



Reuse of treated waste water and septage at Wai

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CWAS CENTER
FOR WATER
AND SANITATION

CRDF CEPT RESEARCH
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FOUNDATION

CEPT
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Abbreviations

Sl.No	Abbreviation	Explanation
1	CEPT	Center for Environmental Planning and Technology
2	CPHEEO	Central Public Health and Environmental Engineering Organisation
3	FSSM	Faecal Sludge and Septage Management
4	FSTP	Faecal Sludge Treatment Plant
5	KLD	KiloLitre per Day
6	MIDC	Maharashtra Industrial Development Corporation
7	SWM	Solid Waste Management
8	WMC	Wai Municipal Council
9	WW	Waste Water

In Wai, scheduled desludging is carried out and the septage is treated at a 70 KLD FSTP

Wai is a small city in Satara district of Maharashtra, with a population of 43,000 (est, 2019).

Wai Municipal Council with support from CEPT University has become India's first city to implement scheduled emptying of septic tanks at 3 years emptying cycle along with treatment of collected septage at a dedicated Faecal Sludge Treatment Plant (FSTP).

At present, treated waste water is reused for on-site gardening and cleaning vehicles.

Need for reuse study

Due to scheduled emptying, high volume of septage is generated. In order to explore some economic benefit of treated resources, this reuse study is being conducted for Wai.

With 311 FSTPs planned in Maharashtra and the state government advocating scheduled emptying, the options for reusing treated wastewater and treated sludge identified in this study can be explored at other FSTP sites as well.



Scheduled Desludging



FSTP with thermal treatment

Reuse parameters and options are identified based on the quality and quantity of the by-products produced at the FSTP

- There are **three by-products** generated after treatment in Wai FSTP, i.e – treated waste water, dewatered sludge and biochar.
- The **quantities** and **qualities** of by products were assessed.
 - i. It is observed that on an **average daily 20 kilo litres of treated waste water (TWW)** is generated and the quality results from the on-site monitoring system that is installed after the tertiary treatment unit shows that it is within the fit for reuse limits for all parameters.
 - ii. **Dewatered sludge average generation is 1000kg daily.** It is converted into compost after 60 days of drying. This compost is shared with local farmers on an experimental basis.
 - iii. On an average, **39 kg of biochar* is being generated daily.** Its quality shows that it can be used as an additive for the fertilizer.
- Deciding on reuse is dependent on the following parameters: physical parameters, financial parameters, and user perspective parameters

Physical



Land Availability



Quantity of TWW



Quality of TWW



Distance of reuse from FSTP

Finance



Capital Cost



O&M Cost

User Perspective



Human Contact



Demand

* Biochar generation is specific to Wai because there is pyrolysis of septage

Onsite and offsite reuse plans are developed and discussed with various stakeholders

- **Discussions** were conducted with stakeholders from the Wai Municipal Council (WMC), the team from Tide technocrats operating the FSTP, and other potential stakeholders to understand feasibility of various reuse options, demand, costs, quantities required, etc.
- **Based** on the **discussions, plans** were prepared
 - On-site reuse** includes bio-mining and urban forestry, it satisfies all parameters and requires minimal investment from WMC making it a feasible option for the long term.
 - Off-site reuse has two modules** – one within the city limits and which is more prioritized by city officials.
 - Module two of the **off-site reuse** plan required permission from various stakeholders and involves human contact.
 - MIDC reuse** plan will be expensive for industries and most major industries already have their own waste water treatment plant.

Stakeholders

Wai Municipal Council

- Chief Officer
- Sanitation Dept. officials.

FSTP team, Tide Technocrats

- Site in-charge
- Senior team members

Others

- Sanitary supervisors
- Water tanker vendors
- Agricultural officer
- Landscape expert
- Farmers
- Workers involved in various reuse activities

Priority of Reuse

A: Onsite reuse
- existing practice

B: Offsite reuse_1
- More prioritized

C: Offsite reuse_2
- Less prioritized

D: MIDC reuse
- As per Maharashtra Reuse Policy

Proposed reuse plan for treated wastewater, dewatered sludge and biochar

- Following are the **proposed options for reuse**.
 - Treated wastewater** : on-site reuse option involving – landscaping of the FSTP, site maintenance, vehicle washing, for nearby WMC gardens, SWM compost and urban or social forestry. About 54,000 liters of waste water per day will be reused and this requires capital investments and operations and maintenance cost for a year. This is the most preferred option based on parameters.
 - Dewatered sludge** : can be used for plant additives, pig farming (it helps them in digestion) and in making road medians, bricks and pavers.
 - Biochar** : can be used to increase farm yield in the form of compost and has numerous agricultural uses which are being explored.
- The most common reuse practices currently being followed are in FSTP landscaping, urban forestry, bio-mining landscape and WMC gardens.
- Research is still in process for identifying uses which can generate market value for the by-products.

Treated Waste Water



Dewatered Sludge



Biochar





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A first of its kind scheduled emptying is being carried out in Wai and the septage is treated at the 70 KLD FSTP

- Wai is a small city in Satara district of Maharashtra, with a population of 43,000 (in 2019). Under Citywide Inclusive Sanitation, Wai Municipal Council with support from CEPT University has become India's first city to implement scheduled desludging of septic tanks at 3 years emptying cycle along with treatment of collected septage at a dedicated Faecal Sludge Treatment Plant (FSTP). The FSTP produces treated wastewater and sludge.
- Due to scheduled emptying high volume of septage is generated. In order to explore some economic or indirect benefit from the plant, the reuse study is being conducted for Wai.
- Maharashtra government has adopted a policy in 2017* that makes municipalities responsible for recycling wastewater and reusing treated wastewater to cool thermal power plants, serve industrial estates, and for other non-potable purposes. ... The municipalities have been given the responsibility of creating a draft action plan regarding the policy within a year and commission the recycling plants within the next three years. The Maharashtra reuse policy was formulated for 71 cities that have STPs.
- However, with 311 FSTPs coming up in Maharashtra and with the state moving to scheduled desludging there will be high volume of treatment, hence reuse policy for FSTP is also necessary.
- The study aims to explore various onsite and offsite reuse options for treated WW and Septage at Wai FSTP. It will identify parameters based on which reuse options can be assessed.
- Experience of Wai will be useful in developing a policy for reuse of treated water from FSTPs in the state.

* Source: Government Resolution Number: Misc-2016/P.No.259/UD-33, December-2017

Maharashtra introduced treated wastewater reuse policy and has provided priority on reuse options which can be adopted

Why Reuse?

नागरी भागातील सांडपाणी प्रक्रिया पुनर्चिकीकरण व पुनर्वापर धोरण निश्चित करण्याबाबत.

महाराष्ट्र शासन
नगर विकास विभाग
शासन निर्णय क्रमांक: संकीर्ण-२०१६/प्र.क्र.२५१/नावि-३३
मंत्रालय, मुंबई
तारीख: ३० नोव्हेंबर, २०१७

प्रस्तावना -

गेष्ट्या काही काळात निर्यातीतील सततच्या बदलामुळे राज्यातील पर्जन्यमान अतिथितीत बनले असल्याने राज्याला धारदार अवर्षण परिस्थितीला सामोरे जावे लागत आहे. त्याचा विपरीत परिणाम विधान व पिण्याच्या पाणीपुरवठ्यावर होत आहे. या बदललेल्या परिस्थितीत पाण्याचा प्रत्येक थेंबाचे संवर्धन व नियोजनपूर्वक वापर करण्याची गरज निर्माण झाली आहे.

जल प्रदूषण प्रतिबंध व नियंत्रण अधिनियम कलम २४ नुसार नागरी भागामध्ये निर्माण होणाऱ्या सांडपाण्यावर प्रक्रिया करणे आवश्यक आहे.

जलसंपदा विभागाकडून प्राप्त झालेल्या माहितीनुसार राज्यात प्रतिवर्षी घरगुती कारणासाठी १६४ टीएमसी व औद्योगिक कारणासाठी २२ टीएमसी इतक्या पाण्याचा वापर होतो. त्यापैकी सर्वसाधारणपणे घरगुती वापराला ८० टक्के व औद्योगिक वापराला १७.५ टक्के इतके सांडपाणी निर्माण होते. या सांडपाण्यावर प्रक्रिया करण्याची निश्चिती करण्यासाठी नागरी भागातील सांडपाणी प्रक्रिया पुनर्चिकीकरण व पुनर्वापर धोरण निश्चित करण्याची बाब शासनाच्या विचाराधीन होती.

शासन निर्णय -

राज्याच्या नागरी भागातील सांडपाण्याचा पुनर्वापर व पुनर्चिकीकरण (Recycle and Reuse) याबाबतचे राज्याचे धोरण खालीलप्रमाणे निश्चित करण्यात येत आहे.

1. प्राथमिक कर्तव्य :- राज्यातील नागरी भागात तयार होणाऱ्या सांडपाण्यावर प्रक्रिया करण्यासोबतच पुनर्चिकीकरण व पुनर्वापर करणे हे संबंधित नागरी स्थानिक स्वराज संस्थेचे प्राथमिक कर्तव्य राहिले. त्यानुसार सांडपाणी व्यवस्थापन क्षमता निर्माण करून त्याचे पुनर्चिकीकरण व पुनर्वापर करणेबाबत आराखडा तयार करून निधीच्या उपलब्धतेनुसार त्याची अंमलबजावणी करण्याची जबाबदारी ही संबंधित नागरी स्थानिक स्वराज संस्थेची राहिली.
2. सांडपाणी पुनर्चिकीकरण व पुनर्वापर नियोजन:-
 - 2.1 शासनाच्या विविध योजनांमधून किंवा नागरी स्थानिक स्वराज संस्थांच्या निधींमधून शहरामध्ये स्थापित असलेल्या व प्रगतीपाश्चात्तर असलेल्या मलप्रक्रिया प्रकल्पांच्या बाबतीत सधर धोरण लागू झाल्यापासून एक वर्षांच्या आत सधर मलप्रक्रिया क्षमतेतून निर्माण होणाऱ्या प्रक्रियायुक्त पाण्याचा शास्त्रोक्त पध्दतीने पुनर्वापर करणेबाबतचा कृति आराखडा तयार करण्यात यावा व सधर कृति आराखड्यानुसार प्रकल्पांची अंमलबजावणी निधीच्या उपलब्धतेनुसार करण्यात यावी.
 - 2.2 शासनाच्या विविध योजनांमधून किंवा नागरी स्थानिक स्वराज संस्थांच्या निधींमधून मरिच्यामध्ये स्थापित होणाऱ्या मलप्रक्रिया क्षमतेतून निर्माण होणाऱ्या प्रक्रियायुक्त पाण्याचा शास्त्रोक्त पध्दतीने पुनर्वापर करण्याबाबतचा कृति आराखडा प्रकल्प पूर्ण होण्यापूर्वी तयार करून सधर कृति आराखड्यानुसार प्रकल्पांची अंमलबजावणी निधीच्या उपलब्धतेनुसार करण्यात यावी.

Objective

To recycle and reuse of treated wastewater in the urban areas in order to ensure the treatment of wastewater.

Priority order for use of treated water

Thermal Power Plants

Industrial areas under MIDC

In railways or other bulk buyers

Agriculture

Non-potable water components (as per the standards of the Maharashtra Pollution Control Board).

Project Funds

Funds from **Central, State, ULB and PPP**

Highlights of the policy

- ULBs - **reuse the treated waste water** and implement **WW treatment projects**
- Reuse of treated waste water by **Thermal power plants, MIDC** and other industries made **compulsory** - 50km buffer distance
- By 2020, **Water Resources Department** should **cancel the reservation for natural water supply** to these establishments, **in proportion to the treated water being made available.**
- The state **government** envisions to **reuse at least 6,800 million liters of wastewater daily** and reduce industrial dependence on freshwater.

Source: Government Resolution Number: Misc-2016/P.No.259/UD-33, December-2017

Key Points of Maharashtra Wastewater Policy

TECHNOLOGY

- Along with traditional technology, **innovative technology developed by IIT/NIRI** should preferably be used when implementing the wastewater recycling and reuse projects.

INSTITUTIONAL AND ADMINISTRATIVE ARRANGEMENTS

- ULB' s to **recycle and reuse the wastewater**.
- The **Water Resources Department** should **cancel** the natural water supply for industries who use the treated wastewater

REUSE MANAGEMENT

- Special areas shall be identified** for priority implementation.

PRIORITY OF REUSE

- Thermal electricity plants** (Mandatory within 50 km)
- MIDC** (Mandatory within 50 km)
- Railways or other bulk buyers.**
- Agriculture.**
- Non-potable components** (as per MPCB).



FINANCING PLANS

- Stage wise implementation of STP' s** due to limited availability of funds
- Funds shall be raised through the various schemes of **Central as well as State Government or through PPP.**
- Funds to be allocated** to the ULB **after** the wastewater reuse plan is completed

MONITORING AND EVALUATION

- State committee to **check the feasibility and cost effectiveness** of the wastewater recycling and reuse projects **before the execution** of these new projects
- If the **ULB' s bear 100% of the cost**, no need for the committee to do the checking.

FINANCIAL RIGHTS OF WASTEWATER

- ULB' s treating the water** have the **financial right** to it.

TIMELINE

- An **action plan** be formulated for the reuse of the treated water within **one year** of the implementation of the policy
- Reuse of **wastewater for thermal power plants** and **MIDC' s** within 50km of a STP should start within **three years** of the implementation of the policy

SOURCE – GOM- Department of Urban Development: Maharashtra' s wastewater reuse policy, 2017.

The Wai study was conducted by understanding quantity and quality of by-products, identifying parameters through desk research and stakeholder interviews



Understanding quantity and quality

- **Understanding quantities and quality** of treated waste water and treated septage generated at Wai FSTP.



Identification of parameters

- **Identifying parameters** which **affect selection** of an option (offsite and onsite) based on stakeholder consultation.



Consultation with stakeholders

- Based on **consultation** with **stakeholders** and **assessment** of various qualitative and financial parameters **developing a reuse proposal** for TWW and septage.



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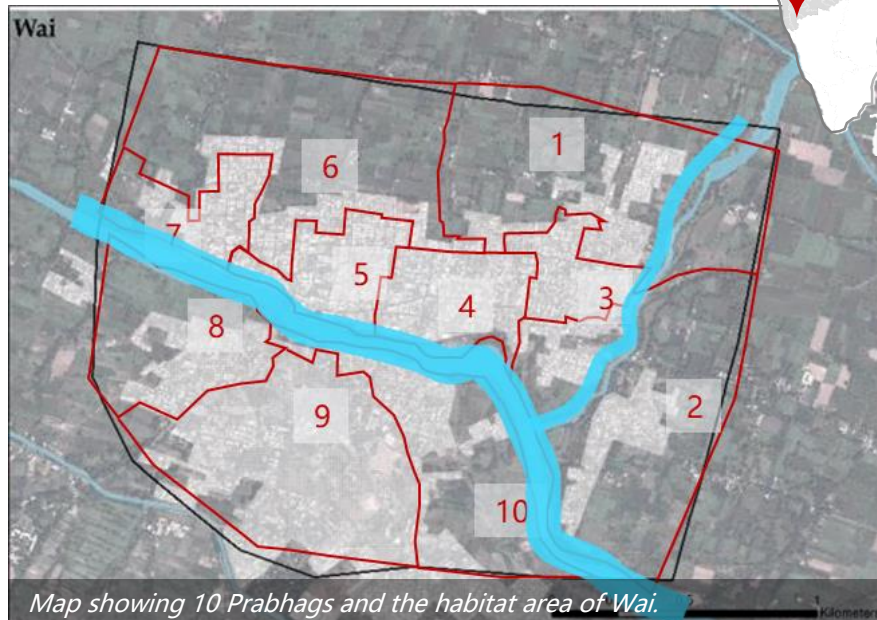
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Wai, a small town in Maharashtra is moving towards universal access to sanitation



Table 1: Demographic details of Wai

C Class Municipal Council	
District	Satara
Location	95km south of Pune; 35km from Satara
Area	3.54 sqkm
Population (2019)	43000
Households	8991
Literacy Rate	81%
Slum population	6%
Toilet Coverage	85%



Map showing 10 Prabhags and the habitat area of Wai.



Figure 1: Aerial view of Wai

Under the FSSM plan of Wai, scheduled emptying is being carried out and septage is treated at the 70 KLD FSTP. Wai is the first city in India to adopt scheduled desludging

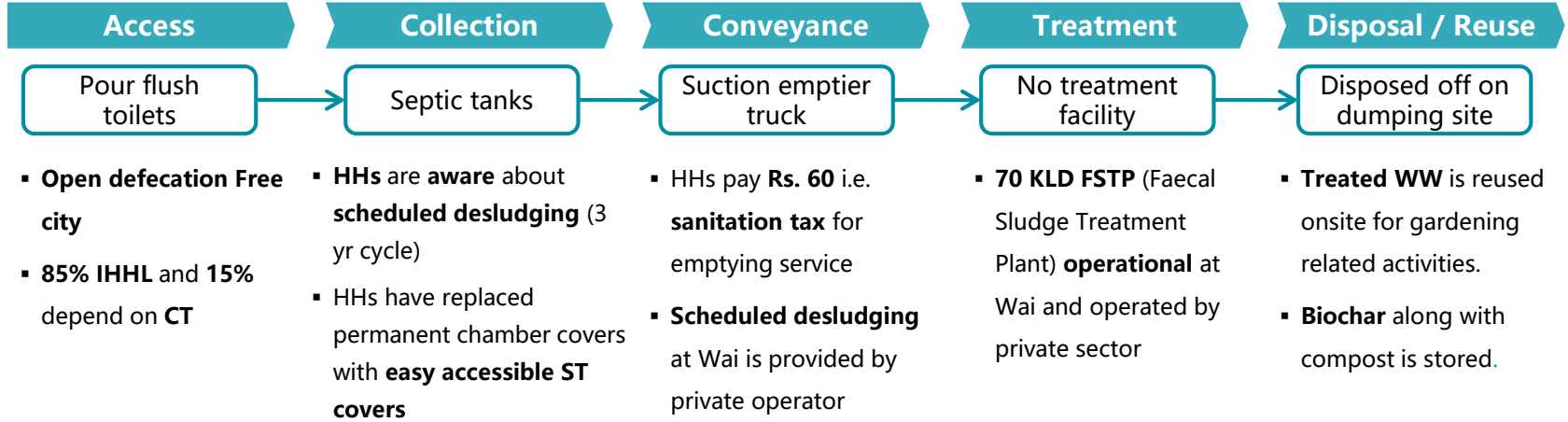
- **6-7 septic tanks desludged per day** as compared to 7-8 per month in 2017 when demand desludging was happening.
- **Dedicated treatment facility** for treating the collected septage. Also **reuse of the by products** is done.
- **10 million liter septage delivered by May 2020 in 2 years operation** to treatment facility.
- **Overwhelming positive response** from HHs for scheduled **service**.
- **Households pay nominal sanitation tax** instead of high user charges for desludging.



Scheduled desludging and treatment facility at Wai

With implementation of FSSM plan, Wai has moved towards improved sanitation across the value chain

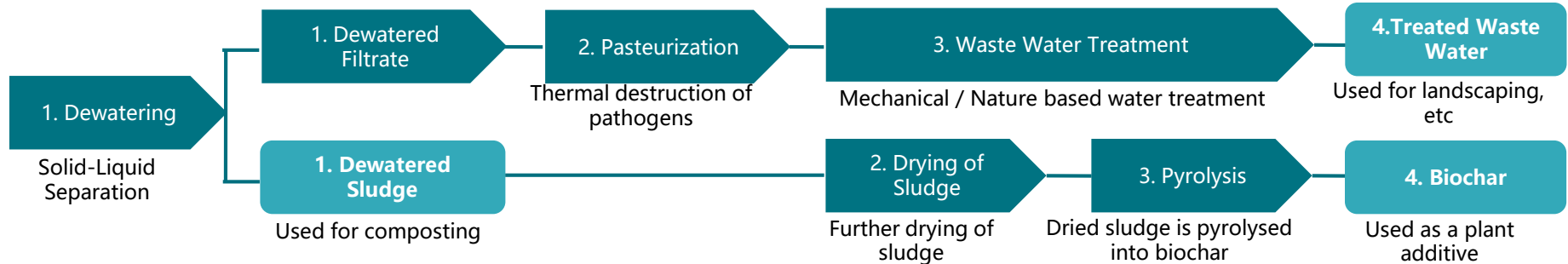
After implementation of FSSM



Treated wastewater, dewatered sludge and biochar are generated as by-Products at Wai FSTP after treatment

Wai has a **Fecal Sludge Treatment Plant** that uses **Pyrolysis** technology. .

It is set up by **Tide Technocrats**, Bangalore based company **on land provided by Wai Municipal Council**.



Source : Tide Technocrats, 2019

Large quantities of by-Products are generated at Wai FSTP after treatment

Details of Septage received and treated
(May 9, 2018 to March 21, 2020)

Quantity of septage received	9346 KL
Quantity of septage treated	9346 KL

Treated Waste Water

Quantity of TWW generated	6542 KL	<i>70-75% of septage received.</i>
Quantity of TWW reused	6542 KL	

Average Daily Generation of TWW:
20 KL

Dewatered Sludge

Quantity of dewatered sludge	5,60,808 KG
Quantity of biochar	13,477 KG

Average Daily Generation of Dewatered Sludge: **1000 KG**

Average Daily Generation of Biochar:
39 KG

Biochar

Source: Tide Technocrats

The quality of treated wastewater is achieved within the permissible limits provided by MPCB

Quality test results of treated waste water

From March 2018 to Feb 2020

Standard Norms by MPCB	5.5 - 9.0	<30 mg/l	<150 mg/l	<50 mg/l	100-1000 MPN/100ml
	pH	BOD	COD	TSS	Fecal coliform
01-Mar-19	8.08	35	168	98	39
12-Jun-19	7.2	22	94	5	8
06-Jul-19	8.77	16	53	45	17
23-Aug-19	7.13	42	110	14	63
8-Feb-20	7.46	28	96	21	17

- The treated WW quality results are within or **near to the given standards/limits**.
- Tide has installed **Tertiary Filter** for further treatment of WW using **UV filter technology** since Feb 2019.
- **Onsite monitoring system** for **quality** of treated **waste water** has been installed.

Source : Tide Technocrats



It shows BOD and COD as required

The treated dewatered sludge has good NPK values which will be beneficial for preparing compost

Quality test results of Dewatered Sludge

Date	Loss on Drying	Carbon as C	Phosphorus as P2O5	Nitrogen as N	Potassium as K2O	Fecal Coliform
12-Mar-20	51.7 %	24.12 %	1.90 %	3.63 %	0.234%	1.3×10^4 Index/100gm

- The **dewatered sludge** after **60 days of drying** becomes **compost**.
- Tide has shared a very small amount of compost with one of the **farmer** on demand for **trial basis**.
- Farmer has said that the **compost is good quality** and has **increased** his **yield**. He would like to take more.



Sr. No	Potential reuses of Dewatered Sludge
1	Use as compost (after 60 days) in farming , as it may increase increases farm yield
2	FSTP landscaping, Urban Forestry, biomining landscape, WMC garden, etc
3	Tide team is researching other potential uses of this by product to generate market value

Source : Tide Technocrats

The treated biochar has good carbon values which can be used as an additive for preparing compost

Quality test results of Biochar

Date	Moisture (%)	Ash at 5°C (%)	Fix carbon (%)	Gross Cal. Value (Kcal/kg)
27-Jun-19	1.53	84.93	1.43	872
16-Jul-19	3.35	57.63	1.83	1755.2
01-Sep-18	28.71	56.32	0.64	2867.46
10-Oct-18	38.67	49.11	1.45	3165.8
13-Dec-18	15.42	74.03	2.16	1417



Source : Tide Technocrats

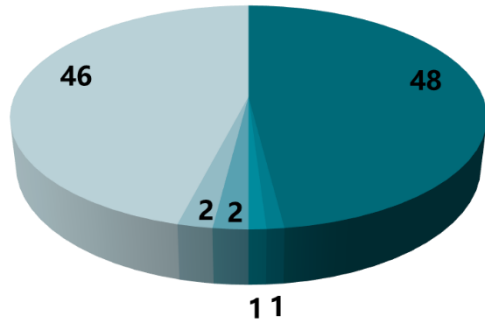
- The biochar test results are **within** the **recommended limits**.
- They have **good** percentage of **carbon content**.
- It can be used as an **additive to the fertilizer**.
- It can be used for **co-composting with dewatered sludge**.
- The **carbon** helps achieve the temperature to **kill** the **pathogens**.
- This helps **speed up the composting process**

Sr. No	Potential reuses of Biochar
1	Plant additive
2	Used in Pig farming as it helps them in digestion
3	Road medians, bricks, paver blocks, etc
4	FSTP landscaping, Urban Forestry, biomining landscape, WMC garden, etc
5	Tide team is researching other potential uses of this by product to generate market value

At present, the treated wastewater is being used for onsite landscaping

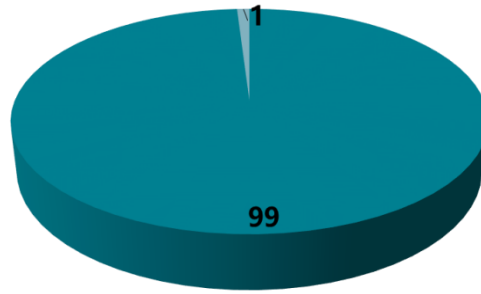
Summary of quantities of by-products reused in various activities. (May 9, 2018 to March 21, 2020)

Treated Waste Water



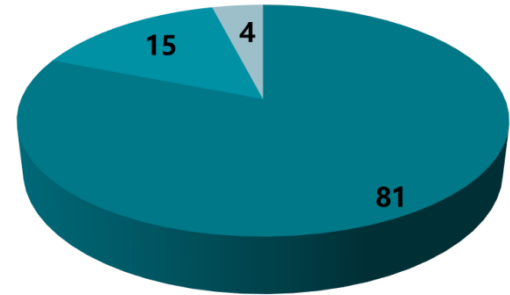
- Onsite landscape
- WMC burial ground
- Site maintenance
- Nearby WMC garden
- Extinguishing fire on SWM site
- Vermi composting garden

Dewatered Sludge



- Storage
- Given to Farmer

Biochar



- Storage
- Research purpose
- Used in FSTP landscape

- The generated quantity of treated WW is **completely reused on site** and in adjacent WMC garden.

- The dewatered sludge becomes **compost after 60 days of drying**.
- **Currently** it is being **stored**.
- They have offered **1%** to one of the **farmers for trial bases**.

- Most of the **biochar** is **stored** and for **experimental purpose** it is also used in the FSTP landscape.

Source : Tide Technocrats

The biochar and dewatered sludge are stored and some quantity is used for composting purpose

Treated Waste Water



Dewatered Sludge



Biochar



Consultations with stakeholders on response to current practices for treated byproducts

Tide

Tide officials mentioned that one of the farmers has approached to use dewatered sludge for trial basis

Tide also mentioned that farmers are not willing to use because it is generated from human waste and they lack awareness about treated sludge

Tide plans to generate a video and circulate over social media for awareness regarding use of treated sludge

WMC

The main focus of WMC is generating market from the byproducts.

WMC also insisted on maintaining the records, of use of treated byproducts as it can be an income generating activity



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2 Existing reuse practices in Wai

Potential options for reuse

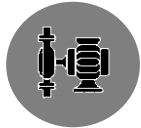
- 3**
- I. Treated waste water
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4 Details proposals implemented by Wai
Municipal council

5 Annexure

Globally and nationally we have learnt that reuse of treated wastewater and sludge for reuse practices such as composting, landscaping, vehicle washing, groundwater recharge, is prevalent

Internationally



Jordan

Groundwater Recharge



Bangladesh, Kampala, Malaysia

Co-composting
SWM site



Nepal, Bangladesh, South Africa

Agriculture

The reuse options were majorly

concentrating to agriculture, garden, etc

Source - Various. (2017). *Fsm4. Case Studies. First Edition. Fsm 4, (February), 142.*

Nationally



Unnao, Uttar Pradesh

Agriculture



Leh

Nursery /
Horticulture



Devanahalli, Tamil Nadu

Groundwater
Recharge



Wai

Fire Fighting



Wai, Sinnar, Warangal, Devanahalli

Landscape / Urban
Forestry



Sakhipur

Garden/ Public
Spaces



Devanahalli, Adigaratti

Co-composting
SWM site



Sinnar

Vehicle Washing

The are multiple reuse options based on the context and other parameters

Source – various - *Chhattisgarh's wastewater policy rationale ; Wastewater: Global issues, trends and impacts ; Wastewater report 2019 – IWA ; Recycling and reuse of treated wastewater in Urban India – IWMI ; Center of science and engineering (n.d.)* retrieved from <https://www.cseindia.org/topics/decentralised-waste-water-treatment>



Based on the case studies and policies various opportunities for the reuse of treated waste water are identified.

They are categorized as onsite and offsite options depending on multiple factors such as cost, land availability, distance, regulations, etc.

Based on existing practices and factors, an exhaustive list of onsite reuse options is developed

Onsite options

Landscaping	Social/Urban Forestry	Vehicle washing
Toilet maintenance	Co-composting	Toilet flushing
Site maintenance		

Factors to be considered as per context for Onsite options

- Land availability
- Cost of Land

Common factors considered for both onsite and offsite options

- Human Contact
- Applicable Regulations
- Quality and Quantity of WW
- Demand from users

Based on existing practices and factors, an exhaustive list of off site reuse options is developed

Off-site options

Construction sites	Agriculture	Industries (MIDC)	Septic tank emptying
CT/PT cleaning	ULB lands	Road cleaning	Drain/gutter cleaning
Fire fighting	Bus/Railway station	Toilet flushing	Nursery
Bricks manufacturing		Public gardens; Medians, road side plants, etc	

Factors to be considered as per context for Offsite options

- Distance
- Capital Cost
- Revenue
- Availability of Data
- Institutional Permission
- Social Acceptance

Common factors considered for both onsite and offsite options

- Human Contact
- Applicable Regulations
- Quality and Quantity of WW
- Demand from users

Through stakeholder discussion and desk review physical parameters, financial parameters and user perspective parameters are identified which needs to be considered to develop a reuse plan

Parameters for FSTP reuse



Discussion with associated stakeholder

Discussions were conducted with various **associated stakeholders** in order to **understand priority** of the reuse options and develop a **more feasible plan**.

Wai Municipal Council

- Chief Officer
- Sanitation Dept Officials

FSTP team, Tide Technocrats

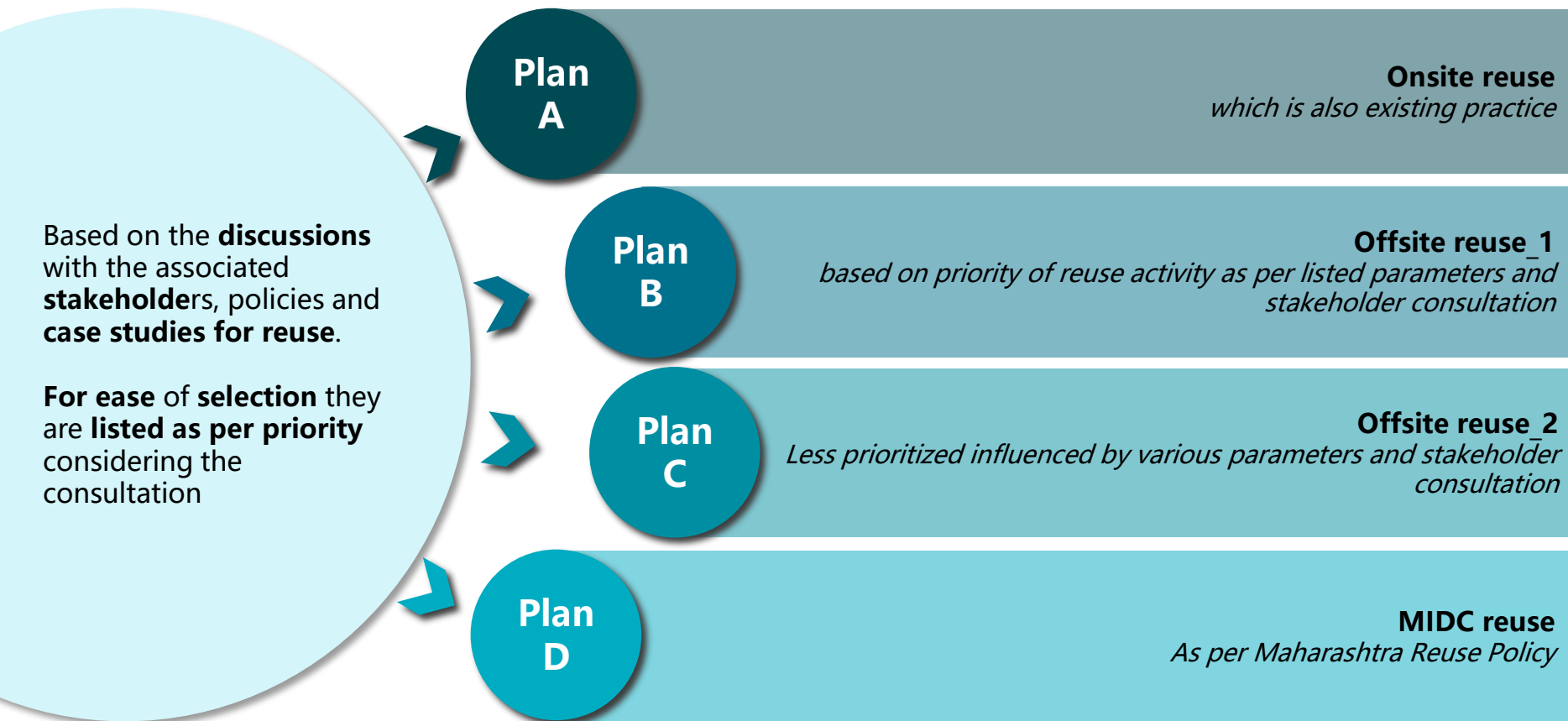
- Site In charge
- Senior team members

Others

- Sanitary supervisors
- Water tanker vendors
- Agriculture officer
- Landscape expert
- Farmers
- Workers involved in various reuse activities

- The **discussions** helped understand the **reason for selecting** particular **reuse option**.
- Discussion with **other stake holders** allowed to identify factors like **demand, cost and quantities**.

The onsite reuse plans are given first priority than offsite reuse options

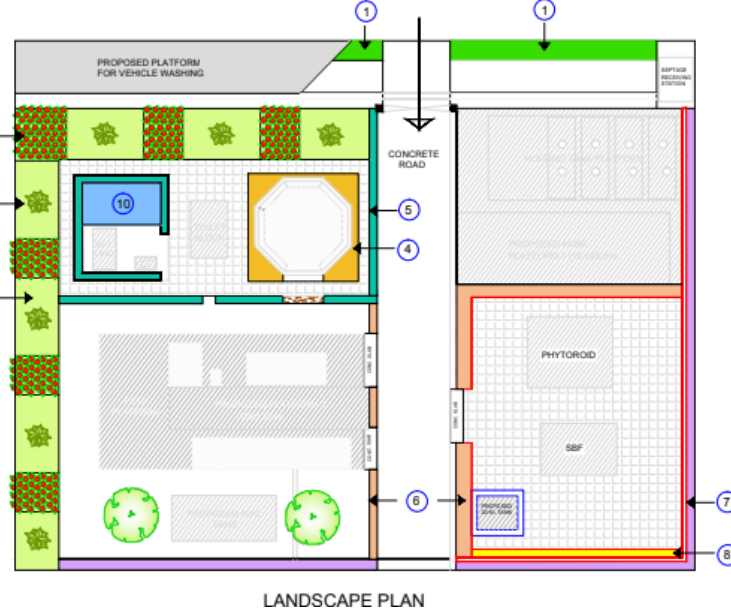


Plan A : Based on the identified parameters, onsite reuse plan is developed proposing 54 KL/day of treated wastewater reuse

Based on the above parameters following reuse options were considered in Plan A



Reuse Option	Quantity of treated water required (Lit/day)
Landscaping at FSTP	10,000
Site maintenance	500
Vehicle washing	3,500
WMC garden nearby	5,000
SWM Compost	5,000
Social/Urban Forestry	30,000

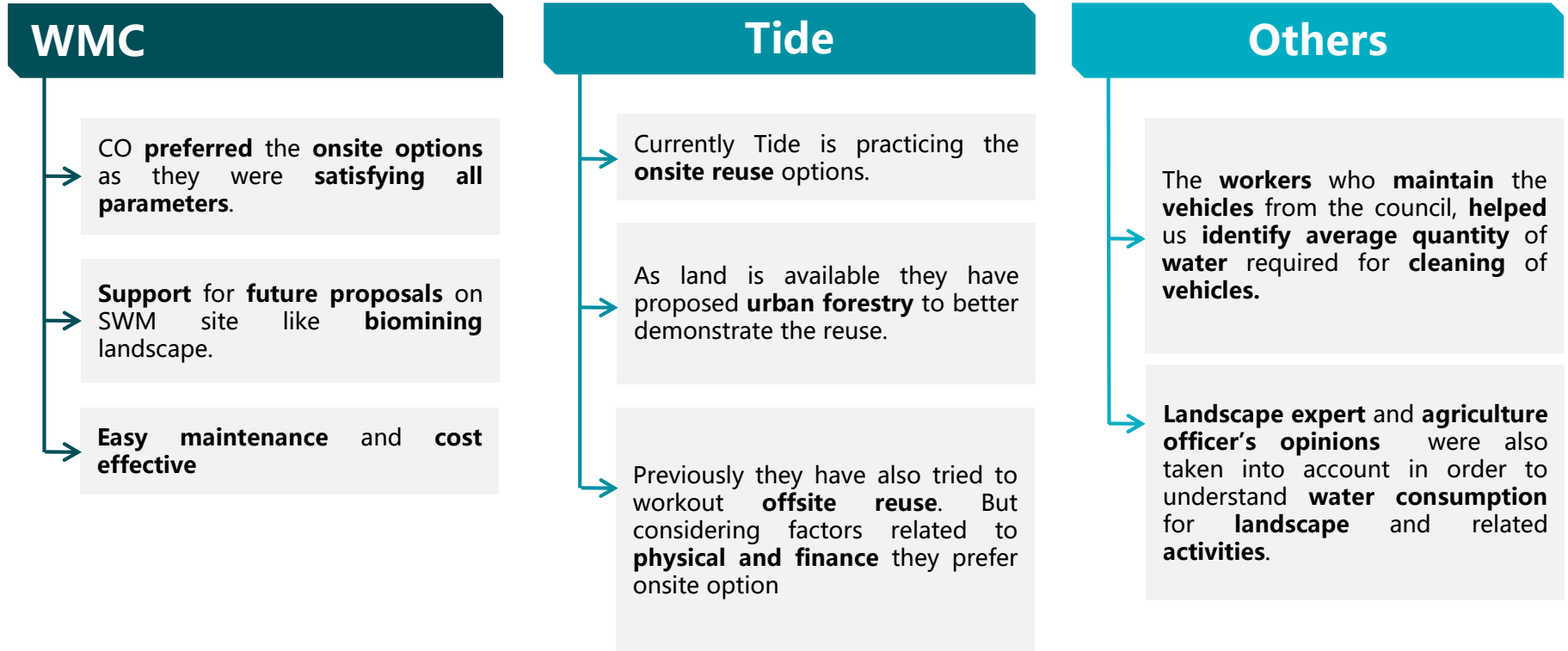


- ① BUDDHA BAMBOO AND WADELIA PLANTATION
- ② RED IXORA
- ③ CHAMPA
- ④ JATROPHA
- ⑤ LANTINA RED AND YELLOW
- ⑥ MIXED - JATROPHA AND UMBRELLA SEDGE
- ⑦ BOGANVELA
- ⑧ UMBRELLA SEDGE
- ⑨ LAWN
- ⑩ LEMON GRASS

Total Quantity of WW reused Onsite = 54,000 Lit/day

Refer to [Annexure 1](#)

Plan A: Potential options were discussed with the stakeholders and their opinions and preferences were understood to develop the onsite plan



The treated by products achieve the fit for reuse norms provided by MPCB

Reuse option	MPCB
Landscape at FSTP site	<p>pH - 6.5 to 9.0</p> <p>B.O.D - 30 mg/l,</p> <p>C.O.D -150mg/L</p> <p>D.O. - Not less than 2 mg/l</p>
Social / Urban forestry	<p>pH - 6.5 to 9.0 ;</p> <p>B.O.D - 10 mg/l ;</p> <p>D.O. - Not less than 3 mg/l</p>
Vehicle washing	<p>pH - 6.5 to 9.0</p> <p>B.O.D - 10 mg/l</p> <p>D.O. - Not less than 3 mg/l</p>
SWM Composting (From CPCB)	<p>Arsenic – 10 mg/kg</p> <p>Cadmium – 5 mg/kg</p> <p>pH – 5.5- 8.5</p>

These are being attained at Wai FSTP



Urban forest, bio mining and SWM compost are the major projects and most prioritized onsite reuse options

Urban Forest

- Tide has been given **2 acre WMC land** , where they will **develop urban forestry**. Also **demonstrate reuse of treated water and biochar**.
- The **initial cost** for land **development** will be borne **by Tide**.
- In future any **profits generated** from the land will be **owned by WMC**.

Biomining (proposed)

- **Reuse of most of the generated treated waste water for landscaping at biomining site** in the coming months.
- As **SWM site** will be **completely landscaped after biomining**.

SWM Compost

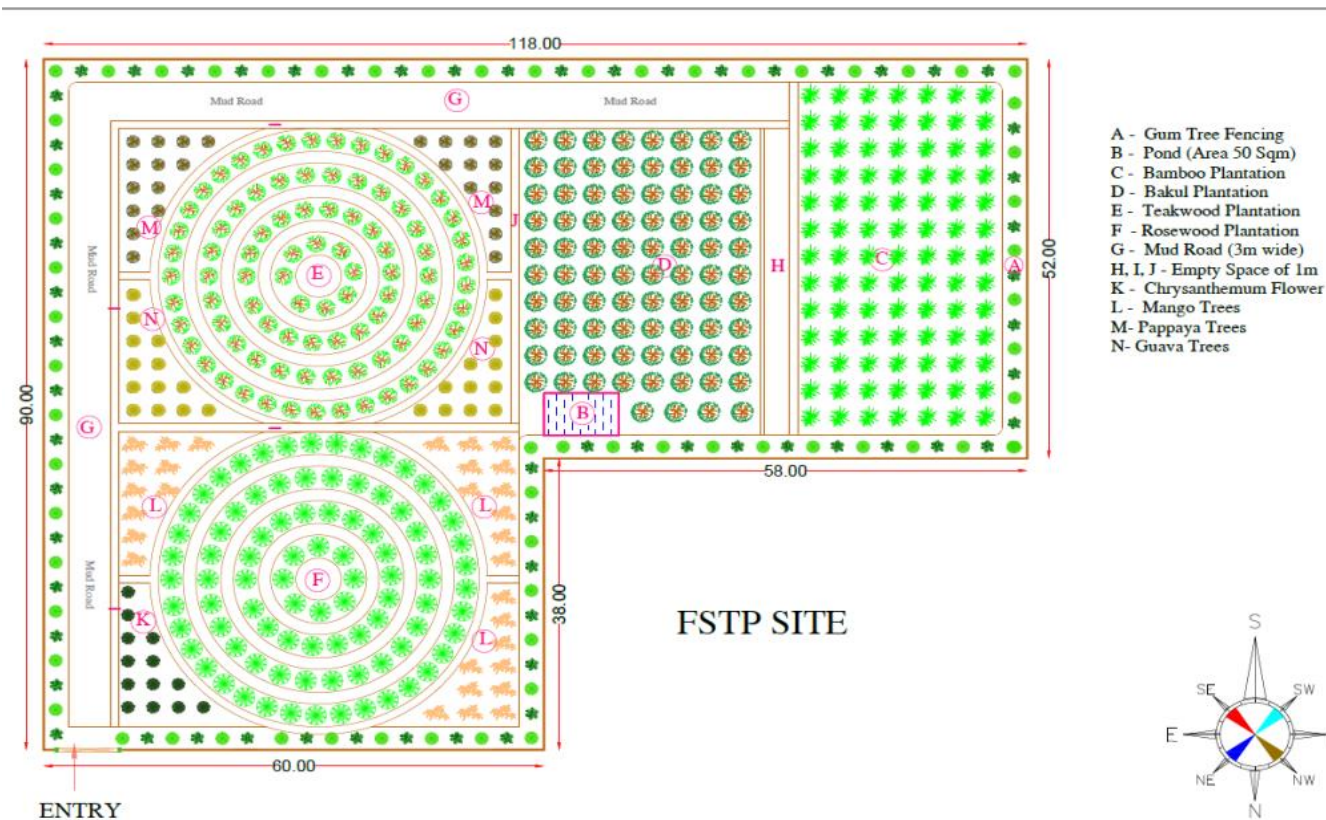
- **Supply treated WW as required for SWM composting**.



Located near FSTP	Low cost for required infrastructure	No Human Contact	Daily requirement
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Urban Forest with additional pond of 55KL capacity is proposed as an onsite reuse option

- The **proposal** will be **implemented** and **maintained** by **Tide Technocrats** for period of 1 year
- The **plantation area** is planned to include species of **Bamboo, Bakul, Teakwood and Rosewood.**
- An **additional pond** of **55,000 lit** capacity will be constructed
- **SHG** can be **involved** in the **urban forest activity.**



Proposed urban forest layout by Tide

The dewatered sludge and biochar can be used for the upcoming biomining and SWM compost plant

Biomining

Agency: WMC through private contractor

Status: 40% work completed

Area: 1.7 acres land will be reclaimed

- **Post completion** of **biomining** project the entire **site** will be **landscaped**.
- This will be done **by** another **private contractor** appointed by formal process.



AFTER BIOMINING

SWM Compost Plant

Agency: WMC

Status: On going activity

Area: 5 sheds with each having 6 pits. Capacity 50 cum

- **Currently** the **SWM compost plant** is **not operational daily**.
- But the **implementation** of **SWM project** will **ensure daily composting** of collected wet waste from the city.



For the onsite reuse plan 12 lakhs of capital investment will be required with an O&M of 1.3 lakhs annually

Land is available for setting up necessary infrastructure for supplying treated waste water for onsite uses. **WMC also recommends to use entire treated WW on SWM site activities.**

Incase of fully functional FSTP to its 70 kld capacity

Quantity of septage treated per day	Quantity of treated waste water per day	Requirement of treated WW per day as per Plan A
70 KLD	55 KLD	54 KLD

- As per Plan A reuse options all the generated treated water can be reused onsite per day.
- As per current situation, there is requirement for additional treated water after completion of urban forest project.

Costing Details

Capital Cost Invested	Capital Cost	O&M costs (annually)
30,000 Water pumping and 200ft pipe line for supplying water	11,65,840 For urban forest	1,29,600 <i>Refer Annexure 1</i>

Note: Currently all capital costs are invested by FSTP Operator Tide. In addition to this for a period of 1 year the O&M cost will be also done by Tide

Plan B: Based on the priorities of Wai Municipal Council, an offsite reuse plan is developed which comprises public places landscaping and tree plantation activities

Based on the above parameters following reuse options were considered in Plan B



Most favorable reuse options for WMC

Reuse Option	Quantity of treated water required (Lit/day)
1300 trees planted	40,000
Burial Ground (RP Smashan Bhumi)	5000
Medians	2500
CO bungalow	400
WMC Landscape	2500
Smarak	4500
Total	54,900



1. All uses are within city limits
2. Requires only WMC permission
3. Daily requirement of water
4. No human contact

Total Quantity of WW reused OFFSITE = 54,900 Lit/day

Agriculture officers and landscape experts were also consulted to develop the offsite reuse options

WMC

- They are listed **based on discussion with WMC.**
- **No human contact** and requires **only WMC permission**
- WMC workers regularly involved in these activities provided estimates for water requirement.

Others

→ To confirm on the estimated quantity required for these activities as suggested by WMC, experts such as **agriculture officer** and **landscape expert** were also consulted

Reuse option	MPCB
Gardens / Public Space	pH - 6.5 to 9.0 ; B.O.D - 30 mg/l ; C.O.D - 150mg/L; D.O. - Not less than 2 mg/l
Median / Road side planting	pH - 6.5 to 9.0 ; B.O.D - 30 mg/l ; C.O.D - 150mg/L; D.O. - Not less than 2 mg/l

These are being attained at Wai FSTP



For the offsite reuse plan ~10 lakhs of capital investment will be required with an O&M of 6.3 lakhs annually

Incase of fully functional FSTP to its 70 kld capacity		
Quantity of septage treated per day	Quantity of treated waste water per day	Requirement of WW per day as per Plan A
70 KLD	55 KLD	54.9 KLD

- **WMC prefers not to use its own tanker as it is only for potable uses.**
- As per Plan B reuse options all the generated treated water can be reused offsite per day.
- WMC has a tender which states to provide tractor, trolley, tanker, etc with diesel and driver. In case of additional tanker requirement WMC can rent a water tanker under this tender.

Scenario 1 : If WMC purchased own tanker	
Costing Details:	
Capital Cost	Annual O&M Cost
8,14,000 Tractor water tanker +100 ft pipe	6,33,156 Labor + vehicle servicing + Diesel Cost

Scenario 2 : If WMC rented a tanker
Costing Details:
Water tanker on rent (annual cost)*
10,50,000 Rs. 3500 per day, considering 25 working days

Source: GEM Portal

Refer to [Annexure 2](#)

*The tanker rent is based on enquiry from local vendors at Wai

As per the costing details, it is more beneficial for WMC to purchase a separate tanker for reuse activity.

Plan C: A second offsite reuse plan is prepared with the options that were on the last priority of the stakeholders

Based on the above parameters following reuse options were considered in Plan C



Reuse options which require additional permission

Reuse Option	Quantity of treated water required (Lit/day)
Drain/gutter cleaning	1500
Road cleaning	3000
Scheduled desludging	3000
Nursery	7000
School ground	5000
Wai Bus Stand	10,000
Agriculture	60000
Total	89,500



1. No demand on daily basis

2. Quantity of TWW may vary

3. Distance may vary

4. Involves human contact

Total Quantity of WW reused OFFSITE = Average 55,000 Lit/day

Note : The calculations are done for limited area/road width. It may vary as per actual demand.

Quality norms were identified for nursery usage, agricultural usage and road side cleaning options

WMC

→ Would require permission from **respective authorities for reuse of some of these options**

→ Based on **consultation** with **farmers** , the **estimated quantum** of treated WW **required** has been **derived**. The farmer requires water every 2 days.

Others

→ **WMC workers, emptying staff, nursery owner, education dept and farmers' opinions** were considered to for water requirements. The **average quantities** are considered in the estimates

Reuse option	MPCB
Nursery / Horticulture	pH - 6.5 to 9.0 ; B.O.D - 10 mg/l ; D.O. - Not less than 3 mg/l ;
Agriculture	pH - 6.5 to 9.0 ; B.O.D - 30 mg/l ; C.O.D - 150mg/L; D.O. - Not less than 2 mg/l
Road and other cleaning / Ground cooling	pH - 6.5 to 9.0 ; B.O.D - 10 mg/l ; D.O. - Not less than 3 mg/l
These are being attained at Wai FSTP	



For the second offsite reuse plan ~10 lakhs of capital investment will be required with an O&M of 5.6 lakhs annually

Incase of fully functional FSTP to its 70 kld capacity

Quantity of septage treated per day	Quantity of treated waste water per day	Requirement of WW per day as per Plan A
70 KLD	55 KLD	55 KLD

- **WMC prefers not to use its own tanker as it is only for potable uses.**
- As per Plan C reuse options all the generated treated water can be reused offsite per day. In fact there might be demand for additional water.
- Since there is demand , WMC can levy charges and it can act as a source of revenue.

Scenario 1 : If WMC purchased own tanker

Costing Details:

Capital Cost	Annual O&M Cost
8,14,000 Tractor water tanker +100 ft pipe	5,66,556 Labor + vehicle servicing + Diesel Cost

Source: GEM Portal

Refer to [Annexure 3](#)

Scenario 2 : If WMC rented a tanker

Costing Details:

Water tanker on rent (annual cost)*
10,50,000 Rs. 3500 per day, considering 25 working days

*The tanker rent is based on enquiry from local vendors at Wai

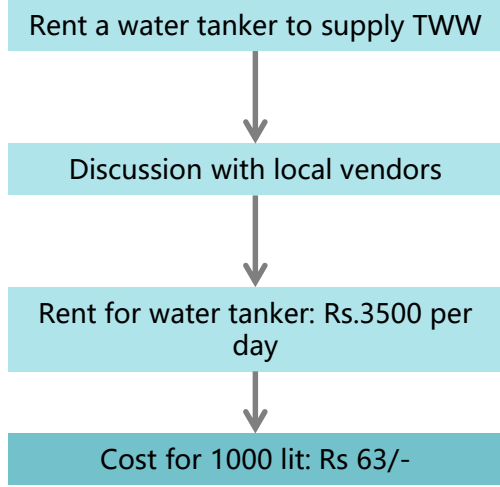
As per the above costing details, it is more beneficial for WMC to purchase a separate tanker for reuse activity.

Plan D: As per the Maharashtra reuse policy's priority options, industrial reuse plan is also developed



MIDC supplies fresh water to the industries at Rs. 16 per 1000 lit. It is also one of the major income sources.

Mode to supply TWW to MIDC



Discussions with MIDC

- **Not allowed** to use **other external source of water.**
- **Major industries** have their **WWTP**
- Mostly used for **gardening** purpose
- The **supply** of our **TWW** will be **expensive** for the industries.
- He **suggested** to **discuss** with **Mapro** for **non potable use.**

As per **Maharashtra Reuse Policy**, MIDC has to reuse TWW. Wai MIDC is located **1.2 km from FSTP**. We **proposed to supply TWW** to industries for landscape purpose.

The MIDC reuse option is **not feasible** as the cost of supply of TWW is more than that of MIDC

Onsite reuse plan has higher capital needs than the offsite options, although its O&M cost is quite less than offsite options

Summary			
Option	Quantity of waste water reused (lit/day)	Capital Costs	Annual O&M Costs
Plan A	54,000	11,65,840	1,29,600
Plan B	54,900	8,14,000 Purchase tanker 10,50,000/ year Rent tanker	6,33,156
Plan C	55,000		5,66,556

- **WMC recommends we reuse the entire treated waste water on SWM site for activities such as SWM compost, biomining landscape and onsite uses of FSTP.**
- **A mix of onsite and offsite option can be explored till all the possible reuse of onsite are developed on site**
- **For offsite options, despite cost differences WMC prefers to rent tanker than buying.**





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Wai municipal council has selected Plan A for implementation and initiated further process

TREATED WASTE WATER

Most preferable option for reuse based on above factors and also as per WMC's suggestions is **Plan A**

Onsite Reuse Of Treated Waste Water

	Quantity of waste water reused (lit/day)	Capital Costs	Annual O&M Costs
Plan A	54,000	11,65,840	1,29,600

- **Capital investment** will be done **by Tide** and they will be **responsible** for the **O&M costs** for **1 year atleast**.
- Thus **WMC** has to **ensure proper usage** of TWW and **monitor** the **activities**.
- In future for biomining the infrastructure can be extended.
- Also a **mix** of **onsite** and **offsite** can be **explored till** all the **options** for **onsite reuse** are **developed**.

Located on same site as FSTP

Low cost for required infrastructure

No Human Contact

Daily requirement

Based on selected Plan A, WMC has entered into an agreement with Tide to develop urban forestry on the WMC land to ensure better demonstration of FSTP by-products

Key highlights :

- Tide has shared the **urban forestry proposal** with WMC. **Post WMC's suggestions the proposal was finalised**
- **Agreement has been done** between Tide and WMC for the developing **urban forestry**.
- **Treated wastewater and septage** from the FSTP will be **reused** for **urban forest plantation**
- Tide Technocrats would **maintain & monitor** the **plantation** for a period of **1 Year** from the **completion** of the **plantation process**.
- Tide will be developing the plantation area is planned to include **four different species** of trees i.e. **Bamboo, Bakul Tree, Teakwood and Rose wood**.
- The plantation would be handed over to WMC after 1 year for ongoing care & maintenance.
- **WMC is the sole owner of the land & all the value created there on.**

Cost For Setup & Maintenance For First Year

- **Tide Technocrats will spend** an amount of up to **Rs. 11,65,840** for the setup of the plantation & its maintenance over the first year.

वाई नगरपरिषद, वाई

करारनामा

(नगरपरिषद अॅक्ट १९६५ चे कलम ९३ अन्वये)

करारनामा लिहून घेणार	:	मा. मुख्याधिकारी, वाई नगरपरिषद वाई
करारनामा लिहून देणार	:	टी.टी.पी.एल. करिता श्री. एन. संपतकुमार मॅनेजिंग डायरेक्टर टाईड टेक्नोकॅन्ट्रस प्रायव्हेट लि. रा.३३/३३/५ अ, तिसरा मजला अन्नपूर्णा इंडस्ट्रीयल कंपाऊंड, कणकपुरा रोड जरगणाहाडी, जे. पी. नगर बॅंगलोर पिन कोड ५६००७८ करणे करारनामा लिहून देतो की,
१. कामाचे नाव	:	वाई शहर हद्दतीतील स.नं. सोनापूर कचराडेपो वेस्ट मॅनेजमेंट फॅसिलिटी एम.आय.डी.सी. एरिया आणि टी.टी.पी.एल. यांच्या संयुक्त विद्यमाने वनक्षेत्र विकसित करणे व १ वर्षा करिता देखभाल करणे कामाबाबत.
२. करार पत्र मंजूरीचा ठराव	:	सर्वसाधारण सभा ठराव क्र. दि. / /
३. करार पत्रानुसार कामाची मुदत	:	१ वर्ष (दिनांक / / ते दिनांक / /)

वरील कामाबाबत मी खालील प्रमाणे करारनामा करून देत आहे.

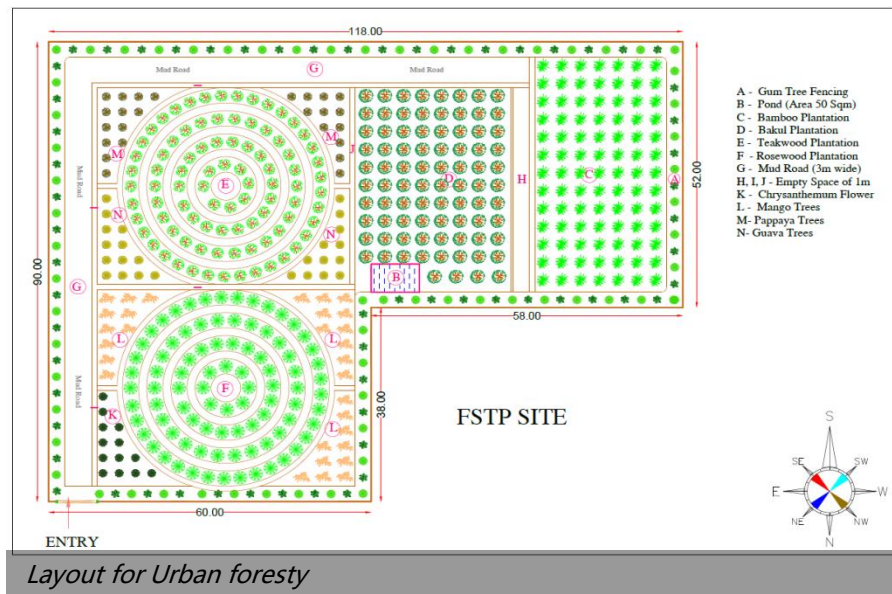
१. वाई नगरपरिषदेकडील वर नमूद केलेल्या कामासाठी करून घेणेत आलेल्या करारामध्ये नमूद केलेप्रमाणे सोबतच्या रक्कम रुपये १२००/- चे स्टॅंप पेपरवर करारनामा करून देत आहे.
२. सदरचे कामास सुरुवात करणेपूर्वी न.पा. चे संबंधित विभागाचे अधिकारी यांची लेखी परवानगी घेतलेनंतरच व त्यांचे कडून कामाची आखणी करून घेऊन व तसे नगरपरिषदेस लेखी कळविले नंतर कामास सुरुवात करेन.
३. सदरचे काम नगरपरिषदेचे मुख्याधिकारी, अध्यक्ष, व इतर संबंधित अधिकारी यांचे देखरेखीखाली करणेचे आहे.

Agreement for development of urban forest

The implementation and maintenance plan by Tide for the urban forestry project

Implementation Plan

S N	Time	Activity
1	Day -1	Approval to go ahead
2	Week - 1	Clearing of allocated area
3	Week - 2	Fencing & Land Levelling
4	Week - 3	Fencing & Gate construction, Marking of land
5	Week - 4	Pond construction, start plantation
6	Week - 5	Pond Completion, continue plantation
7	Week - 6	Plantation Continuous
8	Week - 7	Plantation Continuous
9	Week - 8	Plantation Complete
10	Week - 9	Establish the plant care procedures



Maintenance Plan For First Year

- All **pest controls** will be **organic** material.
- **Appointment of a full-time gardener** for the maintenance of the urban forestry development, **watering** will be done on a **daily basis**.
- **Manuring & pest controls** would be based on the **Expert input**.
- The **pond** will get **emptied regularly** and cleaned **to avoid mosquito** breeding
- FSTP **Treated Water** from the pond will **provided** to the different zones by using **Pump & Local piping**

Monitoring of reuse practices must be attained through various mechanisms



Log book by water tanker driver/helper



App based: Dashboard, live monitoring



Daily checking by FSTP site in charge



Monthly review by SI or engineer



Submission of Fortnightly reports by operator on Reuse practice



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Annexure 1

Name	Purpose	Number/Area	Current water source	Water Quantity that can be used	Comment	Tentative requirements for implementing the option
FSTP landscape	Gardening	0.5 acre	FSTP treated water	10000 lit	WMC is already reusing water here.	
WMC garden near FSTP	Gardening	0.02 acre	FSTP treated water	5000 lit	WMC is already reusing water here.	
WMC vehicle cleaning	Cleaning	10 Ghantagadi 1 Compactor 1 Fire brigade 1 Septage emptier truck 1 Water tanker 1 Sumeet's emptier truck	WMC tap connection	200 to 250 lit/vehicle = 3000 - 3500 lit	Emptier trucks and gphantagadi can be cleaned at the FSTP site	Permission required from SI (formal letter). Verbal discussion with Sumeet for their truck.
SWM composting	Compost	5 shades with 6 pits each (total 30 pits)	WMC connection	5000 lit	Can be considered for reuse by WMC	Permission required from SI (verbal)



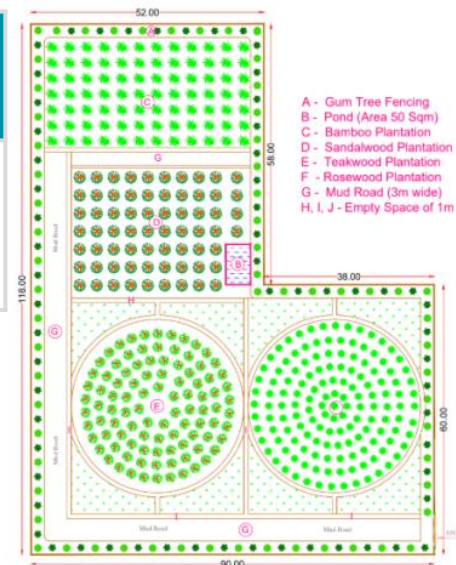
Annexure 1: Plan A Onsite reuse options

Name	Purpose	Number/Area	Current water source	Water Quantity that can be used	Comment	Tentative requirements for implementing the option
Social Forestry	Gardening	2 acre	NA	30000 lit	Project is proposed by Tide to demonstrate reuse of FSTP by products.	-

O&M costs

Activities	Nos.	Per Month	Annually
Urban forest and FSTP landscaping			
Repair works eg. Pipe lines, cleaning, etc	-	800	9600
Labor for plant maintenance, spraying insecticides, etc	2 labors	10000	1,20,000
Total		10,800	1,29,600

Note: Cost calculations are based on discussion with landscape expert and local workers



Annexure 2: Plan B Offsite reuse options (1/3)

Name	Purpose	Number/Area	Current water source	Water Quantity that can be used	Comment	Tentative requirements for implementing the option
1300 trees planted by WMC	Gardening	1300 locations	WMC tanker	40000 lit	Can be considered for reuse by WMC	Requires permission from SI (formal letter)
Raviwar Peth Smashan Bhumi	Gardening	2000 sqft	WMC tap connection	5000 lit	WMC is already reusing water here.	
Road median	Gardening	1.7km length along main road	-	2500 lit	Can be considered for reuse by WMC	Requires permission from SI (formal letter)
CO's Bungalow, Dhom colony	Gardening (landscape near tank)	200 sq.ft	WMC tap connection	400 lit	Can be considered for reuse by WMC.	Requires permission from SI (formal letter)



Annexure 2: Plan B Offsite reuse options (2/3)

Name	Purpose	Number/Area	Current water source	Water Quantity that can be used	Comment	Tentative requirements for implementing the option
WMC landscape	Gardenin g	1,300 sq.ft	WMC tap connection	2500 lit	Can be considered for reuse by WMC.	Requires permission from SI (formal letter)
Smarak near Court	Gardening	3000 sqft	WMC tap connection	4500 lit	Can be considered for reuse by WMC	Requires permission from SI (formal letter)



Annexure 2: Plan B Offsite reuse options (3/3)

Cost calculations -

Reuse Option	Round Distance	Area/KM	Quantity of treated water required (Lit)	No. of Trips	Diesel Per month	Labor Per month	Vehicle O&M Per month	Annual Cost
1300 trees planted	8		40,000	8	16560	25000	800	$(26963 + 25000 + 800) \times 12$ = 6,33,156
Burial Ground (RP Smashan Bhumi)	5	2000 sqft	5000	1	1294			
Medians	12	1.7 km long	2500	1	3105			
CO bungalow	8.8	200 sqft	400	1	2277			
WMC Landscape	6.8	1300 sqft	2500	1	1760			
Smarak	7.6	3000 sqft	4500	1	1967			

O&M costs

Activities	Nos.	Per Month	Annually
Labor (driver & helper)	2 labors	25000	300000
Vehicle Maintenance	1	800	9600
Diesel Cost	-	26963	323556
Total		52,763	6,33,156

Considerations

1. Cost of Diesel: Rs.69/lit
 2. Tanker capacity: 5000 lit
 3. Tanker average: 8-10 km/lit
 4. Labor cost: Rs. 15000/month (Driver) + Rs.10000/month (Helper)
 5. Maintenance: Rs. 800/month
- The total cost is calculated considering above factors, distance, no. of trips and area of land.

Annexure 3: Plan C Offsite reuse options (1/3)

Name	Purpose	Number/Area	Current water source	Water Quantity that can be used	Comment	Tentative requirements for implementing the option
Road cleaning	Cleaning and maintenance	1km road	WMC tap connection/ tanker	3000 lit	Can be considered for reuse by WMC. Currently, WMC cleans roads as per the demand or during local festivals	Requires permission from SI (formal letter)
Schedule Desludging	Need to put water in ST for softening the hard septage	5 STs	HH water connection i.e. WMC tap connection	2000 - 3000 lit	Can be considered for reuse by WMC Water tanker will be at the location, and according to the costing and usage efficiency shall be considered.	<ol style="list-style-type: none"> 1. Discussion between Tide and Sumeet. 2. Approval to be taken from SI. 3. Finally, approval from HHs to be taken on the site.
Nursery	Gardening	1 nursery	WMC connection	7000 lit	Can be considered for reuse by WMC	Verbal discussion with the nursery owner by SI



* Note: The details are of 1km road only, as per cleaning schedule/requirement quantities will change

Annexure 3: Plan C Offsite reuse options (2/3)

Name	Purpose	Number/Area	Current water source	Water Quantity that can be used	Comment	Tentative requirements for implementing the option
School ground	Watering open ground	4000 sqft	WMC connection	5000 lit	Can be considered for reuse by WMC	WMC to take permission from school authorities
Bus stand cleaning and maintenance	Cleaning	2 acre (87,120 sq.ft)	WMC tap connection	10k lit	Can be considered for reuse by WMC.	WMC to take formal approval from the transport authority (MSRTC)
Sugarcane farm	Farming	1 acre	Private connection (Well)	60k lit	Can be considered for reuse by WMC by convincing more farmers.	SI to have verbal discussions with the farmland owners.



* Note: The details are of only one farmland, multiple farmers can be approached and quantities will change accordingly

Annexure 3: Plan C Offsite reuse options (3/3)

Cost calculations

Reuse Option	Round Distance	Area/KM	Quantity of treated water required (Lit)	No. of Trips	Diesel Per month	Labor Per month	Vehicle O&M Per month	Annual Cost
Drain/gutter cleaning	7	1km	1500	1	1811.3	15000	800	$\frac{(31413 + 15000 + 800) \times 12}{2} = \mathbf{5,66,556}$
Road cleaning	7	1km	3000	1	1811			
Scheduled desludging	9	5 STs	3000	1	2329			
Nursery	7.8		7000	2	4037			
School ground	7.2	4000 sqft	5000	1	1863			
Wai Bus Stand	7.8	2 acre	10,000	2	4,037			
Agriculture	5	1 acre	60,000	12	15525			

O&M costs

Activities	Nos.	Per Month	Annually
Labor (driver)	1 labor	15000	180000
Vehicle Maintenance	1	800	9600
Diesel Cost	-	31413	376956
Total		47,213	5,66,556

Considerations

1. Cost of Diesel: Rs.69/lit
 2. Tanker capacity: 5000 lit
 3. Tanker average: 8-10 km/lit
 4. Labor cost: Rs. 15000/month (Driver) + Rs.10000/month (Helper)
 5. Maintenance: Rs. 800/month
- The total cost is calculated considering above factors, distance, no. of trips and area of land.

Annexure 4: Quality norms by various guidelines

These guidelines have identified quality norms for various reuse options. Details of which are given further.

	<u>MPCB</u>	<u>CPCB</u>	<u>CPHEEO (2013)</u>	<u>WHO Standards</u>	<u>USEPA (2010)</u>
	1 st	2 nd	3 rd	4 th	5 th
Agriculture	✓	✓	✓	✓	✓
Vehicle washing	✓		✓		✓
Landscape at FSTP site, Gardens / Public Space, Social / Urban forestry, Median / Road side planting	✓	✓	✓	✓	✓
Ground water recharge					✓
Need of water during septic tank emptying, CT/PT cleaning	✓				
Nursery / Horticulture	✓		✓		✓
MIDC	✓	✓			✓
Building Construction					✓
Water body rejuvenation			✓		✓
Road and other cleaning / Ground cooling	✓				✓
Fire Fighting			✓		✓
Co-composting SWM site					✓
Used in Townships (Backupslide 50)				NA	

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