PROJECT COMMISSION REPORT

Fecal Sludge Treatment Plant
at Kalpetta, Waynad District
Plant Capacity 10 KLD

unicef

by

PRIMOVE

PriMove Infrastructure Development Consultants Pvt. Ltd.
C3, 304B, Saudamini complex, Bhusari colony,
Paud road, Pune - 411 038.
www.primoveindia.com

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Contents

1. INTRODUCTION

Kalpetta is a town and a municipality in the Wayanad district in the state of Kerala, India. Kalpetta is the headquarters of Wayanad district as well as the headquarters of Vythiri taluka. It is a bustling town surrounded by dense coffee and tea plantations and mountains. It lies on the Kozhikode-Mysore National Highway NH 766 (formerly NH 212), at an altitude of about 780m above mean sea level. Kalpetta is approximately 72km from Kozhikode and 140km from Mysore.

Apart from being the administrative capital of the district, Kalpetta is also the center of tourist activities in Wayanad due to its central location within the district and its proximity to some of Kerala's most visited tourist sites.

In August 2018, Kerala received heavy rainfall and as a result, witnessed the worst instance of flooding in nearly a decade. Along with the damage to nature, life, and property, a noteworthy aspect of the floods was the unintended evacuation of fecal sludge from the septic tanks built in people's homes. This incident highlighted the need for comprehensive fecal sludge management (FSM) in Kerala.

FSM is the collection, transport, and treatment of fecal sludge from pit latrines, septic tanks or other onsite sanitation systems. Fecal sludge is a mixture of human excreta, water and solid wastes (e.g. toilet paper or other anal cleansing materials, menstrual hygiene materials, etc.) that are disposed of in pits, tanks or vaults of onsite sanitation systems. Fecal sludge that is removed from septic tanks is called septage.

FSM is necessary in densely populated areas, such as Kerala, where a significant proportion of the population is not connected to a sewerage network, and the covering and rebuilding of pit latrines is not possible. This is the case in most urban areas of developing countries, but such services are also used in developed countries where sewerage systems are unavailable. FSM services are usually provided by formal and informal private sector service providers, local governments, water authorities and utilities. However, in many developing countries, FSM services are often unavailable or if they are available, are often informal, unregulated, unhygienic, and unsafe. This can lead to surface water and groundwater pollution, spreading of pathogens into the environment and adverse public health impacts. It can also result in unreliable services with relatively high costs to the households which need them.

Fecal sludge collection services can be made available on a scheduled basis or on a call-for-service basis (also known as on-demand, on-request or non-scheduled services). The collected fecal sludge may be transported to treatment plants by using a vacuum truck; a tank and pump mounted on a flatbed truck; a small tank pulled by a motorcycle; or in containers on a hand cart. Mobile or permanent transfer stations can be used to improve the efficiency of fecal sludge transportation by transferring the waste to larger tankers for haulage to treatment. The wider use of multiple decentralized sludge treatment facilities within the city (to avoid long haulage distances) is currently being researched and piloted.

The collected fecal sludge should preferably be processed at dedicated fecal sludge treatment plants, instead of being co-treated with sewage in municipal sewage treatment plants, unless these are able to take the additional load, and facilities to separate liquids and solids are available. The treatment process can produce useful products such as treated effluent which can be used for irrigation. Another possibility is to use the treated fecal sludge (which is in the form of fertile vermicompost) after composting as a soil conditioner. Historically, the term night soil was used to describe fecal sludge.

1.1 PROJECT DESCRIPTION

In August 2018 Kerala received its worst ever flood since after July 1924. Several NGO, GOs and private sector organizations assisted the Government of Kerala for flood rescue and rehabilitation majors. UNICEF, a primary agency among these, is actively engaged in rehabilitation measures. As a part of their programme, UNICEF selected PriMove Infrastructure Development Consultants Pvt. Ltd as a Contractor by e Tendering system with Purchase Order No. 81066913 Dt. 20th December 2018. The contract includes 2 districts namely Kalpetta and Pathnamthitta for construction of 10 KLD FSTP.

Inclusions in the contract:

- **Supply and Installation of Sludge Treatment Unit**-

  Design Construction, Supply, Installation Testing & Commissioning of 10 KLD Capacity Faecal Sludge Treatment Plant based on Tiger Biofilter Technology.

- **Annual Maintenance of Sludge Treatment Unit**-
  One-year Operation and Maintenance of Faecal Sludge Treatment Plant.

2. OBJECTIVE

The objective of the FSTP to be built at Kalpetta is to provide a facility for the rapid treatment of fecal waste being generated in the Kalpetta MC. Given the adverse experience of the involuntary emptying of septic tanks during the floods, the treatment mechanisms employed in the FSTP had to ensure a reduced risk to public health and the environment. Therefore, the treatment mechanism of the proposed FSTP at Kalpetta is based on the Tiger technology, which uses earthworm-based vermifiltration to rapidly treat waste matter, with no smell and need for desludging (a common phenomenon in traditional and informal fecal waste treatment).

Vermifiltration is reportedly a superior form of sanitation technology, compared to conventional methods such as septic tanks and pit latrines. Earthworms are known to promote digestion of organic waste, which results in the production of vermicompost. In vermifilters, this behavior is combined with filtration to digest organic matter present in septage. The worms need only air, water and organic matter to form a sustainable population in the vermifilter.

The technology is adequately studied and researched having references in manual on sewerage and sewage treatment (Second Edition) by CPHEEO and MINISTRY OF URBAN DEVELOPMENT 1993 under chapter 26 EMERGING TECHNOLOGIES FOR SEWAGE TREATMENT point no. 26.3 VERMICULTURE TECHNOLOGY.

3. PROGRESS OF THE PROJECT

3.1 PROJECT INITIATION

The PriMove team visited Kalpetta municipality officials and District collector for introduction and orientation program. During this visit we delivered technical presentation for proposed Fecal Sludge Treatment Plant (FSTP). The presentation includes introduction of PriMove, Technical details of Tiger Biofilter Treatment system, plant Layout drawing etc. After this meeting, the Kalpetta Municipality officials accompanied us to the Proposed Site at Solid Waste Dumping ground outside Kalpetta city. During this period, meetings were held on 22nd, 23rd, 25th, 30th and 31st Jan 2019 with stakeholders.

Site visit

Technology Presentation

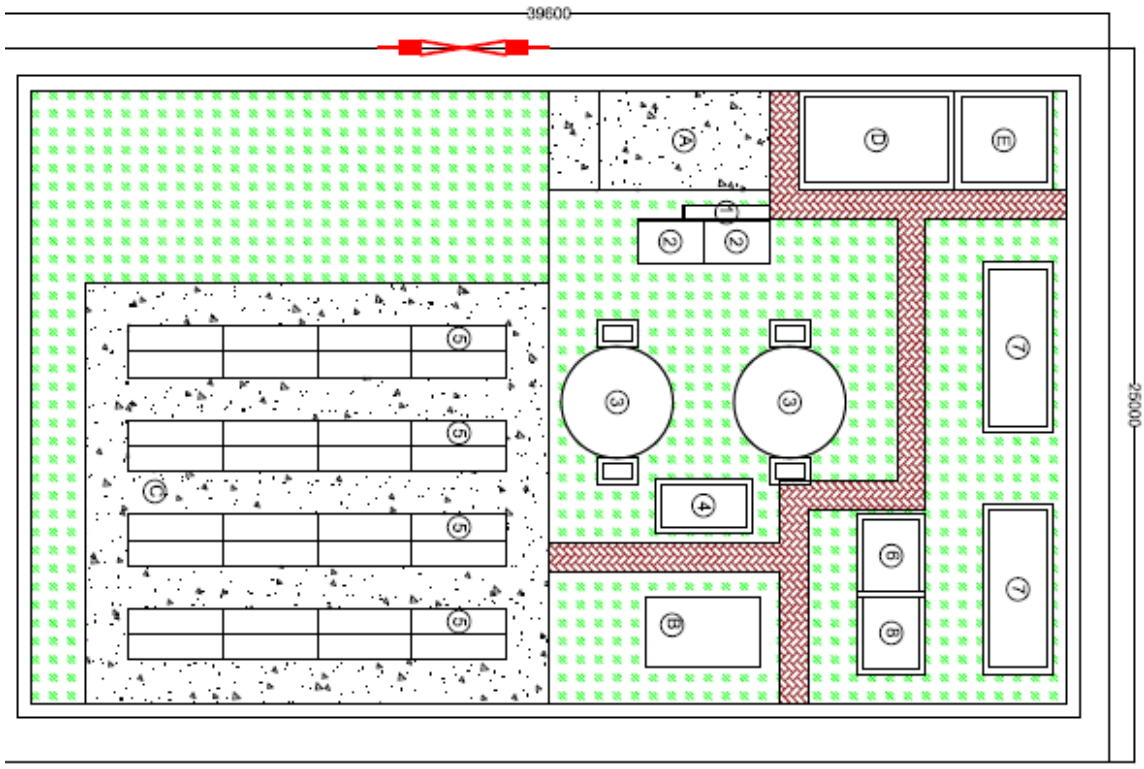
3.2 SITE SURVEY AND QUALIFICATION OF THE INITIAL SITE

After receiving site clearance from Kalpetta Municipality, we carried out topographic survey and underground strata analysis for proposed site. There was also an exposure visit arranged by Gramalaya officials for the process of desludging of Septic tank/ soak pit/ single pit/ two pit latrines. During this period meetings were held on 2nd, 7th, and 9th Feb 2019 with stakeholders.

Suction truck (Honey Sucker)

3.3 INITIAL LAYOUT FINALIZATION AND APPROVAL

On 9th Feb 2019, a meeting with the Kalpetta MC was held to confirm and approve the site for the proposed FSTP. In accordance with the topography of the site, a layout for the FSTP was designed, presented below.



Process Unit Details

Sr No.	Description	No.
1	Screen Chamber	1
2	Solid Liquid Separation tank	2
3	Anareobic Digester	2
4	Filter Press Feed	1
5	Tiger Biofilter Bed (For Sludge)	32
6	Liquid Storage Tank	1
7	Tiger Biofilter Bed (For Liquid)	2
8	Treated Water Tank	1

Building Details

Sr No.	Description	No.
A	Unloading Platform	1
B	Filter Press Platform (G+1)	1
C	TBF Shed	1
D	Admin cum Control Room	1
E	Storeroom	1

3.4 START OF WORK AT INITIAL SITE AND PROBLEMS ENCOUNTERED

Following the finalization of the layout for the FSTP, site leveling work was started at the initial site of the FSTP after 16th Feb 2019.

However, some major problems with the sight were soon brought to light. The initial site chosen was a garbage dumping ground. At this location, waste heaps were present. With a joint effort, site levelling was attempted, wherein several issues were encountered for preparing the site for FSTP installation.

It was observed that the landfill site required excavation of 3 m or more, since only waste material was present, and a suitable foundation stratum could not be reached. Further, the soil bearing capacity of the area is extremely low as the landfill is fairly un-stabilized. The site faced settlement risk due to heavy rain, which would affect the FSTP. Lastly, the presence of the slaughter waste poses issues of odour and hygiene for labour as well as operator.

The instability of slopes for excavation, and the lack of safety of working personnel in terms of soil profiles and health risks were classified as major concerns by all potential execution contractors.

Some pictures demonstrating the mounds of refuse and waste are displayed.

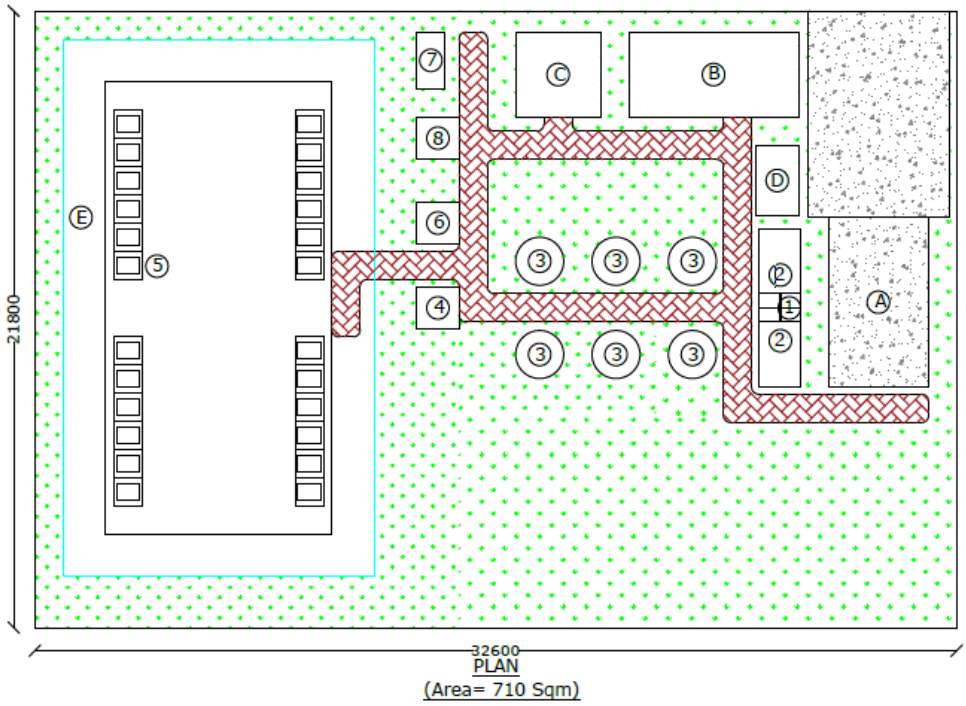
3.5 CHANGE OF SITE AND SITE FINALISATION

As a result of the many drawbacks faced at the initial site for the FSTP, PriMove appealed to the Kalpetta MC to change the location of the FSTP to a new site that would be free of the above-mentioned problems. The Kalpetta MC took cognizance of the situation after analyzing the above problems and issued a revised area for the development of the FSTP in Kalpetta District. The new proposed site is located approx. 100 m downstream to existing solid waste dumping ground. The new site was handed over the PriMove on 2nd March 2019.

We executed a topographic survey for the proposed site and revised the layout drawing in order to optimize the technology units.

3.6 REVISED LAYOUT OF THE FSTP

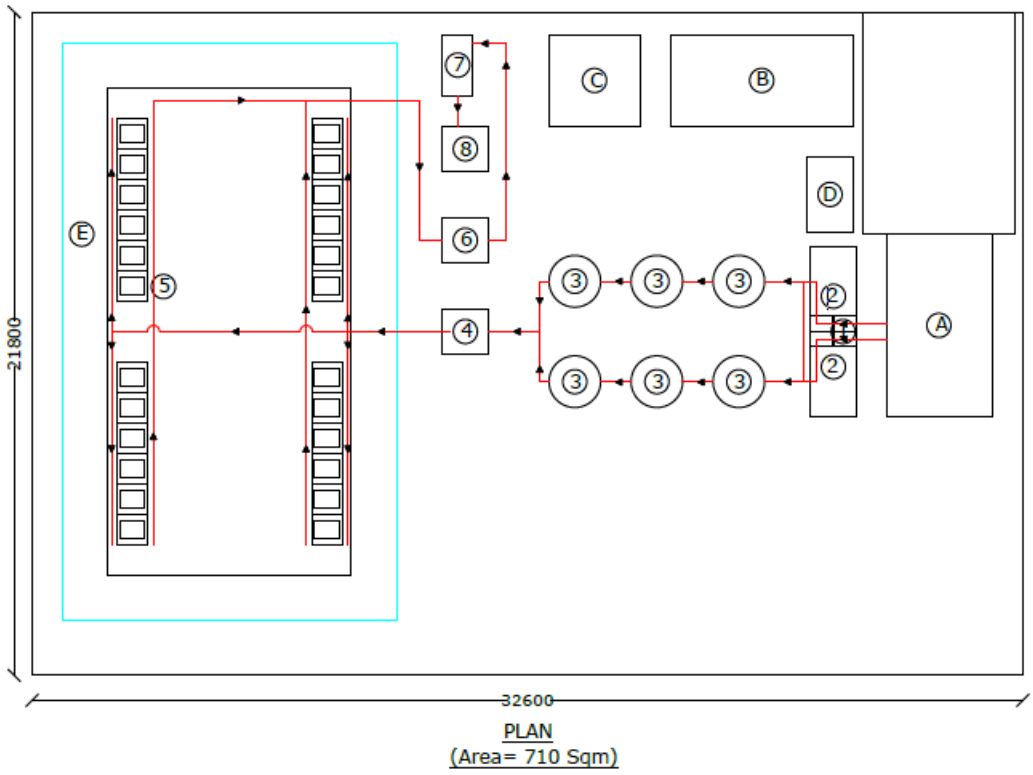
Considering the changes in topology introduced by moving the FSTP site, a new layout for the plant was prepared. In accordance with the new design, construction work of the FSTP was started on 16th March 2019.



Building Details

Sr No.	Code	Name
1	A	Unloading Platform
2	B	Admin cum Control Room
3	C	Store Room
4	D	Wash Room
5	E	TBF Shed

3.7 PROCESS SCHEMATIC AND DESCRIPTION



Process Unit Details

Sr No.	Code	Name
1	1	Screen Chamber
2	2	Solid Liquid Separation Tank
3	3	Anaerobic Digester
4	4	Intermediate Storage Tank
5	5	Tiger Biofilter Bed
6	6	Filter Feed Tank
7	7	Filter Platform
8	8	Treated Water Tank

The Technology proposed for Fecal Sludge treatment mainly comprised of solid liquid separation tank, Anaerobic Digestion, Tiger Biofilter and tertiary treatment. The technology units are explained are as follows.

3.7.1 Screen Chamber & Solid-Liquid Separation Tank (2 nos.)

These tanks are made of Fibre-Reinforced Plastic (FRP). This tank consists of 2 chambers:

- Screen chamber
- Solid-Liquid Separation Tank.

The screen chamber is outfitted with one SS 304 bar screen of 10 mm c-c Spacing with 3 mm bar thickness. Its primary purpose is the removal of unwanted large objects (Sanitary pads, plastic etc.) from fecal sludge. The screened fecal sludge then enters Solid-Liquid Separation Tank. These tanks hold the fecal sludge load of 5000 ltrs approx. This allows Fecal sludge to stagnate into a quiescent condition. This settles the settable inert solids (Grit) from fecal sludge. These settled solids are removed periodically and treated with vermifilter technology separately. The fecal sludge is removed and taken to the next tank for anaerobic digestion.

3.7.2 Anaerobic Digestion (6 Nos.)

Anaerobic digestion is a collection of processes by which microorganisms break down biodegradable material in the absence of oxygen. The digestion process begins with bacterial hydrolysis of the input materials. Insoluble organic polymers, such as carbohydrates, are broken down to soluble derivatives that become available for other bacteria. Acidogenic bacteria then convert the sugars and amino acids into carbon dioxide, hydrogen, ammonia, and organic acids. These bacteria convert the resulting organic acids into acetic acid, along with additional ammonia, hydrogen, and carbon dioxide. Finally, methanogens convert these products to methane and carbon dioxide. The methanogenic archaea populations play an important role in anaerobic wastewater treatments.

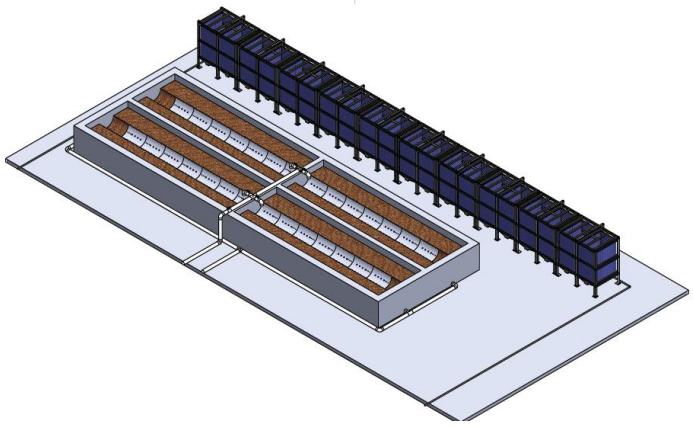
In the Kalpeta FSTP, two parallel sets of 3 tanks each have been connected which enable anerobic conditions in the system, with the help of an added inoculum which rapidly degrade the waste.

3.7.3 Tiger Biofilter

The sludge that is treated in the anaerobic digester is then spread on small beds of the Tiger Biofilter, comprising earthworms, bacterial culture and a material suitable to provide a habitat and respiration zone for earthworm growth and reproduction. The earthworms used in the vermicomposting filter unit are the species capable of compositing fecal waste. Organic matter is consumed by the earthworms as an energy source for metabolism and reproduction. The system is designed accordingly with sufficient surface area and worm quantity. The worms consume the septage organic load in 15-25 days, making the beds available for unloading of compost. This system provides additional ventilation and more surface area for worm activity resulting in increased efficiency and operational feasibility.

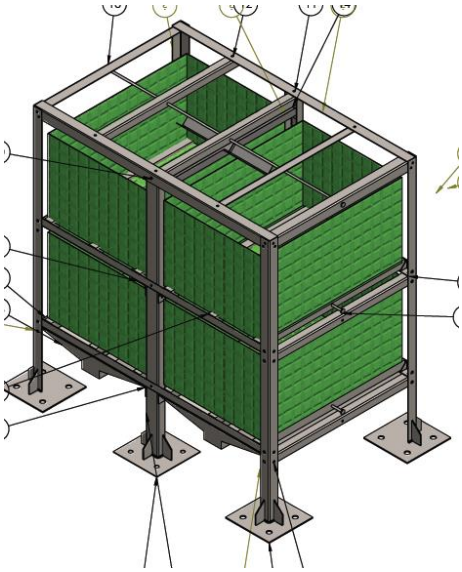
3.7.3.1 TBF I: Sludge water separation and treatment tank

In these beds, almost 90% of the sludge is separated from water by gravity filtration. Sludge is periodically removed and fed to the other Tiger Biofilter bed, having a rich earthworm culture bed. This tank accumulates the sludge and releases water with a smaller organic load. This liquid is stored in a separate storage tank. The sludge will be converted to nutrient-rich vermicast/ vermicompost. This sludge can then be dried, sieved and sold in market.



3.7.3.2 TBF II: Water Treatment

Liquid from the TBF I unit is stored and pumped to the TBF II system. This is a modular Vermifilteration unit designed to reduce the residual BOD from Fecal Sludge. Each unit in this system is designed to handle 500-750 ltrs of fecal sludge per day.



Single TBF Bed Unit

TBF Bed Containment Shed

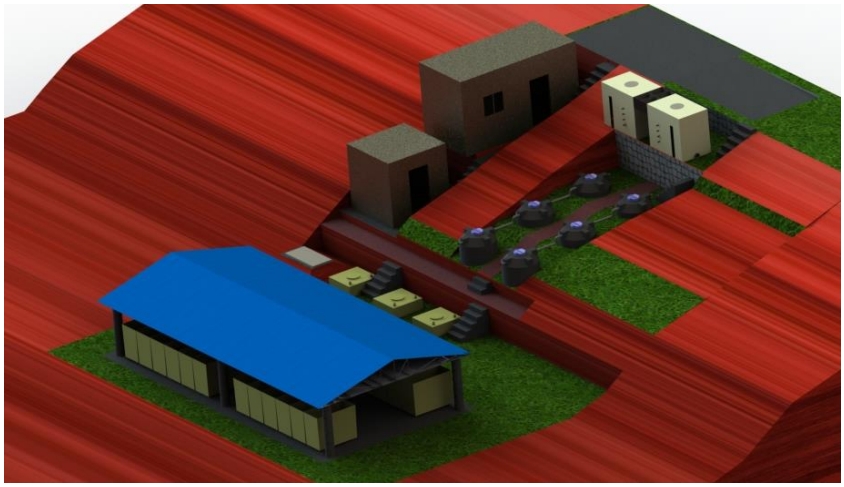
TBF II Setup

3.7.4 Tertiary Treatment

The treated effluent coming out from TBF II is treated with Pressure Sand Filter (PSF), Activated Carbon Filter (ACF) and is finally disinfected using chlorine. This is a safety measure and removes any objectionable color, odor, and virii and other pathogens from the treated effluent. The treated effluent is stored and may be used for gardening, irrigation, or other land applications.

3.8 PROJECT STATUS

As of 12th May 2019, the supply of material and its installation at the FSTP site is complete. The test and trial run for the components of the FSTP is carried out and the results have been found to be satisfactory. The plant has commenced primary operations by receiving and treating fecal sludge in smaller quantities in order to establish the bacterial culture and acclimatize it to the nature of fecal waste in Kerala. In due course, the culture will flourish and degrade the waste efficiently.



4. IN THE FUTURE

With the plant operational, PriMove will now be carrying out O&M of the plant for 1 year, as per the contract with UNICEF. Further, to ensure smooth operation of the plant after the one-year AMC tenure is exhausted; PriMove will be responsible for training 2 persons nominated by the Kalpetta MC during its O&M tenure to run the plant.

4.1 SUPPORT PROVIDED BY PRIMOVE

Primove will also be providing support to Kalpetta Municipality of operate the plant by training two operators during its O&M period. Primove will also be supporting Kalpetta Municipality to carry out a survey of the town related to fecal sludge. A survey format has already been shared and Primove will further support by providing a half day training to surveyors as well as in processing of data collected during the survey.

4.1.1 Surveyor Orientation

To support the Kalpetta Municipality to carry out household survey for fecal sludge, Primove has developed Google form that can be completed online or offline from any android based device. This will enable Kalpetta Municipality to monitor, compile, analyze the survey data from there official Google account. PriMove will conduct an orientation of surveyors and then assist analyzing data collected.

4.1.2 Personnel Training

To support the Kalpetta Municipality to identify 2 persons to be appointed on FSTP O&M, Primove will provide a job description and the necessary training for the plant operators. Provided that the chosen candidates are in agreement with PriMove's conditions, they will be employed as Project Associates of PriMove during the active O&M tenure and will be trained to operate and maintain the plant.

4.1.3 Business Models

PriMove will share a draft of an operational/business plan (O&M, risk assessment, and revenue model) of the FSTP with the UNICEF and Kalpetta Municipality, subsequent to which it will finalize these models after the required deliberation.

4.1.4 Extraneous Support

PriMove will prepare a handover document at the end of O&M period which will give detailed as-built drawings and O&M guidelines.

On agreement and support from the Kalpetta Municipality, PriMove can also support (with additional resources) the Municipality to prepare bylaws to monitor and regulate Fecal sludge collection, treatment and disposal.

PriMove will provide support in preparation of IEC material on Tiger technology in English and Malyali.

5. ANNEXURE A

5.1 SURVEY FORMAT DEVELOPED FOR SHORTLISTING SITE LOCATIONS AVAILABLE IN KALPETTA DISTRICT

- GPS location:
- Population that can be served for fecal sludge treatment for each short-listed location: (ballpark estimate of residential population from where suction vehicles can deliver the fecal waste matter)
- Whether the town has piped underground sewer network?
- Number (Approx. if exact number is not available) of septic tanks and pit latrines in the catchment area
    - Septic Tank: Not Available
    - Pit latrines (Single Pit): Not Available
    - Pit latrines (Twin pit): Not Available
- System available for emptying of septic tanks
    - For MECHANISED Vehicles
        - How many vehicles currently serve the areas in catchment of shortlisted sites
        - Volumetric capacity of the vehicles
- Space (Plot size) proposed for installation of Fecal sludge treatment plant (area) – 330 Sqm (Approximate)

  _____m x _____m

  (The minimum area available should be of approx. 40mx25 m or equivalent, preferably)

- What is the distance of the proposed plot from the nearest residential area?
- (preferred distance approx. 500m)
- Whether the shortlisted site is already in possession of authorities:
- Whether the area is accessible by an all-weather motorable road:
- Whether the area is secured / fenced:
- Whether the area has an electricity connection:
- Whether the area has water connection:
    - If Not, what is the access to water?
- Is there a natural disposal point/drain available nearby for disposal of treated effluent?

5.2 INDIVIDUAL HOUSEHOLD INFORMATION FORM FOR COLLECTION OF SEPTAGE

- Family name
- Village
- District
- Coordinates
- Number of members in the family
- Whether the household has a toilet
    - Yes
        - Number
    - No
- If No, what facility do they use for defecation
    - OD
    - Public Toilet
    - Shared Toilet
    - Other
- If Yes, what is the toilet connected to?
    - Septic Tank
    - Pit latrines (Single Pit)
    - Pit latrines (Twin pit)
    - Open drain
    - Any other
- When was the septic tank or pit constructed?
    - Date
- If pit latrine, material
    - RCC Rings
    - RCC Panels
    - FRP Storage tanks
    - Brick tanks
    - Unlined pit
    - Any other
- Size of the pit
    - length
    - breadth
    - depth
    - Diameter
- If septic tank, material
    - RCC tank
    - Readymade plastic tanks
    - Brick tanks
    - RCC Pipe tanks
    - Any other
- Size of the septic tank
    - Length
        - If pipe
    - Breadth

        - capacity
    - depth
- Whether the septic tank or pit can be observed
    - Yes
    - No
- Whether the septic tank or pit is easily accessible?
    - Yes
    - No
- Whether the septic tank or pit is functioning smoothly
    - Yes
    - No
- If no, what is the type of problem
    - Smell
    - Leakage
    - Overflow
    - No cover or lid
    - Flies or other pests
    - flooding in monsoon
    - Any other
- Date of last evacuation
    - Date
- How is the tank emptied?
    - Manual
        - Date of construction
    - Mechanical
    - Neither
- If available, service provider for evacuation
    - Private
    - Public
- Frequency of desludging
    - Never
    - Before 5 years
        - More frequency options
    - After 5 years
- Accessibility from road: Where is the storage unit located?
    - Front of the house
    - Behind the house
    - Next to the toilet
    - Under the toilet
    - Below the road
    - Away from the house
- Current cost of desludging
    - Less than Rs 1000
    - Rs 100 to Rs 2500
    - Rs 2500 to Rs 5000
    - More than Rs 5000
- How much would you ideally pay for sludge evacuation?

    - Number
- Do you know what is done to the evacuated waste?
    - yes
    - no
- If yes, what do you think happens?
    - treatment facility
    - dump in farms
    - dump in water body
    - dump in drains
    - any other
- Do you think it is safe to dispose it in the open?
    - Yes
    - No
- Do you think this should be taken to a treatment facility?
    - Yes
    - No
- Have you had a diarrhoea event in the house recently?
    - Yes
    - No
- If yes, when
    - Date

6. ANNEXURE B - PHOTO GALLERY

Bhoomi poojan

Survey work at site

Excavation work

Foundation stone material

Site marking for anaerobic tank

Excavation for anaerobic tank

Site levelling after excavation for cabin

Excavation for storage tank

Sand, aggregates material

Retaining wall for cabin

Rubble soling work for screen chamber tank

Rubble soling for anaerobic digester

Prefabricated office cabin

Anaerobic digester and culture

Unloading material with help of crane

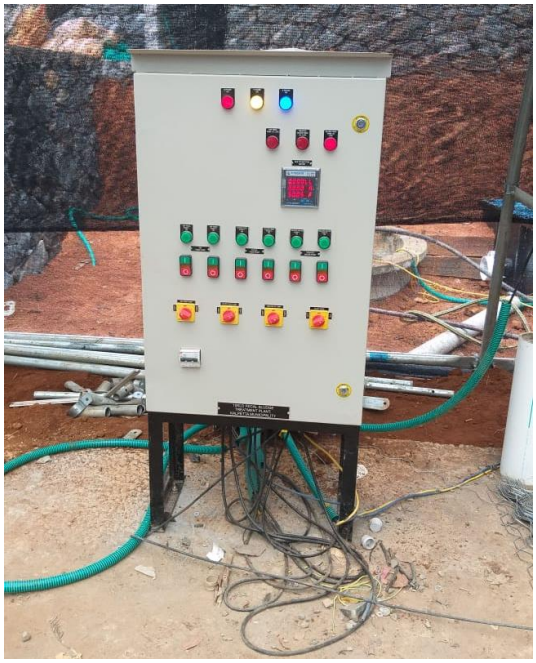
PCC work for cabin footing

Anaerobic Digesters installed

Office of the FSTP

Unloading platform

TBF Shed



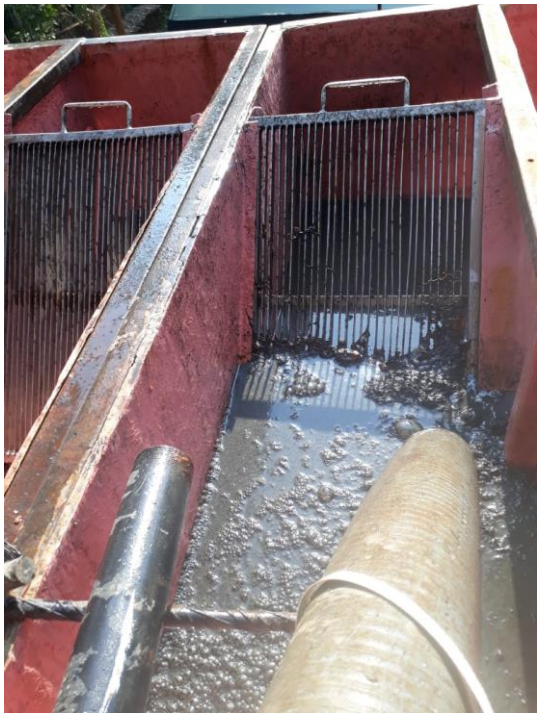
Control Panel

Solid-Liquid separation tank

Access to all parts of the FSTP

Intermediate collection tanks for partially treated effluent

Installation of the FSTP is complete



Septage Addition started on 10th May 2019

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