



REPORT OF THE COMPTROLLER AND AUDITOR GENERAL OF INDIA

PERFORMANCE AUDIT OF MANAGEMENT OF STORM WATER IN BENGALURU URBAN AREA



**GOVERNMENT OF KARNATAKA
REPORT NO. 2 OF THE YEAR 2021**

**Report of the Comptroller and Auditor
General of India**

**Performance audit
of
Management of storm water in
Bengaluru Urban area**

Government of Karnataka
Report no. 2 of the year 2021

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- 1.** This Report of the Comptroller and Auditor General of India has been prepared for submission to the Governor of Karnataka under CAG's DPC Act, 1971.
- 2.** The Report covering the period 2013-18 contains the results of performance audit of 'Management of storm water in Bengaluru Urban area'.
- 3.** Audit has been conducted in conformity with the Auditing Standards issued by the Comptroller and Auditor General of India.

Executive Summary

The city of Bengaluru is a victim of a paradoxical situation - urban flooding on one hand and depletion of ground water table levels, on the other. There is an urgent need for urban managers to address this issue from the water security/environment and urban planning perspectives.

Rapid increase in frequency of flooding in the city over the last few years, leading to destruction of roads, traffic congestion lasting several hours and extensive damage to public property and health has highlighted the need for a thorough examination into the design, agility/adaptability of the infrastructure for the management of storm water and other relevant issues; hence this performance audit (PA).

The scope of this PA is not limited to the SWD infrastructure. We have attempted to address the larger conceptual question of redefining storm water as a critical natural resource worthy of conservation. The PA which covers the period 2013-14 to 2017-18 involved test-check of records in the Office of the Commissioner, Bruhat Bengaluru Mahanagara Palike (BBMP) and Chief Engineer, SWD along with joint physical inspections of drains. Audit conducted an independent study of long term changes in land use patterns utilising geospatial inputs with technical support from Regional Remote Sensing Centre-South, Indian Space Research Organization, Bengaluru to obtain details of changes across specific time periods which affect ground water recharge, simultaneous variations in SWD infrastructure in order to identify weaknesses in their management/monitoring.

The PA revealed that Bengaluru witnessed large scale encroachment of lakes/drains and depletion of natural drainage systems. The changes in land use such as decrease in vegetation cover and open spaces and increase in built up area resulted in loss of inter-connectivity between water bodies impacting effective recharge of ground water and increase in runoff of storm water. A study by the Indian Institute of Science states that the city (covering an area of 741 sq km) had 1,452 water bodies with a total storage capacity of 35 TMC during early 1800s. By 2016, the number of water bodies in the same area reduced to 194 with a storage capacity of 5 TMC. The current storage capacity which has further declined due to siltation is merely 1.2 TMC (2016). Out of 210 lakes under the jurisdiction of BBMP as at the end of December 2020, 18 lakes with a total area of 254 Acres and 17 guntas were identified as disused lakes; making them vulnerable to encroachments and future conversions.

A robust policy governing storm water management does not exist. The State Government and BBMP failed to consider urban surface runoff (average annual rainfall being 969 mm during 2013-19) as a water resource despite the growing scarcity of water in the State/city. More than 40 *per cent* of properties under the purview of Bengaluru Water Supply and Sewerage Board (BWSSB) failed to adopt mandatory rain water harvesting structures.

The storm water drains of Bengaluru are documented in two different documents prepared by two different agencies – Revised Master Plan 2015 by Bengaluru Development Authority (BDA) and Master plan of drains by BBMP. There were significant discrepancies between these two plans with regard to identification and classification of drains. This deprived the planners of a single source of truth for planning/development of the city. BBMP did not possess fool-proof data on the total number/length and nature of different types of drains under its jurisdiction. The absence of a comprehensive inventory of drains and their proper classification contributed to lack of clarity on critical issues such as the extent of buffer zone to be maintained, *etc.* This in turn hampered maintenance of drains as many utility lines like electrical, telephone, optical cable, *etc.*, were laid across the drains in many locations obstructing flow in the drains.

Comprehensive Detailed Project Reports (DPRs) prepared for improvement of SWDs were reportedly not available with BBMP and the only available revised DPR was deficient. Works executed were either incomplete or were abandoned due to non-availability of required land and poor performance of the contractors. This resulted in BBMP not submitting the Utilisation Certificates and consequent loss of financial assistance of ₹83.59 crore under the Jawaharlal Nehru National Urban Renewal Mission.

Though a large number of works were abandoned and rescinded due to poor performance of contractors, risk and cost clause were not invoked. This led to extension of undue financial benefit of ₹35.31 crore to the contractors. BBMP also resorted to payment of ₹94.93 lakh to an agency without the original records and proper reconciliation under questionable circumstances.

BBMP failed to prepare a SWD manual specifying the design, construction and maintenance of the SWD infrastructure of the city. It failed to factor in reasons for high intensity rainfall due to rapid urbanisation and did not adhere to the provisions of Indian Road Congress and the guidelines of National Disaster Management Authority while designing and constructing roads/drains. Ground water recharge structures were not taken up due to flow of sewage in SWDs. Water bodies and drains were not inter-connected and linkage between different drains was absent. This affected free flow of storm water leading to frequent flooding in various parts of the city.

BBMP executed construction/remodeling of 332 km and maintenance of 308 km of SWDs (primary and secondary) respectively till 2017-18 from out of its own funds and funds received from Central/State Government. The performance audit showed instances of improper and delayed execution of works and execution of SWD works by multiple authorities within BBMP which was fraught with the risk of duplication of claims. It incurred an expenditure of ₹8.51 crore on items of works, which were objected to by audit earlier and though the Committee on Local Bodies and Panchayat Raj Institutions had endorsed Audit's observations. Records such as 'completion plans' and 'as built drawings' and works history registers, which are vital for subsequent planning were absent and basic financial records such as grants register, deposit register, register of securities, schedule of work expenditure,

register of advance *etc.*, were not maintained. This was indicative of a weak financial control mechanism within BBMP.

Rampant mixing of sewage (780 MLD) with storm water is a serious problem. Sewerage lines were drawn inside the SWDs and large quantity of sewage was illegally let into SWDs. Joint inspection of drains confirmed the existence of sewerage lines within SWDs and sewage being discharged into the SWDs directly or through fractured manholes at many places. Since the water in SWDs is not treated in the same manner as sewage, the untreated sewage is flowing into water bodies and affecting the quality of ground water adversely. This carries substantial risk of spurt in vector/water borne diseases such as dengue, typhoid, cholera, hepatitis, *etc.*, and adverse environmental outcomes including disappearance of biodiversity and aquatic ecosystems. The Chief Health Officer (Public Health), BBMP confirmed an outburst of cholera in the city during March 2020 and stated that seven out of the 25 suspected cases had been confirmed as cholera. He, *inter alia*, attributed sewage flowing in open SWDs to the spreading of the epidemic.

The Revised Master Plan 2015 and NGT directions stipulated a buffer zone on either side of primary, secondary and tertiary drains and the statutory provisions stipulated putting in place boundary marks for such descriptions. None of the test-checked drains, though had such boundary markings. This led to encroachment of drains as well as construction in buffer zone. BBMP was yet to take action on 714 out of the 2,626 identified encroachments. The completeness and reliability of the data on encroachments available with BBMP was low as audit noticed significant instances of encroachments, in addition to those recognised by BBMP. Removal of encroachments was incomplete.

Severe blockages of surface drains/SWDs indicated absence of periodical inspections as well as its regular maintenance of drains. BBMP failed to adopt quality monitoring measures and install Sewage Treatment Plants, despite Court directives leading to continuous contamination of water bodies. BBMP did not take up any information, education and communication activities/awareness camps for educating people regarding importance of SWDs and their proper upkeep and did not enforce penal provisions for violation/dumping of debris in SWDs. Consequently, BBMP failed to protect and maintain the drain infrastructure resulting in continuous misuse of the drains.

List of recommendations

1. The State Government/BBMP should formulate a comprehensive policy which clearly recognises urban runoff as a potential source of water requiring clear plan of action for conservation in consonance with the NDM guidelines.
2. BBMP should prevent further reduction in water bodies and length of the natural drains and ensure inter-connectivity of water bodies for proper conservation of the ecosystem as well as ground water.
3. BBMP and BWSSB should jointly prepare a plan of action to prevent sewage flow into SWDs within a definite time schedule and the implementation thereof should be monitored by the State Government.
4. The State Government/BBMP should explore the possibility of letting the treated water to the water bodies in the city to prevent drying up of water bodies and to aid in enhancing ground water recharge.
5. The State Government/BDA should take immediate action to finalise and notify the revised master plan to prevent encroachments of Government assets such as land, water bodies *etc.*, and rectify the omissions with regard to SWDs.
6. BBMP should prepare a comprehensive database of SWDs in coordination with parastatal agencies like BDA, BWSSB *etc.*, to serve as a single source for effective planning and management of SWDs.
7. The State Government/BBMP should ensure that DPRs prepared are comprehensive and realistic and include details such as extent and availability of land, the requirement and sources of fund, coordination with other institutions *etc.*
8. BBMP should initiate immediate action to comply with the instructions of the Government for recovery of risk and cost amounts from all the contractors who have violated norms and blacklist persistent violators. It should initiate action against the concerned officers/officials responsible for non-compliance. It should also put in place adequate and resilient financial controls through proper documentation.
9. BBMP should maintain all the basic records to ensure proper accounting and comply with the statutory provisions for transparency in implementation and execution of works.

10. The State Government should conduct a detailed investigation into the issues regarding preparation of incomplete and deficient DPRs, loss of files by SWD division, payments made under questionable circumstances and take appropriate action based on the findings of the investigation.
11. BBMP should factor in all parameters such as rainfall pattern, increase in impervious layers, decrease in vegetation *etc.*, while designing and executing the roads and drains to increase ground water recharge and prevent flooding. It should ensure strict adherence to the guidelines and norms prescribed for construction of roads/drains.
12. BBMP should prepare action plans, comprehensive project reports, completion plans *etc.*, maintain a works history register and repository of all such records for future use in planning and implementation
13. Since SWD works are identified as emergency works, BBMP should ensure that the works are completed within the prescribed time schedule. It should also consider establishing a separate technical wing for meticulous scrutiny of the estimates to ensure execution of works economically and efficiently.
14. The State Government should ensure strict action against the officers/officials responsible for non-compliance with Government instructions and Committee recommendations. Care should be taken to avoid excess/avoidable payments to contractors.
15. The State Government should conduct an independent verification of the status and quality of all SWD works to ensure their quality and completion.
16. BBMP should accord high priority to prevent discharge of sewage into SWDs. There is a need to prepare and execute (i) medium term strategy for complete cessation of sewage contamination of storm water and lakes eventually and (ii) a short term strategy for installation of sewage treatment plants in coordination with BWSSB to prevent contamination of water bodies.
17. BBMP needs to escalate its efforts to conduct robust surveys to identify and evict all encroachments on SWDs and maintain the stipulated buffer zone.
18. BBMP should put in place an adequate mechanism to conduct and document periodical inspection and maintenance of all categories of drains.
19. BBMP should educate the urban population on the effects of improper management of SWDs and explore the possibility of involving Residential Welfare Associations/Non-Government Organisations for effective management of waste/drains and providing them with incentives.
20. BBMP should prepare the budget clearly indicating the scheme-wise receipts of funds and expenditure incurred thereon and for both capital and revenue activities under each function.

1 Chapter

Introduction

1.1 Introduction

Storm water is that portion of precipitation that does not naturally percolate into the ground or evaporate, but flows via overland flow, interflow, pipes and other features of a storm water drainage system into a defined surface water body, or a constructed infiltration facility¹. Storm water management is the control and use of storm water runoff. It includes planning for runoff, maintaining storm water systems, and regulating the collection, storage, and movement of storm water. Storm water management should also factor in drainage in the design of cities and housing developments. The drainage system should best preserve or mimic the natural hydrologic cycle and fit within the capacity of the existing infrastructure.

1.2 Geography of Bengaluru

Bengaluru is located at 12.59° north latitude and 77.57° east longitude, almost equidistant from the eastern and western coast of the South Indian peninsula, and is situated at an altitude of 920 metres above mean sea level. The mean annual total rainfall as per an Indian Institute of Science (IISc) study² (henceforth referred to as 2017 study) is about 880 mm with about 60 rainy days a year over the last ten years. Bengaluru is located over ridges delineating four watersheds, viz. Hebbal, Koramangala, Challaghatta and Vrishabhavathi. The catchment area of major valleys of Bengaluru is shown in **Chart 1.1**.

1.3 Storm water drainage network in Bengaluru

Bruhat Bengaluru Mahanagara Palike (BBMP) spread over an area of 741 square kilometre (sq km) is demarcated into eight³ zones. As per the records of the Chief Engineer, Storm Water Drains (SWD), BBMP has a total drain network (primary and secondary drains only) of 842 kilometre (km). However, as per the master plan of drains also prepared by BBMP, the total length of drains was 856.74 km which includes the length of drains that are outside the jurisdiction of BBMP but are considered for hydraulic analysis purposes only. BBMP did not have on records the length of the tertiary drains under its

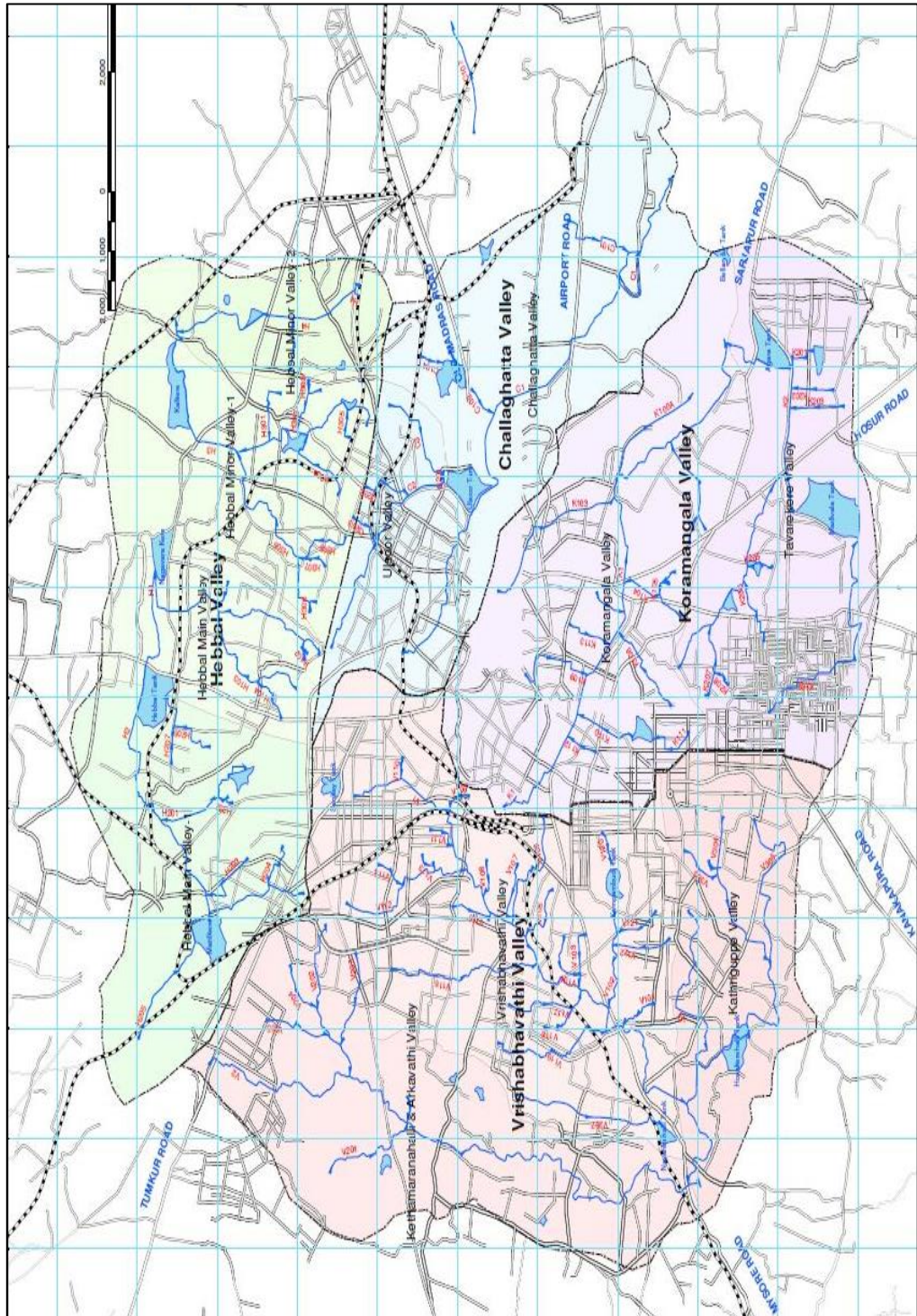
¹ National Disaster Management Guidelines: Management of Urban Flooding. A publication of the National Disaster Management Authority, Government of India. ISBN: 978-93-80440-09-5, September 2010, New Delhi.

² Ramachandra T V, Vinay S, Bharath H. Aithal, 2017. Frequent Floods in Bangalore: Causes and Remedial Measures, ENVIS Technical Report 123, Environmental Information System, CES, Indian Institute of Science, Bangalore 560012

³ Bengaluru East, Bengaluru South, Bengaluru West, Bommanahalli, Byatarayanapura, Dasarahalli, Mahadevapura and Rajarajeshwari Nagar.

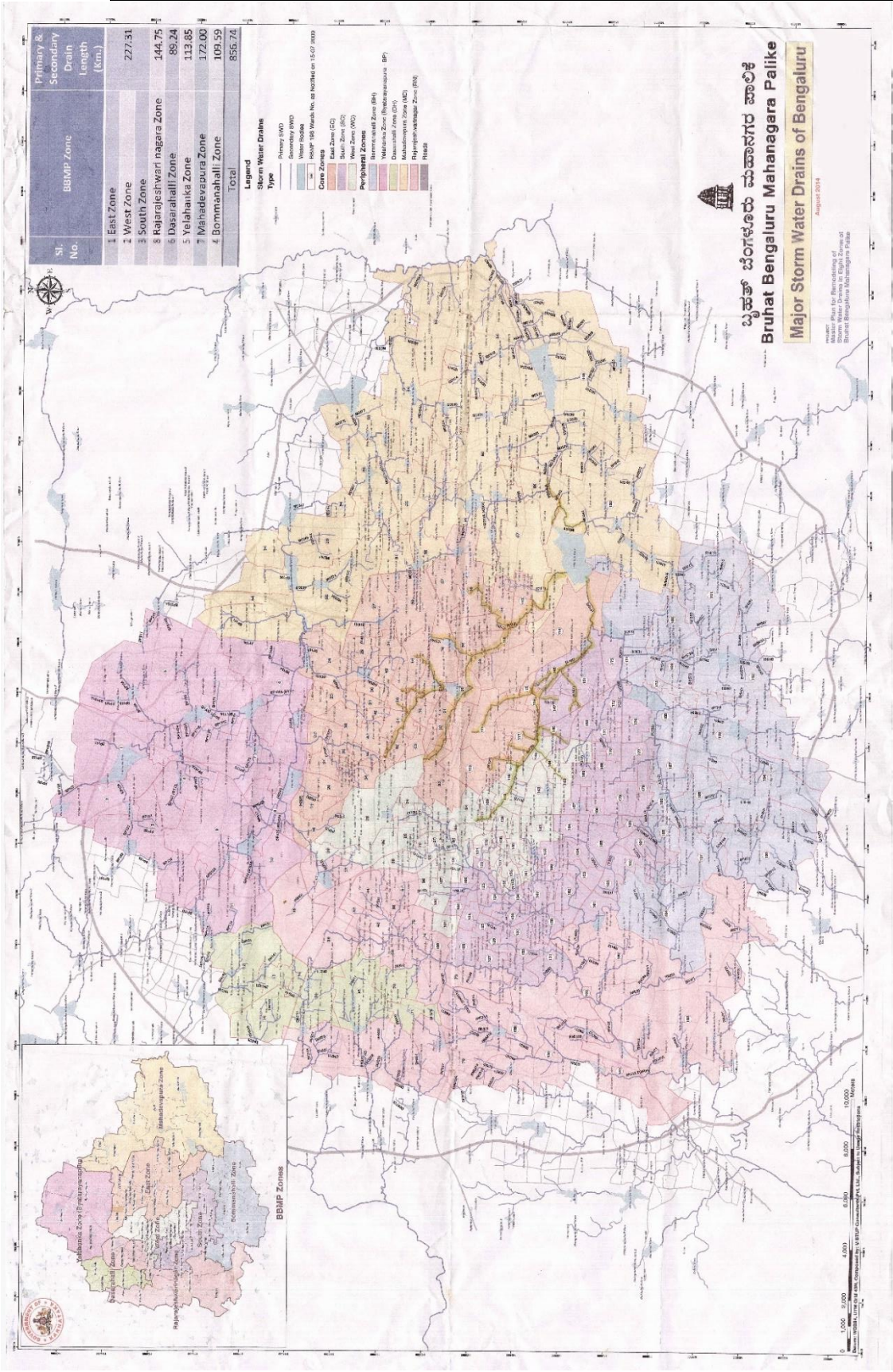
jurisdiction. Even the drainage network map of BBMP has no mention/sketch of the tertiary drains. The storm water drainage network under BBMP is depicted in **Chart 1.2**. Zone-wise maps showing the drains is exhibited in **Appendix 1.1**.

Chart 1.1: Map showing the catchment of major valleys of Bengaluru



Source: CE, SWD, BBMP

Chart 1.2: Map depicting Storm Drainage Network under BBMP



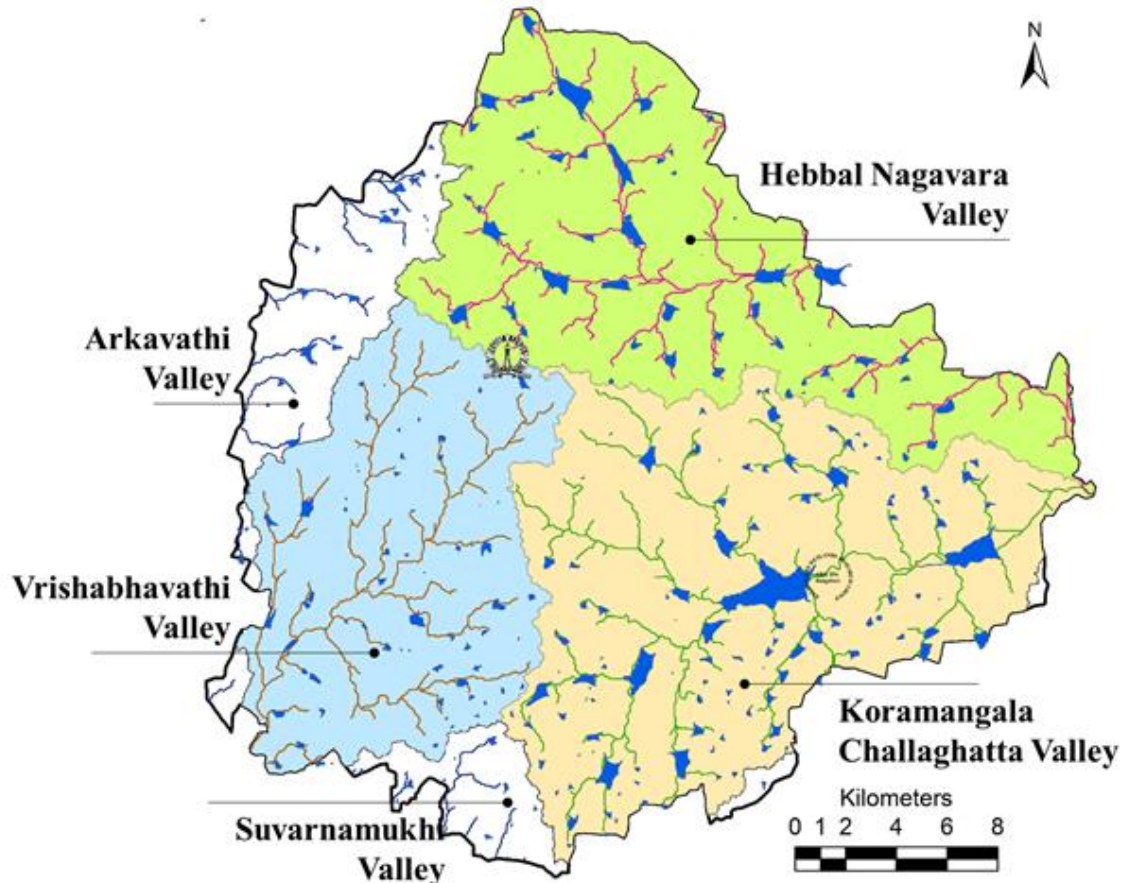
Source: CE, SWD, BBMP

1.4 River and lake network in Bengaluru⁴

The undulating terrain of Bengaluru city (varying from about 700 m to about 962 m above mean sea level) has led to the formation of interconnected lakes. By design, these lakes were all interconnected with canals/drains to enable the transfer of excess water to the next lake. These lakes catered to basic needs such as maintaining and recharging ground water, drinking water, habitat for fish and other aquatic life and agricultural activities.

Bengaluru being located on the ridge, forms three watersheds as precipitation flows as runoff in three directions along the valleys (**Chart 1.3**) – Koramangala-Challaghatta valley (K&C valley), Hebbal valley and Vrishabhavathi valley. Both K&C valley and Hebbal valley join at Nagondanahalli village (BBMP Ward 94 – Hagadur) which further flows to Dakshina Pinakini river while Vrishabhavathi valley joins Arkavathi river which is a tributary of river Cauvery.

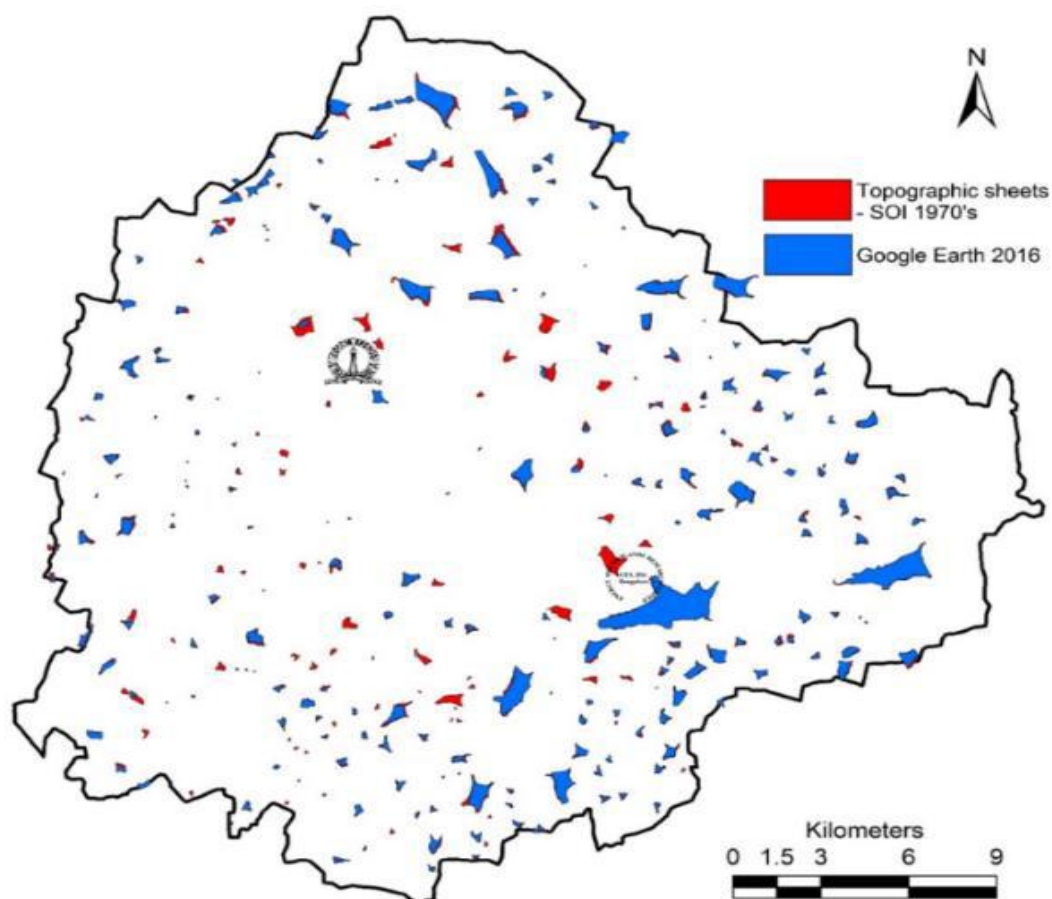
Chart 1.3: River and lake network along major valleys



⁴ Study on Water situation in Bengaluru - Ramachandra T V, Vinay S, Durga Madhab Mahapatra, Sincy Varghese, Bharath H. Aithal, 2016. Water situation in Bengaluru, ENVIS Technical Report 114, Environmental Information System, CES, Indian Institute of Science, Bengaluru 560012

As per the study on Water situation in Bengaluru (henceforth referred to as 2016 study), the city had 1,452 water bodies with a total storage capacity of 35 TMC (thousand million cubic feet) (in the current spatial extent of 741 sq km) during early 1800s. By 2016, the number of water bodies in the same area reduced to 194 with a storage capacity of 5 TMC. Due to siltation, the current storage capacity further decreased to 1.2 TMC (2016). The status of lakes in Bengaluru is given in **Chart 1.4**.

Chart 1.4: Status of lakes in Bengaluru

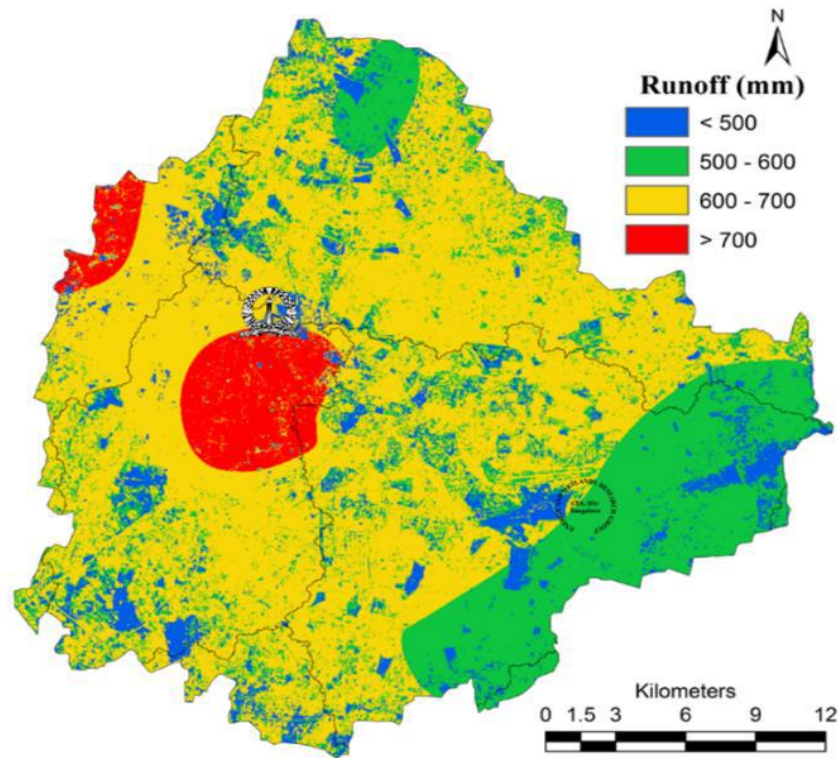


(Red colour indicates lost lakes between 1970's and 2016)

1.5 Rainfall and runoff yield in Bengaluru

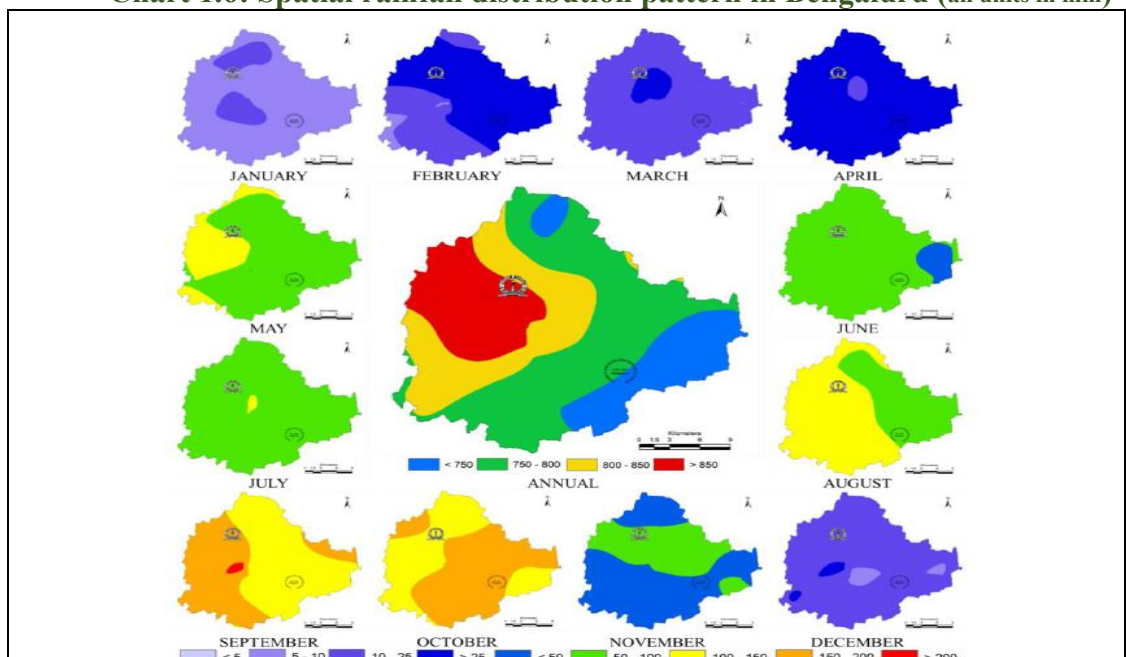
The average annual rainfall in Bengaluru is about 787 mm with 75 per cent dependability and return period of five years. The runoff yield is in the range of 600-700 mm in most of Bengaluru as indicated in **Chart 1.5**. Catchment wise water yield analysis indicates about 49.5 per cent of water yield in the Vrishabhavathi valley, followed by 35.2 per cent in K&C valley and 15.3 per cent in Hebbal valley. The total annual water yield in Bengaluru is about 14.80 TMC.

Chart 1.5: Runoff yield in Bengaluru (mm/year)



Considering the rainfall data for 115 years between 1901 to 2015, the 2016 study reports that the rainfall in Bengaluru was spread across seven months (i.e., 87 per cent of rainfall occurs between the months of May and November, September being the highest with average rainfall of 156 mm). The spatial monthly rainfall distribution pattern is depicted in Chart 1.6.

Chart 1.6: Spatial rainfall distribution pattern in Bengaluru (all units in mm)

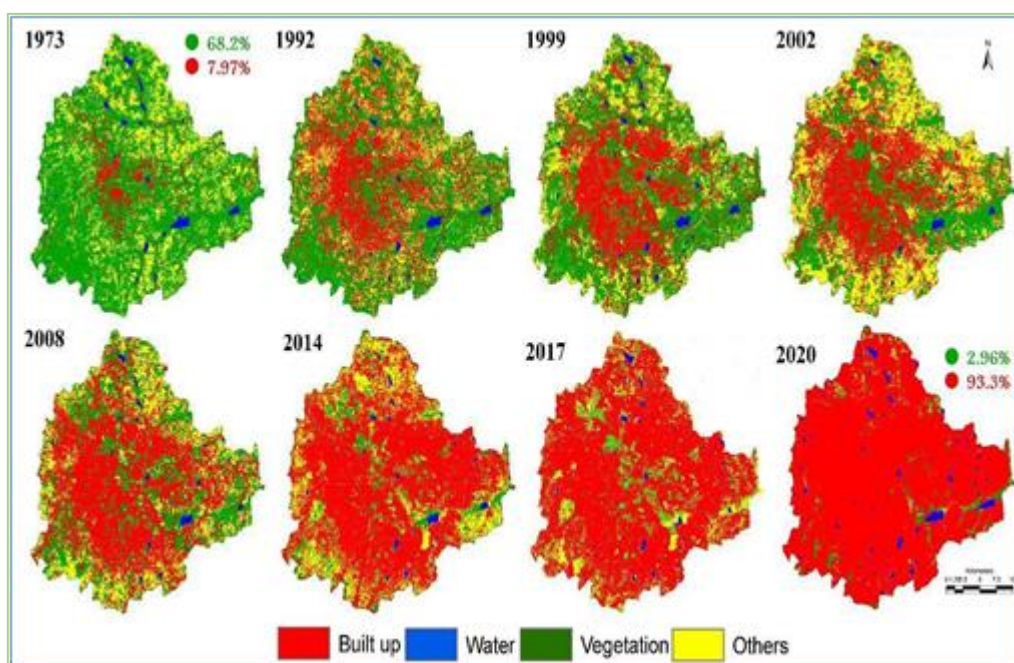


The 2016 study also estimates the requirement of water for domestic consumption at 20.08 TMC. Ideally, about 73 per cent of Bengaluru's water demand can be met out of rain water. Steps towards achieving this would include rejuvenating of lakes and re-establishing inter connectivity, treatment of sewage generated in households, rainwater harvesting, etc.

1.6 Need for storm water management

Bengaluru is experiencing rapid urbanisation. Accelerated growth has resulted in population increase and consequent pressure on infrastructure and natural resources leading to encroachment of water bodies/drains and depletion of natural drainage systems. Increase in concretisation and impervious layer results in increase of storm water runoff. The higher the runoff, the more the flooding. A 2017 IISc study estimated an increase of more than 1,000 *per cent* urbanisation since 1970s and an alarming decrease in vegetation cover (88 *per cent*) and water bodies (79 *per cent*) during the same period. The change in land use in Bengaluru as per the above study is depicted in **Chart 1.7**.

Chart 1.7: Land use dynamics in Bengaluru



The frequency of floods has increased over the years and has become a regular phenomenon resulting in submergence of low areas causing water stagnation at several locations, restricting pedestrian movements, traffic holdups for several hours, and extensive damage to public property. The need for effective storm water management is thus paramount.

Effective storm water management provides environmental, social and economic benefits to local communities. When storm water is managed well, streams, rivers and lakes are cleaner; flood risks are reduced; costs due to flood damage decrease and quality of community life increases.

1.7 Organisational structure for management of storm water drains in Bengaluru

The Urban Development Department (UDD) headed by Additional Chief Secretary (ACS) to Government of Karnataka is the controlling department for all Urban Local Bodies in the State, including BBMP. The Commissioner, BBMP is responsible for enforcing and overseeing the implementation of storm water management under the BBMP area. The Commissioner is assisted by Special Commissioner (Projects), Engineer-in-Chief and Chief Engineer (SWD). For the management of SWDs, the BBMP is divided into nine zones⁵ each headed by an Executive Engineer (EE).

⁵ Bengaluru East, Bengaluru South, Bengaluru West, Bommanahalli, Byatarayanapura, Dasarahalli, Koramangala, Mahadevapura and Rajarajeshwari Nagar.

2 Chapter

Audit Framework

2.1 Audit objectives

The main objectives of the PA were to ascertain:

- Whether there exists an adequate mechanism for collection and conservation of storm water;
- Whether storm water management was efficient and effective in terms of planning, designing and construction of required infrastructure;
- Whether the protection and monitoring of storm water management systems were effective; and
- Whether funds provided for management of storm water were utilised efficiently, economically and as per relevant rules.

2.2 Audit criteria

The main sources of audit criteria for the PA were:

- Indian Road Congress (IRC) SP:50 of 1999 and 2013 – Guidelines on Urban Drainage;
- National Disaster Management Guidelines: Management of Urban Flooding (September 2010) (NDM Guidelines);
- Karnataka Town and Country Planning Act, 1961
- Revised Master Plans (RMP) of Bengaluru Development Authority;
- Karnataka Municipal Corporation Act, 1976;
- Karnataka Transparency in Public Procurement (KTPP) Act/Rules, Karnataka Financial Code, Karnataka Public Works Departmental and Accounts Code; and
- Government orders, court judgments, executive instructions and circulars issued from time to time.
- Research and study reports of Indian Institute of Science and other reports

2.3 Audit scope and methodology

The PA covering the period 2013-14 to 2017-18 was conducted through test-check of records (April-August 2018) in the Office of the Commissioner, BBMP and Chief Engineer, SWD. Relevant information was also gathered

from Bengaluru Development Authority (BDA), Bengaluru Water Supply and Sewerage Board (BWSSB), Karnataka State Natural Disaster Monitoring Centre (KSNDMC), Department of Revenue, Karnataka Lake Conservation and Development Authority (KLCDA).



Two valleys - Vrishabhavathi and Koramangala which included drain length of 467.10 km were selected for detailed scrutiny. Audit adopted random sampling for selection/analysis of works and conducted joint physical inspections with BBMP officers/officials along approximately 70 drains⁶ (under the six zones of the selected two valleys) to examine the status of drains (drains were physically inspected traversing along the stretch, wherever accessible). A few illustrative videos taken during joint inspection have been included in the report at relevant places by providing the link and also the QR code for scanning.

An entry conference was held (4 April 2018) with ACS, UDD to discuss the audit objectives, scope and methodology. The results of the PA were discussed with the ACS, UDD in an exit conference held on 6 December 2018. The State Government furnished its replies on 8 January 2019. Audit verified the actions and corrective measures stated to have been initiated as per the reply during November-December 2019 and the updated position has been incorporated wherever applicable. The State Government furnished revised replies on 6 August 2020, which have also been incorporated at appropriate places.

2.4 Joint study on geospatial data along with Regional Remote Sensing Centre, ISRO

Audit conducted an independent study of long term changes in land use patterns utilising geospatial inputs with technical support from Regional Remote Sensing Centre–South, Indian Space Research Organization, Bengaluru (RRSC). Geospatial technology can provide valuable inputs and tools for mapping and monitoring of natural resources. The monitoring abilities of Remote Sensing (RS), Geographical Information System (GIS) and Global Positioning System (GPS) technologies are valuable for the tracking of dynamics of land use over a period of time.

The aim of the study was to understand the potential application of geospatial and collateral data for generation of inputs for audit. Time series maps were generated using geospatial and ancillary data to analyse significant land use changes covering Koramangala and Vrishabhavathi valleys (out of four valleys).

Methodology adopted for the study

Spatial databases containing building foot prints, road network, lakes, drainage network and sewer lines in vector format obtained from BBMP, BDA and other departments were used for the analysis. The spatial information about natural and artificial features was created/updated to create time series data of lakes, drains, roads, buildings, vegetation and open land layers. These were analysed to understand the changes in land use patterns.

⁶ In addition, few unmapped drains were also inspected.

The work was done by way of superimposition of Satellite Images of 1960 (Corona imagery), 2008 satellite imagery and 2016/2017 satellite imagery and identifying and quantifying the changes in land use and land cover. Shape files (.shp files) of natural and artificial feature layers - built up layer, roads layer, lakes and tanks layer, drainage network layer and open lands layer were created/updated. Details of counts, lengths and areas of these features were generated by way of summaries and statistics of the geospatial features using tools available in the ArcGIS. During this study, several points for joint inspection were identified from the imagery such as drains existing but not shown in departmental maps, possibility of mixing of sewage lines and storm water drains *etc.* The time series data of land use changes were prepared from the layers so created for decrease in water bodies and drains, increase in impervious layer, decrease in wetlands/open lands *etc.*, which have impacts on flooding.

Databases: Departmental spatial databases, High Resolution Imagery, e-Procurement database

Tools: ArcGIS

Technical Help, hardware & software provisioning, mentorship: Regional Remote Sensing Centre, ISRO, Bengaluru.

Field visits and joint inspections substantiated the outcomes of this study. The findings of the study are incorporated at relevant places in this Report.

2.5 Acknowledgement

Audit acknowledges the cooperation and assistance extended by the State Government, BBMP, BDA, BWSSB, KSNDMC and Regional Remote Sensing Centre–South, Indian Space Research Organization, Bengaluru in conducting the performance audit.

2.6 Audit constraints

Absence of complete set of records in the office of the CE, SWD of BBMP (commented at various places in the report) hampered audit analysis. Hence, the findings of the joint physical inspections documented in the form of photographs formed the basis for highlighting the impact of insufficient storm water management. The findings have been substantiated with references to various studies conducted by the Indian Institute of Science, Bengaluru, Media Reports and official tweets of the traffic department.

The State Government, in its reply, cited the continuous flow of sewage in the SWDs as the main reason for not taking up many of the activities envisaged such as ground water recharge structures, restoring interconnectivity among water bodies and drains *etc.*, which are vital for effective storm water management. It further stated that BWSSB was in the process of segregation of sewage from SWDs but did not provide the details of works taken up, the action plan drawn and proposed to be drawn to prevent mixing of sewage with storm water and the time frame within which these works would be completed. In the absence of the details of works taken up for segregation of sewage from

SWDs and a definite commitment from the Government in this regard, audit could not verify the claim of the Government.

2.7 Previous audits

Some of the issues covered in this PA were covered in two earlier performance audits;

- a. SWD works under BBMP were reviewed earlier, as part of the Performance Audit on Jawaharlal Nehru National Urban Renewal Mission (JnNURM) covering the period 2005-06 to 2011-12 and the findings were included in the Report of the CAG of India on Local Bodies (Paragraph 4.1 of Report no.6 of the year 2013-Government of Karnataka). The Committee on Local Bodies and Panchayat Raj Institutions, after discussion, placed its report containing recommendations before the State Legislature (March 2016). The UDD is yet to submit the Action Taken Report on the Committee's recommendations. The gist of the audit observations, recommendations thereon and compliance, if any, is given in **Appendix 2.1**.

The State Government endorsed (January 2019) the reply of Commissioner that the officials who worked between 2006-2010, the projects proposed during that period and the duties/responsibilities of each official at that time were being identified. It further replied that based on the findings by verification of records detailed report on dereliction of duty would be submitted and disciplinary action will be initiated accordingly. However, we noticed that neither the identification of the defaulting officials nor disciplinary action were initiated even as of December 2020. The reply shows BBMP's neglect of the recommendations of the Committee on Local Bodies and Panchayat Raj Institutions. Moreover, the inordinate delay in initiating action against officials responsible for financial loss to BBMP would result in officials going unpunished for reasons such as retirement *etc.*

- b. A Performance audit on "Conservation and Ecological restoration of Lakes under the jurisdiction of Lake Development Authority and Urban Local Bodies" (hereinafter referred to as Report on Lakes) was conducted for the period 2009-14 (Report no. 1 of the year 2015 – Government of Karnataka). The report has been partly discussed by the Committee. The findings of both the reports have been referred to at appropriate places in this report.

2.8 Organisation of audit findings

The findings of the PA have been arranged in line with the audit objectives and are discussed in the following chapters.

Chapter 3: *Collection and conservation of storm water*

Chapter 4: *Planning, designing and construction of storm water drains*

Chapter 5: *Protection and maintenance of storm water management systems*

Chapter 6: *Financial management*

3 Chapter

Collection and conservation of storm water

3.1 Policies and regulatory framework

3.1.1 *Absence of regulatory framework governing storm water management in Bengaluru*

The State formulated (2002) a Water Policy in tune with the National Water Policy, which provides policy guidance for the management of water resources in the State. The Policy stated that the State had experienced a ‘serious destabilisation of the water sector with hydrological, economic and ecological impacts’. The State also has the Karnataka Urban Drinking Water and Sanitation Policy, 2002, with the objective of ensuring universal coverage of water and sanitation services. The State enacted the Karnataka Ground water (Regulation and Control of Development and Management) Act, 2011 to regulate and control the development and management of ground water and matters incidental thereto. There was, however, no regulatory framework specifically governing storm water management. The above policies and acts also do not consider the need for management of storm water.

Further, the National Disaster Management Authority (NDMA), Government of India recognised urban flooding as a ‘disaster different from riverine floods’ and brought out (September 2010) detailed guidelines for Management of Urban Flooding stipulating the institutional framework, designing of urban drainage, mode of disaster risk management *etc.* However, the State Government/BBMP failed to fully comply with the NDM Guidelines, 2010 with regard to urban storm water management as detailed in **Appendix 3.1** and discussed subsequently at appropriate places⁷.

The State Government stated (August 2020) that the Water Resources department had brought out the Water Policy which is in force. The reply was, however, silent on the absence of regulatory framework governing management of storm water and the action proposed to be taken to create such a framework.

3.1.2 *State Water Policy - Urban surface runoff not recognised as a resource*

Government of India brought out the National Water Policy 2012, which laid emphasis on conservation of rivers, river corridors, water bodies and/or associated wetlands, the flood plains, ecological buffer areas to be managed in an integrated manner to balance the environmental and social issues. The State Policy was, however, not updated. The State Policy needs to be revisited, since it does not factor in water sector reforms specially recognising urban water

⁷ Paragraphs 4.1.2, 4.1.3, 4.2.1, 4.2.1.1, 4.2.1.5, 5.1.3, and 5.2.3

runoff as a water resource in the wake of growing scarcity and competing demands on the pattern of the National Water Policy.

The State Government stated (August 2020) that surface runoff was not considered as alternate source of water due to the presence of sewage in the drains. It further stated that once the drain and lakes are free of sewage, urban storm water runoff can be an alternate source of water and this issue has since been touched upon in the Master Plan.

The State Government, however, did not furnish the details of action taken/proposed to be taken to free the drains and lakes from sewage despite the fact that huge quantity of sewage continues to flow into the drains.

Recommendation 1: The State Government/BBMP should formulate a comprehensive policy which clearly recognises urban runoff as a potential resource of water requiring clear plan of action for conservation in consonance with the NDM guidelines.

3.2 Coordination between different institutions

The amendments to KM / KMC Acts enacted by the State Government in 1994 transferred the functions of “roads and bridges”, “water supply” and “public health, sanitation conservancy and solid waste management” to ULBs.

However, the situation on the ground was different and responsibilities were highly fragmented:

- (i) BBMP was responsible for construction, maintenance and cleaning of drains and Solid waste management etc.,
- (ii) BDA was responsible for preparation of Comprehensive Development Plan for Bengaluru metropolitan region and development of infrastructure, and
- (iii) BWSSB was responsible for water supply and sewage disposal within the jurisdiction of BBMP area.

The existence of multiple institutions to carry out various inter-related functions had a negative impact on coordination as indicated in subsequent paragraphs.

3.2.1 Coordination Committee

The State Government had put in place (June 2015) a Coordination Committee which included the Additional Chief Secretary, UDD and all the other stake holders like BBMP, BDA, BWSSB etc., for providing basic infrastructure facilities to the citizens of the city under the Chairmanship of the Chief Secretary. Audit observed that meetings were held regularly only from August 2018 onwards *i.e.*, three years after the constitution of the Committee.

Review of the proceedings of the meetings showed that encroachments of SWDs and mixing of sewage were regular items in the agenda and the Committee had time and again issued instructions to clear encroachments and prevent mixing of sewage in SWDs. The situation, however, remained the same

as large number of SWDs continue to carry sewage. Audit also observed that there was absence of coordination between various institutions.

Illustration

The AEE, SWD division of RR Nagar Zone, BBMP registered (22 October 2020) an FIR against the AEE, BWSSB, Banagiri sub-division alleging that BWSSB had dug up the concrete road (Ward no. 160, 1st cross, 2nd main, Gurudatta Layout, Girinagar, Bengaluru-560062 under RR Nagar Zone) laid by BBMP without obtaining the necessary permission from the respective zonal office of BBMP or SWD division to lay underground drainage pipes and construct manholes. The road had a SWD retaining wall on one side and apartments/houses on the other side. He, further alleged that BWSSB had carried out the work unscientifically and without taking necessary precautions; because of which the road was filled with rain water after the rainfall that occurred on 21 October 2020 which resulted in collapse of the retaining wall and damage to the road thereby putting the public to risk (Exhibit 3.1).

Exhibit 3.1: Damage to SWD retention wall and concrete road



Source: Photographs shared by SWD wing of BBMP

3.3 Storm water collection systems

Lakes inter-connected with canals/drains constitute the basic storm water collection systems for Bengaluru city. Various reports/studies have highlighted the fact that rapid urbanisation has given rise to increasing demand on land which led to pressure on water bodies and uncontrolled developmental activities in the neighbourhood of lakes, which led to

- encroachment of lakes and SWDs resulting in decline in ground water table, while increasing the instances of flooding;
- dumping of solid waste, construction debris etc., in SWDs, lake catchment and in lakes;

- sustained inflow of partially or untreated sewage, polluting existing surface and subsurface water resources;
- reduced water holding capacity due to accumulation of silt, debris etc.; and
- loss of interconnectivity between water bodies.

3.3.1 Management of lakes

Bengaluru city was once aptly known as ‘city of lakes’ due to the presence of large number of lakes. As per the 2016 IISc report, it had around 1,452 water bodies during the early 1800s. These were gradually reduced due to conversions/encroachments as discussed in the subsequent paragraph. The lakes/water bodies in Bengaluru city were under the custody of different authorities such as BBMP, Forest Department, BDA, KLDCA, etc. The Government ordered (September 2016 and December 2019) the transfer of all lakes (except Bellandur and Varthur lakes which remained with BDA) to BBMP. The BBMP did not possess comprehensive data on the actual number of lakes, their status and custodians. As per data furnished (December 2020) by the CE, Lakes Division, BBMP, there were 210 lakes under its jurisdiction. Details are furnished in the **Table 3.1** below.

Table 3.1: Status of maintenance of lakes/water bodies in Bengaluru

Status of lakes	Number of lakes
Developed lakes	89
Work in progress	37
To be Developed	66
Disused lakes	18
Total	210

Source: CE, Lakes Division, BBMP

It could be observed that while 66 lakes were yet to be developed, 18 lakes with a total area of 254 acres and 17 guntas were reported as disused lakes. The current status of the disused lakes as per the Google Earth images is shown in **Exhibit 3.2** and the list of disused lakes is given in **Appendix 3.2**. There is a significant risk of these lakes being vulnerable to encroachments and future conversions.

Audit observed from media reports that many citizen forums concerned about the degraded condition of lakes and SWDs approached the courts and National Green Tribunal (NGT) seeking directions for proper maintenance. However, CE, SWD did not furnish the details of court cases pending or judgments thereon. The Karnataka High Court expressed dissatisfaction (July 2019) with the attitude of the city’s authorities towards its lakes and reprimanded BBMP and other civic agencies for not knowing the number of lakes that existed in the city.

The State Government replied (August 2020) that works were being taken for restoration of lakes in a phased manner. However, the number of active lakes are decreasing over a period of time by way of encroachments and conversion for other purposes as detailed in the subsequent paragraphs. Any delay in taking up the restoration works would lead to further reduction in the number of lakes.

Exhibit 3.2: Current status of disused lakes

(Source: Google Earth images as on 19 January 2021)



Chennamma kere



Chikka Kallasandra kere

Exhibit 3.2: Current status of disused lakes contd....



Doresanipalya kere



Lingarajapuram kere 2000



Lingarajapuram kere 2020

3.3.2 Decrease in water bodies and length of drains

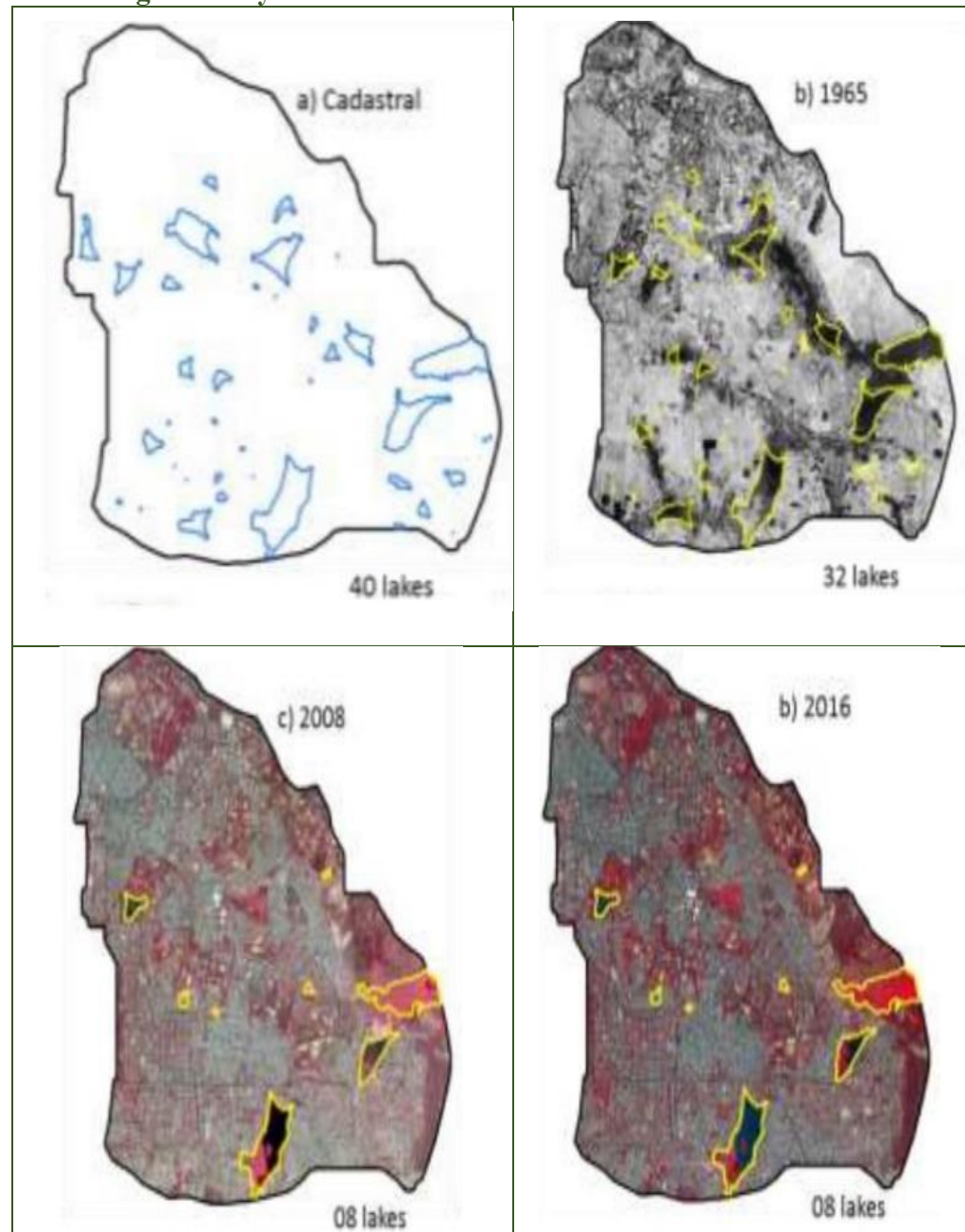
Audit conducted an independent study of long-term changes in land use patterns of Bengaluru city utilising geospatial inputs with technical support from Regional Remote Sensing Centre–South, Indian Space Research Organization, Bengaluru (RRSC). The methodology adopted for the study is already explained in Paragraph 2.4. The study corroborates the fact that urbanisation resulted in decrease in water bodies and length of drains as discussed below.

◆ **Decrease in water bodies**

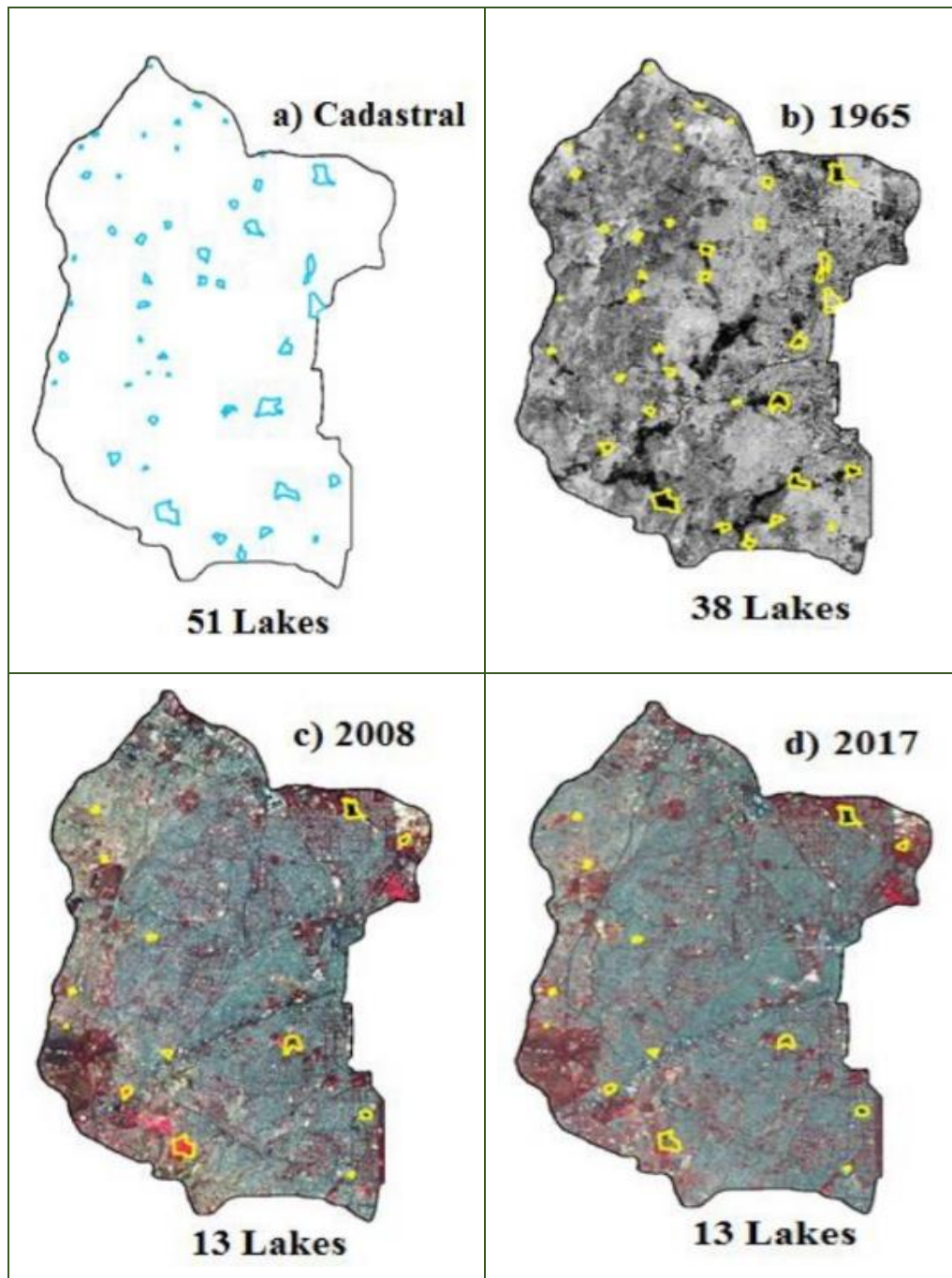
The study revealed that about 41 and 51 water bodies, which existed in Koramangala and Vrishabhavathi valleys respectively as per the cadastral map (prepared through field survey during early 1900s) were reduced to 8 and 13 by the year 2008 indicating the severity of lake conversion. Further, the wetland system (lakes, tanks, *kere* and *katte*), which contributed about 479.48 ha (0.75 per cent) and 215.46 ha (2.24 per cent) to the geographical area of the valleys as per the cadastral map decreased to 262.37 ha and 62.05 ha during 2016/2017 indicating erosion due to land use changes. The time series map showing the changes in lakes/tanks is indicated in **Chart 3.1**.

Chart 3.1: Time series maps showing changes in lakes / tanks

Koramangala valley



Vrishabhavathi valley



The change in size and shape of a few lakes in both the valleys which is indicative of significant reduction of lake foot print is indicated in **Appendix 3.3**. The reduction in the number of lakes can be linked to conversion of lakes for other purposes (**Exhibit 3.3**) such as bus stands, stadiums/sports grounds, National Games village housing complex, residential layouts etc., as indicated in **Appendix 3.4**.

Exhibit 3.3: Conversion of lakes for other purposes

(Source: Photographs taken during field visits)



Kamakshipalya lake converted as sports ground



Dasarahalli tank converted as Dr. B.R. Ambedkar Stadium

Evidently, these conversions were authorised by the State Government, BBMP, BDA *etc.*, over a period of time. Reference is invited to Paragraph 4.4 of the Report on Lakes which refers to instances of irregular grant of lake land to various Government bodies, private parties and others in violation of the codal provisions which resulted in reduction of lake area. These conversions also resulted in the change in land use from being pervious to impervious thereby leading to higher runoff of rain water and consequent flooding.

Further, a Legislative Committee⁸ constituted to study the status of encroachments on lakes/water bodies in Bengaluru and its surroundings covering the period 2014-2017, in its report revealed unabated encroachments of most of the water bodies, both by government departments/agencies and private parties, leading to diminishing boundaries of wetlands besides pollution of the ecosystem. The major encroachers among government agencies were Education department, Forest department, BDA, BWSSB, BBMP, Bengaluru Electric Supply Company, Bengaluru Metropolitan Transport Corporation, Karnataka Housing Board, Railways, Defence authorities, National Highways, *etc.*

The Committee expressed dissatisfaction particularly with the BDA, forming residential layouts over as many as 23 water bodies without obtaining the permission from the Revenue Department. The Committee attributed degeneration of water bodies to the negligence and irresponsibility of officials and recommended action against the offenders through a judicial investigation.

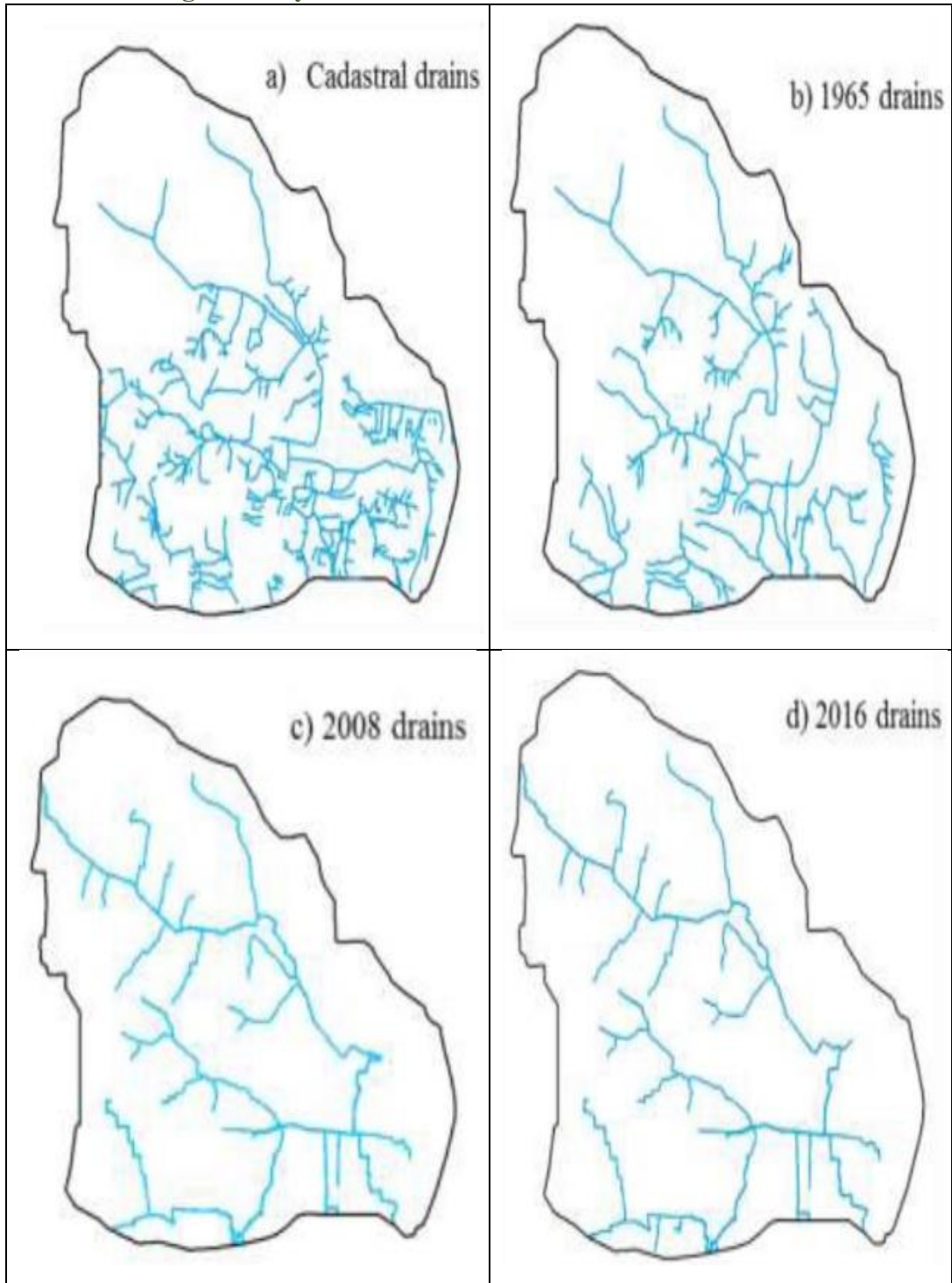
◆ **Reduction in length of drains**

Natural drainage/stream systems were concretised into storm water drains with increase in urbanisation. As per the study, total length of drains (primary and secondary) as per cadastral maps (early 1900s) was 113.24 km and 226.29 km in Koramangala and Vrishabhavathi valleys respectively, which was reduced to 62.84 km and 111.72 km by 2016/2017. The time series drainage maps showing the changes is indicated in **Chart 3.2**.

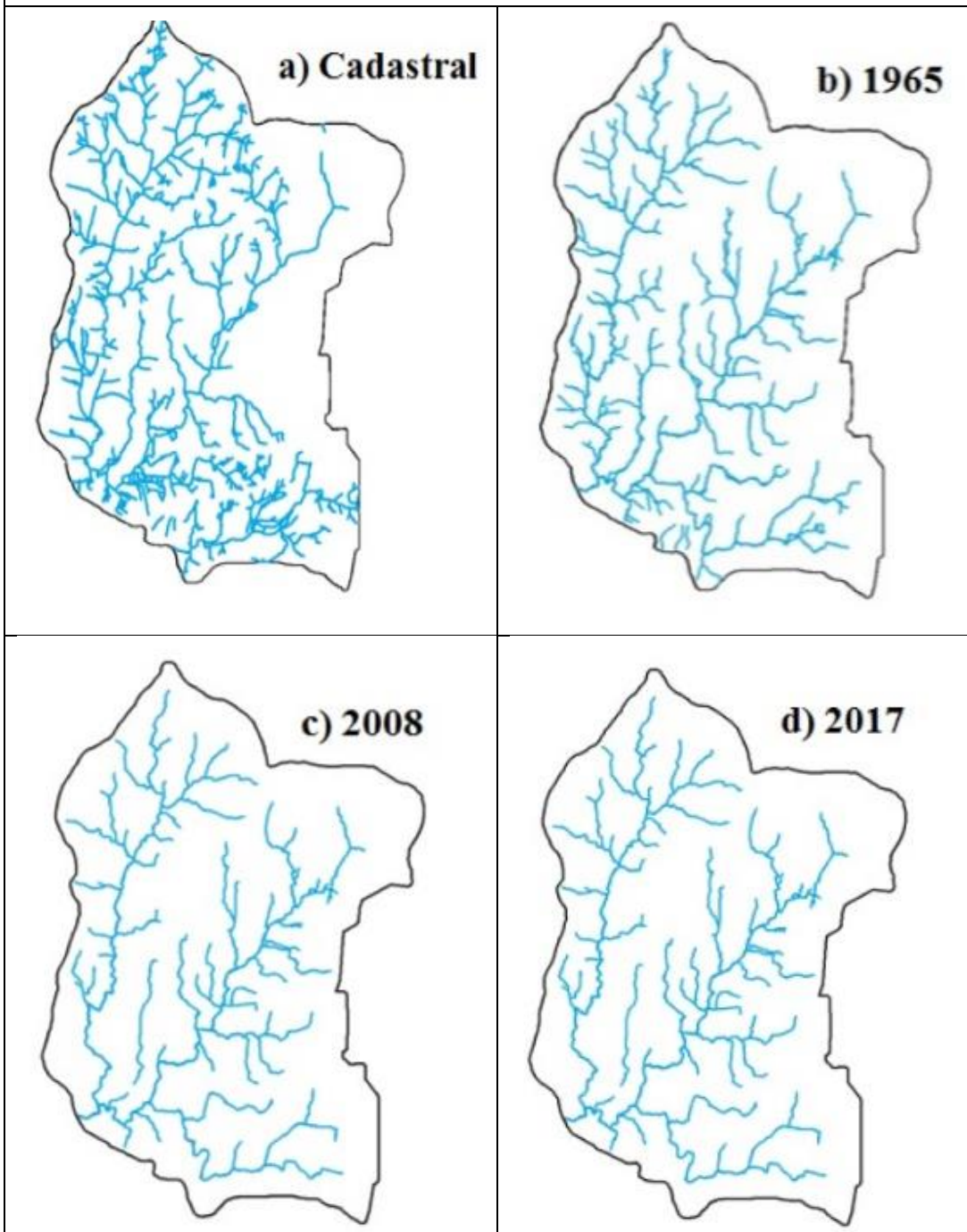
⁸ Headed by Sri..K.B Koliwad, the then Hon'ble Speaker of Karnataka Legislative Assembly.

Chart 3.2: Time series drainage maps

Koramangala valley



Vrishabhavathi valley



The spatial analysis also showed significant changes in the alignment of drains mainly due to remodelling. For example, in Koramangala valley, the length of two drains which merge before entering into Bellandur Lake was reduced from 338 m to 136 m (**Exhibit 3.4**) between the years 2008 and 2016 which allowed constructions thereby affecting the free flow of storm water. In Vrishabhavathi valley, the drain passing along the border of Hosakerehalli lake was remodeled and diverted to flow through the lake thereby reducing the area of the lake (**Exhibit 3.5**).

Exhibit 3.4: Realignment and remodelling of drainage network near Bellandur Lake

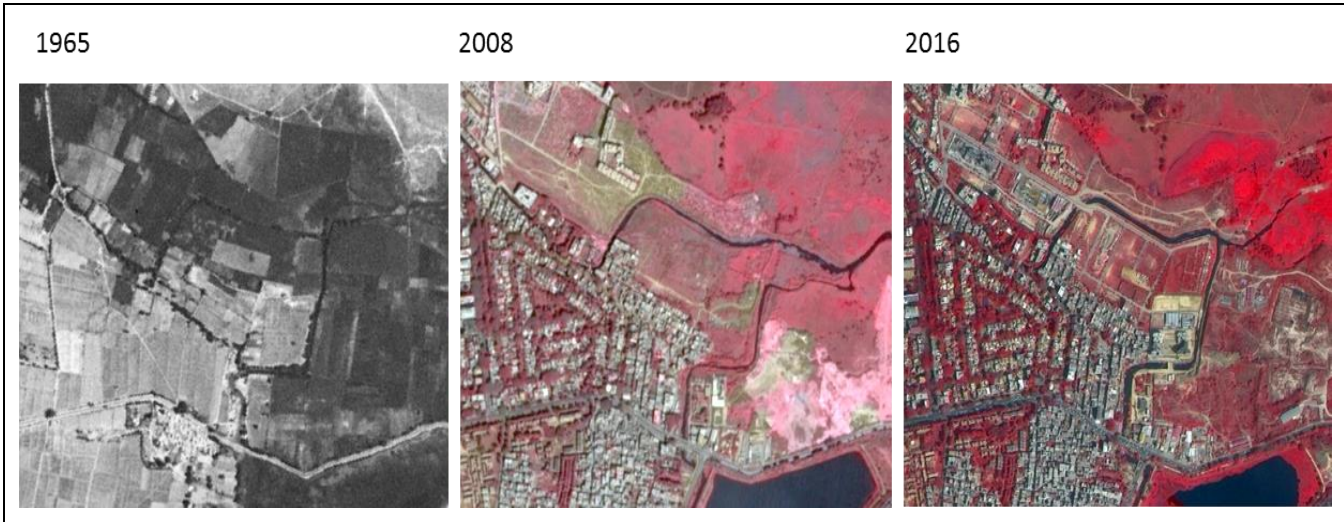
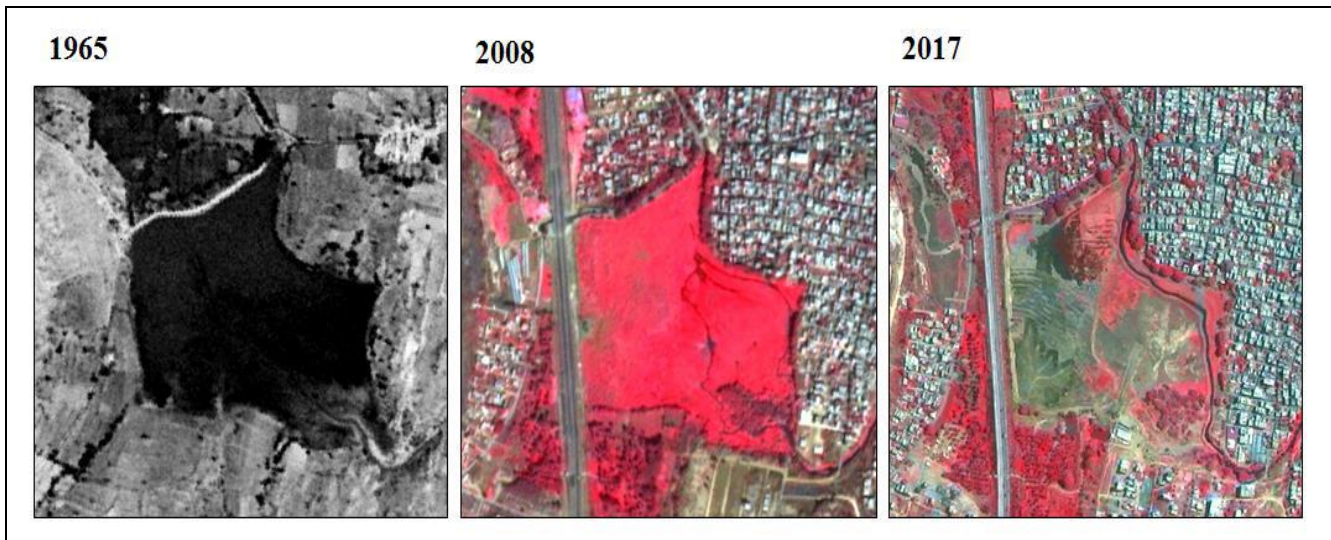


Exhibit 3.5: Realignment of drainage network near Hosakerehalli Lake



Physical verification of few storm water drains revealed that the drains were covered and encroached upon as indicated in **Appendix 3.5**.

The State Government stated (August 2020) that some of the drains were remodeled based on the geographical conditions of the site and for allowing smoother flow.

The reply cannot be accepted as in the instant case of Bellandur lake, the realignment was done in such a manner that it facilitated unauthorised developments in and around the lake area as can be seen from the Google Earth images taken over a period of time as exhibited (**Exhibit 3.6**).

Exhibit 3.6: Google earth images showing the realignment of drains

As at April 2012



As at October 2012



As at March 2014



As at February 2020



Further, large number of SWD work files relating to JNNURM were not on the records of CE, SWD, BBMP and were not furnished to audit; in the absence of which the exact reasons for modifications could not be ascertained.

The State Government further stated (August 2020) that a number of measures were yet to be taken to counter increased runoff.

3.4 Storm water conservation systems

Storm water is best managed through ground water recharge and rainwater harvesting techniques.

3.4.1 Ground water recharge

Groundwater recharge is both natural and artificial. Groundwater is recharged naturally by rain and snow melt and to a smaller extent by surface water (rivers and lakes). This helps in aquifer recharge as well. Natural replenishment of ground water reservoir is a slow process and is often unable to keep pace with

the excessive and continued exploitation of ground water resources resulting in declining ground water levels and depletion of ground water resources. Artificial recharge efforts are basically aimed at augmentation of the natural movement of surface water into ground water reservoir through suitable civil construction techniques. Rainfall and runoff available constitute major sources of water for artificial recharge of ground water. The common recharge structures comprise of percolation ponds/tanks, check dams, recharge pits, injection wells etc.

While the above recharge structures help in replenishing the ground water to a certain extent, a large quantity of storm water runs off the impermeable, non-porous and concrete surfaces in urban areas. This surface runoff is to be conveyed/channeled either to the lakes/rivers or to inlets and recharge structures through SWDs to prevent flooding and aid in ground water recharge. An efficient, well designed/maintained SWD system would minimise the level of water logging and damage, and therefore play an important role in storm water management. In the backdrop of depleted ground water in urban conglomerates, the IRC guidelines stipulated that all SWDs should be efficiently utilised for the benefit of raising the existing ground water table.

BBMP neither had a policy in this regard nor had taken up works relating to recharge structures for replenishment of groundwater.

The State Government stated (August 2020) that implementation of recharge structures was deferred due to sewage flow in the drains.

3.4.2 Rainwater harvesting

The State Government made rainwater harvesting (RWH) mandatory in Bengaluru Urban Area by inserting Section 72A through an amendment to the Bangalore Water Supply and Sewerage Board Act, 1964 (August 2009). After a delay of nearly two years, the State Government notified (May 2011) that the owners and occupiers of residential and non-residential buildings as specified shall comply with providing rain water harvesting structures by 31 December 2011.

As per the information furnished (February 2020) by BWSSB, about 2.12 lakh properties were required to adopt RWH structures out of the total 9.85 lakh properties under the purview of BWSSB. However, only 1.27 lakh properties had adopted RWH structures. The compliance thereof was 60 *per cent*. Non-adoption of RWH structures resulted in failure to tap a potential source of water for storage and adequate ground water recharge. This, in turn, contributed to excess runoff in SWD systems. Further, adoption of RWH structures was not made mandatory for areas/properties not covered by BWSSB.

The State Government stated (August 2020) that measures required for ground water recharging has been indicated in the master plan of drains and the same is being implemented by BWSSB. The reply cannot be accepted as BWSSB is catering to less properties when compared to the properties under the overall jurisdiction of BBMP.

3.4.3 Loss of interconnectivity between water bodies/drains

The reduction in water bodies and drains led to loss of connectivity between water bodies and between water bodies and drains. Joint inspection of drains showed that the SWDs were not directly connected to water body/lake in few cases and the runoff was flowing in constructed deviation canals adjacent to the water body due to the fact that SWDs were carrying large quantity of sewerage. This facilitated overflows in SWDs channels and flash floods thereon.

Failure of BBMP to ensure linkage of drains with water bodies facilitated drying up of a number of lakes in Bengaluru city which in turn facilitated conversion of lakes for other purposes as discussed in Paragraph 3.3.2.

The State Government stated (August 2020) that many of the lakes were disconnected from the drains due to presence of sewage in the SWDs. It also stated that as BWSSB was in the process of segregation of sewage from SWD and implementing sewerage system in the new BBMP zones, the sewage flow in the drain may get minimised.

Though BWSSB was undertaking the segregation of sewage from SWDs as stated in the reply, the flow of sewage into the SWDs continues to be substantial.

***Recommendation 2:** BBMP should prevent further reduction in water bodies and length of the natural drains and ensure inter-connectivity of water bodies for proper conservation of the ecosystem as well as ground water.*

***Recommendation 3:** BBMP and BWSSB should jointly prepare a plan of action to prevent sewage flow into SWDs within a definite time schedule and the implementation thereof should be monitored by the State Government.*

3.4.4 Recharge of water bodies

Recharging the existing water bodies not only helps in ground water recharge but also caters to needs such as drinking water, agricultural activities and habitat for fish and other aquatic life. Hence it is imperative that the existing water bodies be protected for which a definitive plan of action is to be drawn. Out of the 210 lakes under the jurisdiction of BBMP, only 89 lakes were developed, and works were in progress for 37 lakes.

Analysis of the works in progress showed that rejuvenation activities such as desilting, formation/improvements of main and ring bunds, inlet improvements, creation of sewage diversion drains, walkway formations, security rooms *etc.*, were taken up. While these activities help in restoration of the lakes, activities relating to actual recharging of the water bodies were not taken up. The Government of Karnataka had adopted a method of recharging dry water bodies by letting the treated water into the water bodies⁹. This would ensure that all

⁹ In 2010, in respect of Jakkur lake, rejuvenation work was done by the Government where treated water was let into the lake for the purpose of groundwater recharge, agricultural activities *etc.* Since it was successful in respect of Jakkur lake, the filling up of water bodies in Kolar and Chikkaballapura districts were also taken up with treated water.

the inter-connected water bodies would be filled up which in turn would prevent disuse of lakes and their possible encroachments and conversions. This treated water combined with rain water would percolate into the ground and increase the ground water level. It was observed that an average of 170 and 73 MLD of treated sewage water were being pumped to water bodies in Kolar and Chikkaballapura districts respectively.

Recommendation 4: *The State Government/BBMP should explore the possibility of letting the treated water to the water bodies in the city to prevent drying up of water bodies and to aid in enhancing ground water recharge.*

3.4.5 Impact of concretisation of storm water drains on ground water recharge

Natural soil bed inside SWDs would help reducing velocity of flow as well as infiltration leading to ground water recharge.

Joint physical verification and verification of records relating to execution of works for improvements to SWDs revealed that the flow path/bed of drains were invariably concretised which not only affected hydrological functional ability of SWDs but also impacted ground water recharge. Besides, concretisation of SWDs also aggravated vulnerability to frequent floods.

The State Government replied (August 2020) that SWDs were carrying high volume of sewage increasing the pressure on SWDs meant for carrying rainwater and large quantity of debris/wastes were also being dumped into SWDs which was affecting the flow in the drains. Hence, the drain beds were concretised to allow smooth flow and avoid flooding/overflowing due to obstructions from wastes/debris.

The reply is not acceptable as concretising of drain beds allowed drain water to flow with higher velocity and increased runoff. Further, since the floor of the drain was concretised, water could not be absorbed naturally.

3.5 Other factors affecting the conservation of storm water

Besides the reduction in number of water bodies and decrease in length of the drains, the joint study with RRSC also showed significant findings, as indicated in Table 3.2.

Table 3.2: Other significant findings of the joint study

Parameter	Koramangala valley	Vrishabhavathi valley
Changes observed from 2008 to 2016/2017		
Pervious layer	Decreased by 11 per cent	Decreased by 14 per cent
Impervious layer	Increased by 15 per cent	Increased by 13 per cent
Built up area	Increased from 19.98 sq km to 23.88 sq km (20 per cent)	Increased from 39.14 sq km to 44.69 sq km (14 per cent)

Parameter	Koramangala valley	Vrishabhavathi valley
Vegetation cover	Decreased from 20.33 sq km to 19.34 sq km (5 per cent)	Increased from 26.82 sq km to 28.38 sq km (6 per cent)
Open land ¹⁰	Decreased from 13.88 sq km to 10.94 sq km (21 per cent)	Decreased from 17.67 sq km to 9.74 sq km (45 per cent)

The above factors have a direct bearing on the collection and conservation of storm water. The decrease in vegetation cover and open land affects natural recharge of ground water. The increase in impervious layer and built up area results in increased runoff of storm water leading to frequent flooding.

Conclusion

The decrease in natural storm water collection systems and increase in runoff necessitate the need for formulation of a robust policy for storm water management. The depletion in length of natural drains coupled with the failure to construct and adopt storm water conservation structures affected efficient and effective recharge of ground water besides impacting the ecosystem adversely with the increase in runoff. Absence of coordination between various institutions responsible for preventing mixing of sewage with storm water, also highlights the inadequacy of the existing mechanism for efficient management of water.

Summary of important audit findings

Para number	Audit findings
3.1.1	There was no regulatory framework governing storm water management.
3.1.2	Urban surface runoff was not recognised as water resource despite the growing scarcity and competing demands on the existing water situation.
3.2.1	There was absence of coordination between various institutions responsible for providing basic urban infrastructure facilities.
3.3.1	Out of existing 210 lakes under the jurisdiction of BBMP, 66 were yet to be developed and 18 lakes were reported as disused lakes. These disused lakes were vulnerable to encroachments and future conversions.
3.3.2	An independent study conducted with technical support from RRSC, ISRO showed reduction in water bodies and length of drains in the test-checked Koramangala and Vrishabhavathi valleys. The study revealed that (i) about 41 and 51 water bodies, which existed in Koramangala and Vrishabhavathi valleys respectively as per the cadastral map were reduced to 8 and 13 by the year 2008 indicating the severity of lake conversion.

¹⁰ The open land means areas not occupied by any structures like buildings or vegetation typically includes ground, fallow/wasteland.

Para number	Audit findings
	(ii) total length of drains (primary and secondary) as per cadastral maps which was 113.24 km and 226.29 km in Koramangala and Vrishabhavathi valleys respectively was reduced to 62.84 km and 111.72 km by 2016/2017.
3.4.1	BBMP had not taken up any works relating to recharge structures for replenishment of groundwater.
3.4.2	Of the 2.12 lakh properties under the purview of BWSSB that were required to adopt RWH structures, only 1.27 lakh properties (60 <i>per cent</i>) had adopted RWH structures. Adoption of RWH structures was not made mandatory for areas/properties not covered by BWSSB.
3.4.3	BBMP failed to ensure linkage of drains with water bodies which resulted in drying up of a number of lakes in Bengaluru city and in turn facilitated conversion of lakes for other purposes.
3.4.4	Activities relating to recharging of the water bodies were not taken up.
3.4.5	The flow path/bed of drains were concretised which not only affected hydrological functional ability of SWDs but also impacted ground water recharge. Besides, concretisation of SWDs also aggravated vulnerability to frequent floods.

4 Chapter

Planning, designing and construction of storm water drains

4.1 Planning

Section 9 of the Karnataka Town and Country Planning Act, 1961, stipulates that every planning authority should carry out a survey of the area within its jurisdiction and, prepare and publish a comprehensive development plan (CDP)/revised master plan (RMP) consisting of a series of maps and documents indicating the manner in which the development and improvement of the entire planning area within the jurisdiction of the Planning Authority is to be carried out and regulated. Further, Section 13-D of the Act also provides for revision of the master plan at least once in 10 years from the date on which the master plan had come into force. The plans should indicate areas reserved for parks, play grounds and other recreational uses, public open spaces, public buildings and institutions etc. The Act does not explicitly describe the area preserved as tanks or lakes in the CDP/RMP.

4.1.1 Deficiencies in the Master Plans prepared by BDA

The Bengaluru Development Authority (BDA) prepares master plans. The details of plans brought out by BDA are as shown in the **Table 4.1**.

Table 4.1: Details of plans prepared by BDA

Plan	Identified as	Date of approval	Valid till
First	Outline Development Plan	22-05-1972	11-10-1984
Second	Comprehensive Development Plan	12-10-1984	04-01-1995
Third	Revised Comprehensive Development Plan	05-01-1995	24-06-2007
Fourth	Revised Master Plan	25-06-2007	Till the approval of RMP-2031

Source: Information furnished by BDA

BDA did not have on record the first two development plans prepared for the periods May 1972 to October 1984 and October 1984 to January 1995. In the revised CDP approved in January 1995 and valid till June 2007, there was no consistency in the representation of water bodies which were shown as tanks and also as parks and valleys; and drains (water ways) were not exhibited explicitly. The CDP was, therefore, incomplete and deficient. In the absence of clear data on the width/type of the drains at any stage, encroachment / disruption of flow could not be analysed.

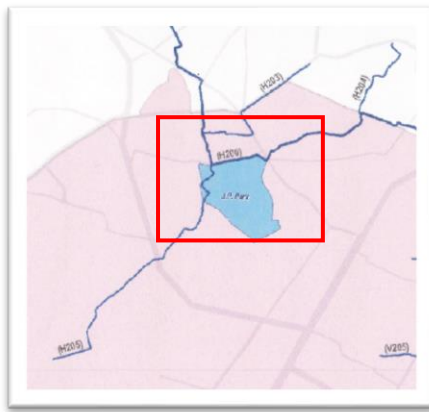
The Revised Master Plan - 2015 for Bengaluru approved in June 2007 and valid till the approval of RMP 2031 was also deficient for the following reasons.

- Though RMP-2015 recognised the importance of having buffer zones¹¹ for different types of SWDs, it did not classify the drains as required and hence, did not notify ‘no development area’ along the drains. As a result, the required buffer zone around/along the water bodies/water ways were neither marked nor maintained.
- Though drains were mapped in the RMP-2015, many existing drains and water bodies (as per the Master Plan of SWDs prepared by BBMP) were not shown in the maps published (**Exhibit 4.1**).

Exhibit 4.1: Illustrative photographs showing drains/water bodies not mapped in RMP-2015 (shown in red rectangles)

Master Plan of SWDs

RMP-2015



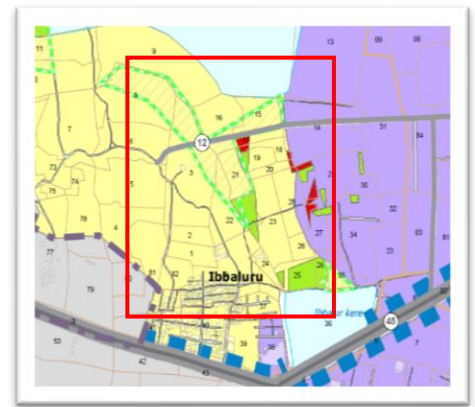
Shown as a water body



Shown as a park

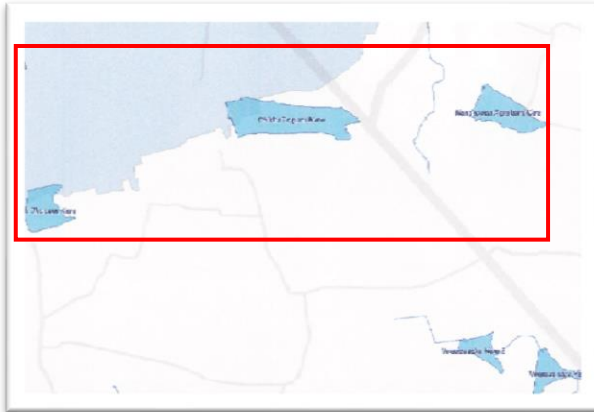


SWD shown between Bellandur and Ibbalur tanks

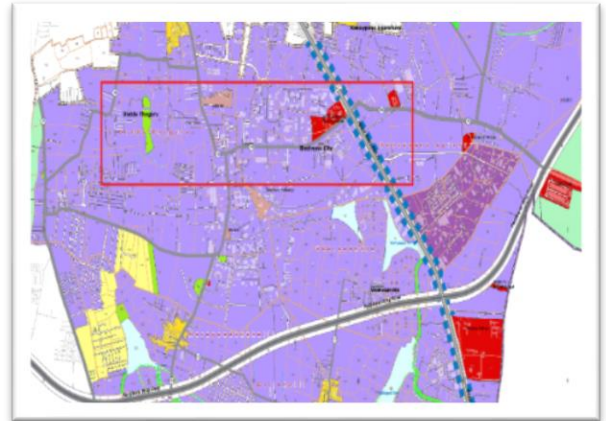


No connectivity between two tanks

¹¹ Buffer zones are areas of land adjacent to a drain or waterbody which are meant for providing utilities such as power, pipelines for water/oil/gas etc., and also to facilitate easy maintenance of drains. The RMP stipulated buffer of 50, 25 and 15 mtrs (measured from the centre of the drain) on either side of primary, secondary and tertiary drains respectively.



Water bodies shown around Thoguru village



No water bodies around Thoguru village



The existing outlet drain (shown in red arrow) from Sankey tank not mapped either in Master Plan of SWDs or RMP-2015

The lapses indicated above facilitated unabated construction along the drains without allowing the required buffer area. Photograph captured during joint inspection showing construction without allowing buffer area along SWDs are shown in **Exhibit 4.2**.

Exhibit 4.2: Illustrative photographs showing construction of buildings allowed without buffer area along storm water drains


<https://youtu.be/sUCfkOnb52k>

Absence of buffer zone



Bommanahalli Zone



Koramangala Zone



Rajarajeshwarinagar Zone



South Zone (Covered Drain)



West Zone



West Zone

Source: Photographs taken during joint inspections

The State Government accepted the omissions in RMP-2015 and stated (January 2019) that corrective measures were being taken in RMP-2031. In this context, reference is invited to Paragraph 4.6 of the Report on Lakes wherein the change

in status of lake area (residential, roads, agricultural land etc.) in the RMP 2015 when compared to the CDP of 2005 which described the status of lake area as tanks, parks and valleys citing few instances was commented upon. The State Government had accepted (March 2015) the findings and had stated that the error would be rectified in the RMP 2031 which was under preparation. The replies of the Government in both the instances could not be verified as the preparation of RMP 2031 was still under progress.

It is thus apparent that the Government and the authorities concerned have overlooked the importance of water bodies and drains at the time of preparation of the master plans.

4.1.2 Delays in preparation of Comprehensive Development Plans/Master Plans

The Karnataka Town and Country Planning Act, 1961, provided for revision of the CDP/Master plan once every ten years. The timely and periodic revision would assist the Planning authorities to factor in rapid growth and urbanisation of the cities for future expansion and developments in compliance with the zoning regulations besides enabling them to take corrective measures to rectify any errors in the earlier plans.

As can be seen from Table 4.1, the revision of the second and fourth plans were delayed by two years. The fifth plan which was due for revision in 2017 has so far not been done. Though the draft RMP 2031 was published (November 2017) for inviting public comments, the final plan was yet to be notified. Delay in revision of the master plans would result in uncontrolled expansion leading to encroachments of Government lands and zoning violations besides the delay in rectification of the omissions pointed out in the above paragraph.

Recommendation 5: The State Government/BDA should take immediate action to finalise and notify the revised master plan to prevent encroachments of Government assets such as land, water bodies etc., and rectify the omissions with regard to SWDs.

4.1.3 Preparation of master plan of drains by BBMP

The master plan prepared by BDA was to be followed by all the authorities for taking up any development work. However, we observed that BBMP got a separate master plan of drains (including the expanded area comprising of City/Town Municipal Councils and 110 villages that was integrated during 2007), water bodies, bridges/culverts, low lying areas, etc., prepared by M/s. STUP Consultants at a cost of ₹3.62 crore during 2010-11¹².

The master plan of drains of BBMP was incomplete as

- it was restricted to identifying only the primary and secondary drains in contradiction of the NDM guidelines which stipulated preparation of comprehensive database of all drains.

¹² Tendered and entrusted during 2007-08.



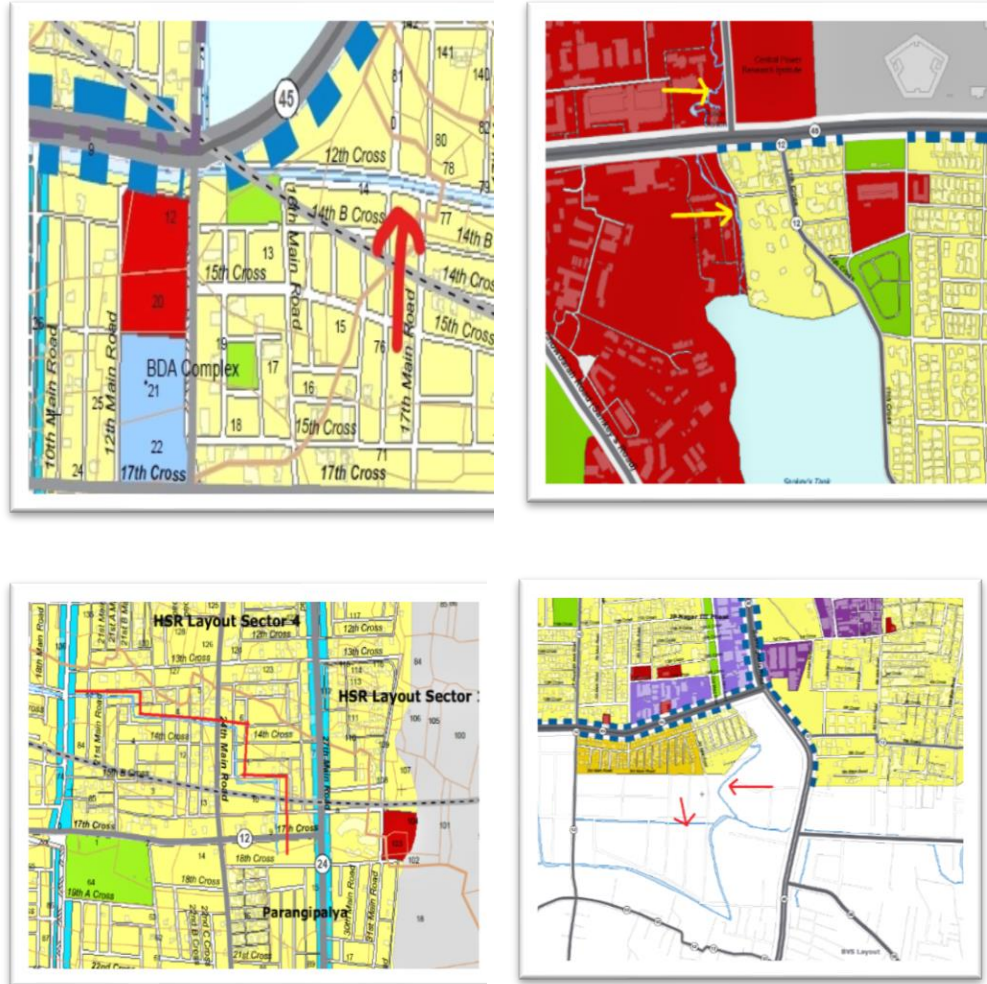
<https://youtu.be/nNXeci28D-E>



Audit trail to trace unmapped drains

- many of the drains shown in RMP-2015 were not mapped in the master plan of drains (**Exhibit 4.3**). Besides, a large number of drains which were in existence but not found in RMP-2015 were also not mapped. This raises questions on the validity and reliability of the database.

Exhibit 4.3: Photographs showing drains identified in RMP-2015 but not exhibited in master plan of drains of BBMP (Arrows show stretches of missing drains)



- the master plan did not provide for buffer zones along the different kind of drains, despite being clearly spelt out in RMP-2015, which was in force.

Further, the records relating to preparation of the master plan of drains containing tender conditions, tendering process, award of contract and payments made to the agency were recorded 'to have been lost' and thus, not furnished to audit. The CE, SWD also did not possess on record the detailed volumes of master plan pertaining to individual zones, except for Yelahanka and Rajarajeshwari Nagar (RR Nagar). Hence, the correctness of the preparation of the master plan by the agency as well as compliance to tender conditions could not be verified.

BBMP did not initiate action to reconcile its master plan with that prepared by BDA. It also did not conduct any physical inspection of the drains to update its master plan and to ensure inclusion of all the drains under its jurisdiction in the RMPs. Significant discrepancies between the two sources of data deprived planners of a single source of truth for planning/development of the city.

The State Government replied (January 2019) that RMP-2015 which was in place at the time of preparing SWD master plan had not captured the drainage networks. The SWD master plan has been shared with BDA and now finds its place in the draft RMP-2031 and the anomalies are getting ironed out.

However, verification of draft RMP-2031 showed that drains shown as primary and secondary in BBMP's map were exhibited as secondary and tertiary in the draft RMP-2031. These discrepancies assume higher significance in light of the judgments of the National Green Tribunal (NGT) enhancing the buffer area¹³ along the drains. Moreover, the basis on which BDA identified, classified and exhibited the tertiary drains in the RMP when BBMP, the authority for construction and maintenance of SWD, does not have the data on tertiary drains was not explained.

The State Government accepted (August 2020) that the nomenclature of primary, secondary and tertiary drains in draft RMP-2031 are different from that mentioned in SWD master plan and action would be taken to discuss the issues with BDA for proper reconciliation and corrective measures.

4.1.4 Storm water drain inventory

Paragraph 4.5 of NDM guidelines stipulate that all ULBs/States/UTs shall prepare an inventory of the existing storm water drainage system on a Geographic Information System (GIS) platform. The inventory was to be both watershed based and ward based with clear mapping of the major as well as minor systems. Further each road was supposed to have drains on both sides for collecting storm water which would ultimately lead into primary/secondary SWDs to allow runoff. Hence, the tertiary/road side drains form the major contributor to urban drain runoff. For quantification of runoff in different kinds of drains and their upkeep without allowing for clogging/flooding, the SWD authorities should have on record comprehensive data of different types of roads (length, width, type of surface, perviousness, gradient, *etc.*) collected at regular intervals.

However, the CE, SWD, the authority for construction and designing SWDs thereon, did not possess comprehensive data of different roads and tertiary/surface road side drains within the jurisdiction of BBMP. The lack of comprehensive data on runoff is bound to have an adverse impact on the design, construction and management of drains.

The absence of comprehensive inventory of drains with BBMP and its failure to classify them properly contributed to lack of clarity on critical issues including the extent of buffer zone to be maintained.

¹³ Buffer of 50, 35 and 25 mtrs (measured from the edge of the drain) on either side primary, secondary and tertiary drains respectively.

This, in turn, would

- hamper regular maintenance of the drains.
- impact one of the purposes of creating a buffer zone *i.e.*, to provide space for laying of utilities. Audit observed that many utility lines like water pipes, sanitation pipes, electrical, telephone, optical cable, *etc.*, were laid across the drains in many locations obstructing the flow in drains and overflows (**Exhibit 4.4**). The absence of buffer zone also results in encroachments as indicated in Paragraph 5.1.3.

Exhibit 4.4: Photos showing the presence of utility lines in SWDs



<https://youtu.be/joRJOi5EIRk>



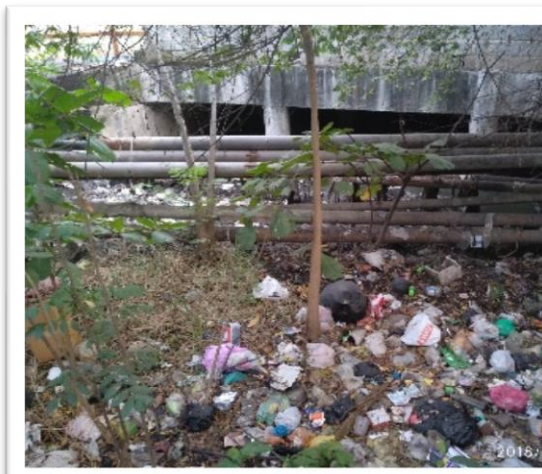
Utility lines blocking flow



Koramangala Zone



Bommanahalli Zone



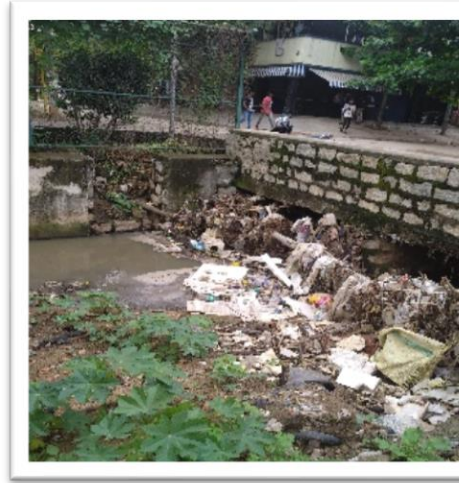
NGV campus, Koramangala Zone



South Zone



West Zone



Bommanahalli Zone

Source: Photographs taken during joint inspections

The State Government replied (August 2020) that action would be taken to compile and document the details of all types of roads and corresponding drains (surface and tertiary drains) under BBMP jurisdiction. However, the data on roads was not made available even as at the end of December 2020.

Audit also observed that the State Government/BBMP had not carried out any evaluation study to ascertain the adequacy/capacity of the existing storm water drainage network in the city.

Recommendation 6: *BBMP should prepare a comprehensive database of SWDs in coordination with parastatal agencies like BDA, BWSSB etc., to serve as a single source for effective planning and management of SWDs.*

4.1.5 Detailed Project Reports for SWDs

A Detailed Project Report (DPR) is a complete document for investment decision-making, approval, planning and implementing the project. It provides details of the basic programme, roles and responsibilities, activities to be carried out, resources required, possible risks and risk mitigation measures. Timeliness of DPRs duly considering the present status and other pre-requisites for each work proposed to be taken up is critical.

4.1.5.1 Preparation of deficient DPRs and consequent non-execution of works (Bengaluru core area)

Audit observed that the BBMP got DPRs prepared (2006-07) for the SWDs under core Bengaluru area¹⁴ through M/s STUP Consultants, Bengaluru, without particular reference to individual works. The DPRs were found to be deficient as indicated in paragraph 4.1.10.1 of the Report of the CAG on Local Bodies for the year ended March 2012 (Report no. 6 of the year 2013 – Government of Karnataka).

¹⁴ As a requirement for obtaining funds under JnNURM scheme.

Summary of deficiencies indicated in Report No. 6 of the year 2013 – Government of Karnataka

- *DPRs did not include the total quantum of land required for the project. Details of land owned by BBMP alongside the SWDs for widening were not available.*
- *The challenges involved in obtaining clearances for shifting of utilities along SWDs from concerned agencies like BWSSB/Bangalore Electricity Supply Company (BESCOM)/Defence/Airport authorities etc., was not brought on record.*
- *The project cost did not have a separate statement on the cost involved in land acquisition, environment compliance cost, cost of surveys and investigations, etc.*
- *The sources for mobilisation of funds of BBMP during the project implementation were not distinctly brought out in the DPRs.*

Subsequently, BBMP got revised DPRs covering the same jurisdictional area prepared (2010-11) through M/s Aarvee Consultants, Hyderabad and the revised DPRs were approved by the State Level Empowered Committee for JnNURM. The CE, SWD did not have on record the copies of revised DPRs, except that of Vrishabhavathi valley. A review of the available DPR revealed the following:

- The major works proposed and taken up (2006-07) were stopped in 2008-09 due to non-availability of sites and poor performance of contractors.
- Works such as construction of detention ponds, wells with pumping arrangements etc., though provided for in the original DPRs were not carried out.
- The revised DPR indicated only the physical and financial progress of works carried out as per the original DPR and the revised cost for carrying out the balance works.
- Bed protection and water recharge arrangement works could not be taken up due to large quantity of sewage flow in SWDs.

Further, as could be seen from the Independent Review and Monitoring Agency (IRMA)¹⁵ inspection reports, the works taken up and executed based on revised DPRs also remained incomplete/abandoned and details of a large number of works were not furnished to IRMA. The reasons cited for abandoning these works were non-availability of work front and poor performance by contractors. Since many of these work files were not available with CE, SWD, the exact location of works could not be ascertained.

The State Government stated (August 2020) that the required width to meet the hydraulic requirements as envisaged could not be procured for want of timely

¹⁵ Appointed by the Central Sanctioning and Monitoring Committee for review of SWD works executed under JnNURM scheme.

revenue records. Hence, due to non-availability of work front, the project could not be implemented as desired. Therefore, BBMP got the revised DPRs prepared based on the availability of land.

The reply substantiates the fact that the original DPRs were prepared without taking into consideration the extent of land required and available with BBMP. Since the revised DPRs were got prepared based on the availability of land, the works of detention ponds, pumping wells *etc.*, were dropped. Further, the non-completion and abandonment of works taken up both under the original DPR and the revised DPR resulted in loss of financial assistance to BBMP and non-recovery of amounts from the contractors as explained below:

◆ *Loss of financial assistance*

Funds were to be released by the Central and State Government under JnNURM in instalments based on the physical and financial progress of the works and submission of Utilisation Certificates (UCs) by BBMP.

As a large number of SWD works taken up under JnNURM were abandoned due to non-availability of sites and poor performance of contractors, Audit observed that BBMP did not submit the required UCs. Consequently, BBMP had to forego financial assistance of ₹83.59 crore as detailed in **Table 4.2**.

Table 4.2: Statement showing the loss of assistance by BBMP

		(₹ in crore)		
Sl. No.		Total amount to be received	Amount actually received	Loss of assistance
1	Government of India	216.94	158.42	58.52
2	State Government	92.98	67.91	25.07
	Total	309.92	226.33	83.59

Source: Report on the performance of JnNURM

Consequent to the above non-receipt of assistance, BBMP was forced to incur expenditure from its own funds for completion of the works taken up under JnNURM.

The State Government agreed (August 2020) that the loss of assistance under JnNURM scheme was due to non-completion of works and consequent non-utilisation of allocated funds by BBMP within the timeframe.

◆ *Non-recovery of 'risk and cost' amounts from contractors*

SWD works relating to all the four valleys taken up under JnNURM were entrusted under 15 packages to different contractors during 2005-06 at an agreed cost of ₹496.90 crore. The agreements with the contractors provided for termination of contract in case of default by contractor. The works under all these 15 packages were abandoned without completion as discussed above. The Conciliation Committee headed by Special Commissioner (Projects) decided (March 2010) to rescind the contracts without risk and cost and submitted a proposal to the Government. The Government, however, ordered (September 2013) to rescind the contract with 'Risk and Cost' to the contractors.

Audit observed from the records made available that BBMP had calculated ₹35.31 crore as the amount of 'Risk and Cost' to be recovered from the contractors under eight packages¹⁶, but had not recovered any amount even after five years. Similar details in respect of seven other packages¹⁷ were not furnished to audit. This resulted in a loss to BBMP and extension of undue financial benefits to the contractors. The CE, SWD did not furnish any reasons for the failure to enforce recovery proceedings.

The State Government endorsed (January 2019/August 2020) the reply of the Commissioner that letters had already been addressed to contractors intimating rescinding of contracts and immediate action would be taken to trace all the records relating to these packages to calculate the risk and cost amount and to recover the same. Further progress in this regard was not furnished to audit (November 2019/December 2020). The revised reply furnished to audit after a lapse of more than 18 months was similar to the initial reply indicating that serious action was not taken to calculate the risk and cost amount and recover it from the contractors.

◆ *Irregular payments to contractors*

In accordance with the terms and conditions of the contract, in case of failure of the contractor to execute the work, it would be binding on the employer to retain the whole of the contractor's security deposit (including further security deposit) and encash the performance security furnished in the form of bank guarantee and get the work executed at the contractor's risk and cost.

Further, in view of the Government's order (September 2013) to rescind the contract with risk and cost, BBMP had to retain the security deposit and encash the performance security and ensure that no further payments were made to the contractors. Audit sought the details of security deposits collected and recovered from the bills and also the bank guarantees obtained in lieu of performance security in respect of the above packages. The CE, SWD did not furnish these documents for scrutiny and verification.

Audit analysed the pass sheets of the bank accounts pertaining to SWD works in respect of one package as a test-check and observed that ₹1.63 crore was paid to the agency during the period October 2013 to April 2017 for Hebbal-2 package subsequent to the Government's order which was highly irregular and amounted to extension of undue benefits to the contractors.

The State Government endorsed (January 2019/August 2020) the reply of the Commissioner that explanation was called for from the executive engineers and accounts branch for the reasons for releasing payments after the instructions from government and action would be taken on the officers/officials found

¹⁶ Hebbal-2 (₹0.56 crore), Hebbal-3 (₹3.81 crore), Koramangala-1 (₹1.20 crore), Koramangala-2 (₹20.30 crore), Koramangala-3 (₹1.06 crore), Vrishabhavathi-2 (₹2.32 crore), Vrishabhavathi-3 (₹0.28 crore) and Vrishabhavathi-5 (₹5.78 crore).

¹⁷ Challaghatta – all three packages, Hebbal – Packages 1 and 4 and Vrishabhavathi – Packages 1 and 4.

guilty. Further progress in this regard was not furnished to audit (December 2020).

Recommendation 7: *The State Government/BBMP should ensure that DPRs prepared are comprehensive and realistic and should include details such as extent and availability of land, the requirement and sources of fund, coordination with other institutions etc.*

Recommendation 8: *BBMP should initiate immediate action to comply with the instructions of the Government for recovery of risk and cost amounts from all the contractors who have violated norms and blacklist persistent violators. It should initiate action against the concerned officers/officials responsible for non-compliance. It should also put in place adequate and resilient financial controls through proper documentation.*

4.1.5.2 Preparation of DPRs through different agencies and deficiencies thereon (Bengaluru agglomeration area)

BBMP invited a single expression of interest for preparation of master plan of drains referred to in Paragraph 4.1.3 and for preparation of DPRs. From the records/information made available, audit observed the following deficiencies/irregularities in preparation of DPRs and execution of works thereon.

- ❖ The scope of the master plan among other things included identifying the drain networks using satellite imagery, terrain modelling and ground verification; preparation of catchment for each drain and preparing uniform guidelines for preparation of DPRs for different zones. Hence, it is imperative to have master plan first on record followed by DPRs for development of drains identified in the master plan. However, single tender was issued including both items with a time period of 28 weeks. Thus, master plan and DPRs were prepared simultaneously.

Audit observed that guidelines were not prepared and apparently the DPRs were prepared¹⁸ without the guidelines. Moreover, in the absence of basic data of drains, entrusting the work of master plan and DPRs simultaneously renders the DPRs unreliable. The audit observations on non-identification of many existing drains in the master plan (paragraph 4.1.3), raises questions on the completeness of the master plan and the veracity of the DPRs prepared.

- ❖ The draft DPRs prepared were reportedly approved (April 2012) by the Technical Advisory Committee put in place for JnNURM scheme. However, Audit could not verify submission of the final DPRs to BBMP by any of the agencies as they were not provided by the CE, SWD. Only longitudinal cross section diagram of drains and cost estimates (submitted during 2013-14 after a delay of more than five years) were available. There is thus, no conclusive proof for the submission of DPRs to BBMP. This

¹⁸ RR Nagar and Byatarayanapura zones – M/s STUP Consultants, Bengaluru; Bommanahalli and Dasarahalli zones – M/s Preethi CAD Consultants; and Mahadevapura zone – M/s TTI Consultants.

conclusion is substantiated by the fact that none of the agencies were paid the full amount as shown in **Table 4.3**.

Table 4.3: Details of payment made to agencies for preparation of DPRs
(₹ in lakh)

Sl. No.	Zone	Agreed amount	Payment made as per available record
1	Rajarajeshwari Nagar	252.92	177.05
2	Byatarayanapura	225.29	214.02
3	Bommanahalli	86.21	60.35
4	Mahadevapura	191.10	152.88
5	Dasarahalli	70.26	Not available

Source: Information furnished by BBMP

- ❖ The non-submission of DPRs by agencies was also confirmed by the fact that CE, SWD/BBMP had not submitted/obtained the approval of State Government for the DPRs.
- ❖ Further, though DPRs were to be prepared for each individual work duly explaining the scope and requirements, the BBMP entrusted for preparation of DPRs for the entire zone without reference to individual stretch/drain. The cost estimates prepared thereon contained the total length/numbers of various components to be executed and the total cost. However, these were not supported with details for individual works. In the absence of comprehensive DPRs for any of the zones, audit could not cross-verify the financial projections between the master plan and DPRs.
- ❖ Besides, documents/records forming part of the DPRs such as Geo-Technical survey, Cost benefit analysis, plans for shifting of utilities interfering with drains, details of encroachment on drains *etc.*, that the agencies ought to have submitted, as per tender conditions, were not available with the CE, SWD.
- ❖ The BBMP had obtained (2014-15) another set of DPRs for the work of “Remodelling of SWDs, flood mitigation and sewage diversion to improve environmental condition near water bodies in Hulimavu Kere and Madivala Kere Watershed Clusters” under Bommanahalli zone through M/s STUP Consultants at a cost of ₹1.34 crore though the DPR for entire Bommanahalli zone was got prepared through M/s Preethi CAD Consultants during 2013-14. The CE, SWD did not explain the reasons for getting the DPRs prepared through a different agency within the short time period.

Audit observed that execution of a total of 14 SWD works with an estimated cost of ₹61.21 crore was entrusted (2014-16) to contractors. Though these works were taken up specifically for sewage diversion and to improve environmental condition near water bodies, joint inspection showed that sewage was flowing invariably in all the stretches of drains and was also directly being discharged into Hulimavu and Madivala lakes. Thus, failure of the BBMP to prevent the mixing of sewage into water bodies, despite taking up works specifically for the purpose rendered the expenditure of ₹62.86 crore¹⁹ largely unfruitful.

¹⁹ ₹1.65 crore on DPRs plus ₹61.21 crore on works.



https://youtu.be/mzM_eKXkwbs



Sewage flowing into the lake

- ❖ None of the work files furnished to audit contained a reference to DPRs except for a longitudinal cross-section/strip plan (location map) showing existing and required width for the stretch of the drain.

With the master plan being incomplete and in the absence of guidelines for DPRs, the effectiveness of the DPRs prepared and the impact thereof on the drainage network could not be ascertained.

The State Government replied (August 2020) that the scope of DPRs included carrying out detailed investigations, detailed engineering for structural measures like drains, culverts, preparation of detailed estimates for the works and preparation of tender document and schedules and does not include detention ponds, meeting with different stakeholders like BWSSB, BDA etc., to meet the master plan objectives, non-structural measures. Hence the master plan and DPRs were two distinctive activities and there was no duplication of expenditure. It further stated that few volumes of DPRs pertaining to five zones were not readily traceable and that action would be taken to obtain another complete set of records (both soft and hard copies) from the agencies and preserved in the division.

It is clear from the reply that the scope of DPRs was not comprehensive and hence the DPRs prepared were deficient. The reply was silent on audit observations regarding non-approval of DPRs by the State Government and the unfruitful expenditure of ₹62.86 crore.

❖ *Injudicious payment to an agency under questionable circumstances*

As explained above, copies of DPRs and documentary evidence for completion of assigned tasks were not available with the CE, SWD and the BBMP had foreclosed the contracts for DPRs. Audit observed that the CE, SWD had recorded that the complete set of records relating to tendering, selection of agency, RA bills, payments made *etc.*, pertaining to preparation of master plan and DPR for RR Nagar were 'lost' but processed (March 2018) the balance payment of ₹94.93 lakh²⁰ to M/s STUP consultants based on duplicate documents furnished by the agency. Scrutiny of the file built up based on the duplicate documents revealed the following:

- The agency while preferring the claim (October 2017) for the balance amount had stated that payments due to it could not be processed by BBMP as BBMP had misplaced the files relating to the above works "twice". This is indicative of the serious system deficiencies existing within the SWD division of BBMP. The action taken by the SWD division/BBMP to trace the records or initiate disciplinary action against the officials responsible for such repeated dereliction of duty was not forthcoming. Instead, the files were rebuilt again based on the documents furnished by the agency.
- The Measurement books for these two works were recorded (indicating the details of payments made earlier to the agency) during February and March 2018 and completion certificate issued accordingly. Neither the

²⁰ ₹19.05 lakh in relation to master plan of drains and ₹75.88 lakh towards DPR of RR Nagar zone

measurement books recording the earlier measurements nor the reasons for delay of more than six years in issuing completion certificate were explained.

- Analysis of the payments showed that the agency was earlier paid during the period from January 2009 to May 2013 and the 5th and pre-final bill was recorded on 29 December 2012. This shows that the work was not completed by January 2012 as recorded during March 2018.
- Further, the earlier payments were made to agency through different zones for different bills (eg. 1st and 2nd bills – Byatarayanapura zone; 3rd bill - RR Nagar zone; 5th bill – Bommanahalli zone). In the absence of basic records, the CE, SWD was to reconcile the payments made earlier with the records of the different zones as well as bank records before processing the final claims for payment. However, this was not done.
- The agency had sought extension of time (October 2016) in respect of the DPR for RR Nagar zone. This further indicates that the work was not completed as recorded in the MBs.
- As per the noting seeking approval for payment of the balance amount, it was recorded that the same agency was entrusted with the work of preparation of DPRs under Nagarothana Yojana; no further details regarding tendering, approval thereon was forthcoming.
- The CE, SWD sought approval of the Commissioner, BBMP for payment of final claims recording that the DPRs for six packages under Nagarothana Yojana was prepared from the same agency. This was highly irregular and resulted in misleading the Commissioner as no DPRs were prepared for the package works under Nagarothana Yojana as detailed in Paragraph 4.3.9.
- Balance payments were due to all the three agencies engaged for the preparation of DPRs. However, the CE, SWD accorded approval only for M/s STUP Consultants without bringing on record the complete set of master plan/DPRs. Thus, the payments made were not for the work actually entrusted but for assignments under Nagarothana Yojana.

Since the approval for the master plan and the DPRs was not obtained, completion of the work and submission of final set of documents by the agency was doubtful and the payments made to the agency was injudicious and irregular. Linking two different works which are mutually exclusive raises questions on the circumstances involved in processing the payments and amounts to fraudulent practice.

Neither the BBMP nor the State Government furnished any reply in this regard.

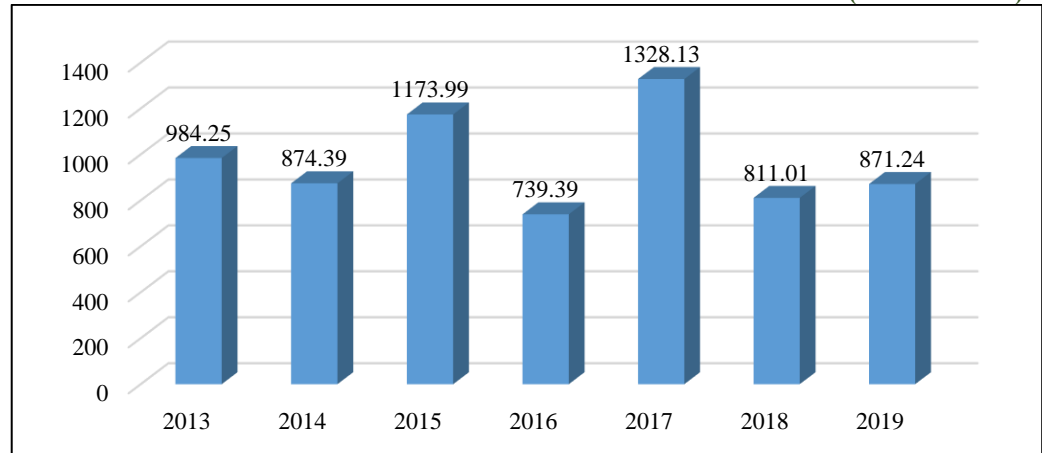
Recommendation 9: *BBMP should maintain all the basic records to ensure proper accounting and comply with the statutory provisions for transparency in implementation and execution of works.*

Recommendation 10: *The State Government should conduct a detailed investigation into the issues regarding preparation of incomplete and deficient DPRs, loss of files by SWD division, payments made under questionable circumstances and take appropriate action based on the findings of the investigation.*

4.2 Designing of roads and drains

Analysis of the rainfall data furnished by KSNDMC for the period 2013-2019 showed that the average annual rainfall was about 969 mm during the above period as indicated in **Chart 4.1**.

Chart 4.1: Data on annual rainfall in Bengaluru area between 2013-2019
(in millimeters)



Source: Data furnished by KSNDMC

The increase in built up area and impervious layers due to urbanisation and consequent decrease in vegetation cover compounded the impact of increase in rainfall. Bengaluru faced repeated instances of flooding during the years 2015-18.

Hence, the patterns in rainfall data available with KSNDMC needs to be factored in while designing the roads and drains in order to mitigate the instances of flooding as discussed in subsequent paragraphs. No evidence was forthcoming from the CE, SWD on whether data on actual rainfall in Bengaluru from reliable sources was incorporated in the existing DPRs.

4.2.1 Deficiencies in designing of storm water drains

Paragraph 4.6 of the NDM guidelines stipulates the need for development of an adequate and functioning drainage system based on sound hydrological and hydraulic design principles. Further, as per paragraph 1.1 of IRC guidelines, urban drainage systems need to be designed such that they capture the storm water runoff from the road surface/right-of-way and infiltrate it into the ground. In case there is lack of space for constructing the drainage system, the rainwater runoff should be conveyed along the right-of-way and discharged at the receiving water body, in addition to infiltrating it in the ground at designated locations only.

Hence, a conducive storm water management needs to ensure detention and retention ponds, permeable surfaces and infiltration trenches, surface and sub-surface groundwater recharge, and other source control measures. Developing a SWD design plan is essential to ensure that storm water runoff could be discharged from the catchment area in an efficient and timely manner with ultimate linkage to natural waterways/water bodies.

4.2.1.1 Absence of data on designing of storm water drains

The primary parameters for designing an optimal storm water drainage system are intensity, duration and frequency of rain in the catchment area. The other parameters to be factored in while designing include vegetation, surface/soil permeability and terrain slope. The runoff coefficient of a particular stretch should be calculated based on such data taking into consideration the existing surface drainage infrastructure. The results obtained from the analysis of design parameters are required to be correlated with the site data and used to check the adequacy of the system to cater to the required return period flood discharge.

The master plan of drains considered Central Public Health and Environmental Engineering Organisation (CPHEEO) norms for urban drainage system and rainfall data from Indian Meteorological Department for the period 1976 to 2008 analysed for 15 minutes' peak rainfall duration. Intensity-duration-frequency curves were prepared for one, two and five years return period. Consequently, the DPRs were to indicate the calculations adopted while projecting the specifications for construction/improvements to storm water drainages.

Audit, however, could not ensure whether the methodology and data were adopted uniformly for preparation of these DPRs as CE, SWD did not maintain DPRs for any of the zones. Moreover, the detailed calculation on designing of drains was not forthcoming from any of the work files furnished to audit and hence the veracity of the specifications adopted for remodeling of drains could not be vouched.

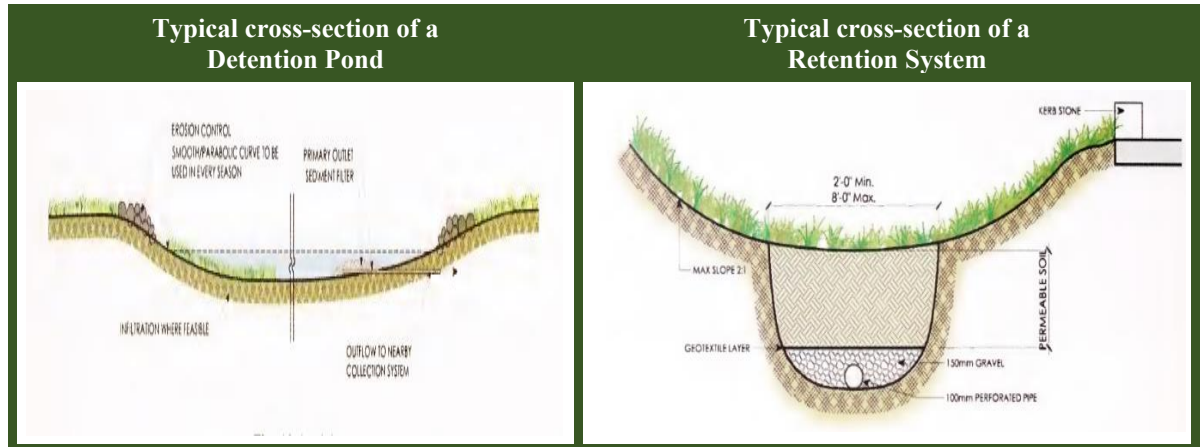
Further, the hydraulic analysis showed in the master plan considered only the rainfall over a period in arriving at the runoff coefficient for drains. This analysis and conclusion thereof for designing of drains would be inappropriate as huge quantum of unassessed sewage flowed in the drains.

4.2.1.2 Non-provision for ground water recharge structures

With a view to conserve the SWD runoff as a ground water recharging method, IRC guidelines suggested infiltration methods like retrofitting the surface roads through different filter layers, providing bore wells in the tertiary and secondary drains, construction of drains with porous layers and filter materials, providing detention ponds and retention system in course of the drains, and rain water harvesting in buildings. Further all possible recharging methods should be adopted before the ultimate disposal of rainwater.

As per paragraph 4.19.1 of NDM Guidelines, urban storm water management systems will include detention and retention facilities to mitigate the negative impact of urbanisation on storm water drainage.

Detention ponds are temporary holding areas for storm water that store peak flows and slowly release them, reducing the demand on treatment facilities during storm events and prevent flooding (Paragraph 10.1(v) of IRC guidelines).



Retention facilities are basically extended detention facilities, infiltration basins and swales²¹ that could be used for water supply, recreation, pollutant removal, aesthetics and importantly recharging of ground water. In the context of serious depletion of ground water table, these infiltration facilities provide significant water quality benefits and need to be used for the primary benefit of urban areas by providing at one or more locations (Paragraph 10.1(v) of IRC guidelines).

Scrutiny of estimates for SWDs executed by BBMP showed that none of the estimates for construction/improvements to SWDs included the items of providing detention ponds/retention facilities. Besides, works were executed with complete concreting of both the walls and bed of drains, which precluded the infiltration of the storm water and the corresponding recharging of ground water, as evidenced by the data provided by the Central Ground Water Board, which showed decrease in ground water level during the period 2013 to 2018.

The State Government stated (August 2020) that retention/detention ponds, percolation tanks and infiltration structures were not attempted in the pathway of SWDs as large amount of sewage, industrial effluents and other chemical wastes were being let into the SWDs. It further stated that action would be taken in this regard once the discharge of sewage into SWDs is stopped by BWSSB. The reply cannot be accepted as it was the responsibility of the Government to ensure strict compliance to Section 230 of the Karnataka Municipal Corporation Act, 1976 (KMC Act, 1976) and Section 72 of the Bengaluru Water Supply and Sewerage Board Act, 1964 which specifically prohibit laying sewerage lines inside SWDs by authorities for ecological and hygienic environment.

4.2.1.3 Absence of infiltration drains

As per the IRC guidelines, the infiltration of rain water, which is discharged from the pavement surface, should be trapped by construction of infiltration-filter median drains, all along the pavement and the regular drains should be located adjacent to the infiltration drains to facilitate surface water from the pavement entering into the infiltration drains and allow excess water to flow

²¹ A swale is a shady spot, or a sunken or marshy place. A swale may be either natural or man-made. Artificial swales are often infiltration basins, designed to manage water runoff, filter pollutants, and increase rainwater infiltration.

into the regular drains. This process was not adopted/ensured by BBMP and drains were constructed without any provision for infiltration drains (Paragraph 10.1(i) of IRC guidelines).

The State Government stated (August 2020) that elaborate detention systems such as rain water harvesting, detention ponds for infiltration and also to minimise flood were proposed in the master plan. However, infiltration inside SWDs are deferred due to presence of sewage in the drain.

4.2.1.4 Construction of roads without proper storm water drainage facility

According to IRC guidelines, while building new roads, storm water facility along the roadside should be mandatory. The type of storm water facility to be used will depend on the street profile or topology. For new constructions, there is far more flexibility for storm water management because the street profile can be designed in a variety of ways.

Audit observed that flooding was a common feature even on newly constructed roads including those constructed under ‘Tender Sure²²’ contracts, where the cost of construction of one km of road was ₹10-12 crore as against ₹2 to 3 crore per km of two lane flexible pavement road. This was because such newly constructed roads were dug for repair works by other authorities indicating deficient dewatering/utility lines system. The execution and effectiveness of drainage system on these roads could not be ascertained/established as the drain stretches were completely covered. Audit also observed non-shifting of sanitary and utility lines at few locations. Evidently, storm water drainage system was deficient in these roads. (Exhibit 4.5).

Exhibit 4.5: Pictures showing the flooding of newly constructed roads



²² Tender Sure (Specifications for Urban Roads Execution) is a flagship project of BBMP to upgrade the selected main roads in Bengaluru to international standards with uniform standard carriage way width, proper camber and profile as per Indian Road Congress (IRC) guidelines, proper storm water drainage system on both sides of the road to eliminate flowing or ponding of rain water on road, properly designed footpaths, dedicated corridors below footpaths to lay conduits of essential amenities such as electricity, water, sewage, OFC etc.



Source: Media reports

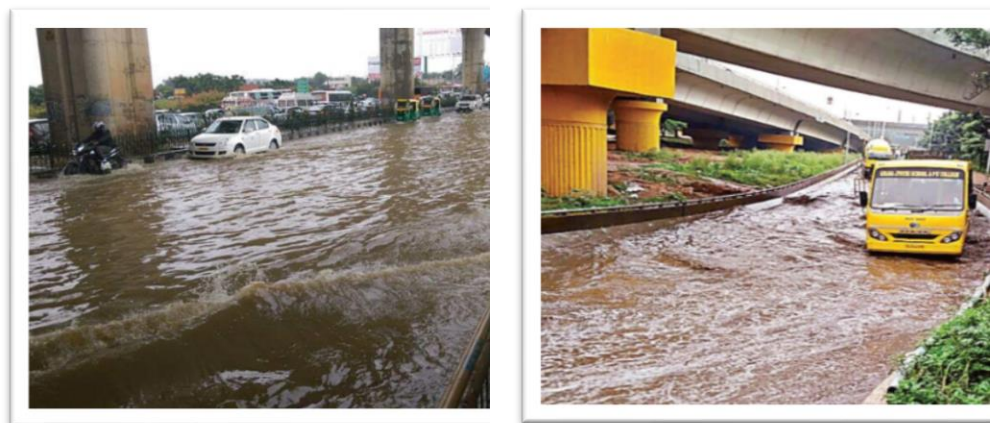
The State Government admitted (August 2020) that these requirements and specifications were required to be taken care of during construction of roads and surface drains and stated that action would be taken to discuss the matter with the authorities concerned and to execute works as per IRC provisions and in proper coordination among all to avoid flooding in Bengaluru.

4.2.1.5 Drainage through pumping

Sump tanks with storm water pumping stations were necessary for removal of storm water from road sections, in respect of structures like under-passes, road under bridges, flyovers *etc.*, where road is required to be depressed to get minimum vertical clearance. The storm water accumulated on the pavement was to be channelised to a sump tank and then pumped to the nearest drain; from where it flows by gravity. The sump tanks were also to be used as infiltration tanks by providing open bottom with necessary filtration system (Paragraph 11.1 of IRC guidelines).

The BBMP did not attempt to put in place sump tank systems leading to roads under bridges and flyovers getting inundated during rains (**Exhibit 4.6**).

Exhibit 4.6: Photograph showing flooding under flyovers

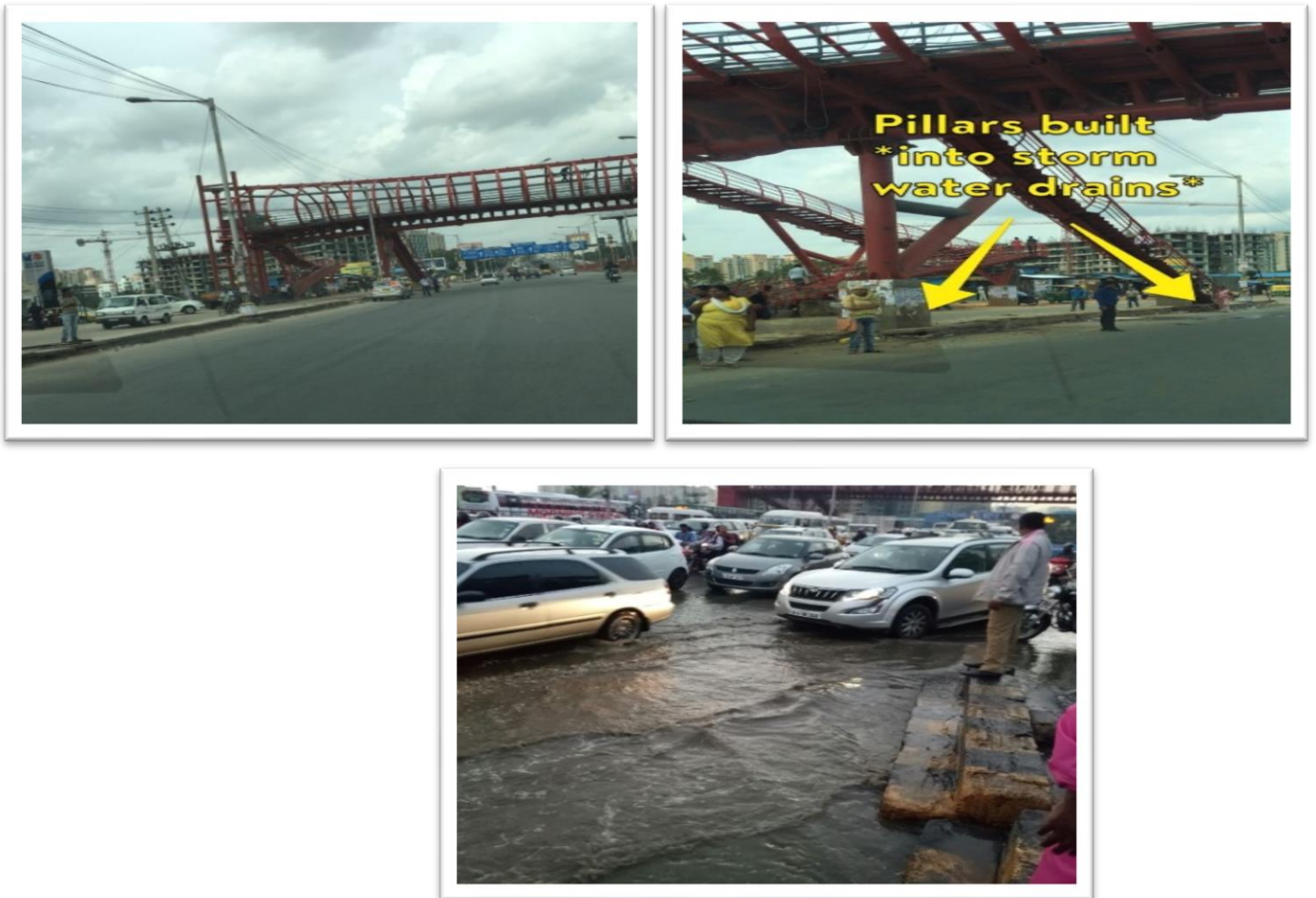


Source: Media reports

Further as per Paragraph 4.13.2.1 of NDM guidelines, road and rail bridges in cities crossing drains should be designed such that they do not block the flows resulting in backwater effect due to the fact that the piers of roads and railway bridges located in major storm water drains are known to cause backwater effects as much as 1 m high and as far away as 5 km upstream thereby resulting in flooding of the upstream catchments.

Audit noticed construction of pillars for walk over bridge inside SWDs which impacted the proper flow of water leading to flooding as shown in **Exhibit 4.7**.

Exhibit 4.7: Construction of pillars inside SWD and consequent flooding at Outer Ring Road, Bellandur



Sources: Media Photos

The State Government replied (August 2020) that these were the requirements and specifications required to be taken care of during construction of flyovers/ROBs/RUBs and many of the flyovers and underpasses were constructed by BDA also. It further stated action would be taken to discuss the issues with the concerned and to execute works as per IRC provisions and in proper coordination among all to avoid flooding in Bengaluru.

The reply cannot be accepted as construction of wells with pumping facility was provided for in the original DPRs prepared during 2006-07 for core Bengaluru area, which ultimately was not executed and subsequently this was not considered in the revised DPRs for SWDs. Evidently, BBMP failed to consider these requirements while undertaking the works.

Thus, improper design of roads and drains and failure to provide for retention/detention structures and infiltration drains *etc.*, impaired the ability of the SWD system to handle runoff efficiently.

4.2.1.6 Multiple authorities within BBMP for construction/management of drains leading to lack of coordination

For an efficient SWD system with due discharge of all the runoff into definitive locations, the interconnectivity of all types of drains is essential.

The IRC guidelines specify that urbanisation of any locality and population needs a well-engineered surface and subsurface drainage system. In the present day context of depletion of water table, the storm water drainage should be effectively utilised for ground water recharging. It should be ensured that water from the road flows to the roadside drains through inlets and gratings. As per paragraph 4.13.4.1 of NDM guidelines, inlets should be provided on the roads to drain water to the roadside drains. For effective drainage, this should join the peripheral drains, which in turn should join the main or trunk drain for ultimate discharge to the natural drain or detention facility or retention facility.

BBMP has in place different authorities²³ for construction and maintenance of different types of drains/roads under its jurisdiction. Audit observed from the joint physical inspection of a few drains that BBMP had constructed roads/drains without ensuring that the inlets to drain water from the roads were properly aligned with the roadside drains/underground drains leading to water logging on roads. Evidently, there was lack of coordination among these authorities to ensure proper cambering/ gradient during formation of roads, regular cleaning of bell mouths/kerb vents provided to surface roads as well as proper linkage with SWDs resulting in choking and clogging of water on roads (**Exhibit 4.8 and 4.9**). The tweets of the various stations of traffic department (**Exhibit 4.10**) attribute water logging to choking and blockage of drains.



<https://youtu.be/dewonCFfc1s>



Drains without connectivity

²³ Storm Water Drains division headed by Chief Engineer; Road Infrastructure division headed by Chief Engineer for arterial and sub-arterial roads, and Zonal Executive Engineers for other types of interior roads/drains.

Exhibit 4.8: Photographs showing unscientific construction of roads/drains – absence of proper gradient/alignment



Koramangala zone

Bommanahalli zone

Source: Photographs taken during joint inspections

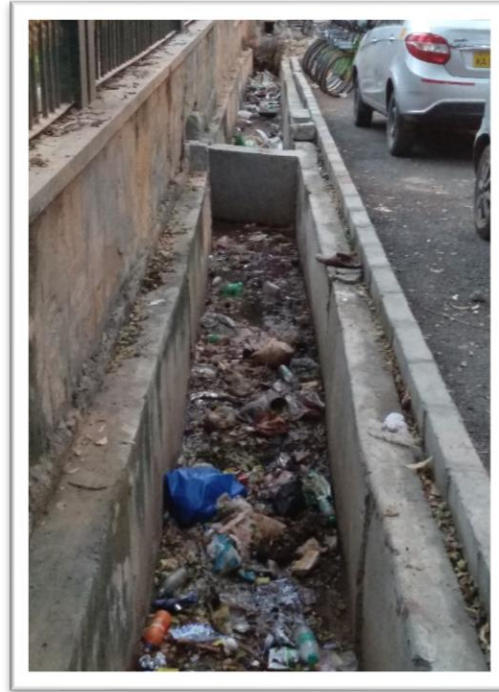


Source: Media reports

Exhibit 4.9: Photographs showing unscientific construction of roads/drains – absence of proper linkage



Bommanahalli zone



Koramangala zone


<https://youtu.be/LWP0FfwW3V4>

Drains without connectivity



South zone



RR Nagar zone

Source: Photographs taken during joint inspections

Exhibit 4.10: Tweets of various stations of traffic department on water logging due to blockage of drains

Mico Layout Traffic
@Micoltytraffic

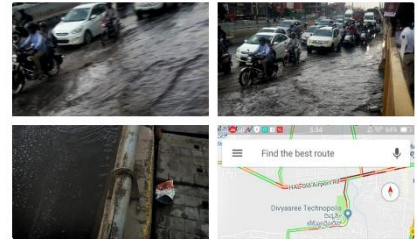
Due to heavy rain, water logging at Bannerghatta main road, between Bangalore Dairy toward Bilekahalli junction, slow moving traffic our staff regulating traffic.



7:31 PM · 16 Mar 18

HSRL TRAFFIC STATION
@hsrltraffics

Water lagging near eco space and Bellandur and drain blocked by silt and soil drain should be clear by consrnd dept as early as possible



5:47 PM · 20 Apr 18

Adugodit Traffic PS
@adugodittraffic1

Due to heavy waterlogging on Bannerghata Rd. between Mico Bande towards Anepalya Jn. Slow traffic movement.

[@blrcitytraffic](#) [@AddICPTraffic](#)
[@DCPTrEastBCP](#) [@AcpSe](#)



6:38 PM · 20 Apr 18

Whitefield Traffic
@WhitefieldTrf

Water logging at Whitefield main road near coffee day due to rain. It's due to Blockages of storm water drain it is removed for free flow of traffic
[@blrcitytraffic](#) [@AddICPTraffic](#)
[@DCPTrEastBCP](#) [@AcpSe](#)



ASHOKNAGAR TRAFFIC BTP
@ashoknagartfips

Ashoka nagara personnel getting into drains to ease free flow of traffic at Mayo hall junction



7:50 AM

CHICKPETE TRAFFIC BTP
@chickpetetrfps

waterlogging at ph underbridge slow moving traffic [@blrcitytraffic](#)
[@AddICPTraffic](#) [@DCPTrWestBCP](#)
[@BBMPCOMM](#)



5:52 PM · 15 Sep 18 · Twitter for Android

Lack of coordination in ensuring proper construction of roads and interconnectivity of drains and their maintenance could result in frequent flooding of low lying residential localities and water logging on roads affecting vehicular movement in the city. Besides, stagnant water on roads for long hours could result in deteriorating quality of roads and appearance of potholes.

The State Government admitted (August 2020) that major and arterial roads were constructed by Road Infrastructure wing of BBMP and internal roads in residential localities were laid by concerned BBMP wards. In addition, many of the major roads and other infrastructure were also constructed by BDA. It further stated that maintenance of all types of roads and drainages fall under the jurisdiction of concerned BBMP wards and maintenance of SWD lies with SWD division. It also stated that action would be taken to coordinate with all authorities concerned for ensuring proper construction/maintenance of drains and to avoid choking of drains and also to ensure adequate interconnectivity of surface drains with SWDs. The reply justifies the audit contention that there was absence of coordination between the different authorities within BBMP.

***Recommendation 11:** BBMP should factor in all parameters such as rainfall pattern, increase in impervious layers, decrease in vegetation etc., while designing and executing roads and drains to increase ground water recharge and prevent flooding. It should ensure strict adherence to the guidelines and norms prescribed for construction of roads/drains.*

4.3 Deficiencies in execution of projects involving remodelling of storm water drains

There are a total of 633 storm water drains (primary and secondary) measuring 842 km under the jurisdiction of BBMP. BBMP had taken up remodelling of 332.02 km of drains up to 2017-18 and maintenance of 308.02 km of drains as indicated in **Table 4.4**.

Table 4.4: Details of various works taken up to 2017-18

Year	Remodelling	Maintenance
	Total length (in km)	Total length (in km)
Till 2012-13	53.00	96.00
2013-14	18.12	10.02
2014-15	20.50	15.00
2015-16	22.08	16.00
2016-17	28.30	69.00
2017-18	35.02	102.00
Total	177.02	308.02
<i>Nagarothana Yojane</i>		
2016-17 to 2017-18	155.00	NF
Grand Total	332.02	308.02

Source: Information furnished by CE, SWD NF: Not furnished

While the major component of expenditure for these works were incurred out of JnNURM grants and funds provided by the State Government, the BBMP also funded the works from its own resources.

4.3.1 Absence of action plans and progress reports

BBMP was responsible for remodelling and maintenance of SWDs. However, the CE, SWD did not possess either the action plans for the works approved or the physical and financial progress report of works executed. This was because the CE had not maintained records such as tender register, works register, contractor's ledger etc. Hence, the CE did not furnish the work-wise details in justification of the claims for executing works for the length of 177.02 km. In the absence of details and any kind of identification structures like information boards/pillars, markings *etc.*, audit could not ascertain/identify the actual site/stretch at which these works were reportedly executed, particularly where the drains were fully covered for long stretches and also the correctness of the claims.

The absence of basic records, action plans and progress reports of works could facilitate incorrect reporting of physical and financial achievement besides abandoning of works with substantial expenditure going unnoticed.

While endorsing (August 2020) the reply of the Commissioner that action plans and progress reports were prepared only in respect of works sanctioned under Nagarothana Yojane during 2016-17, the State Government did not clarify the reasons for non-maintenance of essential records for other programmes.

4.3.2 Non-maintenance of Works History Register

The Karnataka Public Works Code provisions stipulate maintenance of Works History Register for undertaking various works. This register was to contain a distinct folio for each drain duly recording the chainage, length of drain covered, improvements executed, period of execution, total expenditure, *etc.* It was to serve as a record for preparation of action plans, undertaking future works and avoiding duplication.

Audit observed that three²⁴ out of the nine zones had not maintained the prescribed register. The registers maintained in the other six zones were not updated with the progress of work undertaken and were incomplete.

Non-maintenance of Works History Register is fraught with the risk of duplication of works and fraudulent claims going unnoticed, as large number of works were being executed as 'emergency works' without the approval of the action plan. Since works were sanctioned with different nomenclature and without specific reference to exact location, audit could not ascertain whether there were any duplications/fraudulent claims.

The State Government stated (August 2020) that instructions were issued to the concerned EEs to maintain the Works History Register and to update them regularly. However, the updated Works History Registers were not made available to audit for scrutiny (December 2020).

²⁴ Bengaluru East, Bommanahalli and Koramangala.

4.3.3 Non-availability of ‘Completion Plans’ and ‘As built drawings’

BBMP implements large number of works for repair and remodelling of SWDs. On completion of the entrusted work, the contractors are required to submit the ‘As Built Drawings’ and ‘Completion Plans’ clearly showing the actual work done and deviations, if any, from the originally sanctioned specifications/drawings, due to site conditions. Such revised drawings were to be preserved in the SWD division and made use of during subsequent modifications/rectification of SWDs in that location.

These drawings/plans are essential reference materials for subsequent management, as a large number of works are entrusted and executed as ‘emergency works’ without approval of the action plan and without preparing estimates, proper survey and investigation of work site.

The ‘As Built Drawings’ and ‘Completion Plans’ were not forthcoming from the records furnished to audit in respect of any of the zones. Non-availability of ‘as built drawings’ is fraught with the risk of damage to structures/bed of drains during maintenance, particularly in stretches where drains are covered.

The State Government stated (January 2019/August 2020) that the CE, SWD is insisting and obtaining those drawings and completion plans before issue of completion certificates for the works. However, the drawings and plans were not furnished to audit for verification.

Recommendation 12: BBMP should prepare action plans, comprehensive project reports, completion plans etc., maintain a works history register and repository of all such records for future use in planning and implementation.

4.3.4 Execution of SWD works by Zonal Executive Engineers

For all general purposes, BBMP is divided into eight zones having zonal offices each containing an Engineering Division headed by an Executive Engineer. Such Zonal Engineering Divisions are responsible for general maintenance (roads, tertiary/road side drains etc.) at wards level under their zones. However, for the purpose of management of storm water drains, BBMP is divided into nine zones (as indicated in Chapter 1) and has a separate division headed by the Chief Engineer who is assisted by the Executive Engineers of these nine zones. Hence, execution and implementation of SWD works were to be carried out by the EEs in-charge of SWD.

The analysis of the the trends and practices in tenders relating to SWDs through the e-procurement portal of Government of Karnataka, however, showed that tenders for 110 SWD works costing ₹38.59 crore were invited and got executed by the Zonal Executive Engineers who were not responsible for SWD works. Audit further observed that 10 works were awarded to a single contractor for a total cost of ₹10.88 crore during February 2018 by the Zonal EE, RR Nagar zone. Allowing multiple authorities to invite tenders and execute SWD works coupled with the absence of basic registers/records, could facilitate duplication of claims for the same works by both the SWD division and regular zonal offices. Hence, this matter needs to be investigated.

The ACS concurred (December 2018) with the audit observation and directed the CE, SWD to ensure implementation of SWD works by SWD division only. The State Government replied (August 2020) that action would be taken to execute the works relating to storm water drains through the SWD division.

4.3.5 Delay in completion of works

It was the responsibility of the employer (respective EEs in general and CE in respect of six package works) to ensure that the works entrusted to contractors were completed within the time limit prescribed in the work order. In the absence of the basic records, audit could not ascertain the total number of works executed for SWDs and adopt any sampling method for selection of work files. Hence, 143 works files (includes 15 files pertaining to works entrusted to Karnataka Rural Infrastructure Development Limited (KRIDL)) that were made available were examined.

Audit observed that in 25 works test-checked, there were delays in completion of works ranging from one month to 33 months. The reasons for the delays and action taken for the delays were, however, not forthcoming from the records made available.

This apart, the BBMP had entrusted 22 SWD related works to KRIDL under clause 4(g) of the KTPP Act, during the period 2013-14 to 2017-18 without inviting tenders treating the works as 'emergency works' and an amount of ₹15.02 crore was paid to KRIDL for these works. However, in six out of 15 test-checked works, audit observed delays in completion ranging from one month to 23 months defeating the objective of entrusting works without calling for tenders. The works that were delayed comprised construction of road bridge, box drains, retaining wall *etc.* The prolonged delay in completion of these works inordinately distressed the pedestrian and vehicular movement. Besides, BBMP's decision to entrust works to KRIDL contravened the recommendations of the Committee on Local Bodies and Panchayat Raj Institutions prohibiting direct entrustment to KRIDL.

The State Government endorsed (August 2020) the reply of the Commissioner that efforts were made by the divisional engineers to complete the work within the date fixed for the completion, but as drains pass through residential areas and main roads, the delay caused in completion are due to problems such as availability of work sites and permission from various other government authorities. Further, works were entrusted to KRIDL directly based on the recommendations and approval of the Government, as the works were of emergent in nature.

It is clear from the reply that the works were taken up without ensuring that the work front was available and free from all encumbrances and administrative hurdles such as coordination with other government authorities for shifting of utility lines *etc.*, highlighting the absence of proper planning before entrustment of work. The reply that works entrusted to KRIDL were of emergent in nature was not justifiable as the delay in completion of the works ranged up to 23 months.

4.3.6 Avoidable expenditure on diversion of water course

The general specifications of tender document/agreement stipulated that the rates included the cost of shoring, coffer dam channels or other incidental servicing necessary for diverting the water and it should be maintained in good working condition till the completion of the structure.

Audit observed that diversion of water course by providing coffer dam was estimated as a separate item and payments were also made to the contractors to the extent of ₹4.10 crore in 115 test-checked works, which was extra contractual and avoidable. In response to a similar observation (Paragraph 4.1.11.4 of Report no. 6 of the year 2013 – Government of Karnataka), the Committee on Local Bodies and Panchayat Raj Institutions had opined that in cases where the original estimates included all items required for construction of coffer dams, incurring expenditure as a separate item was not permitted.

The State Government endorsed (August 2020) the reply of the Commissioner that the item of coffer dam was provided in the estimates and payment made as it was an absolute necessity for diversion of water course during execution of the works of construction of retention walls/bed protection for SWDs as there was continuous flow in all the SWDs throughout the days due to discharge of sewage. The reply of the Commissioner cannot be accepted as water diversion forms part of excavation, and contract conditions prohibit extra payment. Besides, audit also observed that only the available earth/silt in the drain was used for diverting the water course as exhibited (**Exhibit 4.11**) below:

Exhibit 4.11: Instances of available earth/silt used for diverting water course





Source: Photographs taken during field visits

4.3.7 Excess payments on item of backfilling

As per the specifications for Roads and Bridges issued by GOI, Ministry of Road Transport and Highways (MORTH), the cost of excavation for foundations of Roads and Bridges and retaining walls included backfilling the space between the foundation masonry/concrete and the sides of excavation with approved material including its compaction.

Audit observed that the contractors were paid ₹4.41 crore in respect of 62 test-checked works towards the item of backfilling the foundation. Payment for backfilling separately to the contractors was not warranted as the specification in the estimate and the rates quoted by the contractors for excavation for foundation included this item of work. This amounted to extending undue financial benefits to the contractors.

In response to a similar observation (Paragraph 4.1.11.5 of Report no. 6 of the year 2013 – Government of Karnataka), the Committee took a serious view of the excess payments and directed that action be initiated against the concerned Chief Engineer, Executive Engineer and other officers and to recover the loss caused to the exchequer besides blacklisting the contractors. However, no action was taken by BBMP so far.

The State Government endorsed (August 2020) the reply of the Commissioner that the item of backfilling was provided in the estimates for strengthening the structure on abutment side for allowing seepage of water through granular layer into weep holes and action would be taken to restrict the item to provide granular/porous layer only in estimates for retention walls of SWDs. The reply is incorrect as cost of excavation for foundations of Roads and Bridges and the retaining walls includes backfilling.

4.3.8 Payment made without approval of lead chart

As per codal provisions, cost of lead and lift for conveying the material should be paid only after getting the lead chart approved by the competent authority. The lead chart should clearly show the distance from the point of the work to the place of disposal and the nature of land in which the material has been

dumped. In case of private land, it was also necessary to obtain the written consent from the land owner for dumping drain waste in the land.

Audit observed that an amount of ₹9.97 crore had been paid to contractors in respect of 98 test-checked works though the required lead chart was not prepared and approved by the competent authority for transporting the desilted waste from SWDs. In the absence of the approved lead chart, the genuineness of claims and payment towards desilting and conveyance was doubtful.

The State Government stated (August 2020) that the Engineers concerned would be instructed to document the rate analysis and lead chart pertaining to works showing the distance from the place of work and site for disposal. It further stated that works executed by SWD division were generally of emergency nature and due to the shortage of sanctioned strength for putting in place a separate technical wing in the division, few omissions might have crept into the estimates since they were prepared in a hurry. It also stated that a technical wing has been established in the division with a Technical Assistant and subordinate engineers and estimates are being approved duly showing google map lead chart.

It is clear from the reply that the audit objection has been accepted by the Government. The reply is, however, silent on the action taken or proposed to be taken to ascertain the genuineness of the payments made in the absence of lead charts.

Recommendation 13: *Since SWD works are identified as emergency works, BBMP should ensure that the works are completed within the prescribed time schedule. It should also consider establishing a separate technical wing for meticulous scrutiny of the estimates to ensure execution of works economically and efficiently.*

Recommendation 14: *The State Government should ensure strict action against the officers/officials responsible for non-compliance with Government instructions and Committee recommendations. Care should be taken to avoid excess/avoidable payments to contractors.*

4.3.9 Improper implementation of SWD works under Nagarothana Yojane

The State Government approved (June 2016) 408 SWD works (remodelling / improvements to existing drains) costing ₹800 crore for implementation under Nagarothana Yojane during the period 2016-18. Of these, while 49 works were entrusted individually, the CE, SWD grouped 359 works into six packages as detailed in Table 4.5.

Table 4.5: Statement showing the grouping of 408 works

Sl. No.	Group	Number of works	Total cost (₹ in crore)
1	Six package works	359	671.82
2	Emergency maintenance works	19	26.40
3	Essential emergency works	30	101.78
<i>Total</i>		408	800.00

Source: Information furnished by CE, SWD

The CE, SWD furnished only the soft copies of the details of progress achieved in these package works to audit. Analysis revealed the following:

- (i) The progress report in respect of Package-2 (consisting of 33 works estimated at ₹45.30 crore) submitted to audit by CE, SWD was apparently incorrect as all the works were shown to have been completed with the executed quantities being shown the same as estimated while there were huge variations in financial progress as indicated in **Appendix 4.1**.
- (ii) Of the 326 works entrusted under the other five packages which were stipulated for completion between September 2018 and March 2019 (excepting Package-2), 279 works were reported completed and 15 works had not commenced even as of October 2019 due to reasons like non-clearance of encroachments, not obtaining permission for shifting of utilities/traffic diversion, change of location, *etc.*
- (iii) While the works under packages 5 and 6 were stated to be completed within the time prescribed, audit observed that the progress of works under Package-1 was extremely tardy as only 50 *per cent* of the works were completed even after lapse of one year from the scheduled date of completion.
- (iv) The laxity in execution of works was evident from the fact that 32 works were lingering for periods ranging from six months to one year after the scheduled date of completion for the packages. Details are furnished in **Appendix 4.2**.

Moreover, verification of records disclosed the following irregularities in implementation/execution of works under the different packages.

- (a) The State Government had specifically stipulated that BBMP should group these works into different packages costing not less than ₹10.00 crore and obtain technical sanction from the competent authorities in accordance with the KTPP Act and Rules.

The CE, SWD, pooled a total of 359 works into six packages with number of works ranging from 20 to 138 works and estimated cost ranging from ₹45.30 crore to ₹176.95 crore. This had minimised/restricted the scope of bidding and resulted in limited participation of bidders and was, thus, biased as is evident from the fact that there were single bids for Packages 1, 2 and 3 while Package 5 had five bidders. The details of bidders for Packages 4 and 6 were not made available to audit.

- (b) The CE did not prepare the DPRs for the execution of works under Nagarothana Yojana despite specific instructions from the Government. The CE replied (August 2020) that DPRs prepared during 2011 were the basis for the works and the same agencies were asked to prepare the tender document by updating the estimate to the current Schedule of Rates (SR) at no extra cost. He further stated that required physical survey and total station survey was conducted by consultant agencies before commencement of work and modifications made to Bill of Quantities (BOQ) specification as per site

conditions. The strip plans prepared earlier by DPR agencies were used for the purpose.

Audit, however, observed that the longitudinal cross-section diagrams based on which the estimates were prepared for the works under core areas of Bengaluru pertained to the year 2005-06 or earlier. The action and reply of the CE, thus, indicates that the estimates were prepared without conducting site inspection and the procedure of preparing estimates was only a mere formality that was being complied with for undertaking the works. The fact that modifications were made to BOQ underlines the relevance of the existing DPRs and the strip plans that were stated to have been used. The reply that tender documents were prepared by updating the estimate to the current SR at no extra cost contradicts the recommendation of the CE for making balance payment to an agency citing execution of this work (Paragraph 4.1.5.2 *ibid*).

(c) The rationale behind pooling of the works was not forthcoming from the records made available to audit. However, pooling of huge number of works spread out across different locations/zones (Package 3 had 86 works to be executed under 9 assembly constituencies and Package 4 contained 138 works spread across 11 assembly constituencies) contributed to delay in completion. This is evident from the fact that Packages 5 and 6, which pertained to RR Nagar zone, were only completed within the timeframe.

(d) The packages were entrusted with a consolidated Schedule-B totalling the quantities from each estimate and payments were also made accordingly. This facilitated the contractors/engineers to execute works without reference to estimated length/quantity for the individual works. Audit observed that while the executed quantity in individual works far exceeded (63 to 587 *per cent*) the estimate, works were declared complete even though the total executed quantity was much less than the estimate (46 to 94 *per cent*). Details are furnished in **Appendix 4.2**.

Substantial variation in length/quantities in respect of works in the packages and limiting the total quantity to Schedule-B quantities undermined the preparation of estimates for individual works and their consequent approval by the competent authorities. This also highlights the disregard to the codal provisions by BBMP authorities.

(e) In the absence of defined drain identification number in the nomenclature of works proposed/executed under packages, audit could not verify whether all the works executed were identified SWDs or drains of other types.

(f) None of the photographs on record, in any package, were taken identifying a 'fixed photo spot' clearly showing the status before and after the execution; as a result of which audit could not ensure the genuineness of execution/ completion of works (as works were spread out in various locations and all drains look alike and works are similar in nature). The details of inspections, if any, conducted by the EEs and the inspection reports thereon were not available.

The CE, SWD during the exit conference stated that the package works were nearing completion and would be completed early. Audit, however, observed that works were not completed even as of October 2019. Though the State Government stated (August 2020) that the up-to-date progress of all packages would be furnished to audit, the same was yet to be furnished (December 2020). No specific reply was furnished for the other observations pointed out in audit.

Recommendation 15: *The State Government should conduct an independent verification of the status and quality of all SWD works to ensure their quality and completion.*

4.3.10 Non-implementation of the Master Plan

The verification of available volumes (four out of eleven) of master plan of drains showed that, apart from remodelling of SWDs, the master plan had also proposed works for recharge structures in the drains, intercepting drains, segregation of sewage/ sewerage system from SWDs, removal of bottlenecks, interlinking of drains and lakes to hold flood discharges, etc. However, audit observed that except for remodelling of drains by constructing concrete walls and bridges, none of these recommended items had been incorporated in estimates or executed by BBMP. This defeated the objective of preparation of master plan.

The State Government accepted (August 2020) that BBMP had carried out work of around 15 to 20 *per cent* of the master plan estimates. It further stated on completion of all the works identified in the master plan, flooding problem could be minimised with other benefits such as improved environmental condition, ground water quality and quantity and also the possibility of harnessing rain water at city level as alternate source of water to Bengaluru. The reply, however, did not specify the time frame or the plan of action in this regard.

4.3.11 Non-preparation of storm water drainage manual

A manual/code is intended to define the scope of the administrative and executive functions of the department/organisation. It primarily describes the procedure to be followed by the authorities in dealing with activities concerning planning, design, execution and maintenance of assets created besides maintaining and rendering accounts properly.

The IRC guidelines (paragraph 12.5) provide for a maintenance manual for SWDs, clearly indicating the work to be carried out, the frequency for that work, the equipment and labour to be used and most important, any safety measures and equipment required. Further, the CPHEEO suggest preparation of an action plan for maintenance of SWD to ensure proper functioning of the drains.

Audit noted that BBMP, which is responsible for storm water management was yet to prepare a comprehensive SWD manual to systematically design, execute and maintain the SWD infrastructure of the city. Even the action plan as suggested by CPHEEO was not prepared.

The State Government stated (January 2019) that action would be taken for preparation of maintenance manual for SWDs. No action was, however, taken by the authorities concerned for preparation of manual for SWDs (December 2019). The position remained the same as per the updated reply (August 2020).

Conclusion

Provisions of National Disaster Management guidelines were violated as BBMP did not possess fool-proof data on the total number/length and nature of different types of drains as well as complete master plan of drains. Discrepancies between master plan for the city and master plan of drains regarding mapping of drains and their nomenclature remained unreconciled. BBMP failed to prepare a SWD manual to systematically design, execute and maintain the SWD infrastructure of the city and also did not possess on record the comprehensive DPRs for improvement of SWDs; the DPRs prepared being incomplete and deficient. Many of the works proposed in the master plan of drains were not taken up so far.

Failure to factor in reasons for high intensity rainfall due to rapid urbanisation and non-adherence to the provisions of IRC while designing and construction of roads/drains coupled with improper and delayed execution of works affected free movement of storm water leading to frequent flooding in various parts of the city.

Even though large number of works were abandoned due to poor performance of contractors, the contracts were rescinded without risk and cost and without retaining the security deposit. This led to extension of undue financial benefit to the contractors. BBMP lost financial assistance under JnNURM for storm water drainage due to non-submission of UCs as many of the works taken up were abandoned. The absence of basic records such as action plans, progress reports, works history registers *etc.*, was fraught with the risk of incorrect reporting and duplication of works.

Summary of important audit findings

<i>Para number</i>	Audit findings
4.1.1	BDA did not have on record the first two development plans. The third plan was incomplete and deficient. The fourth plan (RMP-2015) which is valid even as of now did not classify the drains in accordance with the buffer zone parameters. Many existing drains and water bodies identified as per the master plan of drains prepared by BBMP were not shown in the RMP.
4.1.2	There were delays in preparation of the Comprehensive Development Plans/Master Plans.

<i>Para number</i>	Audit findings
4.1.3	The master plan prepared by BBMP was incomplete as did not take into consideration the tertiary drains. Many drains shown in RMP and large number of drains which were in existence but not found in RMP were not mapped raising questions on the validity and reliability of the database.
4.1.4	The CE, SWD, did not possess comprehensive data of different roads and tertiary/surface road side drains within the jurisdiction of BBMP. The absence of comprehensive inventory of drains with BBMP and its failure to classify them properly contributed to lack of clarity on critical issues including the extent of buffer zone to be maintained.
4.1.5	<p>The DPRs prepared for Bengaluru core area were deficient. Major works taken up were stopped due to non-availability of land and poor performance of contractors which led to loss of JnNURM assistance, non-recovery of amounts from contractors and irregular payments to contractors. The DPRs for Bengaluru agglomeration area which were prepared without the required guidelines was not made available to audit. Preparation of DPRs without the basic data of drains rendered them unreliable.</p> <p>14 SWD works estimated to cost of ₹61.21 crore were taken up specifically for sewage diversion and to improve environmental condition near water bodies. The joint inspection showed that sewage was flowing invariably in all the stretches of drains and was also directly being discharged into lakes. This rendered the expenditure largely unfruitful.</p>
4.2.1	In the absence of DPRs, the methodology, data and specifications adopted for remodeling of drains could not be vouched by Audit. Scrutiny of estimates for SWDs executed by BBMP showed that none of the estimates for construction/improvements to SWDs included the items of providing detention ponds/retention facilities and infiltration drains. There was lack of coordination among various authorities within BBMP resulted in absence of proper linkage between roads and SWDs.
4.3.1	Basic records such as tender register, works register, action plans and progress reports were not maintained. The CE did not furnish the work-wise details in justification of the claims for executing works for a length of 177.02 km. Hence, audit could not ascertain/identify the actual site/stretch at which these works were reportedly executed, particularly where the drains were fully covered for long stretches and also the correctness of the claims.
4.3.2/ 4.3.3	Three out of the nine zones had not maintained the prescribed Works History Register and 'As Built Drawings' and 'Completion Plans' were not forthcoming from the records furnished to audit in respect of any of the zones.
4.3.4	The Zonal Executive Engineers, who were not responsible for SWD works, invited tenders for 110 SWD works costing ₹38.59 crore. Allowing multiple authorities to invite tenders and execute SWD works and absence of basic registers/records, could facilitate duplication of

<i>Para number</i>	<i>Audit findings</i>
	claims for the same works by both the SWD division and regular zonal offices.
4.3.6	BBMP estimated diversion of water course by providing coffer dam as a separate item and paid ₹4.10 crore to the contractors in 115 test-checked works, which was extra contractual and avoidable.
4.3.7	Though cost of excavation for foundations of Roads and Bridges and retaining walls included backfilling the space between the foundation masonry/concrete and the sides of excavation with approved material including its compaction, BBMP paid the contractors ₹4.41 crore in respect of 62 test-checked works towards this item resulting in extending undue financial benefits to the contractors.
4.3.8	BBMP paid an amount of ₹9.97 crore to contractors in respect of 98 test-checked works though the required lead chart was not prepared and approved by the competent authority for transporting the desilted waste from SWDs. In the absence of the approved lead chart, the genuineness of claims and payment towards desilting and conveyance was doubtful.
4.3.10	Though the master plan of drains proposed works for recharge structures in the drains, intercepting drains, segregation of sewage/ sewerage system from SWDs, removal of bottlenecks, interlinking of drains and lakes to hold flood discharges, <i>etc.</i> , audit observed that BBMP had neither incorporated these items in the estimates or executed them except for remodelling of drains by constructing concrete walls and bridges.

5 Chapter

Protection and maintenance of storm water management systems

5.1 Protection of storm water drains

5.1.1 Flow of sewage in storm water drains

The SWDs are meant to carry only the runoff from the rain water, and thus were to be generally dry during off monsoon period. Section 230 of the Karnataka Municipal Corporation Act, 1976 (KMC Act, 1976) and Section 72 of the Bengaluru Water Supply and Sewerage Board Act, 1964 specifically prohibit laying sewerage lines inside SWDs. The IRC guidelines (Paragraph 8.1) prohibit sewerage drains and its content entering the SWDs.

The study conducted by Audit with RRSC to analyse the time series land use changes and status of drains (as mentioned in Paragraph 2.4) revealed intersection or overlapping areas between drains and sewer lines that were the likely areas/ zones of possible intermixing of rain water and sewage, a few of which were validated by field visits. The sewer line layer obtained from BWSSB was overlaid on drainage maps and the intersection of the two layers was extracted to identify the overlapping areas. Audit observed that there were continuous stretches where the drains and sewer lines intersect/overlap each other. The total length of such stretches was about 16.0 km with about 728 points of intersection in Koramangala valley and about 28.09 km with about 342 points of intersection in Vrishabhavathi valley. Typical example of overlapping of drains and sewer lines is depicted in **Exhibit 5.1**.

Exhibit 5.1: Intersection of SWD and sewer lines

Koramangala valley



Vrishabhavathi valley



Overlap of sewer line (yellow colour) and drain (blue colour)

Audit also observed that sewerage lines were laid inside the SWDs and large quantity of sewage was invariably let into SWDs in complete disregard of the codal provisions. Out of 1,440 MLD of sewage generated in BBMP areas, about 780 MLD (54 per cent) was discharged into SWDs/water bodies without treatment. BWSSB, which is responsible for sewage disposal within the jurisdiction of BBMP area currently operates 27 Sewage Treatment Plants (STPs) with an operational capacity of 1,073 MLD. The utilisation efficiency was only 60 per cent with 644 MLD of total sewage reaching these STPs. Works in respect of 11 STPs with an operational capacity of 520 MLD were in progress as at the end of March 2021. Further, though 110 villages were made part of the BBMP area in 2007, BWSSB was yet to provide sanitation facilities to these villages.

The joint inspection of drains confirmed the existence of sewerage lines within SWDs. Further, audit noticed sewage being discharged into the SWDs directly or through fractured manholes at many places (**Exhibit 5.2**). This can be attributed to the absence of regular inspections by BBMP as indicated in Paragraph 5.2.1. Consequently, none of the SWDs were dry irrespective of the rainfall.

Exhibit 5.2: Photos showing the flow of sewage in SWDs



Direct discharge of sewage into SWD at Pattanagere, RR Nagar Zone



Discharge of sewage into SWD through fractured manhole at Seshadripuram, West Zone


https://youtu.be/_4s2d2Tjw1w

 Sewage Mixing


<https://youtu.be/jcX0jFzwgGw>

 Sewage Mixing



Sewage flowing in SWD at Ejipura, Koramangala Zone



Discharge of sewage into SWD through fractured manhole at Yeshwanthpur, RR Nagar Zone



Discharge of sewage into SWD through BWSSB pipeline at Silk Board Junction, Bommanahalli Zone



Sewage flowing in the SWDs due to chain of fractured manholes in the drain connecting to Herohalli Lake, Dasarahalli Zone

Source: Photographs taken during joint inspections

Thus, the failure of BBMP to identify and avoid mixing of sewage led to the misuse of SWDs as sewers. Since the water in SWDs is not treated in the same manner as sewage, the possibility of untreated sewage going into water bodies affecting the quality of ground water is very high. This carries substantial risk of spurt in vector/water borne diseases such as dengue, typhoid, cholera, hepatitis, *etc.*, and adverse environmental outcomes including disappearance of biodiversity and aquatic ecosystems.

The Chief Health Officer (Public Health), BBMP (CHO) confirmed the outburst of cholera in the city during March 2020 and stated that seven out of the 25 suspected cases had been confirmed as cholera. The CHO, *inter alia*, attributed sewage flowing in open SWDs to the spreading of epidemic in the city.

The State Government stated (August 2020) that BWSSB had laid sewerage lines and manholes inside the SWDs and as such there were leakages at many places leading to mixing of sewage with drain water. This had increased the pressure on SWDs which has to carry water mixed with sewage throughout the year. It further stated that BBMP was in constant dialogue with BWSSB to segregate sewage from SWD and action was being taken by BWSSB for segregation.

The reply reiterates the absence of coordination between various agencies. However, the details of the action taken for segregation was not furnished for verification.

5.1.1.1 Absence of STPs along SWDs

The IRC guidelines (Chapter 8) stipulate that sewerage drains and their content shall strictly be forbidden from entering SWDs. This can be achieved by providing cut-off drains for sewage all along the SWDs and leading to water body/storage tank. The sewage can then be treated through STPs and used for watering plants on medians, *etc.* Any excess can be led to the main SWD.

Though all types of SWDs invariably carried huge quantity of sewerage, BBMP had not installed STPs for treatment of polluted water in SWDs. Severely polluted water was being discharged into lakes and rivers, without due concern for social, environmental and health impacts.

The Detailed Project Report (DPR) of Vrishabhavathi valley had indicated that an amount of ₹6.73 crore was incurred on construction of STPs at 13 locations during the period 2008-09 as against an estimated cost of ₹7.48 crore. The records relating to five out of 13 STPs were provided to audit. Scrutiny revealed that the works entrusted included both civil works and erection and commissioning of STPs and the works were abandoned after civil works without installation of machinery. The exact reasons for abandoning the works or the details of actual expenditure incurred for construction were not forthcoming from the files. However, as per the letters of the contractors who were entrusted with the works, the reasons for abandoning could be traced to the absence of arrangement for supply of sewage to STPs and instructions by BBMP authorities not to execute the machinery part. This defeated the objective of treating sewage flowing in SWDs before letting into water bodies. Further, in the absence of data on the exact location of these STPs, audit could not locate/identify such installations during the joint inspections.

The State Government replied (August 2020) that BWSSB was responsible for construction and operation of STPs in Bengaluru and sewage flow in SWD was due to illegal connection of sewer in SWD which was not a planned activity. It further stated that an attempt was made by BBMP for construction of STPs along drains under JnNURM scheme as a pilot project in Vrishabhavathi valley wherein the STP sizes were in the range of 250 KLD to 1 MLD whereas the sewage flow in the drain was more than 100-200 MLD. Hence, none of the STPs were commissioned, SWD lines were not connected to any STPs and SWD division was not maintaining the STPs.

The reply was silent on the wasteful expenditure of ₹6.73 crore incurred under JnNURM scheme towards construction of these incomplete STPs. Specific reasons for non-completion and installation of STPs were not furnished. Moreover, as per the revised DPR of Vrishabhavathi valley referred to in Paragraph 4.1.5.1, the work of construction of STPs were executed by BBMP without obtaining the approval of the Ministry. In the absence of the records pertaining to all the works and the fact that the 90 per cent of estimated cost of

expenditure incurred was on execution of civil works, the State Government needs to investigate to ascertain whether the construction of STPs were necessary and actually executed.

5.1.1.2 No quality control measures such as quality monitoring for SWD flow leading to pollution of water bodies

The IRC guidelines (Paragraph 12.9) stipulate that the drainage system should be inspected at least twice a year, out of which at least one should be immediately after heavy rains and the quality and quantity of outflow should be observed and recorded. Monitoring the quality of water flowing into the SWD channels was to be ensured, with stricter norms for solid waste disposal, industrial effluent control and any illegal discharge of waste into the drainage network, in view of the impact on the health of the ecosystem and human consumption. All possible efforts need to be made for continuous and constant removal of pollutants and effluents in the drainage system.

Despite being aware that the drains were connected to water bodies and the runoff gets ultimately discharged into rivers which would be used for human consumption downstream, BBMP had not taken any action to either involve the Pollution Control Board in getting the water samples tested at different stretches, to maintain the quality of water or arrange for any study on the ecological impact of the SWDs on environment. In the absence of required quality control methodology for SWDs, the lakes of Bengaluru are extremely polluted due to sustained flow of untreated sewage and industrial effluents, resulting in lakes frothing/catching fire repeatedly through solid/liquid waste floating on its surface, or flammable methane generated from its oxygen-starved waters (**Exhibit 5.3**).

Exhibit 5.3: Photos showing lakes in Bengaluru affected by pollutants



Fuming Bellandur Lake



Frothing Yamaluru Lake



Dead fish in Ulsoor Lake

Source: Media reports



DRDO Lake, CV Raman Nagar

The audit contention is substantiated by the findings of the ‘Report on Inventorisation of Water Bodies in Bengaluru Metropolitan Area’ prepared by the Environmental Management and Policy Research Institute and submitted (September 2017) to Karnataka Lake Conservation and Development Authority. As per the report, the water quality rating study showed that 98 *per cent* of the lakes were unsatisfactory and only 2 *per cent* were satisfactory during monsoon season. The study further indicates that majority of the lakes in Bengaluru Metropolitan area were in under-deteriorated condition and unfit for direct human consumption as the sewage inflow, various pollution loads from different sources and changing land use patterns were imposing detrimental effects on the quantity and quality of water of all the lakes. BBMP in response to an audit query also accepted that as many as 89 lakes were directly connected to SWDs.

Further, the NGT had warned (December 2019) that it would penalise officials for their failure to meet the deadline to build STPs to stop polluted water from entering the city lakes and had set September 2020 as the deadline to create the STPs and lay sewerage networks to stop unchecked discharge of sewage water into the Bellandur, Agara and Varthur lakes.

As per the information furnished (March 2020) by CE, Lakes Division, BBMP, the STPs were installed to prevent flow of polluted water only for eight lakes and the work was in progress for another nine lakes. Considering the laxity in installation of STPs, despite instructions/intervention of Courts/NGT, the possibility of BBMP meeting the given deadlines for arresting assimilation of sewage with water bodies and preserving healthy ecology appears bleak. Audit observed that BWSSB has submitted (June 2020) an affidavit to NGT, seeking extension of time due to restrictions during lockdown period.

The State Government informed (August 2020) that action would be taken to verify the pollution levels in the SWDs with the help of State Pollution Control Board. The details of action taken were, however, not provided. The reply also reflects the apathy on the part of State Government and BBMP towards monitoring of the state of lakes and SWDs.

Recommendation 16: BBMP should accord high priority to prevent discharge of sewage into SWDs. There is a need to prepare and execute (i) medium term strategy for complete cessation of sewage contamination of storm water and lakes eventually and (ii) a short-term strategy for installation of sewage treatment plants in coordination with BWSSB to prevent contamination of water bodies.

5.1.2 Absence of buffer zone and boundary marking for SWDs

Buffer zones are areas of land adjacent to a drain or waterbody which are meant for providing utilities such as power, pipelines for water/oil/gas etc., and also to facilitate easy maintenance of drains.

The RMP 2015 stipulated a buffer zone (no-development area) of 50m, 25m and 15m (measured from the centre of the drain) on either side of primary, secondary and tertiary drains. This buffer area was modified (May 2016) by the NGT to 50m, 35m and 25m (measured from the edge of the drain). Further, under Section 58 of the KMC Act, 1976, BBMP had the obligatory function of putting in place substantial boundary marks of such description and in such positions as shall be approved by the Government, defining the limits or any alteration.

Audit observed during the joint inspection of drains that none of the test-checked drains had ‘boundary markings’ on either sides clearly specifying the ‘no-development area’ and the stipulation regarding buffer zone was not adhered to in respect of any of the drains. This not only contravened the stipulations regarding the buffer zone/no-development area but also paved the way for construction adjacent to the drains without any off-set space and encroachment of drains.

On audit pointing out the lapse, the State Government stated (August 2020) that action had been taken to form (October 2018) a team under the Chairmanship of the Joint Director of Land Records to mark the boundary of SWDs in a phased manner wherever the land is available along the SWDs and that the work of survey and marking the SWD boundary is in progress.

5.1.3 Survey of encroachments and their removal thereon

Section 234 of the Karnataka Municipal Corporation Act, 1976 (KMC Act, 1976) clearly prohibits construction/erection of any building, wall, fence or other structure on SWDs and empowers the Commissioner, BBMP to remove such structures and recover the cost from the offenders. Paragraph 4.23.1 of NDM guidelines clearly states that the drains should be delineated and boundaries fixed. Further, the Karnataka High Court directed (2011) BBMP to conduct a detailed survey of encroachments on SWDs and to clear all encroachments.

BBMP initially provided a list of 1,988 encroachments identified under its jurisdiction but did not furnish the source/period of information. Hence, audit could not ascertain whether any survey was actually conducted to identify the encroachments.



<https://youtu.be/zF-XoPIjEg>



Encroachments on drains

During the joint inspection of about 70 drains²⁵, Audit observed 23 cases of significant encroachments (**Exhibit 5.4**) as listed in **Appendix 5.1**. Out of these, 16 cases were not in the list provided by BBMP. Thus, the completeness and reliability of the data on encroachments available with CE, SWD was doubtful.

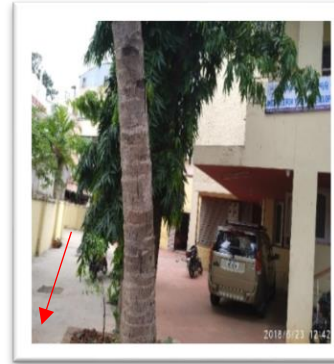
Exhibit 5.4: Photographs showing the encroachments on SWDs



*Himagiri Meadows Apartments,
Bommanahalli Zone*



*Naurang Function Hall,
Tavarekere, Koramangala Zone*



*Private Property at Koramangala
5th Block*



*Private property on JC Road,
Koramangala Zone*



*Private property, Lalbagh Road,
Koramangala Zone*



*Ansal Forte Apartment, Near
Silk Board, Bommanahalli Zone*



*Commercial building at
Koramangala 7th block*



*Private property at BSK 1st Stage,
Srinivasanagar, South Zone*



*Padmavathi Kalyana Mantapa,
Rajarajeshwarinagar Zone*

²⁵ Including few unmapped drains



Spartacus Apartments, 4th T Block,
Jayanagar, Koramangala Zone



Ranka Nest Apartments, West
Zone



Surana College,
Rajarajeshwarinagar Zone

(Arrow marks in red colour shows the width and direction of flow of SWD)

Source: Photographs taken during joint inspections



https://youtu.be/tt_kMnaHFgY



Encroachments on
drains

Audit observed that out of 1,988 encroachments identified by BBMP, 1,225 encroachments were stated to have been removed leaving a balance of 763 encroachments as of October 2018. As per the latest information furnished (December 2020) by CE, SWD, BBMP had identified a total of 2,626 encroachments in various zones, of which 428 were stated to have been removed during the year 2016-17 and 1,484 were removed from 2018-19 onwards. The balance 714 encroachments were yet to be removed. While 52 cases of non-removal were attributed to pending court cases, the reasons for not removing the balance encroachments were not furnished to audit.

The veracity of the claim of having removed the encroachments was doubtful as audit observed during joint inspection that one of the encroachment stated to have been removed continued to exist as illustrated below.

Illustration

RN193 (Primary SWD) under Rajarajeshwari Nagar zone was encroached upon by way of constructing Padmavathi and Meenakshi Kalyana Mantapas. As per the information furnished to audit by BBMP, the said encroachment was removed on 18.08.2016. However, a joint physical inspection (11 June 2018) showed that the kalyana mantapas were existing on either side of the drain and were connected with a concrete platform linking the two buildings (Exhibit 5.5). The impact of the continued encroachment could be seen by way of rainwater entering (20 October 2020) into the dining area of the kalyana mantapa (Exhibit 5.6).

Exhibit 5.5: Existence of kalyana mantapas and concrete platform on drain



Exhibit 5.6: Flooding of dining area of kalyana mantapa



Source: Media reports and photographs taken during joint inspection

Apart from the above, audit also observed that the evictions so carried out were incomplete as only certain portions of the encroached buildings were razed and no further action was taken for improving the conditions of the drains (**Exhibit 5.7**). Hence, the claim of BBMP that 1,912 encroachments were removed cannot be accepted at face value.

Exhibit 5.7: Status of evictions stated to have been carried out by BBMP under RR Nagar zone



Source: Photographs taken during joint inspections

The State Government replied (August 2020) that action was being taken to clear encroachments in a phased manner after obtaining the survey maps and encroachment markings from the Revenue Department. It further stated that action would be taken to clear the encroachments noticed by the joint inspection team, following the due procedure.

Recommendation 17: *BBMP needs to escalate its efforts to conduct robust surveys to identify and evict all encroachments on SWDs and maintain the stipulated buffer zone.*

5.2 Factors affecting/impeding connectivity/smooth flow of storm water in drains: Issues concerning maintenance of the SWD infrastructure

The drainage system is at its best, when it is maintained properly as designed. For this purpose, it is necessary that the drains keep their shape and slope in the designed manner during their life time. It is also necessary to ensure that the drains retain their full cross section, particularly for the monsoons. The system of maintenance can be classified into three categories.

- a) Periodical inspection and maintenance;
- b) Continuous regular maintenance; and
- c) Special maintenance/Repairs for improvement.

5.2.1 Periodical inspection of drains

Failure of drains would occur due to deficiency in maintenance. The IRC guidelines (paragraph 12.3) stipulates periodical inspection and maintenance of drains with principal activities²⁶, particularly at the entry and exit points during the rains. The IRC further stipulates that all cross drainage structures need to be inspected to observe any blockage due to debris, logs and other such materials, problem locations identified and records kept updated.

The details of periodical inspection of drains by field engineers carried out if any, were not made available to audit for scrutiny. During the joint inspections, audit observed severe blockages of surface drains as well as SWDs (**Exhibit 5.8**) indicating either that inspection was not carried out by the field engineers or that no action was taken on the report of the field engineers.

Exhibit 5.8: Photographs showing the blockage of drains



Near Hulimavu lake, Bommanahalli Zone



Pattanagere, Rajarajeshwarinagar Zone


<https://youtu.be/zTsaSmJYZ-o>

Absence of regular inspection

²⁶ Desilting, clearing of weeds, cleaning of obstruction/debris/blockage, repairing of lining immediately at the commencement of damage or deterioration, etc.



Kodipalya, Rajarajeshwarinagar Zone



Jayanagar 7th Block, South Zone



Koramangala 6th Block, Koramangala Zone

Source: Photographs taken during joint inspections



Padmanabhanagar, South Zone

The State Government replied (August 2020) that though there was not record, the drains were generally inspected by field engineers for proposing maintenance work. The reply cannot be accepted as documentation is a very vital evidence for having undertaken the field visits and also for preparing the action plans for regular maintenance of drains. The fact that regular maintenance was absent as discussed below indicates that inspection of drains was not actually carried out.

5.2.2 Absence of regular maintenance of drains

The BBMP did not take up maintenance of drains regularly and continuously leading to blockage and growth of vegetation in the drains, consequently resulting in drains overflowing during rains, particularly where the utility lines were laid. Absence of regular inspection and maintenance also facilitated damage to fencing/ walls of drains allowing inordinate dumping of debris. The lack of maintenance can be linked to the absence of periodical physical inspection of SWDs and documentation of the findings of the inspections by field engineers. This was compounded by the fact that BBMP failed to prepare action plans for regular maintenance activity and also the maintenance manual indicating the roles and responsibilities of the concerned.

Audit observed during joint inspections of drains that SWDs were filled with debris, vegetation and were heavily silted indicating absence of regular maintenance of drains (**Exhibit 5.9**).

Exhibit 5.9: Photos showing the status of drains due to inadequate maintenance



Vegetation inside SWD at Magadi Road Railway Bridge, West Zone



Dumped debris/wastes and garbage inside SWD at Ejipura, Koramangala Zone



Vegetation inside SWD Akshaya Nagar, Bommanahalli Zone



Dumped wastes and garbage inside SWD near Football Stadium, Koramangala Zone



Vegetation inside SWD at Vyalikaval, West Zone



Vegetation inside SWD at Peenya, Rajarajeshwarinagar Zone

Source: Photographs taken during joint inspections

The State Government stated (August 2020) that maintenance of drains has now been entrusted on annual maintenance contract after inviting tenders and obtaining the approval of the competent authority and the work was in progress since 2019-20.

The reply reiterates the fact that regular and continuous maintenance of drains was absent prior to 2019-20. However, audit observed that only 377 km of drain length (45 per cent) out of the total 842 km was entrusted for annual maintenance. Zone-wise analysis further revealed the following:

- The complete length of drains of 73.6 km was entrusted only under East zone
- The entrustment was 97 per cent, 71 per cent and 62 per cent in South zone, Koramangala zone and West zone respectively (Core Bengaluru area).
- In the other five zones, it was less than 50 per cent and ranged from 9 per cent to 49 per cent (Bengaluru agglomeration area).

The partial entrustment for annual maintenance, thus, would not yield the desired results unless the complete length of existing drains are taken up for maintenance on a regular basis.

Recommendation 18: BBMP should put in place adequate mechanism to conduct and document periodical inspection and maintenance of all categories of drains.

5.2.3 Entrustment of desilting works during monsoon period

The IRC guidelines (paragraph 12.6) stipulated desilting of all the drains before the onset of monsoon. Generally, the calendar months from June to September were regarded as 'monsoon period'. Paragraph 4.12.4.3 of NDM guidelines stipulate that pre-monsoon desilting of all major drains shall be completed by 31 March each year. It further stated that the periodicity of cleaning drains should be worked out based on the local conditions for which a roster should be worked out and strictly followed.

Audit observed from the records made available, that BBMP had taken up 175 desilting works at a total cost of ₹117.29 crore during 2013-17 for selective chainage and not for the entire stretch of the drains. Only the records pertaining to 14 works costing ₹17.56 crore were furnished to audit for verification.

Scrutiny of records disclosed that works were entrusted to contractors between July to November allowing a time period varying from 1 month to 24 months (including monsoon period) for completion. Evidently, the works would be carried out during the monsoon period only. This clearly violated the provisions of the IRC/NDM guidelines that the works were to be completed before the onset of the monsoon. Moreover, desilting for select lengths and not the complete length of drains defeats the very purpose of desilting of drains, as silt from the stretch left unattended upstream would flow downstream filling up the stretch that has already been desilted. Since the works were completed before the commencement of audit and in the absence of majority of the work files,

audit could not identify the break in stretches, if any and also ascertain the occurrence of such instances necessitating taking up the same works again.

Audit also observed that BBMP had not prepared any action plan for desilting of drains before onset of monsoon nor was a roster of cleaning works prepared and followed.

The State Government stated (August 2020) that Bengaluru, in the recent past, was receiving spells of rains during off-monsoon periods also forcing the execution of works to prolong to rainy season. It further stated that action would be taken to avoid such omissions in future and to entrust and get the work completed before onset of monsoon.

5.3 Monitoring and awareness

5.3.1 Absence of penal provisions for violations

Paragraph 13.1 of IRC guidelines stipulate that ‘since large quantum of public funds are spent on SWD implementation, time has come for enforcement of certain disposable systems wherein the offending party shall be penalised and booked under various punitive clauses of respective urban local bodies’. It further provided for deployment of patrolling vehicles and imposing criminal proceedings in the light of serious choking of SWDs by reckless disposal of debris.

The BBMP had neither enacted any penal clauses for violations/dumping of debris nor had initiated action for patrolling along SWDs. The absence of penal provision for booking the defaulters would lead to undeterred dumping of debris, construction and demolition waste, garbage including plastic into SWDs.

The State Government stated (January 2019/August 2020) that action was being taken in this regard. However, the details of action initiated in this regard were not furnished to audit (November 2019/December 2020).

5.3.2 Absence of information, education and communication activities

Behavioural change is vital for effective management of drainage infrastructure, particularly in urban domains. Information, education and communication (IEC) is a multilevel tool for promoting and sustaining risk-reducing behaviour change in individuals and communities. The IEC campaign should target households, shops, and commercial and institutional premises as well as other stakeholders such as government service providing agencies, municipal officials, elected representatives, non-government organisations (NGOs), the informal sector, media, etc., to ensure their participation in nicely managing the urban storm water drainage and solid waste management systems in the city.

Various manuals and rules pertaining to solid waste management underscored the importance of IEC activities and required the State Government and ULBs to create public awareness and educate stakeholders in proper disposal of solid wastes adopting measures like re-use, reduction and recycling of wastes.

Audit observed that poor awareness and civic sense, coupled with insufficient solid waste management led to a situation where the urban population dump

debris/wastes and construction and demolition wastes into SWDs. As against 4,200 and 4,500 tonnes per day (TPD) of waste generated excluding bulk generation during 2018-19 and 2019-20, BBMP had lifted 2940 and 3800 TPD, the collection efficiency being 70 and 84 *per cent* respectively. BBMP did not have secondary storage or transit facilities because of which the primary waste collected was transported directly to compactors at transfer points located at intersection of roads. This arrangement resulted in either throwing of unwanted/non-recyclable wastes into nearby vacant plots/drains or open burning of such wastes by BBMP workers themselves. This also facilitated dumping of wastes by public at such spots.

Despite widespread disposal of all sorts of wastes into SWDs by households and industries/commercial establishments, the BBMP had not taken up any IEC activities or awareness camps for educating the population regarding importance of SWDs and their proper upkeep. Audit observed during JPVs that people resorted to damaging/breaking the chain link fencing erected along the SWDs for dumping wastes (**Exhibit 5.10**). Absence of penal provision against offenders facilitate uncontrolled and continuous dumping of debris/wastes in SWDs.

Exhibit 5.10: Photos showing dumping of debris/wastes in/adjacent to SWDs and breakage of chain link fence of SWDs



Austin Town, Koramangala Zone



Ejipura, Koramangala Zone



Manjunathanagar, South Zone



Rajarajeshwarinagar Zone



Akshayanagar, Bommanahalli Zone

Source: Photographs taken during joint inspections



Cholarapalya, South Zone

Besides, the SWDs which carry high level of sewerage with chemical contaminants get stagnant/blocked with siltation/vegetation and turn into breeding areas for mosquitoes and other hazardous phylum/protozoa. It is, therefore, imperative for the BBMP to conduct health awareness campaigns in the localities along the SWDs that are more prone to hazards. The BBMP had neither obtained information on epidemic outbreaks nor arranged for health camps in any part of the city.

The State Government stated (January 2019/August 2020) that action would be taken to conduct IEC programmes and awareness campaigns to educate citizens regarding up keeping of SWDs. Audit, however, observed that no action had been initiated in this regard even as of December 2020.

5.3.3 Absence of grievance redressal mechanism

Grievance redressal is a mechanism through which the BBMP could connect to people in resolving the issues related to encroachments, dumping of debris/wastes, blockages, silting, functioning of officials *etc.*

Audit observed that grievance redressal mechanism was absent in the office of CE, SWD as the Complaint Register to record the grievances had not been maintained. Specific records were not maintained even in respect of applications received for obtaining information through Right to Information Act.

Absence of grievance redressal mechanism with particular reference to SWDs would result in complaints regarding encroachments and dumping of debris being ignored thereby allowing defaulters to go unpunished.

The State Government stated (January 2019/August 2020) that there is a call centre operating in BBMP for receiving complaints. It further stated that action would be taken to obtain and furnish the details of complaints received and attended to and maintain complaint register to record all types of complaints. However, the same were not furnished to audit (November 2019/December 2020).

Recommendation 19: BBMP should educate the urban population on the effects of improper management of SWDs and explore the possibility of involving Residential Welfare Associations/Non-Government Organisations for effective management of waste/drains and providing them with incentives.

Conclusion

Failure of BBMP to coordinate with BWSSB in preventing mixing of sewage in SWDs despite both their Acts specifying separation of sewage and storm water flows led to contamination of fresh water lakes. This, in turn, led to temporary measures disrupting inter-connectivity between water bodies and drains. Though RMP 2015 stipulated a buffer zone on either side of primary, secondary and tertiary drains and section 58 of the KMC Act, 1976 stipulated putting in place boundary marks for such descriptions, none of the test-checked drains had boundary markings. As a result, it paved the way for encroachment of drains as well as construction in buffer zone. Despite identifying 2,626 encroachments on SWDs, BBMP was yet to take action on 714 encroachments. The completeness and reliability of the data on encroachments available with BBMP was also doubtful as audit noticed significant instances of encroachments during joint inspection of drains. The action stated to have taken to clear the encroachments was not complete.

Severe blockages of surface drains/SWDs were noticed indicating absence of periodical inspections as well as its regular maintenance. Failure to adopt quality monitoring measures and non-installation of STPs, despite Court directives resulted in unabated contamination of water bodies. Non-enactment of penal clauses for violation/dumping of debris in SWDs and absence of a grievance redressal mechanism allowed defaulters (encroachment and dumping of debris) to go unpunished. In addition, BBMP did not take up any IEC activities/ awareness camps for educating people regarding the importance of SWDs and their proper upkeep. Thus, the failure of BBMP to protect and maintain the drain infrastructure resulted in continuous abuse of the drains.

Summary of important audit findings

Para number	Audit findings
5.1.1	Sewerage lines were laid inside the SWDs and large quantity of sewage was invariably let into SWDs though the codal provisions prohibit mixing of sewage with storm water. Out of 1,440 MLD of sewage generated in BBMP area, about 780 MLD (54 per cent) was discharged into SWDs/water bodies without treatment.

Para number	Audit findings
	<p>BBMP had incurred ₹6.73 crore on construction of STPs at 13 locations during the period 2008-09. Scrutiny of records relating to five STPs showed that the works entrusted included both civil works and erection and commissioning of STPs and the works were abandoned after civil works without installation of machinery. This defeated the objective of treating sewage flowing in SWDs before letting into water bodies.</p> <p>BBMP had not taken any action to get the water samples tested despite being aware that the drains were connected to water bodies and the runoff gets ultimately discharged into rivers which would be used for human consumption downstream.</p>
5.1.2	<p>Though RMP and NGT stipulated maintenance of buffer zone on either side of the drains, joint inspection of drains showed that none of the test-checked drains had 'boundary markings' on either sides specifying the 'no-development area' resulting in constructions adjacent to the drains without any off-set space and encroachment of drains.</p>
5.1.3	<p>BBMP was yet to remove 714 encroachments out of the identified 2,626 encroachments in various zones. Audit observed 23 cases of significant encroachments, out of which 16 cases were not in the list provided by BBMP. Thus, the completeness and reliability of the data on encroachments available with CE, SWD was doubtful.</p> <p>The veracity of BBMP's claim of having removed the encroachments was doubtful as audit observed during joint inspection that one of the encroachments stated to have been removed continued to exist and the evictions carried out were also incomplete.</p>
5.2.1	<p>The details of periodical inspection of drains by field engineers carried out were not made available to audit. During the joint inspections, audit observed severe blockages of surface drains as well as SWDs indicating either that inspection was not carried out by the field engineers or that no action was taken on the report of the field engineers.</p>
5.2.2	<p>The joint inspections of drains showed that SWDs were filled with debris, vegetation and were heavily silted indicating absence of regular maintenance of drains.</p>
5.2.3	<p>Scrutiny of records of 14 works costing ₹17.56 crore showed that BBMP had taken up the desilting works during monsoon period in violation of the IRC/NDM guidelines which stipulated desilting before the onset of monsoon.</p>
5.3.1/ 5.3.2	<p>As against 4,200 and 4,500 TPD of waste generated excluding bulk generation during 2018-19 and 2019-20, BBMP had lifted 2940 and 3800 TPD respectively. BBMP did not have secondary storage or transit facilities because of which the primary waste collected was transported directly to compactors at transfer points located at intersection of roads. This arrangement resulted in either throwing of unwanted/non-recyclable wastes into nearby vacant plots/drains or open burning of such wastes by BBMP workers themselves.</p> <p>BBMP had not taken up any IEC activities or awareness camps for educating the population regarding importance of SWDs and their proper upkeep. Joint inspection showed that people resorted to damaging/breaking the chain link fencing erected along the SWDs for dumping wastes. Further, BBMP neither enacted any penal clauses for violations/dumping of debris nor had initiated action for patrolling along SWDs.</p>

6 Chapter

Financial Management

BBMP was provided with funds under various schemes like JnNURM, Nagarothana Yojane, Special Infrastructure Projects, Finance Commission Grants *etc.*, apart from its own funds for management of SWDs.

6.1 Allocation and expenditure towards management of SWDs

The details of allocation and expenditure for the years 2013-14 to 2017-18 towards management of SWDs was as indicated in **Table 6.1**.

Table 6.1: Allocation and expenditure towards management of SWDs

Year	Allocation	Expenditure	Remarks
2013-14	107.37	82.07	
2014-15	105.09	102.54	
2015-16	102.58	148.25	BBMP had incurred expenditure on ongoing works under JnNURM but funds were not received from the central government as the scheme was over by end of 2014-15. The expenditure was, therefore, met out of its own funds.
2016-17	186.88	205.90	Apart from SWD works, the State Government released funds under Nagarothana Yojane to BBMP for various other activities. While the BBMP accounted for the receipts under Nagarothana Yojane as a lump sum allocation without exhibiting breakup for different activities in its budget estimates, the expenditure was shown distinctly for each activity including SWD works. In the absence of distinct allocation for SWD, amount allocated could not be identified.
2017-18	268.46	599.58	
Total	770.38	1,138.34	

Source: Data furnished by CE, SWD and Annual Budget Estimates

Analysis of the BBMP budget for the audit period showed that Government grants which constituted about 38 *per cent* in 2013-14 increased to 55 *per cent* in 2017-18. This indicated the BBMP's increased dependency on Government grants for undertaking its activities. Further, the expenditure incurred on SWD constituted a meagre two to eight *per cent* of both the total receipts and the total expenditure of BBMP during the above period.

Audit observed that SWD works were not taken up under any of the other urban development schemes such as Atal Mission for Rejuvenation and Urban Transformation, Smart Cities Mission *etc.* indicating the absence of convergence with these schemes and the lack of priority towards storm water management.

6.2 Deficiencies in preparation of annual budget proposals

Annual financial planning is critical for proper functioning of any organisation. Annual budget proposals were to be worked out based on the cost of the works, funds received, expenditure incurred, anticipated expenditure and probable fund requirement in the ensuing year for the implementation of the works.

The CE, SWD did not furnish the annual budget proposals prepared, if any, to audit. Hence, audit compared the expenditure figures exhibited in the budget estimates of BBMP with the cash book maintained by CE, SWD and found variations as shown in **Table 6.2**.

Table 6.2: Statement showing the variation in expenditure figures between budget estimates and cash book

(₹ in crore)			
Year	Expenditure as per Budget estimates	Expenditure as per cash book	Difference
2013-14	86.36	82.07	(+) 4.29
2014-15	58.41	102.54	(-) 44.13
2015-16	148.56	148.25	(+) 0.31
2016-17	195.74	205.90	(-) 10.16
2017-18	570.98	599.58	(-) 28.60
Total		1,138.34	

Source: Data furnished by CE, SWD and Annual Budget Estimates

The continued discrepancy indicated the omission on the part of the authorities concerned to reconcile and report the correct expenditure figures in the budget estimates which is an essential function to ensure financial accuracy. Further, the laxity also exposes the financial indiscipline reigning in BBMP.

Non-provision of separate budget for maintenance - BBMP did not provide separate budget for the maintenance of SWDs, despite the recommendation by the IRMA.

The State Government endorsed (January 2019/August 2020) the reply of the Commissioner that action would be taken to reconcile the differences with concerned authorities and to ensure reporting expenditure in budget estimates as per actuals. However, the details of reconciliation or specific reasons for discrepancy was not furnished to audit (November 2019/December 2020).

6.3 Short-provision of funds under 14th Finance Commission

As stipulated vide recommendations of the 14th Finance Commission, the BBMP was to earmark a minimum of 10 *per cent* of basic grants received by it for implementation of SWD works. The BBMP had received ₹664.34 crore during the period 2016-18 but had released only ₹24.65 crore for SWD works resulting in short release of ₹41.78 crore.

Non-compliance to recommendations of the Finance Commission and short-release of funds for SWDs works would impact works as proposed in the master plan and diversion of funds for other purposes, leading to a situation where SWDs works do not get adequate priority.

The State Government stated (August 2020) that action would be taken to earmark 10 *per cent* of total basic grant receipts for implementation of SWD works.

6.4 Continued maintenance of bank accounts for JnNURM

The BBMP maintained four different savings bank accounts, one each for the four zones for accounting funds under JnNURM. The JnNURM cell at BBMP was implementing works and operating the funds. Scrutiny of the cashbook maintained by JnNURM cell showed that the transactions pertaining to SWDs under JnNURM came to an end by January 2015. An amount of ₹2.37 lakh was lying in these bank accounts as of May 2018. Audit further observed that ₹7.00 lakh held in term deposits had not been accounted for in the cashbook indicating improper financial management. BBMP did not initiate action to close the accounts and transfer the funds either to the main account or to the SWD account even after four years of the closure of the scheme though it was incurring expenditure out of its own funds for the balance works under JnNURM.

The State Government endorsed (January 2019) the reply of the Commissioner that the matter would be brought to the notice of higher authorities for further action and the same was reiterated in its reply of August 2020. Evidently, BBMP had not taken any action in this regard. The non-closure of bank accounts and non-accounting of the term deposits despite being pointed out by audit is fraught with the risk of the amounts in these accounts going unnoticed.

6.5 Non-reconciliation of statutory recoveries remitted to departments concerned

BBMP (SWD Division) maintained a non-interest bearing current account (bearing No.04091010005485) instead of interest bearing savings bank account since April 2012. The funds required for implementation of SWD works were released to this account from the BBMP main account till April 2015. The last transfer of funds for implementation of works was ₹20 crore on 6 April 2015. The balance as at the end of June 2015 was ₹12.21 lakh. Thereafter (July 2015 onwards), payments were directly released to the contractor's bank accounts from the BBMP main account and amounts deducted from the bills towards statutory deductions like Income tax, VAT/GST, labour cess, royalty, Contractors Benevolent Fund and further security deposit were transferred to this account for onward remittance to the authorities concerned.

The said account was converted into a flexi super current account from July 2017 wherein funds in excess of balance of ₹5.00 lakh was auto transferred to term deposits.

Audit analysed the pass sheets and observed that cheques issued towards remittance of income-tax and Contractor's Benevolent Fund deducted out of contractor's bills amounting to ₹43.86 lakh and ₹37.32 lakh respectively could not be traced to the pass sheets. Evidently these cheques could have remained uncashed. The CE, SWD had not conducted any reconciliation in this regard.

In the absence of reconciliation, audit could not ascertain the amounts under various components that formed part of the balance of ₹31.95 crore available in sweep-in deposit accounts.

The State Government endorsed (January 2019/August 2020) the reply of the Commissioner that instructions had been issued to accounts branch to reconcile the balance in bank account regularly. However, the details of reconciliation, if any, was not furnished to audit (November 2019/December 2020).

6.6 Weak financial control mechanism

Non-maintenance of basic financial records - The provisions of Karnataka Public Works Accounts Code stipulate maintenance of various records for proper accounting of transactions like Grants Register, Deposit Register/Register of Securities, Schedule of Works Expenditure, Monthly Account, Register of Advances, and other miscellaneous records. However, audit observed that none of these registers/records were maintained by the CE, SWD despite incurring significant expenditure on tendered works.

Improper maintenance of cash book - Audit observed that the cashbook maintained by the CE, SWD was improper as:

- The balance on hand at the beginning of each day was not brought forward on the receipt side. The closing balance was not stuck at the end of each day, the abstract of transactions at the end of the month was not recorded, the entries in the cashbook were attested by zonal EEs instead of the Head of the office (CE, SWD);
- Reconciliation between cash book balance and bank balance was not conducted and recorded; and
- A single cashbook was maintained in the office though works were approved and executed under various schemes and in different zones. As a result, scheme-wise and zone-wise expenditure could not be verified.

The State Government endorsed (August 2020) the reply of the Commissioner that instructions had been issued to the accounts branch to maintain all the records as prescribed under the codal provisions.

Recommendation 20: *BBMP should prepare the budget clearly indicating the scheme-wise receipts of funds and expenditure incurred thereon and for both capital and revenue activities under each function.*

Conclusion

BBMP had a weak financial control mechanism as it did not maintain basic financial records such as grants register, deposit register, register of securities, schedule of work expenditure, register of advance etc. Further, the cash book maintained by the CE, SWD was deficient. The budget exercise was deficient and did not indicate the allocation of funds for SWD activities under Nagarothana Yojana. The expenditure incurred on SWD constituted two to eight per cent of the total expenditure of BBMP during the period 2013-14 to

2017-18. There was no separate budget for maintenance of SWDs and SWD works were not taken up under any other development schemes indicating the lack of commitment by BBMP towards effective storm water management.

Summary of important audit findings

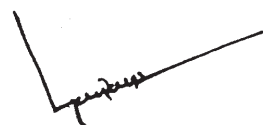
Para number	Audit findings
6.1	BBMP was largely depended on Government grants. The expenditure incurred on SWD constituted a meagre two to eight <i>per cent</i> of both the total receipts and the total expenditure of BBMP during the period 2013-14 to 2017-18.
6.2	There were discrepancies between the figures exhibited in the budget estimates and actual expenditure recorded in the cash book. This indicated the lack of reconciliation mechanism and correct reporting of expenditure and exposes the financial indiscipline reigning in BBMP.
6.3	BBMP short provided the funds under 14 th Finance Commission to the extent of ₹41.78 crore.
6.5	The CE, SWD had not maintained the basic records such as Schedule of works expenditure, monthly accounts, register of advances etc. The cash book maintained was improper as it did not indicate the closing balance at the end of each day and reconciliation between cash and bank balances was not carried out and recorded.

Bengaluru
The 26 JUL 2021



(E. P. Nivedita)
Principal Accountant General (Audit-I)
Karnataka

Countersigned



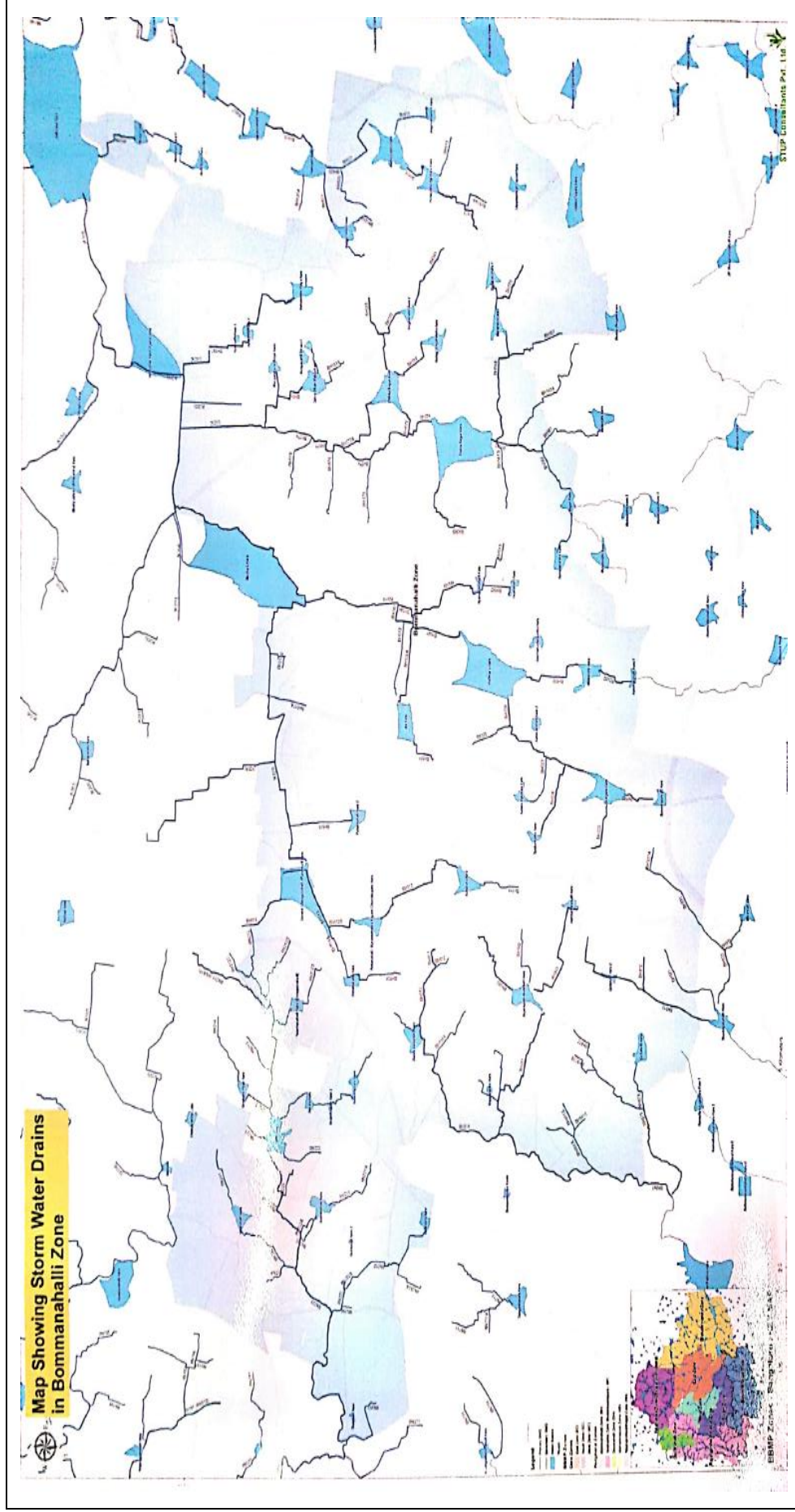
New Delhi
The 30 JUL 2021

(Girish Chandra Murmu)
Comptroller and Auditor General of India

Appendix 1.1

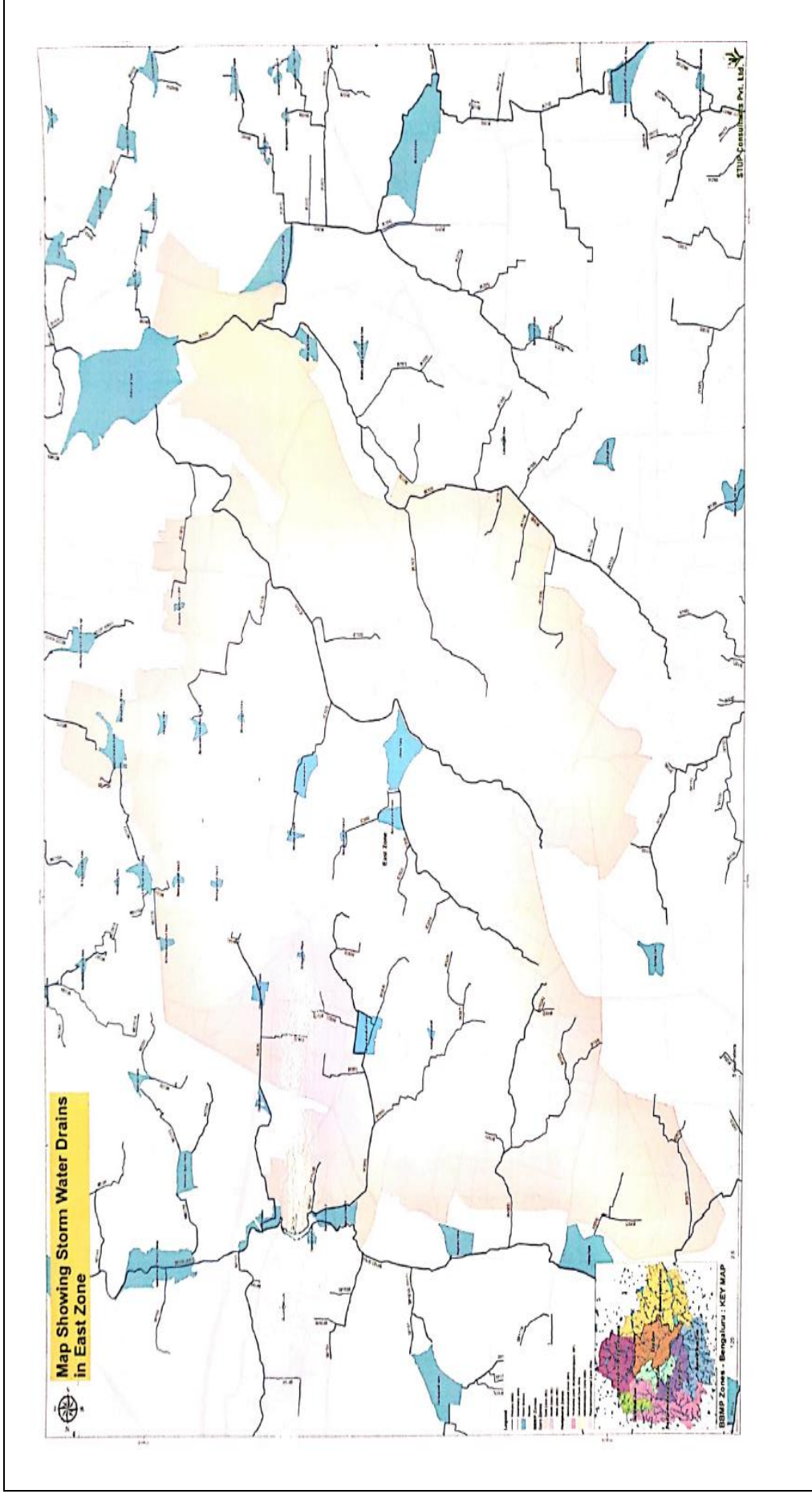
(Reference: Paragraph 1.3/Page 2)

Storm water drains as mapped in master plan of BBMP under Bommanahalli Zone



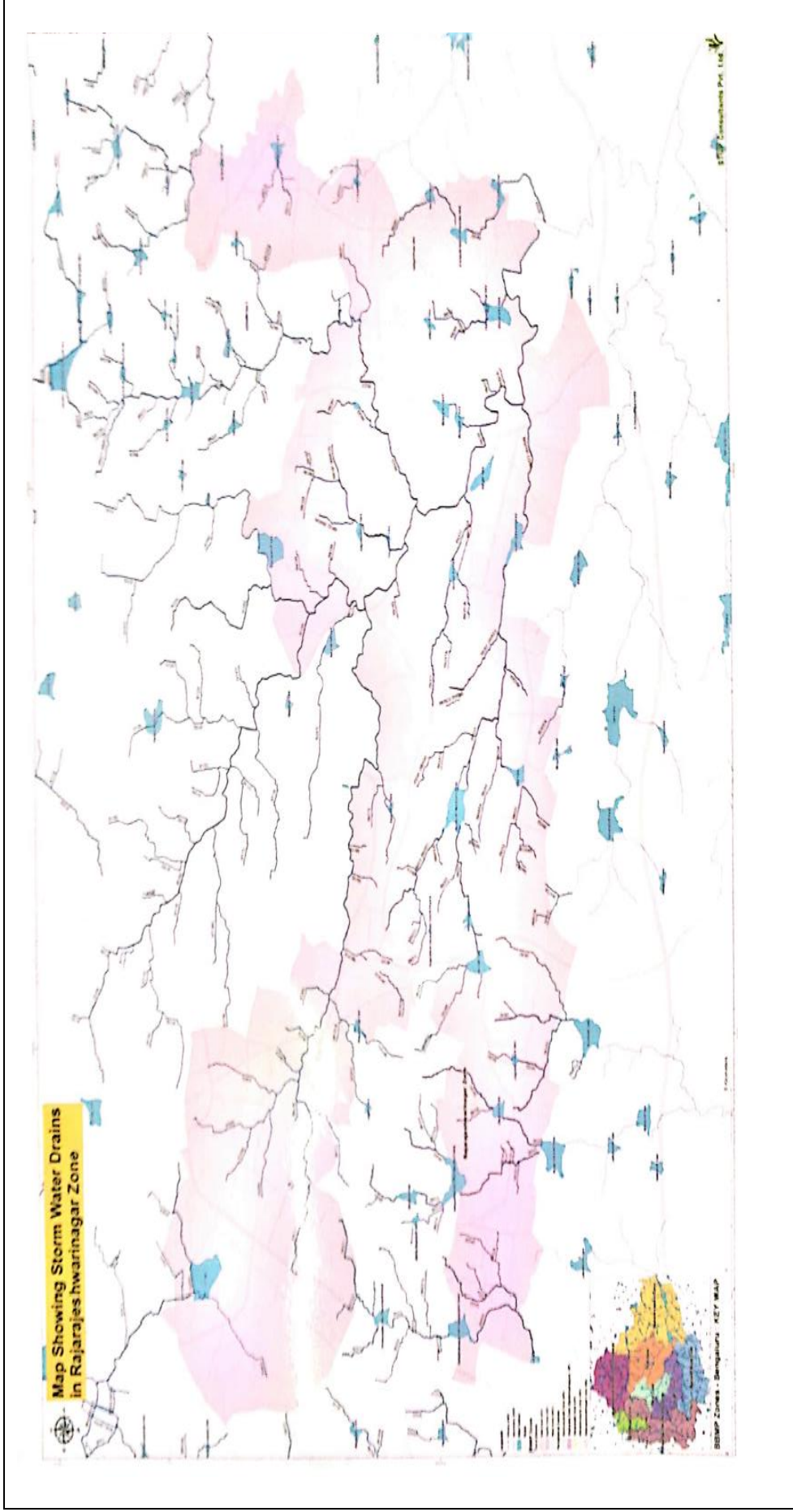
Appendix 1.1 contd...

Storm water drains as mapped in master plan of BBMP under East Zone



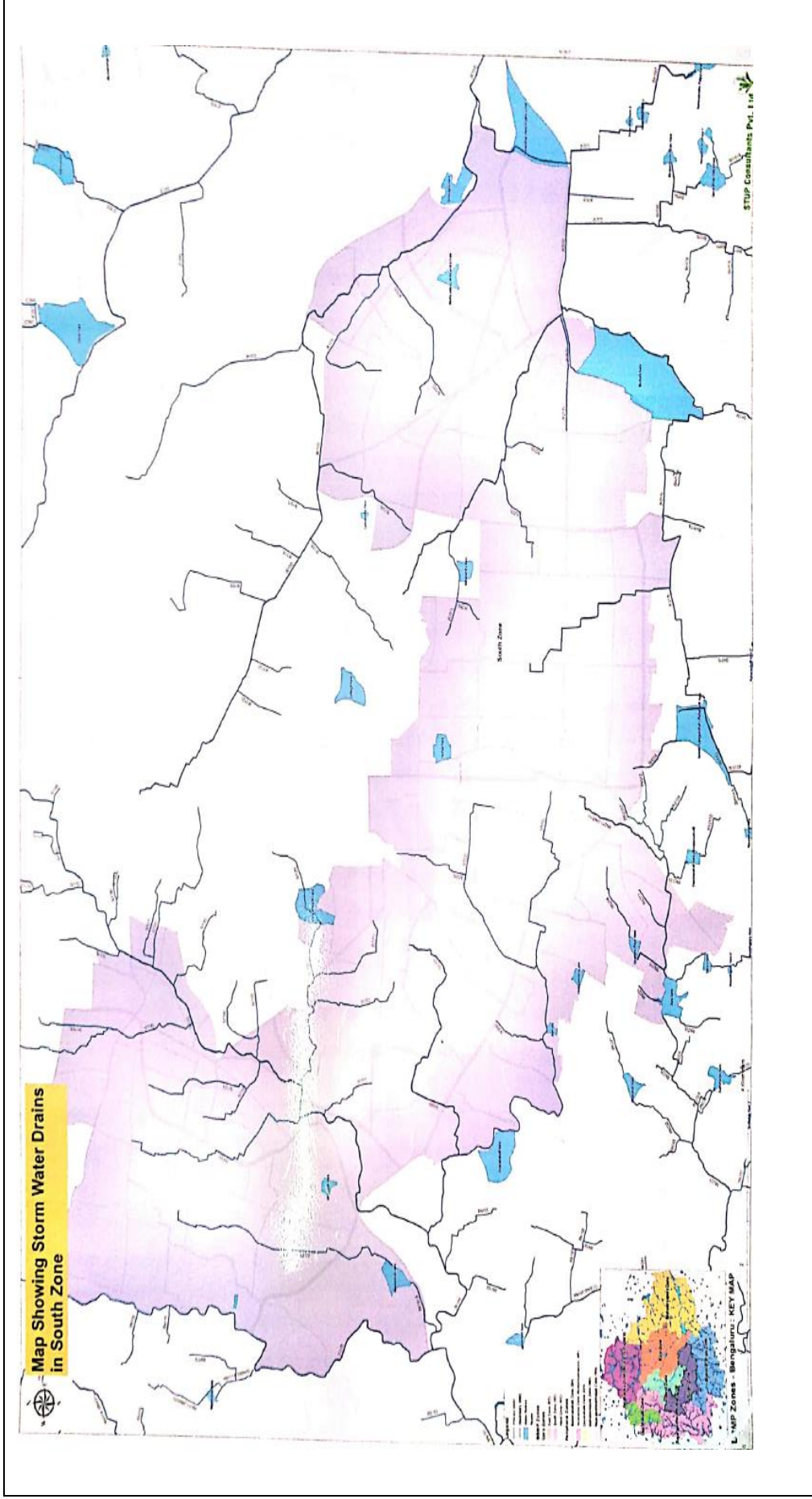
Appendix 1.1 contd...

Storm water drains as mapped in master plan of BBMP under Rajarajeshwarinagar Zone



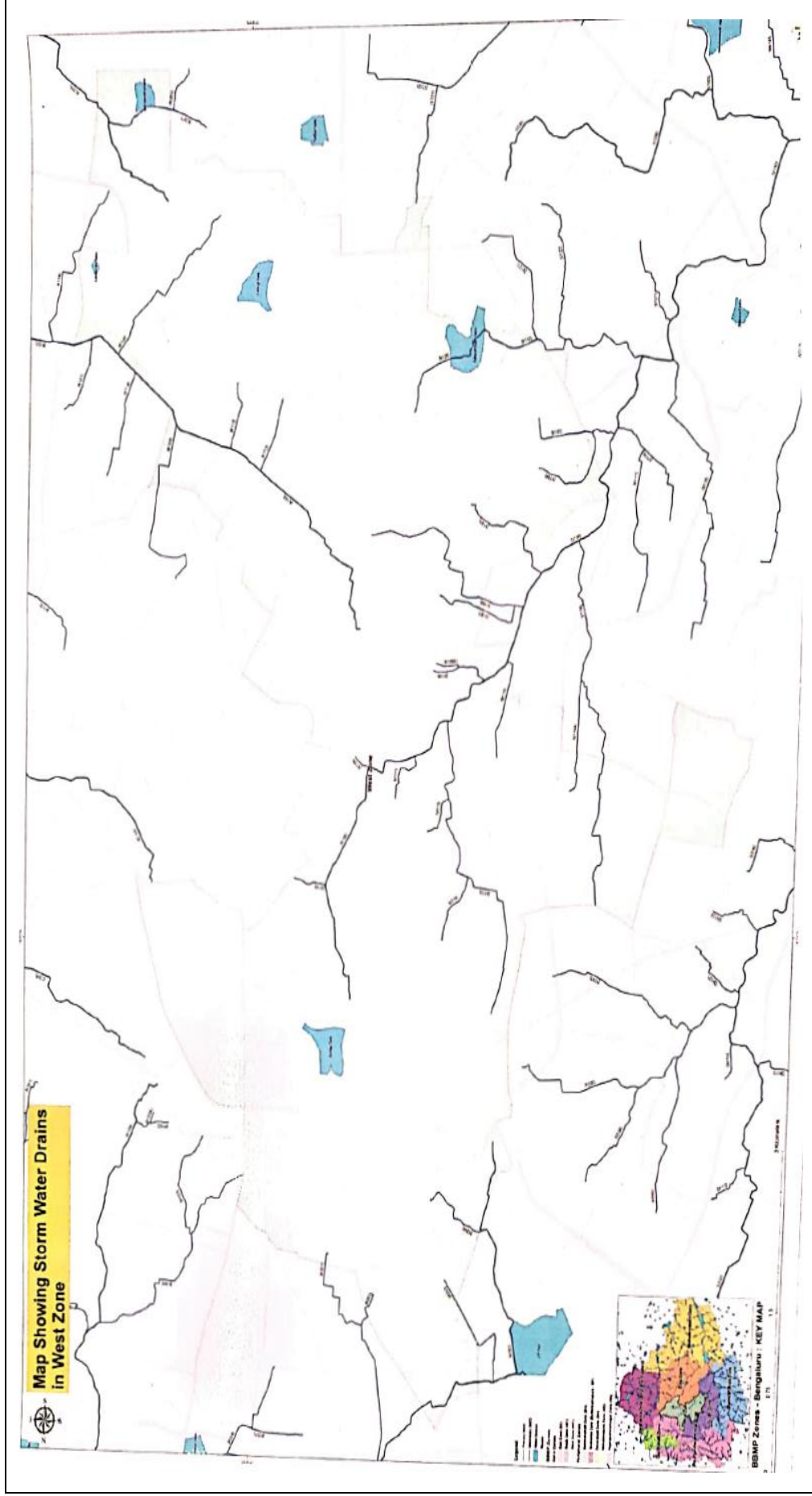
Appendix 1.1 contd...

Storm water drains as mapped in master plan of BBMP under South Zone



Appendix 1.1 contd...

Storm water drains as mapped in master plan of BBMP under West Zone



Appendix 2.1

(Reference: Paragraph 2.7/Page 12)

Statement showing the gist of audit observations and recommendations of Committee on Local Bodies and PRIs pertaining to storm water drainage works executed under JnNURM (Para 4.1 of Report no. 6 of 2013, Government of Karnataka)

Sl. No.	Paragraph No.	Gist of audit observation	Recommendations	Compliance
1	4.1.7	Delay in completion of projects	Initiate disciplinary action on officials for the dereliction of duty causing loss of financial assistance	Not complied
2	4.1.9.2	Diversion of funds towards interior works of the Office of CE, SWD	Initiate disciplinary action on engineers responsible for diversion of funds in contravention of the financial rules.	Not complied
3	4.1.9.4	Non-renewal of Bank Guarantees	The bank guarantees should be compulsorily renewed on expiry to ensure quality of works executed by the contractors.	Not complied
4	4.1.11.1	Execution of additional / supplementary works	Initiate disciplinary action on erring officers/officials.	Not complied
5	4.1.11.2	Irregularities in awarding contracts	Initiate disciplinary action on officials responsible for flouting KTPP norms.	Not complied
6	4.1.11.3	Irregularities in holding negotiations with contractors	The Committee taking serious note of the non-submission of information sought for by it, directed the department for submission of a detailed report.	Not complied
7	4.1.11.4	Avoidable expenditure on diversion of water course	The Committee opined that the original estimates included all items required for construction of coffer dams and incurring expenditure as a separate item was not permitted.	Not complied
8	4.1.11.5	Excess payments on: Item of Back filling Adoption of rates for 'manual means' though works executed mechanically Lead charges for earth	Disciplinary action to be taken against the officials and to recover the financial loss of ₹5.98 crore from the officials found responsible. Blacklist the contractors Instructed the Principal Secretary, UDD to submit the details of action taken in this regard to the Committee	Not complied
9	4.1.11.7	Defective estimates in chain link fencing works	All the factors should be taken into consideration while preparing the estimates and payments for other than the estimated works should be avoided. The practice of making payments towards extra works should be avoided so that there is no scope for suspicion.	Not complied

Appendix 3.1

(Reference: Paragraph 3.1.1/Page 13)

Status of compliance to NDMA Guidelines by the State Government/BBMP

Sl. no.	Paragraph no.	Actionable item	Action taken by State Government / BBMP	Audit observations
1	4.5.1	All ULBs/States/UTs shall prepare an inventory of the existing storm water drainage system on a Geographic Information System (GIS) platform. The inventory was to be both watershed based and ward based with clear mapping of the major as well as minor systems.	BBMP got prepared the inventory of drains under its jurisdiction, as a Master Plan of drains which identified only the Primary and Secondary drains.	The tertiary drains, which are substantially contributing components of drainage system were not identified and mapped. This rendered the Master Plan deficient.
2	4.7.1	Catchment will be the basis for planning and designing the storm water drainage systems in all ULBs.	Master Plan of Drains adopted catchment and watershed basis	
3	4.12.4.3	Pre-monsoon desilting of all major drains will be completed by March 31 each year; Besides the pre-monsoon desilting of drains, the periodicity of cleaning drains should be worked out, based on the local conditions. The roster of cleaning of such drains should be worked out and strictly followed	Neither periodic action plan prepared for desilting of drains before onset of monsoon nor roster of cleaning worked out and followed	The works for desilting of drains, at various different stretches, entrusted to contractors during the monsoon period
4	4.12.4.3	Suitable interventions in the drainage system like traps, communitors, trash racks can reduce the amount of solid waste going into the storm sewers.	Not adopted for any of the drains	Floating debris and sewage observed continuously in all types of drains during joint verification
5	4.12.4.3	Ageing systems will be replaced on an urgent basis	Not adopted	
6	4.12.4.3	A master plan will be prepared to improve the coverage of the sewerage system so that sewage will not be discharged into storm water drains	Master Plan of Drains recommended for taking measures to evade sewage mixing into storm water drains	No measures taken to avoid mixing of sewage into storm water drains. Instead, audit observed damaged/open manholes, direct discharge of sewage into drains contaminating the flow in storm water drains.
7	4.13.3.1	All road re-leveling works or strengthening/overlay works	Not followed	Repeated relaying of roads on existing surfaces

		will be carried out by milling the existing layers of the road and recycling of materials obtained as a result of the milling so that the road levels will be not be allowed to increase.		led to increase in elevation of roads than level of houses in the street over a period of time
8	4.13.4.1	Inlets should be provided on the roads to drain water to the roadside drains and these should be designed, based on current national and international practices.	Generally complied with	Audit observed variations in levels of road and inlets leading to stagnation of water on the roads. No provision was made to drain out water at many road humps. Absence of monitoring led to clogging of inlets.
9	4.16.1	Every building in an urban area will have rainwater harvesting as an integral component of the building utility. ULBs will ensure that this is implemented.	Rain water harvesting made (May 2011) mandatory for houses constructed on a plot measuring 1200 square feet	Instead of BBMP (which has a database of more than 20 lakh properties), the authority which sanctions plan for construction of buildings, the responsibility of implementing RWH entrusted to BWSSB, which is having very limited coverage, compared to total number of properties under the jurisdiction of BBMP. 40 per cent of the buildings under the purview of BWSSB have not adopted the rain water harvesting units
10	4.17.2	Concept of Rain Gardens will be incorporated in planning for public parks and on-site storm water management for larger colonies and sites that are to be developed. People will be encouraged to adopt this concept even for sites already developed.	Not complied with	
11	4.18.1	All urban water bodies will be protected. Efforts will also be made to restore water bodies by de-silting and taking other measures. Efforts will also be made to revive water bodies that have been put to other uses. Water bodies will be an integral part of the storm water system.	Lakes/water bodies under the jurisdiction of BBMP, headed by a Chief Engineer is responsible maintenance and development of lakes.	As many as 89 lakes in the city are directly connected to storm water drains which carry high level of sewage and chemical contaminants

12	4.19.1	Urban storm water management systems will include detention and retention facilities to mitigate the negative impact of urbanization on storm water drainage.	Not adopted	
13	4.21.1	Integrated planning and coordination will be ensured to take into account all components of the urban water systems, and Best management practices should be adopted by all ULBs to reduce the load on the major drainage system.	Department/stakeholder functioning independently	
14	4.22.6.2	Low-lying areas should be reserved for parks and other low-impact human activities; Wherever unavoidable, buildings in low-lying areas should be constructed on stilts above the High Flood Level (HFL)/Full Tank Level (FTL).	Not complied with	
15	4.23.1	Encroachments on nallahs / drains / watercourses will be removed by providing alternative accommodation to the Below Poverty Line (BPL) people and appropriate rehabilitation package for other categories of people; The nallahs/ drains/ watercourses/ flood plains should be clearly delineated and boundaries fixed in new developments. There will be strict enforcement of the relevant byelaws/regulations in the new layouts, and Any encroachment on the drain will attract penal action and be treated as a cognizable offence, both against the encroachers and the officials responsible for enforcement of the byelaws/ regulations.	Survey conducted, with the office of Land Records to identify encroachments on storm water drains. Boundary marks not fixed in respect of any of the drains No penal action on either encroachers or the of officials responsible for enforcement of the byelaws/regulations for their dereliction	Action towards clearance of encroachments is apparently too sluggish Buildings allowed to construct abutting the drains and without allowing the buffer zone for drains Data of encroachments with BBMP is deficient as audit observed large number of encroachments on drains, for which no action has been taken.

Appendix 3.2

(Reference: Paragraph 3.3.1/Page 16)

List of disused lakes under BBMP

Sl. No.	Zone	Name of the lake	Village and survey number	Area	
				Acres	Guntas
1	Bangalore	Tavarekare	Tavarekere -74	10.00	16.00
2	South	Karisandra Lake	Karisandra - 7	13.00	0.00
3		Nandi Shettappa Lake	Jaraganahalli-53	0.00	0.00
4		Chikkalsandra Lake	Chikkalasandra-76	12.00	26.00
5		Ittmadu	Ittamadu-17	4.00	0.00
6		Bommanahalli	Belakahalli (Lingannana Kere)	Belakahalli-172/2A	7.00
7	East	Doresani Palya	Belakahalli-167	56.00	37.00
8		Konena Agrahara lake	Konena Agrahara -60	20.00	10.00
9		Byatagunte Palya Lake	Byatagunte palya-14	5.00	25.00
10		Geddalahalli Lake	Geddalahalli-03	21.00	18.00
11		Lingarajapura Lake	Lingarajapura-49	16.00	14.00
12	Mahadevapura	Vijanapura Lake	Vijanapura-42	29.00	15.00
13	RR Nagar	Bovimaranahalli	Halagevaderahalli - 124	22.00	34.00
14	West	Gundopanth Lake	Pantharapalya-59	2.00	1.00
15		Anche ramana kere (Gangondanahalli)	Gangondana halli-8	0.00	17.00
16		Sanigoruvahalli	Sanigoruvahalli-120	15.00	24.00
17		Shivanahalli (Agrahara Dasarahalli)	Agrahara dasarahalli- 72	9.00	25.00
18		Kamakshi palya	Sanegoruvanahalli-60	6.00	35.00
	Total			247.00	297.00

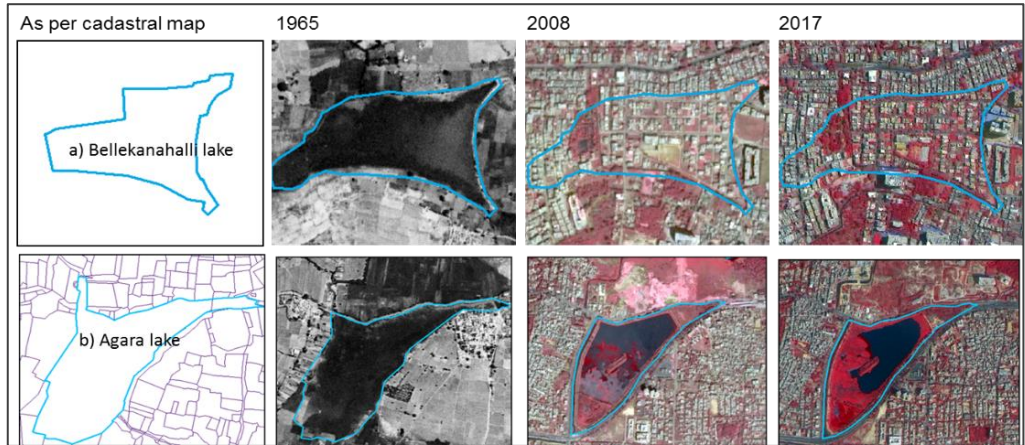
Source: Information furnished by CE, Lakes Division, BBMP

Appendix 3.3

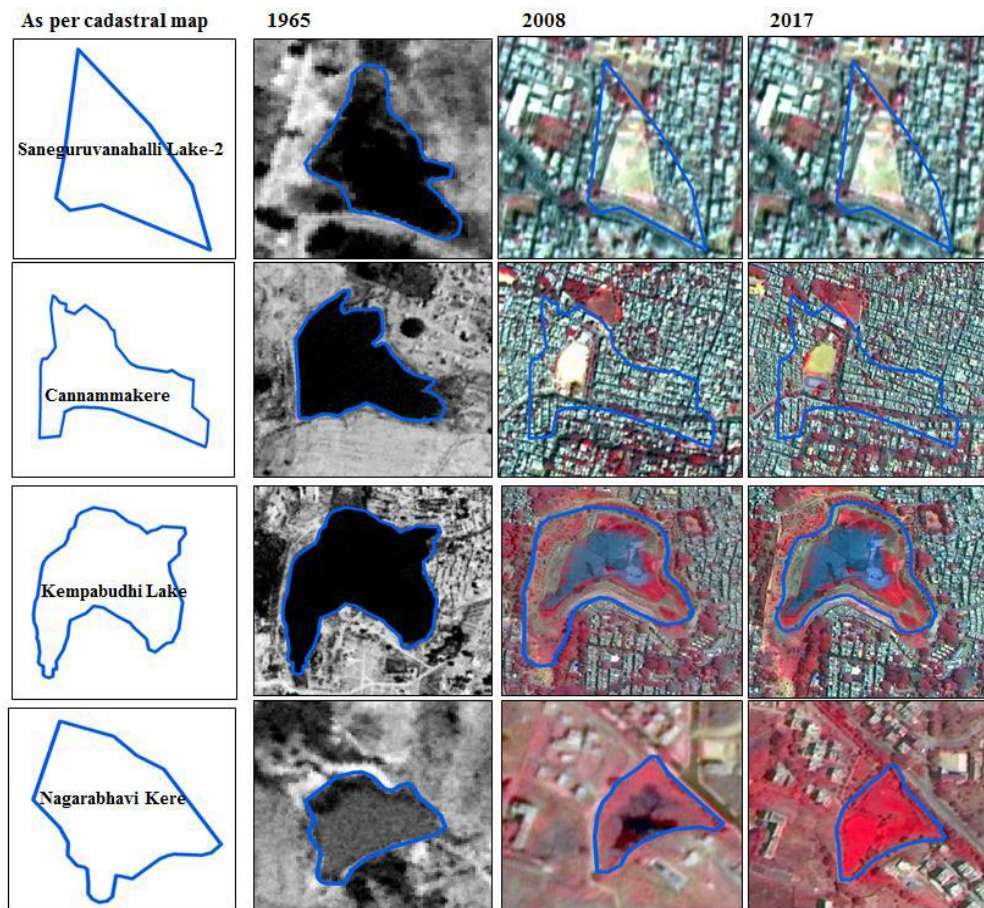
(Reference: Paragraph 3.3.2, Page 20)

Typical changes (change in size and shape) noticed in lakes

Koramangala valley



Vrishabhavathi valley



Appendix 3.4

(Reference: Paragraph 3.3.2, Page 20)

Table showing a few lakes converted for other purposes

<i>Name of Lake</i>	<i>Status now</i>
<i>Akkithimmanhalli Lake</i>	Hockey Stadium
<i>B.Channasandra Lake</i>	BDA Layout - East of NGEF Layout
<i>Baalayyana Lake</i>	Sports Ground
<i>Bagalagunte Hosa Lake</i>	Residential Layout
<i>Challaghatta Lake</i>	Golf ground - Karnataka Golf Association
<i>Challakere Lake</i>	BDA Layout - HBR 2nd Block
<i>Channasandra-2 Lake</i>	BDA Layout - HRBR 1st Block
<i>Chennamma Lake</i>	BDA Layout - Banashankari 2nd Stage
<i>Dasarahalli Lake</i>	Dr. B.R Ambedkar Stadium
<i>Dharmambudhi Lake</i>	Majestic Bus Stand
<i>Domlur Lake</i>	BDA Layout - Domlur 2nd Stage
<i>Government Lake</i>	BDA Layout - Nagarabhavi 2nd Stage
<i>Government Lake</i>	BDA Layout - RMV 2nd Stage
<i>Government Lake</i>	BDA Layout - HBR 1st Block
<i>Government Lake</i>	BDA Layout - Banashankari 6th Phase
<i>Hennur-Nagavara Lakes</i>	BDA Layout - HBR Layout 1st Stage, 5th Block
<i>Jakkarayana Lake</i>	Sports Ground
<i>Kadugondanahalli Lake</i>	Ambedkar Medical College
<i>Kamakshipalya Lake</i>	Sports Ground
<i>Karanji Lake</i>	Gandhi Bazar Residential area
<i>Kempambudhi Lake</i>	Sewerage collection tank
<i>Kethmaranahalli Lake</i>	BDA Layout - Rajajinagar 1st Block
<i>Kodihalli Lake</i>	Residential Layout
<i>Koramangala Lake</i>	National Games Village housing complex
<i>Krishnarajapuram Lake</i>	BDA Layout - East of NGEF Layout
<i>Kurubarahalli lake</i>	Residential Layout
<i>Lingannana Lake</i>	BDA Layout - Sarakki Dollars Colony
<i>Manganahalli Lake</i>	BDA Layout - Sir MV Layout 6th Block
<i>Marenahalli Lake</i>	Residential Layout
<i>Miller's Tank</i>	Guru Nanak Bhavan, Badminton Stadium
<i>Nagashettihalli Lake</i>	Space Department
<i>Sampangi Lake</i>	Sports Stadium
<i>Shivanahalli Lake</i>	Playground, Bus stand
<i>Shoolay Lake</i>	Football Stadium
<i>Siddikatte Lake</i>	KR Market
<i>Srinivagalu Lake</i>	BDA Layout - ST Bed Layout Koramangala
<i>Subhashnagar Lake</i>	Residential Layout
<i>Thippasanda Lake</i>	BDA Layout - HAL 2nd and 3rd Stage
<i>Venkatarayana Lake</i>	BDA Layout - Banashankari 6th Phase
<i>Yellugunte Lake</i>	BDA Layout - HSR 3rd Sector

Source : Sri Koliwad Committee Report, <http://parisaramahiti.kar.nic.in/lostlakes.html>, and https://en.wikipedia.org/wiki/Lakes_in_Bangalore

Appendix 3.5

(Reference: Paragraph 3.3.2, Page 25)

Results of verification of few drains in Vrishabhavathi valley

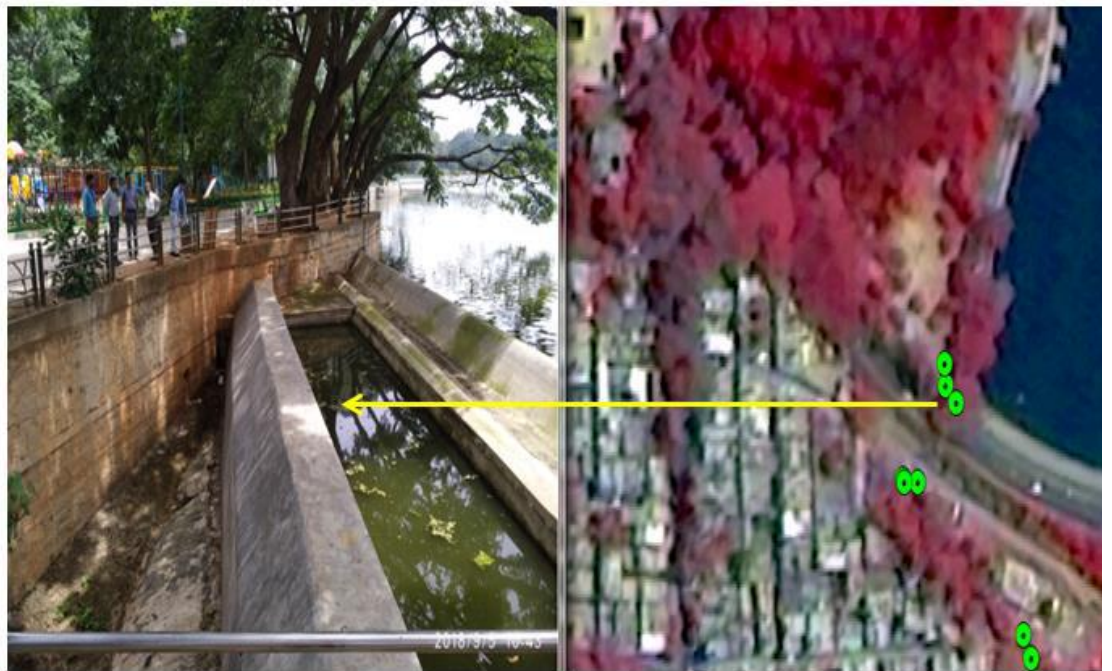


Covered drain in Sheshadripuram



Drain encroached and covered by an apartment

Appendix 3.5 contd.



Outlet of Sankey tank



Covered drain adjacent to Sankey tank

Appendix 3.5 conclud.



Discharge of sewage into SWD through fractured manhole



Covered drain

Appendix 4.1

(Reference: Paragraph 4.3.9, Page 66)

Statement showing the details of SWD works executed under Package 2 of Nagarothana Yojane

Sl. No.	Name of the Work	Estimated cost (₹ in lakh)	Financial Progress (as per estimate)	Physical Progress		Remarks	Percentage of excess/savings over estimated cost		
				Tackled Length	Balance Length				
1	Construction of SWD behind Old Age Home near Voddrapalya at Geddalahalli in KR Puram ward no:25	100.00	24.75	40.00	40.00	0.00	0.00	Completed	(-) 75
2	Construction of Box Drain to SWD near outlet of Horamavu Agara tank and U Shape drain in ward no:25	250.00	395.86	600.00	600.00	0.00	0.00	Completed	58
3	Construction of drain to SWD from Poojarappa layout to Chelekere main road joining glass factory and Construction of drain to SWD from Nagreshwara-Nagenahalli to Geddalahalli ward no:25	200.00	247.99	253.00	253.00	0.00	0.00	Completed	24
4	Construction of RCC drain to SWD near Kothanur village and Hennur main road ward no:25	100.00	125.78	134.00	134.00	0.00	0.00	Completed	26
5	Construction of RCC drain to SWD from bank avenue layout via Papatah layout joining Horamavu kere .	100.00	128.34	265.00	265.00	0.00	0.00	Completed	28
6	Construction of RCC drain to SWD joining Bennis Satya layout in Geddalahalli village ward no:25	100.00	189.45	213.00	213.00	0.00	0.00	Completed	89
7	Remodelling of SWD near Kothanur and B.Narayanapura in ward no:25	250.00	186.09	307.00	307.00	0.00	0.00	Completed	(-) 26
8	Remodelling of SWD near Yarranrapalya Madakari Nayaka road Muneshwara nagar to Arun ice cream in ward no:25	200.00	240.02	130.00	130.00	0.00	0.00	Completed	20
9	Construction of Box Drain at 1st cross Ramamurthy nagar near Arun ice cream behind ITI compound ward no :51	100.00	42.11	75.00	75.00	0.00	0.00	Completed	(-) 58
10	Remodelling of SWD near Ambedkar slum of R.R.Layout ward no:51	150.00	194.33	291.00	291.00	0.00	0.00	Completed	30
11	Construction of culverts to SWD and allied works in Vijinapura ward no:51	200.00	280.06	271.00	271.00	0.00	0.00	Completed	40

12	Construction of SWD near NRI layout and providing chain link fencing to SWD in KR Puram ward no:26	100.00	109.85	200.00	200.00	0.00	Completed	10
13	Remodelling of SWD near Gayathri layout and Basavanapura main road MD272 Ward no:52	100.00	165.36	214.00	214.00	0.00	Completed	65
14	Construction of RCC drain near TC Palya back side of Assidan School behind Garden City College (balance portion) ward no:52	90.00	79.42	180.00	180.00	0.00	Completed	(-)12
15	Remodelling of SWD from Koudenahalli tank to Vengiahana kere near Brundavananagar and Anandapura ward no:52	150.00	203.85	225.00	225.00	0.00	Completed	36
16	Remodelling of SWD near Vengiahana kere in ward no:52	250.00	317.35	397.00	397.00	0.00	Completed	27
17	Construction of RCC Bridge and SWD at KV Layout	60.00	105.56	110.00	110.00	0.00	Completed	76
18	Construction of RCC drain and culvert to SWD near Pai layout Ward no:56	100.00	115.25	136.00	136.00	0.00	Completed	15
19	Construction of RCC drain near Darga Mahal (balance portion) ward no:56	100.00	14.82	95.00	95.00	0.00	Completed	(-) 85
20	Construction of RCC drain from Seggahalli lake towards Medahalli ward no:53	150.00	174.19	146.00	146.00	0.00	Completed	16
21	Remodelling of SWD to MD 271 from Chikkadevasandra lake to Gokula and near Cambridge College ward no:53	200.00	201.05	231.00	231.00	0.00	Completed	1
22	Construction of culverts and drain at Medahalli to Yellamallappa chetty lake ward no:53	150.00	185.60	328.00	328.00	0.00	Completed	24
23	Remodelling of SWD from Koudenahalli tank via Manjunatha layout and Priyadarshini layout.ward no:53	150.00	141.36	365.00	365.00	0.00	Completed	(-) 6
24	Construction of RCC drain from Mahadevapura lake to join Doddanekkundi lake ward no: 81	90.00	183.30	184.00	184.00	0.00	Completed	104
25	Construction of RCC drain near SCT college (balance portion) ward no: 81	50.00	80.07	91.00	91.00	0.00	Completed	60
26	Construction of SWD and providing chain link fencing to SWD near Chinnapa layout in K.R.Puram constituency	100.00	120.80	97.00	97.00	0.00	Completed	21
27	Construction of RCC drain to SWD near Choice Bakery in Mahadevapura old village ward no: 81	50.00	69.23	100.00	100.00	0.00	Completed	38
28	Construction of RCC culvert to Vibuthipura lake outlet and Remodelling of SWD in ward no: 81	200.00	0.00	130.00	0.00	130.00	Yet to commence	

29	Remodelling of SWD near Kalappa block in ward no: 81	150.00	175.82	206.00	206.00	0.00	Completed	17
30	Remodelling of SWD near Kumbarkote via Abbaiah Reddy layout and Nagappa Reddy layout in ward no: 81	200.00	231.13	370.00	370.00	0.00	Completed	16
31	Construction of RCC U drain to SWD from Gangashetty lake to Nethravathi layout	90.00	113.56	250.00	250.00	0.00	Completed	26
32	Construction of RCC box drain and Remodelling of SWD near Annasandrapalya in ward no:87	200.00	329.90	513.00	513.00	0.00	Completed	65
33	Constructing RCC boundary markings in Mahadevapura zone	50.00	Details not furnished					

Source: Progress reports furnished by CE, SWD as of October 2019

Appendix 4.2

(Reference: Paragraph 4.3.9, Page 66 & 67)

Statement showing the details of SWD works executed under Nagarothana Yojane

(₹ in crore)

Package	Number of works	Estimated cost	Agreed cost	Date of work order	Stipulated date for completion	Completed	Ongoing	Yet to start	Execution more than estimated length		Execution less than estimated length in completed works	
									No. of works	Up to	No. of works	Up to
1	43	128.57	158.49	30-03-2017	30-11-2018	21	20	2	21	196%	6	(-) 52%
3	86	155.00	191.32	03-04-2017	03-12-2018	73	10	3	20	234%	18	(-) 94%
4	138	176.95	219.24	20-03-2017	20-03-2019	128	2	8	63	587%	63	(-) 71%
5	39	95.00	116.38	23-03-2017	23-09-2018	37	0	2	12	113%	22	(-) 68%
6	20	71.00	86.83	23-03-2017	23-09-2018	20	0	0	8	63%	10	(-) 46%
Total	326					279	32	15				

Source: Progress reports furnished by CE, SWD as of October 2019

Note: The progress report in respect of Package-2 submitted to audit by CE, SWD was grossly incorrect as all the works were shown to have been completed with estimated quantity and executed quantity being the same while there were huge variations in financial progress. Hence, audit could not analyse the actual progress achieved.

Appendix 5.1

(Reference: Paragraph 5.1.3, Page 80)

Instances of encroachments noticed during joint physical verification

<i>Drain-ID</i>	<i>Location</i>	<i>Encroached by</i>
V-201	Peenya	Surana College
K-100	JC Road	Cargo Tarpaulins Industries
K-100	JC Road	Private Property
K-100	Lalbagh Road	BBMP leased property
V-100	Near Dobhi Ghat	Vyalikaval Education Society
V-100	Adjacent to Magadi road railway bridge	Rank Nest Apartment
K-102	0.00 chainage	Private Property (Standard Chartered Bank)
K-102	0.00 chainage	Private Property
K-102	Next to Empire Hotel	BBMP waste segregation unit
K-102	KHB Colony, 5 th Block, Koramanagala	Private Property (Opposite to Nati Mane shop)
K-102	17 th B Main, 5 th Block, Koramanagala	Private Property No.97
K-102	4 th Cross, 5 th Block, Koramanagala	Private Property
K-102	6 th Block, Koramangala	Private properties between 17 th E and F main roads
K-102	5 th A cross, 6 th Block, Koramangala	No. 868, Sipani Grande Apartments (private property)
K-102	Koramangala 6 th Block	Koramangala Club
RN-193	RR Nagar	Padmavathi Kalyana Mantapa
V-301	Ittamadu	Terrace Garden apartments
--	Madivala	RO drinking water plant of BBMP
V-113	Okalipuram	RO drinking water plant of BBMP
BH-524	Gottigere	Himagiri Meadows Apartments complex
BH-554	Adjacent to Madivala lake, Hosur Road	Ansal Forte Apartments
BH-554	Hosur Road	Tirumal splendour Apartments
BH-554	Adjacent to Madivala lake, Hosur Road	Adithya Tussar Apartments

Source: Joint physical verifications

Glossary

ArcGIS: *It is a geographic information system for working with maps and geographic information maintained by the Environmental Systems Research Institute (ESRI). It is used for creating and using maps, compiling geographic data, analyzing mapped information, sharing and discovering geographic information, using maps and geographic information in a range of applications, and managing geographic information in a database.*

Cadastral map: *A large-scale map showing the boundaries of subdivisions of land, usually with the directions and lengths thereof and the areas of individual tracts, compiled for the purpose of describing and recording ownership. It may also show culture, drainage, and other features relating to use of the land.*

Chainage: *Chainage is a measure of distance between two points (invented in 1620 by Edmund Gunter), which refers to a technique of measurement where steel chains of 100 links were once used to measure distances in surveying. While such equipment is no longer used for measurement, the term chainage is still commonly used particularly in relation to construction of roads, drains and irrigation channels.*

Check dam: *These are relatively small structures constructed to slow down the flow of water for controlling soil erosion. The purpose of check dam is to retain water up stream, so that the water percolates into the ground and recharges the ground water table.*

Dependability: *Dependable rainfall is defined as the rainfall, which can be expected in a set number of years out of a total number of years.*

Detention ponds: *These are temporary holding areas for storm water that store peak flows and slowly release them, reducing the demand on treatment facilities during storm events and prevent flooding.*

Geographic information system (GIS): *It is a framework (software/applications) for gathering, managing, and analyzing data. It analyzes spatial location and organizes layers of information into visualizations using maps and 3D scenes. For ex, when a road is laid, the alignment, length, classification of the road and location on earth can be maintained using a Geographical Information System. Distinctiveness – Maintain information of assets by inserting and updating records in a database using the software.*

Global Positioning System (GPS): *It is a radio navigation system that allows land, sea, and airborne users to determine their exact location, velocity, and time 24 hours a day, in all weather conditions, anywhere in the world.*

Infiltration drains: *Infiltration drains are the channels constructed with filter media adjacent to the pavement of the road and regular drains to facilitate water from pavement to enter infiltration drains for allowing recharging and in case of excess, will flow to regular drains.*

Injection wells: *Injection wells are structures similar to a tube well but with the purpose of augmenting the groundwater storage of a confined aquifer by pumping in treated surface water under pressure.*

Percolation ponds/tanks: *It is an artificially created surface water body, submerging in its reservoir a highly permeable land so that surface runoff is made to percolate and recharge the ground water storage.*

Primary Drains: *These are natural drainage systems connecting series of major water bodies' up to the disposal location in a particular catchment area. They originate as a tributary of a river basin and receive water from one or more watershed regions through secondary drainage network, tertiary drainage network or directly from road side drains during their course of flow.*

Recharge pit: *A recharge pit is a small well like structure which allows the rainwater to replenish groundwater by recharging the underground aquifers. It can be built just to help the water infiltration in an area.*

Remote sensing: *It is the process of detecting and monitoring the physical characteristics of an area by measuring its reflected and emitted radiation at a distance (typically from satellite or aircraft). Analysis of images of the earth continuously captured by various satellites as they travel in their orbits. Depending on the time and frequency of presence in the orbit over a particular region, the image will reveal absence or presence of objects at different points in time. For ex, it can help calculate the approximate area of a lake at different points in time. Distinctiveness - Help view places beyond easy reach, during floods, deep forests.*

Retention facilities: *These are basically extended detention facilities, infiltration basins and swales that could be used for water supply, recreation, pollutant removal, aesthetics and importantly recharging of ground water.*

Return period: *Probable time gap/frequency between two rainfall events of a particular magnitude.*

Secondary Drains: *These are natural or manmade network of drains connecting to a primary drain or a water body. They originate from a particular watershed region and receive water from one or more micro watershed regions through tertiary drainage network or from road side drains during their course of flow.*

Swale: *A swale is a shady spot, or a sunken or marshy place. A swale may be either natural or man-made. Artificial swales are often infiltration basins, designed to manage water runoff, filter pollutants, and increase rainwater infiltration.*

Tertiary Drains: *These are natural or manmade network of drains connecting to secondary drains or a water body. They originate from a network of road side drains and receive water from micro watershed regions directly or through road side drains or in combination of both. Any higher capacity road side drain when compared to a normal road side drain is also a tertiary*

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