Osho Teerth

Pune

Developed by the Shunyo Foundation and maintained by OSHO International Foundation in the Koregaon Park area of Pune city in 1994, Osho Teerth is a beautiful garden crafted out of 5 hectares of wasteland that earlier surrounded a sewage filled *nala*. The other name for it, 'Nala Park', pithily captures common citizens' appreciation of the transformation of a gutter into an elegant Japanese Zen garden. Spread over five hectares of land with indigenous flora, eye-pleasing greenery and magnificent waterfalls, the park is designed around the restored stream. Cobbled pathways usher visitors through beautiful landscapes of rock gardens with decorative wooden bridges and statues of Buddha. It has become a place where nature has reclaimed her rightful place and provided the citizens of Pune with a much-needed quality open space.

Osho Teerth is not only a beautiful park but also an ecological statement made by the devotees of a spiritual master, who inspired them to reverse-engineer the degradation of nature into a model project which has helped re-establish the balance between a clean, healthy environment and the needs of a modern city. The project addresses issues related to water regeneration and reuse, irrigation, health and social education, land use, reforestation and beautification.

The Nala Bagh, 900m long and 60-70m wide, which lies downstream along a slum of 5,000 persons, is designed to handle peak monsoon flows without damage to the biological community of flora and fauna that naturally feed on stream pollutants along the length of the park. A chain-link fence is installed to screen plastic bags. A system of four ponds in series coupled with a backup expanse of wetland running parallel to the last two ponds is stocked with a wide variety of flora and fauna to feed on the stream's pollutants. Aeration is done through in-pond fountains and tiny waterfalls, which rejoin the stream bed odour-free and relatively clear. A sand filter at this re-entry point allows use of the stream-water for sprinkler irrigation of the beautifully landscaped banks where every inch of ground is covered with greenery.

Figure 10.15- Nala Bagh: Once a dirty and smelly gutter in the middle of the city. Now a proud tourist destination in Pune

Figure 10.16- A quiet urban forest for birds and humans

Figure 10.17-: A statue of Osho in a spiritual garden

The tremendous recreational value of this exquisite stretch of once-filthy *nala* has to be seen to be believed. No effort was spared for bringing in 7,000 truckloads of building-excavation soil, huge rocks for landscaping, connecting village drains to sewer lines and constructing retaining walls to prevent flooding of the slum.

The park is a great example of how different stakeholders can work together to achieve a common goal. The project was implemented through a collaboration between the State Government which owned the land, Pune Municipal Corporation in whose jurisdiction it lies, and the Shunyo Foundation which conceived, funded and executed it.

'Teerth' in Indian culture connotes a sacred water body and a place for pilgrimage. Osho Teerth is thus a unique example of turning a sewage canal into a sacred place for meditation, prayer and spiritual recreation. (Patel, 2002)

Marine Drive Refurbishment

Mumbai

This project is not a case study in riverfront development. Nor is it a greenfield project. We have, however, included it in our report to show how concerned citizens' activism forced the government to take up long-neglected refurbishment of an iconic waterfront in Mumbai, and how a talented city architect restored it to its old glory.

Marine drive has for long been one of the premiere boulevards in India and the pride of Mumbai right from the 1930's when it was built as part of the Backbay reclamation. The Backbay reclamation is one of the few works that was started by the British but competed after independence. Marine Drive is seen as a symbol of a shift from Victorian to International architecture in Mumbai. Indeed, after city of Miami in the USA, Mumbai has the largest collection of Art Deco Buildings, most of which are located on Marine Drive. It also has the distinction of being the largest viewing gallery in the world.

Both the road and the promenade are very wide in comparison to the average Mumbai road and footpath. There is an unbroken seawall extending all the way from Nariman Point in the South to Chowpatty Beach 3km north.

From 1930 to 2006, Marine Drive remained relatively unchanged with respect to its basic design. It was maintained by the MCGM much like all other footpaths in the city. This is rather unfortunate as the quality of footpaths has consistently declined since independence under the MCGM as is evident from old photographs of Bombay. Over the years as sea wall crumbled in places it was patched up till such a time that it gave way again. The footpath was in a far worse condition - uneven and unfit to walk upon in several places. This was also due to the frequent works on the underground water mains, power cables and other utilities that required frequent digging-up of the footpaths. The ensuing patchworks always left the footpaths in a worse condition. Areas under the Princess Street flyover had become dens for anti social activities and a narrow passage behind the bridge was practically unused thereby making it a de facto north-south divide on Marine Drive. So walkers from the north or south end of the promenade would only walk up to the bridge before turning back in fear of being mugged or just to avoid the anti social elements.

The spirit of Marine Drive extends beyond the promenade and sea wall. Indeed, the uninterrupted view of the Arabian Sea and the skyline of Mumbai against the setting sun are an integral part of its experience. Similarly, the picturesque gymkhanas whose grounds touch one another on the east footpath reflect the multicultural environment along this stretch. Chowpatty beach towards the north end of the arc-like boulevard attracts thousands of

Figure 10.18- Marine Drive sea wall in 2005. Photo courtesy: *www.marinedrive.org*

Figure 10.19- Marine Drive sea wall redesigned to a 'seat-wall' in 2007
Graphic courtesy: *www.marinedrive.org*

Mumbaikars and tourists on a daily basis. It is also the site of the famous *Ganesh Visarjan* which takes place around September each year. All these elements were part of the 'Marine Drive' experience but rarely were they all part of the same experience.

In the year 2006, the Marine Drive refurbishment project came alive. Inspired citizens teamed up with the MMRDA and formed a pressure group to monitor the works. The critical task of designing and implementing of the project was entrusted to Ratan J Batliboi Architects. Under the leadership of chief architect, Shri. Ratan Batliboi, the plan took shape. Finalising and getting an approval for each component proved to be a painstaking job due to the tardy process of public consultations and permissions and clearances required from various government agencies including the MCGM, MMRDA, BEST, CWPRS and PWD. Never before had the refurbishment of a footpath in India been monitored so closely by so many people. Even an empowered committee comprising all the top bureaucrats of the government of Maharashtra and representative of the Citizens' Action Group kept a tab on the progress of this project during monthly review meetings and site visits.

While planning the refurbishment, the architect took a holistic approach. All elements of the Marine Drive experience were seamed together to make the overall experience more complete. The footpath presented a difficult problem as the utilities below it would require servicing from time to time which meant it would be dug up repeatedly. Flexi paver concrete blocks were used to finish the footpath surface instead of permanent floor panel to allow servicing of the water main lines or power lines under the footpath. Once work is completed the paver blocks are replaced which give a seamless unpatched look to the pavement.

The sea wall profile was redesigned based on CWPRS and PWD requirements hence the seats faced the street front. Due to the persistent requests of citizens to have seats facing the sea, the architects have provided such seating in areas like the Oasis, and under the flyover. The old seawall was designed as a barrier between land and sea. The architect modified the design and presented the city with an unbroken seating for 3.5 km!

The entire footpath was made free of visual clutter and even the run down bus stops made way for arguably the finest bus shelters in the country. Around theses bus shelters, were well placed oasis where people could sit facing the sea. In fact, every component of the Marine Driver refurbishment project is well planned and well executed. Every part has function and beauty. The entire promenade bears sober tones of grey today. This too was part of the plan. The grey serves as a brand new canvas on which the people of Mumbai add colour. Many used Marine Drive before the refurbishment and many more use it today. What has changed is how people enjoy it.

Figure 10.20- Marine Drive sea wall and footpath in 2005
Photo courtesy: *www.marinedrive.org*

Figure 10.21- Marine Drive sea wall and footpath after refurbishment
Graphic courtesy: *www.marinedrive.org*

Our vision of reclaiming Mithi and its transformation as an iconic new waterfront for Mumbai is considerably influenced by the Project for Public Spaces (PPS), a New York-based non-profit planning, design and educational organisation dedicated to helping people around the world create public spaces that build stronger communities. It has pioneered the concept of Placemaking, which helps citizens transform their public spaces into vital places that enrich local assets, boost urban rejuvenation and serve common needs of the community. PPS believes that creatively redeveloped places give identity to cities. “Without great public places, there would be no great cities.” Moreover, it argues that great public places create an overarching sense of belonging and benefit all kinds of communities, and not any particular privileged group. William H. Whyte, famous urbanist, people-watcher and mentor PPS once said, “It is hard to create a space that will not attract people; what is remarkable is how often this has been accomplished.” How true this statement is for open spaces created by the MCGM and the MMRDA for the citizens of Mumbai over the years. Our public spaces today are unplanned, poorly maintained and our open spaces have been cancerously encroached upon. Between 1966 and 2005 alone, 85% of the open spaces and vacant lands in the Mithi's catchment were lost (J. Kamini, 2006). We dearly wish to see this most undesirable of trends reversed. Our recommendations have a minimal focus on engineering solutions as provided by previous government-funded studies. Engineering solutions for flood control exist, and these can easily follow once a holistic vision is accepted. Rather, our recommendations address socio-economic issues, the health and environment of the river and its banks, public amenities along the proposed corridor, and the multiple ways in which the recreated harmony between land, river and the sea can be experienced by millions of people.

We envision an unbroken Mithi River-Park Corridor that brings together citizens from India's most culturally vibrant city that is also the melting pot of the nation - an endeavour that will hopefully inspire a movement for urban renewal in India. Our canvas is in the heart of Mumbai, India's financial capital and the world's second largest city. It has the potential to positively impact the quality of life of millions of Mumbaikars over a stretch of 18km. Such opportunities for urban renewal of this magnitude in a city as old and populated as Mumbai are very rare indeed. Only once will we have the privilege of shaping the Mithi River and public places around it. Thereafter, these places will shape us for generations to come.

1. Stop point source pollution

The highest priority will have to be accorded to stopping all forms of pollution from affecting the river including sewage, industrial effluent, debris and garbage. Only when all sources of pollution have been checked, will any redevelopment plan centred on the river be practical.

2. River must have banks

Without its banks, the river is a drain. There can be no compromise on this count and all encroachments up to 50 m on either side of the banks must be cleared making it a Zone of Zero Tolerance. The width may be slightly reduced in the upper reaches of the river, but only there and nowhere else. This zone must be crafted with vegetated berms and swales. While this zone will not have much tree cover, it will be covered with grasses and shrubs that will optimize drainage and percolation. Vitiver grass, native to India should be planted all along the river course and especially near the water's edge. It is excellent at erosion control which will help in stabilizing the banks reducing sedimentation. The much polluted banks of the river will greatly benefit from the Vitiver's ability to remove oils, fuels and heavy metals accumulated over the years in the soil by a process known as Phytoremediation. This Zone of Zero Tolerance is meant to be a no development zone which would partially or fully cover a flood plain for a once in 25 years rainfall event and also overlap with the minimum distance from the water level as required by the Coastal Regulatory Zone (CRZ) norms[11] applicable in the estuarine reach of the river. However, certain activities can be permitted, including - agricultural uses such as outdoor plants, nurseries and horticulture and recreational uses such as tennis courts, swimming pools, picnic grounds, wildlife and nature preserves, fishing areas.

Figure 11.2- 50m zone of zero tolerance along the Mithi river — digitally superimposed on satellite image.

Beyond the zone of 50m, a retaining wall may be constructed if the ground levels are lower than the flood risk zone of a 1 in 25 year probability. The walls may also be used as a preventive measure against ingress encroachments and as a sound barrier. Slum settlements removed from the Zero Tolerance Zone along the river should be humanely rehabilitated in the vicinity. The scheme for the redevelopment of Dharavi (which is being considered by the Government of Maharashtra) should be recast to relocate a large section of slum dwellers along the Mithi. Slums that are farther away from Dharavi can be rehabilitated in scientifically designed slum redevelopment schemes in respective neighbourhoods. The principle of in-situ rehabilitation should be replaced by a policy of relocation in properly constructed clusters of buildings in the neighbourhood. These clusters should provide both residential accommodation and spaces for small-scale enterprises that have mushroomed in Mumbai's slums. The success of this endeavour will, of course, depend on our political parties abandoning the myopic policy of vote-bank politics, a deceptively pro-poor practice that condemns slumdwellers permanently to an undignified life in squalor and insecurity.

11. Zone of Zero Tolerance along the Mithi River will closely match the requirements of the coastal regulatory zone (CRZ I & II) applicable to the lower reaches of the river.

Figure 11.3- Artist's impression of Mithi River Park Corridor. Graphic courtesy: *Ms. Supriya Krishnan, JJ School of Architecture, Mumbai*

3. Mithi River-Park Corridor

The 50m zone of zero tolerance would be the foundation of an uninterrupted Mithi River-Park Corridor. It will be an unbroken corridor and multi-use destination starting from the Sanjay Gandhi National Park and extending all the way to the sandy shores of Mahim Bay. In places where mangroves are found touching the banks of the river, the 50m zone must be measured from behind the wooded area and not from the water's edge. Environmental restoration along the corridor is vitally important, however, it must not preclude human use. In places where it is simply not possible to maintain contiguity[12] of the corridor, bridges and skywalks must be installed to facilitate uninterrupted movement of users. The Mahim Beach and Mahim Fort must be included in this corridor. The beach today is in a pathetic condition due to uncontrolled open defecation and dumping of solid waste. The beach still has 500m of unreclaimed shoreline which must be made squeaky clean and tourist friendly. The corridor must be designed based on a shared community vision that makes public goals the primary objective.

4. Desludge the river

At least a million tons of garbage has been dumped into the river over the past 30 years. Much of this has settled on the river bed and decomposed resulting in a permanent foul odour during low tide. To tackle this issue, the entire river must be desludged to remove putrefying matter thoroughly. Simply desilting the river bed to achieve a required depth for flood management is not sufficient. Further, wherever possible phytoremediation should also be used to revive the river bed.

5. Existing gabion and retention walls and odour removal experiment

The gabion wall at BKC is the foundation of a beautiful, 900m long promenade constructed by the MMRDA. It is feared that the wall will eventually catalyse the destruction of the substantial mangroves behind it. The ability of the wall to reach water to the mangroves behind must be studied. If the wall cannot ensure the survival of the mangroves then it must be removed. From December 2009, the MMRDA experimented with the installation of the DynamOx odour removal device designed to remove foul odour from the waters of the Mithi. However, since the river bed happens to be the main source of the foul odour, the experiment has clearly failed and must be discontinued. The device has been rented by the MMRDA at a cost of Rs 16,00,000 per month. Instead, solutions should aim to tackle all pollution at the source itself.

6. Mangrove protection and revival

Over the years, the mangrove vegetation has been reduced drastically. These mangroves are very important from an ecological perspective and represent the last remaining green lung for some of the most populated and polluted parts of the city. A study dedicated to the protection and revival of the mangrove forest along the Mithi River must be undertaken before it is too late. A unique Marine Park should be created along the corridor and connected to the Mahim Nature Park, which, ironically, has been fenced off from the mangroves and the estuary even though it is situated in their lap. The Marine Park will thus become an extension of the Mahim Nature Park, thereby enhancing the latter's charm and tourism potential (which, at present, is very low.) Besides creating awareness among the people about mangroves, the Marine Park should actively reintroduce mangroves in open areas where they previously existed. The park should cover all the mangroves in the Mahim Estuary that have been systematically eroded from the inside out. This is perhaps the most beautiful part of the entire Mithi ecology and must be made accessible to the citizens and tourists.

12. The contiguity of the corridor may have to be broken on one bank of the river in places where it flows very close to the airport and other vital installations including defense facilities

7. A river everyday

Any river that is clean and flows perennially, is an asset to the city. The Mithi flows during the monsoon and perhaps for a month or two after that. For the rest of the year it would run dry assuming that unlawful sewage and effluent disposal is arrested. It is highly desirable to keep the river flowing throughout the year. For this, water from Powai and Vihar Lakes could be used for flushing the river after increasing the reservoir capacities. In addition, a small volume of treated sewage and effluent could also be released into the river to augment the supply during the dry months. The released waters should be treated on site in decentralized treatment plants and further passed through constructed wetlands for tertiary treatment and phytoremediation - a process of decontaminating soil by using plants to absorb heavy metals or other pollutants.. This should be used as an optional water source and all generators of liquid wastes must be compulsorily connected to the city's sewerage network.

8. Parks and Open spaces

While the entire corridor is intended to serve as a continuous park, efforts should be made to connect and integrate neighbouring ponds, parks and playgrounds increasing the productivity and usefulness of the corridor. Once again all facilities should be disabled-friendly. These will be welcomed by citizens who are choked for clean and usable open spaces particularly in this part of the city. The BKC, a prime business destination, would also benefit from increased access to open areas where people can come to take a quick break. Parks and recreation areas should be designed to blend into the surrounding environment. The theme should subtly evolve to mirror the experience of lush green hilly region upstream, and bring in more urban elements midstream, in the region of urban interaction. The estuarine region with the Marine Park should employ elements that capture the confluence and the merging of the river into the Arabian Sea. Amphitheatres should be designed to encourage public performances by local and visiting artists.

9. Dedicated pedestrian and cycle paths in line with the National Urban Transport Policy (NUTP)

It may come as a surprise to many that over 50% of Mumbaikars' trips are made entirely on foot[13] and yet such little attention is paid to their needs (MMRDA). This apathy has also resulted in alarming reduction in the number of cycle trips as noted by the NUTP which cites increased risk of accidents as one of the major reasons. The policy which is aimed at promoting sustainable transport systems in urban centres states the following as part of its objective:

a. Encouraging integrated land use and transport planning in all cities so that travel distances are minimized and access to livelihoods, education, and other social needs, especially for the marginal segments of the urban population is improved
b. Bringing about a more equitable allocation of road space with people, rather than vehicles, as its main focus
c. Encourage greater use of public transport and non-motorized modes by offering central financial assistance for this purpose
d. Enabling the establishment of quality focused multi-modal public transport systems that are well integrated, providing seamless travel across modes
e. The NUTP's section dedicated to 'Priority to non-motorized Transport', which supports the Mithi River-Park Corridor, states:
    i. "The Central Government would give priority to the construction of cycle tracks and pedestrian paths in all cities, under the National Urban Renewal Mission (NURM), to enhance safety and thereby enhance use of non-motorized modes. Cities would also be encouraged to explore the possibility of a Public bicycle program, where people can rent a bicycle for use in specially designated areas."
f. ORF envisions dedicated walking paths on both banks of the Mithi and dedicated cycling paths on one or both banks. These should have convenient ramps for bicycles and pedestrians alike to enter and exit the corridor from the city roads. Ample provision for safe parking and renting of bicycles should be made at key locations along the length of the corridor. Once ready, this corridor should become an integral part of the annual Mumbai Marathon, a highly popular event which is a great opportunity to showcase the river to the world.

13. A total of about 2 Crore people in MMR make about 2.85 Crore journeys (trips) every day, counting going-to and coming-back separately. More than half of these journeys, about 1.5 Crore, are made entirely on-foot making walking the most important mode of transport in Mumbai. Source: MMRDA - Comprehensive Transport Study for MMR.

10. Seamlessy connect destinations

The Mumbai airport has its domestic and international terminals, and its cargo complex along the Mithi River. There are five major railway stations along the Mithi River including Mahim and Bandra on the western line and Sion, Chunnabhatti and Kurla on the central line. The upcoming Versova-Andheri-Ghatkopar corridor of the Mumbai Metro project that also crosses over the Mithi River has two stations planned along the Mithi River at Marol and Saki Naka. There are also several bus stops located close to the river all along its banks which need to be integrated into the system. Taking the agenda of the National Urban Transport Policy (NUTP) a step further, the ORF envisions that all these stations and bus stops be connected to the Mithi River- Park Corridor which will allow for Mumbaikars to use multiple modes of transport in a seamless manner in a stress free environment. This, too, is in line with the NUTP. The Mithi River is also surrounded by business districts, government offices, courts, local market places, educational institutions, places of worship, hospitals, playgrounds, residential and commercial complexes, malls, retail stores, hotels and restaurants. These are places that people use and the corridor must connect all these destinations. Only then can its function be optimized.

11. For the people

The Mithi River Corridor Park will attract several citizens and tourists each day. The central idea of the corridor is a place that embraces people from all walks of life and makes them feel special. Water fountains and public toilets (clean and aesthetically designed) must be made available in adequate numbers. These must necessarily be designed to be child friendly and disabled friendly. Similarly, waste management must be given very high priority during the planning process and adequate space and resources must be provided to encourage source segregation and recycling. Ignoring waste management will lead to uncontrolled littering as is typical of most public spaces in Indian cities. Aesthetically designed lighting, street furniture and rain shelters must also be planned at the outset. Transport linkages and public amenities should be planned keeping in mind that the park will also be heavily used in the late evenings. Local markets around the corridor must also be made accessible to users creating a unique shopping environment which is both safe and enjoyable and simultaneously improves the local economy. Safety and security of the users cannot be compromised at any stage. The corridor should be thoroughly patrolled by security guards at all times and be well connected to all police stations in the vicinity.

12. Bridge to beauty

New, aesthetically pleasing bicycle-cum-pedestrian bridges should be constructed across the river at key locations. A good example to emulate for constructing such bridges is the world famous White Bridge across the Nervion River in Bilbao in northern Spain. Such audaciously designed bridges become iconic landmarks for the entire city. Currently, connectivity across the river is poor. All existing vehicular bridges are ugly and poorly kept. The river course is forcefully narrowed under these bridges. They need to be rebuilt in order to blend with the larger theme of the Mithi River-Park Corridor. While traffic management will be challenging when old bridges are broken, this must not be used as an excuse for not executing the works.

13. Concert hall on the Mithi

Like the Sydney Opera House on Sydney Harbour, it is an example of how a unique and visually spectacular building can put a city on the world map. Mumbai, unfortunately, has not created any such attraction in recent decades. NCPA at Nariman Point, which had an excellent locational advantage, unfortunately lowered its ambition by becoming architecturally invisible. We believe that the regeneration of the Mithi and its surrounding areas provides Mumbai with yet another opportunity to create a 21st century cultural landmark. Perhaps the ideal location for it would be the nearby BKC, which, unlike great business districts around the world, becomes a 'dead place' after office hours.

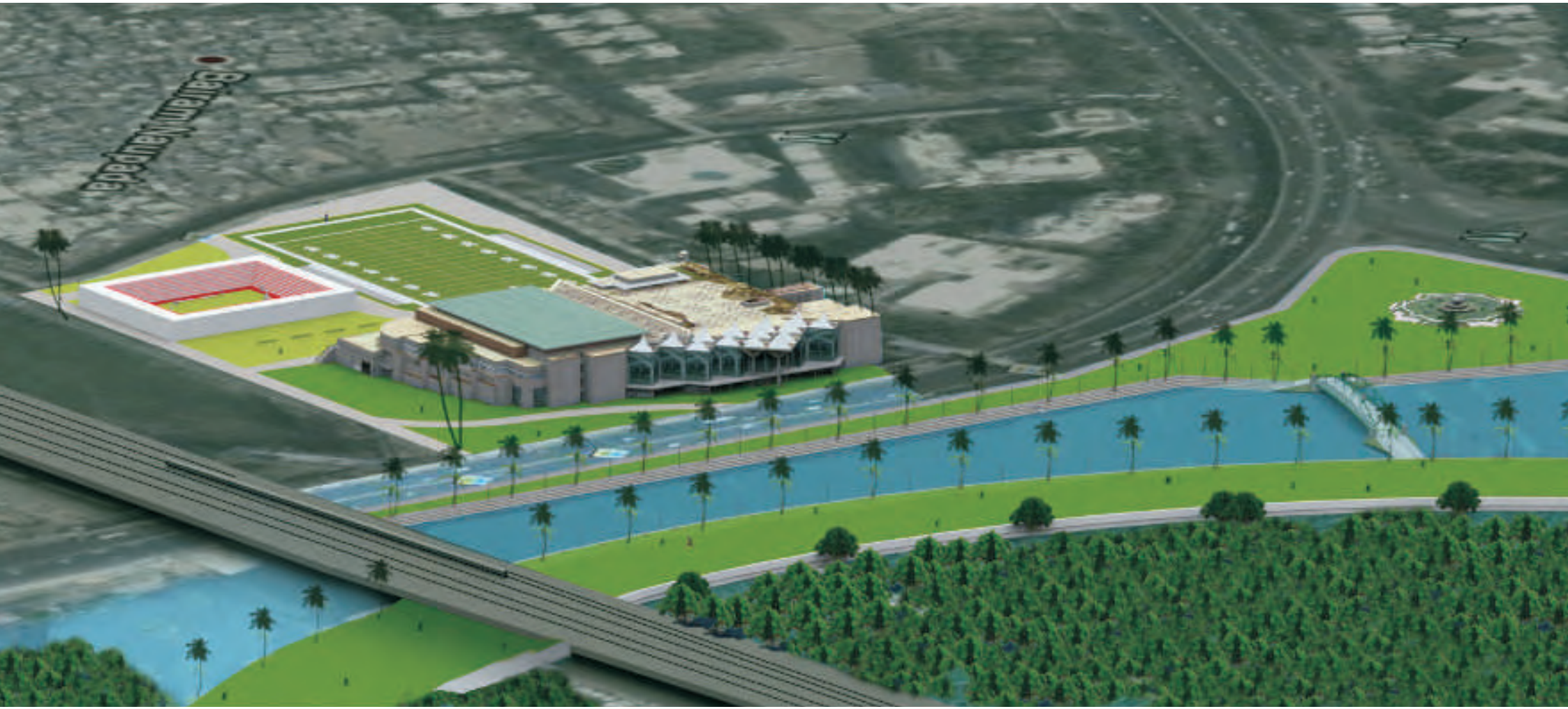


Figure 11.4- Artist's impression of Mithi River Park Corridor. Graphic courtesy: *Mr. Chaitanya Chavan, JJ School of Architecture, Mumbai*

14. World-Class Museum and History Precinct

There is a unique idea that Mumbai can emulate from Bilbao in Spain. The Guggenheim Museum on the bank of Bilbao's River Nervion, the centerpiece of a major urban renewal of a city that had regressed badly due to pollution and death of old industries, has after painstakingly meticulous restoration, become a big attraction for foreign tourists to Spain. The Mahim esturine region has been the site of many battles between the Portuguese, Marathas and the British. The forts of Mahim, Castella de Aguada, Sion and Riwa have witnessed the making of Mumbai's history. These city treasures must be restored and integrated into the Mithi River corridor as a priority. If any city can so easily ignore and forget its past, then its future is bleak. One of the forts could be converted into a Museum dedicated to the history of Mumbai, which has for long been the Gateway to India and the most cosmopolitan and culturally vibrant city in India with a very rich and fascinating history. Unfortunately, this history is not taught to students today and is in danger of being lost. Here Mumbai should learn from the Cheonggyecheon river restoration project in Seoul, South Korea, which, among other things, has been used for making Korean people know a little bit about the glorious chapters in their own national history.

15. Music and Performing Arts

Cultural activities in a theatre setting, though desirable, have a limitation: they usually cater to the rich and the aficionados. Also, they play host to only established artistes. However, since the Mithi Corridor would be attracting thousands of people each evening, it should actively encourage street music (a popular genre in big cities around the world but almost absent in Mumbai) and other open-air performing arts events such as street plays, poetry reading sessions, exhibitions, etc. This would give a big boost to budding and amateur artistes.

16. Sports and Fitness

The National Youth Policy, 2003, reiterates the commitment of the entire nation to the all-round development of the young sons and daughters of India. It seeks to establish an all-India perspective to fulfil their legitimate aspirations so that they are all strong of body, heart, mind, and can successfully accomplish the tasks of personal development and national reconstruction. The policy advocates that every youth of India should clearly understand the 'what', 'why' and 'how' of good health. This sentiment is also echoed in the larger vision of the proposed Mithi River-Park Corridor. The corridor should be designed in a manner that invites fitness-seekers for an enjoyable experience of walking, jogging, yoga, mass exercises and meditation to promote general health, mental health and spiritual health. The corridor must be extended to include the existing sports grounds, stadia and gardens that are located closeby. These should all be part of a larger master plan to promote underdeveloped sports such as tennis, soccer, skating, cycling and martial arts. Velodromes, skating rinks and public swimming pools would be wonderful gifts to the people of Mumbai. The sheer number of potential young users would justify these features and the ultimate reward would come in the form of international acclaim for sportspersons emerging from this corridor. Space should also be reserved for Indian sports such as *Mallakhamb, Kabbadi* and *Kho-Kho* and these should be proactively promoted.

"The sacred realm is a crucial part of our environment, but over the last few decades we have increasingly blanked it out of our consciousness. The price we have paid is incalculable....We must enlarge our perspective so as to take cognizance of not only the public and private issues involved in our decisions but of the sacred ones as well."

- Charles Correa

Mumbai's own globally renowned architect,
In his latest book *'A Place in the Shade: the New Landscape & Other Essays'* published by Penguin (2010)

17. Boat rides

After adequate dredging, the river could be used for non motorized boating. Marinas need to be constructed at suitable locations. Tidal action in the river goes 7km upstream to the Air India Colony, providing sufficient length for enjoyable boat rides and even boating competitions.

18. Signage, street furniture and public service advertising

Prominent and clean signage should be installed all along the corridor in Marathi, Hindi and English. Brail signage should also be installed at every location. The signage should be comprehensive telling users about entry's and exits, location of parks, school, toilets etc. Entrances, exits and pathways should be disabled-friendly. The high usage of this corridor by Mumbaikars must be used to create awareness about the need to preserve our history and environment as well as current civic issues that need attention using effective signage and public service advertising displays. This will help create a feeling of ownership towards the river and the city of Mumbai at large. As this region is prone to intense flooding, there should be adequate provision for warning systems including loud speaker systems. The corridor must provide aesthetically planned places to sit and gathering points at key locations. It should be free from any dysfunctional features that add no value to the experience of the visitors. It should also be totally free of the very ugly posters, banners and hoardings put up shamelessly all over the city by party cronies to flatter their political patrons.

19. Well protected and well managed

The river corridor must not have political affiliations and should not be used for political rallies as is today the case with so many open spaces in the city. It must be fiercely protected at all costs from encroachments, hawkers and antisocial elements and should always remain a treasured and cherished space of the people of Mumbai. The Mithi River Parrk Corridor must embrace all and exclude none.

20. Social upliftment of slum dwellers

In Mumbai, the Mithi River and Vakola Nala interact with the administrative wards of F (North), G (North), H (East) and K (East). These wards have some of the highest percentages of slum population in the city; in the case of the L ward (Kurla), it is 84.86%. These wards also have the highest number of marginal workers, who occupy the lowest rung of the socio-economic ladder. Infant mortality rates here are the highest and literacy rates are the lowest. Communicable and non-communicable diseases are rampant, resulting in a lower average lifespan than in the rest of Mumbai. The L ward, which is the face of life around the Mithi, is ranked 23rd out of 24 wards in Mumbai with respect to the quality of life. Four of the six worst wards in Mumbai with respect to quality of life are located along the Mithi River. (MGCM, 2010)

All these facts can be directly traced to the unspeakable environmental degradation that characterises slums in the Mithi's neighbourhood. Slum tenements here are so densely built that not even a bicycle - much less an ambulance or a fire engine - can pass through them in an emergency. Water management is improper. There is no semblance of an efficient sewage and solid waste disposal system. Theft of both water and power from the distribution network is common. However, since water and power supply are controlled by the slum lords, slum dwellers often end up paying more for both electricity and water than regular rates. Community toilet blocks in Mumbai slums lack running water, drainage connectivity, ventilation and electricity. But their condition in the Mithi area is far worse, almost amounting to no sanitation at all. Unhygienic open defecation by a large percentage of slum dwellers, including children who are most vulnerable, is a common sight. Women are the worst victims of the lack of sanitation facilities.

All such ill-effects of illegal encroachments and the resultant "slummification" of Mumbai are well known. However, those who have the responsibility to plan and implement healthy urbanisation namely, elected representatives, are the very people who have so far fiercely resisted any such plans. For them, slum dwellers are not human beings deserving a better life, but mere "vote banks" to be exploited. With their myopic vision, sectarian perspectives and selfish financial interests, almost all political parties in the city have evolved a consensual approach to slum redevelopment which is based on exploitation of the insecurity of slum dwellers on the one hand, and patronage of the *babu*-builder[14] mafia on the other. They simply refuse to evolve, or support, innovative and practicable habitat improvement plans which take into account both the legitimate needs of the poor for decent housing and the imperatives of well-planned, eco-friendly, safe and healthy urbanisation. This explains why elected representatives of almost all political parties have resisted relocation of slums on the banks of the Mithi, even after a government-appointed committee recommended this as a priority flood-control measure after the deluge of July 26, 2005. Although they project their stance as proof of their concern for the poor, in reality they are perpetuating hellish living conditions for millions of the poorest residents of Mumbai.

Therefore, ORF firmly believes that any plan for the restoration of the Mithi would demand a new mindset on the part of the political and governing establishment in Mumbai and Maharashtra. The cornerstone of this new approach is, as we have described in the earlier pages, a humane plan for the relocation and rehabilitation of slumdwellers in the 'Zone of Zero Tolerance' in the Mithi corridor area in good-quality mass housing projects in the vicinity. In other words, slum dwellers must be regarded as one of the most important group of stakeholders of the Mithi restoration project and the plan should be prepared around their needs. Every care should be taken to ensure that the project is not seen as "elitist", but as something that would benefit the poor more than the non-poor. Failing to do so would lead to unrest and people's opposition to the project, which can be quickly exploited by vested interests to stall it forever.

For slums located beyond the 'Zone of Zero Tolerance', the following amenities should be provided:

Sanitation: The shortage in the quantity and quality of public toilets in the slums is unacceptable. Access to toilets should be treated as a fundamental right and its provisioning will lead to multiple social benefits, especially for women who will have an increased sense of security. After all, the vision statement of the National Urban Sanitation Policy reads: "All Indian cities and towns should become totally sanitized, healthy and liveable and ensure and sustain good public health and environmental outcomes for all their citizens with a special focus on hygienic and affordable sanitation facilities for the urban poor and women."

Expand the sewerage network to cover the slums: The sewerage network does not cover a large number of slums along the Mithi. This uncovered region in places extends over 100m from the river. All the unstated liquid waste generated by slum households and small scale industries gets directly released into the river. The sewerage network must be expanded to include these areas. Two sewer lines must run parallel to the river banks and collect discharge from any uncovered area. These lines must also be connected to decentralized sewage treatment plants which have been proposed for augmenting the water supply from the lakes during the dry season, meant for flushing the river and maintaining perennial flow.

Extend the water supply network to provide piped water supply to slum dwellers: The theft of water and electricity is common in Mumbai's slums. Although slum dwellers pay for both, the revenue goes to slum lords. This must be stopped, and water and power should be provided to slum dwellers in an organized manner.

a. Solid Waste Management

Like sanitation, solid waste management is critical to improving the quality of life in slums. Decentralized and segregated waste management should be encouraged along the concepts of the Advanced Locality Management and the slum Community-based Organisations (CBOs), which have become successful in several parts of Mumbai. Slum dwellers will comply with water and waste management laws if the necessary infrastructure is provided to them. Once it is provided, defaulters may be penalized.

14. The word *'babu'* is commonly used to describe a government secretary in India.

b. Re-organize the recycling industry

Massive quantities of waste rejects are currently dumped into the Mithi by the large unorganized recycling industry that thrives along the banks of the river. This must be stopped. These wastes must find their way into the formal waste collection system. Using the "Polluter Pays" principle, generators of these commercial and industrial wastes must be made to pay for their disposal as per the law. While this may be met with resistance initially, in the long run it will be beneficial to all. In addition, government, financial institutions and the organised industrial establishment should help the informal recycling industry become formalised and mainstreamed. Academic institutions like the IITs and research institutes of repute, should help this industry learn from best recycling business practices from around the world. All this should be done in such a way that primary waste collectors (rag-pickers), whose number in Mumbai runs into several lakhs and who are among the poorest and most vulnerable sections of slum dwellers are able to earn more and live better.

c. Education and employable skills development training

There is an urgent need to invest in the future of the slum dwellers by focusing on an innovative human resource development strategy. All the public schools along the course of the Mithi should be upgraded under a PPP plan. One of the components of this plan can be twinning of government-run primary and secondary schools with good private schools, including world-class schools such as the Dhirubhai Ambani International School in BKC. Since Mumbai University's Kalina campus is located in the vicinity of the Mithi, the university should undertake special outreach educational programmes for slum youth.

Figure 11.5- Impression of an Education Precinct, including Primary, Secondary and Vocational Education Centers - adjacent to the Mumbai University Campus at Kalina, on the banks of the Vakola Nala.
Graphic courtesy: *ORF Mumbai*

Business houses in Mumbai should be obliged to set up vocational training institutes in the area to aggressively promote livelihood development with a strong focus on women and disabled groups. According to the National Skills Development Policy, 93% of workforce in India is from the unorganised sector and they account for 60% of India's GDP. The policy is aimed at facilitating training of 500 million Indians by 2022. Some of the fields identified are Electronics, IT Hardware, Gems and Jewellery, Building, Construction and Real Estate Services, IT and ITES, Auto and Auto Components, Banking, Financial Services and Insurance, Textile and Clothing, Leather and Leather Goods, Furniture and Furnishings, and Organised Retail. According to a study by MMRDA done in 2001, the average monthly income of a slum household in Mumbai was Rs. 2,978. The high concentration of potential beneficiaries along the Mithi River must be capitalized to strengthen the skill base and improve the productivity, working conditions, rights, social security and living standards. As a matter of fact, workers in the small-scale industrial hub of Dharavi possess a high level of native skills, and can become highly productive with formal skill upgradation. On the east of the Mithi River at Kurla is the regional office of the Central Board for Workers Education under the auspices of the Ministry of Labour and Employment, Government of India. This institute by virtue of its vision and objectives would provide a fillip to such an initiative.

21. Administrative issues

At present the works on the Mithi River are divided between the MMRDA and the BMC on grounds of an administrative division formed a few years ago. Whatever be the existing justification for this division of works, it should not interfere with this project. There should be no tolerance for illogical division of works and lack of coordination and cooperation between these two agencies, which has often marred even the most critical civic works in Mumbai. The implementation of works on the river by both agencies up to July 2010 has come under heavy criticism. The Comptroller of Auditor General had also raised questions about the transparency of works carried out up till 2006. Government and municipal agencies in Mumbai over the years have developed a reputation of being corrupt, inefficient, citizen-unfriendly and unimaginative. The Mithi restoration project, as we have envisioned it, will come a cropper if they continue to work with the same reputation. Therefore, this project presents them with a golden opportunity at redemption. A long-term plan for the Mithi waterfront redevelopment is crucially dependent on a strong institutional framework, backed by robust political will. Therefore, one of the first administrative decisions that the Government of Maharashtra should take is to strengthen and broadbase the Mithi River Development and Protection Authority, by including non-governmental town planners and architects of high reputation. International organisations like the Project for Public Spaces (PPS) should be requested to advise and guide the project, so that it can be benchmarked against the greatest waterfront redevelopment initiatives around the world. There also needs to be a widespread and genuine public consultation which has been absent from the redevelopment planning process thus far.

"A Good City is the one where men come together and co-operate with the aim of becoming virtuous, performing noble activities, and attaining happiness. It is distinguished by the presence in it of knowledge of man's ultimate perfection, the distinction between the noble and the base and between the virtues and the vices, and the concerted efforts of the rulers and the citizens to teach and learn these things, and to develop the virtuous forms and states of character from which emerge the noble activities useful for achieving happiness."

-Abū Naṣr al-Fārābī

(c. 872-950), a great Arab scientist and philosopher

Countless seasons have passed since man first settled on my banks. For a long time, till a century ago, my companionship with him was really joyful. He would fish, he would boat, he would swim and he would sing. He would drink my sweet waters. He also found my banks an ideal place to pray, meditate and dream. I must confess that, of all the creatures that I came in contact with, I paid most attention to him. There was something amazing, mysterious and awe-inspiring about him.

However, I also had a sense of foreboding, which grew stronger as the 20th century rolled on. Then came a time when the joy that I felt from man's company turned into sorrow and, eventually, into despair. I could not believe that, in the pursuit of his own progress, he was wreaking destruction on me. He polluted my waters which killed fish and plant life in and around me. I wondered what fruits of progress he enjoyed by doing all this, because many of his own kind lived in pathetic conditions. He had made me such a repulsive sight of filth and stench that neither buildings nor slum liked my company. Nevertheless, they continued to spread until not an inch of my bank was left to be encroached. Wounded and abused, I reeked of decay and slow death.

The denouement of my decay could only be deadly for man himself. And the comeuppance for him came in the form of the deluge on 26th July 2005.

The good thing about man is that, though he can hurt, he can also heal. When he realises his mistake, he can redeem himself by taking corrective action. This is what he started doing about a decade ago. He went about cleaning my waters and reviving my banks. One by one every horrible wrong that I had been subjected to was undone. Clean waters flowed through my veins once again. Smiles lit up the faces of people who came to my banks, which are now verdant with vegetation and vibrant with music and merriment. Everything around me has been transformed like magic. The all permeating-stench is long gone and the air has become clean and pure. Mangroves have come back, and the ponds attract birds from near and far, including those that I had thought I would never see again. The noise of the city has moved further away, replaced by the song of waves, birds and trees.

It pleases me most to see thousands of children each day running along my banks to get to school. The ugly houses that once choked me have long been removed and their residents now live in large and beautiful buildings a few hundred yards away. Many of them are children of parents who had initially opposed my revival, but are now very happy to open their windows to greet me each morning.

Millions from Mumbai and all over the world now come to enjoy my company. People come in the mornings to jog, do yoga and meditate. Families come in the evenings to enjoy the sunset from my banks and the children play carefree. There is a constant bustle from the wee hours of the morning till long after the sun has set. I have been transformed from a sewer that nobody wanted, into a River again - the pride of Mumbai. But more importantly what has changed is the nature of man. He had lost his connection with nature but something changed and he stopped his madness to hear a dying river's cry.

~Mithi River, 2020

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ABOUT THE AUTHORS

Gautam Kirtane is a graduate in Life Sciences and a post graduate in Environmental Sciences from the University of Mumbai. His post graduation thesis was on the land use and environmental health of the Mithi River in 2004. At ORF, he has focused his work largely around this project itself. He also contributes to other ongoing projects at ORF including 'Encroachments in Sanjay Gandhi National Park'. Before joining ORF, Gautam has worked on Corporate Sustainability Reporting and has extensive experience in working with municipalities in Maharashtra state particularly in the areas of water supply, sanitation and solid waste management. He has worked on the Mumbai Transformation Project with the Government of Maharashtra in 2007.

Dhaval Desai started his career in Mumbai as a journalist, spending 13 years with both print and electronic media. He worked with The Daily and The Indian Express before switching over to television news, working in senior editorial positons in Zee News and Sahara Samay. He quit active journalism in 2006 as the Chief of Bureau of Sahara Samay Mumbai. He later did a two-year stint with Hanmer & Partners, a public relations agency, where he was part of a World Bank consortium handling communications for a consultant appointed by the Municipal Corporation of Greater Mumbai to study and recommend ways to improve the city's water distribution. At Observer Research Foundation Mumbai, Dhaval works as Research Fellow and Programme Coordinator, and is involved with outreach and media relations.

Riddhi Jaydeo Chokhawala is an architect with a post graduate in Industrial Designing from the Indian Institute of Technology Kanpur. Her architectural thesis was on National Level Sports and Recreation Complex at Seawoods, Navi Mumbai, which was nominated for the Charles Correa Gold Medal in the year 2005. She has worked on the set designs of various documentary and commercial films including the documentary on Mithi River by the National Geographic Channel. Her interest lies in documentary film making and at ORF she will conceptualise and produce several such short films to complement her ongoing research work.

Observer Research Foundation is a multidisciplinary public policy think tank founded in Delhi in 1990 by the late Shri R K Mishra, a widely respected public figure, who envisaged it to be a broad-based intellectual platform pulsating with ideas needed for India's nation-building. In its journey of twenty years, ORF has brought together leading Indian policymakers, academics, public figures, social activists and business leaders to discuss various issues of national importance. ORF scholars have made significant contributions towards improving government policies and produced a large body of critically acclaimed publications.

In 2010, ORF Mumbai was set up to conduct complementary research and policy advocacy on various issues, especially in areas of local importance and of relevance to urban India at large. We have selected a broad mandate, consisting of six diverse research areas for our work: Education, Health, Urban Renewal, Inclusive and Sustainable Development, Youth Development and Promotion and Preservation of India's Priceless Heritage, Arts and Culture. ORF's Centre for the Study of Indian Knowledge Traditions is another ambitious initiative. It has organised lectures by eminent scholars on India's contribution to astronomy, mathematics and other sciences. It has also sought to promote traditional systems of medicine and yoga for health and well being. Promotion of inter-religious harmony through dialogue is yet another important activity of this Centre.

ORF Mumbai's mission statement is: Ideas and Actions for a Better India. It champions the cause of balanced socio-economic development, and a better quality of life for all Indians. It also works towards strengthening India's democratic institutions to make them more responsible, responsive and sensitive to common people's needs and concerns, especially those of the most vulnerable sections of society.

Some of the recent research reports of ORF Mumbai are:

- A study on the NCHER Bill (2010) and Higher Education Reforms
- A study on Promotion of Information and Communication Technologies (ICTs) for Maharashtra
- A study on Sanitation on Mumbai's Suburban Railways
- A study on Mumbai's Second Airport Too Little Too Late
- India-Russia strategic partnership: Prospects for the next 10 years
- A Bridge Over The Himalayas - Commemoration of the 60th anniversary of India-China Diplomatic Relations
- China 2020 A Confucian Democracy?
- Promoting Inter-Faith Harmony through Hindu Christian Dialogue

Some of the recent roundtable discussions and other events are:

- Open and Green Spaces for a Healthier Mumbai
- Problems faced by Maharashtra's Farming Community: The Need to Promote Best Practices in Sustainable Agriculture
- Reforming Medical Education to Promote Healthcare for All
- Joint roundtable with Municipal Corporation of Greater Mumbai on 'A Vision for Mumbai's Healthcare needs'
- A lecture series by eminent scientists titled 'Gurus of Science'. Lectures have been delivered by Nobel laureate scientists Prof. Jean Marie Lehn, Sir Harold Kroto and Dr. Ada Yonath; and Dr. R A Mashelkar, Dr. Spenta Wadia and Dr. S.M. Ahmed.

Forum for India-China Citizens' Dialogue

ORF Mumbai believes that in the changing world order, friendship between India and China is not an option. It is a mutual necessity. Moreover, it is also an essential factor for peace and stability in Asia and the world. Obviously, diplomatic efforts are not alone enough to restore India-China relations to the desired level of affinity. The imperative need, to create mutual understanding and cooperation between our two countries, demands closer and vastly increased people-to-people contacts. It is against this backdrop that ORF Mumbai has taken the initiative to establish the Forum for India-China Citizens' Dialogue. This is a non-partisan, non-political and non-governmental platform for all those who believe in, and are willing to contribute to, the cause of promoting fraternal and cooperative relations between the peoples of India and China.

Centre for the Study of Indian Knowledge Traditions

ORF Mumbai's Centre for the Study of Indian Knowledge Traditions seeks to promote the rich reservoir of knowledge and wisdom in Samskrit and other Indian languages, especially focusing on their enormous contemporary relevance. The Centre aims at studying India's knowledge traditions not from a purely academic perspective, but from the point of their contemporary relevance and usefulness. It is the endeavour of the Centre to highlight how these traditions can enlighten and benefit our institutions of governance, political establishment and civil society initiatives.

Maharashtra @ 50 Study Centre

Maharashtra is one of the leading states of India. With a population of over 10 crore, every development that takes place in the State – positive or negative –markedly impacts India's development and destiny. Therefore, attaining deep knowledge of all the major issues, challenges, achievements, failures and emerging trends is necessary from the point of view of the progress of Maharashtra as well as the nation. The overriding purpose of the Centre is to create hope in place of pessimism, clarity in place of confusion, consensus in place of discord, and cooperative action for lofty, integrative goals in place of confrontational pursuit of sectional interests.

India-Israel Innovation Initiative

Israel has emerged as a powerhouse in innovation and hi-tech industries in the recent past. India, on the other hand, is growing at more than 8% and, together with China, has become an engine of global economic growth. India and Israel share common values of democracy and entrepreneurship. Both are knowledge-driven societies. The economies of both are complementary to each other. In the last two decades, Indo-Israel cooperation has grown exponentially, with bilateral trade expected to soon cross USD 5 billion. This special relationship has a long way to go, particularly in the field of joint R&D and innovation. Against this backdrop, and to mark the beginning of the 20th year of diplomatic relations between our two countries, ORF Mumbai has mooted the idea of the India-Israel Innovation Initiative. This will be an alliance comprising academia, public and private sector companies, and think tanks from India and Israel, for a deeper engagement with the subject of innovation-led cooperation between the two countries.

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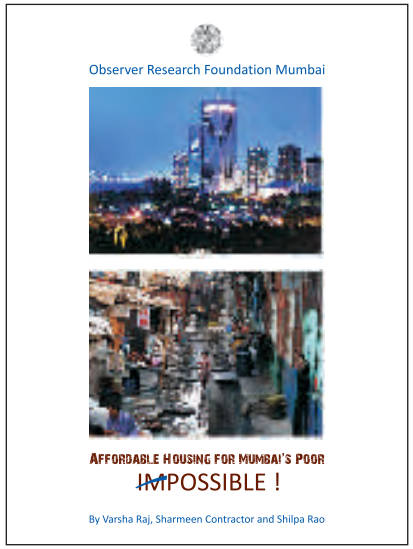

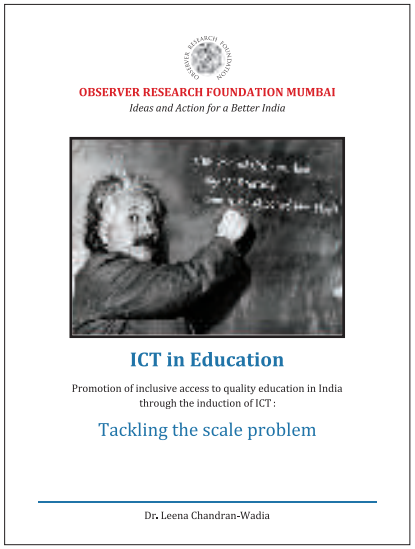

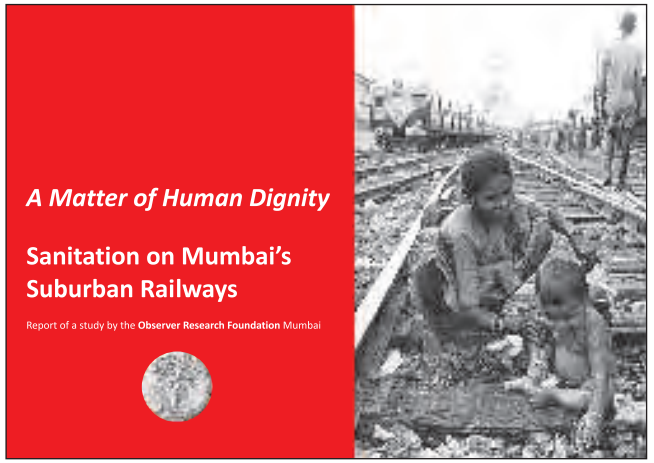

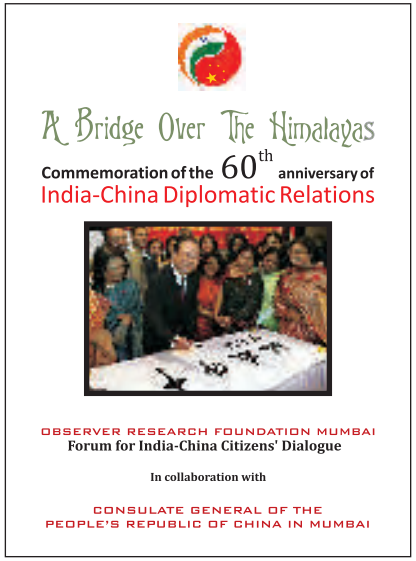

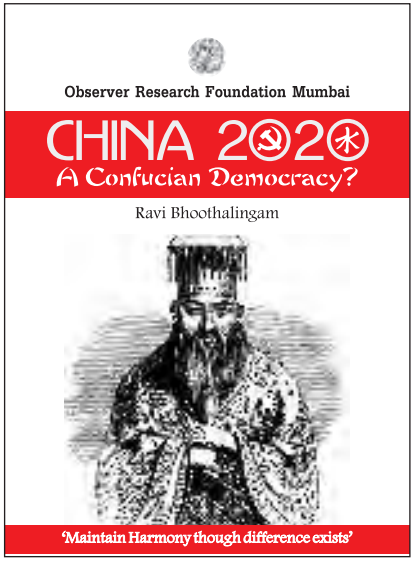

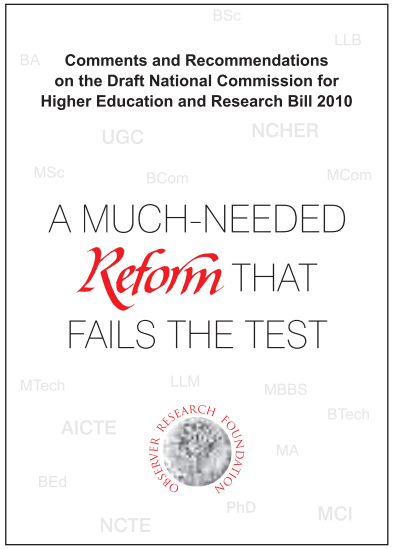

MAKING THE SEWER... A RIVER AGAIN

A COMPANION DOCUMENTARY FILM

Synopsis

Have you ever taken a local that passes between Mahim and Bandra? Have you ever noticed the pitch black body of water that lies below? Have you ever recoiled at the stench that emanates from it? Mumbai presents to you – The Mithi River. Yet this unpleasant smell is not the first thing that comes to mind at the mention of the Mithi. That is reserved for the day that she brought Mumbai down to her knees and claimed a thousand lives. Slums, sewers, garbage, illegal industries, incompetent government authorities - these are other things that come to mind when we think of the Mithi.

The water in this stinking, pitch black body originates 800 feet up in the hills of the Sanjay Gandhi National Park in Borivali, flows through the most densely populated parts of the city and empties into the Arabian sea at Mahim.

Why has the Mithi become the most hated river in the world? This was not always the case.

In this documentary, we have made an attempt to explore the Mithi that was, the Mithi that is and the Mithi that can be – provided the riverfront is redesigned, developed and beautified, by the concerned authorities, thereby restoring the lost charm and treasure of this city.

OBSERVER RESEARCH FOUNDATION MUMBAI

Ideas and Action for a Better India

5th Floor, NKM International House, Behind LIC Headquarters 'Yogakshema', Nariman Point, Mumbai 400020
Contact: Gautam Kirtane on +91 22 61313800 Email: gautamkirtane@orfonline.org Website: www.orfonline.org