

**Report of the
Comptroller and Auditor General of India
on Performance Audit of Flood Management
and Response in Chennai and its
Suburban Areas**

for the year ended March 2016

**Government of Tamil Nadu
Report No. 4 of 2017**

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PREFACE

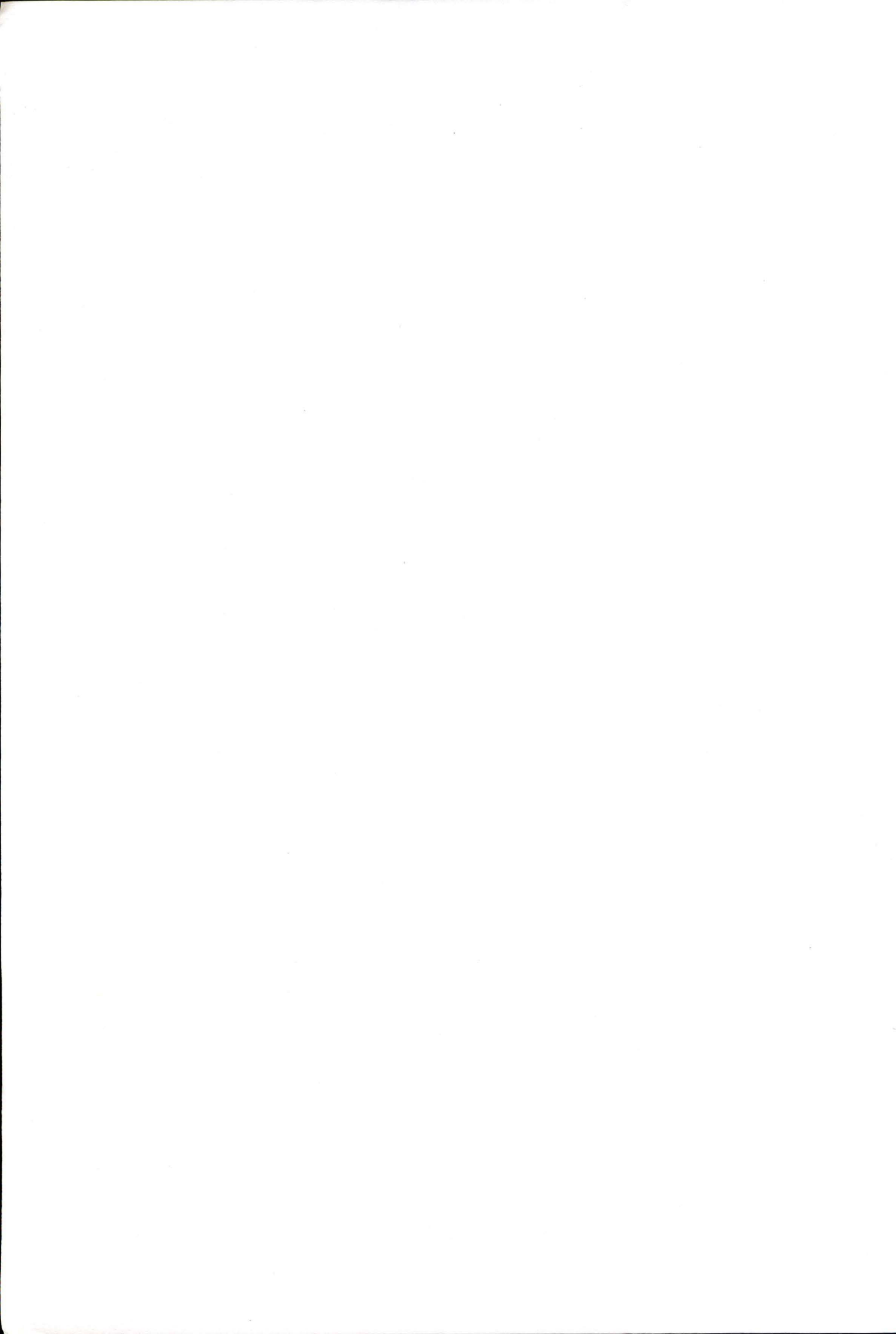
This Report for the year ended March 2016 has been prepared for submission to the Governor of Tamil Nadu under Article 151 of the Constitution of India, for being laid before the State Legislature.

The Report of the Comptroller and Auditor General of India contains the results of Performance Audit of Flood management and response in Chennai and its suburban areas covering the period from 2011-12 to 2015-16.

The instances mentioned in the Report are those, which came to notice in the course of the performance audit conducted during June 2016 to November 2016. Matters relating to the periods outside the audit period have also been reported in places where they were found necessary.

The Audit has been conducted in conformity with the Auditing Standards issued by the Comptroller and Auditor General of India.

Audit wishes to acknowledge the cooperation received from Revenue and Disaster Management Department, Housing and Urban Development Department, Municipal Administration and Water Supply Department and Public Works Department.



EXECUTIVE SUMMARY



Inundation in suburban Perungalathur area

EXECUTIVE SUMMARY

The Purpose

Chennai city has a long history of facing the vagaries of nature in the form of cyclones and high intensity rainfall. Chennai had experienced catastrophic flooding in 1943, 1976, 1985, 1998, 2002, 2005 and 2015 due to heavy rains associated with cyclonic activity. The December 2015 floods in the city and its suburban areas claimed 289 lives, inundated 23.25 lakh houses, disrupted power and telecommunication services, halted air, rail and road transport, caused extensive damage to public and private property and brought the city to a standstill for several days.

The agonising impact of the floods brought to public domain the failure in the roles, which ought to have been played by various Government bodies in effectively managing the disaster. With a view to ascertain the preparedness of Government of Tamil Nadu (GoTN) in minimising the magnitude of loss due to floods and to assess whether the disaster was avoidable, a Performance Audit of 'Flood management and response in Chennai and its suburban areas', was conducted from June to November 2016, covering the period from April 2011 to March 2016.

The objectives of the Audit were to assess the (i) effectiveness in implementing the Master Plans for orderly development of the city with due regard to preservation of water bodies and structures, (ii) effectiveness in addressing the issue of encroachments, which hinder free flow of rain water, (iii) economy and effectiveness in carrying out flood management programmes, (iv) efficiency and effectiveness in disaster management, and (v) the effectiveness of internal control mechanism, including performance evaluation and monitoring.

Results in brief

Results of Audit scrutiny indicated that the laxities in urban planning and ineffective enforcement of statutes and Master Plans had impacted natural water bodies and thereby, paved the way for flooding. Several plans to restore and augment capacities of tanks and reservoirs, to reduce surface runoff and to meet the ever increasing drinking water demands of the water-starved city failed due to poor project management, ineffective handling of land acquisition process and lack of co-ordination among different departments and agencies of GoTN. Unrestrained encroachments blocked free flow of flood water and had inundated several parts of the city. Flood mitigation projects to revive the waterways suffered delays due to poor project management and unresolved encroachment issues. Even routine desilting and cleaning of macro and micro drains were not carried out as envisaged. The city and its suburban areas were way behind the target on putting in place storm water drainage networks due to lack of importance attached to this crucial infrastructure. Underground Sewage Schemes did not cover several areas and sewage entering and clogging storm water drainage network was not a rare sight.

Flood relief activities were hampered by absence of dedicated institutional mechanism to spearhead rescue and relief activities. Absence of a Disaster Management Plan impeded the efforts of extending rescue and relief in an organised manner.

Principal Findings

PLANNING

- The State lacked a law on Flood Plain Zone (FPZ) and an updated Water Policy to protect natural waterways. Frequency - based flood inundation maps, Emergency Action Plan for dams and Basin-wise comprehensive master plans were not prepared to respond to challenges posed by heavy rains.

(Paragraph 2.2)

- Though the Tamil Nadu District Municipalities Building Rules, 1972 had envisaged for maintaining a buffer zone of 15 metres from the margin of the waterways, the Second Master Plan, 2008 of Chennai Metropolitan Development Authority (CMDA) did not attempt to demarcate flood plain zones to regulate constructions along waterways, resulting in large buildings coming up on the banks of rivers, obstructing free flow of flood water.

(Paragraph 2.3)

- CMDA liberally allowed constructions through conversion of land use from Agriculture, Non-urban and Open Space & Recreation zones to other zones, resulting in steep increase in built up areas and consequent reduction of soil recharge of rain water. Such unauthorised constructions shrank the water bodies and had led to massive inundation during December 2015 floods.

(Paragraph 2.4)

MANAGEMENT OF WATER BODIES

- Failure of Water Resources Department (WRD) to create two new reservoirs in the upstream of Chembarambakkam Tank though recommended by Nucleus Cell for flood mitigation and improper planning/non-completion of augmentation work across Kosasthalayar River resulted in non-achievement of envisaged water storage and flood control.

(Paragraph 3.1)

- Tardy implementation of project for restoration and protection of water bodies resulted in abandoning of lakes and consequent reduction in the water storage capacity of the water bodies.

(Paragraph 3.2)

ENCROACHMENTS

- Encroachment of tanks, lakes and river beds played a major role in causing the massive floods in Chennai. Despite enactment of a law in 2007 to protect tanks from encroachment, the percentage of tanks encroached, kept increasing year after year.

(Paragraph 4.2)

DRAINAGE SYSTEM IN CHENNAI METROPOLITAN AREA

- Eight projects taken up under Jawaharlal Nehru National Urban Renewal Mission, to provide new channels and strengthen existing channels in Chennai Metropolitan Area (CMA) could not be completed due to encroachments and lack of co-ordination between different departments, contributing to flooding in many areas.

(Paragraphs 5.1.1 to 5.1.8)

- Inadequate coverage of storm water drains (SWD) due to poor outlay, coupled with improper design and missing links in the SWD networks, contributed to flooding. Furthermore, rainfall intensity adopted by Greater Chennai Corporation for designing SWDs was incorrect leading to construction of lower capacity SWDs which also contributed to the floods of 2015.

(Paragraph 5.2)

- In 2014 and 2015, the annual desilting works of waterways in CMA had not commenced before the onset of monsoon. GoTN had not attached due importance to the desiltation work and had not bothered to release funds well before the monsoon and as a result, none of the sanctioned works could be completed before the onset of the monsoon. The non-execution of works before monsoon hindered the free flow of flood water, thus contributing to floods in 2015.

(Paragraph 5.6.1)

- Chembarambakkam Tank, despite being a major tank, did not have any scientific inflow forecast system and lacked a mechanism for real time flood forecast, which was not in accordance with the Central Water Commission (CWC) norms for Dam Safety Procedures and Reservoir Regulation Schedules.

(Paragraph 5.8.5)

- In the absence of Emergency Action Plan for Chembarambakkam Tank, the outflow of water was much more than the inflow leading to unsustainable release of water into Adyar River. The water at the tank was never maintained at the full tank level. On 01 December 2015, water was stored upto 3.481 TMC against the total capacity of 3.645 TMC, as WRD wanted to protect the private land, which were illegally allowed to remain in the foreshore area, from being submerged.

(Paragraph 5.8.5)

- Considering the opportunity to store an additional 0.268 TMC in Chembarambakkam Tank, 12,000 cusec of discharge could have been maintained for six hours during which period, water was actually released at 20,960 to 29,000 cusec. Hence, an additional quantity of 0.266 TMC could have been stored in the Chembarambakkam Tank and yet the storage level would not have reached the brim.

(Paragraph 5.8.5)

- Paragraph 8.1.2 of the Report on Dam Safety Procedures issued by CWC, GoI (July 1986) concludes that flood disaster can be logically classified as man-made if the quantum of outflow from the dam exceeds the inflow. The indiscriminate discharge of water at 29,000 cusec for 21 hours on 1 and 2 December 2015 had led to a man-made catastrophe.

(Paragraph 5.8.5)

DISASTER MANAGEMENT

- The Governing Body of Tamil Nadu State Disaster Management Authority (Authority) did not meet even once since its constitution in November 2013. The Tamil Nadu State Disaster Management Agency (TNSDMA) did not have the financial autonomy contemplated by GoI.

(Paragraph 6.1)

Principal Recommendations

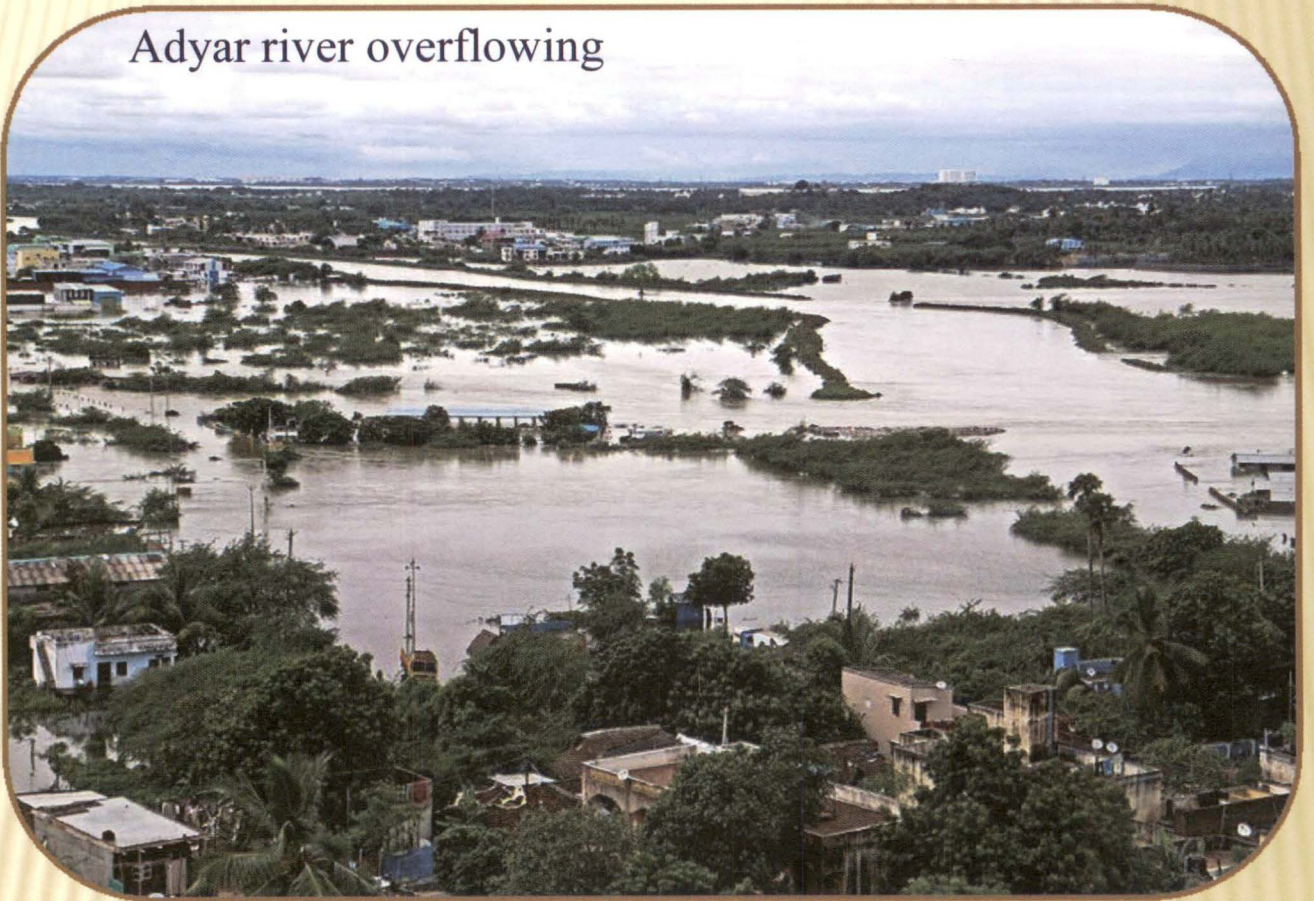
- *Action should be taken to enact a law on Flood Plain Zoning, on the lines suggested by GoI, to minimise the impact of construction on water bodies.*
- *Chennai Metropolitan Development Authority should not allow development along water bodies without ensuring ameliorating measures taken by developers to prevent the impact of such developments. The system of conditional approvals should be stopped forthwith.*
- *Government should ensure co-ordination with all line departments/agencies in evicting encroachments along water ways and inside water bodies.*
- *Thrust should be laid on expansion of Storm Water Drain networks with due importance to design of water carrying capacity of the drains and annual maintenance.*
- *Preparation of Emergency Action Plan for dams should be completed on priority.*
- *Government should put in place an operational institutional framework for disaster management with financial autonomy as contemplated by GoI.*



CHAPTER I

INTRODUCTION

Adyar river overflowing



CHAPTER I

INTRODUCTION

1.1 Floods of 2015

In November - December 2015, Chennai and its suburban areas received multiple torrential rain spells. In the worst affected districts of Chennai, Kancheepuram and Tiruvallur, the floods associated with the rains claimed 289 lives due to drowning, electrocution, wall collapse etc. The floods inundated 23.25 lakh houses and put life out of gear for several days. Floods are not new to the city; Chennai had experienced catastrophic flooding in 1943, 1976, 1985, 1998, 2002, and 2005 due to heavy rains associated with cyclonic activity.

Chennai receives sixty percentage of its annual average rainfall of 1,324 mm during North East Monsoon, between October and December, every year. The contours of Chennai and its suburban areas have an average elevation of 6.7 metre above Mean Sea Level (MSL), with few isolated hillocks in the south west with maximum height of 60 metre above MSL. Adyar, Cooum and Kosasthalaiyar are the three main rivers in Chennai Metropolitan Area¹ (CMA). Buckingham Canal, constructed as a navigational canal in 1806, along the coast, flows through CMA, connects the three rivers. Besides the three rivers and the Buckingham Canal, a host of smaller *nullahs* also play their role in draining rain water.

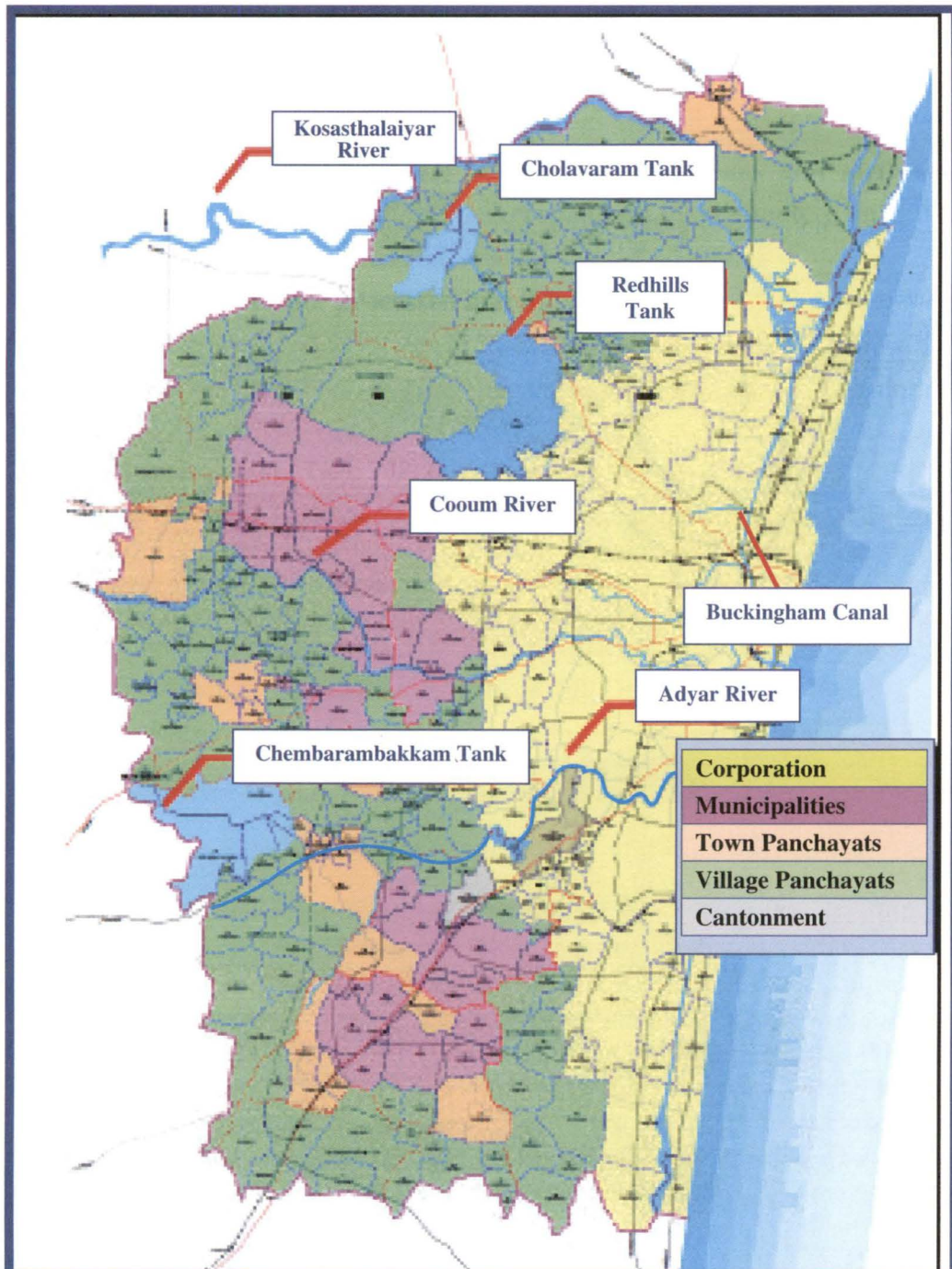
The three major tanks in CMA are Cholavaram (capacity 1.005 TMC²), Redhills (3.300 TMC) and Chembarambakkam (3.645 TMC). Cholavaram Tank is the secondary storage tank, receiving water from the Poondi Reservoir, which lies outside CMA. Redhills Tank is the main source of water supply to Chennai City and during storm events, water is released into Redhills surplus channel, which enters the Kosasthalaiyar River and discharges into the sea. Chembarambakkam Tank, in the southern part of CMA, releases its surplus into Adyar River. These tanks play a major role in moderating flow of flood water in the rivers and consequently, impact the flooding in CMA. **Map 1.1** depicts the water bodies in CMA.

Abbreviations used in this report are listed in the Glossary at Page 145

¹ Metropolitan area comprises Greater Chennai Corporation, eight Municipalities, 11 Town Panchayats and 179 Village Panchayats in Chennai, Kancheepuram and Tiruvallur districts

² Thousand Million Cubic Feet

Map 1.1: Rivers and tanks in Chennai Metropolitan Area



(Source: Chennai Metropolitan Development Authority)

1.2 Incidence of rainfall

During North East Monsoon, 2015, heavy rains lashed Chennai between 15 and 17 November 2015 and the second spell of heavy rains was on 23 November 2015. The third spell on 1 December 2015 marooned large parts of the metropolis. Worst affected areas were Adyar, Alandur, Ambattur, Kodambakkam and Perungudi zones of Greater Chennai Corporation (GCC)

and adjoining suburban areas of Pallavapuram, Peerkankaranai, Perungalathur, Sembakkam and Tambaram, due to overflowing of rivers, chocking of storm water drains, etc.

The details of normal rainfall³ and the actual rainfall in millimetre during North East Monsoon, 2015 are given in **Table 1.1**.

Table 1.1: Normal and actual rainfall (in millimetre)

District	12 to 18 November 2015		19 to 25 November 2015		26 November to 2 December 2015	
	Normal rainfall	Actual rainfall	Normal rainfall	Actual rainfall	Normal rainfall	Actual rainfall
Chennai	104.9	449.9	82.0	217.5	53.4	347.3
Kancheepuram	59.8	452.3	66.6	238.6	46.0	459.0
Tiruvallur	67.3	414.0	54.5	180.1	41.1	342.6

(Source: Data from India Meteorological Department)

The floods during November - December 2015, brought to fore the indiscriminate development in the watershed areas, encroachment of water bodies and deficiencies in development and maintenance of infrastructural facilities for flood prevention and control and lack of preparedness, inadequacies in flood management and response, as commented in the succeeding chapters of this Report.

1.3 Statutory and Institutional framework for flood management

According to National Institute of Disaster Management, flooding occurs due to uneven distribution of rainfall, coupled with unplanned urbanisation, and encroachment of natural drainage channels and urban lakes.

The TN Town and Country Planning Act, 1971 and the First and Second Master Plans framed under the Act provide the backbone for orderly urbanisation to mitigate the impact of floods. The National Water Policy (NWP) promotes planning, development and management of water resources, to avert natural disasters like floods, through structural and non-structural measures, with emphasis on preparedness for flood along with coping mechanisms. Central Water Commission (CWC) is involved in framing guidelines to prevent flooding and has also instituted a flood forecasting system. The Dam Safety Organisation of CWC has issued Dam Safety Procedures for efficient operation of dams.

Following the enactment of the Disaster Management Act, 2005, (DM Act), GoI constituted the National Disaster Management Authority (NDMA) as the apex body for disaster management in India. TN State Disaster Management Agency (TNSDMA) is the State level body for disaster management.

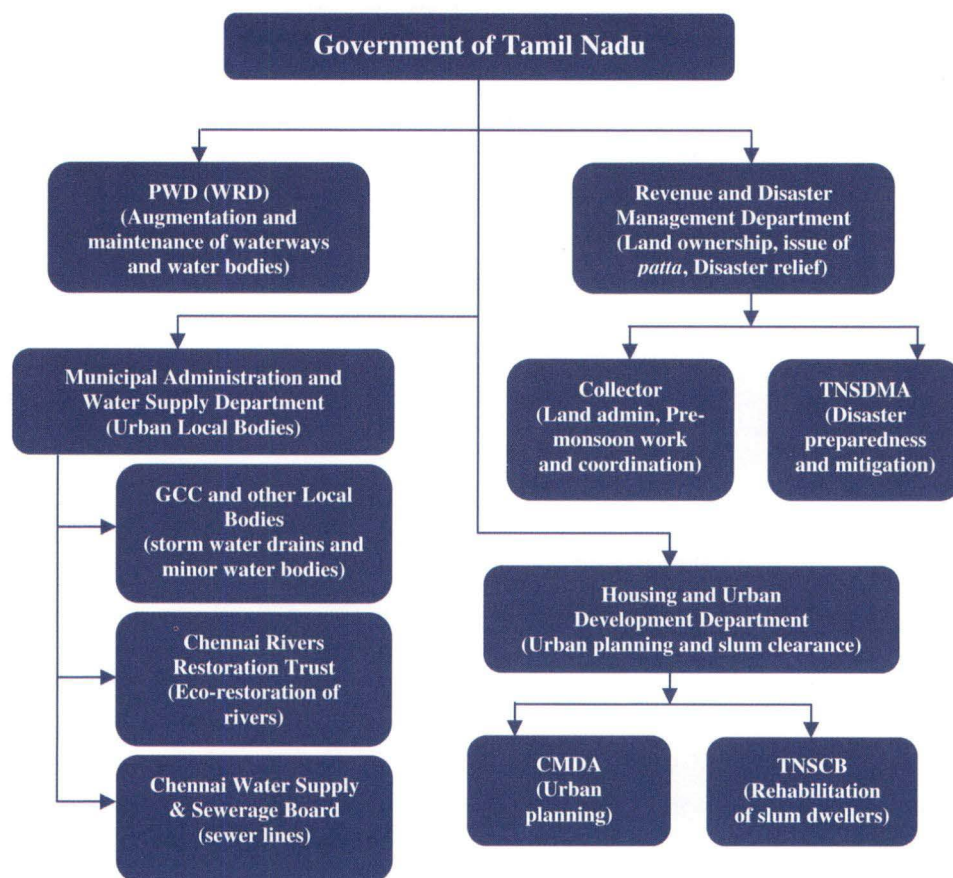
The National Disaster Management Guidelines for Management of Floods, 2008, elaborates the mechanism for (i) preparedness for prevention of flood, (ii) flood forecasting and warning, (iii) maintenance of water storage structures like dams and reservoirs, (iv) regulation and enforcement of

³ Long term average of 30 years rainfall

systemic measures like flood plain zoning, constructions in flood prone areas, (v) capacity development and (vi) institutional framework and financial arrangement for disaster response.

1.4 Departments and agencies audited

Audit teams from the office of the Accountant General (General and Social Sector Audit (G&SSA)) audited Revenue and Disaster Management Department, Municipal Administration and Water Supply Department and Housing and Urban Development Department. Audit teams from the Office of the Accountant General (Economic and Revenue Sector Audit (E&RSA)) audited Public Works Department. The various agencies audited are depicted in the Chart below:



- Chennai Metropolitan Development Authority (CMDA) is involved in planning and overseeing the effective implementation of the Master Plans in minimising the impact of urbanisation on water bodies and waterways.
- Water Resources Department (WRD) is the principal stakeholder for managing large water bodies and the macro drainage⁴ system.
- Revenue and Disaster Management Department is an important stakeholder as custodian of Government land.

⁴ Rivers and canals constitute macro drainage networks

- GCC, Municipalities and other local bodies are responsible for the micro drainage - storm water drainage system.
- Chennai Rivers Restoration Trust (CRRT), a body constituted by GoTN in January 2010, works in coordination with other agencies for restoration of the rivers, tanks and its catchment areas.
- Tamil Nadu Slum Clearance Board (TNSCB) works to evict slums and rehabilitate and resettle the slum families.
- TNSDMA, established under DM Act, 2005, is responsible for preparation of plans for disaster preparedness and managing disasters.

1.5 Audit Objectives

The Performance Audit was conducted with a view to assess whether:

- The Master Plans of CMDA were effectively implemented to ensure sustainable development of the metropolis with due regard to preservation of water bodies and land use plans;
- The Government effectively addressed the issue of encroachments in and around water bodies and elsewhere in CMA, which hinder free flow of rain water;
- Implementation of flood management programmes, including coordination among the related agencies, was effective and economic;
- Response and efforts to mitigate loss during the flood was timely, adequate and effective and
- Internal control mechanism, including performance evaluation and monitoring, was effective.

1.6 Audit Criteria

The Performance Audit was benchmarked against the criteria derived from the following documents:

- National Water Policy 2012 and State Water Policy, 1994
- The TN Land Encroachment Act, 1905
- The TN Protection of Tanks and Eviction of Encroachment Act, 2007
- The National Disaster Management Act, 2005 and National Disaster Management Guidelines for Management of Floods, 2008
- CWC guidelines and Dam Safety Procedures
- The Chennai City Municipal Corporation Act, 1919 and its Rules
- The TN District Municipalities' Act, 1920
- The TN Town and Country Planning Act, 1971 and its Rules
- The Registration Act, 1908
- First and Second Master Plans of CMDA and GCC's City Development Plan
- XII Five Year Plan

- Guidelines of Indian Roads Congress
- Manuals of various Government Departments/Boards/Agencies

1.7 Scope and Coverage of Audit

The Performance Audit was conducted from June to November 2016, covering the period from 2011-12 to 2015-16. In respect of relief measures, the Audit covered the period 2015-16. References to earlier periods were made, wherever necessary for trend analysis.

We focused on:

- Adherence to the Master Plans prepared by CMDA and regulation of developmental activities by way of layout approvals in flood plains, extent of reclassification of zones and monitoring the execution of recommendations
- Eviction of families encroaching the river margins by TNSCB and status of projects executed by WRD under Jawaharlal Nehru National Urban Renewal Mission (JNNURM) scheme and for augmentation of water storage facilities
- Construction and maintenance of Storm Water Drains (SWD) and canals in Chennai City by GCC and in the suburban areas by the respective local bodies
- Pre-monsoon works carried out in rivers and canals, *nullahs*, SWDs, and other water bodies
- Flood management, preparedness, mitigation and response by TNSDMA, in coordination with other related agencies

Action taken on previous audit observations/recommendations on the subject and also Public Accounts Committee (PAC) recommendations, as detailed in **Paragraph 1.8**, were also the focus of study.

1.8 Previous Audits

(i) A Performance Audit on "Alleviation of flood and abatement of water pollution in Chennai City through Chennai Waterways Project" was included in the Report of the Comptroller and Auditor General of India (C&AG) (Civil), GoTN for the year ended 31 March 2006 with recommendations for flood alleviation in Chennai City. The Report was discussed by PAC in November 2009. PAC recommended for (a) prompt action for increasing the storage capacity of tanks by removing encroachment, (b) completion of flood prevention works undertaken in Buckingham Canal and (c) taking steps on sustainable basis, to keep the Adyar mouth open by removal of sand bars and by construction of groynes⁵.

(ii) A Performance Audit was conducted on the implementation of JNNURM and findings included in the Report of C&AG (Local Bodies), GoTN for the year ended 31 March 2011. The findings included non-completion/delay in completion of several works to prevent flooding. Another Performance Audit on Irrigation activities in Chennai Region was

⁵ Barrier to protect from erosion

conducted and included in the Report of C&AG (Economic Sector), GoTN for the year ended March 2013. This Report included finding on mismanagement of projects aimed at improving water bodies. These Reports were not taken up for discussion by PAC (March 2017).

1.9 Audit Methodology

Records were checked at the Secretariat and field offices of various departments, GCC, Chennai Metropolitan Water Supply and Sewerage Board (CMWSSB), CMDA, TNSCB and CRRT, and three Municipalities and three Town Panchayats in Chennai suburban areas.

Besides scrutiny of records and collection of information through Audit enquiries and analytical procedures, the methodology included, (i) analysis using *Google Hybrid- Land use information system* – the GIS tool available in the website of CMDA to identify the extent of developments in water bodies, open space, non-urban zones and catchment areas which are to be preserved as per Second Master Plan (SMP), (ii) joint inspections conducted by the Accountants General (G&SSA) and (E&RSA) and Audit teams along with the officials from WRD, Revenue Department, GCC and sampled local bodies, (iii) Digital analysis of satellite imageries of CMA, and (iv) Consultations with Experts engaged by Audit for technical issues on town planning and water resources, brought out in the Report.

1.10 Sampling

Sample selection was based on judgmental basis, largely dependent on areas affected due to floods in 2015. Urban planning, flood management/augmentation of storage facilities, macro and micro drainages and encroachment on water bodies were studied in the departments and related agencies. Sampling was not applied for audit of preparedness, rescue and relief measures.

Field units sampled for audit were as given in **Table 1.2** below:

Table 1.2: Field units audited

Auditee Units	Total	Samples
Zones of GCC	15	5 ⁶
Municipalities	8	3 ⁷
Town Panchayats	11	4 ⁸
WRD Divisions	3	3 ⁹

⁶ Adyar, Alandur, Ambattur, Kodambakkam and Perungudi

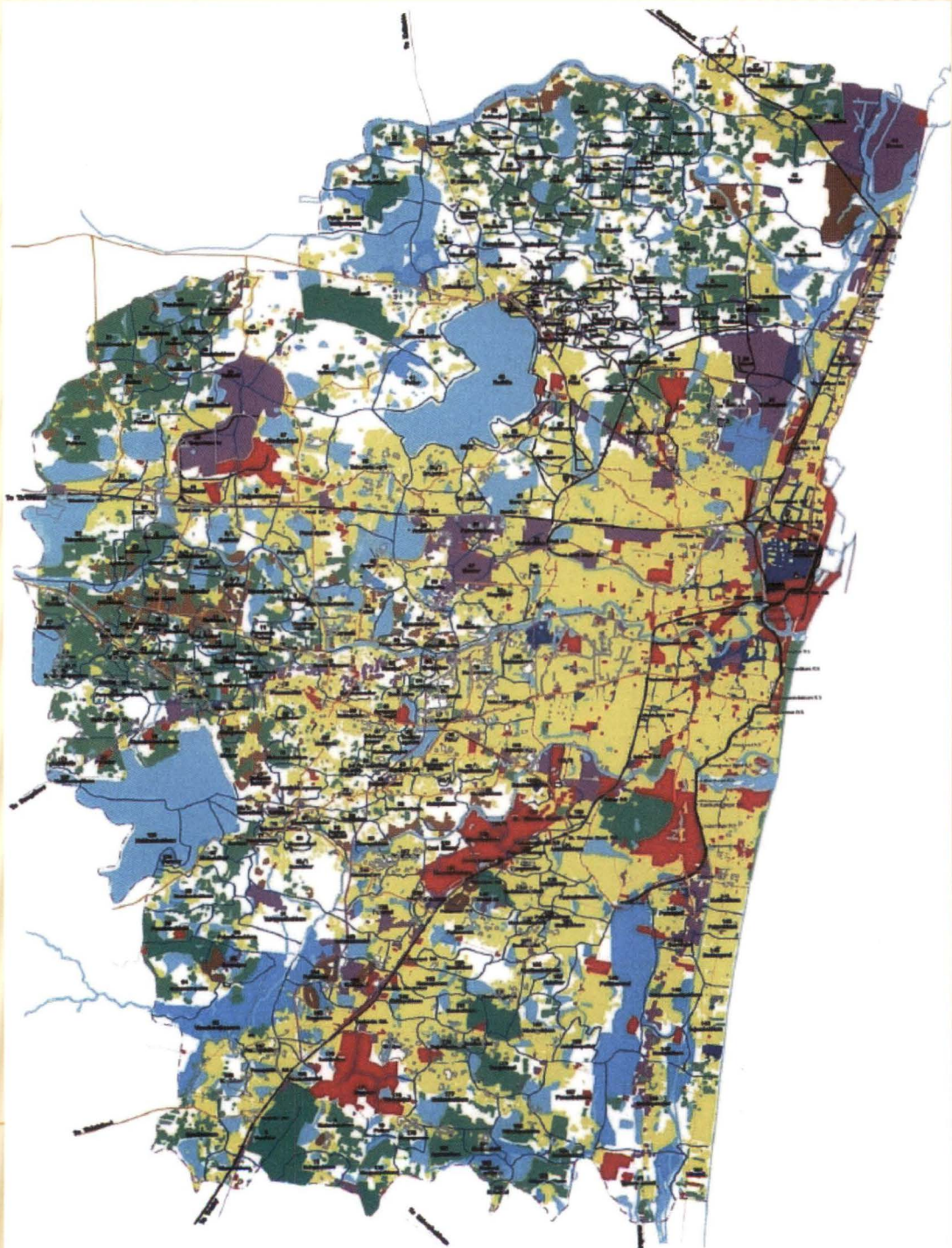
⁷ Pallavapuram, Sembakkam and Tambaram

⁸ Kundrathur, Peerkankaranai, Perungalathur and Thiruneermalai

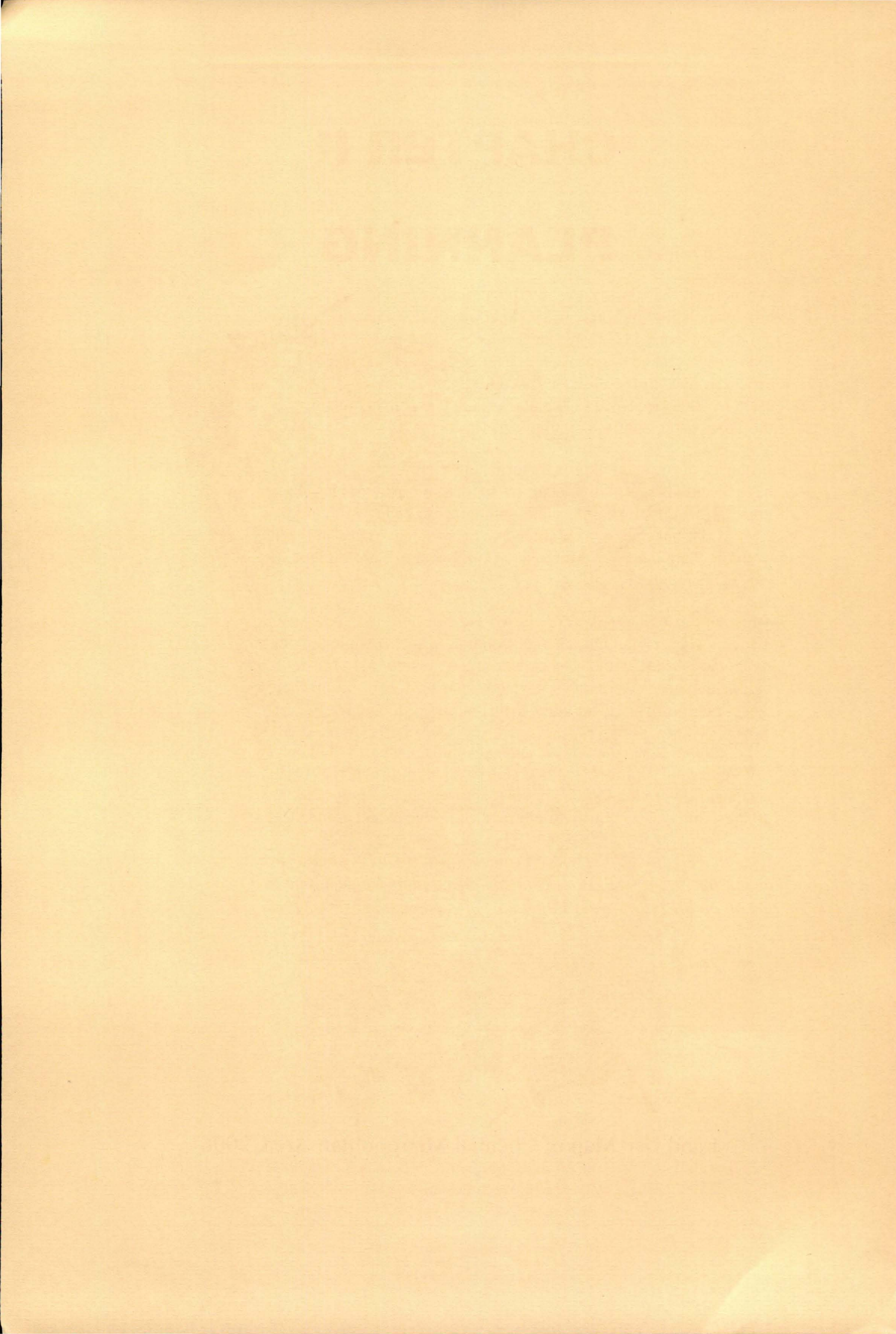
⁹ Three jurisdictional divisions - Araniyar Basin Division, Lower Palar Basin Division and Kosasthalaiyar Basin Division

CHAPTER II

PLANNING



Land Use Map of Chennai Metropolitan Area, 2006



CHAPTER II

PLANNING

Holistic planning holds the key to manage flooding and simultaneously addresses the need to harness water resources in the context of increasing urbanisation and depleting ground water tables.

Section 9-C of the TN Town and Country Planning Act, 1971 provides for preparation of a Master Plan for the Chennai Metropolitan Area (CMA) by Chennai Metropolitan Development Authority (CMDA). Master Plans prescribe policies and strategies for the overall development of CMA, taking a long term view of requirements like efficient functioning of traffic and transportation sector, plan for reclassification of land and development of basic amenities. As part of the strategy, land use and construction of buildings were required to be regulated by CMDA under Master Plans for orderly development of the city.

2.1 Planning for regulation of land use

The First Master Plan (FMP) for CMA came into effect in 1976 for a period covering 20 years till 1995. FMP dealt with land use planning through earmarking of land for residential, commercial, institutional, agricultural and recreational use. Under the Development Control Rules (DCR), 1976, framed under FMP, CMDA was responsible to regulate land use in CMA in terms of the FMP.

Further, FMP proposed to develop three satellite towns and six urban nodes to absorb future urban population and to construct ring roads, express ways, Mass Rapid Transit System (MRTS), etc. The proposals for satellite towns and urban nodes to decongest the city were not achieved as planned. Moreover, the CMDA failed to maintain the land use conversions, as the agricultural land and open space decreased more than what was projected. The agricultural land, which was projected to decrease by 36,510 hectare, had decreased by 61,120 hectare and the open space which was projected to increase by 2,556 hectare had actually decreased by 5,176 hectare. The area under agriculture and open space got reduced due to their conversion for various other purposes like, residential, commercial, institutional and industrial use. Thus, the violation of FMP resulted in haphazard growth of the city, leading to adverse consequences such as congestion, impact on environment and flooding in the city.

After FMP, the Second Master Plan (SMP) ought to have come into place with effect from 1996. But, the SMP, originally prepared by CMDA in 1995, was finally approved by GoTN only in 2008 as it was not properly prepared by CMDA after taking into account the urban development, having taken place by doing necessary survey. SMP, which came into effect with effect from 2008, was to guide the development of CMA till 2026. Under the

Development Regulations (DR), 2008, framed under SMP, CMDA was responsible to regulate land use in CMA in terms of the broad parameters of the SMP.

We observed that GoTN did not accord adequate importance to urban planning as evidenced by the delay of five years to approve the FMP after the TN Town and Country Planning Act, 1971 came into force, and an abnormal delay of 13 years in notifying (2008) the SMP after the end of plan period of FMP (1995).

The strategies of SMP were, *inter alia*, (i) to address the present constraints in disposal of flood water as an opportunity to manage and use the excess water for augmenting urban water supply through creation of additional storage capacity, (ii) developing a network of open spaces to provide green environment to be used as flood moderators during critical months of the year, (iii) to maintain existing water bodies by preventing encroachments, and (iv) improvement of macro drainage systems and integration of micro drainage with the macro system. The observations relating to non-adherence to the strategies of SMP are discussed in this Report.

2.1.1 Unauthorised land use conversion

(a) The TN Town and Country Planning Act, 1971 envisages approval of Master Plan, which includes the land use plan, by GoTN. Further, the Act envisages review of the approved Master Plan every five years for effecting necessary changes in the plan if considered appropriate based upon survey.

With a view to cater to the growing population, the Master Plans projected additional requirement of land for housing, industrial and institutional purposes and for other infrastructural facilities by converting agricultural land. The land use in CMA (a) as projected in FMP and SMP, (b) the actual area available in 1973 and 2006 as per survey done by CMDA and (c) the position in 2016 as arrived at based on approved land use changes, are shown in **Table 2.1** below:

Table 2.1: Land use changes in CMA

Land use	(Land in hectare)				
	Area available as of 1973 (Before FMP)	Area projected in FMP for 1995	Area available in 2006 (After FMP and before SMP)	Area projected in SMP for 2026	Area available in 2016 (during SMP)
(Figures in bracket represent percentage to total land area)					
Agriculture	73,689 (60)	37,179 (31)	12,569 (10)	7,296 (6)	12,322 (10)
Open space	5,742 (5)	8,298 (7)	566 (0.5)	1,393 (1)	553 (0.5)
Residential	16,932 (14)	41,667 (35)	32,400 (27)	52,937 (43)	32,628 (27)
Others	26,611 (21)	31,772 (27)	76,602 (62.5)	60,511 (50)	76,634 (62.5)
Total	1,22,974	1,18,916	1,22,137	1,22,137	1,22,137

(Source: Details furnished by CMDA)

As could be seen from the above, during the period between 1973 and 2006, the area under agriculture came down from 73,689 to 12,569 hectare, i.e., from 60 per cent to 10 per cent of the total area. During the same period, open space came down from 5,742 to 566 hectare, i.e., from 5 per cent to 0.5 per cent of the total area. We observed that the area under agriculture and open space, which are flood moderators, came down by beyond what was projected in master plans.

We noticed that during the interim period between FMP and SMP, without any plan being in force, CMDA allowed 439 land use conversions from agriculture zone (1,229 hectare), Open Space and Recreation (O&R) zone (345 hectare) and sensitive areas such as water bodies (14 hectare). We observed that, in the absence of a Government approved Master Plan during 1996 to 2008, approval of the above land use conversions was in violation of the Town and Country Planning Act, 1971.

Instances of irregular approvals for land use conversion after approval of SMP have been discussed in detail in succeeding paragraphs (**Paragraphs 2.3 and 2.4**). Further, despite rapid demographic changes taking place in CMA, CMDA did not review SMP after five years as envisaged in the TN Town and Country Planning Act. Moreover, GoTN also did not direct CMDA to carry out such a review.

Thus, land use changes were carried out not only in excess of the projection made in Master Plan, but also in violation of the Town and Country Planning Act, 1971 and without the envisaged review of Master Plan. The indiscriminate development of land increased soil runoff and consequent depletion of ground water table, contributing to flooding.

Highlighting the importance of planning, the Parliamentary Standing Committee on Home Affairs, which presented (August 2016) its Report on Chennai flood to the Parliament, had also concluded, *inter alia*, that unplanned urbanisation was a contributing factor for floods in and around Chennai.

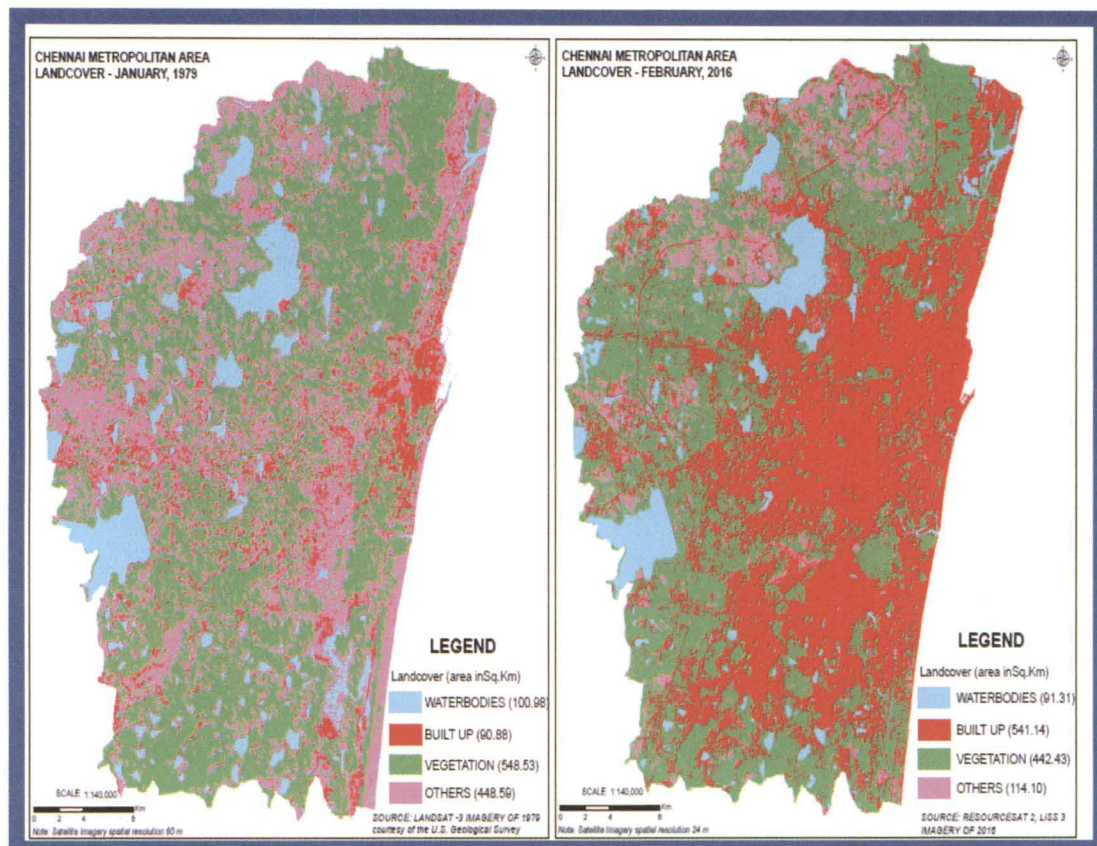
Recommendation No. 1: We recommend that GoTN should initiate timely action for review of SMP as contemplated and to decide a time frame to start action on the next Master Plan to avoid gap between Master Plan periods.

(b) Changes in land use, either authorised by CMDA or taking place through illegal constructions as discussed in **Paragraph 2.1.2** below, contributed to changes in the overall land cover of CMA.

In order to analyse the change in land cover over a period of time, we sourced satellite imageries of CMA as of January 1979 and February 2016 through National Remote Sensing Agency, Hyderabad, a body under the Indian Space Research Organisation (ISRO), and got the imageries digitally analysed (April 2017) by the Institute of Remote Sensing, Anna University, Chennai. The analysis disclosed that the built-up area in CMA increased from 90.88 sq.km in 1979 to 541.14 sq.km in 2016. Correspondingly, the area under water bodies and vegetation came down from 100.98 to 91.31 sq.km

and 548.53 to 442.43 sq.km respectively as shown in the **Map 2.1** (detailed map at **Appendix 2.1**).

Map 2.1- Digitally analysed satellite images of CMA



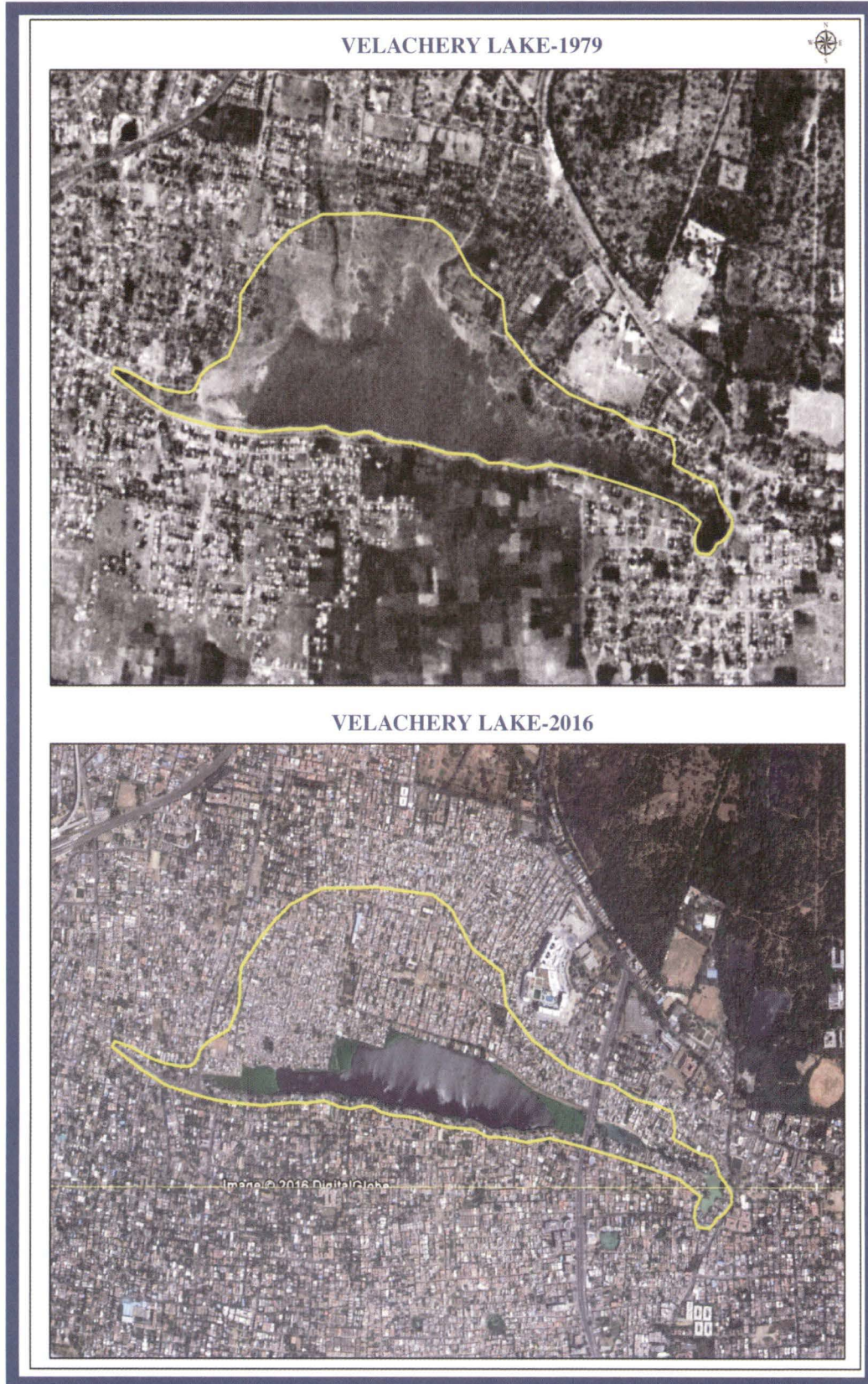
(Source: Analysis by Institute of Remote Sensing, Anna University, Chennai)

While the FMP and SMP, together projected a total increase in built-up area by 330.58 sq.km (33,058 hectare) over the 50 years period between 1976 and 2026, the actual increase in built-up area, as worked out using satellite imageries, over 37 years period between 1979 and 2016 was 450.26 sq.km. Thus, the satellite data, which depicts the actual ground reality, indicated that much higher building activity had taken place than what had been approved by CMDA, pointing to large scale illegal constructions as has been pointed out in **Paragraph 2.1.2** below. Simultaneously, the area under water bodies declined 9.67 sq.km between 1979 and 2016.

The disappearance/shrinkage of some of the urban lakes between 1979 and 2016, as noticed from the satellite maps are depicted in **Exhibits 2.1 to 2.5**.

Exhibit 2.1: Velachery Lake

Velachery Lake, located in the thickly populated southern part of the city, shrank over the years, leading to reduction in storage capacity of the lake.



Map not to scale

(Source: National Remote Sensing Agency, Hyderabad and Google Digital Globe)

Exhibit 2.2: Pallikaranai Marsh

The Pallikaranai Marsh, a unique fresh water swamp in CMA, which was measuring 5,000 hectare in 1975 shrank to 695 hectare in 2016 mainly due to the decision of GoTN to allow construction on a stretch of 500 metres on either side of Rajiv Gandhi Salai (IT corridor) to facilitate development of IT industry.



Map not to scale

(Source : National Remote Sensing Agency, Hyderabad and Google Digital Globe)

Exhibit 2.3 : Adyar Estuary

Adyar Estuary, a unique eco-system at the mouth of Adyar River, is surrounded by thickly populated areas of Adyar, Raja Annamalaipuram and Mandaveli. Large scale constructions in the Estuary shrank the area over the years as depicted below.

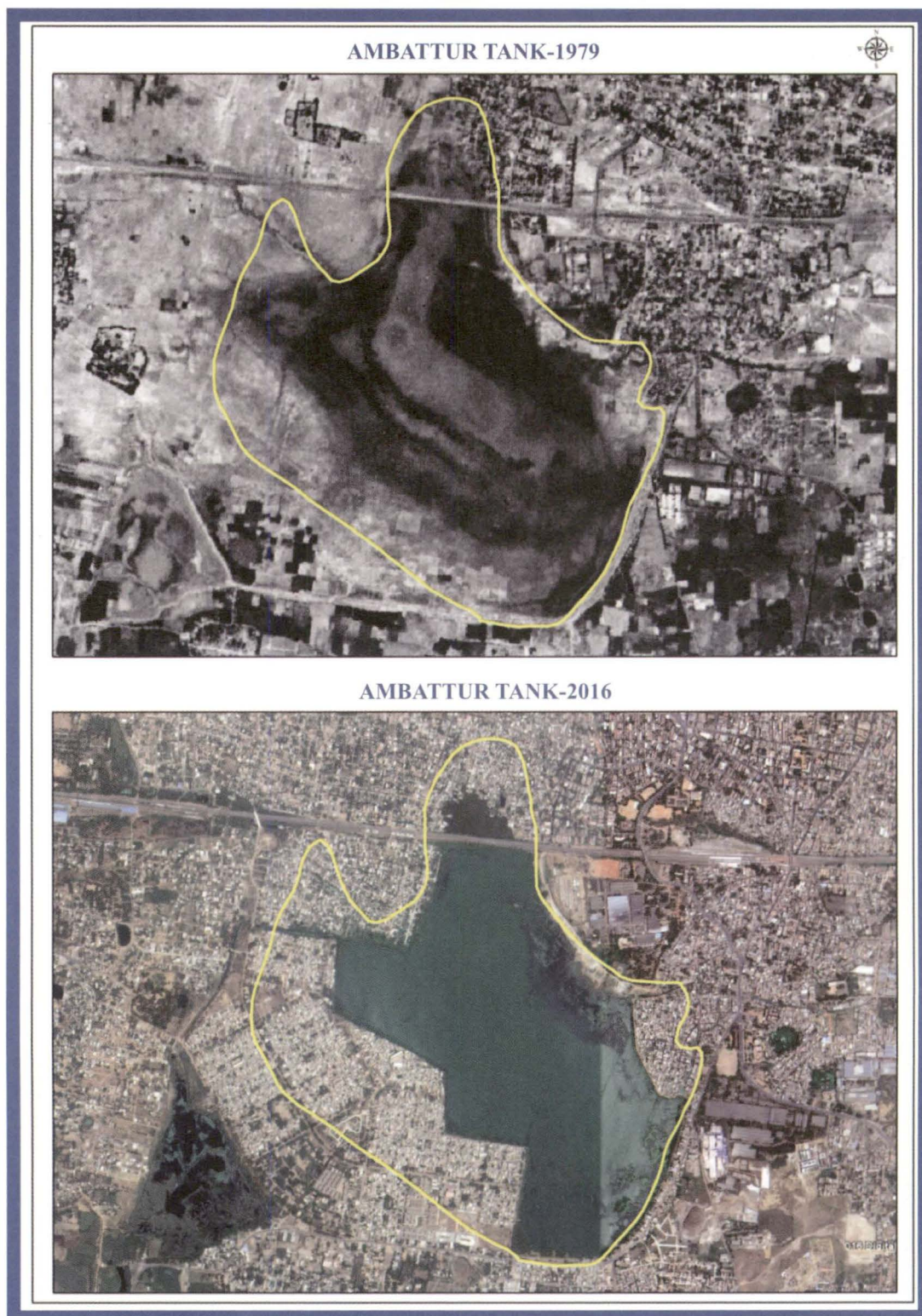


Map not to scale

(Source : National Remote Sensing Agency, Hyderabad and Google Digital Globe)

Exhibit 2.4: Ambattur Tank

Ambattur, located at the north western side of the city, is a thickly populated residential area with scattered small industries. The Ambattur Tank, adjoining Ambattur, which influences flow in Kosasthalaiyar River shrank in size over the years due to constructions inside the tank bed. The overflowing Ambattur Tank caused inundation in the adjoining areas.

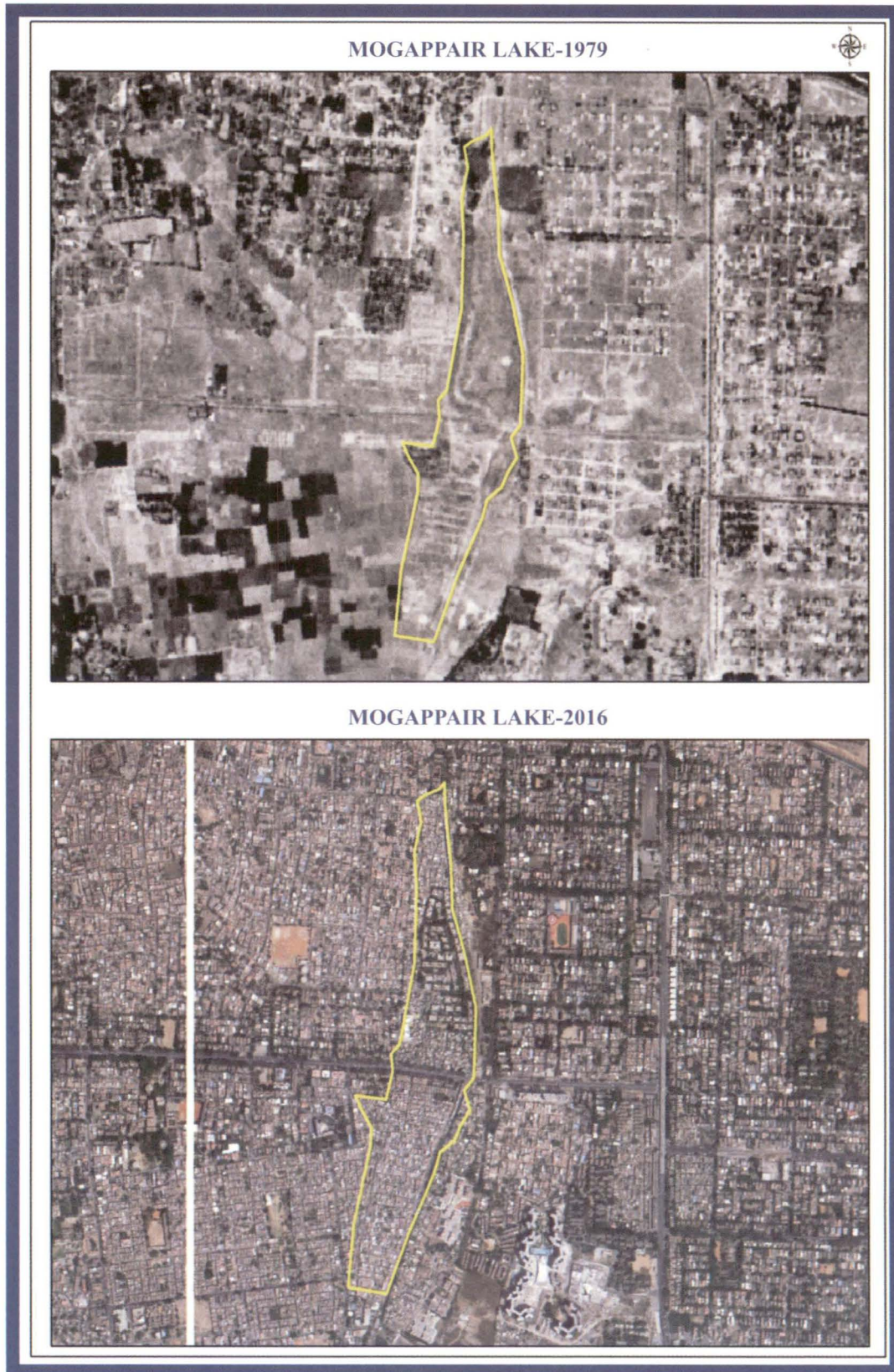


Map not to scale

(Source : National Remote Sensing Agency, Hyderabad and Google Digital Globe)

Exhibit 2.5 : Mogappair Lake

Constructions on the lake bed consumed the entire Mogappair Lake located in the north western part of the city.



Map not to scale

(Source : National Remote Sensing Agency, Hyderabad and Google Digital Globe)

We observed that drastic increase in the built-up area including those unauthorisedly allowed, which contributed to decrease in the area of water bodies and increase in soil runoff of rain water, exposed the city to the risk of flooding.

2.1.2 Illegal residential colonies

Development Regulations (DR), 2008, framed under Master Plans prohibited development of sites without CMDA's approval. The Honourable Madras High Court, Chennai, hearing a petition on illegal colonies, directed (March 2016) the GoTN to furnish information on illegal colonies which had come up after 1989¹. CMDA, however, did not have any mechanism to monitor illegal colonies cropping up within its jurisdictional area. Therefore, CMDA called for this information from local bodies. We noticed that only 19 out of 45 local bodies (including zones of GCC) furnished the required information. The information, as furnished by the local bodies, was furnished to GoTN for placing before the Court. The matter was under judicial scrutiny (March 2017).

As per the data obtained by CMDA, the details of illegal colonies in CMA, as of March 2016, was as under:

Table 2.2: Illegal colonies in CMA

Category of local body	Total number of local bodies in CMA	No. of local bodies for which data was available	No. of illegal colonies identified	No. of houses/ house sites involved	Area in hectare
Zones of GCC	15	05	54	NA	NA
Municipalities	08	08	113	7,320	155.87
Town Panchayats	11	05	30	1,259	19.43
Panchayat Unions	10	01	NA	NA	NA
Cantonment bodies	01	NA	NA	NA	NA
Total*	45	19	197	8,579	175.30

* Total has been worked out with available information. NA- Not Available

(Source: Data furnished by local bodies)

Considering the fact that data was not available in respect of all the local bodies, the number of illegal colonies and the land area of these illegal colonies could be much higher than the above figure of 197 colonies and 175 hectare. During the same period of 1989 to 2016, the actual number of layouts approved by CMDA for residential colonies was 3,084, which meant that illegal colonies were substantial in number.

¹ All unapproved layouts before 1989 were regularised by GoTN

We found that GoTN was aware of the issue of illegal colonies and amended (2009) the Registration Act, 1908, to prohibit registration of unapproved layouts. The amendment was to come into force on such date as the GoTN may issue by notification. As GoTN delayed notification of the Act, registration of unapproved layouts continued unabatedly. In 2015, based on a writ petition filed by an individual, the Honourable Madras High Court, noted that large scale unapproved layouts contributed to the floods of 2015 and imposed a ban (September 2016) on registration of plots/buildings in unauthorised layouts. GoTN also issued (October 2016) an order notifying the 2009 amendment to Registration Act 1908. We observed that the GoTN, by delaying enforcement of the amendment to the Act, contributed to the growth of illegal colonies.

Thus, the abnormal delay of GoTN in notifying the amendment to the Registration Act, 1908 and lack of control on the part of CMDA and failure of local bodies in controlling unauthorised developments had rendered the mechanism for urban planning ineffective, as even with the limited data, 197 illegal layouts had come up in CMA after 1988.

Recommendation No. 2: We recommend strict enforcement of the amended Registration Act to curb mushrooming of illegal colonies. CMDA should strengthen its monitoring activities and play a proactive role in identifying and stopping illegal constructions.

2.2 Policies and plans focusing on flood prevention and moderation

2.2.1 Non-revision of State Water Policy

Tamil Nadu State Water Policy (SWP), 1994 was formulated based on the National Water Policy (NWP), 1987. NWP was updated in 2002 and 2012. NWP 2012 envisaged planning and management of water resources by incorporating coping strategies for possible climate changes. As per NWP 2012, the acceptability criteria for new water resources projects were to be re-worked in view of the climate changes. However, SWP was not revised in line with NWP. A comment was also included in the C&AG's Audit Report (Economic Sector), GoTN for the year ended 31 March 2013, regarding non-revision of SWP. GoTN constituted (August 2013) a Committee for revising the SWP and the Committee presented its draft policy in August 2014. The draft policy, however, was not approved and notified by GoTN even as of November 2016. Non-revision of SWP had impacted various systemic measures like preparation of flood inundation maps, emergency action plan for dams, basin-wise master plans etc., as was required under Central Water Commission (CWC) norms and NWP. We further observed that non-creation of new reservoirs taking into account the climate changes as emphasised in NWP 2012 was one of the reasons for inundation during Floods 2015.

Such lackadaisical approach of Government indicated that no lessons were learnt from the catastrophic floods of 2015 causing huge loss to human lives and properties.

2.2.2 Non-preparation of frequency based flood inundation maps

Flood forecasting is an important and cost effective non-structural method to mitigate the impact of floods. The CWC is involved in flood forecasting in a scientific manner. With a view to facilitate CWC in forecasting floods, the National Flood Commission recommended (1982) to assess the areas prone to floods, flooded areas, damages to properties and lives and furnish the same along with connected maps to CWC. The NWP 2012 also envisaged that every State should prepare flood inundation maps based on frequency of floods to evolve coping strategies besides conducting morphological² studies for planning and taking measures to prevent permanent loss of land eroded by the river causing damages to their revetments, spurs, embankments, etc. The Water Resources Department (WRD), as the custodian of major waterways, was responsible for preparation of flood inundation maps.

We observed that WRD did not assess the area prone to floods, flooded area, damages to property and lives during the period from 2012-16. As a result, no data as required under National Flood Commission recommendations were furnished to CWC. The connected maps as well as river basin maps were neither prepared by WRD nor furnished to CWC. Further, morphological studies, to evolve flood coping strategies and protecting water bodies were also not conducted as was required under NWP 2012.

GoTN, while admitting non-preparation of flood inundation maps, stated (May 2017) that flood prone areas had been assessed. The reply was not tenable as assessment of flood prone areas would not serve the purpose unless frequency based flood inundation maps are prepared and furnished to CWC for flood forecasting and evolving appropriate coping strategies. As a result, WRD did not have a comprehensive plan for flood prevention measures such as construction of revetments, spurs and embankments and CWC was not facilitated to scientifically issue flood forecasts.

Recommendations No. 3: We recommend that SWP may be immediately revised by GoTN making it mandatory for WRD to prepare frequency based flood inundation maps.

2.2.3 Non-preparation of Emergency Action Plan for Dams

NWP 2002 stressed the need for preparation of Emergency Action Plan³ (EAP) for all large dams. Dam Safety Organisation of CWC had also issued (May 2006) guidelines for development and implementation of EAP for dams with due emphasis on procedure to be followed to minimise damage to property and loss of life. The NWP 2012 also reiterated on increased preparedness for sudden and unexpected floods by preparing and updating of EAP.

² Study of the configuration and evolution of land forms

³ Emergency Action Plan is a formal document that identifies potential emergency conditions at a dam and specifies pre-planned actions to be followed to minimise property damage and loss of life

In Tamil Nadu, there are 127 large dams/reservoirs, and in Chennai and suburban areas, there are four large reservoirs (Poondi, Cholavaram, Redhills and Chembarambakkam) which required EAP. However, WRD did not attach due importance to the guidelines of NWP and CWC to prepare EAP for the reservoirs in Chennai and its suburban areas (December 2016). Engineer-in-Chief, WRD stated (March 2017) that action was being initiated to prepare EAP for the dams under World Bank funded Dam Rehabilitation and Improvement Project in a phased manner. He further stated that approval of EAP proposal for two dams (Sothuparai and Servalar dams) was awaited from CWC. Based on the approval of CWC, EAP for other dams would be prepared.

We observed that EAP was a cost effective non-structural measure and it was not appropriate on the part of WRD to link it with the larger and cost intensive Dam Rehabilitation programme. EAP for the reservoirs in CMA could have helped better management of flood discharge from all reservoirs, including Chembarambakkam Tank (**Paragraph 5.8.5**).

Recommendation No. 4: We recommend early action on preparation of EAP for taking care of safety of dams.

2.2.4 Non-availability of basin-wise Master Plan

In 1990, CWC had issued detailed guidelines for preparation of Master Plan for river basins. The guidelines were revised in 2007. The Master Plan was to take into account the catchment area, water potential, storage availability, consumption pattern etc. The SWP, 1994 had also emphasised preparation of a basin-wise master plan for every flood prone basin, as a measure for flood control and water management.

We observed that Master Plan for Chennai and its suburban areas, for its three rivers viz., Adyar, Cooum and Kosasthalaiyar was not prepared (August 2016) to manage the flood situation and for augmentation of water resources.

GoTN stated (March 2017) that the Master Plan would be prepared by engaging a Consultant. We observed that preparation of Master Plan involved coordination between WRD and local bodies as major waterways are under the control of WRD and minor ones are under local bodies. We noticed that no action was taken by WRD to coordinate with local bodies for preparing basin-wise master plan.

Non-preparation of basin-wise Master Plan for CMA, led to unplanned execution of macro and micro drainage networks, as commented in **Paragraphs 5.1, 5.2, 5.3 and 5.4**.

2.2.5 Non-enactment of legislation on Flood Plain Zoning

Flood Plains are low-lying land areas adjacent to a river. Flood Plain Zoning (FPZ) is a concept to regulate land use in the flood plains to restrict the damage caused by floods and aims at determining the locations and the extent of areas for developmental activities in such a fashion that it does not impact the environment.

In 1975, CWC circulated a model Bill on FPZ, envisaging provisions for flood zoning authorities, surveys and delineation of flood plain area, notification of limits of flood plains, prohibition or restriction of the use of the flood plains, compensation, and power to remove obstruction after prohibition etc., for enactment. As per National Disaster Management (NDM) guidelines, the areas vulnerable to frequent floods and areas on either side of the existing and proposed drains including rural drains were to be declared as green belts, where no building or other activity, except parks and playgrounds, were to be allowed. The SWP, 1994 mandated that watershed management and flood forecasting for reservoir operations, FPZ and prevention of flood plain encroachment by human settlement and obstruction to flow would be considered along with structural measures, such as embankments and flood channels. The same was reiterated in NWP 2012.

We, however, observed that the suggested legislation on FPZ was yet to be enacted and the SMP, approved by GoTN in 2008, did not provide for FPZ, specifying the distance from the water body i.e. off-set space, upto which development/construction activities were to be restricted. CMDA also did not stipulate any FPZ in its Development Regulations.

To an audit query on enactment of FPZ Act, CE, WRD replied (August 2016) that a proposal (June 2014) to form a Committee to give recommendations for enacting the legislation was under consideration of GoTN (August 2016).

Thus, the lack of legislation for flood plain zoning, resulted in developments abutting waterways, as discussed in **Paragraph 2.3** below.

Recommendation No. 5: We recommend that the FPZ bill may be enacted at the earliest to prevent constructions along the three rivers of CMA.

2.3 Construction activities along water bodies

Despite clear policies, as discussed in **Paragraph 2.2** above, on preservation of water bodies which are flood accommodators, construction activities along water bodies reduced the area of water bodies and contributed to the floods of 2015. Specific lapses of GoTN and CMDA in this regard are discussed in this paragraph.

2.3.1 Granting unauthorised building permission along waterways by CMDA

In the absence of demarcated FPZ and specification of off-set space requirements in the Development Regulations of SMP, Tamil Nadu District Municipalities Building Rules, 1972, regulate the approvals for construction of buildings in urban areas of the State. As per the Rule 7, if a construction site was within 15 m of a water body, water course or well, such measure as may be necessary or as the executive authority may direct, should be carried out to protect the water body.

In June 2012, a committee headed by the Vice-Chairman, CMDA, recommended a buffer zone of at least 15 m between the river and the proposed building, and to issue an office order to that effect.

We noticed that in violation to the extant rules and the recommendation of the Committee, CMDA continued to issue planning permission for buildings within 15 m of water bodies without ensuring any ameliorating measures to prevent damage to the water body. CMDA adopted a procedure of obtaining No Objection Certificate (NOC) from WRD for issuing conditional approvals for constructions adjacent to water bodies. We observed that neither the TN Town and Country Planning Act nor the Development Regulations framed under SMP allowed CMDA to issue conditional approvals subject to adherence to NOC conditions of WRD.

During joint site inspections (August 2016) along with officials of the test checked Municipalities, Town Panchayats and Zones of GCC along Adyar and Cooum Rivers, we observed that special and multi-storeyed buildings listed in **Table 2.3** were approved by CMDA which were falling within 15 m of the waterways. These buildings were inundated and contributed to inundation of neighbourhoods, during the floods of 2015.

Table 2.3: List of buildings approved on river banks

Sl. No.	Name of the builders	Year of construction	Name of the water body	Distance from water body
1	Residential building by Pace builders	2012 to 2015	Pappan channel	10 ft
2	Residential building by Shakul Hamid and Bros	2012	Periya Eri	14.06 m
3	Residential building by Mantri Hamlet Private Ltd	2014	Periya Eri	11.72 m
4	Residential building by Jain Housing	2014	Nattukkalvai	Less than three metres
5	Residential building Orchid Springs by Alliance	2012	Korattur Lake	10 m
6	MIOT hospital	NA	Ramapuram Nullah	On the bank
7	Jayanth tech park	NA	Adyar River	On the bank
8	Residential building by Arihant builders	NA	Adyar River	On the bank
9	Residential building by Casa Grande	Ongoing	Adyar River	On the bank

NA: Not available

(Source: Information collected from CMDA and WRD)

Scrutiny of records revealed that in violation to the TN Town and Country Planning Act and the DR framed under SMP, CMDA issued approvals for these buildings on the basis of NOCs. Though CMDA by violating the prescribed rules, issued conditional approvals, the conditions of NOC, so irregularly set, were not even satisfied by the builders/realtors and nor ensured by the CMDA as to whether such conditions were complied with. This is indicative of the fact that CMDA did not bother about the protection of water bodies while issuing the approvals for residential buildings though it was responsible for ensuring implementation of the provisions of the TN Town and Country Planning Act.

The wrong practice of allowing conditional planning permissions on the basis of NOC, had not helped preservation of waterways as adherence to NOC conditions were not enforceable, leading to unplanned developments, contributing to floods.

To an audit enquiry, CMDA stated (October 2016) that in the flood plains of Adyar River and in the areas adjoining the Cooum River, the land had been reserved for agriculture use zone/non-urban use zone to safeguard these areas from flood hazards. The reply was not tenable as CMDA itself had approved special and multi-storeyed buildings, as detailed in **Table 2.3** above and 51 layouts (**Table 2.4**) in selected local bodies along the flood plains of river/channel during the years from 2009 to 2016.

2.3.2 Approval of layouts without preservation of water bodies

Regulation 2 (25) of DR defines layout as division of plots exceeding eight in number and provides for approval of layouts of more than 10 acres by CMDA in CMA.

Regulation 7 (2) of DR prohibited development of sites without CMDA's approval. Approval was not to be accorded without ameliorative measures if CMDA considered the site (i) to be near a water body/course (ii) likely to be inundated with no possibility of proper drainage arrangement, (iii) was a filled up tank or low lying and (iv) was likely to be affected by dampness owing to the sub-soil water. Ameliorative measures that were to be satisfied by CMDA were not defined in the DR.

In the absence of demarcated FPZ, CMDA, without any authority, obtained NOC from WRD which is the custodian of the water bodies, and issued conditional approval for development of sites as layouts which were located within 15 m of the waterways.

NOC issued by the CE, WRD stipulated conditions that were to be fulfilled by the promoter, such as (i) culverts⁴ to be constructed across the water way, (ii) provision of storm water drain in the layout, (iii) leaving off-set space from the waterway and (iv) raising the level of the site above maximum flood level of the waterway. CMDA issued layout approvals along with the NOCs issued by WRD, to the local bodies, with instructions to local bodies to ensure

⁴ A small structure to allow water to pass under a road

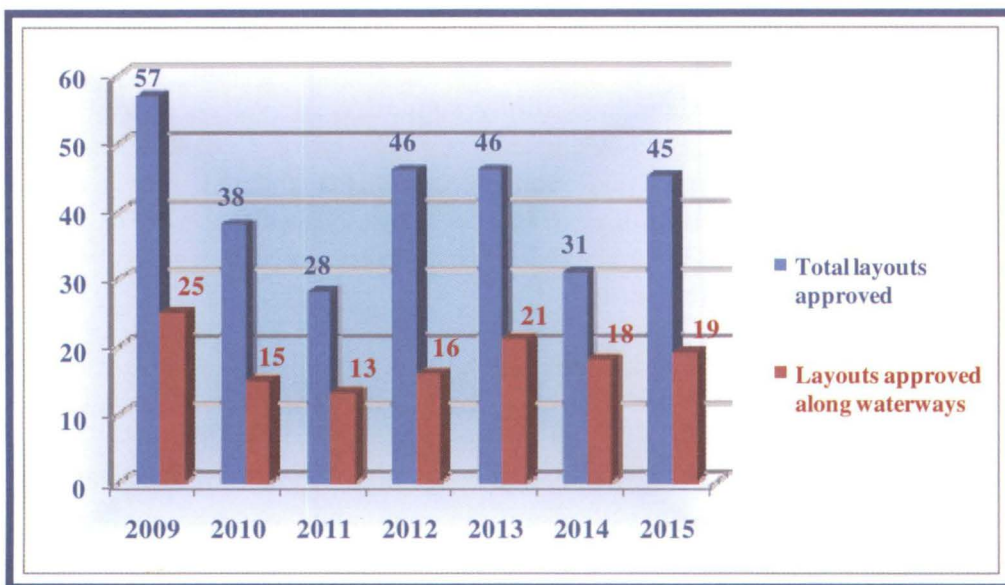
compliance of all conditions stipulated by the WRD by the promoters of the layout and obtain a letter from WRD confirming compliance before release of layout approval.

Once local bodies received application for layout approvals from an individual, which was beyond their delegated powers, they forwarded the application to CMDA for approval. CMDA accorded approval after verifying the conditions like classification of land use, road width, provision of storm water drains and ownership of the site, but had not ensured the distance of 15 m between the water bodies and the sites, which was required under the TN District Municipalities Building Rules, 1972.

We observed that *prima facie*, CMDA issued incorrect approvals to layouts in flood plains along waterways without satisfying ameliorative measures as required under Regulation 7 (2) of DR 2008. In the absence of ameliorative measures that were to be undertaken, CMDA was not competent to give conditional approvals for sites which were located in flood plains. Further, CMDA failed in its responsibility and passed it on to local bodies to ensure that NOC stipulations were complied with. These failures of CMDA are discussed in the succeeding paragraphs.

During 2009-15, CMDA approved 291 layouts in CMA, of which 127 were within 15 m of waterways. The year-wise details of total layout approvals given by CMDA and approvals for layouts which were located in the flood plains of waterways are as shown in **Chart 2.1**.

Chart 2.1: Year-wise layout approvals - 2009-15



(Source: Data from CMDA)

Out of the above, we examined the approval process in respect of 51 layouts approved during the period 2009-15, located in three local bodies given in **Table 2.4**.

Table 2.4: Details of layouts approved in CMA in selected local bodies

Sl. No.	Area	No. of layouts approved	No. of layouts within 15 metres of waterways	Area in acres along water course converted as layouts	Original land before conversion into layout
1	Kundrathur	63	23	125.07	Ayacut ⁵
2	Thiruneermalai	1	1	5.59	Agriculture
3	Poonamallee	50	27	153.00	Not available

(Source: CMDA)

We observed that 23 layouts were approved by CMDA in Kundrathur Panchayat Union and Kundrathur Town Panchayat, one in Thiruneermalai and 27 in Poonamallee Panchayat Union. Joint inspection (October 2016) of 23 sites (**Appendix 2.2**) by Audit along with officials of local bodies, revealed the following factors contributing to flood:

(i) In one layout, abutting the Kolapakkam Channel in Manappakkam and Kolapakkam Villages, buildings were constructed very close to the channel without any off-set space. Untreated waste water from these buildings was directly let into the channel through outlet PVC pipes, contributing to choking of the channel. CMDA stated that the water course was not affected by the site. The reply of CMDA was found incorrect through field visit.

(ii) In one layout in Kulathuvancherry and Srinivasapuram Villages, CMDA had even failed to ensure that NOC conditions imposed by WRD in constructing culverts on the roads across a channel passing along the layout were complied with. Further, land filling suggested by WRD, in view of possible inundation, was also not carried out. Though the channel and its branch were duly demarcated in Revenue records, the channel, which runs along the layout, was silted with no traverse. This showed that CMDA was desperate in approving the layouts even when such layouts did not satisfy the NOC conditions to facilitate realtors.

(iii) In one layout in Varadarajapuram Village, an apartment constructed on the bund of the Adyar Odai⁶, narrowing its width and in another layout the natural drain (vaikal), was encroached by a temple and houses. On this being pointed out by Audit, CMDA stated that the Commissioner of Kundrathur Panchayat Union was requested to ensure the compliance of NOC conditions of WRD. The reply, being futuristic in nature, had not addressed the deficiency pointed out. It appears from the reply that CMDA is still resorting to the inappropriate NOC conditions of WRD and is in a mode of complete denial from their act of violation of the extant rules. CMDA, without taking any measures to evict the encroachers and demolish the buildings occupying the water body, approved the layout, causing further damage to the water body.

⁵ Agricultural area irrigated by a tank

⁶ Rivulet

(iv) In three out of six layouts in Kundrathur Village, there were unapproved buildings and encroachment on the channel. The channel was not continuous and no demarcations were available. It was filled with debris. The road culvert provided across the channel was only for a length of three meters as against 10 m stipulated by WRD (**Exhibit 2.6**). In three other layouts, the channel was occupied by unapproved buildings.

Exhibit: 2.6: Smaller than stipulated culvert at Kundrathur Village



(Source: Photo taken by Audit team during Joint Inspection)

(v) In three layouts in Mannancherry Village, culverts as stipulated by WRD across a field channel were not constructed. The channel was occupied by buildings. No action was taken by the Executive Officer of Kundrathur Town Panchayat to ensure provision of culvert as stipulated in the NOC. In another case of two layouts in Naduveerapattu, the WRD conditions to earmark channel boundary were not fulfilled.

CMDA replied that removal of encroachments and removal of debris was the responsibility of local body. The reply did not address the issue that approvals were given without ensuring ameliorating measures. It further indicated the fact that despite knowledge about encroachments, CMDA did not pay due attention to preservation of the water body, leading to inundation and still CMDA was passing the blame on local bodies.

CMDA further stated (November 2016) that the proposals for layouts were approved with the permission of the WRD. The reply revealed that the CMDA was incorrectly putting the onus of preserving the water bodies on WRD. The NOC issued by WRD had prescribed the condition that the promoter should maintain the channel to its width, protect the channel from encroachment and also desilt the channel in some cases. It was seen that the promoter had no role, once he had sold all the plots in the layout. Thus, CMDA in connivance with WRD, promoters and local bodies allowed

development/construction activities along flood plains without ensuring the fulfillment of the conditions of NOCs.

Recommendation No. 6: We recommend that CMDA should stop issuing conditional approvals for layouts and buildings along water bodies. Approval should be issued only after ensuring that ameliorating measures were completed.

2.4 Non-adherence to land use planning

Section 9-C of the TN Town and Country Planning Act, 1971, empowered CMDA to prepare an existing land use map and such other maps as may be necessary for preparing any development plan. Zoning provides spatial segregation of conflicting uses besides preservation of open space, prime agriculture land and ecologically sensitive areas. The DCR and DR framed under FMP, 1976 and SMP, 2008 respectively for CMA contained detailed regulations on land use zoning and reservation of open space for recreation and public use.

Land use is divided into various zones and all developments in an area are to be regulated with reference to the Land Use classification⁷ indicated in the SMP and the DRs specify the permissible usage in each zone.

Section 32 of the TN Town and Country Planning Act empowers GoTN to approve variations of land use. CMDA, however, was not authorised to reclassify water bodies, O&R zone, Non-urban zone and Redhills catchment areas for other purposes as per FMP and SMP.

In order to curtail indiscriminate conversion of agricultural wet lands, the TN Town and Country Planning Act, 1971 was amended in March 2012 which stated that “while preparing the Master Plans, most of the agriculture wet lands are earmarked under agricultural use zone and any conversion to other uses will be entertained only after obtaining a Government order after following due procedures with full justification as per the Act provisions”.

Results of the scrutiny of zone conversions approved by CMDA are discussed in the sub-paragraphs below:

2.4.1 Non-preservation of agricultural land

In the XII Five Year Plan (2012-17), one of the thrust areas was to develop a mechanism to control diversion of fertile agricultural land and wet land for non-agricultural purposes and protection of wet land and water bodies was one of the strategies while preparing the Master Plans. We noticed that historically, the area of agriculture land in CMA kept shrinking. The area which stood at 73,689 hectare in 1973, had shrunk by 83 per cent in 2006 to 12,569 hectare.

⁷ Land uses are categorised as Primary Residential, Mixed Residential, Commercial, Industrial, Institutional, Agricultural, Urbanisable, Open Space and Recreation, Non-urban and Water bodies

During preparation of SMP, the Director of Agriculture had recommended (August 2007) the implementation of SMP without affecting the area of agricultural land. A Group of Ministers had also decided (July 2008) that the land use allocation should not push down the agricultural activity and substantial allocation of land for agricultural activities should be ensured. Contrary to these recommendations, SMP, 2008 projected that there would be no agricultural land in Chennai City by 2026 and only 7,296 hectare would remain as agriculture land in CMA. This further indicated a projected reduction of 42 *per cent* in the agriculture area from what was existing in 2006.

On analysing the issue concerning conversion of agricultural land for other uses, we noticed that in 1991, GoTN had imposed a ban on conversion of agricultural wet lands except with the concurrence of the Government in Agriculture Department. Subsequently, in 1992, Government, while reversing their own order, exempted agricultural wet lands which were already approved for conversion in Master Plans prepared by planning authority, from obtaining concurrence of Government. As such, CMDA got the freedom to convert agricultural wet lands which were already approved in the Master Plan for other uses. We observed that between 1996 and 2008, CMDA approved conversion of 1,229 hectare of agricultural land without Government concurrence, even though the FMP period had ended in 1995 and this period was not covered by any Government approved Master plan.

We noticed that, in the SMP, while planning to earmark 5,273 of the available 12,569 hectare of agricultural land for other uses, CMDA had not identified the parcels of land earmarked for conversion. Whenever, a promoter approached CMDA for planning permission on an agricultural land, CMDA accorded approval without seeking the concurrence of Government in Agriculture Department, as conversion of 5,273 hectare had already been approved in the SMP.

We observed that, CMDA violated the Government order of 1991 in approving conversion of 1,740 hectare of agricultural land during the period from 1992 to 2016. Over a 40 years period, between the commencement of FMP in 1976 and 2016, agricultural land in the suburban areas of Chennai in the districts of Kancheepuram (part) and Thiruvallur (part) declined by 47.5 *per cent*, from 1,22,162 hectare to 64,117 hectare.

As conversion of agricultural land for residential or other building purposes affect the water holding capacity of soil, the action of CMDA in approving conversion of agricultural land contributed to the ill effects of floods of 2015.

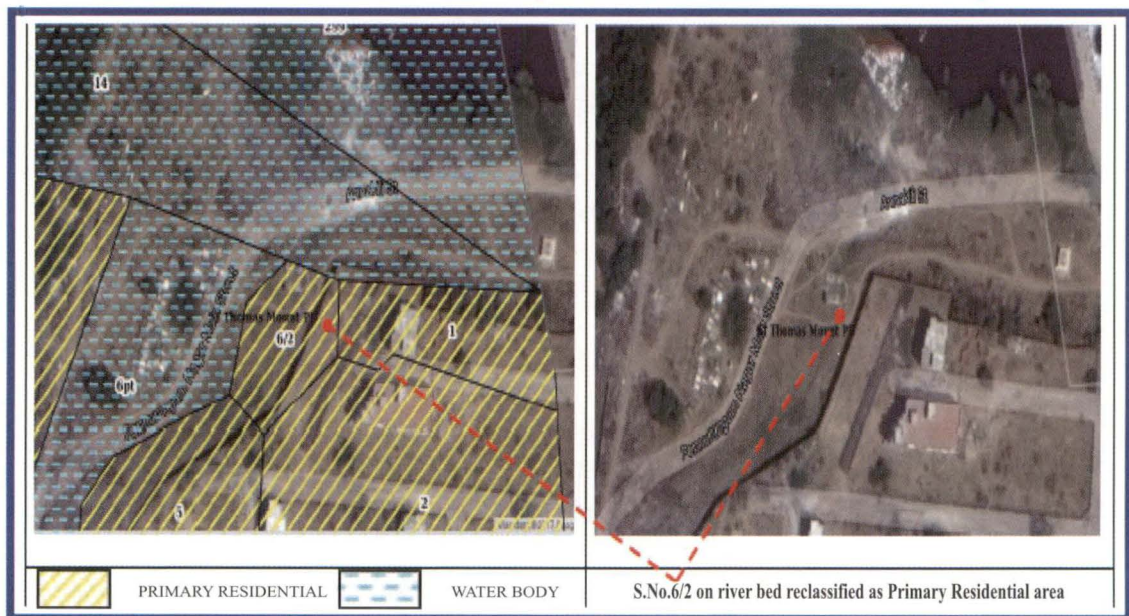
Recommendation No. 7: We recommend strict implementation of the Government order stipulating Government approval for zone conversion from agricultural land.

2.4.2 Conversion of water bodies as residential areas

SMP stipulated that water body land should not be converted for any other use. Further, as per GoTN's order (January 1987), "It is important to protect and maintain water streams, wells and tanks. The encroachment in water bodies are to be evicted and monitoring arrangement has to be made to avoid future encroachments. As such, Government imposed ban on regularisation of any encroachment in water bodies".

Despite the above stipulation, CMDA approved during 2009-16 conversion of 9.32 hectare of water bodies as residential zone at seven locations. Audit scrutiny of five cases involving five acres, revealed that in three cases (0.60 hectare), survey numbers⁸, which related to water bodies/river courses were subdivided by the Revenue authorities and *Pattas* granted to private individuals. CMDA approved reclassification of these water bodies land as Primary Residential⁹ and Mixed Residential¹⁰ zones on the strength of the ownership established through *Patta* issued by Revenue authorities though these lands were lying well within Adyar River. GIS maps of water bodies super-imposing survey numbers showing developments inside water bodies are shown in Exhibits 2.7 to 2.11 below:

Exhibit 2.7: Reclassification of water body in St.Thomas Mount - Pozhichalur Village



Map not to scale

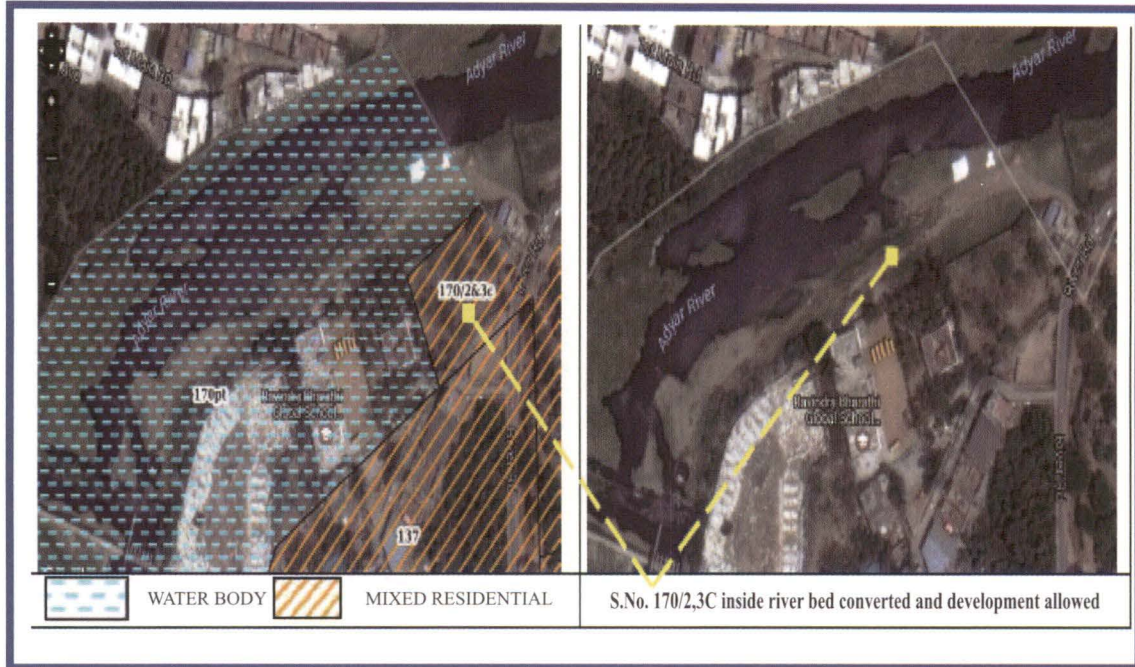
(Source: Google Hybrid Land use Information System available in CMDA website)

⁸ Survey Nos. 170/2 and 170/3C of Nandambakkam Village in Nandambakkam Town Panchayats 6/2 of Pozhichalur Village and Survey No. 1/3B3 of Manapakkam Village in Kundrathur Panchayat Union

⁹ Zone earmarked for residential buildings, professional consulting offices, petty shops, schools, parks and play fields

¹⁰ Zone earmarked for all uses permitted in PR and hotels, community halls, recreation clubs, dispensaries, Government and Municipal offices, banks, educational institutions and restaurants

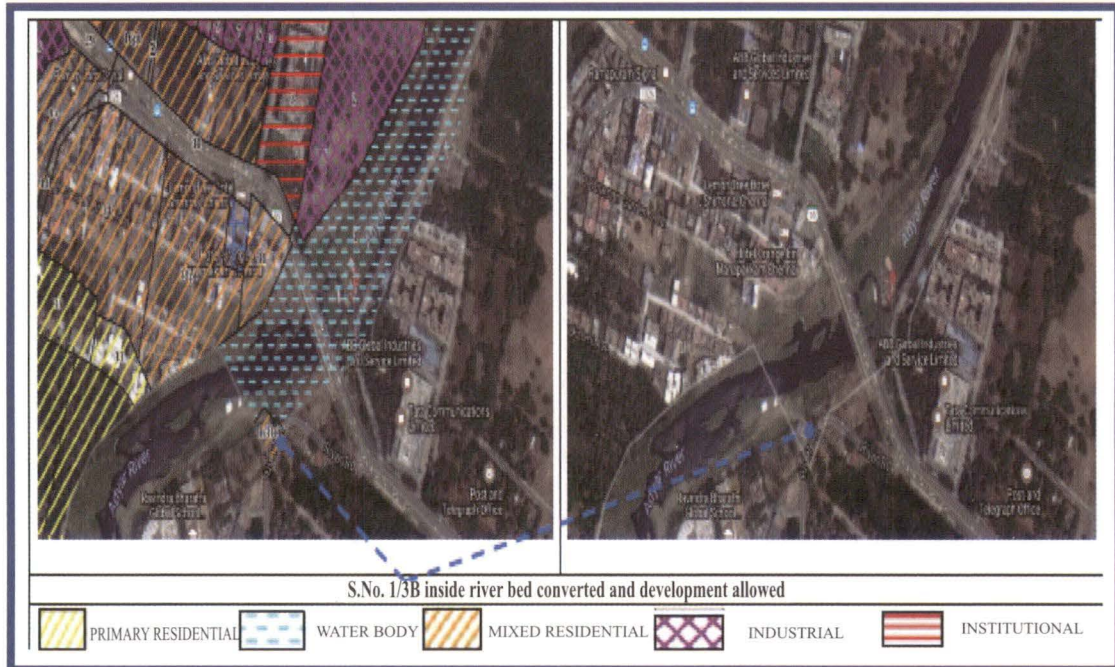
Exhibit 2.8: Reclassification of water body in Nandambakkam Village



Map not to scale

(Source: Google Hybrid Land use Information System available in CMDA website)

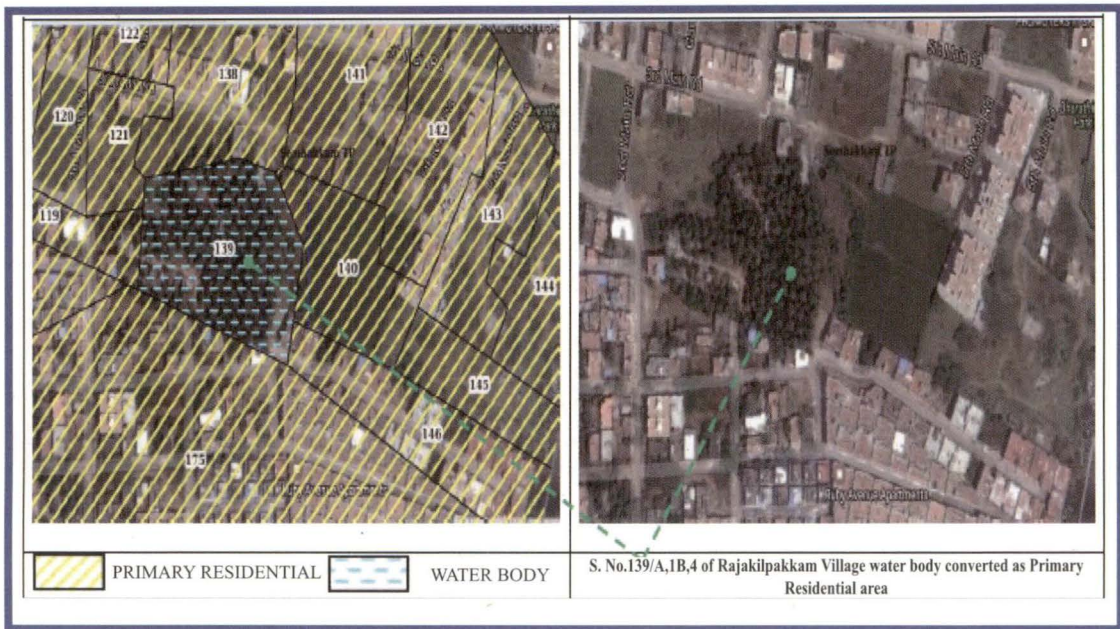
Exhibit 2.9: Reclassification of water body in Manapakkam Village



Map not to scale

(Source: Google Hybrid Land use Information System available in CMDA website)

Exhibit 2.10: Reclassification of water body in Rajakilpakkam Village in Sembakkam Town Panchayat



Map not to scale

(Source: Google Hybrid Land use Information System available in CMDA website)

Exhibit 2.11: Reclassification of water body in Varadharajapuram in Kundrathur Panchayat Union



Map not to scale

(Source: Google Hybrid Land use Information system available in CMDA website)

We noticed that as per the earliest available Revenue records pertaining to 1912 (Revision Survey and Resettlement Register), all the above lands were parts of water bodies. Revenue authorities sub-divided the Survey number pertaining to water bodies and issued *Pattas* to private individuals over the years, despite a Government order as early as in 1954 banning assignment of water body lands. As such, issue of *Patta* to private persons by sub-dividing water bodies by Tahsildar was in violation of Government orders. CMDA, violating SMP and the stipulated rules and orders, approved conversion of water bodies for residential purposes, treating these *pattas* as ownership title.

Thus, the wrong and inappropriate actions by CMDA in allowing conversion of water bodies and issuing *patta* by Revenue authorities, which was in violation of Government orders, had resulted in loss of natural water bodies and blocking of natural flow of water leading to inundation in all these areas.

Recommendation No. 8: We recommend the GoTN to impose ban on conversion of water body land and to evacuate and demolish all illegal constructions in water bodies.

2.4.3 Non-preservation of Open Space and Recreational zone

According to SMP, construction in areas declared as ‘open spaces’ is not allowed. The DR specifies the permissible usage of the O&R zone as below:

“All public and semi-public recreational uses and open spaces, parks and playgrounds, zoological and botanical gardens, nurseries, waterfront developments, museums, necessary installations for the above uses are normally permissible. With the special sanction of the CMDA, theme parks and amusement parks, open air theatres, exhibitions, circuses, fairs and festival grounds, public utilities, burial and burning grounds or crematoria, incidental residential/commercial uses for essential staff required to be maintained in the premises, hotels and restaurants not exceeding 300 sq.m., beach cottages each not exceeding 100 sq.m in floor area and 7.5 metres in height, Sports stadia and recreational complexes can also be allowed. All other uses shall be prohibited”.

Agricultural land and areas along a water course were classified as O&R zone to maintain ecological balance and to preserve water bodies.

As per land use policy of 2006, there was 566 hectare O&R land. SMP had prohibited conversion of O&R land for other uses. It was noticed that during the SMP period from 2009-16, 11 hectare of O&R land were reclassified for residential, commercial and industrial purposes in violation of SMP. We examined all eight cases (11 hectare) of reclassification of O&R zone during 2009-16, for residential/industrial purposes, as detailed in **Appendix 2.3**. CMDA approved reclassification by obtaining a certificate from local bodies that there was no proposal for developing any park and play fields in the site reclassified. We observed that there was no Rule or Government order facilitating this action of CMDA in allowing conversion of O&R land by relying on the certificate from local body. CMDA had unilaterally put this system in place to work in tandem with the local bodies in a manner detrimental to the overall interest of preventing O&R land being allowed to be developed. Thus, the action of CMDA and local bodies in these cases was in violation of the stipulations of SMP.

Since the local bodies failed to develop park and playfields in Government lands classified as O&R zone and also could not acquire private lands classified as O&R zone for park and playfields as per DR, the purpose of earmarking O&R zone was, thus, defeated, affecting the smooth flow of flood water to the sea.

Recommendation No. 9: We recommend that responsibility should be fixed for the lapses in allowing development of O&R zone. We also recommend that the practice of obtaining certificate from local bodies should be stopped and O&R land should not be allowed to be converted.

2.4.4 Non-preservation of Non-Urban zone

SMP had classified low lying areas as non-urban zone wherein, all agriculture uses, burning, burial grounds, crematoria and cemeteries, salt pans, brick works, etc., were permissible with usage of electric motors not exceeding 50 HP. Incidental residential uses were permissible with special sanction of CMDA. All other uses were to be prohibited. SMP also stipulated that conversion of non-urban zone for other purposes may be considered after reviewing the SMP after five years depending on the demand. As per the provisions of the TN Town and Country Planning Act, 1971, the Master Plans are required to be reviewed after every five years, but SMP was not reviewed even after eight years.

We observed that CMDA had approved reclassification of 132 hectare (six cases) from non-urban use zone to residential zone during 2009-16, without reviewing SMP, which was required to be done to assess the quantum of conversion from non-urban zone to other purposes. Scrutiny of three cases revealed that nine hectare of land were reclassified by CMDA, subject to conditions laid down by WRD, stating that there was no bar on DR of SMP to reclassify non-urban land for residential purpose. This presumption of the CMDA was against the stipulations of SMP as brought out above.

Thus, CMDA, without any authority, reclassified 132 hectare of non-urban zone for residential/commercial/industrial purposes in an arbitrary manner against the provisions of SMP. The purpose of zoning an area as non-urban in SMP had become redundant. Allowing development in non-urban zone, being predominantly located in low lying areas along river banks, also contributed to the floods which calls for fixing of responsibility.

2.4.5 Non-preservation of catchment areas

In view of GoTN's decision (1990) to restrict developments to preserve the Redhills catchment area, CMDA resolved (December 1990) (i) to keep all the land classified as Agricultural use zone as it was and not to entertain any request for reclassification in this area (ii) that the Government land in this area to be zoned for O&R use for developing social forestry and (iii) to keep the land classified as Primary Residence and Mixed Residential zone as per the FMP, as they were.

Consequent to the above resolution, CMDA had reclassified land from Institutional, Residential etc., to either agriculture or O&R zones. The SMP had rejected (October 2007) petitions for reclassification of land use in the catchment areas into Residential/Institutional/Industry/Other uses, thus protecting 27 villages in Redhills catchment area.

Despite a decision not to allow development in Redhills catchment area, the land use map showed agricultural land¹¹ and a water body¹² at Pakkam Village as Primary Residential zone and further developments inside the water body were visible in the GIS land use information map.

To an audit enquiry about developments in catchment area, CMDA stated (November 2016) that the lands at Pakkam Village were zoned as Industrial use in SMP and reclassification of land in Morai Village was approved by GoTN as a special case (November 1998) for construction of quarters for Police personnel. The reply of CMDA was not correct as the reclassification of lands in Pakkam Village as industrial zone in SMP was not legal as per the Government policy. This area was erroneously exhibited in SMP. Government has no authority or justification to relax the policy decision of not allowing any development in Redhills catchment area as a special case which would become precedence for future reclassifications.

The purpose of restricted developments in the Redhills and Puzhal Lake catchments areas, which serves as the major source for city water supply to maintain the area free from possible contamination, was defeated.

Thus, non-adherence to land use planning envisaged in SMP and reclassification of land arbitrarily by the CMDA led to loss of water bodies and land with high water holding capacity, thus contributing to flooding in 2015. As such, there is a need to ensure strict adherence to the policy of not allowing developments in catchment area.

2.5 Analysis

The monsoon rains during 2015 were compounded with multiple failures in adopting policies and putting in place suitable plans to mitigate the impact of floods. The State lacked an updated Water Policy to guide plans to minimise the impact of urbanisation on natural waterways. Frequency based flood inundation maps, EAP for dams and basin-wise comprehensive master plans were not in place to respond to challenges posed by heavy rains in an organised and scientific manner. Urban planning lacked legal backing, as the State did not enact the envisaged statute on regulating developments/construction activity in flood plain zone. CMDA, not only repeatedly failed to check large scale constructions along waterways, but also allowed constructions in an unauthorised manner, which choked waterways and altered land uses in the metropolitan area. CMDA's action in allowing conversion of agricultural land without Government's approval, the unauthorised conversion of water body land and non-urban land and the way in which it converted O&R land for various other purposes in connivance with local bodies, indicated the lack of seriousness on the part of CMDA in ensuring planned urbanisation.

¹¹ Survey Nos. 236, 352/4, 5, 429/1 to 13, 14B, 15B, 24A, 25A, 26A, 28 of Morai village

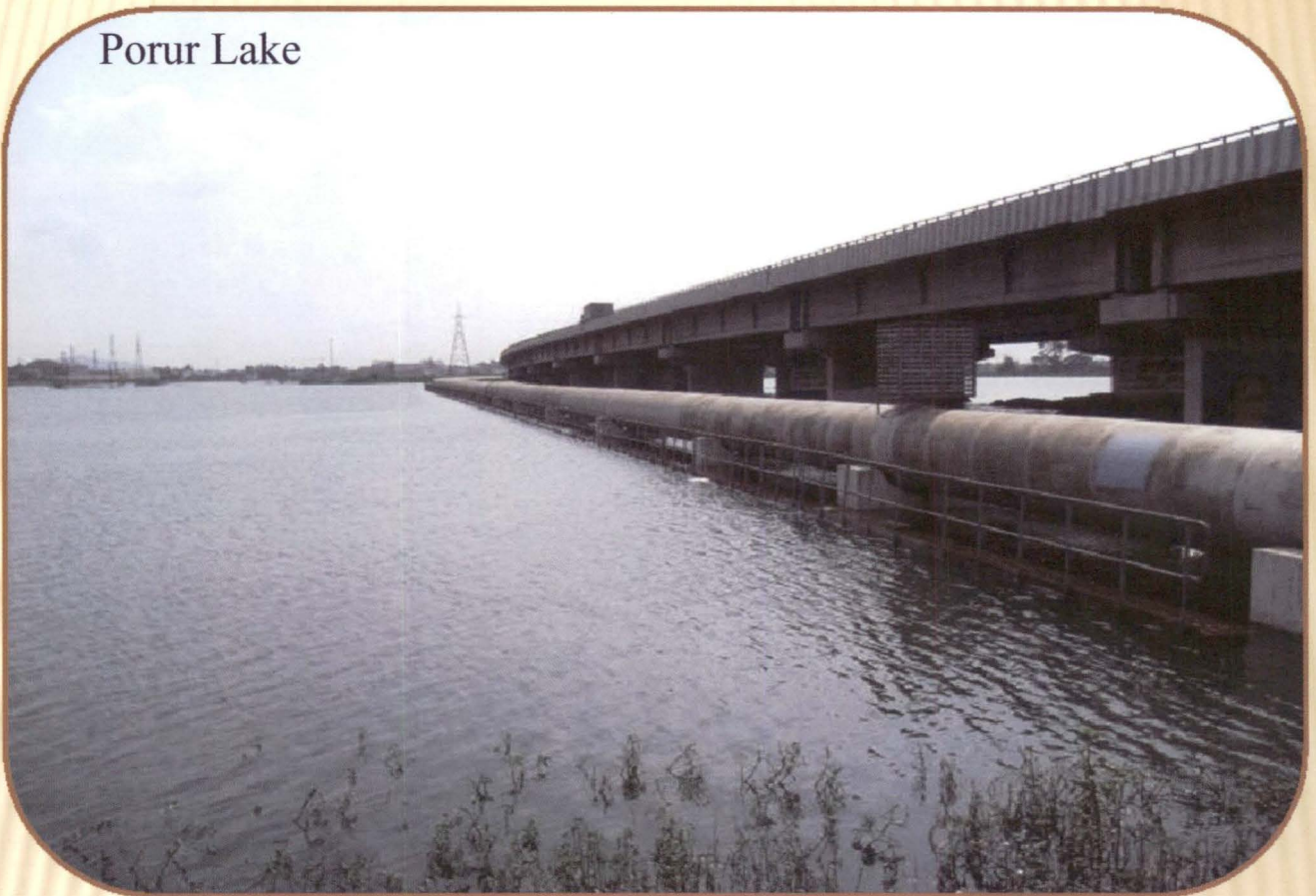
¹² Survey No.851 which is within the water body (Survey No. 850)



CHAPTER III

MANAGEMENT OF WATER BODIES

Porur Lake



CHAPTER III

MANAGEMENT OF WATER BODIES

Management of water bodies is vital for providing quality water for human consumption, along with their important role as flood accommodators by restricting rainwater discharge into sea. Such management includes creation of water storage facilities, maintenance of the length and width of water bodies and keeping water courses free from encroachment and disuse. Neglect of tanks, canals and illegal encroachments played havoc in the management of water bodies, leading to vast amounts of rain water draining into the sea. National Water Policy, 2002 envisaged that water is a scarce and precious national resource to be planned, developed, conserved and managed in an integrated and environmentally sound basis, keeping in view the socio-economic aspects.

3.1 Deficiencies in increase in storage capacity of water bodies

State Water Policy, 1994 envisaged creation of additional storage facilities, restoration of rivers, preservation of existing water bodies and eviction of encroachments as crucial components for flood control. Standard on Operation of Reservoirs (IS 7323:1994), issued by Bureau of Indian Standards, envisaged construction and/or augmentation of water storage facilities of Reservoirs as one of the measures to control floods.

A study conducted (2008-12), with the approval of GoTN, by the Institute of Remote Sensing, Anna University, Chennai, on 'Flood Risk Mapping of Chennai and its suburbs', also recommended for creation of additional storage facilities to moderate floods.

Deficiencies noticed in augmenting storage capacity of reservoirs and preservation of existing water bodies are discussed in succeeding paragraphs:

3.1.1 Failure to create storage capacity of reservoir

Considering the catastrophic floods, in 1976, GoTN constituted (1979) Nucleus Cell in CMDA to suggest flood mitigation measures. The Nucleus Cell recommended (1980) creation of two new reservoirs in the upstream of Chembambakkam Tank, influencing Adyar River, to capture 1.57 Thousand Million Cubic feet (TMC) of water. We noticed that after a delay of eight years, WRD proposed (1987) for creation of a reservoir at Thiruneermalai across Adyar River by which time, the said site had become populated due to which the requisite land was not available. Thus, the WRD failed to construct the reservoir which could have accommodated the surplus water in Adyar River in 2015. The WRD had not made any efforts for construction of a second reservoir.

Instead of creating new reservoirs in the upstream of Chembambakkam Tank, GoTN envisaged (2011-12) creation of three new tanks in the

upstream/downstream of Poondi reservoir, across Kosasthalayar River to augment storage capacity by 4.2 TMC as given in **Table 3.1**.

Table 3.1: Projects proposed for increase of storage capacity

Projects approved	Additional storage capacity in TMC			Expenditure (₹ in crore)	Remarks
	Targeted as per Policy Note	Targeted as per GO	Created upto December 2016		
New reservoir at Thervaikandigai	1.0	1.0	Nil	186.47	Work not completed. Reasons discussed in Paragraph 3.1.2 below
New reservoir at Thirukandalam	1.0	0.26	Nil	28.65	Work completed, but structure breached as detailed in Paragraph 3.1.3 below.
New reservoir at Ramanjeri	1.0	Nil	Nil	Nil	Project was dropped by GoTN.
Deepening of Cholavaram Tank	0.3	0.2	Nil	74.51	Work completed. But full capacity not utilised as detailed in Paragraph 3.1.4(A).
Restoration of six existing tanks*	0.9	0.368	0.17		Failures are brought out in Paragraph 3.1.4(B).
Total	4.20	1.828	0.17	289.63	

* Nemam, Porur, Ayanambakkam, Ambattur, Korattur and Madhavaram
(Source: Policy Note of GoTN for the year 2011-12)

We observed that, against an outlay of ₹ 500.36 crore to increase the storage capacity by 1.83 TMC, an expenditure of ₹ 289.63 crore was incurred upto the end of March 2016 to achieve an increase of only 0.17 TMC. These projects initiated during 2011-12 and scheduled to be completed in 2014-15, with the objective of augmenting drinking water supply and flood control had not been achieved due to various reasons, as discussed in Paragraphs 3.1.2 to 3.1.4 below.

Recommendation No. 10: We recommend Government to create new reservoir in the upstream of Chembarambakkam Tank as recommended by Nucleus Cell and ensure early execution of the sanctioned works on augmentation of reservoir capacity.

3.1.2 Commencement of work before acquisition of land leading to non-completion of reservoir

Para 180 of Tamil Nadu Public Works Department Code stipulates that no work should be started unless the required land has been duly handed over by the responsible civil officer.

Engineer-in-Chief, WRD, submitted (December 2011) proposals based on WRD's tentative design for formation of new reservoir at Thervaikandigai village (including Kannankottai village) at Tiruvallur District. GoTN accorded (January 2012) Administrative Sanction for ₹ 330 crore (including ₹ 160 crore for land acquisition). The reservoir was intended to store one TMC of surplus water per year from Krishna Water Supply Project, besides harnessing water from its own catchment area. The CE, WRD, Chennai

Region, accorded Technical Sanction in August 2012. The work of formation of reservoir involved connecting the two¹ tanks besides acquisition of land. The land requirement was assessed (May and June 2013) after field investigation as 601.28 hectare² which was approved by GoTN in January 2014.

Pending acquisition of land, CE, WRD finalised (July 2013) the tender for ₹ 149.11 crore and awarded (September 2013) the work to the lowest bidder for completion within 24 months from the date of handing over the site. The work was commenced in September 2013.

The department completed (October 2016) acquisition of private lands to an extent of 324.15 hectare out of 601.28 hectare. However, 130.72 hectare of the acquired private land could not be physically taken over due to pendency in determination of quantum of compensation. As of December 2016, the department had spent an amount of ₹ 90.67 crore towards land acquisition (₹ 54.35 crore paid as interim compensation and ₹ 36.32 crore kept in civil deposits). Therefore, though the poramboke lands and forest lands were taken over, the work could not be completed by WRD despite spending an amount of ₹ 95.80 crore on civil works due to not getting possession of private lands. The total expenditure incurred till March 2016 was ₹ 186.47 crore.

Thus, the failure on the part of the GoTN to acquire unencumbered land and the hasty action on the part of the CE to commence the work without ensuring possession of the entire extent of land required for the work, resulted in non-achievement of the objective of increasing the storage capacity of reservoir for which the responsibility may be fixed.

3.1.3 Imprudent decision and faulty design leading to breach of a check dam

GoTN envisaged (2011-12) construction of a storage reservoir at Thirukandalam in Tiruvallur District, across Kosasthalayar River to store one TMC of water. The proposed reservoir was to be located at the downstream of Poondi reservoir and Thamaraiykkam anicut³. As the proposal required acquisition of private land of 1,376.52 hectare in 15 villages, GoTN instructed WRD to revise the project with minimum land acquisition. Accordingly, WRD downsized the project to construct a check dam to store 0.26 TMC instead of the original proposal of constructing a reservoir with a storage capacity of one TMC. We observed that WRD had resorted to construction of check dam instead of a reservoir, in order to avoid land acquisition. GoTN accorded (October 2012) Administrative Approval for construction of check dam for a length of 470 metres at a cost of ₹ 35 crore. CE, Chennai Region, WRD conducted detailed investigation (December 2012) of the site and considering the width of the river at Thirukandalam reduced the length of the check dam (March 2013) to 175 metres, with further reduction in storage

¹ Kannankottai Hissa Rajaneri and Thervaikandigai

² Patta land 324.15 hectare; poramboke land 255.03 hectare and Reserve forest land 22.10 hectare

³ A small concrete structure in the stream to store water

capacity to 0.16 TMC. Accordingly, Technical Sanction was accorded (March 2013) by the CE, restricting the cost to ₹ 32.90 crore. The Technical Sanction envisaged designing the check dam considering the maximum flood discharge of the two upstream reservoirs, viz., Poondi reservoir and Thamaraiakkam anicut.

We further noticed that the structure was designed to withstand a maximum flood discharge of 65,000 cusec⁴, considering 59,725 cusec registered during 1966 floods at Thamaraiakkam check dam. We, however, observed that the WRD had failed to take into account the discharge of 92,260 cusec registered at Poondi reservoir in 1966.

The work was awarded (July 2013) to a contractor for ₹ 28.19 crore for completion in 18 months. The work, commenced in July 2013, was completed in September 2014 at a cost of ₹ 28.65 crore.

Scrutiny of the records revealed that during the floods in 2015, the left side retaining wall of the check dam breached due to inflow of 79,564 cusec; left side of main structure distorted and body wall for a length of 38 metres of the check dam had sunk. WRD proposed (March 2017) to reconstruct the damaged check dam with revised design to accommodate maximum discharge capacity of 90,000 cusec at an estimated cost of ₹ nine crore.

Thus, we observed as under:

- Though WRD had submitted a proposal for construction of one TMC reservoir keeping in view the water potential, to prevent flooding, harness excess flood water and cater to drinking water needs, yet the GoTN advised the WRD to construct check dam by reducing the storage capacity to 0.16 TMC with minimum land acquisition to avoid acquisition of private land of 1,376.52 hectare in 15 villages for construction of reservoir.
- The imprudent decision of the GoTN to reduce the storage capacity to 0.16 TMC just to avoid land acquisition, which was indicative of abdication of its responsibility, which resulted in failure to harness excess flood water to cater to the future requirements as envisaged by WRD.
- Incorrect adoption of flood discharge capacity for construction of the check dam resulted in its breach during 2015 floods thereby causing inundation of nearby areas.

Recommendation No. 11: We recommend the GoTN to institute investigation into the faulty design of check dam for fixing responsibility and ensure completion of reconstruction work without delays.

⁴ Cubic feet per second

3.1.4 Increase in capacity of existing tanks

(A) Cholavaram Tank

GoTN accorded (September 2010) Administrative Sanction for strengthening of Cholavaram Tank and Chief Engineer, WRD Chennai Region, accorded (June 2012) Technical Sanction for ₹ 7.96 crore. The work was awarded (April 2013) to a contractor and completed (July 2015) at a cost of ₹ 7.58 crore.

We noticed that despite execution of works of strengthening the tank and increasing the capacity to store 1.08 TMC, WRD failed to maintain water to the increased capacity of the tank. Reasons for not maintaining water to its increased capacity were not available on record. The highest storage reached was only 0.91 TMC for 12 hours on 3 December 2015 and the average storage was only 0.73 TMC during December 2015 as against the available increased capacity to store 1.08 TMC of water.

We further observed that well before the tank could reach its full capacity, WRD released 400 cusec of water during December 2015 to the already overflowing Redhills Tank which resulted in inundation of residential areas in the downstream, viz., Balaji Nagar, Thiruneelakanda Nagar, Baba Nagar, Burma Nagar and Manali.

Thus, failure of the CE, WRD to ensure full utilisation of the increased storage capacity of the tank and consequent discharge of flood water prematurely had contributed to inundation of residential areas in the December 2015 floods. We observed that the expenditure of ₹ 8.01 crore incurred on increasing the storage capacity of Cholavaram Tank remained largely unfruitful.

On being asked, Government replied (March 2017) that the objective was achieved as the capacity of the tank was increased to 1.08 TMC. The reply was not relevant as the increased capacity to store water upto 1.08 TMC was not fully utilised. Moreover, 400 cusec of water was released without utilising the available increased capacity to store water upto 1.08 TMC. We observed that increasing the capacity was of no use as the increased storage capacity was not utilised despite specifically spending an amount of ₹ 8.01 crore.

(B) Nemam, Porur and Ayanambakkam Tanks

Nemam Tank (capacity of 0.257 TMC) in the upstream of Chembarambakkam Tank and Porur Tank (capacity 0.046 TMC) in its downstream influence the flow in the Adyar River. Ayanambakkam Tank (capacity 0.290 TMC) influence the flow in Cooum River.

WRD proposed (August and October 2011) to renovate these three tanks by desilting, deepening through excavation of earth, and by rehabilitation of the bund. It was also proposed to construct a new surplus water regulatory arrangement for Nemam Tank and for restoration of flood carrying capacity of the surplus course.

GoTN accorded (December 2011) Administrative Sanction for renovation of these three tanks at a cost of ₹ 129.50 crore. GoTN also directed WRD to identify the selling option for the earth excavated by following the prescribed procedure for realisation of revenue to Government. CE, Chennai Region, WRD accorded (December 2011) Technical Sanction for these three works at a cost of ₹ 129.50 crore. The work was awarded (December 2012) to three contractors for execution within 18 months from the date of handing over of the site. The sites for the work were handed over in January 2013.

As stipulated by the Tender Approval Committee, the contractors and the Superintending Engineer concerned furnished joint declaration to the effect that they had inspected the site and ensured the accuracy of the quantity of the earth available for excavation. The agreements also stipulated for payment of the departmental rate of ₹ 102.98 crore⁵ for the disposal of the excavated earth by the contractors and no payments need to be made for the earth utilised for strengthening the bunds of the tanks.

The details of the additional capacity envisaged, work proposed and executed have been shown in **Table 3.2**.

Table 3.2: Details of augmentation works in three tanks

Particulars	Nemam	Porur	Ayanam-bakkam
(1)	(2)	(3)	(4)
Existing capacity of the tank (TMC)	0.257	0.046	0.290
Additional capacity envisaged (TMC)	0.320 ⁶	0.024	0.024
Civil Works			
Percentage of civil works completed till March 2016	34	90	96
Value of work done (₹ in crore)	18.52	13.91	24.27
Earth excavation work			
Proposed quantity of earth excavation (in lakh M ³) for bund strengthening and for disposal through sale	3.48 + 114.37 =117.85	2.75 + 12.48 =15.23	2.19 + 1.89 =4.08
Quantity of earth actually excavated (in lakh M ³)	3.31+9.61=12.92	2.73 +1.06 =3.79	2.15+1.0 =3.15
Percentage of excavation of earth completed and utilised for formation of bund	95	99	98
Percentage of excavation completed for sale of earth by contractors	8	8	53
Overall percentage of excavation of earth	11	25	77
Increased capacity achieved with reference to the overall percentage of excavation of earth (in TMC)	0.0216	0.006	0.0185

(Source : WRD)

⁵ Departmental rate realisable as per agreement for Nemam Tank - ₹ 91.49 crore; Porur - ₹ 9.98 crore and Ayanambakkam - ₹ 1.51 crore

⁶ Adding 0.196 TMC by deepening the tank and 0.124 TMC by construction of new regulatory arrangement, which was achieved in full.

As may be seen from the above table,

- Though 128.74 lakh M³ of earth was required to be excavated for sale in the three tanks, only 11.67 lakh M³ (nine *per cent*) was excavated and a revenue of ₹ 11.48 crore⁷ was realised. Thus, the non-excavation of the agreed quantity of earth from the tanks resulted in non-achievement of objective of enhancement of capacity of tanks for harnessing flood water to an extent of 23 to 89 *per cent*. Short achievement of the envisaged objective resulted in discharge of flood waters to the nearby areas causing inundation.
- The works were proposed to augment the storage capacity of the three tanks by 0.368 TMC. But, the actual achievement was only 0.170 TMC (46 *per cent*) despite incurring an expenditure of ₹ 74.04 crore against the estimate of ₹ 129.50 crore for the work.
- In respect of the Nemam Tank with the lowest achievement, only 34 *per cent* of civil works, such as flood wall, regulator, etc., which formed part of the surplus course was completed at a cost of ₹ 6.71 crore due to non-completion of land acquisition. This led to overflow of water over the surplus course and inundation in the nearby areas during December 2015 floods.

Thus, the works proposed to augment the storage capacity of the three tanks in Chennai and its suburban areas by harnessing the rain waters were ill-conceived due to wrong feasibility study for earth excavation, leading to non-achievement of the envisaged objective of increase of storage capacity of water and to take care of flooding in the area despite spending an amount of ₹ 74.04 crore.

Government stated (March 2017) in reply that the civil works in Nemam Tank would be completed after acquisition of land. In respect of non-excavation of earth by contractors for sale, Government replied that the estimation of the quantity of earth in the estimates were arrived on the basis of arithmetical calculations due to presence of water in the tanks and hence the entire quantity could not be excavated.

The reply was misleading as the quantity of earth to be excavated was calculated and certified by both the Contractors and the Superintending Engineer after doing joint survey and confirmed by both of them while signing the agreement of the work. Moreover, no action had been taken against the contractor for leaving the work incomplete in violation of the terms and conditions of the agreement.

⁷ Departmental rate realised for Nemam Tank - ₹ 8.28 crore; Porur Tank - ₹ 2.40 crore and Ayanambakkam Tank - ₹ 0.80 crore

3.2 Non-implementation of project for restoration and protection of lakes

As per Tamil Nadu Protection of Tanks and Eviction of Encroachment Act, 2007, Pallavaram Lake and Kilkattalai Lake in the suburban area of Chennai having a total storage capacity of 0.310 TMC were under the control of WRD, who was responsible for maintenance of these lakes. The Pallavapuram Municipality initiated (June 2014) a proposal to restore and protect the two lakes and GoTN accorded (January 2015) administrative sanction for ₹ 22.02 crore for the said work.

Since the creation and maintenance of lakes falls under the jurisdiction of WRD, the municipality was not competent to take up the work owing to which the EE, WRD objected to the proposal of the municipality and insisted (January 2016) on implementation of the project through WRD as Deposit Work. Due to the dispute between WRD and the local body, the project could not be commenced. Subsequently, the local public took the neglected condition of the lakes to the National Green Tribunal, which intervened and ordered (September 2016) WRD to take up the work. The work was yet to be started (January 2017).

We observed that, the WRD had failed to undertake routine maintenance of these two lakes which had led to abandoning of the lakes, besides non-utilisation of water storage of 0.310 TMC for flood mitigation and cater to drinking water needs. Further scrutiny of records revealed that during the floods in December 2015, the two lakes had breached and flooded the neighbourhood.

The laxity on the part of WRD to execute the work in time calls for fixing of responsibility.

3.3 Incomplete river restoration works

The three east flowing rivers in the CMA viz., Adyar, Cooum and Kosasthalayar are the natural waterways draining into Bay of Bengal. Free flow of flood waters in these rivers is crucial for flood control. Failure to desilt these rivers and encroachment on river banks, which contributed to the floods of 2015 are discussed in the succeeding paragraphs. The lapses on the part of various agencies concerned are discussed below:

3.3.1 Deficiencies in eco-restoration of Adyar River

GoTN established (2006) Adyar Poonga, a special purpose vehicle, for development of eco-park in 23.48 hectare in Adyar River. Adyar Poonga was renamed as Chennai Rivers Restoration Trust (CRRT) in 2010, with an extended mandate to develop, maintain and conserve eco-parks in Chennai and any other places of Tamil Nadu to preserve ecological and natural resources such as waterways and water bodies.

CRRT prepared (2010) a DPR for restoration of 121.46 hectare of Adyar River in Adyar estuary and creek⁸ (**Exhibit 3.1**).

Exhibit 3.1: Project area of eco-restoration of Adyar Creek



(Source: Website of Chennai Rivers Restoration Trust)

GoTN accorded (December 2010) administrative approval for the project at an estimated cost of ₹ 18.93 crore and subsequently, revised (March 2013) it to ₹ 24.93 crore due to change in the scope of work. The restoration works included capital dredging⁹ at the river creek and mouth to manage flood discharge. It was also envisaged that dredging at mouth of river at 400 metres wide and 1.5 metres deep below Mean Sea Level would keep the river mouth open.

Coastal Regulatory Authority, Ministry of Environment and Forests, GoI, while approving the above project, restrained CRRT from dredging the river mouth till all the sewage outfalls identified by Chennai Water Supply and Sewerage Board (CMWSSB) were plugged. CMWSSB proposed (July 2012 and December 2014) to plug all the 49 outfalls in a phased manner with State funds. The works were started in phases in January 2014 and September 2015. As of November 2016, though civil works relating to 31 outfalls were executed by laying sewer lines, the outfalls were not plugged as the sewage source was not yet connected to the newly laid sewer lines. Remaining 18 works were still under progress; 14 of them had overshoot the original target date by 10 months. The expenditure incurred on the project till September 2016 was ₹ 16.06 crore.

Thus, the failure of CMWSSB to connect sewage source to sewer lines, as planned, had resulted in delay in plugging the outfalls. Ultimately, the

⁸ A narrow area of water that flows into the land from the sea, a lake etc.

⁹ Deepening the bed of river by removing accumulated sand

dredging works in the mouth of Adyar River were not started even as of November 2016, defeating the objective of smooth discharge of flood water. Non-opening of Adyar River mouth prevented free flow of water to the sea and the resultant flood in Adyar basin during 2015.

3.3.2 Deficiencies in eco-restoration of Cooum River

During 2000-01, GoI formulated the Chennai City River Conservation Project (CCRCP) with an objective to prevent sewage entering into waterways, augment the treatment capacity of sewage treatment plants (STP) and to keep the city waterways clean on sustainable basis. Under the project, CMWSSB carried out the works relating to laying of interceptor sewerage lines along Cooum River to intercept and divert all untreated sewage entering the river. The scope of the works involved laying of sewage pumping mains and construction of four STPs at a cost of ₹ 382.24 crore during 2001-06. C&AG's Audit Report on GoTN (Civil), 2006, pointed out non-removal of sand bars and failure to carryout measures to keep the river mouth open on sustainable manner. WRD, however, had not taken any measures in that direction.

After a delay of five years, GoTN directed (2011) CRRT to prepare a DPR for restoration of Cooum River. The consultant engaged (2012) by CRRT submitted the DPR in November 2014 and GoTN accorded (January 2015) administrative sanction for implementation of Integrated Cooum River Eco-restoration Project at a cost of ₹ 604.77 crore by various agencies. The objective of the project was to improve and maintain flood carrying capacity by dredging the river mouth and to abate pollution by intercepting sewage outfalls. The project is scheduled to be completed in 2018.

(A) One major component of the project was to improve the river channel through dredging from its mouth to Chetpet bridge. As the work site was in coastal zone, it was mandatory to obtain clearance from Coastal Regulatory Authority. Though the project was approved in January 2015, we noticed that Chennai Rivers Restoration Trust (CRRT) applied for clearance from Coastal Regulatory Authority only in February 2016, after a delay of 13 months, mainly due to administrative delays. CRRT's application (February 2016) for clearance was pending with Coastal Regulatory Authority (December 2016). As per CRRT's DPR, there were 118 sewage outfalls into the river. The study report of Public Affairs Committee, Bengaluru, highlighted that Cooum River was spoilt by filth and pollution and the water quality was considered to be highly toxic. In order to improve the water quality, CMWSSB planned (June 2016) for laying interceptor lines to divert sewage. The work was planned by CMWSSB in 10 packages covering a length of 10.51 km. We noticed abnormal delay in executing these works as discussed hereunder:

- four works were not taken up for want of Coastal Regulation Zone clearance and the issue was under correspondence with Coastal Regulatory Authority,
- two works were not taken up due to lack of response for repeated tender calls,

- two works were not taken up as CRRT declined to release funds as there was no progress in works and CMWSSB required funds to pay mobilisation advance to contractor to commence the work, and
- two other works were not taken up due to delay in eviction of encroachments by Tamil Nadu Slum Clearance Board (TNSCB).

(B) Under the project, TNSCB was responsible for resettlement of 14,257 slum families and 458 vendors enumerated along the banks of Cooum River. GoTN approved (January 2015) an outlay of ₹ 181.85 crore to CRRT for resettling the slum families. CRRT was to release funds to TNSCB based on progress in work. The expenditure included shifting allowance, subsistence allowance, EB service connection charges, community development programme, land cost, etc. TNSCB sought (October 2016) ₹ 181.85 crore from CRRT for eviction of slum dwellers. CRRT, however, did not release any funds to TNSCB till November 2016, citing lack of progress in the preliminary works for resettlement of slum dwellers. This indicated lack of coordination between CRRT and TNSCB on how to go about with eviction.

Thus, due to lack of planning, the project was taken up after delay of five years. Further, the slackness in execution of works on plugging of sewage outfalls and resettlement of slum families, had resulted in slow progress of the project to restore Cooum River. We observed that completion of the project by 2018, as per schedule, would not be possible.

3.4 Analysis

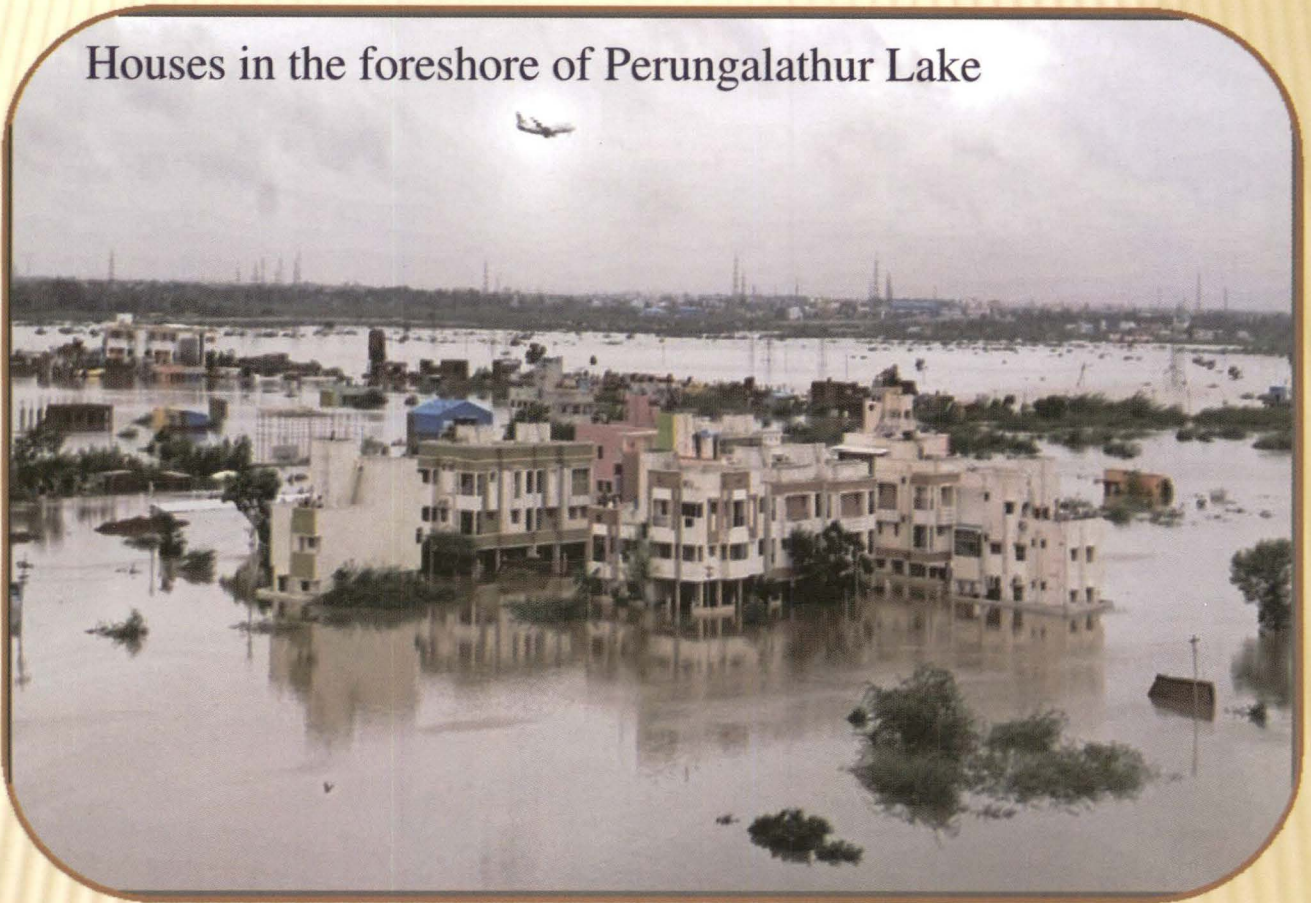
Three rivers and several *nullahs* criss-crossed the city's length and breadth. But, siltation and unplanned construction and encroachments impacted their flood carrying capacities. Projects to restore and increase the storage capacities of the tanks and reservoirs suffered setbacks due to faulty planning and lack of co-ordination between various Government agencies.



CHAPTER IV

ENCROACHMENTS

Houses in the foreshore of Perungalathur Lake



CHAPTER IV

APPENDICES

CHAPTER IV

ENCROACHMENTS

The Tamil Nadu Land Encroachment Act, 1905, envisaged continuous monitoring of occupation of Government lands to identify encroachments. As per the Act, encroachment of rivers, streams, *nullah*, lakes, tanks, canals, roads, parks, and all other Government lands including land held by Central and State Government Departments and Local Bodies is totally prohibited. Besides this Act, the Tamil Nadu Protection of Tanks and Eviction of Encroachment Act, 2007 was enacted to protect the tanks under the control of WRD, and to evict the encroachers occupying such land illegally.

Issues such as lack of timely action in preventing encroachment, failures on the part of public authorities to clear illegal encroachments and local bodies which contribute to blocking of waterways are discussed in this chapter.

4.1 Encroachments contributing to the floods

SWP, 1994 emphasised the need to maximise the benefits from the available water resources by removal and prevention of encroachment in water courses and water bodies. GoTN instructed (August 2011) the Regional Chief Engineers of the WRD to take stringent action to evict encroachment of WRD land with the help of police authorities.

An audit comment was made in the Report of C&AG (Civil Audit), GoTN for the year 2005-06, on non-restoration of storage capacity of 525 irrigation tanks. We had pointed out that 40 *per cent* of the test checked tanks were encroached, leading to floods in Cooum and Adyar River during November 2005. The Public Accounts Committee (PAC) of Tamil Nadu Legislature had instructed (June 2014) the GoTN to undertake effective action on restoration of storage capacity of the tanks. Again, in the Audit Report for the year ended March 2013, we had pointed out that 43 *per cent* of the sampled tanks were encroached, indicating ineffective enforcement of the Act for eviction of encroachment.

We noticed that despite highlighting the spate of encroachments in successive Audit Reports, the encroachments were still continuing to pose a grave threat due to inaction of GoTN in removing encroachments. As of October 2016, the percentage of tanks encroached went up to 69, as discussed in **Paragraph 4.2** below.

At a macro level, we noticed that as of 31 March 2016, there were 7,83,767 documented encroachments illegally occupying Government land of 79,649 hectare in the State. The Ministry of Water Resources, GoI, in its submission to the Parliamentary Standing Committee on Home Affairs, stated (August 2016) that encroachment of lakes and river beds played a major role in causing the massive floods in Chennai.

Despite these provisions of the Act and comments in the earlier Audit Reports, efforts made by GoTN and PWD in prevention, identification and eviction of encroachments in the water bodies were not effective as detailed in the succeeding paragraphs.

4.2 Encroachment in tanks

(A) The Tamil Nadu Protection of Tanks and Eviction of Encroachment Act, 2007 was enacted to protect the tanks under the control of WRD and for checking the encroachments besides early eviction of the same. The Act also provided for conduct of survey of the tanks in the State by the Officer nominated by the Revenue Department to determine their limits, demarcate boundaries and initiate action for eviction of encroachment in co-ordination with Revenue Department and police authorities.

The details of the total tanks, tanks surveyed, encroachments identified and evicted in the three districts of Chennai and its suburbs are as detailed in **Table 4.1**.

Table 4.1: Survey of encroachment in tanks

Period	Total tanks under WRD	No. of tanks surveyed	No. of tanks for which boundaries fixed	No. of encroachments identified	No. of encroachments evicted	No. of tanks restored
Up to 31.03.2013	1,540	296	215	16,546	10,083	170
2013-2014	1,540	0	0	0	0	0
2014-2015	1,554	214	222	200	100	0
2015-2016	1,554	41	90	19,168	576	0
Total	1,554	551	527	36,814	10,764	170

(Source: Details furnished by the WRD)

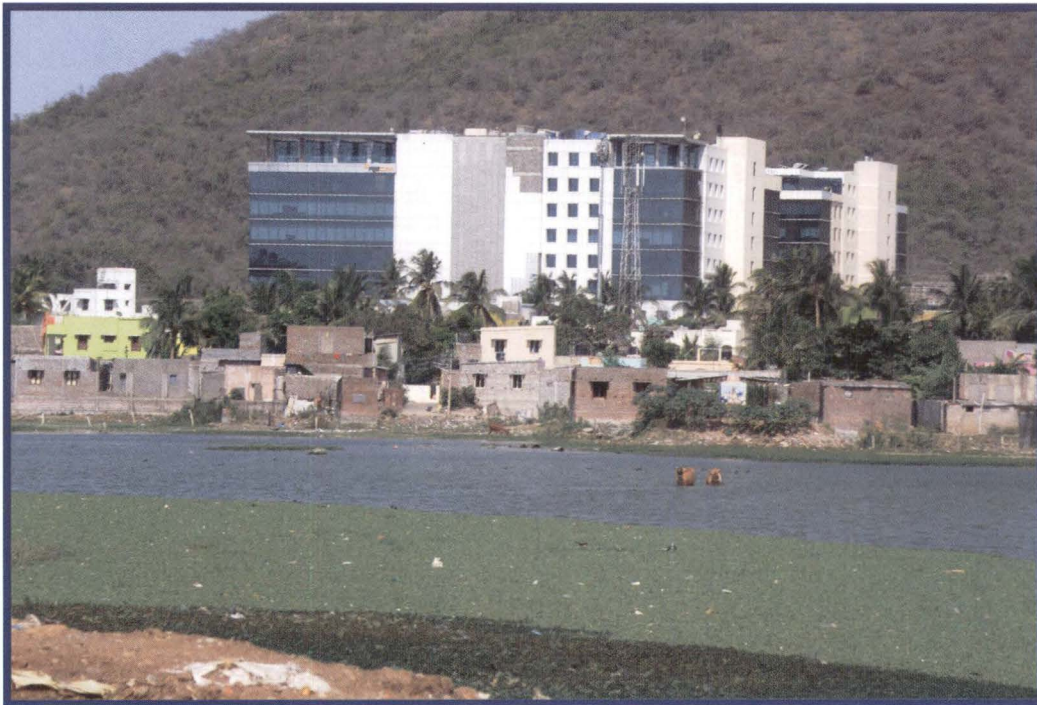
As could be seen from the table,

- Department could complete survey of only 551 out of 1,554 tanks (35 *per cent*) after the enactment of the Tamil Nadu Protection of Tanks and Eviction of Encroachment Act, 2007. The fixing of boundaries of all these surveyed 551 tanks could not be completed.
- Though, 36,814 encroachments were identified till March 2016, only 10,764 of the identified encroachment (30 *per cent*) were evicted and only 170 tanks were restored to their original capacity, leaving the remaining 381 tanks (69 *per cent*) yet to be restored. No tanks were restored during the period 2013-14 to 2015-16.

- Department failed to conduct any survey to identify encroachments and take action to evict encroachments during the year 2013-14 indicating lack of action for removal of encroachments.

(B) Field visit to Perungalathur Big Tank (**Exhibit 4.1**) in Kancheepuram District and scrutiny of relevant records revealed that 279 encroachers had encroached 4.36 hectare of water spread area. WRD replied (October 2016) that efforts were being made for identification and removal of encroachment in coordination with line departments and agencies like Revenue Department, Police Department, Tamil Nadu Slum Clearance Board, etc.

Exhibit 4.1: Encroachment in Perungalathur Big Tank



(Source: Photo taken by Audit team during Joint Inspection)

Thus, despite availability of strong statutory backing and the matter being pointed out in the earlier Audit Reports, majority of encroachments in water bodies continued to thrive without eviction, even after lapse of nine years from the enactment of the Act resulting in non-achievement of objective of preservation of water bodies besides contributing to flooding in Chennai and its suburban areas during December 2015.

Recommendation No. 12: We recommend framing stringent laws to fix responsibility on the officials responsible for non-enforcement of the provisions of the TN Tank Protection and Eviction of Encroachment Act in identifying and eviction of encroachments of any nature.

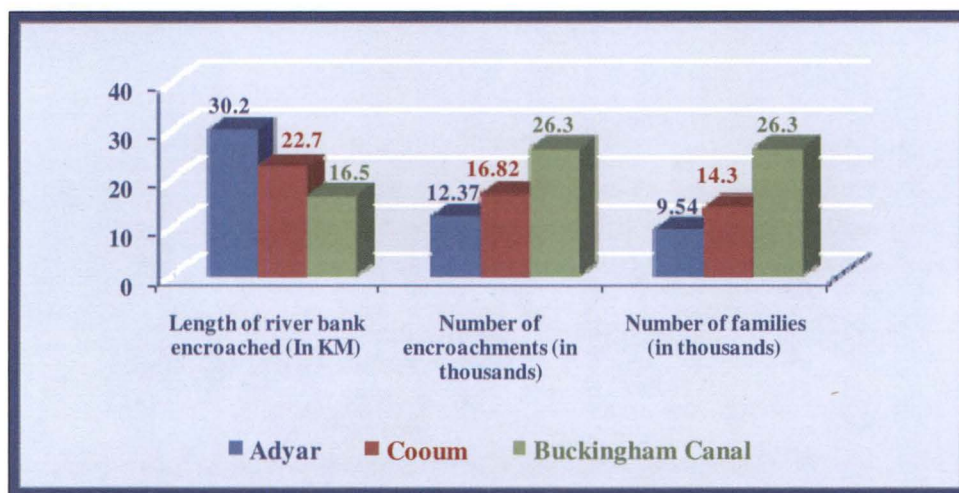
4.3 Encroachment of rivers

Though it is a bounden duty of the Revenue Authorities to protect Government land from encroachments, every year, before monsoon, the Commissioner of

Revenue Administration issues a circular with a checklist to all District Collectors, *inter alia*, directing them to remove all encroachments along water bodies. Despite having statutory powers and clear knowledge and directions on the issue, the Revenue Authorities and WRD had continued to tacitly allow encroachments and failed to remove encroachments.

The details of encroachments in the Adyar, Cooum Rivers and Buckingham Canal available in Chennai and suburban areas, number of encroachment and slum families living on encroached land as of December 2015 are given below:

Chart 4.1: Encroachment along rivers

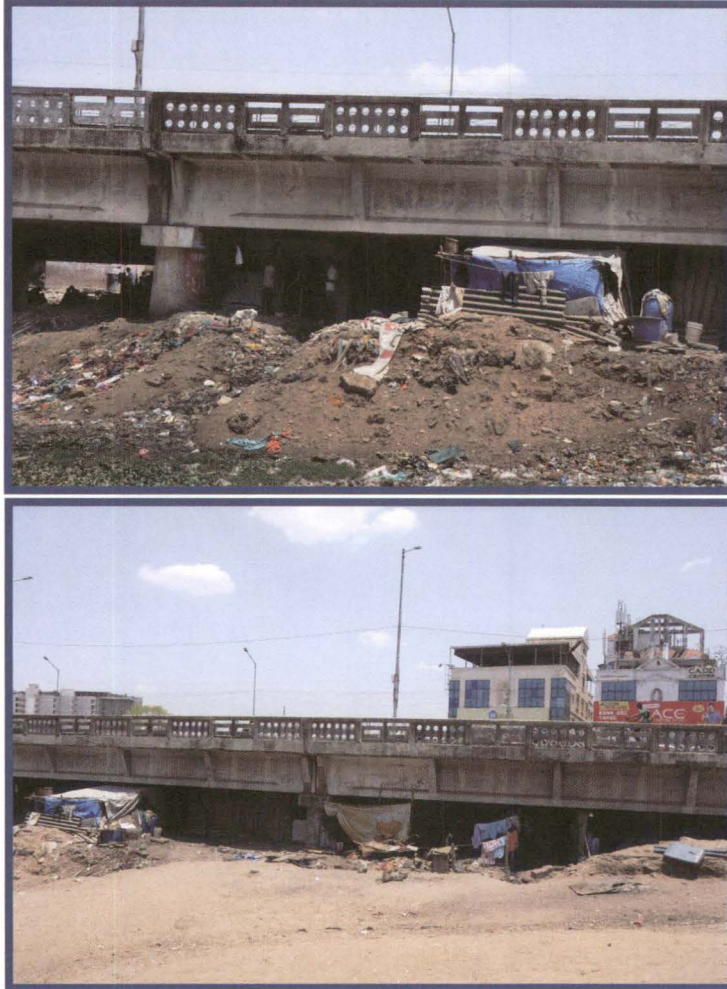


(Source: Data furnished by Tamil Nadu Slum Clearance Board)

As may be seen from the above, either side of Adyar River bank was encroached to an extent of 30.2 out of 85 km (36 per cent) by 9,539 families. Absence of effective action in eviction of these encroachments resulted in obstruction of the flow of flood water in the Adyar River which caused inundation in the adjoining areas. During Joint Inspection (October 2016) of Accountant General's (E&RSA) Team along with officials of WRD, CE, WRD admitted that at the time of December 2015 floods, 9 out of 12 vents¹ under Maraimalai Adigalar Bridge across the Adyar River at Saidapet were encroached leading to overflowing of the river at Saidapet. We observed during the Joint Inspection that 5 out of these 12 vents were continued to be encroached (**Exhibit 4.2**) by slum dwellers indicating absence of effective steps in removal of encroachments despite huge loss to life and property in the catastrophic floods.

¹ Openings under the bridges which permit flow of water in the river

Exhibit 4.2: Encroachments in Maraimalai Adigalar bridge (with blocked vents)



(Source: Photo taken by Audit team during Joint Inspection)

- Along Cooum River, out of the total length of 80 km of the banks, 22.7 km (28 per cent) was encroached by 14,257 slum families and others. We conducted a joint inspection of river bank along with officials of the line departments and found that the slum encroachment along the bund of the river (**Exhibit 4.3**) had reduced the width of its carrying capacity.

Exhibit 4.3: Encroachment along Cooum River



Blocked vent and sewage outfall (Langs Garden)

(Source: Photo taken by Audit team during Joint Inspection)

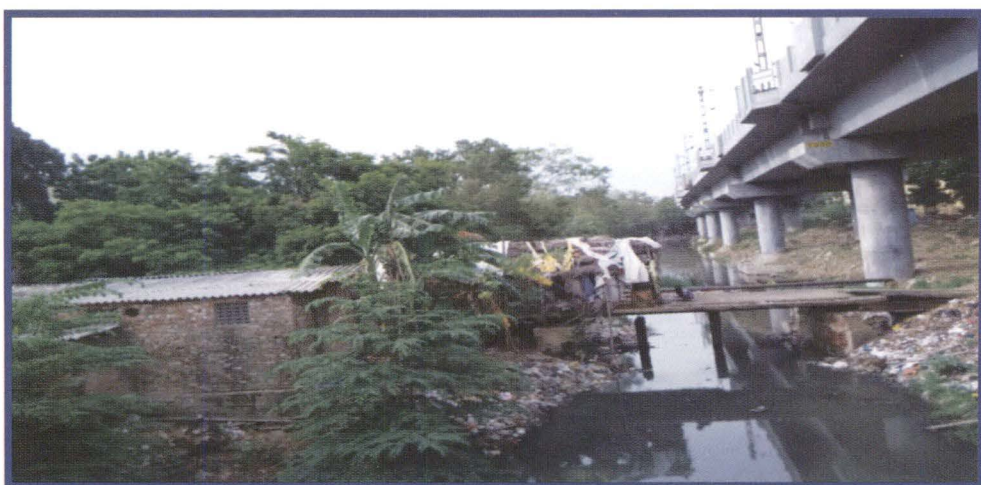


Encroachment and sewage outfall (Pallavan Nagar)

(Source: Photo taken by Audit team during Joint Inspection)

- Seventeen *per cent* of the banks of Buckingham Canal (16.5 out of 96 km) was encroached by 26,300 families. Joint site inspection of central Buckingham Canal by the Audit team with the departmental officials revealed that encroachers were provided with electricity connection, proper roads, common water supply and ration cards indicating tacit support of the GoTN in helping encroachments. It was also noticed that the sanctioned flood protection works in Buckingham Canal could not be carried out due to existence of encroachments (**Exhibit 4.4**) to an extent of about three km.

Exhibit 4.4: Encroachment in Buckingham Canal



(Source: Photo taken by Audit team during Joint Inspection)

Thus, the encroachment in the rivers and canals had contributed to flooding in slums and also the adjoining areas of the test checked zones of Adyar, Alandur, Ambattur, Kodambakkam and Perungudi. The District Collector,

Chennai (July 2016) stated that encroachment to an extent of 58.58 hectare in Adyar River at various reaches, which contributed to the floods of 2015, were identified subsequent to the floods and boundaries were fixed for 39.28 hectare, leaving boundaries to be defined for 19.30 hectare.

WRD stated (August 2016) that 4,134 families encroaching the banks of Adyar River were evicted through a special drive after the floods of December 2015. The number of families evicted was 43 *per cent* of the encroachments along Adyar River. But, only 397 families encroaching Cooum River were evicted through special drive after the floods, which was negligible in comparison with the total of 14,257 families encroaching the margins of Cooum River.

Chief Engineer, WRD, in the exit conference, expressed that the Department did not possess independent powers for eviction of encroachments in rivers as the Tamil Nadu Protection of Tanks and Eviction of Encroachment Act 2007 did not include rivers. The reply was not acceptable as the Department failed to comply with the instructions of the Government and efforts for demarcation of boundaries and eviction of encroachments could have been made in co-ordination with the Revenue Department.

Recommendation No. 13: We recommend strict enforcement of the TN Land Encroachment Act, 1905 to prevent encroachment and to evict encroachments already taken place.

4.4 Encroachment of water bodies by local bodies

Scrutiny of records in the test checked Municipalities and Town Panchayats revealed that the local bodies had encroached the water bodies, for construction of permanent structures and also as dumping yard, as discussed hereunder:

(i) Peerkankaranai Town Panchayat requested (2004) the District Collector for assigning land for Solid Waste Management (SWM) facility. Without waiting for assignment of land by the District Collector, the Town Panchayat established (July 2005) the SWM facility in a 0.20 hectare plot inside Peerkankaranai Lake (**Exhibit 4.5**). Despite objection on environmental concern by the TN Pollution Control Board, the Town Panchayat constructed (July 2013) a compound wall at a cost of ₹ 20.84 lakh. In reply, GoTN stated (May 2017) that the District Collector had allotted (August 2016) an alternative land for construction of SWM facility and the unit will be shifted soon. We observed that WRD, which is responsible for maintenance of this tank failed in its mandated duties to prevent the Town Panchayat from the callous action of encroaching the water body for solid waste disposal. The failure of District Collector, who took 12 years to identify and assign a suitable land for the SWM facility, also contributed to the degradation of the lake.

Exhibit 4.5: SWM facility inside Peerkankaranai Lake



(Source: Photo taken by Audit team during Joint Inspection)

(ii) Sembakkam Municipality constructed (2006) a compost yard in Sembakkam Lake encroaching an area of 300 square metre. Though SWM activities were discontinued in September 2015, the site still remained encroached (November 2016). Government stated (April 2017) that clearing the dumped garbage from the banks of lake would be taken up under Swachh Bharat Mission component for which administrative approval had been accorded for ₹ 163 lakh.

(iii) Pallavapuram Municipality utilised 40.49 hectare in Pallavaram Big Lake as a dumping yard till June 2015. Even though the SWM activities were discontinued, the damage caused to the lake had not been restored (November 2016). Government stated (April 2017) that the dumped garbage would be disposed by scientific closure method.

We observed that these encroachments of water bodies had reduced the capacity of Peerkankaranai, Sembakkam and Pallavaram Lakes to store water, thereby contributing to inundation in the adjacent areas.

4.4.1 Illegal constructions in water bodies in suburban areas

WRD and local bodies are the custodians of water bodies. Revenue Department is the custodian of Government land and has the power and responsibility to check encroachment of Government land.

Scrutiny of records of Peerkankaranai and Thiruneermalai Town Panchayats and joint inspections revealed that there were encroachments in the water bodies as discussed below:

- (a) A colony was developed by Tamil Nadu Slum Clearance Board (TNSCB) to accommodate the slum dwellers from other parts of the city in the Peerkankaranai Chitheri. The Revenue authorities had alienated water body to TNSCB to construct tenements. As per the provisions of the Revenue Standing Orders, in areas where agriculture had ceased to be practiced and the irrigation tanks serving them were under disuse, Revenue Authorities were empowered to hand over the tank bed land for construction activities. We observed that this

provision, granting legitimacy to urbanise tank beds contributed to the shrinkage of water bodies in CMA and contributed to the floods of 2015. We found the above provision was against the stipulations of SMP, according to which construction activities have been prohibited in water bodies.

- (b) Two illegal colonies had encroached upon the tanks viz., Veeraraghavan Eri, Periya Eri and Chitheri in Thiruneermalai Town Panchayat. The local body had provided infrastructure facilities such as roads, lighting and water supply in all the above illegal colonies indicating that the Government agencies were also involved in encouraging illegal colonies and they were working against the declared policy, statutes and instructions according to which illegal colonies and encroachments should not be allowed to exist in the State.
- (c) Four illegal colonies had encroached upon a stream in Perungalathur village for 1.40 hectare.
- (d) Illegal houses had encroached upon an area of a lake in Varadarajapuram village to the extent of 2.40 hectare.
- (e) Five illegal colonies had encroached upon water bodies (Adyar River, Odai and bund) in Anakaputhur village to the extent of 6.03 hectare.

To an audit enquiry, the Executive Officer, Peerkankaranai Town Panchayat replied that as occupants of all illegal colonies inside water bodies in the Town Panchayat were issued with Patta by Revenue Authorities, taxes were collected and basic amenities like roads, street lights and water supply were provided. The Executive Officer, Thiruneermalai Town Panchayat replied (July 2016) that, since these developments were not covered by Patta from the Revenue Department, property tax was not collected for these buildings. He further stated that other amenities such as roads, street lights and water supply were provided in all the areas including areas covered under water body.

Thus, we observed that in these cases of illegal colonies in water bodies, WRD, local bodies and Revenue authorities had failed to prevent the encroachments. Further, the Revenue Authorities and GoTN, applied the provisions of Revenue Standing Orders, with impunity, on disposal of tank bed land of unused irrigation tanks. The RSO being in violation of the provisions of the TN Tank Protection and Eviction of Encroachment Act, 2007, allowed constructions in water bodies thereby endangering the life and property of the people during floods which are being faced frequently in the city, the ill effects of which have been witnessed in the recent floods in 2015 by the State.

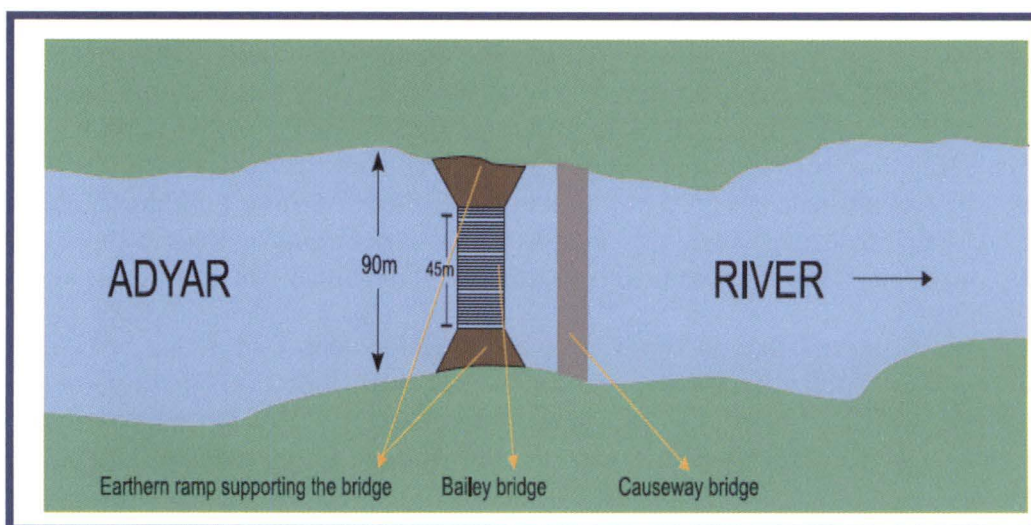
Recommendation No. 14: We recommend that the Revenue Standing Order (RSO) should be amended to make it illegal to dispose of the tank bed land.

4.5 Structural hindrances in Adyar River course

(i) The main campus of the Officers Training Academy (OTA) of Ministry of Defence is located on the northern side of Adyar River at Saint Thomas Mount in Chennai. The training area of OTA is located on the southern side of the river. An existing causeway² across Adyar River served for accessing the training area of OTA from its main campus. The permission sought by OTA for construction of a bailey bridge across Adyar River was rejected (June 2012) by GoTN as it would obstruct the free flow of water in the river and hence not feasible to allow permission. Based on the subsequent request from OTA (June 2012), GoTN accorded permission for construction of bailey bridge for a length of 45 meters (150 feet) on temporary basis. OTA constructed the Bailey bridge for a length of 45 meters with earthen ramps on either side across the Adyar River thereby intruding the water course to obstruct free flow of water.

We observed that while granting permission for construction of Bailey bridge to cover a width of 45 meters, GoTN failed to consider the 90 meters width of Adyar River at that point. As the bridge covered only 50 per cent of the river width, earthen ramps were constructed on either side of the bridge for the balance 50 per cent of the river width, blocking the free flow of the river (**Exhibit 4.6**).

Exhibit 4.6: Ramp of Bailey bridge protruding into Adyar River



(Source: Water Resources Department)

The bridge permitted on temporary basis during June 2012 continued to be operational till December 2015, without any proposal for construction of permanent bridge at the site. The obstructions created by the causeway and the Bailey bridge with earthen ramps, caused overflow of flood water at that point during heavy flow of water in the Adyar River during floods in 2015, thereby inundating Nandambakkam and Manapakkam areas. We noticed that

² A raised road or path to cross a water body which allows water to flow over the structure

the floods had washed away the Bailey bridge and that during joint inspection (October 2016) of the site, it was observed that the damaged ramps of the Bailey bridge were continuing to hinder free flow of water in the river.

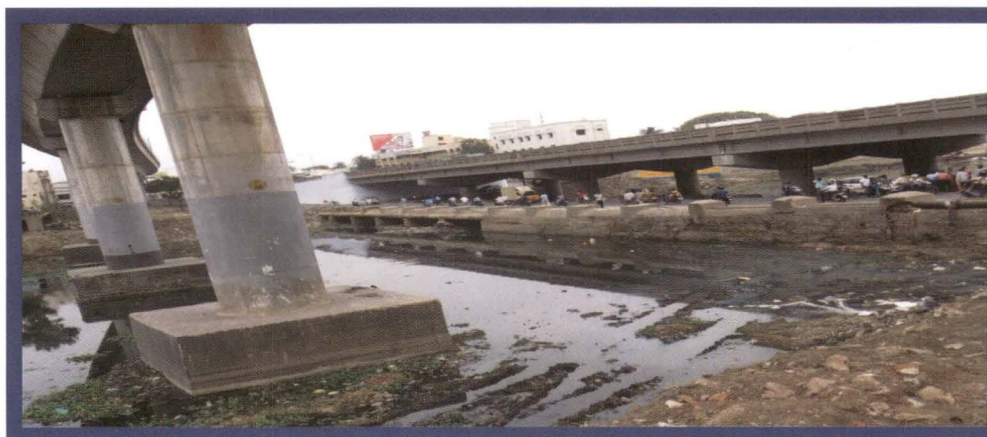
Thus, failure of the Government to consider the width of the river while allowing construction of Bailey bridge with ramps across the Adyar River, resulted in inundation of residential areas during the December 2015 floods.

On being asked, Government did not furnish any specific reason for granting permission but stated (March 2017) that efforts would be made to remove damaged portions of the ramp from the river.

(ii) A causeway bridge at Jafferkhanpet, blocking the free flow of water in Adyar River, was not removed though an over-bridge in lieu of the causeway bridge was already constructed by Highways Department and put into use. At the same location, Chennai Metro Rail Limited (CMRL) had constructed a bridge across the river with its three pile caps protruding above the river bed (**Exhibit 4.7**) without obtaining NOC from WRD. We observed that WRD had turned a blind eye to these violations by CMRL, which is also a Government Agency. The existing causeway and the pile caps by CMRL in violation of Government instructions hindered free flow of water in Adyar River resulting in inundation of flood waters in Ekkaduthangal, MGR Nagar, Jafferkhanpet and K.K. Nagar areas.

The Divisional Engineer, Highways Department stated (December 2016) that line Departments had been requested for removal of utilities to enable dismantling of the causeway bridge. Government agreed (March 2017) to initiate action in this regard.

Exhibit 4.7: Metro Rail pile caps and old causeway



(Source: Photo taken by Audit team during Joint Inspection)

(iii) Scrutiny of records of GCC revealed that a 420 metres long high level bridge constructed (December 2009) under JNNURM had encroached upon the river at Guindy Industrial Area to an extent of 15 metres from the boundary of the river, reducing the carrying capacity of the river. GoTN stated (April 2017) that the bridge was constructed according to the site conditions and river boundary available at that time. The reply was unacceptable as the ramp of the bridge was clearly protruding into the river

obstructing its flow as was pointed out by the Chief Engineer, WRD and observed during joint inspection of the site.

(iv) Across Adyar River at Kotturpuram, a high level bridge was constructed in lieu of an old bridge. The old bridge, though not utilised for vehicular traffic, was not demolished. It was being utilised for carrying pipelines of CMWSSB (**Exhibit 4.8**), which acted as barricade to the flow of water and caused afflux of flood waters causing huge inundation in the upstream areas of Kotturpuram.

Exhibit 4.8: Old bridge blocking the free flow of water



(Source: Photo taken by Audit team during Joint Inspection)

We are constrained to record the callous attitude of the WRD in allowing these obstructions in the water bodies which contributed to the 2015 floods.

(v) Airports Authority of India approached WRD (May 2009) and sought NOC for expansion of Chennai International Airport by construction of secondary runway across Adyar River, which also necessitated dismantling recently constructed check dam. The proposal was agreed to by the GoTN and NOC was issued with conditions, *inter alia*, that (i) the construction cost of the check dam i.e. ₹ 3.52 crore be remitted to GoTN account, (ii) Airports Authority should deploy flood safety arrangements on either side of the bridge, and (iii) Airports authority should carry out periodical maintenance including desilting works. The Airports authority constructed (2011-12) the secondary runway. A study (2012) by Anna University indicated that the piles under the runway reduced the width of the Adyar River, thereby increasing the possibility of floods in the nearby areas. The findings of Anna University were proved right as the Airport and the adjoining areas were severely inundated during 2015 flood (**Exhibit 4.9**). During joint inspection conducted by the Audit team along with CE, WRD, it was noticed that the individual pillars supporting the runway, without any wall connecting them, acted as filth accumulators thereby obstructing the free flow of river.

Exhibit 4.9: Flooding of Chennai International Airport

(Source: Airports Authority of India)

We observed that WRD failed to ensure compliance to the NOC conditions relating to flood protection works and periodical maintenance by the Airport authority. GoTN stated (March 2017) that detailed survey would be done to tackle this issue. The reply did not address the audit findings as compliance to NOC conditions should have been monitored continuously by WRD.

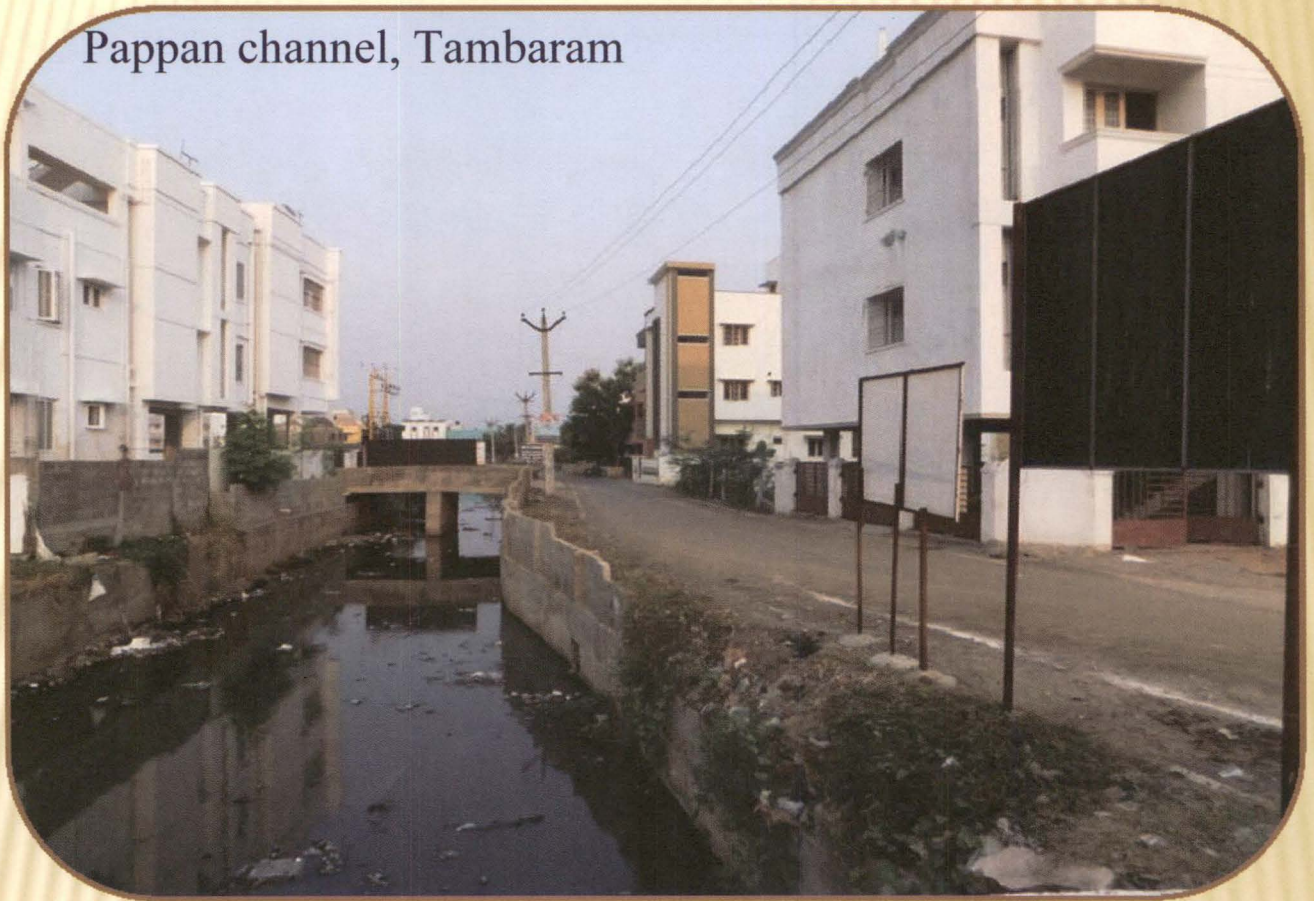
4.6 Analysis

Encroachments, a menace, in the path of flood mitigation works, had not been effectively handled by the Government. Though the city is well endowed with several natural lakes and manmade tanks and reservoirs, encroachments reduced their water storing capacity. Local bodies had themselves encroached upon tank beds for dumping of garbage and contributed to pollution and choking of water bodies. Even Government agencies encroached water bodies for developing public infrastructure, unmindful of the damage they caused to flood carrying capacity of water bodies. Encroachment on tank beds and river margins remained unchecked despite TN Land Encroachment Act, 1905 and TN Protection of Tanks and Eviction of Encroachment Act, 2007 are in place to tackle this menace.

CHAPTER V

DRAINAGE SYSTEM IN CHENNAI METROPOLITAN AREA

Pappan channel, Tambaram



CHAPTER V

DRAINAGE SYSTEM IN CHENNAI METROPOLITAN AREA

5.1 Flood protection works

The National Water Policy recommends that water resource development and management has to be done for a hydrological unit such as a drainage basin as a whole, or for a sub-basin. The approach needs to address not only irrigation but other requirements such as, domestic, industrial, energy, recreational and other uses as well. The importance of planning any project within broad framework of river basin master plan has been, therefore, amply emphasised. Improvements to macro and micro drainages¹ are, therefore, vital to address the challenges of flooding.

The macro drainage works are executed by Water Resources Department (WRD) and the micro drainage works are executed by Greater Chennai Corporation (GCC) and respective local bodies.

With a view to mitigate flooding in Chennai city due to frequent heavy rains, after the floods of 2005, WRD proposed to carryout flood protection works under the centrally sponsored scheme of JNNURM. As JNNURM works were related to urban areas, the preparation of Detailed Project Report (DPR) was entrusted to GCC to provide solution for the inundation problems of Chennai city. The DPRs were prepared in 2008-09.

GoTN accorded (October 2009) administrative sanction for improvement to macro drainages maintained by WRD in the four basins² of Chennai at a cost of ₹ 633.03 crore using JNNURM funds (35 *per cent*) and State funds (65 *per cent*). The works were to be executed in 10 packages. The works in seven packages were awarded between June 2010 and April 2011 to various contractors. The C&AG's Audit Report on GoTN (Economic Sector) for the year ended 2012-13 had pointed out that these works were not completed due to improper planning, non-acquisition of land, lack of co-ordination with other departments, and non-eviction of encroachments. We observed that these issues continued to persist and consequently, the works were getting delayed as discussed in the following paragraphs. Works in three other packages were not commenced due to non-removal of encroachments in waterways by WRD, where such works were required to be carried out.

¹ Rivers and canals, under the control of WRD, constitute macro drainages and storm water drains under the control of GCC, constitute micro drainages

² Northern Basin (Ambattur, Kathirvedu, Korattur and Otteri); Central Basin (Arumbakkam, Koyambedu, Maduravoil and Virugambakkam); Eastern Basin (Adyar, Ice House, Mandaveli, Muttukadu, Mylapore, Triplicane and Wall Tax Road) and Southern Basin (Manapakkam, Pallikaranai, Porur, Ram Nagar, Taramani and Velachery)

While implementing the seven packages awarded in 2010-11, WRD faced constraints in the DPR prepared in 2008-09 such as low soil bearing capacity of the work site, need for changing the construction methodology, non-availability of land due to encroachments, non-feasibility of the proposed alignment, etc. Therefore, WRD prepared (September 2012) a revised DPR for executing the work in all the ten packages including in the seven packages which were awarded, but faced various constraints in implementation. The revised DPR was approved by GoI, Ministry of Urban Development in December 2012.

After approval of the DPR by GoI in December 2012, and subsequent approval by Technical Advisory Committee and Tender Award Committee, GoTN accorded (September 2014) Revised Administrative Sanction for the ten packages at a total cost of ₹ 699.86 crore.

We observed from the fact that the works could not be carried out based on the DPR of 2008-09, which indicated that the DPR was defective, warranting a revised DPR and the consequent delay in implementation of the works.

As of March 2016, three out of the ten packages were successfully completed. Deficiencies in the execution of the remaining packages, contributing to non-achievement of objectives of these works despite incurring an expenditure of ₹ 274.05 crore, are discussed in **Paragraphs 5.1.1 to 5.1.8**.

Northern Basin

5.1.1 Work not completed due to non-completion of land acquisition despite directive by the Hon'ble Supreme Court to acquire remaining land

GoTN sanctioned (October 2009) construction of a diversion channel for carrying 300 cusec of surplus water from Kolathur Tank to Madhavaram Tank to reduce inundation in adjoining areas due to overflowing of Kolathur Tank's surplus course. The work of creation of the channel for 1,830 m out of 3,150 m was completed by incurring an expenditure of ₹ 13.92 crore. The balance work of creation of channel for 1,320 m was not executed due to legal proceedings in the acquisition of land and the partly executed work was closed by WRD (July 2015).

We observed that the legal appeal filed by the land owners was disposed of (September 2014) by the Hon'ble Supreme Court of India with direction to GoTN to start land acquisition process afresh. But, WRD without taking any initiative to acquire the land, closed the work in July 2015, ten months after the Hon'ble Supreme Court's direction. This lackadaisical approach of WRD had resulted in non-achievement of the objective of constructing diversion channel from Kolathur Tank to Madhavaram Tank and thus, the expenditure of ₹ 13.92 crore incurred on the partial work proved unfruitful. Non-completion of the channel resulted in inundation of nearby areas of Thanikachalam Nagar of Kolathur during the December 2015 floods.

GoTN replied (February 2017) that efforts would be made to complete the land acquisition. The reply was not tenable as GoTN had not initiated any action even after a lapse of three years since the judgement of the Hon'ble Supreme Court allowing fresh land acquisition. Thus, there is need for GoTN to complete the work after ensuring acquisition of remaining land as per directives of the Hon'ble Supreme Court for achieving the intended objective of the work.

5.1.2 Failure to create additional vent resulted in afflux of water

GoTN sanctioned (October 2009) the work of improvements to Ambattur Tank surplus drainage channel to mitigate inundation in Ambattur industrial area of North Chennai by discharging 1,830 cusec of surplus water from Ambattur Tank to Korattur Tank. The works included construction of weirs at left and right flank, flood protection walls, bridge etc.

We had observed³ that the work could not be fully completed even after incurring an expenditure of ₹ 18.68 crore due to non-receipt of permission for provision of additional vent for transferring 570 cusec under the Railway track considering the safety of the tracks.

We also observed from the scrutiny of records that no efforts were made by WRD for redesigning the vents in accordance with the safety requirements of the Railways but pre-closed the execution of work (March 2015). This resulted in non-achievement of the objective of transferring 570 cusec of water and continued inundation and flooding in Ambattur and SIDCO industrial areas.

Thus, failure of WRD to commence the work after obtaining necessary permissions or to initiate efforts for redesigning the vents in accordance with the requirement of railways resulted in non-achievement of desired objective, besides unfruitful expenditure of ₹ 18.68 crore.

5.1.3 Unfruitful expenditure on partially executed surplus channel work

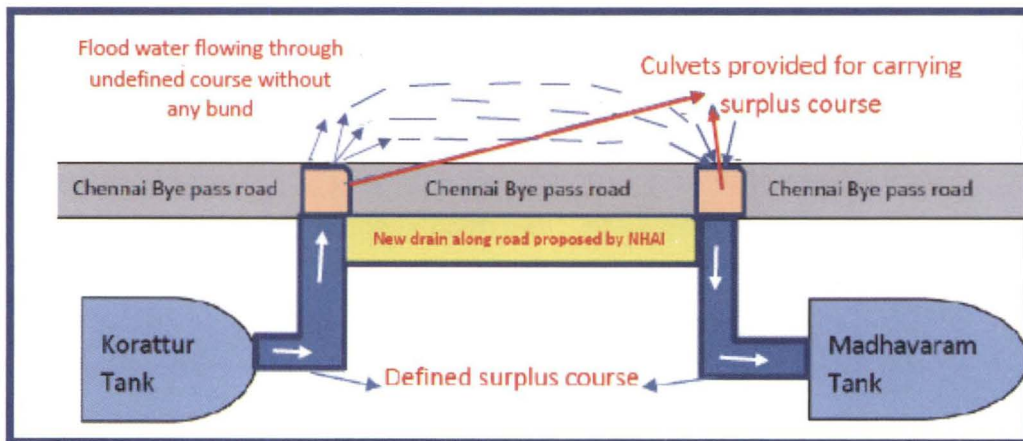
Para 100 of Public Works Department (PWD) Code envisaged that no estimates should be prepared for any work except on the basis of a detailed investigation on the site. Para 180 also stipulated that no work should be started on land which was not duly handed over.

(A) Korattur Tank having capacity of 0.236 TMC is situated in Ambattur taluk, Tiruvallur District. The tank had a defined surplus course only for a length of 1,750 m. Thereafter, it spreads over and takes a natural course for a length of 1,290 m., passing through *patta* lands before falling into Madhavaram Tank. In 2010, the National Highways Authority of India (NHAI) proposed construction of Chennai bypass road, with its alignment cutting across the surplus course of Korattur Tank. During commencement of the work on the bypass road, NHAI had proposed (February 2010) for

³ Paragraph 2.13.4 of C&AG's Audit Report (Economic Sector), GoTN for the year 2012-13

construction of a drain along the service road for taking the Korattur Tank's surplus water to Madhavaram Tank (**Exhibit 5.1**). The proposal was discussed by NHAI and WRD authorities, and it was suggested by WRD for construction of box culverts at two locations to carry surplus water across the road to its natural drains. WRD had not agreed to the NHAI proposal of construction of a drain along service road. NHAI had completed (2011) Chennai Bypass road and service road with box culverts at two locations as suggested by WRD.

Exhibit 5.1: Illustrative sketch showing existing and proposed alignment of Korattur Tank's surplus course



Not to scale

The bypass road work was completed with box culvert underneath the road to carry the surplus water of Korattur Tank, instead of constructing a drain along the service road as was suggested by NHAI. After crossing the bypass road through box culverts, the surplus water took natural course over the *patta* lands, thereby contributing to inundation in adjoining areas. The failure of WRD to agree to the proposal of NHAI resulted in continued flow of the surplus water through thickly populated areas contributing to the inundation in the adjoining areas.

(B) Subsequent to the construction of Chennai Bypass, the work of improvements to diversion channel to Korattur Tank surplus course to carry 600 cusec water was approved (December 2012) in the Revised DPR. The work involved creation of regulatory arrangement to the existing weirs, construction of cut and cover type surplus channel for 850 m along the service road of NHAI and construction of flood protection wall to the surplus channel.

Based on the approval (July 2013) of the Technical Advisory Committee of GoTN, Technical Sanction was accorded (December 2013) by CE, WRD for execution of the work at a cost of ₹ 27.76 crore. The work was awarded (February 2014) for ₹ 27.67 crore to the lowest bidder for completion in nine months.

WRD requested (June 2014) permission from NHAI for construction of cut and cover type surplus channel along the service road. NHAI refused (October 2014) permission citing non-availability of sufficient land for

execution of work in the service road and such construction would also disturb the embankment of the existing NHAI bridge. WRD engaged the services of a consultant from IIT, Madras to assess the possibility of undertaking cut and cover type surplus channel and the consultant opined that excavation of the service road for box type surplus channel would weaken the embankment of the bridge. The contractor completed the other items of the work at a cost of ₹ 17.94 crore and requested for foreclosure of the work citing non-availability of work front and the work was foreclosed (May 2015).

We observed that despite non-initiation of proceedings seeking permission from NHAI and without ensuring work front for execution of work, WRD had prematurely finalised the contract and commenced other components of the work. This resulted in pre-closure of the work after incurring an expenditure of ₹ 17.94 crore. Thus, absence of proper planning in management of macro drains in diversion of surplus waters, finalisation of alignment without proper feasibility study, commencement of work without ensuring the availability of work front and in contravention of the codal provisions resulted in unfruitful expenditure of ₹ 17.94 crore on the partially executed work besides non-achievement of the envisaged objective. Partial execution of the work was of no use as the surplus course of 600 cusec from Korattur Tank could not be linked to the downstream Madhavaram Tank, thus, defeating the very objective of the project.

Thus, (a) the injudicious decision of WRD in 2010 to construct box culvert instead of drain along the service road and (b) the resultant failure in executing the drain work sanctioned in 2013 due to refusal of permission by NHAI as it would damage the existing bridge, had contributed to huge inundation and loss of property in the residential areas of INTUC Nagar, Collector Nagar and Ambedkar Nagar of Kathirvedu village during 2015.

Government replied (March 2017) that efforts were being made to commence the work in the service road without damaging the embankment of highway. The reply was not tenable as WRD should have done a proper feasibility study as the alignment of the channel along the service road was not at all feasible with the present design.

Southern basin

5.1.4 Incorrect assessment of field conditions in the DPR resulted in non-achievement of objective and unfruitful expenditure

During the floods in 2005, Velachery and its adjoining areas were one of the worst affected areas which faced massive inundation, the reasons for which may be primarily attributed to poor drainage system and non-existence of diversion channel from Velachery Tank to South Buckingham Canal. As such, GoTN sanctioned (October 2009) the work of providing a short cut diversion drainage channel for a length of 4,100 m to carry surplus water from Velachery Tank to South Buckingham Canal near TIDEL Park at a cost of ₹ 58.15 crore, which was subsequently revised to ₹ 88.34 crore. The work was subsequently awarded (June 2010) to a contractor for completion in

18 months. WRD handed over the site to the contractor in May 2011 after a delay of 12 months due to defects in the DPR, which are as follows:

- As no field study was conducted during the preparation of DPR, WRD could not ascertain that Grade separator piers of Highways Department were lying, which were overlapping the alignment of the proposed channel work in one stretch (LS 0-220 m), resulting in delayed execution of work.
- The DPR failed to assess that routine traffic was required to be diverted for execution of the work in a stretch of 60 m (4,040 – 4,100 m), for which prior permission from Police Department was required to be obtained. No such field study was conducted, which again contributed to delayed execution of the work.

We further observed that the DPR had even failed to assess that the conventional construction method would not be feasible for a length of 2,690 m out of the total length of 4,100 m as there were 23 road crossings including a major crossing near Velachery Bus Stand. As a result, the entire stretch of work, which should have been completed by the stipulated period i.e. November 2012, was not completed till date (May 2017).

Thus, incorrect preparation of DPR without assessing the field conditions, delayed handing over of work front and absence of co-ordination for finalisation of alignment resulted in unfruitful expenditure of ₹ 72.42 crore besides non-achievement of flood mitigation in the areas. This led to inundation in the Velachery area during the December 2015 floods.

Government stated (March 2017) that presence of heavy traffic in the stretch and necessity of required permission from various agencies delayed the completion of work. The fact however remains that WRD failed to ensure the correctness of methodology suggested in the DPR while according Technical Sanction for the work which resulted in non-achievement of the objective even after five years despite being pointed out in the earlier Audit Report.

5.1.5 Non-commencement of diversion channel work resulting in inundation

GoTN sanctioned (January 2010) two works, viz., (i) improvements to South Buckingham Canal from Okkiyum Maduvu to Muttukadu backwater to carry 9,000 cusec of flood waters and provide relief from inundation of Velachery and (ii) a short cut diversion channel from Buckingham Canal (near confluence of Okkiyum Maduvu) to the Bay of Bengal to carry 3,500 cusec of flood waters for effective draining of flood waters from the Pallikarnai marshland at a total cost of ₹ 131.90 crore.

WRD completed (December 2014) the first component of the work of improvements to south Buckingham Canal to carry 9,000 cusec of flood water from Okkiyum Maduvu to Muttukadu backwater. But, while preparing the revised DPR in 2012, WRD proposed to drop the second component of the work of constructing short cut diversion channel from Buckingham Canal to

the Bay of Bengal as the proposed alignment was to pass through ‘VGP Golden Beach’, a popular sea shore resort-cum-amusement park, citing land acquisition cost of ₹ 100 crore. The Central Public Health Environmental Engineering Organisation (CPHEEO) of GoI, Ministry of Urban Development, while appraising the revised DPR did not agree to the proposal of WRD to drop the diversion channel work and instructed that the decision was required to be reviewed by GoTN keeping in view the importance of the component. Despite strong recommendation of CPHEEO, GoTN dropped the work after incurring an expenditure of ₹ 90.34 crore. We had observed⁴ that the work of short cut diversion channel from Buckingham Canal to Bay of Bengal, was not commenced due to the involvement of acquisition of private lands costing about ₹ 100 crore. GoTN finally dropped (October 2014) the project citing land acquisition problems.

We observed that absence of short cut diversion channel led to increased discharge of 12,500 cusec of flood waters into the Buckingham Canal, designed to carry 9,000 cusec, resulting in inundation of Velachery and adjacent areas.

Thus, the action of the Government in not considering alternative options and deciding to drop the project citing land acquisition cost, indicated lack of seriousness in fulfilling the objective of providing a permanent solution to the inundation problems of the thickly populated Velachery area.

5.1.6 Unfruitful expenditure on partially completed surplus course

Porur Tank situated in the city limits of Chennai was catering to the drinking water needs of the residents of the city. The tank did not possess a defined surplus course or regulatory arrangement. The tank discharged 600 cusec of surplus water through weirs which passed through *patta* lands causing inundation during monsoon.

WRD proposed (August 2009) for providing a defined surplus course to connect the Porur Tank to the existing Manapakkam drain for final discharge into Adyar River. Accordingly, GoTN sanctioned (October 2009) ₹ 26.96 crore for improvements to Porur Tank surplus drainage by weir reconstruction, widening and deepening canal and widening of existing bridges.

We had observed⁵ that the work could not be commenced due to inability of WRD to acquire the required land for the project.

WRD revised the alignment of the surplus course for length of 1,165 m and for provision of cut and cover canal with pre-cast concrete in the service road of NHAI to an extent of 745 m, at a cost of ₹ 49.92 crore and CE accorded (January 2014) revised Technical Sanction. The work was awarded to the

⁴ Paragraph 2.13.1 of C&AG’s Audit Report (Economic Sector), GoTN for the year 2012-13

⁵ Paragraph 2.13.4 of C&AG’s Audit Report (Economic Sector), GoTN for the year 2012-13

lowest bidder for ₹ 45.53 crore for completion in 15 months from February 2014. WRD forwarded (June 2014) a proposal seeking permission from NHAI to undertake the work in the service road for a length of 745 m. NHAI returned (December 2014) the proposal stating that the drawing indicated the total width of canal as 5.9 m and considering the width of service road (5.5 m), execution of the work would damage drain along the main carriage way.

Despite notice from NHAI (February 2015) directing not to commence the work without approval, WRD commenced construction work and partially executed 495 m of the canal work. The work was stopped after the matter was taken up by NHAI with GoTN indicating that the continuance of work by WRD without permission amounted to trespassing and illegal activity under the provisions of National Highways Act, 1956. The work was stopped (March 2016) after incurring an expenditure of ₹ 45.03 crore.

We observed as under from the scrutiny of records:

- WRD failed to undertake proper field investigation and to determine the adequate width of the canal in consonance with the width of the service road resulting in non-receipt of required permission from NHAI.
- Commencement of work on the service road without permission resulted in illegal activity by WRD contravening the provisions of National Highways Act which calls for fixing of responsibility on the officials concerned.
- The work was pre-closed without completing 250 m, which was in the initial stretches of the surplus canal, which resulted in unfruitful expenditure of ₹ 45.03 crore incurred on the canal in subsequent stretches due to its non-utilisation besides inundation in the nearby areas.

Thus, the failure of WRD to undertake proper field investigation and to determine the adequate width of the canal resulted in unfruitful expenditure on the partially completed work besides non-achievement of the envisaged objective despite being pointed out in the earlier Audit Report.

In the Exit conference (February 2017) with the Secretary to Government, PWD, WRD officers informed that the work would be completed after obtaining necessary permission from NHAI. The reply did not address the Audit observation that the work was commenced without following the due process leading to stoppage of work and non-achievement of the objective.

Central basin

5.1.7 Abandoning of work due to absence of feasibility study

GoTN accorded (October 2009) administrative sanction for ₹ 17.52 crore for improvements and construction of diversion channel from Maduravoyal Tank to Cooum River for discharging 962 cusec of surplus flood water.

We had observed⁶ that the work awarded (June 2010) to the contractor was not commenced due to existence of multi-storeyed tenements of Tamil Nadu Slum Clearance Board and heavy encroachments at work site. In order to overcome the issues posed by encroachments, WRD, without initiating any measure to evict the encroachers, proposed an alternative alignment.

The proposed alternative alignment required obtaining of permission from other agencies like Highways, TNEB, BSNL, CMWSSB and NHAI for execution of the project. The Tender Award Committee decided (September 2013) to execute the work by calling for fresh tenders after obtaining clearances from these agencies. GoTN accorded (September 2014) revised administrative sanction for ₹ 32.59 crore for construction of straight cut diversion channel in the alternate alignment for discharge of surplus flood water. We observed that WRD failed to obtain necessary permission from the agencies concerned, resulting in non-commencement of the work even as of January 2017.

Government replied (March 2017) that delay in obtaining necessary permissions from the agencies concerned delayed the commencement of the project. The reply was not tenable as other than writing letters to the agencies concerned, WRD did not make any serious efforts to obtain permission from them.

Thus, the failure of WRD to evict encroachments at the site of the original alignment and the absence of effective co-ordination to obtain necessary permission from various agencies for execution of work in the alternative alignment, resulted in non-commencement of diversion channel to discharge 962 cusec of surplus flood waters into Cooum River. This had also led to inundation in Maduravoyal area and its adjacent areas during 2015 floods.

Eastern Basin

5.1.8 Non-completion of improvement works to Central Buckingham Canal due to encroachment

Non-commencement of the work of improvements to Central Buckingham Canal sanctioned in October 2009 for ₹ 68.62 crore was pointed out in C&AG's Report on GoTN (Economic Sector), 2013.

National Disaster Management Guidelines, 2008 envisaged provision of embankment in the existing course of rivers for preventing overflowing of water over the banks. It was also envisaged that concrete or masonry flood walls may be constructed where adequate space was not available in developed areas for provision of embankments.

GoTN accorded (October 2009) administrative sanction for improvement to Central Buckingham Canal for ₹ 68.62 crore to mitigate the inundation in the residential areas of Triplicane, Ice House, etc., due to overflowing of the canal

⁶ Paragraph 2.13.3 (a) of C&AG's Audit Report (Economic Sector), GoTN for the year 2012-13

during monsoon seasons. Technical Sanction was accorded by CE, Chennai Region for the work including construction of flood protection wall on both banks of the canal, having total length of 14,200 m (7,100 m on either side) besides widening of two bridges viz., Ice House road bridge and Kutcheri Road bridge which had vents with width of 5 to 6 m as against the required 15 to 17 m.

We had observed⁷ that the work could not be commenced due to incorrect adoption of soil conditions in the DPR (December 2008) and encroachment of the canal area by slum dwellers.

WRD revised (January 2014) the scope of the work for adoption of pile foundation instead of open foundation and reduced construction of flood protection wall to a length of 1,115 m due to the failure of the WRD to evict the encroachments by slum dwellers who demanded alternative residential accommodation in nearby areas. The work was awarded (February 2014) to the lowest bidder for ₹ 16.18 crore for completion in 12 months. The work commenced in March 2014 was completed in March 2015 incurring an expenditure of ₹ 15.72 crore except for important sub component, viz., construction of additional vent facilities to two bridges for the reason that the additional work would weaken the existing structure.

We observed from the scrutiny of records as under:

- WRD failed to ensure the correctness of the soil condition at the time of according Technical Sanction, resulting in revision of scope of work of construction of flood protection wall from open foundation to pile foundation.
- Failure of WRD to evict the slum dwellers from the banks of the canal forced the department to reduce the scope of the work of flood protection wall to 1,115 m. as against 14,200 m. We also observed that the encroachers were provided with electricity connection, voter identification cards, ration cards and well laid roads in violation of GoTN's own statutes, orders etc. All these indicated lack of seriousness on the part of GoTN to mitigate the hardships due to inundation and loss of property in the nearby areas.
- Non-commencement of important sub components of providing additional vent facilities under two bridges indicated inadequate field investigation by the departmental officials while sanctioning Technical Sanction.
- Without exploring alternative ways for creation of additional vent facilities, WRD pre-closed the work resulting in flow of water in a width of 5 to 6 m as against the required 15 to 17 m, which contributed to flooding in the adjoining areas during December 2015.

Government replied (March 2017) that the encroachments could not be evicted due to stiff resistance from the encroachers and efforts were being made to

⁷ Paragraph 2.13.4 of C&AG's Report (Economic Sector), GoTN for 2012-13

evict them in stages. The reply was not acceptable as it was GoTN's duty not to allow any encroachments as per its own law and orders.

Thus, failure of the WRD to ensure the correctness of soil conditions and stability of the existing structure and to take stern action for removal of encroachments resulted in reduction in scope of work and non-achievement of the objective of mitigating the inundation of residential areas despite incurring an expenditure of ₹ 15.72 crore. The failure of the GoTN to remove encroachments clearly demonstrated its lack of seriousness to handle serious issues affecting the life and property of the people of Chennai city.

Recommendation No. 15: We recommend that GoTN should take effective steps to complete all the above eight flood prevention works, approved way back in 2009 under JNNURM, by evicting encroachments, facilitating acquisition of land, finding alternative alignments and instructing WRD to redesign the construction methodology, wherever required, so that the threat of inundation is reduced.

5.2 Micro drainage system

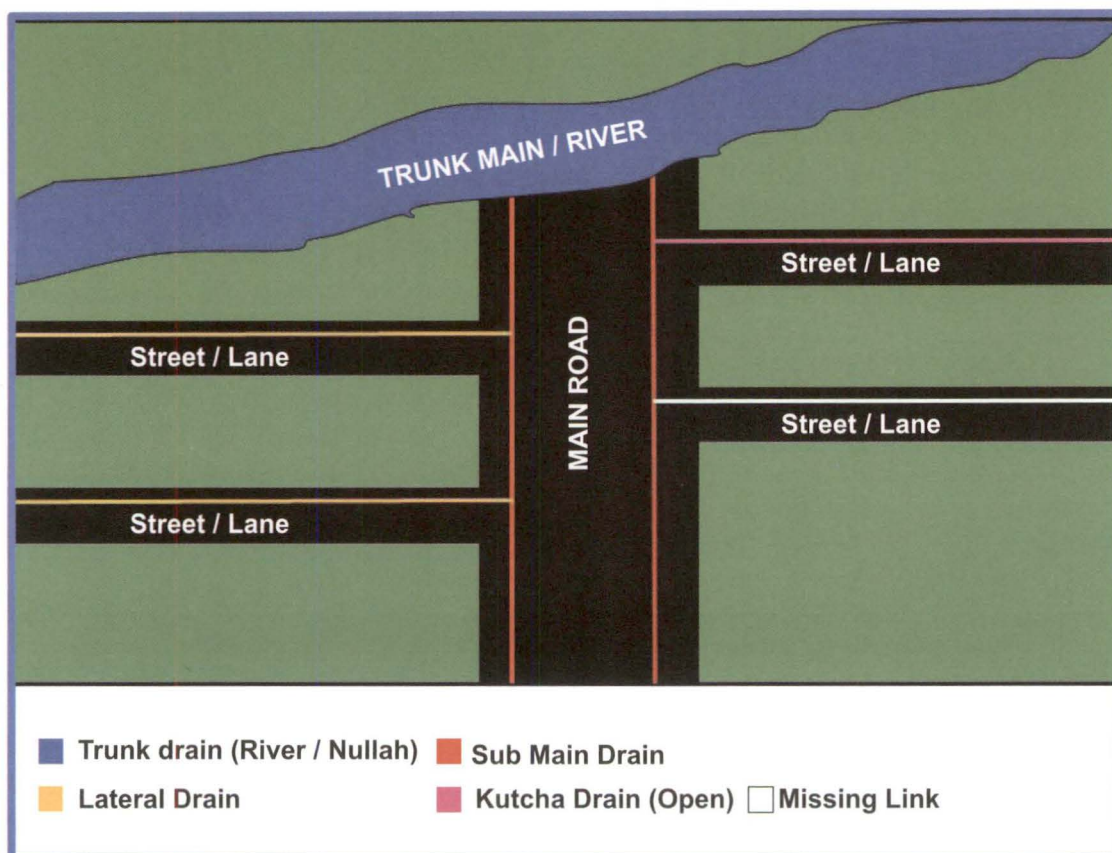
Storm water drains (SWD) are intended to collect surface rain water from the streets and discharge into water courses. An efficient, well designed and well maintained storm water drainage system would minimise the level of water logging and damage and therefore play an important role in flood management.

Indian Roads Congress (IRC) Guidelines of 1999 and 2013 provide that urban drainage system has to be designed in such a way that it captures the rainwater runoff from the road surface and infiltrate and takes it into the ground closest to the source. In case of lack of space, it should be conveyed along the road to the receiving body, in addition to infiltrate it into below ground at designated locations only.

SWD networks comprise of lateral drains, sub-mains and trunk or main drains. Rain water gets collected in the lateral drains along road margins. The lateral drains join to make sub-main drain and finally joins trunk or main drain.

As per the existing system and as envisaged in the SMP, the local bodies are responsible for management of micro drainage system within their jurisdiction. In GCC areas, as against the road length of 7,303 km, SWDs were provided only for a length of 1,894 km which formed only 26 per cent of the total road length. Scrutiny of records of sampled zones revealed that SWD network was not adequate, as discussed in succeeding paragraph. A sketch depicting, macro drain, sub-mains, lateral drains and missing links in SWD network in Ward 127 of Kodambakkam Zone is shown in **Exhibit 5.2**.

Exhibit 5.2: Illustrative sketch depicting SWD network



Not to scale

(Source : Storm water network in GCC)

5.2.1 Non-preparation of master plan for Storm Water Drains

The guidelines issued (1999/2013) by IRC envisaged preparation of comprehensive master plan to manage storm water. The master plan was to be based on watershed⁸-based planning, focusing on retaining and recharging the rain water locally. It also envisaged Geographical Information System (GIS) - based analysis of drainage patterns, hydrological mapping, topography and open spaces of the city.

We noticed that GCC did not prepare any master plan for SWDs. Though a Department headed by a Superintending Engineer had been functioning to deal with construction of SWDs, no attempt was ever made by GCC to prepare a master plan for SWDs to approach the issue in a systematic manner. Lack of a master plan with a timeline had resulted in poor coverage of SWDs and unidentified missing links⁹ in the network. During monsoon 2014, GCC identified (November 2014) 52 missing links of SWDs in road margins and sub-mains which were not connected to SWD network, which ultimately

⁸ The area that drains into a single river is the watershed for that river

⁹ SWDs not connected with the network. These SWDs empty the rain water in undesignated areas

caused inundation during floods of 2015. The details of missing links are given in **Appendix 5.1**. Subsequent to the floods, remedial measures for connecting the missing links were carried out in 42 links and works were in progress in 10 links (November 2016). Out of 52 missing links, 24 links were in the test checked zones, which reported inundation during December 2015. Government stated that (April 2017) a Master Plan was prepared (2009) by a Consultant appointed in 2008. The reply was incorrect as the DPR for JNNURM work, prepared in 2009 could not be equated to a Master Plan as it dealt with only the works proposed to be carried out and it did not have any plan for covering the whole area of the city.

We observed that non-preparation of comprehensive master plan for SWD as envisaged in IRC guidelines had resulted in poor coverage of SWDs in CMA and non-completion of the work of correcting the missing links in the network prior to floods of 2015.

Recommendation No. 16: We recommend preparation of a Master Plan on watershed basis to guide a time-bound strategy for construction of SWDs on all required roads for ensuring flow of storm water to the sea/destination/at its disposal point.

5.2.2 Wrong designing of storm water drains due to incorrect adoption of rainfall intensity

(i) IRC guidelines (1999) envisaged that rainfall intensity¹⁰ was to be considered for designing SWDs. Other parameters to be considered for designing SWDs are the catchment area, land pattern and location of disposal point. CMDA appointed (1993) a Consultant to recommend a programme of works for the alleviation of flooding in the city and CMA. The Consultant viz., Matt MacDonald arrived (1994) at a rainfall intensity of 48.63 mm per hour using Gumbel's extreme value distribution method¹¹ to be adopted for designing SWDs. National Institute of Hydrology, Roorkee, which evaluated the World Bank - aided Hydrology Project II¹² (Project 2006) also arrived at a rain fall intensity of 48.89 mm per hour using the same method. We observed that both Matt MacDonald and National Institute of Hydrology, Roorkee had adopted the same method to calculate rain fall intensity. The negligible variation in the rainfall intensity calculated by the Consultants was due to adoption of different base years for calculation.

In June 2008, GCC engaged a Consultant for preparation of DPR for improvement of SWDs under JNNURM Project. While preparing (2009) the DPR for SWDs, the Consultant had considered two methods for arriving at the rainfall intensity based on which the size of SWDs were to be designed. The

¹⁰ Rainfall intensity is defined as the ratio of the total amount of rain falling during a given period to the duration of the period. It is expressed in mm per hour (mm/h)

¹¹ In probability theory and statistics, the Gumbel distribution is used to model the distribution of the maximum or the minimum. This theory is used by CMDA as well and the workings were vetted by the Consultant appointed by Audit

¹² Project executed by PWD during 2006 to 2014 for storm water management in Cooum River

Consultant arrived at a rainfall intensity of 31.39 mm per hour under one method (hourly rainfall data obtained by interpolation of data of rain fall for periods less than 60 minutes) and 49 mm per hour under another method (recurrence interval method). GCC adopted the rainfall intensity of 31.39 mm per hour and constructed SWDs for a length of 345 km at a cost of ₹ 610.55 crore under JNNURM project during 2011-14 with design based on lesser rainfall intensity. We observed that adoption of lesser rainfall intensity had resulted in construction of SWDs of lower rain water carrying capacity which was one of the findings of Anna University in respect of SWDs available in 2009.

On being pointed out during audit, GCC justified adoption of lesser rainfall intensity citing approval given by Central Public Health and Environmental Engineering Organisation (CPHEEO), a body under GoI, Ministry of Urban Development. We observed that GCC could not source the required data from India Meteorological Department (IMD) as required under CPHEEO guidelines and went in for interpolation of available data to arrive at the rainfall intensity of 31.39 mm per hour. Rather than interpolating the data, GCC could have adopted the method as suggested in SMP.

We noticed that the second value of rainfall intensity as worked out by GCC's own Consultant for the JNNURM project and the values worked out by CMDA's Consultant Matt MacDonald and the National Institute of Hydrology, Roorkee, ranged between 48.63 mm and 49 mm. This clearly established that the rainfall intensity adopted by GCC for designing SWDs was incorrect leading to construction of lower capacity SWDs which contributed to the floods of 2015.

To substantiate the argument for adoption of the recurrence interval method, the Report on Functional Plan on Drainage for National Capital Region, under the Ministry of Urban Development, GoI, had also emphasised that the design of SWD should be on the basis of recurrence interval method. This Report further stated that CPHEEO Manual was not applicable to cities like Chennai, where rainfall intensity is more than 20 mm per hour and executing SWD works based on the method suggested by CPHEEO may cause severe floods.

Recommendation No. 17: We recommend adoption of the correct rainfall intensity for designing SWDs in future.

(ii) In the aftermath of 2005 Floods, the GoTN had entrusted the work of flood risk mapping for CMA to Anna University, Chennai using Airborne Laser Terrain Mapping (ALTM) and Geo Information System at a cost of ₹ 2.17 crore with partial financial support from GoI (Department of Science and Technology).

The University submitted its report in 2012 containing recommendations by experts group proposing flood mitigation works with site plans and also conducted workshops for dissemination of knowledge in which officials from GCC, Revenue Department, WRD and other Departments participated. The Report attributed the flooding in Chennai and its suburbs to reduction in

capacity of the waterways due to encroachment, construction of roads and bridges across water bodies, inadequate size of drains, obstructions in the drains, obstructions in rivers' mouth due to sand bars, etc.

The recommendations of Anna University, *inter alia*, included inter-linking of SWDs with temple tanks¹³ which were not taken up seriously by GCC as discussed below:

Based on lithological studies on recharge capabilities, the Report classified areas of Chennai city and its suburbs into seven zones based on their geo locations which were intended to recharge coastal and river sands (aquifer zone), parks, open spaces, play grounds, temple tanks and institutions. The Report recommended intensive artificial recharge by redesigning SWDs, by providing recharging bore holes at potential recharge locations and by connecting SWDs to temple tanks to divert the flood water and to minimise surface run off.

As per GCC's norms, rain water harvesting structures were to be provided in SWDs at 30 m intervals along the roads. However, GCC did not construct rain water harvesting structures in SWDs as required. In respect of temple tanks, GCC identified 17 tanks for rejuvenation and inter-linking of them with SWDs. Out of this, GCC took up (2016) two tanks on pilot basis and completed at a cost of ₹ 0.40 crore.

GoTN stated (April 2017) that a total of 9,113 rain water harvesting structures were constructed in the SWD network of GCC. We observed that as per GCC's own plan, rain water harvesting structures were to be provided at 30 metre intervals along the roads. Considering the SWD length of 1,894 km, 63,133 rain water harvesting structures were required. While appreciating the efforts of GCC to start providing rain water harvesting structures in SWDs, we observed that the achievement was only 14.43 *per cent*, indicating a need for greater thrust.

We observed that non-adoption of the recommendations of Anna University and improper design in construction of drains with incorrect capacity also contributed to the floods during 2015.

5.3 Storm Water Drain network of Greater Chennai Corporation

GCC had taken up improvement of SWD network under Centrally Sponsored JNNURM and World Bank-aided TN Sustainable Urban Development Programme (TNSUDP).

(i) Under JNNURM, SWD works for Chennai City were approved (April 2009) for a length of 533.32 kms at a cost of ₹ 814.88 crore. The project comprising of 1,203 works was to be carried out in four basins *viz.*, North, Central, East and South.

¹³ Tanks located in temple complex which are used for temple ceremonies, poojas, etc.

A Performance Audit on the implementation of JNNURM was conducted and audit findings were included in C&AG's Report (Local bodies) – GoTN for the year ended March 2011. The Report highlighted delays in execution of SWD works. The present position of execution of SWD works under JNNURM by GCC as of December 2016 has been given in **Table 5.1** below.

Table 5.1: Projects under JNNURM in respect of SWD by GCC

Name of the basin	Revised Plan		Completed		Number of works dropped
	Number of works	Length of SWD (km)	Number of works	Length of SWD (km)	
North	329	118.91	329	117.73	0
Central	328	144.32	245*	82.92	83
East	244	91.48	195	86.38	49
South	131	65.19	116	57.97	15
Total	1,032	419.90	885	345.00	147

* includes a canal work partially completed
(Source: Details furnished by GCC)

As against revised plan to execute 1,032 works for a length of 419.90 km, GCC executed 885 works for a length of 345 km during June 2012 to June 2015 and dropped the remaining 147 works due to reasons such as commencement of works for Metro Rail project, narrow roads, service lines, heavy traffic, good condition of SWD and public objection. Audit scrutiny in sample Zones revealed that areas in Adyar and Kodambakkam zones, where works under JNNURM were dropped, were affected during floods, since no alternative measures were proposed to mitigate the flood in these areas.

(ii) Under TNSUDP, GoTN accorded (January 2015) administrative approval for provision of SWDs in newly added areas¹⁴ of GCC at a cost of ₹ 2,212.89 crore. As per the conditions of World Bank relating to such works, tenders were to be finalised only after resettlement of families living along the canals. GCC invited (April 2015) tenders for providing SWDs in the basins of Adyar and Cooum Rivers under 39 packages.

Audit scrutiny of the records of GCC disclosed that work orders were issued (January-February 2016) for 35 packages. There were delays in issue of work orders by GCC, ranging from two to five months. Further, the milestones, as provided in the agreement (20 per cent of work in six months period), were not achieved in 25 packages and achievement was less than 10 per cent in ten packages, as of August 2016 (**Appendix 5.2**).

The remaining four packages, which were to be executed in Nandambakkam, Padikuppam, Ambattur SIDCO and Nolambur Canals, were not taken up due to non-clearance of encroachments. Subsequent to 2015 floods, GCC

¹⁴ Alandur, Ambattur, Perungudi and Valasaravakkam zones, which were added (2011) to Chennai Corporation as part of additional eight zones

prepared (July and August 2016) Resettlement Action Plan to motivate voluntary resettlement of encroachers. Based on the action plans prepared for three of the four canals, TNSCB rehabilitated the encroachers of Nandambakkam Canal area and action was being taken to rehabilitate the encroachers dwelling in Ambattur SIDCO, Nolambur and Padi kuppam Canals.

Despite eviction of encroachers from one canal and progress made in respect of other canals, GCC had not initiated action for commencing work in these four packages. However, the works for construction of SWDs in the streets, which had disposal points in these canals, were awarded (January 2016) and were being executed.

The delays in execution of SWD works delayed accrual of the benefits. We observed that construction of SWDs without execution of works in canals would not mitigate the floods.

5.3.1 Construction and maintenance of Storm Water Drains

Expenditure on construction and maintenance of SWDs, as a percentage of total expenditure of GCC, during 2011-12 to 2015-16 is given in **Table 5.2**.

Table 5.2: SWD in GCC

(₹ in crore)

Year	Total expenditure			Expenditure on SWD			Percentage of SWD expenditure to total expenditure
	Revenue	Capital	Total	Revenue	Capital	Total	
2011-12	924.66	269.55	1,194.21	0.41	77.90	78.31	7
2012-13	1,413.78	732.72	2,146.50	1.13	162.76	163.89	8
2013-14	1,973.15	1,392.63	3,365.78	1.02	236.01	237.03	7
2014-15	2,222.67	1,923.91	4,146.58	7.90	198.31	206.21	5
2015-16	2,536.01	1,742.79	4,278.80	11.81	158.55	170.36	4
Total	9,070.27	6,061.60	15,131.87	22.27	833.53	855.80	6

(Source: Details furnished by GCC)

The percentage of expenditure on SWD to the total expenditure of GCC during 2011-16 ranged from four to eight *per cent*. The financial outlay for SWD was found to be inadequate in the face of the huge shortfall in the coverage of SWDs in GCC area, leading to inundation of areas, as discussed in the succeeding paragraphs.

5.3.2 Non-achievement of targets due to poor outlay

Achievement of targets, as of August 2016, against the targets set (April 2006) under City Development Plan for provision of SWD in City and other urban areas by 2011/2016 is given in **Table 5.3**.

Table 5.3: SWD - Targets and achievements

Zone	Length of road (in kms.)	Target for SWD achievement as per City Development Plan (in per cent)		Length of SWD provided (in kms.)	Actual achievement Percentage (as of August 2016)
		2011	2016		
Adyar	411.52	100	100	136.33	33
Alandur	231.84	40	60	86.17	37
Ambattur	496.51	40	60	29.97	6
Kodambakkam	456.36	100	100	189.60	42
Perungudi	455.47	40	60	55.94	12

(Source: Details furnished by zonal offices)

We observed that even the targets fixed for 2011 were not achieved as of August 2016 in any of the sampled Zones and the GCC had a long way to go to achieve 2016 target. From the above, it could be observed that the length of SWD in the selected zones was 6 to 42 *per cent* of the total length of the roads. In terms of number of streets, scrutiny of records revealed that SWDs were not provided in 4,854¹⁵ out of 9,225 streets in four¹⁶ of the five sampled Zones (53 *per cent*).

While conceding to the low coverage of SWDs, GoTN stated (April 2017) that in respect of Ambattur Zone, works were in progress to provide SWDs under the World bank aided TNSUDP. Further, GoTN stated that the natural topography of Adyar zone was sloping towards water body, requiring lesser coverage of SWD network. The reply was untenable as Adyar was one of the worst affected areas during floods of 2015. The fact of vulnerability of Adyar area to inundation was indicated by the fact that according to a micro level study conducted by GCC in 2014, the Adyar Zone had 21 out of 52 water stagnant 'hot spots' in the city, requiring attention. This proved that the contention of GoTN that Adyar required lesser coverage of SWD in view of its topography was incorrect.

5.3.3 Poor maintenance of Storm Water Drains

As per the Disaster Management Plan prepared (2014) by GCC, zonal offices should complete the pre-monsoon activities, which *inter-alia* included cleaning of SWDs, before the onset of monsoons.

Scrutiny of records in the test checked zones revealed that cleaning of SWDs was not done in 163 out of 614 streets with drains in Kodambakkam zone during 2013-16 and in all 898 streets with drains in Perungudi zone during 2015-16. Further, work orders for cleaning of SWDs in four Divisions of Kodambakkam zone were issued in October 2015 after the onset of the

¹⁵ Alandur: 397, Ambattur: 780, Kodambakkam: 1,776 and Perungudi: 1,901

¹⁶ Except Adyar zone for which details were not furnished

monsoons and the works were completed in December 2015 and January 2016. Non-cleaning of SWDs contributed to inundation of these areas.

GoTN, in their reply (April 2017) reasoned that the ban on manual scavenging imposed by the Hon'ble Madras High Court caused difficulties in cleaning SWDs. We noticed that only because of the 233 illegal sewer lines linked to SWDs (October 2016), cleaning of SWDs became an issue. We observed that GCC failed to effectively prevent sewage entering SWDs, leading to non-cleaning and consequent flooding due to overload and clogging of these SWDs.

5.4 Storm Water Drain network in suburban areas

Scrutiny of records of Tambaram, Sembakkam and Pallavapuram Municipalities and Perungalathur, Peerkankaranai and Thiruneermalai Town Panchayats and joint inspection of sites alongwith the local bodies' officials revealed the following regarding maintenance of SWDs:

5.4.1 Inadequate funds for Storm Water Drain

The details of total expenditure of the selected local bodies and the expenditure incurred by them on SWDs during 2011-16 were as under (Table 5.4).

Table 5.4: Expenditure on SWD

Name of Municipality/ Town Panchayat	Total expenditure (₹ in crore)						Expenditure on SWD (₹ in crore)						Percentage
	2011-12	2012-13	2013-14	2014-15	2015-16	Total	2011-12	2012-13	2013-14	2014-15	2015-16	Total	
Pallavapuram	25.13	33.41	37.18	40.25	49.80	185.77	0.49	1.37	2.11	1.44	2.93	8.34	4
Peerkankaranai	2.50	2.78	3.10	3.91	5.51	17.80	0.22	0.73	0.99	0.96	1.18	4.08	23
Perungalathur	4.95	5.09	6.89	5.82	11.10	33.85	0.08	0.10	1.07	0.21	0.76	2.22	7
Sembakkam	4.76	5.30	8.30	8.67	11.67	38.70	0.15	0.72	1.51	2.81	2.81	8.00	21
Tambaram	24.56	30.45	41.28	47.85	58.80	202.94	3.66	8.03	8.27	8.33	12.86	41.15	20
Thiruneermalai	4.06	4.24	6.19	5.04	5.00	24.53	0.15	0.55	0.86	0.33	0.37	2.26	9

(Source: Details furnished by the respective local bodies)

As seen from the above, the percentage of expenditure incurred for provision and maintenance of SWDs, with reference to total expenditure, ranged from 4 to 23 *per cent* during 2011-16. The poor outlay had resulted in non-provision of SWDs leading to inundation of areas in the selected local bodies during floods, the details of which are given in **Appendix 5.3**.

Government stated (April 2017) that lesser percentage of expenditure for SWD was due to paucity of funds and the need to incur expenditure on unavoidable and more essential works. The reply was incorrect as these local

bodies had accumulated surplus¹⁷ as of March 2016 and hence there was no paucity for funds. We observed that the local bodies were not making serious efforts to provide SWDs which had contributed to flooding causing huge loss to life and property.

5.4.2 Inadequate/non-provision of Storm Water Drains by local bodies

According to the service level benchmark for SWDs, stipulated by GoI, Ministry of Urban Development, only 'covered pucca drains' are to be considered for the purpose of calculation of achievement of SWD coverage. *Kutcha* drains are unreliable as they are constructed without scientific design and get clogged by filth entering them as they are not covered. The length of SWDs provided by selected local bodies, as of March 2016, was as under (Table 5.5).

Table 5.5: SWD in suburban local bodies

Municipality/ Town Panchayat	Length of road (in kms.)	Length of SWD provided (in km.)		Percentage	
		Kutcha	Pucca	Kutcha	Pucca
Pallavapuram	242.00	172.00	3.00	71	1
Peerkankaranai	41.65	26.60	0	64	0
Perungalathur	83.56	40.18	0	48	0
Sembakkam	100.42	0	85.35	0	85
Tamparam	164.75	0	142.75	0	87
Thiruneermalai	39.36	32.86	0	83	0

(Source: Details furnished by the local bodies)

It is evident from the table above that without constructing pucca drains as per service level benchmark for SWDs, four out of six local bodies had mostly constructed *kutcha* drains. Therefore, *kutcha* drains constructed without proper scientific design with cover were not considered as proper SWDs.

We observed that in four out of six local bodies test checked, construction of pucca SWDs with reference to total length of the roads was almost nil while in two local bodies, it ranged from 85 to 87 *per cent*. Pallavapuram Municipality and Peerkankaranai, Perungalathur, and Thiruneermalai Town Panchayats did not achieve coverage of SWD in 321¹⁸ streets as against the target of 50 *per cent* set out in the City Development Plan to be achieved by 2016.

We, therefore, observed that lack of a Master Plan as envisaged in IRC and non-attachment of adequate importance for SWD works resulted in poor coverage of SWDs in suburban areas leading to inundation.

¹⁷ Pallavaram Municipality - ₹ 43.16 crore; Sembakkam Municipality - ₹ 20.45 crore; Tamparam Municipality - ₹ 48.41 crore; Peerkankaranai TP - ₹ 9.55 crore; Perungalathur TP - ₹ 32.93 crore and Thiruneermalai TP - ₹ 12.51 crore

¹⁸ Pallavapuram: 206, Peerkankaranai: 5, Perungalathur: 103 and Thiruneermalai: 7

Government stated (April 2017) that adequate funds would be provided to construct SWD in left out streets. The reply was not tenable as even with the available funds the local bodies had spent on *kutchha* drains instead of pucca drains as per the service level benchmark for SWDs, thereby defeating the very objective of constructing SWDs.

5.4.3 Non-implementation of consultant s recommendations on improving Storm Water Drains in Tambaram

In 2011, GoTN appointed a consultant for preparation of a DPR for construction of SWDs in six Municipalities, including Tambaram in CMA. In Zone 5 and Zone 9 of Tambaram Municipality, 14 Wards¹⁹ were identified as priority areas for SWDs at a cost of ₹ 17.24 crore, which were to be taken up in the first phase of four months.

We observed that despite a lapse of three years the Municipality did not take up any of the proposed works in the priority areas as suggested in the DPR as GoTN had not yet issued Administrative Sanction for taking up SWD works in the six Municipalities based on the DPR of March 2014. Major flooding had occurred during 2015 in the areas identified in the DPR as flood prone and priority areas, leading to damages including to roads, which were estimated to cost ₹ 25 crore for repairing.

GoTN replied (April 2017) that SWDs were constructed in 2 of the 14 prioritised wards. We noticed that even in the two wards mentioned by GoTN, SWDs were constructed only in few streets, and no work was approved in the remaining 12 wards. Thus, the DPR proposal to construct SWDs on priority basis in 12 out of the 14 wards, which required urgent action, did not materialise even after a lapse of three years, contributing to flooding in these areas during 2015.

5.4.4 Inadequate provision of Storm Water Drain on State Highways

Inside Tambaram Municipal area, 9.7 km of roads were owned and maintained by State Highways Department. Scrutiny of records of Highways Department revealed that SWDs were provided in a scattered manner for a length of 3.47 km on left side and 3.26 kms on right side without linkage and continuity. To an Audit query on non-construction of SWDs for the full length of the roads, the Assistant Divisional Engineer (Construction and Maintenance), Highways Sub Division, Tambaram and Government stated (June 2016/April 2017) that due to non-availability of land, SWDs were provided only in the locations, wherever the land was available. We observed that construction of SWDs in a sporadic manner, citing non-availability of land, indicated that the Highways Department had worked in an unprofessional manner without draining the rain water from the roads. On scrutiny of records pertaining to flood affected areas of Tambaram Municipality, we noticed that rain water stagnated in the areas abutting the highways during 2015.

¹⁹ Ward numbers 11, 12, 13, 14, 17, 18, 20, 22, 28, 29, 30, 31, 32 and 38

Thus, failure of the Highways Department in not constructing the SWDs for full length of the roads resulted in wasteful expenditure on sporadic construction of SWDs without linkage, and consequent inundation of the areas abutting Highways in Tambaram Municipality.

5.4.5 Partial execution of Storm Water Drain works

SWDs in internal streets (small lanes and by lanes) were to be designed in such a way that they collected rain water, seamlessly connected with sub-main and discharged the water into the main drain. However, scrutiny of records of Pallavapuram Municipality revealed that SWDs were constructed in bits and pieces, without seamless connectivity in the streets (**Appendix 5.4**), as against the provisions made in the respective estimates. When pointed out by Audit (June 2016), the Municipal Commissioner stated that the works were stopped due to public objection.

We observed that non-provision of SWDs to the full length in the streets, despite sanction of funds, defeated the objective of creating comprehensive drainage facilities, which contributed to inundation of these areas during floods of 2015. Government stated (April 2017) that the work of connectivity would be taken up during 2017-18 as the public had come forward for construction of SWD.

We observed that executing SWD works in bits and pieces was indicative of an unprofessional style of functioning of Pallavapuram Municipality. Stoppage of the SWD works, which were to benefit the public citing public objection, indicated that the Municipality failed to authoritatively negotiate with public to overcome the objection.

5.5 Clogging of storm water drains due to unauthorised entry of sewage

Underground sewerage system (UGSS) scheme was intended to carry sewage from households, commercial establishments and industries to treatment plants. UGSS is helpful to mitigate health issues arising due to open sewers. The untreated sewage carried by UGSS are treated by sewage treatment plants before being led into major drains. In places where the UGSS were either not available or not functioning, sewage got discharged into SWDs, which were constructed to carry rain water. The illegal action of allowing untreated sewage to enter SWDs caused clogging of the drains thereby blocking the flow of rain water through the existing SWD system.

The position in sample local bodies is discussed below:

5.5.1 Non-completion of underground Sewage Scheme in Tambaram Municipality

GoTN accorded (May 2009) administrative approval for implementing UGSS at a cost of ₹ 160.97 crore in Tambaram Municipal area through CMWSSB. The project was to be completed by August 2014. Out of four packages of works included in the project, one package entrusted (September 2009) by the CMWSSB to a contractor was terminated (June 2014) due to slow progress. The execution of the package was taken over by the Municipality in June 2014, but entrusted to a contractor only in March 2016 due to poor response to first three tender calls. The three other packages executed by CMWSSB were also not completed due to slow progress of work.

The project scheduled to be completed by August 2014 was not completed even as of March 2017 and the sullage from houses in many parts of the town continued to flow into SWDs and clogged them leading to inundation in Tambaram Municipal area.

5.5.2 Non-implementation of Project in other selected local bodies

GoTN accorded (December 2009) administrative sanction for implementing UGSS in the areas of Perungalathur, Peerkankaranai and Sembakkam local bodies at a cost of ₹ 130.72 crore, funded equally by JNNURM (50 per cent) and loan (50 per cent).

While the preliminary works were underway, the GoTN cancelled (September 2010) the implementation on the ground that these local bodies were not financially sound to repay the loan proposed to be taken for implementation of this scheme.

After six years, Sembakkam Municipal Council (January 2016) decided to implement UGSS in its area and sought approval of Commissioner of Municipal Administration for preparation of Detailed Project Report, which was awaited (March 2017).

We observed that rather than finding source of funds, GoTN took a wrong decision to drop an approved project to provide UGSS to three suburban areas of CMA. This clearly indicated bad governance, contributing to sullage being let out into SWDs. We observed that clogging of SWDs also contributed to the inundation in the suburban areas of Pallavapuram, Peerkankaranai, Perungalathur, Sembakkam, Tambaram and Thiruneermalai.

5.6 Pre-monsoon preparedness work

The rivers and drains in CMA are seasonal in nature with water flow only during monsoon. The rivers and drains get dried up in the non-monsoon period, except for the sewage unauthorisedly entering them. Misuse of dried rivers/drains for dumping solid waste and debris and growth of vegetation hinders free flow of water in the monsoon months. Therefore, every year, CE, WRD initiates action before the onset of North East monsoon for removal of silt, floating materials, vegetation and other obstructions to ensure free flow of

water. These pre-monsoon works also include continuous cleaning of vulnerable points during monsoon also.

5.6.1 Delay in release of funds for pre-monsoon works

Paragraph 4.12.2 of the National Disaster Management guidelines for urban flooding envisaged that desilting of drains is a major activity in flood management. Unauthorised disposal of untreated sewage, garbage, bio-degraded solid waste and growth of vegetation causes siltation of major and micro drains.

Commissioner of Revenue Administration (CRA) in their circular for disaster preparedness for the North East Monsoon also instructed (August 2015) that all water courses had to be desilted well before the onset of North East Monsoon.

The pre-monsoon work involving removal of silt, slush, debris, weeds, desilting and reforming the bund of the drains maintained by WRD was proposed for execution every year. North East Monsoon in the State is from October to December and hence the pre-monsoon works were required to be executed prior to onset of monsoon for effective clearance of debris from the water bodies.

The details of the pre-monsoon works proposed, sanctioned, executed in Kosasthalaiyar Basin, Lower Palar Basin and Araniyar Basin Divisions along with the expenditure and the dates of onset of monsoon are given in the **Table 5.6**.

Table 5.6: Details of execution of pre-monsoon works

Year	Date of Administrative Sanction	No. of works proposed	No. of works sanctioned and executed	Expenditure (₹ in crore)	Date of onset of monsoon	Date of commencement of pre-monsoon works	Date of completion of pre-monsoon work
2011	30/08/2011	58	58	3.59	24/10/2011	02/09/2011 to 27/09/2011	21/09/2011 to 15/12/2011
2012	18/09/2012	71	63	3.59	19/10/2012	25/09/2012 to 01/10/2012	17/10/2012 to 31/12/2012
2013	06/09/2013	68	58	3.57	21/10/2013	27/09/2013 to 03/10/2013	23/10/2013 to 30/12/2013
2014	13/10/2014	54	43	3.60	18/10/2014	16/10/2014 to 02/12/2014	31/10/2014 to 31/12/2014
2015	29/10/2015	52	41	3.59	28/10/2015	06/11/2015 to 01/12/2015	15/11/2015 to 31/12/2015

(Source: Details furnished by WRD)

From the details illustrated in the table, we observed as follows:

- GoTN did not sanction all the proposals received for undertaking pre-monsoon works, except during 2011.
- As sanction of funds during the five year period of 2011 to 2015 was almost the same, the number of pre-monsoon works sanctioned was in the decreasing trend during 2012 to 2015.

- GoTN belatedly released funds for pre-monsoon works during 2014 and 2015, leading to commencement and execution of 84 works after the onset of the monsoon. The execution of work after the commencement of monsoon hindered the free flow of flood water
- Though pre-monsoon works for the year 2013 were sanctioned by GoTN prior to monsoon, the works were not completed before the onset of monsoon.

Thus, the GoTN did not provide adequate funds on the basis of the proposals received from WRD, and failed to release funds prior to the onset of the monsoon in the year 2014 and 2015, leading to ineffective execution of pre-monsoon works, contributing to floodings.

Government replied (March 2017) that the pre-monsoon works were commenced prior to monsoon and continued during the monsoon period for clearance of debris, etc. The reply was not acceptable as the works which were required to be carried prior to the onset of monsoon were not completed before onset of monsoon in 2013, 2014 and 2015.

5.6.2 Non-desilting of canals by GCC

As per extant Rules, water bodies catering to 40 hectare or more of agricultural land were to be maintained by WRD and other than those were to be maintained by the respective local bodies. The details of water bodies maintained by GCC and WRD in the selected zones, Municipalities and Town Panchayats are given in **Appendix 5.5**.

During joint inspection (August to October 2016) of water bodies in GCC area by Audit and GCC officials, it was noticed that GCC failed to undertake any desilting works in the three out of four canals in Kodambakkam Zone and six out of eight canals in Ambattur Zone during 2011-16, which contributed to inundation in respective areas during floods of 2015. Further, Veerangal Odai (Alandur Zone) intended for draining excess water from the Adambakkam Lake, which finally drains out in Pallikaranai marsh, was also not maintained by WRD to facilitate free flow of flood water, leading to flooding in Adambakkam area.

5.7 Non-adherence to instructions on supervising desilting of water bodies

The CRA issued circulars prior to North East Monsoon 2014 and 2015 to all the Collectors to oversee the cleaning/desilting of natural water courses, clearance of encroachment etc.

We noticed that the District Collector, Chennai had not done any supervision of pre-monsoon works. To an audit query, the District Collector, Chennai replied (June 2016) that the pre-monsoon works were being carried out by the GCC and WRD. The reply was not tenable as the District Collector was responsible for overseeing the work by WRD. The District Collector, Tiruvallur inspected the pre-monsoon works only after the monsoon. The

District Collector, Kancheepuram inspected the works carried out only in 4 out of 12 Taluks.

Thus, the instructions of the CRA were not followed by the respective Collectors in overseeing pre-monsoon works which also contributed to flooding.

5.8 Flood mitigation measures in Adyar River

Adyar River course starts from Adanur Tank in Kancheepuram District and flows through Chennai city before draining into Bay of Bengal. The width of the river was not uniform in the entire stretch and it ranged between 30 m and 200 m. As per WRD records, 222 tanks with storage capacity of 7.41 TMC, influence the flow of water in Adyar River. The surplus course of a major tank Chembarambakkam with storage capacity of 3.645 TMC flows into the Adyar River near Thiruneermalai. The maximum flood carrying capacity of Adyar River in Chennai city as of October 2013, determined based on 100-year discharge ranged between 30,229 cusec and 49,652 cusec.

Historically, flooding in Chennai city was caused by overflow of flood water in Adyar River. Floods in Adyar River had caused inundation in Chennai and suburban areas in 1976, 1985, 1996 and 2005. The river with a carrying capacity ranging from 30,229 to 49,652 cusec, recorded a flow of 1.34 lakh cusec²⁰ on 1 December 2015 due to incessant rains and discharge of surplus water from Chembarambakkam Tank and several other unregulated tanks.

The recommendations made for mitigation of flood in Chennai city and its suburbs by various agencies nominated by GoTN and GoI were as detailed below:

- Nucleus Cell formed in CMDA to suggest measures for flood problems recommended (1980) creation of two new tanks above Chembarambakkam Tank and diversion channel from Perungalathur/Tambaram to transfer 10,000-15,000 cusec of surplus water from Adyar River to Covelong backwaters of Bay of Bengal.
- Report on Dam Safety Procedures issued by Central Water Commission, GoI (July 1986) envisaged preparation of Inundation map as the first input for planning an effective emergency preparedness. It was also envisaged to analyse the inundation history of the past 25 years and 50 years to assess safe carrying capacity of the downstream channel and the vulnerability of different areas through which the surplus water from the dam passed through. These inundation maps were to facilitate in prioritising structural measures to prevent floods.
- Report on Dam Safety Procedures issued by Central Water Commission, GoI (July 1986) envisaged that the flood carrying

²⁰ Estimated by Indian Institute of Science, Bengaluru adopting simulated hydrologic model

capacity of the river channels downstream of the dam shall be reviewed at intervals of five years.

- National Disaster Management Authority (NDMA) in their Guidelines (January 2008) recommended the State Governments to identify the locations and to take up channel improvement works like embankments, flood protection walls, etc., to increase the velocity or area of flow and reduce flood level in the river depending upon site-specific conditions and techno-economic considerations.
- Anna University, Chennai, engaged²¹ (2010) to prepare flood mapping of Chennai city and its suburbs by using Air-borne Laser Terrain Mapper (ALTM) technology, recommended (March 2012) for establishment of Automatic Weather Stations for development of an Early Warning and Decision Support System for Urban Flood Management in addition to IMD predictions.
- The National Water Policy 2012 envisaged installation of real time data acquisition system for flood forecasting and flood preparedness.
- An Expert Committee constituted by GoTN to suggest measures to minimise flood hazard and to optimise utilisation of monsoon rains recommended (October 2012) for construction of two check dams at Varadharajapuram and Anakaputhur villages to harness the surplus flow of flood waters through Adyar River.

We observed that these recommendations were not given due importance by GoTN to mitigate the floods arising due to North East Monsoon which resulted in unprecedented floods in Chennai and its suburbs during December 2015, as detailed below:

5.8.1 Creation of new reservoirs

Non-construction of two tanks in the upstream of Chembarambakkam Tank, as per Nucleus Cell's recommendations, and dropping of the proposal to construct a reservoir across Adyar River at Thiruneermalai have already been commented in **Paragraph 3.1.1**. Failures of WRD in execution of other structural measures suggested by the Nucleus Cell and the Expert Committee (2012) are discussed hereunder:

- GoTN did not consider the recommendation of the Nucleus Cell for construction of diversion channel from Perungalathur/Tambaram to transfer 10,000-15,000 cusec of surplus water from Adyar River to Covelong backwaters. We observed that the diversion channel proposed by the Nucleus Cell could have diverted a substantial flood load from Adyar River so that the flow in the river gets reduced. We also observed that GoTN neither made any attempt for acquiring land to construct the diversion channel nor made any provision in the SMP to earmark land for the channel by restricting development in the area.

²¹ By GoI, Ministry of Science & Technology and GoTN at a cost of ₹ 2.47 crore

- GoTN did not consider construction of two check dams at Varadharajapuram and Anakaputhur villages to minimise flood hazard and to harness the surplus flow of flood waters through Adyar River despite it being recommended by the Expert Committee on North East Monsoon rains. On the contrary, it allowed the Airports Authority of India to demolish a check dam constructed across Adyar River as discussed in **Paragraph 4.5(v)**. We observed that construction of the suggested check dams could have accommodated flood and to that extent the flow in Adyar River would have been reduced.

Thus, GoTN failed not only to create new reservoirs and check dams to mitigate the flood hazard due to monsoon rains, but also did not take any action to divert flood water from Adyar River despite recommendation by Nucleus Cell and Expert Committee resulting in inundations due to floods during December 2015 rains.

GoTN stated (May 2017) that the proposed and sanctioned reservoirs could not be taken up due to non-acquisition of land and urbanisation of the city. The issues like non-acquisition of land and urbanisation cited as reasons for not creating new reservoir by the GoTN were well in its capability and authority as brought out in this Report in the light of the benchmarks mentioned in the FMP and SMP.

5.8.2 Non-creation of flood protection wall

The NDM guidelines, 2008 recommended to carry out river channel improvement works as a measure to reduce the flood level in the river. Taking into the account the flood vulnerability near Nandambakkam bridge on Adyar River, GoTN sent (July 2008) to GoI, a detailed proposal for flood protection works on left bank of Adyar River for execution under centrally sponsored Flood Management Programme (2007-12). The proposal was withdrawn (March 2012) by the WRD on the plea that an amount of ₹ 1.06 crore would be required for acquisition of 0.69 ha of agricultural and residential land, which in fact was a very meagre amount. Thus, the injudicious decision of the WRD for deletion of the proposal resulted in non-execution of flood protection work as envisaged in the NDM guidelines which led to huge inundation in adjoining areas.

Thus, the failure of WRD in acquiring the meagre area of land by way of paying compensation had led to non-creation of important component of river improvement work by constructing flood protection wall. This was one of the failures, which contributed to inundation in the adjoining areas. The issue of failure of WRD in acquiring meager area of land requires to be investigated by GoTN, which entailed serious consequences.

Furthermore, this failure of WRD had also contributed to the inundation at MIOT Hospital, where critical patients were admitted and no help could be extended during the time of flooding.

5.8.3 Non-desilting of Adyar River

Report on Dam Safety Procedures issued by Central Water Commission, GoI (July 1986) envisaged that the flood carrying capacity of the river channels downstream of the dam shall be reviewed after every five years. Watershed Management Division of WRD, Pollachi, was responsible to conduct sedimentation survey to identify the extent of siltation in the tanks and rivers.

We observed that in terms of CWC guidelines, the Watershed Management Division of WRD did not conduct any survey to assess the extent of siltation in the Adyar River during the years 2011-12 to 2015-16 enabling WRD to carryout desiltation works to enhance the flood carrying capacity in violation of CWC guidelines. It was pertinent to note that the flood mapping of Chennai city and its suburbs by using ALTM technology conducted by Anna University had also recommended desilting the river courses as an immediate flood mitigation measure in CMA. Non-desilting of Adyar River resulted in overflowing of surplus water over the banks of the river at many points and resultant inundation in the residential areas of Chennai and its suburban areas.

WRD replied (October 2016) that no periodicity for conducting sedimentation studies had been fixed in the Departmental Manuals and survey would be conducted on priority basis. The reply was not acceptable as the CWC guidelines are quite clear about reviewing the carrying capacity of river channels after every five years.

The reply is also indicative of the fact that Manuals are outdated and need to be updated soon. Furthermore, needless to mention that desiltation is a very significant work of flood mitigation, WRD had not even bothered to carry out the work despite knowing the fact that CMA had witnessed several catastrophic floods even in the past. Instead of according seriousness to the desiltation work in the river, WRD cited non-provision of periodicity in Manual, which indicated lack of interest shown by the WRD towards flood mitigation measures.

5.8.4 Absence of Early Warning System for flood management

The Adyar River carried the surplus water from four major unregulated tanks²² besides surplus discharge of Chembarambakkam Tank joining in the midcourse before passing through Chennai and its suburbs for discharging water into Bay of Bengal. Despite recommendations for installation of Automatic Weather Stations for development of an Early Warning and Decision Support System for Urban Flood Management in addition to IMD predictions by Anna University and National Water Policy, WRD did not initiate efforts for installation of Early Warning System. This resulted in non-regulation of the flow of surplus water in the river after obtaining inputs from the controlling officers of various Tanks and overflowing of water over its banks causing inundation.

²²

Adanur, Mannivakkam, Nandhivaram and Urappakkam

WRD in the Exit Conference stated that efforts were being made to complete installation of Early Warning System.

5.8.5 Flood Management of Chembarambakkam Tank influencing Adyar River

Report on Dam Safety Procedures issued (July 1986) by CWC, GoI envisaged that the aim of reservoir operation is to reduce the risk of man-made floods to the area on the downstream through carefully prepared reservoir regulation schedules, release procedure and gate operation schedules aided by an accurate and reliable flood forecasting and warning system.

Paragraph 8.1.2 of the guidelines also stipulated that floods disaster would be considered natural if the quantum of outflow from the dam is equal to the inflow flood. If, however, due to very existence of a dam, the outflow exceeds the inflow, the disaster can be logically classified as man-made. Paragraph 8.2.1, further stipulated that outflow in excess of inflow can be taken care of by developing operation rules with built-in factor of safety and adequate and efficient warning system.

Paragraph 8.8.1 of the guidelines envisaged that an efficient communication system with wireless communication facility should be in place for the success of emergency preparedness plan. Emergency Action Plan (EAP) for Dams, 2006 formulated by CWC, GoI recommended the requirement of inflow forecasting arrangements for better flood management.

Chembarambakkam Tank is one of the largest tanks with a capacity to store 3.645 TMC of water. The original surplus arrangement with three weirs²³ was converted into regulated arrangement by constructing five vented regulators with discharge capacity of 20,410 cusec and subsequently enhanced to 33,060 cusec by constructing (July 1993) 19 vented regulators.

The Rules for Flood Regulations of Chembarambakkam Tank, forming part of Compendium of Rules of Regulations (COR) issued by PWD in October 1984, provided for release of surplus water through three weirs without regulating arrangements. The Rules also provided for estimating the inflows into the tank and promptly intimating the flood discharges to the Chief Engineer, District Collector, Commissioner of Police and Commissioner of Chennai Corporation.

We observed from the scrutiny of records as follows:

Despite stipulations in the CWC guidelines for preparation of reservoir regulation schedules, the COR for Chembarambakkam Tank was not revised by WRD taking into account the regulated discharge of surplus water and enhancement of the height of the tank to 24 feet.

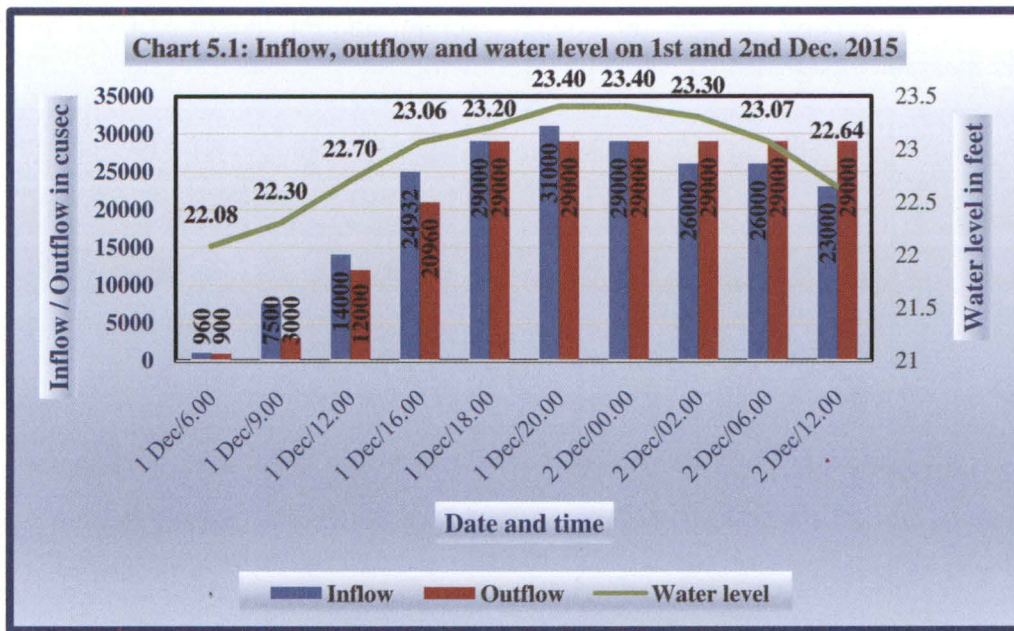
²³ Weirs are structures provided in tanks for surplus water to pass through

A comparison between COR for Poondi reservoir and the unrevised COR for Chembarambakkam Tank revealed the following:

Subject	As per COR for Poondi reservoir	As per COR for Chembarambakkam Tank	Applying the regulated COR of Poondi Reservoir to Chembarambakkam Tank	
			Required	Actuals
(1)	(2)	(3)	(4)	(5)
Declaration of state of Extra-ordinary Emergency	As soon as the reservoir level reaches three feet below Full Reservoir Level.	No such emergency declared. Information to other Departments when the weirs are likely to surplus and water level crosses 25 m.	Extra-ordinary Emergency should have been declared when the depth of water reached 21 feet (It reached 21 feet on 16/11/2015 (12 noon) and the water was maintained above that level till 02/12/2015).	Extra-ordinary Emergency was not declared. District Collector and Police officials were informed on 01/12/2015 when depth of water in the tank was 22.5 feet and flood warnings were issued.
Rainfall and discharge details of upstream tank	During emergency, the details of rainfall, duration, intensity, discharge particulars of upstream tanks were to be obtained.	No reference to emergency. The details of rainfall, inflow and outflow of upstream tanks were required to be collected.	Duration and intensity of the rainfall in the upstream tank were to be collected.	We observed that surplus from Sriperumpudur and Nemam Tanks discharged to Chembarambakkam Tank and there were only two rain gauges to measure the rainfall in its catchment and upstream tanks measuring 357 sq.km. We also observed that the duration and intensity of discharge of upstream tanks was not recorded.
Opening of regulator shutters	The gates should not be opened suddenly. They should be lifted giving time to allow the water level to rise gradually.	No provision as the COR was based on unregulated arrangement.	Gradual opening of gates and release of water.	We observed that the release of water was not gradual as detailed in the succeeding paragraph.

The surplus course of Chembarambakkam Tank joined Adyar River at Thiruneermalai. In the absence of gauges, the inflow into the tank from catchment areas was to be measured based on the increase in the height of water in the tank.

The details of inflow, outflow and water levels of Chembarambakkam Tank for the period from 16/11/2015 to 17/11/2015 and 01/12/2015 to 02/12/2015 are indicated in **Appendix 5.6**. The inflow, outflow and water levels pertaining to the crucial days of 1 and 2 December 2015 are shown in **Chart 5.1**.



(Source: Chart prepared based on data provided by WRD)

We analysed the discharge with reference to the extant rules and observed as under:

Imprudent and injudicious release of water causing massive flood

As per the COR for Regulated Tanks, WRD should store water at the Full Reservoir Level in the month of December, as the monsoon starts receding. The COR also does not allow presence of private *patta* land inside water spread area. As such, the *patta* land was required to be acquired for ensuring storage of water till the full capacity of the reservoir. We observed that the full tank capacity of Chembarambakkam was 3.645 TMC at a storage depth of 24 ft. However, the same was not achieved on any of the days during the receding monsoon of 2015. Even on the days of maximum inflow (01/12/2015 and 02/12/2015), water was stored only up to a maximum of 3.481 TMC, leaving 0.164 TMC of remaining capacity unutilised. We observed that the WRD did not maintain Full Reservoir Level to avoid possible submergence of the *patta* land on foreshore area, which was in absolute violation to the compendium of rules of regulations.

The Department had, therefore, failed to acquire *patta* land to operate the tank to its full capacity. GoTN stated (May 2017) that considering the cost of acquisition of *patta* land, a proposal to enhance the bunds in the foreshore of the tank was in pipeline, the documentary evidence for which was not made available to Audit. Had WRD acquired the *patta* land, the storage capacity could have been maintained to its fullest and magnitude of flooding could have been reduced as more water could have been stored in the reservoir.

The following observation substantiate that maintaining the storage capacity to the maximum, could have reduced the magnitude of the disaster:

- On 01 December 2015, at 2 pm, when the storage stood at 3.377 TMC, which was 0.268 TMC less than the total capacity of the tank, the discharge of water was abruptly increased from 12,000 cusec to 20,960 cusec. Again at 5 pm, the discharge was increased to

25,000 cusec and from 6 pm to 29,000 cusec. Considering the opportunity to store another 0.268 TMC, we firmly hold the view that the discharge could have been maintained at 12,000 cusec for another six hours²⁴, by which an additional quantity of 0.266 TMC could have been stored and yet the storage level would not have reached to the brim. We further observed that this indiscriminate water discharge was made to happen also because of the fact that *patta* land, which was allowed in the foreshore area, was to be saved from submergence. The tank-in-charge, therefore, had not maintained the tank capacity upto the maximum level and consequently, abrupt and un-sustained release of water was done. This was a serious failure in operation of the reservoir, thus, contributing to the massive disaster. Such imprudent and injudicious action by the Tank-in-charge as well as WRD warrants detailed enquiry.

- The discharge of water at 29,000 cusec continuously for 21 hours from 01/12/2015 - 18.00 hrs to 02/12/2015 - 15.00 hrs into the Adyar River coupled with surplus water from the upstream tanks and catchment area, caused huge flow of flood waters into Adyar River. Non-taking up of the desiltation work in Adyar River for increasing the flood water storage capacity along with other flood protection works in Adyar River and the injudicious decision to indiscriminately increase the discharge of water from 12,000 cusec to 29,000 cusec had proved that the disaster that had happened in November-December 2015 was not a natural disaster but was indeed a man-made catastrophe as per CWC norms, for which GoTN was responsible.
- According to CWC norms on Dam Safety, the surplus water released from the tank should be based on the actual inflow only. In the absence of Emergency Action Plan and due to GoTN's failure to update its system/manuals as per CWC guidelines, the water was released in an un-sustained manner. We also observed that the outflow of surplus water was more than inflow into the tank for 13 hours on 02/12/2015 (2.00 hrs to 15.00 hrs; Inflow 23,000 to 26,000 cusec – outflow 29,000 cusec) during the period of rain and despite non-storing of water to its full capacity, in contravention of the Guidelines of CWC prescribing the procedure for Dam safety, resulting in increased flow of water to the already swelling Adyar River.
- We observed that a total quantity of 8.7 TMC of water, which was more than 75 *per cent* of the total capacity of four reservoirs in CMA put together, was discharged from Chembarambakkam into the sea during 17 November to 10 December 2015. As Chembarambakkam Tank plays a very significant role in catering to the water supply needs

²⁴

Additional discharge of 8,960 cusec for three hours, over and above 2 pm discharge of 12,000 cusec between 2 pm to 5 pm would have increased storage by 96.768 mcft ($8,960 \times 60 \times 60 \times 3/10,00,000$) + Additional discharge of 13,000 cusec for one hour, over and above 12,000 cusec between 5 pm to 6 pm would have increased storage by 46.80 mcft ($13,000 \times 60 \times 60 \times 1/10,00,000$) + Additional discharge of 17,000 cusec for two hours, over and above 12,000 cusec between 6 pm and 8 pm would have increased the storage by 122.40 mcft ($17,000 \times 60 \times 60 \times 2 / 10,00,000$)

of Chennai city, the upstream reservoirs, if constructed, as was proposed by the Nucleus Cell, would have helped in storing at least 1.57 TMC and the issue of catering to the drinking water needs could have been addressed to that extent, besides reducing the load on Chembarambakkam.

Absence of scientific real-time flood forecasting and communication facility

- No real-time flood forecast and scientific assessment of inflow, as envisaged in the guidelines of CWC and Anna University (2012) was carried out. As regards inflow, WRD did not have any scientifically proven inflow forecast system and depended only on IMD for weather forecast and reverse mechanism method²⁵ based on the actual increase in the water level of the water spread area. As a result, the actual assessment of inflow could not be ensured and the total outflow exceeded the actual inflow for 13 hours during 02/12/2015 from 2.00 am to 3.00 pm, leading to the massive flooding.
- A scrutiny of periodical Inspection Report on safety of Chembarambakkam dam conducted and submitted to Dam Safety Directorate of the State revealed that the wireless communication facility was not functioning for more than six months before December 2015 floods, indicating that WRD did not possess adequate emergency preparedness plan as envisaged in the Dam Safety Procedure. As a result, on 01 December 2015, when the inflow was more, necessary communications could not be made using the wireless communication devices as was also evident from the fact that no records were made available to audit for ascertaining the fact that communication from the tank-in-charge was actually made with the Government/Departmental authorities on the incoming flood.

Absence of monitoring in release of water from Chembarambakkam Tank

- CWC guidelines on Release Procedure states that the aim of reservoir operation is to reduce the risk of man-made floods through careful preparation of reservoir regulation schedule, release procedure and gate operation schedules with accurate and reliable flood forecasting and warning system. The discharge of water from the Chembarambakkam Tank was monitored and executed by a Section Officer (SO) who was the in-charge of the tank. In absence of any gate opening schedule as prescribed under CWC norms, the decision to release water from the tank vests with the SO in-charge of the tank. As no record was made available to Audit on any communication made by the SO with the Departmental/Government authorities, we observed from the data that on 01 December 2015, when there was a huge discharge of 29,000 cusec of water, the imprudent decision was made by the in-charge of the tank. The Department had stated that there was telephonic communication made by the in-charge of the tank and the Chief Engineer, PWD was personally monitoring the entire activity;

²⁵

Assessment of inflow is made with reference to the rise in the water level of the tank

documentation of the telephonic conversation was though not found on record to ascertain the veracity of the claim made by WRD. The fact, however, remains that even if it was accepted on basis of the reply that supervision and monitoring at Chief Engineer level was in place, the actual inflow and outflow was, nevertheless, not regulated as per CWC norms. Consequently, indiscriminate discharge of water in excess of inflow took place which had further reduced the water level in the tank, as a result of which, burden on Adyar River was more, leading to massive flood in Chennai and in its suburban areas. Thus, though a watchful supervision was in place, as was claimed by WRD, it could not be even ensured that total outflow from Chembarambakkam Tank did not exceed the inflow for 13 hours, as no schedule for gate opening was available. This implies that due to non-ensuring of discharge of water in sustained manner, the catastrophe that had happened during North East Monsoon 2015 may be categorised as a man-made disaster as per CWC Guidelines.

Thus, Department failed to consider the Report on procedures for Dam safety issued by CWC by updating the COR of Chembarambakkam Tank taking into account the regulated surplus arrangement, non-maintenance of full capacity of the tank, non-release of surplus water in a sustained manner, release of surplus water in excess of inflow of water into the tank and to formulate EAP for determination of the actual inflow and management of the tank resulting in un-planned release of water in excess of the carrying capacity of the Adyar River causing huge floods in the residential areas of Chennai and its suburbs during December 2015 rains.

Government replied (March 2017) that the release of water was based on the existing Compendium of Rules of Regulations and revision of Compendium and formulation of EAP were under progress. The reply was not tenable as WRD failed to revise the Compendium even after a lapse of 23 years from the date of installation of regulated arrangement to the tank and no lessons were learnt from the damages caused to life and property in the floods of 2005.

Recommendation No. 18: We recommend immediate updation of the Compendium of Rules of Regulations of Chembarambakkam Tank and fixing responsibility on officials for their failure to follow CWC's guidelines on Dam safety.

5.8.6 Inundation at Thiruneermalai confluence point due to afflux of water and encroachment by local body

The surplus course of Chembarambakkam was constructed in such a way that it joins the Adyar River at Thiruneermalai confluence point on a perpendicular line. Owing to the existence of perpendicular line of meeting design, water flowing from Chembarambakkam surplus course collided with water flowing from Adanur and other Tanks causing afflux action and consequent inundation in the upstream areas during 2015. Besides, the river portion of the confluence point had been encroached by the compound wall of solid waste management unit operated by Thiruneermalai Town Panchayat increasing the afflux action.

Thus, due to heavy discharge of 29,000 cusec of water for continuous 21 hours on 01/12/2015 and 02/12/2015 from Chembarambakkam Tank, the discharged water could not smoothly pass through the confluence point causing immense inundation in the nearby areas. GoTN replied (March 2017) that under the project 'Rehabilitation and Restoration of Floods - damaged Adyar', Administrative Sanction had already been issued (October 2016) for various works including construction of a meeting point curve at Thiruneermalai confluence point where Chembarambakkam surplus water meets the surplus water from Adanur and other tanks. The belated action of GoTN in planning for corrective measures at the confluence point also contributed to flooding.

5.9 Inundations in suburban areas of Chennai

The inundations in various locations of Chennai and its suburbs due to overflowing of flood waters in Adyar River and the major factors contributing to the inundations are discussed in the subsequent paragraphs.

5.9.1 Inundation due to non-desilting of tanks

Report on Dam Safety Procedures issued by Central Water Commission, GoI (July 1986) envisaged that reservoir silt survey should be undertaken at regular intervals and the area capacity of the curve need to be revised accordingly. Watershed Management Division of WRD, Pollachi, was responsible to conduct sedimentation survey to identify the extent of siltation in the tanks.

We observed that no sedimentation survey was conducted in any of the tanks in Chennai, Kancheepuram and Tiruvallur districts except Poondi reservoir (2010). Check of five tanks²⁶ influencing Adyar River by Anna University also revealed that the storage capacity had reduced by 30 per cent, i.e. from 0.780 TMC to 0.576 TMC, due to siltation. Shrinkage of original capacity of 222 tanks led to overflow of water triggering the flooding in Adyar River and non-harnessing of rain waters to an extent of 2.2 TMC²⁷. We also noticed that four tanks viz., Mannivakkam, Nandhivaram, Urappakkam and Adanur, which

²⁶ Manimangalam, Nemam, Pillaipakkam, Porur and Sriperumpudur

²⁷ Capacity of 222 tanks was 7.412 TMC; siltation of 30 per cent worked out to 2.2 TMC

influence Adyar River, breached during the rains. We also observed that due to non-desilting of these tanks, flood waters could not be accommodated to the full tank capacity resulting into heavy inflow of flood waters in Adyar River.

WRD replied (October 2016) that no periodicity for conducting sedimentation studies had been fixed in the Departmental manuals and survey would be conducted on priority basis. The reply was not acceptable because such studies were required to be conducted as per CWC guidelines and their departmental manuals required updation in tune with CWC guidelines.

Recommendation No. 19: We recommend for conduct of sedimentation survey of the tanks in Chennai and its suburbs for taking effective action in removal of the silt and maintaining the original capacity of the tanks.

5.9.2 Inundation due to abrupt ending of channel

Pappan Channel in the southern part of the city, carried surplus water from nearby uncontrolled tanks to Adyar River. The channel passed through a defined course²⁸ on Government land and along road sides, before spreading over private *patta* land and emptying into Adyar River.

We noticed that developments including construction of culverts and foot paths by local bodies and a small bridge and retaining wall constructed by Highways Department, without obtaining NOC from WRD reduced the width of the Channel. Downstream, the channel ended abruptly as residential buildings had come up on the *patta* land near confluence with Adyar River, thus causing inundation in Tambaram, Mudichur, Mannivakam and Perungalathur areas. Joint inspection also showed that a major residential colony was developed on the end point of the Pappan Channel. CMDA stated that the residential area was developed on a *patta* land. The reply was not tenable as the role of CMDA was also to ensure protection of waterways through proper planning. Due to the abrupt ending of the channel, WRD provided a diversion channel after the floods.

During floods of 2015, surplus water from Peerkankaranai and Irumbuliur Lakes caused heavy floods in the Pappan Channel. Due to its limited carrying capacity, the channel could not drain the surplus water received from the lakes quickly into Adyar River and could not negotiate with the Adyar River, which was already in floods, thereby causing heavy inundation in these areas, shown in **Exhibit 5.3**.

²⁸

Defined course is a channel with earthen or concrete bund, as against an undefined or natural course of channel which does not have any structure like a bund to carry the flood through a definite path

Exhibit 5.3: Heavy inundation in the areas of Ward 32 of Tambaram Municipality



(Source: Tambaram Municipality)

Thus, the failure of CMDA in allowing constructions of residential buildings without preserving water course and WRD's failure in protecting the channel under its jurisdiction resulted in inundation of adjoining areas.

Recommendation No. 20: We recommend the GoTN to conduct investigation in the matter of establishment of colonies and constructions in the water bodies in violation of the SMP and CWC guidelines and allowing facilities like power, water connections, roads and other community works.

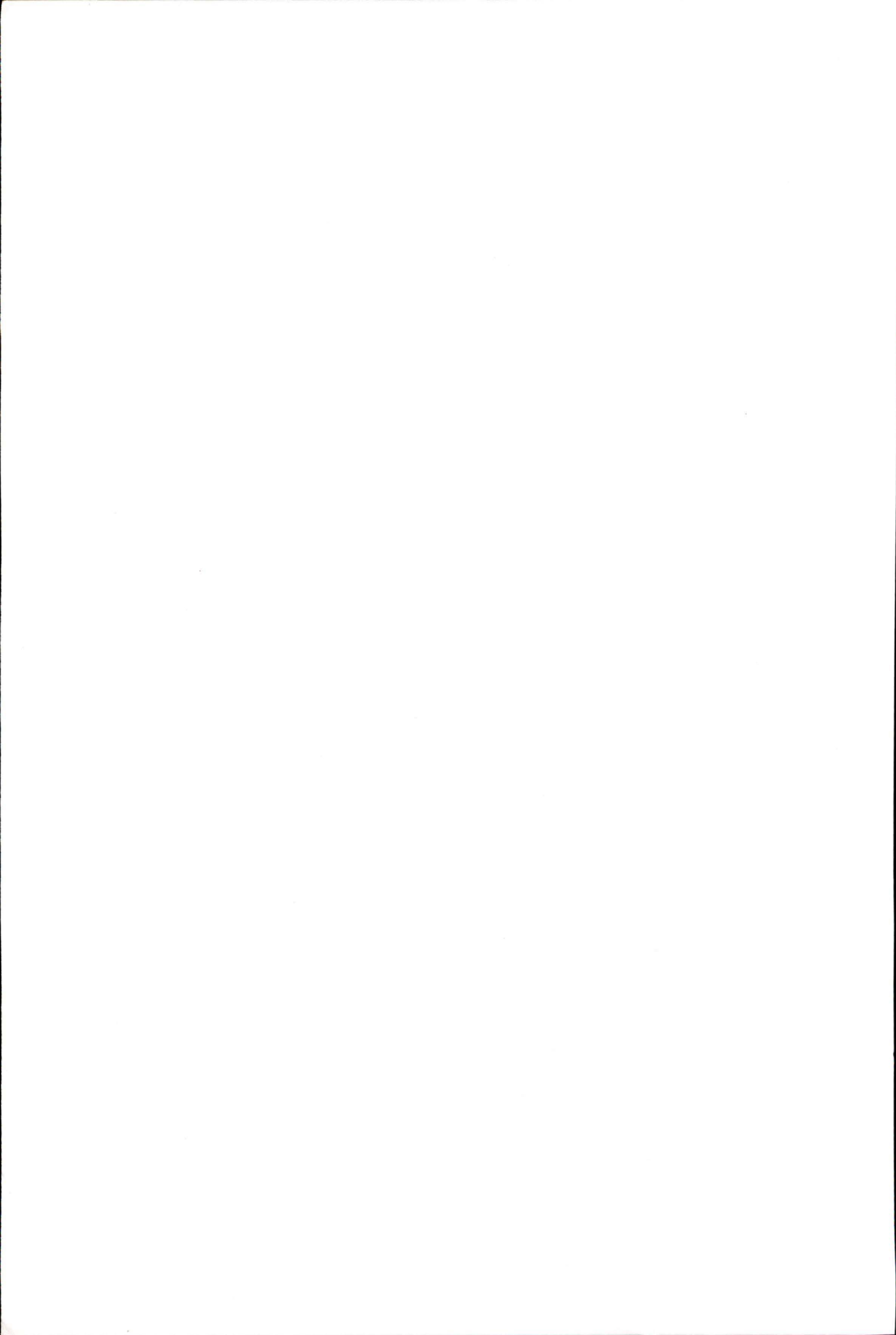
5.10 Analysis

Though Chennai and its suburban areas witness high intensity rainfall during a short span of two to three months every year, Government and its agencies failed to keep the mitigation machinery in full preparedness. Even the stipulated annual desilting of micro and macro drains was largely not carried out or started after the onset of monsoon.

Allowing *patta* lands in the foreshore area of the tanks and inability to acquire lands for flood protection walls indicate the helplessness of GoTN in ensuring safety to its people against disaster.

Improvements to macro drains did not fructify due to encroachment and pending clearance from other agencies. No system existed for real-time flood forecast for releasing of surplus water with due regard to the water carrying capacity of waterways. SWDs were not scientifically designed and lacked seamless connectivity to trunk mains/rivers. Lapses in implementing Underground Sewage Schemes by local bodies led to continued outflow of sewage into SWD and consequent clogging of drains.

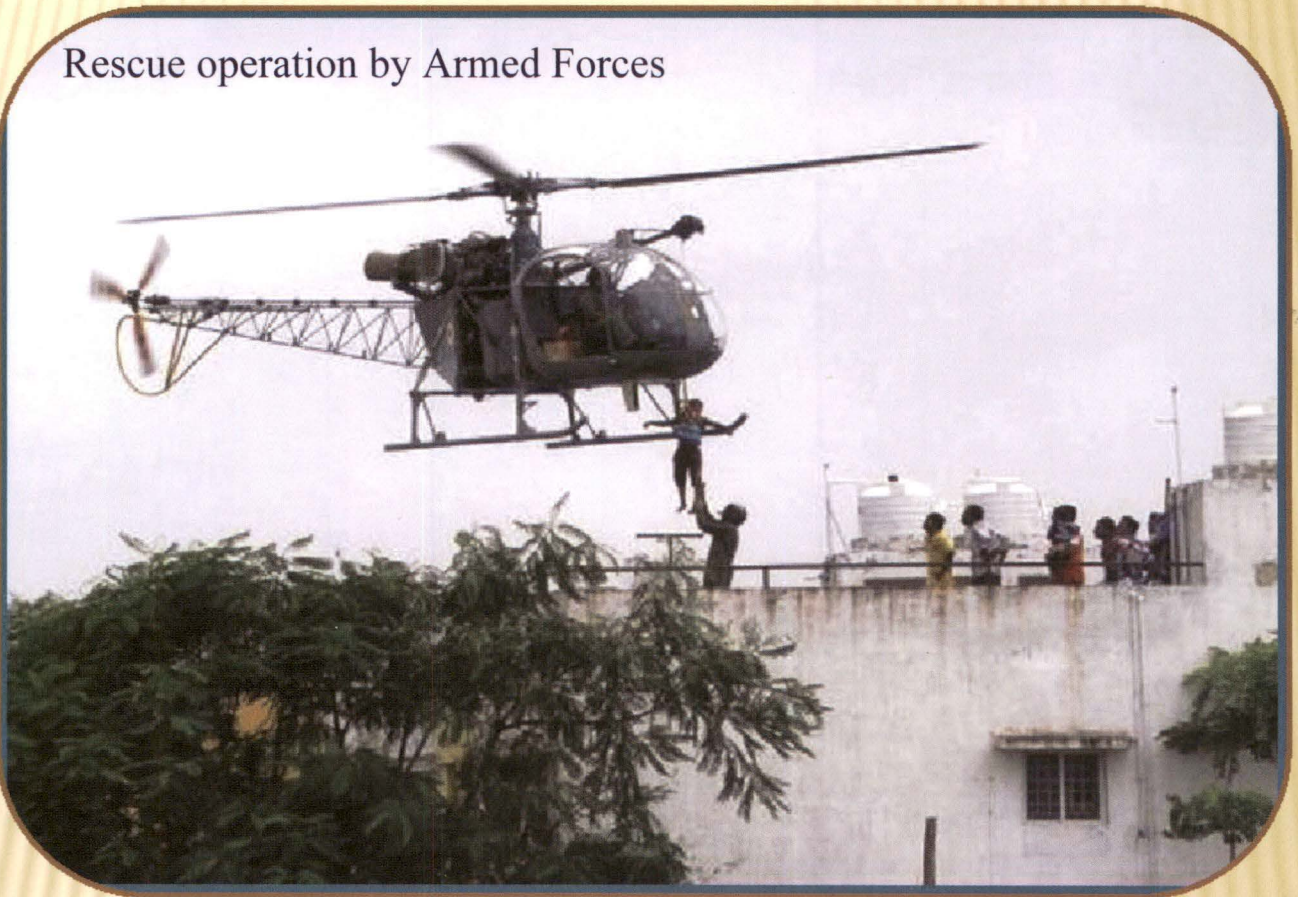
We observed failure of GoTN in carrying out the recommendations of various experts/committees on creation of additional storage capacity in the upstream of Chembarambakkam Tank, construction of diversion channel to Adyar River and construction of two check dams across the river. Moreover, the GoTN did not ensure desilting of the channels and tanks feeding Adyar River besides non-execution of flood protection works, non-adherence to CWC's guidelines on dam safety and release procedures and non-clearance of structural hindrances in the river. Due to all these factors, we conclude that the flooding was man-made in terms of the CWC guidelines.

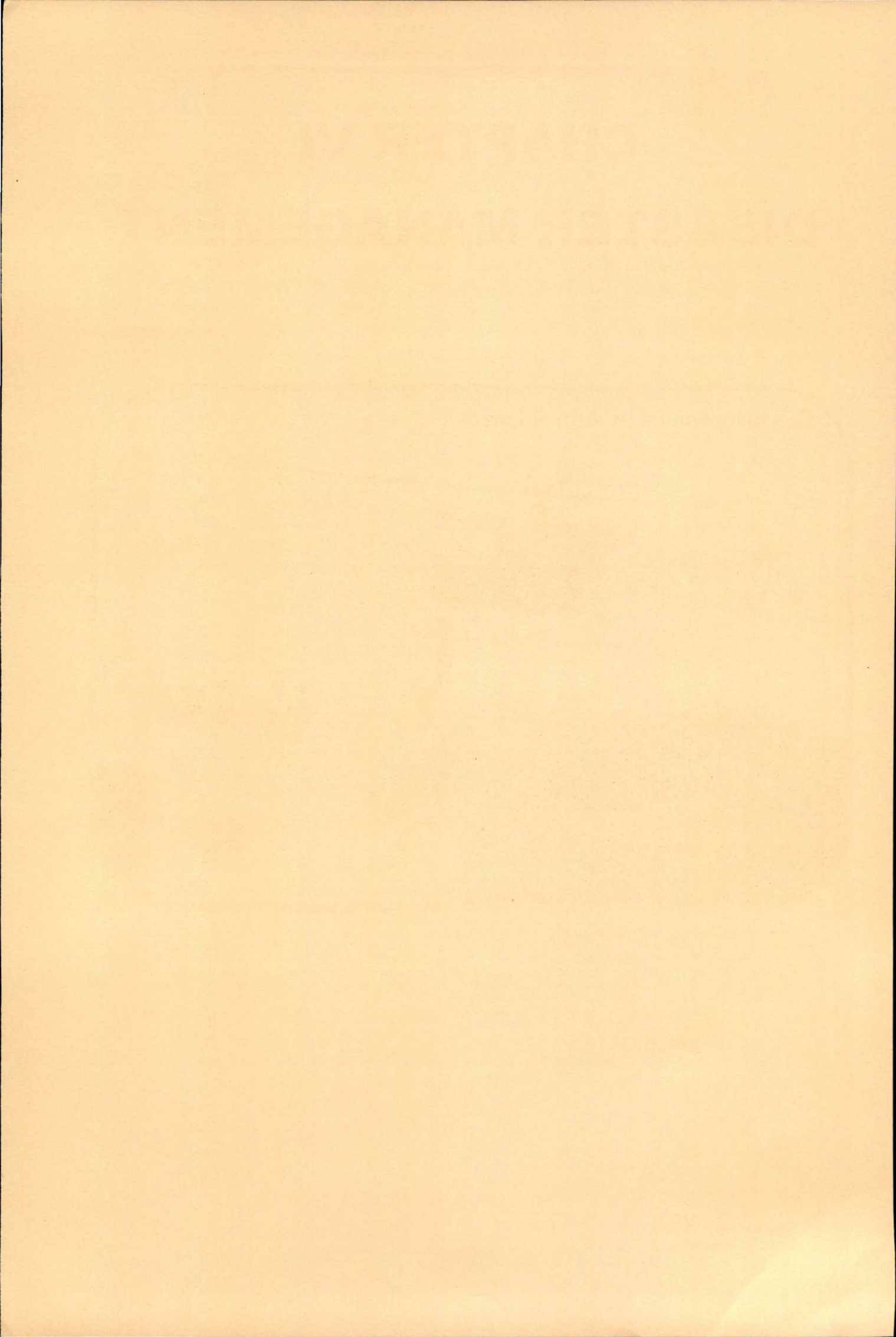


CHAPTER VI

DISASTER MANAGEMENT

Rescue operation by Armed Forces





CHAPTER VI

DISASTER MANAGEMENT

According to Disaster Management Act, 2005 (DM Act), disaster management involves continuous and integrated process of planning, organising, coordinating and implementing measures which are necessary for (i) prevention of threat of any disaster, (ii) mitigation of risk of disaster, (iii) capacity building, (iv) preparedness to deal with disaster, (v) rescue, relief and rehabilitation and reconstruction, etc. After the floods of 2015, GoTN launched rescue and relief operations with the help of various agencies. Deficiencies noticed in long term planning and institutional mechanism and issues in handling the rescue and relief activities are discussed in this chapter.

We have already discussed in previous chapters about various factors which severely handicapped the Government to face the 2015 disaster such as (i) failures in prevention of disaster due to non-adherence to Master Plans, (ii) failures in taking timely action to effect removal of encroachments at various places in the Chennai City including in water bodies, (iii) faulty design and insufficient coverage of SWDs, (iv) failures in mitigation of risk of disaster such as non-construction of several planned channels to divert flood water and (v) non-removal of identified and planned to be removed obstructions, blocking free flow of flood water in river, etc. This chapter deals with deficiencies in capacity building, preparedness to deal with disaster and rescue, relief and reconstruction activities.

6.1 Deficiencies in the institutional framework

6.1.1 Deficiencies in the functioning of State Disaster Management Authority

The Tamil Nadu State Disaster Management Authority (Authority) formed under Section 14(1) of DM Act, 2005, is responsible for disaster preparedness and coordinating rescue and relief measures in the event of a disaster. The following deficiencies on the part of the Authority added to the vulnerability of Chennai city and its suburban areas during the floods in 2015.

The State at its own level, had constituted a Disaster Management Authority under the chairmanship of the Chief Secretary in 2003. However, under Section 14 (2) of DM Act, 2005, the Authority was to be constituted with the Chief Minister (CM) as the Chairperson. Though the Act came into force in 2005, the Authority, which was functioning under the Chief Secretary, was re-constituted in November 2013, with the CM as the chairperson, after a delay of eight years indicating lack of seriousness on the part of the State Government to take care of disasters. The Authority's responsibilities included laying down the State Disaster Management Policy and approving Disaster Management Plan (DMP). We observed that the Authority did not hold its meeting even once after its constitution in November 2013, again

showing lack of seriousness on the part of the State Government at the highest level.

We further noticed that three years after reconstitution of the Authority and after the floods of December 2015, the Executive Council (EC) of the Authority passed (August 2016) a resolution for seeking convenient date from the CM for holding its first meeting, but no such meeting was held till date (April 2017). The delay in constitution of the Authority under the chairmanship of the CM and non-convening of meetings indicated lack of seriousness attached to disaster preparedness on the part of the State Government. GoTN stated (May 2017) that non-convening the meeting of Authority did not dilute the functions, and the response to the natural disaster was carried out effectively under the direction of the CM. The reply was misleading and did not address the issue that GoTN lacked an organised structure and approach for disaster preparedness as mandated under DM Act, 2005 even after facing disastrous floods of 2015.

TN State Disaster Management Agency (TNSDMA), constituted in November 2013, functioning under the Authority was to provide institutional framework for disaster management. As per its bye-laws, it is mandatory for TNSDMA to hold its Annual General Body Meeting (AGM) once a year to discuss the (i) report of the EC, (ii) assets and liabilities, (iii) income and expenditure statement (iv) report of the Auditor and (v) other issues connected with disaster preparedness etc. We, however, observed that the TNSDMA did not hold its AGM since its constitution in November 2013 indicating lack of seriousness for adequate preparedness for facing disaster during 2015 as discussed in subsequent paragraphs.

TNSDMA had been envisaged as a body with financial and administrative resources, to manage disasters. As per existing NDM guidelines, the Central and State funds were to be released to the bank account of TNSDMA. But, we noticed that the bank account was not opened to ensure the envisaged financial autonomy. On the contrary, we noticed that GoTN provided funds through budget which were to be drawn through separate financial sanction, thereby making TNSDMA an entity without the required financial autonomy to swiftly respond to disasters. As a result, the TNSDMA remained dependent on orders from GoTN for release of funds for meeting expenditure for relief measures, such as payment of cash doles, procurement of sarees and dhotis and rice for free distribution to beneficiaries. Thus, the dependence on GoTN had taken avoidable time, which could have been avoided had there been financial autonomy with TNSDMA.

As per Section 17 of the DM Act, 2005, an Advisory Committee had to be constituted consisting of experts in Disaster Management and those having practical experience on Disaster Management. Detailed proposals submitted (September 2014) by TNSDMA on constitution of the Advisory Committee was approved by Government only in October 2016. As a result, the State was deprived of expert advice on disaster preparedness. It was, therefore, evident that GoTN was not serious in adhering to NDM guidelines to protect the lives and properties of the people.

Sections 48(1) (b) and (d) of the DM Act, 2005, envisaged constitution of District Disaster Response Fund and District Disaster Mitigation Fund. Further, GoI advised (September 2010) the State to constitute the above funds. These funds, which were essential to ensure swift response to disasters, were not constituted in all the three audited districts, viz., Chennai, Kancheepuram and Tiruvallur.

Thus, from (i) the delay in constitution of the Authority, (ii) non-convening of Authority's meetings and the AGM of TNSDMA, (iii) the lack of the envisaged financial autonomy to TNSDMA, (iv) the delay in constitution of Advisory Committee and (v) non-establishment of Disaster Response Fund and Disaster Mitigation Fund at District level, we observed that the State lacked an organised system for disaster preparedness and response.

Recommendation No. 21: We recommend that Government should put in place the institutional framework envisaged in the Act and the guidelines issued by GoI. Regular convening of meetings and grant of financial autonomy to TNSDMA should be ensured.

6.1.2 Abnormal delay in preparation of Disaster Management Plan

Section 23(1) of the DM Act, 2005, envisaged preparation of a State DMP. The DMP was to *inter alia* include the roles and responsibilities of the different departments of the Government in responding to the disaster. The DMP was to assess hazard vulnerability and plan preventive measure and disaster response. The DMP was to be updated annually and approved by the Authority.

We observed that in the absence of DMP at the time of floods, preventive measures and disaster response were not organised in a planned manner. We further observed that Anna Institute of Management, Chennai, was engaged (November 2013) to update the draft DMP prepared in 2010. The draft submitted (August 2014) by Anna Institute of Management was not approved (March 2015) by TNSDMA as the plan was not drafted as per the template suggested by National Disaster Management Authority. Though the plan revised in 2016 by the TNSDMA was agreed to by GoTN (October 2016) but it was not approved by the Authority due to non-convening of its meetings (April 2017).

6.2 Shortfalls in capacity building for disaster management

The 13th Finance Commission emphasised the need to train manpower and equip District Emergency Operation Centre (DEOC) to handle complex disaster situations.

The 13th Finance Commission's capacity building grant entitled to GoTN and actually received are given in **Table 6.1** below:

Table 6.1 : 13th Finance Commission s capacity building grant

(₹ in crore)

Year	Grant entitled	Grant actually received	Remarks
2010-11	5.00	0.00	Grant for the first year was received in 2011-12. Grants for 2011-12 and 2012-13 were received only in 2013-14 due to delayed submission of utilisation certificates (UCs). Grant for 2013-14 and 2014-15 were not received due to delayed submission of UCs.
2011-12	5.00	5.00	
2012-13	5.00	0.00	
2013-14	5.00	10.00	
2014-15	5.00	0.00	
Total	25.00	15.00	

(Source: TNSDMA)

The capacity building grant was to be utilised for training manpower, strengthening of DEOC, preparation of educational materials for creating awareness, etc. District authorities procured inventories such as TV, desktop computers, laser printer, fax, furniture, scanner and digital camera etc., using 13th Finance Commission grant for strengthening of DEOCs. We observed that the funds released to districts were inadequate as the sampled Kancheepuram DEOC lacked even basic inventories such as TV, fax machine, scanner and CCTV, which were essential to keep the communication channel open during floods. None of the DEOCs had satellite phones suggested by GoI, which were crucial in situations where the communication network broke down. Further, the DEOCs had not put in place the online Decision Support System envisaged by NDMA to ensure effective communication and swift decision making. The Director, Disaster Management stated (March 2017) that Government was considering procurement of advanced communication equipment. But, the fact remains that due to non-availing of 13th Finance Commission grant in full due to administrative delays on the part of Commissioner of Revenue Administration (CRA), the State could not strengthen its DEOCs to effectively handle the disaster in 2015. Thus, GoTN may review the infrastructural requirements of DEOCs to equip them adequately.

6.3 Deficiencies in functioning of Emergency Operation Centre

As per NDM guidelines of 2008, EOCs were to be established as an offsite facility, functioning from the State/District headquarters. EOC was to be an augmented control room having communication facilities. It coordinates all line departments in rescue and relief work after disasters. Shortage of manpower in the EOC at TNSDMA's office at Chennai was pointed out in C&AG's Audit Report on GoTN (G&SSA) for the year ended March 2012. As per NDM guidelines, one Senior Administrative Officer with required number of Assistants and representatives of various line Departments were to be posted in the EOC. Despite this being pointed out by Audit in 2012, no dedicated staff were posted. Twelve desk personnel (contract staff) outsourced from Electronics Corporation of TN (ELCOT) were manning the EOC. As the period from January to June was considered non-calamitous season, every year, the number of desk staff stood reduced to six. Scrutiny of

TNSDMA's records revealed that even during the monsoon months of 2015, there were only six desk personnel who were not adequate to handle the EOC.

In Chennai and Tiruvallur DEOCs, desk personnel were not engaged from ELCOT during November and December 2015. In Kancheepuram DEOC, only one out of two Desk personnel were available during 01 November 2015 to 31 January 2016. It was replied that in the absence of regular desk personnel, officials of Revenue Department were placed in charge of the DEOCs. The reply was not acceptable as the officials deputed to work in the DEOC did not report there for work as per the record verified during audit.

We further observed that the non-posting of desk personnel in EOCs hampered their efficiency as discussed below:

- In order to facilitate easy accessibility during disasters, EOCs have been equipped with toll free contact numbers (1070 and 1077). These numbers are accessible from all landline and mobile networks. EOCs were to coordinate with line departments to take action on the complaints received through these toll free numbers. EOCs maintained the contact details of field level functionaries of line departments to coordinate rescue, relief and restoration works. We observed that during November and December 2015 i.e., during the months when flood took place, the Chennai District EOC received 1,586 calls from flood affected people. All the calls were recorded in registers and the messages were forwarded to GCC (1,371 messages), TN Electricity Board (TNEB)(78) and Taluk offices (18).

We further observed that apart from forwarding the messages, no further action was taken to coordinate with the line departments to find solution for the complaints received. On this being pointed out by Audit, District Collector, Chennai replied that there was no response from the Call Centres run by the GCC and TNEB. The reply was untenable as the EOC itself could have approached the field officers of line departments rather than just passing on the message to the call centres of GCC and TNEB.

- The DEOCs of Tiruvallur and Kancheepuram districts received 970 calls and 1,330 calls respectively, during November and December 2015. These DEOCs were also not in a position to monitor action taken reports from line departments. Thus, DEOCs did not follow up on the complaints received over phone, but functioned with a limited scope of just forwarding the complaints to other agencies.

On being asked, CRA stated (May 2017) that shortage of Desk Personnel did not impact the functioning of DEOCs as regular staff were deployed. CRA further stated that in addition to EOCs, control rooms of Police, GCC, etc., also functioned in a decentralised manner. The reply was not acceptable as posting of staff in an *ad hoc* manner rather than through regular engagement in

deviation from the NDM guideline for centralised coordination of disaster response through EOCs indicated lack of planned and structured approach.

6.4 Rescue operations

In terms of the DM Act, 2005, GoI had created National Disaster Response Force (NDRF) to respond to natural disasters. One of the battalions of NDRF is stationed at Arakkonam, located close to Chennai. NDRF battalions have teams with high skill training and latest equipment for water rescue. Further, in case of emergencies, civil authorities can request the army for help. Scrutiny of records relating to response to floods disclosed the followings:

6.4.1 Deployment of National Disaster Response Force for rescue

As per the information furnished to the Parliamentary Committee, 1,200 Army men, 600 personnel from Navy, Coast Guard and Air Force and 1,920 NDRF personnel were involved in the rescue and relief operations. However, we could not ascertain the date and time from which the NDRF were deployed in rescue operations.

According to NDRF Guidelines, three days before the approaching calamity, alert to nearest NDRF battalion and armed forces had to be made for relief and rescue operations. We observed that instead of approaching the NDRF at least three days in advance as per NDRF guidelines, the GoTN actually contacted the Director General (DG), NDRF only on 01 December 2015, after the flooding had taken place. Due to delayed intimation made to NDRF by GoTN, the NDRF could deploy its forces between 01 December and 04 December 2015 only, which resulted in delay in rescue operations. Had the timely action been taken in this regard, the extent of loss of human lives could have been reduced.

6.4.2 Lack of communication equipment for rescue operations

Keeping communication channels working is crucial for rescue and relief operations during disasters. As power supply and telecommunication networks broke down due to floods, mobile and telephone services got disturbed in Chennai and suburban areas during floods. Very High Frequency (VHF) sets were the only reliable communication system for rescue and relief works. The details of availability of VHF sets in Collectors' offices, Revenue Divisional offices and Taluk offices in Chennai, Kancheepuram and Tiruvallur districts as of June 2016 are given in **Table 6.2**.

Table 6.2: Availability of VHF sets

Chennai			Kancheepuram			Tiruvallur		
No. of offices	No. of VHF sets available		No. of offices	No. of VHFsets available		No. of offices	No. of VHF sets available	
	Base Station	Mobile Station		Base Station	Mobile Station		Base Station	Mobile Station
15	8	7	20	16*	16**	22	18	17

* Three of them were not installed and five of them were not in working condition

** Eight of them were not in working condition

(Source: Revenue and Disaster Management Department)

Guindy, one of the affected taluks in Chennai District where 1,472 huts were fully damaged and 1,415 huts were partly damaged did not have any VHF sets. The Revenue Divisional Officers in Egmore, and Tondiarpet and four other taluk offices did not have VHF sets. In Tiruvallur District, the worst affected Taluks of Maduravoyal, Thiruvottiyur and Avadi did not have any VHF sets. We observed that non-availability of these critical communication equipment revealed inadequacies in disaster preparedness.

6.5 Relief work

6.5.1 Relief extended by Government

Besides food and shelter provided as immediate relief, GoTN approved the following relief to the affected population:

- A cash dole of ₹ 5,000 for each of the families of inundated house/hut
- A cash dole of ₹ 5,000 and ₹ 5,200 for each of the families of partly damaged huts and tiled houses respectively
- A cash dole of ₹ 10,000 for fully damaged huts
- One set of saree and dhoti to each of the affected households
- 10 kg of rice to each of the affected households
- Special drive to issue certificates, ration cards and other official documents to families who lost them in floods

Deficiencies noticed in relief and rehabilitation activities are discussed in Paragraphs 6.5.2 to 6.5.6.

6.5.2 Deficiencies in beneficiary identification

We noticed discrepancy in the estimation of number of families affected by floods. While the number of families affected by floods for the purpose of cash doles was 25.13 lakh, the number of families affected for the purpose of

issue of rice and sarees and dhotis was depicted as 24.71 lakh, as shown in **Table 6.3**.

Table 6.3: Beneficiary data

District	Number of families affected according to		
	Cash dole list	Rice allotment list	Sarees and dhotis distribution list
Chennai	13,15,000	12,36,253	12,36,253
Tiruvallur	5,97,826	6,34,000	6,34,000
Kancheepuram	5,99,843	6,00,713	6,00,675
Total	25,12,669	24,70,966	24,70,928

(Source: Data furnished by CRA)

Adoption of different number of families affected for each category shows the inaccuracy of the data presented by CRA. While the estimation of number of affected households for the purpose of cash dole was done by door to door enumeration conducted by officials drawn from other districts, estimation for supply of rice and sarees and dhotis were not based on the same.

We observed the following:

- In Chennai District, there was a short payment of ₹ 50.45 crore towards payment of cash dole to beneficiaries, which was remitted back to Government account. Similarly, in Tiruvallur district, ₹ 4.76 crore was surrendered and in Kancheepuram district, ₹ 15.20 crore was surrendered/remitted back. The relief amount were surrendered/remitted back to Government account, due to defective preparation of enumeration i.e., incorrect account number/names of beneficiaries etc. We observed that the defective enumeration had resulted in short payment of relief totaling ₹ 70.41 crore to eligible beneficiaries enumerated after floods.
- In Chennai, the District Collector issued 16,70,000 serially numbered enumeration forms to enumerators and 12,87,735 beneficiaries were given relief. However, Audit scrutiny of the data revealed that Tahsildars paid ₹ 33.65 lakh to 662 persons enumerated through forms which were not issued by the Collector's office. The District Collector attributed (December 2016) typographical errors in respect of 424 of the 662 applications, but did not produce copies of the said applications. By analysing the electronic data furnished by the District Collector, we noticed that 146 of the 662 persons who were paid assistance based on unnumbered enumeration forms had received assistance based on enumeration forms supplied by the Collectorate as well. CRA stated (May 2017) that 424 of the 662 cases of payments based on unnumbered enumeration forms were identified as genuine cases, and the remaining 238 constituted a very small percentage of the total of 13.17 lakh cash dole applications. We could not verify the genuineness of the 424 cases cited in the reply and observed that even

a small percentage of cases of irregular payments pointed towards deficiencies in the system of enumeration, supervision and authorising payments.

- In Thenneri Village of Wallajabad Taluk (Kancheepuram District), the Tahsildar paid ₹ 4,100 each to 155 families as compensation for partly damaged huts based on certificate in Form-20¹ by the Revenue Inspector. However, Form-20 for obtaining details of the family and copy of ration card was not available on record in respect of 128 families. Neither the Tahsildar, Wallajabad nor the District Collector, Kancheepuram furnished the Form 20 in respect of the 128 families. We could not confirm the genuineness of the payment of ₹ 5.25 lakh to them. We observed that the payment was made in these cases in violation of the prescribed procedure as per Government order for giving benefit for flood affected persons for which door to door enumeration was required.
- Cash dole was to be paid based on enumeration by teams of officials constituted by District Collectors. Enumeration involved certification to the effect that the house hold was affected by flooding. The Tahsildar of Sholinganallur Taluk, Kancheepuram District, however, paid (February 2016) ₹ 4.17 crore as cash dole to 8,354 persons without any enumeration. On this being pointed out by Audit, the District Collector, Kancheepuram admitted (August 2016) making payments without enumeration, but stated that these people were left out during the enumeration. CRA was not sure about the circumstances under which the payments were made when he replied (May 2017) to Audit that “some of the beneficiaries who did not receive the cash dole in the first phase might have submitted their applications to Collector’s office and Chief Minister’s Special Cell”. The reply was not acceptable, being presumptive and not based on records, as payment was to be made on the basis of enumeration only. We observed that the Tahsildar, Sholinganallur and Collector, Kancheepuram had failed to exercise due diligence in making cash dole payment of ₹ 4.17 crore to 8,354 persons.

6.5.3 Multiple payment of relief to same beneficiaries

Government decided (December 2015) to provide cash assistance to all families living in houses/huts inundated, with water stagnation for more than two days. Cash dole payments were made based on enumeration done by Government officials drawn from various districts. Enumeration forms included the name of the head of family, address, Ration card number (identity proof) and carried the signature of the head of family. All eligible beneficiaries enumerated were paid (January and February 2016) the entitled cash dole through ECS by the Tahsildars concerned.

We analysed the electronic data on cash dole payment, which were maintained by the three District Collectors, and noticed instances of payments of cash doles more than once to the same household/beneficiaries. Details of

¹ A existing certificate prescribed for assistance to victims of natural disaster

households/beneficiaries who received multiple payments, based on single identification document (Ration card, Adhaar card etc.) are given in **Table 6.4**.

Table 6.4 : Multiple payments of relief to same beneficiary/household

District	Nature of payment	Details of multiple payments	Excess payment (₹ in lakh)
Chennai	Cash dole (₹ 5,000 for partly damaged huts/inundation)	28,934 beneficiaries received multiple payments (two to eight times to same beneficiary/household)	1,514.60
Kancheepuram		38,712 beneficiaries received multiple payments (2 to 35 times to same beneficiary/household)	2,149.60
Tiruvallur		26,507 beneficiaries received assistance twice	574.36
Total excess payment (94,153 cases)			4,238.56

(Source: Electronic data furnished by District Collectors)

In addition to the scrutiny of electronic data on payment of relief, as mentioned in **Table 6.4** above, we conducted manual scrutiny of all the 1,856 applications, which the electronic data had indicated multiple payments in Guindy Taluk of Chennai District. The results of the manual scrutiny are given in **Table 6.5**.

Table 6.5: Analysis of multiple payments of relief to same beneficiary/household

i	Number of cases of multiple payment detected through scrutiny of electronic data at Guindy Taluk	1,856
ii	Number of cases manually scrutinised	1,856
iii	Number of cases wrongly seen as multiple payment due to data entry error at Collectorate	601
iv	Different persons getting payment at different addresses based on one Ration card	453
v	Actual number of cases of multiple payment (ii-iii-iv)	802
vi	Cases of same person/household getting more than one payment based on one Ration card at the same address	187 cases
vii	Cases of same person/household getting more than one payment at different address, based on one Ration card	183 cases
viii	Cases of different persons/households getting payment at the same address based on one Ration card	432 cases

(Source: Analysis of data and enumeration forms of Guindy Taluk)

In respect of multiple payments pointed out, CRA stated (May 2017) that multiple payment on the strength of one ration card number happened in the case of married son/daughter of the head of the family, who were living

separately without separate ration card and tenants who migrated recently giving the ration card number of house owner for claiming cash dole.

The reply was incorrect as manual checking of all the 1,856 cases of multiple payment for single ration card or identity document at Guindy Taluk had indicated same person receiving more than one payment in 187 cases based on one ration card at the same address, which worked out to 10 *per cent* of the number of cases of multiple payment as observed through analysis of electronic data.

Further, we provided a list of 321 cases of multiple payment on the strength of single ration card or other identity document to the Collectors of Chennai, Kancheepuram and Thiruvallur, to verify the genuineness of the payments. Based on verifications, the Collectors found that double payments were made to 23 of the 321 cases, which worked out to seven *per cent* of the cases of multiple payment as observed through analysis of electronic data.

The detailed manual scrutiny of records in addition to analysis of electronic data and verifications done by District Collectors clearly established multiple payment of cash dole to same beneficiary, which indicated serious lapses in payment of cash dole, despite putting in place an elaborate system which included direct payment of cash dole to the bank account of the beneficiaries.

6.5.4 Inequitable distribution of relief to beneficiaries

According to GoTN Order (January 2016), the relief amount payable was ₹ 10,000 for fully damaged huts and ₹ 5,000 for partly damaged huts. The following short payments were noticed:

We noticed that only ₹ 5,000 was paid to the 3,447 fully damaged huts against ₹ 10,000 allowed in Tiruvallur District and 9,290 out of 28,097 fully damaged huts in Kancheepuram district. The total short payment of relief to 12,737 families whose houses were enumerated as ‘fully damaged’ was ₹ 6.37 crore. We observed that this serious lapse on the part of Revenue officials had led to deprivation of eligible assistance to 12,737 families amounting to ₹ 6.37 crore.

In Kancheepuram District, families of 10,649 of the 17,755 partly damaged huts were paid only ₹ 4,100, leading to short payment of ₹ 95.84 lakh (₹ 900 to 10,649 huts). Similarly, families of 884 out of 986 partly damaged huts in Tambaram Taluk in the same district were paid only ₹ 3,800. The total amount of short payment in the two districts to 11,533 families whose houses were enumerated as be ‘partly damaged’ was ₹ 1.06 crore².

We observed that in both the above cases, the Revenue Officials wrongly adopted the pre-revised rates of assistance without giving effect to the Government order (December 2015) raising the rates of assistance to ₹ 5,000 per family for house inundation and another ₹ 5,000 for partly damaged houses and ₹ 10,000 for fully damaged houses.

² (10,649 x ₹ 900) + (884 x ₹ 1,200)

6.5.5 Excess procurement of sarees and dhotis

CRA estimated (February 2016) a requirement of 24.71 lakh sets of sarees and dhotis for supply to the people affected by floods in Chennai, Tiruvallur and Kancheepuram districts. Government decided (February 2016) to source the sarees and dhotis from Weavers Cooperative Societies and released (February 2016) ₹ 64.78 crore at ₹ 262.15 per set, to the Director of Handloom and Textiles (DHT).

DHT organised supply of sarees and dhotis from Weavers Cooperative Societies to Taluk offices in the three districts, for distribution to beneficiaries through ration shops. Sarees and dhotis were received by Tahsildars between December 2015 and March 2016 and the same were distributed to ration shops for issue to beneficiaries. The details of sarees and dhotis supplied to Tahsildars and distributed to ration shops are given in **Table 6.6**.

Table 6.6: Issue of sarees and dhotis

(Number in lakh)

District	Item	Received by Taluk Offices	supplied to ration shops	Balance available at Taluk offices
Chennai	Sarees	11.29	6.86	4.43
	Dhotis	11.32	6.86	4.46
Kancheepuram	Sarees	4.43	1.35	3.08
	Dhotis	4.45	1.44	3.01
Tiruvallur	Sarees	2.51	2.38	0.13
	Dhotis	2.54	2.41	0.13
Total	Sarees	18.23	10.59	7.64
	Dhotis	18.31	10.71	7.60

(Source: Data furnished by respective District Collectors)

Thus, against the receipt of 18.23 lakh sarees and 18.31 lakh dhotis by Taluk officers, only 10.59 lakh sarees and 10.71 lakh dhotis were distributed to ration shops for issue to affected people. The Tahsildars did not obtain details of actual distribution by ration shops.

Based on excess stock lying in taluk offices, we noticed that 7.64 lakh sarees and 7.60 lakh dhotis valued at ₹19.99 crore (7.64 lakh x ₹ 169.45 (+) 7.60 lakh x ₹ 92.70) were procured in excess. The CRA replied to Audit (May 2017) that the quantity procured in excess were distributed for Pongal festival 2017. The reply confirmed inadmissible use of sanction under State Disaster Response Fund (SDRF) for supply of sarees and dhotis for Pongal 2017, which was in violation of SDRF norms as SDRF funds was not allowed to be utilised for supply of free sarees and dhotis for Pongal festival.

We further observed that the very idea of providing immediate relief to affected people was not fulfilled as the sarees and dhotis reached taluk offices between December 2015 and March 2016. The District Collectors did not

have any data on the actual distribution of sarees and dhotis by ration shops to beneficiaries.

GoTN stated (May 2017) that the sarees and dhoties procured for supply to flood affected people could not be distributed due to lack of interest shown by many of them. Thus, incorrect estimation of requirement without any survey or basis, resulted in excess procurement and the delayed procurement rendered the relief not reaching the beneficiaries on time.

Recommendation No. 22: *We recommend that the cost of sarees and dhotis, procured under SDRF, but distributed for Pongal 2017, may be worked out and adjusted, as SDRF assistance cannot be utilised for free supply of sarees and dhotis for Pongal.*

6.5.6 Procurement of rice in excess of requirement

CRA estimated (February 2016) a requirement of 24,709.66 Metric Tonnes (MT) of rice for supply to 24.71 lakh families at 10 kg per family and paid ₹ 52.69 crore to Tamil Nadu Civil Supplies Corporation (TNCSC). The details of rice procured by TNCSC from Food Corporation of India (FCI), supplied by TNCSC to ration shops and balance held by TNCSC are given in Table 6.7.

Table 6.7 : Issue of rice to affected families

Name of District	Requirement assessed by CRA	Procurement made by TNCSC	Issued by TNCSC to ration shops	Balance stock with TNCSC	Value of Balance stock
Chennai	12,362.53	12,362.53	4,748.12	7,614.41	16.24
Kancheepuram	6,007.13	6,007.13	433.30	5,573.83	11.88
Tiruvallur	6,340.00	6,340.00	810.85	5,529.15	11.79
Total	24,709.66	24,709.66	5,992.27	18,717.39	39.91

(Source: Data furnished by respective District Collectors)

Out of 24,709.66 MT of rice procured by TNCSC for free distribution to affected families in the three districts, only 5,992.27 MT (24.25 per cent) was actually issued to ration shops for distribution. The cost of the quantity of rice procured in excess was ₹ 39.91 crore. On being pointed out (June 2016), TNCSC refunded (November 2016) the cost of rice procured in excess after deducting administrative charges. The rice procured in excess was utilised for regular civil supplies by TNCSC.

The wrong estimation of beneficiaries without any survey and release of funds by CRA on the basis of estimation had resulted in blocking of Government funds in the form of idle stock/funds to the tune of ₹ 39.91 crore with TNCSC for about nine months, which could have been spent elsewhere.

6.6 Inadmissible expenditure from SDRF on restoration works in flood affected areas

Instances of ineligible expenditure from SDRF, were as discussed below:

- As per the norms for assistance under SDRF, GCC was entitled for an assistance of ₹ 1 lakh per km of roads damaged by floods to carry out immediate restoration work. GCC repaired 41 km stretch of affected roads at a cost of ₹ 75.44 crore³. As per the norms, GCC was entitled to an assistance of ₹ 0.41 crore only. Non-adherence to SDRF guidelines resulted in an unauthorised expenditure of ₹ 75.03 crore. As the funds were sanctioned under SDRF, it was to be utilised based on the scale prescribed.
- As per guidelines, SDRF funds could be utilised only to restore traffic on public roads. However, road work within the campus of GCC's headquarters (Ripon Buildings) was executed under SDRF at a cost of ₹ 65.50 lakh. Utilisation of SDRF funds for relaying of roads within the office complex of GCC was in violation of SDRF norms.
- District Collector, Kancheepuram utilised SDRF assistance for procuring a 40 KVA generator and petty repair works in his office at a cost of ₹ 10.27 lakh. This expenditure was in violation of SDRF norms, which did not allow SDRF funds for equipping Government offices.
- As per SDRF guidelines, capital expenditure was not permissible. Two Zonal Officers⁴ of GCC created assets by purchase of motors, at a cost of ₹ 15.97 lakh using SDRF, which was not permissible. GCC replied that due to high cost involved in renting motors for pumping water, procurement was made rather than renting the motors. However, no details substantiating this decision were made available to us.

CRA justified the above expenditure under SDRF citing the role of the agencies/offices in disaster management. The reply was not acceptable as the norms were very specific and did not allow these expenditure.

Recommendation No. 23: *We recommend that excess/ineligible assistance extended to GCC and District collector, Kancheepuram be recouped to SDRF.*

6.7 Non-receipt of Utilisation Certificate

In the aftermath of 2015 floods, GoTN sanctioned a sum of ₹ 3,039.24 crore, including GoI funds, for relief and restoration works in all Districts of the State, as tabulated in **Table 6.8**.

³ Cost of work as per agreement. Actual expenditure is awaited as bills are still to be settled (March 2017).

⁴ Zone 6 and Zone 7

Table 6.8 : Funds sanctioned for 2015 floods

Date of sanction of funds	Amount (₹ in crore)
17/11/2015	500.00
15/12/2015	300.00
15/12/2015	1,000.00
07/01/2016	500.00
11/01/2016	340.79
15/02/2016	398.45
Total	3,039.24

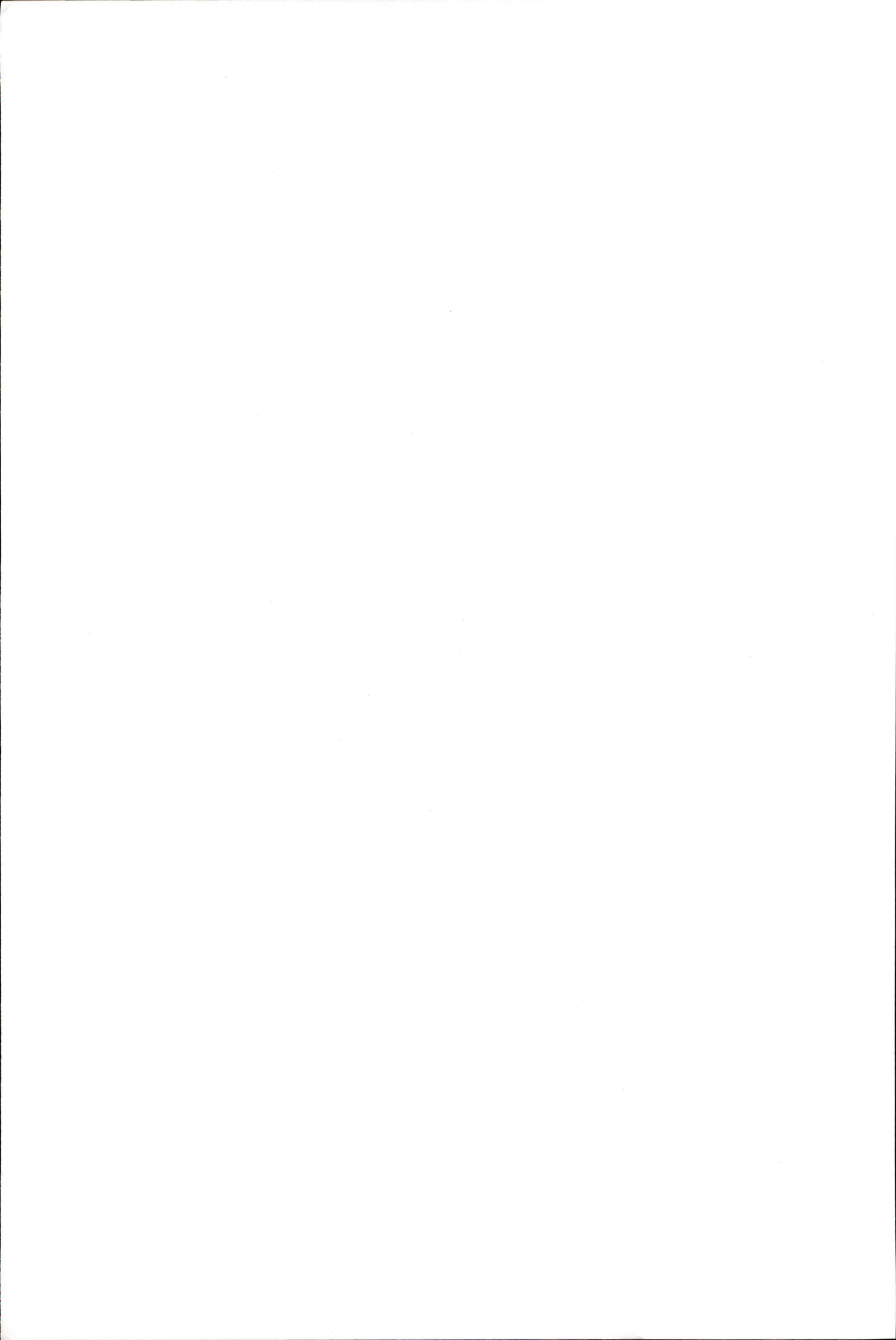
(Source: Government orders)

Out of the sum of ₹ 3,039.24 crore sanctioned for relief and restoration works of 2015 floods, ₹ 1,587.66 crore was released to the District Collectors of Chennai, Kancheepuram and Thiruvallur and GCC towards cash doles and relief and restoration works. The Collectors in turn released the funds to various agencies executing the rescue, relief and restoration works.

We noticed that UCs were received (February 2016) only for ₹ 1,477.33 crore from District Collectors and GCC. Despite specific direction by the Chairman of the EC of TNSDMA in August 2016 in this regard, UC for the balance ₹ 110.33 crore was still awaited from GCC (March 2017).

6.8 Analysis

The State of Tamil Nadu, being prone to frequent cyclonic effects, failed to put in place a functional institutional mechanism to face disaster situations. The TN State Disaster Management Authority did not play its envisaged role, as it neither had the contemplated financial autonomy nor had dedicated staff. The apex body for disaster management under the chairmanship of the Chief Minister never met to evolve policies. Disaster Management Plan was not prepared to institutionalise and coordinate rescue and relief operations during the floods of 2015. Relief activities were marred by delayed extension of relief, excess/short payment of cash doles and blocking up of funds due to wrong estimation of requirement of relief materials. SDRF funds were utilised on ineligible works and spending excess over the norms.



CHAPTER VII

MONITORING



Tamil Nadu Government Secretariat

CHAPTER VII

MONITORING

Monitoring is essential to evaluate on a regular basis the progress made so as to achieve the milestones envisaged, by intervention and corrective action.

7.1 Monitoring the implementation of Second Master Plan

7.1.1 Insufficient monitoring of implementation of recommendations by line agencies

In order to monitor implementation of SMP, CMDA formed five sector-wise committees in 2009. Two of these committees viz., (i) Land Use and Environment Committee, and (ii) Investment and Infrastructure Planning Committee¹ were to deal with implementation of recommendations relating to flood control measures.

As these committees were non-functional during 2009 to 2012, CMDA reconstituted these committees in October 2013. The reconstituted committees were to meet at least once in three months and their main functions were as under:

- Advise about the action to be taken to achieve the objectives of SMP relating to land use planning
- Prioritise the policies, programmes and action plans recommended in SMP and advise the departments/agencies
- Recommend detailed studies to draw up programmes for effective implementation of the Master Plan
- To frame detailed policies for Government's approval and adoption
- Review the progress of implementation and recommend timely corrections, if any, for effective implementation
- To identify measurable indicators to evaluate and monitor the progress made in achieving the objectives of SMP

Audit scrutiny of functioning of these committees revealed the following:

The two Monitoring Committees, comprising of heads of line departments, never held any meetings during 2009 and 2012. After reconstitution in October 2013, till December 2016, they should have held ten meetings²; against which, they held only two meetings. We noticed that the members who attended the first meeting did not attend the second meeting. The meetings were attended by lower level officers of the agencies. Line departments were to furnish action taken report on the decisions reached. We noticed that out of eight line departments, only TN Pollution Control Board

¹ Original name was Investment and Planning and Governance Committee. Renamed in 2013

² At one meeting every quarter

furnished an action taken report for the first meeting of Land Use and Environment Committee. Similarly, only Chennai Metropolitan Water Supply and Sewerage Board and TN Pollution Control Board furnished action taken report for the second meeting of the Committee.

We observed that infrequent meetings, non-participation of senior officers of line departments and lack of response from line departments/agencies, hampered monitoring of land use planning and infrastructure planning functions of CMDA as discussed below.

(a) One of the recommendations of SMP was to preserve water bodies and to prohibit developments in O&R zone including Redhills catchment area. Reclassifications of water bodies, O&R zone and catchment area were approved by CMDA during the period 2009-16 against the SMP recommendations. These reclassifications were not discussed by CMDA in the Land Use and Environment Committee to evolve an alternate action plan to achieve the objectives of SMP.

(b) One of the objectives of SMP was to protect water bodies from encroachments. CMDA did not bring the subject of encroachments in water bodies and about the periodical check exercised by local bodies in preventing encroachments for discussion by the Committee. The Committee did not prioritise the action plans recommended in SMP which was one of its main functions.

(c) One of the important policies in SMP was to use excess flood water for augmenting urban water supply through creation of additional storage capacity. We observed that against the target of creating three new reservoirs with a capacity of one TMC each, the achievement was nil as construction of one reservoir was dropped, capacity of one was reduced and another one was yet to be completed (**Paragraph 3.1.1**). WRD did not bring the constraints in implementation to the notice of the Investment and Infrastructure Planning Committee for evolving a solution.

(d) SMP stated that the role of CMDA was to evaluate on a regular basis the progress made towards achieving the objectives for which CMDA was to identify measurable indicators in several sectors to monitor the progress made by the stakeholders.

(e) The committees did not identify and employ measurable indicators to monitor the progress made by various stakeholders, which was one of their main function.

Thus, we observed that the above deficiencies in monitoring had impacted the implementation of SMP as discussed in **Chapter II**.

7.1.2 Lack of monitoring of local bodies by CMDA review team

In order to review and advise the local bodies on planning permissions, CMDA's Review Team inspects local bodies. We noticed that during such inspection, the Review Team did not ensure that the local bodies abided by the provisions of DR on preservation of water bodies. Scrutiny of files relating to

seven inspections conducted during 2013-15 in Kundrathur Panchayat Union and Kundrathur, Thiruneermalai and Perungalathur Town Panchayats revealed that the Inspection Reports did not cover examination of files relating to layout approvals along water bodies. On being asked, CMDA replied (November 2016) that the Review Team verified Planning Permission/Building permits issued by local bodies and not that issued by CMDA. The reply was not tenable since it was the responsibility of CMDA to ensure that local bodies took actions on the conditions stipulated by CMDA.

7.1.3 Lack of action by Technical Advisory Committee

Based on CWC instructions, GoTN revived (January 1985) the Technical Advisory Committee (TAC) with functions *inter-alia* included:

- identification of flood prone areas and formulation of schemes to contain the flood and recommending to Government,
- devising measures to evict encroachment in vulnerable areas and safe guarding the flow ways and flood places,
- evolving a methodology for the flood warning system in the State.

The TAC was reconstituted (October 2010) under the chairmanship of Engineer-in-Chief, WRD and again reconstituted (December 2011) under the nomenclature 'State TAC', by including one member from the Regional Central Water Commission. The committee was to meet as and when necessary, but not less than once in six months.

However, the Committee met only twice³ during 2011-16 against the required minimum 10 times, contrary to the GoTN instructions. Despite availability of ₹ 400 crore under XII Five year plan (2012-17), the Committee had neither identified flood prone areas nor formulated any schemes to contain the flood. TAC failed to devise any measures to prevent encroachments and to evict encroachment in vulnerable areas and safeguarding the flow ways and flood places and for the flood warning system in the State. Further, lack of monitoring by TAC denied an opportunity to WRD to regulate issue of NOCs for constructions and to ensure adherence to NOC condition.

7.1.4 Monitoring achievement against Service Level Benchmark

GoI, Ministry of Urban Development determined (2008) Service Level Benchmarks for Urban local bodies for water supply, sewage, solid waste management and storm water drainage. Details of achievement against the benchmarks in provision of SWDs by the selected zonal offices of GCC and suburban local bodies are given in **Appendix 7.1**, which revealed that there was shortfall in achievement in providing SWD ranging from 13 to 100 *per cent* and shortfall of 100 *per cent* in prevention of water logging. GoTN/Commissioner of Municipal Administration failed to monitor the achievement by GCC/local bodies in providing SWD and preventing water logging.

³ 8 March 2013 and 30 January 2015

7.2 Absence of monitoring in leasing of land

Para 172 of WRD 'D' Code envisaged the granting lease of land including the land in river margins (river berms) of waterways and water bodies for non-agricultural purpose viz., construction of bridges/culverts and laying of pipe lines, etc., upon collection of lease rent charges. The manual also envisaged maintenance of Miscellaneous Property Register by the Sub-Divisional Officers, to record the details of the period of grant of lease, lease rent to be recovered, actually recovered, etc. As per GoTN instructions (December 2012), WRD was to issue NOC for granting right of way. The NOC was to stipulate essential conditions for maintenance of existing status quo of the drains without any hindrance to free flow of water.

We observed that WRD did not possess consolidated details of adjoining areas of water bodies leased to private individuals or other organisations. We further noticed that in one of the three WRD Divisions (Lower Palar Basin Division) audited, lease register was not maintained. In the two other Divisions (Araniyar Basin and Kosasthalaiyar Basin Divisions), lease registers, though maintained were not monitored for periodical renewal of lease agreements and collection of lease rent. In the three Divisions, out of 44 cases of leasing of land by WRD, only 15 were periodically renewed, leaving the balance 29 not renewed or revoked.

Thus, non-availability of consolidated details of the lease agreements resulted in non-ensuring the adherence to NOC conditions. GoTN accepted the audit findings and stated (February 2017) that remedial steps would be taken.

7.3 Analysis

CMDA, after preparing the detailed Master Plan for regulated urbanisation, failed to monitor implementation of the plans despite specific provision in the SMP to monitor through various committees. The Technical Advisory Committee of WRD failed to monitor identification of flood prone areas and formulate schemes to contain floods.

CHAPTER VIII

CONCLUSION

Post - flood works at Nandambakkam canal



CHAPTER VII

CONCLUSION

CHAPTER VIII

CONCLUSION

8.1 Lessons learnt

GoTN was quick to learn from the floods of 2015 and acted swiftly based on the lessons learnt as discussed below:

- After the floods, Revenue Department, WRD, GCC, and TNSCB jointly conducted a special drive and evicted 4,531 out of the total of 23,840 slum families living along the margins of Adyar and Cooum Rivers.
- WRD swung into action to widen, deepen and strengthen the banks of Adyar River at vulnerable points inside CMA (**Exhibit 8.1**).

Exhibit 8.1 - Post flood works in Adyar River



(Source: Photo provided by WRD)

- GCC realised the importance of SWDs and in 2016-17 took up works to construct 292 km of SWD by earmarking ₹ 463 crore for SWDs in 2016-17 budget. The expenditure on SWD increased from ₹ 170.36 crore in 2015-16 to ₹ 441.50 crore in 2016-17, an increase of 159 per cent.
- After the floods, Government notified (October 2016) the 2009 amendment to the Registration Act, 1908, to comply with the orders of the Hon'ble Madras High Court, imposing ban on registration of residential plots in unapproved lay outs.
- The draft Disaster Management Plan for the State, which was prepared way back in 2010 was finally approved by GoTN in October 2016.

8.2 Lessons not learnt

While swift actions taken based on the lessons learnt were on the positive side, several long term failures in heeding to expert advices, earlier audit findings, PAC recommendations etc., have been pointed out in the previous paragraphs. Few instances of serious failures in acting on the lessons learnt from past disasters are highlighted below:

- In the aftermath the floods in 1976, GoTN constituted (1979) Nucleus Cell in CMDA to suggest flood mitigation measures. The Nucleus Cell's major recommendation to create additional reservoirs to store flood water was not implemented, as commented in **Paragraph 3.1.1**.
- In 2007, after the floods of 2005, GoTN enacted the TN Protection of Tanks and Eviction of Encroachment Act, 2007, to protect the tanks under the control of WRD. The issue of encroachments on tanks was brought out in the C&AG's Audit Report in 2005-06 and again in 2012-13. PAC also directed (June 2014) the GoTN to undertake effective action on restoration of storage capacity of the tanks. Despite all these, WRD was not serious in evicting tank bed encroachments and the percentage of tanks encroached kept growing from 40 per cent in 2005-06 to 43 per cent in 2012-13 and further increased to 69 per cent in 2016 as commented in **Paragraph 4.1**.

- After the floods of 2005, Government engaged Anna University to study the floods and make recommendations for preventions. Major recommendations of Anna University on design of SWDs, real-time flood forecast system, desiltation of tanks in CMA were not acted upon as commented in **Paragraphs 5.2.2, 5.8.5 and 5.9.1.**
- The issue of inadequate staffing of DEOCs was pointed out in C&AG's Audit Report (2011-12). GoTN had not strengthened the DEOCs to effectively manage rescue and relief activities after disaster in an organised manner, as commented in **Paragraph 6.3.**

8.3 Conclusion

The flood of 2015 were caused by heavy rains coupled with multiple failures on the part of various Government agencies. Non-structural measures to prevent floods such as Flood Plain Zone Act, State Water Policy, Frequency-based Flood Inundation Maps, Emergency Action Plan for dams and Basin-wise Comprehensive Master Plans were not in place. CMDA failed to check large scale constructions along waterways, which choked waterways and altered land uses in the metropolitan area. CMDA's action in allowing conversion of agricultural land without Government's approval and the unauthorised conversion of water bodies, non-urban and O&R land for various other purposes, resulted in drastic changes in land use and thereby contributed to the floods.

Three rivers and several *nullahs* criss-crossed the city's length and breadth. But, siltation, unplanned constructions and encroachments impacted their flood carrying capacities. Projects to restore and increase the storage capacities of the tanks and reservoirs suffered setbacks due to faulty planning and lack of co-ordination between various Government agencies. Failure in implementing projects recommended by various experts/committees to create additional storage capacity in the upstream of Chembarambakkam Tank caused severe flooding in Adyar. Unmindful of the damage it caused to natural water bodies, local bodies and Government agencies had themselves encroached upon them for developing public infrastructure. Encroachment on

tank beds and river margins remained unchecked in the absence of an effective system to prevent and evict encroachments. Even with an Act providing legal authority to WRD to prevent encroachment in tanks, the percentage of tanks under encroachments kept increasing year after year.

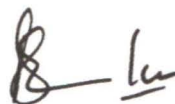
Encroachments, a menace in the path of flood mitigation works, had not been effectively handled by the Government. Allowing *patta* lands in the foreshore area of the tanks and inability to acquire lands for flood protection walls indicate the helplessness of GoTN in ensuring safety to its people against disaster.

Improvements to macro drains did not fructify due to encroachments and for want of clearance from other agencies. No system existed for real-time flood forecast for releasing of surplus water with due regard to the water carrying capacity of waterways. SWDs were not scientifically designed and lacked seamless connectivity to trunk mains/ rivers. Lapses in implementing Underground Sewage Schemes by local bodies led to continued outflow of sewage into SWD and consequent clogging of drains.

The State of Tamil Nadu, which is prone to frequent cyclonic effects and other disasters, failed to put in place the institutional mechanism envisaged in Disaster Management Act, 2005, to manage disasters. The TN State Disaster Management Agency did not play its envisaged role, as it neither had the contemplated financial autonomy nor had dedicated staff. The apex body for disaster management under the chairmanship of the Chief Minister never met to evolve policies. Disaster Management Plan was not prepared on time to institutionalise and coordinate rescue and relief operations during the floods of 2015. Relief activities were marred by delayed extension of relief, excess/short payment of cash doles and blocking up of funds due to wrong estimation of requirement of relief materials. SDRF funds were utilised on ineligible works and spending excess over the norms.

The monitoring committee of CMDA and WRD did not hold meetings as envisaged to discuss issues which have direct relation with prevention of flooding.

All factors put together indicate that it was a man-made disaster. Unless the GoTN takes full charge of mitigating the contributing factors leading to December 2015 floods, another disaster cannot be ruled out.



(DEVIKA NAYAR)

Principal Accountant General
(General and Social Sector Audit),
Tamil Nadu and Puducherry

Chennai
The 18 June 2017

Countersigned



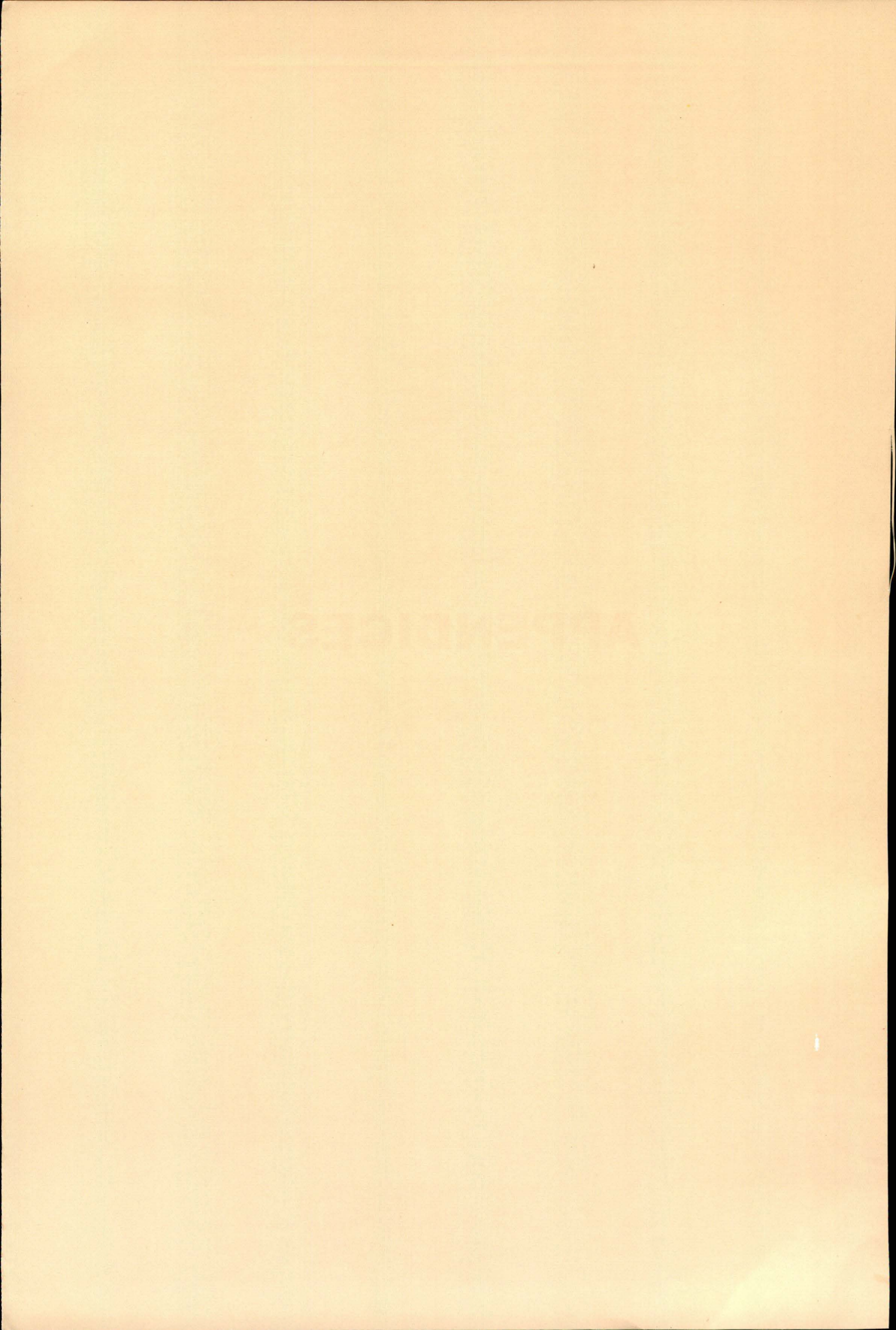
(SHASHI KANT SHARMA)

Comptroller and Auditor General of India

New Delhi
The 19 June 2017



APPENDICES



Appendix 2.2
(Reference: Paragraph 2.3.2; Page 26)

Joint Field Inspection Report of layout approvals along water body in Kundrathur Panchayat Union (PU), Kundrathur Town Panchayat (TP) and Poonamallee PU

Sl.No	Layout and WRD's conditions	Audit Observations during field visit
(1)	(2)	(3)
1	<p>Site in Survey No (S.No): 490/1, 492 of Manapakkam and 1/1pt of Kolapakkam village :</p> <ul style="list-style-type: none"> <i>To provide a channel.</i> 	<p>A SWD was under construction to link to the channel. The channel was not maintained as it was stagnant with plastic waste and aqua plants. It was also seen that the waste water from these building were let out through outlet PVC pipes into the channel.</p>
2	<p>Site in S.No: 55/1A1, 58 of Kulathuvancheri and 178/1,2, 179, 180, 181, 182/1, 184/2, 185, 186/1,2,3,4,5,7,8,9, 187 of Srinivasapuram:</p> <ul style="list-style-type: none"> <i>Site to be filled up and two culverts provided.</i> 	<p>Site was not filled up/raised. Culverts were not provided. The water channel as seen in the layout map was not visible in the site.</p>
3	<p>Site in S.No:15/2A, 3B, 16/2 in Naduveerapattu village Kundrathur PU:</p> <ul style="list-style-type: none"> <i>No structure should be developed within three metre from the channel.</i> 	<p>Channel's boundaries were not earmarked.</p>
4	<p>Site in S.No: 343/3A, 3B, 4D, 4E, 5E to 5G, 6C2, 7A, 7C, 7E of Naduveerapattu village:</p> <ul style="list-style-type: none"> <i>Layout roads should be provided with SWD of size 0.45x0.45m on both sides.</i> 	<p>Layout did not have Storm Water Drain</p>
5	<p>Site in S.No: 72, 73/1A1, 1B, 2, 74/1, 2, 3/75, 76, 77/1,2,3, 81/1,2, 82, 83/1B, 1C, 3A to 3H, 84, 85/2 of Varadarajapuram village in Kundrathur PU:</p> <ul style="list-style-type: none"> <i>No development allowed in the area upto 1.5 m along the channel.</i> 	<p>A residential apartment was built on the bund of the channel. The work of widening of the channel was stopped with this building encroaching into the channel and the width of the channel was narrowed.</p>
6	<p>Site in S.No : 163/2B2, 3, 164/1, 2, 3A, 3B of Varadarajapuram village in Kundrathur PU:</p> <ul style="list-style-type: none"> <i>Storm Water Drain network of size 0.60x0.90m to be constructed all-round the site and the channel linked with existing Adayar Odai. –</i> <i>A compound wall to be constructed around site on west and east side.</i> 	<p>The channel/natural drain passing in front of the layout was encroached by a temple and houses. No roads were formed on the layout and storm water drain all around the site connecting to the existing Adayar Odai was not constructed.</p>
7	<p>Site in S.No : 215 and 216 of Kundrathur village in Kundrathur TP:</p> <ul style="list-style-type: none"> <i>Minimum offset of one metre should be maintained from the boundary of the channel.</i> <i>A road culvert of 10 metre to be provided across the channel.</i> 	<p>One RCC box type culvert for a length of approximately three meters was provided. The channel was not continuous and found encroached on both sides by buildings.</p>

(1)	(2)	(3)
8	<p>Site in S.No : 410/1, 2A, 411/1B, 2, 412/1 of Kundrathur village in Kundrathur TP:</p> <ul style="list-style-type: none"> <i>The site should be raised to a minimum level of +18.150 m uniformly.</i> <i>RCC box type culvert with a vent of size 3.00x1.00m should be constructed.</i> <i>Width of the channel to be maintained, setback space of six metres to be provided adjacent to the channel.</i> 	<p>No culvert constructed. Channel not maintained along the road. Ground level not raised. Setback space of six was not provided, but a compound wall constructed.</p>
9	<p>Site in S.No : 1179/1, 2 of Kundrathur village in Kundrathur TP:</p> <ul style="list-style-type: none"> <i>No structure within 2m from the channel boundary stone.</i> <i>Box type culvert should be constructed at S. No. 1181.</i> 	<p>Boundary stones were not laid. Channel was not maintained, filled with aqua plants. Unapproved buildings were seen constructed abutting the channel adjacent to this approved layout.</p>
10	<p>Site in S.No : 36, 37, 38/1, 2A, 2B, 42/1,2 of Kundrathur village in Kundrathur TP:</p> <ul style="list-style-type: none"> <i>Demarcation stone should be laid for the waterway.</i> <i>Ground level to be raised to 17.09 m above MSL.</i> 	<p>No demarcation stone laid. The channel abutting the site was filled with debris to form an unapproved layout (in eastern side). Thereby, the channel was narrowed down into a small drain.</p>
11	<p>Site in S.No : 11/2A1, 2A2, 2A3, 1379/1A to 1C, 2, 3A, 3B, 4A3, 4A4, 4B2, 5, 6A3, 6B of Kundrathur village in Kundrathur TP:</p> <ul style="list-style-type: none"> <i>To raise ground level by 2.18 m to reach 18.06 m above MSL.</i> 	<p>Ground level was not raised. Clear channel was not maintained including the width required. Channel was covered with shrubs and aqua plants.</p>
12	<p>Site in S.No : 320, 321/2, 322/1 of Kundrathur village in Kundrathur TP:</p> <ul style="list-style-type: none"> <i>Width of the channel is to be maintained.</i> 	<p>Layout was not clear. The channel was not maintained and was encroached.</p>
13	<p>Site in S.No : 97 and 123 of Manancherry village in Kundrathur TP</p> <ul style="list-style-type: none"> <i>Two road culverts to be provided across field channel with a vent opening of four metres.</i> 	<p>No channel was seen. In survey number 96, the channel was occupied by a building. No culvert was seen.</p>
14	<p>Site in S.No : 98, 99/2, 121/2 of Manancherry village in Kundrathur TP:</p> <ul style="list-style-type: none"> <i>Culvert should be constructed.</i> 	<p>The channel was occupied by a building. No culvert was seen.</p>
15	<p>Site in S.No : 93/2, 99/1 of Manancherry village in Kundrathur TP:</p> <ul style="list-style-type: none"> <i>Culvert should be constructed.</i> 	
<p>Joint field inspection report of layout approvals in Poonamallee Panchayat Union</p>		
16	<p>Site in S.No: 26/2A,2B, 31/1C,1D, 32/1A of Kannapalayam village:</p> <ul style="list-style-type: none"> <i>Site should be raised in layers by earth by more than 0.30 metre.</i> <i>RCC box type culvert to be provided with a vent of size 7.20 metre x 6.00 metre x 1.2 metre should be constructed and promoter should do periodical desilting work.</i> 	<p>Site was not raised. A smaller culvert was provided and the channel was not desilted.</p>

(1)	(2)	(3)
17	Site in S.No: 60, 61/1, 2 of Meppur village: <ul style="list-style-type: none"> • Site level to be raised to the level of channel. • Permanent fencing should be done along the boundary between the site and the channel and the layout to be formed three metres away from the fencing. 	No permanent fencing was constructed along the boundary between the site and the channel. Layout was formed three meters away from the temporary fencing.
18	Site in S.No: 79 to 81, 83/1,2, 84/1, 2, 85/1, 86/1, 98/2, 111/2A2, 112, 113/2, 114 of Meppur village: <ul style="list-style-type: none"> • Minimum offset of 1.50 metre from the channel. 	Channel was encroached by plantations.
19	Site in S.No 83/8B, 9 to 11, 13, 14, 15B, 16B, 84/2B, 3A2, 3B, 4 to 7, 85/3, 86/2, 3, 7, 87/2A, 2B, 3pt, 6, 88/1, 2, 3, 4, 5A, 5B, 11, 12, 13A, 13B, 94/2B of Sorancherry village: <ul style="list-style-type: none"> • Ground level to be raised with an average filling varying from 0.435 to 1.35m. Should provide adequate SWD. • Demarcation should be done at both sides of the channel. 	Ground level was not raised. SWD was not provided. The channel was not demarcated, it was encroached.
20	Site in S.No 108/5B of Sorancherry village: <ul style="list-style-type: none"> • The site should be raised to the level of 24.13 m by filling the earth to the height of 0.75 m. 	Channel flowing adjacent to the layout leading to Cooum River not being visible.
21	Site in S.No 107/5 of Sorancherry village: Site should be raised to a height of 1.50 metre <ul style="list-style-type: none"> • RCC box type culvert with vent size 7.2 x 2.4 m to be constructed 	RCC culvert was not provided. Channel was not visible.
22	Site in S.No. 240/2A,2B2 of Voyalanallur village	This site is in continuation of the site in S.No. 107/5 of Soranjeri village. The channel which passes through the layouts ibid in Soranjeri village pass through this layout to join Cooum River. This channel in Voyalanallur village is encroached by a Compound wall and a garden.
23	Site in S.No. 604/2,3, 605/2 to 5, 606/3, 607/2 of Annambedu village <ul style="list-style-type: none"> • Site should be raised by 1.50 m • RCC box type culvert 3 x 9 m in between S.No. 606/3 and 607/2 • Channel running inside the site should not be encroached and boundaries of the channel to be earmarked. 	No channel is visible in the layout and no culvert constructed.

Appendix 2.3

(Reference: Paragraph 2.4.3; Page 33)

Reclassification of Open Space and Recreation (O&R) zone to others

Sl.No	Survey No. / village	Field verification and decision by CMDA
1	<p>Old Survey No 209 part, Present Town Survey (TS) No. 4 Block No 58 Ward -D of Thirumullaivoyal village</p> <p>The Commandant, Tamil Nadu Special Police Battalion-V, Avadi requested for reclassification of O&R zone for construction of Administrative Buildings.</p> <p>The extent of site is 6.92 ha.</p>	<p>CMDA inspected the site and found that the site abuts the 91 feet wide public road. Four to five buildings were existing and used as Administrative office, Barracks (Guest houses for training people) and store rooms etc.</p> <p>The Technical Committee on 6.5.2015 recommended the reclassification of O&R use zone to Institutional use zone and the Authority resolved to reclassify in the meeting held on 4.8.2015.</p>
2	<p>S. No 158/2A1B & 2B of Koladi village, Ambattur Taluk, Thiruvallur District, Thiruverkadu Municipality.</p> <p>The applicant had applied for reclassification of O&R use zone to Mixed Residential use zone to construct a commercial complex. The total extent of the site is 0.36 ha.</p>	<p>CMDA inspected the site on 30.1.2014 and found that the site was vacant. The site abuts 33 feet wide road. The site slopes down from road to its rear side and low lying by about 3.0 m. The Cooum River runs on the southern side after a small parcel of land from the site under reference. The surrounding developments were predominantly with mixed activity.</p> <p>CMDA addressed PWD on 27/1/2014 for NOC on inundation point of view and it was awaited.</p> <p>The Technical Committee in its meeting (7.2.2014) discussed the subject and observed that the site abuts a public road, lying low and adjacent to the Cooum River. The representative from PWD clarified that the ownership of the applicant on the site under reference would be confirmed before issue of NOC for the site as it is close to the Cooum River in which case the ownership of the river part is vested with the PWD. Considering these, the Technical Committee recommended the reclassification and the Authority resolved on 10.9.2014 to reclassify the land.</p>
3	<p>S. No. 59/7A1A (old survey No 14/18, 15/14) of Numbal Village, Ambattur Taluk</p> <p>The applicant requested for reclassification of Green Belt use zone to Industrial zone. Extent is 0.07 ha.</p>	<p>As per CMDA inspection report, the site abuts 45 m wide Poonamallee High Road and was surrounded on the north by vacant land, south by PH Road, east by vacant land and west by IT company & College.</p> <p>The Technical committee recommended (27.02.2012) to reclassify the site under reference from Green Belt Use zone to Industrial use zone subject to the condition that the applicant had to demolish the existing small structure before applying for planning permission for new/additional building and the Authority resolved on 13.03.2014 to reclassify the site.</p>

Sl.No	Survey No. /Village/File No.	Field verification and decision by CMDA
4	<p>Survey No 2/3,3C and 2/3B of Veeraraghavapuram and 25/1A, Sundarasholavaram village</p> <p>The applicant requested reclassification from O&R use zone to Institutional zone for construction of College building</p> <p>Extent 1.21 ha</p>	<p>CMDA in their inspection report stated that the land was vacant with abutting road width of 22.6 metre with surrounding developments as residences and Cooum River on the eastern side.</p> <p>The Technical Committee stated that the site under reference abuts 22.60 metre Avadi-Poonamallee High Road. The local body had recommended for reclassification of land use from partly Agricultural use zone and partly O&R use zone into Institutional use zone subject to the condition that the applicant should get NOC from PWD before making any development in the site under reference. The Authority resolved on 7.5.2012 for reclassification of land use.</p>
5	<p>TS No 5 Block No 16 Velachery Village</p> <p>The applicant requested for reclassification from O&R use zone to commercial use zone-</p> <p>Extent 1.96 ha</p>	<p>CMDA in its inspection report stated that the present use of the land was old horse stable and old Quarters for horse trainers with abutting road width of 23.5 metre with surrounding developments as residences and commercial buildings.</p> <p>The Technical Committee viewed that the site was a <i>patta</i> land and did not form part of 10 per cent OSR land. Considering the adjacent developments, the Committee recommended for reclassification of the site and the Authority also resolved to reclassify the site on 7.5.2012.</p>
6	<p>TS No 7/2,3&4 Block No 17 Velachery-</p> <p>The applicant requested for reclassification from O&R use zone to commercial use zone-</p> <p>Extent 0.15 ha</p>	<p>CMDA in its inspection report stated that the classification of land as 'wet' land abutting 55 feet wide Tar Road with surrounding developments as residences and commercial buildings.</p> <p>The Technical committee noted that a ground Floor and first floor (part) building was in existence in the site and it was being used as Hospital and also the applicant had furnished approved demolition plan for the building. Therefore, the compliance of existing building to Development Regulations did not arise. Also, the committee noted that the site was surrounded by residences, commercial and institutional activities and recommended to reclassify the site under reference from O&R use zone to commercial use zone and the Authority resolved on 14.2.2011 to reclassify the site.</p>
7	<p>Survey No. 159/1A2, 5, 6 of Koladi village, Tiruverkadu Municipality</p> <p>The applicant requested for reclassification from O&R use zone to Mixed Residential zone</p> <p>Extent: 0.30.90 ha</p>	<p>The site was abutting 11.40 m wide Permalagaram Road on the North and vacant lands on other sides.</p> <p>The Technical Committee recommended the site under reference for reclassification of site subject to the condition that the applicant obtain NOC from PWD and Authority resolved to reclassify the site on 16-02-2016.</p>

Appendix 5.1
(Reference: Paragraph 5.2.1; Page75)

Details of missing links

Sl.No.	Zone No.	Division No.	Name of the Street	Length in Metres
(1)	(2)	(3)	(4)	(5)
1	1	5	TH Road junction of MRF Road	8
2	1	6	Kalaignar Nagar	275
3	2	15	Manalai New Town 60 Feet Road	11.2
4	2	16	Rajiv Gandhi Nagar from TPP salai to Andarkuppam Main Road	100
5	2	16	From Kanniammanpet pond to Kadapakkam Lake	80
6	3	22	Mahalakshmi Nagar	6
7	3	23	Punitha Anthoniyar Street	15
8	3	23	Othai Vadai Street	10
9	4	45	Ganesapuram Main Road	12
10	4	47	KH Road	16
11	5	58	EVK Sampath Salai	17
12	5	61	Egmore High Road	720
13	5	62	Arunachalam Road	70
14	5	63	Chella Pillayar Kovil Street	50
15	5	63	G.P.Road	45
16	6	68	Maduraiswamy Madam Street	100
17	6	70	Bharathi Main Road	560
18	8	100 & 101	5 th Main Road Surroundings	100
19	8	100 & 101	4 th Main Road Surroundings	40
20	9	118	Mayor Sundra (Rao) Road	120
21	9	121	Thiru-Vi-Ka 3 rd Street	9
22	10	136	North Usman Street	22
23	10	127	100 Feet Road (Junction of Kalamman Koil Street)	25
24	10	127	Kalamman Koil Street (in front of Police Station)	20
25	11	154	Bharathi Salai	20

(1)	(2)	(3)	(4)	(5)
26	12	167	Nanganallur 44 th Street	12.3
27	13	173	MRC Nagar	370
28	13	173	Vasantha Avenue	270
29	13	173	Kasthuri Avenue	164
30	13	175	L.B. Road	8
31	13	175	Kasthuribai Nagar	20
32	13	175	Indra Nagar	6
33	13	175	Anna Avenue	5
34	13	176	Sastri Nagar II, IX & XV Cross Street	18
35	13	178	A.G.S Colony	20
36	13	179	V.G.P.Selva Nagar Extension I to V streets	856
37	13	179	V.G.P.Selva Nagar I Cross Street & I Main Road	440
38	13	179	Bhuvaneswari Nagar I & III Cross Street & III Main Road	299
39	13	179	Veenus Colony II Street	200
40	13	181	Dr.Radhakrishnan Nagar	50
41	13	181	Valmigi Street	100
42	13	180	CSIR Road	10
43	13	174	Nehru Nagar – Veerapandiya Kattabomman Street	270
44	13	174	Nehru Nagar – Periyar Street	330
45	13	174	Nehru Nagar – Anbil Dharmalingam Street	270
46	13	174	Velacherry Main Road	900
47	13	182	Journalist Colony	200
48	14	169	Ram Nagar (North)	30
49	15	192	Ellaiamman Koil Street	160
50	15	193	MCN Nagar	100
51	15	194	OMR – Mettukuppam (VGP Avenue Junction)	180
52	15	197	Wipro Salai	2,500

Appendix 5.2
(Reference: Paragraph 5.3(ii); Page78)

Physical and Financial Progress of works under TNSUDP as on 31 August 2016

Sl. No.	Package No.	Name of the Contractor	Total length (in 'm') as per BoQ	Length (in 'm') completed						Value of work done ₹ in crore	Percentage of financial progress	Delay in issue of work orders (in months)
				Earthwork	PCC	RCC Raft	RCC Side Walls	RCC Top Slab	percentage of physical progress			
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)
1	1	M/s RPP Infraproject (P) Ltd	13,299	1,454	1,431	1,431	1,211	1,041	7.83	2.13	5.38	5
2	2	M/s RPP Infraproject (P) Ltd	8,825	1,227	1,192	1,164	1,057	1,033	11.71	2.03	6.10	5
3	3	M/s Saravana Engineering Bhavani (P) Ltd	2,801	1,115	1,115	1,115	1,085	1,065	38.02	4.90	12.57	2
4	4	M/s Sri Sivaram & Co.	7,791	2,952	2,932	2,902	2,802	2,782	35.71	6.29	21.82	-
5	5	M/s RPP Infraproject (P) Ltd	7,608	1,395	1,350	1,315	1,315	1,240	16.30	3.47	7.60	5
6	6	M/s P&C Project (P) Ltd	2,848	428	413	338.4	308.1	299	10.50	2.35	9.12	2
7	7	M/s P&C Project (P) Ltd	8,071	1,007	978	976	956	946	11.72	1.97	5.93	2
8	8	M/s Kumar Builders	2,244	60	0	0	0	0	2.67	0.01	0.04	2
9	9	M/s Gurumurthy Engineering Enterprises	6,901	2,781	2,781	2,756	2,581	2,581	37.40	5.88	16.31	2
10	10	M/s Annai Infra Developers (P) Ltd	12,893	2,661	2,641	2,601	2,601	2,506	19.44	6.06	14.15	2
11	11	M/s Saravana Engineering Bhavani (P) Ltd	7,049	3,002	2,965	2,940	2,894	2,864	40.63	7.85	28.76	2
12	12	M/s P&C Project (P) Ltd	11,557	1,490	1,486	1,458	1,432.6	1,372	11.87	2.42	6.92	2
13	13	M/s Sri Sivaram & Co.	10,644	2,405	2,385	2,380	2,360	2,360	22.17	4.49	19.62	5
14	14	M/s P&C Project (P) Ltd	5,278	246	215	200	182	182	3.45	0.11	0.31	2
15	15	M/s Annai Infra Developers (P) Ltd	4,743	196	172	150	150	104	2.19	0.12	0.30	5
16	16	M/s Annai Infra Developers (P) Ltd	9,792	1,106	1,066	1,011	935	853	8.71	2.74	6.63	5
17	17	M/s Annai Infra Developers (P) Ltd	15,294	2,177	2,170	2,098	2,078	2,014	13.17	6.14	10.37	5
18	18	M/s Sree Venkateswara Road Constructions	4,966	872	852	784	746	658.2	13.25	1.43	9.58	2
19	20	M/s Thirumala Traders	1,927	590	340	80	0	0	1.30	0.61	3.44	5
20	21	M/s Landmark Corporation	8,462	3,069	2,984	2,854	2,806	2,759	32.60	5.27	18.99	5
21	22	M/s Gurumurthy Engineering Enterprises	10,124	4,190	4,155	4,095	4,012	3,880	38.32	10.87	35.17	2

(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)
22	23	M/s R.Krishnamurthy & Co.	12,249	1,190	1,123	1,081	1,072	814	6.65	1.78	3.95	2
23	26	M/s Selliamman Constructions (P) Ltd	1,326	787	787	787	787	782	58.97	2.19	11.50	-
24	27	M/s Sakthi Constructions	9,798	1,693	1,693	1,687	1,622	1,579	16.12	1.30	3.64	2
25	28	M/s Rock & Arch Construction India (P) Ltd	14,845	1,860	1,776	1,771	1,771	1,759	11.85	3.52	8.95	2
26	29	M/s Rock & Arch Construction India (P) Ltd	7,289	429	429	419	419	395	5.42	0.89	3.32	5
27	30	M/s Landmark Corporation	8,921	1,722	1,680	1,555	1,464	1,400	15.69	1.90	8.13	-
28	31	M/s R.Krishnamurthy & Co.	9,129	1,246	1,246	1,155	1,111	997	10.92	1.76	4.93	2
29	32	M/s R.Krishnamurthy & Co.	9,996	2,143	2,108	2,100	2,100	1,953	19.54	4.56	13.41	2
30	33	M/s Selliamman Constructions (P) Ltd	11,028	4,239	3,969	3,747	3,637	3,557	32.25	4.27	12.20	2
31	34	M/s Sree Venkateswara Road Constructions	4,047	2,126	1,996	1,926	1,926	1,906	47.10	2.99	12.88	2
32	35	M/s P&C Project (P) Ltd	8,684	550	505	490	465	425	4.89	0.82	2.77	2
33	36	M/s P&C Project (P) Ltd	9,060	467	467	419	344	300	3.31	0.54	1.62	2
34	37	M/s Annai Infra Developers (P) Ltd	10,982	1,408	1,348	1,303	1,283	1,238	11.27	1.13	2.89	2
35	38	M/s Annai Infra Developers (P) Ltd	11,414	1,412	1,389	1,337	1,297	1,267	11.10	1.88	4.14	2
		Total	2,91,885	55,696	54,140	52,426	50,811	48,912	16.76	106.66	9.16	

Total length = 2,91,885 metres;

Physical progress percentage = 16.76;

Financial progress percentage = 9.16;

PCC- Plain Cement Concrete;

RCC- Reinforced Cement Concrete

Appendix 5.3

(Reference: Paragraph 5.4.1; Page 81)

Areas in selected suburban areas affected by flood

Name of the local body	Areas affected
Tambaram Municipality	CTO Colony, Mullai Nagar, Mangalapuram, Arputham Nagar, Nehru Nagar, Motilal Nagar, Tiruvallur Nagar, Adhi Nagar, Ananthapuram, Ambedkar Nagar and Bharat Nagar
Sembakkam Municipality	Raja Rajeswari Nagar, Tellus Avenue, VallalUsuf Nagar, Gokul Nagar, Sivakami Nagar and Shanthi Nagar
Pallavapuram Municipality	Sakthi Nagar, Medavakkam Main Road, Bhavani Nagar, Ambaal Nagar, Mummoothy Nagar and Nethaji Nagar
Perungalathur Town Panchayat	Bharathi Nagar, Moovendar Nagar Extn., Samathuva Periyar Nagar, AnnaiAnjugam Nagar, Indira Nagar, Kannan Avenue, Meenatchi Avenue, Goodwill Nagar, Kurunji Nagar, Balaji Nagar, Sasivaradhan Nagar, Kumaran Nagar, Gandhi Nagar, Thangaraj Nagar, EB Colony, Sri Ram Nagar, Parvathi Nagar and Mudichur Road
Peerkankaranai Town Panchayat	Sri Ram Nagar, Devanesan Nagar, KK Nagar, Imanuel Street and Cross Street, Velu Nagar and Cross Street, Ambedkar Street, Kalaimagal Street, Rajiv Gandhi Street, Gandhi Road, Uma Nagar, Archana Nagar, Shakthi Nagar, Mullai Nagar, Bhavani Street, Church Road, Karthik Avenue, AS Rajan Nagar and Extension, Swami Vivekandar Street Extension, Balaji Avenue, Annai Indira Nagar, Bharathidasan Nagar, TTK Nagar and Cross Streets and Thanga Raj Nagar
Thiruneermalai Town Panchayat	Subbaraya Nagar, Saraswathipuram, Parvathipuram, Ranga Nagar, Anna Street, MallimaVeethi, Arignar Anna Street, Selva Vinayagar Koil Street, V.G.N. Nagar and Bajanai Koil Street

Appendix 5.4
(Reference: Paragraph 5.4.5; Page 84)

Details of SWD constructed partially in Pallavapuram Municipality

Sl. No.	M.Book No.	Nature of the work	Estimate amount (in ₹)	Expenditure incurred (in ₹)	Length in metres		Difference in metres
					As per estimate	As per execution	
1	197/14-15	Construction of SWD at Ramaswamy street in ward No.30	8,00,000	3,62,290	210	188.95	21.05
2	37/14-15	Construction of SWD at Joy Nagar Ist street and Padmavathy street in ward No.24	7,00,000	2,07,400	140	130.30	9.70
3	112/13-14	Construction of SWD with RCC culvert at Dharga Road in ward No.11	11,70,000	3,93,485	371	79.00	292.00
4	63/13-14	Construction of SWD at Janakiraman street and Hasthinapuram Main Road in Ward No.22	4,50,000	2,80,435	220	121.60	98.40

Appendix 5.5
(Reference: Paragraph 5.6.2; Page 87)

Maintenance of water bodies in selected Zones/Municipalities and Town Panchayats

Sl. No.	Name of the local body	Details of water bodies	Position obtained	Department responsible for maintenance
(1)	(2)	(3)	(4)	(5)
1	Adyar Zone of GCC	Guindy industrial estate canal, Raj Bhavan Canal, Mambalam Canal	Width of Canal reduced due to encroachment	GCC
2	Alandur Zone of GCC	Adambakkam Lake and Veerangal odai	Width of Veerangal Odai reduced due to encroachment	WRD
3	Ambattur Zone of GCC	Korattur Canal, Ambattur Canal, Canal near VAO Office,, Padikuppam Canal and Coovam Canal	Width of Canals reduced due to encroachment	GCC
		Korattur and Ambattur Lakes	Water bodies were poorly maintained and encroachment was noticed	WRD
4	Kodambakkam Zone of GCC	Virugambakkam Canal, MGR nagar Canal, Jaferkhanpet Canal and Mambalam Canal	Width of canals reduced due to encroachment	GCC
5	Pallavapuram Municipality	Pallavapuram Periya Eri, Kilkattalai Eri, Sembakkam Eri and Moovarasampattu Eri	Water bodies were poorly maintained and encroachment was noticed	PWD
6	Sembakkam Municipality	Rajakilpakkam and Sembakkam Lakes	Water bodies were poorly maintained and encroachment was noticed	PWD
		Gowrivakkam Lake	Water body poorly maintained	St.Thomas Mount Panchayat Union
7	Tambaram Municipality	Peerkankaranai Lake, Irumbuliyur Lake and Thiruvancheri Lake	Water bodies were poorly maintained and encroachment was noticed	WRD
		Pappan Channel	Channel abruptly ended and WRD was diverting the channel to join with Adyar River. Width of Channel reduced due to encroachment and developments	PWD
		Adyar River (Kishkinta Road point)	River was poorly maintained and encroachment noticed	PWD
8	Perungalathur Town Panchayat	Periya Eri and Sitheri	Water bodies were poorly maintained and encroachment was noticed	PWD
9	Peerkankaranai Town Panchayat	Periya Eri and Sitheri	Periya Eri was poorly maintained and encroachments noticed. Sitheri was encroached and converted into residential areas	PWD
10	Thiruneermalai Town Panchayat	Periya Eri, Sitheri and Veeraraghavan Lake	Water bodies were poorly maintained and encroachments were noticed	PWD
		Channel connecting Periya Eri and Adyar River	Width of channel reduced due to encroachments	PWD

Appendix 5.6
(Reference: Paragraph 5.8.5; Page 93)

Details of inflow and surplus discharge from Chembarambakkam Tank

Date	Time	Water availability (in TMC)		Inflow (cusec)	Discharge through Surplus course (cusec)	Depth (feet)
		Maximum capacity	available			
16.11.2015	21.00	3.645	3.388	17,685	5,000	22.85
17.11.2015	21.00	3.645	3.388	17,685	5,000	22.85
	2.00	3.645	3.293	12,722	18,000	22.67
	4.00	3.645	3.256	12,762	18,000	22.53
	6.00	3.645	3.197	12,031	18,000	22.30
	10.00	3.645	3.141	12,000	15,000	22.08
	12.00	3.645	3.113	11,000	10,000	21.97
	14.00	3.645	3.113	10,000	10,000	21.97
	16.00	3.645	3.108	9,653	10,000	21.95
	18.00	3.645	3.094	7,362	10,000	21.90
	20.00	3.645	3.080	7,362	7,500	21.85
	22.00	3.645	3.080	7,500	7,500	21.85
	24.00	3.645	3.067	6,350	6,000	21.80
1.12.2015	6.00	3.645	3.141	960	900	22.08
	9.00	3.645	3.197	7,500	3,000	22.30
	10.00	3.645	3.248	10,000	10,000	22.50
	12.00	3.645	3.299	14,000	12,000	22.70
	14.00	3.645	3.377	23,629	20,960	23.02
	16.00	3.645	3.390	24,932	20,960	23.06
	17.00	3.645	3.429	25,000	28,000	23.20
	18.00	3.645	3.429	29,000	29,000	23.20
	19.00	3.645	3.460	30,000	29,000	23.35
	20.00	3.645	3.481	31,000	29,000	23.40
	22.00	3.645	3.481	29,000	29,000	23.40
	24.00	3.645	3.481	29,000	29,000	23.40
2.12.2015	2.00	3.645	3.455	26,000	29,000	23.30
	3.00	3.645	3.442	26,000	29,000	23.25
	6.00	3.645	3.396	26,000	29,000	23.07
	9.00	3.645	3.332	23,000	29,000	22.83
	12.00	3.645	3.284	23,000	29,000	22.64
	15.00	3.645	3.225	23,000	20,000	22.41
	18.00	3.645	3.200	15,000	15,000	22.31
	21.00	3.645	3.161	12,000	14,000	22.16
24.00	3.645	3.132	11,500	13,000	22.05	
3.12.2015	6.00	3.645	3.094	10,200	11,000	21.90
	9.00	3.645	3.067	5,000	3,500	21.80

Appendix 7.1
(Reference: Paragraph 7.1.4; Page 121)

Achievement against service level bench mark

(i) Provision of SWD

Name of the local body	Total length of road network (more than 3.5 metres carriage way) (Kms.)	Total length of primary, secondary and tertiary drains (only pucca construction and covered drains) (Kms.)	Percentage of coverage	As per GoI norms (in percentage)	Shortfall (Percentage)
Adyar Zone	411.52	136.33	33.13	100	66.87
Alandur Zone	231.84	86.17	37.17	100	62.83
Ambattur Zone	496.51	29.97	6.03	100	93.97
Kodambakkam Zone	456.37	189.60	41.55	100	58.45
Pallavapuram	242.00	3.00	1.04	100	98.96
Peerankaranai	41.65	Nil	0.00	100	100.00
Perungalathur	83.50	Nil	0.00	100	100.00
Perungudi zone	455.47	55.94	12.28	100	87.72
Sembakkam	100.42	85.35	85.00	100	15.00
Tambaram	164.75	142.75	86.65	100	13.35
Thiruneermalai	39.36	Nil	0.00	100	100.00

(ii) Report of water logging

Name of the local body/GCC Zone	Number of flood prone areas identified* (A)	Number of occasions of flooding/ water logging in a year (B)	Aggregate number of incidents of water logging (stagnant water for more than four hours of a depth more than six inches) (A x B)	As per GoI norms (Number of water loggings)	Shortfall (in percentage)
Adyar Zone	75	1	75	0	100
Alandur Zone	60	1	60	0	100
Ambattur Zone	74	1	74	0	100
Pallavapuram	6	2	12	0	100
Peerankaranai	27	1	27	0	100
Perungalathur	18	1/2	9	0	100
Sembakkam	6	2	12	0	100
Tambaram	11	1	11	0	100
Thiruneermalai	12	1	12	0	100
Perungudi Zone	31	3	93	0	100
Kodambakkam Zone	6	3	18	0	100

* Water logging at key road intersections, or along a road length of 50 m or more, or in a locality affecting 50 households or more

Glossary of Abbreviations

Abbreviation	Full form
AGM	Annual General Body Meeting
ALTM	Airborne Laser Terrain Mapping
C&AG	Comptroller and Auditor General of India
CE	Chief Engineer
CMA	Chennai Metropolitan Area
CMDA	Chennai Metropolitan Development Authority
CMRL	Chennai Metro Rail Limited
CMWSSB	Chennai Water Supply and Sewerage Board
COR	Compendium of Rules of Regulations
CPHEEO	Central Public Health Environmental Engineering Organisation
CRA	Commissioner of Revenue Administration
CRRT	Chennai Rivers Restoration Trust
CWC	Central Water Commission
DCR	Development Control Rules
DEOC	District Emergency Operation Centre
DHT	Director of Handlooms and Textiles
DM Act, 2005	Disaster Management Act, 2005
DMP	Disaster Management Plan
DPR	Detailed Project Report
DR	Development Regulations
E&RSA	Economic & Revenue Sector Audit
EAP	Emergency Action Plan
EC	Executive Council
EE	Executive Engineer
ELCOT	Electronics Corporation of Tamil Nadu
EOC	Emergency Operation Centre
ETRP	Emergency Tsunami Reconstruction Project
FMP	First Master Plan
FPZ	Flood Plain Zoning
G&SSA	General & Social Sector Audit
GCC	Greater Chennai Corporation
GoI	Government of India
GoTN	Government of Tamil Nadu
IRC	Indian Roads Congress
ISRO	Indian Space Research Organisation
JNNURM	Jawaharlal Nehru National Urban Renewal Mission
Mcf	Million Cubic Feet
MRTS	Mass Rapid Transit System
MSL	Mean Sea Level
NCDS	National Committee on Dam Safety
NDM	National Disaster Management

NDMA	National Disaster Management Authority
NDRF	National Disaster Response Force
NHAI	National Highways Authority of India
NOC	No Objection certificate
NWP	National Water Policy
O&R Zone	Open Space and Recreation Zone
OTA	Officers Training Academy
PAC	Public Accounts Committee
PWD	Public Works Department
SDRF	State Disaster Response Fund
TNSDMA	Tamil Nadu State Disaster Management Agency
SMP	Second Master Plan
SO	Section Officer
STP	Sewage Treatment Plant
SWD	Storm Water Drain
SWM	Solid Waste Management
SWP	State Water Policy
TAC	Technical Advisory Committee
TMC	Thousand Million Cubic Feet
TNCSC	Tamil Nadu Civil Supplies Corporation
TNEB	Tamil Nadu Electricity Board
TNSCB	Tamil Nadu Slum Clearance Board
TNSUDP	Tamil Nadu Sustainable Urban Development Programme
UC	Utilisation Certificate
UGSS	Underground Sewage System
VHF	Very High Frequency
WRD	Water Resources Department