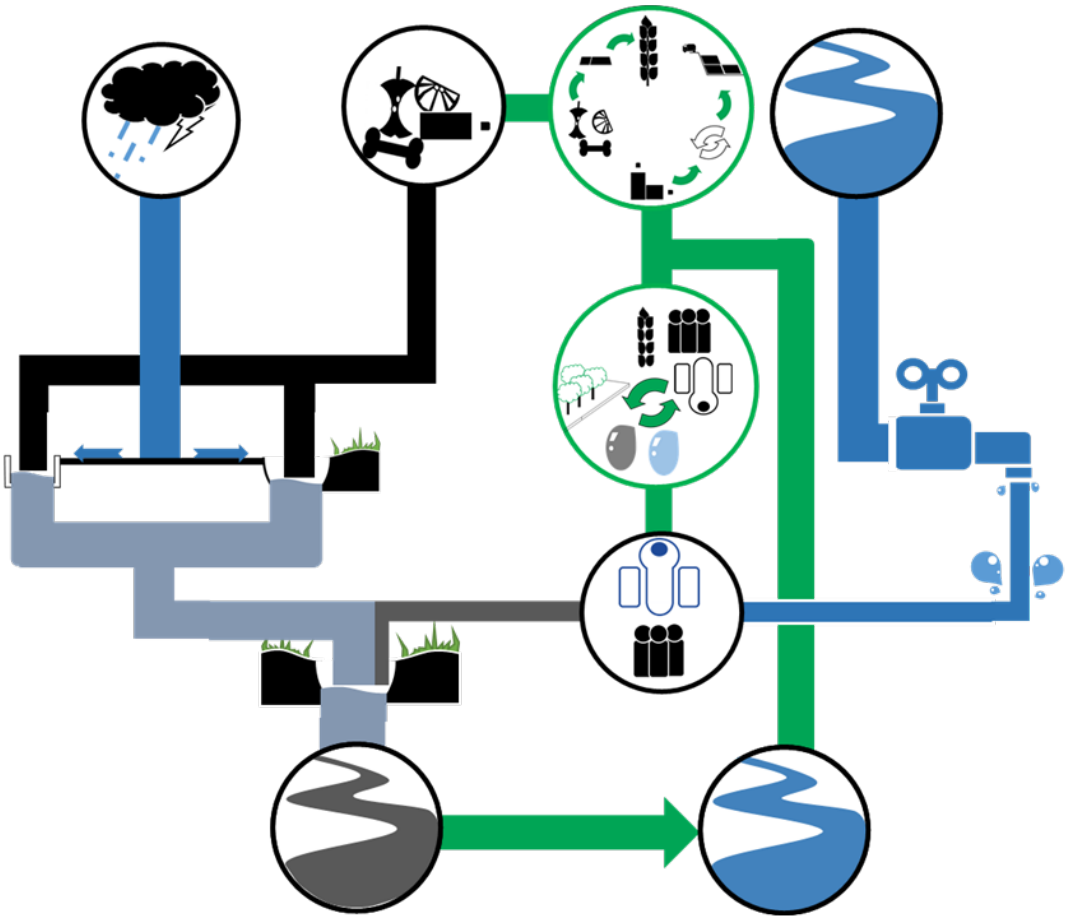
City Sanitation Plan for CUTTACK



Preparation of CSPs for Cities of Odisha

Sanitation Action Plan

2017

Prepared By:

Consortium for DEWATS Dissemination Society

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NATIONAL INSTITUTE OF URBAN AFFAIRS

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LIST OF ACRONYMS

%	Percentage
°C	Degree Celsius
°F	Degree Fahrenheit
AMRUT	Atal Mission for Rejuvenation and Urban Transformation
BIS	Bureau of Indian Standards
CAPEX	Capital Expense
CDD SOCIETY	Consortium for DEWATS Dissemination Society
cm	Centimetre
CMC	Cuttack Municipal Corporation
CPHEEO	Central Public Health and Environmental Engineering Organisation
CSP	City Sanitation Plan
CT	Community Toilets
cu m	Cubic Metre
FSM	Faecal Sludge Management
FSSM	Faecal Sludge and Septage Management
H & UD Department	Housing and Urban Development Department
JICA	Japan International Cooperation Agency
JNNURM	Jawaharlal Nehru National Urban Renewal Mission
IHHL	Individual Household Latrines
km	Kilometre
l	Litre
lpcd	Litre per capita per day
lts	Litres
m^3	Cubic Metre
MC	Municipal Corporation
MLA	Member of Legislative Assembly
MLD	Million litres per day
MoUD	Ministry of Urban Development
MPLAD	Members of Parliament Local Area Development Scheme
NIUA	National Institute of Urban Affairs
nos	Numbers
OISIP	Orissa Integrated Sanitation Improvement Project
OPEX	Operating Expense
OWSSB	Orissa Water Supply & Sewerage Board
PT	Public Toilet
PHEO	Public Health Engineering Organization
Rs	Rupees
SAAP	State Annual Action Plan
SBM	Swachh Bharat Mission
SCBP	Sanitation Capacity Building Platform

SeTP	Septage Treatment Plant
SFC	State Finance Commission
SLIP	Service Level Improvement Plan
sq. km	Square Kilometre
SRT	Sludge Retention Time
STP	Sewage Treatment Plant
SWM	Solid Waste Management
ULB	Urban Local Body

1 CSP Self Review Checklist

1 MOUD CSP SELF REVIEW CHECKLIST

The checklist below shows all the sections that are required to be covered under the City Sanitation Planning process. The checklist, as developed by Ministry of Urban Development (MoUD), helps in the assessment of the scope of the City Sanitation Plan (CSP). The indicators in the Checklist are drawn to measure whether the key dimensions of sanitation are addressed in the contents; and ensure that the process followed in the preparation of the CSP was consultative and has full ownership of the city stakeholders.

TABLE (1): CSP CONTENT SELF-ASSESSMENT

No	Item	Yes/No	Remarks/Status
I. Baseline Data Collection & Situational Analysis in terms of identification of short term or mid – term or long term measures			
1.	Has the city carried out a baseline data collection (secondary and primary) and Situation Analysis of different aspects of sanitation viz:	**Yes**	**Stakeholder consultations and field visits were conducted during the following periods:** • 2nd Feb 2017 (Project Inception Meeting) • 27th February 2017 meeting with Commissioner and all the corporators. • 8th, 9th and 10th of March 2017 (Stakeholder consultation and field visits) • 23rd March 2017 Meeting with SBM State PMU Cell, Bhubaneswar • 24th , 25th, 27th April 2017 (Stakeholder consultation, field visits, surveys, WW flow studies)
i.	Access to household level sanitation arrangements in general residential and slum areas	**Yes**	**SBM Data for number of applications for new toilets and 2011 Census Data** Information sources include • Data from SBM Cell of the city and • Census 2011 data (The city also uses the 2011 data for all its decision making) • Note: The Swachh Sarvekshan Survey was underway during the course of the project. The data once received as an outcome of this project needs to be collated with the supply demand gap calculated within the CSP. This will provide the additional demand for toilets among the population that has grown between 2016 and 2017.
ii.	Community and Public Toilets – location and status	**Yes**	• Information source- SBM Cell. • location available for existing CTs, no location for new CTs (Demand for new CTs have been calculated); location are available for existing

			PTs • Toilet gap has been assessed.
iii.	Safe collection and conveyance of human excreta (on-site and sewerage) – infrastructure and management (including status of de-sludging services)	**Yes**	• Information for toilet containment units is sourced from Census 2011 • Information source for desludging trucks- City Health Officer, CMC and one private desludging service provider. • Information on sewerage sourced from OWSSB (Mr. A. Biswal). • Details and gaps in OSS and desludging services have been covered.
iv.	Treatment and safe disposal of human excreta	**Yes**	• Information source- Mr. A.Biswal, Deputy Project Engineer, OWSSB, Cuttack and OWSSB office at Bhubaneswar • DPR shared for upcoming Faecal Sludge Treatment Plant • DPR of up under JNNURM and JICA-OISIP.
v.	Solid waste collection, transport and safe disposal	**Yes**	All details on Human Resources, waste collection and conveyance assets, treatment site details collected from Solid waste specialist, SBM Cell
vi.	Drainage and flooding	**Yes**	• Information source- D.R Tripathy, Dy. Ex. Engineer, Drainage Division, CMC; Basanta Kumar Parida, Project Director, OISIP, JICA; and Mr. A.Biswal, Deputy Project Engineer, OWSSB, Cuttack. • DPR for existing drainage system • Drainage infrastructure- Sluice gates, interception and diversion points • Water logged and low lying areas • Location of drain outfalls
vii.	Drinking water quantity, quality and coverage	**Yes**	• Information Source- PHED • The focus on Water Supply sector is only to the extent that it has a bearing on the sanitation of the city. Technical inputs in this sector will be limited (and this has traditionally been the case). • These three data sets were collected and presented in the Situation Assessment reports. All these 3 points are covered here.
viii.	Institutional arrangements and finances for capital creation and O&M management of environmental services (water, sanitation, solid waste, drainage)	**Yes**	• Information source- CMC. • Staffing situation is presented in the Situation Assessment report as well as institutional arrangements; • Municipal budget has been assessed.

ix.	Current population and socio-economic categories; and projections by different categories	**Yes**	Population data used in 2011 data; Existing situation of services were studied for all sectors
x.	Arrangements and practices of commercial, public and other institutions in respect of sanitation and solid wastes	**Yes**	Public Toilets data have been collected along with sample surveys at selected units to understand their O&M arrangements. Specific focus on commercial establishments was not placed in the CSP. The focus of the report was holistic and citywide.
xi.	Maps and physical features of settlements (wards, slums, etc.) and key city infrastructure (water, sewerage, drainage, roads, treatment plants, water and sewage pumping stations, etc.)	**Yes**	Map source MIS cell CMC, GIS shape files from CMC; OWSSB and OISIP-JICA for sewerage and drain related projects. These have been used in the relevant sections.
xii.	Data on health-related indicators of sanitation and water supply	**No**	Health related indicators have not been evaluated in the study. However, solutions for solid waste and wastewater management have been sensitive to the public health situation in the city.
xiii.	Other important and locally relevant details (specify)	**Yes**	• Storm water flow and quality was studied. • Reuse potential was assessed and suggestions provided for FSM and SWM.
2.	Has the draft CSP identified specific data gaps and developed a plan for detailed data collection?	**Yes**	Supply demand gap assessment has been incorporated.
II. Institutional Roles and Issues			
3.	Has the city identified an institutional home/s for sanitation planning, implementation, monitoring and regulation?	**Yes**	The ULB anchors the implementation of CSP
4.	Has the draft CSP proposed specific actions to resolve institutional gaps and overlaps for:	**(Score overall "Yes" if at least five indicators below score "Yes", else "No")**	
i.	Planning and financing	**Yes**	• Plan has been provided with action points and their prioritization over a time frame • Costs for the same has also been highlighted in the action plan
ii.	Creation of physical infrastructure	**Yes**	Infrastructure assets to be built have been identified (costs and O&M considerations) for solid waste processing, wastewater conveyance, treatment and FS reuse
iii.	O&M Management	**Yes**	
iv.	Training and Capacity Building	**Yes**	Training and capacity building has been highlighted for toilet creation, FSM and SWM related activities.
v.	Monitoring of Outcomes	**Yes**	Monitoring activities have been suggested for water quality in the drains and solid waste management.

vi.	Communications	**Yes**	IEC activities to be undertaken have been provided for all the sectors.
vii.	Regulation	**Yes**	Regulatory provision for FSM and SWM has been included.
III. City-wide Sanitation Campaign			
5.	Does the draft CSP contain a plan for the launch of a 100% Sanitation Campaign in the city?	**Yes**	The ancillary activities such as IEC campaigns and training programs have also been suggested within the action plan.
IV. Technology Options and City-wide design			
6.	Has draft CSP detailed and evaluated different technology options (on or offsite as well for collection, transport and safe disposal – i.e. full-cycle) for sanitation?	**Yes**	Different technology options have been evaluated for: • Wastewater conveyance and treatment options • FS Reuse options • Solid waste processing facilities
7.	Do the proposed sanitation interventions (rehabilitation, retrofitting or new investments) consider the whole city? (not just a part thereof)	**Yes**	For conversion of insanitary to sanitary toilets
V. Urban Poor and Unreached			
8.	Has the draft CSP identified the locations or settlements of the urban poor and other unreached population segments with have no or limited access to sanitation?	**Yes**	Slum locations have been identified
9.	Does the draft CSP identify actions for assisting unreached/poor households with individual, community or public sanitation facilities (in that order); and efficient disposal from these facilities?	**Yes**	Information on the number of slums and their access to sanitation has been included
10.	Has the draft CSP identified or proposed sources of financing the CSP (schemes, grants, loans, etc.) for extending access to sanitation and related behaviour change communication activities?	**Yes**	• Costs have been identified for all action points (involving asset creation, capacity creation and awareness generation) and funds available from AMRUT and SBM are known. Additional avenues for funding have not been identified.
VI. Financing and O&M Management			
11.	Does the draft CSP consider an appropriate time-frame and spatial and demographic dimensions to remain relevant (at least for the 12th Five Year Plan period, even if investment numbers are indicative or work-in process)?	**Yes**	A short term, medium term and long term timeframe has been considered while providing solutions Spatial dimension has been considered wherever necessary, such as while locating the citywide composting unit. For HH level interventions, the ULB will have to do site level feasibility to exactly determine space availability for implementations. Funds available from the SAAP and municipal budget are known for meeting the costs of the actions (involving asset creation, capacity creation and awareness

			generation) identified in the plan.
12.	Were the different sanitation options (hardware plus software) evaluated on the basis of financial viability? (i.e. Cost Benefit Analysis done)	**Yes**	Cost comparison and pros and cons have been reflected for different technology options meant for toilet installation, solid waste treatment options and wastewater conveyance and treatment options
13.	Whether O&M implications of each of the investment options evaluated i.e. implications on tariff increases and willingness to pay for services; personnel number and capacities etc.?	**Yes**	
14.	Has the draft CSP considered options for partnering with private sector, NGOs etc. for implementation or O&M management of sanitation facilities?	**Yes**	• For toilets and wastewater management operations, the options for partnering with private sector are being indicated in Action Plan. • The O&M of 4 of the 6 FSM trucks is already being outsourced to private agencies. • For SWM, collection is outsourced already to private agencies. • Outsourcing of biomedical waste treatment plant, C&D plant, biogas plants and material recovery facilities has been suggested.
VII. Expedient and Other Actions			
15.	Has the draft CSP identified the steps for implementing improved enforcement of existing laws and provisions? (e.g. prohibiting hazardous discharge of untreated sewage, scrutiny about sanitation arrangements before issue of building permits)	**Yes**	Enforcement frameworks have been suggested for effective SWM and FSM
16.	Have gaps and overlaps in existing regulations identified for resolution? (e.g. provisions in development regulations or building bye-laws to promote sanitation including safe disposal)	**Yes**	Gaps and overlaps are identified for toilets, FSM and SWM.
17.	Does the draft CSP have a plan for improving septage management?	**Yes**	See **FSM section**
18.	Whether the draft CSP includes an Implementation Plan and Timeline?	**Yes**	Action plan
19.	Whether the draft CSP has a disaster preparedness component?	**No**	
20.	Whether the draft CSP identifies Short term/Medium Term/Long Term Measures to achieve identified outcomes?	**Yes**	Action plan
21.	Does this draft CSP leads to improvement of service levels with respect of SLB related to MSW/Storm Water Drainage/Solid Waste Management?	**Yes**	If the ULB works in alignment with the action plan temporally and incrementally it will leads to improvement in service levels across the whole of the sanitation sector.

22.	Outline of expected improvements on rating as per NUSP?	**Yes**	The Action Plan reflects the expected improvements.

TABLE (2): CSP PROCESS SELF-ASSESSMENT			
No.	**Item**	**Yes/No**	**Remarks**
I. Stakeholder Participation			
1.	A multi-stakeholder City Sanitation Task Force has been formed and has met at least sufficient consultations have been held?	**Yes**	• Discussions were conducted with stakeholders which included- corporators, sanitary inspectors • Corporators also filled out a form highlighting the sanitation issues in their respective wards.
2.	All agencies working in the City (ULB, State Government, NGOs, private sector involved in planning, implementation, management or regulation of environmental services (water, sanitation, solid waste, drainage), representatives of different community groups, and key waste-generating segments have been consulted in the process of preparation of the draft CSP?	**Yes**	Unstructured interviews were conducted across stakeholders for assessing all sectors.
3.	Number of Area Sabhas/Mohallas/RWA's etc. consulted?	**No**	Discussions were limited to the executive members of the municipal corporation, OWSSB, other project consultants and PHED
4.	Whether sufficient consultations have been held with urban poor groups in the city? Indicate the number.	**Yes**	Field visits at slum settlements and community toilets
II. Ownership of the Draft CSP			
5.	Has the draft CSP gone through an appropriate process of "appraisal" or "agreement" at the ULB and the City Sanitation Task Force?	**Yes**	Shared with the ULB. No adverse comments received.
6.	Is the draft CSP aligned to other plans of the city (CDP, Master-plan, Development Plan, etc.) and differences if any, highlighted for resolution in the CSP?	**Yes**	
7.	Are there are any current or pending/ proposed projects (under various schemes) that are in conflict with the recommendations and decisions in the CSP? Have these been highlighted for resolution?	**No**	
III. Communications			
8.	Has the CSP process formally recognized the importance of communicating with stakeholders, right from the beginning of the process, and drawn up as a Communications Plan?	**Yes**	• A project inception and stakeholder consultation was conducted across three meetings; Additionally a implementation support meeting is also envisaged

			• Discussions also conducted with E&Y who serve as TSU (Tech Support Unit) and activities and analysis shared with TSU. However, no citizen level communication was done.
9.	Have the basic steps of the communication plan started being implemented?	**Yes**	• A project inception was conducted with the executive staff • Implementation support envisaged beyond the CSP submission
10.	Level of awareness in the city about CSP (Indicate Yes/No)?	**Yes**	
IV. Links with Related Exercises			
11.	If the city is participating in the Service Level Benchmarking (SLB) exercise, have the relevant indicators been measured and uniformity ensured between that and the CSP?	Yes	SLB data has been considered while analysing the sectors

2 Introduction

2 INTRODUCTION

2.1 Background

The National Institute of Urban Affairs (NIUA) with support of Consortium for DEWATS Dissemination (CDD) Society under its Sanitation Capacity Building Platform (SCBP) is assisting the Government of Odisha to revise the City Sanitation Plans for the 4 (four) cities and towns- Bhubaneswar, Cuttack, Puri, and Baripada. City Sanitation Plans were formulated for these respective cities in overall conformity to the framework proposed within the National Urban Sanitation Policy (NUSP). The plan documents will also align the sanitation priorities of the cities with the National Missions such as Swachh Bharat Mission (SBM) & Atal Mission for Rejuvenation and Urban Transformation (AMRUT).

2.2 Approach and Methodology

The preparation of the CSP will be organised to capture information across all segments of the sanitation value chain, for which all sanitation services will be evaluated. As such, the project will undertake following activities:

I. Stakeholder consultations with officials concerning sanitation from the city:
   A. State Government personnel including Joint Secretary, Project Team Leader and other key State Government Officials
   B. Municipality Officials, mainly responsible for solid waste management. The engagement includes discussions with the Chief Health Officer[1], City Engineer, Sanitary Inspector, Chief Finance Officer, Town Planner
   C. Officials from the Swachh Bharat Mission cell within the municipality- who are responsible for IHHL and solid waste management
   D. Officials from the Odisha Water Supply & Sewerage Board (OWSSB), who are mandated with the responsibility for septage and sewerage management in the project cities
   E. Officials from the Public Health Engineering Department (PHED), who are responsible for the supply of water in the project cities.
   F. Accounts department for assessment of municipal budgets for the latest three years
   G. Elected representatives from all project cities

II. Rapid feasibility studies for solid waste management, FSM and wastewater management across all segments of the value chain:
   A. Sector wise detailed engagements (for FSM) will include:
      i. Toilets from households, community, public toilets were surveyed to get an understanding of the user charges, O&M expenditure, service level agreement and issues faced.
      ii. Understanding of the containment systems: Sample households from low-income areas (slums) and public, community and hybrid toilets were surveyed for their desludging practices and user demand

[1] Note: The Chief Health Officer is the main nodal officer at the municipality for managing the mandate of solid waste

iii. Discussions with masons to assess construction practices for toilets and containment systems
iv. Discussions with mechanical sludge emptying operators to assess their activities and frequency
v. Discussion with sewage treatment plant operators to assess treatment processes within plant, O&M practices and costs
vi. Discussions with farmers to assess reuse potential of faecal sludge/septage
vii. Discussion with brick and cement industries for the reuse potential of faecal sludge/ septage

B. Evaluate Infrastructure availability within city (for FSM)
   i. Technology and capacity of existing wastewater/ faecal sludge treatment facility
   ii. Identifying the following for prospective plants:
      - Technology concept
      - Site assessment
      - Site identification
      - Soil Testing

C. The project will adopt a micro pocket planning approach[2] to optimize the systems (human resource, infrastructure assets and processes in place) for the existing solid waste value chain in the respective cities. The sector wise detailed engagements (for SWM) will be to assess activities, frequencies and resources deployed across all segments of the chain. This will include the following study activities:
   i. The project will undertake household surveys only to validate information on solid waste disposal and collection practices retrieved from the municipality
   ii. Discussion with waste collectors to assess waste collection quantities, activities and frequencies of waste collection routines
   iii. Survey of dry resource collection units
   iv. Survey of transfer stations (if any)
   v. Survey of solid waste processing units
   vi. Exploring recycling potential for dry solid waste resources (plastics, glass etc.)
   vii. Discussion with the municipal officials for setting up composting units in large market complexes

D. Evaluate Infrastructure availability within city (for SWM)
   i. Details of existing sanitary land fill
   ii. Technology and Capacity for existing solid waste processing unit
   iii. New technologies that can be incorporated, i.e. identifying prospects for improving treatment processes. Different technology concepts will be explored in this regard.

[2] The Micro Pocket planning approach is a planning methodology pioneered in Andhra Pradesh under the provisions of the A.P. State's Government Order 279

III. Secondary data collection (old CSP document, policy documents, DPRs etc.) and review from the cities on service levels and sectoral situation for the aforementioned sectors
IV. Rapid city level surveys (at sewage outfalls, topographic analysis of city, visits to sanitary landfills and solid waste processing site) specifically to map environmental and public health issues associated with sanitation
V. Flow assessment at main outfalls were also undertaken (in Bhubaneswar, Cuttack and Puri) to understand the quality of wastewater being conveyed out of the town.
VI. Undertaking situation assessments across water supply and Storm water management in the respective cities
VII. Identifying potential technical feasibility interventions for storm water management in the project cities
VIII. Preparing financing and business models for different components of the selected interventions for access to toilets, SWM and FSM. CAPEX and OPEX should both be considered for the business model to ensure sustainability. Recommend any incentives needed for contractors and/ or waste haulers to guarantee safe disposal of sludge and solid waste
IX. Evaluating the Municipal Budgets, State Annual Action Plan (SAAP) and the Service Level Improvement Plans (SLIP) and organizing the investment planning for sanitation in the project cities in alignment with these plans

2.3 Scope of the Report

The report focusses on solutions for each of the sections. Key issues and gaps are highlighted for the complete sanitation value chain, which includes access to toilets, sewerage and FSM, storm water drainage, and solid waste management. The demand supply gap in the infrastructure provided is also assessed through for each of the sectors. Specific on-site details have also been covered in this section. The key issues for each of the sectors in sanitation are given solutions through an action plan in the short term (within 2 years), medium (3-5 years), and long term (5-10 years). The solutions would also follow an incremental approach to improvements in all the sectors of sanitation. This would mean interventions and investments which can be sustained- technically, environmentally and socio- economically over a period of time, with a gradual improvement over the three terms.

The components that have been covered under each of the sectors are as follows:

2.3.1 Access to Toilets

The section focusses on the infrastructure required for providing access to toilets to all households. The following aspects were covered to provide solution to access to toilets.

- The demand supply gap in individual, community and public toilets are assessed for the population of Cuttack.
- The location of the public and community toilets (including Project Samman toilets for Bhubaneswar and Cuttack) are also provided for this section. Details of some of the public and community toilets which were assessed in detail during the site visits have also been incorporated in the report. The details include information about the number of seats, user charges collected, septic tank dimensions, cleaning and desludging frequencies, and issues faced by the toilets. The selection of the toilets has been done

to cover all income segments within the municipality, and also in different areas of the city.

- The current situation and the issues/ gaps are highlighted for each type of toilet. The issues would include gaps in infrastructure, service level issues and future demand projections.
- The demand supply gap is assessed at a quantitative number where the number of toilets required is estimated. Based on the incremental approach of infrastructure provision, households with no toilets were estimated to be provided with community/ public toilets, and households with existing access to public/ community toilets were estimated to be provided with individual toilets. However, the actual number of toilets to be provided is to be finalised based on feasibility studies undertaken in the city/ town.
- An action plan for the provision of toilets is to be provided. Interventions were planned for the short, medium and long terms along the following areas- technical/ infrastructure interventions, operations, IEC and policy measures.

2.3.2 Sewerage and Storm water Drainage

- In sewerage, the current situation in generation of wastewater, conveyance and treatment are assessed. Both the existing infrastructure and upcoming projects are detailed in this section, and the gaps from each of the segments of the value chain are estimated.
- The location of the existing sewerage treatment plants (if any) are provided through a map.
- The key issues in the sewerage system are highlighted and interventions are provided for the short, medium and long terms. Since all the towns/ cities have sewerage or FSM systems or a combination of both, solutions are provided both for FSM and wastewater management in the city/ town. Cross cutting interventions are also planned out for wastewater and FSM- such as IEC campaigns to be undertaken, floating of tenders for detailed projects and the preparation of DPRs.
- For storm water drainage, the major concern areas are mapped out through the waterlogged areas. Other aspects of storm water drainage, such as coverage, major natural drains and rivers, and outfall points are mapped out in the map.
- The length of the drainage network, their slope, and the direction of the course of the storm water drains are provided to give a holistic view of the storm water drainage system in the city/ town. The details of the catchment area are also provided to give an idea of the major outfall points and waterbodies which convey greywater (or wastewater) from the town/ city.
- Water quality is assessed at various outfall points for each of the towns to provide an estimate of the chemical levels and nutrient content in the major drains conveying the wastewater from the city/ town.
- Solutions for the provision of sanitation systems in the city/ town are provided in the next part of the section. The details of implementation of decentralised systems, small bore systems, simplified sewer and conventional sewer line systems are provided through their main features, pros and cons of implementation. The capital cost, the water quality

after treatment and the O&M costing after implementation of the various systems are provided for each of the treatment technologies.

- Key issues in storm water management are then resolved through an action plan for short, medium and long terms, which would include both infrastructure development and also cross-cutting measures, such as IEC campaigns, policy mechanisms and the kind.

2.3.3 Faecal Sludge Management

- Since there has been an increased dependency on FSM in the project cities/ towns. The report provides an assessment of the faecal sludge management situation in the city/ town. The current situation is assessed across the FSM value chain- including containment, collection and conveyance, disposal and treatment, and reuse.
- The possible recommendation for each segment of the value chain is estimated from the assessment of the current situation and gaps.
- The action plan for faecal sludge management would include the highlighting of the key issues in FSM, definition of the major goals to be achieved for each of the issues, and the action plan over short, medium and long terms. Technical, operational, IEC and policy interventions are defined for solving each of the issues.

2.3.4 Solid Waste Management

- The report highlights the current situation based on the various components of the value chain in solid waste management.
- This would include the total amount of waste generated, amount of waste collected from households, road sweeping and drain cleaning. Details regarding the municipal and private operators responsible for the management of the solid waste are also given in the section.
- Conveyance details are provided through the number of vehicles and machines that are utilised for collection and conveying solid waste in the city/ town.
- Ward wise details of operational service providers, manpower engaged, number of dustbins utilised and the vehicle details are also provided in this section.
- Transfer station details, amount of waste treated and ultimately disposed are also provided in the section.
- Based on the above assessment, the gaps/ issues are highlighted for each segment of the value chain in SWM, followed by the possible recommendations. Gaps in policies related to SWM are also covered in this section.
- The major issues are highlighted, and goals are provided for resolution of the issues. Measures are undertaken in short, medium and long terms along the following aspects- technical, operational, IEC and policy mechanisms.
- Technical details of various technologies for the treatment of waste are also provided in the section. The feasibility of implementation of any of the solutions is to be further assessed by the town/ city.

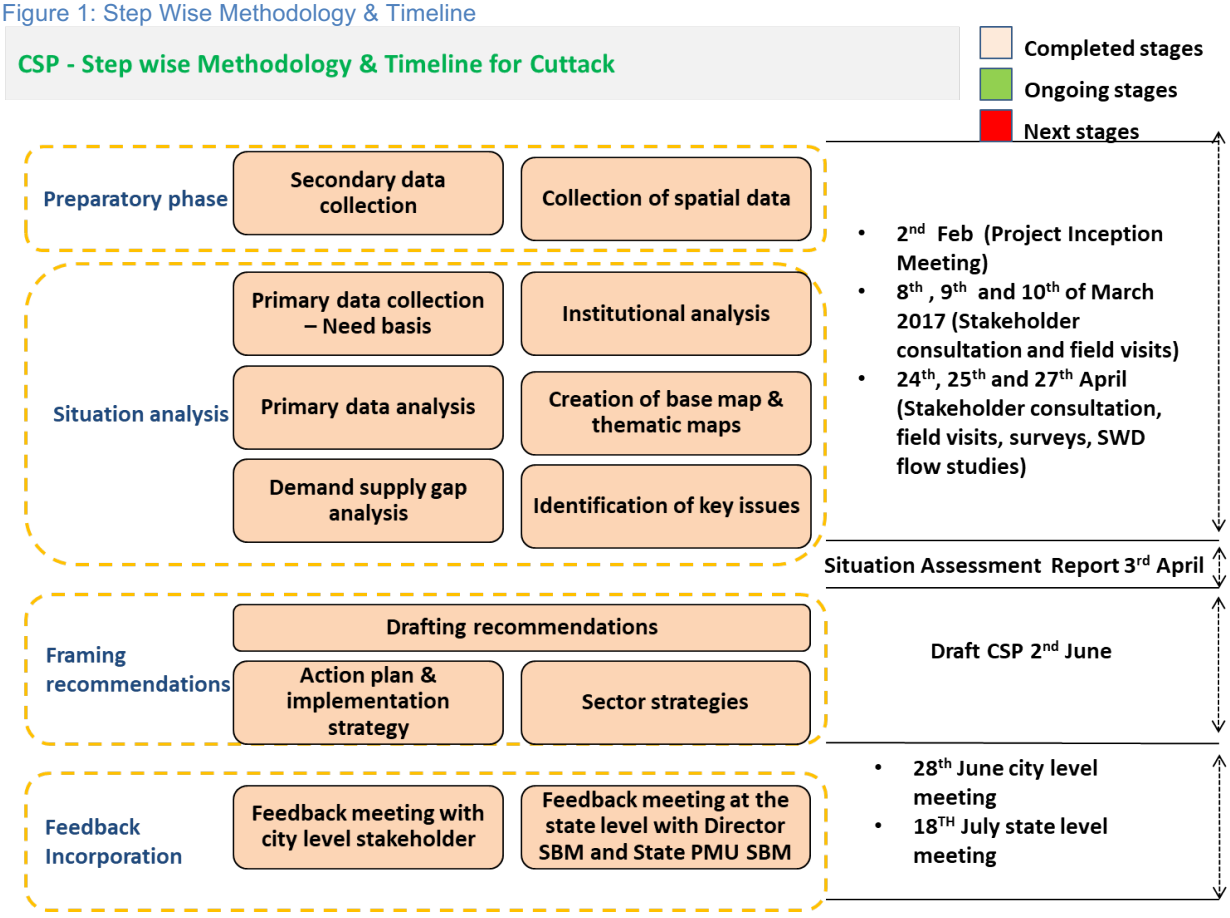
2.3.5 Institutional and Financial Interventions

- The report provides information on the responsibilities for water supply and sanitation sectors in the state of Odisha and the city/ town.

- The organogram of the municipal body is also provided, showing the responsible departments for water supply and sanitation related sectors.
- The section also provides the vacancies in the sanitation related departments, and in the overall municipal structure, allowing an estimate of the departments where capacities are to be immediately strengthened.
- The municipal budget assessment shows the financial capacity in the overall and sanitation related budgets.

2.4 Project Activities and Timeline

Figure 1: Step Wise Methodology & Timeline



The dates for the various project stages will be as follows:

- Project Inception: Feb 1st
- Project data collection: Up to March 20th
- Completion of Situation Assessment: April 3rd
- Defining solutions and technology options: By April 25th
- First Draft of CSP: By May 15th
- Final round of feedback meetings on draft CSP with city and the state-level with Director SBM and State SBM-PMU: completed on 28th June and 18th July respectively

Tasks completed:

- Project Inception Meeting (NIUA)
- 1st city stakeholder meetings:
  - Bhubaneswar (1st Feb), Cuttack (2nd Feb) and Puri (3rd Feb)
  - Balasore (2nd Feb) and Baripada (3rd Feb)
- 2nd city stakeholder meetings:
  - Bhubaneswar (23rd Feb) and Puri (23rd Feb)
  - Cuttack (27th Feb)
- 3rd city (detailed city level consultations): 5th March to 20th March
- 4th city level consultations and completion of fieldwork: 17th April to 30th April
- 5th city level feedback meetings on the 1st draft of CSP: 28th June
- State Level meeting to get feedback on the 1st draft of CSP :18th July

3 City Profile

3 CITY PROFILE

3.1 About the City

Table 1: City Profile- Cuttack Municipal Corporation

District	Cuttack
Demography	
Total Population 2001 (nos.)	5,34,654
Total Population 2011 (nos.)	6,10,189
Population Density (persons per km²)	3161
Number of Households (nos.)	1,16,820 (Census 2011)
Avg. Household Size (nos.)[3]	5
Sex Ratio[4]	930
Slum Information	
Number of Slum settlements (nos.)	258
Slum Population 2011 (nos.)	1,29,471
Slum Population as a percentage of total population (%)	21.21
Location, Climate & Topography	
Area (km²)	193
Agro Climatic Zone	Tropical savanna climate
Soil Characteristics	Alfisols, Ultisols, Entisols
Ground Water Table (below ground level) (m)	10 m below ground level
Avg. max Temperature (°C)	37.5°C
Avg. min Temperature (°C)	15.0°C
Annual mean Rainfall (mm)	150

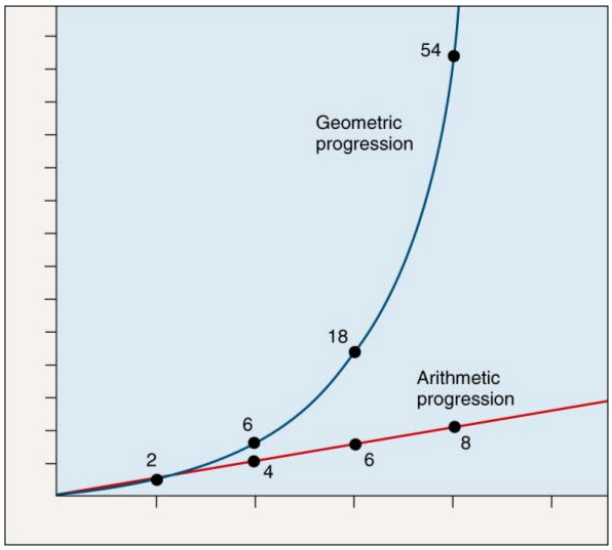
Table 2 Population Projection for Cuttack

Progression Method	Year	Population	Household
Census 2011 Population	2011	6,10,189	1,16,820
	2019	6,38,775	1,27,755
Exponential	2025	6,61,089	1,32,218

[3] Calculated from the Census 2011 population and households
[4] Based on Census 2011 information

Towards making the population projections, the exponential progression of population was taken into consideration. Two reasons for adopting an exponential projection of population over the arithmetic or geometric progression methods are:

Figure 2 Graphical representation of arithmetic and geometric projections

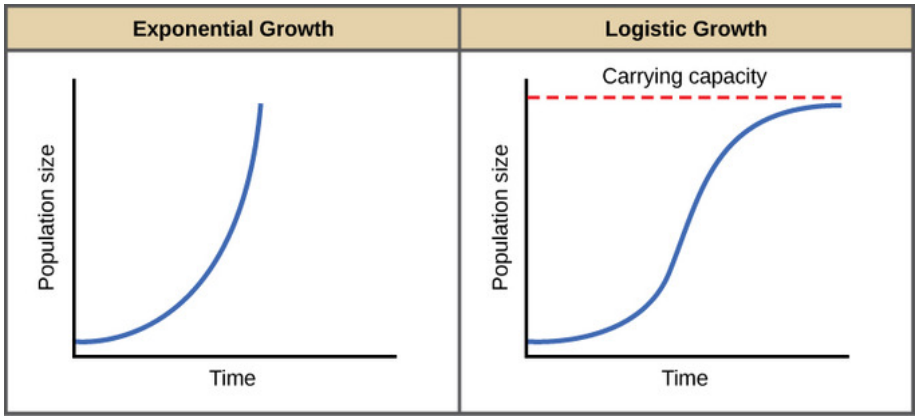


Source McGraw Hill Companies Inc. (McGraw-Hill Online Learning Center Test)

- In a Geometric progression, the sequence of population increase for each term is by a fixed multiplier growth rate.
- In Arithmetic progression, the sequence of population increase is in a linear manner, where the same amount of population gets added to the base population every year.

Both the above cases of population projections would provide an unrealistic portrayal of the future increase in population. However, in an exponential population progression, the city's future population is proportional to the amount already present.

Figure 3Graphical representation of exponential projections

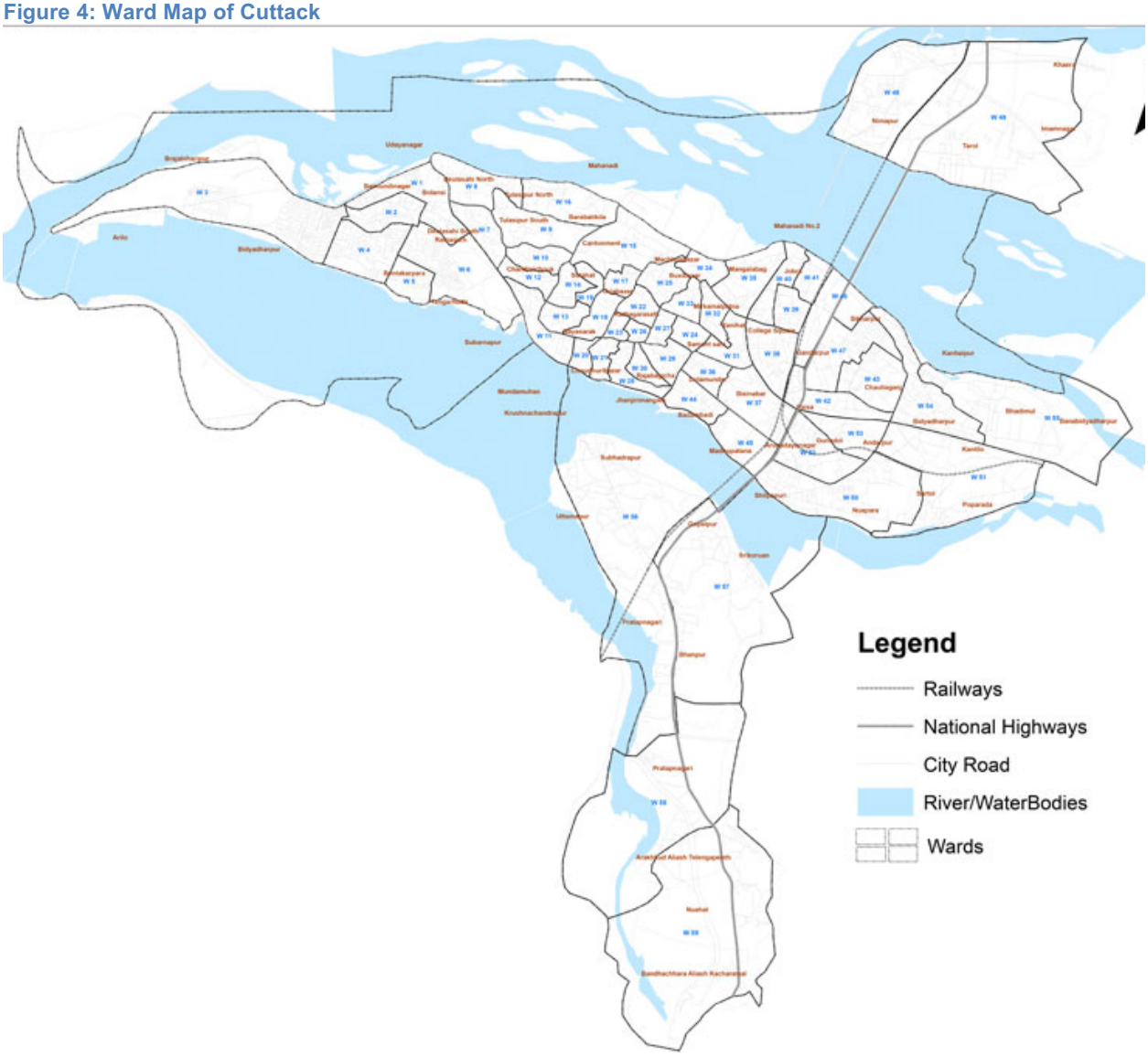


Source (Socratic organisation)

Although growth may initially be exponential, the modelled phenomena will eventually enter a region in which previously ignored negative feedback factors like lack of regional resources become significant (leading to a logistic growth model). Moreover, there are not enough data to adopt the logistic growth model and calculate accordingly. For a logistic model, the carrying capacity of the region needs to be known after which the population growth rate becomes stagnant.

Taking all these aspects into account, the exponential approach is the most realistic approach to be adopted in this project case.

Figure 4: Ward Map of Cuttack



Source: Cuttack Municipal Corporation (2017)

4 Sanitation Interventions


Water Supply
102.90 MLD
Total supply:
55.7% lost
Non-revenue water
59 municipal wards
15 of which is partially covered
Future Demand
In 2019: 100 MLD (Exponential)
In 2025: 102 MLD (Exponential)

4 SANITATION INTERVENTIONS

4.1 Water Supply[5]

- The source of water supply is the Mahanadi River
- Number of pumping wells and open wells: 182
- Total water demand (MLD) @ 155 lpcd (including 15% loss): 94 MLD
- Total supply of water: 102.90 MLD
- Rate of supply (lpcd): 158
- Total number of service connections: 59,182
- Total number of stand posts: 2028
- Wards fully covered under piped water supply: 44
- Wards partially covered under piped water supply: 15
- Non revenue water comprises 55.7% of the total water supplied
- The quality[6] of water supplied is 100%
- The duration of water supply is 8-10 hours on an average.

4.1.1 Future projects:

There are a number of projects, which have been planned for Cuttack under AMRUT funding. The projects are as follows:

1. **Improvement in water metering**
   a. Improvement of water metering planned at a total cost of 3,763 lakh for the year 2015-16, which is still underway because of a delay in the tendering process
2. **Improvement of water supply to uncovered areas**
   a. Improvement of water supply to the uncovered areas including laying of pipelines and procurement of pipes at a cost of Rs. 3,878 lakh in the year 2015-16, which is still underway because of a delay in the tendering process
   b. Improvement of water supply to uncovered areas including slums at the total cost of Rs. 92.16 crore in the year 2017-18.

4.1.2 Projection for Water Supply Demand

Table 3 Projection for Water Supply Demand

Progression Method	Year	Population	Water demand in MLD (approx.)
Census 2011 Population	2011	610189	94
Exponential	2019	638775	100
	2025	661089	102

[5] The information shared on the water supply sector have been sourced from the Service Level Benchmarks and the consultation with officials from the Public Health Engineering Organization

[6] The quality of water supplied is as important a performance indicator as other service delivery indicators. Poor water quality can pose serious public health hazards. Water-borne diseases are quite common in Indian cities, particularly among the urban poor. Although, in most cases, the source of water that causes such diseases/epidemics is not the municipal piped water supply, it is very important to monitor the supply. Therefore, this performance indicator must be regularly monitored, the benchmark value for which is 100 percent

For the purpose of projection, we are using exponential projections. (see Population Projection for Cuttack for details)

Assuming that the per capita water supply remains unchanged, the demand for water supply has been calculated. As per exponential projections, in 2019, the projected population of Cuttack will be 6,38,775 and the consequent water supply demand will be 100 MLD. In 2025, the population is projected to increase to 6,61,089 and the consequent water supply demand will be 102 MLD.

As evident, in both the cases the water demand can be met upto 2025 with the existing water supply. However, in order to reduce the pressure on the existing water resources in future, alternatives such as ways can be explored to meet this additional demand. This can be reuse of treated wastewater to meet a part of demand; especially toilet flushing, gardening, industrial and agricultural demand.

Access to Toilet

18,588 households

yet to be covered under SBM

11.5% of households

Go for open defecation

Lack of awareness

Towards public health, sanitation & hygiene

Future Projections

Gap in 2019: **20238** (Exponential)

Gap in 2025: **21039**(Exponential)

4.2 Access to Toilets

Individual toilets are used by the members of one household. Shared toilets are used by a number of households living in one building or plot. Community toilets are shared by a group of households, primary in low income and/ or informal settlements/ slums, where space and/ or land are constraints in providing a household toilet. Hybrid toilets are community toilets located near slum settlements, which are used by the local public as well.

4.2.1 Public and Community Toilets

Public Toilets

Figure 5: Public Toilet at Badambadi bus stop

Cuttack has 21 public toilets (293 seats) of which 6 (with 62 seats) are completely defunct, 12 are partially functional (with 162 seats functional and 30 seats defunct), and 3 PTs with 39 seats are fully functional. Thus there is a need to renovate or re-construct at least seats 18 public toilet blocks with 92 toilet seats.

1. **Jagatpur Bus Terminus (Ward No. 49)**
   The public toilet is located near the truck terminus. The area is also located near a slum where a hybrid toilet is undergoing construction currently. The toilet has been operation since the last 11 years. There are 4 seats for ladies, and 7 seats for gents. Around 70-80 people use the toilet every day. There are 2 staff members and 1 cleaner, who have salaries of Rs. 4000 and Rs. 3500 respectively. The septic tank of the toilet is 12m*3m, and is cleaned every 2-4 years. The toilet is cleaned twice every day. Waterlogging happens in the area every rainy season.
2. **Badambadi Bus Stop Public Toilet (Ward No. 44)**
   This is one of the oldest public toilets in Cuttack, and has been operational since the last 30 years. Located near the Badambadi bus stop and one of the areas of highest footfall in Cuttack, the toilet is used by 300-400 people. The toilet is operated and maintained by Sulabh Sauchalaya. The user charge is Rs. 5 per head. There are 4 sweepers and 3 staff members. The septic tank has the approximate dimensions of 12 feet*8 feet*1.5 feet, and is cleaned once every 6 months. There is a washing area present in the toilet. There is an issue of waterlogging in the area.

Community Toilets

Cuttack has 32 community toilets (407 seats) of which 8 (with 88 seats) are completely defunct, 16 are partially functional (with 99 seats functional and 134 seats defunct), and 8 CTs with 86 seats are fully functional. Thus there is a need to renovate or re-construct at least seats 24 community toilet blocks with 222 toilet seats.

1. **Shikharpur Kaliaboda (Ward No. 46)**
   The toilet has been outsourced to Sulabh Toilet. The toilet is being used by 100-150 people, out of more than 500 households which are located in the surrounding 4 slums. There are 10 seats each for ladies and gents. There is one staff member and one cleaner whose salary is Rs. 2000 each. The agreement with Sulabh toilet is for 3 years. The septic tank is cleaned once every 5 years. The area is prone to waterlogging.
2. **Odisha Military Police Complex (OMP)- 6th Battalion**
   The community toilet has been operational for the last 12-14 years. There are 6 seats each for men and women. The toilet is used by 100-200 people (around 60 households). The toilet has been made for the protected area, by the government, for the workers who work and live at the battalion. The sweeper from the battalion cleans the toilet twice every month. Cleaning expenses are about Rs. 200-300 per month. The septic tank has never been cleaned or accessed by the users/ inhabitants. There are 2 more community toilets which are constructed nearby in the barracks.

Figure 6: Community toilet in Cuttack- Washing area, toilet seat and septic tank

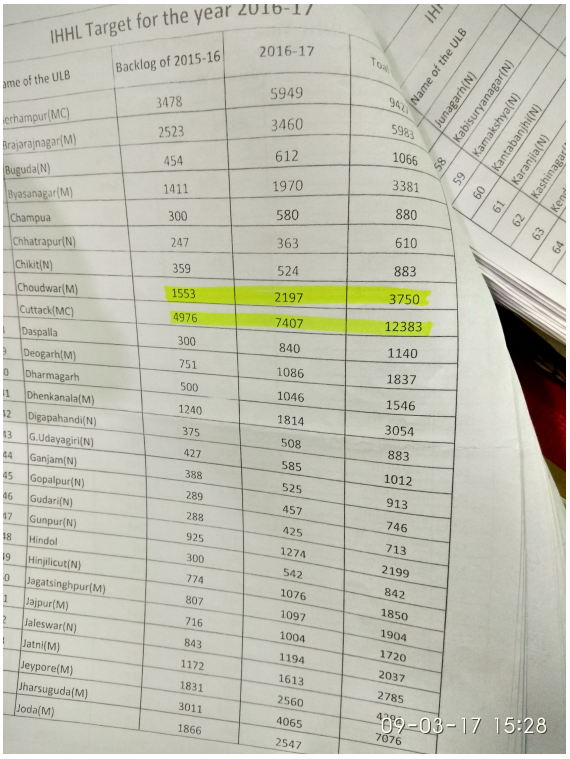
4.2.2 Current Situation and Gaps

As per Census 2011, 15.8% households (18482 households) either have no toilets or have access to public/ community toilets. Of this, 11.5% (13390 households) undergo open defecation and 4.4% (5, 092 households) are dependent on community/ public toilets.

Additionally, 4.5% households (5331households) are having insanitary latrines which include single pit latrines (with and without slabs), service toilets (by humans and animals) and toilets directly connected to drains.

4.2.2.1 IHHL Gap

Figure 7 IHHL Target for the year 2016-2017



For the purpose of IHHL construction the Cuttack Municipal Corporation was given a target of 12,383 toilets to be constructed under the SBM for 2016-2017. For implementation, they rely on application for IHHL and physical verification of the same to construct the toilets with the SBM funds. (Swain, 2017).

In the present report, therefore, in the absence of reliable estimates of the numbers exist for 2016, the figures from Census 2011 have been used for the purpose of defining the gaps in the total number of toilets. The individual toilets sanctioned to be constructed under SBM have been considered while calculating the gap in individual toilets. Once the total number of households with no access to individual toilets and those with insanitary toilets are calculated (23,831 households), the toilets approved for construction under SBM have been deducted (5225 IHHL). Thus, **18,588 sanitary IHHL is the gap is left** after the SBM interventions, as on 8th of August 2017. Ideally, all these households should be provided IHHL. However, given the money and space constraints for many slum households, community toilets will be a better option. (see Projection for IHHL Gap)

4.2.2.2 Community Toilet Seats Gap

In the State level feedback meeting on the first draft on this report, it was suggested that NULM data needs to be referred to for the purpose of slum population based on which the CT requirement can be estimated. In case of CMC, ward-wise slum Population data was sourced from NULM. (SBM Cell, 2017). (Refer Ward-wise slum population and community toilet estimation). Also, the CMC provided the data of existing CTs (both functional and defunct). (Refer Existing CT & PT Status)

For the purpose of CT seats requirement estimation for this report, the total CT seat estimation has been done using the ward level slum population data. The demand has been calculated for the entire slum population (1,29,471) as 1 toilet seats every 35 men and 1 toilet seat for every 25 women. Based on this calculation, the total community toilet seat demand is 4187 (1850 for male and 2337 for female). (Refer Projection for CT seat gap) From this, the existing number of functional CT seats has been subtracted and thus the gap has been assessed.

There are 32 community toilet blocks with 407 seats of which only 173 seats are functional. This means that 234 community toilet seats (123 male and 111 female seats) need to be repaired. (Refer Existing CT & PT Status)

Therefore, the existing gap community toilet seats 4014 if all the slums are provided with community toilets only. If the defunct CT seats are repaired and made functional, then the gap will reduce to 3780 community toilet seats. Also, this gap will reduce to a great extent when the population of slum households having IHHL is subtracted.

If just the repair work is considered, about 57% of the CT seats are defunct and need to be repaired immediately. This will reduce the need to create new CT seats.

4.2.2.3 Public Toilet Seats Gap

The floating population for Cuttack is 30,510, as per 2011 Census. Assuming the male to female ratio in the floating population is 1:1, 86 PT seats for male (1 per 100 persons up to 400 persons; for over 400 persons, adding at the rate of one per 250 persons or part thereof) and 212 PT seats for female (2 for 100 persons up to 200 persons; over 200 persons, add at the rate of one per 100 persons or part thereof) will be required. This equals to a requirement of **219 public toilet seats**. Currently, Cuttack has 293 PT seats of which 201 seats are functional. Therefore, there is a gap of 18 PT seats. However, new infrastructure will not be needed if 92 defunct PT seats are repaired. (Refer Existing CT & PT Status; Projection for PT seat gap)

Table 4 Toilet status- current situation, issues and recommendations

Current Situation	Issues/ Gaps	Possible Recommendations

• 84.2% of the households in Cuttack have access to individual toilets (Census 2011).
• According to Census 2011, 15.8% (18,482 households) either have no toilets or have access to public/ community toilets.
  ○ 11.5% of the current households (13,390) undergo open defecation
  ○ 4.4% of the households (5, 092) are dependent on community/ public toilets, according to Census 2011 population.
• Additionally, 4.5% households (5331 households) are having insanitary latrines which include single pit latrines (with and without slabs), service toilets (by humans and animals) and toilets directly connected to drains.
• 5225 toilets have been approved for construction under SBM of which 1777 have been constructed under the SBM as on July 2017. (IHHL Status Cuttack, 2017)
• There are 32 community toilet blocks with 407 seats of which only 173 seats are functional.
• There is a requirement of 219 public toilet seats.
• There are Cuttack has 293 PT seats of which 201 seats are functional 31 hybrid toilets have been proposed to be built and only 1 of them has been completed. During observations on the field, it was noted that community toilets are often not functional due to issues related to the ownership of toilets and water supply[7].
	• **Gap as per 2011 Census**:
	  ○ 18,588 sanitary toilets need to be constructed for individual households.
	  ○ 234 community toilet seats (123 male and 111 female seats) need to be repaired.
	  ○ There is a gap of 18 PT seats.
	• Beneficiaries receive full amount i.e. Rs. 5300 only after the toilet and containment system is fully constructed by beneficiary. The amount as subsidy is very less when compared to the expenditure that is incurred in construction of toilet and septic tank.
	• Public lacks awareness towards sanitation, public health and hygiene. In most of the cases people, mostly male population prefer to defecate in open even if they have individual toilet at home. This was validated based on discussions with municipal officials and during visits to slum settlements.
		• 18,588 sanitary toilets need to be constructed for individual households.
		• 234 community toilet seats need to be repaired.
		• Repair of 92 defunct PT seats are repaired.
		• IEC campaigns for household communities on the importance of usage of toilets, and health and hygiene
		• Increasing the incentive given to households in order to meet the actual expenditure incurred in building toilets IHHL. In order to achieve this, other sources of funding apart from SBM needs to be approached. (Refer Fund Mobilisation for IHHL)

[7] Data source: CMC and observations on field by CDD Society.

4.2.3 Requirement based on population projection

For the purpose of projection, we are using exponential projections. (see Population Projection for Cuttack for details)

4.2.3.1 Gap projection for IHHL[8]

Table 5 Projection for IHHL Gap

Progression Method	Year	Population	Household	Households with either no toilet and dependent on PT/CT	Insanitary Toilets	SBM Coverage till 2017	Gap for IHHL (if SBM coverage doesn't increase beyond 2017)	SBM Coverage till 2019 (End of SBM)	Gap for IHHL (if SBM coverage increases at 8754 IHHL per year till 2019- end of SBM)
Census 2011 Population	2011	6,10,189	1,16,820	18,482	5331	5225	18,588		
	2019	6,38,775	1,27,755				20,328	8710	16,844
Exponential	2025	6,61,089	1,32,218				21,039		17,433

As per exponential projections, in 2019, the projected population of Cuttack will be 6,38,775 and the number of households will be 1,27,755. In 2025, the population is projected to increase to 6,61,089 and the number of households will be 1,32,218.

For calculating the gap two approaches have been used:

1. If IHHL approvals under SBM continue till 2017
2. If IHHL approvals under SBM continue upto 2019 (the terminating year of SBM) at the same rate.

If the IHHL approval continue only till 2017, the number of households lacking access to **sanitary IHHL** (this includes households with insanitary toilets) **will be 20,328** in 2019. If the gap is not addressed by 2019, it will further increase to **21,039** in 2025.

If the IHHL approval continues at the same rate till 2019, **16,844** households will still lack access to **sanitary IHHL** (this includes households with insanitary toilets) in 2019. The gap will further increase to **17,433** in 2025.

[8] The number might vary depending of the actual changes on the ground such as people taking initiative to construct individual household latrines owing to increased awareness.

Ideally, all these households should be provided individual household toilet. Since this is limited by space and financial constraints, therefore a part of the slum population will be covered under community toilets.

4.2.3.2 Gap projection for Community Toilet Seat[9]

Table 6 Projection for CT seat gap

Progression Method	Year	Population	Slum population	Requirement for CT seats male	Requirement for CT seats female	Total Requirement for CT seats	Existing CT seats	Gap for CT seats
Census 2011 Population	2011	6,10,189	1,29,471	1850	2337	4187	173	4014
	2019	6,38,775	1,35,537	1937	2711	4648		4475
Exponential	2025	6,61,089	1,40,272	2004	2806	4810		4637

Assuming that slum population as a percentage of total population remains constant at 21.21%, the slum population will be 1,35,537 (as per exponential projection) in 2019. This will further increase to 1,40,272 in 2025.

The numbers has been calculated for the total demand of community toilet seats if the entire slum population is to use community toilets. Assuming the male to female ratio in the slum population is 1:1, the number of CT seats is calculated as 1 community toilet seat for 35 male and 1 community toilet seat for 25 female. The total of these seats gives the total requirement of CT seats. From this total, the existing and under construction CT seats are deducted to arrive at the gap. (Guidelines for Swachch Bharat Mission-urban, 2017)

Based on the above calculations the gap in CT seats will be 4475 CT seats in 2019. If the gap is not addressed, it will further 4637 in 2025. If the defunct 234 CT seats are repaired and made functional, then the gap will reduce to 4241 CT seats for 2019 and 4403 CT seats, respectively. Also, this gap will reduce to a great extent when the population of slum households having IHHL is subtracted.

[9] The number will vary depending of the actual changes on the ground such as construction of more community toilet seats and change in slum population.

4.2.3.3 Gap projection for Public Toilet Seat[10]

Table 7 Projection for PT seat gap

Progression Method	Year	Population	Floating population	Requirement for PT seats male	Requirement for PT seats female	Total Requirement for PT seats	Existing PT seats (Functional)	Gap for PT seats
Census 2011 Population	2011	6,10,189	30,510	64	155	219	201	18
	2019	6,38,775	31,939	67	162	229		28
Exponential	2025	6,61,089	33,055	69	168	237		36

Assuming that floating population as a percentage of total population remains constant at 5%; the floating population will be **31,939** (as per exponential projection) in 2019. This will further increase to **33,055** (as per exponential projection) in 2025.

Assuming the male to female ratio in the slum population is 1:1, the number of PT seats is calculated as 1 per 100 persons up to 400 persons; for over 400 persons, adding at the rate of one per 250 persons or part thereof and PT seats for female has been calculated 2 for 100 persons up to 200 persons; over 200 persons, add at the rate of one per 100 persons or part thereof. The total of these seats gives the total requirement of PT seats. From this number, the existing PT seats are deducted to arrive at the gap. (Guidelines for Swachch Bharat Mission-urban, 2017)

Based on the above calculations the gap in PT seats will be **28 PT seats** in 2019. If the gap is left unaddressed, then it would increase to **36 PT seats** in 2025. For PT seats, there exists **201 functional PT seats in Cuttack and an additional 92 PT seats which are defunct**. Together, there are 293 PT seats. Considering that the current requirement is 219 PT seats, **the PT seats will be sufficient to meet the future demand till 2025 (if the population grows exponentially)**.

4.2.4 Site specific conditions to be considered

- Sewered areas: The core area is being covered under sewer network. The toilets in these areas can be connected to the sewer network once the network is in place.
- Unsewered area: Ward no 48, 49, 56, 57, 58 and 59 will remain unsewered for some years. Hence, ccontainment systems need to be built as appropriate for the site-specific conditions such as Groundwater table and soil conditions. If building a containment

[10] The above projections will vary depending of the actual changes on the ground such as the increase in number of high footfall areas in the cities and construction of more public toilet seats.

system is challenging for each toilet, alternate conveyance and treatment systems such as simplified (shallow) sewer lines with decentralised treatment systems and community septic tanks with soak pits can be implemented.

4.2.5 Fund Mobilisation for IHHL

With regard to the public funding for individual toilets, it is largely left to the SBM Funds. That apart, there are various approaches for making available the investment towards construction of new toilets have been explored in this part of the report. The selection of the investment strategy is the discretion of the CMC. To begin with, 3 possibilities of funding toilet construction can be considered:

Table 8 Funding Models for financing Construction of Toilets

Financing Source	Options
Bipartite Model	CMC's contribution
	Government of Odisha's contribution
Tripartite Model	Beneficiary Contribution
	CMC's contribution
	Government of Odisha's contribution
Quadripartite model	Beneficiary Contribution
	CMC's contribution
	Government of Odisha's contribution
	Aid Organisation/ Not-for-Profit that can bring funding and/or for-profit entities involved in Corporate Social Responsibility

Note: Within these models also, BC could range from 12% to 50% depending on the income segments.

The following aid organisations and for-profit organisations involved in Corporate Social Responsibility should be contacted by the CMC for mobilizing funds for increasing the incentives for construction of IHHL.

Table 9 Aid agencies

Name	Scope of work	Relevance
Sulabh International Social Service Organisation	Cost-effective sanitation, liberation of scavengers, social transformation of society, prevention of environmental pollution and development of non-conventional sources of energy.	They undertake CSR activities of various organisations like SAIL, IOCL, etc. for household level, community level toilets.
Gram Vikas	Water and Sanitation; Livelihoods; Social Housing; Community Health; Education; Renewable Energy	Initiated as a support volunteer group during the cyclone in Odisha, and since then, has been one of the NGOs that get things done; lead by Joe Madiath who's known in the sanitation sector
Water Aid	Safe water; Sanitation & Hygiene; Menstrual hygiene; Urban WASH; School WASH; WASH in health; CC & DRR	An international aid agency in WASH sector
Care Today	Construction of Clean toilets	It is a part of India Today group and has been active in construction of household toilets under Clean Toilet Initiative

Table 10 For-profit entities involved in Corporate Social Responsibility

S.N	Name	Scope of Work	Relavance
1	**Mahanadi Coalfields Limited**	Healthcare;, Sanitation	They have done similar kind of projects based on water supply as well as building toilets in the schools.
2	**National Aluminium co. Ltd.**	Drinking water; Sanitation & Health	They have been involved actively involved in SBM in Korapat and Angul districts; in setting up drinking water treatment plant in villages etc.
3	**M/S Indian Farmers Fertilisers Co Op.Ltd**	Building toilets, cleaning of ponds, providing water cooler/ filter	They are very active in constructing the bio-toilets in villages and also care about water purification
4	**Paradeep Phosphates Ltd.**	Health, Drinking water & sanitation	Their objective and work focuses on providing healthcare and sanitation.
5	**M/S. Jindal Stainless Limited**	Health care, Rural Development	They have been focusing on health care and being part of Swatch Bharat Mission

6	**Infosys Limited**	Healthcare, Sanitation, safe drinking water	Their focus areas include promoting healthcare and sanitation as per their CSR policy
7	**M/S Cybertech Software and Multimedia Pvt Ltd**	Sanitation	One of their project include working under Swachh Bharat Mission
8	**M/S Hindustan Aeronautics Limited**	Drinking water, Healthcare, Developing Infrastructure	They have installed BioToilets on ,any public spaces in Koratpur district
9	**M/S Sail Rourkela Steel Plant**	Water Sanitation Project	SAIL has actively involved in Swachh Vidhyalaya
10	**OCL India Ltd Rajgangpur**	Health, Drinking water	Have spent 34 Lakhs in making a village ODF in Sundergadh district
11	**Tata Sponge Iron Ltd**	Health, Drinking Water	Have invested in water and sanitation projects

4.2.6 Action Plan

The key action points to improve access to toilets is in terms of construction of new toilets (both individual latrines and community and public toilets) and upgrading the insanitary toilets to sanitary toilets; creating a policy mechanism for scheduled desludging and IEC campaign for improving toilet usage.

Table 11 Action Plan for access to toilets

Issue 1		**Individual Toilets**
Key Issue		1. To provide toilets to those who either have access to community toilets or have no toilets. 2. Behavioural block of resorting to open defecation even when toilets are there.
Goal		➢ To provide 100% access to sanitary toilets to the city ➢ To improve the understanding of health and hygiene among individuals and communities
Actions	**Short term (within 2 years)**	**Technical** • The focus on improving access to toilets is not only to construct new toilets but also upgrade insanitary toilets to sanitary toilets. • Constructing **20,328 IHHL** (as per exponential projection) by 2019. • The household toilets can be connected to the sewerage network in the sewered areas. Ensuring last mile connectivity to the sewer line is hence of prime importance in these areas. • For unsewered areas, the cost of construction of one individual toilet connected to septic tank and soak pits. In such cases, regular deluding of the septic tanks need to be done tanks at least once every 2 or 3 years and transported off-site for treatment prior to disposal. Municipal utility or private contractors are required for desludging of septic tanks and to ensure safe disposal of septage at a treatment plant. However the responsibility for O&M of the septic tank itself lies

		with the owner of the property. • In unsewered areas, localised wastewater treatment systems can also be put in place. (Refer Approaches for wastewater management in unsewered pockets and newly constructed multi-storeyed building Approaches for wastewater management in unsewered pockets and newly constructed multi-storeyed building) • Detailed design of the individual toilets are given in Toilet Designs • Increasing the incentive given to households in order to meet the actual expenditure incurred in building toilets IHHL. In order to achieve this, other sources of funding apart from SBM needs to be approached. (Refer Fund Mobilisation for IHHL) **IEC** • Households and community members should be made aware for the need for the use of toilets. Awareness programs focussed on the environmental and health issues faced due to open defecation should be highlighted. • Training should be conducted on the O&M mechanisms for individual toilets. **Policy** • Policy measures which would discourage individuals to go for open defecation should be formalised- this would include penalties, incentives for construction of individual toilets, and others.
	Medium term (3-5 years)	Upgradation of households with public/ community toilets to individual toilets. If funds and conditions are viable, households should be encouraged to construct individual toilets.
	Long term (5-10 years)	Constructing **771 IHHL** by 2025.

Issue 2	**Community/ Public Toilets**
Key Issue	1. At least 234 community toilet seats need to be constructed/ renovated in order to replace the defunct or partially functioning ones. 2. 92 public toilet seats needs to be constructed/ renovated in order to replace the defunct or partially functioning ones
Goal	➢ To provide community/ public toilets in areas where there are no individual toilets due to lack of space or funds. ➢ Conversion of unhygienic/ defunct community and public toilets to functional community/ public toilets ➢ To improve the understanding of health and hygiene amongst individuals and communities

Actions

Short term (within 2 years) To Medium term (3- 5 years)

Technical

- Repairing **234 defunct CT seats** by 2019.
- **Repairing the 92 defunct PT seats**.
- If need arises, new CTs seats must be constructed.
- In case of unsewered areas, septic tanks need to be constructed and regular deluding must be done.
- Recommended sizes of septic tanks for CT/ PT (up to 300 users) is given in the table below

No. of Users	Length (m)	Breadth	Liquid depth (Cleaning Interval of)	
			2 years	3 years
50	5.0	2.00	1.0	1.24
100	7.5	2.65	1.0	1.24
150	10.0	3.00	1.0	1.24
200	12.0	3.30	1.0	1.24
300	15.0	4.00	1.0	1.24

Source: Manual on Sewerage and Sewage Treatment Systems, 2013 Part A Engineering

Note 1: *A provision of 300 mm should be made for free board.*

Note 2: *The sizes of septic tanks are based on certain assumptions on peak discharges, as estimated in IS: 2470 (Part 1) and while choosing the size of septic tank exact calculations shall be made.*

Note 3: *For population over 100, the tank may be divided into independent parallel chambers of maintenance and cleaning*

- In case of community toilets, the responsibility of O&M should be clearly defined.

IEC

- Awareness programs focussed on the environmental and health issues faced due to open defecation should be highlighted.

Training

- Training should be conducted on the O&M mechanisms for community toilets.
- Training should be conducted for the O&M of public toilets within the sanitation staff members of the municipality, if the public toilets are maintained by the Municipality itself.

Policy

- Policy measures which would discourage individuals to go for open defecation should be formalised- this would include penalties, and others.
- There should be policy directives for the regular maintenance of community toilets by the users of the community toilets.


Stormwater Management
860 km
of drains: 17.66km natural
701 km pucca; 562.5 km kuccha
40 MLD
of Blackwater (55.6% of total)
Direct Discharge
From toilets
Waterlogging Issues

4.3 Storm water Management

Figure 8 Contour Profile of Cuttack

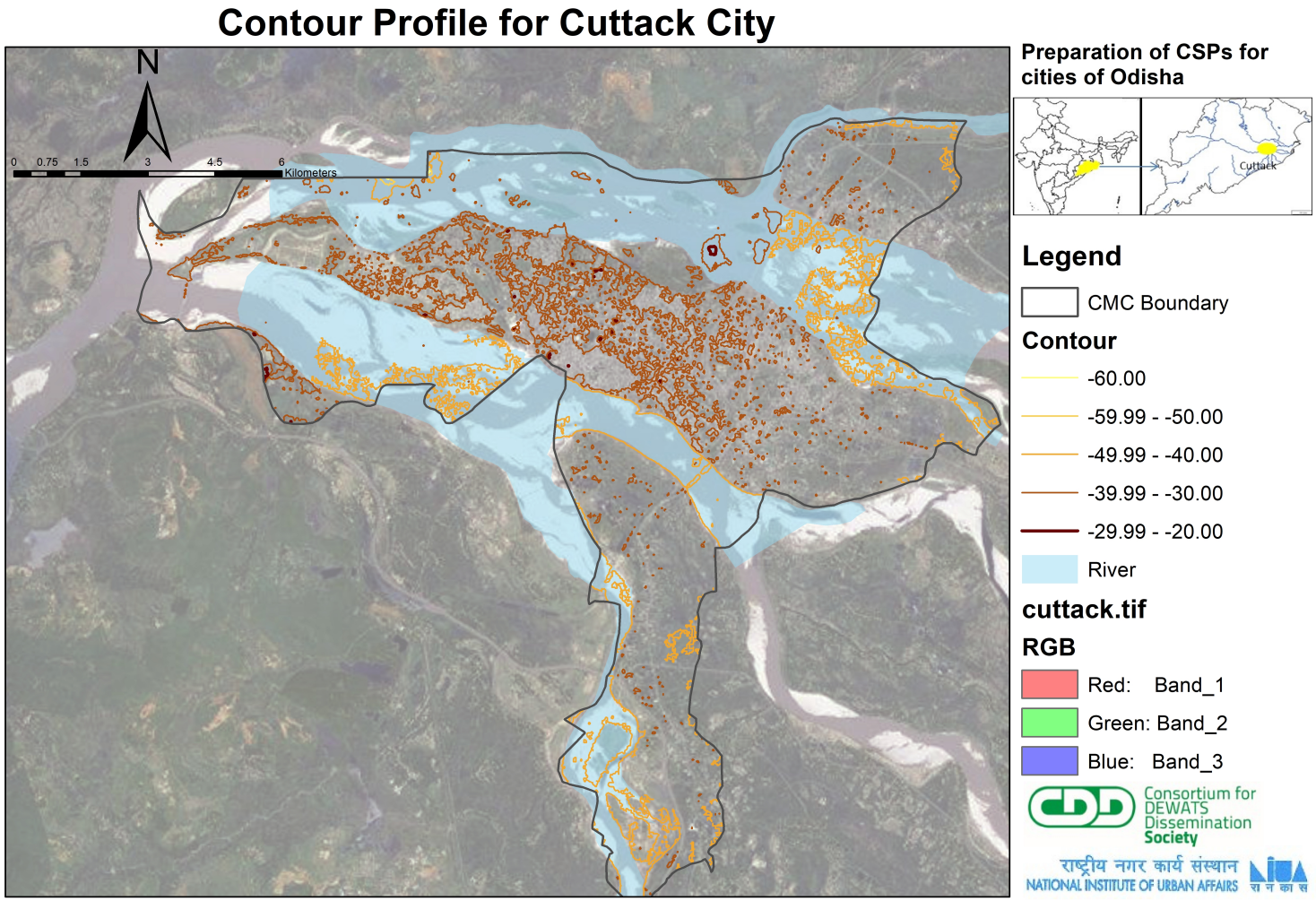
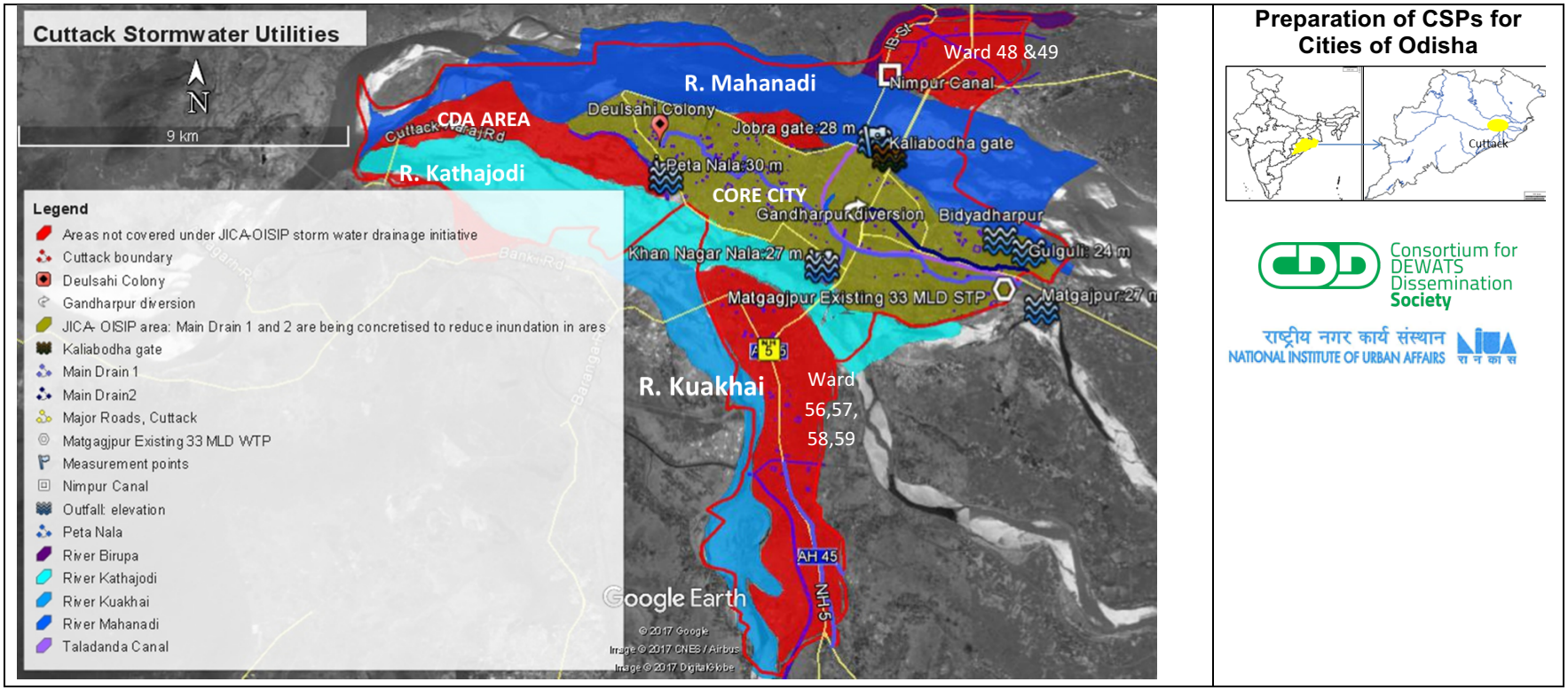


Figure 9Cuttack Drainage Map



4.3.1 Storm Water Drainage network

- For total road length 860 km, Cuttack has 701.01 km of constructed pucca drains, 562.5 km of constructed kuchha drains and 17.66 km of natural drains. (Drainage data, Cuttack Municipal Corporation, 2017). This means 74.4%[11] of the city is covered by storm water drains.
- The core city area is drained by Main Drain 1 and 2, emptying into River Kathajodi (via Matgajpur) and River Mahanadi (via Gulguli). The CDA area is drained via Peta Nala. The drainage in other areas (part of ward No 3, Ward No. 48, 49, 56, 57, 58, and 59) is currently under study in an ongoing project for a new Drainage DPR preparation by WAPCOS.
- **Recommendation-** Constructing new drains as per suggestions in the new Drainage Master Plan

[11] Most of the areas in Cuttack have drains on both the sides. Therefore, the total length of drain is divided by double the size of road to arrive at the figure.

4.3.2 Catchment areas

- The core city are (marked in light green in Cuttack Drainage Map) can be broadly divided into 3 drainage system.
    - Peta Nala (marked in Cuttack Drainage Map) caters to the areas developed by Cuttack Development Authority (marked in florescent green in Cuttack Drainage Map). This includes part of Ward No 3 and Ward No 4.
    - Main Drain 1 starts from Deulsahi Colony (marked in Cuttack Drainage Map as Deulsahi Colony) and ends at Matgajpur into the River Kathajodi.
    - Main Drain 2 starts at Gandharpur (marked as Gandharpur Diversion in Cuttack Drainage Map) and ends at Gulguli Gate into River Mahanadi
- Earlier Main drain 1 and Main drain 2 used to merge at Bidyadharpur and go via Taladanda Canal (marked in Cuttack Drainage Map as Bidyadharpur and Taladanda Canal) to the Matgajpur 33 MLD Plant where the water from the storm water drains would undergo treatment. Treated wastewater was then discharged into the River Kathajodi.
- Now, the STP is closed (by OWSSB) because the inflow of wastewater into the treatment plant reduced due to the JICA funded OISIP project under which sewer lines are being laid in the areas covered by these drains.
- Currently, the water is diverted directly into the rivers.
    - The water from CDA area is getting into the River Kathajodi via the Peta Nala Sluice gate.
    - The water from Main Drain 1 is getting into the River Kathajodi via the Khan Nagar Nala Sluice gate and Matgajpur outfall (marked in Cuttack Drainage Map as Matgapur: 27m).
    - The water from Main Drain 2 is getting into the River Mahanadi Gulguli Sluice gate (marked in Cuttack Drainage Map as Gulguli: 24m).
    - After the completion of the JICA project, the Main Drain 1 and 2 would flow into the rivers directly for they are expected to carry on rain water.
- A DPR for Drainage System under OISIP Project was prepared in 2011 covering on the core city area. However, since the time of the study, the city has expanded and new areas have been included into it. So another detailed is being taken up to include the new areas

4.3.3 Natural Drains of Cuttack

Cuttack has 580.16 km of natural drain and constructed pucca drain. Natural drains of the city and the vegetation and wetland around them are playing a key role in naturally treating the wastewater in the drains. The vegetation in these systems not only takes up the nutrients in the water, but also slows down the velocity of water thereby controlling flooding in the downstream areas. However, these systems are constantly under threat from human activities like construction and littering. Therefore, these natural systems need to be protected.

Solutions

- Demarcating drain using pillars or fencing and protecting them from encroachment by maintaining buffer zones (such as 50m, 25m and 15m from the primary drains, secondary and tertiary drains respectively) as mentioned in the Wetland Rules (Conservation and Management) 2010. (National Green Tribunal)
- Bush cutting along the drains and clearing the vegetation in the drain at the beginning of monsoons in order to increase the water carrying capacity of the drains for the season.
- Letting the vegetation in the drain to grow towards the end of the monsoon so that it can treat the dry season flow.
- Clearing solid waste at regular intervals from the drains.
- Concretisation of drains should be avoided. Although it is known that a significant part of the drains is the city is being concretised to allow the water drain out of the city in order to curtail water logging issues, the city can also explore options such as swales and raingardens. (refer Natural Drains of Cuttack)
- Water sensitive urban **design using swales and raingardens**)

Figure 10 Natural Drains of Cuttack- a. Matgajpur b. Khannagar c. Jobra

a b c

It was informed that the natural drains in many parts of the cities may be concretised owning to lack of space necessitating water to drain out fast. However, it was agreed in the feedback meetings that there should be minimum concretisation in the peripheral areas

and outskirts such as Ward 48, 49, 56, 57, 58 and 59. Along with this, site specific issues such as high density clusters within the wards, road width, settlement pattern need to be taken into consideration before formulating any policy or guidelines to provide for maximum amount of natural drains and constructed kuchcha drains. Factors that need to be taken into consideration to maintain natural drains and create new constructed kuchha drains are:

- In areas with less population density avoiding concretisation.
- Settlement pattern- areas with scattered population are ideal for natural drains
- Road width

The OWSSB is taking measures like recharge pits and sand traps for better maintenance of the natural drains and these needs to be promoted.

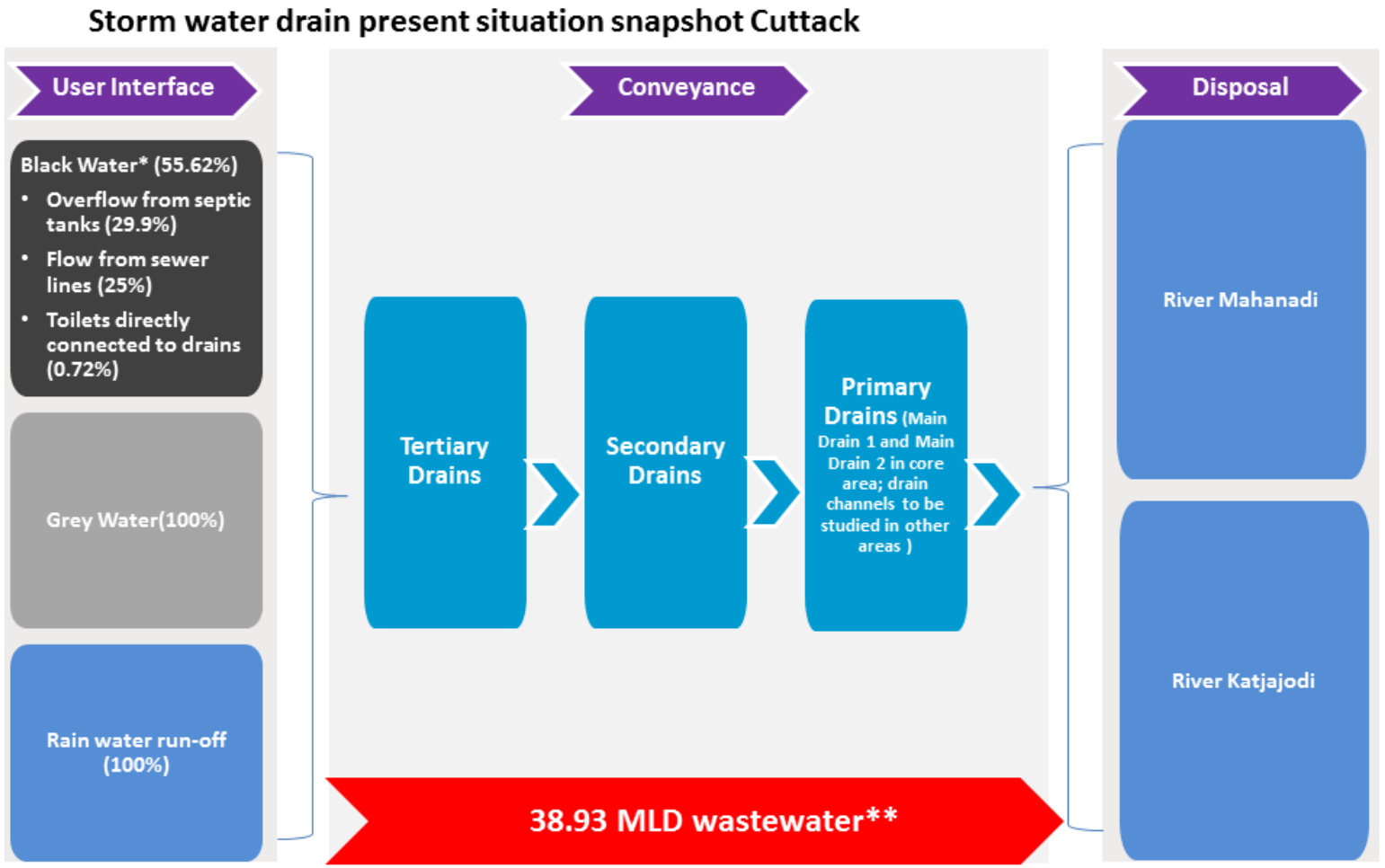
4.3.4 Water Quality in the drains

An estimated 55.62% of the total 70 MLD sewage generation of Cuttack is flowing through the storm water drains. This amounts to 39.83 MLD of wastewater. This includes overflows from septic tanks in the absence of soak pits (29.9%[12] i.e. fifty percent of the 59.81% of toilets connected to septic tanks); black water from toilets directly connected to drains (0.72%) and wastewater from the sewerage network (25%) is conveyed through the open drains since the existing treatment plants are under maintenance and new plants are being constructed. (District Census Handbook Part XII B, 2011) (Service Level Imrprovement Plan, 2016)

Greywater is entirely conveyed through the drains.

[12] This figure has been arrived at based on the assumption that 50% of septic tanks do not have soak pits. The Census definition of toilets with septic tanks refers to only the containment system and doesn't distinguish between septic tank with soak pit and septic tank without one (Latrine facility, 2017) . However, it is well known that overflow from septic tanks is one of the key reasons for pollution of water bodies. (Biswas & Jamwal, 2017). Since the exact number or percentage of septic tanks without soak pits is not known, therefore we are assuming that have of the septic tanks are not having soak pits. This is supported by the field observations and conversations with the sanitation staff of urban local bodies. This number doesn't include unhygienic/ insanitary toilets. (SBM_Guideline, 2017)

Figure 11: Storm water drain snapshot Cuttack



*As a percentage of total household black water generated.
**This figure has been arrived at as a percentage of total sewage generation of the city is 70 MLD
#Assuming that 50% of the flow from septic tanks into open drain due to absence of soak pits, this number has been calculated.

4.3.4.1 Analysis of wastewater sampling results

In the filed visit undertaken as a part of the current project, drain and flow measurements at 3 locations and water samples were taken at 3 locations to get a glimpse of quantity and quality of water flowing through the drains. 1 sample was taken at the Nimpur Canal for lack of a better alternative. The drainage network is Nimpur-Jagatpur area (marked as Ward 48 & 49 in Cuttack Drainage Map) is yet to be assessed by the CMC.

Table 12: Drain water sampling and flow tests

Date	Sample Points	Sample ID	Time of sampling	Wastewater generation	Avg Daily Discharge (MLD)	Quality					
						TSS, mg/l (CPCB Standard 20)	pH (CPCB Standard 6.5-9.0)	TDS, mg/l	BOD, mg/l (CPCB Standard 10)	COD, mg/l (CPCB Standard 50)	VS, mg/l
27-04-2017	Petanala (marked as Peta Nala :30m on Cuttack Drainage Map)	143(F)	10.00 am	70 MLD	7.85	30	7.1	110	25	113	180
	Jobra (marked as Jobra Gate:28 m on Cuttack Drainage Map)	143(G)	10.30 am		25.53	190	7	276	60	264	164
25-04-2017	Khan Nagar Nala (marked as Khan Nagar Nala:27m on Cuttack Drainage Map)	143(A)	12.00 pm		137.86	40	7.2	322	30	132	60
	Nimpur-Kendrapada Canal (marked as Nimpur Canal on Cuttack Drainage Map)	143(B)				10	8.2	294	15	66	94

Table 13 Picture table for outfalls

Place	Description	Pictures	
Peta Nala (marked as Peta Nala :30m on Cuttack Drainage Map)	This serves the CDA areas which includes part of Ward No 3 and Ward No 4 (area marked with fluroscent green on the map)		
Jobra (marked as Jobra Gate:28 m on Cuttack Drainage Map)	Jobra Gate is the starting point of Taladanda Canal is getting into the River Mahanadi. Currently, there is flow from the Gate into the river because of construction work on the Taladanda Canal for bridges.		

		Jobra Sluice Gate	Jobra Outfall
Khan Nagar Nala (marked as Khan Nagar Nala:27m on Cuttack Drainage Map)	Receives water from Main drain 1. Heavy flow was noticed in the nala.	 Khan Nagar Nala	 Khan Nagar Nala Outfall
Nimapur-Kendrapada Canal (marked on Cuttack Drainage Map as Nimpur Canal)	The flow appeared to be very stagnant. This is because the water is		

4.3.4.2 Inference

- The flow measurements and water analysis was done are 4 locations: Peta Nala and Khannagar Nala (storm water drain outfalls); Jobra Gate and Taladanda Canal (these are irrignational channels but many of the nearby storm water drains from nearby areas join them). The parameters of pollution at these locations are:
    - BOD mg/l
        - 25 at Peta Nala, 60 at Jobra, 30 at Khannagar and 15 at Nimpur Canal
    - COD mg/l
        - 113 at Peta Nala, 264 at Jobra, 132 at Khannagar and 66 at Nimpur Canal
    - TSS mg/l
        - 30 at Peta Nala, 190 at Jobra, 40 at Khannagar and 10 at Nimpur Canal
    - PH mg/l
        - 7.1 at Peta Nala, 7 at Jobra, 7.2 at Khannagar and 8.2 at Nimpur Canal
- Low strength wastewater. This is possibly because:
    - Peta Nala: The extensive vegetation just before the outfall
    - Khannagar: The volume of water flowing through
    - Nimpur Canal: it is canal meant for agricultural purpose. But the parameters indicate presence of wastewater in it.
    - Jobra Gate: Even though the water flowing through it is mainly from the Taladanda canal, yet its pollution levels are highest among the samples.
- Natural drains create scope for treatment natural treatment of water to some extent. The fact that 65% of the storm water drains in Cuttack is natural has contributed to the fact that the pollution levels are found to be low. However, the pollution levels at the outfalls are still higher than the CPCB limits. Therefore, interventions are required in order to bring down the levels of pollution of the receiving water bodies of River Mahanadi and Kathajodi.

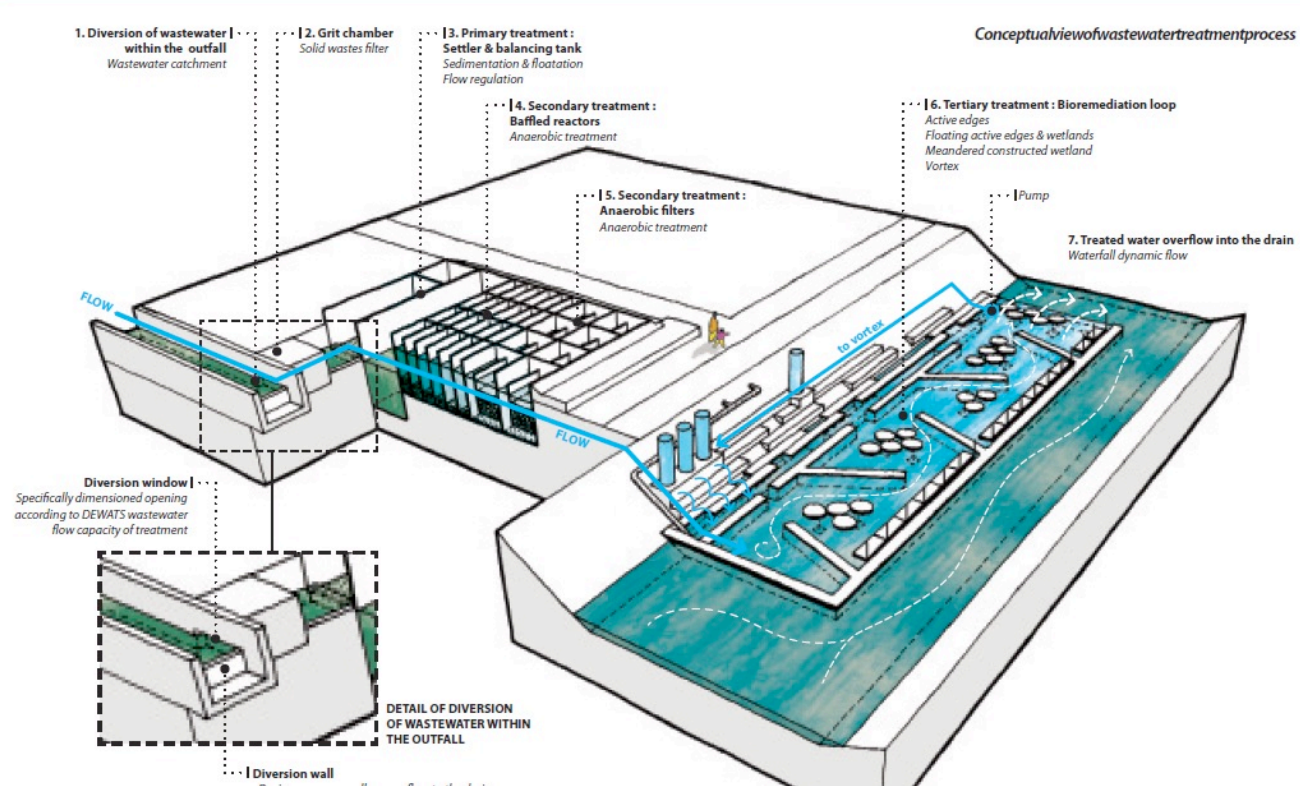
4.3.4.3 Recommendations

1. **Stopping entry of wastewater into storm water drains**:
   A major portion of wastewater in storm water drain comes from domestic wastewater. In order to keep this wastewater out of the drains, all the domestic wastewater should be safely disposed. Since 60% of the city is going to get covered under sewerage network, ensuring that all the households are connected to sewer network and maximising the collection efficiency of wastewater will address the issue. In unsewered areas this issue can be addressed by mandating construction of septic tanks with soak pits.

2. **Maintaining and increasing the number of natural drains:**
   As said in section Natural Drains of Cuttack, natural drains due to their ecosystem act as a treatment system to treat limited quantities of wastewater. Maintaining the drain ecosystem is the major part of this. The vegetation in the drains should be minimised at the beginning of monsoons in order to increase the water carrying capacity of the drains for the season. Thereafter, the vegetation should be allowed to grow towards the end of the monsoon so that it can treat a limited dry season flow.
   Hence, more drains should be maintained as natural and the newly constructed drains should be constructed as kuchcha drains to improve the water quality in drains by means of treating the small quantities of wastewater flowing through them.

3. **Treating the wastewater in the drains by using bio-remediation techniques:**
   a) At Cuttack, the drains join Mahanadi or Kathajodi Rivers. (refer Cuttack Drainage Map)
   b) Ward no 48, 49, 56, 57, 58 and 59 are going to remain unsewered for as of now. Also, these areas are at outer side of the city and hence are likely to have enough free space to construct bio-remediation units at the outfall of the storm water drains into river for treating the water in the drains, especially greywater. A schematic diagram of a bio-remediation plant if given below :

Figure 12 Schematic Diagram of a DEWATS cum Bioremediation Plant



4.3.5 Water logging areas

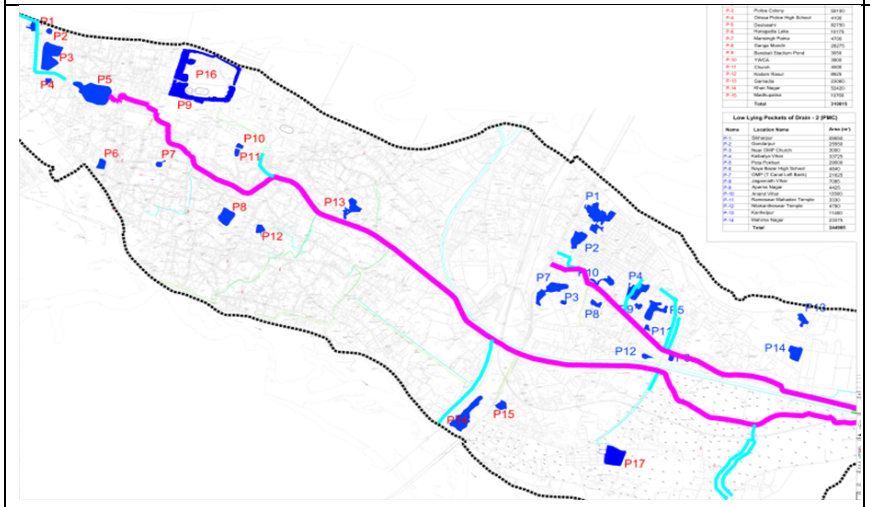
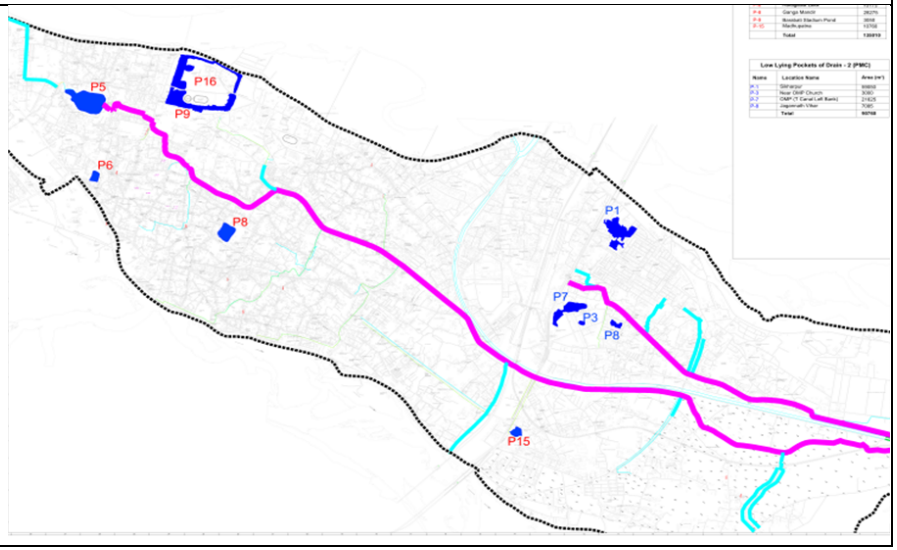
4.3.5.1 Existing problems

- The entire city (as shown in Contour Profile of Cuttack) is of very low elevation and especially the core city (see Cuttack Drainage Map) lower than the flood level of the river resulting in it getting flooded easily. This area therefore, most vulnerable to water logging.
- Storm water drains have been functioning as combined sewers carrying sewage from different sections as in discussed earlier sections. Most of the drains therefore flow in nearly full capacity, even during dry season. Hence, the capacity of the

drains to carry rain water is significantly reduced. Also, open dumping of solid waste results in the drains being clogged resulting in reduced flow and inundation during rains.

4.3.5.2 Existing solutions

Figure 13 Impact of JICA OISIP Project

Before	After – 60 % reduction in inundation areas
	

- There are 42 pumping stations and 6 major outfall points with sluice gates in the core city area, namely Khan Nagar, Peta Nala, Matagajpur, Gulguli, Jobra and Kaliabodha. These sluice gates close when the water level in the rivers rises during monsoon. Each of these sluice gates either has permanent pumping stations or pumps are deployed to them to pump out the water collected at the gate into the river. (see Figure 9Cuttack Drainage Map)
- Currently, water from the drain is flowing out into the river from Khanna Nagar and Matagajpur gates (for Main Drain 1); Peta Nala Sluice Gate (for Peta Nala); and Gulguli (for Main Drain 2). The water from Khan Nagar Nala is diverted into Gandharpur Diversion from where it flows into the Main Drain 2. The Jobra Gate is the starting point of Taladanda Canal is getting into the River Mahanadi. Currently, there is flow from the Gate into the river because of construction work on the Taladanda Canal for bridges. (see Figure 9Cuttack Drainage Map)

- In order to tackle the inundation issues, under the OISIP, the Main Drain 1 and Main Drain 2 are getting reconstructed from existing stoneware to RCC. This would result in 60% reduction in the core areas that get inundated during monsoon. Refer Impact of JICA OISIP Project)
- Also, once sewage system for the core city area is completed, the amount of water flowing through these drains is expected to reduce significantly.

4.3.5.3 Gaps

- The water logging issues of 40% of the core areas and the entire outskirts i.e. part of ward No 3, Ward No. 48, 49, 56, 57, 58 and 59 (marked in Cuttack Drainage Map in red) will continue to face inundation issues.
- No plan for addressing the issue of solid waste clogging drains...

4.3.5.4 Ongoing Projects

- Under Japan International Cooperation Agency (JICA)-funded Orissa Integrated Sanitation Improvement Project (OISIP) project, the Main drain 1 and Main Drain 2 are getting reconstructed to from existing stoneware drains to RCC drains.
- Preparation new Drainage Master Plan for the entire city of Cuttack is being undertaken WAPCOS Ltd (a Government of India Undertaking). (Department of Water Resources, Government of Odisha, 2016) Major focus of this plan will be on flood management and construction of new drains.

4.3.5.5 Recommendations

Besides completion of the ongoing projects, the following measures can be taken to reduce water logging in the city.

1. **Improving inlets into the existing drains**- This can be done by using alternative options while dealing with covered drains such as mesh covers (see Drain Mesh); keeping the inlet pipes into covered concrete drains free of solid waste; and managing solid waste in the drains.

Figure 14 Drain Mesh

Source (Steel mesh)

2. **Increasing drain coverage and constructing new drains as constructed kuchha drains.** The vegetation in the natural drains (kuchcha drains) helps in controlling flooding as referred to in Natural Drains of Cuttack**)**
3. **Water sensitive urban design using swales and raingardens**
   "Water Sensitive Urban Design" or WSUD for short is an approach that recognizes the adverse impact of traditional urban forms have on the urban water cycle. (Water Sensitive Urban Design in UK, 2013) Hence WSUD takes the approach of finding opportunities to renew and redesign existing urban forms so they may positively enhance the urban water cycle. Examples of such redesigning of roadside to include incorporation of permeable surfaces as well as vegetated and landscaped areas (such as raingardens and swales see Diagrammatic representation of roadside swales and rain garden) that are specially designed to slow down the flow of the storm water run-off from road and other paved surfaces, retain and treat the pollutants that is often picked up by the first flush of the storm water run-off and discharge cleaner water to the discharge point. Such WSUD elements provide other multiple benefits such as enhancement of the aesthetics of the urban areas and reduced flooding and water logging following rains. This means the Cuttack, swales can be constructed in the roadsides as shown in Diagrammatic representation of roadside swales and rain garden and incorporate a program of building raingardens in public premises in partnership with the agency responsible for road and storm water; as well as in private premises in partnership with private landowners.

4.2.2.1.1 Diagrammatic representation of roadside swales and rain garden

Figure 15 Roadside swale

(Swale, 2017)

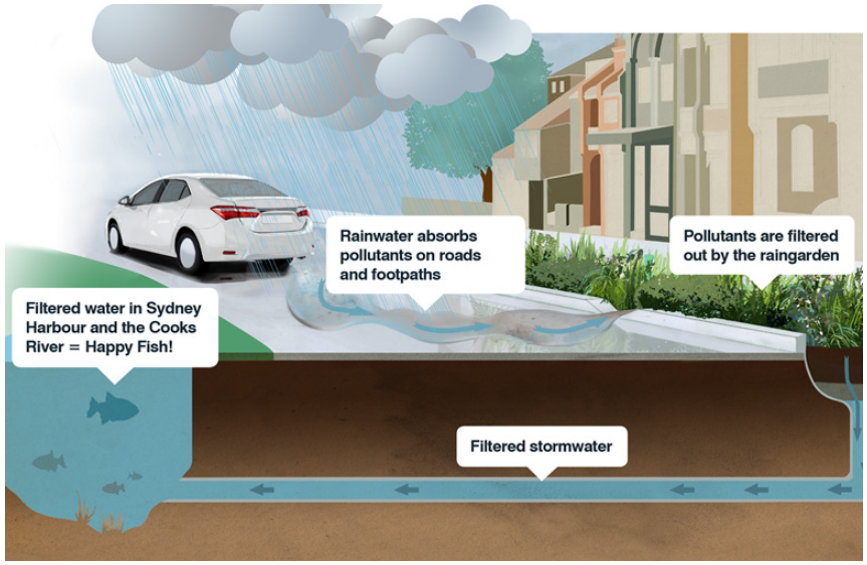
Figure 16 Roadside swales installation

1. Road patch without swale

2. Road patch with swale

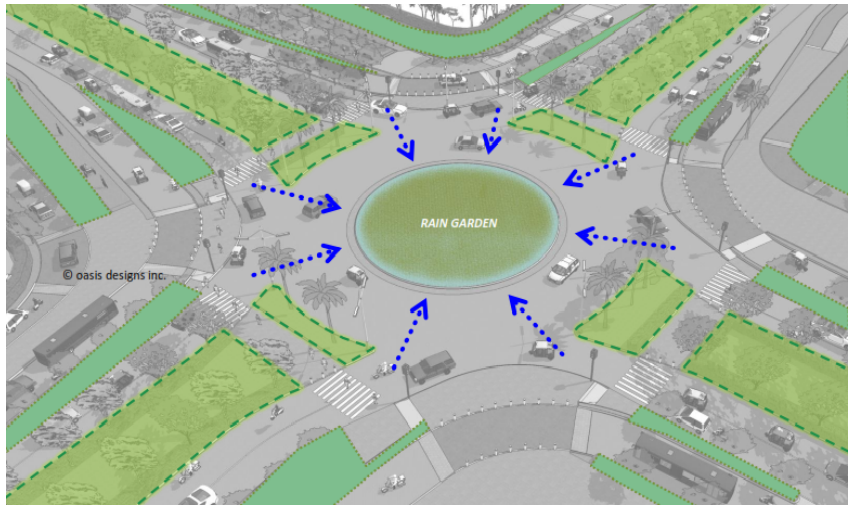
(Storm Water Management, Uttipec, Delhi Development Authority, 2012)

Figure 17 Representation of working of a rain garden and swale



(Rain gardens)

Figure 18 Representation of rain garden at roundabouts for Delhi



(Storm Water Management, Uttipec, Delhi Development Authority, 2012)

4.3.6 Action Plan

The key action points for improvement in storm water drainage are in terms of construction of water sensitive drainage in order to address multiple challenges of drain coverage, control the problems of inundation and letting maximum water to seep into the ground in order to improve the ground water levels. Maintaining and increasing the coverage of natural drains and constructed kuchcha drains and construction of swales and raingardens are central to this idea of water sensitive urban design. Also, stopping wastewater from entering the drains and regular maintenance of drains in terms of solid waste management and maintaining the vegetation in the drains are essential to improve upon storm water drainage system.

Table 14: Action Plan for Storm water Management

Issue 1		**Inadequate drain coverage**
Key Issue		26% deficit in stormwater drain coverage
Goal		To improve drain coverage
Actions	**Short term (within 2 years)**	The newly constructed drains should be constructed kuchcha drains (wherever possible)
Issue 2		**Inundation issues**
Key Issue		Drain design issues- covered drains and related issues
Goal		To create new drain designs using water sensitive urban design approach.
Actions	**Short term (within 2 years)**	• **Improving inlets into the existing drains by unclogging inlet pipes; and switching to alternate covering such as mesh cover.** • **Increased coverage of natural drains.**
	Medium term (3- 5 years)	• **Water sensitive urban design using swales and raingardens (**See Diagrammatic representation of roadside swales and rain garden**)**
Issue 3		**Wastewater into storm water drains**
Goal		To improve the water quality in the drains
Actions	**Short term (within 2 years)**	• **Stopping the entry of sewage into the storm water drain** • **Maintaining and increasing the number of natural drains**
	Medium term (3- 5 years)	**Treating the wastewater from the drains by creating constructed wetlands**


Wastewater Management
70 MLD
Wastewater Generation
75% non-sewered
Ongoing sewerage projects under OISIP
Future Projections
In 2019: 74MLD (exponential)
In 2025: 79MLD (exponential)

4.4 Wastewater Management

Figure 19 City level gaps in liquid waste management in Cuttack

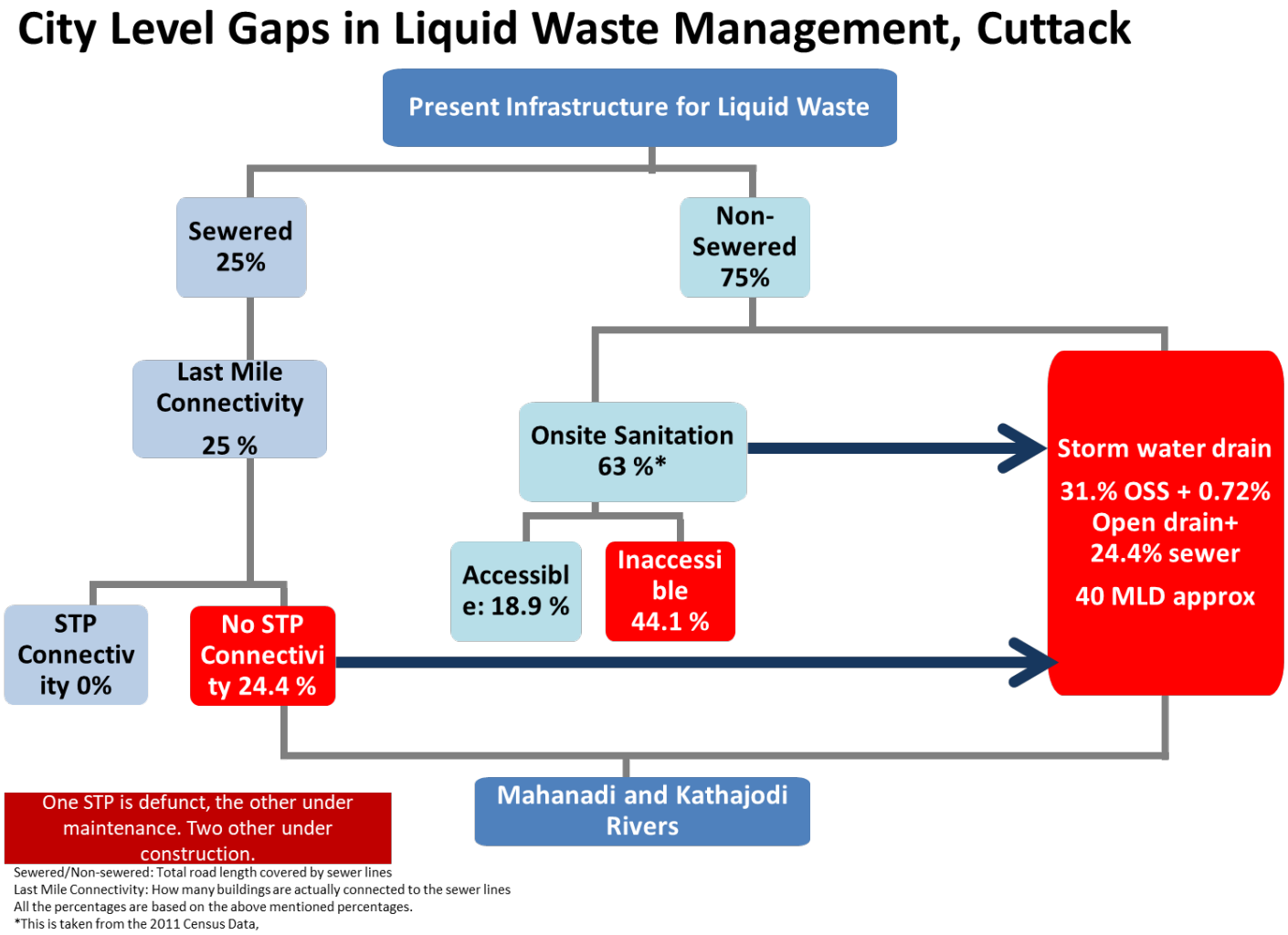
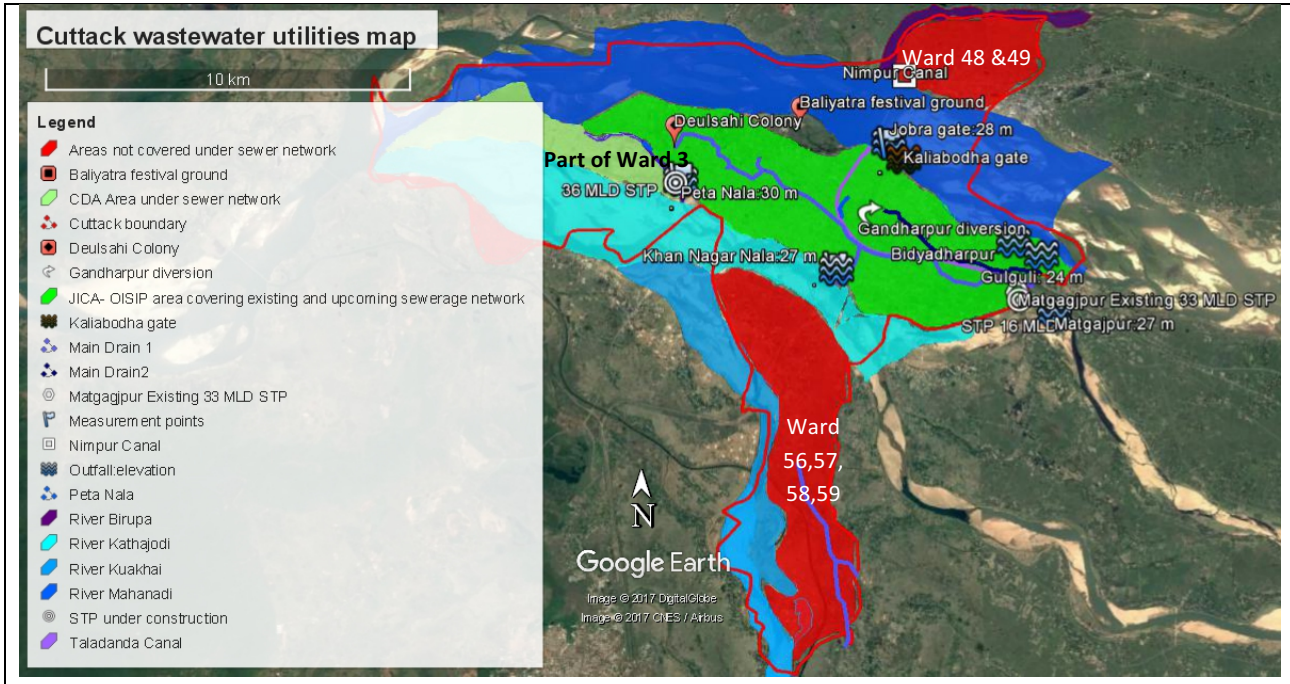


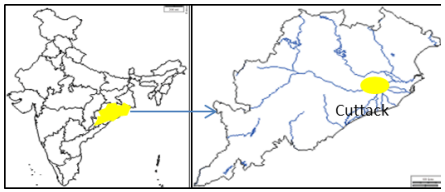
Table 15Wastewater Management- Current Situation, Gaps and Possible Recommendations

SN	Aspects	Details	Gap	Possible Recommendations
1	**Generation**	The sewage generation is 70 MLD. Of this 25% i.e. 17.5 MLD is conveyed through the existing sewer lines. (Service Level Imrprovement Plan, 2016)		
2	**Conveyance**	**Existing Network** • 68 km of sewer line covering 25% of the city. As per the Census 2011, 15.7% of the households in Cuttack are connected by sewer lines (Service Level Imrprovement Plan, 2016) **Ongoing and Upcoming Projects** • Under the Odisha Integrated Sanitation Improvement Project (OISIP), funded by the Japan International Cooperation Agency (JICA), about 60% of Cuttack's population will be covered, by laying 382 km sewer network. Of this, 187 have already been laid (Service Level Imrprovement Plan, 2016).	Even after completion of the projects, the part of ward No 3, Ward No. 48, 49, 56, 57, 58 and 59 (marked in Cuttack Sewerage Map) will remain unserved. The area around the Baliyatra Festival ground would also remain unserved.	• Covering the unserved area faecal sludge/septage management (FSM) solutions. Given that the farthest point in the ward is about 20 km away from the proposed SeTP, alternatives such as sludge transfer stations or additional SeTP can be looked into upon assessing the demand-supply of FSM services. • In places where FSM solutions are not feasible or inadequate, wastewater treatment solutions such as small bore systems can be used.
3	**Treatment**	**Existing situation** • Currently, the sewage from the core city are (marked in light green and lemon green on Cuttack Sewerage Map) is running directly into the rivers Mahanadi and Kathajodi as the existing sewage treatment plants (STP) of 33 MLD in Matgajpur (marked as Matgajpur Existing 33 MLD STP) is closed for repair and maintenance and hence the water is diverted into the rivers from Peta Nala, Khan Nagar Nala, Jobra Sluice Gate, Gulguli (Cuttack, 2017). **Ongoing Projects** • Under the JICA funded OISIP project, 2 new STPs of 36 MLD and 16 MLD, which are currently under construction. These will treat the water from the core city are (marked in light green and florescent green in Cuttack Sewerage Map)) • The plants are expected to be opened along with the existing 33MLD plant at Matgajpur in September 2017.		

Figure 20: Cuttack Sewerage Map



Preparation of CSPs for Cities of Odisha



Consortium for DEWATS Dissemination Society

राष्ट्रीय नगर कार्य संस्थान
NATIONAL INSTITUTE OF URBAN AFFAIRS

4.4.1 Funding details of ongoing sewerage projects

The sewerage Project in Cuttack is being funded under Japan International Cooperation Agency (JICA)-funded Orissa Integrated Sanitation Improvement Project (OISIP) project. This includes reconstruction of Main drain 1 and Main Drain 2 (refer Cuttack Sewerage Map); sewerage network is being laid and 2 new STPs are getting constructed (Cuttack Sewerage Map). The total cost of this project is Rs 2069.33 crore.

4.2.3 Projections for Wastewater Generation

Table 16 Wastewater generation projection

Progression Method	Year	Population	Water demand in MLD (approx.)	Wastewater generation in MLD (approx.)
Census 2011 Population	2011	610189	94	70
Exponential	2019	638775	100	74
	2025	661089	102	76

For the purpose of projection, we are using exponential projections. (See Population Projection for Cuttack for details). Assuming that the per capita wastewater generation remains constant, the values have been calculated. The total capacity of the upcoming STPs is 85 MLD. Considering this, the STPs will be able to cater to the wastewater generated till 2025. However, in order to avoid the need for putting more STPs beyond this point, unsewered areas such as Ward No 48,49, 56, 57, 58 and 59 and bulk wastewater generators such as new multi-storeyed buildings (more than 50 households or institutional and commercial complexes) and new areas should be mandated to have localised treatment plants. This policy legislation has been instituted in the city of Bangalore. It would allow gated communities to be self-sufficient in terms of their wastewater treatment and thus not create a negative impact on the environment. The earlier such measures are taken, the lesser would be the pressure to create new centralised STPs. Also, the earlier such mandates are passed, the greater is the likelihood of compliance as the city as maximum number of new buildings can go for decentralised solutions.

4.4.2 Action Plan for wastewater management

The key action points for improvement in wastewater management focuses on the intervention in the Ward No 48, 49,56, 57, 58 and 59 which will remain unsewered after the completion on the ongoing projects.

Table 17 Action plan for wastewater management

Issue 1		Area out of sewer network
Key Issue		The entire city except for Ward No 48, 49, 56, 57, 58 and 59 will be covered either under JICA-OISIP or under JNNURM projects.
Goal		➢ To deliver FSM solutions ➢ To deliver wastewater treatment solutions
Actions	Short term (within 2 years)	**FSM Solutions** • Implementation of the FSM solutions as highlighted in the FSM sections. **Wastewater solutions** • Implementation of localised conveyance and treatment solution in, clusters left out of the sewered areas as suggested in the Approaches for wastewater management in unsewered pockets and newly constructed multi-storeyed building • **Ensuring last mile connectivity for the sewer network** in areas covered under sewer system o IEC activities for citizens to connect to the sewer network o Legal enforcement for mandating connections in sewered areas o Incentivising or subsiding the sewer connection cost to households. • Training of operators
	Medium term (3- 5 years)	• Identifying potential reuse options
	Long term (3- 5 years)	• Bulk generators of sewage such as apartments and institutions; and any new multi-storeyed buildings can be mandated to treat their wastewater at source.

4.4.3 Approaches for wastewater management in unsewered pockets and newly constructed multi-storeyed building

Decentralized sanitation systems: Considering the future infrastructure development in the town, the cluster approach for wastewater treatment can be proposed for the town. This requires the clustering the town based on the contours available and provide conveyance system along with wastewater treatment. This allows the usage of low energy for conveyance system and low construction cost.

Table 18 Different conveyance systems options

Options	Features	Pros	Cons	Cost per running meter (in INR)	Estimated cost (in crores)[13]						
					Ward 48	Ward 49	Ward 56	Ward 57	Ward 58	Ward 59	Total
Small bore systems	A solids-free sewer is a network of small-diameter pipes that transports pre-treated and solids-free wastewater (such as Septic Tank effluent).	➢ Does not require a minimum gradient or flow velocity ➢ Can be used where water supply is limited ➢ Lower capital costs than conventional gravity sewers; low operating costs ➢ Can be extended as a community grows	➢ Space for interceptors is required Interceptors require regular desludging to prevent clogging ➢ Requires training and acceptance to be used correctly ➢ Requires repairs and removals of blockages more frequently than a conventional gravity sewer ➢ Requires expert design and construction Leakages pose a risk of wastewater exfiltration and groundwater infiltration	2400	5.3	10.73	5.3	6.3	7.2	4.8	29
Simplified sewer systems	A simplified sewer describes a sewerage network that is constructed using smaller diameter pipes laid at a shallower depth and at a flatter gradient than conventional Sewers	➢ Lower capital costs than Conventional Sewers; low operating costs ➢ Can be extended as a community grows ➢ Greywater can be managed concurrently ➢ Does not require onsite primary treatment units	➢ Requires repairs and removals of blockages more frequently than a Conventional Gravity Sewer ➢ Requires expert design and construction ➢ Leakages pose a risk of wastewater exfiltration and groundwater infiltration and are difficult to identify	Rs 2800	6.1	12.5	6.2	7.3	8.4	5.6	46.4
Conventional sewer lines	Conventional gravity sewers are large networks of underground pipes that convey	➢ Less maintenance compared to Simplified and Solids-Free Sewers ➢ Greywater and	➢ Very high capital costs; high operation and maintenance costs ➢ A minimum velocity must be maintained to prevent the deposition of solids in the sewer	Rs 4800	10.5,	21.4	10.7	12.6	14.5	9.6	79.3

[13] Calculated by multiplying the cost per running metre with the road length in each ward as received from the CMC. Road length of Ward no 48, 49, 56, 57, 58 and 59 are – 22.08 km, 44.73 km, 22.32 km, 26.30 km, 30.28 km and 20.19 km.

	blackwater and greywater	possibly storm water can be managed concurrently ➢ Can handle grit and other solids, as well as large volumes of flow	➢ Requires deep excavations ➢ Difficult and costly to extend as a community changes and grows ➢ Requires expert design, construction and maintenance								

One of the most challenging aspects of a sustainable sewage treatment system (either centralized or decentralized) design is the analysis and selection of the treatment processes and technologies capable of meeting the requirements. The process is to be selected based on required quality of treated water. While treatment costs are important, other factors should also be given due consideration. For instance, effluent quality, process complexity, process reliability, environmental issues and land requirements should be evaluated and weighted against cost considerations

Table 19: Wastewater treatment technologies

Sl.No	Parameters	Activated Sludge Process (ASP)	Sequential batch Reactor (SBR)	DEWATS	Membrane Bioreactor (MBR)	Moving bed Bioreactor (MBBR)[14]
1	**Capital Cost (Rs. Lacs/MLD)**	**80**	**125**	**300**	**220**	**130**
	Civil Construction/Prefab (% Capital Cost and Electrical and Mechanical)	55	30	100	20	40
2	**Area Required (Sq.m/MLD)**	**800**	**400**	**4750**	**200**	**400**
3	**Performance of Technology-Effluent**					
	BOD (mg/l)	<20mg/l	85-98%	<20mg/l	<2mg/l	92-97%
	COD (mg/l)			<50mg/l	15-20mg/l	94%
	TSS (mg/l)	<30	85-98%		NA	
4	**Operation and Maintenance cost**					
	Energy Cost					

[14] ASP cost estimates based on Ganga River Basin Management Plan
SBR, MBR and MBBR cost estimates based on Kavali STP DPR.
DEWATS cost estimates based on CDD Society quotation.

	Total Power required(Treatment Process) (KW/day)	184	172.5	0	302.5	202.5
	Yearly Power cost (Rs.Lacs PA/MLD)	2.65	2.48	0	4.36	2.92
	Recurring cost (Rs in Lacs PA/MLD) (List of chemicals, safety equipments will be attached)	5.3	0.2	0		0.4
	Annual Maintenance Cost (Equipments)					
	Civil Parts Maintenance Cost (% Of civil works cost) (List of equipments will be attached)	1.94	1	3.72	1	
	Electrical and Mechanical parts Maintenance cost (% Of civil works cost)	3	2.5	0		3
	Other Repair Cost Rs.Lacs	3.2	2.34			3.2
	Annual Human Resource Cost, in Lacs PA/MLD					
	Plant Manager	4.8	4.8	0	4.8	4.8
	Operator	1.44	1.44	0.6	1.44	1.44
	Chemist/Engineer	2.4	2.4	0	0	2.4
	Total O&M cost in Lacs PA/MLD	24.73	17.16	4.32	11.6	18.16


Faecal Sludge Management
4
cesspool vehicles owned by MC.
Unregulated dumping
of untreated faecal sludge
59.8% of households
Connected to a containment system
4.6% of households
Connected to pits

4.5 Faecal Sludge Management

4.5.1 Faecal Sludge Management- Current Situation, Gaps and Possible Recommendations

Table 20 Faecal Sludge Management- Current Situation, Gaps and Possible Recommendations

Faecal Sludge Management cycle in Cuttack **Containment** ⇨ **Collection and Conveyance** ⇨ **Disposal and treatment** ⇨ **Reuse**				
Aspect/Parameter		Details	Gaps	Possible Actions to be taken
1	**Containment**	As per the Census 2011, the toilets of the majority of the households in Cuttack • 59.8% are connected to septic tanks (with and without soak pits) and • 18.6% are connected to the sewer system. • Another 4.6% of the households have toilets connected to pits • 0.7% have their toilets connected to open drains, which has been also included in the above point. • 1.2% households use other systems. As of today, these septic tanks and pits are cleaned in a sporadic and possibly ineffective manner, which can create water pollution and other health and environmental hazards. As per the Swachh City Plan, there are 1.57 % households having pit latrines and 1.93% households with insanitary latrines	- No enforcement of standard pit/septic tank design and size (mostly depends on space available within the house) - Unhygienic Toilets, i.e. pits/Septic Tanks are un-scientifically constructed resulting in frequent overflow and leakages - Lack of understanding - O&M of containment units. - Grey water is entering the septic tanks, - Majority of the containment systems in the city are inaccessible for cleaning. - Many containment units' outlets are directly opened into the drains.	- Enforcement of standard containment size code regulations strictly - Increasing the incentive mechanisms/amount for converting the insanitary to sanitary - Awareness/IEC campaigns on open defecation and other aspects
2	**Collection and Conveyance**	• There are both government desludging service and private desludging service providers. • The ULB operates 2 vehicles of capacities of 3,000 litres each. Furthermore, the ULB has received 4 new cesspool vehicles of 3,500	- There is no proper mechanism for monitoring and tracking the cesspool vehicle esp. the private players. - Accessibility is an issue in many areas and unscientific method - Manual handling of faecal sludge is a significant issue (as per the discussion with government officials and private cesspool	- Gulper/small cesspool vehicles where the existing cesspool vehicles cannot access - Make GPS and other ICT interventions mandatory for both private and

		litres capacity from OWSSB/ State Government to provide desludging/ septic tank cleaning. • The new vehicles owned by ULB are being outsourced to private parties through tendering out the cesspool truck operations. The quote which has been accepted for tendering out the O&M of the trucks is Rs. 1,300 per trip through PPP mode. • There are 3 private operators with 4 cesspool vehicles. Their capacities range from 2000 to 4000 litres. Private operators charge around Rs. 1,200 to 1800 per trip of desludging. • The Municipality takes around 2-3 days to provide their services whereas private operators supply immediately on demand. The working hours of ULB cesspool vehicles is from 8 am to 6 pm and private operate 24 hours a day.	operators). Lack of data on private operators involved in desludging. - The private operators are not regulated. Desludging of septic tanks is not carried out regularly (once in every 2-3 years). - Proper safety gears are not used	government vehicles. - Licensing the private operators - Form to be filled by the customer availing the desludging service which has to be submitted at the MC/during the disposal. - Separate account for handling cesspool vehicles account. - 24 hrs call center for desludging services - Mechanisms to reduce the manual scavenging activities - Scheduled desludging should be implemented by incorporating user fee or property tax incorporation
3	**Disposal and treatment**	• The site allocation of a faecal sludge treatment plant of a capacity of 60 m³ at Matgajpiur has been completed. • There is no proper monitoring of the disposal practices of faecal sludge in Cuttack.	- Unsafe faecal sludge/septage disposal practices currently (SeTP is due in Oct/Nov,2017) - The distance of the disposal point/treatment plant site from the city center. - Incentive mechanism/regulation to promote the disposal at treatment site is not yet available. - No designated disposal sites available as of now until SeTP is constructed	- Introducing temporary transfer[15] stations at the SWM transferstations in the form of huge tanks for disposal of FS - Disposal at the SeTP to be mandatory - IEC campaign with the cesspool operators both private and government
4	**Reuse**	No reuse/reuse plan is present in the form of usage of waste water and sludge in few areas in the agriculture	One should explore the potential of reuse of dried sludge/co-compost.	- Exploring of technologies for enhancing the nutrient value in the dried sludge and also to reduce the helimenth eggs which may

[15] Transfer stations or underground holding tanks act as intermediate dumping points for faecal sludge and septage when it cannot be easily transported to a (Semi-) Centralized Treatment facility. A vacuum truck is required to empty transfer stations when they are full. Details of transfer stations have been provided in the annexure A5.

				be prevalent in the dried sludge. - Reuse plan for selling the dried FS - Converting the dried FS into co-compost for enriching the nutrient content - Exploring it to sell for cement industries/ brick factories - To encourage reuse among the farmers through IEC campaigns

Figure 21: Faecal Sludge Disposal Site at Chakradharpur

Figure 22: Parking for the Cesspool Vehicles within Cuttack Municipal Corporation

Figure 23: Cesspool Vehicles Owned and Operated by Cuttack Municipal Corporation

4.5.2 Progress of Septage Projects under AMRUT in Odisha (2017)

Table 21 Septage Projects under AMRUT

Planning and Design	Construction/ Implementation	O&M
• Planning and design of the Faecal Sludge Treatment Plant (FSTP) is undertaken by OWSSB	• Construction/Implementation of the Faecal Sludge Treatment Plant (FSTP) is undertaken by OWSSB • Regarding the operationalization of the FSTP, the following are the Work Order	• The overall responsibility of operation and maintenance of the FSTP is the responsibility of the Cuttack Municipal Corporation.

• Procurement of the cess pool vehicles is however done by the Municipal Corporation.	details: 1. Agency: M/s Ionex Envirotech Pvt. Ltd., Mumbai 2. Agreement cost: Rs. 1,49,39,999 3. Scheduled Date of Completion: 17th October 2017 4. Status of FSTP Construction and implementation : ▪ The land has been physically handed over to the agency on the 16th of Jan 2017. ▪ The Topographical Survey has been completed. ▪ Geotechnical survey to be taken up ▪ General Agreement and Site technical drawings (Hydraulic Flow Diagram) not yet submitted to OWSSB. • Status of truck procurement: Trucks procured by OWSSB and tendered out by the Municipal Corporation. The tender allotment is in process.	• Though the trucks are procured by OWSSB, they will be owned and managed by the ULB. • As such, the O&M of cess pool vehicles will be under the supervision of the Municipal Corporation

4.5.3 Catering to future demand

In order to meet to the future demand, the city can rely increasingly on localised wastewater treatment (Refer to Projections for Wastewater Generation). This way the septage generation of the city can be limited, thereby reducing the pressure on the SeTP.

4.5.4 Action Plan

The SeTP is planned to be constructed and be operational by the end of 2017. The following table shows the key issues, action plan and cost estimates for improvement of faecal sludge management in Cuttack. These measures will help in the proper functioning of the SeTP.

Table 22 Action Plan for FSM

Issue 1		Containment	Costs
Key Issue		• No enforcement of standard pit/septic tank design and size (mostly depends on space available within the house) • Unhygienic Toilets, i.e. pits/Septic Tanks are un-scientifically constructed resulting in frequent overflow and leakages • Lack of understanding - O&M of containment units. • Grey water is entering the septic tanks, • Septic tanks are inaccessible for cleaning.	
Goal		• Complete conversion of existing insanitary toilets to sanitary toilets • New constructions or toilets construction in the pipeline are to be completely standardized • Creating capacities to undertake O&M of containment units • Implementation of rules and regulations which would standardize the existing and upcoming containment systems	
Actions	**Short term (within 2 years)**	**Technical** • Enforcement of standard size/designs of the septic tanks which needs to be incorporated in the house construction design which needs to be in accordance with the provisions of the o National Building Code of India, 2005; o Bureau of Indian Standards, Code of Practice for Installation of Septic Tanks; o Manual on Sewerage and sewage treatment systems, CPHEEO, 2013; o Swachh Bharat Mission Guidelines, 2014 **Operations** • Implementation of standard containment size code regulations strictly by making Cuttack Development Authority (CDA)/ relevant monitoring authority accountable **IEC** • Awareness/IEC campaigns on open defecation and other aspects • Masons training for building the containment systems **Policy** • Enforcement of Odisha Urban Septage Management Guidelines, 2016.	

	Medium term (3- 5 years)	**Operations** • Increasing the incentive mechanisms/amount for converting the insanitary to sanitary **IEC** • Behaviour change campaigns and workshops periodically in the newly developing areas	• Rs 8,000 – Rs 10,000 increase in incentive for every toilet converted from insanitary to sanitary toilet (based on other states implementation of incentives under SBM plan)
Issue 2		**Collection and Conveyance**	
Key Issue		• There is no proper mechanism for monitoring and tracking the cesspool vehicle esp. the private players. • Accessibility is an issue in few areas and unscientific method • Manual handling of faecal sludge is a significant issue (as per the discussion with private cesspool operators) • The private operators are not regulated. Lack of data on private operators involved in desludging. • Desludging of septic tanks is not carried out regularly (once in every 2-3 years). • Private operators are not regulated • Proper safety gears are not used while desludging both by government and private operators	
Goal		➢ 100% collection of FS/Septage generated in the city and 100% conveyance to the treatment/disposal site ➢ No manual scavenging/ manual handling of FS ➢ Use of safety gears and proper equipment while desludging ➢ Regulating the private operators through licensing and periodic renewal	
Actions	**Short term (within 2 years)**	**Technical** • Monitoring of private and government cesspool vehicles by mandating GPS and other ICT interventions. • Safety gears to be given to government operators and are to be made compulsory for the government and private operators **Operations** • Separate account for handling government cesspool vehicles account. • Maintain the database of private operators • Mechanisms to fill the form by the customer availing the desludging service which has to be submitted at the MC/during the disposal. **Training** • Training the operators on standard practices and safety measures for collection and conveyance	For ICT technology interventions : CapEX and OpEx is approx. Rs 1,20,000 per vehicle per year

		• Training of ULB officials on monitoring of cesspool vehicles **Policy** • Licensing the private operators and periodic renewal • Enforcement of Odisha Urban Septage Management Guidelines, 2016.	
	Medium term (3-5 years)	**Technical** • Procure 3-4 Gulper machines /small cesspool vehicles where the existing cesspool vehicles cannot access **IEC** • Behaviour change campaigns and workshops periodically in the newly developing areas	**For Gulper machines/small cesspool vehicles:** - Rs 32 Lakh for 4 vehicles as CapEx and Rs 2.8 Lakh for OpEx of vehicles(which will not include the fuel costs) - HR salaries will be around Rs 14.4 Lakh per year for 8 people employed (2 per vehicle)
	Long term (5-10 years)	**Operations** • Assess between the demand generated for collection and supply of FS collection in the city and accordingly procure cesspool vehicles if necessary **Policy** • Scheduled desludging should be implemented by incorporating user fee or property tax incorporation	**For procuring of new cesspool vehicles:** Rs 28 Lakh for 1 cesspool of 4.5 Kld Rs 20 Lakh for 1 cesspool of 3 Kld
Issue 3		**Disposal and treatment**	
Key Issue		• Unsafe faecal sludge/septage disposal practices currently (SeTP is due in Oct/Nov,2017) • The distance of the disposal point/treatment plant site from the city center. • Incentive mechanism/regulation to promote the disposal at treatment site is not yet available. • No designated disposal sites available as of now until SeTP is constructed	
Goal		➢ 100 % disposal of FS generated at the treatment plant ➢ 100% of the FS generated is to be treated ➢ Scientific disposal sites are made available	
Actions	**Short term (within 2**	**Technical**. • Complete SeTP by end of 2017 • Outsource the operations and maintainence of the SeTP to third party	• To build a transfer station of 30,000 litres, the total CapEX

	years)	**Operations** • Introducing temporary transfer stations at the SWM transferstations in the form of huge tanks for disposal of FS • Depending on the need, tankers of 15,000- 20,000 Litres may be required to transport faecal sludge from the tranfer station to the SeTP. • This would be at the same places where SWM tranferstantions are present and would be operating 24x7 Disposal at the SeTP to be mandatory **IEC** • Capacity building of ULB and operators for handling the SeTP • IEC campaign with the cesspool operators both private and government for behaviour change regarding the disposal **Policy** • Licensing the private operators and periodic renewal and disposal to be made mandatory at the designated sites • Enforcement of Odisha Urban Septage Management Guidelines, 2016.	would be Rs. 30,000*12= Rs. 3.6 lakhs. • Cost of the trucks for transport
	Medium term (3- 5 years)	**Technical** • Different business models assessment for the SeTP and work on sustainability of the operations of treatment plant • Assess the demand supply gap for treatment and disposal of FS in the city and according create plan for setting up of more treatment plants **Operations** • Outsourcing of O&M of the plant to third party by releasing tenders **Policy** • Inclusion of property tax as part of making the operations of SeTP sustainable	• Tender Handling charges: Rs 2.5 Lakh approx. for design of tender • Business models for possible reuse options are provided in Business Models for FSM
	Long term (5-10 years)	**Technical** • Integrating the solid-liquid waste treatment at the same location **Operations** • Plan for ODF++ declaration **Policy** • Policy resolution leading to 100% disposal and treatment of the FS generated	
Issue 4		**Reuse**	
Key Issue		• No reuse is present or formally institutionalized in the city	
Goal		• 100% reuse of the treated sludge	

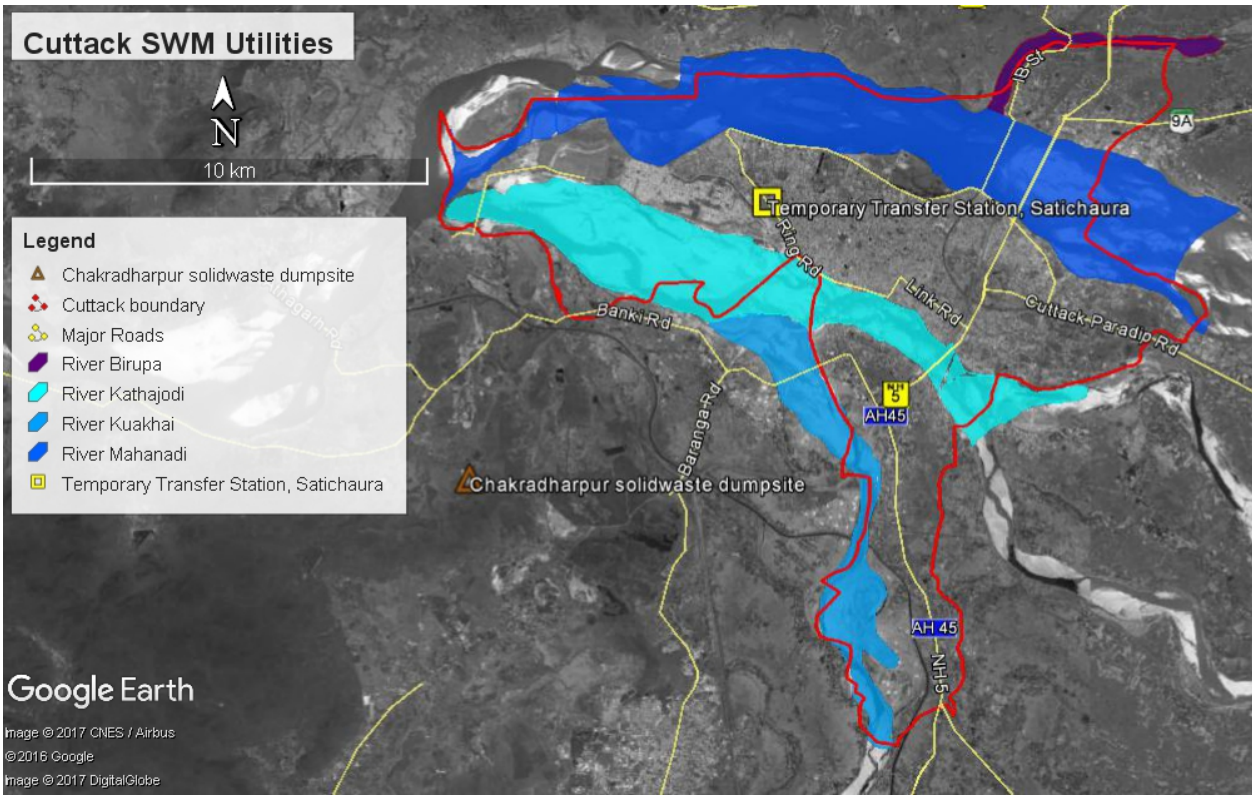
Actions	**Short term (within 2 years)**	**Technical** • Co-compost plan for enhancing the nutient value • Explore other technologies for reuse **Operations** • Collaborate with chemical fertilisers companies • Reuse plan for selling the dried FS and to be outsourced • Converting the dried FS into co-compost for enriching the nutrient content **IEC** • To encourage reuse among the farmers through IEC campaigns **Policy** • Reuse policy to be formulated for the city	• Cost of setting up co-composting unit[16] = Rs 0.7 Crore/70 Lakhs • The OpEx costs would be approx. = Rs 7 Lakh per year assuming 10% of CapEx. • For the compost to be sold in the market, it should pass the FCO (2013)[17] norms.
	Medium term (3-5 years)	**Technical** • Exploring possibilities of using Black soldier flies usage of solar energy at the SeTP **Operations** • Exploring possibilities to sell for cement industries/ brick factories	

[16] Based on case study of FSTP Devenahalli, the Co-composting unit CapEx will cost 25% of the FSTP cost
[17] Fertiliser (Control) Order 2013 Norms, brought out by the Department of Agriculture and Cooperation


Solid Waste Management
183 MT
of MSW generated
84% collection
Majority of D2D collection done by private contractor
Future Projections
In 2019: 192 MT (Exponential)
In 2025: 199 MT (Exponential)
Open Dumping
15% open burnt;
No processing facility; No scientific Landfill

4.6 Solid Waste Management

Figure 24 Cuttack SWM Utilities map



4.6.1 Generation of Municipal Solid Waste

As per Swachha City Plan, Cuttack generates around 183 MT of municipal solid waste per day.[18]

4.6.2 Collection & Conveyance of Solid Waste

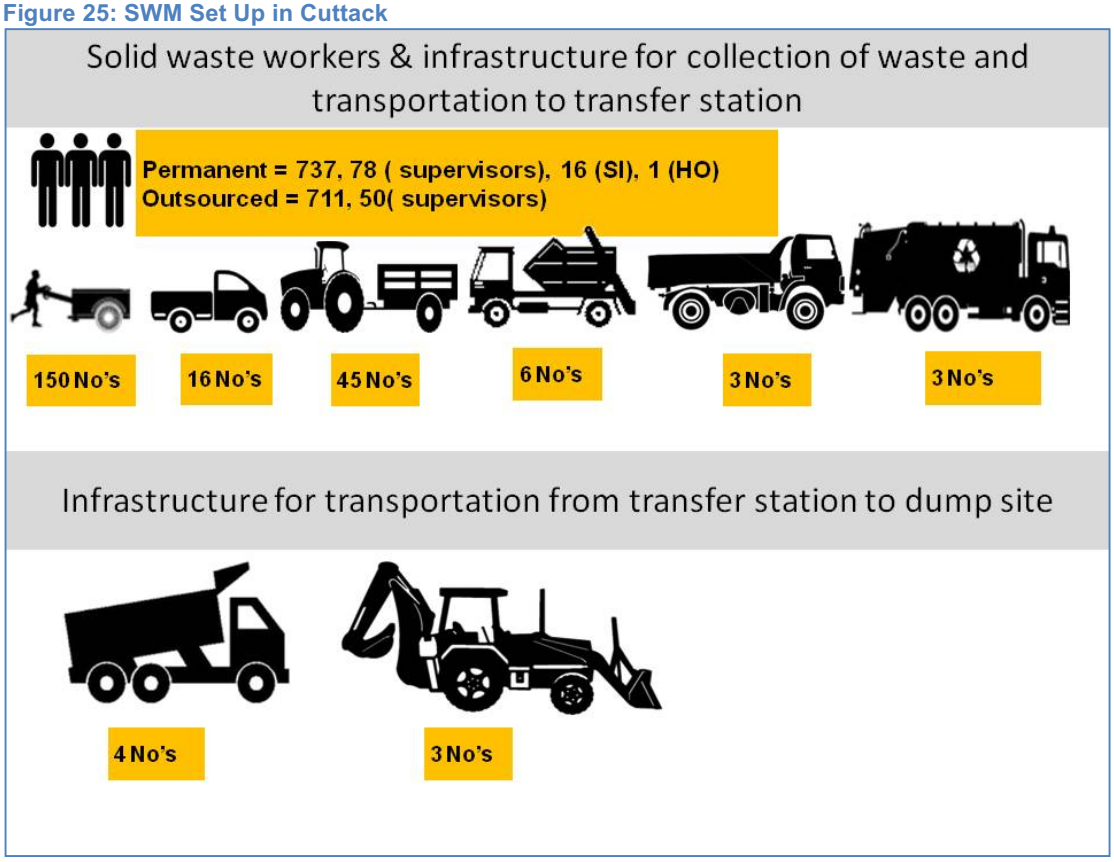
Household collection: In Cuttack, solid waste is collected through both door to door collection and collection from secondary and community bins. Door to door waste collection is carried out through private a service provider i.e. M/s Ramky Enviro Engineers Ltd. However out of 59 wards municipal wards only 4 wards are covered fully by door to door waste collection and 36 wards are partially covered. In the remaining 19 wards there is no door to door collection of waste.

Waste conveyance: 16 auto tippers, 45 tractors, 6 dumper placers, 3 trucks, 3 compactors are used for collection and transportation of mixed waste to transfer station located at Sati Chaura. As per Swachha city plan out of 183 MT generated on daily basis, only 154 MT are collected per day. From the transfer station all the waste is transported to the dumping site at Chakradharpur,

[18] Swachha Bharat City Plan, Cuttack Municipal Corporation (2017)

which is located 15 km away from the city boundary, using compactor trucks and 4 Hiwa trucks of 20 m³ capacity.[19]

Figure 25: SWM Set Up in Cuttack



4.6.3 Solid Waste Treatment & Disposal

There is no solid waste treatment plant in the city. There are 160 composting pits constructed at the transfer station at Sati Chaura, but these are not functional at present. All the waste from the city is transported to the Chakradharpur landfill which is spread across 25 acres of land. 10-15 informal rag pickers segregate recyclables from the waste at dumping yard but it is negligible in quantity. The entire waste generated in the city is being dumped untreated at the unscientific landfill. Regarding the landfill, however, it was learnt during the discussion at the city level stakeholder meeting on 28th June 2017 (see Project Activities and Timeline) that there is an impervious layer below dumping site at Chakradharpur.[20]

[19] Cuttack Municipal Corporation (2017)

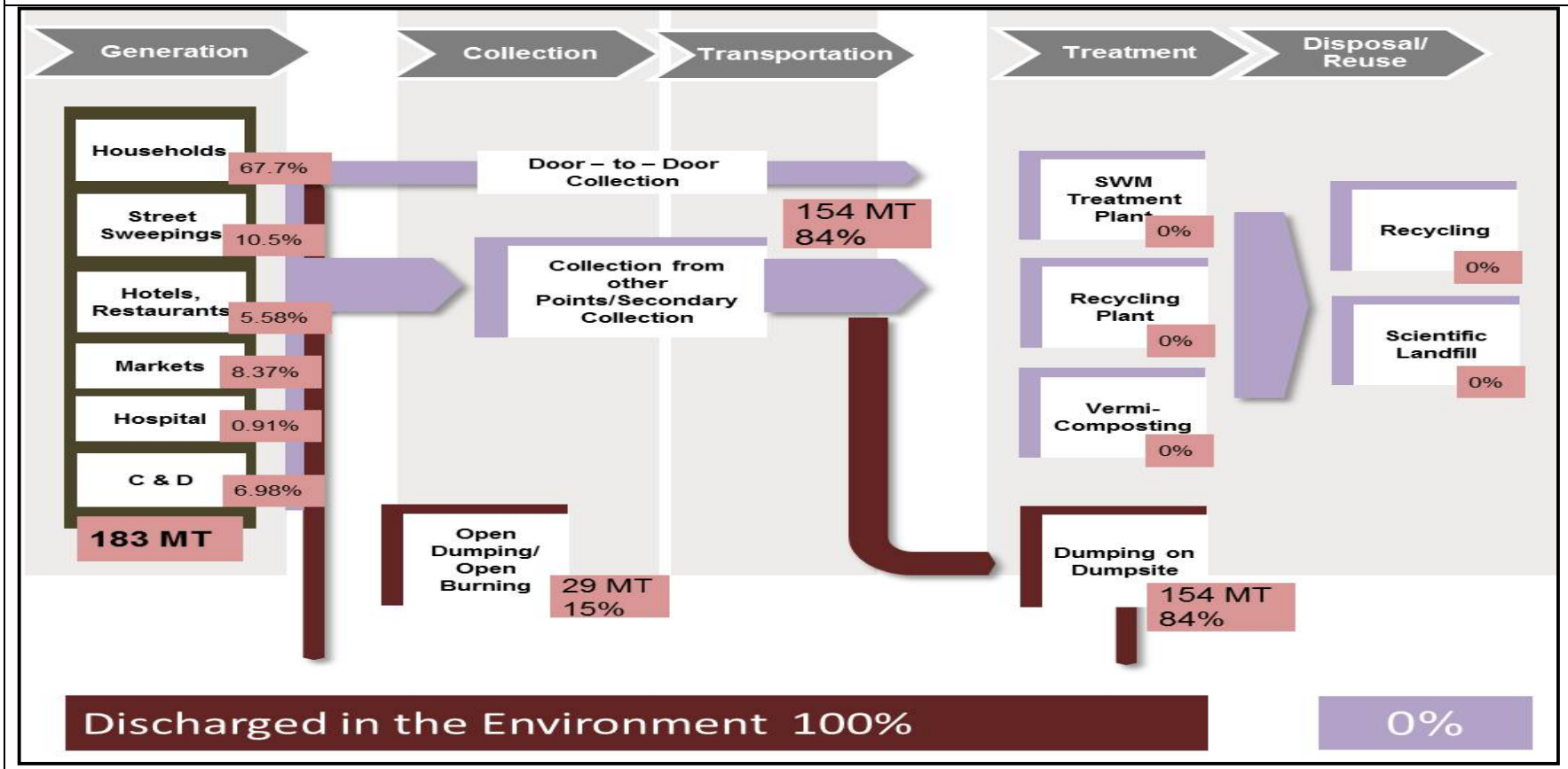
[20] Cuttack Municipal Corporation (2017)

4.6.4 Salient features of current Solid waste system

Figure 26: Process Flow Diagram for Solid Waste Management, CMC

Solid waste Management cycle in Cuttack

Generation → Collection → Transportation to Transfer station → Transportation to dumping site at Chakradharpur



Source: Cuttack Municipal Corporation (2017)

Table 23 Solid Waste Management- Current Situation, Gaps and Possible Recommendations

S. No.	Aspects/ parameters	Current situation	Issues/ Gaps	Possible Recommendations
1	Generation	• Total waste generated= 183 MT per day		
2	Collection and transportation	• Waste collection is carried out by both Municipal Corporation and Private Service providers. • Out of total 59 wards, only 4 wards are fully covered under door to door waste collection services whereas 36 wards are partially covered under door to door waste collection services and in remaining 19 wards there is no door to waste collection services. • As per Swacch Bharat City plan, out of 183MT waste generated only 154 MT (83%) of waste is collected.	• Collection of waste is not 100% • No door to door waste collection services in 19 wards • Segregation of waste is not managed at source • Labourures are differentiated for door to door waste collection, street sweeping and drain cleaning. • Increase in collection cost due to collection of unsegregated waste	**Solid Waste collection using Micro-pocket planning approach.** For efficient handling of the sanitation and solid waste management function, CMC is required to bundle the related activities (door to door collection, into three major work units based on the size and work load quantities. Work packages can be classified as follows:- •Residential Micro Pocket •Commercial and Bulk Solid Waste Handling •Mechanical Sweeping of Main Roads The SWM activities within one micro-pocket is supposed to be handled by one or two set of dedicated personnel who will work as a team and takecare of all the activities in the given micropocket. (refer Micro Planning Approach)
3	Segregation	• No household segregation happening	• No incentives given to promote segregation at source	• Provision of incentives in the form of property tax rebates or rebate on solid waste collection charges under polluters pay principle. • IEC campaign for awareness generation towards segregation of waste.

4	**Treatment/ Processing**	• No treatment of waste is happening at present. • There are 160 composting pits constructed at transfer station at Sati Chaura which are non-functional at present. • All collected waste is dumped at dumping yard at Chakradharpur. • Cuttack Municipal Corporation and Bhubaneswar Municipal Corporation together have plan of setting up 11MW waste to energy plant but due to protest from locals, BMC is not being able to go forward with the plan.	• All the 154MT of waste collected is dumped without any treatment and processing • Increase in garbage heaps affects environment due to release to greenhouse gases • Loss of resources in the form of recyclable materials (plastic, metals, glass, paper etc.) and compostable materials. • No scientific landfill for safe disposal of inert materials • No separate treatment happening for Bio medical waste and sanitary waste.	• Repair of the 160 composting pits at Sati Chaura to make them functional. • Material Recovery facility for recovering recyclable materials • C & D waste plant to handle construction and demolition waste • **Source Treatment for bulk generators:** Biogas plant at source reduction for bulk waste generators like vegetable Market • Separate incineration treatment for Bio medical and sanitary waste to be constructed under PPP mode. • Installation of Organic waste converter (OWC) machine at public parks for source reduction of waste[21]
5	**Policy**		• No holistic Soild waste management DPR prepared which is a mandate under Swaccha Bharat Mission	• Preparation of Solid waste management DPR for claiming funds under Swachha Bharat Mission

4.2.5 Projections for Solid Waste Generation

Table 24 Projection for solid waste generation

Progression Method	Year	Population	Solid waste generation (MT) (approx.)
Census 2011 Population	2011	6,10,189	183
Exponential	2019	6,38,775	192
	2025	6,61,089	199

For the purpose of projection, we are using exponential projections. (see Population Projection for Cuttack for details)

The solid waste generation has been calculated with the assumption that the per capita waste generation of the city will remain constant. The existing Chakradharpur Dump yard is already overflowing. The total capacity of the proposed centralised waste to energy plant at Bhuasuni is 600 MT. However, owing to the constant protest against it, the implementation

[21] All the above waste technologies are suggested based on general characteristics of Municipal Solid Waste in India. Swachha Bharat Mission (2016) Municipal Solid Waste Manual, Volume I, Page-43, Government of India.

will remain a challenge. Also, it will be shared by Cuttack Municipal Corporation and Bhubaneswar Municipal Corporation. Therefore, **even if the plant is set up, it will not be able to cater to all the waste generated in the city. Hence, it is important that maximum amount of waste is retrieved locally and sent through the reuse and recycle channels.** Therefore, the action plan focusses on maximum segregation to promote recycle and localised management of waste. The aim is to reduce the quantity of waste reaching the dump yard so as to enhance resource retrieve maximum resources from waste.

4.2.6 Action Plan

The key action points for improvement in solid waste management pertain to improvements in various segments in the value chain. At the user interface, policy and IEC interventions for household segregation are suggested. For the collection system, micro-pocket approach in which the city is divided into multiple micro-pockets and all the solid waste collection activities - door-to-door collection, road sweeping and drain cleaning- is assigned to one or two individual workers who will take care of all the activities. This will lead to increased accountability of workers and easy monitoring of their work. For treatment, it is suggested that the city must have dry resource collection centre/s in order to ensure that there is a place where the segregated dry waste collected is received and processed (or sent for processing from this facility). For bulk generator of wet waste, it is suggested that treatment units are made mandatory in order to manage the solid waste at source itself.

Table 25 Action plan for SWM

Issue 1		**Collection of waste**	**Cost**
Key Issue		1. No door to door waste collection services in 19 wards 2. Segregation of waste is not managed at source 3. Labourures are differentiated for door to door waste collection, street sweeping and drain cleaning. 4. Frequency of door to door waste collection is low in slums and lower income settlements.	
Goal		➢ 100% collection of solid waste generated in the city and 100% conveyance to the treatment/disposal site. ➢ To achieve 80% source segregation of waste	
Actions	**Short term (within 2 years)**	**Micro-pocket planning approach.** For efficient handling of the sanitation and solid waste management function, CMC is required to bundle the related activities (door to door collection, drain cleaning and road sweeping) into three major work units based on the size and work load quantities. Work packages can be classified as follows:- •Residential Micro Pocket •Commercial and Bulk Solid Waste Handling •Mechanical Sweeping of Main Roads The SWM activities within one micro-pocket is supposed to be handled by one or two set of dedicated personnel who will work as a team and takecare of all the activities in the given micropocket. (refer Micro Planning Approach) Steps involved: I. Clear demarcation of residential, commercial and main road sweeping pockets for carrying out the sanitation and solid waste management activities II. Clearly defining of job responsibilities and key	

		performance indicators for the service providers III. Making realistic estimates of resource requirements in rationalized and standardized manner (manpower, transportation vehicles, tools, implements and conservancy materials) IV. Develop clear resource inputs and results-outputs correlations to achieve standard service delivery results across the ULBs in a uniform manner. V. Identifying and developing clear wok quantities, key performance indicators and performance monitoring mechanisms, in the event of outsourcing complete work packages to private agenciesClear demarcation of areas and tasks for waste collectors. VI. Calculating total human resource requirements. It can be calculated as per 2 workers per micropocket who would undertake all the activities such as door to door waste collection, road sweeping and drain cleaning inside designated micropocket. (Refer to Micro Planning Approach) VII. For the micro-planning approach to succeed secondary bins should be removed from all the areas except high floating population areas. **Training** • Training for solid waste collection workforce for both Govt. and private waste collectors about waste collection process in micro pockets **IEC** • Household awareness campaigns about segregation of waste to be carried out by waste collectors • Getting local self-help groups (SHGs) and community based organisations (CBOs) involved in the IEC campaign for household segregation of waste **Policy** • Policy amendment for Provision of incentives in the form of property tax rebates or rebate on solid waste collection charges under polluters pay principle.[22]	
Issue 2		**Treatment/ Processing of waste**	**Cost**
Key Issue		1. All the 154 MT of waste collected is dumped without any treatment and processing 2. Increase in garbage heaps affects environment due to release to greenhouse gases 3. Loss of resources in the form of recyclable materials (plastic, metals, glass, paper etc.) and compostable materials. 4. No scientific landfill for safe disposal of inert materials	
Goal		➢ **Management of waste at source**	

[22] This model is being implemented In State of Andhra Pradesh.

Actions	**Short term (within 2 years)** **To Medium term (3- 5 years)**	**Technical** • Carry out waste composition study to know the actual content of wet and dry waste and composition of different materials like, biodegradable, paper, metals, glass etc. [23] • Mandating all bulk waste generators whose waste characteristics are mainly wet waste eg vegetable market, public parks etc. to treat waste at source by means of using technology opetions such as bio gas digestors and Organic waste converter to be outsourced to private service providers	• Prefeasibity study, waste compostion study, and a preparation of holistic solid waste management DPR= **Rs.7.5 lakhs** • Biogas digestor= **Rs.15-16 Lakhs per tonne** • Onsite composting (windrow)= **Rs.3-4 lakhs per tonne** • Onsite Composting (Vermicomposting)= **Rs. 5 lakhs per tonne** • Organic waste converter machine = Rs.4-5 lakhs per unit
Goal		➢ 100% treatment of waste at city level.	
Actions	**Short term (within 2 years)** **To Medium term (3- 5 years)**	**Technical** • Repair of the 160 composting pits at Sati Chaura Transfer Station. This will cater to the wet waste from residential micro-pockets. • Construction of new treatment facilities at city level: ○ Material Recovery Facility ○ C & D Waste Plant Exisiting SWM facility such as the Chakradharpur dumpyard can be used to locate the plants. **Training** • Training for supervisors and helpers.	• Material Recovery Facility= Assuming 40% of total waste as dry waste Total waste to be treated= 200 MT Capital cost = Rs.2-2.5 Crore (the above cost is just an indicative cost, however deatiled assessment study to be corried out before setting up the plant.) • C & D plant= Rs. 3.6 lakhs pe tonne.
Goal		➢ 100% treatment of Bio-medical and domestic sanitary waste.	
Actions	**Short term (within 2 years)**	**Technical** • Construction of incinaration facility to treat biomedical and sanitary waste. Exisiting SWM facility such as the Chakradharpur dumpyard can be used to locate the plants. **Financial** • O & M cost to be recovered from hospitals and clinics depending upon no. of beds.	Bio medical waste treatment plant= Rs. 40 Lakhs per tonne
Goal		➢ To achieve 100 % scientific disposal of inert waste by 2020.	
Actions	**Short term (within 2 years)**	**Technical** • Construction of construction of scientific landfill. **Operational** • For operations, there shold be 1 full time technical person, 2 supervisors, 4 helpers permanently stationed at sanitary landfill site.	

[23] Waste composition study should be carried out according to this given reference- Swachha Bharat Mission (2016) Municipal Solid Waste Manual, Volume II, Page-47, Government of India.

		Financial • SBM, 14th Finance Commission Grants, State Government Grants. **Training** • Training for supervisors and helpers.	
Issue 3		**Filling up of Chakradharpur Dump yard**	**Cost**
Key Issue		Chakradharpur Dump yard is fast filling up	
Goal		➢ **To make space for the waste that ends up in the landfill**	
Actions	**Short term (within 2 years)** **To Medium term (3- 5 years)**	• **Minimise the quantity of waste ending up at the landfill:** To treat maximum waste locally by implementation of source segregation and collection of waste; treating the wet waste at the composting units at Sati Chaura ; setting up an MRF centre for dry waste and localised processing of bulk waste. • **Dump yard reclamation:** Dumpsite reclamation is used to expand municipal solid waste landfill capacity, and avoid the high cost of acquiring additional land. It involves sorting out mixed municipal waste according to material size (oversized material, intermediate sized waste and soil or humus) by using a trommel. Dumpsite reclamation typically consists of two basic operations: excavating waste and screening waste. (refer Dumpsite Reclamation – Case Study of Gorai Dumping Ground, Mumbai)	

5 MT Treatment plant

Following are 3 technological options for treatment of 5 MT of waste to be installed at bulk waste generators, to achieve treatment of waste at source:

Table 26 Technological options for 5 MT Solid Waste Treatment plant

Technology options	Cost assumption	CapEx	OpEx	Odour issues	Space required
Biogas digestor	Rs.15-16 Lakhs per tonne	Rs.15-16 Lakhs (1 tonne) Rs.45-48 Lakhs (3 tonne) Rs.75-80 Lakhs (5 tonne)	O & M operations to be outsourced.	Low	9 sq.mt for 1-5 MT (System can be also buried under ground in places of space constraints.)
Onsite composting (windrow)	Rs.3-4 lakhs per tonne	Rs.3-4 Lakhs (1 tonne) Rs.9-12 Lakhs (3 tonne) Rs.15-20 Lakhs (5 tonne)	Less than Rs.2 per kg	High	6- 10 sq.mt for 1 – 5 MT (depends on height of the windrow)
Onsite Composting (Vermicomposting)	Rs.5 lakhs per tonne	Rs.5 Lakhs (1 tonne) Rs.15 Lakhs (3 tonne) Rs.25 Lakhs (5 tonne)	Less than Rs.2 per kg	Medium	5 Sq.mt(1 tonne) 15 sq.mt (3 tonne) 25 sq.mt (5 tonne)

- The above costs are calculated for a prototype facility of 1 tonne, 3 tonne and 5 tonne capacities for one bulk waste generator like vegetable market, Hotels, Hostels etc.
- Technology option should be selected based on space availability, odour issues and availability of funds.
- Advantages of biogas over windrow and vermicomposting is low space requirements, low odour issues and biogas generated can be converted into electricity and used for lighting of market premises and for cooking in case of bulk generators like hotels, hostels and restaurants.
- Total cost of installation of below 5 MT treatment plants should be calculated depending upon type of technology selected and number of bulk waste generators at which these facilities will be installed.

Table 27: Investment Plan for SWM interventions

Proposed Work	Cost assumption	Amount (CapEx)	Amount (OpEx)
Carring out Prefeasibity study, waste compostion study, and a preparation of holistic solid waste management DPR		7.5 Lakhs	
Biogas digestor	Rs.15-16 Lakhs per tonne	Rs.15-16 Lakhs (1 tonne) Rs.45-48 Lakhs (3 tonne) Rs.75-80 Lakhs (5 tonne)	O & M operations to be outsourced.
Onsite composting (windrow)=	Rs.3-4 lakhs per tonne	Rs.3-4 Lakhs (1 tonne) Rs.9-12 Lakhs (3 tonne) Rs.15-20 Lakhs (5 tonne)	Less than Rs.2 per kg[24]
Onsite Composting (Vermicomposting)	Rs.5 lakhs per tonne	Rs.5 Lakhs (1 tonne) Rs.15 Lakhs (3 tonne) Rs.25 Lakhs (5 tonne)	Less than Rs.2 per kg[25]
Organic waste converter machine		Rs.4- 5 lakhs (per unit)	Rs.0.1 lakhs per year
Material Recovery Facility (70 MT Dry waste)		Rs 1 crore Per plant	
Windrow composting (110MT wet waste)	Rs.3-4 lakhs per tonne	3.3-4.4 Crore	Less than Rs.2 per kg
C & D Plant	Rs.3.6 lakhs per tonne	To be calculated as per requirements.	
Bio medical waste treatment plant	Rs.40 lakhs per tonne	To be calculated as per requirements.	

[24] Amount may change according to place.
[25] Amount may change according to place.

4.6.7 Contractual amendments to solid waste service contracts for incorporating advantages of micro-pocketing planning approach in the collection and conveyance process

1. **Outsourcing of work as opposed to outsourcing of labourers**: This implies that the contract with private agencies for collection and conveyance of solid waste should be based on the work that needs to be done. The supervision and management of the labourers should be with the private agency and not the municipality. The municipality would be monitoring and evaluating only the work under taken.

2. **Different the pockets for solid-waste collection based on area wise and not on activities i.e. collection of waste, street sweeping and drain cleaning.** Refer to Micro Planning Approach for the detailed micro-pocket plan

3. **Incentivizing segregation process** – Building an incentive structure in the contract for waste collectors to advocate and push for more segregation at the HH level
4. **Waste collector has to double up as advocates for segregation in their respective micro-pockets**. For this appropriate capacity building has to done to enable this.

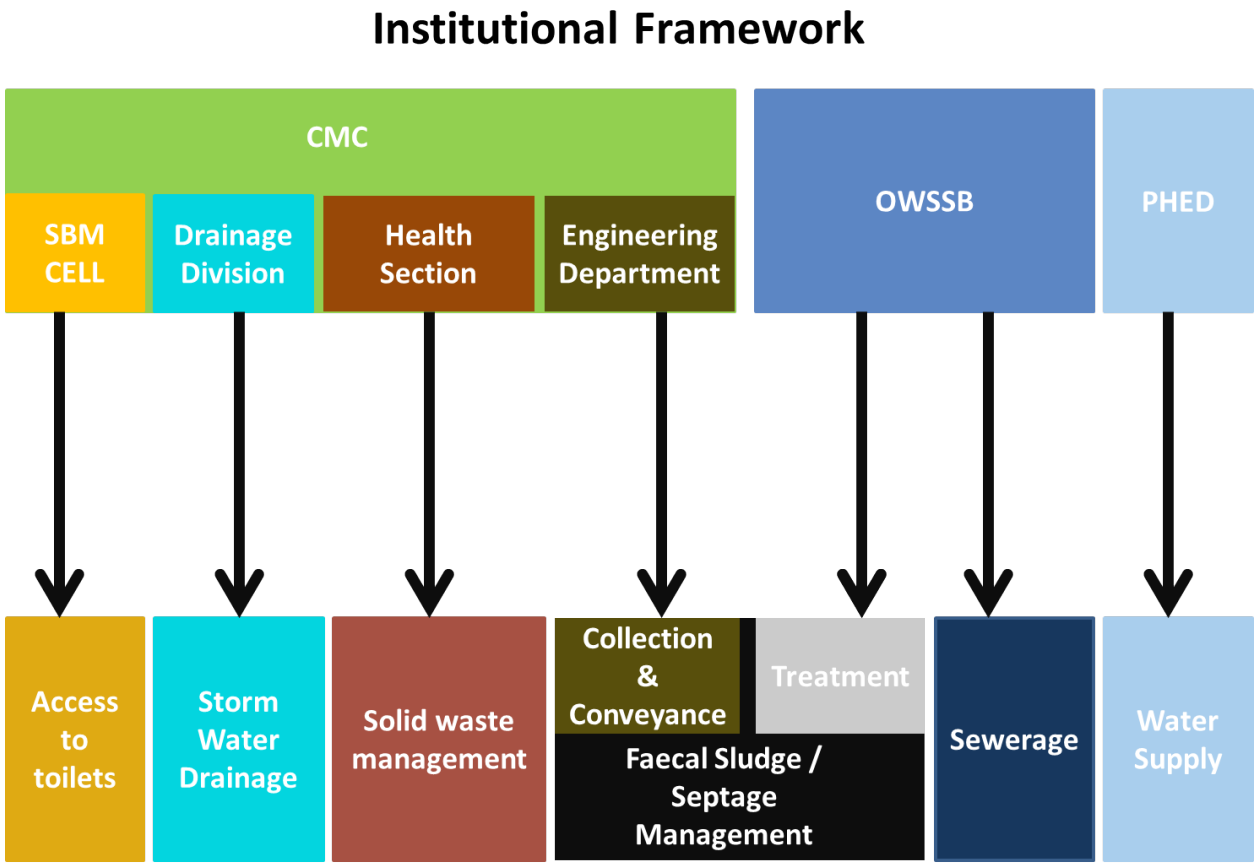
5 Institutions & Financial Capacity

5 INSTITUTIONAL & FINANCIAL CAPACITY GAPS

5.1 Institutional Framework

The following figure shows the Institutional Organogram for the Cuttack Municipal Corporation.

Figure 27 Institutional Framework for sanitation in Cuttack



A number of organisations are handling the sanitation infrastructure in Cuttack.

Cuttack Municipal Corporation (CMC) handles toilet construction (IHHL, CTs and PTs) through the SBM cell headed by the Slum Improvement Officer.
Solid waste management is carried out by Health Section headed by City Heath Officer
The Engineering Section is responsible for collection and conveyance of faecal sludge as it manages the operations of the cesspool vehicles maintained by CMC.
The responsibility of maintaining storm water drains and construction of the new drains is handled by the Drainage Division of the CMC.

Orissa Water Supply and Sewerage Board (OWSSB) is currently handling the treatment of faecal sludge since the construction of the Faecal Sludge/Septage Treatment Plant (FSTP/ SeTP) is with them.
Sewerage (construction of sewer network and sewage treatment plants; and managing household connections to the sewer) is also handled by the OWSSB.

Public Health Engineering Department is responsible for water supply (water treatment plants; managing household connections to the water supply; and connections to public stand posts).

5.2 Capacity Assessment

There are 2005 positions in the Cuttack Municipal Corporation, out of which 1445 positions are filled. 600 positions are vacant, which form a percentage of 29.93% of the total number of positions in the city.

5.3 Capacity Building Interventions

5.3.1 Access to Toilets

Workshop on introduction on hygienic sanitation

The one day workshop would be planned to provide a basic understanding of access to toilets to the officials of the cities. Workshop should me aimed to complete following training modules:-

- ✓ Introduction to current sanitation situation in India
- ✓ Importance of Swacch Bharat Mission and access to toilets
- ✓ Importance of Public health and hygiene
- ✓ Benchmarks
- ✓ Hygienic and unhygienic user interface

- ✓ Types of containment units.
- ✓ Public and community access to sanitation.

Target Group: Commissioners, Municipal Engineers, health officer, public representatives who are involved in provision of sanitation services and improvement in access to sanitation.

Workshop on Training for Toilet Builders on Onsite Sanitation Systems

Masons play a vital role in the overall faecal sludge value chain in construction of toilets and containment systems for the individual users in every city. The success of faecal sludge management in any city relies heavily on its onsite sanitation systems which includes the toilets, septic tanks. To ensure the sustainability of the activities, capacity building of the masons who are responsible for the construction of these facilities is mandatory.

The workshop is planned to create awareness on the significance of toilets in sanitation and its impact on environmental protection, to provide Mason's with technical knowledge and skills on the design and principles of the Onsite Sanitation Systems (OSS) as specified under Swachh Bharat Mission, to familiarise the participants with the construction norms and the specific requirements for construction of OSS Systems and to stress on the importance of O&M of these OSS Systems in order to understand the role played by the elements of the OSS relevant to O&M.

Target Group: Masons working in the Cuttack who have been building toilets under the Swachh Bharat Mission

5.3.2 Wastewater Management

5.3.2.1 Training of Sewage Treatment Plant Operators

The aim of these training sessions was to create a cadre of operators of STPs who have a strong understanding of the basic principles behind what they do, which gives them a foundation to work on as they operate and maintain the technology on which the STP is based. The operators who are responsible for the maintenance and upkeep of the treatment systems need to be abreast of the correct protocol and the basics behind operations they do on a daily basis.

Target Group: STP operators

5.3.3 Faecal Sludge Management

Appropriate and adequate management of faecal sludge from on-site containment systems is imperative for the protection of human and environmental health. Through these various capacity building activities, we intend to strengthen the knowledge and skills of the officials working with the various town municipalities on various aspects of Faecal Sludge Management.

We propose various capacity building activities through workshops which would address the current knowledge elements of this rapidly evolving field, and present an integrated solutions approach that includes technology, management and planning. It will focus on the planning and organisation of the entire faecal sludge management service chain, from the collection and transport of sludge and treatment options, to the final end-use or disposal of treated sludge.

In addition to providing fundamentals and an overview of technologies, the workshop will go into details of operational, institutional and financial aspects, and will provide guidance on how to plan a city-level faecal sludge management project with the involvement of all stakeholders.

The objectives of these proposed workshops are to:

- To provide participants with technical and practical knowledge and skills on the concept and principles of design and implementation of FSM in Indian context.
- To enable participants to gain knowledge and skills for systematic planning and implementation of a series of activities for collection, containment, transportation, treatment and safe disposal/reuse in FSM.

3 workshops are proposed as part of capacity building activities and both of them have different target groups and are aimed to achieve the objectives. The details of the workshops are discussed below.

Introduction on FSM

The one day workshop would be planned to provide a basic understanding of FSM to the officials of the cities. Upon completion of the one day workshop the participants will be able to appreciate the need of FSM in their city.

Target Group: Commissioners, Engineers & Planners of the cities who are involved in the management of sanitation infrastructures.

Introductory Workshop & Exposure visit on FSM

The two day workshop is planned to provide customised inputs towards the potential of the FSM activities in the city. The workshop would provide in-depth understanding of the methodology involved in planning FSM for a city and the participants will be able to get first-hand experience about operations of a FSTP.

Target Group: City Commissioners and State level officials who are involved in the planning of sanitation in state and city levels.

Location: Bangalore

Training for cesspool vehicle operators on using of technology integrated with faecal sludge transport and conveyance

A good quality, reliable faecal sludge transport and conveyance systems are required to ensure end-to-end Faecal Sludge Management services are provided by the city. The cesspool vehicle operators play an important role in the faecal sludge management.

The two day workshop is planned to provide overview of the technology integrated with faecal sludge transport and conveyance. The activities are designed in such a way that the cesspool operators get hands on experience with the technology which would strengthen the faecal sludge management. They will be provided with customised inputs towards the potential of the FSM activities in the city and how using the technology will help in addressing the key issues faced. The workshop would provide in-depth understanding of the technology and various aspects of undertaking a business/service in the form of desludging services for Cuttack.

Target Group: Cesspool operators working in Cuttack who have been handling desludging services and also potential desludging services in order to develop the team.

5.3.4 Solid Waste Management

Suitable and acceptable solid waste management techniques are necessary for the protection of human and environmental health. Through these various capacity building activities, we intend to strengthen the knowledge and skills of the officials working with the various town municipalities on various aspects of solid waste management right from waste collection to waste treatment and reuse.

We propose various capacity building activities through workshops which would address the current knowledge elements of this rapidly evolving field, and present an integrated solutions approach that includes technology, management and planning. It will focus on the planning and organisation of the entire solid waste management service chain, from the waste collection to waste treatment and reuse options.

Training should be carried out for following groups

1. Public representatives (ward counsellors, corporators, ward members)
2. Engineers, health officers and managers
3. Sanitary supervisors, sanitary inspectors and contractors supervisors
4. PH workers, sweepers and waste collectors
5. Household and commercial waste generators

Workshop on Introduction on Solid waste Management

The one day workshop would be planned to provide a basic understanding of SWM to the officials of the cities. Workshop should me aimed to complete following training modules:-

- ✓ Introduction to SWM in India
- ✓ Importance of SWM Rules 2016
- ✓ Best Practices in SWM
- ✓ SWM System -Implementation STEPS
- ✓ Infrastructure requirements for the short-term and long-term ISWM
- ✓ Benchmarks
- ✓ Ensuring proper records of daily work output
- ✓ Maintaining Cordial Relations with community
- ✓ Maintain complaints and feedback for waste generators.
- ✓ Handling the Workforce (Labour Management – challenges – welfare)

Target Group: Commissioners, Municipal Engineers, health officer, public representatives who are involved in the management of Solid waste infrastructures.

Training for waste collectors on sanitation and public health awareness

The one day workshop would be planned to provide a basic understanding of SWM to the solid waste collectors. Workshop should me aimed to complete following training modules:-

- ✓ Introduction to SWM in India
- ✓ Importance of SWM Rules 2016

- ✓ Best Practices in SWM
- ✓ Trainings on proper waste collection process.
- ✓ Trainings on micro pocketing, steps to increase efficiency of waste collection.
- ✓ Training on handling different types of wastes.

Target group- Sanitary supervisors, sanitary inspectors, contractor's supervisors, PH workers, sweepers and waste collectors responsible for collection and transportation of waste.

Training for waste generators on sanitation and public health awareness.

The one day workshop would be planned to provide a basic understanding of SWM to the solid waste generators i.e. general public and commercial establishment owners. Workshop should me aimed to complete following training modules:-

- ✓ Introduction to SWM in India
- ✓ Importance of SWM Rules 2016
- ✓ Best Practices in SWM
- ✓ Awareness creation about solid waste management and public health.
- ✓ Trainings on process of segregation of waste, storage of waste and handing over of waste to waste collectors in prescribed manner.
- ✓ Trainings of household treatment of waste eg. Composting, biogas etc.

Target group- General public, commercial establishment owners, and bulk waste generators.

5.4 Financial Capacity

This section provides a measure of the financial capacity of Cuttack to maintain the new infrastructure built in Cuttack. In maintaining new facilities like Public Toilets, and operating a city FSM, or water supply related activities such as increasing metering or the number of connections, the MC would have to undertake the operating expenses related to running these infrastructures, and so the existing gap in the water supply and sanitation budget is bound to increase. As such, the new interventions are proposed to make the MC as self-sufficient as possible.

The income and expenditure patterns under sanitation have been calculated for Cuttack Municipality by analysing the estimated budgets for the years of 2014-15, 2015-16, and 2016-17 respectively[26]. It has been observed that Cuttack registers a **surplus** of

[26] Source: Assessment of the Municipal Budgets for MC Cuttack (2014-15,2015-16 and 2016-17)

about 4.14% in 2014-15, 10.54% in 2015-16 and 0.70% in 2016-17. The maximum revenue generators are assigned revenue grants. These assigned revenue grants include AMRUT scheme funds, OUIDF loan and grants, HUDCO loans, Solid Waste Management Funds, NULM, Harish Chandra Sahayata Yojana, Swachha Bharat Mission, UIDSSMT Grants, SJSRY, IHSDP Grants, various infrastructure grants and tourism related grants.

Water Supply

In Cuttack, provision of water supply is the responsibility of the Public Health Engineer Organisation (PHEO), who handles the construction of the water supply related infrastructure, and is also responsible for the provision of connections and collection of revenue from the consumers. However, in this section, water supply revenue and expenditure components from the municipal budget are undertaken. Since there are no different budget heads for water supply, there can be investments for water supply under other budget components, which has also not been included.

In Table 28: Income Heads and Percentage for Water Supply- Cuttack Municipal Corporation (all figures in Rs. lakh), it can be observed that UIDSSMT grant for water supply form the major revenue component from water supply for the years 2014-15 and 2015-16, while AMRUT funds for water supply is the major budget component for 2016-17.

Table 28: Income Heads and Percentage for Water Supply- Cuttack Municipal Corporation (all figures in Rs. lakh)

Income Heads for Water Supply	2014-15	2015-16	2016-17
UIDSSMT Grant - Water Supply	3450 *(100%)*	4000 *(100%)*	-
Water Tax	-	-	1000 *(11.63%)*
AMRUT Water Supply	-	-	7600 *(88.37%)*
Total Income	**3450**	**4500**	**8600**

Source: Assessment of the Municipal Budgets for Cuttack Municipal Corporation (2014-15. 2015-16, 2016-17)

In Table 29: Expenditure Heads & Percentage for Water supply - Cuttack Municipal Corporation (all figures in Rs. lakh), it can be observed that UIDSSMT grants for water supply in and around Cuttack, Drainage (original and repair), and expenditure for AMRUT water supply form the major expenditure component from water supply and drainage for the years 2014-15 and 2015-16 and 2016-17 respectively.

Table 29: Expenditure Heads & Percentage for Water supply - Cuttack Municipal Corporation (all figures in Rs. lakh)

Expenditure Heads for Water Supply and Drainage	2014-15	2015-16	2016-17
Purchase of pumps, hose pipe, repair and maintenance & Tube-wells / Water Supply including Heat Wave, Flood & other Calamity Management	125 *(4.76%)*	175 *(100%)*	50 *(0.65%)*
U.I.D.S.S.M.T Grant- Water Supply in & around Cuttack city including provision for slum dwellers	2500 *(95.24%)*	-	
AMRUT Water Supply			7600 *(99.35%)*
Total Expenditure	**2625**	**175**	**7650**

Source: Assessment of the Municipal Budgets for Cuttack Municipal Corporation (2014-15. 2015-16, 2016-17)

It can be observed from the above budgets that CMC registers a surplus of 23% in 2014-15 in water supply. However, there is a need for a separate revenue and expenditure assessment for water supply within CMC, which would also be overseen by PHEO, who is responsible for water supply in CMC.

Storm Water Drainage

Storm water drainage is the responsibility of the Public Health and Engineering Organisation (PHEO). However, this section deals with the revenue and expenditure for storm water drainage in Cuttack's municipal budget, and does not include components from the PHEO.

In Table 30: Income Heads and Percentage for Storm Water Drainage - Cuttack Municipal Corporation (all figures in Rs. lakh), funds for dying water bodies form the major revenue component in 2014-15, while funds for both dying water bodies and drainage system at Cuttack Development Authority forms the major revenue components in 2015-16.

Table 30: Income Heads and Percentage for Storm Water Drainage - Cuttack Municipal Corporation (all figures in Rs. lakh)

Income Heads for Storm Water Drainage	2014-15	2015-16	2016-17
Dying Water Bodies	100 *(100%)*	100 *(50%)*	-
Drainage System at CDA	-	100 *(50%)*	-
Total Income	**100**	**200**	**-**

Source: Assessment of the Municipal Budgets for Cuttack Municipal Corporation (2014-15. 2015-16, 2016-17)

In Table 31: Expenditure Heads & Percentage for Storm Water Drainage - Cuttack Municipal Corporation (all figures in Rs. lakh), it can be observed that drainage (original and repair), and desilting of drains, remodelling and renovation form the major expenditure component from storm water drainage for the years 2014-15, while drainage (original and repair) form the major expenditure component for 2015-16 and 2016-17.

Table 31: Expenditure Heads & Percentage for Storm Water Drainage - Cuttack Municipal Corporation (all figures in Rs. lakh)

Expenditure Heads for Storm Water Drainage	2014-15	2015-16	2016-17
Drainage (Original & Repair)	200 *(41.67%)*	200 *(74.07%)*	50 *(100%)*
Drainage System at CDA	80 *(16.67%)*	50 *(18.52%)*	
Desilting of M.S.W.C.& B.S.W.C., Re-modelling & Renovation	200 *(41.67%)*	-	
Procurement of Suction Machine & Jetting Machine		20 *(7.41%)*	
Total Expenditure	**3155**	**495**	**7700**

Source: Assessment of the Municipal Budgets for Cuttack Municipal Corporation (2014-15. 2015-16, 2016-17)

There is a huge disparity in the revenue and expenditure amounts in storm water management, which results a huge deficit in the budget for storm water management. Therefore, it reflects the need for a separate ledger for storm water drainage in the budget documentation for CMC.

Sewerage and Wastewater Management

In Cuttack, execution of sewerage and wastewater projects is the responsibility of the OWSSB. However, maintenance of existing sewerage projects is the responsibility of the Municipal Corporation. In this section, sewerage and wastewater revenue and expenditure components from the municipal budget are taken into consideration. There are no different budget heads for sewerage and wastewater in the municipal budget, and there may be some budget heads with a sewerage and wastewater component in its combined figure. However, those heads have not been included since it is not possible to differentiate the components.

In Table 32: Income Heads & Percentage for Sewerage and Wastewater Management- Cuttack Municipal Corporation (all figures in Rs. lakh), it can be observed that funds for grants for dying water bodies, JAICA, and AMRUT funds for septage management form the major revenue component from sewerage and wastewater management for 2014-15, 2015-16 and 2016-17 respectively.

Table 32: Income Heads & Percentage for Sewerage and Wastewater Management- Cuttack Municipal Corporation (all figures in Rs. lakh)

Income Heads for Sewerage and WW Management	2014-15	2015-16	2016-17

User charges for cleaning of latrine tank (sludge pump)	4 *(1.96%)*	5 *(0.8%)*	10 *(1.64%)*
Sewerage treatment plant at Matgajpur (Non-plan funds)	100 *(49.02%)*	100 *(16%)*	-
JAICA	-	420 *(67.2%)*	-
AMRUT Septage Management	-	-	600 *(98.36%)*
Dying Water Bodies	100 *(49.02%)*	100 *(16%)*	-
Total Income	**204**	**625**	**610**

Source: Assessment of the Municipal Budgets for Cuttack Municipal Corporation (2014-15. 2015-16, 2016-17)

In Table 33: Expenditure Heads & Percentage for Sewerage and Wastewater Management- Cuttack Municipal Corporation (all figures in Rs. lakh), it can be observed that expenditure from privatisation of sanitation work / job contracts form the major expense head in 2014-15 and 2016-17, while expenditure on the JAICA project forms the major expenditure component in 2015-16.

Table 33: Expenditure Heads & Percentage for Sewerage and Wastewater Management- Cuttack Municipal Corporation (all figures in Rs. lakh)

Expenditure Heads for Sewerage and WW Management	2014-15	2015-16	2016-17
Purchase of Conservancy Articles	75 *(14.73%)*	100 *(9.85%)*	80 *(2.83%)*
Latrines, Urinals and Public Toilets, I.E.C. and other Health Awareness Activities including Jalachatra.	32 *(6.29%)*	30 *(2.96%)*	20 *(0.71%)*
Privatisation of sanitation work / job contracts	300 *(58.94%)*	300 *(29.56%)*	2076 *(73.46%)*
Latrine Loan recovery	2 *(0.39%)*	-	-
Sewerage Treatment at Matgajpur	50 *(9.82%)*	50 *(4.93%)*	-
Procurement of sludge pumps & its water tanker including Mosquito Control equipment.	-	-	25 *(0.88%)*
Procurement of Suction Machine & Jetting Machine including treatment plant at Bhuasuni	-	-	25 *(0.88%)*
Procurement of 2 sludge pumps & its water tanker	-	35 *(3.45%)*	-
JAICA	-	350 *(34.48%)*	-
Public Toilet	-	100 *(9.85%)*	-
AMRUT-Septage Management			600 *(21.23%)*
Water body	50 *(9.82%)*	50 *(4.93%)*	-
Total Expenditure	**509**	**1015**	**2826**

Source: Assessment of the Municipal Budgets for Cuttack Municipal Corporation (2014-15. 2015-16, 2016-17)

From the above table, it can be observed that for all the years, CMC registers a deficit in wastewater management and FSM. However, this includes revenue and expenditure components as included in the municipal budget. Since CMC is undergoing the construction of the STPs, SeTP and also the construction of wastewater drains, there will be no returns on the investment from the infrastructure unless it is fully constructed. The OWSSB should work with CMC to have an efficient revenue system for the sewerage and FSM infrastructure constructed.

Solid Waste Management

In Cuttack, solid waste management is the responsibility of the Municipal Corporation. Solid waste management has a separate component in the budget document.

InIncome Heads & Percentage for SWM- Cuttack Municipal Corporation (all figures in Rs. lakh), it can be observed that state funds for solid waste management form the major revenue component from solid waste management for 2014-15, 2015-16 and 2016-17.

Table 34: Income Heads & Percentage for SWM- Cuttack Municipal Corporation (all figures in Rs. lakh)

Income Heads for Solid Waste Management	2014-15	2015-16	2016-17
Solid Waste Management (State)	50 *(100%)*	50 *(91.74%)*	40 *(89.89%)*
Fees for stacking of materials & rubbish on public streets & lifting	-	4 *(7.34%)*	4 *(8.99%)*
Hire Charges of JCB / Roller / Bobcat	-	0.5 *(0.92%)*	0.5 *(1.12%)*
Total Income	**50**	**54.5**	**655**

Source: Assessment of the Municipal Budgets for Cuttack Municipal Corporation (2014-15. 2015-16, 2016-17)

In Table 35: Expenditure Heads & Percentage for SWM- Cuttack Municipal Corporation (all figures in Rs. lakh), it can be observed that expenditure from the Integrated SWM (transportation of garbage and debris & door to door garbage collection & other sanitation work) form the major expenditure component from solid waste in all the years.

Table 35: Expenditure Heads & Percentage for SWM- Cuttack Municipal Corporation (all figures in Rs. lakh)

Expenditure Heads for Solid Waste Management	2014-15	2015-16	2016-17
Procurement of Baytex, ML Oil, Malathion, Phenyle, Bleaching Powder & other antilarva.	-	-	100 *(20.49%)*
Stray dog sterilisation, V.S. Wing activities, Sanitation of office & other CMC building	25 *(1.64%)*	40 *(1.30%)*	43 *(8.81%)*

Expenditure Heads for Solid Waste Management	2014-15	2015-16	2016-17
Integrated SWM (transportation of garbage and debris & door to door garbage collection & other sanitation work)	1500 *(98.36%)*	3000 *(97.40%)*	300 *(61.48%)*
Procurement of 2 Medium Fogging Machines with AMC	-	20 *(0.65%)*	20 *(4.10%)*
Fogging Operation & cost of POL, HSD & Labour Charges	-	20 *(0.65%)*	25 *(5.12%)*
Total Expenditure	**1525**	**3080**	**488**

Source: Assessment of the Municipal Budgets for Cuttack Municipal Corporation (2014-15. 2015-16, 2016-17)

In solid waste management, CMC registers a deficit in all the three years. However, the huge disparity reflects on certain heads which may have been combined with other sectors of expenditure, Therefore, there is a need for a separate revenue and expenditure assessment for SWM within CMC, which would also be overseen by the SBM officials within the MC, who are in charge of the operations.

The Cuttack Municipal Corporation budget calculates revenue and developmental budget accounts. The revenue income budget has heads on taxes and fees, rent, own source income. The developmental income budget includes SFC and grants awarded to the municipality. The revenue expenditure budget has heads on own income expenditure, delegated functions, maintenance/ repair / depreciation of assets and other expenditure heads. The developmental expenditure budget has expenditure from the SFC and grants awarded.

Budget components from other organisations related to water supply and sanitation, such as OWSSB and PHEO will be detailed in the next phase when the solutions are formulated for each of the sectors.

Table 36: Municipal Income across all sanitation sectors

Sector	Income in Municipal Budget (in crores)
Access to Toilets	-
Storm water management	2
Wastewater management	6.25
Solid waste management	5.45

Source: Assessment of the municipal budgets of Cuttack and Odisha SAAP for 2016-17

In the above table, the municipal budget of 2015-16 shows the total income for all the sanitation sectors as Rs. 13.7 crores. The total allocation under SAAP is Rs. 85.64 crores. Therefore, depending on the discretion of the municipality and suitability of technological options, interventions can be planned for Cuttack.

6 Implementation & Rollout Plan

6 IMPLEMENTATION AND ROLL-OUT PLAN

Table 37: Indication of Phases

Phase	Time Period	Characteristics
Short Term	Upto 2 years	Urgent improvements that require some planning steps
Medium Term	3- 5 years	Recommendations with a significant impact; needs more elaborate planning steps and requires substantial funding
Long Term	5- 10 years	Recommendations for the sustainable functioning of the system and adaptation to future developments

Table 38: Phase-Wise Implementation of Actions

Phase	Activity
Improvements in Water Supply	
Short Term	• The focus should be on improving water supply distribution to create more equitable distribution of water. • Completion of upcoming projects which include improving of water supply infrastructure by means of improvement in water metering; construction of water treatment plant and improvement of water supply to uncovered areas.
Medium Term	• Improvement of water supply to the uncovered areas, including slum areas
Improvements in Toilet Access	
Short Term	• Constructing **20328 IHHL** (as per exponential projection) by 2019. • Repairing **234 defunct CT seats** by 2019 • **Repairing the 92 defunct PT seats**. • Mandating connections to sewer network in sewered areas and to septic tanks or localised treatment systems in case of unsewered areas. • **Awareness programs** focussed on the environmental and health issues faced due to open defecation for households and other communities. • Training on the O&M mechanisms for individual toilets. • Increasing the incentive given to households in order to meet the actual expenditure incurred in building toilets IHHL. In order to achieve this, other sources of funding apart from SBM needs to be approached. (Refer Fund Mobilisation for IHHL) • Policy measures discouraging individuals to go for open defecation should be formalised- this would include penalties, incentives for construction of individual toilets, and others
Medium Term	• Upgradation of households with public/ community toilets to individual toilets. If funds and conditions are viable, households should be encouraged to construct individual toilets.
Long Term	• Constructing **771 IHHL** by 2025.
Storm water Management	

Short Term	• To increase drain coverage
	  ○ The **newly constructed drains should be constructed kuchcha drains (wherever possible)**. (refer Natural Drains of Cuttack)
	• For solving water logging problems:
	  ○ **Improving inlets** into the existing drains by unclogging inlet pipes; and switching to alternate covering such as mesh cover.
	• Addressing the problem of wastewater in drains

	○ Stopping the entry of wastewater into the storm water drain ○ Maintaining and increasing the number of natural drains since it would enable the drain ecosystem can handle small quantities of wastewater
Medium Term	• Addressing the problem of wastewater in drains ○ Treating the wastewater in the drains by using bio-remediation techniques. • For solving water logging problems: ○ **Water sensitive urban design using swales and raingardens**
Wastewater Management	
Short Term	• **Implementation of localised conveyance and treatment solution** in clusters left out of the sewered areas as suggested in the Approaches for wastewater management in unsewered pockets and newly constructed multi-storeyed building • **Ensuring last mile connectivity for the sewer network** in areas covered under sewer system ○ IEC activities for citizens to connect to the sewer network ○ Legal enforcement for mandating connections in sewered areas ○ Incentivising or subsiding the sewer connection cost to households. • Training of operators
Medium Term	• Identifying potential reuse options
Long Term	• **Bulk generators of sewage** such as apartments and institutions; and any new multi-storeyed buildings can be mandated **to treat their wastewater at source** in order to reduce the pressure on the centralised sewer infrastructure.
Improvements in Faecal Sludge Management	
Short Term	• **Implementation of standard containment size code regulations** • **Awareness/IEC campaigns on open defecation** and other aspects, training the operators on standard practices and safety measures for collection and conveyance • **Masons training** for building the containment systems • Adhering to **Odisha Urban Septage Management Guidelines, 2016.** • **Monitoring of private and government cesspool vehicles** by mandating **GPS and other ICT** interventions. • **Mandating safety gears** to be given to government operators private operators • Separate account for handling government cesspool vehicles. • Maintain the **database of private operators** • Mechanisms to fill the form by the customer availing the desludging service which has to be submitted at the MC/during the disposal. • **Licensing the private operators** and periodic renewal • Complete SeTP by end of 2017 • **Introducing temporary transfer stations** at the SWM transferstations in the form of huge tanks for disposal of FS • Depending on the need, tankers of 15,000- 20,000 Litres may be required to transport faecal sludge from the tranfer station to the SeTP. • **Capacity building of ULB and operators for handling the SeTP** • **IEC campaign with the cesspool operators** both private and government for behaviour change regarding the disposal • Co-compost plan for enhancing the nutrient value • **Plan for selling the dried and co-composted FS to farmers** and through collaboration chemical fertilisers companies to sell it as a part of their product. • Converting the dried FS into co-compost for enriching the nutrient content • To encourage reuse among the farmers through IEC campaigns • **Treated FS Reuse policy** to be formulated for the city
Medium Term	• **Procure 3-4 Gulpur machines /small cesspool** vehicles where the existing cesspool vehicles cannot access

	• **Different business models assessment for financial sustainability** of the SeTP. • **Inclusion of property tax as part of making the operations of SeTP sustainable** • **Policy resolution leading to 100% disposal and treatment of the FS generated** • Exploring possibilities of using Black soldier flies usage of solar energy at the SeTP • Exploring possibilities to sell for cement industries/ brick factories
Long Term	• **Scheduled desludging should be implemented** by incorporating user fee or property tax incorporation
Solid Waste Management	

Short Term to medium term	• Implementation of **Micro-pocketing approach** for solid waste collection (Refer to Micro Planning Approach)
	• **Household awareness campaigns about segregation of waste** to be carried out by waste collectors
	• Policy amendments for provision of incentives in the form of property tax rebates or rebate on solid waste collection charges under polluters pay principle.
	• Carry out waste composition study to know the actual content of wet and dry waste and composition of different materials like, biodegradable, paper, metals, glass etc.
	• **Mandating all bulk waste generators** whose waste characteristics are mainly wet waste eg vegetable market, public parks etc. **to treat waste at source** by means of installation of biogas digester/ onsite composting system/ Organic waste Converter (OWC) machines in the bulk waste generation sites.
	• Identify and Demarcate land parcel for construction of Material Recovery Facility (MRF) for recyclable dry waste and C & D waste plant at Chakradharpur dumpyard.
	• Repair of the 160 composting pits at Sati Chaura Transfer Station. This will cater to the wet waste from residential micro-pockets.
	• **Construction of new treatment facilities at city level**:
	  ○ Material Recovery Facility
	  ○ C & D Waste Plant
	  ○ Incineration facility for biomedical waste
	  ○ Scientific landfill for inert waste
	• **Training for solid waste management personnels-** from the gound level worker to the officials implementing the systems.
	• **Land reclamation from Chakradharpur Dumpyard.**

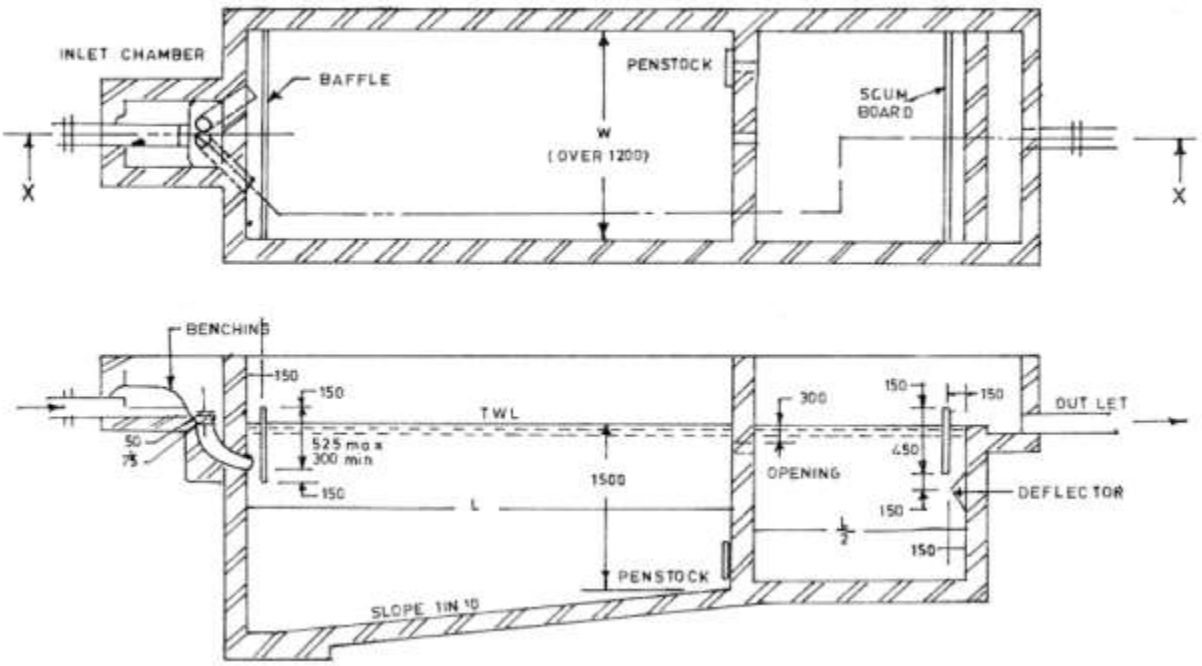
Long Term	• Integrating the solid-liquid waste treatment at the same location

7 Annexures

7 ANNEXURE

7.1 Toilet Designs

Figure 28: Typical sketch of a two- compartment septic tank for 5 users (dimensions in mm)



Source: Manual on Sewerage and Sewage Treatment Systems, 2013, Part A: Engineering

7.2 Existing Community Toilet & Public Toilet Status

Table 39 Existing CT & PT Status

INFORMATION REQUIRED FOR EXISTING CT & PT AND ITS STATUS													
SN	Ward No.	Location Name	Mention Category (CT / PT)	Year of Construction	Total No. of Seats	No. of Seats for Male		No. of Seats for Female		No. of Urinals For Male		No. of Urinals for Female	
						Functional	Defunct	Functional	Defunct	Functional	Defunct	Functional	Defunct
1	11	COLLECTORIATE	PT	2002	10	3	2	1	4	2	0	0	0
2	25	BUXI BAZAR	PT	1988		10	0	4	1	0	0	0	0
3	16	GADAGADIA CHAMABANA	PT	2006	10	7	0	2	1	0	0	0	0
4	31	RANIHAT CANAL ROAD	PT	1984	28	10	4	10	4	0	0	0	0
5	27	RAUSAPATANA	PT	1983	25	14	3	4	4	0	0	0	0
6		UCHA SAHI	PT	25 yrs before(approx.)	15	5	0	10	0	0	0	0	0
7	35	MEDICAL CAMPUS	PT	1984	30	11	0	4	2	0	0	0	0
8	21	PURIGHAT PANASAHI	PT	25 yrs before(approx.)	10	3	2	3	2	0	0	0	0
9	38	MALGODAM	PT	1985	17	11	0	4	2	0	0	0	0
10	39	COLLEGE SQUARE	PT	1987	8	6	0	2	0	3	0	0	0
11	39	PATARA SAHI	PT	1982	20	10	0	10	0	0	0	0	0
12	40	JOBRA FISH MARKET	PT	2002	10	5	0	4	1	1	0	0	0
13	44	BADAMBADI	PT	30yrs before(approx.)	27	18	2	7	2	0	0	0	0
14	49	JAGATPUR	PT	2007	11	7	0	4	0	0	0	0	0
15	11	SISHUBHABAN	PT	2010	10	6	1	3	0	0	0	0	0
16	29	RAJABAGICHA	PT	2002	8	0	5	0	3	0	0	0	0
17	38	PILIGRIM ROAD	PT	30 yrs	10	0	5	0	5	0	0	0	0

INFORMATION REQUIRED FOR EXISTING CT & PT AND ITS STATUS													
SN	Ward No.	Location Name	Mention Category (CT / PT)	Year of Construction	Total No. of Seats	No. of Seats for Male		No. of Seats for Female		No. of Urinals For Male		No. of Urinals for Female	
						Functional	Defunct	Functional	Defunct	Functional	Defunct	Functional	Defunct
				before(approx.)									
18	6	KRUSAK BAZAR	PT	2008	10	0	7	0	3	0	0	0	0
19	26	NIMA SAHI(SILPI KUMBHARA SAHI)	PT	15 yrs before(approx.)	10	0	5	0	5	0	0	0	0
20	38	CHATRABAZAR	PT	30 yrs before(approx.)	14	0	14	0	0	0	0	0	0
21	35	MEDICAL CANCER WARD	PT	30 yrs before(approx.)	10	0	5	0	5	0	0	0	0
22	3	BIDANASI MUNDA SAHI(S)	CT	10 yrs before(approx.)	16	2	6	3	5	0	0	0	0
23	3	BIDANASI MUNDA SAHI(N)	CT	10 yrs before(approx.)	16	3	5	3	5	0	0	0	0
24	1	BIDANASI NUA SAHI	CT	7 yrs before(Approx.)	6	3	0	3	0	0	0	0	0
25	6	HAIRANPUR	CT	8 yrs before (approx.)	12	0	6	0	6	0	0	0	0
26	29	RAJABAGICHA	CT	15 yrs before(approx.)	10	0	5	0	5	0	0	0	0
27	11	HADAGADIA	CT	10 yrs before(approx.)	10	0	5	0	5	0	0	0	0
28	26	NIMA SAHI(PANA SAHI)	CT	15 yrs before(approx.)	10	0	5	0	5	0	0	0	0
29	29	KUSUMPUR	CT	20 yrs	6	0	3	0	3	0	0	0	0

INFORMATION REQUIRED FOR EXISTING CT & PT AND ITS STATUS													
SN	Ward No.	Location Name	Mention Category (CT / PT)	Year of Construction	Total No. of Seats	No. of Seats for Male		No. of Seats for Female		No. of Urinals For Male		No. of Urinals for Female	
						Functional	Defunct	Functional	Defunct	Functional	Defunct	Functional	Defunct
				before (approx.)									
30	1	BIDANASI	CT	20 yrs before(approx.)	16	1	7	1	7	0	0	0	0
31	8	TULSIPUR TANLASAHI	CT	25 yrs before(approx.)	10	0	5	0	5	0	0	0	0
32	16	GORAKABAR	CT	10yrs before(Approx.)	20	2	8	2	8	0	0	0	0
33		TULASIPUR REFUSE COLONY	CT	27 yrs before(approx.)	10	3	2	3	2	0	0	0	0
34	4	DEULASAHI	CT	20yrs before (approx.)	10	4	1	3	2	0	0	0	0
35	10	SIDHESWAR SAHI	CT	20 yrs before(Approx.)	4	1	1	1	1	0	0	0	0
36	10	MANSINGH PATANA	CT	40 yrs before(Approx.)	10	0	5	0	5	0	0	0	0
37	25	BUXI BAZAR POLICE LINE	CT	1996	20	0	12	2	6	0	0	0	0
38	17	SUTAHAT	CT	25 yrs before(approx.)	28	9	5	10	4	0	0	0	0
39	19	DEWAN BAZAR	CT	30 yrs Before(Approx.)	10	2	3	2	3	0	0	0	0
40	23	CHOUDHURY BAZAR MATHASAHI	CT	1997	10	5	0	5	0	0	0	0	0

INFORMATION REQUIRED FOR EXISTING CT & PT AND ITS STATUS													
SN	Ward No.	Location Name	Mention Category (CT / PT)	Year of Construction	Total No. of Seats	No. of Seats for Male		No. of Seats for Female		No. of Urinals For Male		No. of Urinals for Female	
						Functional	Defunct	Functional	Defunct	Functional	Defunct	Functional	Defunct
41	37	SANKARPUR	CT	30 yrs before(approx.)	10	2	3	3	2	0	0	0	0
42	31	RANIHAT SAGADIA SAHI	CT	30 yrs before(approx.)	20	0	10	0	10	0	0	0	0
43	33	THORIASAHI	CT	2010	10	5	0	3	2	0	0	0	0
44	38	CHHATRA BAZAR BEHERA SAHI	CT	1987	8	2	2	2	2	0	0	0	0
45		CHHATRA BAZAR (LADIES)	CT	Dismantled						0	0	0	0
46	41	JOBRA NADIKULA SAHI	CT	2016(Renovated)	20	10	0	10	0	0	0	0	0
47		KALIABODA (NEW)	CT	2005	19	2	7	4	6	0	0	0	0
48	50	UTKAL BALASHRAM(NEW)	CT	2004	8	8	0	0	0	0	0	0	0
49	47	OMP CAMPUS	CT	27 yrs before(approx.)	20	8	2	5	5	0	0	0	0
50	54	NEHRUPALLI	CT	2011	10	2	8	0	0	0	0	0	0
51	51	TINIGHARIA	CT	2005	20	3	7	3	7	0	0	0	0
52		PITHAPUR PANA SAHI	CT	25yrs before(Approx.)	6	3	0	3	0	0	0	0	0
53	42	CHAULIAGANJ MANGALA SAHI	CT	2016	10	6	0	4	0	0	0	0	0
54		MALGODAM BEHERA SAHI	CT	1987	12	6	0	6	0	0	0	0	0
					407	92	123	81	111				

7.3 Ward-wise slum population and community Toilet estimation

Table 40 Ward-wise slum population and community toilet estimation

Data Received				Data inferred Number of toilet seats		
Ward No.	**Male**	**Female**	**Total Popln.**	**Male**	**Female**	**Total**
WARD-0001	3303	3065	6368	95	123	218
WARD-0002	1320	1247	2567	38	50	88
WARD-0003	2397	2203	4600	69	89	158
WARD-0004	1290	1245	2535	37	50	87
WARD-0005	1616	1566	3182	47	63	110
WARD-0006	487	491	978	14	20	34
WARD-0007	334	313	647	10	13	23
WARD-0008	1367	1249	2616	40	50	90
WARD-0009	1212	1160	2372	35	47	82
WARD-0010	347	317	664	10	13	23
WARD-0011	982	922	1904	29	37	66
WARD-0012	806	795	1601	24	32	56
WARD-0013	989	945	1934	29	38	67
WARD-0014	1948	1977	3925	56	80	136
WARD-0015	682	622	1304	20	25	45
WARD-0016	2300	2207	4507	66	89	155
WARD-0017	627	568	1195	18	23	41
WARD-0018	457	410	867	14	17	31
WARD-0019	359	319	678	11	13	24
WARD-0020	1606	1623	3229	46	65	111
WARD-0021	371	355	726	11	15	26
WARD-0022	2642	2483	5125	76	100	176
WARD-0023	1079	1049	2128	31	42	73
3	2470	2230	4700	71	90	161
WARD-0024	653	686	1339	19	28	47
25	433	406	839	13	17	30
WARD-0025	598	609	1207	18	25	43
WARD-0027	1551	1407	2958	45	57	102
WARD-0028	117	126	243	4	6	10
WARD-0029	1423	1325	2748	41	53	94
WARD-0030	846	787	1633	25	32	57
WARD-0031	1128	1113	2241	33	45	78
WARD-0032	725	707	1432	21	29	50
WARD-0033	1835	1796	3631	53	72	125

Data Received				Data inferred Number of toilet seats		
Ward No.	**Male**	**Female**	**Total Popln.**	**Male**	**Female**	**Total**
WARD-0034	2585	2601	5186	74	105	179
WARD-0035	1093	1058	2151	32	43	75
14	139	112	251	4	5	9
WARD-0036	1155	1117	2272	33	45	78
WARD-0037	1103	1152	2255	32	47	79
WARD-0038	1792	1664	3456	52	67	119
WARD-0039	255	235	490	8	10	18
WARD-0040	413	411	824	12	17	29
WARD-0041	1240	1227	2467	36	50	86
WARD-0042	529	495	1024	16	20	36
WARD-0043	134	138	272	4	6	10
WARD-0044	1709	1698	3407	49	68	117
WARD-0045	2279	2215	4494	66	89	155
WARD-0046	1020	970	1990	30	39	69
WARD-0047	2146	1928	4074	62	78	140
WARD-0048	404	384	788	12	16	28
WARD-0049	131	128	259	4	6	10
WARD-0050	1515	1372	2887	44	55	99
WARD-0051	2205	2160	4365	63	87	150
WARD-0052	4048	3887	7935	116	156	272
WD-026	64	60	124	2	3	5
WARD-0053	1814	1740	3554	52	70	122
WARD-0054	532	544	1076	16	22	38
12	1417	1307	2724	41	53	94
TOTAL	70,022	66,926	136,948	2029	2705	4734

7.4 Solid Waste Management Options

7.4.1 Micro Planning Approach

For efficient handling of the sanitation and solid waste management function, MC Cuttack is required to bundle the related activities into three major work units based on the size and work load quantities. Work packages can be classified as follows:-

- Residential Micro Pocket
- Commercial and Bulk Solid Waste Handling
- Mechanical Sweeping of Main Roads

Further all these above packages should include sweeping of streets and cleaning of drains within the package boundary.

Steps involved:

I. Clear demarcation of residential, commercial and main road sweeping pockets for carrying out the sanitation and solid waste management activities
II. Clearly defining of job responsibilities and key performance indicators for the service providers
III. Making realistic estimates of resource requirements in rationalized and standardized manner (manpower, transportation vehicles, tools, implements and conservancy materials)
IV. Develop clear resource inputs and results-outputs correlations to achieve standard service delivery results across the ULBs in a uniform manner.
V. Identifying and developing clear wok quantities, key performance indicators and performance monitoring mechanisms, in the event of outsourcing complete work packages to private agencies

Strategies for handling work packages:

1. Residential micro package

A household is defined as a domestic living accommodation of any type such as: a) any type of a dwelling structure; b) a slum house; c) a multi-floor housing complex of not more than 20 units and also small shops and petty commercial units situated in residential areas. For solid waste collection purpose, each of these households will be counted as one unit. Single residential micro package should consist of a continuous area with 300- 350 of waste generating units.

Residential micro packaging include:-

i. Collection of source segregated solid waste (wet, dry and hazardous waste separately) at the gates / doors of the households, shops, vendors and public places - Daily
ii. Manual sweeping of streets, footpaths, pavements and open spaces and removal of any litter in these areas, and removal of animal carcasses - Daily
iii. Cleaning of and removal of garbage, litter, silt or blocks from the street side shallow surface drains – Daily
iv. Sweeping of main and arterial roads and all the abutting road surfaces, foot paths and paved areas – Daily
v. Sweeping and Litter Collection in Parking Lots, Foot Over Bridges, Bus Shelters, Sub

Ways, Traffic Islands, and any other structure abutting the main roads – Daily

vi. Cleaning of Shallow Surface and Storm Water Drains (other than underground sewerage drains)

vii. Observe the places of water logging and water stagnation and clear the clogging garbage and silt for ensuing free flow of water.

viii. Disinfectant spraying, shrubs cutting, removing earthen heaps and or any other vector control activities as specified by the ULB.

ix. Transfer of the collected waste from all the above activities to the points of designated locations such as Transfer Stations, Compost or Material Recovery Yard, Landfill Facility – Daily

2. Commercial and bulk waste handling package

A Bulk Waste Generating Unit is an independent building structure or a building complex which houses a Commercial or Institutional unit(s); a high rise building or a gated community of more than 20 units used for either residential, commercial or mixed purposes. For example, any entity such as a restaurant, bank, chit fund office, educational institution, government or private office, religious place, hostel, hotel, training institute, function hall etc., which generate waste in bulk volumes can be classified as a bulk waste generating source. A group of more than 20 dwelling units located in the same complex used for either residential or commercial purpose will also be classified as a bulk waste generator.

For enumerating bulk waste generating units, each gate at which the waste can be handed over to the waste collector should be considered as one unit. Bulk waste will be collected at the gates of the buildings. It is the responsibility of the building owner on whom the property is registered, to arrange for handing over the waste at the gate of the building to the waste collector. Roadside vending units are to be considered as bulk waste generators and to be enumerated in the respective roads and streets in which they are located. Mobile vending carts are also to be enumerated in the respective streets / roads in which they normally cart for maximum time.

Depending on the size of the commercial activities and the physical spread of these commercial and institutional establishments in the ULB, a ULB can have more than one Commercial bulk waste zone.

3. Mechanized road sweeping

Based on the conditions of the roads and the financial capacity of the MC to bear the costs, specific road stretches can be swept by mechanical sweeping. MC Cuttack shall deploy power driven mechanical sweeping machines for specific stretches

Outsourcing work packages:

Instead of taking workers on contract basis for deployment in Solid waste collection activities, MC Cuttack is required to shift to a system of outsourcing complete work packages to any registered legal entity/ society / contractor / agency that are covered by income tax and other statutory regulations. The system of outsourcing complete work packages is meant for getting the following benefits to the MC as measurable operational results such as better delivery of services; compliance to MSW rules & NGT directives; availing better technology, management methods and capital through private, social sector & CSR participation and overall positive

impact on the living environment by mitigating pollution and environmental hazards.

Outsourcing of residential Micro Pocket Work Packages:

For outsourcing micro pocket Work Packages, MC is required to adopt the following steps.

I. The available permanent PH workers on the rolls of the MC are to be fully allocated for all micro pocket management activities in the wards that are identified as high density low public movement and low density low public movement areas. They should be allocated for the activities such as micro pocket management – (Gate-to-gate solid waste collection, street sweeping, litter collection, drains cleaning, disinfectant spraying, vector control, removal of weeds and unwanted vegetative growth, berms cutting, removal of animal carcasses from residential areas and the main and arterial roads that are part of the micro pocket.), as loaders for secondary transportation and gang Work
II. The remaining micro pockets and the respective wards should be earmarked for outsourcing. The micro pockets that are earmarked for outsourcing are to be bundled into 2-3 work packages, covering the rest of the MC area other than those micro pockets and wards that are identified for services by the MC permanent staff. As an illustration, each work package for outsourcing may contain 80-100 micro pockets. However, MC can decide on the number of micro pocket work packages that can be outsourced, not exceeding three.

Outsourcing of Commercial, Institutional and Bulk Solid Waste and C&D Collection and Transportation

I. Commercial, institutional and bulk solid waste collection and transportation activity shall be outsourced as a complete work package.
II. MC shall suitably make the RFP, following the model RFP and shall procure the services of a competent bidder.
III. Based on the size and spread of the commercial activities in the MC, the required number of packages can be worked out. Municipal Corporations and larger Special Grade ULBs may have 2-3 Commercial and Bulk Waste Wok Packages, whereas other smaller ULBs may have one work package for commercial, institutional and bulk waste collection and transportation. For deciding upon the work packages, MC shall consider the financial viability on the part of the MC to outsource this activity as a permanent arrangement.
IV. As the approximate quantities of C&D waste that need to be lifted and transported to designated places cannot be determined based on some norms, lifting of this component is to be outsourced to the successful contractors as an additional work on rate contract basis. As and when the C&D wastes are to be lifted, the MC will notify the contractors and make payments separately according to the work executed by them. To this effect, MC shall set up a process to enable citizens to approach MC for service at a quantity based fixed rate. The citizen can make the specified amount through a challan and this amount will be transferred to the contractor after completing the lifting.

Outsourcing Mechanical Sweeping

Mechanical Sweeping of the select road stretches based on the road conditions (well paved longer roads) can be outsourced as a complete work package.

MC can follow the decision matrix as given in the following table:-

Table 41: Decision Making Matrix for Outsourcing of Work

Residential Area and Main Roads Sanitation, Solid Waste Collection and Drains Cleaning	Commercial and Bulk Waste Collection and Transportation	Mechanical Sweeping
1. Adjust all the available permanent workers to as many micro pockets as possible 2. Outsource the remaining micro pockets	Outsource	Outsource
- In case, where outsourcing the works as independent work packages is not possible, create one package for outsourcing after adjusting the existing permanent workers to as many micro pockets as possible. - Where Mechanical Sweeping is not feasible, this package need not be considered as the sweeping and litter collection in the major road areas will be carried out by the respective micro pocket workers		

- MC should issue separate government orders / guidelines for levy of user fee in the form of SWM Cess.
- MC is required to identify suitable locations for depositing the collected waste from the processes as detailed above by the contractors / MC sanitation workers teams.
- Ongoing monitoring of the field activities that are carried out by the MC staff and the outsourced agencies by the senior officials of MC under the management and supervisory guidance of the Commissioner is an important component.
- Municipal Commissioners are required to ensure implementation of the guidelines issued for micro planning, micro pocket management, bulk waste handling, street sweeping etc. without fail.
- Penalties will be levied on the citizens / repeat violators, if they
  - Fail to handover waste, despite the visit of the service provider Fail to handover waste in segregated manner
  - Resort to public littering.
- Municipality should conduct training and capacity building for responsible personnel and agencies for solid waste management. Community IEC should also be conducted on regular basis.

7.4.2 Dumpsite Reclamation – Case Study of Gorai Dumping Ground, Mumbai

Dumpsite reclamation involves sorting out mixed municipal waste according to material size (oversized material, intermediate sized waste and soil or humus) by using a trommel. The size and type of screens used depend on the end use of the recovered material. Dumpsite reclamation typically consists of two basic operations: excavating waste and screening waste.

Case study of Scientific Landfill Closure and Methane Capture: Gorai Dumping Ground, Mumbai

Background: Closure and scientific capping of garbage dumpsite is essential for containing its pollution potential. Usually, old dumpsites are left without any remedial steps and allowed to degenerate over the years in terms of leachate percolating down to groundwater, vector breeding, and air pollution. Some dumpsites have been covered with thin layer of soil and vegetation to beautify the area. However, generation of leachate continues. With ingress of rainwater, more leachate is formed. This goes on for years until the material in the landfill is stabilized, which may be 20–50 years in warm climates.

The first known example of scientific capping of a garbage dumpsite in India happened in Mumbai at Gorai dumpsite. This is a specific example where an ongoing dumpsite was systematically closed and then capped. Normally, this procedure would be well suited for already closed dumpsite where dumping of fresh garbage has been stopped.

Operational since 1972, Gorai dumpsite is in the western suburbs of Mumbai. The 19.6-hectare site is adjacent to Gorai creek and is very close to habitation. Approximately 2.34 million tons of waste up to an average height of 26 m was lying at the site, causing significant environmental damage to the creek and the neighborhood. The capacity of the dump was already exhausted. The creek waters had been polluted due to inflow of leachate, and the air quality had deteriorated from the frequent burning of garbage.

The Municipal Corporation of Greater Mumbai (MCGM) took up this challenge and, with technical assistance of Infrastructure Leasing & Financial Services Ltd (IL&FS) (Environment Division), worked out a scientific plan for controlled closure and scientific capping based on detailed survey and consultation.

Design strategy and action plan:
Since it was not possible to go under the huge dump to lay a containment layer, gradual reduction of leachate was planned by restraining rainwater from entering the dump by providing a multilayered cover over the dump. At the same time, a leachate collection system (LCS) was planned in the best possible manner. Ingress and inundation of tidal water was controlled by putting vertical concrete sheet piling on the creek side.

The scientific closure plan included the following components:

1. Fresh dumping stopped and relocation and slope reformation (1:3) of existing waste.
2. Laying of C & D waste and compaction
3. Laying of liner system consisting of :-
    - Top vegetation layer
    - 300 mm thick top soil layer
    - Geo composite layer
    - 1.5 mm geo-membrane layer
    - 200 g/m2 and 400 g/m2 geotextile
    - 300 mm thick drainage layer
    - Installation of landfill gas collection, venting and flaring system
    - Installation of LCS using perforated pipes along the periphery of the landfill, followed

by storage in a leachate tank and transportation to the nearest STP
- Sheet piling on the seaward side to prevent leachate from entering the creek
- Surface water drainage for channeling storm water
- Construction of bunds, access roads and compound wall on the landward side of the site

4. Landscaping and greenery, irrigation and lightening of the area
5. Post closure care for 15 years with close monitoring of the indicative parameters like leachate, watering and maintaining the greenery, checking leakages of landfill gas, checking subsistence of the cover etc.

The construction and O & M contract for this work was awarded through pen competitive bidding to consortium of an India and a German company. The construction was completed in 24 months with a cost of about Rs.50Crore, with the O & M estimated at Rs.12Crore for 15 years of post-closure care.

The following are the outcomes of the project:

I. There has been a marked improvement in quality of life of people living in the vicinity.
II. The project has created 19 hectares of green space and restored mangroves which had degenerated due to toxic leachate from the dumpsite.
III. The project has improved public health and hygiene; eliminated foul odor, fire, and vermin nuisance; improved the quality of creek water; and increased avian fauna population.
IV. Property value in the area increased with higher property tax collection for the MCGM.

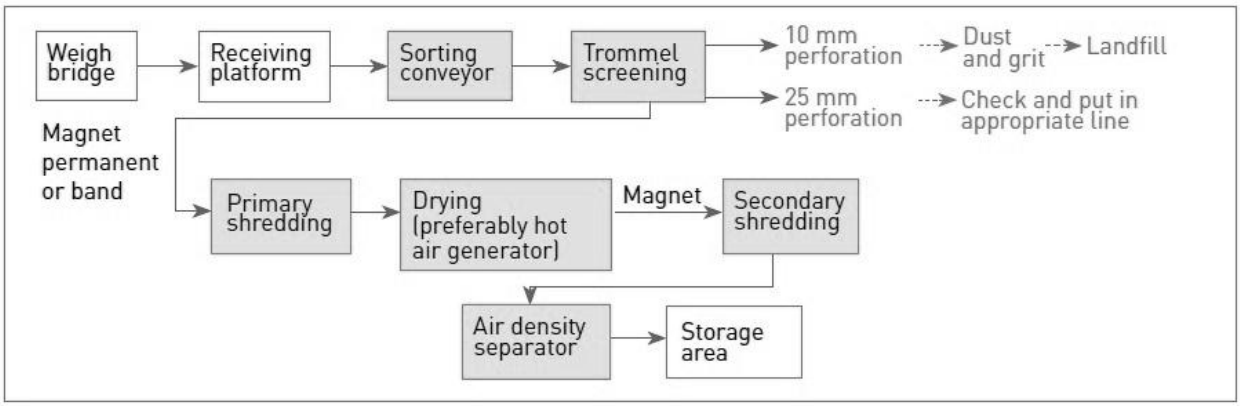
An important aspect of this project is the demonstration impact, which can be modified for local requirements and replicated across old open dumpsites in the country.[27]

[27] Source: Swachha Bharat Mission (2016) Municipal Solid Waste Manual, Volume I, Government of India.

7.4.3 Solid Waste Management Technologies

Material Recovery Facility

Figure 29: Indicative Material Recovery Facility and Pre-sorting Facility dedicated to Dry waste



Source: Swachha Bharat Mission (2016) Municipal Solid Waste Manual, Volume II, Government of India.

Salient features of Material Recovery Facility

- Depending on the scale of operations and the level of mechanisation in the facility, MRFs may be classified as manual or mechanised.
- Usually small- scale units, manual MRFs largely employ manual sorting practices and are typically owned, managed, and operated by the informal sector.
- Mechanised MRFs are large facilities with sophisticated systems and equipment that enable efficient separation of large quantity of material into different fractions.
- Segregated dry waste is received in a mixed form consisting of a combination of fibres (paper, card board, mixed paper, magazines, etc.) and commingled containers (plastic, glass, metal, etc.), among other materials.
- The first stage of processing typically uses manual labour or equipment that separate material into various streams (fibre, paper, plastic, containers, etc.).
- Land Requirements:
  - 500 m for facilities dealing with 100 TPD or more of MSW
  - 400 m for facilities dealing with 75–100 TPD of MSW
  - 300 m for facilities dealing with 50–75 TPD of MSW
  - 200 m for facilities dealing with 10–50 TPD of MSW
  - No buffer zone for facilities dealing up to 5 TPD of MSW
  - No buffer zone for decentralised plants handling less than 1 TPD of MSW (but adequate environmental controls are required)
- Different process or stages and equipment employed in material recovery facility are shown in table below.

Table 42 Stages of Material Recovery Facility

PROCESS OR STAGES	EQUIPMENT
Pre-sorting material handling equipment	• Belt conveyor • Screw conveyor • Apron conveyor • Bucket elevator • Drag conveyor • Pneumatic conveyor • Vibrating conveyor
Ferrous metal separation	• Magnetic separator and screening
Screening	• Disc Screening • Trommels
Air classification	• Horizontal air classifier • Vibrating inclined air classifier • Inclined air classifier
Non-ferrous metal separation	• Rotating disk separator • Eddy current separator
Size reduction	• Can densifier • Can flattener • Glass crusher • Plastic granulator • Plastic perforator
Pollution control	• Dust collection system • Noise suppression devices • Odour control system
Other fixed equipment	• Fixed storage bin • Live-bottom storage bin • Floor scale for pallet or bin loads • Truck scale

Source: Swachha Bharat Mission (2016) Municipal Solid Waste Manual, Volume II, Government of India.

Windrow Composting

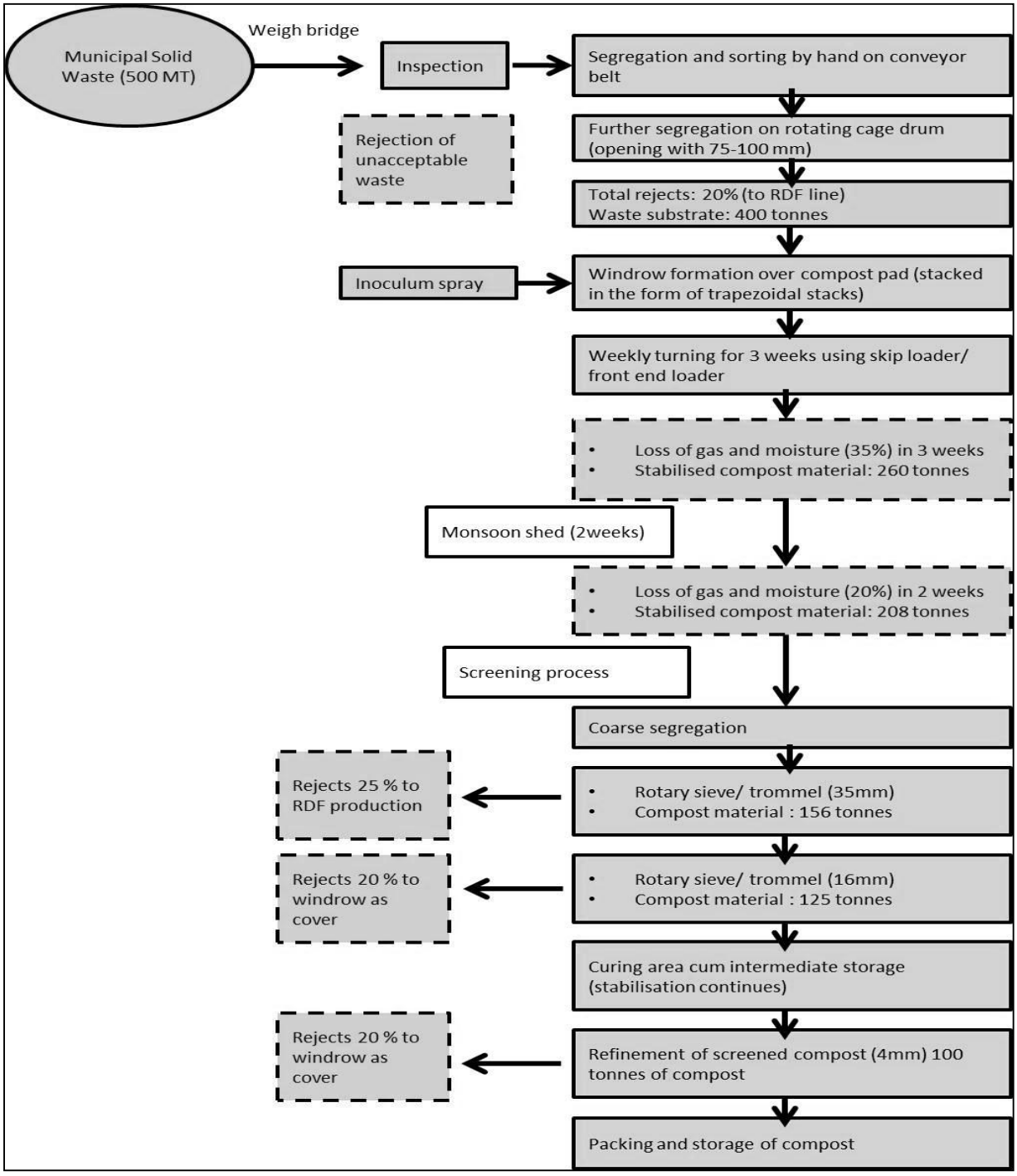
Windrow composting process consists of placing the pre-sorted feedstock in long narrow piles called windrows that are turned on a regular basis for boosting passive aeration. The turning operation mixes the composting materials and enhances passive aeration.

Figure 30 gives an overview of the windrow composting process although the figures presented may vary with the characteristics of the waste, design of the plant, and the rigorousness with which the standard operating process is followed. Compost yield of 10-15% is more common from mixed municipal solid waste.

Figure 30 depicts a process flowchart for a 500 TPD plant, indicating 20% process efficiency. While 20% efficiency is possible under good operational conditions, the typical efficiency of a windrow compost plant receiving segregated organic solid waste

is around 18%–20%, i.e., for an input feedstock of 100 TPD of segregated waste, it should be able to produce 18–20 tonnes of finished compost. Where mixed waste is received as input feedstock, compost yield of 10%–15% is expected.

Figure 30: Process Flowchart and mass balance for anaerobic windrow composting of 500 MT per day of waste of waste



Source: Swachha Bharat Mission (2016) Municipal Solid Waste Manual, Volume II, Government of India.

The pre-processed MSW is transferred onto the compost pad into windrows. The compost pad is an area where the windrows are stacked. The compost pad must be stable, durable, and impervious, so it is constructed with an appropriately designed combination of reinforced cement concrete (RCC) and plain cement concrete (PCC). The compost pad shall have a slope of about 1% to drain the excess water (storm water or leachate) from the windrows into a leachate collection tank. The leachate tank is placed in the lowest corner of the compost pad area. This leachate should be reused for recirculation of nutrients and for maintaining the moisture content of windrows. The height to base width ratio of the windrow depends basically on the angle of repose of the material. Windrows are typically trapezoidal in cross section. The space between windrows should be sufficient for movement of the windrow turning machine. Normally, it is 1–3 meters.

Windrow Formation: The size, shape, and spacing of windrows depend on the equipment used for turning. For example, bucket loaders are used to build high windrows, whereas turning machines create low and wide windrows. Manual labor is also used for windrows of a smaller scale, where additional equipment costs and use of machinery are not feasible.

Windrow Turning: Windrows are turned frequently to maintain aerobic conditions inside the pile. Windrow turning is a mechanized operation. Generally, pay loaders (wheel or tracked) or tractors with hydraulic attachments are used to scoop the material from one windrow to make a new pile in an adjacent location on the compost pad, while placing and mixing the material. Other equipment such as front-end loaders or windrows re-shifters may also be used for turning windrows. Windrow turning ensures that outer layers of piles are moved to inner layers. This process is repeated once every week for 5 weeks; high temperatures within the windrow (55°C–65°C) sanitized the material. During the rainy season where the interstitial spaces are filled with water, more frequent turning is necessary (interval of 3–4 days).

Regular turning of the windrows helps oxygenate the pile; breaks up particles to increase surface area; improves the porosity to prevent settling and compaction; and allows trapped heat, water vapour, and gases to escape. In general, the more frequently a pile is tuned, the more quickly the composting process is completed. However, too frequent turning has two disadvantages: (i) formation of heated pile in the core area being hampered (necessary for pathogen kill), and (ii) additional costs resulting from equipment and associated energy use. A balance is therefore to be achieved between number of turnings and cost of production.

A turning schedule should be established based on the rate of decomposition, moisture content, porosity of the material, and the desired composting time (often a function of land availability). Normally, once a week turning is done but more frequent during rainy season (once in 3–4 days).

In general, each windrow should be allowed to stay on the compost pad for 35 days; at the end of the 35th day, the compost is ready for use. Each windrow should have a flag board depicting the age of the waste. Fresh incoming waste is always depicted as “Age 1.” The numbering on the windrow changes from Age 1 to Age 2 on the second day, Age

2 to Age 3 on the third day, and so on. Each windrow may be turned manually or mechanically. This turning process has to be done every 7th day. Hence, only those windrows having a flag board showing Age 7, 14, 21, and 28 should be turned.

Curing: Screened material coming out of the coarse segregation section requires further maturation and moisture control for producing a product that is beneficial for plants and soil. The degree of maturity is determined through either oxygen or CO2 production rate. The cured material does not release odours because of carbon stabilization during aerobic decomposition of biodegradable material in the windrow. Microbial activity continues during the curing phase also, but at a lower rate compared to the main composting phase.

Nevertheless, also during curing, the supply of adequate oxygen is ensured through passive movement of air through the pile and moisture content is maintained within 25%–30%. The curing piles are placed either in a storage area or covered area for a minimum duration of 2 weeks. In general, the area needed for the curing process is one quarter of the size needed for the windrow or composting process. The completely cured well-composted material does not release foul odour and is ready for final screening and for the preparation of the finished product for marketing.

Compost Refinement: At the end of composting phase, the material usually contains 30% to 35% moisture. The composting is normally taken to be complete when the active decomposition stage is over and the carbon-to-nitrogen (C/N) ratio is around 20.

The refinement section also consists of a feeder conveyer and a trammel with 4 mm perforations. The screened product less than 4 mm is passed through air density separator (ADS) or de-stoner to remove sand and grit. Then the compost can be put in bags and stored for sale. The remaining material greater than 4 mm should be put on top of the fresh incoming waste heap to speed up the process of composting and for absorbing excess leachate. The residue material from the ADS is inert laced with fine organic material. This should be kept out of the composting stream. This material can be used for landscaping.

The finished product is dark brown with an earthy smell, fragile, and rich in organic matter content and nutrients.

Value-added product can be produced depending on the market demand by enriching compost with beneficial microorganisms and nutrient sources such as rock phosphate, pyrite, etc. The product is bagged and dispatched for marketing to be used on farmer's fields.

Based on the desired end use, the compost should comply with specifications of the Fertilizer Control Order (FCO), 2009 & 2013 and SWM Rules, 2016.

Salient Features of Windrow Composting: -

- Land Requirements:
  - 500 m for facilities dealing with 100 TPD or more of MSW
  - 400 m for facilities dealing with 75–100 TPD of MSW
  - 300 m for facilities dealing with 50–75 TPD of MSW

- 200 m for facilities dealing with 10–50 TPD of MSW
- No buffer zone for facilities dealing up to 5 TPD of MSW
- No buffer zone for decentralised plants handling less than 1 TPD of MSW (but adequate environmental controls are required)

- Composting in coastal/high rain- fall areas should have a shed to prevent waste from becoming excessively wet and thereby to control leachate generation.
- Land requirement: - For 300 TPD of segregated/pre-sorted MSW: 5 ha of land including buffer zone is required.
- Upto 500MT of waste can be managed by a single facility.
- High requirement of segregation prior to technology
- If only composting is done the about 30% of rejects including inert materials are obtained. If RDF facility is located in same plant then percentage of rejects can be reduced to 15%.
- Capital cost comes up to 15-20Cr for a 500 TPD plant. I.e. around 3-4 lakhs per tonne.
- Quality of compost should be compliant with FCO 2013. It has a good market potential.
- Windrow composting is labour intensive. It required technically qualified and experienced and semi-skilled staff.
- Atmospheric pollution is low. Only odour issues.
- In high rainfall areas, the windrow need to be covered either temporarily or permanently to control leachate generation. However, the design of the shed should be such that good natural ventilation is maintained.
- Fire and safety issues should be taken care of.[28]

Vermi Composting

- Vermicomposting is the process of composting the biodegradable fraction of MSW with the help of earthworms, resulting in the production of vermicompost which can be used in agricultural fields as a soil conditioner and nutrient supplier.
- Vermicomposting draws better market price as compared with compost and, in addition, sale of worms can bring in additional revenue.
- Vermicomposting is typically suited for managing smaller waste quantities.
- Land Requirements:
  - 500 m for facilities dealing with 100 TPD or more of MSW
  - 400 m for facilities dealing with 75–100 TPD of MSW
  - 300 m for facilities dealing with 50–75 TPD of MSW
  - 200 m for facilities dealing with 10–50 TPD of MSW
  - No buffer zone for facilities dealing up to 5 TPD of MSW
  - No buffer zone for decentralised plants handling less than 1 TPD of MSW (but adequate environmental controls are required)
- Composting in coastal/high rainfall areas should have a shed to prevent waste from becoming excessively wet and thereby to control leachate generation.
- Land Requirement: - For 20 TPD of segregated/pre-sorted: 1.25 ha.
- 1 TPD – 20 TPD quantity of waste can be managed in single facility. Higher

[28] Source: Swachha Bharat Mission (2016) Municipal Solid Waste Manual, Volume I, Government of India.

capacities can be also planned but then the land requirements become very high.

- Very high requirement of segregation prior to technology
- 30% of the rejects including inert materials are rejected.
- Capital cost comes up to 1Cr per 20 TPD plant i.e. around 5 lakhs per tonne.
- By-product has Good market potential in urban and rural areas.
- Vermi-composting is labour intensive. It required technically qualified and experienced and semi-skilled staff.
- Very low leachate problems.[29]
- Following are some vermin-compost problems, possible causes and solutions.

Table 43 Problems and solutions to vermicomposting issues

PROBLEMS	POSSIBLE CAUSES	SOLUTIONS
Foul odour	Overfeeding	Remove the excess food, remove meat or dairy products if any
	Not enough air circulation or anaerobic	Fluff up or loosen bedding
	Bed too wet	Add bedding to absorb moisture
Flies	Waste exposed	Bury the waste completely
Ant infestation		Immerse the base or feet of the vermi bed in water
		A barrier of chalk or petroleum jelly may repel the ants
		If bedding seems dry, add water
Mite infestation		Avoid adding foods with high moisture content
Worms are dying or crawling away	Bed too wet	Do not water till it reaches appropriate moisture
	Bed too dry	Sprinkle water till it turns moist
	Excess temperature, not enough air, not enough food	Sprinkle water till it turns moist and temperature drops, add waste appropriately
	Bed packed tightly	Turn bed and make it fluffy

Source: Swachha Bharat Mission (2016) Municipal Solid Waste Manual, Volume II, Government of India.

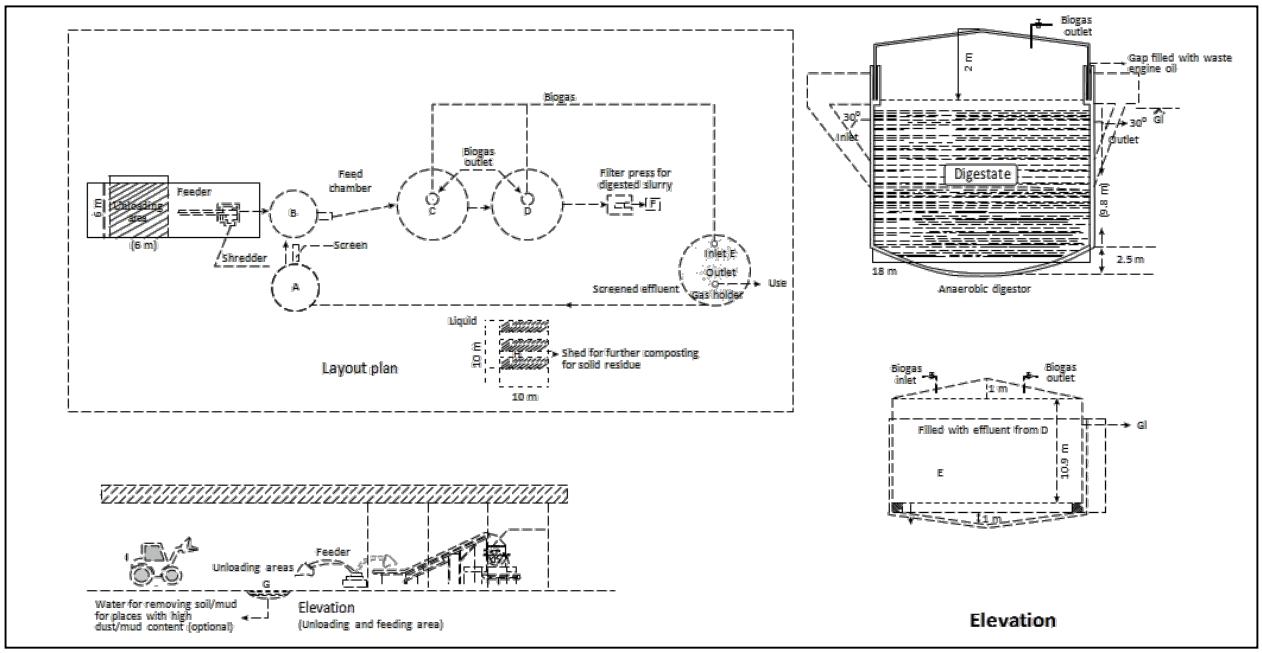
Bio- Methanation

- Land Requirements:
  - 500 m for facilities dealing with 100 TPD or more of MSW
  - 400 m for facilities dealing with 75–100 TPD of MSW
  - 300 m for facilities dealing with 50–75 TPD of MSW
  - 200 m for facilities dealing with 10–50 TPD of MSW
  - No buffer zone for facilities dealing up to 5 TPD of MSW
  - No buffer zone for decentralised plants handling less than 1 TPD of MSW (but adequate environmental controls are required)

[29] Source: Swachha Bharat Mission (2016) Municipal Solid Waste Manual, Volume I, Government of India.

- Land Requirement: - For 300 TPD of segregated/pre-sorted: 2.5 ha.
- 1 TPD can be managed at small scale 500 TPD can be managed at larger scale.
- Very high requirement of segregation prior to technology
- 30% of the rejects from mixed waste are rejected.
- There is a potential for direct energy recovery
- Capital cost comes up to 75-80Cr for 500 TPD plant. I.e. around 15-16 lakhs per tonne.
- Biogas generated can be used for generation of electricity which can be used for illumination of market premises and other bulk wet waste generators which supply raw materials for the plant
- Biomethanation is less labour intensive which require only technically qualified and experienced staff.
- Leakage of biogas and fire and safety issues to be taken care of. [30]
- General plan and elevation for 50 TPD is shown below, however it is only for illustration purpose and will change according to quantity and type of waste.
-

Figure 31: Biomethanation plant for 50 TPD of waste

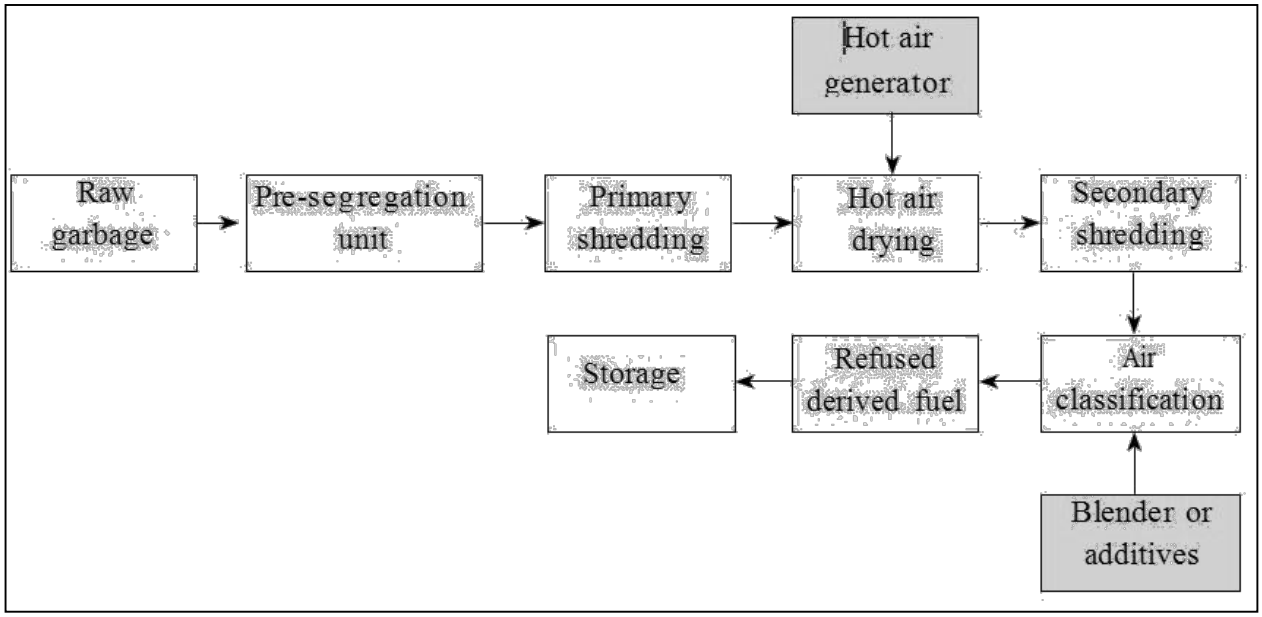


Source: Swachha Bharat Mission (2016) Municipal Solid Waste Manual, Volume II, Government of India.

[30] Source: Swachha Bharat Mission (2016) Municipal Solid Waste Manual, Volume I, Government of India.

Refused Derived Fuel (RDF)

Figure 32: Refused Derived Fuel production line (Palletization).



Source: Swachha Bharat Mission (2016) Municipal Solid Waste Manual, Volume II, Government of India.

- Land Requirements:
  - 500 m for facilities dealing with 100 TPD or more of MSW
  - 400 m for facilities dealing with 75–100 TPD of MSW
  - 300 m for facilities dealing with 50–75 TPD of MSW
  - 200 m for facilities dealing with 10–50 TPD of MSW
  - No buffer zone for facilities dealing up to 5 TPD of MSW
  - No buffer zone for decentralised plants handling less than 1 TPD of MSW (but adequate environmental controls are required)
- Land Requirement: - For 300 TPD of segregated/pre-sorted: 2 ha.
- 100 TPD and above of segregated waste can be managed in a single plant facility.
- High requirement of segregation prior to technology
- 30% of the rejects from mixed waste are rejected.
- No direct potential for energy, but RDF is an excellent fuel for burning in other industries like cement.
- Capital cost comes up to 17-20 Cr for 500 TPD plant.
- Good market potential for RDF especially for the areas where cement plants are located in radius of 100km.
- RDF is labour intensive which require only technically qualified and experienced staff.[31]

[31] Source: Swachha Bharat Mission (2016) Municipal Solid Waste Manual, Volume I, Government of India.

7.5 Reuse Options for FSM

Co-composting Technologies

Two main types of composting systems are generally distinguished: 1) open systems such as windrows and static piles and 2) closed 'in-vessel' systems. These in- vessel or 'reactor' systems can be static or movable closed structures where aeration and moisture are controlled by mechanical means. Such systems usually require an external energy supply, either by electricity or through decentralized electricity generators, whereas the latter is often provided by diesel engines. In general, in vessel or reactor systems require higher investment compared with static systems and are also more expensive to operate and maintain. Static composting systems on the other hand, require much lower investments and are hence the preferred option for composting in developing countries. Among them, windrow composting is the most commonly applied system.

The identification of the best-suited option for composting depends on numerous parameters. The main choices to be made are related to a) scale (household, community, commercial), b) input materials, c) business models (public, private or combined), d) demand and market situation, e) Investment and operation cost, f) technology option and equipment, f) standards and legal framework and g) environmental and health concerns as shown in Figure 5. Decision-making has to be done on a case-by-case basis aiming at the highest possible cost- and co-benefits and sustainability level for the operator, community, stakeholder and the environment.

Different technological options are available to establish a specific composting project, as presented in Table below:

Table 44 Composting Technologies - their advantages and disadvantages

Key Features	Advantages	Disadvantages
Static Pile		
Static piles are the simplest form of composting Typically larger than heap size whereas heaps are usually not turned Generally ideal for feedstock with larger particle size and higher porosity	Requires minimal management and equipment Aerobic conditions can be achieved if the porosity in the initial pile is high (>60%) and if there is a high proportion of bulking materials to keep pores open for air exchange	While simple, this method takes longer to produce matured compost; the final product is often quite heterogeneous due to the lack of mechanical treatment and physical breakdown of feedstock during the process. Anaerobic conditions can occur in the core of the heap which can also result in odor emissions
Trench and Pit composting		
Characterized by heaps which are partly or fully contained under the soil surface Structuring the heap with bulky material or turning is usually the choice for best aeration	Requires low capital investment Requires less moisture, thus suitable for dry areas	Control of leaching is difficult in trench or pit composting Monitoring the composting process is difficult The process is labor-intense, especially digging of the pit and

In some cases, composting materials are completely buried in the trench which then serves as a planting bed		emptying it
Aerated static pile/heap		
Aerated static pile (ASP) composting is comprised of forcing (positive) or pulling (negative) air through the pile. In a static aerated pile, a 15-30 cm thick layer of finished compost or wood chips is placed all around the MSW pile to provide insulation. This arrangement minimizes odor generation and also leads to uniform sustained heating of waste leading to destruction of plant pathogens and weed seeds The ASP can be used together with other composting technologies at the curing stage	The land requirements for this method are lower than that of windrow composting The technology allows for capturing and treating air to reduce odor generation Large volumes of feedstock can be treated with the help of aeration systems	The primary disadvantage of using this technology is the lack of mechanical agitation, which slows down physical breakdown of materials Usually suitable for feedstock of similar consistency and homogeneity The compost pile/heap can dry out quickly and therefore requires regular monitoring The aeration system may require capita-intensive installations
Windrow composting		
The material is piled up in heaps or elongated heaps (called windrows) Suitable for outdoor composting in piles that rely on passive, manual or mechanical aeration Some portions of waste piled up in the windrows may not be exposed sufficiently to a temperature of over 55 °C for a period of 7-10 days	Can be low cost Windrow composting produces the highest volume reduction compared to static piling (passively aerated with minimum turning) and forced aeration (static aerated pile) Introducing air mechanically speeds up the composting process and greatly reduces emissions of methane Methane emissions from windrow composting are comparably lower, e.g. passively aerated piles produce higher methane emissions (x100) than windrow turned piles whereas forced aeration piles produced even 1,000 times greater methane emissions	Anaerobic conditions could occur in the core of large piles or windrows, and together with a larger emitting surface, could result in odor generation Such plants often experience resistance from the community where they are set up ƒ Should be sited with consideration of the risk of odor Workers are in close contact with material during composting The minimum windrow/pile size must be 3 m3
In vessel- enclosed composting		
Refers to a group of composting systems, which range from enclosed halls to tunnels and containers, rotary drum or bins Often have one exhaust air	Allows easy collection and discharge (through a chimney) or treatment of air (e.g. bio filter) to minimize emissions of odors and greenhouse gases Operating temperature is	More costly than other units and, in addition, more equipment maintenance is required Skilled labor required for operation and maintenance

outlet	uniform, more efficient in sterilizing the compost compared to open composting techniques *f* Production of leachate is low (can be recycled if any) Requires less processing time (2-3 weeks) and less labor Less land requirement Effect of weather on the composting process is limited Public acceptance of the facility is higher	Comparable higher investment cost and energy consumption Additional cost for operation and maintenance There is a need to treat exhaust air
Vermi-composting		
A non-thermophilic, bio oxidative process that uses earthworms and associated microbes to transform organic waste into rich humus, similar to compost Local varieties of both surface and burrowing earthworms can be used In broad-scale vermiculture, the earthworms are introduced to organic waste piled in elongated rows that are covered with protection layers to prevent water logging Appropriate process indicators are survival rate, biomass production and reproduction of earthworms	Both pathogens and weed seeds can be destroyed in the intestines of worms during vermicomposting. Protozoa and fungi are important parts of their diet The earthworms mix, grind, aerate, fragment and digest waste Vermicomposting hastens the decomposition process by 2-5 times Produces much more homogeneous materials compared to thermophilic composting It is particularly suited to urban agriculture because it can be applied in a variety of settings and at different scales	A pre-composting may be required before earthworms are added to the mixture Tolerates temperatures between 0 and 40 °C with pH of 7, while optimal growth is at temperatures from 25-40 °C Optimal moisture content: 40-45%. Higher moisture content may result in the death of earthworms Organic matter is rich in nitrogen Sorting is required after composting to allow removal of earthworms Earthworms may die when conditions are unfavorable; e.g. anaerobic They may be affected by pests/mites

All composting technologies allow production of a safe recycling product but require variable processing time, process control, human and financial resources while having different impacts on the environment and health. The degree of compost stability attained within a certain time is a key indicator which can be used to compare different composting techniques. Decomposition of organic matter through composting can be achieved in the presence or in the absence of oxygen. Therefore, different composting methods involve either aerobic (with oxygen), anaerobic (without oxygen) phases and sometimes even alternate between the two during the decomposition process. Under anaerobic conditions, composting is often achieved at mesophilic temperatures with the disadvantage that the process temperature may be too low to efficiently eliminate pathogens that are especially present if organic input materials from municipal waste management, manures and faecal sludge are utilized for composting. Anaerobic conditions may also generate strong odors which could pose a major nuisance in urban areas. Conversely, under aerobic conditions, composting is achieved at thermophilic temperatures due to the accelerated growth rate of bacteria that results in a higher biodegradation rate of the waste. As

a result, pathogens are more quickly eliminated. A composting facility which is not well managed could generate odor that can expand over a radius of 2 to 3 kilometers (km) around the plant and bother residents.

So one should use/undertake implementation of co-composting technologies based on above discussed points.

Other reuse technologies which can be explored apart from co-composting are Biochar and Black Soldier Flies (BSF)

Biochar

The term charcoal refers to the carbon-rich material obtained from heating wood or plants anaerobically. Biochar is charcoal produced for mixing into soil. Technically, biochar is nothing but a new term for charcoal that is intended for application to soils as a soil amendment and or carbon sequestration

Process

There is a cycle in nature wherein plants use solar energy to covert carbon dioxide into biomass. Biomass is then transformed into biochar thereby producing energy and other co-products. Approximately 50% of the carbon remains in the form of biochar acting as a soil conditioner and delaying release of carbon into atmosphere by 1000 to 2000 years.

Biomass can be transferred to biochar through three processes: slow pyrolysis, fast pyrolysis and gasification. The plant takes faecal sludge along with carbon rich materials like coffee husks. They are subjected in the ratio of 7:3 for a smooth charring process. The faecal sludge has a lot of moisture content in it. It is dried down to a moisture content of 30-35% with the help of using the energy deriving from the carbonizer. In carbonizer a direct pyrolysis happens at temperatures of 300-600°C. Direct pyrolysis here refers to no steering through external heating of the chamber but through the heat generated from the pyrolysis process only.

The material is fed into a reactor after being transferred from a drying belt with the material flow being vertical and the ember remaining on top of the added material.

The hot fumes that originate from the process are redirected from the carbonization chamber and for further processing in a catalyst chamber, where the gases, for example carbon monoxide (CO) is burned.

Simultaneously, cooling of the whole system is maintained by circulating water through the drying component of the plant and thereby, drying the sludge at a temperature of 40-55°C.

The output of the plant, 30 kg per 100 kg of the mixed input material (70% Sludge, 30% carbon rich material), is a fine crumbled charcoal, with a carbon content of 55%.

The carbonizer unit faces problem of sand content. Directly drying faecal content on sand bed is thereby not an option as it was in co-composting. However, a geotextile or filter bag can be

sandwiched between sand and the put in the bottom to separate the sand from the drying material if we choose to use drying beds for dewatering.

The plant is equipped with sensors for temperature and can be steered via computer and monitored via Wi-Fi. The plant needs to be under constant surveillance to be able to remove disturbance, such as stones getting stuck in the spiral conveyor.

Outputs

The biochar process results into three outputs:

Biochar (Solid): The charcoal as the main product is currently not sold, but the price is estimated to be in the range of Rs. 9 to 13 per kg. Slow pyrolysis results into high amounts of biochar in comparison to other processes.

Bio-oil (Liquid): Bio-oil is a synthetic fuel being worked upon as a potential substitute for petroleum. It is a kind of tar with high level of oxygen. Fast pyrolysis gives 60% gas and 20% biochar and syngas each. Bio-oil is not a ready to use product. It requires further up gradation into a special engine fuel or syngas and then bio-diesel for making it usable (Zafar, 2015).

Syngas (Gaseous): Also called synthesis gas, syngas is a mixture of fuel gas consisting primarily of carbon monoxide, hydrogen, and very often some carbon dioxide. It is mainly used in electricity generation. Being combustible, it can be used as fuel of internal combustion engines.

Leachate: The leachate obtained from the dewatering process is a valuable output too. If treated properly and applied in adequate doses, it can be an excellent fertilizer. On the contrary discharging it into water bodies would lead to eutrophication.

Costs

The cost of the whole plant is estimated to be around Rs. 30, 48,000 per annum, including two labourers and the energy costs. The energy needed is 4 kW; 1 kW for each of the two exhausters alone, in addition to the consumption in feeding and transporting mechanism (spiral conveyors, belt) and the steering equipment. The cost of a similar machine used in India for pyrolysis of tires is Rs. 55, 00,000.

The salary of composting workers is around Rs. 9,000 to Rs. 10,000. The plant can scale up through adding more carbonization chambers with one chamber being able to process 70kg of solids per hour. The plant size is suitable for towns with a population of 30,000-40,000 people.

Snake and scorpion bites: Charcoal attracts reptiles like snakes and scorpions and can pose a threat to life of farmers. It might result to increased deaths, effect on saving and income due to medical expenditure and reduced productivity.

Benefits

Farmers

- **Higher pH of soil:** Biochar can be used as a buffer for acidic soils, improving the pH and thus increase nutrient uptake for plants. It brings down the minute cost incurred for liming agents.
- **Increased resistance against crop diseases:** Biochar can buffer the soil and increase their resistance against crop diseases.
- **Enhance microbial population:** Biochar has a significant impact on population of healthy microbial organisms in the soil. It also results create a suitable environment for earthworms.
- **Absorption of harmful elements:** Biochar is known to absorb harmful chemicals like phytotoxins and nitrification inhibiters.
- **Increased plant uptake of fertilizer:** Soil requires at least 3% carbon in them to make fertilisers use adequate enough to recover the initial investment. Biochar can act as a substrate for nutrients and raise efficiency of plants to uptake the fertilisers used. This will bring down the overall cost of fertiliser and reduce the damage caused by fertilisers on the soil.
- **Increased nutrient holding capacity:** Compost increases the **cation exchange capacity (CEC)** of soil increasing the nutrient holding capacity of the soil. The increased supply of nutrients to the soil reduces the expense on additional artificial fertilizer to fulfil those requirements.
- **Lower expenditure on Fertilizers:** Farmers are highly dependent on fertilizer for agriculture production. This has led to a surge in fertilizer prices since its introduction in India. Using biochar, the fertilizer requirement will come down due to better absorption from the current supply of nutrients.
- **Improved germination of seedling:** Biochar is known to have positive effects on germination of seedling.
- **Higher water retention capacity:** Biochar altered soil increases the capacity of soil to hold water, thus reducing cost of irrigation and letting crops survives in drought like situation.

The table below describes various effects that biochar has on property of soil as a result of certain property of biochar.

Effect of Biochar on Soil, Plant and Environment

Property	Effect	Biochar property
Soil		
Organic matter	Increased	High C content
Water-holding capacity	Increased	Porous structure
Porosity	Increased	Porous structure
pH	Increased	Alkaline nature
Cation exchange capacity (CEC)	Increased	Specific surface area
Plant		
Crop yield	Increased	Soil organic matter, pH, bulk density, CEC, high porosity
Plant productivity	Increased	Colour, P and K cycling
Environment		
CH_4 emissions	Decreased	Porous structure, pH
N_2O emissions	Decreased	Recalcitrant, porous structure
Carbon sequestration	Increased	Recalcitrant or stable C; black carbon (BC) resists decomposition
Nutrient leaching	Decreased	Porous structure, surface area and negative surface charge

Public

- **Reduced Green House Gases:** The biochar results in retention of as much as 50% of the carbon from escaping into the environment. The carbon gets locked down for 100s to 1000s of years. Lower CO_2 results in lowering of global warming and all the problems caused by it. It reduces the risk of many diseases caused by increased temperature and CO_2 in the air. Every 1% increase in retained Soil Organic Matter (SOM) through biochar, 100 tons of atmospheric CO_2 will be taken out from environment. Other than CO_2, biochar also reduces emission of nitrous oxide (N_20) by 50-80%, Nitrogen Oxide (NO_X) and Methane (CH_4) from soil. Gases like nitrous oxide are 310 more potent as a greenhouse gas then CO_2.
- **Reduced groundwater contamination:** Increased quantities of biochar in soil will lead to higher absorption of agriculture chemicals and other fertilisers and thus reduced groundwater contamination.

- **Reduced eutrophication and bioaccumulation:** Eutrophication is a result of fertilisers being washed off in rain to river bodies. Biochar will help absorb a great part of the fertilisers applied and thus result in less eutrophication. Biochar is the best method when it comes to absorbing nutrients in all the three methods and thus has the greatest impact.
- **Energy generation:** Biochar production produces bioenergy in two forms: syngas and bio-oils. These can be further processed and upgraded into biodiesel and gasoline substitute thereby reducing pressure on fossil fuels. Syngas can be put into use directly in gas turbines or be processed to produce ammonia, synthetic natural gas and other energy sources. Syngas also has the potential to replace petroleum as a material to create certain products and chemicals from it. Bio-oil is a substitute for heating oil or fuel oil. It also has the potential to be used in a bio-refinery where valuable chemicals and compounds are extracted and the remainder is upgraded to fuel or syngas.

Government

- **Aid in solving energy crises:** The government can take care of the energy crises through biochar while taking care of faecal sludge at the same time. It proves to be a better alternative on this aspect than compost since its energy producing outcomes is greater in quantity.

Limitations

- **Skilled labor required:** Operating a biochar plant requires people with in-depth technical knowledge of the field. The search cost and the salary paid would be higher in comparison to what was paid earlier.
- **Further processing:** Bio-oil cannot be used directly and needs to be processed further to be made usable. This would require further cost and labor charges.
- **Only long term benefits:** Biochar does not reveal short term benefits and thus, can be used only by farmers who are financially able enough to experiment with it and afford to take long term benefits.

Black Soldier Flies (BSF)

Black Soldier Flies in their pupae stage uses organic waste and produce some compost as a result that can be used in small scales in farms or gardens.

Process

An adult BSF has a sole objective of reproduction. It lays its eggs in decomposing organic matter and dies right after. The male would have already died right after mating. The larva stays in the mix while slowly progressing in its growth stages. After some time they burrow into the mix to complete their development into adults. When the larvae are ready to pupate (around 2 to 4 weeks after eggs are laid), they secrete their digestive system, lose their mouth, and produce an antibiotic coating. Therefore, unlike house flies, they cannot carry disease between wastes and foods we plan to eat. This also makes them safe to feed to our animals.

Each day BSF larvae can digest up to 15 kg of waste per m^2 of feeding surface area (2 lbs/ft^2). The input used in the current facility in Tamil Nadu for experimental purpose is 10 tons of dry sludge along with 3.5-4 tons other organics.

Outputs

- **Feed for hens and fish:** The BSF larvae or pupae that remains at the end has proved to be a good source of balanced lipids, complete protein and calcium and thus can be fed to one's chickens. They can also be fed to fish and livestock. The larvae are approximately 34% – 45% protein, 42% fat, 7% fiber, and 5% calcium. The protein is priced at Rs. 40 per kg and is the main source of income. It will cover a huge amount of expenditure incurred.
- **Compost:** There is a very little amount of compost left after the process. For every 100 kg, 5 kg of compost is made generally.
- **Biodiesel:** One of the products that can be generated on further processing the larvae is biodiesel which has various energy applications. The pupae obtained from it can be further fractionated into their two parts: protein for animal feeds and fats converted into biodiesel.

Costs

- **Capital and Operating and Maintenance expenditure:** The capital expenditure required to establish a BSF plant is Rs. 3, 71, 80,000. The operation and maintenance expenditure along with other supplementary expenses amount to Rs. 1, 05, 36,000.
- **Pathogen infection:** It has been found through various experiments that black soldier flies is inefficient in eliminating pathogens like Enterococcus spp. and A. suum ova. It might run a health risk for farmers and consumers of the final produce. It can be taken care of with additional expenditure incurred in treating the compost with ammonia sanitization.
- **CO_2 emission:** BSF during composting release a very negligible amount of CO_2. It is not a major concern in comparison to the actual CO_2 emission it is saving.

Benefits

Farmers

- **Nutritious feed:** BSF pupae are a very protein rich feed for chicken and fish. They will result into decreased expense on chicken feed and increased productivity in terms of eggs. Alternatively, it can be sold in market or directly to farmers as chicken feed or fish food. It will be obtained in the range of 16-40% of the input.
- **Compost:** The process yields small amount of compost that can be used in small area of farming. Thus, a small scale of nutrient recycling happens when using black solider flies for composting. It is generally obtained as a 5% of the input supplied. However, in the plant in Tamil Nadu, the plant operators were able to obtain up to 30% of the input.

Public

- **Biodiesel:** The larvae can be used to produce biodiesel. Although the process will get a lot more complicated but might result into bringing in profit and making the whole operation sustainable.
- **Reduced houseflies:** BSF larvae acts as a repellent for many pests and problematic flies like houseflies. Houseflies are responsible for serious diseases like typhoid. Typhoid costs were 100 and 29 US $ to public sector and private sector respectively.
- **Wound dresser:** BSF shells left can be used as a wound dresser for no healing wounds.
- **Reduced CH_4 and CO_2 emissions:** BSF have an advantage over other methods like composting when it comes to methane and carbon dioxide production. It prevents anaerobic bacteria from transferring waste into carbon methane and mesophilic and thermophilic bacteria from producing huge amount of CO_2 from waste.

Government

- **Aid in solving energy crises:** The government can take care of the energy crises through biochar while taking care of faecal sludge at the same time.

Limitations

- **Small quantity of compost:** Agriculture is not the main purpose of using black soldier flies because compost produced through BSF is very low and thus, does not serve the purpose of an entity looking for a technology to produce commercial compost.

- **Winter season:** BSF are inactive during the winters and thus, might not provide a round the year solution for all the places. They might be made active by creating a warm environment through consumption of electricity.

7.6 Business Models for FSM

This write up discusses aspects of effective financial models complementing sustainable sanitation solutions such as revenue/business models, sales channels, equity models which can be implemented at various parts of the sanitation value chain and also to strengthen the faecal sludge management.

1. PPP: Public private partnership Model

Also known as P3 model is a long term contractual agreement between the government and private entity to provide public services. Under this model the government shares the burden of cost through partnership with private entities. Such financial models have been successful project such as “Bhakra Nangal Dam”, “Akshaya Patra”, “Mars orbital project”, “Kerala tourism” etc.

Table 45: Available Options under PPP model and their details

Type of Model	What is it?	Potential Strength	Drawback
Lease contracts	Private player is responsible for overall service chain, leases the component from public sector based but capital investment done by government	High incentives for operators	Very risky since Private player is responsible for any loss
Concessions	Private player is responsible for entire capital expenditure, operations and maintenance expenditure and public entity only sets norms and monitors	Highly incentives for operators ,effective and efficient systems can be established	Complex contracts, government needs to have better monitoring process and resources for the same.
Build Operate Transfer Model (BOT)	The private player generates capex to build the facility and owns it for the definite time period to generate the returns then transfers the entity to gov.	Reduced commercial risk for private player since only one type of customer is present	Less impact on operations and output
Management contracts	The investment is provided by the government but working capital is provided by private players.	Without transferring the asset to private player operational gains be leveraged.	No autonomy of authority for private player required to efficient returns.
Service contracts	The government contracts out certain parts of its operations/services to private players majorly done for a time period of 1-3 years.	Building of managerial strength and provide quick impact on operations efficiency. Can be monitored easily	Since operator does not source capex, is not effective of other sources of fund such as government funds etc. not available

Other models under PPP are BOO model, DBO model etc. and in the long run the PPP models tend to be more effective.

2. Hybrid Annuity based PPP model

Hybrid version of the BOT model: 40% of project cost paid by the government and 60% of the project cost paid by private party. Private player bears the operations and maintenance and is paid periodically for the service rendered by government and to meet the costs government issues taxes and tariffs. Service level standards are set and based on the delivery and adherence to the standards the government pays the private players. Major benefits being; reduced initial investment, private player manages the operations, pay only if services are delivered by private party.

Governance and management:

With proper monitoring protocols, regulations and standards supported by effective policies and resolutions, better return on investment is probable in terms of positive social impact. This approach allows creating sustainable business models around each of the components which results in inclusive socio-economic uplift. It is paramount to look at human excreta as a potential resource for the agricultural and energy industry, rather than a problem. With this approach the realization of real sustainable sanitation services is possible.

7.7 Brief about Transfer stations

Transfer stations or underground holding tanks act as intermediate dumping points for faecal sludge and septage when it cannot be easily transported to a (Semi-) Centralized Treatment facility. A vacuum truck is required to empty transfer stations when they are full. Transfer stations reduce transport distance, may encourage more community-level emptying solutions and prevent illegal dumping. The moderate capital costs may be offset with access permits and the construction and maintenance can create local income. However, expert design and construction supervision are necessary.

Operators of small-scale cesspool vehicles discharge the sludge at a local transfer station rather than illegally dumping it or travelling to discharge it at a remote treatment or disposal site. When the transfer station is full, a vacuum truck empties the contents and takes the sludge to a suitable treatment facility. Municipalities or sewerage authorities may charge for permits to dump at the transfer station to offset the costs of operating and maintaining the facility. In urban settings, transfer stations have to be carefully located; otherwise odours could become a nuisance, especially, if they are not well maintained.

Design Considerations

A transfer station consists of a parking place for vacuum trucks or sludge carts, a connection point for discharge hoses, and a storage tank. The dumping point should be built low enough to minimize spills when labourers manually empty their sludge carts. Additionally, the transfer station should include a vent, a trash screen to remove large debris (garbage) and a washing

facility for vehicles. The holding tank must be well constructed to prevent leaching and/or surface water infiltration.

A variation is the sewer discharge station (SDS), which is like a transfer station, but is directly connected to a conventional gravity sewer main. Sludge emptied into the SDS is released into the sewer main either directly or at timed intervals (e.g., by pumping) to optimize the performance of the sewer and of the wastewater treatment plant, and/or reduce peak loads. Transfer stations can be equipped with digital data recording devices to track quantity, input type and origin, as well as collect data about the individuals who dump there. In this way, the operator can collect detailed information and more accurately plan and adapt to differing loads.

The system for issuing permits or charging access fees must be carefully designed so that those who most need the service are not excluded because of high costs, while still generating enough income to sustainably operate and maintain the transfer stations.

Table 46: Advantages and Disadvantages of a FS Transfer Station

Advantages	Disadvantages/limitations
- Makes sludge transport to the treatment plant more efficient, especially where small-scale service providers with slow vehicles are involved - May reduce the illegal dumping of faecal sludge - Costs can be offset with access permits - Potential for local job creation and income generation	- Requires expert design and construction - Can lead to odours if not properly maintained

Appropriateness

Transfer stations are appropriate for dense, urban areas where there are no alternative discharge points for faecal sludge. Establishing multiple transfer stations may help to reduce the incidence of illegal sludge dumping and promote the emptying market. Transfer stations are especially adequate where small-scale sludge emptying takes place. In big cities, they can reduce the costs incurred by truck operators by decreasing transport distances and waiting times in traffic jams. Local service providers can discharge sludge at transfer stations during the day, while large trucks can empty the tanks and go to the treatment plant at night when traffic is light.

Transfer stations should be located where they are easily accessible, convenient, and easy to use. Depending on their maintenance, odours could become a problem to local residents. However, the benefits gained from them compared to open-air illegal dumping greatly offset any nuisances.

Health Aspects/Acceptance

Transfer stations have the potential to significantly increase the health of a community by providing an inexpensive, local solution for faecal sludge disposal. By providing a transfer station, independent or small-scale service providers are no longer forced to illegally dump sludge, and homeowners are more motivated to empty their septic tanks/pits. When septic tanks/ pits are regularly emptied and illegal dumping is minimized, the overall health of a community can be significantly improved. The location must be carefully chosen to maximize efficiency and minimize odours and problems to nearby residents.

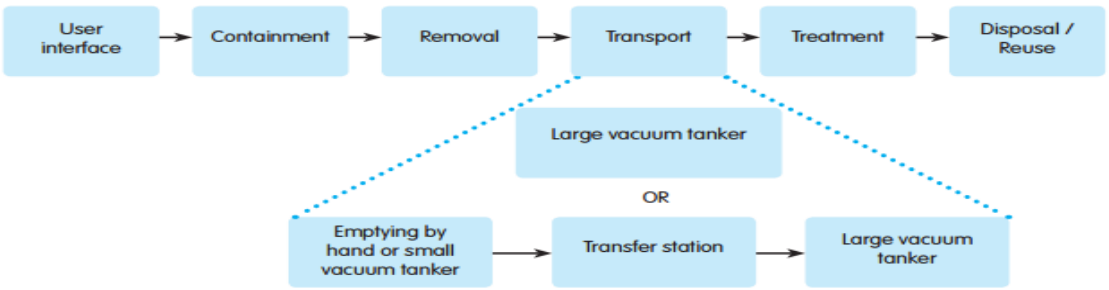
Operation & Maintenance

Screens must be frequently cleaned to ensure a constant flow and prevent back-ups. Sand, grit and consolidated sludge must also be periodically removed from the holding tank. There should be a well-organized system to empty the transfer station; if the holding tank fills up and overflows, it is no better than an overflowing pit. The pad and loading area should be regularly cleaned to minimize odours, flies and other vectors from becoming nuisances.

Upgrading

Transfer stations are relatively common in North America. There, they are equipped with digital data recording devices to track quantities, input types and origin, as well as collect data from the individuals who dump there. In this way, the facilitators can collect detailed information and more accurately plan and adapt to the changing loads.

Figure 33: Process flow of conveyance of faecal sludge through a transfer station



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