City Sanitation Plan

BHUBANESHWAR

Research Study Series No. 119

June 2012

National Institute of Urban Affairs
New Delhi , India

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In association with
All India Institute of Local Self Government – Planning and Resource Development Affairs (AIILSG-PRUDA)

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PREFACE

The overall goal of the National Urban Sanitation Policy (NSUP) is to transform Urban India into community–driven, totally sanitized, healthy and livable cities and towns. Each state needs to formulate its own sanitation strategy and their respective cities should prepare sanitation plan in conformity with the NUSP.

In this context, the Government of Odisha (GoO) selected eight cities/towns to prepare City Sanitation Plans (CSPs) viz. Bhubaneshwar, Cuttack, Berhampur, Sambalpur, Rourkela, Puri, Balasore, Baripada. These cities/towns were selected on the basis of (i) geographical representation; (ii) emerging demand and interest of ULB to take-up initiative; and (iii) poor sanitation conditions that require urgent attention. GoO has also prepared a State Urban Sanitation Strategy in 2011, which served as guidelines for the selected cities/towns to prepare CSP.

GoO has identified National Institute of Urban Affairs (NIUA), New Delhi, as a technical coordinator to carry out the work. Subsequently, NIUA has undertaken the work in association with All India Institute of Local Self Government – Planning and Resource for Urban Development Affairs (AIILSG-PRUDA) and OP& HS (infra).

Out of the eight CSPs, five have been prepared by AIILSG-PRUDA viz. Bhubaneshwar, Puri, Cuttack, Balasore and Baripada and three by OP&HS (infra) viz. Sambalpur, Raurkela and Berhampur. NIUA is thankful to the above agencies for carrying out the work. NIUA would like to thank officials of Department of Urban Development, GoO, selected cities/towns and Ministry of Urban Development, Government of India for their continued guidance and support. Special thanks are due to Dr. M.P.Mathur, Mr. Ajay Nigam and Mr. Naveen Mathur who have overseen the in-house work, visited the cities, attended meetings and provided their valuable comments.

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Executive Summary

Sanitation, being one of the basic amenities essential for healthy living, can be seen as safe management of human excreta, including its safe confinement treatment, disposal and associated hygiene-related practices. The Millennium Development Goals (MDGs) enjoin upon the signatory nations to extend access to improved sanitation to at least half the urban population by 2015, and 100% access by 2025. This implies extending coverage to households without improved sanitation, and providing proper sanitation facilities in public places to make cities open- defecation free.

There are 103 Urban Local Bodies in Odisha, which comprises of 3 Municipal Corporations, 37 Municipalities and 63 Notified Area Councils. Although Odisha has a projected urbanization rate of about 20 per cent in the year 2011, the actual growth in some pockets of the state in the recent years seems to be much faster than what is being generally perceived. Large conglomeration of people belonging to poorer strata of the society in Odisha cities has led to unplanned growth, immense pressure on the existing resource base, increasing number of slums and a large chunk of people without having access to provisions of basic amenities like potable drinking water, sanitation, housing and infrastructure support like roads, drainage and public transport. Provisions for these services not only require proper planning but also huge financial support by way of budgetary allocation.

With the existing trend of urbanization, the status of sanitation in the State of Odisha, especially in the slums and low-income settlements, is unsatisfactory. The facilities for safe disposal of solid and liquid waste are also not adequate. More than 1 million households in the state do not have access to toilet facilities, due to which they are forced to defecate in the open.

The State Government and the Urban Local Bodies (ULBs) have been implementing various programmes to address the issue of sanitation. However, in the absence of uniform policy guidelines, lack of a progress monitoring mechanism, multiplicity of agencies, overlapping jurisdictions and low awareness amongst the population, the results are not encouraging.

It is in this background that the Government of Odisha (GoO) has formulated the State Urban Sanitation Strategy (SUSP) on the lines of National Urban Sanitation Policy (NUSP) that was announced by the Ministry of Urban Development, in December 2008. As a first step in implementing the SUSP, the GoO has undertaken 8 cities/towns for developing City Sanitation Plans (CSP) with the funding support from Government of India with National Institute of Urban Affairs as the central coordinating agency and Technical Advisor.

All India Institute of Local Self Government (AIILSG- PRUDA) has been appointed as the consultant for five cities viz. Bhubaneswar, Puri, Balasore, Baripada and Cuttack.

The City Sanitation Plan (CSP) for Bhubaneswar has been prepared through a participatory process, using community/citizen led total sanitation (CLTS) approach. PRUDA of AIILSG organised consultation workshops and other follow-up activities with community/citizen groups at the locality level in all wards in the city during the plan preparation stage.

The plan has been prepared in line with the requirements of the National Urban Sanitation Policy (NUSP) of Government of India. The time horizon of the plan is 5 to 20 years. Despite the best efforts of Bhubaneswar Municipal Corporation, the task of achieving sanitation goals is herculean.

As per information provided by the Bhubaneswar Municipal Corporation, the city has a population of 900000 residing in 191985 households. It has registered nearly 39% growth over past decade. As per Census 2001, slum population is 47% of the city's population. The slums are in woeful condition – unhygienic, densely cluttered and often sitting on natural drains. 60% of slum households have no access to toilets. The situation is aggravated further by inadequacy of community toilets (total 98 in the city), lack of access or scarce or non-availability of municipal water supply. Child excreta is most often thrown into open. The CSP proposes to make Bhubaneswar city free of open defecation by year 2021 by combining construction of individual and community toilets.

Bhubaneswar is supplied with 251 mld of water which is almost 100 mld in excess of current demand, not taking into consideration the likely non-revenue water (distribution losses). This is ironic as the piped water supply network coverage of population is only 39 percent. In this background, conservation and infrastructure augmentation alone can remove the anomaly of poor distribution and its inequity (only 20% of slum population gets piped water supply). And yet, past reports suggest that in coming future, the demand-supply gap will only increase progressively thereby also affecting the water treatment and storage capacities.

While the Integrated Sewerage & Drainage Project for Cuttack being implemented by OWSSB has been planned with a 40-year perspective, it should be noted that the current system is grossly inadequate (50% wards fully or partly covered) and poorly maintained; the water treatment plant is too conventional for a city like Bhubaneswar; however, the said OWSSB project has planned for advance technology. In the current situation, the wastewater (black and grey water) finds its way into open drains - leading to issues of sullage management and health - and ultimately draining into river Daya, the primary drain and one that carries a significant load of pollution, including industrial effluents.

The storm water drains network has a gap of 885 km that needs to be bridged if storm water is to be efficiently managed. Open drains are clogged with solid waste and covey sewage that often spills over into inhabited areas.

One major aspect of sanitation that needs immediate attention of the authorities is the municipal solid waste and its management. The 450 TPD of waste generated in Bhubaneswar is dumped in small cement concrete bins or in open heaps and finally in an open dump at Bhausuni. The city not only lacks a scientifically engineered landfill site (already proposed by GoO), but also does not process its waste into compost; the primary collection, secondary storage and transportation suffers from inadequate infrastructure, staff and more importantly, lack of civic sense and attitude of the citizens. Thus, the BMC is not in compliance with the MSW Rules 2000. The CSP has projected MSW generation, biomethanation as a processing option and landfill design dimensions with a 15-year perspective and has given indicative cost estimates.

The following Table summarises the sanitation requirements over next 10 years:

Indicators	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021
Proposed Works											
Household Sanitation											
Individual Toilets Required	-	3713	3744	3776	3810	3844	3879	2823	2824	2825	2827
Community Toilet blocks (22 community toilets with 176 seats and 60 public toilets already available)	-	53	53	53	54	54	55	39	39	39	39
Drainage											
Rehabilitation of existing drains Kms	-	18.27	54.81	91.35	127.89	164.43	182.7				
Construction of new drainage network (Km)	-	120.33	360.99	601.66	842.32	1082.98	1203.31				
Sewerage											
DPR prepared by OWSSB with a 40-yr perspective											
Solid Waste Management											
Litter Bins Nos	-	3654	-	-	-	-	-				
Containers	-	465	481	497	513	530	548				
Mini Waste Collector (7 Mt Capacity)	-	66	69	71	73	76	78				
Bio Methanation Plant (100 tpd capacity)					**1**						
Water Tanker (3000 lit)					**2**						
Weigh Bridge (10Mt)					**1**						
Engineering Landfill (1560375 Mt capacity)							**1**				

The total capital investments has been proposed at Rs. 174,00,85,500 over next 10 years. This should be viewed against the commitments already made by GoO in its published plans, policies and project financial outlay as given in the CSP.

Apart from capital investment, the CSP also details, the recurring costs of O&M for all aspects of sanitation over the entire plan period and per capita O&M cost each year that indicates any tariff revisions or introduction of fresh tariffs.

The overall strategy for achieving hundred percent access to sanitation is twofold - one, to trigger and mobilise communities to take local and collective action and; two, to ensure timely and quality implementation of related interventions under various schemes.

Municipal tariffs will need to be revised upwardly and fresh taxes such as sewerage and SWM imposed to increase the revenue. More importantly, tax collection efficiency with support from penal provisions, need to be improved drastically. A partial willingness to pay or willingness to contribute free labour among the urban poor for individual toilets is an opportunity to motivate the rest through pilot projects. The financial provisions in state government and central government schemes should be utilised fully each year – all this to fulfil the aspirations of the Bhubaneswar City Sanitation Plan.

Capacity building of all stakeholders will be crucial to achieving the goal of the CSP. As in the majority of ULBs across the country, in Bhubaneswar, too there are problems of lack of skills and multi tasking.

The City Sanitation Plan (CSP) of Bhubaneswar is intended to be a flexible, dynamic and responsive document open to suitable changes as per emerging learning and needs. Changes are most likely to be in terms of data correction and updation and re-adjusting the planned activities in response to new learning.

Sustainability of sanitation outcome on the ground and sensitive environmental management will be the core concerns during the implementation phase. Awareness, education and sensitisation should lead to active citizen involvement that will be key to effective and successful CSP implementation on the ground.

ABBREVIATIONS

AIILSG	All India Institute of Local Self Government
AVR	Annual Ratable Value
BOD	Biological Oxygen Demand
BOT	Build, Operate and Transfer
BOOT	Build, Own, Operate and Transfer
BPL	Below Poverty Line
CPHEEO	Central Public Health and Environmental Engineering Organization
Cum	Cubic Meter
DEWATS	Decentralized Waste Water Treatment System
DPR	Detailed Project Report
EWS	Economically Weaker Section
FGD	Focus Group Discussion
GoI	Government of India
GoMP	Government of Madhya Pradesh
Ha	Hectare
HHs	Households
IEC	Information, Education and Communication
ILCS	Integrated Low Cost Sanitation Scheme
IPC	Interpersonal Communication
JNNURM	Jawaharlal Nehru National Urban Renewal Mission
lpcd	Litres Per Capita Per Day
MDG	Millennium Development Goal
M&E	Monitoring and Evaluation
Mld	Million Litres per day
MSW	Municipal Solid Waste
Mt/MT	Metric Tonne
NFHS	National Family Health Survey
NGO	Non Government Organization
NSS	National Sample Survey
NUSP	National Urban Sanitation Policy
O&M	Operation and Maintenance
PHE	Public Health Engineering
PRUDA	Planning and Resources on Urban Development Affairs
PVC	Polyvinyl Chloride
RCC	Reinforced Cement Concrete
SWM	Solid Waste Management
Sq.m	Square Meter
UADD	Urban Administration and Development Department, Govt. of Madhya Pradesh
UIDSSMT	Urban Infrastructure Development Schemes for Small and Medium Towns
ULB	Urban Local Body
WSP	Water and Sanitation Program

Chapter 1 : Introduction

1.1 Urban Sanitation Scenario in India

Sanitation situation in Urban India is improving with several initiatives at the government and local level but still the statistics of Census 2001[1] indicate that there is a long way to go to achieve cleaner environments in Urban Areas in India. According to the Census of 2001, of 285 million urban population in India, 26 percent of the households do not have access to toilets and almost 50 million people (17.5%) defecate in the open.

1.2 Government of India Initiatives

Over the last three decades, Government of India has been taking several initiatives to accelerate and support in improving sanitation in urban India. Some of these[2] are -

The Integrated Low Cost Sanitation Scheme (ILCS) launched in 1980-81 for the replacement of service-latrines and the rehabilitation of workers engaged in the occupation of manual cleaning, achieved conversion of about 2.3 million service latrines (of the 5.4 million reported by NSS, 1989) were converted into sanitary ones by July 2007, and more than 50,000 scavenging workers rehabilitated. Over Tenth Plan (till June 2006), about 0.6 million individual household latrines were reported to have been constructed under the ILCS Scheme

Under the Valmiki Ambedkar Awas Yojana (VAMBAY, a successor to the National Slum Development Program) Scheme during the Tenth Plan (by Jan 2006) around 40,000 community toilet seats have reportedly been constructed.

Assistance is provided since December 2005 for creating infrastructure for sewerage and sanitation under JNNRUM and UIDSSMT. Approximately 20% and 14% of projects sanctioned under JNNRUM and UIDSSMT respectively are for sewerage systems. A separate scheme for creation of urban infrastructure including sanitation in satellite towns of the million plus cities[3] is under way.

In 2008-09, Government of India revised Integrated Low Cost Sanitation Scheme (ILCS) to convert dry latrines or construct sanitary latrines for Economically Weaker Section (EWS) households in towns. Under the scheme, funds are available for the EWS Households up to Rs.10, 000 for single unit of two pit latrines. In hilly areas, the funding is raised up to Rs. 12,500.

Recently, the Ministry of Urban Development has formulated benchmarks for service delivery in the sanitation sector. The benchmarks will be used to appraise projects which are proposed for assistance under various schemes of the Ministry as well as externally aided projects. Besides, the extent to which various ULBs achieve the benchmark will be monitored.

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[1] Provisional Census 2011 figures are not available for access to sanitation.

[2] Sustaining the Sanitation Revolution, India Country Paper-Sacosan III, November 2008

[3] 35 such cities are there in India

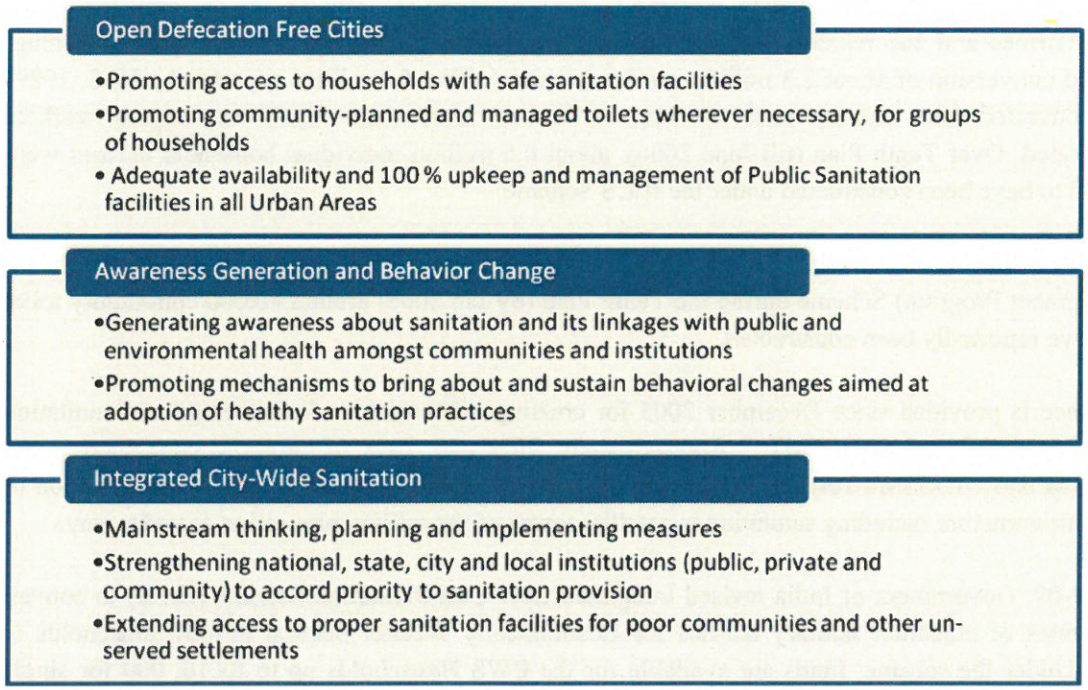
1.3 National Urban Sanitation Policy

Government of India envisages providing access to water supply facilities and sewerage and on-site sanitation facilities to 100% of the urban population by the end of the 11th Five Year Plan (March 31 2012) a little before the MDG target in 2015.

The Government of India on 12th Nov 2008, announced the National Urban Sanitation Policy aiming at sanitizing all cities and towns of the country and making them open defecation free cities. The vision for Urban Sanitation in India is:

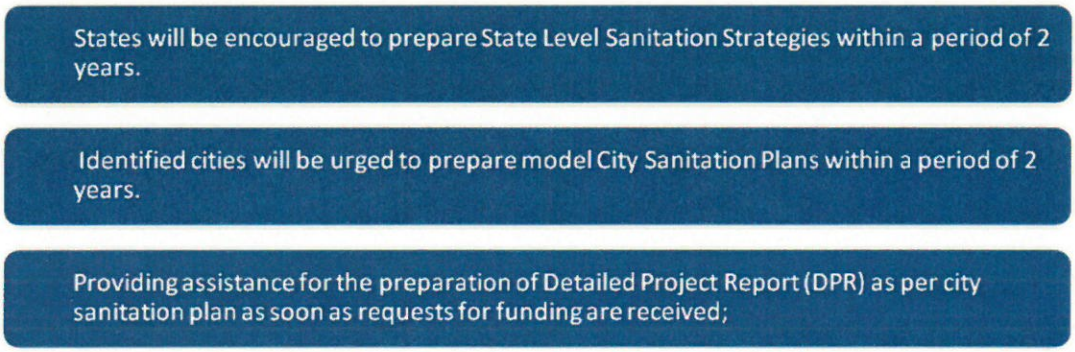
"All Indian cities and towns become totally sanitized, healthy and liveable and ensure and sustain good public health and environmental outcomes for all their citizens with a special focus on hygienic and affordable sanitation facilities for the urban poor and women".

Thus, the goals of NUSP can be summarized as follows:



Source:NUSP 2008 by GoI

For achieving the goals of NUSP in order to make the city totally sanitized, Government of India will support for:



1.4 Overview of Sanitation Initiatives in Odisha

Odisha has the lowest level of urbanisation (nearly 15 percent of the state population of 37 million) amongst the major states in India. There is significant inter-district variation with Khurda district in coastal Odisha reporting an urbanisation rate of 43 per cent at one end of the spectrum and Boudh in south-central Odisha, having an urbanisation rate of only 5 per cent at the other. Urban Odisha population comprises of 13 per cent SC population (12 per cent of the state total) and eight per cent ST population (6 per cent of state total). Over the period 1991-2001, urban population has grown nearly twice than the state population. However, starting from a low base of urbanisation, while these rates appear high, the challenges posed by absolute numbers do seem manageable[4].

The State Slum Rehabilitation & Development Policy (SRDP) has been prepared and approved by the Govt. for holistic development of urban slums in the state. The overarching vision of SRDP is to build a Slum Free Orissa by the year 2020 and bring about a significant reduction in the urban poverty level. The policy is aimed at creating an enabling environment at the State and city level for citywide slum upgrading and poverty reduction.

Water Supply[5]

So far as water supply in urban Orissa is concerned, at present, about 776.48 million liters of drinking water is supplied per day to the 103 ULBs and 2 Census Towns in the state benefiting about 45.60 lakh people. There are about 25,000 nos. of hand pump tube-wells functional in different Urban Local Bodies and Census Towns.

Under Urban Infrastructure Development Scheme for Small and Medium Towns (UIDSSMT), 11 water supply projects are being implemented. Under the Revised Long Term Action Plan (RLTAP), 20 projects have been approved for an estimated cost of Rs. 155.64 Crore. Of these, augmentation of Water Supply to Bolangir, Titilagarh, Nawarangpur, Jeypur, Khariar Road, Koraput & Rayagada; Bhawanipatna, Kesinga, Binika, Khariar, Sunabeda, Kotpad & Jeypur are in different stages of execution. Five new projects as part of 'Augmentation of Water Supply' to Bolangir, Junagarh, Nawarangpur, Tarava & Malkangiri have been undertaken.

As part of Water Supply Project for Puri town[6], the State Govt. has released Rs.41.72 Crore for implementation of the project. So far, expenditure of Rs.17.02 Crore has been incurred. Detailed planning, engineering, design and pre-tendering activities are under progress.

Amendments to Orissa Water Works Rules has been made by launching a programme called "PIYUSH" ("Amrut") with an objective of providing Universal Access to Safe Drinking Water in

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[4] Orissa Urban Sanitation Strategy 2011, H&UDD, GoO, Mar 2011

[5] Minister's Budget speech, 2011

[6] GoO Activity Report, 2010-11

Urban Local Bodies. The proposed scheme has enabled an urban poor to avail drinking water supply connection by paying Rs 500 only in 5 equal EMIs. This action is an evidence of State Government's commitments towards achieving Millennium Development Goal -7. Under devolution of powers to the ULBs, a novel tripartite MoA has been worked out involving the ULB concerned, the PHEO and the H & UD Department to make the PHEO accountable to the ULBs for water supply.

At present about 776.48 million liters of drinking water is supplied per day to the 103 ULBs and 2 Census Towns benefiting a population of 45.60 Lakh **(approximate), out of which, about 12.70 Lakh urban populations are benefited** through 2,32,186. house connections and the rest 32.90 Lakh populations are served through 21,481 public stand posts. Besides, there are 24,273. hand **pump tube-wells functional in different Urban Local Bodies and Census Towns to cater to the water demand during non-supply hours and demand of population** residing in areas not covered by piped water supply (W/S) systems.

An amount of Rs. 2425.01 lakh has been provided for Urban W/S Programme in the Budget for the Year 2010-11 for 563 Nos. W/S Schemes. Out of this, 238 nos. are new W/S Schemes, 80. are having Token Budget Provision & balance are ongoing projects. Till date, 100 nos. of projects have been completed and the rest are in different stages of execution.

Urban Infrastructure Development Scheme for Small & Medium Towns (UIDSSMT):

Total 23 Water Supply Schemes for 22 ULBs have been sanctioned under UIDSSMT. Of these schemes, 17 Water Supply Schemes have been accorded with A/A by the Government. Some 7528.27 lakh rupees for 11 schemes have been received out of **the estimated cost of Rs. 12861.35 lakh for concerned ULBs. The works are under progress. For preparation of DPRs of 3 schemes, State Government has released Rs. 200.00 lakh for one Scheme & authorization given for 2 schemes of Rs.** 200.00 lakh each. The detailed engineering for 3 schemes are under progress by M/s Tetratech India Ltd. Funds for balance 9 schemes amounting to Rs. 22448.05 lakh **are yet to be sanctioned & released. Out of 23 W/S Schemes, 1 no. scheme** has been completed.

Access to Toilets

The urban sanitation scenario is a cause for concern – nearly 45% of urban households in the state do not have access to a latrine. The level of access to sanitation is even lower in the slum settlements of the urban areas. The impact of unsafe sanitation conditions and behaviour is immense, and one that adversely affect the urban poor, women and children. Besides poverty, lack of tenure, housing and environmental conditions in slum etc., constrains the urban poor households from gaining access to safe sanitation. Housing and Urban Development Department (H&UDD) of the Government of Odisha has prepared an action plan for 100% coverage of the state with sanitation facilities in urban areas and making the cities open defection free by the financial year 2020.

Under the Integrated Low Cost Sanitation (ILCS) scheme, 25 Detailed Project Reports (DPRs) in respect of 25 Urban Local Bodies (ULBs) comprising of 25, 423 low cost toilets have been approved by the State Level Coordination Committee (SLCC) and forwarded to HUDCO for appraisal & onward transmission to the GoI for release of funds[7].

[7] Budget Speech by H'ble Minister for H&UDD, March 2011

Total Sanitation Campaign[8]

Orissa State Water and Sanitation Mission (OSWSM) was formed on August 14, 2002 as a Registered Society under Society Registration Act to oversee the functioning of District Water and Sanitation Mission (DWSM) and to ensure effective implementation & monitoring of Total Sanitation Campaign in the State. OSWSM is the nodal agency at State level set up under the Chairmanship of Chief Secretary to Government of Orissa. The Commissioner - cum – Secretary to Govt., Rural Development Department is the Member Secretary.

A Chief Engineer, looking after day-to-day activities of OSWSM, is the Additional Member Secretary of the State Mission. He is also the Director of Communication and Capacity Development Unit (CCDU).

State Urban Sanitation Strategy

The State Urban Sanitation Strategy has been developed with the objective of making all cities and towns of Orissa Open Defecation Free by the year 2017.

Sewerage System

The project "Integrated Sewerage System for Bhubaneswar City" has been sanctioned for an estimated cost of Rs.754.23 Crore. Bhubaneswar city has been divided into six sewerage districts for smooth implementation of the project. So far, expenditure for Rs.121Crore has been incurred. Out of 193 km of sewers under Sewerage District-III, 36 km of sewers have already been laid.

For improvement of existing sewerage & drainage facilities and providing reliable sewerage and storm water drainage service in Cuttack city, a comprehensive project with financial assistance from Japan International Cooperation Agency (JICA) is being implemented. An amount of Rs. 945.13 Crore has been sanctioned for integrated sewerage and drainage system for Cuttack city and Sewerage district –VI of Bhubaneswar city, out of which Rs. 756.36 Crore is availed through the JICA loan and the rest amount of Rs. 188.77 Crore is borne by the State Govt. Besides, Rs. 100 Crore have been proposed under Externally Aided Project (EAP) for the year 2011-12.

Roads and Drainage

For strengthening of urban infrastructure, the ULBs have constructed CC roads and drains with budgetary allocation of Rs. 60 Crore during 2010-11. Construction of 200'.0" Master Plan four lane road from Sum Hospital to Shampur is under progress. Construction of 100'.0" Master Plan four lane road from Damana square to Netaji Subash Enclave at Gadakan is also under progress. Commercial Complex at Pokhariput, K-VII & K-VIII Kalinga Nagar, Kalyan Mandap at K-VII & K-VIII, Kalinga Nagar, Bhubaneswar is under progress. Rs. 3.33 Crores has been sanctioned for development of roads in Cuttack.

[8] Report of state level workshop on formulation of Operational Guidelines for Implementation of TSC on 12th & 13th February'08

Final City Sanitation Plan

Under the Storm Water Drainage project for Bhubaneswar and Puri, the State Govt. has released Rs.35.41 Crore. Detailed planning, Engineering, Design and pre-tendering activities are under progress.

Solid Waste Management

With a view to streamline the solid waste disposal system in the twin cities of Bhubaneswar-Cuttack, a common regional land fill site at Bhuasuni is being developed on PPP mode. IDCO has been engaged as the Nodal Agency for the purpose. After the site is developed, 550 MTs of solid waste will be scientifically disposed of on daily basis, providing better and cleaner cities.

Similarly, City Sanitation Plans (CSPs) for 8 Class – I cities and towns of Odisha i.e. Bhubaneswar, Puri, Cuttack, Balasore, Baripada, Berhampur, Sambalpur and Rourkela are being prepared.

1.5 Objective of Bhubaneswar City Sanitation Plan (CSP)

The task for preparing City Sanitation Plan for Bhubaneswar is part of the initiative of Government of Odisha to implement the National Urban Sanitation Policy in the State. The preparation of this plan is a joint effort of Government of Odisha, Bhubaneswar Municipal Corporation, AIILSG and MoUD under the leadership of NIUA.

The City Sanitation Plan for the city of Bhubaneswar aims at achieving sanitation infrastructure development along with developing awareness in the community and encouraging public private partnerships in the sector.

Following are the broad objectives of Bhubaneswar City Sanitation Plan.

- Eradicate the practice of open defecation in the city by providing household toilets, community toilets and public toilets.
- Safe disposal of human excreta, solid and liquid waste
- Improve the 'quality of life' of the sanitation workers.
- Engage civil societies and communities (women in particular) in awareness generation, hygiene education, creation of sanitation infrastructure and its maintenance.
- Strengthen institutional set up and build the capacity of the municipal staff for effective Program implementation and meeting the challenges of technology and management.
- Encourage Public Private Partnerships (PPPs) to ensure generation of funds and sustainable program implementation.
- Ensure inter-departmental coordination and integration of various relevant projects/schemes/programs for their optimum use and outcome.

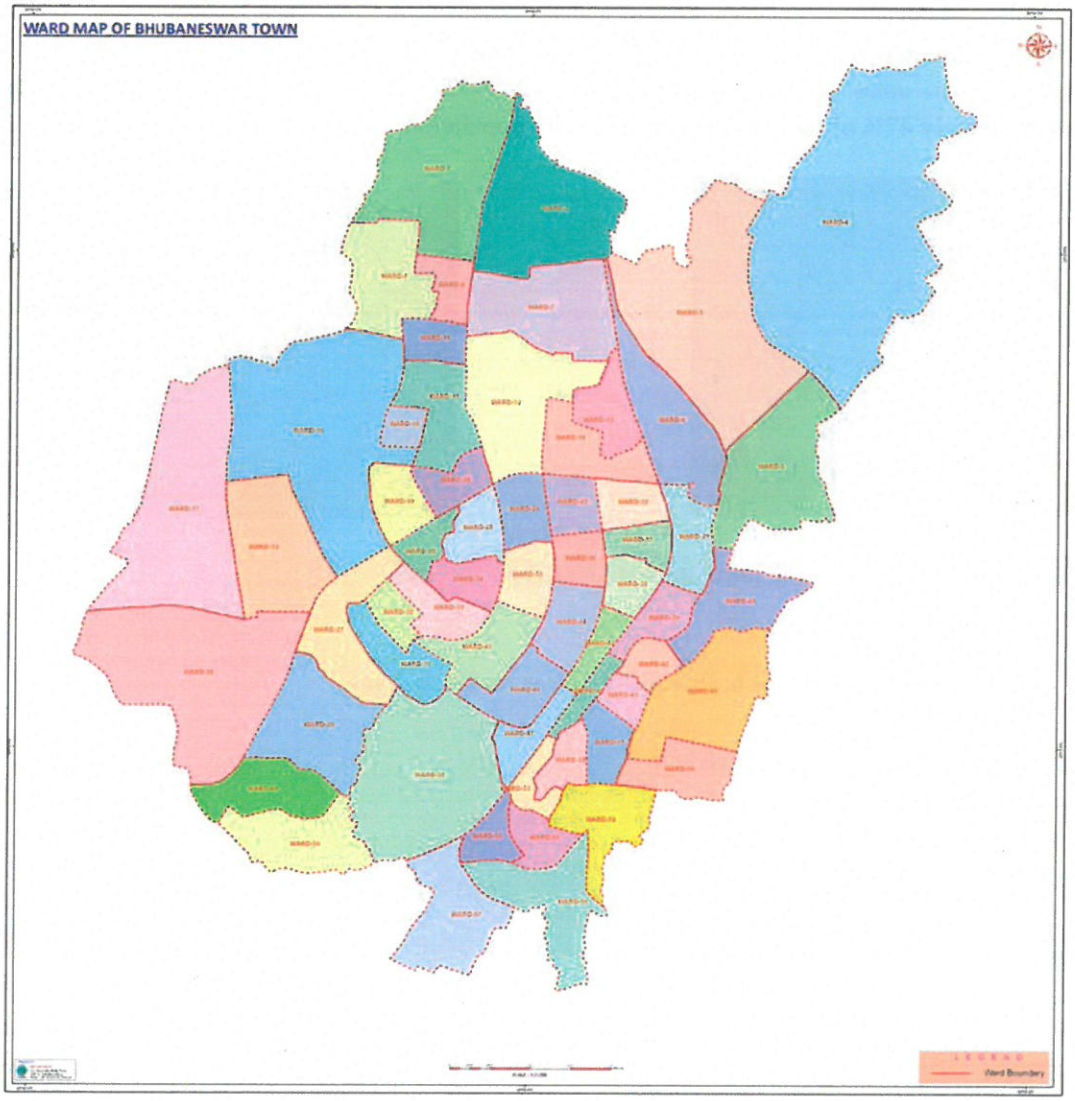
Chapter 2 : Profile of Bhubaneswar City

2.1 Location

Bhubaneswar is the capital city of the State of Odisha. It has a long history of over 2000 years. The largest city of Odisha occupying an area of 419 sq km., Bhubaneswar today is a center of economic and religious importance in the region. Bhubaneswar is situated between 21° 15' North Latitude 85° 15' Longitude and at an altitude of 45 meters above sea level. Geographically, Bhubaneswar is situated in the eastern coastal plains of Odisha and south-west of the Mahanadi River.

Bhubaneswar is connected to the rest of the country by National Highways-NH 5, NH 203. The East Coast Railway has its headquarters in Bhubaneswar. Bhubaneswar is connected by rail to major cities of the country such as New Delhi, Mumbai, Pune, Kolkata,Chennai, Bangalore, Jamshedpur, Ranchi, Guwahati, Siliguri, Ahmedabad, Hyderabad, Lucknow, Bokaro etcetera. Biju Patnaik Airport, also known as Bhubaneswar Airport, is currently the only major domestic airport in Odisha. There are regular flights to many destinations across India from this airport, such as New Delhi, Hyderabad, Kolkata, Mumbai and Bangalore.

Map 1: Ward Map of Bhubaneswar City



2.2 Climate

The city has a tropical climate, specifically a tropical wet and dry climate. The average temperatures range between a minimum of around 12 °C (54 °F) in the winter to a maximum of 42–45 °C in summer. The south-west monsoons appear in June. The average annual rainfall is 154 cm, most of which is recorded between June and October.

2.3 Population

As per Census 2011, the city has a population of 900000 as told by BMC. The decadal population growth of the city is given in Table below.

Table 1: Bhubaneswar - Decadal population

Year	Population	Growth, %
1991	411542	87.74
2001	648032	57.46
2011	900000	38.88

Data source: CDP Bhubaneswar 2006; 2011 data from BMC

2.4 Slums in the City

As per survey (2009-10), the city has 99 authorised slums (HH: 13420; population 70667) and 278 unauthorised slum areas (HH: 46706; population 237947)[9]. Based on Census 2011, the slum population is nearly 47% of the then existing total city population.

2.5 Health, Educational and Institutional Establishments

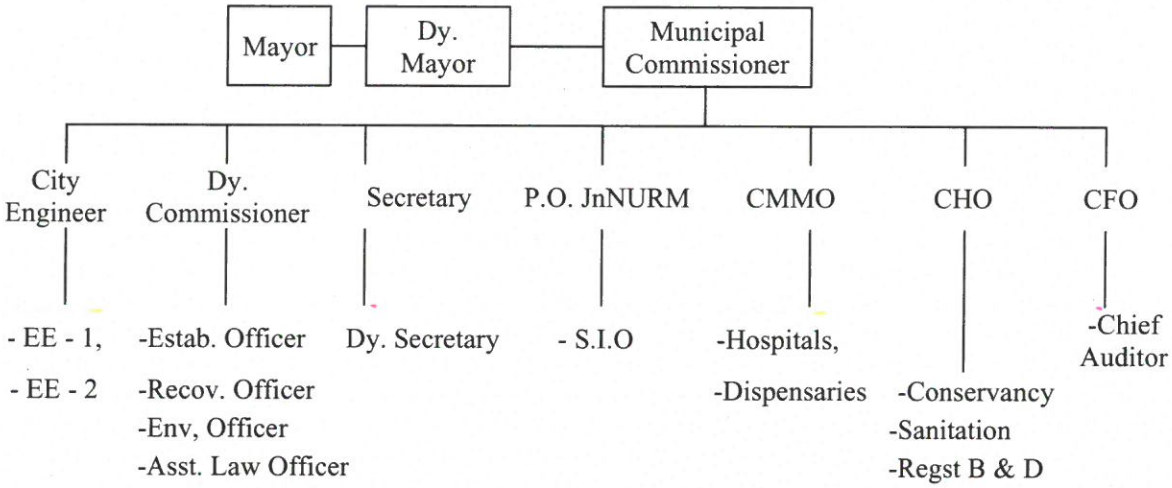
- Total Schools: 204
- Total Colleges: 123 (Govt 6; Private 100; Rest on block grants)
- Public Institutions: 150
- Hospitals: 25 (Govt 6; rest private)

[9] BMC Slum Survey, 2009-10

2.6 Workforce Participation

Nearly 95% of the workforce representing 32% of population is engaged in tertiary trade and commerce, transport and service sector. The remaining workforce percentage is shared equally between farmers/farm labour, and household industry, manufacturing services and repairs[10].

2.7 Institutional Set-up of Bhubaneswar Municipal Corporation (BMC)



2.8 Staff Position of BMC

L.F.S (Group-C)	122
Non-LFS (Group - C)	85
Non-LFS (Group - D)	930
Totals	1137
NMR	72 (Conservancy - 67 + General - 5)
DLR	552 (Conservancy - 260 + General - 292)
CLR	790 (Conservancy - 700 + General - 90)
Total	1414 (Conservancy - 1027 + General - 387)
Grand Total	2551 (Regular - 1137 + Other- 1414)

Source: BMC Website

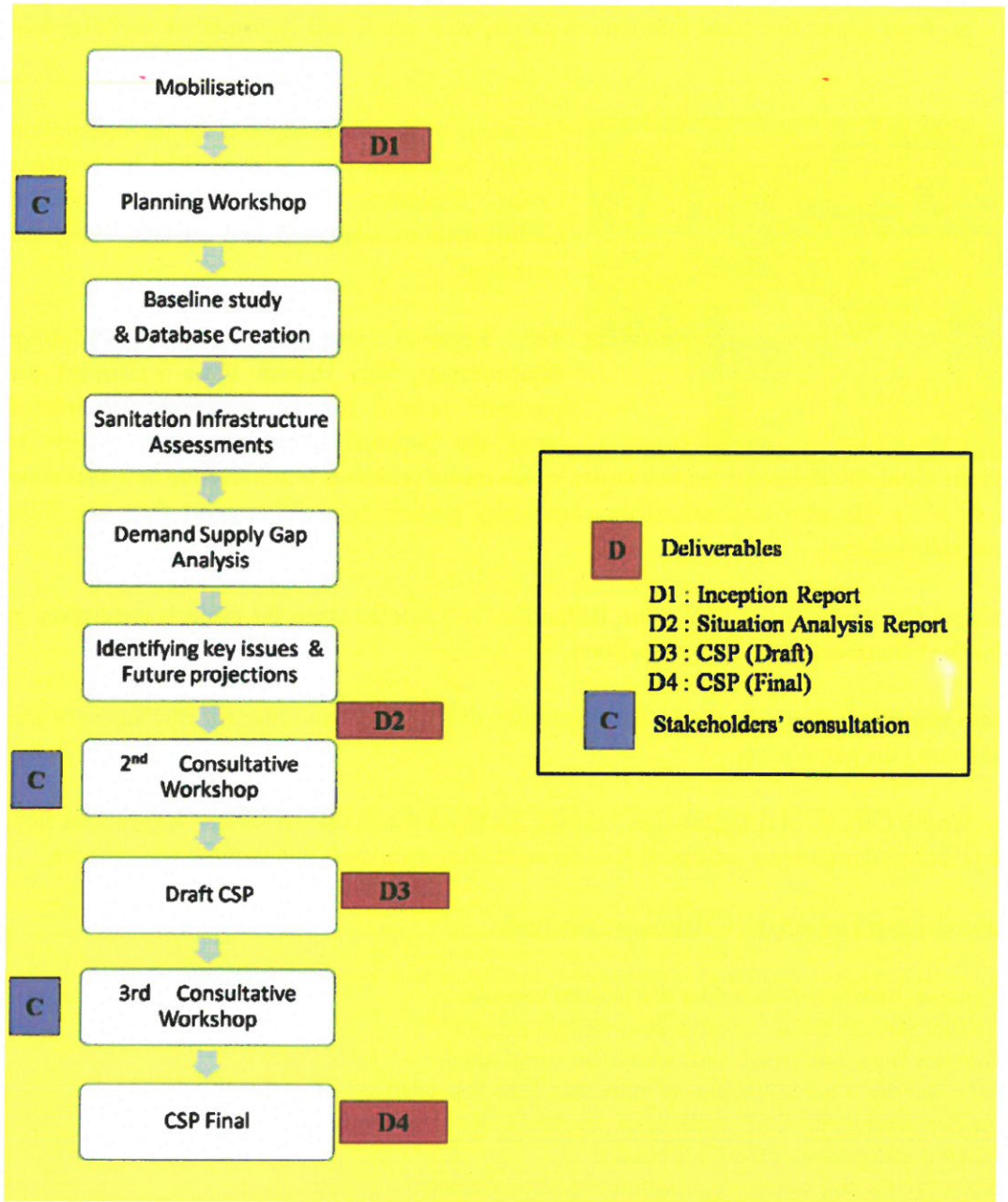
[10] Census 2001

Chapter 3 : Approach & Methodology for Preparation of City Sanitation Plan

3.1 Approach and Methodology Adopted

The preparation of the city sanitation plan generally follows the Terms of Reference provided for the assignment by the MoUD and the framework given in the National Urban Sanitation Policy of Government of India. The preparations were guided by the NIUA and officials of Urban Administration and Development Department, Government of Odisha.

Following were the tasks and activities undertaken in line with the Terms of Reference given in preparing the sanitation plan for Bhubaneswar:



3.1.1 Planning Workshop

The first CSP consultation, a Planning Workshop, was organised at Bhubaneswar on 8th March 2011. The objective was to introduce the concept of the CSP, processes and the objectives in terms of defecation-free city. The planning workshop was organised at the Conference Hall of BMC wherein the basic aspects and the need for preparation of City Sanitation Plan were discussed among the local population. There were 11 participants.

In the workshop, the consultant and its team (PRUDA – AIILSG) were introduced to the officials of the BMC and the local representatives. PRUDA made a presentation on aspects of, and processes in , preparation of the City Sanitation Plan, approach and methodology adopted, and the time span required for the preparation of City Sanitation Plan.

At the same time, PRUDA – AIILSG got a chance to interact with the local representatives and the BMC official, from whom first hand information on city as a whole and on sanitation facilities was obtained..

The focus of the workshop was on the preparation of City Sanitation Plan as prescribed by National Urban Sanitation Policy and the suitable modification as suggested and agreed during the workshop.

The Regional Director, AIILSG (PRUDA), Bhubaneswar, Shri Debesh Patra welcomed the members present for the workshop. He briefed about the National Urban Sanitation Policy its vision and the Goal. He discussed the key issues which create problems to achieve the best sanitation practices in India. He also emphasized on community participation and support from the local residents as stakeholders.

The Municipal Commissioner of BMC, Shri Bishal Dev IAS briefed about the projects undertaken in the city for the betterment of the living condition.

A document containing all the details for the preparation of City Sanitation Plan for Bhubaneswar was circulated among the participants.

Asst. City Health Officer, Shri Diptiranjan Tripathi discussed the sanitation issues. Suggestions from participants included improving sanitation facilities including awareness and training programmes.

Overall, the following aspects of CSP process emerged:

- Personal interface/stakeholder discussions required
- School sanitation may be covered in this programme.
- Support from concerned staff should be interlinked
- 20% Survey is not sufficient, so more than 50% is needed to be surveyed.
- Before conducting CSP, training of trainer (TOT) to be conducted
- Total participation of the ULB needed
- More NGOs and social organization should participate.
- AIILSG should discuss the issues of the BMC staff, PHE, Sewerage and other Govt staff

- More number of toilets to required
- Emphasis on awareness of sanitation among the slum dwellers and changing their habit of open defecation

Setting up City Sanitation Task Force

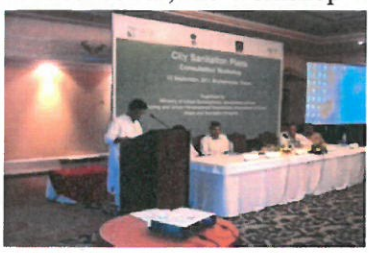
AILSG facilitated the formation of City Sanitation Task Force for Bhubaneswar on 18th February, 2011 to guide the sanitation plan preparation process for the city. There are 8 members included in the Task Force at the time of its formation and they are as below.

- Mayor, BMC
- Municipal Commissioner, BMC
- Chairman, Standing Committee on Public Health, Electricity Supply, Water Supply, Drainage and Environment, BMC
- Chairman, Standing Committee on Planning & Development
- City Health Officer (Member, Convener)
- City Engineer
- Slum Improvement Officer
- Senior representative of CEPH, Odisha
- Corporators (2 Nos)
- Representative of NGOs
- Representative of Local Industry
- Eminent Social Worker

AIISLG constantly interacted with the Task Force Members on various issues during the preparation of this sanitation plan. Task Force provided continuous support and valuable suggestions; those have been integrated while developing the plan.

3.1.2 The 2nd Consultative Workshop

The 2nd Consultative Workshop to discuss Draft CSPs of all cities in Odisha was held at Hotel Mayfair at Bhubaneswar on 12th Sept 2011. Apart from Pruda staff at Bhubaneswar, the workshop was attended by H'ble Housing and Urban Development Minister Sri Sarada Prasanna Nayak, Commissioner-cum-Secretary, Housing & Urban Department (H&UD) Mr. Sourav Garg, IAS, officials of Bhubaneswar Municipal Corporation, Cuttack Municipal Corporation, and Puri, Balasore, Baripada, Berhampur, Rourkela and Sambalpur Municipalities. Officials from MoUD and WSP also remained present. NIUA was represented by Shri Naveen Mathur, Shri Ajay Nigam and Shri Mukesh Mathur. The Regional Director of All India Institute of Local Self Government and PRUDA presented the draft CSPs.



Sri Debesh Patra, Regional Director of PRUDA (Bhubaneswar) made presentations on draft CSPs of 5 cities viz. Bhubaneswar, Cuttack, Puri, Balasore and Baripada. They were commented upon, and critiqued by delegates in the audience. Some important suggestions were as follows:

1. Format as given in the meeting held earlier and as agreed upon may be followed.

2. SLB data may be included. Open defecation figures may be rationalised by including non-slum areas.

4. O&M costs for any proposed sewerage/drainage may be covered in projected Sanitation O&M

5. Bhubaneswar population should be 8.38 lakhs and not 10.60 lakhs as told by the Jt. Secretary, H&UD (and later confirmed with BMC- all projections should be accordingly

6. Pruda should visit all cities for certain data validation to avoid confusion.

7. Pruda should visit again later with slide show to train the EOs as they would now make revised presentation on 7th Nov 2011 (proposed).

8. NIUA to send feedback and suggestions later.

3.2 Baseline Data Generation and Creating Database/GIS

Baseline data was collected and generated through several visits, consultations, facility condition assessment surveys, and household surveys conducted across the city. Primary and secondary level data was obtained on availability and adequacy of sanitation facilities, hygiene and sanitation practices, socio-economic conditions, perceptions on present sanitation services, willingness to pay or contrary, and information on institutional related issues and finances. GIS maps were developed based on the base maps specially prepared using the information collected from the field.

Situation Analysis Process

Condition Assessment Surveys

Situation Analysis of the existing sanitation facilities and services was carried out through condition assessment surveys along with the concerned municipal officials and consultations with them on the performance of these facilities. Such surveys covered obtaining comprehensive information on collection, conveyance, treatment and disposal facilities in respect of sullage, sewage and solid waste generated in the city. This information was useful in understanding the adequacy of the available facilities, current performance and physical condition, and gaps in meeting the sanitation needs of the city.

Ward-wise Assessment and Consultations

Specific sanitation needs of the residents of Bhubaneswar, especially of the poorer families residing in slums and underdeveloped areas of the city, ward-wise assessments using various participatory techniques such as Focused Group Discussions (FGDs), structured interviews and transect walk etc were conducted in select wards to assess sanitation facilities, understand the sanitation needs and priorities of residents, perceptions and preferences for sanitation technologies and their willingness to contribute to the facilities and participate in operation and maintenance.

A sample representing 20% of 60 wards was selected and consultations were held to discuss the potential technical options and their financial implications in terms of capital and maintenance costs, to gauge the acceptance and affordability of such options among residents. Discussions were also held with municipal councilors to understand their vision for improving sanitation in Bhubaneswar.

3.3 Preparation of City Sanitation Plan

Development of Technical Options

The findings of the ward wise assessment and consultations have been used to refine the technical options further and develop cost effective and techno-economically feasible sanitation options in areas of household sanitation, wastewater management and solid waste management. The other but important considerations for suggesting technical options included the current performance of sanitation technologies used in the city, the geology and topography, affordability of users, capacity and skills available within the city for operation and maintenance of the proposed facilities, and the available best practice technologies used in India.

Ongoing and Planned Development

Several service improvements plans have been developed for Bhubaneswar. Various para-statal agencies and BMC have prepared detailed project reports, activity reports, CDP, booklets etc. for improvements in water supply, sewerage and solid waste management. These improvements have also been reviewed and taken into account, where feasible, while developing the sanitation plan for Bhubaneswar.

While preparing budgets for the new improvements that are required, block cost norms based on the Schedule of Rates (SoR) developed by Urban Administration and Development Department of Odisha, and costs observed in other cities have also been considered when they were not readily available for Bhubaneswar.

Funding sources for financing the proposed sanitation improvements have been identified and indicated in the proposed Sanitation Plan.

3.4 Preparation of Implementation Plan

The implementation plan has been developed for the city based on the priorities identified for the, medium term and long term within an average time horizon of 10-15 years from 2011. Short term plan focuses on immediate improvements required in the city that address needs identified during the ward-wise assessments in the city. Some of the key needs are achieving access to sanitation facilities in poorer areas thus making the city open defecation free, improving solid waste collection and improving coverage of drains to address recurrent water logging/flooding problems in various parts of the city. Medium term and long terms plans are developed in a progressive manner to achieve integrated city wide sanitation by the end of the 20 year. Medium and Long Terms plans have been developed to focus on augmenting the sanitation infrastructure and services and achieving financial as well as operational sustainability in sanitation services.

Capacity building and Awareness Strategy are integral parts of implementation plans and these have been developed considering local context and needs.

Chapter 4 : Situation Analysis of Sanitation Facilities and Services

The focus of the entire city sanitation plan is on the slums as these slums are bereft of proper sanitation facilities. These slums are identified by overall poor sanitation conditions. Open defecation due to lack of individual and community toilets, disposal of waste in the open, often by burning, lack of proper roads, lack of service delivery, lack of proper drainage, lack of public health facilities are some of the grappling issues of the slums. During a sample study of the slums it was found that of the 62 sample slums, only 4 had community toilets. That means more than 90% slums do not have access to community toilets. If we look at the slum profile of Bhubaneswar, then we find that more that 50% slums do not have access to both individual as well as community toilets. This clearly underscores the fact that almost 50% of the slum population and at least 40% of the city population does not have access to toilets and defecate in the open.

4.1 Water Supply Status

Total production of water (MLD)	251
No. of connections	63204
No. of Stand-posts	nil
No. of tube wells Hand pumps	2972
Coverage (direct piped connection)	45%
LPCD	95
NRW (%)	69.5
Hours of supply (Hrs) daily	2
Cost Recovery (%)	32.1

The present drinking water sources of Bhubaneswar Municipal area includes surface sources (rivers) and ground water sources. The important rivers of the area are Mahanadi, Daya and Kuakhai. These rivers supply around 80% of the total daily demand of potable water, while the balance is obtained from groundwater sources through production wells and tube wells[11].

[11] Draft CDP Bhubneswar, 2008

The water demand[12] in 2011 is 143.10 MLD at 135 LPCD based on current population. The water supply exceeds demand, at 251.013 MLD. A total of 199.938 MLD of water is treated at the six WTPs.

Of the 60 wards, 25 are fully covered by piped water supply, 31 wards partly so, and 4 wards are not covered at all. The total water connections number 63204, mostly domestic connections. There are 2972 Hand Pump Tubewells in the city.

Only 20-30% of the slum residents get piped water supply against taxes paid. The rest fetch their water from Hand Pump tube wells. It is reported that the water supply in slums is irregular and inadequate. The water supply coverage thus shows inequities in terms of distribution for the urban poor. One must however take into account the unauthorised slum population and households not willing to pay.

Since 40% of the populations are using ground water, and that its quality is reported 'at stake' at many locations (excess iron), it becomes necessary to have a monitoring of tube well waters to have a water quality assurance[13].

The existing water tariff is Rs. 50 per month for domestic and Rs. 100 per month for non-domestic.

Though the per capita supply of water in BMC exceeds the stipulated drinking water supply guidelines, the present system of supply could feed only a maximum of 55% population. So, the present infrastructure facilities for water supply demands augmentation[14].

4.1.1 Projections and Gap Analysis[15]

The current water supply at 135 LPCD and for the current population (2011) is in excess of demand. But over a short term up to 2024, and long-term, up to 2039, the Bhubaneswar CDP has reported projections and progressively increasing gap in demand-supply, water treatment capacities and storage capacities as given in the Table below

[12] PHEO publication on Bhubaneswar Water supply and Sewerage System as 1st April 2011

[13] Draft CDP Bhubaneswar, 2008

[14] Draft CDP Bhubaneswar, 2008

[15] Bhubaneswar CDP, 2006

Table 2 Water Supply Demand - Gap Analysis

: Water Supply System - Demand-Gap Assessment

Sl. No.	Component	Normative Standard		Short-Term Demand-Gap Assessment (2009-2024)			Long-Term Demand-Gap Assessment (2009-2039)		
		Unit	Quantity	Demand	Existing	Gap	Demand	Existing	Gap
1.	Source - Surface and Ground Water (MLD)	Lpcd	181	242	217	25	315	217	98
2.	Water Treatment Plant - Installed/Capacity w.r.t. Supply (MLD)	%	100	242	217	25	315	217	98
3.	Storage Capacity w.r.t. Supply (ML)	%	33	Designed for long term demand as per CPHEEO guidelines			104	40	64
4.	Distribution System Coverage w.r.t. Road Length (% of PTAs)	%	100	Designed for long term demand as per CPHEEO guidelines			100	57	43

Source: Analysis / PHEO (Urban), Bhubaneswar, 2006

4.2 Household and Public Sanitation Facilities

It would be pertinent to note here that of the 60 Wards, only 13 are fully covered by the sewerage system, 24 are partly so and 23 wards have no sewerage system[16]. In other words, roughly 47 wards have open drains.

Base-line Survey of the Project area

The AIILSG field team visited 17 wards of Bhubaneswar Municipality. To have a clear insight into the local conditions of each ward, the project team undertook site inspections covering the area of the wards and gathered first hand information and also had discussions with available local staff. Baseline survey had conducted with the direct interaction of the inhabitants of the wards and schools and Anganwadis.

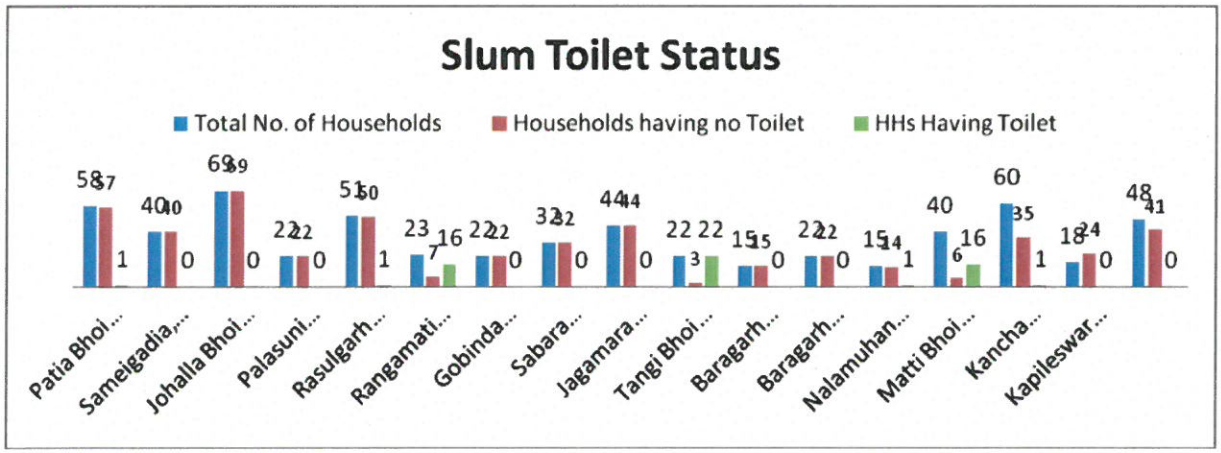
The slum data on individual toilets reflects very poor access thus promoting open defecation

Table 3 Details of Slums

Slum Name	Total No. of Households	HH having no Toilet	HHs Having Toilet	BPL	APL	SC	ST	General
Patia Bhoi Sahi	58	57	1	22	36	52	6	0
Sameigadia, Sabar Sahi Basti	40	40	0	31	9	1	39	0
Johalla Bhoi Sahi	69	69	0	25	44	47	20	0
Palasuni Bhoi Sahi	22	22	0	4	18	1	21	0
Rasulgarh Kenal Bhoi Sahi	51	50	1	30	21	44	6	0
Rangamati Bhoi Sahi	23	7	16	9	14	11	0	0

[16] PHEO publication on Bhubaneswar Water supply and Sewerage System as 1st April 2011

Gobinda Prasad (Tala Sahi & Upara Sahi)	22	22	0	8	14	22	0	0
Sabara Sahi, (Nua Sahi) Baramunda	32	32	0	18	14	0	32	0
Jagamara Bhoi Sahi	44	44	0	25	0	36	0	0
Tangi Bhoi Sahi	22	3	22	9	0	12	0	0
Baragarh Hadi Sahi	15	15	0	4	0	15	0	0
Baragarh Sabar Sahi	22	22	0	7	0	22	0	0
Nalamuhana Sahi & Dhoba Sahi	15	14	1	12	0	15	0	0
Matti Bhoi Sahi/Bharti Mattha Bhoi Sahi	40	6	16	19	0	21	0	0
Kancha Bhoi Sahi	60	35	1	26	0	35	0	0
Kapileswar Tangi Sahi	18	24	0	12	0	24	0	0
Dumduma Bhoi Sahi	48	41	0	23	0	40	1	0
Total	**613**	**506**	**67**	**284**	**170**	**398**	**125**	**0**



4.2.1 Access to Sanitation at Household level

Further, secondary data also shows that of the 60259 slum sample households, only 11378 households have individual toilets. 50% of this number that is 5689 has septic tanks. The rests have toilets with soak pits. Also, only 13 wards are fully covered by underground sewerage system, and 23 wards are partially covered. Wastewater from toilets mostly flows into open drains. Majority of households, nearly 60% do not have access to individual toilets, forcing such families to defecate in open; this problem is aggravated by lack of accessibility to community toilets (total 98 nos., 8 non-functional).

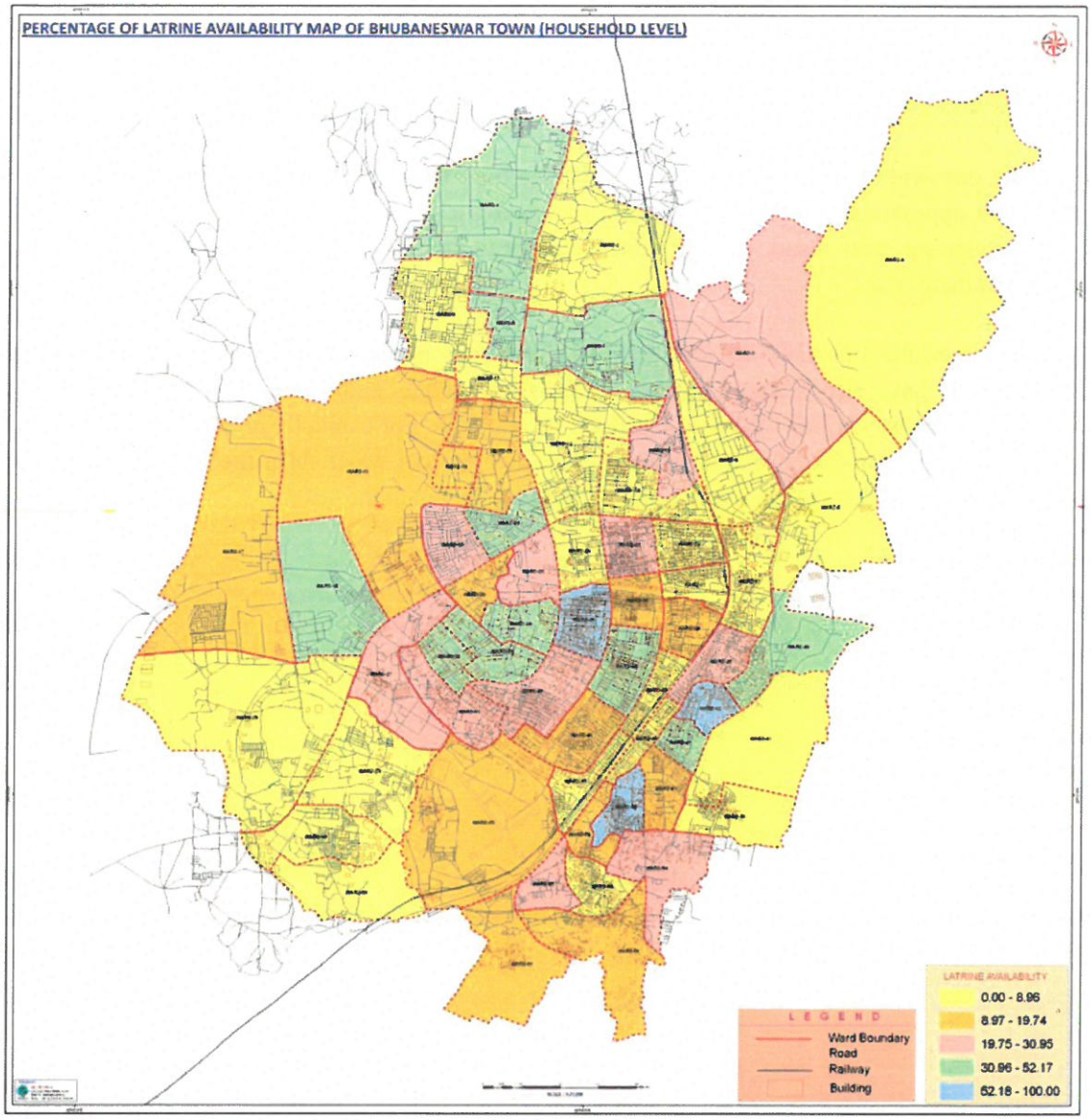
Table 4: Access to Household Sanitation facilities

Ward No	Total HH	Tot No. Toilets	% HH having Individual Toilets	HH without toilets	Community Toilets Blocks
1	2147	940	43.78%	1167	1
2	2147	4	0.19%	238	0
3	995	308	30.95%	697	0
4	630	5	0.79%	589	0
5	337	24	7.12%	313	0
6	956	74	7.74%	1223	1
7	844	282	33.41%	562	0
8	1129	589	52.17%	1103	0
9	1192	62	5.20%	1130	2
10	258	32	12.40%	226	0
11	176	6	3.41%	170	0
12	1475	84	5.69%	1391	0
13	309	65	21.04%	244	0
14	1370	137	10.00%	1233	0
15	7450	1471	19.74%	5997	0
16	5897	1080	18.31%	4837	0
17	3529	671	19.01%	2858	0
18	584	240	41.10%	344	0
19	293	88	30.03%	205	0
20	675	280	41.48%	788	0
21	223	5	2.24%	218	0
22	419	25	5.97%	404	0
23	584	160	27.40%	424	12
24	838	31	3.70%	807	0
25	451	105	23.28%	346	0
26	153	20	13.07%	133	0
27	1723	376	21.82%	1197	0
28	926	83	8.96%	843	0
29	741	28	3.78%	713	0
30	768	136	17.71%	632	8
31	1269	300	23.64%	969	0
32	181	78	43.09%	103	5
33	953	396	41.55%	713	6
34	674	280	41.54%	394	1
35	145	98	67.59%	48	0
36	701	121	17.26%	580	4
37	853	13	1.52%	840	6
38	1250	205	16.40%	1046	1
39	1004	234	23.31%	570	0
40	344	125	36.34%	219	0
41	152	13	8.55%	139	0
42	1028	675	65.66%	353	0
43	1061	20	1.89%	1036	3
44	331	124	37.46%	207	0

45	884	197	22.29%	687	0
46	955	160	16.75%	789	10
47	1438	65	4.52%	1471	8
48	1123	43	3.83%	1080	37
49	143	50	34.97%	93	0
50	324	20	6.17%	304	0
51	1376	140	10.17%	1237	3
52	92	92	100.00%	91	0
53	413	42	10.17%	462	0
54	301	81	26.91%	218	0
55	0	0	0.00%	0	0
56	470	70	14.89%	500	0
57	94	10	10.64%	84	0
58	482	129	26.76%	353	0
59	1566	76	4.85%	1491	0
60	1433	110	7.68%	1256	0

Source: BMC (2008-09, 09-10 UNDP Survey

Map 2: Ward wise percentage of latrine availability at household level



Source: baseline survey

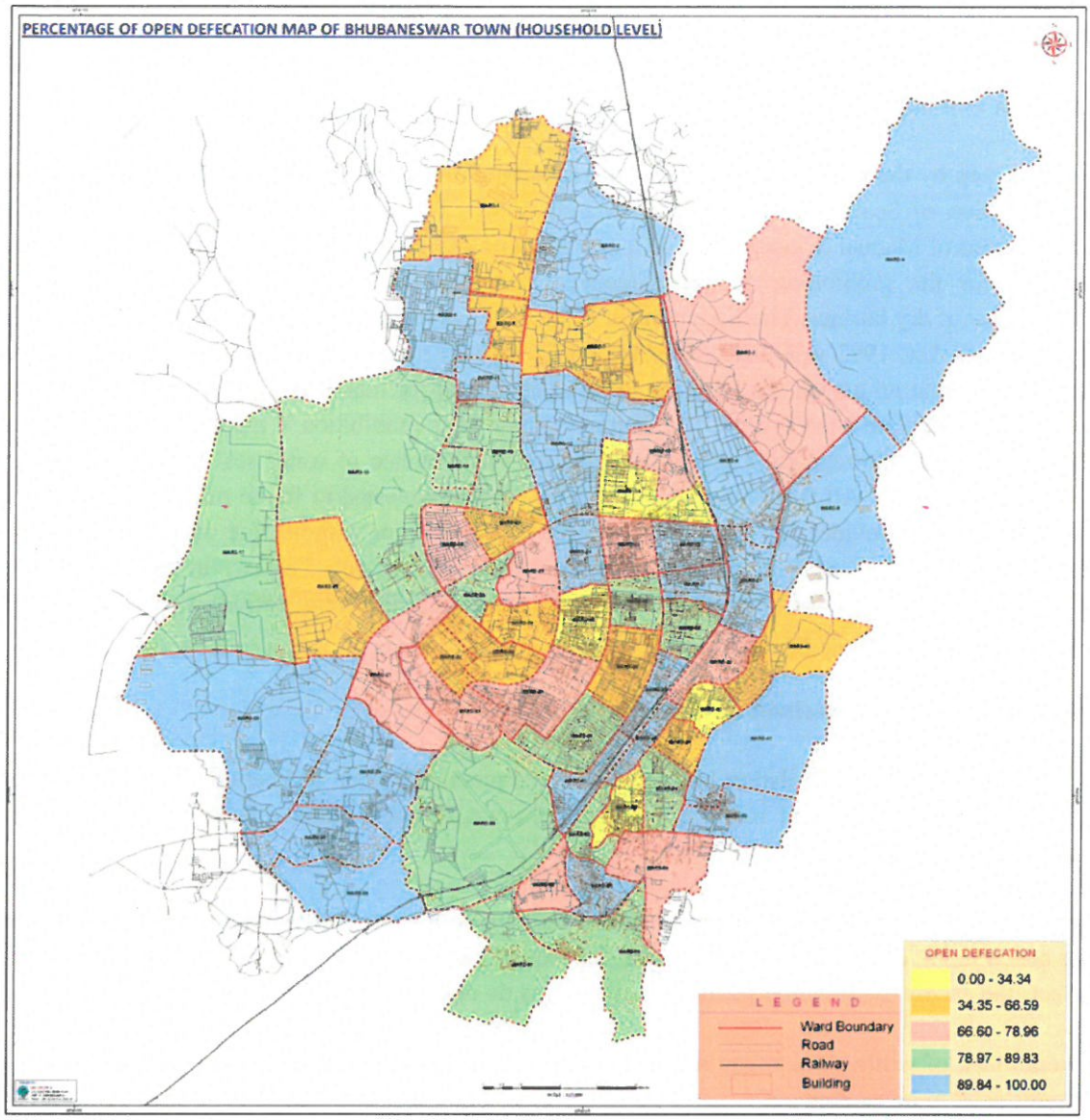
4.2.2 Population resorting to Open Defecation

- City-wide Open defecation 35%.
- Total 22 Community Toilets; 176 functional seats
- 60 pay-use toilets (JICA-33, Sulabh International-27) – all maintained by Sulabh

While the city-wide open defecation is at 35%, the household level survey conducted by AIILSG reveals that approximately 60% population from economic weaker sections and living in slums and newly developing areas resort to open defecation due to lack of individual or community sanitation facilities in their area.

Ward-wise consultations have revealed that the scarce or non-availability of municipal water supply in the vicinity have also affected the use of individual toilets either constructed on their own by households or under various schemes e.g. ILCS Programme. For example, in Sikharchandi slum, the families go out for open defecation when they do not receive water from the nearest public stand posts/hand pumps since enough water is not collected to maintain the toilet.

Map 3: Ward wise percentage of population practicing open defecation



Source: baseline survey

Gap Analysis – Household sanitation

35% of the total population does not have access to any sanitation facilities and therefore, they resort to defecating in open. Large proportion of children also defecates in open. It is a common practice to dispose infants' excreta in open. Baseline survey indicated that over 20% of households having children defecate in open fields and over 30% of the households throw infant's excreta in open field in unsafe manner. Overall situation causes unhygienic conditions in the city area and also poses risks for spread of diseases through flies and ground water contamination.

In areas where water logging problem persists especially in monsoon, such areas pose constraints for pit technology for latrines. Congested areas in the heart of the city and smaller plot areas also pose space constraints in construction of latrines and discourage households to construct latrines. The household level survey indicated that more than half of the population is urban poor, and falls under

BPL category. They have low paying capacity, and yet such households prefer to have individual toilets. There is a willingness to pay among 60% of such households, and the rest are willing to contribute labour free of cost.

Adoption and implementation of 1993 Prohibition Act – Legal Scene

The first step by the Government has been the launching of the "National Scheme for Liberation and Rehabilitation of Scavengers", NSLRS in March, 1992 . Thereafter the Government enacted "The Employment of Manual Scavengers and Construction of Dry Latrines (Prohibition) Act, 1993" which provides for the prohibition of employment of manual scavengers as well as construction or continuance of dry latrines. The Employment of Manual Scavengers and Construction of Dry Latrines (Prohibition) Act, 1993 was enacted by the Parliament on 5 June 1993. The Act provides, among other things, that no person shall engage in or be employed for manually carrying human excreta or construct or maintain a dry latrine. The contravention of this prohibition is made punishable. The act also provides for the regulation of construction and maintenance of water seal latrines and matters connected therewith. All the State governments have been requested to frame rules for enforcing the act. The act also provides for imprisonment up to 1 year with or without fine which may extend to Rs.2000/- or both in case of failure or contravention of the act. Further, in case of repeated contraventions, there is fine to the tune of Rs.100/- per day for the entire period of contravention. No case has yet been filed by BMC.

4.2.3 Key Issues in Household level sanitation

A good percentage of population has been observed practicing open defecation. Generally, children defecate in open areas and infant's excreta is thrown in open fields. Such areas do not have public/community toilets for use.

Lack of space availability, affordability, dense housing structures, and rental accommodation affects the construction of toilets and septic tanks. Inadequate public and absence of community toilets also affects the access to sanitation facilities to those who do not have toilets at their homes.

Overall lack of willingness to pay raises the financial burden of constructing new toilets and funding options need to be worked out

4.2.4 Septage Management

Septage from septic tanks and pit latrines is collected by the Municipal Corporation using suction machines available with them and disposed off in the current landfill site used for dumping solid waste of the city. Septic tanks are cleaned once in a year based on the request from households. Generally, about 20-30 tanks are cleaned per year within the city limits, according to the municipal officials.

4.3 Public Sanitation facilities

Description	BMC
HH with access to Individual toilets	127392
Toilet Coverage (%)	76

Sewerage network Coverage (%)	17
Major HH sanitation practice in slum	Temp Pit & Drain
No. of community toilet seats	176/22 toilets
No. of public toilet/pay&use	60
User Fee (Rs)	5
% Open Defecation city-wide	35
% Open Defecation in slum	60
Final sewage disposal point	land

The number of community toilets with 176 functional seats seem totally inadequate for the city where the slums are in large numbers.

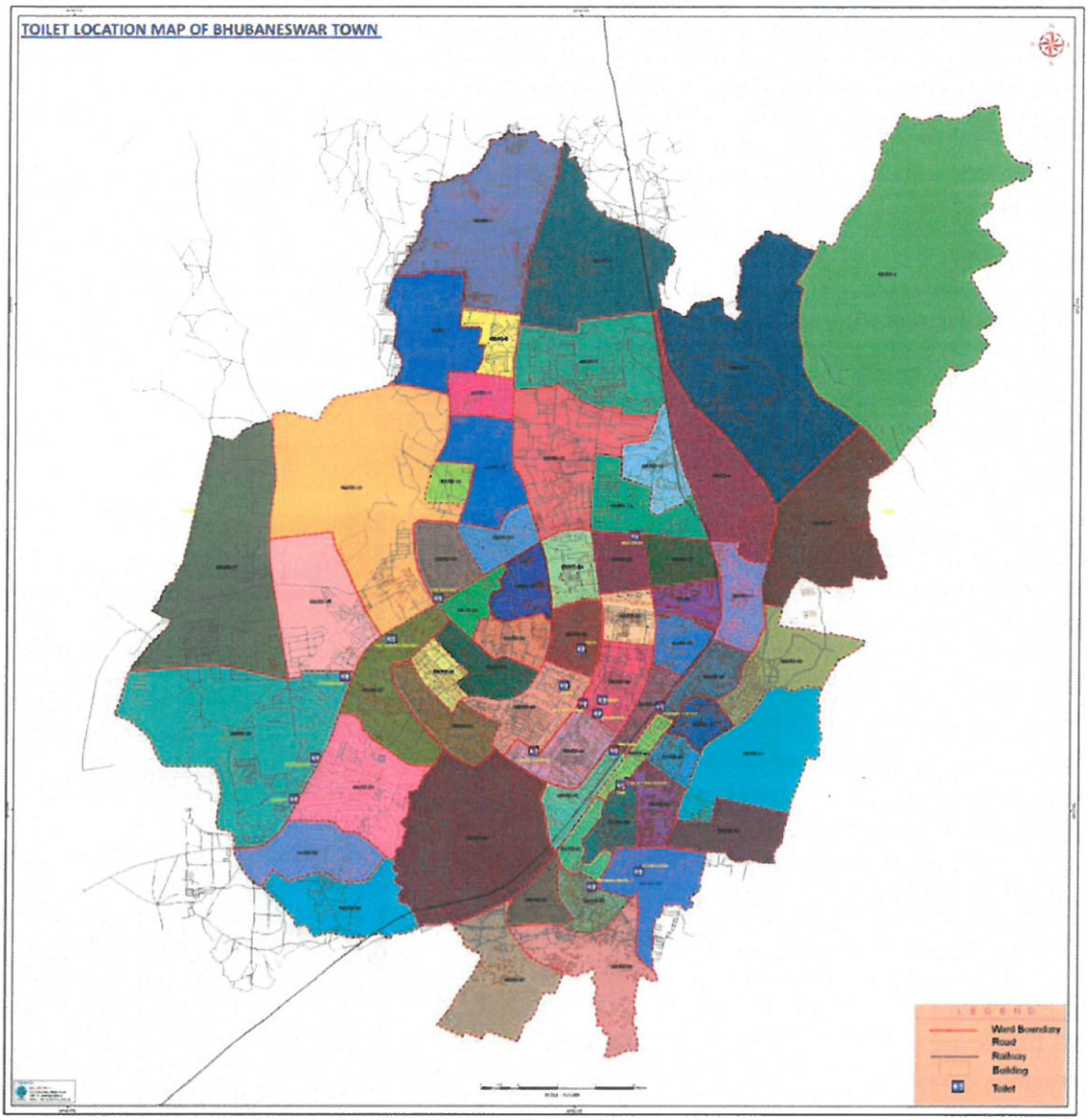
There are only 60 public toilets blocks in city maintained by Sulabh Souchalaya Sulabh International Sanitation Organization on pay and use basis. Each toilet at 10 seats, 5 for gents and 5 for ladies. Users are charged Rs. 5/- per single use for both men and women. Tourists and few local residents use the toilet facility. List of public toilets and locations has been given in the annexure. The physical condition of public toilets is not good as they are poorly maintained.

O & M Issues

All toilets are cleaned on daily basis with acid, phenol and bleaching powder. The toilets are connected to Septic tanks and effluent from the septic tanks is discharged into municipal open drains/sewerage system as applicable.

The public toilets with pay and use model exists and are being run with the private sector involvement. However, the use of these toilets is considerably low probably due to the user charges. Replication of such models in other parts of the city may pose difficulties in running them on financially sustainable basis. Further, such pay-and-use toilets are not generally accessed by children – on account of user fees as well as non-child friendly designs of such toilets. Infrastructure of the toilets is of very low quality. These aspects require careful considerations while planning future public toilets in case these are proposed.

Map 4: Location of Public toilets and commercial establishments



Source: primary survey

Overall availability of public toilets in the city is very inadequate in the crowded areas like market places such as Indradhanu market, market complex unit-1, Big Bazaar and Banivihar Chhak, VSS nagar, etc. The existing market places bring in considerable floating population from the surrounding region which does not have any kind of sanitation facility. Women, especially suffer severely due to absence of such facilities. Such public places, in turn being heavily crowded, showcase filthy and unhygienic environment, especially on the days when weekly *bazzars* are conducted on different days.

Major institutions such as Schools, Hospitals and health centres were visited to assess the use and adequacy of sanitation facilities in these institutions. About 25 educational institutes were visited which included government as well as private schools and colleges.

4.3.1 Gap Analysis – Public Sanitation Facilities

As per CPHEEO guidelines for public sanitation facilities, for market places, hospitals and other public utility buildings, 1 urinal per 200 users and 1 seat per 100 users should be provided.

- Field visits to the crowded market areas in the city and the discussion above makes it explicitly obvious that there is a huge gap between norms and the fact that there are only 14 pay-and-use and only 98 community toilets in entire city of Bhubaneswar, let alone the floating population to market places.

- Public level sanitation facilities for women are grossly lacking in the city, especially in the market area.

As reported by local media in January, 2011, the Bhubaneswar Municipal Corporation (BMC) has decided to construct 58 additional public toilets and 22 additional community toilets in the city.

The project would be undertaken with funds from Japan International Cooperation Agency (JICA) and Jawaharlal Nehru National Urban Renewal Mission (JNNURM).

While public toilets will be constructed in crowded places such as bus stops, market complexes, railway station and major traffic islands, community toilets would be set up for the urban poor in slum areas.

"The BMC aims to have at least one community toilet in each authorised slum. There are 99 such slums in the city. However, with growing population of the city, the crowded places also need the public toilets to keep the surroundings clean and pollution free,'' said a senior BMC official.

Sources said that 31 public toilets would be constructed in Bhubaneswar with assistance from the Japan International Cooperation Agency (JICA). Another 12 would be set up in Cuttack.

The JICA would provide Rs 5.16 crore for constructing these toilets. Sites for the toilets were yet to be selected and detailed project report (DPR) has not been prepared. Similarly, there is a plan to have 27 public toilets under the JNNURM.

The funds would also be used for setting up 22 community toilets in the city slums. The expenditure would be to the tune of Rs 6.96 crore.

The baseline survey for the site selection for the public and community toilets will start very soon.

4.4 Drainage

4.4.1 Sewerage System

BMC is only partially covered with an underground sewage collection and conveyance system and as a result majority of sewage flows through open drains. River Daya, ultimately receives these huge pollution loads and is functioning like a 'major sewer'. Majority of the existing systems for sewage collection and treatment are not functioning well. It is obvious that the existing sewerage system

needs major augmentation to almost full extent to ensure full coverage of the population and future wastewater generation[17].

It has been reported that about 80% of the existing sewer is inadequate or damaged and needs replacement or repair. About 20,000 manholes are provided out of which around 80% is damaged and needs replacement or repair work. Treated wastewater is discharged through outfalls into the Gangua Nallah and finally to Daya River. Only part of the generated sewage flows through closed conduits leading to treatment systems, and a major quantity flows through the open drains (10 nos.) The drain No.1 opens into the river Kukhai and the remaining 9 open drains (Nos.2-10) to Gangua Nallah which in turn transfer the volume and load to River Daya. Collected sewage is treated in different treatment units constructed in different parts of the municipal area[18].

Under JnNRUM, a sum of Rs.9978.27 lakhs has been received as Additional Central Assistance towards 1st installment and the State Govt. have released Rs.11225.55 lakhs including the State Share in favour of the Orissa Water Supply & Sanitation Board for implementation of the project "Integrated Sewerage System for Bhubaneswar City". In anticipation of GOI receipts, the State Govt. has released Rs.6570.71 lakhs (ACA of Rs.5840.63 + state share of Rs. 730.08 lakhs) to the implementing agency.

OWSSB is executing this project at an estimated project cost of Rs.754.23 crores. The sources of funding are (a) Rs.140.00 crores – 12th FCA, (b) Rs.399.13 crores - Additional Central Assistance (ACA) under JNNURM, (c) Rs.99.79 crores – Japan International Cooperation Agency (d) 49.89 crores – ACA under JNNURM & GoO and (e) Rs.65.42crore – Land Cost – GoO.

Bhubaneswar city has been divided into six sewerage districts for smooth implementation of the project. Rs.140.00 crore has been sanctioned under 12th FC grants to execute the sewer laying component of work in sewer District I & II. The work has been awarded to M/s East Coast Construction & Infrastructure Ltd Chennai So far, expenditure for 9050.00 lakhs has been incurred.

Out of 193 kms of sewers of Sewerage District-III for which work order has been given, 57.20 kms have been laid[19].

Table 5 Status of Sewerage System in City

Sr. No.	Details	Remarks
1	Population as per 2001 Census.	**6,57,477 Nos.**
2	Cuurent Population	**10,60,000 Nos**
3	Total numbers of wards.	**60**
	• Fully covered.	**13**
	• Partly Covered	**24**

[17] Draft Bhubneswar CDP, 2008

[18] PHEO publication on Bhubaneswar Water supply and Sewerage System as 1st April 2011

[19] Annual Activity Report 2009-10, BMC

	• Uncovered.	**23**
4	Length of sewer line	**5,34,254 Mtrs**
5	**Treatment System**	
	A. Septic Tank	**111**
	B. Aerated Lagoon	
	1. 1 MGD Capacity	**2 Nos. (1 No. at Laxmisagar & 1 No. at VIP Leased Plot Nayapalli).**
	2. 200m x 200 m	**1 No. (BDA Colony Phase-I, Chandrasekharpur)**
	3. 80 m x 150 m	**2 Nos.(OSHB Colony Phase-I, Chandrasekharpur)**
	C. Waste water treatment plant (30m X 100m)	**1 No. (Sainik School). (HRTS System)**
6	Sewage pumping station.	**• Laxmisager – 1 No. • Toshali Plaza Complex- 2 Nos. • RHS Colony, Baramunda – 1 No. • DAV School, Unit-VIII – 1 No. • VIP lease plot, Nayapalli – 1 No.**
7	Manhole chambers	**30,814 Nos.**
8	Population covered with sewerage system	**1.97 Lakhs.**
9	**Disposal point with location**	**• Disposal to Ganguanala at Bomikhal & Old Town. • Disposal to Bhudhinala at Chandrasekharpur. • Disposal to open nala near Gandamunda. • Disposal to open nala near Baramunda. • Disposal to open drain near Jayadeva Vihar**

4.4.2Generation of Wastewater

Ward-wise generation of wastewater has not been published yet. However at reported 135 LPCD (MoUD SLB states this as 92% LPCD), the total water supplied at Bhubaneswar is 251.013 MLD. Considering 15% NRW, and at 80% standard wastewater production, an estimated 190 MLD is the total wastewater generation in Bhubaneswar.

However, the PHEO publication on "Bhubaneswar Water supply and Sewerage System as on 1st April 2011" mentions that 199.938 MLD of water is treated at the six WTPs (oxidation ponds; waste water from bathrooms, kitchen, cooking activities and other domestic uses) as well as black water component from toilets

4.4.3 Sewerage Demand-Gap Assessment[20]

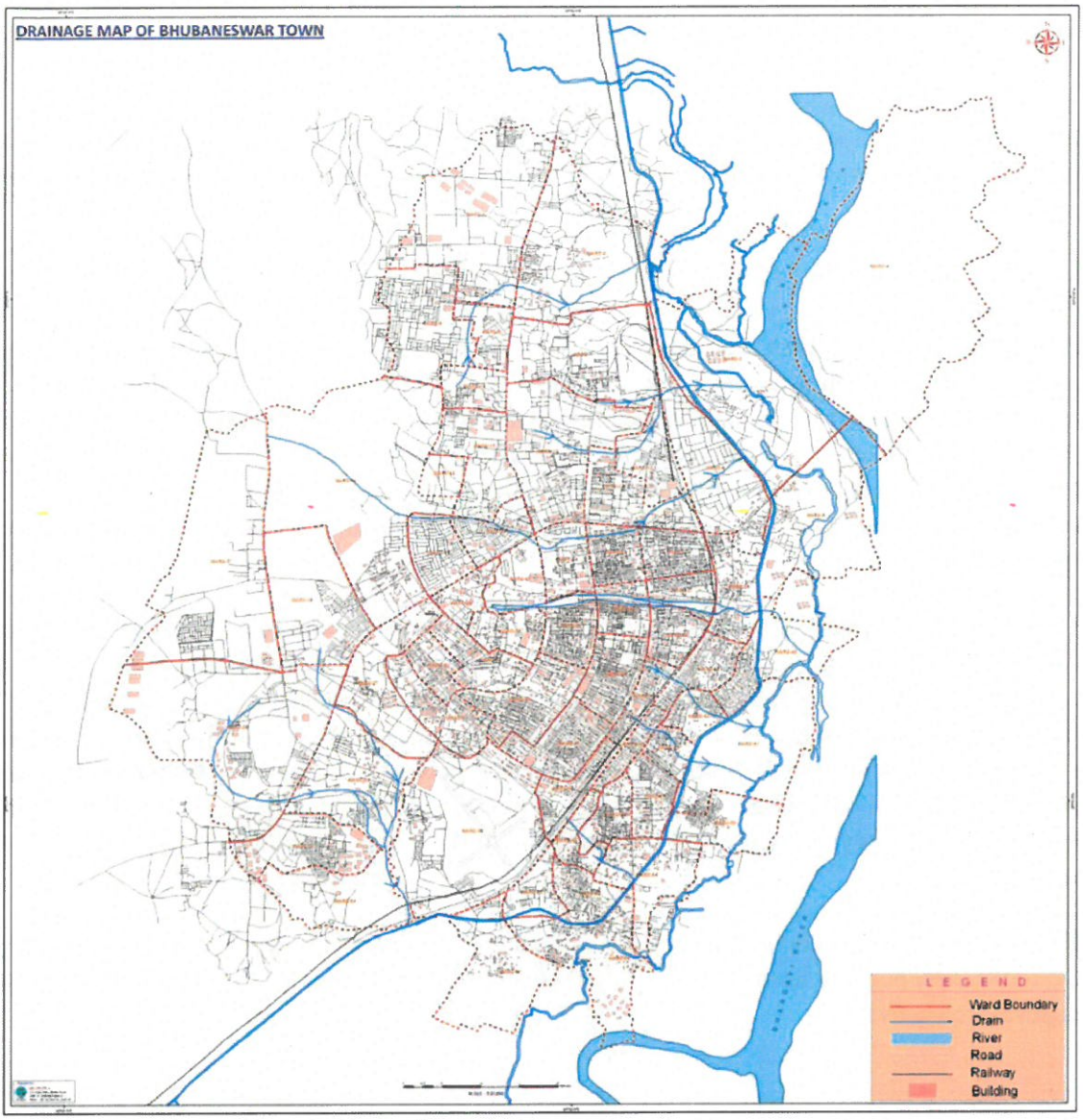
: Underground Sewerage System - Demand-Gap Assessment

Sl. No.	Component	Normative Standard		Short-Term Demand-Gap Assessment (2009-2024)			Long-Term Demand-Gap Assessment (2009-2039)		
		Unit	Quantity	Generation / Demand	Existing	Gap	Generation/ Demand	Existing	Gap
1.	Sewage Generation (MLD)	Lpcd	126	169	82	87	219	82	137
2.	Treatment Capacity/ Potential w.r.t. Generation (MLD)	%	100	169	Nil	169	219	Nil	219
3.	Sewage Collection System Coverage w.r.t. PTAs (Percent)	%	85	85	35	50	85	35	50
4.	Sewage Collection System Coverage w.r.t. Road Length (km)	%	85-100	1360	345	1015	1600	345	1255
	Estimate of Requirement of Land for Sewage Treatment Alternatives								
1.	Waste Stabilization Pond (Acres)	Acres/ MLD	4.00	674	--	674	876	--	876
2.	Activated Sludge Process (Acres)	Acres/ MLD	0.25	42	--	42	55	--	55

Source: Analysis / PHEO (Urban), Bhubaneswar; 2006

[20] *CDP Bhubaneswar, 2006*

Map 5: Open drains in Bhubaneswar



4.4.4 Storm Water Management System – Key Issues

The general elevation of Bhubaneswar is approx. 45 m above MSL and the overall topography provides a natural north-to-south advantage of drainage and the natural drains are aligned accordingly.

Bhubaneswar has a network of 10 major (natural) drains totaling 623.69 kilometers. The BMC maintains 486.61 kms and the PWD maintains 79.45 kms. Under JnNURM, 20 km of open drain has been constructed by BMC. They are primarily catchment drains that receive storm water (from minor drains) and covey the same from inhabited areas to Gangua Nallah and onwards to Daya river (*See Annex*).

It has been reported[21] that there are 11 water polluting industries in Bhubaneswar which generate 86,000 m3/d of wastewater which is either treated in septic tanks or spread on low lying land without proper treatment and is ultimately discharged into these drain channels. The pollution level of River Kuakhai and River Daya are not very significant. But, however, the pollution load from Gangua Nallah on River Daya will be considerable as it carries all discharges from the nine major drains. It was reported that the water quality in Daya river upstream reach of the confluence with the Gangua Nallah is moderate but that in the downstream reaches of the confluence is well below satisfactory levels.

In absence of a sewerage system in a given area, people are using septic tanks and soak pits. In most of the places sewage is discharged into open drains without any treatment, which is ultimately discharged to Gangua Nallah. The Gangua Nallah with a length of 35.7 km, bed width of 30 m and average depth of 2.62 m is having a catchment area of 75.6 sq.km with a discharge of 652 cusecs. In its course of 12 km in the city of Bhubaneswar, it receives wastewater discharges from nine drains. The major contributor to the water pollution for BOD load is Patia drain followed by Sainik School drain. These drains discharge both domestic and industrial wastewater from densely populated old city areas. It was estimated that the River Kuakhai receives about 27.22 MLD of wastewater from Patia drain[22].

It has been observed that the surface water runoff and domestic wastewater is discharged into the road side surface drains. Most of these drains have lost their original flow carrying capacity due to the indiscriminate dumping of garbage in the drain and also due to the accumulation of sand and grit. The high rate of urbanization has led to water logging situation in some areas as infiltration to the sub soil is reduced with increase in built up area. The situation points to the necessity for public awareness against dumping of solid waste and discharge of sewage/sullage from households into the natural drains. However, only by providing a systematic solid waste disposal and collection system can this be curbed.

The drainage facilities demand management of drains, involving the prevention of flooding and illegal encroachments, periodic maintenance, and provisions of adequate land for future reconstruction and augmentation activity.

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[21] Draft Bhubaneswar CDP

[22] Draft Bhubaneswar CDP

Table 6 Ward wise Length of Existing Drains

Ward No.	Length (mts)	Ward No.	Length (mts)	Ward No.	Length (mts)	Ward No.	Length (mts)
1	1867	16	9835	31	2429	46	4879
2	284	17	9145	32	3274	47	2677
3	0	18	4999	33	1805	48	5842
4	0	19	10421	34	7705	49	3853
5	157	20	8087	35	2986	50	4443
6	1502	21	19696	36	426	51	4867
7	905	22	13782	37	1415	52	6282
8	2869	23	9568	38	46	53	9432
9	25	24	7534	39	2637	54	7684
10	1298	25	4234	40	170	55	1148
11	12562	26	17859	41	3647	56	5702
12	136	27	8469	42	543	57	8090
13	12731	28	9456	43	4249	58	7020
14	1311	29	11126	44	3858	59	14880
15	18283	30	5237	45	3127	60	11616
Total Length of Existing Drains							**340110**

Source: Preliminary Project report of W.R.D, GoO for "Preparation of Comprehensive Master Plan and Detailed Project Report for Storm Water Drainage System of Bhubaneswar City under JnNURM scheme of GoI"

4.4.5 Gap Analysis for Storm Water Management[23]

The principal problems identified (in CDP) are inundation, encroachment removal along the drains and land availability/acquisition issues for re-construction and augmentation activities. Notwithstanding these issues, renovation of listed major drains in the core area was performed through construction of masonary drain sections in 1996-97. These sections have been damaged significantly due to past 'super cyclone' and resulting torrential rains, and need reconstruction.

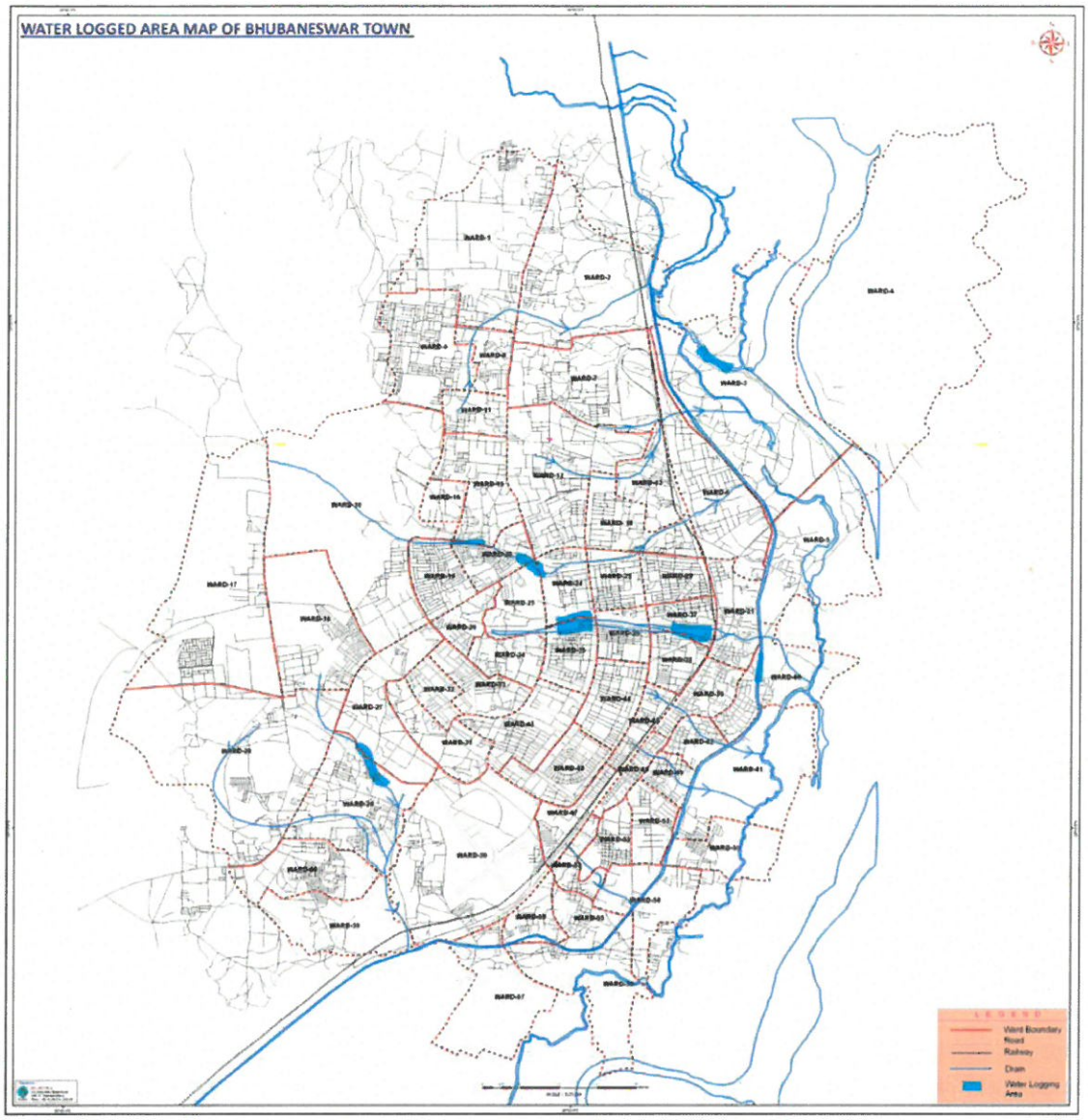
Considering the total road length of 1827 km in Bhubaneswar (PWD-445, NH-10, **BMC-1372**),and the demand for optimum coverage is at appx. 1.30 times the road length (one-third roads would have open drains on both sides), there is a gap of 885 km of drains needed to ensure efficient storm water management. Some other gaps include, awareness creation, non- existence of drain perimeter protection (e.g. fencing), chocking of drains due to indiscriminate dumping etc. as also:

- Improvements of existing major and minor drains and channels
- Improvements in channel sections of major drains

[23] Preliminary Project Report on " Preparation of Comprehensive Master Plan and DPR for Syormwater drainage system of Bhubaneswar city under JnNRUM Schme of GoI" WRD, GoO, 2008

- Reconstruction/widening of major drains for enhanced hydraulic capacity

Map 6: Water logging areas



Source: baseline survey

Table 7: Locations of Major water logging areas

Areas	Remarks
Beherasahi (Nayapalli), Acharya Vihar, Jaydev Vihar and Shastrinagar	Along major drain no.4; encroachment; issue pending administrative/legal issues
Laxmisagar area	Along major drain no.5; obstructions specifically at Laxmisagar Chaak and at DWBC crossing
Old town area, Gaurinagar and Garrage Chaak	Along major drain no.7; low lying; non-availability of freehold land and non-acquisition of private lands; encroachment on sections of drain
Jharapada, Bomikhal Govindaprasada & Shantinagar	Along major drain no.7; significant encroachment along Daya west branch canal; area experiences breaching of the drain section and spilling over

4.4.6 Storm Water Drainage Project of Bhubaneswar[24]

The State Govt., under JnNRUM, has released Rs.3541.25 lakhs including the ACA component of Rs.2491.60 lakhs & the state share of Rs.1049.65 lakhs for implementation of the projects in Bhubaneswar (and Puri). Detailed planning, Engineering, Design and tendering activities are under progress. Work has been started in 2 Nos. of drains of Bhubaneswar city.

4.4.7 Existing status of Sullage Management

Drains are used to dispose sullage water, sewage and stagnated water on the road. The total length of Pacca roads in the Bhubaneswar is approx. 1600 km. Most of the city roads have open drains. However, their functioning is hindered by blockages due to solid wastes dumped in drains. Narrow drains, drains with improper slopes or non-existence of drains in some areas have caused flooding and water logging thus increasing the risk of diseases like malaria etc. Existing drains are also used to carry effluents from latrine pits as well as from septic tanks. In few pockets, a raw sewage was also being discharged in the drains from the latrine pits. Connections from houses to drains are also not properly done in many places causing spilling of such wastewater on roads or nearby areas.

When complained, the sullage is dumped by the roadside after cleaning a drain and never lifted. Residents complain of serious odour nuisance and unhygienic conditions.

4.5 Solid Waste Management

The city of Bhubaneswar generates 450 metric tonnes of solid waste is every day (at0.500 gms per capita). To collect the waste from the city and to keep the city clean, 3100 personnel have been deployed by BMC. Mainly wheel barrow, tri-cycles and tractors are used for transportation of

[24] PHEO publication on Bhubaneswar Water supply and Sewerage System as on 1st April 2011

solid waste. According to the data provided by the BMC, there are 600 wheel barrows, 270 try-cycles and 120 tractors which are pressed into solid waste collection and transportation every day. The tractors every day make 300 trips to transport solid waste from the city.

Of the 60 wards, 40 wards are managed by private contractors namely Jagruti Welfare Organization, Manoj Kumar Routray, Raj Kishore Nayak and Prabhakar Pradhan. The rest of the 20 wards are covered directly by the BMC. The solid waste is heaped near Sainik School and from there it is transported to dumping yard in Bhuasuni. Apart from collection and transportation of solid waste, the corporation also engages its work force for bush cutting and drain cleaning.

4.5.1 SWM – Gaps

In general, SWM remains non-compliant with MSW Rules 2000 in all sub-sectors such as segregation at source, processing and scientific disposal. With a view to streamline the solid waste disposal system in the twin cities of Bhubaneswar-Cittack, a common regional land fill site at Bhuasuni is being developed on PPP mode. IDCO has been engaged as the Nodal Agency for the purpose. After the site is developed, 550 MTs of solid waste will be scientifically disposed of on daily basis, providing better and cleaner cities.

The major contributors of MSW in the planning area include domestic, institutional, commercial, hotels and restaurants, temples, marriage halls, street sweeping, construction and demolition, industrial, and biomedical wastes. A substantial part of the MSW generated remains unattended and grows in heaps at poorly maintained collection centers and dumping yards. The choice of a disposal site also is more a matter of what is available than what is suitable. There are waste bins to collect, mainly, the household wastes, but the system is not efficient. The bins are, however, only randomly provided in most of the Bhubaneswar development areas. Further, these waste bins are inadequate in size and are open, thus providing easy access for birds and other animals. Some of these bins are often misplaced, forcing the residents to throw away garbage in open areas of the probable bin sites. Even when the bins are available, wastes are sometimes thrown outside the bins anyway and since the wastes are always thrown loose the problem become unmanageable very quickly. Not only in the residential areas, loose wastes from large market places and grocery centers are thrown on the ground around the roadside waste bins. Stinky rubbish lies around the waste bins in the residential areas and market centers for a long time before being collected by the waste collectors. The collectors have to clean up the areas messed up by loose waste and shovel the loose waste into baskets, and then onto trucks[25].

Despite the efforts of the municipal corporation, the sheer number of the slums and lack of basic amenities in the slums ensures that Bhubaneswar still languishes at 124th position out of 423 cities in Sanitation Ratings of MoUD (2009).

[25] Draft Bhubaneswar CDP, 2008

Chapter 5 : Technology Options

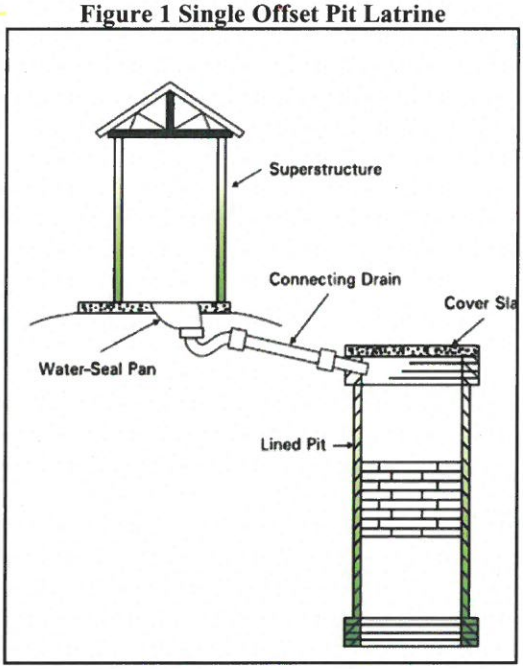
5.1 Options for Latrines/toilets (Onsite disposal)

Following options are suggested for the on-site collection at household level.

5.1.1 Pit Latrine

Simple leach pit latrine is the basic low cost toilet for containing the human excreta safely. A pit is either constructed directly below the latrine superstructure or constructed away (Offset) from the superstructure. This could be decided based on the availability of space. If adequate space is available, standby pit can be constructed adjacent to the existing pit. The Pit is lined with open-jointed brickwork, similar to the single pit design. When the pit is full, it should be cleaned and emptied after allowing some time for the fecal matter to decompose. Pit latrines are easy to construct using the local available material and are also cheap and can be afforded by poorer families.

Figure 1 Single Offset Pit Latrine



5.1.2 Eco Sanitation Latrines

Ecological sanitation latrine (referred as eco san toilet) is a dry type of latrine where latrine urine and other water content are separated from faeces and are collected separately. It consists of two water tight chambers for faeces collection. No water is to be utilized along with faeces and it is collected in the chambers are covered with saw dust, soil, leaves or any other material that can help faeces decomposition. These two chambers are expected to use in alteration one after another. Ones the tank is full of faeces, it is allowed to decompose for a period of year and then the decomposed matter can be used as manure at fields.

Water used for anal cleansing and urine are collected separately. Urine collected from this system can be used for gardening and water used for anal cleansing can be disposed off separately by constructing soak pit.

Figure 2 Eco Sanitation Toilets

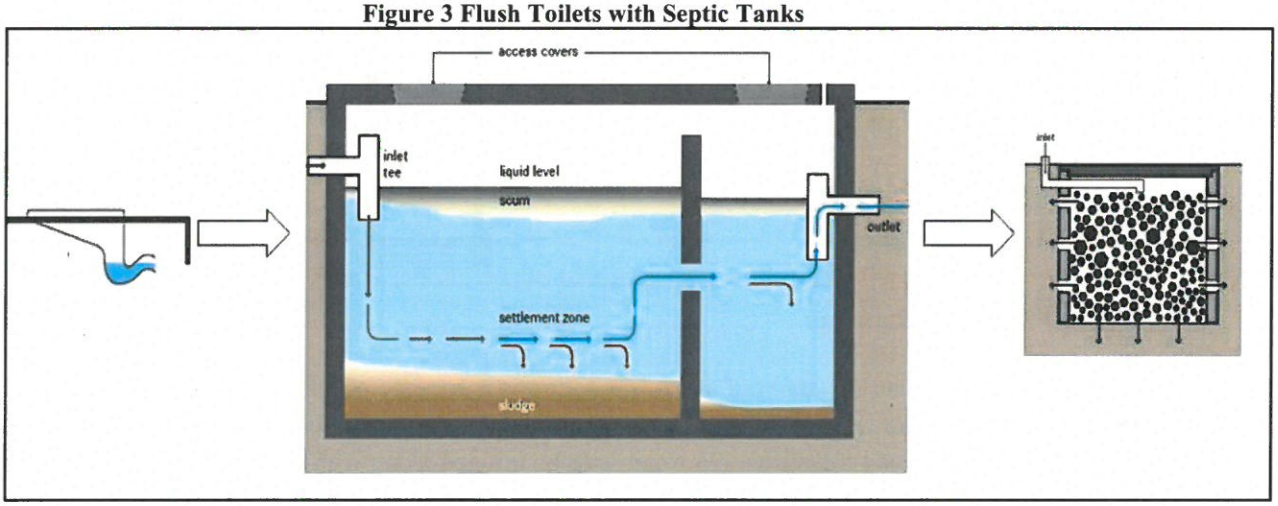
5.1.3 Flush Toilets with Septic Tanks

A septic tank is a chamber, essentially underground, which collects and stores domestic wastewater (grey and black) Organic waste is treated there under anaerobic conditions. Effluent from septic tanks should be discharged to soak pit which acts as an infiltration system. It is recommended that the effluent is treated on-site before discharge into surface water.

The standard septic tank design incorporates two chambers as shown below. Most of the treatment takes place in the first chamber.

Properly designed septic tank will remove about 50% of the biological load in the wastewater.

Figure 3 Flush Toilets with Septic Tanks



5.1.4 Flush Toilets connected to the proposed sewerage system

In this option, pour flush toilet is directly connected to the sewerage system. The water component as well as faecal part of waste generated and disposed though latrine is carried through sewer line to the Sewer treatment Plant (STP). Such toilets are useful when water is use high and it is available. Such toilets are expensive and are most suitable for areas where sewerage system exists.

5.1.5 Community Toilets connected with septic tanks

The option of community toilets is suggested considering the socio economical background of the city population. The community toilets are suitable in the areas where people are of low income groups (slums or economically weaker sections) where affordability level of having/ constructing and maintaining individual toilet is very low. It is suggested that the community level toilets can be provided at such places which will be connected to septic tanks to ensure onsite treatment of waste. Community toilets are suitable when it is difficult to construction individual toilets especially in poorer areas of the city, either on account of lack of space or non-affordability among poorer families to construct their own toilets.

Operation and maintenance of such toilets is challenging unless a dedicated arrangements are made for regular cleaning. In view of the poorly maintained toilets in many part of the country, they are now being operated on pay and use basis to ensure that they are maintained clean.

5.2 Options for conveyance system

Increased water availability (about 135 lpcd) in near future will influence the choice of the citizens for toilets and the amount of water they use in cleaning the sanitation facilities. When more water is available, citizens tend to prefer water flush toilets over Pit toilets. However, increased amount of sewage water adds to the challenges of on-site disposal of the sewage considering low permeable soil conditions and water logging situation in the town. Off-site disposal is therefore suitable.

There are various technology options that could be applicable and used in Bhubaneswar for collection and transportation of sewage. These are:

5.2.1 Small bore sewerage and Shallow Sewer system

Shallow Sewer and Small bore sewerage system are cost effective and may require to be supported with decentralized treatment facility. Shallow sewers are suitable in areas of high water use and low traffic situation.

Small bore sewerage system uses small diameter sewers laid at shallow depth and connected with interceptor tanks at the household level connections. The system requires decentralised treatment facility. Interceptor tanks require maintenance by households.

5.2.3 Conventional Underground Sewerage System

Conventional Underground Sewerage System is already designed for Bhubaneswar with facultative ponds as treatment option. However, conventional underground sewerage system requires high capital and maintenance costs. In case of Bhubaneswar, high proportion of BPL population may not afford high cost of maintenance of conventional sewerage system. Also, narrow roads and dense development might affect the efficiency of the network. It is therefore necessary to consider cost effective system in the town that is affordable and operated in a financially sustainable manner.

5.3 Treatment System (Off Site Sanitation)

5.3.1 Waste stabilization ponds

Waste Stabilisation Ponds are a series of anaerobic, facultative and maturation ponds. These are connected in series to provide a two or three stage treatment process. Waste Stabilisation Ponds with two stage treatment processes comprising anaerobic and facultative ponds are suggested for the city.

- Anerobic Ponds: These are small ponds with depth 3-4m. The sewage is treated and digested by anerobic bacteria.
- Facultative Ponds: These are shallow ponds (1.5-2m depth) with large surface area. They consist of aerobic zone close to the surface and a deeper anaerobic zone at the bottom. These are suitable for medium to low density habitations and are effective in removal of pathogens. BOD can be decreased to the extent of 70-95% in ponds. Ponds are easy to operate and maintain.
- Maturation Ponds: These are again shallow ponds with depth of 1-1.2m with a large surface to enable light penetration.

The cost data suggests that Waste Stabilisation Ponds may be marginally expensive in capital costs compared to other treatment technologies but it is the cheapest technology in terms of O&M costs which small municipalities can afford. The treatment technology requires large land. Treated water from the ponds could be used for irrigation and that needs to be promoted among the farmers around the pond area for utilization of wastewater as well to generate revenue.

5.3.2 Conventional Sewage Treatment Plant

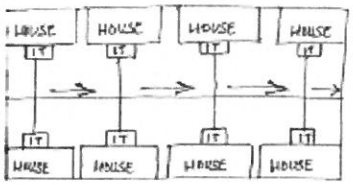
Conventional sewage treatment plant may be designed based on activated sludge process. This process involves rapid mixing and aeration of wastewater followed by a secondary settling tank designed to remove suspended micro-organisms prior to discharge. Active biomass is recirculated to the aeration tank.

Such plants are used for the treatment of municipal wastewater from medium to large towns. The plant however consumes high energy resulting in high recurring costs.

5.3.3 Decentralised Wastewater Treatment System

The most predominate sewer system relies on a Centralised Treatment System in which all the waste water/ effluents generated from sources such as houses, schools, hospitals, industries etc are collected and taken via open or covered drains / sewers to a centralized treatment plant. In most cases, storm water is also drained through these drains. These systems are mostly based on Aerobic treatment procedures. These centralised aerobic systems require large land areas, high power and skilled labour for regular maintenance.

DEWATS or Decentralised Waste Water Treatment System on the other hand looks at smaller dispersed treatment systems, which are basically anaerobic, with low maintenance, low



Cost. It is now well established that such Decentralised Anaerobic Treatment of Sewage and Waste water, is suitable for tropical climates like India. DEWATS is basically not a system to deal with excreta alone. It is part of a larger system to treat and re-cycle waste-water from all domestic and industrial and other sources. DEWATS also does not actually refer to a particular technical design or structure. DEWATS is an approach that uses several processes to treat wastewater, which is adapted to the local situation.

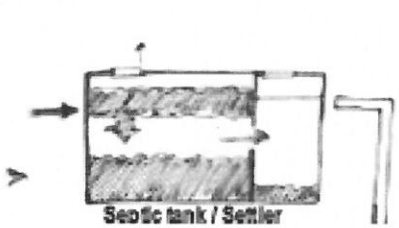
In Structure, DEWATS works like a sewer system, except the system is decentalised, which makes it simpler in process, technology, and operations and maintenance. It has three characteristics or rather, basic principles on which it is applied:

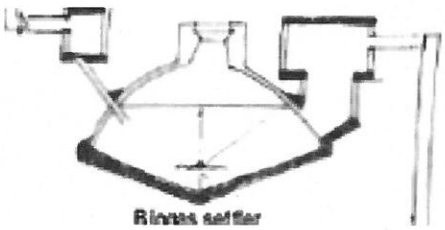
- Decentralization: Responsibility, Capacity, Treatment.
- Simplification: Process, Technology, O&M (operations & maintenance)
- Conservation: Recycling Water, Nutrients, Energy

Waste Treatment

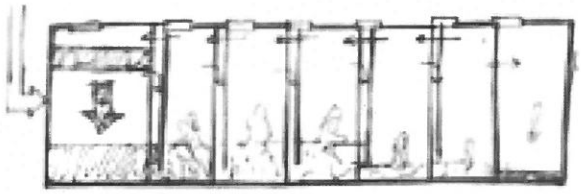
Pre-treatment is done to eliminate solids by putting in an interceptor tank like a septic tank where all settle-able solids settle. The interceptor tank can be provided for every house or for a cluster depending on space availability The solid-free effluent is then let into the collection system. The sewers are laid at shallow depth as there is no solid component in the effluent, no regular manholes required. However a clean-out can be provided which can be used to push water to clean up in case of any clogging. Since solids are seperated out at the first stage, deep sewer lines are not required Treatment of this effluent waste is done in decentralised clusters through a variety of secondary and tertiary treatments systems such that the effluent conforms to discharge standards of the Pollution Control Boards. This treatment is based on four treatment systems:

- Sedimentation and primary treatment in settlers, septic tanks or Imhoff tanks





- Secondary Anaerobic Treatment in Anaerobic Baffled Reactors or Anaerobic Filters

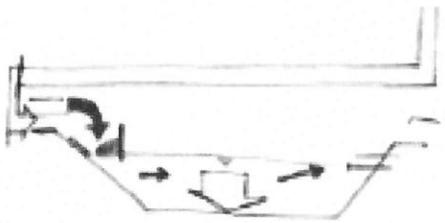


Anaerobic Baffled Reactor

- Secondary and tertiary aerobic / anaerobic treatment in Planted Gravel Filters

Planted Gravel Filter

- Tertiary anaerobic /aerobic treatment in ponds.



Pond Systems

Further the water is such that it can be used for irrigation and other non-portable purposes. The various process are chosen such that the treatment process is does not need electricity and they are reliable and durable, requiring minimal maintenance

Since it is decentralised: The design and nature of treatment can be specific to the nature of waste including domestic and industrial waste.

The waste doesn't have to traverse long distances, distances thereby eliminating huge costs on pipes, pumps and appurtenances. The main disadvantage of the technology is that it requires space at the local level. Also like all decentralised and locally built options, quality.[26]

5.3.4 Anaerobic baffled reactor (ABR)

It consists of a settling compartment of equal dimensions followed by a number of smaller compartments. Sewage passes through the compartments from bottom to top. Baffled reactor involve a combination of physical treatment and anaerobic digestion as the incoming wastewater passes through a blanket of suspended flocculation of active bacterial sludge in each compartment. BOD

[26] *Taken from ECOSAN Costing. TNTRC Newsletter. www.tntrc.org*

removal is about 70%. It is suitable for small community schemes or housing settlements with no access to municipal sewerage. ABR process is however capital intensive.

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Table 8: Comparative analysis of suggested options

Option	Advantages	Disadvantages	Capital cost	O & M	Intensity of Impact on environment
Onsite disposal					
Pit latrine	• Easy construction techniques with locally available and materials low construction cost • Less space availability • Faecal material can be used as **soil conditioning** • Reduction in pathogens to a considerable level • Reduced in foul odours due to effective ventilation	• Manual removal of sludge • Possibility of ground water contamination	Low	Low	Low
Eco Sanitation Latrines	• Suitable in water logged areas. • Requires less water. Separates Urine and Excreta and both can be used as rich manure.	• Requires careful use while cleaning of anal to avoid entry of water in excreta hole. • Higher cost as the vaults are built above ground.	Low	Moderate	Low
Flush Toilets with Septic Tanks	• Can be built with locally available materials • Preferred for long term usages • No electrical energy required • Onsite treatment carried with septic tank	• Comparatively higher construction cost than pit latrine • Requires more space than a pit latrine. May not be suitable in densely developed or congested areas may due to unavailability of space	High	Low	Low

Option	Advantages	Disadvantages	Capital cost	O & M	Intensity of Impact on environment
Flush Toilets connected to the proposed sewerage system.	Saves investments on pits or septic tank.	• Requires high amount of water for cleaning	High	High	High
Community Toilets connected with septic tanks	• Suitable for slum areas and low income groups • Can be seen as source of revenue generation • Onsite treatment carried with septic tank	• High maintenance cost • Requires more space than a pit latrine. May not be suitable in densely developed or congested areas may due to unavailability of space	High	High	Low
Conveyance system					
Small bore	• Less Expensive due to smaller size of sewers. Suitable for small communities	• May not be suitable for large communities	Low	Low	Medium
Shallow sewer	• Relatively less expensive as the sewers are laid at shallow depth with inspection chambers	• May not be suitable in areas where traffic load on roads is high	Moderate	Moderate	Medium
Conventional Underground Sewerage System	• Can carry any flows and suitable for medium and large populations	• Capital cost high	High	High	Low
Treatment					
Waste Stabilisation ponds	• Low operational cost • Treated waste water can be used for irrigation purpose	• Requires more land area	Moderate	Low	Medium
Conventional Sewage Treatment Plant	• Can handle any organic loading	• High Energy Consumption and maintenance	High	High	High

Option	Advantages	Disadvantages	Capital cost	O & M	Intensity of Impact on environment
		requirement			
Anaerobic baffled reactor (ABR)	• Useful for smaller communities with no access to municipal sewers	• Periodical removal of sludge required	High	High	High

Source: Technology Options for Urban Sanitation in India, GoI, 2008

5.4 Collection, Treatment and Disposal of Liquid Waste (Off site treatment)

With water supplied in excess of demand in Bhubaneswar, there will be more sullage and sewage generated in the city. Low lying areas with poor drainage arrangements offer challenges for on-site sanitation for disposal of increased quantities of sullage and sewage. Possible on-site and off-site technical options for sullage and sewage are discussed below.

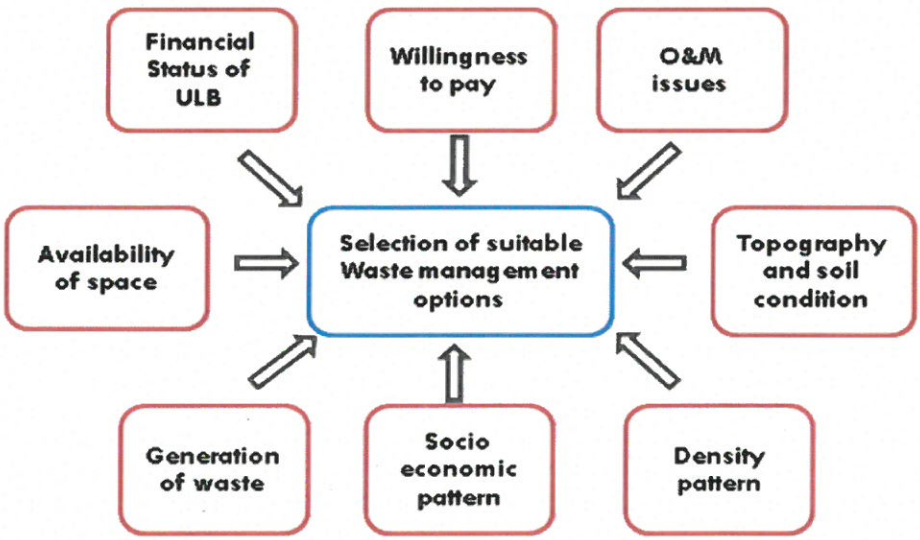
Sullage: Currently, sullage is disposed off in open drains. There are problems with effective functioning of the drains either on account of narrow drains or blockages. By resolving these problems, it may be possible to collect the sullage effectively across the city. Sullage however needs to be disposed off safely with treatment and this could be done at various places in the city as the flat terrain of the city may not allow carrying all the sullage to a single point of disposal.

Until the proposed sewerage system or other decentralized system is implemented, sullage needs to be collected through the drains and disposed off. It is therefore proposed that sullage collection shall continue to be done through the existing drains with the provision for rehabilitation of drains in areas where they do not function properly and with treatment facilities at several locations around the city where the topography permits gravity flows. Such arrangement is suggested as an interim arrangement till the appropriate sewerage system is in place. Once such sewerage system in place, the sullage shall be combined with the sewage and transported through the sewerage system.

5.5 Parameters for selection of suitable options

While drafting effective solutions for solid and liquid waste management, numerous factors were considered in context of city which directly or indirectly might affect the selected option. The factors broadly subsumed socio economic pattern, topography, soil conditions and subsoil strata, density pattern and urban sprawl, future volumes of waste generations, existing financial and institutional status of local governing body.

Figure 4: Factors influencing the choices of appropriate technologies for waste management



Currently, there are three types of toilet technology that exist in Bhubneswar for excreta disposal; pit latrines and flush toilets with septic tanks and flush toilets connected directly to sewers. With the proposed extension of sewerage system or introducing more such systems under various schemes (JnNRUM etc) in coming few years, affordability, space availability, and availability of sewerage system shall continuously influence the choice of toilets for the households, particularly in slums in Bhubaneswar and as a result, a combination of these choices will always exist in the town.

High proportion of BPL households in the city may not opt for flush toilets with septic tank due to their low investment capacity and in many cases, a space constraint. The baseline survey has indicated that majority of them prefer to have individual toilets provided subsidy is available. Few of them still prefer community toilets as they may not even afford to pay their contribution under the ILCS programme. Pit latrines are more suitable especially in dry areas (not suitable for water logging areas) and affordable for poorer families in the town where toilets with septic tanks may be preferred by middle and higher income group families.

5.6 Proposed options for Solid Waste Management

5.6.1 Processing of Biodegradable Waste

Various technology options are available for the treatment of municipal biodegradable waste. These are discussed below.

5.6.1.1 Vermi composting

Vermicompost is the product or process of composting utilizing various species of worms, usually red wigglers, white worms, and earthworms to create a heterogeneous mixture of decomposing vegetable or food waste, bedding materials, and vermicast. Vermicast, similarly known as worm castings, worm humus or worm manure, is the end-product of the breakdown of organic matter by a species of earthworm.

Containing water-soluble nutrients, vermicompost is an excellent, nutrient-rich organic fertilizer and soil conditioner. The process of producing vermicompost is called vermicomposting.

Vermicomposting involves stabilization of organic solid waste through earthworm consumption which coverts organic material into worm castings. Vermicomposting is the result of combined activity of earthworms and microorganisms such as fungi, protozoa and actinomycetes that inhabit the gut of earthworms.

Earthworms consume various organic wastes and reduce the volume by 40–60%. Each earthworm weighs about 0.5 to 0.6 g, eats waste equivalent to its body weight and produces cast equivalent to about 50% of the waste it consumes in a day. These worm castings have been analyzed for chemical and biological properties. The moisture content of castings ranges between 32 and 66% and the pH is around 7.0

The earthworm species that are commonly considered are Pheritima, Eisenia and Peronyx species. They are known to survive in the moisture range of 20-80% and temperature range of 20-40 deg Celsius. Due to constraints of temperature, moisture, fermentable organic substances and heavy

metals, use of this method is recommended for specific mass of organic waste collected from household, eateries, gardens, housing colonies.

The commercial model

A commercial model for vermin-composting developed by ICRISAT, Delhi consists of four chambers enclosed by a wall (1.5 m width, 4.5 m length and 0.9 m height) (Fig. 2). The walls are made up of different materials such as normal bricks, hollow bricks, shabaz stones, asbestos sheets and locally available rocks. This model contains partition walls with small holes to facilitate easy movement of earthworms from one chamber to another. Providing an outlet at one corner of each chamber with a slight slope facilitates collection of excess water, which is reused later or used as earthworm leachate on crop. The four components of a tank are filled with plant residues one after another. The first chamber is filled layer by layer along with cow dung and then earthworms are released. Then the second chamber is filled layer by layer. Once the contents in the first chamber are processed the earthworms move to chamber 2, which is already filled and ready for earthworms. This facilitates harvesting of decomposed material from the first chamber and also saves labor for harvesting and introducing earthworms. This technology reduces labor cost and saves water as well as time.

5.6.1.2 Compost bins

This facility is used to compost the waste in container or large bins. The waste is filled in the compost bins and they are sprayed with microbes which fasten the rate of composting

5.6.1.3 Bio gas plant

This is a biological process that occurs in the absence of oxygen. Anaerobic processes can either occur naturally or in a controlled environment. The organic waste is put in an airtight container called a digester where decomposition begins and the biogas is captured and sold for electricity. The residue can be used as a fertilizer similar to compost. This option however requires careful operation and maintenance of the plant to run it successfully.

5.6.1.4 Windrows (Aerobic Microbial) Composting

This type of facility is where material is composted in long piles (windrows) on a flat site. Windrows are kept porous mechanically by turning the material periodically. If piles are not turned often enough, the center of the pile may not receive enough oxygen, producing strong, unpleasant odors.

This is best done at a minimum scale of one tractor-load or truck-load of waste, so that suitable high temperatures can be reached within the center of the heap which will kill germs, weed seeds and worm eggs. A load of waste is unloaded on the ground and sprayed with water. This heap is then pushed by blade-tractor or front-end loader into a higher heap, sprayed again, and heaped again (and again) to a heap of minimum 4 ft height (and maximum 10 ft height). Spraying should achieve a moisture content of about 40%, moist but not wet or waterlogged, so that air can enter the heap. To accelerate the process of composting dilute solution in water of cow-dung can be sprayed or compost starting bio-culture can be used (initially 2 kg per tonnes of waste and later 1 kg. Per tonne of waste).

In 4-10 days, the temperature within the heap will rise to 65-70 degrees C. Turn the heap with tractor-blade or front-end loader, so that the outer (cool) layer goes to the center of the new high heap and the hot inner material covers it. Then spray as before. By this time the volume of the heap is reduced to two-thirds, as water-vapour escapes and some carbon turns to carbon dioxide. After another 7-15 days, when temperatures rise, repeat the process to form a third heap (with 50% of original volume) and later a fourth heap of stabilized ready compost (with 33% of original volume) which will not decompose, generate any more heat or shrink further and can safely be applied to soil without fear of spreading disease or germs.

5.6.1.5 Mechanical Composting in machine

Mechanical composting is an aerobic composting that happens under the presence of oxygen. Wet waste from household and bulk generators consists of mainly cellulose which can be broken down by microbes into a soil like substance with manure like values, called compost. These microbes can multiply and increase rate of composting if provided with right temperature, moisture, and enough oxygen to multiply. This process can handle the mixed waste in any form and quantity. This option is suitable for large quantities of waste and may not be suitable for small towns.

5.6.1.6 Biomethanation (waste-to-energy) Process

The total solids in the organic waste decompose rapidly (i.e. is highly putrescible) and therefore these wastes can be treated by biomethanation process (more commonly called Anaerobic Digestion, AD) in more effective manner. In this method, the solid waste is treated in closed vessels where, in the absence of oxygen, microorganisms break down the organic matter into a stable residue, and generate a methane-rich biogas in the process. This biogas can then be used as a source of renewable energy to produce electricity. The solid residue which remains after biomethanation process comprises solid / fibrous material and liquid, which can be separated and rendered to meet local needs. The fiber represents an effective organic material, which can be sold as 'manure' or blended into organic compost.

The aqueous liquor is a nutrient-rich fertilizer, which can be used to recycle nutrients back to agricultural land. The treated water is then further treated using Diffused Aeration and Chlorine disinfection methods. Therefore, in this particular case, treated liquor discharge can be permitted to water sources.

This is a two-stage design. The sizes of the digesters for the first stage and the second stage are decided on the basis of the suspended organic contents of the slurry to be treated. This first stage fermentation is hydrolysis stage and the second methanation and polishing stage. The first stage is designed to give maximum solid retention time for the hydrolysis and the second stage is either proprietary modular UASB construction or specially developed hybrid design. Both stages operate in the Mesophillic range.

Area Requirement

Approximately 3 Acres of area is required to set up the plant. The digesters are totally covered and this being an anaerobic plant, there is no foul odor at the plant site.

The Advantages of Biomethanation Process

- Combined treatment of sewage and solid wastes.
- Treated water conforms to river disposal norms laid down by PCB.
- Generation of a Renewable Energy sources in the form of Biogas
- Environmental benefits
- Reduced land requirement
- Reduction in odor, vermin, etc
- Reduced greenhouse gas emissions
- Recycling of organic matter and nutrients
- Reduction in quantity requiring subsequent disposal, reuse potential of the remaining faction
- Reduction of pathogens and weed seed in the waste applied to land

It is expected that about 100 TPD of organic solid waste will be bought at site for treatment. There will be a variation in this quantity during the monsoons.

Process Description of Biomethanation Plant

The proposed scheme includes the following sections:

A. Segregated Organic Waste Handling Section
B. Two Stage Anaerobic Reactors
C. Manure Handling Section
D. Biogas Collection and Scrubbing Section
E. Power Generation Section
F. Final Disposal of Treated Effluents
   Aeration Section
   Disinfection section

Power Generation Section:

It is suggested that for 100 TPD of biodegradable waste, one may install 1 x 0.50 KW Biogas Engine. Gas Engine use specially designed components to make the engine structurally much more robust than other conventional spark ignited engines. The combustion chamber components are designed to withstand high cylinder temperatures & peak pressures. This lowers the stress levels resulting in longer service life, high reliability & lower maintenance cost.

Special features and advantages:

- Lowest running cost
- Complete and particulate fee combustion
- Low emissions
- Longer service life
- Non dilution of lube oil
- Compact size
- Easy paralleling
- No fuel storage and handling
- Extended lube oil and filter change period

The electricity generation potential from the expected production of 6000 cum/day of biogas is based on the methane content of 55-65% Calorific value of methane as 4800 k cal / m3 and the conventional

efficiency of 35%. Taking these values into consideration the electricity generation from biogas is estimated as follows:

Energy Generation details

1. Biogas generation
   i. Gas generated 6000 + 5% m3 / day
   ii. Calorific value 5.75 kWh/m3
2. Power station: Electrical efficiency 35%
3. Energy generation – power plant: Energy generated in the plant 12000 kWh/day + 5%
4. Auxiliary power requirement (@10 % of generation) = 1200 kWh/day
5. Net energy available for factory use 10800 kWh/day + 5%
6. Power plant installed capacity 500 KW

Biomethanation Details - NISARGRUNA BARC Model

The Principle

Biomass in any form is ideal for the Biomethanation concept, which is the central idea of the Nisargruna Biogas plants. BARC Mumbai based on thermophilic microorganisms and microbial processes develop the design of the biogas plant. The plant is completely gravity based.

Brief Process Description

The segregated wet garbage (food waste) is brought to the plant site in bins and containers. It is loaded on a sorting platform and residual plastic, metal; glass and other non-biodegradable items are further segregated. The waste is loaded into a Waste Crusher along with water, which is mounted on the platform. The food waste slurry mixed with hot water is directly charged into the Primary digester.

This digester serves mainly as hydrolysis cum acidification tank for the treatment of suspended solids. For breaking slag compressed air is used for agitation of slurry. Compressed air will also help in increasing aeration since bacteria involved in this tank are aerobic in nature. The tank is designed in such a way that after the system reaches equilibrium in initial 4-5 days, the fresh slurry entering the tank will displace equal amount of digested matter from top into the main digester tank.

Main digester tank serves as a methane fermentation tank and BOD reduction takes place here. The treated overflow from this digester is connected to the manure pits. This manure can be supplied to farmers at the rate of 4-5 Rs. per Kg. Alternatively municipal gardens and local gardens can be assured of regular manure from this biogas plant.

The biogas is collected in a dome (Gas holder) is a drum like structure, fabricated either of mild steel sheets or fibreglass reinforced plastic (FRP). It fits like a cap on the mouth of digester where it is submerged in the water and rests in the ledge, constructed inside the digester for this purpose. The drum collects gas, which is produced from the slurry inside the digester as it gets decomposed and rises upward, being lighter than air. 1" GI piping will be provided up to a distance of 50 m from the Biogas plant. Biogas burners will be provided. The biogas can be used for cooking, heating and can be supplied through pipeline. Biogas is also used for electric power generation purpose. This power can be used in offices, houses or street lighting.

Cost details, saving and payback period from a Nisargruna biogas plant:
The cost details and the savings envisaged from the plant are given in the following table. The life of the plant could be 20-30 years and payback period is 4-5 years.

Capacity (Tons / Day)	Installation Cost (Rs In Lacks)	Monthly Operation and Maintenance Charges (Rs)	Methane Generation M^3	Manure production (tons /day)	Area Required M^2	Power	Manpower	Hot water (Ltr / day of 50-60 C^0)	No. of tube lights for 12 hours	Cooking Fuel (Equivalent to LPG Cyl / day)
1	8-10	8,000/-	100-120	0.1	300	5hp(2hr)	2	200	200	2-3 (5Kw)
2	10-12	12,000/-	200-240	0.2	500	5hp(3hr)	3	400	400	4-5 (10Kw)
4	20-22	22,000/-	400-480	0.3	700	5hp(3hr)	4	400	800	8-10 (20Kw)
5	25-28	30,000/-	500-600	0.5	800	10hp (4hr)	5	600	1000	12-14 (25Kw)
10	65-70	50,000/-	1000-1200	2.5	1200	15hp (4hr)	10	1000	2000	22-25 (50Kw)

For Dung Waste Methane Gas Generation 60-70 Cu M per Tone Dung Waste
** This is an approximate cost for biogas generation plant and may increase by 10%–20%, depending on location, site-specific parameters, cost of materials, labour cost, etc., in different states/cities. Cost of additional infrastructure like office space, toilets, security, Godown, Shades and power generation will be extra, if required. Rs – rupees; m3 – cubic meters; m2 – square meters; h – hour; kL – kilolitre; LPG – liquefied petroleum gas; kW – kilowatt; cyl – cylinder*

5.7 Final Disposal of Rejects and Residues

Sanitary landfill is the only option that can be considered for disposal of rejects and residues and one that complies with the MSW Rules 2000.

Chapter 6 : Ward wise Needs Assessment and Consultations

AIILSG has conducted Ward-wise consultations in Bhubaneswar to assess and understand the sanitation needs of households, their preferences for technology choices, willingness to pay or contribute for various technology options and their role in operation and maintenance of the sanitation facilities. This section presents the broad findings of these consultations, which have been used to develop and refine the technology options which are discussed earlier in the Technical Options Section.

Ward wise needs assessment and consultations were conducted from 1st March to 5th March, 2011. Annexure 2 and 3 present the key points and the summary of the findings.

6.1 Sanitation Needs

The major needs emerging from the assessment and consultations is provision of toilets for poorer families, solid waste dumping in open areas or in open drains, inadequate coverage of drains-improper construction of drains and resultant flooding in several areas of the city.

6.1.1 Household and Community Sanitation

With respect to toilets, there is a perception of a demand for community toilets as individual toilets are not affordable to poorer families. The space is also a constraint for construction of community toilets in many of these areas due to congestion. Many of the families were not aware of the ongoing ILCS programme though it could not be confirmed on site whether they were included in the ILCS programme. There is a common perception among households that the toilets are expensive and require about Rs. 20,000-30,000 to build. Many of the households are not aware of the low cost toilets and there is a need to promote such toilets. In areas of water logging, toilets get flooded and effective stormwater management is the only solution on water logging.

In few areas, water scarcity or non-availability of general water points in nearby locations have forced families to go out for open defecation despite having toilets with them. Households demanded water points to ensure sufficient water supply to them.

Overall, individual toilets are preferred by majority of the households. Pit latrines are preferred by poorer families and toilets with septic tanks are preferred by middle income group families. There exists a majority who are not willing to pay towards either construction or possible connection charges.

6.1.2 Sullage and Sewage Management

Overall, there was a strong feeling among most of the households consulted that the existing drainage system is not sufficient and not correctly designed to drain out wastewater. Dumping of solid waste in drains is also cited as a common problem for poor functioning of the drains. Immediate improvements in existing drains and additional drains were demanded in areas where water logging occurs. Households also raised issues of encroachments and illegal constructions along nallahs in the city thus blocking the natural flow. They suggested that appropriate legal measures are required to monitor and control such encroachments and illegal constructions.

Poorer families clearly indicated their inability to afford sewer connections for underground sewerage system. Middle income groups were ready to pay one time sewer connection amount of Rs. 1000. They also preferred underground sewerage system as they perceived that it would be bring more cleanliness in the area. Two major benefits they see are a) existing pit toilets smells and after connecting them to the underground sewerage will eliminate the smell around the pit toilet and b) cleaning of the filled pits will save cleaning costs which generally they have to pay every 3 years or so.

With respect to technology choice, low cost sewerage system was preferred by poorer as well as middle income group families due to constraints in paying higher connection charges that are required in conventional underground sewer system.

6.1.3 Solid Waste Management

The situation of the solid waste collection and disposal is very poor in the city area. There are strong perceptions among households, and also visible in the city, that the number of collection bins provided and their placement does not match the waste generation. The collection is mostly irregular and door-to-door collection is conspicuous by its absence.. Households' do not have options but to throw the waste in drains or open areas. However, there is a strong need for awareness towards inculcating civic sense, hygiene practices and behaviour change.

6.2 Willingness to Pay

Poorer families expressed their inability to contribute any cash as capital contribution in the new sanitation infrastructures such as community toilets, drains etc. They were willing to contribute free labour for such works. Most families have also expressed inability to pay for sewer connections. Middle income group families are willing to pay higher charges towards sanitation tax.

Chapter 7 : Proposed Sanitation Improvements in Bhubaneswar

The proposed City Sanitation Improvements have been designed to address the issues and deficiencies identified earlier in improving the delivery of safe sanitation services which includes infrastructure (e.g. latrines, sewer, solid waste), associated hygiene behaviours, (e.g. toilet usage, segregation of waste, hand-washing etc), knowledge dissemination (low cost sanitation technologies, maintenance requirements etc) and a requisite enabling environment (e.g. institutional strengthening, public health regulations, fiscal incentive schemes for achieving sanitation outcomes). The improvements are designed based on the feedback obtained from the various stakeholders consulted in Bhubaneswar and their priorities. The improvements are proposed for the requirements of population for the next 5 years. Improvements suitable for the context of Bhubaneswar and cost effective in capital and maintenance costs have been identified and recommended.

7.1 Population Projections

Population Projections for Bhubaneswar have been fresh for the next 10 years (upto the year 2021) have been made using Geometric Progression method. The projections are represented below.

Table 9: Population Projections for Bhubaneswar

City	Bhubaneswar	Households
2001	648032	138236
2011	900000	191985
2012	930052	198396
2013	961107	205020
2014	993199	211866
2015	1026363	218940
2016	1060634	226251
2017	1096049	233806
2018	1132647	241613
2019	1170467	249680
2020	1209550	258017
2021	1249938	266633

The UIDSSMT Report for Water Supply argues that the Arithmetical mean method provides projections on lower side and such projections are suitable for the city where there are very low prospects for growth in near future. Other methods such as Graphical Method, Arithmetical Progression give projections on higher side which are not matching with the growth prospects of the city and hence, their results have not been used. The arguments are acceptable and hence the results obtained by Geometric Progression Method have been considered to estimate future sanitation requirements for Bhubaneswar.

7.2 Future Requirements for Individual and Community Toilets

Baseline survey indicated that 65% households in Bhubaneswar have access to sanitation facilities for defecation. 35% population, mainly residing in slums does not have access to any sanitation facilities. Though, these families might be covered under any programme such as the ILCS Programme, it is observed during the ward level assessments and consultations that there are families who do not have toilets, and may not be covered under any programme as many of them (the owner of the house) do not fall under BPL category (which is targeted by ILCS programme) or they are illegally occupying the land.

Overall, for projections to make the city open defecation-free by year 2021, it is assumed that 60% of households/population with constraints (such as extreme poverty, non-availability of land, unwilling to pay etc) for making a choice for individual toilets, shall have access to Community toilets.

In addition to the uncovered population, there would be new houses (especially *Kaccha*) coming up in the city especially in the newly developing areas; they may also require toilets. So despite the ILCS or similar other programme, there will be demand for more household level sanitation facilities. The projections include such an eventuality.

Table no-10
Projected requirements of individual toilets

Indicator	2011	2012	2013	2014	2015	2016	2017	2018
Population	900000	930052	961107	993199	1026363	1060634	1096049	1132647
Increase in city population	-	30052	31055	32092	33164	34271	35415	36598
Individual Toilets								
Total no. of Households*	191985	198396	205020	211866	218940	226251	233806	241613
Increase in no. of HHs	-	6411	6625	6846	7074	7311	7555	7807
% Population defecating in open for increased no. of HHs	35	35	35	35	35	35	35	0
Estimated no. of HHs defecating in open	67195	2244	2319	2396	2476	2559	2644	0
Estimated no. of HHs to be covered under the individual toilet schemes (40% of total O.D. HHs)**	26878	897	927	958	990	1023	1058	0
Estimated no. of toilet required (Assuming 1 toilet required for 1 household)	-	26878	927	958	990	1023	1058	0
Percentage distribution to cover the backlog of 35% O.D. of individual toilets (26878)	-	10%	10%	10%	10%	10%	10%	10%
Estimated no. of toilets to be built by	-	3585	3615	3646	3678	3711	3745	2688

Indicator	2011	2012	2013	2014	2015	2016	2017	2018
Government every year								
Total no. of kutcha houses in newly developing areas (at 0.5% of total HHs)	960	992	1025	1059	1095	1131	1169	1208
Additional increase in toilets for kutcha houses in newly developing areas	960	32	33	34	35	37	38	39

* Average HH size as per BMC

** Only 40% of O.D. HHs covered under individual toilet schemes as 30% of HHs assumed in extreme poverty, 30% as not having required land; this total of 60% HHs are assumed to be covered under the community toilet scheme.

Table 11: Projected Requirements of Community Toilet Blocks

Indicator	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021
Population	900000	930052	961107	993199	1026363	1060634	1096049	1132647	1170467	1209550	1249938
Additional increase in city population	-	30052	31055	32092	33164	34271	35415	36598	37820	39083	40388
Community Toilets											
% Population defecating in open*	35	35	35	35	35	35	35	-	-	-	-
Estimated no. of Persons defecating in open	315000	10518	10869	11232	11607	11995	12395	0	0	0	0
Number of Persons to be covered under the community toilets (30% of people is in extreme poverty and 30% of people having non availability of land, so they will be covered under the community toilet schemes)	189000	6311	6522	6739	6964	7197	7437	-	-	-	-
Total no. of Community toilet blocks required (It is assumed that the 1 seat for 60 persons and 8 seats in 1 block)**	394	13	14	14	15	15	15	-	-	-	-
Estimated no. of toilet blocks required (It is assumed that in 2011, no work to be done by Government)	-	394	14	14	15	15	15				

Percentage distribution to cover backlog of 35% O.D. (394)	-	10%	10%	10%	10%	10%	10%	10%	10%	10%	10%
Estimated no. of Community toilet blocks required each year	-	53	53	53	54	54	55	39	39	39	39

** Assume Open defecation may be same for next 5 years*

*** As per CPHEEO guidelines*

Table 12: Summary of Projected Individual/ Community Toilets

Indicator	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021
Population	900000	930052	961107	993199	1026363	1060634	1096049	1132647	1170467	1209550	1249938
Total no. of Households*	191985	198396	205020	211866	218940	226251	233806	241613	249680	258017	266633
Total individual toilets required	-	3713	3744	3776	3810	3844	3879	2823	2824	2825	2827
Estimated no. of Community toilet blocks required each year	-	53	53	53	54	54	55	39	39	39	39
Total population to be covered under both the schemes (Individual toilets and Community toilets)	-	42618	42975	43343	43723	44116	44522	32133	32139	32145	32152
Open Defecation (%)	**35**	**30**	**26**	**22**	**18**	**15**	**11**	**8**	**5**	**2**	**0**

It is anticipated that a combination government initiatives and those of individual families construction of individual toilets will progressively cover the city's population in providing access to sanitation facilities making the city open defecation free by 2021. It is also necessary that these facilities are also used by children to ensure that they do not defecate in open. Mothers have to take extra care to ensure that their infant's excreta are also disposed off in toilets.

7.3 Future Projections for Sewage Generation

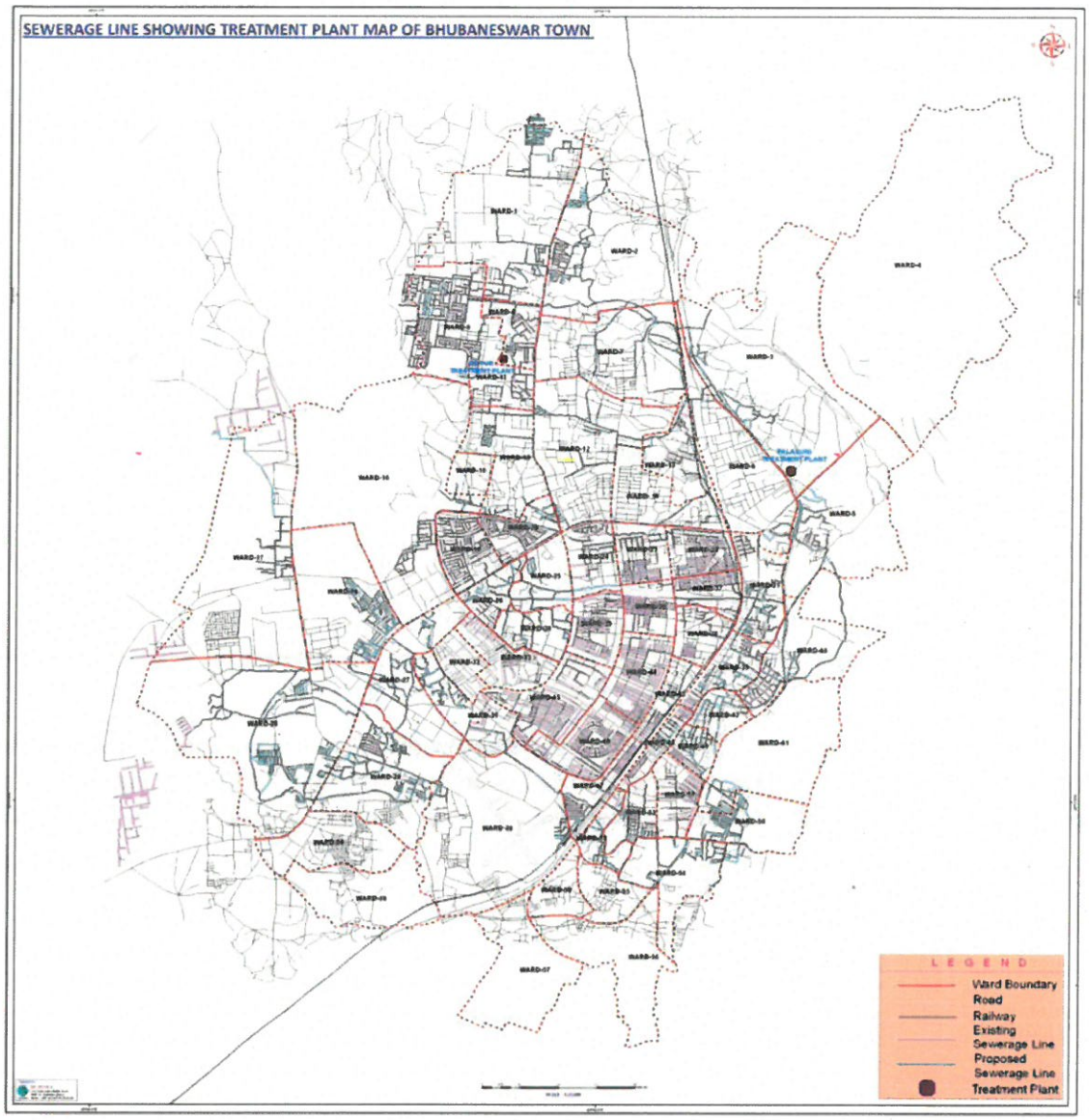
Sewage flow is generally assumed as 80% of the total water supplied. The estimated sewage flows in Bhubaneswar for the projected population shall be as below.

Table 13: Future projection for Generation of Wastewater

Indicator	2011	2012	2013	2014	2015	2016	2017
Population	900000	930052	961107	993199	1026363	1060634	1096049
Water Supply @ 135 lpcd (Mld)	122	126	130	134	139	143	148
Water Losses 15% (Mld)	18	19	19	20	21	21	22
Total Water Supply (Mld)	103	107	110	114	118	122	170
Sewage Flow (80% of 135 lpcd) (Mld)	97	100	104	107	111	115	118

Currently, the sewage is partially treated in septic tanks or pits and effluents largely discharged in drains and open areas. In future, with the increased quantity of sewage, discharging into open areas poses major threat in terms of contamination of water sources, spread of diseases and odour nuisance.

Map 7 Wastewater Treatment Plants in Bhubaneswar



7.4 Septage Generation

7.4.1 Projections for Septage Generation and Management

Table 14: Estimation of Generation of Septage in future

Indicator	2011	2012	2013	2014	2015	2016	2017
Population	900000	930052	961107	993199	1026363	1060634	1096049
No. of Households	191985	198396	205020	211866	218940	226251	233806
% of households connect to sewer system (30% of total population)*	57596	79358	102510	127120	153258	181001	210425
Households with Septic Tanks**	12479	15316	17963	20756	22620	23417	24200
Households with Soak Pits**	74874	91899	107777	124536	135723	140501	145201
No. of Septic Tanks to be cleaned every year (50% of total)	6240	7658	8981	10378	11310	11708	12100
No. of Soak Pits to be cleaned every year (25% of total)	18719	22975	26944	31134	33931	35125	36300
Total Tanks/Pits to be cleaned every year	24958	30633	35926	41512	45241	46834	48400
Septage Generation @ 2cum/septic tank or pit	49916	61266	71851	83024	90482	93667	96801
Daily Generation (for 300 days in a year)	166	204	240	277	302	312	323

**Rate of access to toilet assumed to increase by 10% every year*
***The septic tanks and soak pits assumed be increased by 2% to 5% (CPHEEO guidelines)*

For estimating the quantity of septage generation for management, it is assumed that about 50% of the septic tanks have to be cleaned every year assuming a cleaning cycle of 2 years for each septic tank. Pit latrines will require cleaning once in 4 years. It is also assumed that in near future, the households in the city will connect their toilets to the proposed sewer system and it will happen in phases in line with the progress made on laying of sewers in different areas. Every year, 2-5% increase in septic tanks as well as pit latrines is considered in line with the annual population growth of 2-5%. So, with the introduction of sewer system in future, the septage generation shall come down.

7.5 Future Solid Waste Management

With the current generation rate of 0.5 kg/person, the quantum of solid waste will grow up to 713 TPD (Tons per Day) during the SWM Plan period of 2025 as estimated below; the biodegradable component will increase to 428 TPD.

Table 15: Estimation of future generation of Solid Waste

Indicator	2011	2012	2013	2014	2015	2016	2017	2021	2025
Population	900000	930052	961107	993199	1026363	1060634	1096049	1249938	1425434
Solid Waste Generation (Mt)*	450	465	481	497	513	530	548	625	713
Biodegradable (Organic) Waste (60%)	270	279	288	298	308	318	329	375	428

** Per capita generation appx.@ 0.5 kg/day as per BMC*

7.5.1 Collection and Transportation

The existing collection and transportation facilities and infrastructure available with the Municipal Corporation have to be substantially improved to increase the effectiveness and efficiency of the collection and transportation of the solid waste generated in the city. Adequate provision of bins along with the use of push carts is the critical in safe collection of the solid waste generated. Along with the collection of the solid waste, cleaning of the drains shall also have to be undertaken by the Municipal Corporation to avoid blockages in drains.

Table 16: Future requirements for collection and Transportation

Indicator	2011	2012	2013	2014	2015	2016	2017
Population	900000	930052	961107	993199	1026363	1060634	1096049
Households	191985	198396	205020	211866	218940	226251	233806
Solid Waste Generation (MT)*	450	465	481	497	513	530	548
Required Sweepers 1 Sweeper for 650-750 m of road length (assuming that road length will be remain same as 1827km)	-	2610	2610	2610	2610	2610	2610
No. of Litter Bins required (1 Bin for 500m distance)	-	3654	3654	3654	3654	3654	3654
No. of Push Carts required –Max of no of Sweeper or 1 for 175 HHs	-	1134	1172	1211	1251	1293	1336
No. of Containers required -1 Container of 4 cum for 2000 persons	-	465	481	497	513	530	548
No. of Mini Waste collector (1 Mini Waste Collector for 7 MT of MSW)	-	66	69	71	73	76	78

7.5.2 Processing and Disposal - Biomethanation

As the organic content of the solid waste in Bhubaneswar is around 50-60% of a large mass of waste generated, biomethanation process or waste-to-energy process is recommended. The segregated, bio-degradable material would be appx. 250-350 TPD. The electricity generation potential from the expected production of 6000 cum/day of biogas is based on the methane content of 55-65% Calorific value of methane as 4800 k cal / m3 and the conventional efficiency of 35%. Taking these values into consideration the electricity generation from biogas is estimated as follows:

1.Biogas generation
   i. Gas generated 6000 + 5% m3 / day
   ii. Calorific value 5.75 kWh/m3
2. Power station: Electrical efficiency 35%
3. Energy generation – power plant: Energy generated in the plant 12000 kWh/day + 5%
4. Auxiliary power requirement (@10 % of generation) = 1200 kWh/day
5. Net energy available for factory use 10800 kWh/day + 5%
6. Power plant installed capacity 500 KW

Approximately 3 Acres of area is required to set up the plant with a capacity of 100 TPD. The digesters are totally covered and this being an anaerobic plant, there is no foul odor at the plant site.

Project Cost Estimates (Rs. in lakhs)

- Civil Costs 205.00
- Plant & Machinery 250.00
- Other Expenses 105.00 **Total: Rs. 560.00 lakhs** (given for 100 TPD capacity plant)

7.5.3 Design of Landfill

Note: A regional landfill site is at concept stage for Bhubaneswar and Cuttack at Bhausuni.

Non-biodegradable and non-recyclable material shall be land filled (@30% of total waste, after an allowance for 10% recyclable solids such as metal, pet bottles, waste paper etc). A scientific, engineered land fill is recommended in compliance with the MSW Rules 2000. The land required for the estimated quantity of waste to be disposed for the next 15 years is about 9.87 Ha.

Table 17: Design of Landfill site

Design Period	15 years
Fraction of total waste to be land filled	30%
Total Waste to be land filled in design life	1560375 Mt
Assumed Waste density in landfill	1 cum/t
Total Waste Volume	1560375 cum
Volume of daily cover (10% of the above)	156037.5 cum

Volume of liner and cover system	187245 cum
Volume available due to settlement	156037.5 cum
Total Volume	343282.5
Assume height of landfill	5 m
Area of landfill required	68657 sqm
Additional required (trapezoidal shape)-25%	17164.13 sqm
Area of landfill required	8.58 Ha
Add 15% for buffer	1.09 Ha
Total Area required for landfill	9.87 Ha

Source: as per CPHEEO Guidelines

7.6 Drainage

It is proposed to carry sullage and sewage together in a shallow sewer system proposed here. However, till such sewer system is in place, rehabilitation of existing drains and low cost treatment options at various suitable sites around the town are proposed for the collection and treatment of sullage. Improving drains is also crucial to address water logging problems in the town. The lengths of the drains to be rehabilitated are estimated as below. It is assumed that about 10% of the existing road lengths require rehabilitation. The existing road length in Bhubaneswar is 1827 km. In order to provide 100 % coverage of drainage network, appx 1200 km of additional drains are required over next 5 years.

Table 18: Future Requirements of Drainage Network

Indicator	2011	2012	2013	2014	2015	2016	2017
Existing Road Length (km)	1827						
Rehabilitation of Drains reqd. (10%) km	182.7						
Proposed Drainage works							
Rehabilitation of existing drains km	-	18.27	54.81	91.35	127.89	164.43	182.7
Construction of new drainage network (Km)	-	120	361	602	842	1083	1203.31

As the drain cleaning is to be combined with the sweeping and collection operations of the solid waste, appropriate equipment for cleaning the drains need to be made available to the staff involved in drain cleaning.

7.7 Summary of the Proposed Sanitation Improvements

Table 19: Proposed Sanitation Improvements up to 2021

Indicators	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021
Proposed Works											
Household Sanitation											
Individual Toilets Required	-	3713	3744	3776	3810	3844	3879	2823	2824	2825	2827
Community Toilet blocks (22 community toilets with 176 seats and 60 public toilets already available)	-	53	53	53	54	54	55	39	39	39	39
Drainage											
Rehabilitation of existing drains Kms	-	18.27	54.81	91.35	127.89	164.43	182.7				
Construction of new drainage network (Km)	-	120.33	360.99	601.66	842.32	1082.98	1203.31				
Sewerage											
DPR prepared by OWSSB with a 40 year perspective											
Solid Waste Management											
Litter Bins Nos	-	3654	-	-	-	-	-				
Containers	-	465	481	497	513	530	548				
Mini Waste Collector (7 Mt Capacity)	-	66	69	71	73	76	78				
Bio Methanation Plant (100 tpd capacity)					**1**						
Water Tanker (3000 lit)					**2**						
Weigh Bridge (10Mt)					**1**						
Engineering Landfill (1560375 Mt capacity)							**1**				

7.8 Capital Cost Estimates

Following are the indicative costs for the proposed improvements in sanitation in Bhubaneswar (up to 2021). The estimates have been prepared using the indicative costs observed in other cities in India and in few cases, market rates have been used. The detailed designing and rate analysis, DPR in other words, would be required to arrive at fairly accurate costs of the improvements proposed in eqach sector.

Table 20: Summary of Capital Cost Estimates at 2021

	Quantity	Cost Assumption	Amount (Rs)
Proposed Works			
Household Sanitation			
Individual Toilets required	34066	Rs. 10500/Toilet	357693000=00
Community Toilet Blocks (Total 8 seats in 1 block)	480 Blocks	Rs.56000/block*	28800000=00
Drainage			
Rehabilitation of existing drains (Km)	182.7	Rs.300/RM*	54810000=00
Construction of new drainage network (Km)	1203.31	Rs 800 /RM*	962648000=00
Sewerage			
Project of OWSSB is in Progress			
Solid Waste Management			
Litter Bins No.	3654	Rs.3000/Bin	10962000=00
Containers No.	548	Rs.15000/Bin	8220000=00
Mini Waste Collector (7 Mt Capacity)	78	Rs.4,50,000/-	35100000=00
Bio Methanation Plant (100 tpd capacity)	1		56000000=00
Tipper Tractor	10	Rs.600,000/-	6000000=00
Water Tanker (3000 lit)	2	Rs.400,000/-	800000=00
Weigh Bridge (10Mt)	1	Rs.600,000/-	600000=00
Engineered Landfill site	1		
Civil works		Rs.140/Mt[$]	218452500=00
TOTAL			**1740085500=00**

**Cost of individual toilets based on Nirmal Gujarat Shauchalaya Programme by Government of Gujarat*

***Rates of community toilets are given by Goverrtment civil work contractor*

Chapter 8 : Suggested Strategies and Phasing plan

Based on the assessment of various technical options in relation to city context, as well as the intensity of issues related to wastewater management, various strategies were chalked out which would consider the existing shortfalls in the service level as well as the future requirement pertaining to growth of the city population and urban areas. Thus the phasing plan was suggested for the city of Bhubaneswar.

8.1 Immediate Action Plan

The plan refers to achieve the immediate needs in the sanitation sector for household sanitation, wastewater management and solid waste management. The plan aims at immediate5 years and can be taken up through pilot demonstrations for selected areas.

8.2 Short Term Action Plan

These strategies will be mainly addressing existing demand gap in the household sanitation facilities (and in turn issue of open defecation) for next two to three years and will provide recommendations.

8.3 Mid Term Action Plan

Midterm strategies are aiming at enhancement of efficiency level of infrastructure design as well as monitoring mechanism. It will address the issues like achieving maximum sanitation coverage, up-gradation of existing designs for wastewater treatment and disposal mechanism.

8.4 Long Term Action Plan

Long term strategies mainly look for achieving demand based strategy for developing sanitation infrastructure in future years. Increased participation and involvement of private sector can be looked upon by developing incentive based models for the community driven facilities.

Figure 4 Phasing Plan

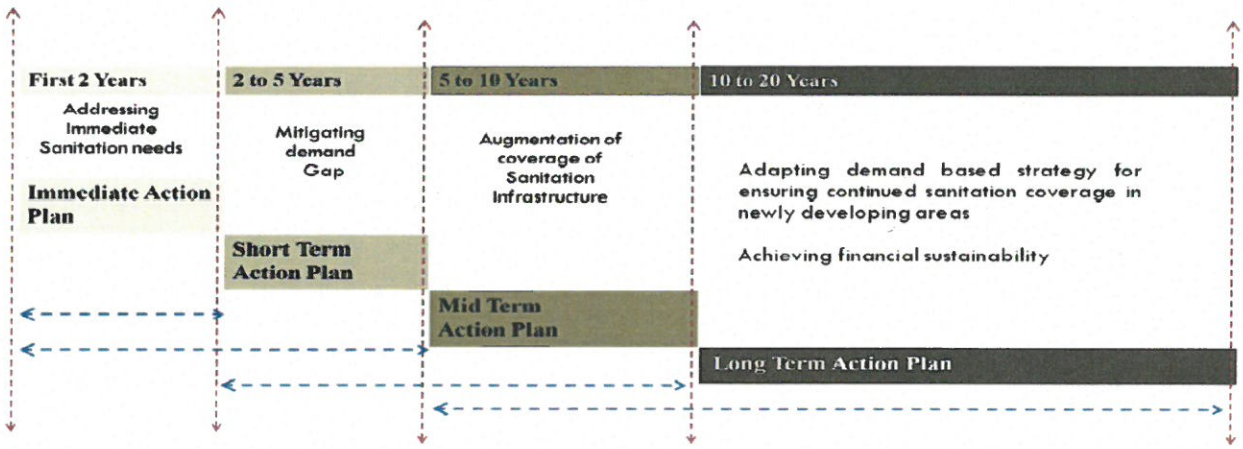


Table 21: Phasing Plan

Sector	Immediate Action Plan	Short term Action Plan	Mid Term Action Plan	Long term Action Plan
Household sanitation	• Provision of Household toilets • Ensuring effective implementation of ongoing ILCS program	• Connecting toilets with small bore sewerage system • Initiating new proposals under ILCS and implementation		• Ensuring household level sanitation facilities for newly emerging areas
Public Sanitation	• Provision of 2 Public Toilets on Pay and Use basis in Market Areas	• Connecting toilets with small bore sewerage system	Ensuring effective O & M through involving Public Private Partnership	
Wastewater management	• Rehabilitation of existing drains	• Improving coverage of drains in water logged areas • Prohibitive measures to control encroachments and illegal constructions in natural streams/ nallas and on drains • Explore private sector participation in wastewater management • Adapting Recycling and Reuse mechanism for treated wastewater • Increase Revenue generation by levying appropriate sanitation taxes	• Developing city wide network of drains covering 100% of road length • Connecting new developments with the existing network	
Solid waste management	• Provision of Adequate Waste collection bins • Initiating Door to Door collection • Improving Collection efficiency and Transportation	• Initiate Segregation of waste at household level • Explore private sector participation in Solid Waste management • Developing composting plant • Increase Revenue generation by levying appropriate sanitation taxes	• Developing engineering Landfill site and composting plant • Developing adequate infrastructure for • Extend Solid Waste infrastructure in newly developing areas and upgrade existing system of collection- transport and disposal • Achieving zero waste management	

Chapter 9 : Awareness Strategy for Improving Sanitation Behaviour in Bhubaneswar

9.1 Objectives of the Awareness Strategy

The strategy will have objectives of a) establishing linkages of hygiene and sanitation behaviors and health impacts to improve knowledge and among general public for improved healthy living conditions' and b) developing mechanisms for collective action to bring about and sustain behavioral changes aimed at adoption of healthy sanitation practices.

9.2 Need for Specific Strategies

It is clear that the awareness strategy needs to address following specific hygiene behaviours that were observed during the household level survey carried out by AIILSG.

Table 22: Observations and expected Interventions

Observed Behaviours	Expected intervention or Hygiene Behavioural Change
Majority of the families allow their children to use open fields for open defecation	Children should be encouraged to use household level toilets for defecation
Infants excreta is thrown in open fields and drains	Infants excreta is equally harmful as of adults excreta and hence, it should be disposed off safely in toilets or pits where every disposed excreta needs to be covered with soil
Individual Toilets are not affordable	Models of low cost toilets to be promoted through awareness programme to provide wider choices to citizens on low cost toilets
Solid Waste is thrown in open fields or drains	Adequate community bins based on preferred locations to be provided, collection efficiency to be improved and awareness among citizens to be raised through campaigns on using the bins for disposal of their solid waste.
Kitchen liquid waste thrown in open fields	In house plumbing for effective of collection of kitchen waste and its disposal into the outside drains to be promoted. Where drains are not available, soakpits to be promoted. Awareness of citizens also needs to be raised on such connections and soakpits.

9.3 Target Audience

The awareness programme will target the following segments to promote the sanitation plan.

Population segments

- Youth (local and those among floating population) - there is likelihood of gaining good participation
- School children – awareness generation at early stage useful in long term
- Women – they are involved in maintenance activities at residential level and also work in sanitation services
- People engaged in informal sector – these are the ones who have least awareness
- Elected Representatives
- NGOs, Local Community Groups (SHGs, Youth Mandals, Hotel Associations, School Associations)
- Civil Societies

- Spatial segments
- Residential areas – elite areas, slums, EWG housing areas, etc.
- Commercial areas, hotels, etc.
- Public places – markets, bus stands, etc.
- Other – hospitals, schools, government offices, religious places, Municipal Council Office etc.

9.4 The Proposed Awareness Strategy

The suggested Awareness (IEC) strategy has four major elements which are discussed below. The Task Force for City Sanitation Plan shall be involved in designing and delivering the awareness strategy in the city.

Engagement of a Media Agency and NGOs

The BMC will engage an experienced Media Agency to develop print material (pamphlets, brochures, messages, pictures etc) and audio-visual as well other forms of raising awareness such as street plays, folk media etc. NGOs involvement would be useful to develop implementation strategies maximizing participation of citizens in the programme.

Development of IEC Material

The material should be developed based on the targeted behaviours, low cost technology options for toilets, sanitation facilities proposed including tariffs, and the demographic traits of local and floating population. Material developed should be tested among sections of citizens to assess its appropriateness prior to its printing.

Developing Outreach Strategy

Multiple strategies for reaching floating population as well local population have to be developed to ensure continuity and to increase its effective in terms of reach as well costs with participation of other relevant partners and stakeholders.

***Inter-sectoral Collaborations*:** The Corporation needs to explore inter-sectoral collaborations with other departments such as PHEO, OWSSB, Health Department, Education Department and Department for Information and Publicity. Such collaborations could be in a form of sharing of resources (funds, material, staff etc) and integrating some of the awareness strategies in their programmes. For example, education department can take up special programmes for schools using their own resources.

Private Sector Participation: The BMC can also explore participation of private partners in the awareness programme. The involvement of private partners could be beyond awareness programme also in the form of sponsorship, sharing of costs (fully or partially) for various events organized in the city and IEC material development etc, funding infrastructures/maintenance etc.

Launch of the Awareness Campaign: This activity need not to wait for the above two activities to complete. But initial planning would help participation of other departments and potential private sector players in such launch campaign. Awareness Campaign shall be launched through a formal

programme of all stakeholders and representatives. Hoardings of this launch initiative shall be displayed at public places – preferably at bus stands, hospitals, theatres, colleges, near traffic squares, Municipal Council building itself, etc. *This is to be done only to announce about the initiative – this is not meant for mass awareness about the schemes or IEC contents itself.*

Community Mobilisation: This is an important and critical activity which will help reach the grass-root sections of the community and will help motivate and trigger initiative at the individual, group or community level. Such community mobilisation is recommended for slum areas and among population who is resorting to open defecation. Mobilisation could be done through intensive and continuous interactions with the targeted population. Through mobilisation, issues such as high cost of toilets, segregation of waste etc can be effectively handled through comprehensive discussions and demonstrations on low cost toilet models, financing mechanisms available, availability of masons, and technical advice and supervision available from the the Corporation. Community mobilisation activities could be led by concerned Councillors to ensure that there is adequate political support for the awareness campaign.

9.5 Time Frame for Implementation of Awareness Strategy

Awareness Strategy is to be implemented intensively in a campaign mode during the first year involving a range of stakeholders in the city. In order to continue sustained efforts for behavioural change, activities which are effective shall be continued based on the outcomes of the activities of the first year.

9.5.1 Monitoring and Regulation

- Awareness campaigns and other activities help generate awareness but this would not necessarily result into practices and expected behavioral change. The Awareness has to be backed up with
- Resources in case of demand for any particular resources by communities (e.g. collection bins in areas where they do not available now),
- Motivation where change is happening and needs to be further supported with incentives for replicating it across other sections of community,
- Regulation where change is not happening and change can be brought about by legal actions.
- In order to decide on the support required to further the behavioral change, it is necessary that the awareness programme is monitored closely. Based on this monitoring, the strategies could be continued or modified.

Chapter 10 : Implementation and O&M Strategy

The Bhubaneswar Municipal Corporation, along with PHEO and OWSSB, is responsible for implementation and operation and maintenance of all public sanitation, sewerage and solid waste management facilities that exist and proposed in this plan in the city area. There is a need to improve the performance of the services substantially in disposal of liquid waste and solid waste management. There is also a need to strategise maintenance to ensure that the facilities are operated and used on sustainable basis. Further strengthening of the concerned departments in terms of improving work efficiency, additional facilities and equipment are needed to improve services in sanitation.

Capacity building shall be an integral part of the implementation strategy to enhance the knowledge of the staff/personnel involved from the Corporation for ensuring technically sound execution of the works, understanding maintenance requirements and improving their work efficiency.

10.1 Awareness Strategies for Bhubaneswar

As behavioral change is a gradual process and therefore, intensive but sustained efforts are needed not only for raising awareness to address socio-cultural biases against sanitation and the impact of environmental sanitation on public health, but also to inculcate practice among public to ensure sanitary conditions prevail in the city.

It is also important that the awareness strategy promotes the Proposed City Sanitation Plan to seek participation of citizens of the city. The communication with citizens / community and within ULB should be transparent which would help to develop initiative at various levels.

10.2 Household and Public Sanitation

Implementation of household level toilets shall be the responsibility of the BMC. The construction of these toilets shall be contracted out to local agencies. The BMC's responsibility is to supervise the construction and ensure adequate funds flow for completing the works on schedule. Construction of modified pit latrines in water logging areas is critical area that requires special attention during the construction of t toilets.

Individual toilets will be constructed by households themselves but the BMC needs to ensure that adequate technical and monitoring support – promoting low cost toilet models, licensing trained masons and ensuring technical supervision and advice to households, is mobilised.

Using the successful experience of existing public toilets being run by a private party (Sulabh Shouchalaya), similar mode of operations can be extended to the two public toilets in proposed in this plan. Constructing these toilets on BOOT basis may not be economically affordable to the users due to anticipated higher user fees which may discourage use of such toilets and hence, the BMC can construct these and contract out its operation and maintenance.

Institutional Requirement: Currently, there is no technical staff available with the Corporation to monitor the construction of toilets. It may be useful to engage an experienced technical person to ensure that adequate technical attention is paid to the modified toilets in water logging areas.

Capacity Building requirement: Training of local masons on low cost toilets and modified pit toilets in water logging areas is required. These masons may be from the construction agency or engaged directly by the Corporation.

Maintenance Arrangement: General experience with the public toilets is that user fees, if not designed appropriately, can act as deterrent to use the toilets. Families do not encourage children to use these toilets as user fees to be paid for the entire family become non-affordable. It is therefore advised that the user fees have to be charged for the entire family including children (and not for a single person), and to be charged on monthly basis. The maintenance costs have to be subsidised by the Corporation to bring down the user fees so that it becomes affordable especially for BPL families.

10.3 Drainage and Sullage Disposal Arrangements

These works can be contracted out for construction as routinely done through the Corporation.

Institutional requirement: Technical staff would be needed at the Corporation to supervise the works.

Capacity Building requirement: A training for the plumbing staff of the BMC and the senior Technical staff (may be engaged on hire basis) on aspects of in-door sullage connections to the drains and technology options for the treatment and disposal of sullage is required.

Maintenance Arrangement: Cleaning of the drains should be combined with the sweeping and collection of solid waste management in the local area. A regular work schedule and responsibilities have to be chalked out by the Corporation for effective use of the available manpower (Sweepers).

10.4 Sewerage

Again, these works can be contracted out for construction as routinely done through the BMC.

Institutional requirement: A technical staff would be needed from the Corporation to supervise the works.

Capacity Building requirement: A training for the plumbing staff of the Corporation and the senior Technical staff (may be engaged on hire basis) on aspects of sewer connections, sewer laying and maintenance, treatment and disposal arrangements is required.

Maintenance Arrangement: There are two options available for maintenance of sewerage network that may come up in a couple of years in Bhubaneswar: i) undertake maintenance internally ii) contract out maintenance services. The option one requires strengthening of the BMC substantially in terms of staff and equipment especially for sewerage networks which may prove to be expensive and difficult to manage. The option ii) of contracting out services may be considered (as observed in cities where the maintenance is contracted out) and such contracts can be managed easily using limited staff within the Municipal Corporation.

10.5 Solid Waste Management

Biomethanation as processing option and landfill site are the new major additions recommended in this plan. There are two options to execute and maintain these works i) by engaging a contractor(s)

and maintaining it through the Corporation ii) by engaging a contractor on BOOT basis for implementation and maintenance.

The operation of the biomethanation plant requires technical skills as well as enough resources to maintain for its sustainable operations. It can also generate revenue through the sale of power/compost but it requires additional management and marketing which may not be possible for the Corporation to do within the current institutional set-up.

There are examples available now where these works are executed and maintained through BOOT contracts. Such contract could cover collection, transportation and disposal of MSW. In such case, the current manpower can be handed over to the contractor. A tipping fee would be payable to the interested contractor which can be paid at mutually agreed time schedule.

The following comparison indicates that the integrated BOOT contract (combining collection, transportation and landfill) proves to be cost effective to the Corporation. Such BOOT contracts can be engaged for a long term period of 15 years or so.

Table 23: Indicative O&M Cost estimation for Solid Waste Management

	Cost Assumption	Maintenance Expenditure (Rs Lakhs)						
		2011	2012	2013	2014	2015	2016	2017
Solid Waste Management								
Option I : In House Maintenance								
Collection, Transportation for Landfill	Rs.3200/MT*	-	5431.50	5612.86	5800.28	5993.96	6194.10	6400.93
Option II: Maintenance through BOOT Contracts								
Collection, Transportation for Landfill	Rs.1800/MT+	-	3055.22	3157.24	3262.66	3371.60	3484.18	3600.52

**Based on rates given by BMC*

+ Based on Ahm Mun Corpn rates

Institutional requirement: A Technical staff would be needed from the Corporation to supervise the works. In case of BOOT contracts, external support of a consultant for development of BOOT contracts would be required.

Capacity Building requirement: A training for Corporation Officials, Staff and Elected representatives on importance of segregation of waste at source, composting and landfill processes and hazards, the economics of composting and marketing mechanisms, the maintenance requirements and the BOOT Contracts.

Maintenance Arrangement: There are several options available for maintenance of facilities and equipment created or to be created for solid waste management in the city. These are discussed below.

10.5.1 Collection and Transportation

Option I: With the adequacy of staff and equipment except for more bins, collection and transportation can be effectively done through the existing institutional set-up. However, it needs planning, scheduling the work and effective leadership to guide the entire team of sweepers and other staff. This would be more cost effective as no new investments are required.

Option II: The other option is to contract out collection and transportation as it is being done in several small cities in India. The existing staff can be managed by the contractor and continued in such contracts. The advantage of such contract is that investments on transportation are generally done by the contractor thus reducing managerial hassles of maintaining own vehicles and reducing new investments on vehicles.

10.5.2 Processing and Disposal

Option I: With additional staff and equipment, the composting plant and landfill site can be operated and maintained. However, despite the availability of staff and equipment, the experience of maintaining especially Biomethanation plant in this case, is not encouraged primarily on account of poor technical knowledge to run such plants and absence of consistent attention and continuity in operation. Marketing of compost is another critical element and good amount of revenue can be lost if effective marketing is not in place.

Option II: Under the BOOT contract, the contractor can deploy his/her staff and equipment and operate and maintain the plant. The option has advantages that the contractor shall be accountable to the performance of the plant and shall also ensure that the compost is sold.

Option of Contracting O&M of the entire services

Under this option, an integrated contract can be developed for collection and transportation, setting up & O&M of processing plant and land-fill site. Such contracts are operational in a few medium size towns in India. Such integrated contracts are still not attractive to contractors but can be explored.

Recommended Maintenance Arrangements

The following options are recommended.

- Continue collection and transportation in-house but improve the efficiency of the operations
- Maintain the Landfill site using in-house resources
- Contract out the maintenance (and marketing of products e.g. power, power/compost etc)of processing plant to the contractor using the BOOT method.

10.6 Sanitation Tariffs

10.6.1 Expected Total O&M Expenditure

Following are likely expenditures on the proposed sanitation facilities in the city estimated for the year 2016. The expenditures estimated below do not include depreciation charges for the hardware facilities.

Table 24: Estimation of O & M Expenditure

	Cost Assumption	Expenditure (Rs Lakhs)										
		2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021
Community Toilets (480 Blocks of 8 toilet seats each with 2 urinals)	Rs.8000/Toilet seat annually*	-	29.44	63.34	97.52	132.01	166.80	201.92	227.12	252.32	277.52	302.72
Sewerage System (@ Rs. 400/Capita per year)*		-	-	-	3972.80	4105.45	4242.54	4384.20	4530.59	4681.87	4838.20	4999.75
Solid Waste Management												
Option I : In house Maintenance	Rs.3200/MT*+	-	5021.36	5152.12	5286.29	5423.95	5565.20	5710.12	5858.82	6011.39	6167.93	6328.55
Total		**0.00**	**5050.80**	**5215.46**	**9356.61**	**9661.41**	**9974.54**	**10296.24**	**10616.53**	**10945.58**	**11283.65**	**11631.03**
Per Capita O & M cost		**0.00000**	**0.00543**	**0.00543**	**0.00942**	**0.00941**	**0.00940**	**0.00939**	**0.00937**	**0.00935**	**0.00933**	**0.00931**

** Based on data collected by GUDM, Government of Gujarat*

'+ Based on actual costs incurred in a large city of Odisha + including cleaning and maintenance of drains*
Maintenance Costs for community toilets have been escalated by 10% every year to account for inflation

10.6.2 Current Taxes & Financial Scenario in BMC

Details	2008-09 (Rs)	2009-10 (Rs)	2010-11 (Rs)
Taxes			
Holding Tax	118500146	128800208	200694112
Base Holding Rate (%)	58	59	64
Tax demand	203785738	217301083	313259141
Tax Collection	85285592	128850208	200694112
Financial			
Revenue Income	755528301	383436751	910358902
Revenue Expenditure	534992591	1084257291	729889348
Budget Income	1530518908	1346959472	1304515465
Budget Expenditure	1376312796	1333845776	990777062

10.7 Proposed Measures for Revenue Improvement

The revenue situation with respect to maintenance of Sanitation facilities within the city area needs to be improved to meet the increasing expenditures on sanitation facilities in the city. This could be done using several strategies outlined below.

Chapter 11 : Implementation of CSP through Pilot demonstration and Immediate Action Plan

The sanitation infrastructure management strategies thus formulated for the city of Bhubaneswar in consultation with the BMC officials and City Sanitation Task Force Committee as well as other stakeholders shall have to be followed by following activities as an extension of the city sanitation planning task so as to ensure effective implementation of the strategies.

The short term strategies can be very well considered and taken up for further elaboration through pilot implementation. It is recommended that each of the sectors discussed above should be considered for model implementation and for that any small area or community or ward can be taken up for detail study and model implementation in consultation with stakeholders.

Model implementation or implementation of pilot demonstration of projects can be initiated for the following sectors as a part of short term strategy.

11.1 Capacity building and awareness generation strategies

Developing an educated community well versed with the current issues and problems and able to mitigate the same is a vital need of any society in the present context and awareness generation strategies play an important role in it especially in the society having middle or lower economical class. After studying the current trends and practices related to sanitation in the city, such need was genuinely felt so as to bring reforms in it.

As a first step, it can be carried out by preparing a detailed methodology involving various NGOs working in the sector as well as by developing SHGs and participatory groups at *mohalla* or ward level in order to take the program at grass root level. Various programs can be initiated with their help through schools and colleges, slums and LIG sectors.

11.2 Demonstration of Pilot project for installation of wastewater management plant

In order to achieve the safe disposal and treatment of the wastewater generated in the city, it is essential to develop collection-conveyance-treatment mechanism, which as of today, is partially lacking.

Initially it is recommended that based on the intensity of the issue certain areas should be prioritized and selected for installation of suitable wastewater treatment plant. Decentralised wastewater System (DEWATS) is a possibility that can be considered subject availability of space within the crowded localities. A Detail Project Report (DPR) should be prepared which would subsume the detail survey of the suitable site and context by studying topography, micro level environment, and generation of waste, type of waste, expected design details, capital as well as O&M costs, human resource involved and other relevant details. Oxidation ponds/waste stabilization ponds are very conventional; there are now modern systems such as activated sludge process or anerobic processes that are capital intensive but low on energy consumption.

11.3 Initiating solid waste management for particular area/ mohalla/ ward

The study showed that the city grossly lacks in the infrastructure needed for managing the solid waste generated across the city. There are insufficient bins at ward or mohalla levels or neighbourhood level to collect the waste generated at household level. They are small less than 4 cu mtrs and placement is far apart.

Lack of door to door collection of segregated garbage collection is lacking affecting daily collection-transportation and disposal of waste.

Chapter 12 Way forward

The concept of implementation of CSP is suggested so as to ensure that the strategies and guidelines suggested through the document can be very well experimented on the site and will help involving community, NGOs as well as private players to take up initiative

A consultation workshop with stakeholders including citizens and government officials is recommended so as to develop a uniform understanding amongst them about the implementation of the pilot projects as an extension of CSP project for the city of Bhubaneswar. It will also help for understanding their perception and enlist the various projects based on their priorities and needs.

12.1 Financial Planning

The financial plan will help for estimating and mobilizing the fund requirements while technical consultancy can be specifically worked out with detail scope of work for each of the project component.

Chapter1 /Para 1.4 detailed earlier as Odisha Govt.'s Policies and financial outlay details State, Central Govt. and other external sources. Such current and finances forecast, as also the long term financial plans in CDP Bhubaneswar (2006), will contribute to CSP's proposed short-term and long-term financial projections.

Chapter 13 ANNEXURES

Annexure – 1 Assessment of Sanitation Facilities in Institutions in Bhubaneswar

Government Hospital (IRC village)

IRC Village hospital is a primary government hospital; it deals with all types of check ups. It has two doctors on duty. There are only five wards. There is no toilet facility for Public. Only two toilet having one seat each. In a day nearly 200 patients are treated.

Govt. UP School (Kharbelnagar)

In this school, there are 150 students studying from 1st to 7th. School has a pucca building having seven rooms. There are three flush toilets each having one seat. The toilets are connected to underground sewerage.

Government Girls High school –Unit IX

There are 800 students studying from 6th class to 10th class in govern girls high school. There are 15 room. The school has 12 toilet having two seats. School building is very beautiful and well. The toilets are connected to the underground sewerage system.

Chakeisuni UP School

There are 270 students in Chakeiseni UP School studying from Class-1 to 5th class. The school has one toilet facility with two seats. There are six rooms in the school. Solid waste is dumped nearby school and burnt.

Annexure – 2: Bhubaneswar Ward wise Need Assessment

Wards, Area	Toilets	Drains	Solid Waste
Ward 1-Sikharchandi			
	56% individual toilets required to cover the gap Not willing to pay	Open drains system coverage poor; need for masonary storm water drainage No underground sewage system	SWM Solid Waste Collection by contractors is not effective. No door-todoor collection More bins required as per norms
Preferences and Priorities	Only one Community toilet; more required; BMC to construct; community ready to maintain.	Protective walls on both the sides of drain to be constructed.	Minimum twice in a day solid waste should be Collected and adequate bin be provied
Ward 8 - Nilamadhaba Basti			
	48% households do not have toilets facility.	There is no sewerage facility in the community.	There is no solid waste collection by BMC . Mixed waste dumped on open fields and road side area.
Preferences and Priorities	More than present two community toilets required having local mentainance	Existing open drainage need repairs	Collection irregular leading to poor hygeinic conditions.
Ward 9- Pandapark			
	97% House holds do not have individual toilets. Unaware regarding City sanitation. There is no toilet facility for women. Common disease like malaria, diarrhea and filaria prevalent. No facility of public toilet Open defecation by most households.	Open Drainage blocked by waste dumping; water logging occurs	No bins for throwing solid waste. Solid waste is dumped in open field and on the road

Preferences and Priorities	Community need low cost toilet from BMC Community toilet also needed.	Drainage should be kept cleane and should be fully covered.	More than 15 bins are needed Awareness and capacity building through IEC method is necessary.
Ward 15: Sriram Nagar			
	Only 19% households have access to individual toilets people are unable to construct the toilets. There is needed community toilets	Open drain exists but blocked	Solid waste is not collected by BMC. Open dumping. Need for bins and awareness
Preferences and Priorities	Community toilets as well as individual toilet needed user group in the community ready to pay for maintenance	Repairing of drainage is needed	BMC not collecting SWM
Ward 15: Nilachakra Nagar			
	Individual toilets very few; open defecation rampant 99% are under BPL	No existing of sewerage and drainage system in the community area; Water logging rampant	Due to poor solid waste collection by BMC, residents face major problems in sanitation.
Preferences and priorities	Individual Toilets needed; space available	Drainage needed	Only five bins; 10 more bins are recquired.
Ward 15: Nayagarh Sahi			
	People are very poor and no capacity to access individual toilet.	One dumped drainage system ,which cause floating of water on the road and nearby house .	Solid Waste dumped in open. No bin at all .BMC is not taking any action
Preferences and Priorities	BMC should construct low cost individual oilet and community toilet because space is available in the area.	Drainage system should be cleaned and awareness programme should be conducted in the community	Awareness programme has to be conducted in the community.
Ward 15: Bajpayee Nagar			
	There is no toilet facility for women Common disease like malaria, diarrhea and falaria is seen	No sewerage and drainage system in the community area Water logging rampant	Poor collection of garbage from the area; irregular; frequency of collection should be increased
Preferences and Priorities	Community toilets as well as individual toilet needed user group maintanance agreeable.	Repairing of drainage is needed	BMC should collect the solid waste more frequently; open dumping poses health hazard
Ward 16: Nirakari Nagar			
	82% of households do not have access to toilet. low income groups are unable to construct their individual toilets.	Drainage and sewerage system not there	There is no space for No bins
Preferences and Priorities	At least 1 community toilet is needed, and low cost toilet from BMC should be	There is space drainage and sewerage should be constructed in the community	Frequency of solid waste collection should be two time in a day

	costructedinthe same locality.		
Ward 16:Adibasi Basti			
	Unaware regarding sanitation Common disease like malaria, diarrhea and filaria is seen No public toilets and individual toilets; Open defecation	There is existing open drainage system, no sewerage system	Ver irregular collection of solid waste; only 5 bins
Preferences and priorities	Need for individual as well as public toilets	--	10 more bins are recquired.
Ward 21-Laxmi Sagar			
	98% of household do not have access to toilets.	No drainage system	No bins
Preferences and Priorities	Individual and community toilets	Open drain needed	Only one five bin are there. 10 more bins are required.

Annexure – 3: Preferred Choices of Technologies and Willingness to Pay

On Site Sanitation	**Individual Toilets**	Poor-to-reasonable knowledge of low cost models, willing to construct. Fund mobilization is a problem. Most cannot afford Rs.1000 as cash contribution under ILCS. Some willing to contribute free labor.	37% HH willing to contribute <= Rs. 1000; 50% of those willing to pay Rs. 50/- monthly for O&M; 11% HH agree to contribute free labour and 52%n HH unwilling to pay
	Septic Tanks	Not Affordable	Only Select families may opt
	Community Toilets	Only labour contribution possible.	Preference for community toilets
Off Site Sanitation Options	Low Cost Sewerage	Preferred provided connection charges are low	
	Conventional Sewerage System	Not preferred on account of connection charges.	.Not willing to pay in general
	Sewerage Connection	Cannot afford connection charges	Not willing to pay in general
Solid Waste Management	House to House Collection	No house-to-house collection	Not willing to pay in general

Annexure – 4: Details of major natural drains in bhubaneswar

DETAILS OF MAJOR NATURAL DRAINS IN BHUBANESWAR							
Drain No.	**Drain Name**	**Outfall Point**	**Major Areas Covered**	**Ward No.**	**Avg. Discharge (Cum/ D)**	**Length (km)**	**Catchment Areas (sq km)**
1	Patia	Daya west canal crossing	Chandrashekhar puradamana, garkhana, Patia, Rokata, Mancheshwar	1	17000	4.32	16.93
2	Sainik school	Railway Bridge (Confluence with drain no.3	Gharkhana	2	1550	1.13	1.44
3	OAP area	Railway Bridge (Confluence with drain no.2	Samantavihar, Vani vihar, Arkana	2,3,5,6,7,8	3550	2.42	3.31
4	Vanivihar	Daya west canal CD	Nayapali, Madhusudan nagar, Vanivihar, Pandar, Garkhana, Bhoinagar	4,6,7,17	16400	5.63	13.67
5	Laxmisagar area	Gangua Nallah	Kesrinagar, Charbatia, East Bargada	23,24	4450	3.13	3.66
6	Baragada area	Gangua Nallah	East bargada, Laxmisagar, Ashoksagar	10,25,26	3450	2.61	2.89
7	Kedar Gauri	Gangua Nallah	Gautamnagar, West bargada, Nuagaon	23,26	5450	4.34	9.46
8	Airport area	Confluence with drain no.8	Baraunda, Jokolandi, Jagmara	13,14,15,16,17	14300	4.33	12.99

Drain No.	Drain Name	Outfall Point	Major Areas Covered	Ward No.	Avg. Discharge (Cum/ D)	Length (km)	Catchment Areas (sq km)
9	Ghatikia	Pokhariput Rly. Bridge	Aginia Dumduma, Jagmara, Begunia, Kochilaput, Ransanghpur, Ebaranga, Pokhariput, Ghatika, Sankarpur	15,16,18,19,20	28800	4.24	12.55
10	Nicco Park	Gangua Nallah	Madhusudan + Bhoi+ Satyanagar, Govindarsad, Kardakanta, Jharpada, Niilkanth nagar	9,10,11,12,21,22	12300	5.48	10.28
Total					**107250**	**37.63**	**87.18**

Source: Storm Water Drainage Projects of Bhubaneswar city Prepared by Departent of Water Resources, Odisha 1996 and Environment Management Plan Prepared by CPCB in 2003 - As quoted in Preliminary Project report of W.R.D, GoO for "Preperation of Comprehensive Master Plan and Detailed Project Report for Storm Water Drainage System of Bhubaneswar City under JnNURM scheme of GoI"

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