

Street Stormwater Harvesting For Nashik City

¹Deore Rashmi, ²ChavanMayuri, ³D.O.Bhavar

¹Student of BE Civil, ²Student of BE Civil, ³Assi.Prof. At GCOERC

¹Civil Engineering Department,

¹GCOERC, Nashik, India

Abstract:

Water scarcity is the problem in the present scenario. Many localities in the state and nation have face droughts according to the observations recorded in the last decade. To overcome the same government has focused on implementing several steps for water conservation and rainwater harvesting is a part of the program. Apart from this, there is a huge runoff from the streets which go unused and further meets the water bodies. The research work focused on harvesting of the storm water, testing, treating, cost optimization and utilization for the purposes such as, street washings, car washings, gardening etc. where it becomes an overburden to the municipal water supply system. This concept has been taken from underground water tanks in Japan. Storm water management reduces or eliminates the negative impacts of storm water runoff. Water logging created in city can be called as manmade floods. Existing storm water drains are not capable for more intensity rainfall and also it gets blocked due to plastic or other waste. Such situations had occurred in many cities of India. In Nashik city, the construction of storm water drains has been done for capacity of 27 mm/hr rainfall intensity. But if the intensity exceeds drains fail to work properly as observed in July 2017. The paper includes

Index Terms - Manmade floods, Flood control, Reuse, Underground water tank.

1. Introduction

More than 3 billion people will move into cities over the next 30 years and to accommodate them all will require increased densification that dramatically changes the urban landscape. This built up landscape is dominated by impervious surfaces which no longer allow the rainfall to infiltrate into the soil and will instead result in increased overland flow that contributes to more widespread flooding. At the same time climatic variability is increasing and the combination of urban densification and climate change will result in increasing runoff events that will result in increased flood risk. When we change land use we change the way the water is distributed in the hydrological cycle. A portion of the precipitation can either be evapotranspired, converted into surface runoff, stored in the soils or percolated into groundwater. When we convert a forested watershed into a paved urban landscape a much larger portion of the rainfall becomes surface runoff, which in traditional management is then conveyed directly into urban streams through an elaborate system of stormwater pipes. It is becoming increasingly apparent that conventional stormwater drainage systems are ill prepared to deal with increasing rain events and a drastically changed land surface.

1.1 Problems associated with street stormwater in cities

As a result the receiving water bodies were adversely affected by pollution. Stormwater pollution includes litter (i.e. cigarette butts, cans, food wrappers, plastic bags or paper), natural pollutants (i.e. leaves, garden clippings or animal faeces), chemical pollutants (i.e. fertilizers, oil or detergents) and sediment pollutants (i.e. soil erosion and runoff from building sites and unsealed roads) etc. The impurities occur in three progressive finer states- suspended, colloidal and dissolved. These pollutants are created by urbanization, development and populating of an area and carried to inland water bodies such as streams, rivers, and lakes by stormwater and deteriorate their quality and endanger their ecosystems. The gap between the flood water accumulated on the streets in urban areas and its reuse is very high. Floods created in our city can be called man-made floods. Existing storm water drains are not capable for more intensity rainfall because of

- 1) Condition of manhole
- 2) Sedimentation in storm sewer
- 3) Small diameter of storm sewer
- 4) Blockage of sewer due to plastic or other waste.

In order to use this water we need to study the storm water drainage network of Nashik city.



Fig.1-near saraf bazaar

1.2 Need of Study

Water is essential to our quality of life, economic growth, and to the environment. There is sufficient water on this planet, but the availability of this water varies in geographic terms, in time and in quality. Quality water is essential for ecosystems development and production processes. But at present around the world, freshwater scarcity is becoming an increasingly significant problem for many countries. In Asia and elsewhere there are many towns where the demand for potable water doubles every 10-15 years. Actually the demand of water increases due to continuous population growth, intensive agricultural development, urbanization and rapid growth of the industry. Besides, there are uneven distribution of water resources and the impact of climate change, like periodic droughts which worsen the situation. This expanding water demand should be met in the longer-term. Undeveloped catchments can absorb and infiltrate up to 90% of precipitation, whereas in built environments the amount of infiltration can be as little as 10% of precipitation. In urban areas, surfaces such as roads, parking areas, paved areas and rooftops mean that rainfall rapidly collects on impervious surfaces and is unable to replenish the superficial groundwater aquifer to the degree of the undeveloped area. Street storm water is simply the water which gets accumulated on the streets in nearby areas of river bank or apart from the bank in some cases. The recent scenario of water shortage and droughts have all highlighted the need to conserve the water or in other words to reuse the water. The alternative water supplies considered for reuse are rainwater, stormwater, greywater; treated sewage, industrial water and managed aquifer recharge (MAR). Stormwater is separated from the municipal wastewater sewers and often when space is available, stormwater is drained through ditches. The quality of stormwater is comparatively better than untreated sewage or industrial discharge. Before 1980s, stormwater was not considered as a valuable resource. But today it is being studied as a source of water in urban areas. The project work focuses on the storage and reusing the storm water.

1.3 Objective

The traditional approach to handle stormwater from cities has been to drain it as fast as possible by means of underground culverts. Thus, in urban areas the natural water cycle is influenced by infrastructure that prevents infiltration and concentrates stormwater flows. This approach has been shown to cause several environmental problems as stormwater from urban areas can be polluted by organic material, suspended material and nutrients. When discharged to the nearest receiving water, it affects significantly the local ecology, biology, etc. Research during the last few decades has concentrated on developing alternative ways to handle stormwater in urban areas. The primary objectives are

- Beneficial Use of Stormwater, thereby creating blue-green open spaces in urban environments.
- To design an underground water tank to collect the water for further use.
- To make the use of treated storm water instead of potable water supplied by the municipal corporation for car washing, street washing, flushing, irrigation and gardening purpose which do not require high quality treated water and will help in conserving the fresh water.

Study Area

The study has been focused on the small area in Nashik: Saraf Bazaar. It is located near the bank of Godavari River having latitude 20.00479° and longitude 73.79021° .

It is one of the congested areas in Nashik where problem of water logging occur frequently. Due to this there is major loss of property and deterioration of road, which affect the economy of the city. The existing stormwater drains in this area are constructed many years ago taking into consideration the needs as per that time, but now due to rapid urbanization impervious areas have taken place of the pervious grounds. This cause increase in the volume of runoff water making the existing drains less capable.

3. Methodology

Runoff Collection Treatment Storage Distribution End User

3.1 Runoff: - Due to urbanization the city has very less pervious areas and stormwater cannot infiltrate which causes high amountof runoff flowing on the streets.

3.2 Collection: - storm water can be collected through traditional urban drainage system of gutters, pipes and channel. Althoughtraditional conveyance system does not provide any treatment but they can maximize the water harvested due to minimal infiltration and evaporation losses. However some minor losses can be occur due to the small cracks in the system which increases with the age of infrastructure.

3.3 Treatment: - at present implementation of storm water use is a lack because of reliable and unaffordable treatmenttechniques. Treatment is necessary for improving water quality so as to make it usable. Treatment methods are depending on the purpose of reuse of water. this can be finalized by conducting some tests on water sample which is to be treated to know its characteristics such as pH, hardness, alkalinity, total suspended solid, conductivity, DO, BOD, COD, etc.

3.4 Storage: - Optimal design of storm water storages forms a key part of effective use schemes as they are central to relatedspace constraint, public safety and aesthetic issues. Typical example includes open storages, above or underground tank. Underground tanks are suitable for storage as they do not have visual issues and public safety issues.

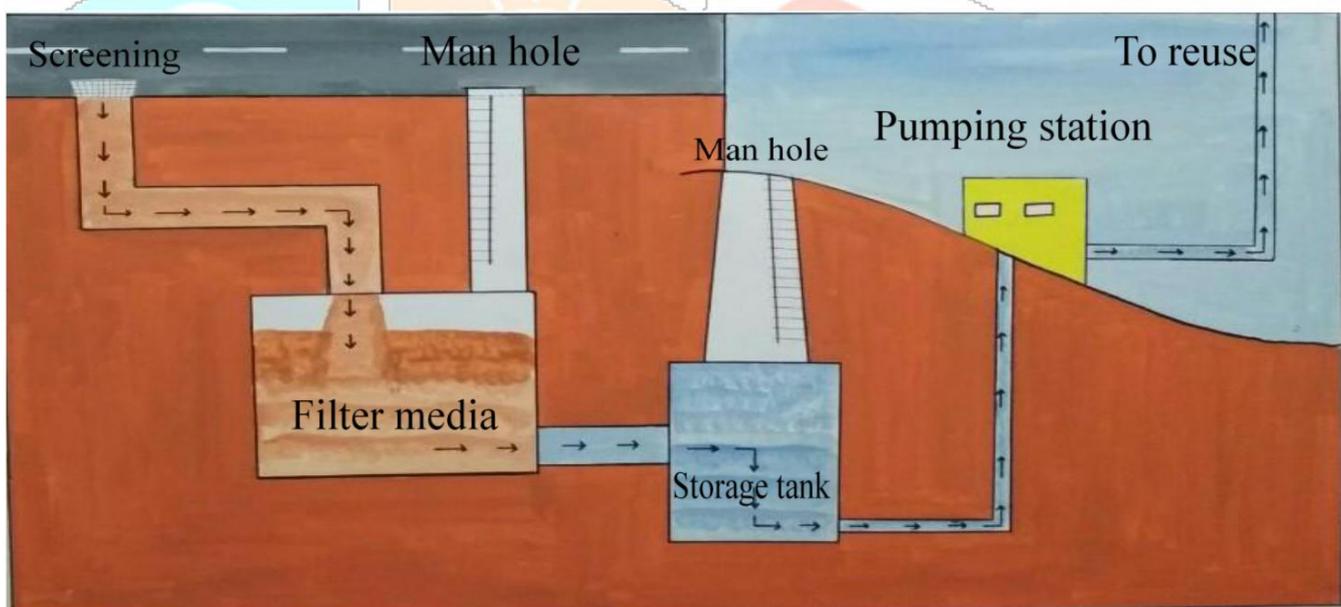


Fig.2 process of operation

4. Data Collection and design: - To analyze the situation in Saraf Bazaar hydrological, topographical data of Nashik city were collected from the Department Of Irrigation Nashik and Municipal Corporation Nashik respectively. From hydrological data the total volume of runoff was calculated from which the underground water tank of size 8x7x6 m is designed. The proposed location of water tank is near to the MayurAlankar at Saraf Bazaar. The filter of size 1.5x2m (Sand Filter) is installed near the storage tank which will insure that further used water will be treated properly.



Fig.3 location of water tank

5. Results and discussion:

Table No. 1- results of testing

CHARACTERISTICS	SAMPLE 1	SAMPLE 2	SAMPLE 3
pH	8.25	7.45	9.20
BOD(ppm)	40.75	42.90	52.70
Total suspended solids(ppm)	2493.30	2339.25	3105.78
Conductivity (mic.sim/cm)	274	298	302
Hardness as CaCO3	115.64	112.52	122.57
Alkalinity (ppm)	109.20	99.25	110.22

COD(ppm)	81.88	78.67	92.68
DO(ppm)	9.0128	8.015	9.522

On the basis of above results it has been seen that all the characteristics ranges between adequate range according to CPCB manual. The water can be useful for non potable purposes without any advanced treatment so the Following treatment method can be adopted:

- 1) Screening
- 2) Filtration
- 3) Disinfection

6. Proposed Solutions:

According to the identified problem during study some of the BMPs could be adopted as:

- Increase the number of screens provided on the streets.
- Collection of stormwater for reuse rather than discharging it into the river.
- Establish a feasible and economic storm water management plan.
- Making use of pervious concrete wherever possible to reduce impervious areas.
- Implementation of laws and publishing stormwater management guidance manual.

7. Conclusion:

Water logging due to storm water is major challenge in urban areas. To reduce the load on water treatment plant as well as sewage treatment plant storm water should be used for non potable purposes. Water scarcity can be reduced. The study was to review the urban needs and best practices for enhanced stormwater management and quality well adoptable for urban areas. The emphasis was on getting good understanding on the different ways for storm water filtration and purification. Urban stormwater management can reduce urban flooding as well as protect ground water and surface waters from being polluted. A municipal strategic stormwater management plan together with legal Acts and technical guidelines, and practical experience formulates a basis of recommendations for stormwater management as a long term strategy for sustainable urban planning. The planning will be based on the suitability of the local areas, the rainfall characteristics and types of development for the particular areas. There is still need of more information for the population so that more sustainable ideas can be promoted.

References:

- [1]Gautam. M, Acharya. K and Stone. M. 2010. Best Management Practice for Stormwater Management in Desert Southwest. Journal of Contemporary Water Research & Education, 146: 39-49.
- [2]Hunt. W. 2010. Introduction to Stormwater Management. Journal of Contemporary Water Research and Education, 146: 1-2. [3]Akram. F, Rasul. M and Khan. M. 2014. A Review on Stormwater Harvesting and Reuse. International journal of Environmental, Ecological, Geological & Mining Engineering, 8(3): 188-197.
- [4]Migosi.P. 2014. Effects OfUrban Stormwater Management Strategy In Reducing Flooding: A Case Of Mombasa. International journal of Managerial Studies & Research, 2(4): 82-90.
- [5] Nichols. P, Lucke. T. 2015. Local Level Stormwater Harvesting and Reuse. Journal Sustainability, 7: 8635-8648.