

MUMBAI AIRPORT was shut down for 30 hours
 MUMBAI PUNE EXPRESSWAY was shut down for 24 hours
 LONG DISTANCE trains were cancelled till 08 August
 MOBILE networks were down for 10 hours

26 July
 2005

Over 50 local trains Damaged
 Over 37000 Auto-Rikshaws Damaged
 Over 4000 Taxis Damaged
 Over 900 BEST buses Damaged
 Over 10000 Trucks and Tempos Damaged

City Development Committee has reviewed and accepted the Storm Water Master Plan. Pune Municipal Corporation has integrated it with building permissions, which protect the natural streams and provide the adequate size for safe water passage. Flooding events in the city considerably reduced due to implementation of the master plan activities.

Effective implementation leading to flooding free city.



storm water management

Designing Smart Waterways

Comprehensive Master Plan of Pune city

Concept, Design and Execution by

PUNE MUNICIPAL CORPORATION

Technical Consultant

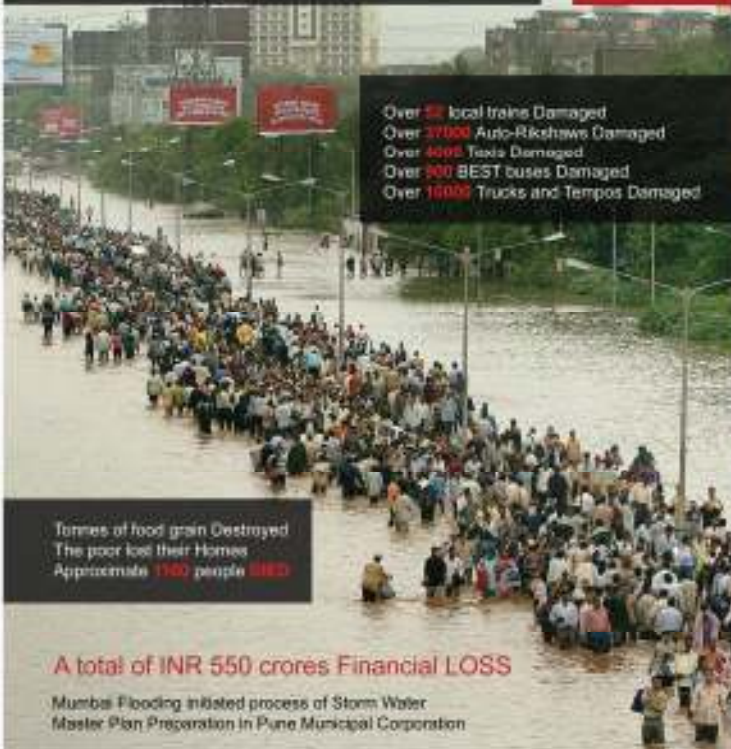


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Tonnes of food grain Destroyed
 The poor lost their Homes
 Approximately 1500 people killed

A total of INR 550 crores Financial LOSS

Mumbai Flooding initiated process of Storm Water Master Plan Preparation in Pune Municipal Corporation



Background

The rapid urbanization has significantly changed the nature of drainage areas in Pune city. The open grounds have nearly vanished and the paved area is substantially increased. This has resulted in increased flood volumes for the same rainfall event. The demand for land has increased, which has affected the natural drains. The widths have been reduced at many places. This has seriously affected the carrying capacity of many drains. The development along the same has not taken place in a scientific and planned manner. This has resulted in emergence of areas which are prone to flooding, even with moderate rainfall intensities. This is especially true in fringe areas, which have been recently added to Pune Municipal Corporation. These areas were of rural character with little or no control on development activities before coming in to Corporation limits.

The uncontrolled development of 'urban poor localities', have generally happened near Nallas. The drainage channels have become vulnerable to deposition of wastes of all kinds, mainly waste water and solid waste.

This has resulted in higher silt load, reduction in carrying capacity and difficulties in maintenance. In the earlier years, the network of roadside drains was present in limited areas. The coverage has increased in last four years especially after severe floods of 2005. However, this is still not adequate to cover all roads.

Topography

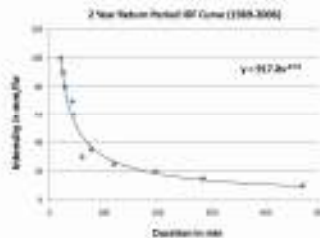
Total area of the city is 243.55 Sqkm. The general topography of ridges and valleys has resulted in formation of independent watersheds, each of which is serving in Mula-Mutha rivers. These rivers are principal carriers of the storm water.



The maximum and minimum levels in Pune are RL 574.77m (at Kalesh Ghul road) and RL 530.10m (near Kharadi Gadhani). There are 324 nallas including tributaries having total length of 362 kms of which, 55 main streams join the River Mula-Mutha.

Rainfall

In year 2005, Mumbai experienced one of the heaviest rainfalls of 944 mm in a single day of July 26, 2005. Pune city also experienced unusually high rainfall of 302.30 mm on the same day causing flooding in many parts of the city. In recent years rainfall pattern is changing and high intensity rainfall occurrences are increasing. The flood water is entering in the houses located near the natural streams and low lying areas along with flooding on road. There have been widespread losses in terms of traffic interruptions, damage to roads, and loss of property causing disruption in normal life.



Prediction of Rainfall intensity

Rainfall intensity is amount of rainfall per hour (mm/hr) which is very crucial for any flood forecasting.

The 38 year daily rainfall data from Indian Meteorological Department (IMD), Pune has been collected and analyzed for various return periods with help from Department of Statistics, University of Pune.

The Return Period is the period in which the chosen storm event will be equaled or exceeded, is worked out as follows

Rainfall intensities for various return periods
 = 2 Years 33.1 mm/hr
 = 15 years 55.56 mm/hr
 = 25 years 60.4 mm/hr

With a view of salvaging the river and protecting urban streams from encroachment, the Pune Municipal Corporation prepared a Master Plan for "Storm Water Management System for Pune city" in March 2007. Design methodology and further implementation is described in the following sections.



Base Map Preparation

Based on satellite imagery (1m resolution, year 2003), a digital map of Pune city is generated with all key physical features like Rivers, main streams and its tributaries, roads, lakhs, canals, culverts, etc. The map also shows contours and is superimposed on the digital map.

Watershed Basin Formation

The Project area is divided into 23 watersheds or basins, each of which has one or more primary natural streams (Nallas) to carry the storm water into the rivers.

The slopes of these networks are generally good enough to carry reasonable storm water volumes. A total catchment area of 23 sub-watersheds/basins is 33500 Ha of which, about 25000 Ha is within the PMC limits.

Topographical Survey

Topographical survey of all the natural streams, roads and culverts has been done with total station. Total survey of 1100 Km length (nalla & road) was carried out. Cross section at 30m drainage is taken. A Contour map with 1 m interval has been generated based on this data for the entire city of Pune. The survey data is used for hydraulic design.

Watershed Basin Map of Pune city



Design of Network

- Defining Flow Patterns within a sub watershed -
- Identified Roads and streams/Nallas that will drain the watershed
- Marked 'nodes' on this network points for which flow will be predicted and appropriate drain size will be designed
- Total of 14000 Nodes marked in all basins
- Design as per Central Public Health and Environmental Engineering Organisation (CPHEEO) manual
- The catchments area is classified depending on the proposed land use of the area.
- Rational formulae used for calculation of flood flow.
- The hydraulic capacity of the drains is computed by using Manning's Formula
- Proposed land use as per Development Plan (DP) is considered for design
- Adequacy of existing nalla & drains is checked and adequate size of drains is designed

Master Plan Findings

<ul style="list-style-type: none"> Natural Streams/Nalla No. of Nallas and its tributaries - 234 Nos Total Length of natural streams/nalla - 390 Km Length of completely obstructed nalla - 75 Km Length of partially obstructed nalla - 80 Km Length of nalla channelized/developed - 26 Km Length of nalla where frequently flooding occur - 20 Km Nallas shown in DP - 150 Km 	<ul style="list-style-type: none"> Cross Drainage (CD) Works Total Cross Drainage Works - 662 Nos Total adequate Cross Drainage Works - 310 Nos Total inadequate Cross Drainage Works - 352 Nos Road Side Drains Total Road Length - 1600 Km Length of road having storm drains - 55 Km Proposed Road Drains - 1026 Km
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Storm Water Drainage Project (Phase-I) under JNNURM

Phase I Detailed Project Report (DPR) costing Rs.399.88 Cr was approved in March 2009 under JNNURM. Under this project, 4 basins (i.e. Baner (G), Waggaon Sheri (M) Basin, Kharadi (N) Basin, and Waggaon (V) Basin) are considered which covers 56 Sq. Km. (23%) area of the total city. This project is implemented by the specially formed Department in PMC. Works completed under Phase-I are Nalla Channelization & Development 58.00 Km, Road Side Drains 92.40 Km and Cross Drainage Works 62 Nos. There is considerable reduction in flooding in these basins.

Storm Water Drainage Works for Frequently Flooding Areas in Pune City

Recently in November 2015, heavy storm (i.e. more than 90mm) today at Kalesh, Dhancor, Vasantnagar, Vastanvadi and Yerwade area caused heavy flooding. With a view of addressing this issue, PMC has identified the flooding spots in the city in consultation with all the ward offices and prepared Detailed Project Report (DPR) of Rs. 492 Cr. PMC has decided to implement the project within 4 years by using own financial resources to make city free from flooding. For financial year 2016-2017, works are proposed in all the 23 basins except 3 basins Baner (G), Waggaon Sheri (M) & Kharadi (N). Total estimated cost is Rs. 117 Cr. Pune Municipal Corporation has made provision of Rs.63.75 Cr in annual budget of year 2016-17. Implementation of this project has started in May 2016. Works included are as follows:

- Mula Development Works - 10.75 Km
- Road Drains - 38.02 Km
- Cross Drainage Works - 14.00 Nos

