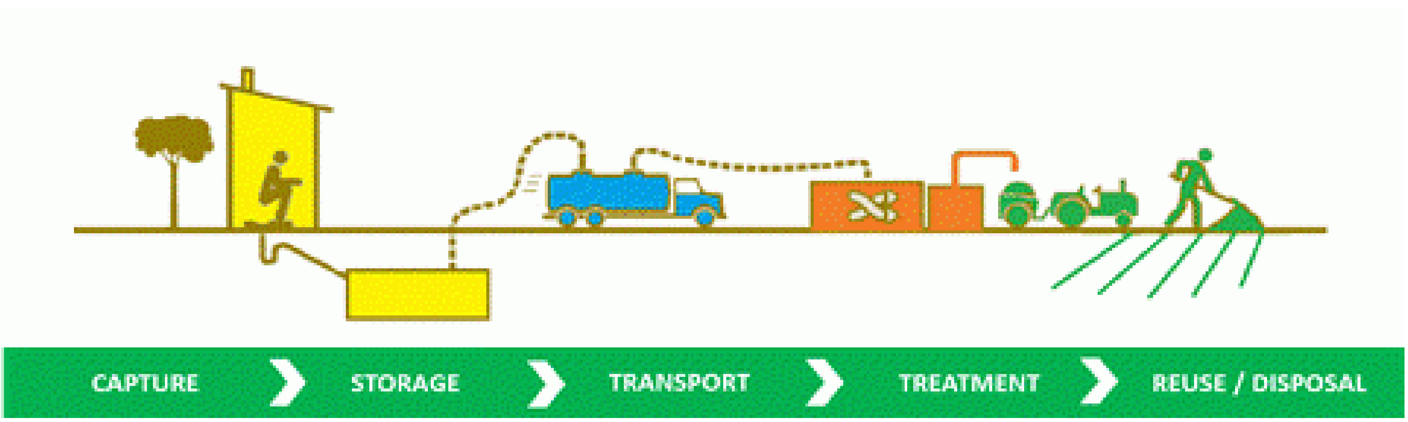
RESILIENT WATERS PROGRAM



NATIONAL FAECAL SLUDGE MANAGEMENT STRATEGY

STATUS QUO OF FSM IN SOUTH AFRICA REPORT

June 14, 2021

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EXECUTIVE SUMMARY

The concept of FSM is new in South Africa, and the historical focus has been on managing sewered sanitation. This report evaluated the status quo of FSM in 3 key areas, as follows:

- Regulatory and Institutional Framework
- Service Delivery and FSM Technologies
- FSM Financing Mechanisms

Key findings for the status quo of the regulatory and institutional framework in South Africa are that there is nothing in the current legislative framework that specifically prohibits the activities of faecal sludge management. Implementation requires consideration of situation-specific circumstances and decision making and implementation by local government, and regulation by national government. However, whilst regulations can be developed and promulgated, the key issue seems to be one of interpretation and implementation, and accordingly where economic and social incentives can be identified and supported to regulate behaviour, rather than more law which needs to be implemented and enforced, this should be the preferred way.

As regards the institutional structures, the roles of local government and DWS are clear. The municipality must plan for sanitation services for its area of jurisdiction, and this includes faecal sludge management if one looks at the definition of "sanitation service" and the right to differentiate in service levels and tariff setting as is appropriate in the local context. DWS must regulate and support sanitation service delivery (note that this function of water sector leader is quite distinct from the role of COGTA which is to regulate local government systems etc.). DWS does not regulate local government- it regulates the water sector, a key player of which is local government in their capacity as water services authority. The roles of other stakeholders require co-ordination if it is triggered in the particular circumstance. In terms of the Constitution and the Intergovernmental Relations Framework Act No. 13 of 2005, there must be co-operation.

Local government must be supported to implement faecal sludge management, which requires focus on each of the activities in the services chain.

As regards service delivery, (according to data collected by StatsSA and presented by DWS[1] in 2019) there were 16.7 million households in South Africa. Of this number, 61.3% used toilets connected to a sewer system. A further 1.7% used bucket toilets or chemical toilets which were managed within the context of an urban sewer system. Of the remainder, 4.2% used septic tanks, 17.2% used ventilated pit latrines, 13.3% used unimproved pit toilets and 0.3% used some form of on-site ecological sanitation system (e.g. urine diversion). Open defecation was still practiced by 1.5% of the population, and the balance (0.5%) used some unspecified form of sanitation. Summarising these numbers, the sanitary waste

[1] From presentation to FSM steering committee by Andre van der Walt, Chief Director, National Sanitation Services, DWS, May 2021

of 63% of the population was processed in wastewater treatment plants on a continuous basis, while 35% of the population used some form of on-site sanitation where the sludge is dealt with infrequently, or not at all. StatsSA also estimates that 10% of households with pit latrines have full pits.

Recently, SFDs are beginning to be used as a tool to evaluate the status of faecal flows in municipalities (10 municipalities in South Africa have done SFDs). A lot of work is needed to ensure that the information on which they are based is current, credible, verified and based on a sound understanding of what is acceptable in terms of containment, emptying, transport and treatment, and what is not.

There is no clear data on the status of FSM outside those 10 municipalities. There is no reliable data for unsewered city areas – served in affluent areas by septic tanks and informal areas, nor for informal settlements where services range from city to city and encompass the full range from chemical toilets to portable toilets, to pit latrines (formal and informal, shared and private) to sewered communal ablution blocks. There is no clear data for emptying, transport and treatment services in peri-urban areas, where people use pit latrines or septic tanks according to what they are able to afford. In many of these areas the government has provided VIP toilets to most homes, or in Durban's case, double-vault urine diversion toilets. There is no reliable or consistent data on emptying, transport and treatment services in rural areas – mainly served by government-provided full VIPs. These are now becoming a general concern as it is hard to find a local authority which has a policy, plan, or budget for FSM management.

South Africa has access to a variety of technologies for toilets / containment technologies, emptying and on-site treatment, but, as indicated above, the services required to use those technologies safely are not in place, and poorly regulated. The number of families with unimproved pit toilets is steadily decreasing as more and more VIP toilets are built, and when the Census 2021 data is released, it will probably be found that the number of families still using unimproved pit toilets is closer to 10% of the national population than the 13% reflected in the current data. These pits will require emptying and effective treatment or disposal services. In terms of re-use technologies, there are a number of examples in South Africa at the moment, but as these are relatively new projects, and most at a small scale, cost-effectiveness has not yet been demonstrated.

The dynamics of sanitation financing practices and options varies across different Category A, B, and C municipalities. In the larger metro-municipalities, local revenues are much higher and there is much less dependence on fiscal transfers from central government to support investments. As such, there are therefore isolated examples where metro-municipalities have been much more proactive in exploring alternative options to FSM in urban areas – such as support to container-based service delivery in Cape Town[2] and a range of alternatives to sewered sanitation implemented by eThekwini municipality such as: community sanitation blocks, scheduled pit emptying, and innovative FSM treatment options including Latrine Dehydration and Pasteurization (LaDePa) systems[3]. In comparison, in many poorer municipalities

[2] Willetts, J. (2019). "Field Trip (FSM5)", in Proceedings of the 5th International Faecal Sludge Management Conference, Cape Town
[3] Serjak, C and Gorelick, J, 2021, Impact Investing for Scaling of Faecal Sludge Treatment Technology, FSM6 Virtual Presentation

the ES grant is the only reliable source of income and soon gets expended on administration costs and salaries leaving little to no space for maintaining basic services.

In addition, historically the larger municipalities are also much better placed to borrow funds from domestic finance sector to fund infrastructure investment. However, overall municipal borrowings have declined over the past 3 years from about 24 to 15 percent of capital expenditure.[4] This is primarily due to a deterioration in their financial health and creditworthiness. Moreover, the recent ratings downgrade in the midst of the COVID pandemic provides further barriers to municipal borrowing and in turn sanitation investments. Borrowing constraints have been compounded by faltering economic growth across the country further squeezing the fiscal space for sanitation investment.

Key issues for FSM financing mechanisms are as follows:

- The Equitable Share is mostly spent on salaries and leaves little for service maintenance.
- The Municipal infrastructure Grant is a well-established mechanism to support on-site sanitation but struggles to keep pace with demand.
- The Water Services Infrastructure Grant tends to focus on water infrastructure in rural areas, the contribution to on-site sanitation and FSM more broadly is unclear.
- Capital subsidy for networked / sewered sanitation services dominates overall sanitation spend.
- Tariff revenue tends to be well short of cost-recovery levels, leaving no room for cross-subsidy.
- Capital and operational subsidy goes primarily to capital spend; in most municipalities, support to operations is rare.
- Cross-subsidy from tariffs doesn't occur.

Fiscal constraints stemming from low economic growth in recent years, and the impact of COVID 19 are likely to lead to substantial real terms reductions in allocations to municipal government and in turn the level of funding available for sanitation investments or sector support. As a result of the exception fiscal constraints it is likely that the national government will reduce transfers to municipalities, including the conditional and unconditional grants intended to support sanitation services.

Data availability is poor, except for wastewater treatment, and our findings suggest that systems to collect decision-support data for FSM planning at municipal level are lacking. Interaction with the broad range of government and non-government stakeholder required for effective FSM is also lacking. The stakeholder engagement process should be robust and transparent in the implementation of the above toolkits, and our experience to date in this process indicates that relationships between the various stakeholders critical to the successful implementation of safe sanitation in South Africa are weak, and the decision support data available currently to the relevant institutions who need it, is poor.

[4] Department of Water and Sanitation, 2018, National Water and Sanitation Masterplan, Volume 1

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LIST OF ACRONYMS

CSDA	City Service Delivery Assessment
DEWAT	Decentralized wastewater treatment
DWS	Department of Water and Sanitation
EMM	eThekwini Metropolitan Municipality
FS	Faecal Sludge
FSTP	Faecal Sludge Treatment Plant
FSM	Faecal Sludge Management
PLM	Polokwane Local Municipality
PPE	Personal Protective Equipment
RWP	Resilient Waters Program
SDG	Sustainable Development Goals
SFD	Faecal waste (Shit) Flow Diagram
USAID	United States Agency for International Development
VIP	Ventilated Improved Pit latrine
WHO	World Health Organisation
WRC	Water Research Commission (South Africa)
WSA	Water Services Authority
WWTW	Wastewater Treatment Works

CHAPTER 1: INTRODUCTION

The Department of Water and Sanitation (DWS) has entered into a collaboration agreement with the USAID Resilient Waters Program to develop a National Faecal Sludge Management Strategy for South Africa (Ref: RWP_CA_ZA_02_11/2019). In addition, the USAID Resilient Waters Program has entered into another collaboration agreement with the Polokwane Municipality to create the evidence upon which the Strategy could be developed (Ref: RWP_CA_ZA_01_11/2019). The latter agreement sees both institutions partnering to pilot the use of various faecal sludge management tools. **FIGURE 1** (below) explains the relationships between the institutions involved, the phases of the project and the project management structures in place at both national, provincial, and team levels.

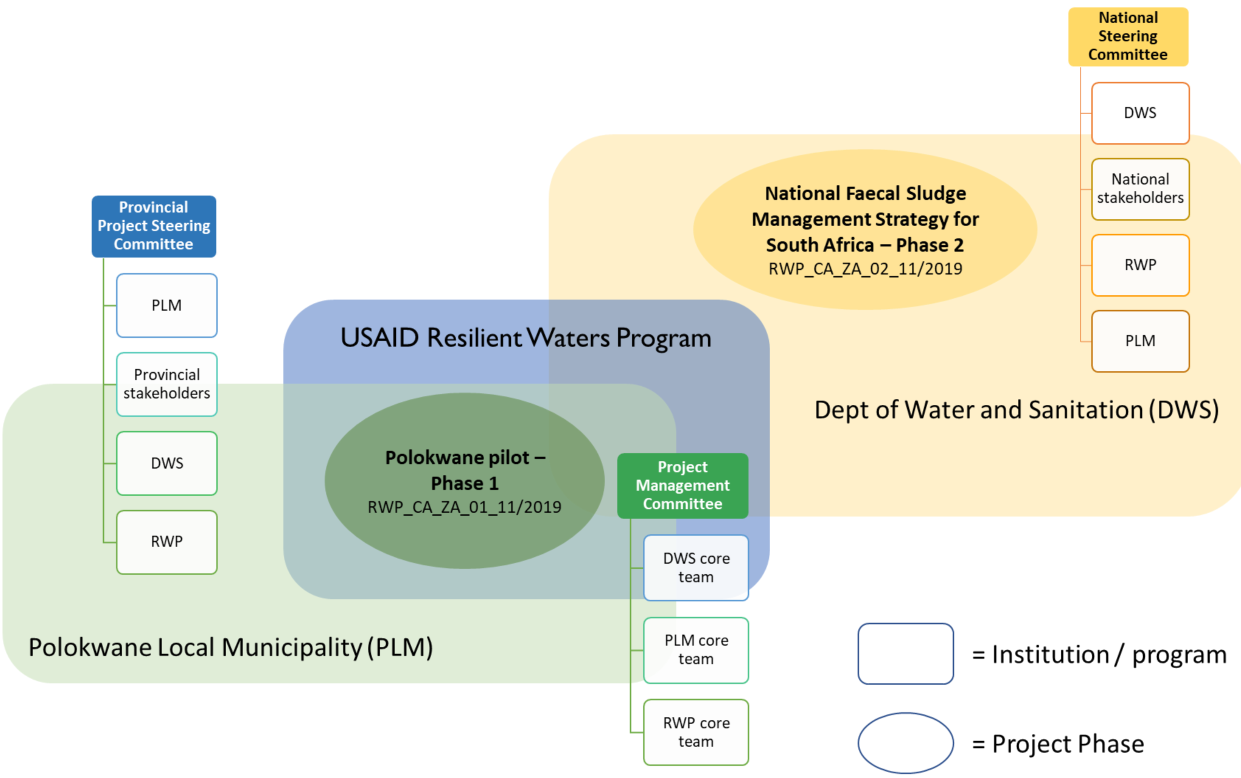

FIGURE 1: OVERVIEW OF INSTITUTIONAL AND PROJECT MANAGEMENT STRUCTURES AND LINKAGES

Both collaboration agreements are set to run concurrently with the collaboration between Polokwane Municipality and the USAID Resilient Waters Program taking place between October 2020-December 2021 and the collaboration between the Department of Water Sanitation and the USAID Resilient Waters Program taking place between October 2020-December 2022.

This document sets out the Status Quo of Faecal Sludge Management in South Africa under the following areas:

- Policy, legislation, institutions and regulation
- Technical issues: technologies, management and service provision

- FSM financing mechanisms

FSM is a relatively new concept in South Africa, with most municipalities focussing services and management on sewered sanitation. It is therefore important to differentiate between wastewater and faecal sludge and also to explain the Sanitation Service chain.

THE SANITATION SERVICE CHAIN

According to the 2019 report on the Global Analysis and Assessment of Sanitation and Drinking Water survey[5], there are very few countries that have an effective enabling environment for the implementation of sanitation in the context of the SDGs.

As a result of this analysis, the global focus is increasingly shifting to strengthening the systems that are in place for the implementation and management of Water, Sanitation and Hygiene (WASH), with particular reference to the surveillance that needs to be in place to ensure that services are safely managed, in alignment with the Sustainable Development Goals (SDGs). In the context of sanitation, the emphasis is on the safe and sustainable management of all aspects of sanitation (SDG6), across the Sanitation Service Chain (**FIGURE 2**).

FIGURE 2: THE SANITATION SERVICE CHAIN

In order to meet SDG6, innovative approaches, tools and mechanisms have been developed to assist countries in aligning their sanitation frameworks with the SDGs, based on the management of a mix of sanitation technologies and the varied management requirements for safe systems across the whole sanitation service chain.

On-site sanitation needs to be safely managed throughout the faecal sludge service chain (**FIGURE 3**) which entails capturing faecal sludge from the toilet, containment, transportation, treatment, and disposal or safe reuse. In South Africa, faecal sludge management and sewer systems would complement the wastewater treatment systems that are regulated by the DWS.

36%[6] of the population rely on on-site sanitation systems.

[5] National systems to support drinking-water, sanitation, and hygiene: Global status report 2019. UN-Water Global Analysis and Assessment of Sanitation and Drinking-Water (GLAAS) 2019 report. ISBN 978-92-4-151629-7. © World Health Organization 2019
[6] Water Research Commission. June 2020. *Country-wide Shit-Flow Diagram: Establishing National Excreta Flows in South Africa*. WRC Report no. TT 825/20. Water Research Commission, South Africa.

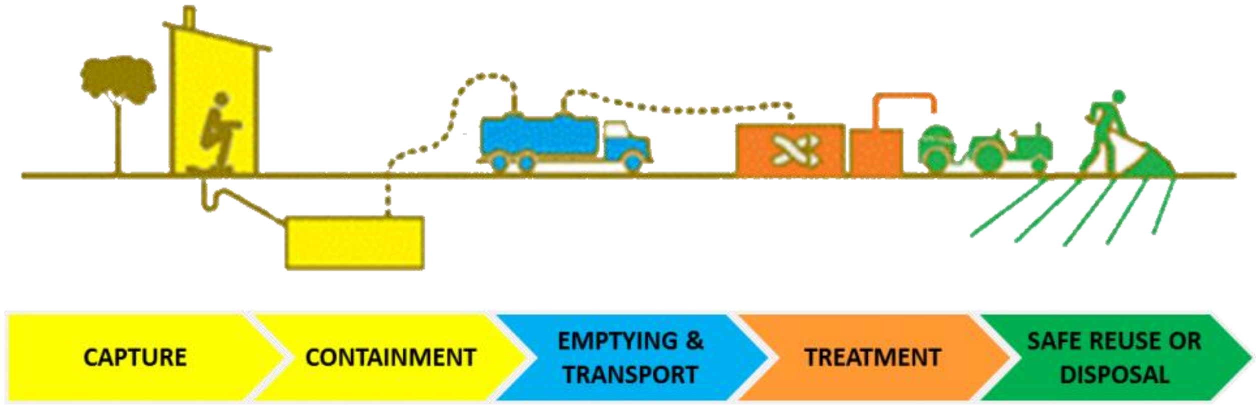

FIGURE 3: THE FAECAL SLUDGE MANAGEMENT SERVICE CHAIN (SOURCE: WWW.IRCWASH.ORG)

DIFFERENTIATING BETWEEN EXCRETA, FAECAL SLUDGE AND WASTEWATER

There are many misconceptions around the differences between excreta, faecal sludge and wastewater – they are not the same.

FIGURE 4 overleaf[7] indicates the differences between excreta, faecal sludge and wastewater, and the processes relevant to faecal sludge and wastewater.

It is also important to differentiate between the terms "on-site sanitation" and "off-site sanitation" which are defined as follows:

- **On-site sanitation** is defined as a sanitation system in which excreta and wastewater are collected and stored or treated on the plot / in the household where they are generated.
- **Off-site sanitation** refers to the networked sewer systems that convey wastewater from the toilet to a treatment site. Off-site sanitation is available where water supply is provided within the dwelling.

[7] Linda Strande. *Wastewater and faecal sludge: what is the difference?* [Online video]. Available at: 3.4 Wastewater and faecal sludge: what is the difference? - YouTube

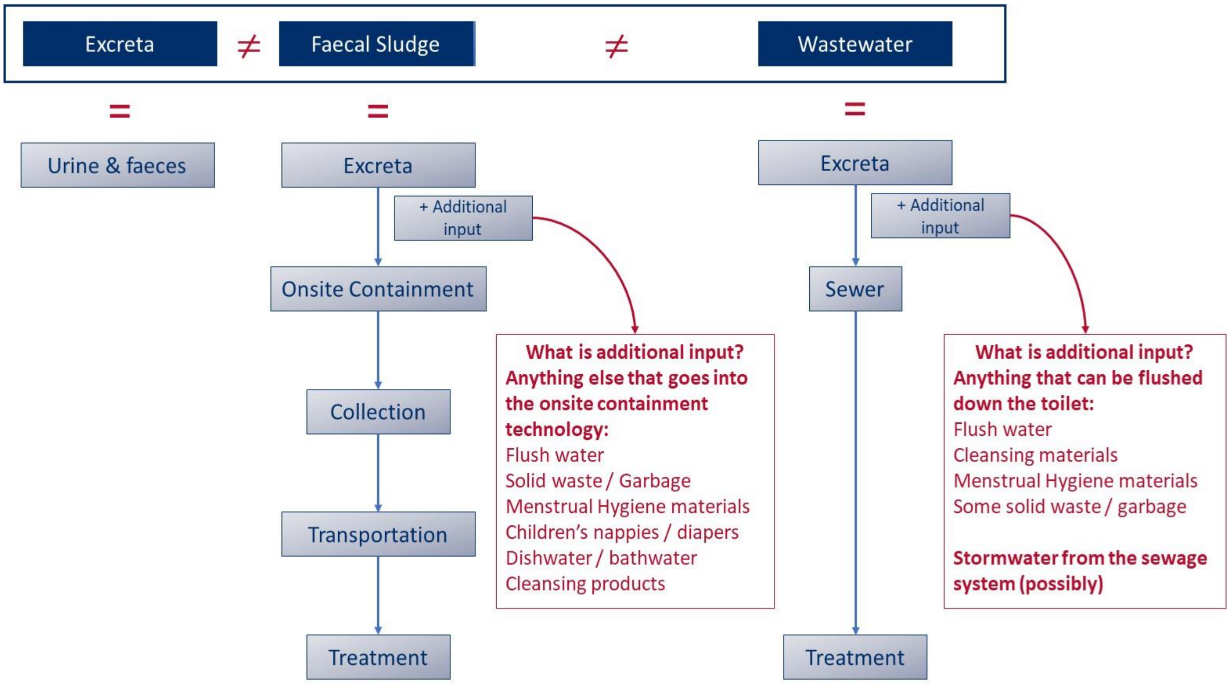

FIGURE 4: THE DIFFERENCES BETWEEN EXCRETA, FAECAL SLUDGE AND WASTEWATER (ADAPTED FROM LINDA STRANDE: WASTEWATER AND FAECAL SLUDGE: WHAT IS THE DIFFERENCE?[7])

TABLE 1 indicates the definitions and typical contents of faecal sludge and wastewater. It should be noted that there are also different types of wastewater sludge.

TABLE 1: TYPES OF SLUDGE AND THEIR TYPICAL CONTENTS

TYPE OF SLUDGE	TYPICAL CONTENTS
Faecal sludge: Faecal sludge' refers to the emptied contents of on-site system containments and includes liquid and solid contents of container-based vaults, pit-latrines, septic tanks, community toilets, or mobile toilets. This refers to on-site sanitation, which means it has not been transported through a sewer network. Faecal sludge in this context differs from other sludges which are part of the wastewater treatment process (see below)	Urine, faeces, flush-water, anal cleansing, and menstrual hygiene management (MHM) materials. Also depending on the toilets type plastics, textiles, paper, other refuse, fats, oils and grease, stones, grit, and sand. Mix of digested, partially digested, and undigested waste with mid-low water content and higher TSS.
Wastewater: "Wastewater" also referred to as "sewage" is the combination of water and excreta conveyed by networked sewer pipes directly to the WWTW. Wastewater (sewage) is only generated when piped water supply is available within the buildings or close to them. The waste conveyed by sewers is also referred to as off-site, or networked sanitation.	Urine, faeces, flushing water, anal cleansing materials and menstrual hygiene management material (MHM) Also bathing, kitchen and laundry wastewater – depending on household plumbing. Undigested waste, with a high water content and lower TSS.

There are three different types of wastewater sludge, as follows:

- **Primary Sludge:** Untreated settled raw sewage sludge from the primary settling tanks. Similar to faecal sludge, but with a higher liquid content.
- **Secondary Sludge or waste activated sludge:** Sludge from the activated sludge process that consists of the excess waste bacteria from the biological treatment process.
- **Tertiary sludge:** Tertiary sludge is treated primary sludge, usually digestate from and anaerobic treatment process.

The National Faecal Sludge Management Conceptual Framework is based on the sanitation service chain and is the basis for the National FSM Strategy currently under development.

NATIONAL FSM CONCEPTUAL FRAMEWORK

The FSM Conceptual Framework (**FIGURE 5**) was developed as a basis for the National FSM Strategy, which looks to address key challenges in South Africa with regard to the widespread use of on-site sanitation technologies and in the context of climate change. These challenges include:

- Water security: South Africa experiences shortages of both potable water and raw water resources owing to the effects of climate change and because of the incidence of prolonged droughts and minimum rainfall.
- Service delivery: Management systems for providing safe faecal sludge management services are limited and severely challenged.
- Rapid urbanization: South Africa's urbanization rate has been increasing more rapidly over the past 20 years which puts urban infrastructure under pressure.
- Groundwater contamination: South Africa has a protocol to Manage the Potential of Groundwater Contamination from Onsite Sanitation (DWS 2003) which can be applied to identify areas where sanitation poses a risk to groundwater.
- Perceptions of on-site sanitation: With 36% of South Africa's households reliant on on-site sanitation solutions, it is critical that the term "on-site sanitation" and the range of solutions that the term covers (smart toilets, septic tanks, improved pit latrines, urine diversion toilets etc.) is well understood. Often perceptions of on-site sanitation are that it relates specifically to pit latrines which are often in the news because of unfortunate incidents where people have fallen into them, and fatalities have occurred. There are limited regulatory mechanisms in place to ensure these latrines are both well-constructed and well managed and therefore public perception of pit latrines has become somewhat negative. It is important therefore, to broaden the understanding and definition of on-site sanitation across the board.

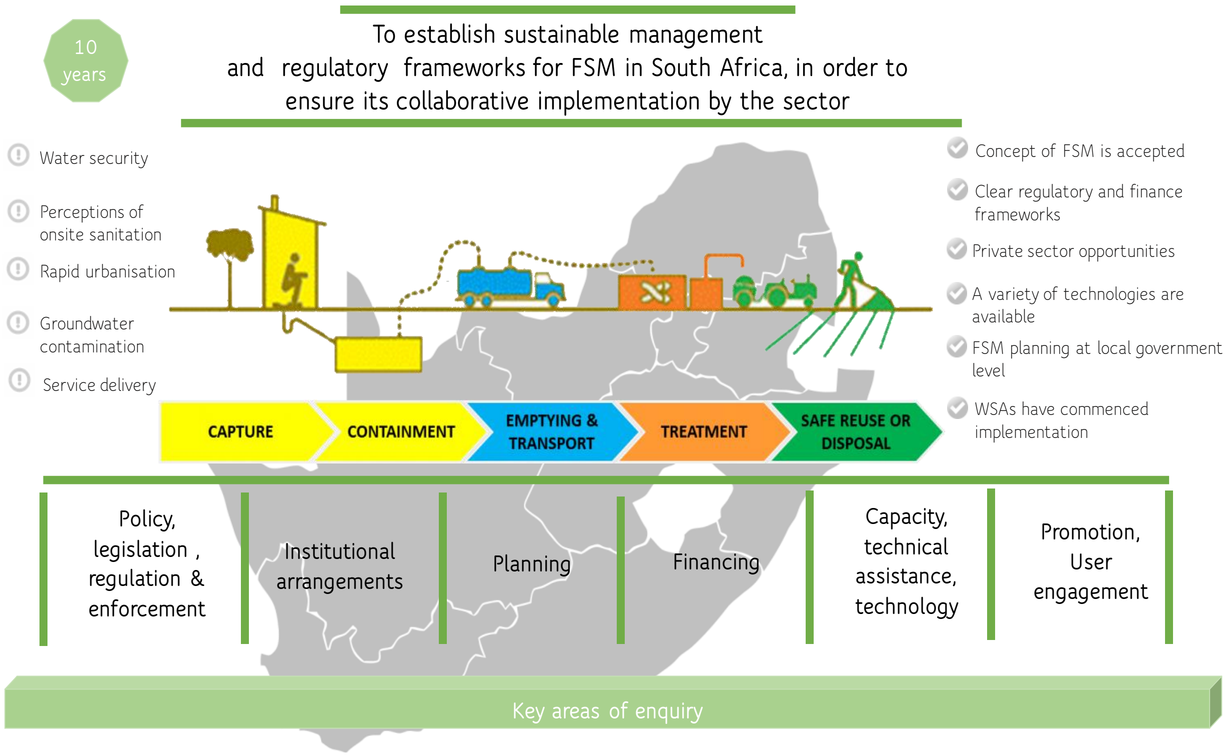

FIGURE 5: THE NATIONAL FAECAL SLUDGE MANAGEMENT CONCEPTUAL FRAMEWORK

The expected outcomes of the 10-year FSM strategy are as follows:

- That the concept of FSM is widely accepted in SA.
- That there are clear regulatory and financing frameworks for FSM across the service chain.
- That private sector opportunities have been identified and the mechanisms to encourage private and other sector stakeholder involvement have been unlocked and established.
- That a variety of appropriate and affordable on-site sanitation technologies have been developed.
- That FSM capacity has been built across the aspects of the sanitation service chain.
- That FSM mechanisms and measures are integrated into planning and management systems of all WSAs (Water Services Authorities) in South Africa.
- That the implementation of the FSM service chain infrastructure and processes has commenced in WSAs.
- That there is robust testing and implementation of FSM re-use opportunities and technologies.

CHAPTER 2: REGULATORY AND INSTITUTIONAL FRAMEWORK FOR FSM IN SOUTH AFRICA

INTRODUCTION

The Resilient Waters team are supporting the development of a faecal sludge management strategy for South Africa. This arises as a result of the uptake of the development of on-site sanitation technology. In addition to the development of on-site facilities, it is now recognised that facilities need to be safely emptied and the content disposed of or reused, also referred to as the "2nd generation challenge"[8]. We thus need to look at the status quo of the regulatory framework and the institutions involved. The key objective is to understand what exists, and what the current challenges and gaps are. We do this by enquiring through the lens of the regulatory framework (what is already enabled and what still needs to be enabled) and the institutions (roles and responsibilities) in regard to faecal sludge management. We conclude with findings.

FAECAL SLUDGE

We understand faecal sludge in this context to be "a mixture of human excreta, water, urine, and solid waste disposed of on-site sanitation technologies"[9]. Because it is human excreta, we are dealing directly with households and accordingly the decentralised powers and functions of local government. We do not intend to deal with industrial or any other waste at this stage.

FAECAL SLUDGE MANAGEMENT

The collection, removal, disposal or purification of human excreta is regarded as a "sanitation service" in terms of the Water Services Act[10]. Legally, South African's have a right of access to basic sanitation[11]; every water services institution must take reasonable measures to realise this right, and every water services authority must, in its water services development plan, provide for measures to realise this right[12]. This is aligned to the Constitutional allocation of the functional area allocated to local government of "domestic wastewater systems"[13]. Local government must ensure that communities have access to sustainable services and promote a safe and healthy environment.

Faecal sludge needs to be managed primarily from a public health perspective. It is thus recognised as a public service – and the function of managing it is allocated to local government[14]. More recently there

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[8] Tackling the second-generation sanitation challenge ay scale: Business solutions for inclusive faecal sludge management in Bangladesh, De La Brosse et al; August 2017.
[9] Faecal Sludge Management Conceptual Framework, DWS, 2021.
[10] Section 1 of the Water Services Act No. 108 of 1997 – definition of "sanitation service".
[11] basic sanitation is defined in Section of the Water Services Act No. 108 of 1997 to mean "the prescribed minimum standard of services necessary for the safe, hygienic and adequate collection, removal, disposal or purification of human excreta from households, including informal households". It is updated in the Norms and Standards for Water and Sanitation Services Delivery, DWS, 2017.
[12] Section 3 of the Water Services Act No. 108 of 1997 – right of access to a basic water supply and basic sanitation.
[13] Local government functional areas listed in Part B of schedules 4 and 5 of the Constitution of the Republic of South Africa Act No. 108 of 1996.
[14] Section 152 of the Constitution of the Republic of South Africa Act. No 108 of 1996.

are also environmental and climate mitigation strategies[15] supporting the approach and need to manage faecal sludge.

There is clear policy imperative for faecal sludge management. In the latest policy statement – the National Sanitation Policy, 2016, the then Minister of Water and Sanitation made it clear that alternative technologies need to be sought. It is a policy position that "the provision of sanitation systems which minimise the use of water resources and the negative impacts on water resources and the natural environment are required". The consequence of this is that faecal sludge is going to increase and needs to be managed in line with the key policy principles "user pays and on increasing the economic value of sanitation". This informed the National Norms and Standards for Domestic Water and Sanitation Services, published by DWS in the Government Gazette No. 982 dated 8 September 2017. The Norms and Standards do specifically address on-site sanitation (section 7.3.2) but does not regulate standards, and rather specifically provides that "The type of sanitation infrastructure or facility adopted and installed shall be an improved facility and depends on the preferences and cultural habits of the intended users, the capacity of the services provider (financial and skills), the existing infrastructure, the availability of water (for flushing and water seals), the soil formation (for groundwater and surface water protection) and the capacity of the applicable wastewater treatment methods"[16]. This means that water services authorities must regulate locally through Council determined and approved policies and by-laws.

KEY ROLE PLAYERS:

We identify 5 key players in faecal sludge management activities namely:

GENERATORS OF FAECAL SLUDGE

Households generate faecal sludge through their sanitation practises. It is globally recognised and supported that households should have infrastructure to collect the faecal sludge[17], and the faecal sludge needs to be removed. As yet, there no promulgated standards for infrastructure for on-site sanitation. It is not always clear who must provide it, and how it should be paid for. This needs to be addressed by municipalities in their legislative process of setting service levels and associated tariffs through the integrated and spatial planning processes and engagement with the community.

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[15] The 2004 National Climate Change Response Strategy, followed by the National Climate Change Response White Paper approved in 2011 (Climate Response Policy) form the foundation of national climate policy. In 2012 climate change became a key element of the National Development Plan.

[16] National Norms and Standards for Domestic Water and Sanitation Services, published by DWS in the Government Gazette No. 982 dated 8 September 2017, pp51.

[17] Sustainable Development Goals, United Nations General Assembly, 2015.

WATER SERVICES AUTHORITY

Municipalities are designated water services authorities. They have a constitutional duty to ensure service delivery and promote a safe and healthy environment and are accountable directly to the households in the area of jurisdiction. As the water services authority there are a number of functional areas that they must attend to including the legislative function (making by-laws and policies; setting tariffs; planning[18]; developing infrastructure; and deciding how to deliver services[19]. These obligations are regulated by the Water Services Act and Local government legislation including the Municipal Structures Act, Systems Act and Municipal Finance Management Act. Because they arise in different legislation, it makes implementation for municipalities challenging and/or opportunities to implement project-specific structures are not followed through. These are implementation issues rather than a legislative issue, which can be addressed through guidelines rather than new legislation.

DEPARTMENT OF WATER AND SANITATION

DWS is the sector leader and in 2014 it was clarified and confirmed that its accountability extended to sanitation. It regulates and supports sanitation services delivery in terms of the Water Services Act No. 108 of 1997.

PRIVATE SECTOR CONTRACTORS

There exist opportunities in the faecal sludge management to involve public and private sector operators and contractors. The scope of involvement needs to be determined in a project by project basis. Once the scope is determined, the risks can be identified and allocated, and this will inform the remuneration model and contracting structure. Once the contracting structure is determined the procurement strategy can be developed and at that stage regulatory requirements determined and complied with. Because of the involvement of collection and transport in FSM, it is sometimes perceived as a "private service" as opposed to off-site sanitation which is regarded as a public service. This misconception must be addressed though proper contracts and performance monitoring of operators through supply chain management and contracting procedures of the municipality.

OTHER NATIONAL DEPARTMENTS

There are a number of other role players whose involvement is triggered due to interacting activities n FSM. The interests are generally aligned to their respective mandates and do not necessarily duplicate but must be co-ordinated.

- Department of Environment regarding environmental management issues.

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[18] For example, Integrated Development Plan in terms of the Municipal Systems Act, Spatial Development Framework in terms of Spatial Planning and Land Use Management Act; Water Services Development Plan in terms of the Water Services Act.
[19] Section 78 of the Municipal Systems Act.

- Department of Housing regarding spatial development and housing.
- Department of Health regarding public health issues.
- Department of Transport who regulates licensing of transport of faecal matter.

– The department of Local Government has a regulatory and support function over the functioning of local government.

KEY ACTIVITIES IN FAECAL SLUDGE MANAGEMENT

The sanitation service chain recognises 4 key activities required to be undertaken. Each activity with its own regulatory imperatives and each can individually or collectively be undertaken in a number of ways (institutional arrangements), depending on the specific situation.

HOUSEHOLD / USER INTERFACE

The municipality designated as the water services authority is accountable for service delivery directly to the community. This interface requires the municipality to undertake its authority functions including integrated planning in regard to the sanitation service chain, infrastructure planning, determining how the activities are to be undertaken and allocating capacity and passing and enforcing of the required policies and bylaws (water and sanitation, tariff, building and planning etc). FSM accordingly will not sit neatly in one plan or one by-law but must be consciously co-ordinated and catered for. In planning and structuring its activities, it is subject to national norms and standards. The Water Services Act specifically empowers the norms and standards for tariffs which allows for differentiation. Planning is required in regard to the municipal service, the facilities, the transport arrangements, the infrastructure and capacity for treatment and the opportunity for re-use. Households need to know what their potential facility/technology options are, what the building standards are and that they need to register their facility with the municipality for monitoring purposes. In terms of law, service levels and tariff structures can be justifiably differentiated by the water services authority.

EMPTYING & TRANSPORT

This activity is directly related to public health and municipal services and thus must be ensured by local government. Planning for emptying must be undertaken. Community must know how to request the service and what it will cost.

The current DWS model by-laws (2005) anticipate both public and private service providers for emptying and transport. Private sector service providers are required to request permission from the municipality to operate.

This service can be provided by the municipality directly – if it has access to the equipment and capacity required to deliver the service. Alternatively, it can consider a process of encouraging local entrepreneurship where potential service providers are registered by the municipality and authorised by the municipality to empty and transport faecal sludge from households, at a Council-prescribed tariff to be collected directly from the household requesting the service, alternatively from the municipality in the case of subsidised services to the indigent. The private party can potentially be expected to take risk in funding their own equipment and capacity planning and requirements and should be incentivised to provide the service. The key issue to consider is how the operator is accessed by households, how it is remunerated, and what it pays (gate fee) to the municipality to deliver the faecal sludge to municipal treatment facilities.

If the municipality chooses not to do it itself, but to rather engage transport operators, this procurement process would be run in terms of the municipality's supply chain management system, requiring competitive tendering process to be registered. If it chose to do it itself, it would need to allocate sufficient budget and capacity as required by the Municipal Systems Act.

TREATMENT & DISPOSAL

This is a significantly regulated activity in terms of health and environment. It requires significant technical skill and infrastructure. It will in the ordinary course be undertaken by the municipality at its wastewater treatment plants unless there is opportunity to involve private sector in funding infrastructure development to assist with alternative waste treatment technologies. It must be operated in accordance with environmental regulations and DWS output requirements.

RE-USE

The National Sanitation Policy, 2016 promotes the circular economy of waste. This is aligned to the international imperatives of climate change mitigation. It is an option for the municipality to try to find an off-take market for the treated faecal sludge. But this is not the core business of a municipality, nor a municipal service. If scope permits, the activities of transport, treatment and re-use can be structured in such a way as to consider an arrangement where a private sector operator is competitively procured and takes all design, technical, financial and operational risk in undertaking the function. Value for money, affordability and risk transfer will need to be demonstrated[20]. At this stage there is limited market (off-take) established and so the risk appetite will be low. It is, however, a structuring option for municipalities with larger faecal sludge input, and established markets for off-take, to consider.

FINDINGS

REGULATORY FRAMEWORK

Findings include:

- The Water Services Act, 1996, the National Sanitation Policy, 2016, and the National Norms and Standards for Domestic Water and Sanitation Services, 2017, promotes a number of key principles which support faecal sludge management. The challenge lies in implementation.

[20] Section 120 of the Municipal Management Finance Act, 2003 regarding PPPs and the PPP Regulations.

- What is potentially missing from the legislative definition of sanitation service in the Water Services Act No. 108 of 1996 is the issue of "treatment". This gap is identified and addressed in the National Norms and Standards for Domestic Water and Sanitation Services, 2017

- The suite of local government legislation regulates local government planning, legislative function, tariff setting, supply chain management and contracting etc. There is nothing prohibiting municipalities from addressing faecal sludge management activities in its internal municipal decision making processes.

- Norms and Standards for construction of facilities needs attention at a national level, which can then filter through into local by-law implementation.

- The draft model by-laws published by the national Department of water in 2005 does in principle deal with on-site sanitation and transport of faecal sludge. It has long been recognised as a matter to be regulated by municipalities in their local context.

In principle, there is nothing in the current legislative framework that specifically prohibits the activities of faecal sludge management. Implementation requires consideration of situation-specific circumstances and decision making and implementation by local government, and regulation by national government. However, whilst regulations can be developed and promulgated, the key issue seems to be one of interpretation and implementation, and accordingly where economic and social incentives can be identified and supported to regulate behaviour, rather than more law which needs to be implemented and enforced, this should be the preferred way.

INSTITUTIONAL

The roles of local government and DWS are clear. The municipality must plan for sanitation services for its area of jurisdiction, and this includes faecal sludge management if one looks at the definition of "sanitation service" and the right to differentiate in service levels and tariff setting as is appropriate in the local context. DWS must regulate and support sanitation service delivery (note that this function of water sector leader is quite distinct from the role of COGTA which is to regulate local government systems etc). DWS does not regulate local government- it regulates the water sector, a key player of which is local government in their capacity as water services authority. The roles of other stakeholders require co-ordination if it is triggered in the particular circumstance. In terms of the Constitution and the Intergovernmental Relations Framework Act No. 13 of 2005, there must be co-operation.

Local government must be supported to implement faecal sludge management, which requires focus on each of the activities in the services chain. From national government perspective this includes:

- National norms and standards for on-site sanitation facilities development (construction and operation)

- National norms and standards for treatment of faecal sludge

- Programmatic support on faecal sludge management including:

- Guidelines on community participation in faecal sludge management (clarity on facility development and funding opportunities; service delivery; costs; WASH etc),
- Guidelines on operator contracting models for emptying/ transport, treatment and disposal and re-use,
- Guidelines for monitoring and evaluation,
- Model FSM by-laws (Faecal sludge management, tariff setting, service levels etc),
- Targeted and conditional grant funding support for infrastructure and systems; and
- Support to incentivise the establishment of private sector off-take markets for re-use.

CHAPTER 3: FSM SERVICE DELIVERY AND TECHNOLOGIES

STATUS QUO OF SERVICE DELIVERY AND TECHNOLOGIES FOR FSM IN SOUTH AFRICA

According to data collected by StatsSA and presented by DWS[21] in 2019 there were 16.7 million households in South Africa. Of this number, 61.3% used toilets connected to a sewer system. A further 1.7% used bucket toilets or chemical toilets which were managed within the context of an urban sewer system. Of the remainder, 4.2% used septic tanks, 17.2% used ventilated pit latrines, 13.3% used unimproved pit toilets and 0.3% used some form of on-site ecological sanitation system (e.g. urine diversion). Open defecation was still practiced by 1.5% of the population, and the balance (0.5%) used some unspecified form of sanitation. Summarising these numbers, the sanitary waste of 63% of the population is processed in wastewater treatment plants on a continuous basis, while 35% of the population used some form of on-site sanitation where the sludge is dealt with infrequently, or not at all. This report deals only with the 35% who use on-site sanitation systems.

Recently the use of Shit Flow Diagrams (SFDs) (**FIGURE 6**) as a tool for summarizing the status of FSM management has been demonstrated in 10 municipalities in South Africa[22]. If this can be done for all municipalities then SFDs could be compiled on a provincial and national basis, and those SFDs would be a useful high-level tool for monitoring overall progress in FSM management. However, SFDs, as potentially useful as they may be, are only as good as the data that is used to generate them. A lot of work is needed to ensure that the information on which they are based is current, credible, verified and based on a sound understanding of what is acceptable in terms of containment, emptying, transport and treatment, and what is not.

[21] From presentation to FSM steering committee by Andre van der Walt, Chief Director, National Sanitation Services, DWS, May 2021
[22] Emanti Management (Pty) Ltd. June 2020. Country-wide Shit-Flow Diagram: Establishing National Excreta Flows in South Africa. Report to the Water Research Commission. WRC Report No. TT 825/20.

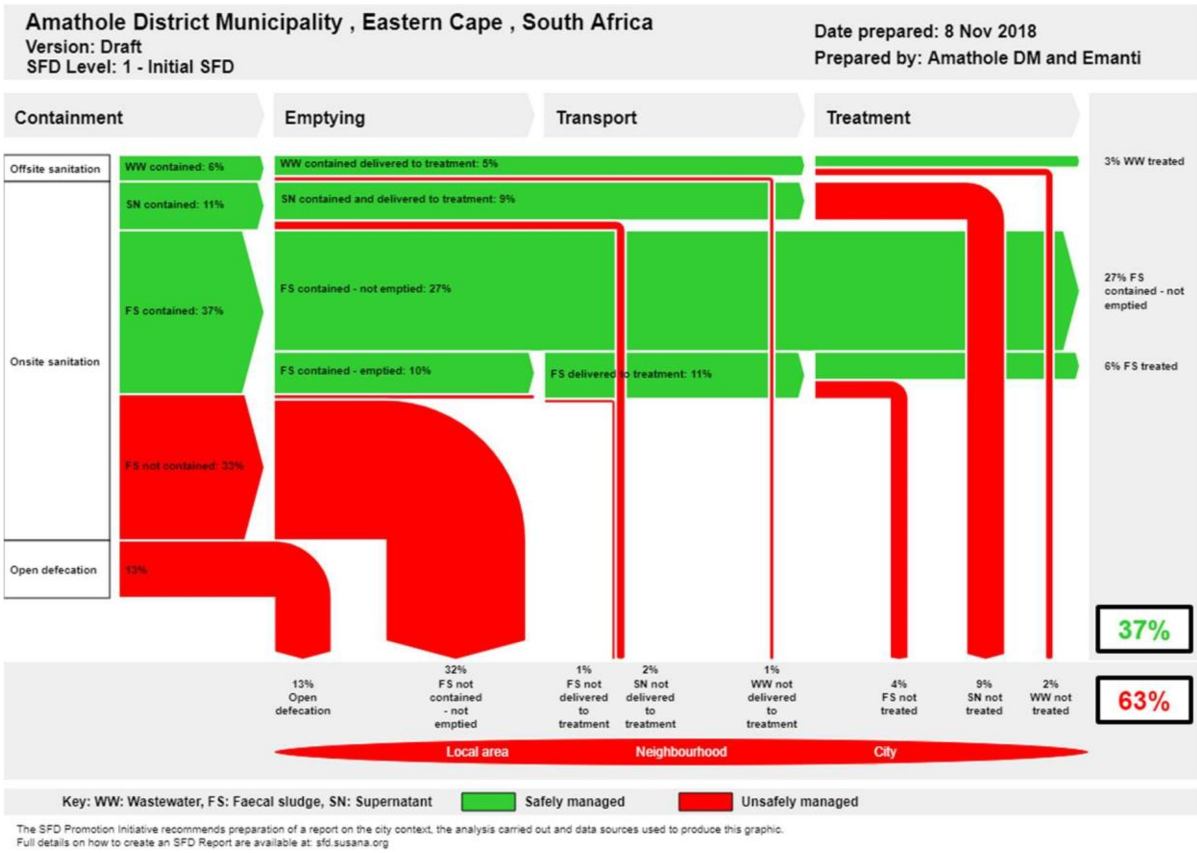

FIGURE 6: THE SFD PREPARED FOR THE AMATHOLE DISTRICT MUNICIPALITY, ONE OF 10 SOUTH AFRICAN MUNICIPALITIES WHICH HAS WORKED WITH THE WRC ON PILOTING THE SFD CONCEPT IN SOUTH AFRICA[23]

ON-SITE SANITATION CONTEXT

In order to discuss FSM policy and strategy in South Africa, it is necessary to first have an understanding of the general context. Broadly speaking, the places where on-site sanitation is used can be categorised as: unsewered urban areas, peri-urban areas and rural areas.

UNSEWERED URBAN AREAS

While most parts of South Africa's towns and cities are served with sewers, there are areas served by a range of other methods. For example, affluent areas, sewage is piped to septic tanks and conservancy

[23] Emanti Management. 2021. SFD Lite Report for Amathole District Municipality. Report prepared for the Water Research Commission.

tanks. Sanitation arrangements in the informal settlements, however, range from city to city and encompass the full range from chemical toilets to portable toilets, to pit latrines (formal and informal, shared and private) to sewered communal ablution blocks.

PERI-URBAN

Peri-urban areas are places in transition from rural to urban. They may be served with electricity and water, but the settlements are not formally laid out, the roads are typically not surfaced and there are no sewers. Unlike informal settlements within the towns, peri-urban settlements tend to be more spread out. People use pit latrines or septic tanks according to what they are able to afford. In many of these areas the government has provided VIP toilets to most homes, or in Durban's case, double-vault urine diversion toilets.

RURAL

South Africa's rural areas are a mix of farmland, dispersed settlements and small towns. The more affluent generally use septic tanks and the less affluent generally use pit latrines. Parts of some of the small towns are served with waterborne sanitation. Owner built pit toilets tend to be of a poor standard (unsanitary and unsafe) and are broken down and moved when they have become too full to use. Several million homes have been provided with VIP toilets as part of the drive to universal access to decent sanitation, with most of these toilets having been built in the last 15 years. The question of full VIPs is only now becoming a general concern and it is hard to find a local authority which has a policy, plan or budget for FSM management[24].

FSM TECHNOLOGIES

TOILET / CONTAINMENT TECHNOLOGIES

Toilets that are not connected to a sewer system can be divided into two categories: those that have a water seal and use some kind of flushing system to move the waste to a tank or pit; and those that do not use water (dry systems).

Flush toilets

Flush toilets typically require anywhere from two to ten litres of water to flush, and the waste is transported by a pipe to a septic tank or a leach pit. A septic tank is sealed and has an outlet from which the overflow drains to a soakpit or seepage bed. A leach pit is not sealed and generally has no overflow and associated soakpit. Whether or not a leach pit is adequate or not depends on the soil permeability and the volume of liquid the pit is required to absorb each day. If kitchens and bathrooms

[24] Still DA, Foxon K. 2012. Tackling the Challenges of Full Pit Latrines - Volume 1: Understanding sludge accumulation in VIPs and strategies for emptying full pits. Water Research Commission Report No. 1745/1/12, ISBN 978-1-4312-0291-1.

are connected to the sewer, then a septic tank and soakpit is needed, whereas if only the toilet is connected and a low flush system is used, then a simple leach pit may suffice.

Dry sanitation systems

The most common dry sanitation system is the **pit toilet**. Waste falls directly into a pit which is below the toilet. The pit may be lined or not, and it may be well drained, or not. Sludge characteristics and filling rates vary considerably. A **Ventilated Improved Pit toilet or VIP** is simply a pit toilet which has been properly designed and built, thus providing an acceptable minimum standard of sanitation. Key requirements for a pit toilet to qualify as a VIP include that it is structurally sound; it has a ventilation pipe of at least 100 mm diameter extending at least 500 mm above the toilet roof, fitted with an intact flyscreen; and it is fitted with a pedestal which is safe for small children to use (i.e. opening less than 200 mm in diameter) and which is made of a material which does not soil easily and is easy to clean. Some toilets which have been built under government VIP building programmes do not meet these requirements, particularly with regard to pedestal design and materials.

Sludge can be considered to be safely contained in a pit toilet if the toilet is structurally sound (i.e. not in danger of collapsing or unsafe to use) and not over full. A pit should be considered to be full once the sludge, when levelled off, is less than 0.5 metres from the underside of the cover slab.

Apart from standard pit toilets, there are a great many other types and designs of dry toilets. These include:

Double vault toilets. These are pit toilets with two vaults, with only one vault used at a time. When the first vault is full, the toilet pan is moved across to the second vault, and the hole over the first vault is sealed. By the time the second vault is full the contents of the first vault have reduced in volume and are much easier to empty than fresh sludge (the pathogen content and the odour are both being diminished). The most notable example of this design in practice in South Africa can be found around Durban, where over 100 000 have been built in the last 20 years. The Durban toilets also incorporate urine diversion to a soakpit, which reduces the odour and the moisture content of the sludge.

Drying or desiccating toilets. These designs generally incorporate enhanced ventilation and solar drying to produce a dryer sludge with reduced volume. They use sealed pits, making them more suitable than ordinary pits in places where the water table is very shallow or where the soil is too shallow to dig standard pits. The most notable example in South Africa is the Enviroloo, which has been used by the Department of Education for many school toilets, primarily in Limpopo and Eastern Cape province. These systems do, however, require more frequent maintenance than standard pit toilets.

Innovative toilet designs. There are many other types of dry toilet designs, too numerous to cover in detail in this report. They include auger toilets, incinerating toilets, composting toilets and a number of designs developed under the Bill and Melinda Gates Foundation's Reinvent the Toilet Programme. Challenges with any sanitation innovation are affordability, user acceptance and reliability. People who are interested in alternative, generally more ecologically appropriate forms of sanitation may choose to use one of these forms of sanitation in which case their acceptance of whatever management and maintenance that system entails is implicit. However, it is generally ill-advised to impose a novel sanitation system on the public unless and until it has become widely known and is considered to be acceptable and even desirable. Innovation is particularly difficult in the South African context where due to our history anything that does not look very much like a conventional flush toilet tends to be considered as second-rate.

SLUDGE ACCUMULATION RATES

Sludge accumulates in all on-site sanitation systems. Any claims by the promoter of a sanitation system that sludge does not accumulate in that particular system should be treated as bogus. Sludge accumulation rates are however very variable.

Septic tanks. Sludge typically accumulates in a septic tank or leach pit at a rate of 30 to 40 litres per user per year[25]. It should be noted however that less than half of the volume of a septic tank is available for sludge accumulation. Before the level of the sludge reaches the level of the inlet to the overflow pipe the tank must be desludged. It is a good idea to empty septic tanks too often rather than not often enough, as neglecting to empty them timeously will result in sludge carry over to the soakpit, which will ultimately lead to the failure of the soakpit. When a vacuum tanker empties a septic tank it removes the scum, liquid and solids, which means that the volume of septage generated per user comes to more than the sludge accumulation rate. A 2000 litre (volume to overflow level) septic tank which serves a family of five should ideally be emptied at least every four years, which means the amount of septage generated works out at approximately 100 litres per user per year.

Pit toilets. Sludge typically accumulates in a pit toilet at a rate of 40 to 60 litres per user per year[26]. If the pit has a usable volume of, say, 2 m^3 then a family of six will fill it in 6 to 10 years. Using the toilet for the disposal of solid waste other than toilet paper, which is unfortunately a common practice, shortens the useful pit life and makes it considerably harder to empty.

Use of pit additives, bio enzymes etc to reduce filling rates. A toilet pit is a natural faecal sludge digestion system, with a very wide range of biological activity from a microscopic scale (bacteria) to insect scale. Through this activity the contents of the pit are in a constant state of digestion, which is why although a toilet user will typically contribute more than 400 litres of liquid and solid waste to the toilet in a year, the long term pit filling rate per user (excluding solid waste) is generally only a tenth of that amount. All this waste processing activity initiates through natural processes without any help from the users. Any claims made that pit additives or bio enzymes will slow down or reverse the pit filling rate are bogus and no public money should be spent on these products[27].

EMPTYING TECHNOLOGIES

Vacuum tankers, also referred to as honeysuckers, are the standard technology used for emptying **septic tanks**. The vacuum pump creates a vacuum in the vacuum tank, which fills with sludge via a

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[25] Wright A. 1999. Septic Tank Systems in the South African Coastal Zone. Report to the Water Research Commission by Environmentek, CSIR. WRC Report No TT 114/99

[26] Still DA, Foxon K. 2012. Tackling the Challenges of Full Pit Latrines Volume 2: How fast do pit toilets fill up? A scientific understanding of sludge build up and accumulation in pit latrines. WRC Report No. 1745/2/12, ISBN 978-1-4312-0292-8

[27] Foxon F and Still DA. 2012. Do pit additives work? Technical note prepared on behalf of the Water Research Commission.

suction hose. No sludge goes through the vacuum pump. The only limitation is that the tanker has to be able to park not more than 5 metres above the level of the septic tank, otherwise it will not be able to empty much of the sludge (this is because no vacuum pump can practically suck to more than a depth of approximately 8 metres, and the inlet to the vacuum tank is usually 2 metres above the ground). In hilly terrain and informal settlements with a poor road network this means that not all septic tanks can be reached by vacuum tanker. Good management is required to ensure that the full contents of the septic tank are emptied, and not just the liquid portion. If a septic tank is little used and is not emptied for a very long time (10 or 20 years) the sludge contents will be very dense and harder to empty. That is why, apart from the need to protect the soak pit from sludge overflow, the other reason to empty septic tanks more often is to ensure the sludge is not too dense.

Sludge in **pit toilets** is very variable in consistency, ranging from similar to septic tank sludge to almost soil like in its density. The consistency depends on the pit design (e.g. whether the walls have been provided with drainage holes or not), the surrounding soil conditions and the amount of water added to the pit during use. There is typically a significant amount of solid waste in pit sludge, which makes emptying harder and slower.

For pits you need a combination of vacuum and manual emptying. Vacuum suction is used for wet sludge, and manual emptying is used if there is no vacuum tanker or if the sludge is very dense and full of trash. For manual emptying one needs long handled spades, forks and scoops (Figure 7). If there is no vacuum tanker available, or if the vacuum tanker cannot access the site where the pit is to be emptied, then a portable vacuum pump, such as the South African developed Pitvaq, can be used (**FIGURE 8**). The Pitvaq fills 50 litre drums, rather than a large vacuum tank so it is a more labour-intensive process than the use of a vacuum tanker.

Pit emptying typically costs between R1000 and R2500. In some places like Ethekwini it has been provided by the city as a free service on a periodic basis (theoretically every 5 years, but in practice more like 8 years), but most municipalities do not provide this service. Where no pit emptying service is available or where people cannot afford to have their pits emptied, one cheap and particularly unsanitary solution which is adopted is to dig a hole next to the toilet, then knock a hole in the wall and sluice the pit contents into the hole.

FIGURE 7: MANUAL PIT EMPTYING USING LONG HANDLED FORKS, SHOVELS AND SCOOPS. AFTER COMPLETION THE SITE IS WASHED DOWN WITH A STRONG DISINFECTANT SOLUTION

FIGURE 8: THE PITVAQ, A PORTABLE VACUUM PUMPING MACHINE DEVELOPED IN SOUTH AFRICA FOR EMPTYING PITS AND SEPTIC TANKS IN HARD TO REACH PLACES. THE PITVAQ IS USED IN CONJUNCTION WITH 50 TO 60 LITRE SEALABLE SLUDGE DRUMS, WHICH CAN BE RELATIVELY EASILY AND HYGIENICALLY CARRIED AND TRANSPORTED.

ALTERNATIVES TO EMPTYING

Those responsible for FSM should not lose sight of the alternatives to emptying.

Unlined pit latrines. If pits are unlined, they generally cannot be safely or easily emptied. When the pit is full the toilet above the pit should be demolished and the pit should be covered over with at least 300mm of soil. Covering over an abandoned pit is a safe form of faecal sludge disposal. What is unsafe is to demolish the toilet and leave the pit open.

Precast Pit Latrines. Some ten years ago, most municipalities in SA standardised on precast concrete designs for VIP toilets. Apart from lower costs, one of the arguments for precast structures is that they could be moved when the pits are full. No large-scale relocation of toilets has as yet been done, but many of the precast toilets are now full and should be either emptied or moved. Moving requires the digging of a new pit to specific dimensions, the building of a collar to reinforce the top of the new pit, the dismantling and re-assembly of the top-structure, and the covering over of the old pit.

Conversion to low flush or pour flush. Instead of emptying, the pit toilet can be converted to a pour-flush or low-flush toilet, with an offset leach pit (ideally two leach pits so that one can be rested while the other is used). With alternating leach pits, pit emptying is a relatively easy, safe and economical task. Pour flush or low flush toilets have significant advantages over pit toilets: sludge accumulation rates are 40% to 50% lower, the pits are not used for trash disposal, and there is a water seal which greatly improves the user experience.

Use of alternate toilet designs where sludge is managed on a routine basis. There are a number of alternate dry sanitation designs which require the user to manage the sludge on a routine basis. These include composting toilets, drying toilets and incineration toilets. These all result is a fairly inoffensive waste product which can potentially be used as a soil conditioner or some kind of garden fertilizer. The key requirement for all of these technologies, however, is that they require user acceptance and buy-in. If they are imposed from the outside on a large scale as part of government programmes, the chances of general acceptance and conformity with the maintenance requirements are not good. All that government can do with the more promising of these technologies is to support demonstration projects using willing volunteers, and to encourage their wider adoption if they prove to be successful.

ONSITE VS OFFSITE DISPOSAL

Faecal sludge typically contains various pathogens (bacteria, viruses and helminths). Surface disposal of faecal sludge is a danger to public health and should be penalised.

In peri-urban areas served by septic tanks, the septage is generally taken to the nearest WWTW.

Off-site disposal of sludge requires transport, so it is much more expensive. On-site disposal by burial is most commonly practiced in the case of pit latrines. On-site burial of pit contents is the simplest form of FS disposal, and it is in line with internationally accepted guidelines for FS management[28]. On-site burial (**FIGURE 9**), or the abandonment and covering up of old pits is the most common practice, and by far the most economical. There is no danger from pathogens in buried sludge as they are fully contained. Sand and soil are an effective medium for the containment of pathogens in FS, and all pathogens eventually die after they have been buried in soil[29]. There is a potential for groundwater contamination is sludge is spilled on the surface during the emptying process. If it is spilled it must be scraped up and the area must be disinfected with lime or a strong bleach solution.

Trees planted alongside or above old pit toilets or sludge disposal sites benefit from the carbon and nutrients added to the soil, and there is evidence that the enhancement to the fertility of the soil has persisted for at least two growth cycles[30].

FIGURE 9: ENTRENCHMENT OF PIT SLUDGE IS A SAFE AND ECONOMICAL DISPOSAL OPTION WHICH ELIMINATES THE NEED FOR TRANSPORT IF THERE IS SPACE FOR IT TO BE DONE ON THE SITE WHERE THE PIT IS EMPTIED. ETHEKWINI HAS USED ON-SITE BURIAL FOR MOST OF ITS PIT SLUDGE DISPOSAL. TREES PLANTED OVER OR NEAR THE DISPOSAL SITE SHOW ENHANCED GROWTH.

TRANSPORT OF FAECAL SLUDGE

Septage is transported in vacuum tankers (honeysuckers). Pit sludge is transported by vacuum tanker, or more commonly, in closed drums. Vacuum tanker hoses must be capped before they are transported otherwise, they may spill sludge. Where drums are used for the transporting of sludge,

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[28] Tayler K. *Faecal sludge and septage treatment: A guide for low and middle-income countries* [Online]. Available at: Faecal Sludge and Septage Treatment: A Guide for Low- and Middle-income Countries (susana.org)

[29] Still DA. Lorentz S and Adhanom G. 2015. Entrenchment of Pit Latrine and Wastewater Sludges. An Investigation of Costs, Benefits, Risks and Rewards. Report to the Water Research Commission. WRC Report No 2097/1/14. ISBN 978-1-4312-0624-7

[30] Tree growth has been found to be significantly enhanced not just in the first growth cycle, but also in the second growth cycle without any further addition of sludge. This is the subject of ongoing research emanating from the earlier WRC project referred to above.

they should be supplied with covers that screw or clamp in place, to prevent the spillage of sludge while in transit. The drums should also be wiped clean with a disinfectant soaked rag before being loaded onto the truck in the event that sludge is spilled on the outside of the drum.

The main concern with faecal sludge transport (Figure 10, **FIGURE 11**) is that it is expensive and operators will tend to dispose of sludge illegally if they are not monitored. There is therefore a need for Faecal Sludge Treatment Plants to serve small towns without wastewater treatment plants, to save on sludge transport costs.

FIGURE 10: TRANSPORT OF PIT SLUDGE IN DURBAN PIT EMPTYING PROGRAMME (NOTE: IT IS BETTER PRACTICE IS TO USE 50 LITRE DRUMS WITH SEALABLE COVERS AS SHOWN IN THE FIGURE 11 BELOW)

FIGURE 11: PIT SLUDGE IN LUSAKA IS TRANSPORTED IN SEALED 50 LITRE DRUMS.

TREATMENT TECHNOLOGIES

Compared with other developing countries, a relatively high percentage of South Africa's population (61%) is connected to a sewer network. This means there is a significant existing capacity for wastewater treatment in South Africa, probably in the order of 7 000 ML/d. Only 4% of South Africa's population use septic tanks, and whereas an average household will produce 700 litres of wastewater per day, the same household using a septic tank will produce only 2 000 litres of septage every 4 years. One would therefore expect that there is plenty of capacity within the country's wastewater treatment plants to treat the septage produced by those with septic tanks, and in very general terms, that is true. However, the concentrations of nutrients (nitrogen and phosphorus) and solids in septage is typically anywhere from 10 to 100 times higher than it is in sewage, and most of the COD in septage cannot be reduced in a wastewater treatment plant, which means that in reality the mixing of septage and sewage needs to be done with some understanding[31],[32]. A small wastewater treatment plant in a rural town which receives a significant amount of septage (say 1% or 2% of the plant's hydraulic capacity) may find that it is overloaded and unable to meet the DWS effluent standards. This may be a factor in the poor performance of South Africa's wastewater plants, most of which according to DWS data comply with effluent standards less than 50% of the time (**FIGURE 12**).

There are a few basic measures that reduce the impact of septage on treatment plants. The most essential measure is that the septage should be discharged not directly into the head of works, but into a septage holding or equalisation tank. The outflow from the holding tank can be set to a more or less steady rate so that the works is not impacted by large nutrient load spikes when septage is discharged from tankers. Apart from the use of a septage equalisation tank, treatment plants which are equipped with primary clarifiers, or which use pond systems, are much more able to process septage than facilities that do not incorporate these features.

[31] United States Environmental Protection Agency. 1994. Guide to Septage Treatment and Disposal. EPA report EPA/625/R-94/002
[32] Centre for Science and Environment. 2017, Septage Management: A Practitioner's Guide, Centre for Science and Environment. Report prepared for the Indian government's Ministry of Urban Development.

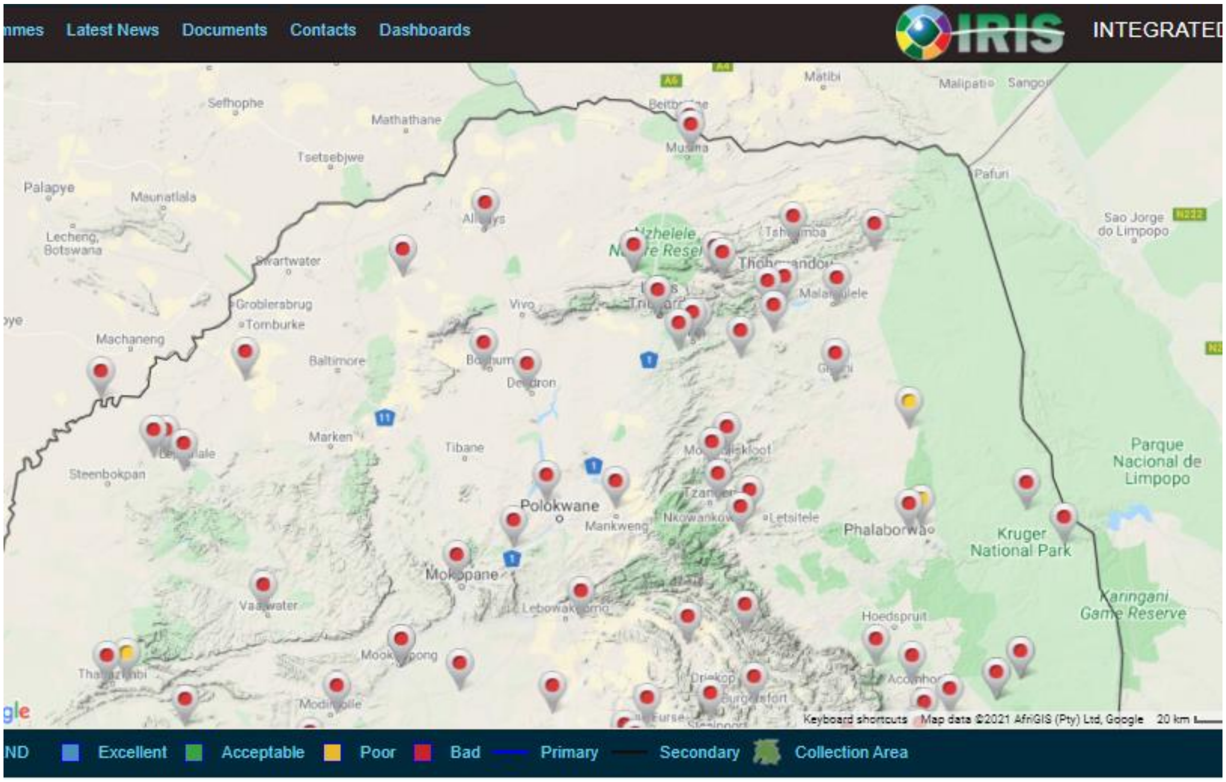

FIGURE 12: EXTRACT FROM THE DWS INTEGRATED REGULATORY INFORMATION SYSTEM (IRIS) SHOWING COMPLIANCE OF WASTEWATER TREATMENT PLANTS WITH EFFLUENT QUALITY STANDARDS, AS AT JUNE 2021. THIS EXTRACT SHOWS ONLY A PORTION OF THE COUNTRY – WHEN THE COUNTRY AS A WHOLE IS VIEWED ALL THE MARKERS MERGE TOGETHER AND THE COUNTRY IS COVERED IN RED WITH ALMOST NO OTHER COLOURS VISIBLE.

What of the sludge accumulating in the pit latrines which serve 31% of the population? Some of that sludge is contained in unimproved pit latrines which are generally unlined and therefore cannot safely be emptied. When these pits are full the toilets should be demolished, and the pits should be covered over with soil. The number of families with unimproved pit toilets is steadily decreasing as more and more VIP toilets are built, and when the Census 2021 data is released, it will probably be found that the number of families still using unimproved pit toilets is closer to 10% of the national population than the 13% reflected in the current data.

The overwhelming majority of VIP toilets built in South Africa in the last 15 years are of the precast concrete type. This construction method was chosen not only to achieve standardisation and to limit costs, but also because they can be taken apart and moved. Moving these toilets will be costly, in fact it will be more expensive than emptying them, but it will eliminate the problem of faecal sludge transport and treatment.

Some pit toilets will however require emptying, either because there is no space to build a new toilet, or because there is not enough money to build a new toilet (or move the existing toilet). As has been discussed above, the least cost most sensible thing to do with pit sludge is to bury it on site. However, that is not always possible or acceptable, in which case the sludge must be taken off site and treated.

While septage is typically 10 to 100 times more concentrated than sewage, pit sludge is typically 10 times more concentrated than septage. The contents of a single pit toilet can be the equivalent of more than 500 kL of regular sewage in terms of nutrient and solids load[33]. It therefore does not make sense to discharge such concentrated waste into the headworks of a standard wastewater treatment plant, even though that might be the most convenient thing to do.

Dedicated faecal sludge treatment plants (FSTPs) (**FIGURE 13**) are being built in increasing numbers in other parts of the world where a much higher percentage of the population uses on-site sanitation. Standard features at most FSTPs are:

- an intake screen where trash is screened out as faecal sludge, particularly that derived from pit latrines, tends to have a high trash content. The trash has to be disposed of at a landfill site.
- Sludge drying beds (Figure 14), which may or may not be planted with suitable vegetation. Plants absorb some of the nutrients in the sludge and help with the process of converting it to a compost like material.

Some FSTPs use ponds, which are simple and robust treatment systems, but require enough space and cannot be too close to residential areas. Others use digestors and septic tanks, while others convert the sludge to fuel usually in combination with other organic waste such as sawdust or charcoal dust. Typically, the smaller the FSTP footprint and the more advanced the technology, the higher the capital and operating costs.

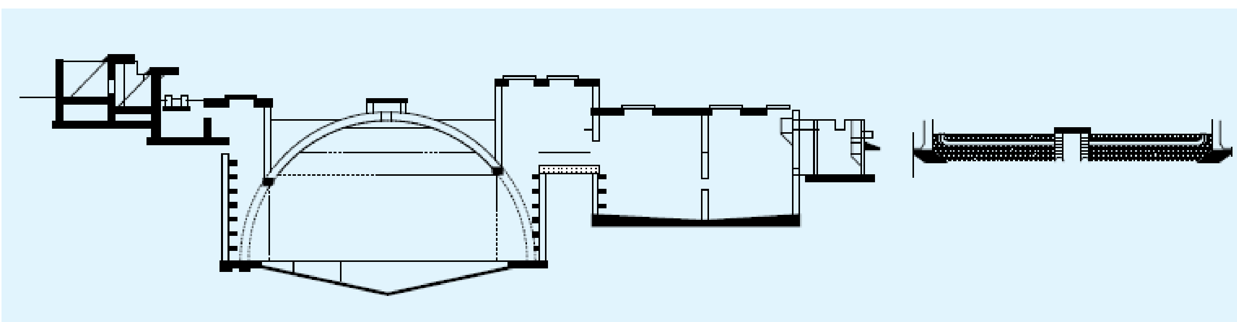

FIGURE 13: PROCESS DESIGN FOR FSTP IN LUSAKA USING ANAEROBIC DIGESTION, SETTLING TANKS AND DRYING BEDS[34]

[33] Still DA, Foxon K. 2012. Tackling the Challenges of Full Pit Latrines - Volume 1: Understanding sludge accumulation in VIPs and strategies for emptying full pits. Water Research Commission Report No. 1745/1/12, ISBN 978-1-4312-0291-1.
[34] ISF-UTS and SNV. 2021. Treatment technologies in practice: On-the-ground experiences of faecal sludge and wastewater treatment, The Hague, SNV Netherlands Development Organisation.

FIGURE 14: SLUDGE DRYING BEDS SERVING AN FSTP IN LUSAKA

FSM RE-USE TECHNOLOGIES

The outputs from wastewater treatment works as well as FSTPs are effluent (water) and dried sludge. In the case of sewage works which are working well the effluent can be discharged into the nearest watercourse. In the case of FSTPs, while the effluent may be free of pathogens it will usually have a nutrient content higher than that which can be discharged into a watercourse. This effluent can be used for **irrigation of non-food crops**, or simply discharged into a soakpit or seepage bed.

If anaerobic digestors are used for the processing of sludge they will produce **biogas** (methane, carbon dioxide and traces of other gases such as hydrogen sulphide). The biogas can be captured and used for heating and cooking, or if the anaerobic digestors are large, even electricity generation.

Sludge derived from WWTP or FSTP works contains small but still useful amounts of nutrients such as nitrogen, phosphorus and potassium, as well as a certain amount of carbon. There are various options for deriving benefit from the resource value contained in the sludge.

Co-composting with supplementary organic waste is a relatively simple option. The most straightforward method for producing compost is windrowing (turning). Windrowing requires either machinery or a large amount of labour. Unless the heaps are properly turned the compost will not be pathogen free. Also, unless other organic waste such as garden waste, animal manure or wood chips is added to the sludge the compost produced will be of a low quality.

Surface application. If the sludge has been derived primarily from domestic sewage, septage or faecal sludge, and has been tested and found to be free of pathogens (i.e. "declassified"), then it can be spread on the surface of agricultural land, provided it is applied at a rate commensurate with the nutrient uptake rate of the crops grown on that land (the agronomic rate).

Deep-row entrenchment or soil injection. Sludge which still contains pathogens can be safely disposed of by burying it or injecting it beneath the soil surface. Evidence indicates that this practice makes a long-term improvement to soil fertility, and sludge disposal does not have to be limited to the agronomic rate[35].

Use of dried sludge for fuel. Dried sludge, ground into a powder and mixed with sawdust or charcoal dust, can be made into fuel briquettes of quality comparable to or better than briquettes made from charcoal only[36]. The process is fairly labour and capital intensive but can be financially feasible if it is done at scale[37].

EXPERIMENTAL TECHNOLOGIES

There are a number of innovative ideas for faecal sludge management. Some of these have been shown to be technically feasible, but the business case is as yet unproven. If any innovative sludge processing technology is to be adopted, then the benefit/cost ratio must be greater than the benefit/cost ratio for the established options described above, and it must also not be too technically complex. Ethekwini has experimented with Black Soldier Fly treatment as well as the LaDePa system. In East London a test facility for conversion of sludge to biochar has also been constructed.

Black Soldier Fly (BSF). The larvae of the Black Soldier Fly (Hermetia illucens) feed on decaying organic matter and grow rapidly. After approximately 14 days of feeding on waste the larvae are harvested and processed into a protein rich animal feed and oil, while the remainder of the waste is turned into compost or biochar. BSF processing is technically complex, capital intensive, and requires as much as 750 m^2 of space per ton of waste being processed per day[38]. It seems that there may be a business case for using BSF to process fresh food waste, but not for faecal sludge which has already

[35] Water Research Commission. 2013. Faecal Sludge Management in Africa: Developments, Research & Innovations [Online]. Sanitation Matters: Issue 4 – March 2013. Available at: http://www.wrc.org.za

[36] Ward B J, Gold M, Turyasiima D, Studer F, Getkate W, Maiteki J M, Niwagaba CB & Strande L. (Switzerland). 2017. *SEEK (Sludge to Energy Enterprises in Kampala): Co-processing Faecal Sludge for Fuel Production* [Online]. 40th WEDC International Conference, Loughborough, UK. Available at: WEDC International Conference Paper (eawag.ch)

[37] Sanivation. 2019. Waste-to-Value Sanitation in Kakuma Refugee Camp. Analysis from the piloting of a business model involving container-based sanitation and a domestic energy reuse product. Report for the UNHCR and the Bill and Melinda Gates Foundation.

[38] ISF-UTS and SNV. 2021. Treatment technologies in practice: On-the-ground experiences of faecal sludge and wastewater treatment, The Hague, SNV Netherlands Development Organisation.

spent several years in decomposition and has little value to offer the larvae. Ethekwini has discontinued its BSF plant.

The Latrine Bio-solids Dehydration and Pasteurisation (LaDePa) process was developed by Ethekwini Water and Sanitation (EWS) in partnership with Particle Separation Solutions (Pty) Ltd (PSS) and piloted over the period 2009 to 2012. A sterilised, pelletised product is produced with a typical solids content of 60% (dependent on the feed moisture content). The pellets contain organic matter, nitrogen (N), phosphorus (P), potassium (K) and micro-nutrients. The process is technically complex and energy intensive. Durban has plans to set up more LaDePa units in the near future, but analysis of the process indicates that the processing cost is significantly greater than the value of the product[39].

Biochar Production. Biochar is charcoal that is produced by pyrolysis of biomass in the absence of oxygen. Over the period 2016 to 2019 the company Amanz'abantu, funded by the African Development Bank via the South African Water Research Commission (WRC) developed a robust process for converting faecal sludge to biochar at the treatment works near East London[40]. The production of biochar from wood waste is a known process, but, while biochar is believed to have a valuable long-term effect on soil fertility, it is not a fertilizer. By mixing (dried) faecal sludge with chipped wood waste an enhanced biochar can be made which contains not only carbon, but also significant amounts of Nitrogen, Phosphorus and Potassium (NPK). By mixing in wood ash (a by-product of the biochar making process) and urea, the N, P, K and Calcium content can all be further enhanced. The end product will be a biochar that provides the short term NPK boost of a balanced fertilizer, while also adding Calcium and Carbon to the soil, as well as other useful micro-elements. The end product will be significantly more expensive than commercial fertilizers and will only pay for itself if it can be sold at a significant premium as an organic fertilizer/biochar combination. Further research and development work is required.

CHAPTER 4: FSM FINANCING

INTRODUCTION

The legacy of apartheid has had a significant impact on how FSM services are managed and financed in South Africa. Since 1994, and particularly from the turn of the millennium, there has been a drive to ensure **free basic services for all** and this has gone hand-in-hand with the progressive **decentralisation of responsibilities** to local municipalities.

In terms of decentralisation, all administrative and financial responsibilities for the provision of basic water and sanitation services have been devolved to local government municipalities. This means

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[39] University of KwaZulu-Natal, Pollution Research Group: Buckley C. 2013. *Economic Evaluation of Faecal Sludge Disposal Routes: Phase 5 Report* [Online]. Report to the Bill and Melinda Gates Foundation. Available at: University of KwaZulu-Natal Work Order 3 (Contract # 22834) (ukzn.ac.za)

[40] Musvoto E, Mgwenya N, Mangashena H, Mackintosh A. 2018. Energy recovery from wastewater sludge: A review of appropriate, emerging and established technologies for the South African industry [Online]. Water Research Commission Report No. TT 752/18. Available at: http://www.wrc.org.za/

municipalities have decision-making authority around investment priorities, service levels, and, tariffs working within the policy framework established by national government. There are three types of municipalities in South Africa; eight metropolitan municipalities (category A) in the biggest cities, 226 local municipalities (category B) and 44 district municipalities (category C)[41] which are usually conglomerations of between 4-6 local municipalities that come together in a district council. For category B and C municipalities the responsibilities for service delivery are often shared and this is especially the case in very rural areas where district municipalities take on more responsibilities. It is important to note that in South Africa there is no specific local government designation for urban areas. This means the larger metropolitan municipalities and some local municipalities are predominantly urban and in other cases, large and small towns exist within largely rural local municipalities.

Since 1994, government financing of basic services such as sanitation has prioritised populations and settlements that were historically marginalised by the apartheid regime. The current arrangements for sanitation financing have been shaped by the Free Basic Services Policy adopted in 2000, and in particular the Free Basic Sanitation Implementation Strategy adopted in 2009.[42] These documents enshrine a strong normative and legislative "universal service obligation" for all municipalities which aims to ensure provision of at least a basic level sanitation service to all residents within their jurisdiction, this covers both on-site and off-site services.

In accordance with the policy, the free basic sanitation implementation strategy sets out the operational arrangements for sanitation financing in South Africa. This covers commitments to capital and operational subsidies, as well as guidelines for municipalities regarding cost-recovery and pro-poor targeting. Some of the key prescriptions of this strategy are given below and for the most part these provide a clear normative picture of sanitation financing responsibilities:

1. **Supply-side capital subsidy for sanitation access (available to all)**: *"free basic sanitation means that consumers get the service without maintaining contributions of cash or in kind"* [42(pp. 9)]

2. **Operational and capital subsidies for poor households**: *"the poor household does not have to contribute towards the cost of providing the service initially (capital) and managing the service in the long term (operating)"* [42(pp.10)]

3. **In relation to FSM, municipalities have some obligations to meet pit-emptying costs and other off-site sanitation costs, but terms of this obligation are somewhat vague and subjective**: "*the principle of free basic sanitation means that poor households do not pay for the costs of operating and maintaining the "off-site" elements, providing the WSA can afford to pay on their behalf. The exception in this regard related to sludge or compost handing…the WSA may decide to cover the costs of pit emptying if there is a permanent single pit VIP system"* [42(pp22-23)]

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[41] South African Government website (www.gov.za)
[42] Free Basic Sanitation Implementation Strategy, April 2009, DWAF

4. **Recommendations for the cross-subsidy of sanitation access for the poor: "***In circumstances where the cost of providing the service free to the poor is greater than the subsidy amount received…part of the income received from the consumers is applied as cross-subsidy"*[42(pp 25)]

The strategic framework sees basic sanitation provision as a "first step" on the sanitation ladder and envisages a situation whereby as economic affordability increases and the backlog of the underserved reduces, it will become possible for more households to be provided with higher levels of services.

From an overall policy point of view therefore, the government of South Africa has provided a relatively simple framework which locates the responsibility for financing FSM services firmly with local government municipalities allied with some expectation of consumer cross-subsidy through tariffs for those with a networked water and sanitation connection. The subsequent sections explore in more detail the effectiveness of the related financing mechanisms to support sanitation access and FSM service delivery.

FINANCING MECHANISMS

TRANSFERS FROM NATIONAL GOVERNMENT

In the years since the commitment of free-basic services, the government of South Africa has implemented a series of regularised fiscal transfers designed to enable municipal governments to reduce the backlog in basic services (see Chapter 3). The administration of these grants has subtly changed over the years, but the overall structure has remained relatively stable.

On an annual basis the national treasury transfers both conditional and unconditional grants to municipalities to support the delivery of the free basic services, including sanitation. These mechanisms are as follows:

1. The **local government Equitable Share (ES) grant** was introduced in 1998 as a way redistribute resources towards poorer and underserved provinces and municipalities. The formula for apportioning the grant accounts for the relative demand (need) for key public services accounting, where possible, for shifts in population across the country as well as levels of access to basic services.

Specifically, the ES grants are intended to be an **"operational grant"** to supplement municipality revenue available to support the ongoing provision of free basic services.

Importantly the **ES is unconditional**, meaning that municipalities have significant autonomy to allocate resources as they see fit. However, in context of increasing strained municipal budgets, high rates of WSA vulnerability,[43] and limited scope for internal revenue generation amongst many local and district

[43] In 2015, over three-quarters (78 percent) of WSA reported their business health as either 'high' and 'extreme' in terms of vulnerability as per the indicators of the Municipal Strategic Self-Assessment (MuSSA), for more details see MUSSA reporting here: http://ws.dwa.gov.za/mussa/Default.aspx#!

municipalities, the ES grant tends to be used to cover core administrative costs like salaries, with very little scope for infrastructure maintenance.

2. The **Municipal Infrastructure Grant (MIG)** was established in 2004 as an overarching financial instrument to finance municipal infrastructure development. Funding for the MIG is derived for the National Treasury and is administered and regulated by the Department of Cooperative Governance and Traditional Affairs (CoGTA) who in turn channels it to its provincial departments and local government.

The MIG is specifically designed to assist the poor to gain access to basic infrastructure and is traditionally the main source of funding for the fully subsidised construction of on-site sanitation facilities. Typically, sanitation subsidies through the MIG are targeted on low-income households listed in the sanitation "backlog" report held at municipal level. In theory, the sanitation investments earmarked using the backlog report are made in an equitable manner, although it is unclear how this works in practice.

The most recent CoGTA annual report indicates that over the 3-year period 2018/19 to 2020/21 the total annual allocations through the MIG range from R15.2 to R16.6 billion (three year average R15.8 billion). Approximately 50 percent of the annual MIG (7.9 billion) is expected to be related to water and sanitation infrastructure. The proportion of this which is actually spent on the provision of basic sanitation is **unknown** as it is not disaggregated in budgetary reporting[44].

The same annual report also states that MIG investments are hampered by limited technical capacities at local levels. In 2017 CoGTA reported that 55 out of the country's 257 municipalities have qualified engineers to assist in the rolling out of infrastructure projects. Moreover, in the five years up to 2017 a total of R3.4 billion in MIG transfers was stopped and was reallocated from underspending municipalities to better spending municipalities because the municipalities lack the skills.[45]

3. The **Water Services Infrastructure Grant (WSIG)** was created in 2017 through the merger of the municipal water infrastructure grant, the water services operating subsidy grant, and the rural household infrastructure grant. This capital grant aims to accelerate the delivery of clean water and sanitation facilities to communities that do not have access to "basic water services", especially those in rural areas. The grant is administered by the Department of Water and Sanitation and provides funding for various infrastructure projects. It is understood that most infrastructure development funded by the WSIG focuses on developing and upgrading community water sources, however, the provision of on-site sanitation is also one of the stated purposes of the grant.

The national medium term expenditure framework has earmarked an average of R4.2 billion annually to the WSIG in the three years up to 2020/21.[46] Overall this constitutes approximately half of the annual

[44] Department of Cooperative Governance, Annual Report 2019/20 Financial Year
[45] ibid
[46] Department of Water and Sanitation, Annual Report 2019/20 Financial Year

grant allocations to water and sanitation infrastructure under the MIG and is expected that WSIG will focus more on water infrastructure and drought resilience measures rather than investments in on-site sanitation or the FSM service chain.

In 2020, the parliamentary portfolio Committee on Human Settlement reported concerns about the utilisation of WSIG funds, citing the example of Limpopo province where only 65 percent of the allocated funds had been spent of water and wastewater infrastructure in the province.[47]

An overarching summary of these government sources for sanitation investments and the links to FSM financing are shown in the table below.

Table 2: Overarching summary of municipal grant funding for sanitation**Funding source**	**Allocation approach**	**Conditionality**	**Relative expenditure on FSM services**
Equitable share grant	Transfer from the national treasury to municipalities by formula based on population growth and basic needs	Unconditional, but designed as an "operational grant" to support the ongoing recurrent costs of sustaining free basic services	Actual allocations to FSM are unknown and not disaggregated in municipal budgetary reporting. In many municipalities the ES grant is thought to be entirely absorbed by staff salaries leaving little room for O&M.
Municipal infrastructure grant	Transfer from the national treasury and managed and administered by CoGTA to fund specific municipal projects	Conditional grant intended for capital investments to increase access to basic services in low-income areas	The MIG primary mechanism used to fund the construction of on-site sanitation infrastructure for poor households. The proportion of MIG funds used to fund on-site sanitation infrastructure is not disaggregated in reporting but is thought to be not insignificant.
Water services infrastructure grant	Transfer from the national treasury and managed and administered by DWS to fund specific water and	Conditional grant intended for capital investments to reduce water and sanitation	The WSIG is a relatively new financing mechanism for water and sanitation infrastructure and is up for review in 2021. The levels of expenditure on basic sanitation are not disaggregated in

[47] Parliament of the republic of South Africa, 2019, further details can be found via the parliamentary website, here: https://www.parliament.gov.za/press-releases/underspending-water-services-infrastructure-grant-limpopo-concern

	sanitation projects in rural municipalities	backlogs, especially in rural areas	existing reporting, although it is thought that expenditures on water supply and drought resilience are the focus of the grants disbursed to date

MUNICIPAL FINANCING

Overview: The dynamics of sanitation financing practices and options varies across different category A, B, and C municipalities. In the larger metro-municipalities, local revenues are much higher and there is much less dependence on fiscal transfers from central government to support investments. As such, there are isolated examples where metro-municipalities have been much more proactive in exploring alternative options to FSM in urban areas – such as support to container-based service delivery in Cape Town[48] and a range of alternatives to sewered sanitation implemented by eThekwini municipality such as: community sanitation blocks, scheduled pit emptying, and innovative FSM treatment options including Latrine Dehydration and Pasteurization (LaDePa) systems[49]. In comparison, in many poorer municipalities the ES grant is the only reliable source of income and soon gets expended on administration costs and salaries leaving little to no space for maintaining basic services.

In addition, historically the larger municipalities are also much better placed to borrow funds from domestic finance sector to fund infrastructure investment. However, overall municipal borrowings have declined over the past 3 years from about 24 to 15 percent of capital expenditure.[50] This is primarily due to a deterioration in their financial health and creditworthiness. Moreover, the recent ratings downgrade in the midst of the COVID pandemic provides further barriers to municipal borrowing and in turn sanitation investments. Borrowing constraints have been compounded by faltering economic growth across the country further squeezing the fiscal space for sanitation investment, see Text Box 1.

TEXT BOX 1: PROSPECTS FOR PUBLIC FINANCE SUPPORT TO FSM

Several years of stagnant economic growth has put the South African national budget under severe strain. GDP growth in 2019 was near zero and the impact of the COVID-19 pandemic on society and economy at large means that the GDP is expected to decline by over seven percent in 2020.[1] Such fiscal constraints are likely to lead to substantial real terms reductions in allocations to municipal government and in turn the level of funding available for sanitation investments or sector support. As a result of the exception fiscal constraints, it is likely that the national government will reduce transfers to municipalities, including the conditional and unconditional grants intended to support sanitation services.

Municipal financing of recurrent expenditures: As mentioned above, the free basic sanitation policy requires municipalities to manage the operational costs of FSM which can include pit emptying as well as transport and treatment of the waste.

To the authors knowledge, in the last decade there has been no published analysis of the national status of VIP services, emptying practices and or municipal financing arrangements across South Africa. This information is not routinely tracked as part of municipal, provincial or national monitoring or budgetary

[48] Willetts, J. (2019). "Field Trip (FSM5)", in Proceedings of the 5th International Faecal Sludge Management Conference, Cape Town
[49] Serjak, C and Gorelick, J, 2021, Impact Investing for Scaling of Faecal Sludge Treatment Technology, FSM6 Virtual Presentation
[50] Department of Water and Sanitation, 2018, National Water and Sanitation Masterplan, Volume 1

reporting. As a result, at the national level there is incomplete and extremely patchy understanding of the of the status and quality of existing sanitation infrastructure and services and levels of municipal financing used to try and sustain these services.

The limited data that is available and an examinations of service outcomes suggest that municipal financing across the FSM service chain is woefully lacking, as outlined below:

Faecal sludge emptying and transport: In 2009, a strategic sanitation review by SALGA found that only 25 of 169 WSA's (15 percent) had a finance policy in place occasional or regularised emptying of VIP latrines. However, this review also reported that 69 (41 percent) of WSAs claimed to empty bucket systems, this claim was not tested in the analysis, nor was information given on the scope or sufficiency of emptying practices.

Anecdotal evidence and discussions with sector stakeholders suggest that a systemic approach to financing municipal pit emptying is the exception rather than the rule. For example, the eThekwini Municipality appears to be only example of a system of regularised pit emptying which is done manually by municipal workers on 5-year cycle and at no cost to the households. Similarly, in 2010 it was reported that most municipalities had "no budgets of plans for the long-term sustainability of VIP toilets".[51] In most municipalities it is widely acknowledged that the decades of investment in increasing access to basic sanitation infrastructure has not been matched by adequate expenditure in the capital maintenance required to sustain this infrastructure, particularly through pit emptying and payment for safe transport of waste. Elsewhere in Southern Africa there is an expectation that the costs of emptying, and transport will at least in part be met by the households, however, in South Africa the free basic service obligation means that in most cases local government municipalities need to invest in providing these services, and this is not happening at the required levels.

Faecal sludge treatment: Other than isolated innovations with FSM treatment options, such as the aforementioned LaDePa in eThekwini, for the most part faecal sludge is left in-situ and untreated causing potential public health risks (see Chapter 3). The faecal sludge which is collected is transported to wastewater treatment works, but the overall functionality of these treatment works as well as their suitability to handle faecal sludge is also constrained by under-investment and a lack of appropriate treatment technologies which can't cope with variations in the quality and consistency of faecal sludge from on-site systems. Historically, the performance of the sanitation situation was monitored by DWS via the Green Drop assessment whereby municipalities are audited on their performance in wastewater management and risk management in wastewater treatment. However, these assessments have not been undertaken since 2014. At that time (2014) compliance with the Green Drop requirements was generally very low with the vast majority of WSAs - approximately 90 percent- achieving less than 80 percent compliance, reflecting the poor management and maintenance of wastewater treatment facilities[52]. The Green Drop assessment system is being revived in 2021 and is it is likely that treatment

[51] Mjoli N, 2010, "Review of Sanitation Policy and Practice in South Africa from 2001-2008", Report to the Water Research Commission
[52] Department of Water and Sanitation, 2014, Green Drop Progress Report

performance will have declined further in the intervening seven years as a result of continued patterns of underinvestment in maintenance.

Faecal sludge reuse: The national sanitation policy emphasises the value of human excreta as a resource. For example, safe compositing allows for the potential resource recovery of valuable nutrients such as phosphorus to be reused in fertiliser and the potential energy and calorific value of faecal waste makes it suitable for biogas generation under the right circumstances. Despite the potential for faecal sludge re-use as a source revenue generation, to the authors knowledge it does not occur at scale anywhere in South Africa, beyond isolated examples in eThekwini which are recipients of external development partner support.

CONSUMER FINANCING

In the context of free basic service provision, the only regularised consumer payments for sanitation services comes through the consumer tariffs for those connected to the networked system. In terms of overall financial flows, consumer payments through tariffs constitute the majority of funding to the water and sanitation sector – estimated at 80 percent.[53] Despite this, most WSAs or WSPs are failing to cover the operating costs for networked water and sanitation services for a nexus of reasons including the effectiveness and efficiency of utility performance, tariff setting, and human capital constraints. As a result, in almost all municipalities there is extremely limited scope for localised cross-subsidy of basic sanitation services as envisaged in the free basic sanitation implementation strategy.

OVERALL FINANCING PICTURE

FIGURE 15 and Figure 16 illustrates two annotated summaries of sanitation financial flows in South Africa.

FIGURE 15 shows the normative situation as prescribed in policy whereby the combination of publicly financed infrastructure and operational grants, as well as cross-subsidies from networked services, support the capital and operational costs of FSM services along the service chain. **FIGURE 16** overlays this normative financial flow map with red annotations outlining key limitations in the financing structure.

[53] WASHFIN, 2021, Creditworthy municipalities invest in water and sanitation to meet growing demand in South Africa, USAID

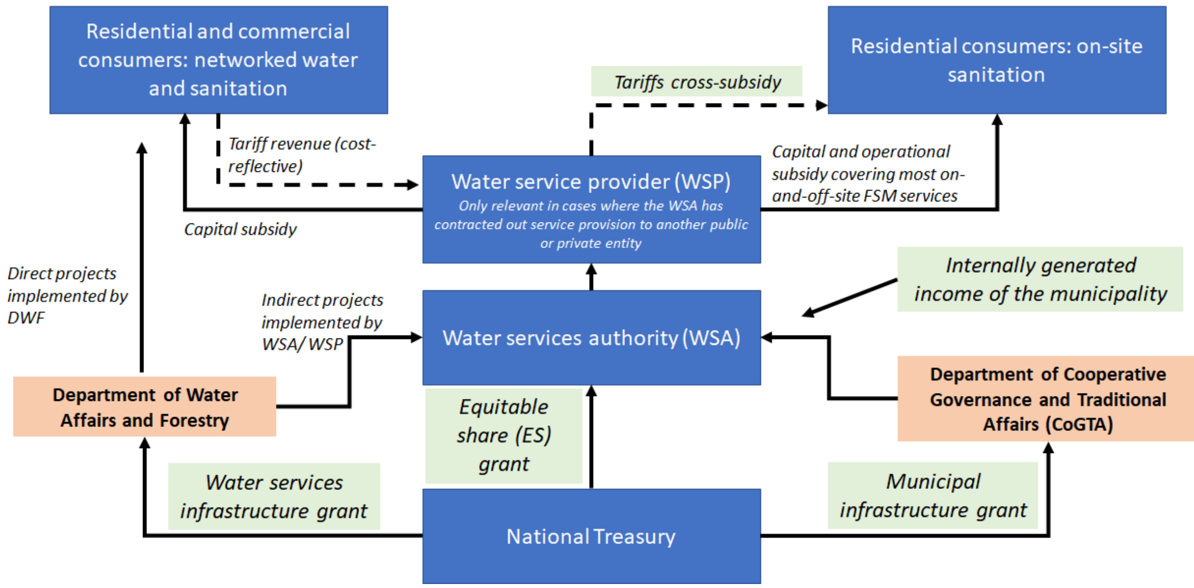

FIGURE 15: NORMATIVE FINANCIAL FLOWS ACROSS THE SANITATION SECTOR IN SOUTH AFRICA

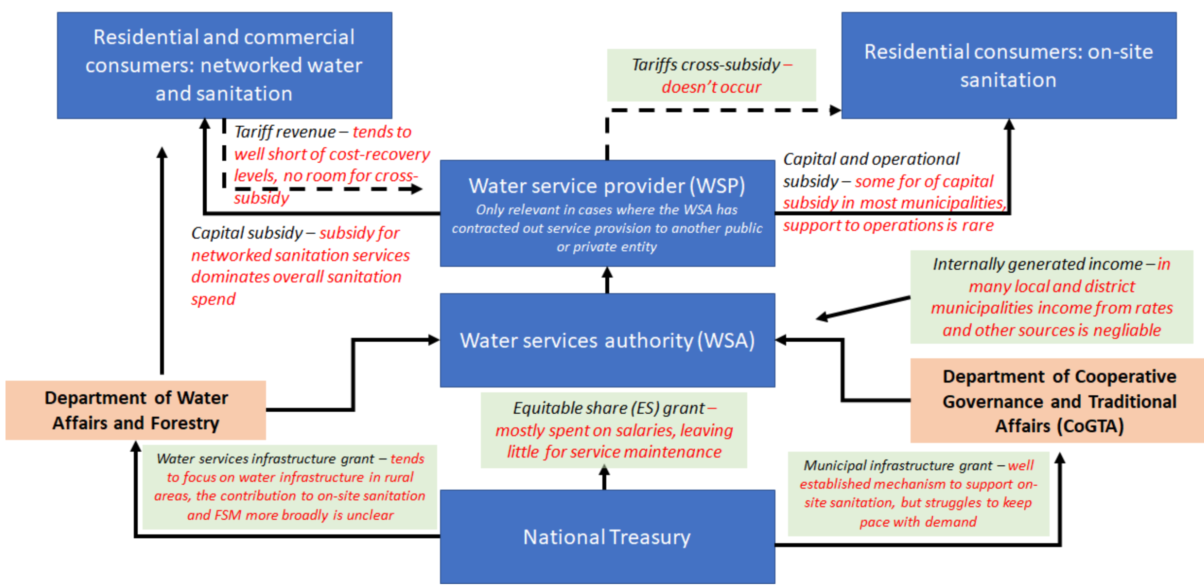

FIGURE 16: ACTUAL FINANCIAL FLOWS TO SUPPORT FSM IN SOUTH AFRICA

CHAPTER 5: FINDINGS AND RECOMMENDATIONS

FSM DATA COLLECTION AND MONITORING AT MUNICIPAL LEVEL

In Phase 1 of this project (The piloting of FSM tools in Polokwane Local Municipality), the compilation of an SFD is underway. There are various stages of the SFD process, with the most data intensive phase being the development of a "Comprehensive SFD". The team has evaluated the data requirements for the comprehensive SFD against what is available in Polokwane, as a means of understanding what the data gaps might be in other municipalities – and therefore the status quo of monitoring FSM at a municipal level.

The evaluation is based on the gradings set out in **TABLE 3** below.

TABLE 3: TRAFFIC LIGHT EVALUATION OF DATA AVAILABLE FOR A COMPREHENSIVE SFD (BASED ON DATA COLLECTION IN POLOKWANE LOCAL MUNICIPALITY)

All data is available and accessible – blue
Most data is available but needs to be collected onsite / not easily accessible – green
Some data is available but systems to collect some data do not exist – yellow
No systems exist for collecting most of the data on these issues - orange
No data is being collected on these issues - red

Please note that this is a very preliminary evaluation in only one Municipality, but it gives insight into the kind of data that municipalities will need to begin collecting once the National FSM Strategy is in place, and WSAs will be required to report on FSM status in their area.

In addition, the data for the SFD by no means represents everything we need to know about safely managed FSM in any municipality. Instead, the SFD is a tool that illustrates the fate of faecal waste based on the population of a municipality, and while it can support planning and advocacy for providing solutions, it does not measure faecal waste by volume or go deeply into the quality of faecal waste content and treatment. Tools such as the City Service Delivery Assessment (CSDA) complement the SFD with an evaluation of the enabling environment for FSM at municipal level, i.e. understanding why the situation is as it is. They provide a framework for systematically assessing the policy and regulatory environment, and institutional capacity related to delivering safely managed sanitation services. This process also requires data and mostly discussion with the municipal team.

The Sanitation Safety Plan (SSP) incorporates climate hazards and risks and evaluates points in the sanitation service chain where there are risks of humans coming into contact with pathogens from excreta. The SSP also requires data on climate hazards relevant to the municipal area and recommends mitigatory processes for those risks – also in discussion with the municipal team and a broad range of stakeholders from outside the municipality.

The stakeholder engagement process should be robust and transparent in the implementation of the above toolkits, and our experience to date in this process indicates that relationships between the various stakeholders critical to the successful implementation of safe sanitation in South Africa are weak, and the decision support data available currently to the relevant institutions who need it, is poor.

TABLE 4: EVALUATION OF THE AVAILABILITY OF DATA IN POLOKWANE LOCAL MUNICIPALITY FOR A COMPREHENSIVE SFD

Enabling environment to service delivery	Data collected at all stages of the service chain: containment to end-use or disposal	Possible sources of data (Primary and secondary)	Data availability
Policy, legislation and regulation	**Policy:** To what extent is provision of sanitation services enabled by appropriate, acknowledged and available policy documents (National/Local or both)?	Policy documentation	
	Institutional roles: To what extent are the institutional roles and responsibilities for sanitation service delivery clearly defined and operationalized?	Policy / strategy documents Existing reports KIIs with lead institutions	
	Service provision: To what extent do the policy, legislative and regulatory framework enable investment and involvement in sanitation services by appropriate service providers (public or private)?	Policy / strategy documents Existing reports KIIs with public and private institutions	
	Standards: To what extent are norms and standards for each part of the sanitation service chain systematically monitored and reported?	Existing reports KIIs with lead institutions	
Planning	**Targets:** To what extent are there service targets for each part of the sanitation service chain in the city development plan, or a national development plan that is being adopted at the city level?	City/national development plans KIIs with city authorities	
	Investment: How much was invested in sanitation services in the last investment plan and how much has been incorporated into the next approved investment plan? What has been achieved as a result of the last level of investment (including investing in human resources, Technical Assistance, etc. as well as infrastructure)?	City investment plans Investment plans of donors, private sector, etc. KIIs with lead institutions	
Equity	**Choice:** To what extent is there a range of affordable, appropriate, safe and adaptable technologies for sanitation services available to meet the needs of the urban poor?	KIIs with lead institutions Observations	

Enabling environment to service delivery	Data collected at all stages of the service chain: containment to end-use or disposal	Possible sources of data (Primary and secondary)	Data availability
Outputs	**Reducing inequity**: To what extent are there plans and measures to ensure sanitation serves all users, and specifically the urban poor?	City authority reports KIIs with lead institutions	
	Quantity / capacity: Is the capacity of each part of the sanitation service chain growing at the pace required to ensure access to sanitation meets the needs/demands and targets that protects public and environmental health?	Studies / reports KIIs with lead institutions	
	Quality: To what extent are the procedures and processes for monitoring and reporting access to sanitation services applied, to ensure safe and functioning facilities and services through the service chain? Is the quality of the facilities and services sufficient to ensure they protect against risk throughout the service chain?	Policy documentation Reports KIIs with lead institutions Observations or measurements	
Expansion	**Demand:** To what extent has government (National or Local) developed any policies and procedures, or planned and undertaken programs to stimulate demand for sanitation services and behaviours by households?	KIIs with lead institutions	
	Sector development: To what extent does the government have ongoing programs and measures to strengthen the role of service providers (public or private) in the provision of sanitation services, in urban or peri-urban areas?	KIIs with lead institutions	
Service outcomes	**Quantity:** To what extent is the excreta generated from on-site and off-site sanitation technologies effectively managed within each part of the service chain? *(Note: This information is used to generate the SFD Graphic)*	Policy documentation Reports KIIs with lead institutions Observations or measurements	

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