SFD Promotion Initiative

KwaDukuza Local Municipality

iLembe District Municipality

KwaZulu-Natal, South Africa

SFD Final Report

This SFD Report was created through field-based research by Emanti Management for a Water Research Commission project and as part of the SFD Promotion Initiative.

Date of production: 13 December 2018

Last update: 13 December 2018

SFD Report

The SFD Promotion Initiative (SFD PI) has developed recommended methods and tools for preparing SFD Graphics and Reports. The SFD Report consists of the SFD Graphic, the analysis of the service delivery context and enabling environment for service provision in the city for which you are preparing your SFD, and the complete record of data sources used. This analysis allows a systemic understanding of excreta management in the city, with evidence to support it.

SFD Report KwaDukuza Local Municipality, South Africa, 2018

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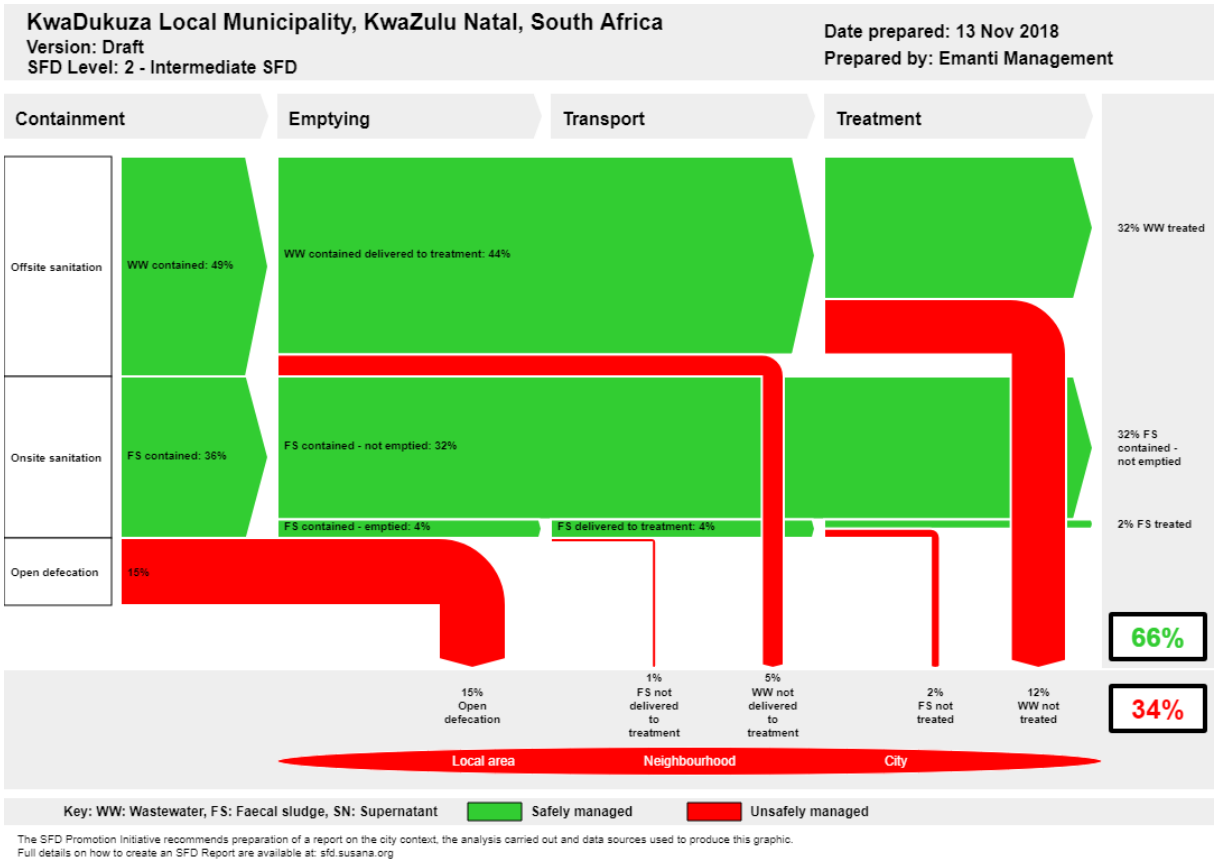
Executive Summary

1. The SFD Graphic



The SFD Promotion Initiative recommends preparation of a report on the city context, the analysis carried out and data sources used to produce this graphic.
Full details on how to create an SFD Report are available at: sfd.susana.org

2. Diagram information

Desk or field based:

This is a field based SFD.

Produced by:

Emanti Management (Pty) Ltd, Stellenbosch, South Africa.

Status:

This is a final SFD.

Date of production:

13 December 2018

3. General Municipal Information

KwaDukuza Local Municipality (LM) covers an area of approximated at 633 km^2 and 29 wards, and is the economic hub of the iLembe DM. The urbanized areas comprise of KwaDukuza (Stanger town), Shakaskraal, Blythedale and Ballito, with high levels of infrastructural development, service development, and social facilities to support the local population. The population of KwaDukuza LM has grown almost 38% since 2001 from 167,805 to 231,187 in 2011. Furthermore, it has been speculated that during peak holiday season KwaDukuza population reaches approximately 320,000 people. Most recent estimates from the StatsSA Community Survey (2016) indicate that KwaDukuza LM has an estimated total population of 276,719 people who are accommodated in 91,284 households (3.0 persons per household). The population density is ~437 people per square kilometre. Of the 20,242 households, 74,936 (82%) are considered formal, 11,674 (13%) are considered

informal, 3,858 (4%) are considered traditional. The average temperature for KwaDukuza (Stanger) ranges from 22.4°C in July to 27.7°C in February, while the average annual rainfall is approximately 900 mm per year.

4. Service outcomes

The following sanitation technologies were noted:

- Toilet discharges directly to a centralised foul / separate sewer – these are flush toilets that are connected directly to the wastewater treatment works.
- Septic tank connected to soak pit – these are buried concrete or plastic tanks from individual households/businesses (flush toilet connected to a septic tank). Most of these tanks are considered to be in a good condition.
- Fully lined tank (sealed, no outlet or overflow) – these are buried concrete or plastic tanks from individual households/businesses (flush toilet connected to a conservancy tank). Most of these tanks are considered to be in a good condition.
- Lined pit with semi-permeable walls and open bottom – these are lined VIPs with an open bottom. Although some VIPs are emptied when funding is available, it is assumed that a emptying backlog exisits.
- Unlined pits – these are VIPs that are unlined. It is unknown if these unlined pits are within areas reliant on groundwater sources. Although some VIPs are emptied when funding is available, it is assumed that a emptying backlog exisits.
- No toilet, open defeacation – these are households that have not been serviced, and do not have a toilet. Their sanitation status is unknown, and it is assumed that open defecation is occuring.

5. SFD development process

Data was collected through secondary sources (reports, plans), and then KwaDukuza LM was visited to conduct interviews with the relevant stakeholders, including site visits to infrastructure to witness the on-the-ground situation. This information was used to fill in gaps and cross-check data collected. Some data gaps still exist, and further verification is recommended.

The data was fed into the SFD Graphic Generator to calculate the excreta flow in terms of percentage of the population.

66% of the excreta in KwaDukuza LM is managed safely, but excreta for 34% is not managed safely, as it is not contained and can pollute groundwater sources and the environment. Open defecation is also noted.

NOTE: Excreta being safely managed or not is dependent on the containment of the system, and not on whether the waste is safely handled or not.

6. List of data sources

Below is the list of data sources used for the development of the SFD.

- Published reports: Census 2011, Community Survey 2016
- Unpublished documents: IDP, WSDP, water conservation and demand management related reports
- Key informant interviews: iLembe DM

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Abbreviations

DM	District Municipality
DWS	Department of Water and Sanitation
FS	Faecal sludge
GDS	Green Drop System
IAM	Infrastructure Asset Management
ICT	Information and Communications Technology
IDP	Integrated Development Plan
IT	Information Technology
LG	Local Government
LM	Local Municipality
MuSSA	Municipal Strategic Self-Assessment
NRW	Non-Revenue Water
O&M	Operations and Maintenance
RDP	Reconstruction and Development Programme
SALGA	South African Local Government Association
SDBIP	Service Delivery and Budget Implementation Plan
SFD	Shit Flow Diagram
StatsSA	Statistics South Africa
VIP	Ventilated Improved Pit Latrine
W_2RAP	Wastewater Risk Abatement Plan
WCDM	Water Conservation and Demand Management
WRC	Water Research Commission
WSA	Water Services Authority
WSDP	Water Services Development Plan
WSP	Water Service Provider
WTW	Water Treatment Works
WW	Wastewater
WWTW	Wastewater Treatment Works

1. Municipal context

The iLembe District Municipality (DM) (DC29) lies on the east coast of KwaZulu-Natal, between eThekwini Metro in the south and King Cetshwayo District in the North. iLembe DM is located between two of Africa's busiest ports, Durban and Richards Bay, and the King Shaka International Airport and the Dube Trade Port are also nearby, making iLembe DM and important economic corridor for the region. The iLembe DM covers an area of 3,260 km², and is the smallest of the 10 KZN District Municipalities with a total population of approximately 657,612 people (Statics SA Community Survey 2016). The majority of its population speaks *IsiZulu* (StatsSA, 2011). The iLembe DM is a Water Services Authority (WSA) for its area of jurisdiction in terms of the Water Services Act (Act 108 of 1997, Water Services Act). It therefore has statutory responsibilities and accountability in terms of legislation and policy with respect to the provision of water services. iLembe DM is constituted by four Local Municipalities; Mandeni, KwaDukuza, Ndwedwe and Maphumulo.

KwaDukuza Local Municipality (LM) covers an area of approximated at 633 km^2 and 29 wards, and is the economic hub of the iLembe DM. The urbanized areas comprise of KwaDukuza (Stanger town), Shakaskraal, Blythedale and Ballito, with high levels of infrastructural development, service development, and social facilities to support the local population. The primary economic hub is the town of KwaDukuza as well as Ballito. The commercial farming areas of KwaDukuza are mainly under privately owned sugar cane. Industrial development is concentrated in KwaDukuza and includes the Gledhow and Darnall Sugar Milling operations. The population of KwaDukuza LM has grown almost 38% since 2001 from 167,805 to 231,187 in 2011 (StatsSA, 2011). Furthermore, it has been speculated that during peak holiday season KwaDukuza population reaches approximately 320,000 people. Most recent estimates from the StatsSA Community Survey (2016) indicate that KwaDukuza LM has an estimated total population of 276,719 people who are accommodated in 91,284 households (StatsSA, 2016) (3.0 persons per household). The population density is ~437 people per square kilometre. Of the 20,242 households, 74,936 (82%) are considered formal, 11,674 (13%) are considered informal, 3,858 (4%) are considered traditional, and 817 (1%) are classified as other (iLembe DM, 2018a).

KwaDukuza LM is situated in a humid part of South Africa with high mean annual precipitation expected. KwaDukuza (Stanger) normally receives approximately 900 mm of rain per year, with most rainfall occurring mainly during summer. KwaDukuza (Stanger) receives the lowest rainfall (16 mm) in July and the highest (121 mm) in January. The monthly distribution of average daily maximum temperatures shows that the average midday temperatures for KwaDukuza (Stanger) range from 22.4°C in July to 27.7°C in February. The region is the coldest during July when temperatures drop to 9.8°C on average during the night (www.saexplorer.co.za). Considering climate change impacts, the projected increases in rainfall for the KwaDukuza area bode well from a water resources availability perspective and from that of potentially increased crop yields, especially in drier years and in the drier months. On the negative side are possible increases in flooding and sediment yield as well as inundation of agricultural lands adjacent to rivers. The monthly potential evaporation is predicted to

increase by 8 to 12% over the next 40 years and this increased evaporation is likely to impact water bodies which already see relatively high evaporative losses, sugarcane irrigators as they will have to purchase more water for their crops, and dry land (rain fed) farmers (iLembe DM, 2018a).

The geology of iLembe DM varies includes sediments of the Karoo Super-group which has Dwyka tillites, mudstones and lesser sandstones of the Adelaide and Tarkastad Subgroups (Beaufort Group) with intrusions of Dolorite. There is also Ecca Group shale present. In some areas Ordovician Natal Group Sandstones dominate and others have layered quartz-feldspar meta-sediments (Mapumulo Group, mokolian). Along the coast dunes of Aeolian deposited sands dominate. Shallow sandy (Glenrosa and Mispah) soils are formed over Ordovician Natal Group Sandstone. Where there is Dwyka-tillite the soils tend to be compact, clayey soils. Karoo Sedimentary rocks give rise to nutrient poor, leached and shallow, sandy soils (SSI, 2012).

Several rivers flow through KwaDukuza LM in a west-east direction into the Indian Ocean, including the Tongati, the Mhlali, the Mvoti, the Nonoti, Zinkwazi. The rivers form part of the Mvoti to Umzimkulu water management area. Major rivers in KwaDukuza are moderately modified, and challenges include, pollution, modification of watercourses by development (especially urban), reduction in stream flow and invasion of riparian areas by alien vegetation (iLembe DM, 2018a).

In KwaDukuza LM, almost 90% of households have a piped water supply either to their dwelling or on site (e.g. communal stand pipes). Approximately 2% of households are reliant on natural and other water supplies (boreholes, springs, river) (iLembe DM, 2018a). The quality of the water obtained from these sources is unknown and cannot be guaranteed, thus possibly leading to health problems.

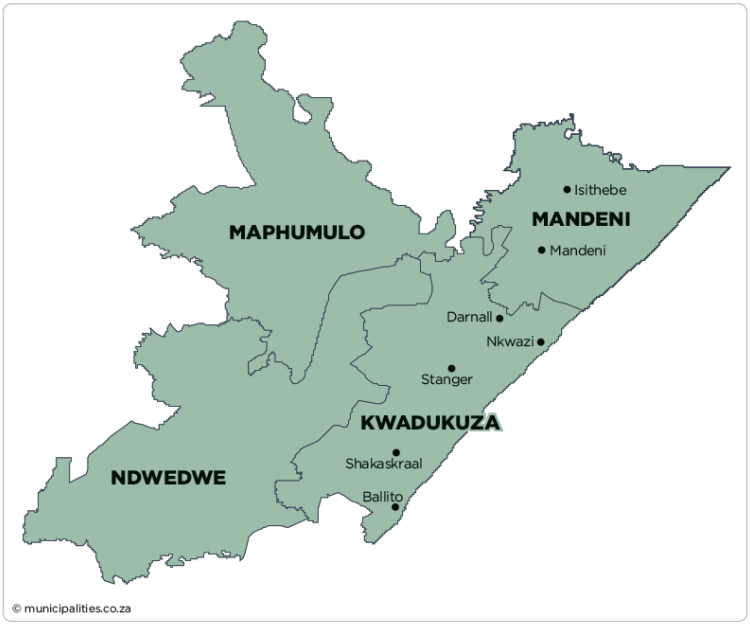

Figure 1: Location of KwaDukuza Local Municipality in iLembe District Municipality

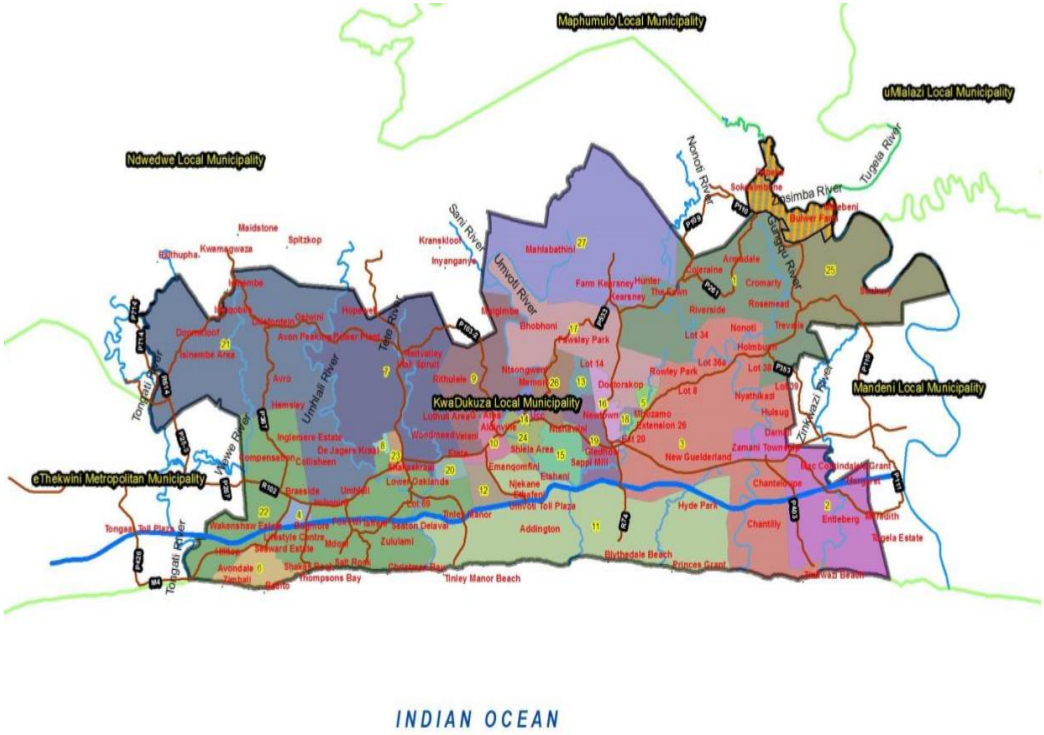

Figure 2: KwaDukuza Local Municipality Wards and Traditional Authority

2. Service outcomes

Service outcome analysis is based on secondary sources. The following key sources of data are used:

- StatsSA Census (2011)
- StatsSA Community Survey (2016)
- Integrated Development Plan for iLembe DM (2018-2019)
- Integrated Development Plan for KwaDukuza LM (2018-2019)
- Water and Sanitation Master Plans for iLembe DM (2016)
- IWA Water Balance and associated calculations for KwaDukuza LM (2017/2018)
- iLembe District Municipality Report on Implementation of Water Conservation/Water Demand Management And Water Turn-Around Strategic Projects in the 2017/18 Financial Year
- Water stock on hand calculations for KwaDukuza LM (as at 30 June 2018)
- Water & Sewerage Tariffs (2018/2019)

Data on emptying and transport is not currently closely monitored, and is mostly qualitative in nature.

2.1 Overview

This section presents the range of sanitation technologies/infrastructure, methods and services designed to support the management of faecal sludge (FS) and/or wastewater (WW) through the sanitation services chain in KwaDukuza LM.

NOTE: Despite data from the StatsSA Community Survey 2016 being available for use, iLembe DM indicated a preference to using the StatsSA Census 2011 data, as this dataset was regarded as more accurate. StatsSA Census 2011 population figures were therefore used is developing this report.

The following breakdown of toilet types per ward (total of 29 wards) is noted:

Table 1: Breakdown of toilet types per ward

Ward	Population	Toilet type	Population served	Comment
1	7 446	unserved	7 446	assume open defecation
2	9 284	flush toilet, sewer	9 284	Darnell WWTW
3	6 129	unserved	6 129	assume open defecation
4	8 720	flush toilet, sewer	8 720	Sembcorp Siza Water
5	7 867	flush toilet, sewer	7 867	KwaDukuza WWTW
6	7 611	flush toilet, sewer	7 611	Sembcorp Siza Water
7	11 158			
8	7 897	flush toilet, sewer	7 897	Sembcorp Siza Water
9	7 471			
10	10 216			
11	9 198			
12	11 450			
13	8 528	flush toilet, sewer	8 528	KwaDukuza WWTW
14	8 210			
15	11 716	flush toilet, sewer	11 716	KwaDukuza WWTW 50%, Gledhow WWTW 50%
16	9 570	flush toilet, sewer	9 570	KwaDukuza WWTW
17	6 808	flush toilet, sewer	6 808	KwaDukuza WWTW
18	8 081	flush toilet, sewer	8 081	KwaDukuza WWTW
19	7 962	flush toilet, sewer	7 962	KwaDukuza WWTW
20	3 506	flush toilet, sewer	3 506	Sembcorp Siza Water

Ward	Population	Toilet type	Population served	Comment
21	6 992	unserved	6 992	assume open defecation
22	11 692	flush toilet, sewer	11 692	Sembcorp Siza Water
23	11 159	flush toilet, sewer	11 159	Sembcorp Siza Water
24	11 503			
25	8 210	unserved	8 210	assume open defecation
26	6 132			
27	6 673	unserved	6 673	assume open defecation
28				
29				
Total	**231,189**			

Considering the above:

- 61,949 persons (or 27% of the total population) are served by flush toilets connected to the sewer, and serviced directly by iLembe DM.
- 50,585 persons (or 22% of the total population) are served by flush toilets connected to the sewer, and serviced by Sembcorp Siza Water, a water service provider appointed by iLembe DM.
- 25,450 persons (or 15% of the total population) are unserved, and the occurrence of open defecation is assumed.
- The balance (83,205) is served by VIPs (unlined), VIPs (partially lined), septic tanks, and conservancy tanks.

Despite numerous requests, the SFD team were unable to obtain a breakdown of these remaining toilet technologies. From insights gathered during discussion and the subsequent site visits, the following assumptions were therefore made:

- 2,000 persons are served by conservancy tanks (0.9% of total population)
- 2,000 persons are served by septic tanks (0.9% of total population)
- The balance 79,205 is served by VIPs. Of this:
    - 60% of VIPs are unlined (47,523) (or 20% of total population)
    - 40% are partially lined (31,682) (or 14% of total population)

Considering the above, the details on the quantitative estimations are presented in the table below and sections that follow.

Table 2: Sanitation technologies and contribution of excreta in terms of percentage of population

No.	Sanitation technologies and systems as defined by:		SFD reference variable	Percentage of population
	iLembe DM	SFD promotion initiative		
1	Toilet flushes directly to sewer	Toilet discharges directly to a centralised foul/separate sewer	T1A1C2	49%
2	Septic tank (plastic or concrete)	Septic tank connected to soak pit	T1A2C5	1%
3	Conservancy tanks (plastic or concrete)	Fully lined tank (sealed), no outlet or overflow	T1A3C10	1%
4	VIPs – partially lined and open bottom	Lined pit with semi-permeable walls and open bottom	T1A5C10 (low risk GW)	14%
5	VIPs – unlined	Unlined pit	T1A6C10 (low risk GW)	20%
6	Not serviced	No toilet, open defecation	T1B7C10	15%

2.1.1 Containment

Almost half of the population (49%) is connected to a sewerage network, with the off-site formal waterborne sewer system linked to various wastewater treatment works within KwaDukuza LM. The remaining areas are reliant on on-site sanitation systems. The following on-site containment systems are generally noted:

- Flush toilet connected to a conservancy tank (concrete or plastic) for an individual house/building,
- Flush toilet connected to a septic tank (concrete or plastic) for an individual house/building,
- VIPs (unlined), and
- VIPs (partially lined).

There is a mixture of septic tanks (mostly on farms, and self-treating) and conservancy tanks (mostly small business and in town, and a rate is paid per load disposed by the municipality), but little clarity on the actual number of each type of structure. At this stage there do not appear to be specific municipal design standards for septic tanks or conservancy tanks and therefore the size, material of construction, configuration of installed infrastructure, etc. is variable.

The conservancy tanks have no formal outlets, they are defined as fully lined tanks within the SFD nomenclature. iLembe DM does not seem to currently have an asset register/database of all these septic/conservancy tanks. No evidence of conservancy tanks overflowing and spilling wastewater into the environment was noted during the site visit.

Some communities within KwaDukuza LM are reliant on VIP toilets. Some of the VIPs installed are thought to be unlined, while some are thought to be partially lined (lined on sides with open bottom). No fully lined VIPs (i.e. both on sides and bottom) are noted. To-date, VIPs are only emptied if funding is obtained for this specific purpose, and indications are that some of these VIPs are filling rapidly (i.e. were they all dug deep enough?). In rural areas, communities are used to covering up and abandoning a full VIP and relocating the VIP to a new location. In the urban context, limited space could prohibit this practice.

No community ablution blocks are noted.

2.1.2 Emptying and Transport

All waste collected by honeysuckers (vacuum trucks) is disposed of at the KwaDukuza WWTW. All trucks sign in at security when arriving to deliver a load. KwaDukuza LM has 2 honeysuckers, mostly supporting conservancy/septic tank emptying. There are also 3 private honeysucker companies that provide a service within iLembe DM (if required).

Reports by KwaDukuza WWTW personnel indicates that approximately 7-8 loads of 7,000 L by iLembe trucks are disposed daily (5 days per day), while private honeysucker service providers dispose 1-2 loads of 8,000 L daily (5 days per day) (following proof of payment for disposal at the WWTW by the service provider). Discussion with one of the private honeysucker companies indicated that they dispose of approximately 10 loads per month at the KwaDukuza WWTW, which supports the feedback provided by iLembe DM.

The KwaDukuza LM vacuum trucks are operated by 1 driver and 2 assistants. Personnel are issued with appropriate personal protective equipment (PPE) including boots and gloves, but they don't always use provided equipment. If the iLembe DM vacuum trucks break down, iLembe DM can contact the private service providers to assist.

Payment is required before conservancy/septic tanks are emptied. Adequate record keeping appears to be a challenge, and associated data analysis/interpretation is therefore limited. The municipality has not had many reported incidents of illegal dumping of honeysucker contents into the environment. It is noted that from a municipal perspective, as municipal officials operate the honeysuckers, they assume that truck contents are delivered to the KwaDukuza WWTW, as these officials will not be turned away, and therefore have no reason to illegally discharge. Furthermore, the distance to travel from the conservancy tanks to the discharge point is relatively short (<40 km). However, as emptiers are salaried staff, there does not seem to be an incentive to manage time efficiently.

VIPs are currently only emptied if funding is available. The normal procedure for emptying appears to be first digging a hole next to the current pit and putting lime together with any solid waste from the VIP, and then backfilling this (i.e. closing the hole). Water is then added to the VIP contents (via water tanker truck) to create a slurry which is then easier for the vacuum trucks to suck up. In some instances,

access by trucks is difficult, and either elongated pipes need to be used, or manual emptying is required (using local labour, bins for faecal sludge storage, shovels, and appropriate PPE). Collected contents are disposed of at the KwaDukuza WWTW.

There does not seem to be a strategy or plan within iLembe DM to deal with VIP empting and disposal/treatment. There have been limited cases of pits being full after a short-period (e.g. 6 months), and it is assumed that these pits were not dug deep enough by contractors (i.e. need for improved supervision of contractors). To-date, the contents of VIPs have not yet been analysed or categorised. User education of VIP operation, maintenance and management is performed by iLembe DM when such structures are handed over.

2.1.3 Treatment and disposal

KwaDukuza LM is serviced by six (6) wastewater treatment works (WWTW). Three (3) of these works are operated and maintained by iLembe DM (namely Darnel WWTW, KwaDukuza WWTW and Gledhow WWTW), while the other 3 are operated and maintained by Sembcorp Siza Water (Frasers WWTW, Shakaskraal WWTW and Sheffield WWTW) through a 30-year concession agreement.

The Sembcorp Siza Water related WWTWs, sewerage network and pump stations appear to be in good condition, and this is confirmed by the relatively good results received during previous DWS Green Drop Certification Audits.

The iLembe DM related WWTWs are unfortunately not in the same condition, and the site visit to the KwaDukuza WWTW confirmed the perceived condition status of satisfactory to poor. Although the works are properly fenced with controllable access via a security guard, it was noted that:

- The site was poorly maintained and safety hazards were noted
- Evidence of flooding and overflow of unit operations were noted.
- As there is no flowmeter, the actual operational capacity of the works is unknown.
- Drying beds do not seem to be in operation, and sludge is stockpiled on-site.

Plans are underway to develop a regional WWTW to replace current iLembe DM old and under-performing WWTWs.

It is unknown whether wastewater sludge from the various WWTWs has been categorised. Currently, there is no beneficial use of sludge, and sludge is stockpiled on-site at the wastewater treatment works (i.e. not disposed of at a landfill).

An overview of the WWTWs is presented in the table that follows.

Table 3: Overview of KwaDukuza LM wastewater treatment works

Name	Treatment type	Design Capacity (ML/day)	Flow (ML/day)	Sludge treatment	Sludge disposal/use
Frasers (Sembcorp Siza Water)	Activated sludge	12	6.8	?	None, stockpiled
Shakaskraal (Sembcorp Siza Water)	Activated sludge	1.6	1.1	Aerobic digestion	None, stockpiled
Sheffield (Sembcorp Siza Water)	Activated sludge	6	0.1	?	None, stockpiled
Darnell (iLembe DM)	Activated sludge	0.3	0.2	Drying beds	None, stockpiled
KwaDukuza (iLembe DM)	Activated sludge	10	10	Drying beds/anaerobic digestion	None, stockpiled
Gledhow (iLembe DM)	Activated sludge	0.7	0.25	Drying beds	None, stockpiled
	Totals	**30.6**	**18.45**		

2.1.4 Human resources

It is noted that within Technical Services in iLembe DM for 2018/2019, of a total number of posts of 390, 318 posts are filled (82%), while 72 posts are vacant (18%) (iLembe DM, 2018a). This could indicate potential gaps with fulfilling all required sanitation services functions/tasks.

2.1.5 Service Charges

The following charges are noted (iLembe DM, 2018f):

- Once-off connection charge
  - Water
    - Varies dependent on connection size
  - Sewer
    - Varies dependent on connection size
- Service charges
  - Water (2018/2019, VAT excl.):
    - Domestic (availability): R158,23 per month
    - Normal consumption: Domestic
      - Steps:
        - 0-10 kl/month: R135.64 (basic monthly charge)
        - 11-30 kl/month: R19.52/kl
        - >30 kl: R32.38/kl
    - Pre-paid consumption: Domestic

- Steps:
  - 0-10 kl/month: R13.56/kl (registered indigents: R0/kl)
  - 11-30 kl/month: R19.52/kl
  - >30 kl: R32.38/kl
- Bulk water sales to industry: tariff per kl (as per signed SLA)
- Water tanker deliveries – domestic: R540.60 per 6 kl
- Customer complaints callouts: Cost + 10%
- Punitive tariffs and controls are in place for dealing with illegal connections, when water availability is scarce, etc.

- Sewerage (2018/2019, VAT excl.)
  - Residential
    - Sewer basic charges/unit charges for domestic, commercial, etc. is based on the valuation cost method
      - Sewer Tariff to be calculated on the market value of the property reflected in the KwaDukuza Municipality's valuation roll and varies by property type (e.g. agricultural, residential, industrial/business/commercial, etc.)
  - Removal of conservancy tank effluent – sewer disposal
    - Normal domestic: R702.53 per load
    - Domestic with maximum total household income to R15 000: R300 per load
    - Indigent: R0 per load
    - Various tariffs are also noted for emergency services, removal of contents of malfunctioning septic tanks, etc.
  - Disposal at Sewer Works by Private Contractor
    - R 294,17 / 10 m^3 load

2.1.6 Water Conservation and Demand Management

The KwaDukuza Local Municipality (LM) currently obtains water from two major water sources namely the Hazelmere Dam on the Mdloti River (located to the south of the LM), as well the Mvoti River running through the middle of the KwaDukuza Local Municipality. The approximate water demand for KwaDukuza is 58.4 ML/day (iLembe DM, 2016a). As the demand for water on the coastal area of KwaDukuza has increased and the current supply from the Umdloti and Umvoti river systems are insufficient to meet the projected water demand, and in order to ensure a reliable supply of water to consumers, the iLembe DM, along with Umgeni Water, is implementing the Lower Tugela Bulk Water Supply Scheme for KwaDukuza LM (KwaDukuza LM, 2018).

The table that follows shows the water source types within KwaDukuza LM, and the associated water treatment works.

Table 4: Overview of KwaDukuza LM water treatment works capacity and flows (as per Blue Drop System)

Water Treatment Works	Water Source (Borehole = b, Surface = S)	Capacity (ML/day)
Umvoti	S	14.50
Darnall	S	2.00
Blythedale	B	0.50
Zinkwazi	B	0.50
Sancousi	S	1.00
Bulwer	S	0.25
Driefontein	B	0.25

Of importance to note is that the above water treatment works are operated and maintained by iLembe DM, while Umgeni Water is supplying the balance of the water demand within KwaDukuza LM.

As of June 2018, water losses for KwaDukuza LM were 449 L/connection/day and non-revenue water (NRW) was 57.3%, while the inefficiency of use was 32.2%. Considering the standard IWA water balance for KwaDukuza LM, the following key related indicators are noted (as of June 2018) (iLembe DM, 2018b):

Table 5: Status overview of key WC/WDM indicators for KwaDukuza LM

Indicator	KwaDukuza
Number of registered connections	20,020
Non-revenue water (NRW) (%)	57.3%
Inefficiency of use (%)	32.2%
Water Losses per connection (L/conn/day)	449
Real Losses per connection (L/conn/day)	341
Apparent Losses per connection (L/conn/day)	108
Infrastructure Leakage Index (ILI)	4.3

The figure below indicates the water balance for the 12-months ending June 2018.

Area: KwaDukuza Consumptions in kℓ/month (YTD) for: June 2018

System Input Volume ± 8.0% 7 742 717	Authorised Consumption ± 6.6% 4 460 577	Billed Authorised Consumption ± 8.6% 3 307 021	Billed Metered Consumption ± 12.0% 2 339 235	Revenue Water ± 8.6% 3 307 021
			Billed Unmetered Consumption ± 5.0% 967 786	
		Unbilled Authorised Consumption ± 6.8% 1 153 556	Unbilled Metered Consumption ± 5.0% 392 209	Non-Revenue Water ± 12.4% 4 435 696
			Unbilled Unmetered Consumption ± 10.0% 761 347	
	Water Losses ± 16.6% 3 282 140	Apparent Losses ± 11.1% 787 714	Illegal Connections ± 15.0% 569 198	
			Metering Inaccuracies ± 8.0% 218 516	
		Real Losses ± 7.2% 2 494 426	Mains Leaks ± 10.0% 1 746 098	
			Reservoir Overflows ± 5.0% 12 472	
			Service Connection Leaks ± 5.0% 735 856	

Figure 3: IWA Standard Water Balance for KwaDukuza LM (for the year ending June 2018) (iLembe DM, 2018c)

Considering the population of 231,189 and System Input Volume (SIV) of 7,742,717 kl/year, this translates into an average consumption of 92 litres per person per day for KwaDukuza LM. For reference purposes, the current South African average consumption of 237 litres per person per day under normal conditions (DWS, 2018).

The following water stock on hand calculations (30 June 2018) provide an indication of the known length of pipelines (km) and size of reservoirs (kl) within the KwaDukuza LM.

	Water Supply Scheme Name	Bulk Water Supplier	Cost per kl	Length of pipelines (km)	Reservoir Size (kl)	Total water in pipelines (kl)	Total water in reservoirs (kl)	Total availible water (kl)	Total Purchased water value
				832	*96 250*	*6 535*	*64 659*	*71 194*	*R 480 656.53*
KwaDukuza	Blythedale Beach	iLembe	6.91	15	450	114	410	524	3621
	Mvoti Supply - KwaDukuza	Umgeni	6.91	136	42380	1071	33124	34194	236315
	Zinkwazi Beach	iLembe	6.91	13	1500	98	1315	1413	9766
	Driefontein	iLembe	6.91		500	0	475	475	
	Darnall/Zamane (Tongaat Hulett)	Tongaat Hulett	4.46	21	4500	165	4000	4165	18576
	Gledhow south (Ushukela Milling)	Ushukela Milling	4.79	7	550	57	488	544	2606
	Groutville	iLembe	6.91		250	0	218		
	Malende Pumpstation	iLembe	6.91		200	0	0		
	Hungose	iLembe	6.91		100	0	0		
	San Souci	iLembe	6.91		5550	0	278		
	Sakhamkhanya	iLembe	6.91		5250	0	35		
	Nsikeni	iLembe	6.91		100	0	85		
	Kamu	iLembe	6.91		1000	0	0		
	Sokesimbone	iLembe	6.91		200	0	0		
	Intaka Storage	iLembe	6.91		500		25		
	Vulinqondo	iLembe	6.91		50	0	3		
	Sunny Hills	iLembe	6.91		50	0	45		
	Ohlange	iLembe	6.91		50	0	3		
	Mgigimbe	iLembe	6.91		2000	0	0		
	EvenGrande res	iLembe	6.91		5000	0	4500		
	Emboniswen Res	iLembe	6.91		50	0	40		
	Madundube	iLembe	6.91		1020	0	868		
	Dvuba	iLembe	6.91		5000	0	4500		
	Bell Reservoir	iLembe	6.91		5000	0	4500		
	Robert Reservoir	iLembe	6.91		5000	0	4500		
	Addinton Lower Tugela	iLembe	6.91		5000	0	500		
	Lushaba	iLembe	6.91		5000	0	4750		

Figure 4: Indication of water supply infrastructure components within KwaDukuza LM (iLembe DM, 2018d)

The Report on Implementation of Water Conservation/Water Demand Management and Water Turn-around Strategic Projects in the 2017/18 Financial Year, indicates some progress made by the iLembe DM, but also recommends the following key activities/targets for implementation in 2018/19 (iLembe DM, 2018g):

- Bulk Meter Replacement
- Pressure Management (installation of PRV's)
- Leak Detection and Repairs
- Control valve maintenance program
- Upgrading Telemetry systems
- Consumer meter reading accuracy assessment
- Billing database/GIS reference and check
- Consumer meter accuracy tests

2.2 SFD matrix

The final SFD for KwaDukuza LM is presented in **Appendix 6.1**.

2.2.1 SFD matrix explanation

In this report, all sanitation infrastructure is categorised according to their design and functioning as per SFD terms. Below is a description of each of the sanitation technologies in KwaDukuza LM.

- Toilet discharges directly to a centralised foul / separate sewer – these are flush toilets that are connected directly to the wastewater treatment works.
- Septic tank connected to soak pit – these are buried concrete or plastic tanks from individual households/businesses (flush toilet connected to a septic tank). Most of these tanks are considered to be in a good condition.
- Fully lined tank (sealed, no outlet or overflow) – these are buried concrete or plastic tanks from individual households/businesses (flush toilet connected to a conservancy tank). Most of these tanks are considered to be in a good condition.
- Lined pit with semi-permeable walls and open bottom – these are lined VIPs with an open bottom. Although some VIPs are emptied when funding is available, it is assumed that a emptying backlog exisits.
- Unlined pits – these are VIPs that are unlined. It is unknown if these unlined pits are within areas reliant on groundwater sources. Although some VIPs are emptied when funding is available, it is assumed that a emptying backlog exisits.
- No toilet, open defeacation – these are households that have not been serviced, and do not have a toilet. Their sanitation status is unknown, and it is assumed that open defecation is occuring.

Considering the above, the following is noted:

Off-site

According to municipal records, 49% of the population are serviced via off-site sanitation. All of this wastewater is transported to the six (6) wastewater treatment works, namely Darnel WWTW, KwaDukuza WWTW, Gledhow WWTW, Frasers WWTW, Shakaskraal WWTW and Sheffield WWTW. In order to determine the proportion of wastewater in the sewer system that is actually delivered to centralised wastewater treatment works, the status of the sewer network needs to be known. Although the average life remaining of the sewer network is unknown (asset register is incomplete), it is assumed that the existing sewer systems in some areas of KwaDukuza LM are beyond their design lives and in poor condition. It is therefore anticipated that leakage will occur. We therefore assume that 90% is delivered to the centralised WWTWs for treatment. Overall, this translates into approximately 5% of wastewater that is not delivered to treatment.

Once the wastewater reaches the WWTWs, it is treated to meet specified requirements. The Sembcorp Siza Water WWTWs appear to be operating effectively, with an effluent compliance of 100%. Data for the iLembe DM WWTWs was, however, not obtained, and considering the findings from the site visit, a flow weighted compliance of 50% is assumed. Considering the various flows per WWTW and associated overall effluent compliance per WWTW, an overall flow weighted compliance of 72% is noted (see table that follows). This implies that a small proportion of the wastewater is not treated effectively, and can pollute the environment. Overall, this translates into approximately 12% of wastewater that is not treated effectively.

Table 6: Compliance for KwaDukuza LM WWTWs

No.	Wastewater Treatment Works (WWTW)	Average Flow (Ml/day)	Overall Effluent compliance (%)
1	Frasers, Shakaskraal, Sheffield (Sembcorp Siza Water)	8	100%
2	Darnel, KwaDukuza, Gledhow (iLembe DM)	10.45	50%
	Total	**18.45**	**72%**

To-date, wastewater sludge has not yet been analyzed or categorized, and sludge compliance still needs to be determined. Wastewater sludge is currently stockpiled at the respective WWTWs.

On-site

All conservancy/septic tanks are considered to be in good condition (i.e. not leaking). It is assumed that 50% of the faecal sludge is emptied from conservancy/septic tanks by honeysuckers (vacuum trucks). Of the total VIPs (i.e. 34% of the total population), 60% are considered unlined (i.e. 20% of the total population), while 40% are partially lined (sides lined and open bottom) (i.e. 14% of the total population). As these VIPs are relatively new, they are considered to be in good condition. iLembe DM only empty VIPs if funding is available, and a VIP emptying strategy has not yet been developed. A

limited number of cases of "full VIPs after 6 months" have been reported, and in these cases it is suspected that contractors did not dig deep enough pits (as per required specifications). It is assumed that 20% of VIPs are emptied and that faecal sludge is transported to the iLembe DM related wastewater treatment works (i.e. KwaDukuza WWTW).

32% of the faecal sludge is contained (31% from VIPs and 1% from conservancy/septic tanks). 50% of the faecal sludge in the conservancy/septic tanks is contained and never emptied, while the other 50% is emptied and transported to the wastewater treatment works. 50% of the faecal sludge in 20% of the VIPs is emptied and transported to the wastewater treatment works (i.e. 3%). Therefore 1% is emptied from conservancy/septic tanks, while 3% is emptied from VIPs. The remaining 1% faecal sludge in conservancy/septic tanks and 31% faecal sludge that is contained within VIPs is never emptied, but considered to be safely managed as it is adequately contained, with low groundwater risk. As it is noted that alternative points of discharge do not appear to be feasible for municipal workers, it is assumed that all of the faecal sludge collected by municipal honeysuckers (vacuum trucks) is emptied at the wastewater treatment works. Although no reports of illegal dumping are noted, it is assumed that 95% of the faecal sludge collected by private honeysuckers (vacuum trucks) is emptied at the wastewater treatment works i.e. 5% is illegally discharged). Once it reaches the KwaDukuza WWTW, it is treated. However, as previously noted, an overall effluent compliance of 50% was assumed. This results in 2% of the total faecal sludge not being adequately treated.

Open defecation

Currently, 35,450 households are not serviced (i.e. ~15%). This is considered the sanitation backlog, and needs to be addressed. As the status of the sanitation practices for these households is unknown, it is assumed that current sanitation practices are unsafe, and that open defecation is occurring.

Table 7: Description of variables used in SFD

Variable	Description
W4a	WW delivered to centralized treatment plant
W5a	WW treated at centralized treatment plant
F3	FS emptied
F4	FS delivered to treatment plant
F5	FS treated

It can be concluded that excreta of 66% of the population is safely managed in KwaDukuza LM, and that 34% of excreta is discharged into the environment untreated. The following figure summarizes the percentages of the population using each sanitation technology and the method along the service chain.

KwaDukuza Local Municipality, KwaZulu Natal, South Africa, 13 Nov 2018. SFD Level: 2 - Intermediate SFD
Population: 231189
Proportion of tanks: septic tanks: 50%, fully lined tanks: 50%, lined, open bottom tanks: 50%

System label	Pop	W4a	W5a	F3	F4	F5
System description	Proportion of population using this type of system	Proportion of wastewater in sewer system, which is delivered to centralised treatment plants	Proportion of wastewater delivered to centralised treatment plants, which is treated	Proportion of this type of system from which faecal sludge is emptied	Proportion of faecal sludge emptied, which is delivered to treatment plants	Proportion of faecal sludge delivered to treatment plants, which is treated
T1A1C2 Toilet discharges directly to a centralised foul/separate sewer	49.0	90.0	72.0			
T1A2C5 Septic tank connected to soak pit	1.0			50.0	99.0	50.0
T1A3C10 Fully lined tank (sealed), no outlet or overflow	1.0			50.0	99.0	50.0
T1A5C10 Lined pit with semi-permeable walls and open bottom, no outlet or overflow	14.0			20.0	100.0	50.0
T1A6C10 Unlined pit, no outlet or overflow	20.0			20.0	100.0	50.0
T1B11 C7 TO C9 Open defecation	15.0					

Figure 5: SFD Matrix for KwaDukuza LM (2018)

2.2.2 Risk of groundwater contamination

Most water supplied is from drinking-water treatment works via pipeline to households with the majority of households either receiving water via household taps or yard connections. Raw water is obtained from the both surface water and groundwater, with the majority of surface water origin.

Some rural areas (outside of the urban boundary) are reliant on groundwater sources, and as little/no treatment is noted, protection of these water sources is essential. Where groundwater is a resource, sanitation activities are located at a suitable distance from the groundwater resource. In some instances, the water table surrounding VIPs was high, and these communities have moved from using groundwater sources to piped water supply.

Groundwater is an important resource to preserve and protect, and the importance thereof is further emphasised by climate change impacts and the increasing water scarcity facing many parts of South Africa and KwaZulu-Natal.

There is a need to continue to create awareness among the rural people about the need to ensure that pit latrines/VIPs are adequately sealed when closed/moved/new pit dug, and of the effects of using polluted water.

3. Stakeholder engagement: key interviews

The relevant iLembe District Municipality staff were contacted through e-mail, letter and telephone call prior to the visit. The purpose of the SFD study and depth of data required was conveyed through an introductory letter to respective staff. Although a number of stakeholders of government departments were noted, this SFD study aimed to focus on interviews with staff from iLembe District Municipality as the Water Services Authority and Water Services Provider, and their associated service providers.

Face-to-face interviews were held with the Water Quality Manager and Community Development Officer, while telephonic interviews were held with a number of key staff members who were in the field on assignment, but who could not attend the meeting at the office. The Water Quality Manager also accompanied the team to the site inspection. During the site inspection, interviews were held with

- Process controller at the KwaDukuza WWTW
- Vacuum tanker service providers (telephonically)
- Members of the public (i.e. private citizens)

A site inspection assisted with verifying data obtained from iLembe District Municipality published reports (e.g. IDP, WSDP). The key informant interviews and data collected helped in understanding the existing situation and upcoming developments plans in the sanitation sector.

4. Acknowledgements

This report was compiled for a Water Research Commission project and as part of the SFD Promotion Initiative. We would like to thank Raynund Ganesh (Water Quality Manager), Bongani Mthiyane (Community Development Officer), and all participating iLembe DM staff who due to other commitments were not able to attend the SFD related meetings, but were able to give their time and necessary information telephonically for the assessment.

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6. Appendix

6.1 SFD Matrix

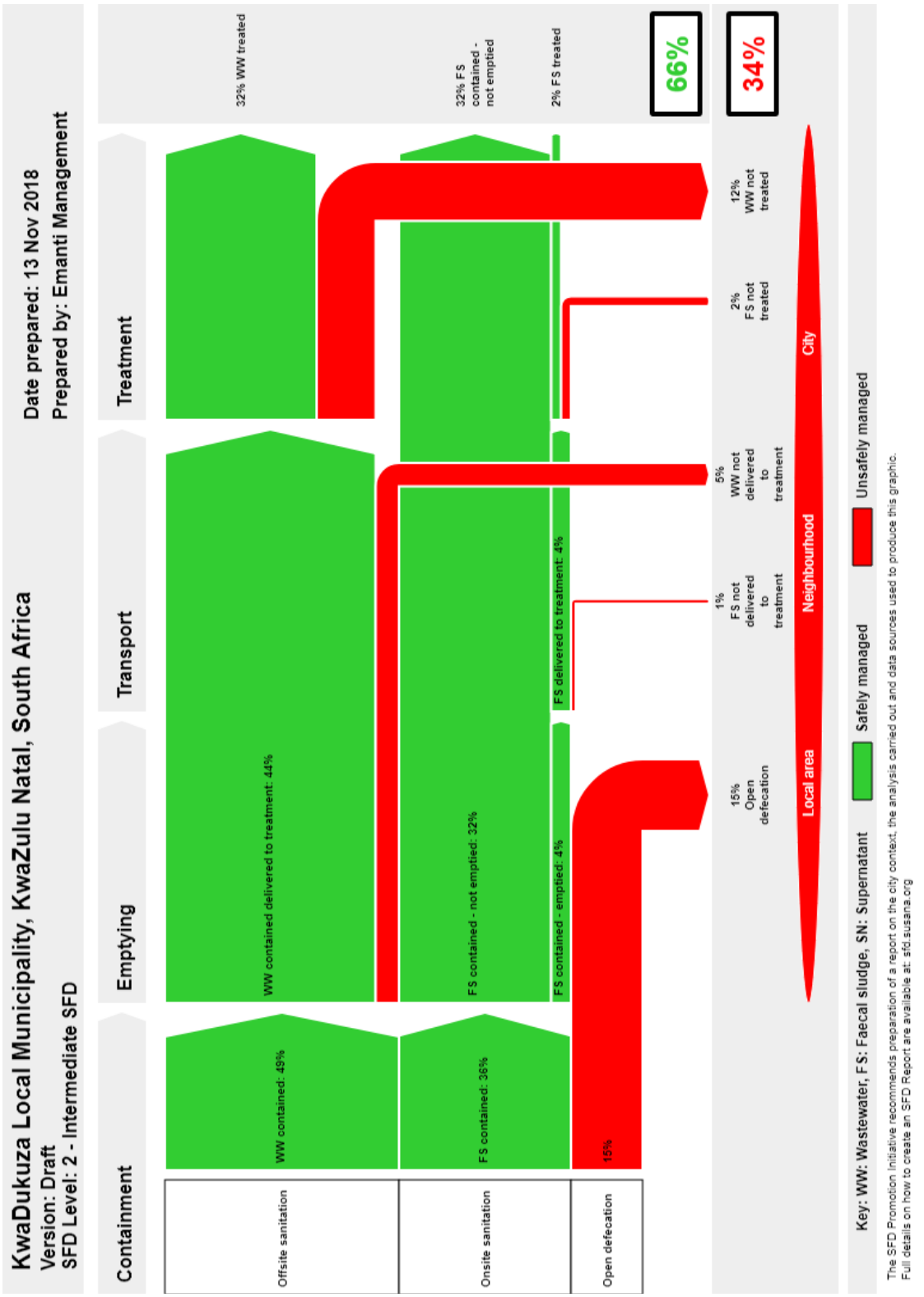

Figure 6: SFD matrix

6.2 Possible Future Scenario

Of concern is that a significant portion of the sanitation technologies within KwaDukuza LM are on-site sanitation systems (VIPs), and that the emptying strategy has not yet been developed and is currently reliant on external funding (i.e. we empty VIPs when we have budget for it). This service is rendered free by the municipality. With time, VIPs will fill and without subsequent emptying, the current status could therefore deteriorate if this is not considered in the near future. Further discussion on this topic, by means of the consideration of a possible future scenario, is presented below.

Currently, 34% of the total population (79,205) utilize VIPs, with:

- 14% lined pits with semi-permeable walls and open bottom, no outlet or overflow, and
- 20% unlined pits, no outlet or overflow.

In this scenario, it is assumed that:

- 33% of current VIP users will remain as is.
- 33% of VIPs will never be emptied, but abandoned when full and adequately covered with soil, no outlet or overflow.
- 33% of VIPs will never be emptied but abandoned when full, but NOT adequately covered with soil, no outlet or overflow.

Considering the total population, this translates into:

- 5% using lined pits with semi-permeable walls and open bottom, no outlet or overflow (partially lined VIPs), and 7% using unlined pits, no outlet or overflow (unlined VIPs)
- 11% of VIPs will never be emptied, but abandoned when full and adequately covered with soil, no outlet or overflow.
- 11% of VIPs will never be emptied but abandoned when full, but NOT adequately covered with soil, no outlet or overflow.

In this future scenario, current VIPs are re-categorised as follows:

Table 8: Possible Future scenario – re-categorisation of VIPs

	SFD Categorisation	Current Status		Possible Future Scenario	
		% of total population	Number	% of total population	Number
1	Lined pits with semi-permeable walls and open bottom, no outlet or overflow	14%	32,366	5%	11,097
2	Unlined pits, no outlet or overflow	20%	46,238	7%	16,645
3	Pit (all types) never emptied, but abandoned when full and covered with soil, no outlet or overflow	0%	0	11%	25,431
4	Pit (all types) never emptied but abandoned when full but NOT adequately covered with soil, no outlet or overflow	0%	0	11%	25,431
	Totals	**34%**	**78,604**	**100%**	**78,604**

An updated SFD for this possible future scenario is indicated below. Considering this, it can be concluded that excreta of 56% of the population in KwaDukuza LM would be safely managed, while 44% of excreta would not be safely discharged into the environment. This highlights the importance of developing and implementing an appropriate VIP emptying strategy supported by adequate budget.

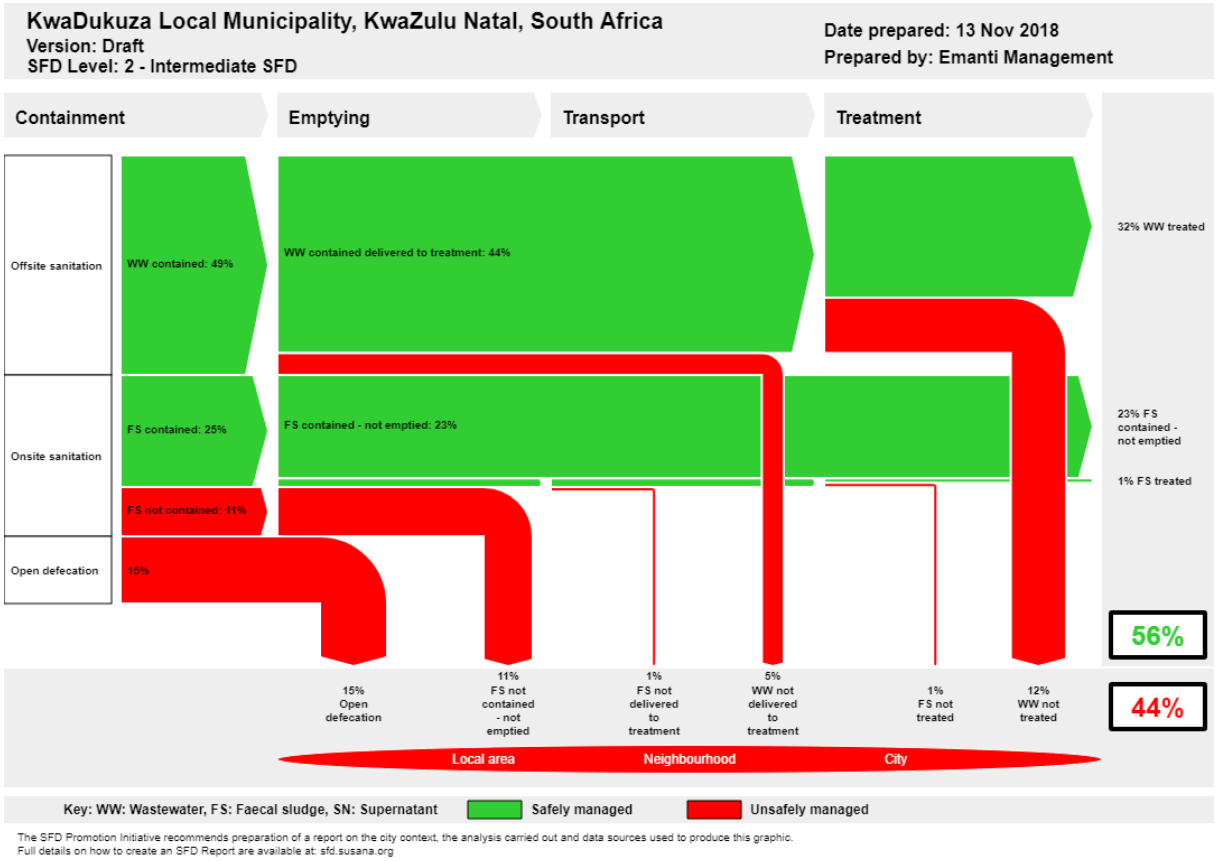

Figure 7: SFD matrix – Possible Future Scenario

6.3 Stakeholder identification

Table 9: Stakeholder identification

No.	Stakeholder group	In KwaDukuza LM context
1	City council / Municipal authority / Utility	Water Services Authority (WSA): iLembe District Municipality Water Services Provider (WSP): iLembe District Municipality
2	Ministry in charge of urban sanitation and sewerage	National: Department of Water and Sanitation Provincial: Department of Water and Sanitation (KwaZulu-Natal)
3	Ministry in charge of urban solid waste	National: Department of Environmental Affairs Provincial: Department of Economic Development, Tourism and Environmental Affairs of KwaZulu-Natal (EDTEA)
4	Ministry in charge of urban planning, finances and economic development	National: Department of Human Settlements Provincial: KwaZulu-Natal Department of Human Settlements National: National Treasury Provincial: KwaZulu-Natal Provincial Treasury Provincial: Department of Economic Development, Tourism and Environmental Affairs of KwaZulu-Natal (EDTEA)
5	Ministry in charge of environmental protection	National: Department of Environmental Affairs Provincial: Department of Economic Development, Tourism and Environmental Affairs of KwaZulu-Natal (EDTEA)
6	Ministry in charge of health	National: Department of Health Provincial: KwaZulu-Natal Department of Health
7	Service provider for construction of on-site sanitation technologies	Various, by tender appointment
8	Service provider for emptying and transport of faecal sludge	Various, by tender appointment
9	Service provider for operation and maintenance of treatment infrastructure	N/A Performed by iLembe District Municipality
10	Market participants practicing end-use of faecal sludge end products	N/A
11	Service provider for disposal of faecal sludge (sanitary landfill management)	N/A
12	External agencies associated with faecal sludge management services (e.g. NGOs, academic institutions, donors)	N/A

6.4 Tracking of engagement

Table 10: Tracking of stakeholder engagement

Name of organization	Name of contact person	Designation	Date of engagement	Purpose of engagement
iLembe District Municipality	Raynund Ganesh	Water Quality Manager	18 & 25 October 2018	Introducing SFD, securing support for project
iLembe District Municipality	Penelope Magwaza	Chemistry Technician		
iLembe District Municipality	Raynund Ganesh	Water Quality Manager	2 November 2018	Data collection, collation, verification and site visits including key informant interviews
iLembe District Municipality	Bongani Mthiyane	Community Development Officer		
iLembe District Municipality	Raynund Ganesh	Water Quality Manager	5 November-11 December 2018	Data gaps, follow-ups
iLembe District Municipality	Penelope Magwaza	Chemistry Technician		
iLembe District Municipality	Raynund Ganesh	Water Quality Manager	-	Draft report review and finalisation
iLembe District Municipality	Penelope Magwaza	Chemistry Technician		

6.5 Selected pictures taken during visit

Figure 8: KwaDukuza WWTW

Figure 9: Evidence of no flowmeter at KwaDukuza WWTW (i.e. no flow measurement)

Figure 10: Evidence of previously overflowing units at KwaDukuza WWTW

Figure 11: Flooded tertiary ponds at KwaDukuza WWTW

Figure 12: Sludge stockpiling at KwaDukuza WWTW

Figure 13: Examples of VIPs identified during site visit