CITY-WIDE INCLUSIVE SANITATION PLAN FOR MALINDI, WATAMU AND THE SURROUNDING PERI-URBAN AREAS

WSUP Water & Sanitation for the Urban Poor

Sanivation

BORDA Solutions GmbH

eawag aquatic research

2020

FOREWORD

Kilifi County Government aspiration is to have a clean, healthy, and productive county. In addition, everyone should enjoy the basic right to sanitation. This should be achieved through an approach that is inclusive of all residents and delivers safe management across the entire value chain. These aspirations can be realized through efficiently managed local government bodies, including Water Services Providers and Municipal Boards.

With the amount of waste that is safely managed in MAWASCO's service area being 25%, over 90% of hand dug wells being contaminated, and there being no waste treatment plant, there is need for concerted efforts to make right investment for sanitation services. Environmental tourism is a driving force of Malindi's economy and we cannot risk having waste be unsafely managed and polluting our environment. To continue being a preferred tourism destination we should focus on the goals outlined in this plan:

Goal 1 Achieve equitable and financially sustainable access to safely managed sanitation for all

Goal 2 Ensure clarity in mandates and market Malindi as the cleanest coastal town

Goal 3. Create jobs and build local capacities to have a thriving sanitation economy

Achieving these goals requires collaboration and coordination. As primary shareholder of MAWASCO, I am committing and urging the the utility in collaboration with other departments to follow these strategies. We will meet regularly to check in on our progress. My department will extend the necessary support ranging from resource mobilization for infrastructure investment and allowing MAWASCO to operate at arm's length including providing enabling environment for public private collaboration

Lastly, I would like to acknowledge and appreciate the support extended to MAWASCO and the Municipal Board by HE. The Governor Hon. Amason Kingi.

COUNTY EXECUTIVE COMMITTEE MEMBER
Hon. Mwachitu Kiringi

PREFACE

Provision of clean, adequate, reliable and convenient water and sanitation services continues to be a paramount priority for the Board of Directors. We are very much cognizant of the constitutional right to sanitation and the standards that have been established to enhance attainment of this fundamental right. We are also very much alive to the fact that as one of the agents of Kilifi County Government, we have an obligation to contribute to the aspiration of the county of achieving universal access to water and sanitation services.

MAWASCO is committing to deliver on both its water and sanitation mandates. With water coverage at 70% and only 25% of safely managed sanitation services in our planning jurisdiction, we are behind in sanitation. In addition, with the population growth at 3.4% per year we are in an uphill climb for everyone to have access to clean and safe sanitation. The journey of developing this city-wide inclusive sanitation plan has been quite instrumental in laying foundation for better services delivery to our customers.

Sanitation is seen as an important focus for MAWASCO, as not only to deliver on our mandate, but also to contribute to a thriving economy for our customers. Without "paying customers" MAWASCO wouldn't be a viable entity. Sanitation enhances the sustainability of this company by improving the cleanliness of the town, creating jobs, and introducing new services to our customers.

In this City-Wide Inclusive Sanitation Plan, we put forth an integrated approach towards service delivery. This means integrating sewers and on-site sanitation in a way where everyone benefits, as well as collaborating with other government agencies such as the Ministry of Health and NEMA.

I am proud of the company, especially want to thank the management, staff and other Board members who have taken up this challenge of improving sanitation. This plan is another way in which we are exhibiting MAWASCO's values of **Customer Focus, Innovativeness, Integrity, Teamwork, Excellence.** Sanitation is a national challenge and this is another example of MAWASCO leading the way.

As we embark on implementation of the strategy, the board will effectively and efficiently play its role and provide leadership that would enhance better governance. The Board will endeavour to develop all the relevant policies and guidelines required to realize this strategic plan and also further engage in resource mobilization to fill the envisaged budgetary deficit.

Last but not least, I would like to remind each and every one of us to our rallying call "**provide every reason for a smile**" and call each one of us to remain faithful to this call.

Mr. Anderson F. Kasiwah
Chairman
Board of Directors
Malindi Water and Sewerage Company

Acronyms

CECMs	County Executive Committee Member
CBD	Central Business District
CBO's	Community Based Organizations
CBS	Container Based Systems
CG	County Government
CIDP	County Integrated Development Plan
CWIS	City Wide Inclusive Sanitation
CWISP	City-Wide Inclusive Sanitation Plan
DBO	Design Build Operate
ESAWAS	Eastern and Southern Africa Water and Sanitation
EMCA	Environmental Management and Coordination Act
FS	Fecal Sludge
FSM	Fecal Sludge Management
FST	Fecal Sludge Treatment Plant
ISUDP	Integrated Strategic Urban Development Plan
KPHC	Kenya Population and Housing Census
KESHP	Kenya Environmental Sanitation and Hygiene Policy
MAWASCO	Malindi Water and sewerage company
NEMA	National Environment Management Authority
NGO	Non-Government Organization
OD	Open Defecation
ODF	Open Defecation Free
SFD	Shit Flow Diagram
SUED	Sustainable Economic Development
UBSUP	Upscaling Basic Sanitation for the Urban Poor
USD	United States Dollar
WWMP	Wastewater Master Plan
WASREB	Water Services Regulatory Board
WSP	Water Service Providers
WSTF	Water Sector Trust Fund
WSUP	Water and sanitation for Urban Poor

Contents

Executive summary

In 2019, Kilifi County and Malindi Water and Sewerage Company (MAWASCO) commissioned this city-wide inclusive sanitation plan (CWISP) to address local sanitation challenges and their respective economic impacts. The following report is a comprehensive plan from stakeholder engagement, data collection, and business modeling to achieve a healthy, clean and sustainable city.

Malindi and Watamu, known for their beautiful beaches and vibrant community, are currently experiencing rapid urbanization, with a growth rate of 3.4% per annum. The population of 311,646 residents currently has no sewerage coverage and no waste treatment options, resulting in less than 25% of human waste being safely managed. The lack of proper sanitation leads to contaminated water sources and loss of income and livelihoods, affecting local health and the economy.

MAWASCO has recently begun expanding its mandate to include sewerage and sanitation, including participating in the UBSUP program, constructing ablution blocks to eliminate open defecation, and developing a master plan for sewerage. The Wastewater Master Plan (WWMP) for Malindi and Watamu Towns that was commissioned by the World Bank in 2017 will only reach 35% of the population and requires over $45 million investment. With a new focus on city-wide inclusive sanitation, Malindi stakeholders were interested in a comprehensive and cost-effective plan to reach all residents with safe sanitation, create jobs, and make Malindi the cleanest coastal town in Kenya. Therefore, a planning committee was formed and developed this 20-year, phased-approach city-wide inclusive sanitation plan. The plan is focused on three goals:

1. Achieve equitable and financially sustainable access to safely managed sanitation for all
2. Ensure clarity in mandates for sanitation service provision and help to market Malindi as the cleanest coastal town
3. Create jobs and build local capacities to establish a thriving sanitation economy

In order to achieve these goals, the existing conditions in the towns were analyzed for infrastructural, institutional, regulatory, financial and capacity gaps, primarily through secondary sources of data and specific primary data collected. Multiple sanitation solutions were evaluated through a consultative process detailing the rationale and requirements for implementing them. This report details the proposed solutions, including sewers, lined pit latrines, container-based sanitation, septic tanks, and ablution blocks. For each solution, the broad estimates of revenue and costs for each stakeholder are evaluated and integrated into the business model with possible long-term financing options. Recommendations are provided for strengthening the existing institutional framework for implementing and regulating the proposed solutions. This includes guidance on compliance, establishing an FSM contact center, and a sanitation marketing campaign. A final comprehensive implementation plan is proposed with a combination of different solutions through three phases: short-term,

medium-term, and long-term. The full 2040 strategy costs $94 million, with an external investment required of approximately $61 million and a positive NPV of $10 million. The plan also creates over 700 jobs and provides capacity building activities such as standard operating procedures and contracting mechanisms. This CWISP presents a blueprint for external partners to collaborate with sanitation stakeholders in Malindi to achieve inclusive sanitation. Ultimately, this strategy will be accomplished with the continued strong leadership and collaboration of local stakeholders in Malindi.

1. Introduction

CWISP background

Malindi Water and Sanitation Company (MAWASCO), in collaboration with the Kilifi County Government and other stakeholders, came together in September 2019 to steer a city-wide inclusive plan (CWISP) for sanitation in Malindi, Watamu, and their surrounding peri-urban areas. A CWISP is a strategic advisory document that puts the principles of citywide inclusive sanitation (CWIS) in practice. CWIS is an approach to urban sanitation that "ensures all members of the city have equitable access to adequate and affordable improved sanitation services through appropriate systems (sewered and non-sewered) of all scales, without any contamination to the environment along the entire sanitation value chain" (Narayan, S. & Lüthi, C., 2020).

City-Wide Inclusive Sanitation in a nutshell:

Each city is organized in a unique way. Local actors need to acknowledge shared responsibilities and work collaboratively to chart their own path to providing urban sanitation to all. The CWIS calls on all actors to work on the basis of four inter-locking principles:

- Prioritize the human right to sanitation for all
- Deliver safe management over the entire service chain
- Recognize that sanitation contributes to a thriving economy
- Commit to working in partnership to deliver citywide inclusive sanitation

In its most recent impact report, the Kenyan Water Service Regulatory Board emphasized that "citywide inclusive sanitation aims to help cities develop comprehensive approaches to sanitation improvement and means that: human waste is safely managed along the whole sanitation service chain; effective resource recovery and re-use are considered; a diversity of technical solutions is embraced for adaptive, mixed and incremental approaches; and onsite and sewerage solutions are combined, in either centralized or decentralized systems, to better respond to the realities found in developing country cities" (WASREB, 2020).

1.1 Malindi CWISP Goals

The CWIS approach aims to understand the stakeholders' interest, needs, constraints, and to develop a clear set of actions to achieve universal sanitation by 2040 in Malindi, Watamu and their peri-urban areas. The Malindi CWISP committee developed three goals and targets to achieve their vision:

1. Achieve equitable and financially sustainable access to safely managed sanitation for all

Metric	Current	2025	2030	2040
% of population with improved sanitation	30%	50%	75%	100%
% of pro-poor access	26%	35%	60%	100%
% of open defecation	5%	4%	2%	0%
% of fecal sludge that is safely emptied and transported	11%	30%	60%	>80%
% of waste safely treated	1%	30%	70%	100%
% of MAWASCO Sanitation O&M costs covered	N/A	15%	85% (increase due to sanitation tariff)	110%

2. Ensure clarity in mandates and market Malindi as the cleanest coastal town

Metric	Current	2025	2030	2040
Clarity in Mandate & Regulations	Legislation processes ongoing	Clear coordination mechanisms for service delivery and well established by laws in place	Improved enforcement	Next 20-year plan created
Marketing Malindi as the cleanest coastal town	Monthly clean ups ongoing	Marketing and awareness campaigns developed and running	Malindi receives awards (WASREB, National Government, World Bank, etc.) as environment and marine leader	Environmental tourism increases

3. Create jobs and build local capacities to have a thriving sanitation economy

Metric	Current	2025	2030	2040
# of jobs created	Approx. 50	100	300	>700
Loans accessed by sanitation enterprises	No	Yes	Yes	Yes

2. Planning Methodology and Background

2.1 Key Stakeholders and Methodology

The planning process was based on a participatory approach that included the inputs of all relevant stakeholders with regards to water and sanitation, including representatives of the Kilifi County government, the Water Service Provider (MAWASCO), and local community-based organizations (CBOs). A committee, with representatives from the government led by MAWASCO, was formed at the beginning of the planning process. The different departments engaged in the process included:

- CECMs for Water, Environment and Natural Resources and Health
- Water Service Provider (MAWASCO)
- Department of Land and Planning
- Municipality (Town Manager)
- Department of Water, Public Health and Environment
- Department of Trade and Tourism
- Department of Roads
- Sub-County Administrator
- NEMA County Director for Environment
- Malindi and Watamu Environment CBO
- Development agencies (WSUP, Eawag, BORDA and Sanivation)

Figure 1 represents the stakeholder categories based on level of interest and power in realizing the sanitation goals.

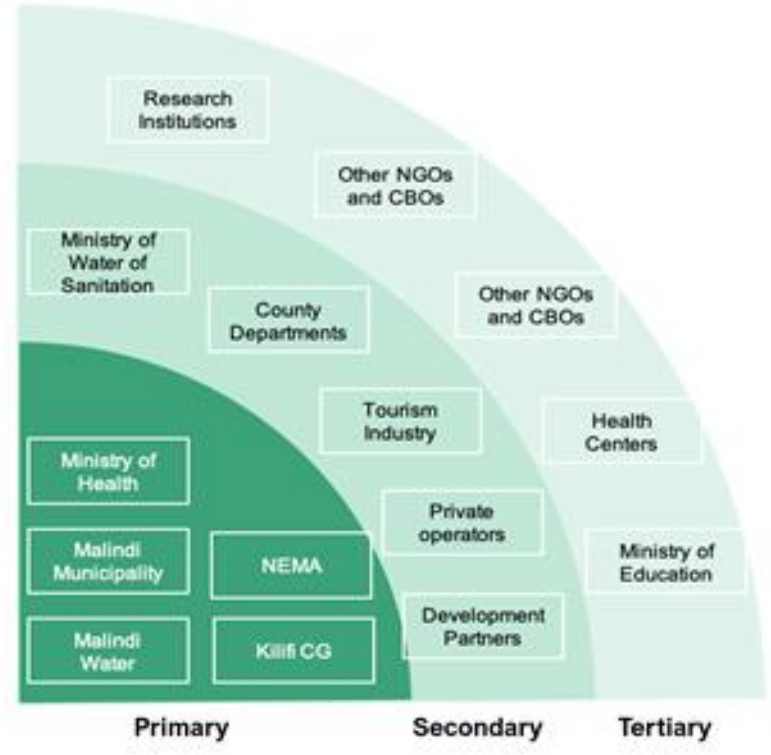


Figure 1: Malindi stakeholder mapping

The planning process and its activities were guided and supported by agencies such as Sanivation, WSUP, Eawag, and BORDA, who provided expertise in urban sanitation planning. Figure 2 highlights the planning process stages and timelines.

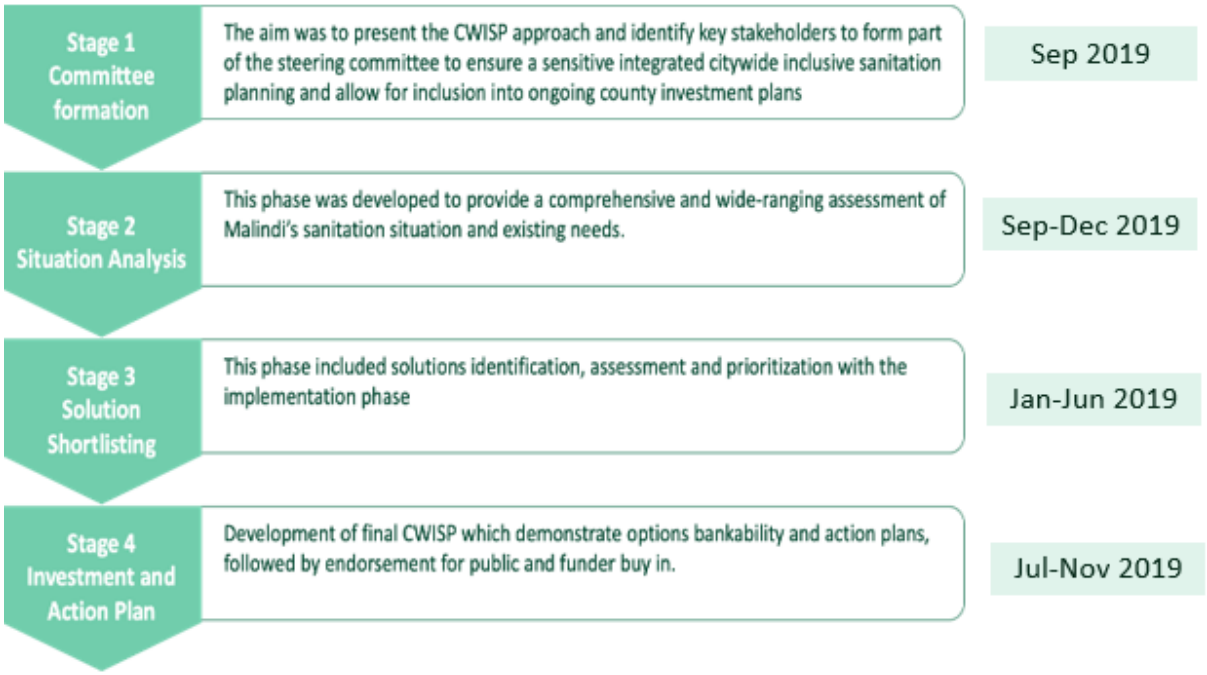


Figure 2: The CWISP planning process and timelines

This plan is based on primary data compiled from a survey of 468 households, 14 key informant interviews, and 6 workshops with the CWISP committee. The secondary data was sourced from, among others: Wastewater Master Plan for Malindi and Watamu (2017), Malindi Integrated Strategic Urban Development Plan, Malindi Water and Sewerage Co. LTD Strategic Plan 2019-2023, Draft SFD report (2019), and Sanitation Landscaping Report (2019).

2.2 Policy and Institutional Context

This plan for Malindi is embedded in the national and local policy, legislation, and regulation. The following is a list of the CWISP's interlinkages to the current institutional context:

National-Level Vision and Policies	
The Kenya Vision 2030	Envisions universal sanitation for all Kenyans by 2030
Public Health Act 1986 (revised 2012)	Prohibits nuisances that are dangerous and prohibitive to health e.g. sewers and garbage receptacles, among others. It further stipulates modalities of notifying the responsible authorities and also outlines sanctions that individuals face if they do not comply.
Water Act 2002 and revised Water Act 2016	Complements the constitution and establishes institutions that govern service provision, roles, responsibilities, and structures.

The Environmental Management and Coordination Act, 1999 (EMCA) amended in 2018	Facilitates a governance structure for management and conservation of the environment. The act established the National Environment Management Authority (NEMA), charged with implementation of all policies related to the environment, and with exercising general supervision and coordination over all matters related to the environment.
Kenya Environmental Sanitation and Hygiene Policy 2016-2030 (KESHP)	Targets include achieving and sustaining 100% ODF, achieving and sustaining access to improved sanitation in rural and urban areas, and increasing public investment in sanitation and hygiene by the year 2030.
County-Level Policies	
County Government Act (2012) of Kilifi County	Emphasizes that counties should give priority to the basic needs of the public and ensure that all members of the public have access to basic services. It also allows for the development of county integrated development plans which include sanitation.
Kilifi County Water and Sanitation Act 2015	Calls for the preparation of a five-year sanitation services master plan, wastewater reuse and ensuring the efficacy of treatment facilities. It also allows for development and imposition of sewerage with all sanitation functions performed either directly by the county government or through public-private partnerships.
Kilifi County Finance Act (2016)	It highlights a service charge for emptying cesspits/septic tanks per day in Kilifi County.
Key National Institutions Governing Sanitation	
Water Services Regulatory Board (WASREB)	Licenses WSPs, sets national standards, recommends water and sewerage tariffs, and monitors compliance standards, including the design, construction, operation and maintenance of facilities for water service provision.
National Environment Management Authority (NEMA)	General supervision and coordination of all matters related to the environment. Serves as the Kenyan government's principal instrument in implementing all policies related to the environment.
Water Sector Trust Fund (WSTF)	Assists in financing water, sanitation, and water resources management projects to underserved and marginalized areas,

	both rural and urban. This is done through conditional and unconditional grants to counties. Funds may be sourced from appropriations from the national government budget, the Country's Equalization Fund, county governments from agreed funds, donations, or any imposed levies.
Water Works Development Agencies (WWDA)	Responsible for the design and construction of water and sanitation service infrastructure.
County Government, e.g. Kilifi	Develops county integrated development plans (CIDP) and annual development plans (ADP) that encompass water and sanitation.
Water Service Providers (WSPs) e.g. MAWASCO	Responsible for water and sanitation service provision. These are commercially-oriented and operate under the jurisdiction of the county governments, while being licensed and regulated by WASREB.
Local Institutions with a Sanitation Mandate	
The Kilifi County Government	Mandated with developing plans, granting permits to exhausters (on a daily basis), compliance, monitoring of standards and building codes, and approving/issuing certificates of occupation/habitation to buildings (residential, commercial, institutional, and industrial).
MAWASCO	The local utility, charged with providing water and sewerage services. However, MAWASCO does not offer sewerage services currently. Under UBSUP, MAWSCO offers partial subsidies for onsite sanitation facilities in households (500 toilets were built) and schools.
Private sector	Provides sanitation-related services such as construction of toilets and containment systems. Also involved in emptying/collection of faecal sludge to designated dumping sites.
Development partners	Provide technical assistance and advising, fund pilot projects and support the sector's general development.
Development banks	Provide loans and grants for developing infrastructure related to water, wastewater and faecal sludge management.

2.3 Existing Strategies and Plans to Improve Sanitation

This CWISP actively supplements and builds on the existing strategies and plans, and proposes solutions in line with the goals and approaches outlined in the following documents:

- Ministry of Water and Sanitation Strategic Plan 2018–2022: Outlines the policies, programs and projects that the Ministry of Water and Sanitation and Irrigation will be implementing during the period 2018–2022 to progressively realize the human right to water and sanitation, SDG 6, and national development goals.

- Kilifi County Integrated Development Plan 2028-2022: Identifies poor sanitation as a key challenge and lists projects that will be implemented to achieve the county's set objectives for the years 2018-2022.

- Malindi Integrated Strategic Urban Development Plan (ISUDP): Prepared in 2015, this assessment estimated sewerage generation of 31,500m3/day in 2035 and proposed the construction of sewer networks for Malindi Town and its environs, including Watamu. It recommends that sewerage services be managed by MAWASCO.

- MAWASCO Strategic Plan 2019-2023: Highlights the overall vision and objective for enhancing water and sanitation services in Malindi and part of Watamu town. This document sets the goal to increase sanitation access from 7-39% by 2030. The plan proposes an external finance budget of USD 1,913,840 (KSH 209,541,715) and an internal budget of USD 16,130 (KSH 1,766,000) with set annual performance targets. The sanitation interventions proposed also include constructing 1,000 improved toilets.

- Sustainable Urban Economic Development (2020): Provides a focused infrastructure development and economic strategy for the Municipal Board and Municipal Departments. It identifies sludge commercialization as one of the anchor infrastructure interventions.

- Wastewater Master Plan for Malindi and Watamu (2017): The World Bank commissioned a Wastewater Master Plan (WWMP) for Malindi and Watamu Towns in 2017 that proposed an extensive sewer network in the towns of Malindi and Watamu. The key objective of the Master Plan was to propose phased investment along the immediate, medium and long-term phases.

  <u>Immediate Interventions (2015-2020):</u>

  1. Construction of ten ablution blocks in selected public places serving transient populations
  2. Procurement of one sludge exhauster truck (capacity of 8,000 m3) and operationalization by either MAWASCO or a private operator
  3. Two sludge handling facilities (drying beds) serving approximately 20,000 people

  <u>Medium Term, Phase I (2021 – 2025) and Long Term, Phase II (2026-2040):</u>

1. A Malindi sewer network to serve Barani, Central, Shella, Sabaki with a population of 157,486, including 69 km of sewer network with 11 pumping stations and wastewater stabilization ponds and a capacity of 12,200m3/day, to be operational by 2040.
2. A Watamu sewer network to serve the areas of Watamu, Jimba, Dabaso, Mbaraka Chembe—a population of 60,474, with 44 km of sewer network with 8 pumping stations and wastewater stabilization ponds and a capacity of 7300m3/day, to be operational by 2040.

2.4 Alignment of CWISP and the Wastewater Master Plan (WWMP)

The World Bank is currently financing urgent works of the existing wastewater Master Plan (WWMP) for Malindi and Watamu towns. The project is executed by the Kenyan Government and being implemented by MAWASCO. Although the WWMP is the right step forward in improving the sanitation situation in the Central Business Districts (CBDs) of Malindi and Watamu towns, it would only serve 221,000 people in the planning area by 2040, approximately 35% of the MAWASCO service area. The remainder of the population would still rely on on-site sanitation. In addition to the wastewater treatment plants, the WWMP also proposes two faecal sludge treatment facilities as immediate measure, but the design capacity of the plants is limited to a population of only 20,000 People.

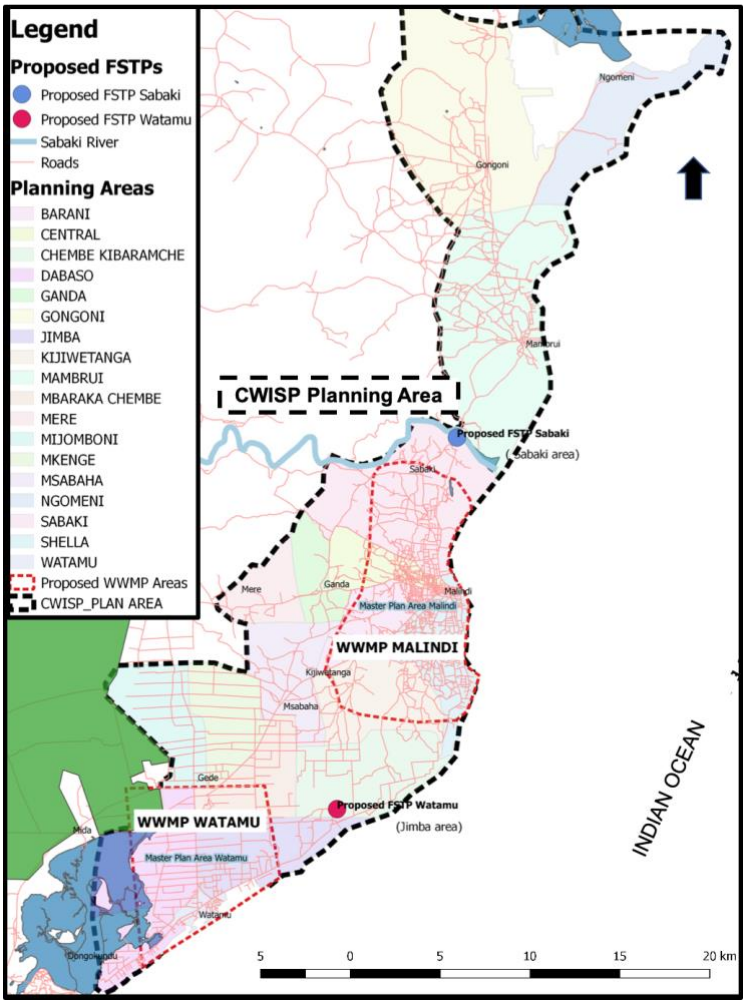


Figure 3:The planning boundary map
Credit: MAWASCO

The CWISP proposes sanitation solutions that will extend beyond the WWMP, including peri-urban areas of Malindi and Watamu and thus creating more comprehensive and holistic sanitation solutions. Figure 3 presents the geographic scope of the CWISP planning boundaries.

2.5 The Planning Area

The CWIS planning area boundaries are based on the service areas mandated to MAWASCO. The utility has a service coverage area of 378 km^2 which includes the towns of Malindi, Watamu, and three additional locations—Ganda, Gede and Magarini—and serves 311,646 people. Annex 1 provides the demographic details of each location and sublocation. The planning area was formed in consultation with MAWASCO, the Planning Department, and the town manager, and is aligned with the scope of the Integrated Strategic Urban Development Plan (2015).

2.6 Demographics of the Planning Area

Half of Malindi's population falls below the poverty line (SUED, 2020). Official data provided by MAWASCO (2019) indicates that the utility's service area has an average population density of 979 persons/km2 and an average household size of five. Figure 5 shows the distribution of population densities of selected areas served by MAWASCO. Central, Barani, Shella and Watamu Town have the highest densities.

. The area heavily relies on tourism. Twelve hotels are classified as international standard tourist hotels, and Watamu alone has 15 resorts. Other activities include fishing, agriculture and salt harvesting (NJN/EOA 2017). Figure 4 depicts the economic status of the planning area, where:

- Medium-high represents income levels over USD 500 per household per month
- Low-medium represents income levels between USD 100 to 500 per household per month
- Low represents income levels below USD 100 per household per month

As noted by Figures 4 and 5, the wastewater master plan is not equitable. It mainly includes plans for higher income levels and fails to address everyone in the planning area.

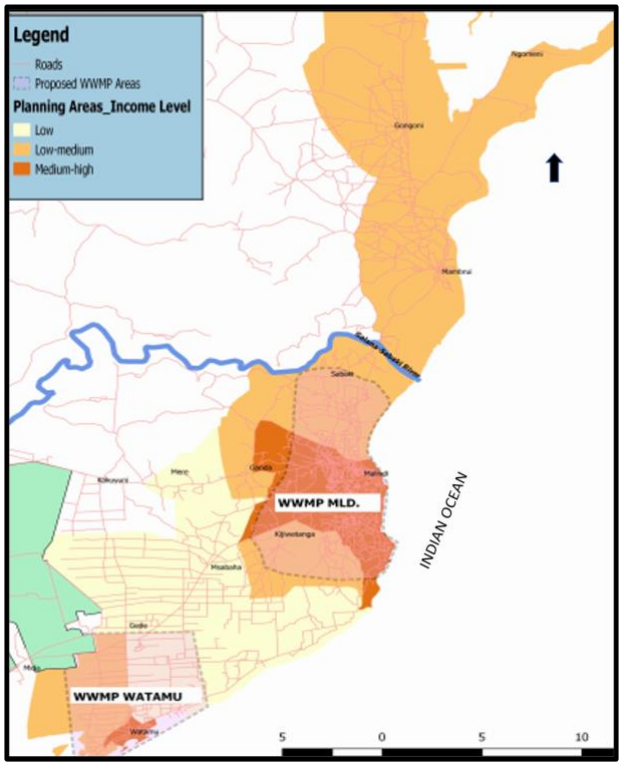


Figure 4: Income levels by coverage of WWMP

Credit: MAWASCO

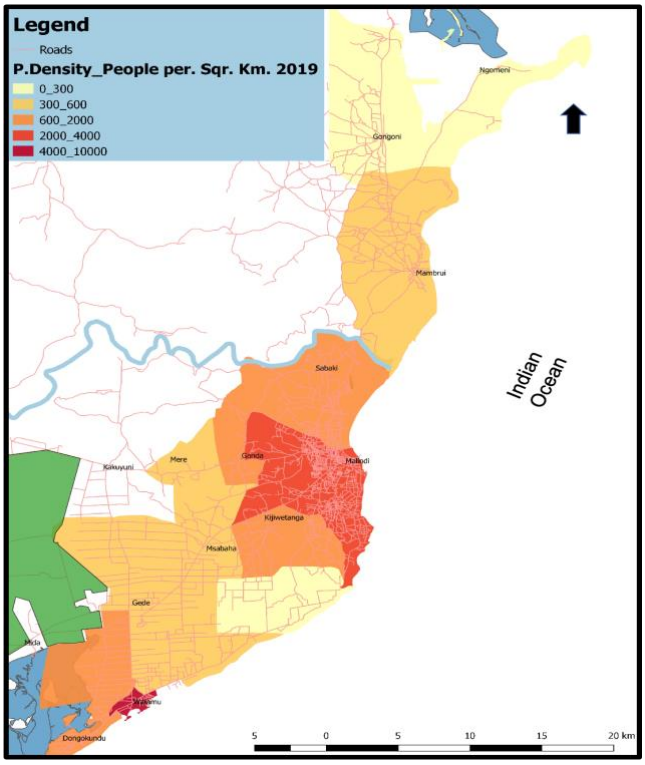


Figure 5: Population densities of the study locations

Credit: MAWASCO

3. Situation Analysis of Sanitation

The following section provides a brief overview of the sanitation situation in the planning area. Details of critical issues pertaining to sanitation challenges are presented in Table 3. Additionally, a Shit Flow Diagram (Figure 6) gives a visual representation of safely and unsafely managed sanitation in the planning area.

3.1 Containment

Both Malindi and Watamu towns are primarily served by onsite sanitation systems. Septic tanks, lined tanks with open bottoms, direct pit latrines, and latrines with offset pits are the most common types of containment systems. The open defecation (OD) rate is 5%.

Figure 5 shows containment by types per location in the planning area.

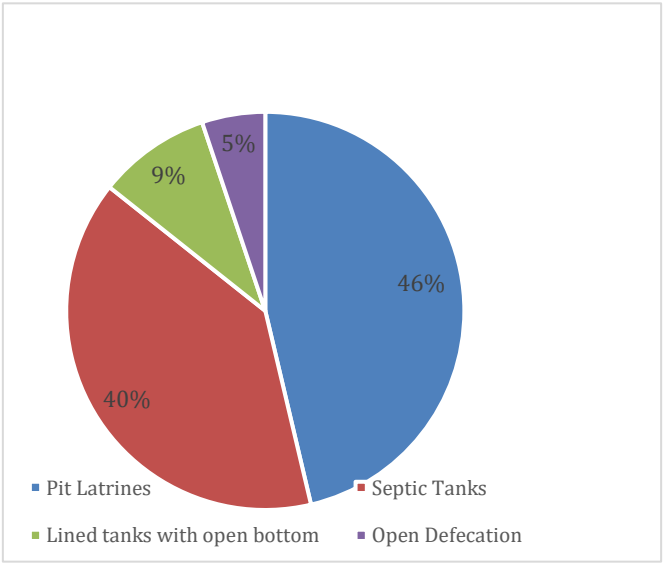


Figure 4:Containment types in the planning area

Septic Tanks

Septic tanks are widespread in residential, institutional, and commercial establishments and form 40% of the containment types in the planning area. They are the recommended standard set by the Public Works Department (Shit Flow Diagram 2019). The recommended septic sizes and capacities are 6000 and 9000-liter capacity. However, interviews with masons and emptiers reported similar designs with deeper depths and average capacity of 16,000 liters. Households with septic tanks reported 17,000 liters with soak pits as the most common means of disposal (97%). Households reported that most of their septic tanks (88%) took more than one year to fill up. Field interviews indicated that most septic tanks are emptied after five to six years. Nine percent of septic tanks filled within six to twelve months and 3% within three to six months.

UBSUP flush toilets connected to a septic tank cost approximately USD 486 (the estimate is based on two toilet units sharing one septic tank) (Schröder, 2016). The cost of constructing septic tanks is prohibitive for the poor compared to a modest monthly income of USD 135 in most of the households.

Lined Open Bottom Tanks

Lined tanks with open bottoms comprise about 10% of all the containment type in the planning area. They have similar design and dimensions as septic tanks except that their bottoms are unlined. In some areas, their depths reach the water table, sometimes intentionally. Most of them (92%) are connected to soak pits, 5% to water bodies and 2% to open drain. There are no directives nor standards for their construction. Most of the people who had this containment technology used squat pour flush toilets, compared to 7% that used western design interfaces.

All Pits (Direct Pit Latrines and Latrines with Offset Pits)

Direct and offset pits comprise about half (49%) of the containment type in the planning area. Their average dimensions are 1.3-meter length, 1.1-meter width, 6-meter depth, and capacity of 6,000 liters. Residents mentioned intentionally digging the pits to reach the water table because it then takes longer for the pits to fill. Some pits are reinforced using locally available materials such as steel drums stacked on top of each other to reduce the risks of the pits collapsing in sandy areas. Residents who are capable financially reinforced the pits with permeable masonry walls and reported that the intention was to prevent the pits from collapsing. Offset pits are covered by a concrete slab on top and typically have a vent pipe connected to them.

Sludge characterization studies indicated that fecal sludge is mixing with ground water, as the total solids, BOD, and COD were significantly low. It is assumed that this is caused by unlined pit latrine and semi-lined septic tanks, which would allow leaching or mixing of groundwater. This could lead to groundwater contamination, and be particularly detrimental in areas where people rely on groundwater for drinking. Analysis of boreholes found 90% were contaminated with fecal matter. The prevalence of diarrhea indicates there could be a significant indirect health impact due to unsafe sanitation practices[1].

[1] Malindi SFD, 2019

3.2 Emptying and Transport

There are currently no sewer lines in the planning area. Emptying services are regulated by county government and National Environment Management Authority (NEMA) and are offered by mechanical, semi-mechanical, and manual emptiers. The key challenge is enforcement. Most of the septic tanks (66%) have never been emptied, 23% are emptied manually, and 11% are mechanically emptied using either exhauster vehicles or in a semi-mechanized manner that uses a combination of manual emptying using buckets and a water pump (to extract the supernatant). The fecal sludge and supernatant are loaded into closed metal containers (approx. 5,000 liters each) and transported on trucks.

There are two exhauster trucks and several semi-mechanized emptiers that provide emptying services in the planning area. The municipality charges the exhausters and the semi-mechanized emptiers a dumping fee of KES 1,000 per dump (Wainaina, 2019). In addition, there are several manual emptiers (approx. 20) that provide emptying services but discharge the fecal sludge in open plots or bury it at site illegally.

3.3 Treatment/Reuse or Disposal

Malindi and Watamu towns currently do not have a wastewater or fecal sludge treatment system. Currently, all the collected sludge is dumped at an unregulated municipal dump site or illegally disposed of in agricultural fields, open grounds, rivers and storm water drains. Most storm water drains terminate near Lawford's Hotel, just behind The Star Hospital, where there is an underground duct to direct it to the Indian Ocean. There are a few small-scale wastewater treatment plants located on-site at well-established hotels and resorts that carry out treatment, serving 1% of the population or less.

3.4 Current and Future Demand for FSM in the Planning Area

Table 1 provides an estimate of fecal sludge treatment capacity required based on data from 2019.

Planning Area	2040 Estimate Based on 3.4% Growth	2019 Total	2019 Watamu	2019 Malindi	Source of Data and Assumptions for Calculations
Total Population	495,060	201,423	35,066	166,357	Projected calculations and KPHC data
No. of Households	143,029	70,875	14,305	56,570	KPHC data (2019)

No. of Households desludged/day	149	74	15[2]	59	Assuming a desludging frequency of once every 4 years and 240 working days/year
Theoretical Volume to be Desludged and Treated/Day	745m^3/day	370m^3/day	75 m^3/day[3]	295 m^3/day2	Average sludge removed/day: 5m^3 (assumed based on Aquaya 2019)

Table 1: Estimation of fecal sludge to be emptied and treated (2019)

Based on the expected population growth of 3.4% per annum, the total theoretical demand of fecal sludge to be emptied and treated by 2040 is estimated at 745 m^3/day without sewer implementation and 624m^3/day once sewers are implemented.

FS Desludged and in Need of Treatment/Year	**2019**	**2040**	**2040 (With Sewer Network in Place)**
Malindi	295 m^3/day	595 m^3/day	390 m^3/day
Watamu	75 m^3/day	150 m^3/day	66 m^3/day
TOTAL	370 m^3/day	745 m^3/day	624 m^3/day

Table 2: Projected volume of total sludge to be desludged and treated in 2019 and 2040

Currently, only 11% of households have their waste collected by private emptiers and disposed of at the dumpsite. A considerable amount of social mobilization and strict compliance monitoring will be required to ensure all the fecal sludge collected would reach the FSTP.

To avoid long periods of low capacity utilization, the CWISP proposes to establish an initial capacity of 50% of the current required volume. Therefore, a capacity of 35m3/day is recommended in Watamu and 150 m3/day capacity for Malindi.

Upon achieving over 75% capacity utilization along with satisfactory treatment results, MAWASCO should assess the status of the sewerage project and if a capacity extension of the FSTPs is required.

[2] No. HH/ Desludging freq./Ave. working days per year
[3] No. HH desludged/ day/Average sludge removed/day

3.5 Water Supply

The current water demand of the planning area is 44,353 m3/day. The main source of water supply to Malindi and Watamu town is Baricho Water Works with a water supply of 21,000m3/day supplied to Malindi Water company. To augment the Baricho water supply, a total of 22 boreholes, 25 dams/pans and 5 shallow wells have been constructed and are being operated by the community and MAWASCO (MAWASCO, 2014).

In terms of usage, the Kenya Population and Housing Census data shows that in the planning area, piped water accounts for 80.8%, ground water 13.3%, and surface water 4.3%. The reliance on groundwater sources for drinking water is relatively low. However, water analysis of the available boreholes and wells indicated about 90% fecal matter contamination. The prevalence of diarrhea indicates that the indirect health impact of unsafe sanitation practices could be significant (Wainaina, 2019).

3.6 Shit Flow Diagram of Planning Area

WSUP and Eawag collected data which informed the Shit Flow Diagram (SFD) for the planning. An SFD is a graphic tool to understand and communicate excreta 'flow' in a city or town. It presents how the excreta generated in a city is or is not contained as it moves from the type of containment systems to disposal or end-use. The red and green colors on the infographic show whether the practice is safe or not. Figure 6 presents the SFD for the planning area.

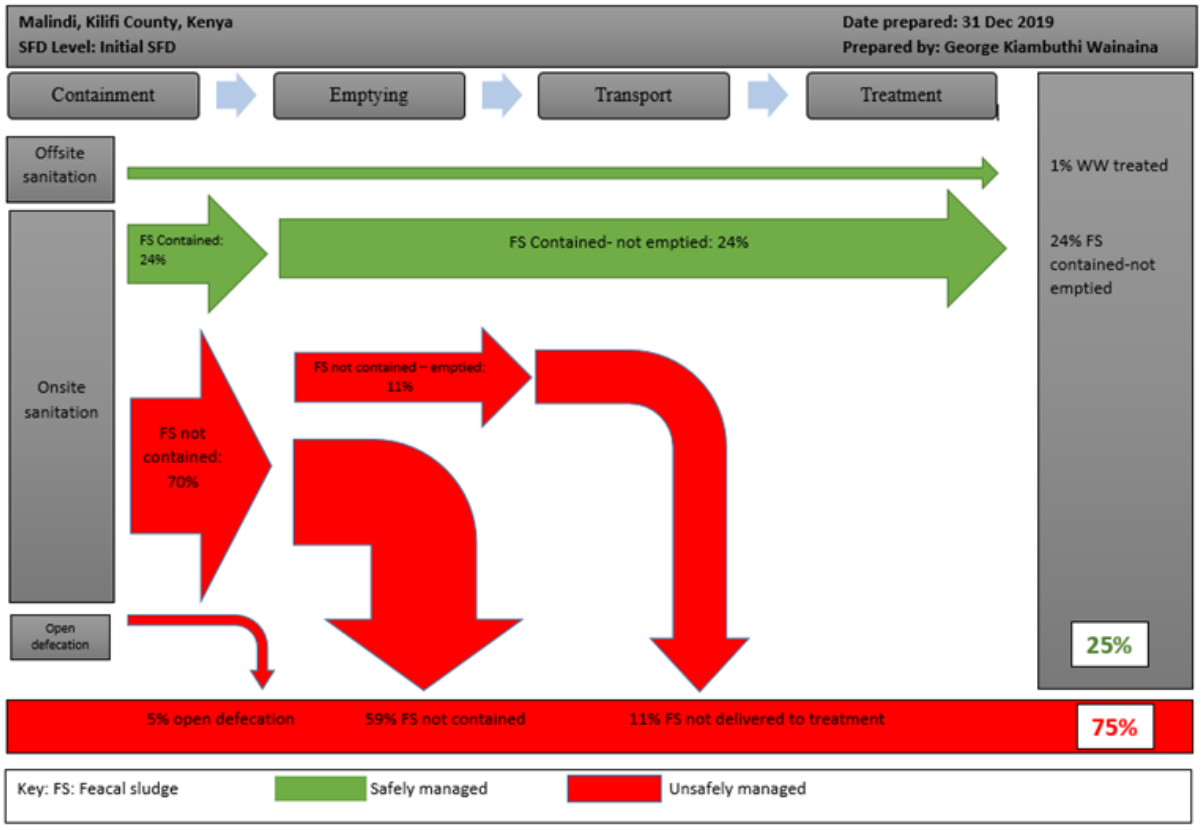


Figure 5: Shit Flow Diagram

3.7 Institutional Setting

Coordination mechanism and standard procedures: The introduction of FSM practices and systems in the planning area is a relatively new field. The current actors and their roles and responsibilities are not clearly defined. Thus, there is a lack of coordination amongst stakeholders to actively engage in FSM activities across the sanitation chain. MAWASCO has expressed strong interest in expanding its mandate to include sanitation, but as of end of 2019 did not have a sanitation unit within the company.

The existing FS emptying practices are ad hoc and rudimentary, with emptiers receiving very little guidance on how FS emptying or treatment can be safely managed. The emptiers make do with whatever little resources they have and try to achieve the best results. The lack of by-laws and standard procedures that govern and regulate the sector at the local level leads to indiscriminate FS emptying and disposal services. An overview of the current status of the sanitation chain is summarized in Table 3.

Table 3: Overview of current sanitation situation

Existing situational analysis	User Interface and Containment	Emptying and Transport	Treatment and Reuse
Current technologies and service delivery practices	▪ 100% onsite technologies ▪ 46% - pit latrine (lined with open bottom) ▪ 9% - Lined tanks (with open bottoms) ▪ 40% - septic tanks (safely contained) ▪ 5% - Open defection (peri-urban areas) ▪ Pits too deep to be emptied by mechanical means	▪ 11% is collected and transported to dumpsite ▪ 59% not collected and pits abandoned when full ▪ 2 Vacuum truck ▪ Appr. 20 manual emptiers ▪ Illegal dumping—the distance to the correct dump sites is too long for manual/semi-mechanized emptiers	▪ 99% of the FS is not treated ▪ 11% of the FS is unsafely dumped at municipal dump site ▪ 1% treated (private luxury resorts/hotels) ▪ No public treatment infrastructure existing
Environmental Impact		▪ High risk of faecal contamination of surrounding environment and ground water sources due to unsafe practices	
Institutional gaps	▪ Lack of enforcement of building codes ▪ Lack of enforcement of standards for affordable containment technologies (lined/sealed pits latrines)	▪ No SOPs for emptying services ▪ Emptying sector is unregulated ▪ Lack of enforcement	▪ No SOPs for treatment facilities
Awareness/behavior gap	▪ Lack of awareness of standards and regulations ▪ High OD rates indicate low community sensitization on health impacts	▪ The majority of manual and semi-mechanized emptiers do not use professional emptying equipment or follow any safety procedures due to lack of incentives, training and awareness	
Capacity	▪ Need for standardization of containment systems and enhanced capacities to construct low-cost low-cost toilets options	▪ MAWASCO and manual pit emptier have no prior knowledge/skills of O&M and financial management of exhauster trucks and FSM services	▪ MAWASCO lacks capacity to design, construct, operate and maintain any treatment facility
Financial	▪ Households are unable to construct standardized sanitation facilities as per regulations	▪ Emptying fees too high for most households ▪ The local government—not MAWASCO—collects the emptying and tipping fee, which should be directed to O&M of treatment plant, but no treatment plant exists, and the fees are not ringfenced for sanitation development ▪ The majority of private operators lack the financial capacity to purchase or rent exhauster trucks	▪ MAWASCO is unable to independently finance a treatment plant

Summary of Key Challenges

- Lack of FSM ownership/plan. Existing WWMP covers less than 35% of population
- Over 75% of waste is not safely managed, impacting Malindi's environment and economy
- No standard operating procedures and regulations across the sanitation value chain
- 47% of households have income below 10,000KES/month and are unable to afford the full cost of adequate sanitation facilities and services
- Existing capacity and corresponding financing resources for professional FSM service delivery is low

Advisory Note from WASREB

The sanitation sector requires conscious efforts, including:

- A strong and functional, policy, legal, institutional and regulatory framework
- A strong regulatory framework to address the full chain of non-sewered sanitation
- Inclusive urban sanitation approach that combines both sewered and non-sewered sanitation services
- A holistic strategy/approach in the form of a citywide/county wide inclusive sanitation

4. Plan and Corresponding Rationale

Based on the challenges identified in the planning area, the committee proposes the following goals to improve the situation:

1. **Achieve equitable and financially sustainable access to safely managed sanitation for all**
2. **Ensure clarity in mandates for sanitation service provision and market Malindi as the cleanest town in Kenya's coastal town**
3. **Create jobs and build local capacities to establish a thriving sanitation economy**

The following sections presents details on how to achieve each of the above goals.

4.1 Goal 1: Achieve equitable and financially sustainable access to safely managed sanitation for all

In order to address the key challenges, sanitation needs to be improved in an equitable and financially sustainable manner. Large financial investments are required to address these needs, whether through tariffs, taxes or transfers. Aquaya recently conducted a study on costs and willingness to pay for different sanitation options in Malindi, including an analysis of subsidy requirements for onsite and offsite sanitation. The data below indicates the total financial and subsidies requirement. It presents an estimate of total resources needed to achieve full sanitation coverage under two independent scenarios sewerage or on-site sanitation (AQUAYA & WSUP, 2019). Through an on-site sanitation approach, approximately four times as many residents could be reached with the same

amount of public investment. The existing wastewater master plan only covers 35% of the Malindi and Watamu planning area. Compared to FSM, it requires significantly more financial resources, both in terms of total financial requirements and subsidies.

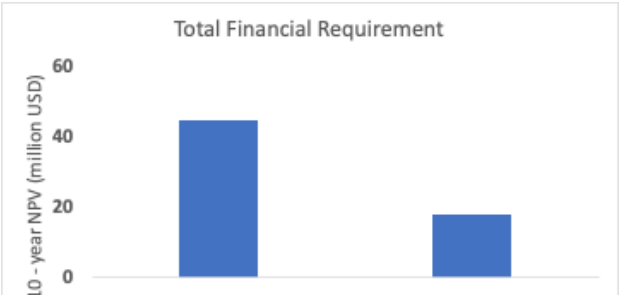


Figure 7: Total financial requirement to achieve safely managed sanitation

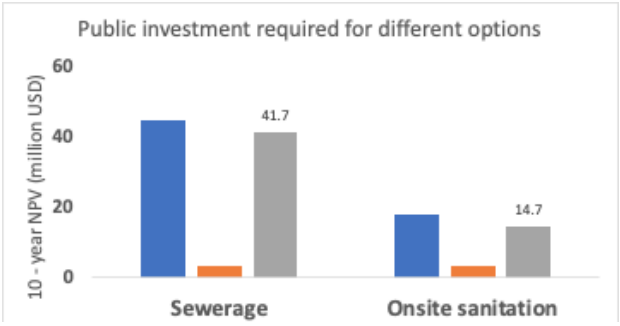


Figure 6:Total public investment required for different options

Description of the four proposed sanitation service delivery types, inclusive of containment and collection recommendations

Below is a phased approach to enable 100% of waste to be safely managed by 2040, ensuring all residents can live in a healthy and clean Malindi. This phased approach includes four types of sanitation systems to address the income and density differences of the planning area. Each approach was selected to fit the specific demands of target population and geographic locations. Together these phased approaches are integrated to achieve city-wide inclusive sanitation.

The phased approach proposes immediate improvement of fecal sludge collection and treatment (Phase 1). Phase 2 proposes the introduction of sewer networks and wastewater treatment systems.

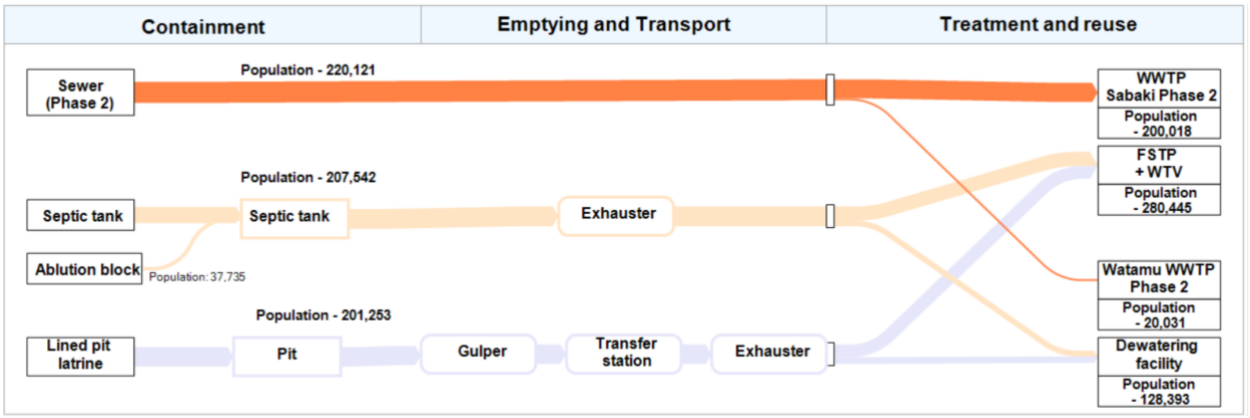


Figure 8: Business model by sanitation systems

Sewers	Toilets connect to sewers and the wastewater treated by a central wastewater treatment plant (as proposed by the WWMP- 2017)
Septic tanks	Toilets connected to septic tanks for partial treatment of wastewater, faecal sludge collected by mechanized emptiers and treated at faecal sludge treatment plant
Lined Pit Latrines/ Container Based Sanitation (CBS):	Toilets connected to lined pit latrines, faecal sludge collected by semi-mechanized emptiers and emptied at a nearby transfer station/dewatering plant and ultimately treated at a FSTP. Densely populated areas with high water tables should consider CBS

Ablution blocks	Construct and operationalize public/communal toilets to eliminate open defecation

The proposed implementation areas of the four sanitation systems are based on four criteria: the population density, income levels, road access, and open defecation hotspot zones.

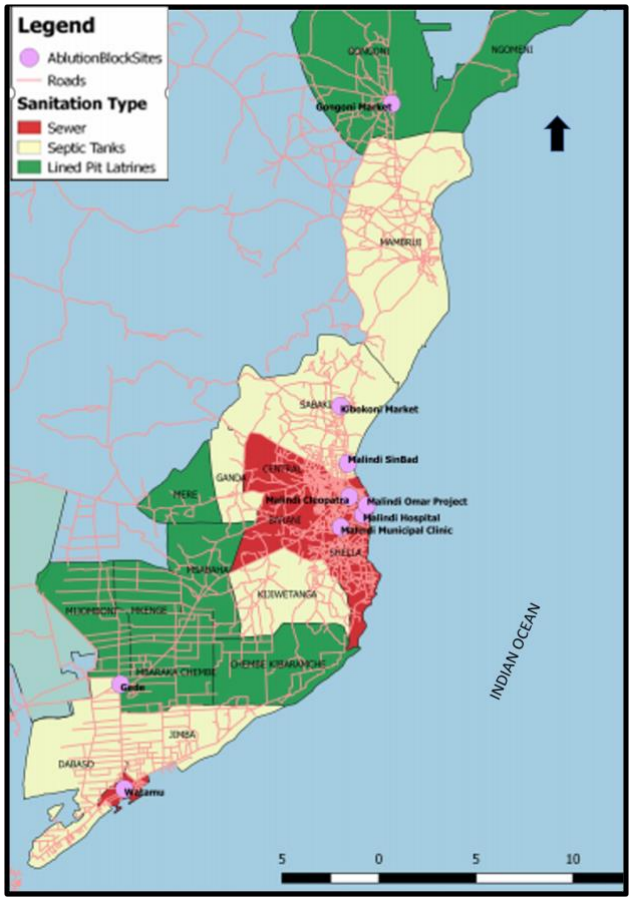


Figure 9: Map depicting proposed delivery models by area
Credit: MAWASCO

Solutions	Population Density (Inhabitants/ km2)	Income Level (High/Mid/Low)	Road Access (Good/Poor)	Inhabitants Served in 2040
Sewer	>2500 (High)	>USD 300 (High-mid)	Good	35%
Septic tanks	Between 2500-1000 (Mid)	Between USD 120-300 (High-mid)	Good	27%

Lined pit latrines	<1000 (Low)	<USD 100 (Low)	Poor	32%
Ablution blocks	All areas with prevalent open defecation	All areas with prevalent open defecation	Good	6%

Table 4: Decision matrix for sanitation service delivery models

Based on the criteria for each of the sanitation solutions as well as location-specific information—population density, income level, and road access—a primary sanitation intervention was selected for each ward

Sub- Location		Density (People/ Sq.Km)	Density	Road Accessibility	Economic Status	Sanitation Types	Ablution Blocks
Ganda	GANDA	604	Med	Medium-High	Low-Medium	Septic Tanks	
	MERE	572	Med	Low	Low	Lined Pit latrines	
	MSABAHA	572	Med	Low	Low	Lined Pit latrines	
Gede	DABASO	735	Med	Medium-High	Low-Medium	Septic Tanks	Ablution Blocks
	MIJOMBONI	408	Low	Medium-High	Low	Lined Pit latrines	
	MKENGE	406	Low	Low	Low	Lined Pit latrines	
Malindi	BARANI	3574	High	High	Medium-High	Sewer	Ablution Blocks
	CENTRAL	2768	High	High	Medium-High	Sewer	Ablution Blocks
	KIJWETANGA	966	Med	Medium-High	Low-Medium	Septic Tanks	
	SABAKI	718	Med	High	Low-Medium	Septic Tanks	
	SHELLA	3577	High	High	Medium-High	Sewer	Ablution Blocks
Watamu	CHEMBEKIBABAMCHE	289	Low	Low	Low	Lined Pit latrines	

	JIMBA	520	Med	Medium-High	Low	Septic Tanks	
	MBARAKA CHEMBE	455	Low	Low	Low	Lined Pit latrines	
	WATAMU	4023	High	High	Medium-High	Sewer	Ablution Blocks
Magarini	GONGONI	300	Low	High	Low-Medium	Lined Pit latrines	Ablution Blocks
	NGOMENI	277	Low	Medium-High	Low-Medium	Lined Pit latrines	
	MAMBRUI	552	Med	Medium-High	Low-Medium	Lined Pit latrines	

Table 5: Criteria for sanitation solutions

4.11 Flush Toilets with Sewers

Figure 10: Flush toilet connected to sewer

Description:

This service delivery model is adopted from the WWMP (2017) and comprises the user interface being a water closet (pedestal or Indian-style squat pan) connected to a central wastewater treatment plant via a network of sewers. The wastewater treatment system proposed is Waste Stabilization Pond. Figure 11 shows a schematic representation of the Sewer Sanitation Model.

The WWMP (2017) proposes a system designed for an estimated population coverage of 157,000 in Malindi and 64,000 in Watamu. The system would approximately cover 35% of the area and population in the planning area in a phased manner by 2040.

In Phase 2, when designs of the sewer system are being evaluated, simplified sewers should be evaluated as an option in certain areas. A simplified sewer is constructed with smaller diameter pipes and the pipes can be laid at a shallower depth and gradient than conventional sewers, often enabling utilities to serve more people with the same level of investment.

Note: Simplified sewers should be considered in area with a high-water table.

Rationale for selection: Sewers are most suitable for areas with high wastewater generation, especially locations with higher density of resident and transient populations (>2500 inhabitants/km2). The CBDs of both towns already exceed the threshold of >2500 inhabitants/ km2. Specifically, the areas in Malindi which exceed this threshold are Barani (3,574 inhabitants/km2, Central (2,768 inhabitants/km2) and Shella (3,577

inhabitants/km2). The CBD of Watamu has a population density of 4,023 inhabitants per square kilometer. Malindi and Watamu are expected to experience high population growth, growing from current populations of 166,000 and 35,000 inhabitants respectively to 410,000 and 80,000 inhabitants by 2040.

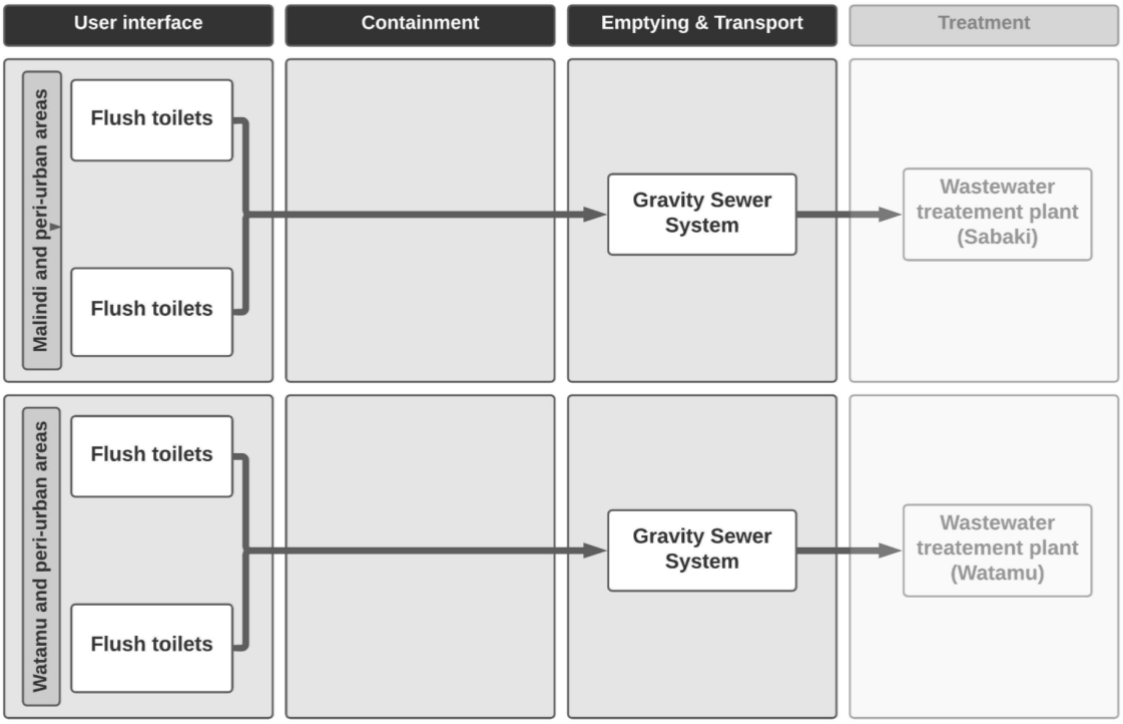


Figure 11: Schematic diagram for Sewers

Outputs for flush toilets with sewer by 2040:

- 115 km of sewer network and 11 pumping station commissioned and operational

FSM solutions—septic tanks, lined pit latrines, ablution blocks—will have distinct containment, emptying and transport but combined treatment and reuse. Below, the types are presented individually from user interface through transport, and then collectively for treatment and reuse.

4.12 Septic Tanks with Exhaustion

Figure 13: Individual septic tank

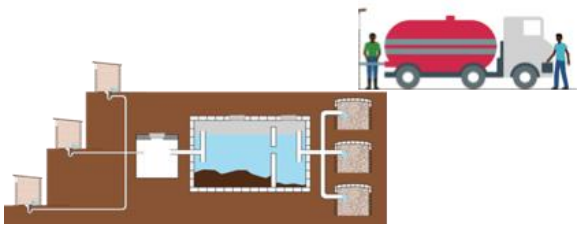


Figure 12: Communal septic tank with safe emptying

These are toilets connected to septic tanks for partial treatment of wastewater, fecal sludge is collected and transported by mechanized emptiers and treated at fecal sludge treatment plant.

Rationale for Selection:

The Septic Tank model is most suitable for areas with a population density between 2,500 and 1,000 inhabitants/ km2, with relatively good access to roads for heavier vacuum trucks to navigate and provide emptying services. The percent of the population served by this technology is estimated around 27% of the planning area, as indicated in Figure 10.

This system is the most common type of containment system being practiced in Malindi and Watamu, with no faecal sludge treatment facilities available and the raw FS is dumped unregulated at the dumpsite at Mayungu, This system will provide for a stable intermediate sanitation system for the entire planning area until the WWTPs are commissioned, which would only serve approximately 35% of the population. The remainder of the population can still utilize the system even after the WWTPs are operational.

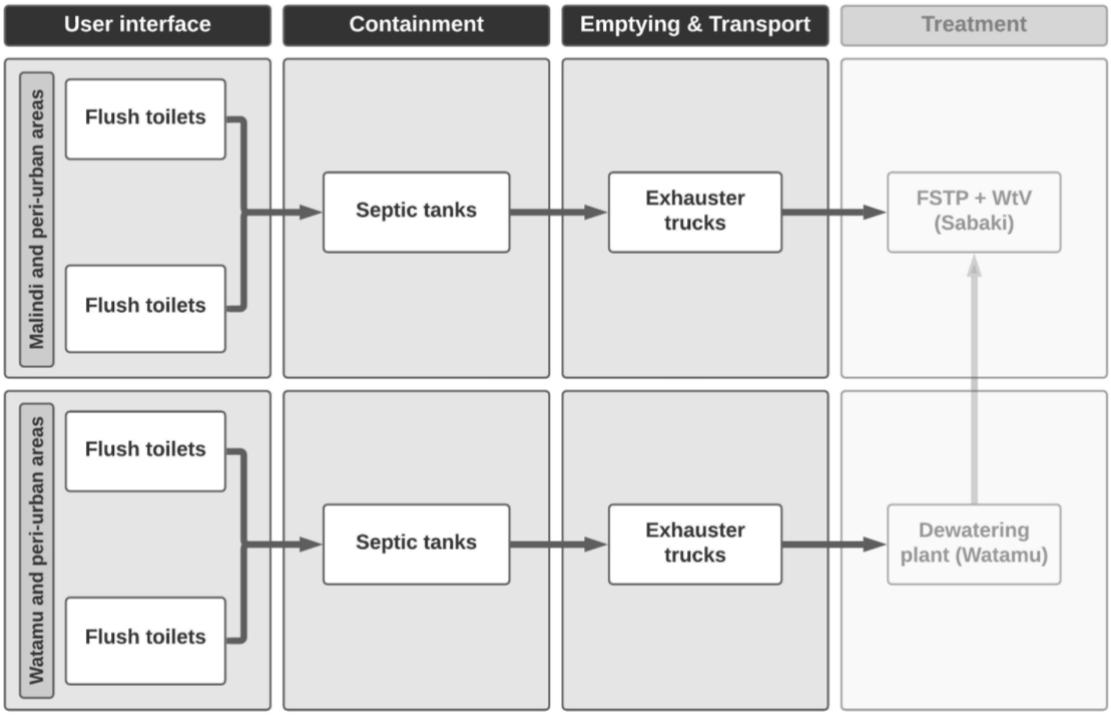


Figure 14: Schematic diagram for septic tank delivery model

Description:

With this on-site sanitation system, containment ideally consists of a septic tank that is fully sealed and isolates the FS from the ground water to minimize pollution. The septic tanks are constructed based on standardized designs and incorporated into the building codes for construction of dwellings, commercial and institutional buildings. Standards for septic tanks are enforced by the county on all existing and to-be built buildings. There

have been examples in Malindi of communal septic tank systems. Ngala Estate is a good example. It has a small, simplified sewer with users sharing septic tanks connected to soak pits serving a small population of Malindi residents.

The emptying is conducted by mechanized exhausters that operate under license from the county government and follow a professional and regulated approach based on standard operating procedures prescribed by the county. The exhausters discharge the collected FS at designated Faecal Sludge Treatment Plants in Sabaki and a dewatering facility in Watamu. A dewatering facility is located in Watamu due to the long distance (46km) of the population center in Watamu to the proposed Sabaki treatment site. The dewatered sludge is periodically transferred to a waste-to-value plant in Sabaki. In order to meet short-term demands, it is estimated that 8 vacuum exhauster trucks of >6m^3 capacity would be required.

Outputs for septic tanks emptying and transportation:

- 8 exhauster trucks operational in the planning area
- Septic tanks are inspected regularly and are in compliance

4.13 Lined Pit Latrines / Container-Based Sanitation (CBS), Emptiers and Transfer Stations

Figure 16: Lined pit latrine with emptying

Figure 15: Container-based sanitation with emptying

Description

These are toilets connected to lined pit latrines. Fecal sludge is collected by manual emptiers and emptied at a nearby transfer station/dewatering plant and treated at a FSTP. Consideration for container-based systems adoption could be made for areas with highwater table. Instead of paying for the capital costs of a pit latrine, users, would rather pay monthly for a service fee for container-based systems. The pit emptiers or CBS operators would bring the sludge to the transfer stations. The proposed sites for transfer locations include: site at the municipal clinic road, Cleopatra and Watamu ablution blocks. Initial feasibility was conducted for transfer station site verification described in annex 4

Rationale for Selection:

Currently, 46% of the population in the planning area relies on direct and off-set pit types of sanitation structures, predominantly dwelling in the low-income and high-density area. The current sanitation structures are poorly designed and constructed. They do not follow standards and are mostly suitable for a rural setting,

not for high-density urban settlements. The unlined pit latrines and abandon-when-full methods are a major pollution risk to groundwater in the area and need to be mitigated. This segment of the population requires the most support and improvements to their sanitation situation, especially for safe containment and emptying services.

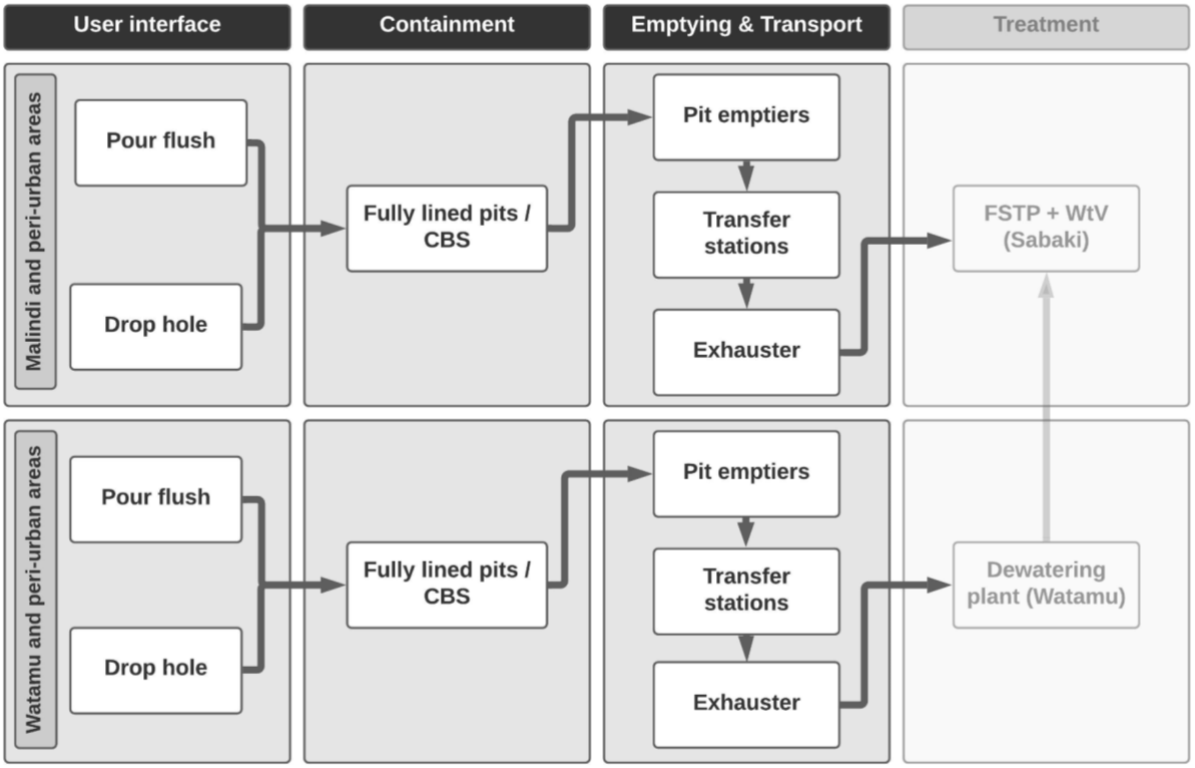


Figure 17: Schematic diagram for pit latrines

Description:

The service delivery model for lined pit latrines proposes improvements to the design, standardization and up-scaling of low-cost toilets and containment systems that can be installed or retrofitted within the range of USD 300-500 per unit. The purpose of this intervention is twofold: 1) to decrease groundwater pollution and 2) to facilitate emptying and ensure affordable transportation and treatment of FS.

A low-cost modular toilets and containment design for low-income groups that do not want to abandon a pit once full, but rather empty and reuse the pit such as a double pit system is proposed. The toilets feature a modular design, making it easy for a toilet to be upgraded over time from a direct, easy-to-empty drop hole to a pour flush toilet with a septic tank at a minimal cost and without demolishing the existing structure. The modular concept is based on the understanding that most inhabitants, given their current low-income status, cannot afford a high-end waterborne system and would prefer to upgrade their sanitary condition over time as their economic status improves. The details of this concept are presented in Appendix 2 of this report. Improved grey water management should be promoted in order to fulfill the goal of a healthy environment.

Container-based sanitation can be considered in areas with high groundwater levels. Instead of households paying a one-time installation cost, they can pay a service provider a monthly fee for an in-home toilet that is serviced regularly.

Improve Access to Finance and Subsidies for Household Lined Pit Latrines:

To increase the uptake of safely managed sanitation, a large proportion of the containment systems need to be upgraded to fully contained systems. Unlined pits are not only challenging to empty but also pose a risk of groundwater pollution and are prone to collapsing especially in areas with the sandy type of soil within the planning area. Efforts need to be put in place to eliminate them over time.

Unfortunately, the population in the planning area relying on unlined pit latrines are also the ones with lower income levels. For them to upgrade their sanitation system to a fully contained system will be financially challenging. They would need financial support in the form of subsidies. This can be achieved via the UBSUP programme that was previously undertaken by MAWASCO, under which a subsidy was provided to households which would build toilets based on the UBSUP standards. UBSUP should also consider providing similar payment for results subsidies to CBS service providers, based on the number of households using a service over a period of one year. Commercial finances could also be tapped into. For example, local banks could be engaged to improve access to credit for toilet and sanitation service providers.

These designs, along with others included in Annex 3 should be readily marketed to enable uptake of the systems across toilet suppliers.

Emptying and transportation of FS:

The emptying of such systems is carried out by a professionalized semi-mechanized pit emptier using either Gulpers or Vaccutug. The emptiers follow SOPs as set by the county government/MAWASCO and pay a nominal license fee to operate as waste handling entities/businesses.

Short Description of Gulpers and Vaccutugs

Gulpers are sludge hand pumps used to manually empty watery sludge from pits more safely compared to use of buckets. The sludge is collected onto small drums which can be then transported using a pickup truck or hand carts. These are especially handy when the pits are difficult to access. Gulpers have proven to significantly improve the working conditions of manual emptiers and they can be manufactured locally.

Costs: 160-250 USD

Source: SuSanA forum

Vaccutug is a low-volume compact mechanized desludging system. It consists of an 8HP engine and 500l capacity tank and can be driven at a speed of 5km/hr. Its compact design makes it a safe desludging solution for areas with low accessibility. Through promotional activities, low-interest loans, and subsidies, the manual pit emptiers can be encouraged to switch to mechanized operations which ensure health safety.

Costs: ~5,100 USD

Vaccutug (Source: UN Habitat (Issaias, 2006))

The FS is collected by gulpers or vacutug from low-income households, transported via three-wheeler/pick-up vans and dumped at a fixed transfer station located close to the emptying area (ideally within 1-2 km of the service radius) to reduce emptying cost. Transfer stations are sludge holding facilities with good road access and have a capacity volume of 15 m3 and covering a total of 300m^2. An estimated 8 transfer stations in Malindi and Watamu with a capacity of 15 m3 each are required to serve the low-cost emptying needs of the planning area. The transfer stations are emptied periodically by an exhauster truck, which transfers the accumulated FS to the treatment or dewatering facility[4], either in Sabaki or Watamu.

Transfer stations are underground holding tanks constructed at strategic locations in the city to provide a designated disposal site for manual emptiers and small volume. These are equipped with easy desludging orifices and an internal baffled wall like in septic tanks to catalyze dewatering. Transfer stations offer cost and time benefits to semi-mechanized emptiers by substantially reducing long-distance travel in between jobs.

Price: ~USD 15,000 for 15m3 capacity

[4] Treatment and dewatering are explained in detail in section X

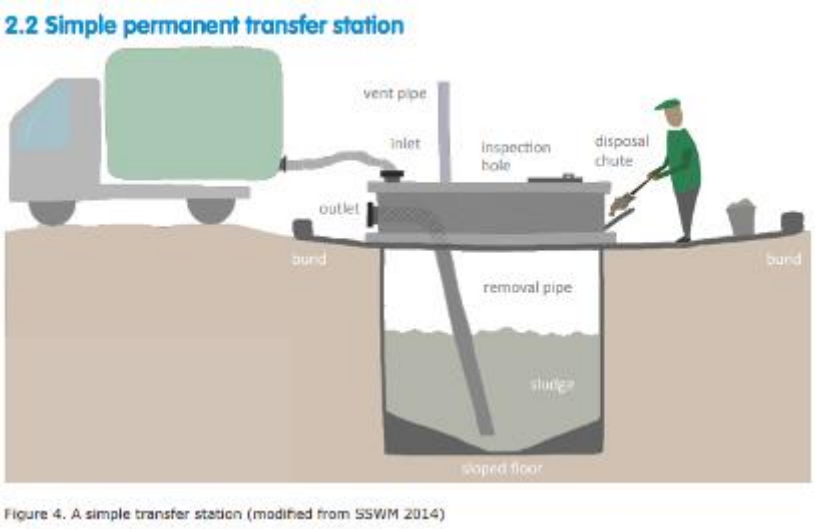


Figure 4. A simple transfer station (modified from SSWM 2014)

Source: SNV Guide to Transfer Station (SNV, 2016).

https://www.pseau.org/outils/ouvrages/isf_snv_a_guide_to_septage_transfer_stations_2016.pdf

A transfer station is included to help formalize pit emptying. Currently, pit emptiers have no safe place to dump the collected sludge. Instead of requiring them to transport sludge to the treatment facility, a smaller-capacity holding tank is installed near areas of high pit emptying demand. This also lowers the cost of service of emptying lined pit latrines to end users, who are often low-income households.

Output:

- 8 x 15m3 transfer stations commissioned and operational
- 10 Gulper operators established
- 1 x 10m3 exhauster truck procured by MAWASCO
- 100 toilets constructed annually via the subsidy program
- 100 toilets rehabilitated/improved
- Develop standard designs for low-cost toilets

4.14 Construct and Operationalize Ablution Blocks to Eliminate Open Defecation

Rationale:

Ablution blocks are specifically intended for transient populations and resident populations practicing open defecation due to lack of access to a sanitation facility. Sixteen open defecation spots have been identified in the planning area (public health data 2019). The provision of affordable ablution blocks and behavior change management for the population living and working nearby could potentially eliminate open defecation. Approximately ten ablution blocks, six in Malindi and four in Watamu, are proposed in these locations based on population density, transit points, and open defecation hot spots (see figure 19). The proposed designs will cater to approximately 720 user's maximum daily capacity per ablution block per day. They will consist of six toilet stances and two showers each for male and female users. Additional ablution blocks should be considered every two years based on future demand.

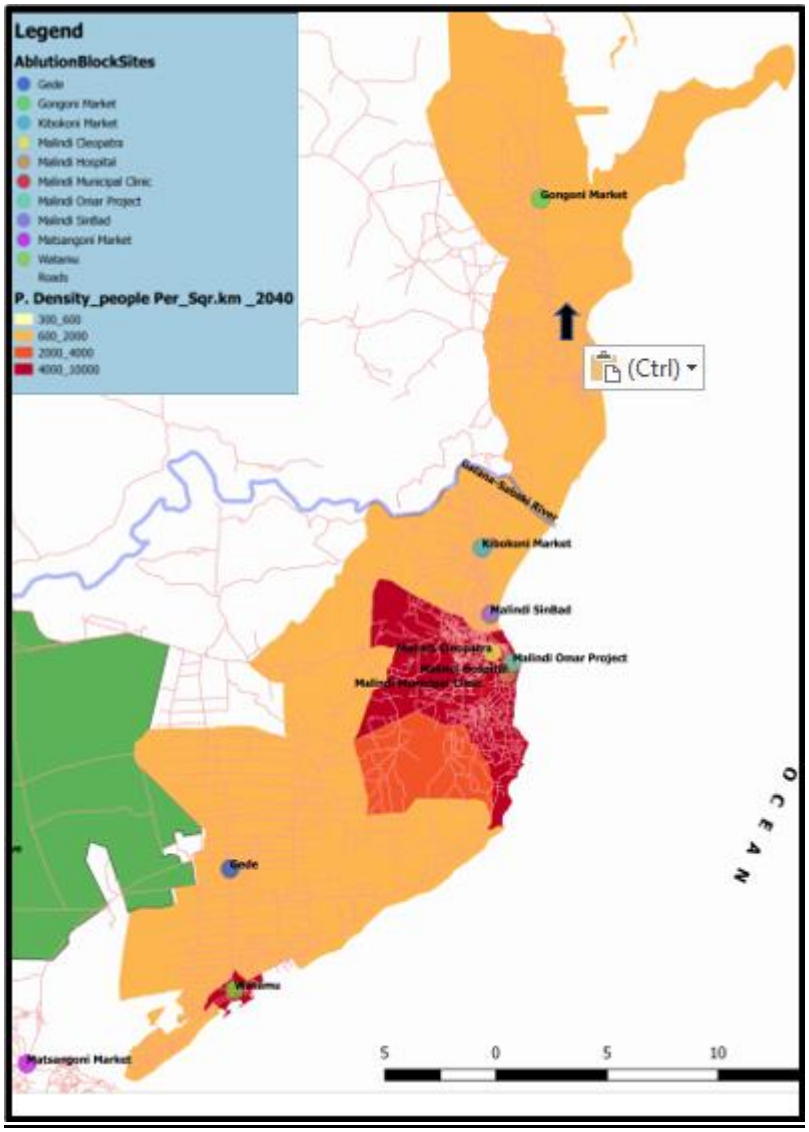


Figure 18: Ablution block location

Credit: MAWASCO

Description

To ensure appropriate operation and maintenance of public sanitation facilities, innovative business models that will sustain an adequate level of service are proposed. This includes a multi-level revenue approach for the sanitation facilities, offering not just toilets but also compatible micro-enterprises like electronic money transfer, mobile phone top-up, newspaper vending, and shoeshine or barber services etc. Sanitation services with other sources of revenue can make the facility more attractive and viable to private operators. Figure 20 presents a graphic representation of the tentative business model for the ablution block.

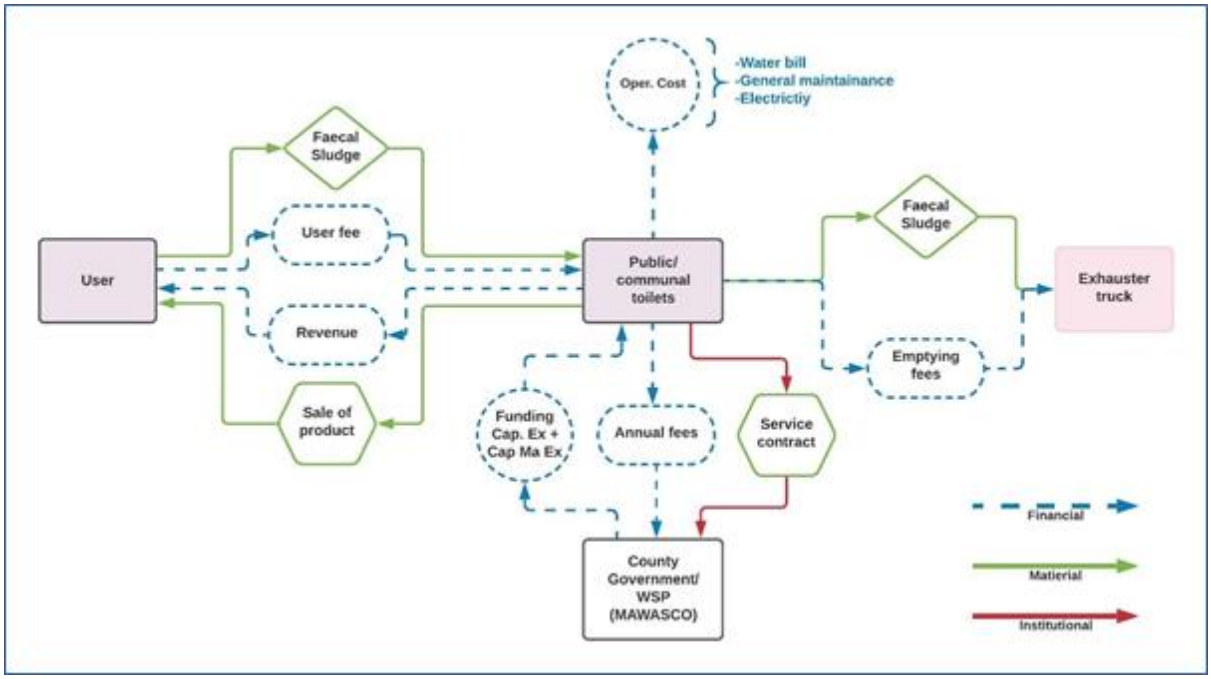


Figure 19: Schematic diagram for ablution block business model

The user pays a nominal fee to use the ablution block, which provides sanitation facilities as well as showers. In addition, the facility offers fast-moving consumer products to its customers to augment the income from user fees. The revenue is used for operation and maintenance of the facilities and the remainder are profits for the service provider to keep.

The facilities are owned by the county government and leased to the service provider via a service contract (annual or biannual) stipulating clearly the conditions for the lease, operation and maintenance requirements and service levels that need to be adhered to. The county government also provides emptying service via its exhauster trucks at a reduced or subsidies rate to the service provider.

Outputs:

- 10 ablution blocks commissioned and operational
- 10 service contracts signed

4.15 Revisiting Treatment for Sanitation Systems

Rationale:

With all households currently using on-site systems, the existing demand for treating fecal sludge is 185 m3/D. This sludge is currently being dumped at an open dump site or other disclosed locations.

Schematic:

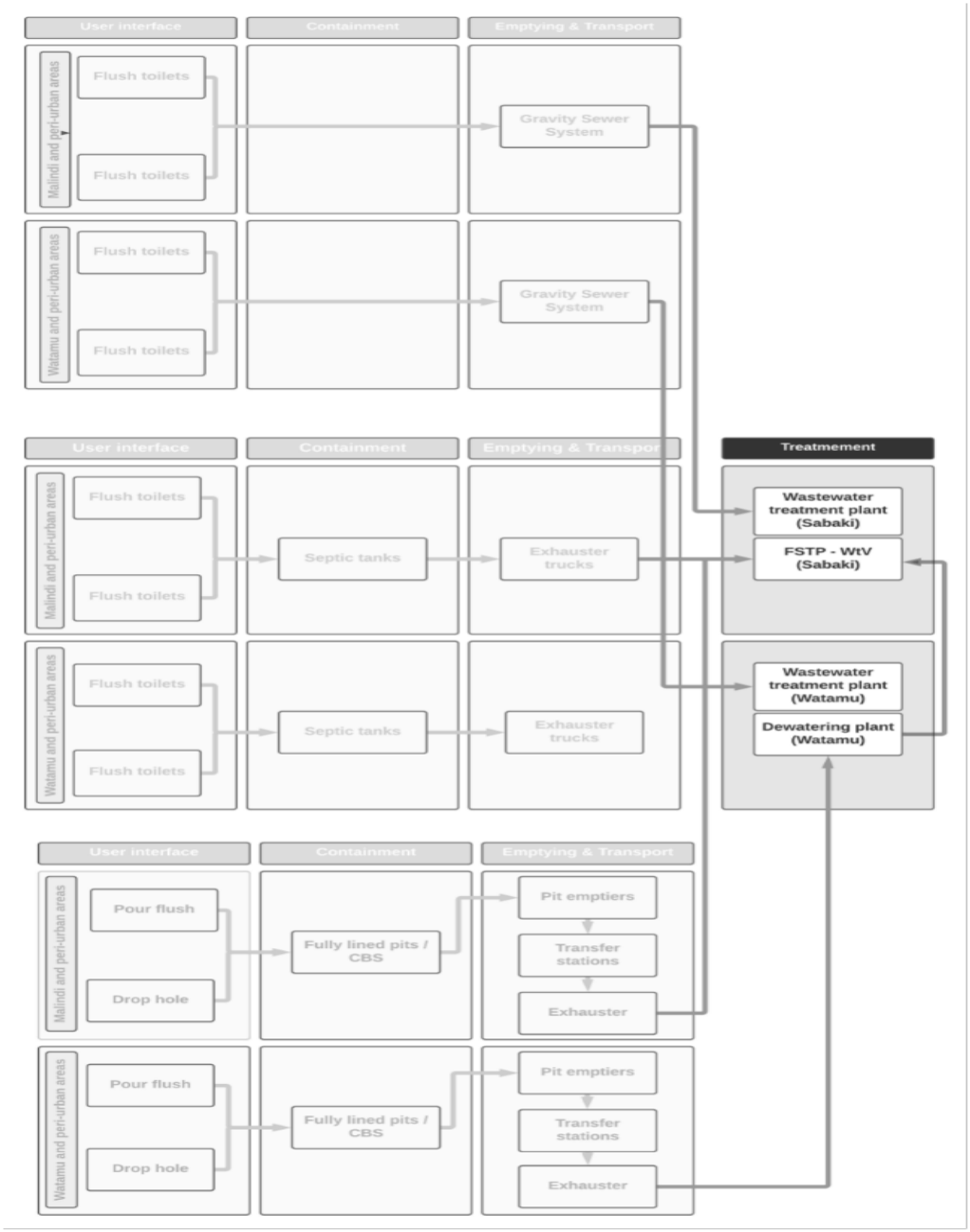


Figure 20: Schematic diagram for treatment

Description:

Considering population growth until 2040 (Table X), the corresponding demand each of the systems will serve and their respective costs are as follows:

- Fecal sludge treatment plant (FSTP) 80,000 people, 185 m3/D of sludge, ~$4.5M Capex
- Wastewater treatment plant 157,000 people (12,200m3/day) in Malindi-capex of $28M and 64,000 people in Watamu (7300m3/day) by 2040 capex of $17M

Because all households are currently on on-site sanitation systems and because the costs of a FSTP are lower, FSTP implementation is prioritized in Phase 1 and seen as a no-regret investment. The wastewater treatment plant is proposed to be implemented in Phase 2 alongside the sewer network with corresponding financing.

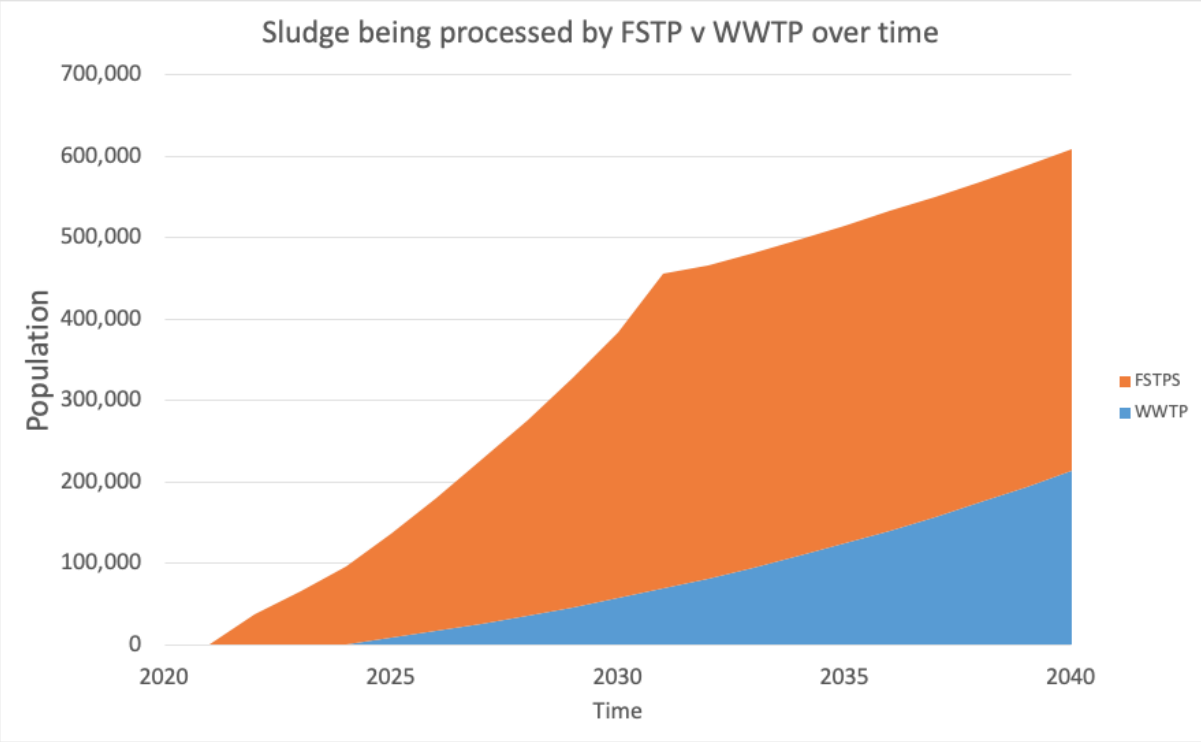


Figure 21: Sludge being processed by FSTP vs WWTP over time

Due to the two urban population centers (Watamu and Malindi) being 46km apart, each town is proposed to have its own treatment facilities at the already identified sites Sabaki and Watamu, although the operations for the sites will be linked i.e., total solids from Watamu will be treated and reused at Sabaki. Considering that existing fecal sludge demand is 185 m3/D, the majority of the population lives in Malindi, and road access to the Watamu site is poor, a large waste-to-value fecal sludge treatment plant serving the entire planning area should be prioritized at the Sabaki site in Phase 1. For the Watamu site, depending on financing availability and road access in Phase 2, the area can be served by a wastewater treatment facility or a dewatering facility.

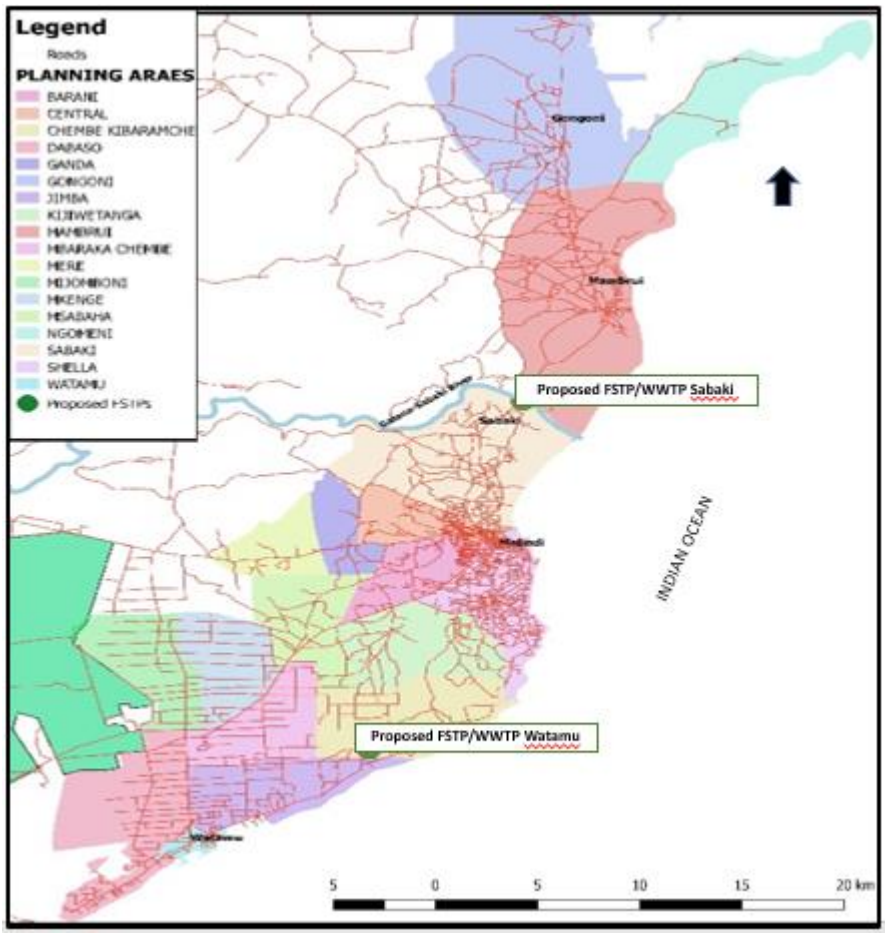


Figure 22: Proposed sites for FSTP and WWTP

Credit: MAWASCO

Phase 1:

185m3/D waste-to-value fecal sludge treatment facility at Sabaki. The plant is sized at 185m3/D to ensure it can meet the current demand of FS treatment. A waste-to-value (WtV) system could partially or fully subsidize the operational costs for treating fecal sludge via the sale of a by-product.

Multi-Criteria Analysis for Fecal sludge treatment option selection

The parameters below were taken into consideration when selecting treatment technology options and specifically the waste-to-value treatment facility at Sabaki:

Land requirement: A technology with minimum land requirement but with maximum output for treatment and waste recovery is preferred to minimize impact and resettlement cost that may arise.

Capital cost: The consultants calculated the capital costs to construct the facility and the return on investment through various model evaluations to confirm the technology that makes the most sense.

Operating cost to the utility: Technology with minimal operations and maintenance cost to the utility was preferred and comparisons to other options were made.

Ability to include waste-to-value components: A technology with the highest ability to include waste-to-value components has been given priority. Market considerations and biomass availability are critical. Suitable products with high revenue generation potential are given high priority

Operational considerations and incentives: Preference has been given to treatment technology whose availability and skill requirement for operations and maintenance can be obtained locally and the operator is incentivized to deliver on set performance targets.

Guarantee NEMA disposal standards: The level of effluent discharge should guarantee NEMA standards are met. Priority was given to the technology that ensures safe disposal and environmental protection.

Risk ownership of performance: It is important to ensure that the performance of the selected technology is guaranteed to serve the intended purpose. Preference was given to an option with high ownership to run the operations

Criteria Analysis	Planted Drying Beds with Constructed Wetlands	Stabilization Ponds + Drying Beds	Mechanical Dewatering	Waste-to-Value System
Land requirement	High	Med	Low	Med
CapEx	Med	Med	Low	Med
OpEx for utility	Med	Med	High	Low[5]
Has ability to include waste-to-value	Low	Low	Med	High
Operational considerations and incentives	Low O&M requirements	Med O&M requirements	Med O&M requirements	High O&M, operator incentivized
Guarantee of meeting NEMA disposal standards	Y	Limitation on Phosphorus & Nitrogen	Y, Total Solids transported to Sabaki plant	Y
Risk ownership of performance	Utility	Utility	Operator	Operator

Table 6: Multi criteria analysis for FSTP selection

Phase 2:

Sewerage and wastewater treatment plants are proposed in Phase 2 to cover the central business districts of Malindi and Watamu. In Malindi, a 6,000m3/D wastewater treatment plant with waste stabilization ponds at the Sabaki site is proposed along with sewer network implementation reaching a projected 10,000 people. In

[5] Private sector bears costs and utility has cost-recovery

Watamu, a 4,000m3/D wastewater treatment plant with waste stabilization ponds at the Watamu site (sites noted below) is proposed along with sewer network implementation reaching a projected 10,000 people. The total costs estimated by the wastewater master plan is USD 45 million.

Project costs for sewerage and wastewater treatment plants (Coast Water Services Board, 2017)

Component	Cost (USD)
Total capital cost for sewerage system and WWTP in Malindi	28,029,698
Total capital cost for sewerage system and WWTP in Watamu	16,922,272
Total capital cost for sewerage systems and WWTP	~45,000,000

Table 7: Project costs for sewerage and wastewater treatment plants (Coast Water Services Board, 2017)

Both wastewater treatment plants were proposed to be a waste stabilization pond due to low operation costs.

Multi-Criteria Decision Analysis with weighted totals for the alternative wastewater treatment options and the ranking of alternatives for Malindi and Watamu:

Wastewater treatment alternatives	Simplicity of Operations and Maintenance	Net Present Value	Environmental Impacts	Land Requirement	Institutional Strength	Weighted Total	Rank
Waste Stabilization Ponds	0.486	0.548	0.456	0.052	0.410	0.457	1
Composite Biofilters	0.11	0.23	0.26	0.09	0.13	0.198	3
Composite Oxidation Ditches	0.108	0.136	0.141	0.192	0.085	0.127	4
Long Sea Outfall	0.30	0.08	0.14	0.66	0.37	0.218	2

Table 8: Multi Criteria Decision Analysis for alternative wastewater treatment options

Additional considerations in Phase 2:

Depending on the ability to raise required financing for sewer network implementation (USD 45 million), Malindi and Watamu could continue to be served with an upgrade in the FSTP at Sabaki and a dewatering facility in Watamu. The dewatering facility would be approximately 30m3/d.

Outputs for wastewater and fecal sludge treatment plants by 2040:

- 185m3/D FSTP at Sabaki commissioned and operational
- 11300 m3/d WWTP at Watamu commissioned and operational
- 12200 m3/d WWTP at Sabaki commissioned and operational

4.16 Business Model and Integration of Sanitation Systems

For inclusive sanitation, it is necessary to have strong mandates, regulations, and appropriate financing mechanisms to ensure everyone is served. Mandates and regulations will be addressed in Section 4.2. For financing mechanisms similar to water, it is best practice for a utility to have a sewerage and sanitation tariff to enable full cost recovery. The exhauster truck licences are to ensure operation within the set NEMA standards to ultimately achieve an effective waste management system that will deliver a clean and healthy environment for all (NEMA, 2014).

The approximate tariff rates, revenue mechanisms, and model are proposed below:

Revenue Mechanism and Responsible Entity	**Approximate Rate**	**Applied To**	**Costs Covered**
Sewerage Tariff (MAWASCO)	75% of water bill	Sewerage customers	• Sewer network maintenance • Wastewater treatment • Utility admin
Sanitation Surcharge (MAWASCO)	10-50% of water bill	All water customers (enabling pro-poor and climate resilient skew)	• 50% of emptying costs (other 50% borne by households) • Fecal sludge treatment • Utility administration
Exhauster truck licenses and market cesses (Malindi Municipality) Public toilets rent per month[6]	• 750 KES below 3T, 1500 KES lorries 7-20T, KES 5000 Lorries >20T • 400 KES per month market cess fees • 2500 KES per month in bus park and markets • 1000 KES per month in open air market	All exhauster trucks and market stalls	• Compliance monitoring

Table 9: Proposed tariff rates, revenue mechanisms and model

Sewerage Tariff

Upon completion of the sewer network and the wastewater treatment facility (completion expected by 2040), the 'user' connects to the sewer lines at their own cost. The connection fee is usually determined by the distance

[6] Source: Kilifi Finance Bill

of the plot/property to the nearest sewer. The operation and maintenance of sewers and the treatment plant is carried out by MAWASCO and the user is charged a sewerage tariff which is charged as a percentage of the water bill. Ideally the tariff should reach >110% cost recovery for the operation and maintenance of the system. The sewerage clients will also continue to pay the sanitation surcharge to support the pro-poor focus of sanitation services.

Sanitation Surcharge

The sanitation surcharge is a new concept that has been recently embraced and encouraged by the Water Services Regulatory Board. In their 2020 report, WASREB notes:

> "WSPs that offer or facilitate the development of on-site sanitation services will be eligible for a special sanitation surcharge reflecting real costs that can be added to the tariff. As part of its Business Plan, the WSP must propose the type of services to be provided and estimate the costs. The WSP may also propose a sanitation surcharge to cover these costs as part of its Tariff Adjustment Proposal. As part of the Business Plan, the WSP must propose performance targets related to on-site sanitation, and demonstrate achievement of these targets".

Source: WASREB's Tariff Guidelines https://wasreb.go.ke/downloads/Tariff%20guidelines.pdf

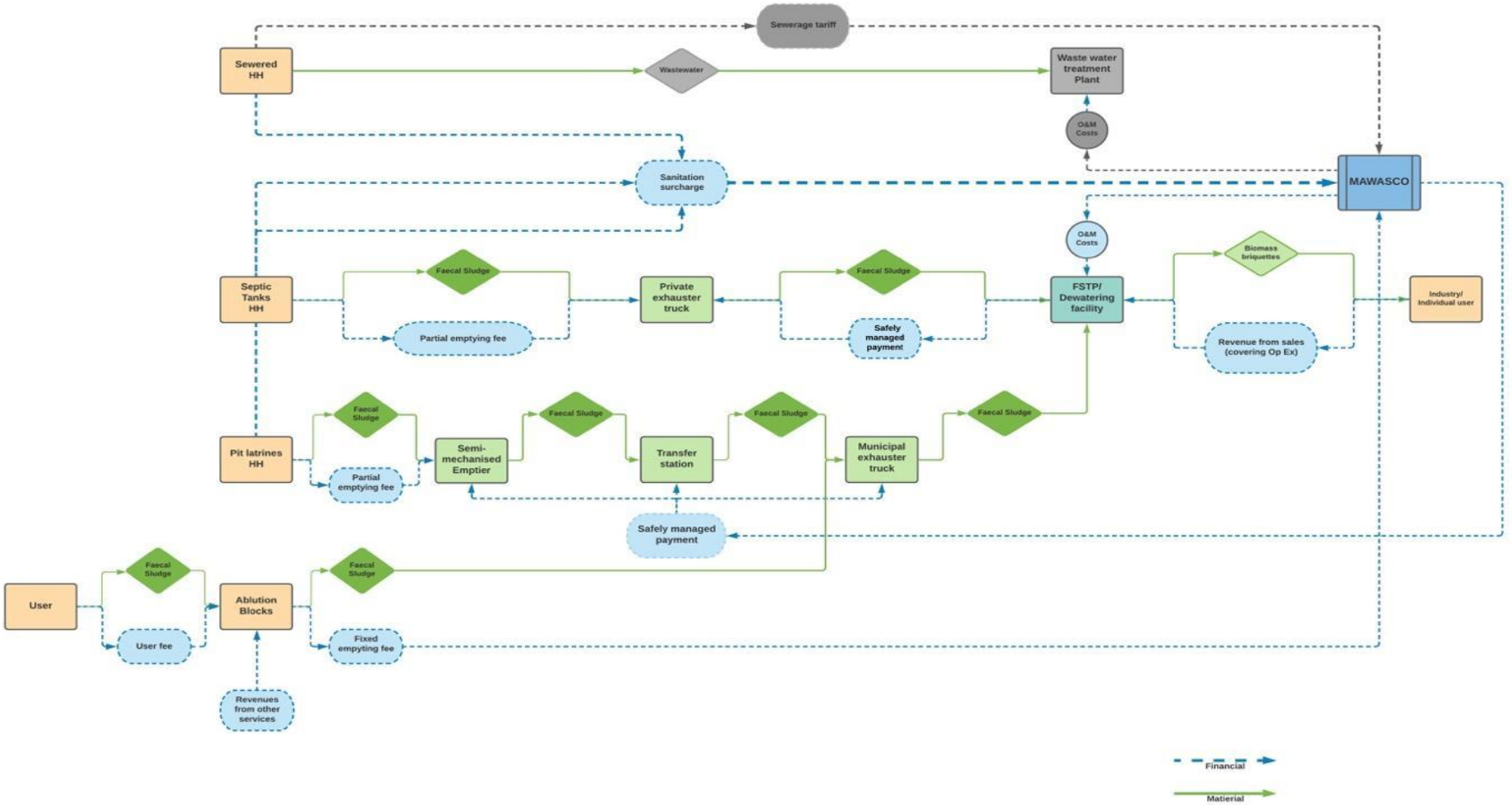
The proposal for how the surcharge should be broken down is as follows:

Cost Item and Receiving Entity	**Percentage of Surcharge (approx.)**
Emptying of septic tanks (Private Exhauster Trucks)	32%
Emptying of pit latrines (Pit emptiers)	32%
Emptying of transfer stations and ablution blocks (MAWASCO)	5%
Operations of transfer stations (Operators)	5%
Operations of fecal sludge treatment plants (Operators)	15%
Administration of services (Utility)	10%

Table 10: Sanitation surcharge breakdown proposal

The summary of the financial and material flows for sanitation services are included in the diagram below. The revenue and costs (i.e. financial flows) for each stakeholder are then explicitly described below the diagram.

Figure 23: Summary of the financial and material flows for sanitation services



Financial flows (revenue and costs) for each stakeholder in the value chain:

Safely Managed Payment Overview

This is payment made by MAWASCO/the transfer station operator in return for safely picking up the collected waste at the right disposal point. The households pay 50% of the emptying charges and the other 50% after safe disposal. This is to incentivize sludge emptiers to safely empty, transport and dispose of the sludge at the right location.

Households

Households connected to sewers pay a sewerage tariff and a sanitation surcharge to MAWASCO. Households

connected to septic tanks and pit latrines pay a sanitation surcharge to MAWASCO on top of the water bill and a partial emptying fee to the exhauster or the pit emptiers.

Pit Emptiers

Pit emptiers collect partial emptying fees from households (connected to pit latrines) and collect a safely managed payment from MAWASCO. The combined revenues (partial emptying and safely managed payment) cover the operation and maintenance cost and any profits for the pit emptier. The pit emptier is required to pay a nominal annual licensing fee to the Malindi municipality. The pit emptier will only receive safely managed payments if it is actively complying with health and safety SOPs.

The capital cost for pit emptiers is covered through a competition. Emptiers submit applications to MAWASCO for a safely managed emptying kit (~10,000ksh) inclusive of personal protection equipment and emptying equipment (i.e. gulper). MAWASCO budgets for 10 emptying kits in grant requests.

Exhauster trucks for households

Exhauster trucks collect partial emptying fees from households and safely managed payments from MAWASCO. The fees collected should cover operation, maintenance and any profits for the exhauster. The exhauster is also required to pay an annual licensing fee to the Malindi Municipality and NEMA. The exhauster will only receive safely managed payments if the exhauster is actively complying with health and safety SOPs. The capital costs for the exhauster trucks are met by exhauster operators.

Exhauster truck for transfer station and ablution blocks

This operation is covered by MAWASCO's exhausters and the costs are covered by the sanitation surcharge and fixed emptying fee from ablution blocks. If a private operator provides the emptying services(on a lease agreement), MAWASCO pays the operator a safely managed payment.

The capital costs for MAWASCO's exhauster truck are met through grants to MAWASCO from the national government or other actors.

Transfer station operators

The transfer station operators receive safely managed payments from MAWASCO to cover the cost of operations and maintenance of the facilities. Ideally, all transfer stations in the area should be managed by one operator which is awarded the annual/biannual contract by MAWASCO.

The capital costs for MAWASCO's transfer stations are met through grants to MAWASCO from the national government or other actors.

FSTP operator

The FSTP operator receives revenue from a design-build-operation contract and from sale of reuse products. This will cover both the design and construction of the FSTP, as well as the operation costs and profits.

The cost of the design-build-operate contract is met through grants to MAWASCO from the national government or other actors.

Ablution block operators

The ablution block operator receives revenue from fixed user fees and any additional entrepreneurial activities (i.e. sale of fast-moving consumer goods). The ablution block is managed by a private operator who is awarded an annual/biannual contract by MAWASCO. The ablution block operator pays fixed emptying fees to MAWASCO and a monthly operator fee to the municipality.

The capital costs for MAWASCO's ablution blocks are met through grants to MAWASCO from the national government or other actors.

MAWASCO

MAWASCO receives all the revenue from the sanitation surcharge, sewerage tariff, and fixed emptying fees from ablution blocks. The utility manages the services of the wastewater and fecal sludge operations. This includes collecting the sanitation surcharge and sewerage tariff, overseeing performance contracts of private operators, dispersing safely managed payments, and collecting sludge from ablution blocks and transfer stations.

Sewer network and WWTP construction

The final design and construction of the sewer network and WWTPs is funded through loans to MAWASCO from the national government or other actors. MAWASCO then contracts out the design and construction through an RFP process. Similar to FSTPs, MAWASCO should consider a design-build-operate contract mechanism.

Outputs:

- A rationalized tariff structure for sanitation and sewerage
- Implementation and operation contracts across the value chain

4.2 Goal 2: Ensure clarity in mandates and help to market Malindi as the cleanest coastal town

Mandates are critical since they provide direction and ownership to allow services to be appropriately delivered. Overall, the mandates follow the bills, acts, and strategies outlined in section 1. Outlined below are the key organizations and respective mandates, additions to the enabling environment, and marketing approaches.

Description:

The institutional framework provides a clear overview of roles and responsibilities of various stakeholders across the sanitation chain. It presents the actions to be undertaken by individual actors, identifies overlaps in roles, and identifies ambiguous areas that were overlooked. Figure 24 presents the institutional setup for the proposed solutions:

Institutional framework - organogram

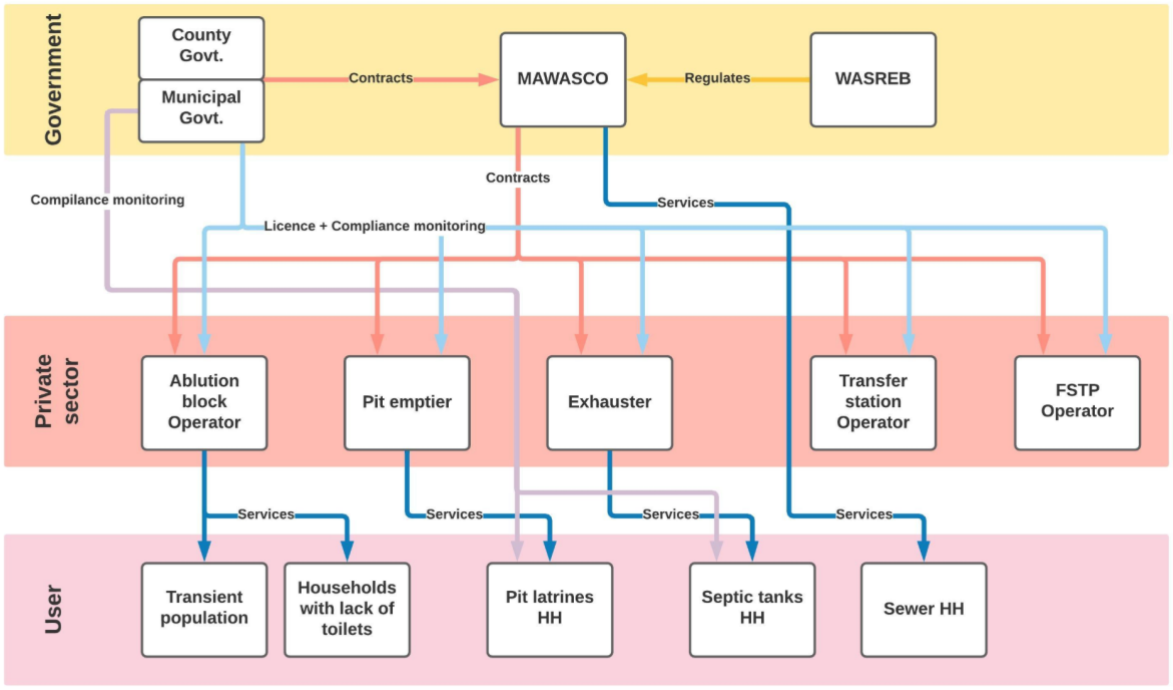


Figure 24: Institutional setup for the proposed solutions

- The county and the municipality have the overall responsibility to provide services to inhabitants. Service provision is delegated to the counties, which are the owners of Water Service Providers (WSPs). Currently, WSBs sign service-level agreements with WSPs and the regulator issues licenses to WSB.

Most importantly, the county and municipal government is responsible for developing and approving by-laws. Additionally, via NEMA and public health departments, the county and municipal government is responsible for compliance monitoring of the health and safety standards for households, institutions, public places, etc. The county government solicits funding from National Government Ministries and Development Partners.

- MAWASCO, as the commercial utility, is responsible for provision of water services and managing fecal sludge and wastewater within the planning area, including the development of county assets. For making services efficient and affordable, MAWASCO sub-contracts to private operators via performance management contracts for the emptying, transport and treatment of fecal sludge, but retains the management of sewerage services. To provide services to the underprivileged and transient population, MAWASCO subcontracts the management of ablution blocks to private operators.

- WASREB regulates MAWASCO and monitors its performance based on WASREB performance indicators reported through the Water Regulation Information System. Additionally, it approves tariffs proposals set for sanitation and sewerage services.

- The pit emptiers and exhauster trucks provide FS emptying and transport services to domestic, commercial, and institutional customers, and are guided by standard operating procedures set by MAWASCO and public health department. The commercial operators provide services to customers and are remunerated via the sanitation surcharge model explained in chapter 4.16.

- Transfer stations are sub-contracted by MAWASCO to safely contain fecal sludge based on standard operating procedures developed by MAWASCO and in line with NEMA's environmental protection guidelines and standards.

- FSTP operators are sub-contracted by MAWASCO to treat fecal sludge in line with NEMA's environmental protection guidelines and standards.

4.21 Key Additions to the Operating Environment

Establish sanitation client contact center and Pit Emptiers Association

- Establish a toll-free contact center within MAWASCO to actively promote and facilitate the uptake of emptying and treatment services. The contact center acts as a platform for providing information (emptying fees, type of services provided, by-laws and regulation, etc.), connecting customers to pit emptier and exhausters, and collecting grievances and complaints by citizens in regards to illegal dumping and non-compliance of the by-law. The contact center will coordinate FS emptying and transport operations as well as integrate water, sewerage and sanitation services in the planning area.

- The Pit Emptiers Association helps to give an official voice to the pit emptiers that are currently informal and lack acceptance and recognition as legitimate service providers in the sector. This also provides a platform for the pit emptiers to coordinate their activities regularly and grow their professional skills via mass training and capacity building programs which will improve their businesses and ultimately improve the quality of services they provide to their customers.

Ensure regular coordinating meetings

- Sanitation management is divided across actors along the sanitation chain. The coordination of these actors is crucial to align policies, give direct on new innovations, influence budget allocation and streamline their activities for efficient operations across the chain. A coordination committee, comprised of the water utility, department of water, public health, land and physical planning, tourism, Town Manager, private sector and representatives from community-based organization is established to oversee and monitor the progress of the various aspects of the sanitation chain. The committee should ideally consist of key decision makers and high-ranking representatives of the municipality, the county government, MAWASCO and representatives of civil society and the private sector.

Implement by-laws and compliance monitoring

- Currently, Malindi municipality lacks a specific sanitation by-law that regulates the sector. Sanitation by-laws and their enforcement is one of the key pillars for improving local sanitation conditions. This provides the legal basis for up-scaling sanitation improvement in the planning area. Key areas such as amending by-laws to include low-cost containment designs and framework that guide all operators and processes, including establishing a degree of control over the safe containment, collection and treatment of FS in the planning area need to be established
- The sanitation by-laws should be developed by the county government, involving key stakeholders in sanitation, passed by the county assembly, and forwarded to the national government for gazettement through the county secretary before implementation. The by-laws should ideally cover all aspects related to sanitation and hygiene, including but not limited to solid waste management, storm water drainage, grey water management, etc.

Develop latrine construction standards and compliance monitoring

- Compliance monitoring of by-laws and standards is one of the cornerstones to improving sanitation services. If enforcement of the gazette law is weak, it gives rise to indiscriminate actions by service providers, as well as by users. The CWISP proposes to improve the capacities of the enforcement units of the county government, with regards to increasing staff and budgetary allocation such that their performance is enhanced.
- Additionally, the current standards of septic tanks are expensive to construct for the majority of the local population and low-cost containment options are required. The low-cost toilet standards

should take into account affordability of designs and ability to produce them locally, by small and medium enterprises in the planning area. Once approved, these standards should be incorporated as minimum requirements for sanitation facilities in the sanitation by-law.

Local branding campaign and customer engagement

To upscale safely managed sanitation, it is necessary that all inhabitants understand what safe sanitation means and act towards achieving a common goal. The common goal of making and keeping Malindi clean should instill a sense of ownership and pride among the inhabitants and local government. Thus, a comprehensive awareness-raising/public relations campaign is crucial, with MAWASCO as a brand in charge of the efforts to improve the sanitation situation. In addition to updating MAWASCO to Malindi Water and Sanitation Company, the awareness-raising and public relations campaign should be implemented at scale and be sustained until 2040. It should target households, landlords, tenants, institutions and public places to inform the inhabitants about safely managed sanitation. The campaign should focus on the following, among other subjects:

- Hygiene and handwashing with soap practices
- Elimination of open defecation
- Popularization of the sanitation by-law
- Popularization of minimum standards/designs
- Popularization of pit emptying practices and links to service providers
- Provide information on sources for home improvement loans/access to sanitation improvement financing

External branding campaign and funding proposals

- To actively promote MAWASCO on both the national and international stage as a champion of city-wide inclusive and safely managed sanitation, a dedicated campaign to enhance its image is required. The improved image will help to attract more funding opportunities from international development agencies and development banks.
- A dedicated PR team and champions among MAWASCO and county government will be selected to actively promote and enhance cooperation and partnerships within the sector. The team will also be responsible for identifying and applying for new funding opportunities, represent the organization at a national and international stage, and boost Malindi's image as a clean town that is restoring tourism to the area.

Develop rationalized tariff with ring fencing

- A rationalized tariff structure is necessary to provide adequate, equitable and sustainable sanitation services to all inhabitants. The tariff structure should ensure that services to the

underprivileged, low-income, marginalized or vulnerable populations across the sanitation service chain are affordable. As a result, a degree of cross-subsidization from other revenues will be required. The revenue collection rate should be high and rates adjusted progressively. All revenues collected by MAWASCO from the sanitation and sewerage surcharge should be ring fenced and used specifically for the improvement of sanitation across the sanitation chain.

- The tariff modalities should be developed in close cooperation with the pit emptiers, county government, MAWASCO, and citizen groups such that each stakeholder is well-represented in regards to tariff decisions. In addition, tariffs should be rationalized separately for mechanized and semi-mechanized emptiers and the dumping fees should be equated according to volumes of sludge discharged. The regulator (WASREB) shall approve, regulate, and monitor the implementation of the tariff.

4.22 Awareness Generation

The goals of the CWISP cannot be achieved without adequate awareness generated among citizens on the importance of sanitation. They must also be educated about their role in building citywide inclusive sanitation. This section describes key involvement by different users of the proposed sanitation systems.

Throughout the city

- Awareness campaign to educate the city population about the advantages of better hygienic and sanitation practices, encouraging residents to construct individual toilet facilities according to standardized designs and connect to the available system in their area
- Awareness campaigns to promote behavioral change, emphasizing personal hygiene, proper sanitation, clean toilet habits, safe drinking water, disposal of wastewater, human excreta disposal/toilets, wastewater recycling, waterless urinals etc. to be integrated in schools
- Awareness and consensus-building on tariff changes required to implement the sanitation solutions
- Sanitation marketing showcasing Malindi's progress as the cleanest coastal town

Users connected to sewers: Campaigns on proper use with messaging against disposing solid waste into sewer systems

Users connected to septic tanks:

- Awareness generation about proper construction design of on-site sanitation systems and their importance
- Awareness generation about proper desludging practices
- Marketing of the FSM contact center and services provided
- Marketing of trained toilet/containment builders and certified desludging operators available for these users

Pit latrine users:

- Awareness generation about proper construction design of onsite sanitation systems and their importance
- Awareness generation about proper desludging practices
- Marketing of trained toilet/containment builders and certified desludging operators available for these users

Ablution block users: Direction signs on streets and maps to access public toilets; positive messaging on usage fee and services.

Users of byproducts from waste to value systems: Social marketing on the safety and sustainability of using products from the waste-to-value system

Private stakeholders (operators of ablution blocks, desludging service providers and treatment plant, toilet builders): Training on professional work ethics and use of PPE while providing sanitation services to citizens. Awareness campaign targeting professional recognition and social security

4.2 Outputs:

- Develop an institutional framework (in line with national and county specific sanitation and hygiene policy guidelines) with clear roles and responsibilities
- Establish a toll-free call center within MAWASCO
- Initiate a Pit Emptiers Association in Malindi
- Initiate a Malindi Sanitation Committee to coordinate and oversee developments in sanitation
- Develop and gazette by-laws that incorporate statutes for FSM
- Enhance capacities of enforcement units for compliance monitoring
- Initiate, implement, and sustain an awareness campaign for sanitation
- Initiate, implement, and sustain a public relations campaign to market MAWASCO as a champion for sanitation
- Develop a rationalized tariff structure for sanitation and sewerage
- Develop awareness and consensus among the public on their role in achieving the goals of the CWISP

4.3 Goal 3: Create jobs and build local capacities for a thriving sanitation economy

Rationale:

The involvement of the private sector in the sanitation sector increases competition among actors, leads to reduction in costs for the end users, and increases efficiency of sanitation service delivery. Sub-contracting service provision to the private sector reduces the burden on the county government and MAWASCO in terms of human and financial capacities and provides access to private investments in sanitation service delivery, which has traditionally been seen as a public sector mandate. Furthermore, the involvement of the private sector increases the prospects of local job creation and improves the local economy.

To attract the private sector into the sanitation sphere, an appropriate enabling environment and framework conditions are required. These framework conditions ideally require clear mandates and regulations, well-defined standard operating procedures, clearly outlined tendering and contracting arrangements, licensing mechanisms, access to commercial financing, etc.

The realm of safe fecal sludge management is relatively new. Capacity development for the county government and MAWASCO is needed to increase their knowledge and skills in FSM, specifically on the topics of safely managed sanitation, standard operating procedures, digitalization, contract management for FSM, etc.

Description:

Standard operating procedures: SOPs form the backbone of safely managed sanitation in the planning area. They provide guidelines to be followed during emptying, transport and treatment operations for FSM. They are ideally defined in conjunction with sanitation by-laws and other legal codes to provide a legal basis for operations and clear punitive measures for non-compliance.

The SOPs define in detail the standards, process and equipment to be used for FSM; safety measures to be undertaken; clear guidance on where and how fecal sludge is to be collected, transported and discharged; which containments systems can or cannot be emptied, and more.

The SOPs should be developed by a team of representatives from MAWASCO, the county government, NEMA and the private operators. The SOPs should be developed in a collaborative manner in order to put forward ideas, concerns, disagreements, etc. and come to a consensus on a way forward.

The SOP training sessions are provided by MAWASCO to the private operators. The trainings should include but not be limited to:

- Safety procedures while conducting emptying and transport operations
- Current regulations of FS
- Dos and don’ts of FSM
- Procedures to handle solid waste from pits
- Customer and client care

Licensing of private operators: A licensing framework provides legitimacy for the private sector to operate in the planning area and effectively formalizes the predominantly informal nature of sanitation service provision. When licensed operators are allowed to function in accordance with the SOPs, this professionalizes FSM

operations and ensures coherent and coordinated supervision and oversight to the regulators, namely MAWASCO, county governments and NEMA. The fear of losing a license or being blacklisted for illegal actions acts as a deterrent for the private sector to undertake illegal activities such as indiscriminate dumping.

Some aspects of the licensing framework for private operators are:

- Only licensed operators are eligible for a safely managed payment and allowed to carry out service delivery in the planning area
- Licenses are provided only to operators who have undergone training on SOPs delivery by MAWASCO and hold a certification. There is a system to monitor performance/regular site checks and audits are conducted to ensure maintenance of health and safety
- Licenses are provided by county government for FS emptying and transport and by NEMA for the FSTP
- The operators renew the license annually against a nominal fee provided to the county government
- The county government ring-fences the licensing fees and uses it to improve compliance monitoring
- The operators are liable to lose their license if found guilty of illegal activities. Depending on the severity of illegal action, they could potentially be blacklisted
- The licensing framework will apply to pit emptiers, exhauster truck operators and the FSTP operators

4.31 Contracts for Private Operators

MAWASCO should use three types of contracts for contracting service providers:

A. Service delivery management contracts with increasing contract tenure for transfer station and ablution block operators

   Service delivery contracts with performance criteria can be used for transfer station and ablution block operators. The initial tenure of these contracts should be one year. The length should then be increased to two years and then five years. Increasing the tenure of the contract as MAWASCO becomes more fluid with management will improve the level of operators and their ability to plan around additional revenue-generating activities, helping to create more jobs in the local area. A service delivery contract includes level of service of performance criteria expectations. These criteria should include standards around cleanliness, proper use of personal protective equipment, and accordance with standard operating procedures.

B. DBO contracts for FSTP and waste to-value plant

   A design-build-operate contract for a fecal sludge treatment plant allows utilities to source the best designs from the private sector to ultimately achieve the operational goal the utilities want: safely managed waste at the lowest operational cost. Instead of the traditional design-bid-build projects, design-build-operate contracts have led to improved outcomes, including lower costs, faster project delivery, and less capacity strain on utilities to manage the construction and then the operation of facilities.

What is a design-build-operate approach and what are its advantages?

Note of guidance from the World Bank

"In a Design-Build-Operate (DBO) Project a private contractor is engaged to design, build and operate the facility on a single responsibility basis. The public sector finances the new facility and owns the resulting assets. By procuring the design, build and operation as a single contract, the Employer can reduce interface risks and improve the incentives for innovation, cost efficiency, and performance delivery.

The DBO model is an output-based contract. In other words, the contract makes the Contractor accountable for meeting the contract outputs, for instance in relation to required potable water quality or treated effluent quality. It is the Contractor's responsibility to select the most efficient treatment process and to ensure that the resulting plant is fit for purpose. Within certain limits (discussed later) the Contractor should be given the maximum amount of freedom to design, build and operate the plant in the most efficient way possible.

Relative to the design-build approach, having a single organization responsible for the design, build and operation of the works brings a number of potential cost and performance advantages. Cost efficiencies are gained because the contract is awarded on the basis of the lowest combined capital and operating costs. The contractor has an interest in making sure that the plant is durable, reliable and efficient to operate. So, the model rewards innovation in design, construction and operations. The DBO model will usually ensure improved works performance relative to public operation in part because the consequences of a breach of contract standards is more severe, for instance involving the imposition of penalties." (World Bank, 2017)

C. Concession contract for container-based sanitation operator

For areas with a container-based sanitation operator, the utility should award a concession contract to an operator for particular zones. The duration of a concession contract for a CBS operator should be at least five years and include subsidized payments to serve low-income areas for over 1,000 households. Under a concession contract, the operator is allowed to set their own rates for consumer fees but is incentivized to reach pro-poor areas because subsidies or safely managed payments are higher for these areas. This would be structured through a UBSUP subsidy program and sanitation tariff.

4.32 Building Capacities, Including Establishing a FSM Function Within MAWASCO

Although MAWASCO is proficient in the spheres of water supply management, FSM and wastewater are relatively new topics and a concerted effort will be needed to build its capacities in this field. The capacity-building exercise should use a holistic approach including MAWASCO and the county government (especially the enforcement and procurement departments) are improved.

The departments involved in the capacity development activities should include a FSM function, activities should not be limited to that new department. Building capacities among procurement and contract management units, departments for digital information, such as GIS experts and the public relations departments is also critically important. These activities should focus on procurements and contract management, concepts of safely managed sanitation and practical guidance on developing SOPs, and use of digital tools in FSM compliance and planning.

The FSM Function: The FSM function within MAWASCO should have the following staff members: a FSM function manager, a contracts and procurements officer, a compliance monitoring officer, a training and knowledge management officer and a call center operator.

Outputs:

- Establish a FSM function in MAWASCO
- Build capacities of MAWASCO and the county government
- Certification system established by MAWASCO
- SOPs for emptying services developed
- A licensing framework for FSM developed and implemented

5. Action Plan

This section presents key actions based on short (2020-2025), medium (2025-2030), and long-term (2030-2040) plans. The full action plan is included in appendix (linked here). Below is a high-level summary of actions.

5.1 Short-Term Action Plan Summary (2025-2030)

Metric	Current	2025
Access to improved sanitation	30%	50%
% of pro-poor access	26%	40%
% open defecation	5%	4%
% of waste safely managed	1%	40%
# of private sector jobs created	NA	100
Clarity in mandate and regulations	No	yes
% of O&M costs covered	N/A	15%

Key short-term activities are as follows:

1. Branding MAWASCO to sanitation and implementation of FSM function
2. Construction of ablution blocks, transfer stations, and implementation and operationalization of fecal sludge treatment plants >185m3/d
3. Set up an essential legal and financial framework that enables a safely managed fecal sludge collection and treatment/reuse system
4. Create a program that provides financial incentives and promotes the installation and operation of improved OSS
5. Develop and finance an institutional capacity development program for the municipality of Malindi and its utility

Short-term investment required: $11,829,996

5.2 Medium-Term Action Plan Summary 2025-2030

Metric	**2025**	**2030**
Access to improved sanitation	50%	70%
% of pro-poor access	40%	60%
% Open Defecation	4%	2%
% of waste safely managed	40%	70%
# of private sector jobs created	100	300
Clarity in mandate and regulations	yes	yes

% of O&M costs covered	15%	85% (Due to sanitation tariff)

Key Medium-term Objectives

1. Monitoring and enforcement that all households have improved sanitation facilities and set emptying SOPs
2. Monitoring of performance of delegated performance management contracts for FSM
3. Regularly collect tariff and show clients value for money on improved service delivery
3. Review sanitation tariff and integrate with sewerage tariff
4. Secure funding for and implement sewer networks and waste water treatment plants in central business districts
5. Implement and sustain a public relationship campaign to market MAWASCO as a champion for sanitation

Medium-Term investment required amount: $42,918,939

5.3 Long-Term Action Plan Summary 2030-2040

Metric	2030	2040
Access to improved sanitation	70%	100%
% of pro-poor access	60%	100%
% open defecation	2%	0%
% of waste safely managed	70%	100%
# of private sector jobs created	300	>700
Clarity in mandate and regulations	yes	yes
% of O&M costs covered	85%	110%

Key Long-Term Objectives

1. Monitoring and enforcement that all households have improved sanitation facilities and compliance of set standards/regulation across the value chain
2. Monitoring of performance of delegated performance management contracts for FSM
3. Monitor implementation and performance of FSTP, sewer networks and wastewater treatment plants
4. Celebrate accomplishments and track learnings from short-term and medium-term action plans. Use learnings to develop sanitation plan for 2060

Long-term investment required amount: $39,562,158

6. Investment Plan

The total financing required to achieve the strategy is $80 million and the strategy generates $10M NPV from the benefits of safely managed sanitation alone. The total financing is broken down by the short term (2020-2025) - $12M, medium term (2025-2030) - $43M, and long term (2030-2040)- $39M, as well as different financing sources. The public investment from the Government of Kenya and development banks is $61M while the remaining 33M is a blend of payments from residents in the form of payments for improving household toilets, sanitation surcharge, and sewerage tariff.

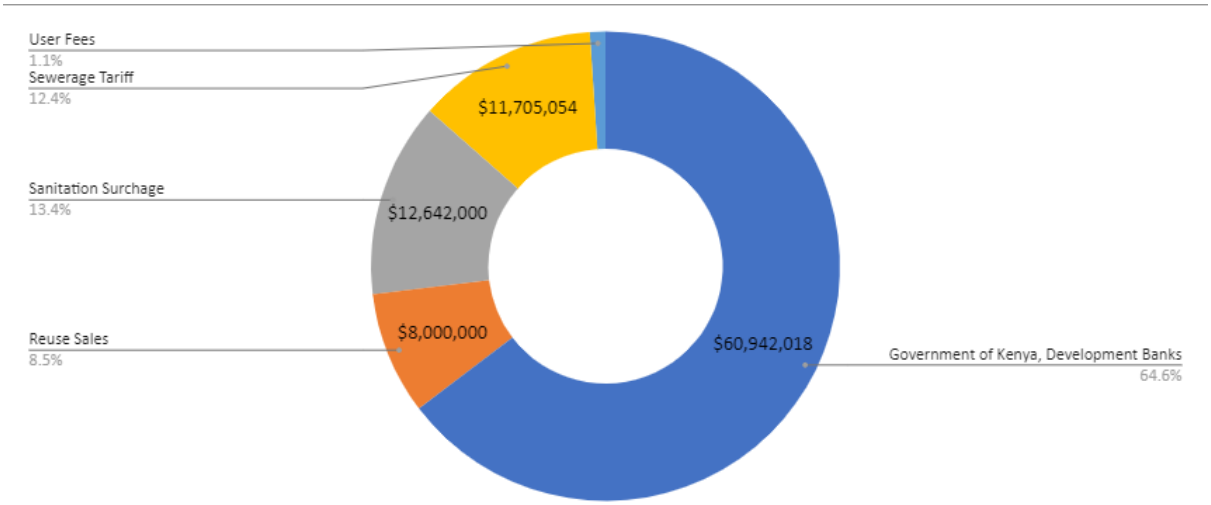


Figure 25: Sum of projected cost vs Source of funds

The action plan is linked to the source of funds from residents through individual investments, sanitation surcharge, and sewerage tariff, and from the Government of Kenya and development banks. A financial flow diagram of source of funds, accountable bodies, and the outcome those funds have is depicted in

Figure 27.

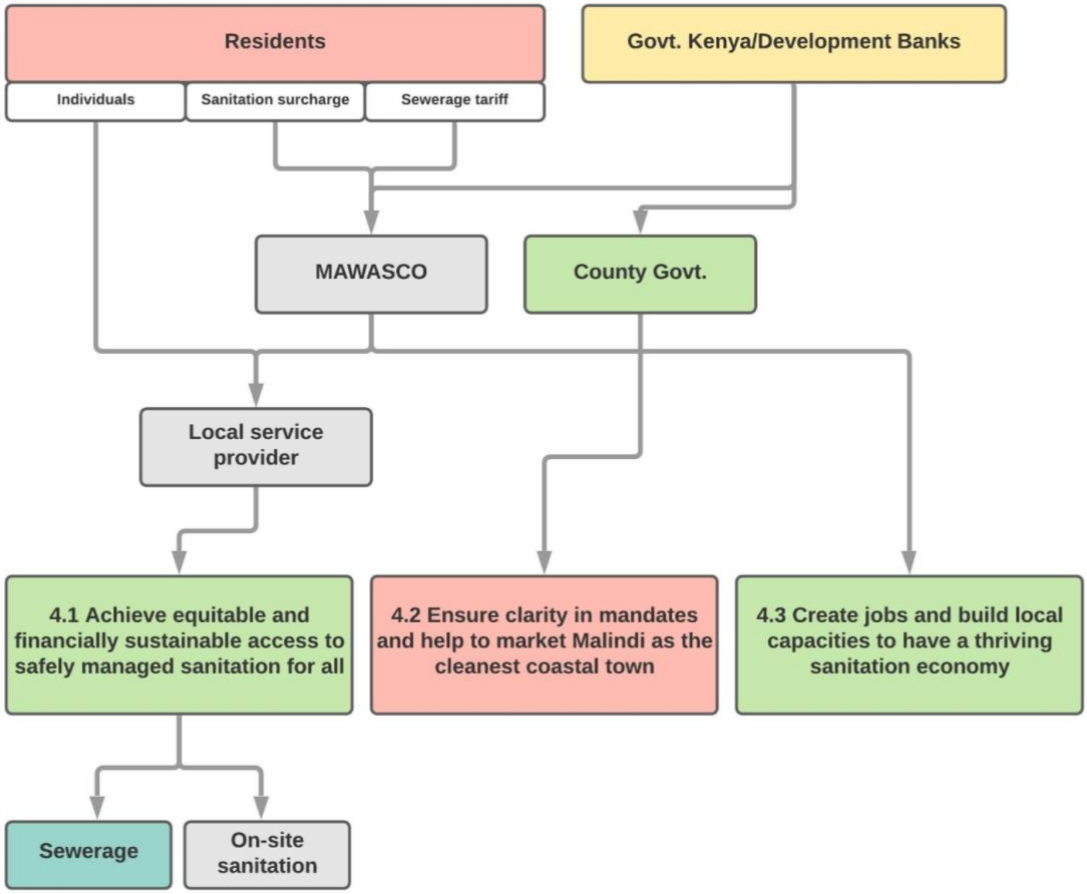


Figure 26: Financial flow, accountable bodies and outcome

Each activity is broken down and included in the action plan.

6.1 Financial Analysis

Investing in sanitation has the potential to have positive impacts on the local economy. From this strategy, MAWASCO is expected to generate over $20M in new revenue, over 300 jobs will be created and have an economic impact on sanitation of ~$300M.

The financial analysis is based on the impacts and returns based on a cost-benefit approach over an entire project lifecycle. The economic viability of the plan is determined using the net present value using the following assessments:

- Cost-benefit cash flow comparing the CapEx and OpEx with the direct and indirect economic benefits
- Determining the net present value of the project, assuming $125[7] per household per year of sanitation coverage

[7] The economic value benefits of sanitation have been adopted from the WHO publication – Hutton and Haller 2004. The publication details a number of aspects and estimates the economic value of savings. For this plan,

- Assuming a discount rate of 10%

With these assumptions, the project has a positive NPV of $10M.

6.2 Risk Management

The following table sets out the key risks and associated mitigation measures. As this plan is proposing a number of interventions across the sanitation value chain, these can only be implemented successfully with a well-developed enabling environment. The institutional and political support towards setting up regulations and enforcing them is critical. These changes are often resource-consuming and require joint effort from various stakeholders.

	Risks	**Mitigation Measures**
User Interface and Containment	• Due to lesser ownership, maintenance of shared toilets might not happen regularly	• Define maintenance responsibilities at the start of the project. MAWASCO should monitor the maintenance tasks at set intervals
	• Poor design and construction of containment units would vary the sludge characteristics	• Rehabilitation projects must have an essential component of containment system and not just the toilet superstructure • General awareness activities can support this initiative
Emptying and Conveyance	• Manual desludging operators can get marginalized when formalization happens	• Regular engagement with the informal private sector, especially manual operators • Increase access credit services to mechanize tasks
	• Emptied sludge is not brought to the treatment site; it is dumped instead	• Set up monitoring mechanisms using a token system: users get a token upon payment which is transferred to the operator after desludging. Operators payment from MAWASCO can be linked to the submission of tokens. ● Enforcement and monitoring by the county government

We adopted a moderate estimate by conservatively taking half of the estimated economic returns (including days of work saved, deaths avoided and time gain). The estimates are based on the African context and consider the provision of sanitation services to at least half of the population.

Treatment and Reuse	• Treatment standards are not met by the operator	• Set up periodic monitoring from MAWASCO or NEMA and performance-linked incentives or fines
	• Operator unable to recover costs from by-products	• Sharing of risks and revenue surplus between MAWASCO and the treatment plant operator while setting up the contract

Conclusion

The CWISP works has built on and complemented existing momentum to drive the county vision of "Towards Realizing People-Focused Transformation for Wealth Creation." With a population growth rate of 3.4% per annum, the challenges of urban sanitation provision will increase and dramatically outpace gains in sanitation access by 2040 in Malindi and Watamu. Lack of sanitation has an impact on health. Increased mortality and reduced productivity are compounded by negative impacts on the environment and, ultimately, on economic growth, especially to the low-income population, who are most affected. The CWISP strategy has proposed a blend of solutions that will ensure that everyone has access to safely managed sanitation, making Malindi an attractive, healthy, clean and sustainable town. The collaboration and coordination from all the stakeholders throughout the planning process has been remarkable. We thank all partners for their support. This strategy is the beginning of a journey together and sets a road map for all actors investing in sanitation in Malindi and Watamu.

The CWIS for Malindi and Watamu is an important starting point to bring attention to the important yet often neglected area of sanitation. It presents a comprehensive snapshot of the issues and a progressive way forward to tackle them.

The municipality and MAWASCO would use this document as a blueprint for working together with the municipal and county government in initiating detailed feasibility studies, designs and development of tender documents to implement the recommended steps. A stakeholders committee comprising all local stakeholders involved in the development of this plan and public representatives would be formed to steer the implementation of actions in the near future.

References

AQUAYA & WSUP. (2019). *Sanitation Policies, Practices and Preferences in Malindi, Kenya.* Retrieved December 03, 2020, from https://www.aquaya.org/wp-content/uploads/2019_Research-Brief_SanCost_Malindi.pdf

Cardone, R. &. (n.d.). Shared and Public Toilets: Championing Delivery Models That Work. doi:10.1596/30296

Coast Water Services Board. (2017). *Final Wastewater Master Plan Report for Malindi Town. Volume 1: Master Plan Main Report.* Retrieved December 2020, 2020, from https://www.cwwda.go.ke/cwsbFiles/publications/WastewaterMasterPlanMalindi.pdf

Coast Water Services Board. (2017). *Final Wastewater Master Plan Report for Malindi Town. Volume 1: Masterplan Main Report.* Retrieved December 02, 2020, from https://www.cwwda.go.ke/cwsbFiles/publications/MasterPlanWatamu.pdf

County Government of Kilifi. (2016). *The Kilifi County Finance Act.* Kilifi. Retrieved 12 02, 2020, from https://kilifi.go.ke/lib.php?com=5&com2=62&com3=68&res_id=562

County Government of Kilifi. (2016). *The Kilifi Couty Finance Act.* Retrieved December 02, 2020, from https://kilifi.go.ke/lib.php?com=5&com2=62&com3=68&res_id=562

County Government of Kilifi. (2018). *Annual Development Plan FY 2019/ 2020.* Retrieved December 02, 2020, from http://kilifiassembly.go.ke/images/ANNUAL_DEVELOPMENT_PLAN_FY_2019_2020.pdf

County Government of Kilifi. (2018). *County Integrated Development Plan 2018-2020.* Retrieved December 02, 2020, from https://www.kilifi.go.ke/lib.php?com=5&res_id=1202

County Government of Malindi, Ministry of Lands, Housing and Urban Development. (2015). *Malindi Draft ISUDP Report.*

Ideas at Work. (2010). *The Gulper –a manual latrine/drain pit pump. Phnom Penh/Casteren: Ideas at Work (IaW).* Retrieved December 02, 2020, from https://www.pseau.org/outils/ouvrages/iaw_ideas_at_work_the_gulper_2007.pdf

Issaias, I. (2006). *UN Habitat Vaccutug FSM Symposium.*

KNBS. (2019). *Kenya Population and Housing Census.* Retrieved December 03, 2020, from https://www.knbs.or.ke: https://www.knbs.or.ke/?wpdmpro=2019-kenya-population-and-housing-census-volume-i-population-by-county-and-sub-county

MAWASCO. (2014). *Malindi Water and Sewerage Company Limited Strategic Plan 2014-2019.* Retrieved December 03, 2020, from https://www.malindiwater.co.ke/downloads/2014%202019%20Mawasco%20Strategic%20Plan.pdf

Narayan, S. & Lüthi, C. (2020, 01). Social Network Analysis for Water, Sanitation, and Hygiene. *Frontiers in Environmental Science 7*. Retrieved December 02, 2020, from http://doi.org/10.3389/fenvs.2019.00198

NEMA. (2014). *The Environmental Management And Coordination (Deposit Bonds) Regulations.* Retrieved December 03, 2020, from https://www.nema.go.ke/images/Docs/Regulations/EMC%20(Deposit%20Bonds)%20Regulations%202014-1.pdf

Schröder, E. (2016). *Upscaling Basic Sanitation for the Urban Poor, Kenya.* Retrieved December 03, 2020, from https://smartnet.niua.org/sites/default/files/resources/3-2547-7-1462544978.pdf

SNV. (2016). *SNV Guide to Transfer Stations.* Retrieved December 03, 2020, from https://www.pseau.org/outils/ouvrages/isf_snv_a_guide_to_septage_transfer_stations_2016.pdf

Strande, L. R. (2014). *Faecal Sludge Management (FSM) book - Systems Approach for Implementation and Operation.* UK: International Water Association (IWA) Publishing. Retrieved December 02, 2020

SUED. (2020). *Sustainable Urban Econimic Development Programme: Malindi Urban Economic Plan.*

TNUSSP. (2018). *Compendium of Innovative Technologies for Urban Sanitation.* Retrieved December 02, 2020, from http://muzhusugadharam.co.in/wp-content/uploads/2019/01/compendium-of-innovative-technologies_4-jan-2019.pdf

Wainaina, G. (2019). *SFD Draft Report - Malindi, Kenya.*

WASREB. (2020). *Impact Report: A Performance Report of Kenya's Water Services Sector - 2018/19.* Retrieved December 03, 2020, from https://wasreb.go.ke/downloads/WASREB_Impact_Report12.pdf

WASREB. (n.d.). *Tarriff Gudelines.* Retrieved December 02, 2020, from https://wasreb.go.ke/downloads/Tariff%20guidelines.pdf

World Bank. (2017). . *Guidance Note: For Standard Bidding Document (SPD) for Works and Operation Services Design, Build and Operation (DBO) of Water and Wastewater Treatment Plants.* Retrieved December 03, 2020, from http://pubdocs.worldbank.org/en/936071500059812029/GuidanceNotewastewatertreatment.docx

Annex 1: Action and Investment Plan

Area	Interventions	Output	Activities	Who's responsible	Cost Estimate in USD	Capex Opex	Short (20202025)	Medium (2025 - 2030)	Long (20302040)	Projected Cost	Source of Funds
4.1	Achieve equitable and financially sustainable access to safely managed sanitation for all						5	5	10		
Area	Interventions	Output	Activities	Who's responsible	Cost Estimate in USD	Capex Opex	Short (20202025)	Medium (2025 - 2030)	Long (20302040)	Projected Cost	Source of Funds
4.11	Establishing a sewer network and WWTP	Design, construct and operationalise wastewater treatment Plant in Watamu and Malindi [Government of Kenya]	Malindi and watamu and land acquisition, sewerage system and wastewater plant(73 km of sewer network, 10,000 m3/day WWTP constructed in Malindi ($18M) and Watamu ($11M) (Sewer Part A) -70% funded Government of Kenya, 30% funded by tariff	MAWASCO	Cost estimates from the WWTP 2017(1 USD = 103 Kshs)	Capex	-	29,690,786	-	29,690,786	GoK, Development Banks
4.11		Design, construct and operationalise wastewater treatment Plant in Watamu and Malindi [Sewerage Tarriff]				Capex		3,750,000	3,750,000	7,500,000	Sewerage Tariff
4.11		Design, construct and operationalise wastewater treatment Plant in Watamu and Malindi [Sewerage Tarriff]	Operating the wastewater network and treament systems	MAWASCO	Cost estimates from the WWTP 2017 both watamu and Malindi (approx. $711412 annually)	Opex	-	1,481,870	1,481,870	2,963,740	Sewerage Tariff
4.11	Expansion of sewerage network and waste water treatment plant	Design, construct and operationalise additional capacities at wastewater treatment Plant in Watamu and MalindI	41 km of sewer network, 9,500 m3/day WWTP constructed in Malindi ($9.5M) and Watamu ($6M) (Sewer Expansion Part B), 60% funded Government of Kenya, 40% funded by tariff	MAWASCO		Capex			15,261,186	15,261,186	GoK, Development Banks
4.11									1,238,814	1,238,814	Sewerage Tariff
4.12	Increase number of vacuum trucks 6m3	1 x 10m3 Exhauster truck procured by MAWASCO and 8 more by 2040		MAWASCO	@ at $170,000- Total of 8 by 2040(estm form 2021/2023 strategy)	Capex	510,000	510,000	340,000	1,360,000	GoK, Development Banks
4.13	Propoor toilet constuction	Develop standard designs for affordable toilets	Develop low cost toilet designs for low-icome groups	County Government	Hire external consultant to develop low-cost standard design	Opex	1,000	-	-	1,000	GoK, Development Banks
4.13	Intiate a pro-poor subsidy scheme for toilets	100 households get access to subsidies for toilets anually	Pro-poor households identifed via survey	MAWASCO, PHE Department	Hire external consultants to map sanitation systems in planning area	Opex	25,000	-	-	25,000	GoK, Development Banks
4.13			Develop and submit conceptnote/project proposal for results based financing of toilets	MAWASCO, PHE Department	Inhouse personel or hired external consultant for proposal writing (Cost estimated at USD 500/day x 5 days = USD 2500)	Opex	2,500	-	-	2,500	Sewerage Tariff
4.13			100 households toilets investment annually		100HH x USD 300(investment)	Capex	150,000	150,000	300,000	600,000	User Fees
4.13			100 households receive results based subsidy of USD 300 annually	MAWASCO, PHE Department	100 HH x USD 300 (subsidy)	Capex	150,000	150,000	300,000	600,000	GoK, Development Banks
4.13	Propoor toilet constuction	100 toilets constructed annually	Construction of toilets	Households	Share of the cost of toilet (300) X 100	Capex	150,000	150,000	300,000	600,000	GoK, Development Banks
4.13	Rehabilitation & improvement of toilets and on-site sanitation systems	100 number of toilets rehabilitated/improved	Toilets identifed via survey	MAWASCO, PHE Department	Costs covered under pro-poor households survey (L7)	Opex	1,000	-	-	1,000	GoK, Development Banks

			Subsidies for rehabilitation of toilets disbursed	MAWASCO, PHE Department	No. toilets X fixed amount for rehabilitation (100 x USD 150)	Capex	45,000	45,000	90,000	180,000	GoK, Development Banks
4.13			Construct 3 transfer stations	MAWASCO	$10,000 per transfer station $5,000 per year transfer station mangement	Capex	105,000	75,000	150,000	330,000	GoK, Development Banks
4.13	Assess fecal sludge demand and construct additional transfer stations	5 additional transfer stations of capcity 15m3/d established	Construct 5 additional transfer stations	MAWASCO	$15,000 per transfer station, 5 additional transfer stations $2,000 per assessment study	Capex	-	152,000	452,000	604,000	GoK, Development Banks
4.13	Introduce gulper to service the highdensity, low-income areas	10 number of Gulper operators establised	Identify (at least 10) manual pit emptier that are willing to upgrade	MAWASCO	Hire external consultant to conduct a market assessment for gulping services	Opex	2,500	-	-	2,500	GoK, Development Banks
4.13			Procure 10 Gulpers	Service provider	10 units X USD 300	Capex	3,000	-	-	3,000	GoK, Development Banks
4.13			Provide operational support to Gulpers via trainings	MAWASCO	Hire external consultant to conduct a one-off training for gulpers	Opex	5,000	-	-	5,000	GoK, Development Banks
4.14	Ablution blocks at open defecation hotspots	20 ablution blocks commisioned and operational	Construct 20 Ablution blocks	MAWASCO, PHE Department	BOQ for ablution blocks, each costing Ksh 150485.5 serving 120 p/day	Capex	1,504,855	752,278	752,278	3,009,410	GoK, Development Banks
4.14			10 Ablution blocks contracted and operational	Service provider	Annual operational and maintenance cost for Ablution blocks	Opex	73,000	109,500	182,500	365,000	User Fees
4.14	Establishing FS treatment	Construction of 185 m3/day FSTP at Sabaki	Detailed feasibility, designs and construction of Waste to value treatment plant at Sabaki	MAWASCO	1 - USD 4,500,000	Capex	4,500,000	-	-	4,500,000	GoK, Development Banks
4.14			Operationalisation of the FSTP	Service provider	Opex calculated at 10% of CapEx	Opex	2,000,000	2,000,000	4,000,000	8,000,000	Reuse Sales
4.2			Compilance monitoring of standards for results based subsidies	MAWASCO, PHE Department	Inhouse personel (costs to be covered under project management fees in the sbusidy scheme)	Opex	-	-	-	-	GoK, Development Banks
4.2	Setting up of tariffs and safely managed payments	A rationalisd tariff structure for sanitation and sewerage established	Develop a concept for rationalised tariff strcuture	MAWASCO, PHE Department/ County government	Hire external consultants to develop a rationalsed tariff structure (USD 500 x 20 days) = USD 10000 and USD 20,000 process	Opex	30,000	-	-	30,000	GoK, Development Banks
4.2			Approval of the tariff structure	WASREB	Inhouse		-	-	-	-	
4.2			Ringfensing mechanism of sanitation tarrif establised	MAWASCO, PHE Department/ County government	Inhouse		8,000	-	-	8,000	GoK, Development Banks
4.2					2020-2025: 50,000 households get their toilet emptied, 2025-2030: 80,000 households get their toilet emptied 2030-2040: 100,000 households get their toilet emptied, subsidy is 50% of average price of pit emptier and exhauster tuck $70=$35		1,750,000	2,800,000	7,000,000	11,550,000	Sanitation Surchage
4.2			Incorporate min standards into the sanitation by-law	County government	Inhouse - add in consultant	Opex	2,000	5,000	-	7,000	GoK, Development Banks

4.2			Compilance monitoring of standards for results based subsidies	MAWASCO, PHE Department	Inhouse personel (costs to be covered under project management fees in the sbusidy scheme)	Opex	60,000	120,000	360,000	540,000	GoK, Development Banks
	TOTAL FOR GOAL 4.2					Total	$11,077,855	$41,941,434	$35,958,648	$88,977,936	

4.2	Ensure clarity in mandates and help to market Malindi as the cleanest coastal town										
Area	**Interventions**	**Output**	**Activities**	**Who's responsible**	**Cost Estimate in USD**	**Capex Opex**	**Short (20202025)**	**Medium (2025 - 2030)**	**Long (20302040)**	**Projected Cost**	**Source of Funds**
4.2	Amend by-laws/standards to accommodate low-cost toilets	Develop and gazette by-laws that incorporate statues for FSM and sewerage	Access current by-laws, identify gaps and develop recomendations for amendments to by-law (amendament to incude statues pertaining to collection, empyting and treatment of FS and sewerage)	County government	Hire external legal consultant to develop recomendations to by-laws	Opex	30,000	-	-	30,000	GoK, Development Banks
4.2			Proposal for amendments passed by council resolution and gazetted	County government	Inhouse	Opex	-	-	-	-	
4.2	Improve compliance monitoring of by-law and standards	Enhance capacities of enforcement units for compliance monitoring	Increase budget allocation for enforcement units	County government	2 person decicated for compilance monitoring (cost of 2 person added annually)	Opex	300,000	600,000	2,400,000	3,300,000	GoK, Development Banks
4.2		Contact center established and operational	Procure equipments for contact center	MAWASCO	Lumpsum of $10,000	Capex	10,000	10,000	10,000	30,000	Sanitation Surchage
4.2			Hire personell for contact center	MAWASCO	1 person 2020-2025, 2 people 2025-2030, 3 people 203-2040 , @$600/month	opex	36,000	108,000	216,000	360,000	Sanitation Surchage
4.2	Regular coordinating and accountability mechanism by county government (CEC, DOW)	Develop an institutional framework with clear roles and responsibilities across the sanitation & sewerage chain	Key stakeholders meeting to clarify roles and responsibilities for FSM and sewerage services	MAWASCO	Hire external moderator to hold key stakeholder workshops (3 workshops @USD 5000/workshop)	Opex	15,000	-	-	15,000	GoK, Development Banks
4.2		Establish a Malindi Sanitation Committee to coordinate and oversee developments in sanitation	Quaterly meetings of key stakeholders to coordinate developments	MAWASCO	Inhouse	Opex	-	-	-	-	
4.2		Initiate a Pit Emptiers Association in Malindi	Establish pit emptiers association, including registeration a legal entity	Service providers	Association($8246), registration($5890), Pulled from transform budget break down	Opex	14,136	-	-	14,136	GoK, Development Banks
4.2			Sustain the association via user fees	Service providers	USD 3000 (assumed)	Opex	12,000	15,000	30,000	57,000	User Fees
4.2	Develop updated brand and local messaging campaign for awareness raising on safely managed sanitation	Initiate, implement and sustain an awareness raising campaign for sanitation	Development of key message and IEC materials for improving Hygene, proper containment and empyting and information on by-laws & standards	MAWASCO	Hire external agency to develop key messages for IEC (Lumpsum USD 25000)	Opex	25,000	-	-	25,000	GoK, Development Banks
4.2			Intiate and sustain awerness campaign via visual aid, TV and radio slots, etc.	MAWASCO	Cost associated vary (assumed to be USD 25000	Opex	120,000	125,000	250,000	495,000	GoK, Development Banks
4.3	Mawasco branding to sanitation and implementaion of FSM unit	Initiate, implement and sustain a public relationship campaign to market MAWASCO as a champion for sanitation	Develop a PR campaign to showcase effort that MAWASCO has undertaken to make Malindi clean	MAWASCO	Hire external agency to develop the PR campaign (Lumpsum at 25000)	OPex	25,000	-	-	25,000	GoK, Development Banks
	TOTAL FOR GOAL 4.2					Total	$587,136	$858,000	$2,906,000	$4,351,136	

4.3	Creating jobs and building local capacities to establish a thriving ecenomy										
Area	**Interventions**	**Output**	**Activities**	**Who's responsible**	**Cost Estimate in USD**	**Capex Opex**	**Short (20202025)**	**Medium (2025 - 2030)**	**Long (20302040)**	**Projected Cost**	**Source of Funds**
4.3		Establish an FSM unit in MAWASCO	Clarify roles and organisational developement requirements	MAWASCO	Inhouse	Opex	-	-	-	-	Sanitation Surchage
4.3			Hire personel required for the FSM unit	MAWASCO	5 persons team @ $500/mo	Opex	30,000	42,000	600,000	672,000	Sanitation Surchage
4.3			Aquire necessay equipment	MAWASCO	Lumpsum of USD 30000	Capex	15,000	7,500	7,500	30,000	Sanitation Surchage
4.3		SOPs for emptying services developed	Define Standard Operating Procedures for pit emptying services	MAWASCO	Hire external consultant to develop SOPs (Lumpsum USD 25000)	Opex	25,000	-	-	25,000	GoK, Development Banks
4.3		Certification system established by MAWASCO	Develop training modules based on SOPs for pit emptiers	MAWASCO	Hire external consultant to develop SOPs (Lumpsum USD 25000)	Opex	25,000	-	-	25,000	GoK, Development Banks
4.3			Conduct trainings for pit emptiers and award certificates	MAWASCO	training conducted bi-annually via workshops (2000/training)	Opex	20,000	20,000	40,000	80,000	GoK, Development Banks
4.3		A licensing framework for FSM developed and implemented	Develop licences specific to FS handling and treatment	County government	Inhouse	Opex	-	-	-	-	GoK, Development Banks
4.3	Improve the skills and capacities of the government and WSP staff	Build capacities of MAWASCO and County government	Staff undergo tainings, exposure visits and capcaity building activities	MAWASCO/Country government (estimated 10 staff @ USD 5000 per staff	Inhouse	Opex	50,000	50,000	50,000	150,000	GoK, Development Banks
	TOTAL FOR GOAL 4.3					Total	$165,000	$119,500	$697,500	$982,000	
	TOTAL FOR ALL GOALS					TOTAL	$11,829,991	$42,918,934	$39,562,148	$94,311,072	

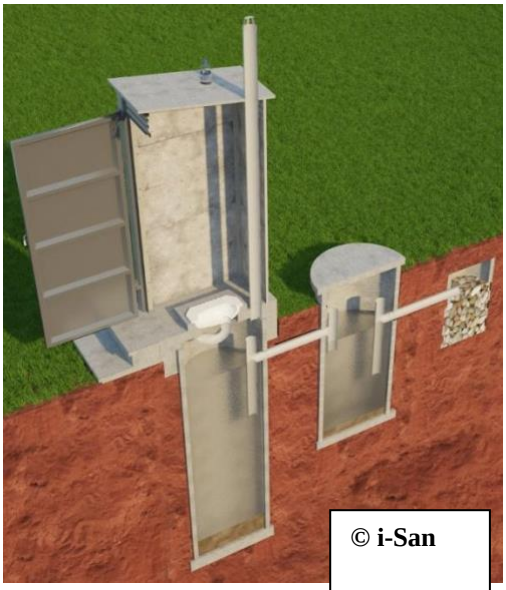
Annex 2: Planning location, population and density details

Sub- Location		Part of Master Plan	Part of Sani Block (Map from MAWASCO)	Total Population	Households	Density (People/Km 2
Ganda	GANDA		YES	5727	981	604
	MERE		YES	8112	1194	572
	MSABAHA		YES	11275	2072	572
Gede	DABASO	YES	YES	18009	3970	735
	MIJOMBONI		YES	7608	1289	408
	MKENGE		YES	5683	1005	406
Malindi	BARANI	YES	YES	40874	12158	3574
	CENTRAL	YES	YES	26811	7031	2768
	KIJWETANGA	YES	YES	19897	3770	966
	SABAKI	YES	YES	24219	4958	718
	SHELLA	YES	YES	54556	14488	3577
Watamu	CHEMBE KIBABAMCHE		YES	6284	1162	289
	JIMBA	YES	YES	10522	2178	520
	MBARAKA CHEMBE	YES	YES	5974	1126	455
	WATAMU	YES	YES	12286	3575	4023
Magarini	GONGONI		YES	21200	4136	300
	NGOMENI		YES	8657	1512	277
	MAMBRUI		YES	23952	4270	552
				311646	70875	

Annex 3: Pre-feasibility of Low-cost, modular toilets for low-income settlements

This modular concept is based on the understanding that most inhabitants, given their current low-income status, cannot afford a high-end waterborne system and would prefer to upgrade their sanitary condition over a period as their economic status improves.

In step1 the household 'purchases' the modular toilet from a local SME. The toilet is a simple drop hole, but the containment is watertight and the supernatant/effluent drains through a pre-installed drainpipe into the soil. This is the cheapest of the models with an approximate cost of US$ 300. Over time the same system can be converted to a septic tank with two chambers (Step 2). The addition of a chamber would cost the household around US$ 100 more.

Step 1 Lined direct drop pit latrine	Step 2 Upgrade to pour flush toilet linked to septic tank
	
• Installation of the dry pit latrine with a drop hole interface	Changes made: • Squatting pan with drop hole rep e with a water closet • Extension pipe is unplugged and c e newly built second chamber that acts as septic tank and subsequent soak pit

Existing toilets with off-set pits can also be retrofitted with the low-cost septic tank made of concrete rings (figure ZZ) at a fraction of the cost (US$ 200) as compared to brick-masonry septic tank, which currently costs around US$ 450-500.

Local production: The proposed design is a sturdy pre-cast concrete structure that can be locally produced by SMEs in Malindi and Watamu. A sanitation marketing campaign by the Pvt sector, supported by MAWASCO and the county government can potentially increase the uptake of the standardized toilets.

Standardization: The lack of standards and its compliance monitoring is required to improve the uptake of better designs. The CWISP propose to include low-cost options in building codes and by-laws to provide the legal basis for sanitation improvements.

Annex 4: Pre-feasibility of Transfer Stations

Date of Visit: Friday 24th July 2020

Attendees: Jim, Sanivation. Levis, MAWASCO. Surveyor, MAWASCO.

Overview of locations:

- Location 1: Muyeye Health Centre
    - Recommended location
    - Good space and access, near densely populated areas so good chance of being used frequently
    - Current land users and established trees could be a hazard during construction and operations
- Locations 2 and 3: Mortuary and Rehabilitation Centre
    - Either location recommended, but chose one
    - They are very near each other so only one necessary
    - Little to distinguish between the two
    - Location 2 would be an easier construction - there is more space and access would be easier
    - Location 3 is in a slightly better location overall, being slightly nearer to the densely populated areas
- Location 4: Sindbad Park / abandoned hotel
    - Not recommended
    - No access road, would need 100-200m of road constructed
    - Not really near any densely populated areas
    - Site has plans for redevelopment so future uncertain
- Location 5: Malindi main market and stadium
    - Recommended location
    - Really good location, walking distance from all the main markets and businesses
    - Access road tight but good space for turning at proposed construction site
    - Big events take place at this location which could be a hazard; large numbers of members of the public coming into contact with the construction and operations

Land requirements

- About 17m x 12m would be required for a 7m long exhauster truck to do a 3 point turn, where there is no road access, this land would be required. 17m x 17m is desired, 17m x 12m is minimum.
- Where less space is available, good access points from a road are essential, a simple lay-by could be constructed on a road adjacent to the land

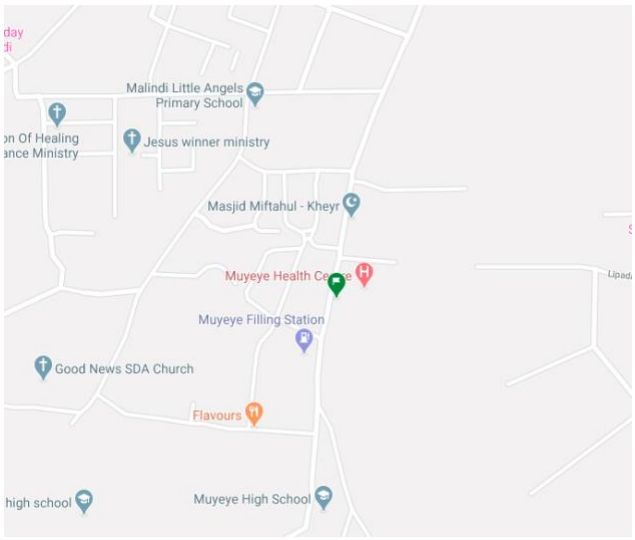
- Where less than 17m x 12m is available, we would also need ensure that the adjacent allocated land (lay-by or space for them to turn) would not be built on in the future
- Transfer station would be approximately 12m x 2m on surface

Locations, Notes and Pictures

Location 1: Muyeye Health Centre

Google maps pin location: https://goo.gl/maps/V8YR1LBM6Jc2rb737

Green flag shows location:



Photos: https://photos.app.goo.gl/6b9afZdkJ4uy9Vu99

Notes:

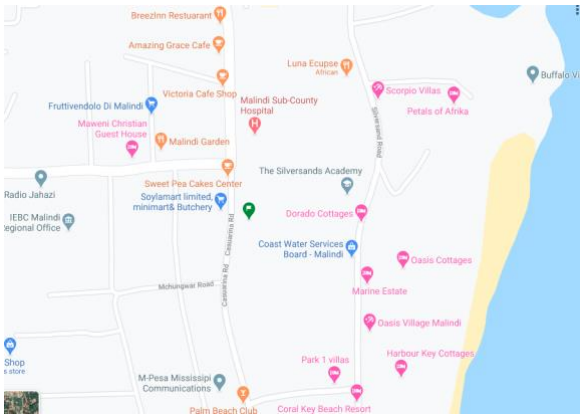
- Good space and access availability from main road
- Would be easy to find space and install transfer station here, with simple access tracks for exhauster trucks

- It is near the main road and the area is fairly densely populated, it is likely it would be well used and accessible to manual emptiers in the area
- Tall and well established trees would need to be considered during / after construction as they could cause obstructions
- Impact caused by pollution from construction and operations would need to be considered with relation to health centre users
- Land requirements:
    - 17m x 12m ideally, but also a lay-by could be constructed on the adjacent road
    - If less than 17m x 12m, land would need to be adjacent to road

Location 2: Mortuary

Google maps pin location: https://goo.gl/maps/x19gxb2tgCttmdTf8

Green flag shows location:



Photos: https://photos.app.goo.gl/JcN5XmUZPXvQgC5Q7

Notes:

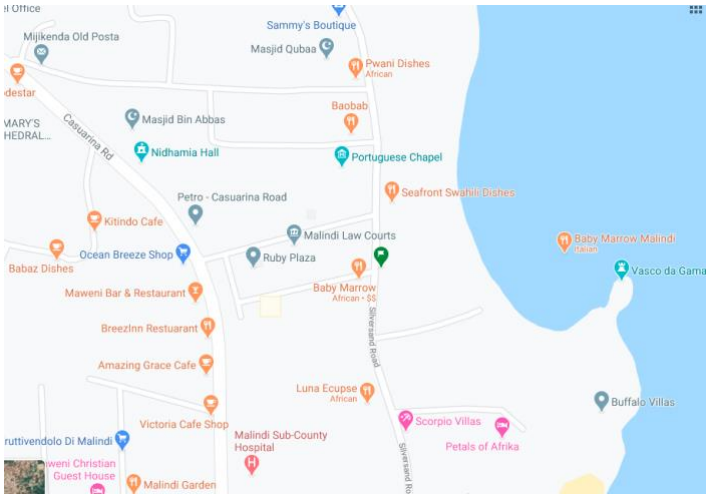
- Good amount of space for tank, access would need some improving but not too far away from main road
- Established trees and electricity cable potential obstructions to consider. Also, some abandoned matatus

- There were a lot of mourners congregating around the front of the gate, this could also cause obstructions / hazards during construction and operations.
- Impact caused by pollution from construction and operations would need to be considered with relation to the large number of mourners and workers nearby
- Some distance away from densely populated areas but probably not far enough that it would discourage use by manual emptiers
- Land requirements:
    - 17m x 12m ideally, but also a lay-by could be constructed on the adjacent turning circle
    - If less than 17m x 12m, land would need to be adjacent to the mortuary turning circle and we would need to know that land would not be built on in the future

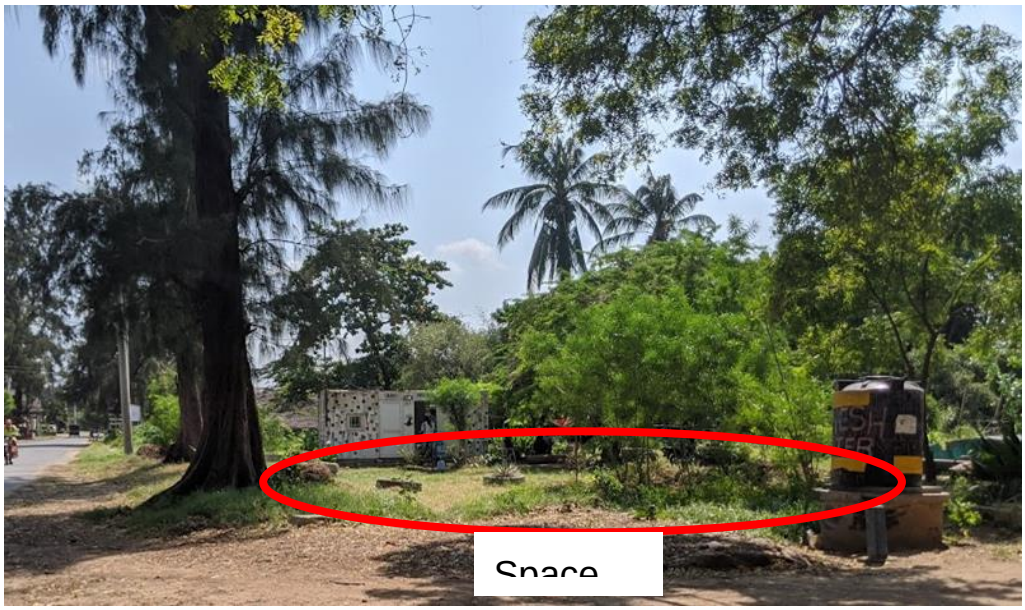
Location 3: Rehabilitation centre

Google maps pin location: https://goo.gl/maps/Nm3UzN9KXi3iwjra6

Green flag shows location:



Photos: https://photos.app.goo.gl/CeouTQvnB3uHhHRa7



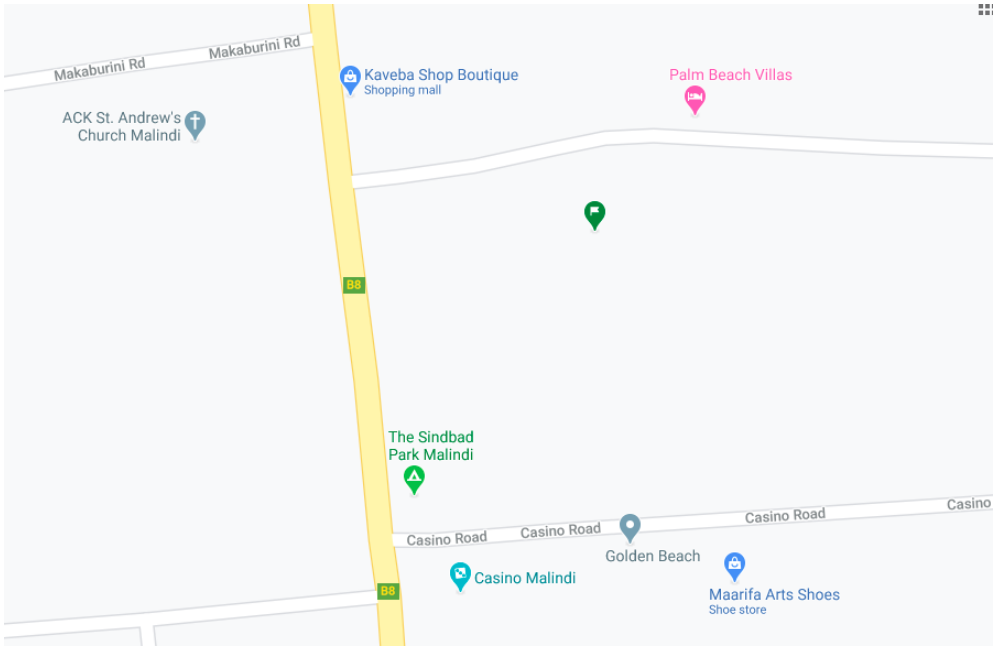
Notes:

- Small space, but probably enough for an underground 10m3 tank
- Access restricted by pipeline to south and big established trees to the west
- Very near the rehabilitation centre, would have to consider sound/dust/machine pollution during construction and operations
- Good location for picking up sludge from densely populated areas nearby
- Land requirements:
    - 17m x 12m ideally, but also a lay-by could be constructed on the adjacent road where the trees are
    - If less than 17m x 12m, land would need to be adjacent to road, trees may have to be chopped down

Location 4: Sindbad Park / Abandoned hotel

Google maps pin location: https://goo.gl/maps/oa2f9vwhHCWXYCW59

Green flag shows location:



Photos: https://photos.app.goo.gl/uhvsAzzpvoDea62B8

Notes:

- Good flat large piece of land for tank construction 0727 045810
- Very poor accessibility - not near a main road, would need to consider constructing 100-200m of access road
- Hotel site has plans for redevelopment so area and access could change soon
- Not near any densely populated areas, unlikely the station would see much use
- Land requirements:
    - 17m x 12m at least, trucks will need space to turn around

Location 5: Malindi main market and stadium

Google maps pin: https://goo.gl/maps/GgFm7yfE1JZ3upu67

Green flag shows location:

Photos: https://photos.app.goo.gl/VYk8CmyFLsZnsim69

Notes:

- Good location, very densely populated area nearby. All the central markets and businesses within walking distance
- Access road quite tight but lots of space for turning once on the field
- Access could be tricky when there are events on the big stage, as there will be big crowds of people on the field. Used as a sports field when no events on, would also need to consider this to try and limit interactions with members of the public
- Land requirements:
    - 17m x 12m, trucks will need space to turn around
    - If less than 17m x 12m, trucks could use existing field to turn around, but we would need to guarantee land is not going to be built on in the future

Annex 5: Pre-feasibility of Waste to Value Fecal Sludge Treatment Plant

For treatment, the CWISP committee prefers a system that is NEMA compliant and embraces a circular economy model. The following criteria for the treatment component of the value chain were developed based on stakeholders' interests.

Criteria for treatment option selection: Parameters considered in selection of the treatment option for Malindi and Watamu are as described below:

1. Land requirement: Land required for installation of treatment plant is crucial depending on availability. Technology with minimal land requirement but with maximum output for treatment and waste recovery in this criterion is preferred. This is to avoid and reduce project-affected persons and resettlement costs and compensation that may arise. The utility owns land at Sabaki that is adequate to incorporate the proposed technology. Dense population location was a determinant factor for the transfer stations location.
2. Capital cost: The consultants calculated the capital costs to construct the facility and the return on investment through various model evaluations to confirm options that make the most sense if selected.
3. Operating cost to the utility: Technology with minimal operations and maintenance cost to the utility was preferred and comparison made with other options.
4. Ability to include waste-to-value component: A technology with highest ability to include waste-to-value component has been given priority. Market considerations and biomass availability was evaluated, including suitable products with high revenue generation potential.
5. Operational considerations and incentives: Treatment technologies whose availability and skill requirement for operations and maintenance can be obtained locally and the operator incentivized has been given preference.
6. Guarantee NEMA disposal standards: The level of effluent discharge should guarantee NEMA standards are met. Priority in technology selection is given to one that ensures safe disposal and that the environment protected.
7. Risk ownership of performance: It is important to ensure that the performance of the selected technology is guaranteed to serve the intended purpose. Preference was given to an option with high ownership of performance

Four options for waste treatment at Sabaki to meet the 130m3/d demand were evaluated. These options include:

Option 1: Planted Drying Beds with Constructed Wetlands

This is a sealed shallow pond with several drainage layers channeled to a constructed wetlands. It use natural processes involving wetland vegetation, soils, and their associated microbial assemblages to improve water quality. Sludge is dried naturally by a combination of percolation and evaporation. Mechanical power is required for regular desludging. Dried sludge will need further treatment.

Option 2: Stabilization ponds + drying beds

Waste stabilization ponds (WSPs) are open basins enclosed by earthen embankments, and sometimes fully or partially lined with concrete or synthetic geofabrics. They employ natural processes to treat domestic wastewater or liquids from septage and sludge. Drying beds are structures used for dewatering sludge. Dewatered sludge will need further treatment, this is usually by using a composting process which can take 3-9months.

Option 3: Mechanical Dewatering

This technology involves sludge moisture content reduction to allow semi solid processing instead of processing as a liquid using a mechanical unit operation. The liquid goes to an activated sludge plant which ensures treatment to NEMA standards. The treated effluent can be used for irrigation purposes. To treat to the dewatered sludge, an anaerobic digestion plant can be used prior to dewatering or a composting process used post dewatering.

Option 4: Waste-to-value System

This system's focus is to achieve 100% treatment and reuse aspects. The component includes a dewatering system that separates liquids and biosolids from the sludge received. The liquid goes to an activated sludge plant which ensures 100% treatment to NEMA standards, and treated effluent used for irrigation purposes. The bio solids is combined with agricultural biomass in the process to create a solid biomass fuel. The biomass fuel is sold to industries to replace traditional firewood in their boilers. These revenues cover the costs of the waste-to-value system, ensuring the plant can operate in perpetuity with no ongoing investment required for operation.

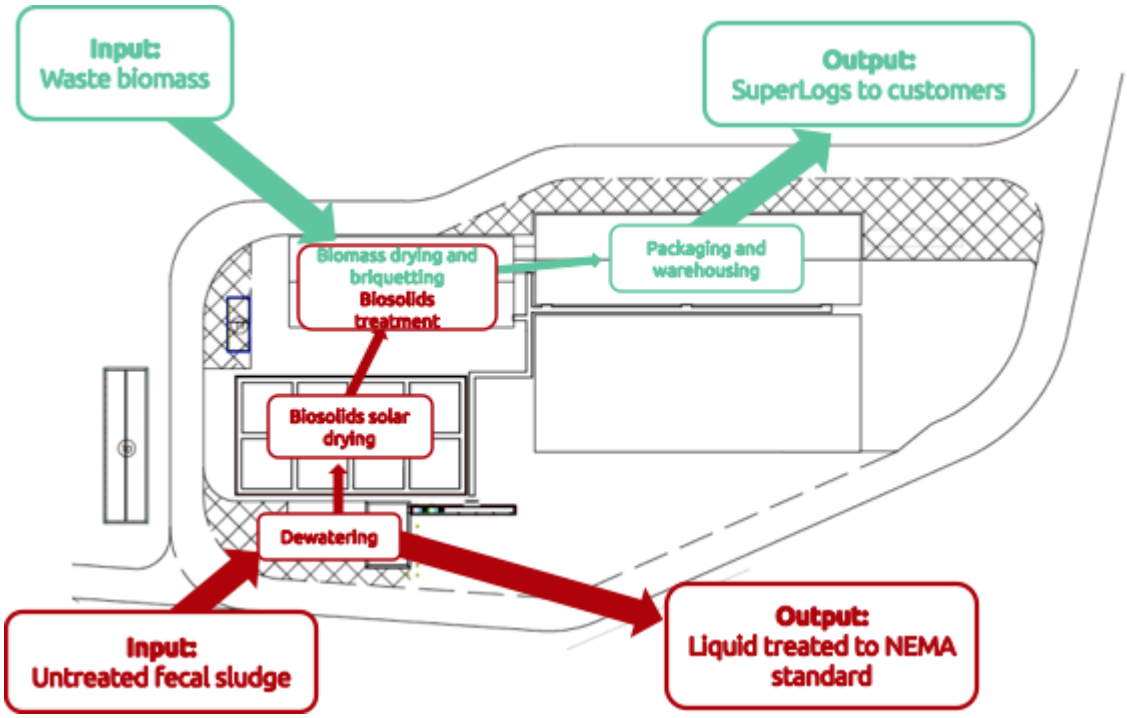
Treatment Options Comparison for 130m3/d at Sabaki

Criteria Analysis	Planted Drying Beds with Constructed Wetlands	Stabilization Ponds + Drying Beds	Mechanical Dewatering	Waste-to-Value System
Land requirement	30,000m2	18,000m2	7,000m2	14,000m2
CapEx	$2.5M	$2.3M	$1.5M	$3.5M

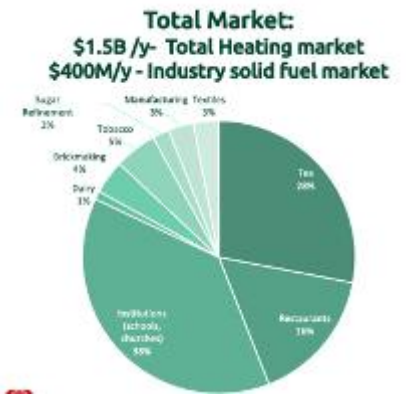
OpEx for utility	$45,000/yr.	$90,000/yr.	$250,000/yr.	Private sector bears costs and utility has cost-recovery
Has ability to include waste-to-value	Low	Low	Med	High
Operational considerations and incentives	Low O&M requirements	Med O&M requirements	Med O&M requirements	High O&M, operator incentivized
Guarantee of meeting NEMA disposal standards	Y	Limitation on P and N	Y, Total Solids transported to Sabaki plant	Y
Risk ownership of performance	Utility	Utility	Operator	Operator

Specifics on the waste-to-value treatment plant

The schematic and 3d render of the waste-to value plant is depicted below:



One of the important risk the private sector is undertaking is the fuel market. From an assessment of the fuel market the total fuel market is a $1.5B/yr. market in Kenya with $400M/yr. being on industrial fuel. Briquette companies have started to capture more and more market share due to their value proposition of a more dense and higher performing fuel. These briquette companies also have the ability to apply for carbon credits to derisk their revenue streams.



The total industrial market is broken down by percentages in Figure above. Locally in Kilifi there are number of industrial fuel clients from the following industries:

- Mining (titanium, coal)
- Manufacturing
- Cement
- Salt
- Power
- Sisal
- Steel
- Dairy
- Textiles

A specific example of industry is Neelkamal Group, who has expressed interest in fuel provision of greater than hundreds of tons of month for their 4,500-person garment factory in Mombasa.