



DISASTER RISK MITIGATION IN MUMBAI CITY

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MUMBAI: CHARACTERISTICS

- POPULATION: 2001 - 11,914,398
2008 - 13,662,885 (World Gazetteer)
- AREA: 437.71 sq km
- DENSITY: 27,000 persons/km²
Ward C - 114,001 persons/km².
- ALTITUDE: 10-15 meters above sea level
some points just 1 meter above msl
- RECLAIMED LAND: Large proportion of city
- ACUTE PAUCITY OF LAND: Insular
City confined to 35° wedge from South to North





HAZARDS THAT HAVE IMPACTED OR CAN POTENTIALLY IMPACT MUMBAI CITY

1) Hydrological & Climatological Disasters

- Floods
- Cyclones
- Cloud Bursts
- Sea Erosion
- Heat Waves
- Thunder & Lightening

2) Geological Disasters

- Earthquakes
- Landslides

3) Chemical, Industrial & Nuclear Disasters

4) Accident Related Disasters

- Fires
- Oil Spills
- Major Building Collapses
- Festival related Disasters
- Electrical Disasters & Fires
- Air, Road & Rail Accidents

5) Biological Disasters

- Epidemics
- Pest Attacks
- Food Poisoning





VULNERABILITIES OF MUMBAI CITY

- India's financial & commercial capital
- State capital
- Extreme population and structural density
- Coastal city with massive reclamation
- Rainfall characteristics - average 2363 mm/year
 - **50 % in 2-3 events**
- Located in seismological zone 3.
- Large number of vulnerable informal settlements
- 184 high rise buildings above 70 mtrs
- Industries dealing with hazardous material
- Strategic target in wartime & for subversive activities



VULNERABLE AREAS OF MUMBAI CITY

- Flooding Spots: 266
- Chronic Flooding Spots: 55
- Landslide Prone Areas: 127
- Slum localities within high tide line: 57
- Buildings vulnerable to collapse: Cess: 328
Non Cess: 278
Municipal: 115
Total: 721





CAUSES OF FLOODING IN MUMBAI

- Rainfall Characteristics
- Flooding of Rivers
- Inadequate Storm Water Drainage System
- Increase in Impermeable Surface Cover





MEASURES INITIATED TO MITIGATE FLOODING OF RIVERS

Widening and Deepening of Mithi, Dahisar, Poisar and
Oshiwara Rivers

Mithi River

- 3,22,000 cubic meters of silt and 4,82,000 cubic meters of hard rock has been excavated from the river bed till 15th May 2010.
- RCC retaining wall of 7.4 km length has been completed
- A 25 meter long and 4.5 meter high weir has been constructed downstream of the Jogeshwari-Vikhroli Link Road with openings at the bed level which will help to discharge water slowly from the river during periods of heavy rainfall.
- Upstream of Jogeshwari-Vikhroli Link Road, in Aarey Colony, a holding pond has been created at the side of the river for flood protection in its micro-catchment.
- 4850 structures have been demolished for widening the river, 735 structures remain to be demolished
- Total expenditure incurred till April 2010 - Rs 430.88 crore



MEASURES INITIATED TO MITIGATE FLOODING OF RIVERS

Dahisar River:

1800 meters of the river has been trained under the BRIMSTOWAD project at a cost of Rs 27.89 crore.

Poisar River:

3550 meters of the river has been trained under the BRIMSTOWAD project at a cost of Rs 67 crore. The project has been delayed due to encroachments. In addition, an NOC from military authorities is awaited.

Oshiwara River

Widening and training of three nullahs has been undertaken under the BRIMSTOWAD project at a cost of Rs 27.50 crore. Encroachments have hampered the progress of the work.





MEASURES INITIATED TO MITIGATE FLOODING BY AUGMENTING STORM WATER DRAINAGE SYSTEM

Implementation of BRIMSTOWAD project

- SWD system is being augmented four times - design for rainfall of 50 mm/hour with run-off coefficient of one.
- Since 2006, the SWD system is being cleaned/desilted to the bottom-most level. Annual expenditure incurred - over Rs 50 crore.
- Widening, deepening and training of major nullahs
- Rehabilitation of old arch/box drains, particularly in the Island City.
- Installation of 9 storm water pumping stations to discharge incoming Storm Water flow in the Sea. In addition, 196 smaller pumps have been provided at 189 locations on storm water lines to overcome invert problems and flat gradients.





OTHER MEASURES INITIATED

Construction of Cyclone Shelters

- Construction of Four Cyclone Mitigation Shelters with financial aid from World Bank
 - Andheri (Versova)
 - Malad
 - Mulund
 - Kurla
- Regularly will be used as Municipal School
- Will benefit about 3000 Disaster affected persons





INSTALLATION AUTOMATIC WEATHER STATIONS & FLOW GAUGES

- 35 automatic weather stations have been installed through out Mumbai to get real time intensity of rain fall.
- Rain fall data is transmitted every 15 minutes.
- The data is monitored, analyzed and the warnings are issued of flooding
- Flow Gauges have been installed upstream of Mithi River to monitor water flow and issue warning to the population living down stream.





MEASURES INITIATED TO MITIGATE FIRE HAZARD

There are 184 high rise buildings which are above 70 mtrs



Building Height	Floors of the building	Provisions with Fire Brigade
42 mtrs	13 floors	Accessible by Turn table Ladders and Hydraulic Platform/Aerial Ladders.
68 mtrs	20 floors	Up to 42 mtrs to 68 mtrs height will be shortly accessible by 68 mtrs Hydraulic Platform/Aerial Ladder.
Above 68 mtrs	Above 20 floors	Limitations to external fire fighting systems and emphasis on in built fire fighting systems.



MEASURES INITIATED TO MITIGATE FIRE HAZARD

- High Rise Inspection Cell instituted since November 1998
- Annual inspection of 500 high rise buildings above 24 meters. Deficiencies observed are communicated to Chairman/ Secretary of the building as well as Asst Engineer, Building department and Asst Commissioner of concerned ward to issue notices for rectification of the deficiencies.
- Annual inspection of malls, multiplexes, commercial office buildings and industrial estate buildings.
- Since 01/01/2010 every member of the society is informed about deficiencies observed during inspection.



PROBLEMS OF URBAN DECAY

- Almost 90% of the buildings located in the 'A', 'B' and 'C' wards in Island City are dilapidated - many in a state of imminent collapse.
- Average plot area - 10,000 sq ft each.
- 4 to 6 storey buildings, mainly constructed 100-125 years ago, built privately in accordance with then available technology
- Very high density of tenements, 60 -100 sq ft size
- Infrastructure in area is crumbling & strained with the additional load
- Roads & lanes narrow, sewage & garbage disposal systems have completely collapsed leading to severely unhygienic conditions.
- These structures act as a death trap in case of tragic accidents, like fire.





JANUARY 09, 2010

**110 Yr Old, Mhada cessed, 5 Storyed bldg
with 90 flats,
Reay Chambers on Dockyard Rd**



The building was under repair by Maharashtra Repair & Construction Board for over a year





MEASURES INITIATED TO MITIGATE URBAN DECAY

1999: Development Control Regulation **33(7)** amended for buildings constructed before 1950 and those declared as dangerous, prior to monsoon of 1997.

February 25, 2009: DCR 33(9) rules amended for repairs and reconstruction of cessed buildings and urban renewal schemes.

- Notification for use of Cluster Approach for redevelopment of cessed buildings, buildings belonging to Government, Semi Government and Municipal Corporation of Greater Mumbai, buildings that are declared dangerous or injurious to health and slum areas.





INSTALLATION OF TETRA COMMUNICATION SYSTEM

- Establishing Terrestrial Trunked Radio (TETRA) system to provide voice, data and video communication during the disaster
- This will be an independent communication network with the erection of towers, switches, controls etc
- This system is fail proof, robust and work under all conditions.
- Under this, systems like GIS, AVL, SCADA etc will be integrated
- Video Walls will be fixed in each control room for tracking quick & effective response





UP GRADATION & ESTABLISHMENT OF EMERGENCY OPERATION CENTRES

- **State of the Art Emergency Operation Center at Head Office & at all Wards**
 - 24 x 7 Operational
 - Deployed required Human Resources
 - Deployed required Vehicles
 - Provided D. G. Sets
 - An array of latest Communication of System
 - Computer system with Disaster Management & Early Warning Software





DISASTER RISK MANAGEMENT MASTER PLAN (DRMMP)

- Collaborative Project Between Earthquake Megacities Initiative (EMI) and the MCGM
- DRMMP has Two key elements:
 - Disaster Risk Management Master Plan (DRMMP)
 - Internal competent structure for Emergency and Crisis Management





DRMMP ORGANIZATION

- Advisory Committee chaired by Municipal Commissioner & members are all stakeholders in Mumbai
- EMI & MCGM jointly established the Project Implementation Team
- Project Director & Project Manager have been appointed
- Local as well as foreign experts have been identified and appointed.





GOALS UNDERTAKEN IN THE DRMMP

- Four main goals:
 - Establish a competent emergency management system with international standards of practice
 - Institutionalize disaster risk management (DRM) practice in MCGM
 - Develop a coherent set of objectives and recommendations to reduce disaster risk within Mumbai
 - Build experience and expertise





TASKS PROPOSED IN DRMMMP

- Analysis and Diagnosis
- Risk Analysis
- DRMMMP Planning and Framework Development
- DRMMMP Framework
- Strategic Planning and Implementation Work Outputs
- State-of-the-Practice Local Level DRM Organizational Structure
- Training and Capacity Building





EXPERTISE INVOLVED IN PROJECT

- Legal, institutional and organizational analyses
- Emergency and crisis management (focusing on local level)
- Disaster risk management
- Hazards, vulnerability and risk assessment
- Social and institutional vulnerability assessment
- Construction standards and practice
- Land use planning and urban development
- Information and communication technology
- Training and capacity building
- Resource and project management





PROJECT STATUS

- Work started from 1st March, 2009
- Five focus groups have been formed
 - Legal, Institutional and Organizational Arrangement
 - Hazard, Vulnerability and Risk Assessment
 - Disaster Risk Management
 - Land Use Planning & Construction Standards and Practices
 - Emergency Management, Social Mobilization and Education
- Duration of project - 2 years
- Cost of project - 1.1 million U.S. dollars (Rs 5 Crore)





THANK YOU

