

# SFD Report

## Mandalay Myanmar

### Final Report

This SFD Report – Level 2 - was prepared by  
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Date of production: 2016-2018

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SFD Report Mandalay, Myanmar, 2019

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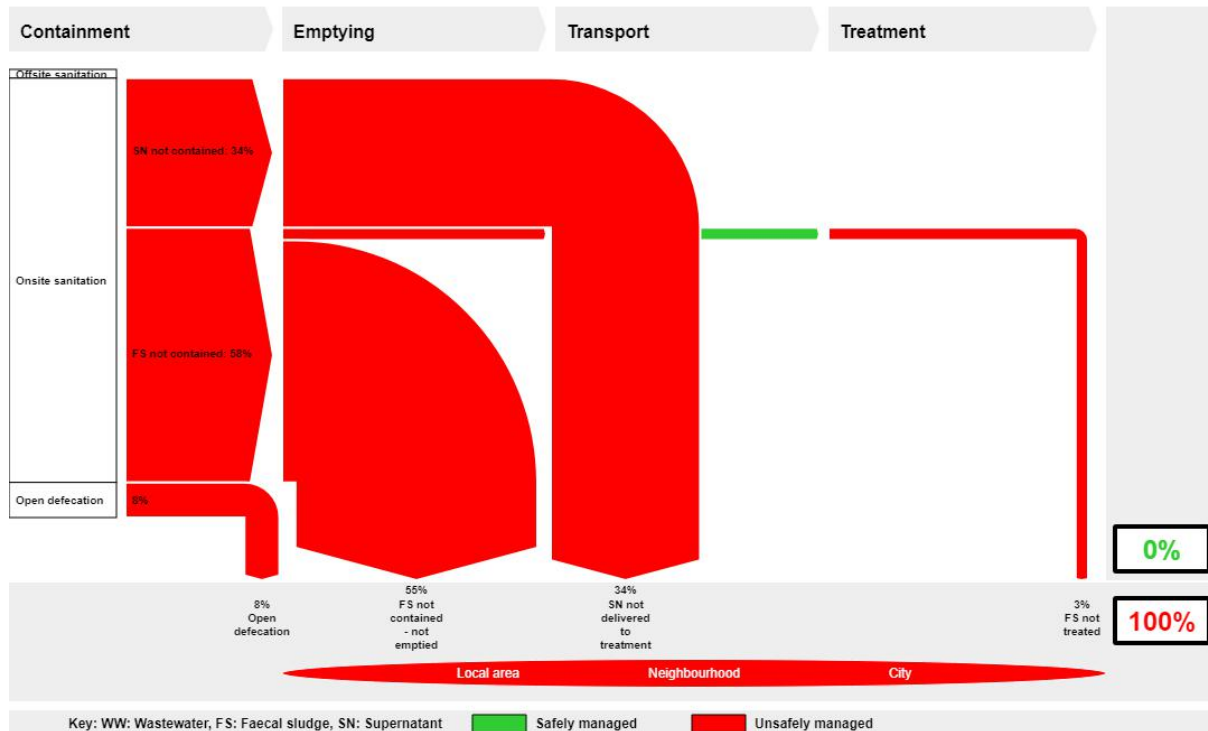
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## 1. The SFD Graphic

**Mandalay, Mandalay, Myanmar**  
Version: Reviewed  
SFD Level: 2 - Intermediate SFD

Date prepared: 31 Jan 2019  
Prepared by: Jérémie Sanchez



## 2. Diagram information

### SFD Level:

This is a Level 2 - intermediate SFD.

The SFD was produced thanks to field research carried out between 2016 and 2018.

### Produced by:

Jérémie Sanchez (University of Lausanne), Su Su Myat (GRET/BORDA), Pyae Phyo Kyaw (ex-MCDC Intern).

### Status:

This is a final SFD report.

**Date of production:** 31/09/2019

## 3. General city information

Mandalay is located on the bank of the Irrawaddy on a rather flat and low flood plain, in the centre of Myanmar's dry-zone.

Mandalay is the second largest city of Myanmar. According to 2014 census data, Mandalay is populated with 1.3 million inhabitants and has an average density of 16,230 inhabitants per square kilometre, hiding important infra-urban disparities (MOIP and UNFPA, 2015). Migrants from surrounding cities, villages and neighbouring States and Regions are increasingly numerous to settle down in Mandalay, contributing to the rapid expansion of the city and notably of its informal settlements.

The city boundaries chosen for the SFD graphic are the administrative boundaries of Mandalay's six townships. They determine the jurisdiction of the Mandalay City Development Committee (MCDC), which is the main sanitation service provider.

#### 4. Service outcomes

All sanitation infrastructures in Mandalay are onsite. Households rely on a mix of septic tanks and a range of impermeable, semi-permeable and permeable tanks or unlined pits as containment facilities. Most discharge into public open drains, which are used for dishwashing, laundry or bathing purposes. Faecal sludge emptying services are performed by the MCDC but only reach about 3% of the population. The faecal sludge emptied is discharged to an oxidation pond outside the city, but not treated.

A large share of the population relies on private borewells to access drinking water. The risk of groundwater contamination is significant. Urban sanitation is loosely encompassed in several national level laws and policies; none of which is enforced. Municipal laws determine institutional responsibilities and concentrate decision making power in the hands of the MCDC's departments' heads.

The SFD graphic shows that 100% of excreta is not properly managed. It consists of: 34% of supernatant not contained from tanks connected to open drains that ends up untreated in the environment; 3% of FS emptied, delivered to treatment to an oxidation pond outside the city, but not treated; 55% of FS not contained and not emptied from tanks and pits, and 8% of people practising open defecation.

#### 5. Service delivery context

Several national-level policies adopted over the last decade loosely relate to urban sanitation, while multiple laws and regulations, sometimes much older, broadly regulate wastewater discharge and distribute institutional responsibilities over several ministries. However, none of them reflects how urban sanitation is actually managed. The National Water Policy, drafted by a committee of national experts supported by the Dutch cooperation and adopted in 2014, includes scarce provisions targeting sanitation. The Water Resources Law, which is to be the juridical counterpart of this policy, is currently at a draft stage.

At the municipal level, Water and Sanitation bylaws were adopted by the MCDC in 2014. They specifically target servicing and drainage, and grant full authority to the Committee and Department Heads to perform all sanitation related duties, while they impose restrictions on the public regarding effluent discharge and infrastructure construction. However, according to both government officials and international

actors, there is a significant offset between what laws and policies state and what is actually implemented.

The effects of poorly managed sanitation remain critical in Mandalay. Stagnant water bodies, often loaded with wastewater and swarmed with mosquitoes, threaten the health of urban dwellers on a daily basis. Groundwater sources, polluted by percolating blackwater, are widely used for drinking purposes. Consequently, both vector-borne and waterborne diseases break out frequently. The incidence of diarrhea-induced deaths among children under 5 seems particularly high (although figures are not available) (ADB, 2013). In addition, seasonal inundations spread wastewater into the streets, destroy urban assets, and cut people from their livelihoods. Polluted urban waterbodies finally host a dwindling aquatic biodiversity, and contaminate the waterways into which they discharge freely.

#### 6. Overview of stakeholders

The MCDC is, since its establishment in 1992, the main sanitation service provider in Mandalay. Also involved in sanitation management are the township and ward offices of the General Administration Department (GAD), which act as brokers between the population and the MCDC (Arnold & Kyi Pyar Chit Saw, 2014; Sanchez & Myat, n.d.); the regional office of the Ministry of Construction (MOC), which drafted the Mandalay Master Plan with the support of JICA (the Masterplan is unknown to most of MCDC staff); and the Ministry of Health and Sports (MOHS), which arguably used to provide latrine construction material to households in need at some point in the past. Ward level Community Based Organisations (CBOs) sometimes join the MCDC staff to perform emergency dredging of overflowing drains.

Table 1. key stakeholders

Key Stakeholders	Organizations
Public Institutions	Mandalay City Development Committee
	Ministry of Construction
	General Administration Department
Non-governmental Organizations	World Vision International Ward level CBOs
Private Sector	Generally not allowed to operate
Development Partners, Donors	ADB, FDA, SUEZ, VEI, GRET



## 7. Credibility of data

This SFD report is based on over 110 interviews and focus group discussions with relevant stakeholders (see list in detail in section 4.1). Interview data were triangulated with 3 years of field observation (see section 4.2) and the analysis of multiple governmental and international cooperation actors records (see section 4.3).

## 8. Process of SFD development

The SFD was created in the context of the first author's doctoral research on sanitation governance in Mandalay, between 2016 and 2018. The SFD methodology, versions 1.0 and 2.0 (SFD Promotion Initiative, 2015, 2017) were used as a basis for field research.

While all data sources are not entirely reliable, the authors do not believe it would be possible to produce a more credible SFD in the current political context of Myanmar.

## 9. List of data sources

- ADB. (2013). Myanmar Urban Development and Water Sector Assessment, Strategy and Road Map. Manila: Asian Development Bank.
- Arnold, M., & Kyi Pyar Chit Saw. (2014). Administering the State in Myanmar. An Overview of the General Administration Department (Subnational Governance in Myanmar Discussion Paper Series No. 6). San Francisco: The Asia Foundation.
- MOIP, & UNFPA. (2015). The 2014 Myanmar Population and Housing Census. Mandalay Region (The 2014 Myanmar Population and Housing Census). Nay Pyi Taw: Ministry of Immigration and Population/UNFPA.
- Sanchez, J., & Myat, S. S. (n.d.). In the Wards of Mandalay: Everyday Urban Governance and Political Society in Contemporary Myanmar.

Mandalay, Myanmar, 2019

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## Abbreviations

ADB	Asian Development Bank
CBO	Community Based Organisation
CD	Cleansing Department (MCDC)
FDA	French Development Agency
FS	Faecal Sludge
GAD	General Administration Department
GRET	Groupe de Recherche et d'échanges Techniques (INGO)
JICA	Japan International Cooperation Agency
MCDC	Mandalay City Development Committee
MOC	Ministry of Construction
MOHS	Ministry of Health and Sports
MONREC	Ministry of National Resources and Environmental Conservation
MUSIP	Mandalay Urban Services Improvement Project
RBD	Roads and Bridges Department (MCDC)
UNFPA	United Nations Population Fund
VEI	Vitens Evides International
WSD	Water and Sanitation Department (MCDC)
WVI	World Vision International
WWTP	Waste Water Treatment Plant

## 1 City context

Mandalay is located on the bank of the Irrawaddy River on a rather flat and low flood plain, in the center of Myanmar’s dry-zone. There is one (sacred) hill in Mandalay, located to the north east of Aung Myay Tharzan Township; topography is otherwise characterized by a light slope running smoothly from the north-east to the south-west.

Mandalay is built above four groundwater tables located at different depths. The first one is between 5 to 10 metres below surface and is extensively used as a drinking water source by households that own a private bore well (this is the source of drinking water for a large share of the population<sup>1</sup>). The second table is located between 20 to 40 metres. The third is located between 200 to 300 metres below surface, beneath an impermeable layer of clay. This one is drained by the bore wells of the Mandalay City Development Committee (MCDC) to provide drinking water to the population that is connected to the public network (about 60% of the population has a connection). The fourth is located at 400 metres below ground and currently untouched.

Rainfall in Mandalay is low, comparatively to other regions of Myanmar, and characterized by two peaks in May and September-October (Figure 1). Nevertheless, monsoon rainfall often leads to important flooding, especially in the lowest areas to the south-west of the city.

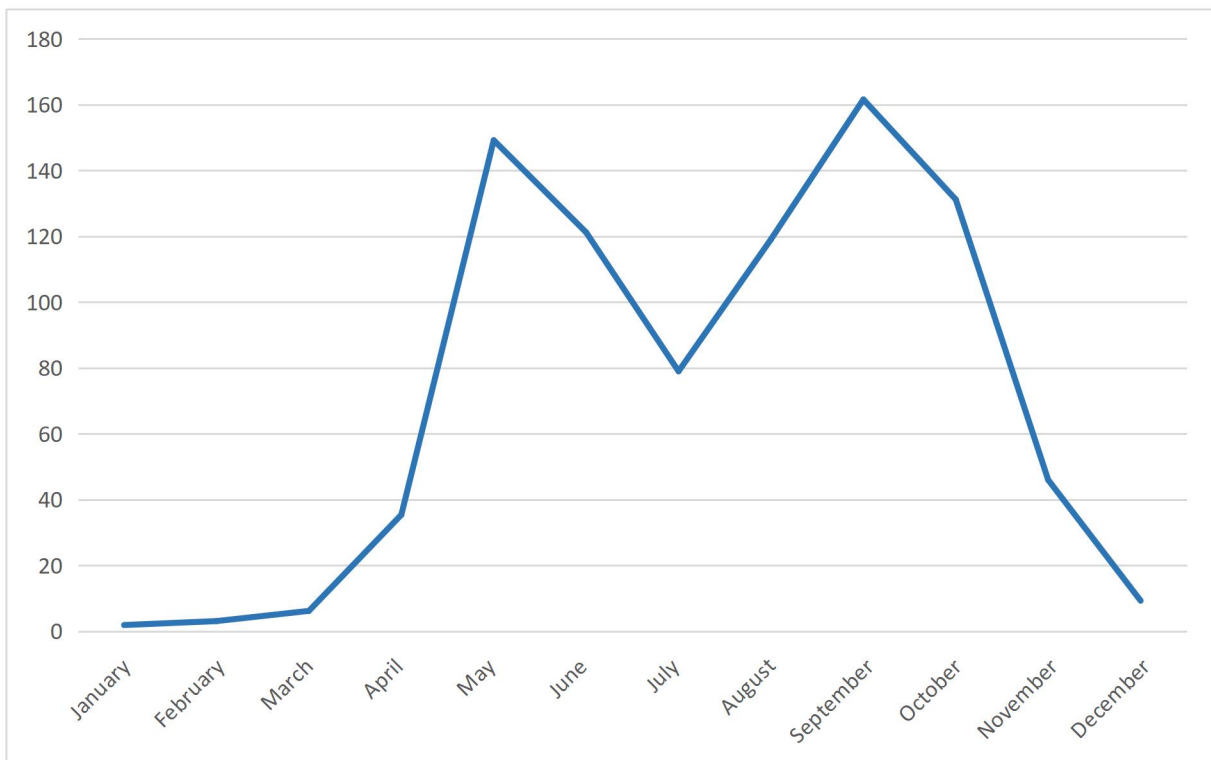


Figure 1. Average monthly rainfall in Mandalay (1889-2014; mm/month). Source: Google Earth. Author: J.Sanchez

<sup>1</sup> Citywide estimates range between 23% and 90%, with several survey reporting around 50%.

Mandalay was founded in 1857 by the penultimate King of Myanmar upon an orthogonal pattern which has been reproduced by the successive governments throughout history. The city hardly grew until the 1970s, when its population started to steadily increase. A first growth boom happened in the 1990s, when large resettlement colonies were established through planned housing programs. Since the beginning of the political-economic transition in 2011, the population seems to have increased at an even faster rate. However, there are no accurate population and population growth historical data records.

According to the census of Myanmar conducted in 2014 by the Ministry of Population with support from the United Nations Population Fund (UNFPA), the city of Mandalay is populated with 1.3 million inhabitants and has an average density of 16,000 inhabitants per square kilometre, which hides important infra-urban disparities (MOIP and UNFPA, 2015). According to the General Administration Department, which collects population data at the ward level and manually aggregates it, Mandalay was populated with 900,000 inhabitants in 2014. The MDCD generally recognizes that city population is somewhere between 1.2 and 1.4 million inhabitants. The central Townships, Chan Aye Tharzan, Maha Aung Myay, and the south of Aung Myay Tharzan, are the densest areas.

Migrants from surrounding cities, villages and neighbouring states and regions are increasingly numerous to settle down in Mandalay, contributing to the rapid expansion of the city and notably of its informal settlements, especially to the very north of Aung Myay Tharzan and in the south of Pyi Gyi Tagon. Infra-urban migration occurs at the beginning and end of the rainy season, when the farmer communities occupying the flood plains immediately to the east of the Irrawaddy River (during the dry season) relocate to the north-west of the city, on higher grounds. Quantitative growth and migration data are unavailable; as are data about the amount of informal settlements.

In 1992, the city boundaries were established and Mandalay was divided into 5 townships: Aung Myay Tharzan, Chan Aye Tharzan, Maha Aung Myay, Chan Mya Tharsi and Pyi Gyi Tagon. As the city expanded, wards from the neighbouring Patheingyi Township were periodically included into the eastern and northern parts of the Townships. In 2011, 9 wards from Amarapura-rural were included as well, forming the sixth Township: Amarapura-urban (Figure 2).

There are two major industrial zones in Pyi Gyi Tagon and a couple other plants downtown. Most industries discharge their liquid wastes into the canals nearby, into Thaung Tha Man Lake, or into the Dhoke Hta Waddy – an affluent of the Irrawaddy River– a few kilometres to the South. Very few industries have a private wastewater treatment plant. In fact, it would seem only a couple of distilleries and beer factories currently have or are building industrial wastewater plants, because of the recent enforcement by the Ministry of Natural Resources and Environmental Conservation of industrial wastewater discharge norms.



Figure 2. Mandalay: township boundaries, water bodies and primary drains. Sources: MCDC/MIMU. Author: J.Sanchez

## 2 Service outcomes

### 2.1 Overview

All information gathered in this report from published reports and documents is properly formatted following Harvard style. However, this SFD report is also based on over 110 interviews and FGDs with relevant stakeholders (see list in detail in section 4.1), making impractical to include all references in the text. Therefore, if any figure appears unreferenced throughout the text, it just means that it was gathered and triangulated from all these interviews and FGDs.

Disaggregated data on the range of sanitation technologies were not made available to the authors during fieldwork (probably because they do not exist). This includes:

- Accurate data regarding the range of offsite and onsite sanitation technologies and systems in use
- The actual percentage contribution of excreta from different origin categories.
- The amount or proportion of shared or communal toilets.
- The contribution of commercial areas.
- The contribution of industrial areas.
- The contribution of restaurants and hotels.

Besides, the authors worked with minimal funding and could not afford the conduction of quantitative surveys and inventories.

According to census data, 91.3% of Mandalay dwellers have access to improved sanitation facilities (MOIP & UNFPA, 2015). The most commonly found user interface is a squatting pour-flush latrine built directly inside the house, or in a separate shelter nearby. In most cases, the infrastructure is used by a single household. However, on the outskirts of the city, shared facilities are widespread and in informal settlements, the practice of open defecation is common, although unaccounted for (best estimates range around 8%).

Figure 3 shows the SFD Selection Grid for the city.

List A: Where does the toilet discharge to? (i.e. what type of containment technology, if any?)	List B: What is the containment technology connected to? (i.e. where does the outlet or overflow discharge to, if anything?)									
	to centralised combined sewer	to centralised foul/separate sewer	to decentralised combined sewer	to decentralised foul/separate sewer	to soakpit	to open drain or storm sewer	to water body	to open ground	to 'don't know where'	no outlet or overflow
No onsite container. Toilet discharges directly to destination given in List B					Significant risk of GW pollution Low risk of GW pollution					Not Applicable
Septic tank					Significant risk of GW pollution Low risk of GW pollution	T1A2C8				
Fully lined tank (sealed)					Significant risk of GW pollution Low risk of GW pollution	T1A3C8				
Lined tank with impermeable walls and open bottom	Significant risk of GW pollution Low risk of GW pollution	Significant risk of GW pollution Low risk of GW pollution	Significant risk of GW pollution Low risk of GW pollution	Significant risk of GW pollution Low risk of GW pollution	Significant risk of GW pollution Low risk of GW pollution	T1A4C8				Significant risk of GW pollution Low risk of GW pollution
Lined pit with semi-permeable walls and open bottom	Not Applicable									T2A8C10 Low risk of GW pollution
Unlined pit										T2A9C10 Low risk of GW pollution
Pit (all types), never emptied but abandoned when full and covered with soil										Significant risk of GW pollution Low risk of GW pollution
Pit (all types), never emptied, abandoned when full but NOT adequately covered with soil										
Toilet failed, damaged, collapsed or flooded										
Containment (septic tank or tank or pit latrine) failed, damaged, collapsed or flooded										
No toilet. Open defecation	Not Applicable						T1B11 C7 TO C9			Not Applicable

Figure 3. SFD Selection Grid

### 2.1.1 Containment

User interfaces in Mandalay are connected to on-site containment facilities, which are generally simple bottomless, semi-permeable or permeable pits made of concrete rings or, especially in informal settlements, bamboo poles. More rarely, proper septic tanks can be found. Calculating the share of each type of facility remains difficult: officials produced estimates ranging from 40 to 75% for city wide septic tank coverage.

In any case, the design and construction of the containment facilities is generally flawed: leakages and overflows are frequent, leading to a significant share of the faecal sludge (FS) and supernatant to percolate into groundwater sources and to pour into the city drains.

The supernatant, and the episodic overflows of the containment facilities are discharged into the city's storm water drains (Figure 4 and Figure 5). Most of them are concrete, open drains, sometimes partly covered. Unlined dirt trenches are also common, especially on the outskirts of the city. Due to the disposal of solid waste and siltation processes, the drains often clog and overflow. Most drains are also too shallow and narrow to absorb heavy rainfall and flooding is frequent during the rainy season.



Figure 4. Brick drain in Pyi Gyi Tagon. Source: J.Sanchez



Figure 5. Precast drain in Maha Aung Myay. Source: J.Sanchez

City drains are dominantly made of bricks, and generally in poor condition. A few sections on the main arteries are made of precast concrete blocks. Secondary drains, especially on the outskirts of the city, are mostly made of dirt (Figure 6). Most drains downtown are covered by means of wooden, iron or concrete panels; they tend to be uncovered on the outskirts.



Figure 6. Unlined drain in Pyi Gyi Tagon. Source: J.Sanchez

### 2.1.2 Emptying

Emptying services are carried out by the Water and Sanitation Department (WSD) of the MCDC: private services are not allowed to operate, and informal emptying is virtually inexistent. The WSD currently owns 10 trucks. According to their operators, they are hardly functional and require frequent maintenance.

Emptying services are based on individual requests, which ought to go through the MCDC's township offices where the fee (about 60,000 kyats, \$40) is to be paid. Legislation states that up to two weeks of waiting can be expected when calling upon the service. In practice, most requests are passed informally and the waiting time depends on whether or not customers are ready to pay an extra amount of money. Several customers mentioned they had waited between one day and one week. Multiple respondents mentioned the fee mostly ended "in the pockets" of the operators.

Monasteries and "VIPs" are given priority over other requests and are sometimes dispensed of paying the service fee. Poorer households who cannot afford the costs are however denied servicing, even when several offer to pool resources. Because of the truck design, households located on narrow roads, or whose tank is too far from the road, are also denied servicing.

### 2.1.3 Transportation

The FS is carried away to be discharged to a stabilization pond located 20km north of the centre of Mandalay. Each WSD truck currently performs up to 3 services per day. Assuming, as claimed by officials, that all the trucks are functioning at full capacity, a maximum of 7,800



tanks are emptied each year: about 3% of Mandalay's 270,000 households (MOIP & UNFPA, 2015).

#### 2.1.4 Treatment and disposal

The FS collected by the WSD trucks is discharged to an oxidation pond that was built in 2016 and has not yet been dredged or otherwise maintained (Figure 7). It is made of 3 successive lined decantation basins built in an open field upon a former communal grave. The pond is not covered, and observation revealed that the basins were sometimes overflowing. The FS is usually dumped into the first of the 3 basins and left to decant. Whenever one the basins overflows, the WSD excavates some of the decanted sludge and dumps it on the open grounds surrounding the facility; or removes the solid waste clogging the pipes that lead from one basin to the next.

The MCDC used to operate two other ponds: the first was closed due to city extension, as was the second one following complaints from the neighbouring community about smelly emanations. Allegedly, while the former ponds were in service, farmers used to come to retrieve the FS to use it as soil conditioner. Officials mentioned they had not yet witnessed such a practice since the new pond had been built. The FS emptied from city drains is otherwise informally dumped outside the city boundaries, or used as fill on construction sites (eg. schools and monasteries) within the city. For the purposes of the SFD graphic, it was considered that all FS that reaches the oxidation ponds is not treated due to the above-mentioned reasons.



Figure 7. FS truck discharging into the oxidation pond. Source: J.Sanchez

## 2.2 SFD Matrix

Mandalay, Mandalay, Myanmar, 31 Jan 2019. SFD Level: 2 - Intermediate SFD

Population: 1300000

Proportion of tanks: septic tanks: 50%, fully lined tanks: 50%, lined, open bottom tanks: 83%

System label	Pop	F3	F4	F5	S4e	S5e
<b>System description</b>	Proportion of population using this type of system	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	Proportion of supernatant in open drain or storm sewer system, which is delivered to treatment plants	Proportion of supernatant in open drain or storm sewer system that is delivered to treatment plants, which is treated
<b>T1A2C6</b> Septic tank connected to open drain or storm sewer	56.0	6.0	100.0	0.0	0.0	0.0
<b>T1A3C6</b> Fully lined tank (sealed) connected to an open drain or storm sewer	9.0	6.0	100.0	0.0	0.0	0.0
<b>T1A4C6</b> Lined tank with impermeable walls and open bottom, connected to an open drain or storm sewer	9.0	6.0	100.0	0.0	0.0	0.0
<b>T1B11 C7 TO C9</b> Open defecation	8.0					
<b>T2A5C10</b> Lined pit with semi-permeable walls and open bottom, no outlet or overflow, where there is a 'significant risk' of groundwater pollution	9.0	3.0	100.0	0.0		
<b>T2A6C10</b> Unlined pit, no outlet or overflow, where there is a 'significant risk' of groundwater pollution	9.0	3.0	100.0	0.0		

Figure 8. SFD Matrix

### 2.2.1 Calculation of Variable Pop

The figure of 56% of septic tanks is a calculation made by the authors based on the range of estimates provided by respondents. However, what respondents and the MDCDC refer to as septic tanks might not systematically be proper septic tanks *per se* (i.e. sealed tanks with multiple chambers). Rather, they can also be single-chamber sealed or unsealed tanks with an outlet connected to a smaller chamber that allows for the evacuation of the supernatant, or directly connected to a drain, as represented on Figure 9.

The figure of 8% for open defecation is again a mean calculated by the authors based on the triangulation of Census and MDCDC sources. Its degree of accuracy is low.

The figures of 9% for respectively sealed tanks (without supernatant chamber), impermeable and semi-permeable bottomless tanks, and unlined pits are indicative that the four technologies are in use and have been observed by the authors. The actual proportion of each is unknown. The Table 1 below summarizes the quantitative data available, by source. It was used as a basis to create the SFD Matrix.

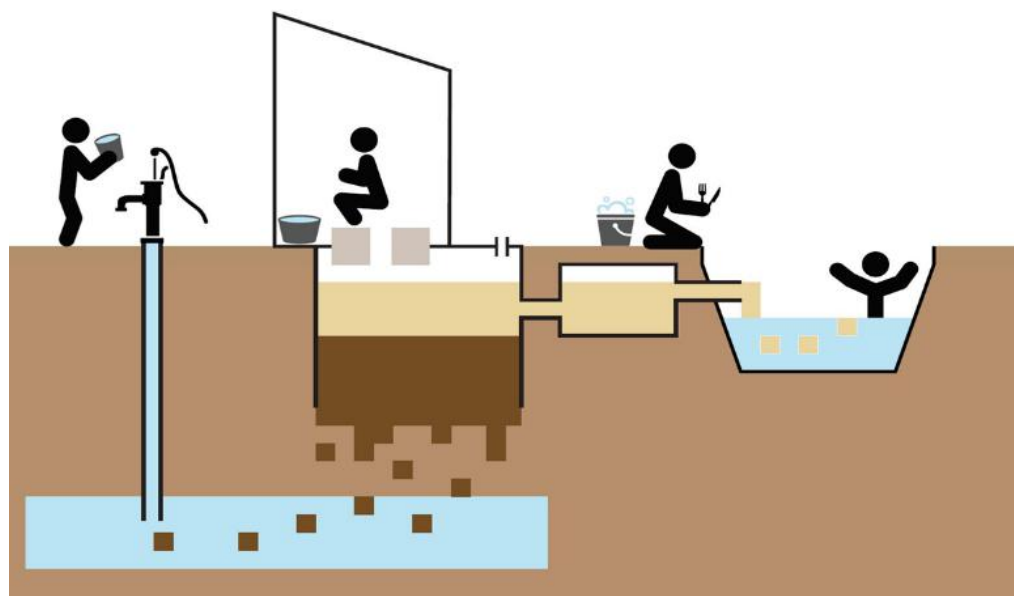


Figure 9. Schematic representation of exposure to contaminated water in Mandalay. Author: J. Sanchez

Table 1. Quantitative data used to produce the SFD, by source.

Township	Septic tank (MCDC 2017)	Septic tank (MCDC 2018)	Other forms of tanks/pits (MCDC 2017)	Other forms of tanks/pits (MCDC 2018)	OD (MCDC 2017)	OD (Census 2014) <sup>2</sup>
AMT	70	80	28	20	2	3
CAT	62	85	38	15	0	1.7
MAM	53	77	31	23	16	4
CMT	33	58	65	42	2	3
PGT	36	85	58	15	5	4.2
AMP	22	35	26	65	52	13.6
City mean	46	70	41	30	12.8	4.9
Sources Mean	58		36		9	
<b>Normalized</b>	<b>56.3</b>		<b>35</b>		<b>8.7</b>	

<sup>2</sup> The MCDC data cited here for 2018 were presented in a public event. The presentation made no mention of open defecation: the MCDC apparently attempted to celebrate the end of open defecation before it happened.

Table 2. Translation of the local system names and their usage into the categories of the SFD methodology

Local System Name	Name of the System according to the SFD Methodology	System Label	%
<b>Septic Tank (56%)</b>	Septic tank	T1A2C6	56
<b>All Forms of Pits (36%)</b>	Fully lined tank (sealed)	T1A3C6	9
	Lined tank with impermeable walls and open bottom	T1A4C6	9
	Lined pit with semi-permeable walls and open bottom	T2A5C10	9
	Unlined pit	T2A6C10	9
<b>Open Defecation (8%)</b>	Open Defecation	T1B1C7-C9	8

### 2.2.2 Calculation of Variable F3

As mentioned previously, about 3% of the city’s households is annually serviced by the MCDC’s desludging trucks. It is unknown which proportion of each technology is actually serviced. Variable F3 was set to 6% for all types of tanks and 3% for all types of pits in order to show that 3% of the city’s households have their sanitation systems emptied. This is because most sanitation systems are connected to open drains or sewers and the content of the FS in septic and fully lined tanks was set to 50% in the Step 2 of the Graphic Generator.

### 2.2.3 Calculation of Variable F4

Based on our interviews and observation, illegal dumping of the FS collected by the vacuum trucks appears to be marginal to inexistent. In only one interview did a respondent mention that a few truck drivers had secured a deal with military personnel to sometimes discharge the content of their trucks on a military fallow ground. For obvious reasons, it was not possible to verify this statement, least to measure the extent to which it impacts the amount of FS delivered. Therefore, we assumed that 100% of the FS collected is delivered to treatment.

### 2.2.4 Calculation of the risk of groundwater contamination

The risk of groundwater contamination is considered significant in Mandalay, according to an assessment made with the groundwater pollution risk estimation tool included in the Graphic generator. Indeed, although the first groundwater table is located between 5 to 10 metres (Q1 = low risk), many of the containment infrastructures actually reach it. Furthermore, due to space constraints, private bore wells tend to be built immediately next to houses or toilet blocks, and due to the city slope, many sanitation facilities are located uphill of groundwater sources (Q2 = significant risk). As stated previously, a large part of the population relies on private, shallow, unprotected bore wells for drinking purposes (Q3 and Q4 = significant risk).

### 2.3 SFD Graphic

The SFD graphic shows that 100% of the excreta is unsafely managed (Figure 10).

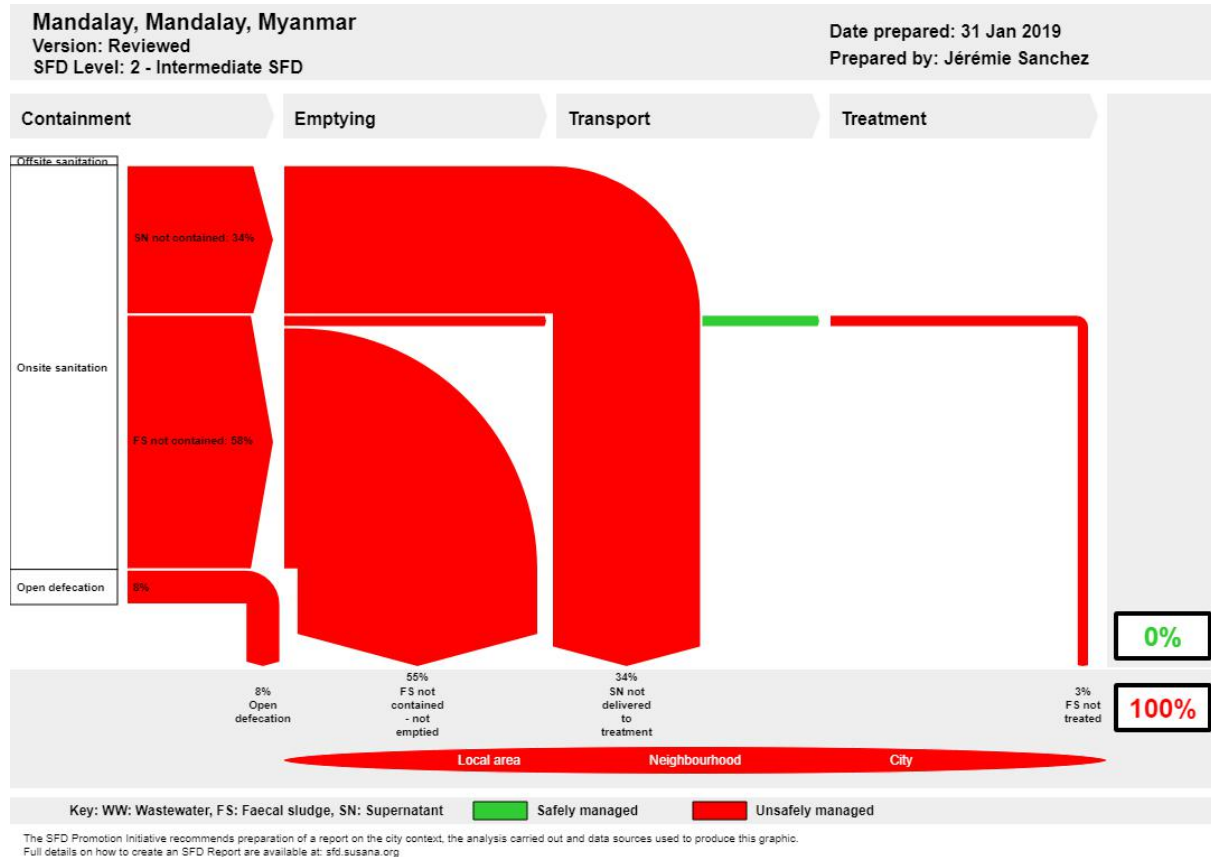


Figure 10. SFD Graphic

All 100% of excreta not properly managed consists of: 34% of supernatant not contained from tanks connected to open drains that end up untreated in the environment; 3% of FS emptied, delivered to treatment to an oxidation pond outside the city, but not treated; 55% of FS not contained and not emptied from tanks and pits, and 8% of people practising open defecation.

### 3 Service delivery context description/analysis

#### 3.1 Policy, legislation and regulation

##### 3.1.1 Policy

Several national-level policies adopted over the last decade loosely relate to urban sanitation, while multiple laws and regulations, sometimes much older, broadly regulate wastewater discharge and distribute institutional responsibilities over several ministries. However, none of them reflects how urban sanitation is actually managed. The National Water Policy, drafted by a committee of national experts supported by the Dutch cooperation and adopted in 2014, includes scarce provisions targeting sanitation. The Water Resources Law, which is to be the juridical counterpart of this policy, is currently at a draft stage.

At the municipal level, Water and Sanitation bylaws were adopted by the MCDC in 2014. They specifically target servicing and drainage, and grant full authority to the Committee and Department Heads to perform all sanitation related duties, while they impose restrictions on the public regarding effluent discharge and infrastructure construction. However, according to both government officials and international actors, there is a significant offset between what laws and policies state and what is actually implemented.

##### 3.1.2 Institutional roles

The MCDC is, since its establishment in 1992, the main sanitation service provider in Mandalay. The MCDC's structure was reformed a first time in 2002 and subsequently in 2014. It is currently ruled by a 13 members Committee partly elected by the population and partly appointed by the Chief Minister of the Mandalay Region Government. Sanitation management is fragmented as duties are spread over several of the MCDC's 14 departments: the Cleansing Department (CD), the Sanitation Division of the Water and Sanitation Department (WSD), the Roads and Bridges Department (RBD), and the Project Management Office (PMO). The latter is in charge of managing international assistance projects, and especially the Mandalay Urban Services Improvement Project (MUSIP), an ADB and FDA funded project launched in 2012, implemented by SUEZ Consulting since 2016, and aimed at improving sanitation and water infrastructures in Mandalay, mostly through the construction of a sewer network downtown (ADB, 2015). The project is currently stalling as most of its components have been cancelled by the MCDC (Sanchez, n.d.).

Also involved in sanitation management are the township and ward offices of the General Administration Department (GAD), which act as brokers between the population and the MCDC (Arnold & Kyi Pyar Chit Saw, 2014; Sanchez & Myat, n.d.); the regional office of the Ministry of Construction (MOC), which drafted the Mandalay Master Plan with the support of JICA (the Masterplan is unknown to most of MCDC staff); and the Ministry of Health and Sports (MOHS), which arguably used to provide latrine construction material to households in need at some point in the past. Ward level CBOs sometimes join the MCDC staff to perform emergency dredging of overflowing drains.

##### 3.1.3 Service provision

The WSD is operating 20-30 public toilets around the city, either directly or through private contractors, usually friends of MCDC staff. In instances of emergency or for public events, the WSD is also in charge of providing mobile toilets.

In Pyi Gyi Tagon, Amarapura-urban and several wards of Aung Myay Tharzan, World Vision International (WVI) provides fly proof latrines to households in need. The process of applying for toilets goes through WVI's community-based volunteers, who assess the requests against a panel of socio-economic criteria, and measure the ability of the household to financially contribute to the installation of the toilet. Sometimes, the entire infrastructure cost is borne by WVI. Informal settlements do not benefit from the scheme, as the NGO is not authorized to work in these. The MOHS officially supports the process by identifying priority zones and contributing to the provision of materials, although several respondents nuanced the positive role played by the MOHS in the scheme, pointing to a generally un-collaborative attitude.

Maintenance of the drains is ensured by the CD. Each township has a dedicated force of daily wage labourers who manually dredge the drains under the supervision of MCDC officials. Although supervisors stated that workers were provided with protection equipment, observation showed they were never wearing any. In the wider canals, excavators are sometimes used. In one ward, local representatives indicated that dredging was regularly performed by a workforce of volunteers from the ward office.

Water supply pipes are often installed inside the drains, making the clogging with solid waste easier and also allowing for the mixture of water supply and wastewater when they break. Especially on the outskirts of the city, drains are also widely used by the population for laundry, dishwashing, and bathing.

Primary drains are currently being upgraded by the RBD. In most places, the works consist in the transformation of dirt trenches into concrete drains. These works are mostly performed by daily wagers under the supervision of RBD officials. In a few cases, brick drains are replaced with precast sections. The works on these 'pilot' sections are supervised directly by the Committee, who shows particular interest in their publicisation via social media. The decision as to which drains are to be upgraded is made either by the head of the RBD, upon the advice of field engineers, or directly by the Committee.

The upgrading of secondary and tertiary drains is supervised by the GAD's ward offices. Local representatives identify the sections to upgrade within their ward, and apply for funding to their township representative at the Union Parliament. Each ward office in Mandalay is endowed with an average of 5 million kyats (\$3,260) per year to perform infrastructural upgrading. In many cases, the population is invited to financially contribute to the envelope, or to get involved in the works. According to several ward officers, the population is generally keen on giving or participating. Respondents suggested this readiness indicated both a general desire for change, and a lack of expectations regarding municipal service delivery.

As there is currently no domestic wastewater treatment plant in Mandalay, the supernatant and other effluents mixed up in the stormwater drains flow back to nature untreated. However, the situation might change in the future, as the MUSIP aims at building a WWTP. One of the MUSIP's targets is to depollute the largest city drains by constructing interceptors along them and rejecting the wastewater thus captured into a single main drain, thus effectively turning several canals of Mandalay into stormwater drains. The last unique black

water drain (Schwe Ta Chaung) would eventually be connected to a WWTP to be built in Amarapura-urban.

## 3.2 Planning

### 3.2.1 *Service targets*

Sanitation planning is encompassed in the Mandalay Master Plan 2040, prepared by the MOC with support from JICA, and approved in February 2017 by the Mandalay Region Government. The overarching objectives of the plan stress the need to address flooding in Mandalay and the urgency to build a wastewater treatment plant. Specific sanitation objectives target sewerage and drainage. They notably propose to establish a sewerage and a drainage master plan, to implement a sewerage project by 2040, to promote the installation of septic tanks and of sewerage connections, to improve maintenance and operation practices, to further upgrade existing infrastructures, and to start collecting a user charge.

Interestingly, the sanitation planning priorities set by the Master Plan actually echo that of MUSIP. The proposition of establishing a pilot sewerage system in particular was one of MUSIP's components, which has been rejected by the Committee in the winter of 2017. At the time of writing, the Master Plan was unheard of at the operational level, as respondents from the SD confidently stated that no sanitation development plan existed.

### 3.2.2 *Investments*

The municipal budget allocated to sanitation service delivery is limited, since the MCDC's resources remain modest and sanitation is not yet a political priority. Respondents from the WSD and CD in particular mentioned that a lack of means impacted their performance. For instance, as drain scavengers are paid the minimum daily wage, the CD struggles to find enough workers to accomplish the task: daily wagers usually prefer to work in the construction sector, which pays more.

On the income side, while the MCDC is supposed to raise its own revenues, no tax is currently levied for sanitation. The emptying service fee is largely diverted, and an overall limited accountability probably means that resources are generally not optimized.

On the donors and lenders side, most of the recent or current projects concerned with urban development in Mandalay have thus far allocated their resources to the improvement of water supply rather than sanitation.

## 3.3 Outputs

The effects of poorly managed sanitation remain critical in Mandalay. Stagnant water bodies, often loaded with wastewater and swarmed with mosquitoes, threaten the health of urban dwellers on a daily basis. Groundwater sources, polluted by percolating blackwater, are widely used for drinking purposes. Consequently, both vector-borne and waterborne diseases break out frequently. The incidence of diarrhea-induced deaths among children under 5 seems particularly high (ADB, 2013). In addition, seasonal inundations spread wastewater into the streets, destroy urban assets, and cut people from their livelihoods. Polluted urban waterbodies finally host a dwindling aquatic biodiversity, and contaminate the waterways into which they discharge freely.



### 3.4 Expansion

#### 3.4.1 *Stimulating demand for services*

Demand for better sanitation services is generally limited, as populations are used to self-sufficiency and have generally low expectations regarding governmental services. In particular, no protest movements or strong socio-environmental activism were witnessed.

Demand for toilet access at the household level is mostly *generated* by WVI through their community-based groups of volunteers rather than spontaneously emanating from the households in need. Demand for emptying services also appears weak. While officials stated they could be overwhelmed with demands, they also produced articles of an advertisement campaign disseminated in local newspapers, whose aim was, among others, to stimulate demand. Currently, the most regular requests actually concern the dredging of drains: officials from the CD mentioned they frequently received requests to intervene around the city.

Demand processes in general seem to follow mostly informal paths, as networks of acquaintance, influence or patronage and individual deals seem to be favoured by urban dwellers. The personality of the ward officer, an influential local figure usually enjoying privileged connection to MCDC officials, is very often involved.

Official procedures otherwise require requests to be submitted in written form and are in fact bureaucratic and lengthy. Several steps of approval are often needed, which means that most demands linger through the centralized decision-making ladders of governmental offices. Department heads, and in the case of MCDC, Committee members, or even the Mayor are thus often involved in the assessment of the simplest requests.

At the population level, awareness levels on the impacts of poor sanitation are critically low, even among educated elites. An encouraging observation, however, is that an awareness campaign involving the MCDC, the MOHS (initially with WHO support), and the ward offices has been ongoing for a couple of years. On a weekly basis, representatives from the institutions involved gather in one neighbourhood to perform drain maintenance activities, supply small goods (such as mosquito nets), and spread awareness on the risks of poor hygiene and sanitation. Several Committee members get personally involved in such activities, as well as in regular dredging operations, making an extensive use of social media to publicize their actions. This seems to indicate a wish to rebuild the expectations of the public in the MCDC's ability to deliver services.

#### 3.4.2 *Strengthening service provider roles*

Most of the municipal operators in charge of sanitation have limited technical and operational expertise. Increasingly numerous capacity building trainings, performed by international organizations, try to remedy to this. Over the last few years, multiple officials from the WSD and CD have thus received technical training (although mostly on water supply) from UNICEF, VEI or JICA programs, and have participated in large scale knowledge-sharing workshops organized by the GRET. Several have also gained experience through "on-the-job" training performed by SUEZ engineers in the context of the MUSIP.

Both trainers and trainee respondents mentioned that capacity building programs had already led to operational improvements. However, one respondent nuanced this positive assessment, pointing out that most trainees actually left the MCDC for the private sector or better governmental positions once they had gained international expertise.

## 4 Stakeholder engagement

### 4.1 Key informant interviews & Focus Group Discussions

Table 3. KIIs and FGDs

Type	Date	Position	Institution
Open Interview	20160522	Consultant	ADB
Open Interview	20170918	Consultant	ADB
Open Interview	20171205	Consultant	ADB
Informal Conversation	20171124	Urban Planner	ADB
Open Interview	20160520	Elected Population Representative	GAD
Open Interview	20171002	Elected Population Representative	GAD
Open Interview	20171005	Elected Population Representative	GAD
Open Interview	20171129	Elected Population Representative	GAD
Open Interview	20171209	Elected Population Representative	GAD
Open Interview	20171108	Ward Officer	GAD
Open Interview	20170906	Clerk	GAD
Open Interview	20171002	Clerk	GAD
Open Interview	20171003	Clerk	GAD
Open Interview	20171120	Clerk	GAD
Open Interview	20171120	Clerk	GAD
Open Interview	20171130	Clerk	GAD
Open Interview	20170925	Deputy District Officer	GAD
Open Interview	20180108	Deputy District Officer	GAD
Open Interview	20170904	Deputy Township Officer	GAD
Open Interview	20170905	Deputy Township Officer	GAD
Open Interview	20170905	Deputy Township Officer	GAD
Open Interview	20170905	Deputy Township Officer	GAD
Open Interview	20170908	Deputy Township Officer	GAD
Open Interview	20171120	Deputy Township Officer	GAD
Open Interview	20170906	Retired District Officer	GAD
Open Interview	20170907	Staff Officer	GAD
Open Interview	20171002	Ward Officer	GAD
Open Interview	20171003	Ward Officer	GAD
Open Interview	20171005	Ward Officer	GAD
Open Interview	20171030	Ward Officer	GAD
Open Interview	20171101	Ward Officer	GAD



<b>Open Interview</b>	20171101	Ward Officer	GAD
<b>Open Interview</b>	20171104	Ward Officer	GAD
<b>Open Interview</b>	20171108	Ward Officer	GAD
<b>Open Interview</b>	20171108	Ward Officer	GAD
<b>Open Interview</b>	20171108	Ward Officer	GAD
<b>Open Interview</b>	20171110	Ward Officer	GAD
<b>Open Interview</b>	20171123	Ward Officer	GAD
<b>Open Interview</b>	20171130	Ward Officer	GAD
<b>Open Interview</b>	20171219	Ward Officer	GAD
<b>Open Interview</b>	20170906	Police Officer	GAD
<b>Informal Conversation</b>	20170808	Country Coordinator	GRET
<b>Informal Conversation</b>	20171113	Country Coordinator	GRET
<b>Informal Conversation</b>	20180726	Country Coordinator	GRET
<b>Informal Conversation</b>	20171107	Engineer	GRET
<b>Open Interview</b>	20170927	Deputy Director	Immigration Department
<b>Open Interview</b>	20171210	MP	Mandalay Region Government
<b>Open Interview</b>	20170825	Lecturer	Mandalay Technological University
<b>Open Interview</b>	20170901	Lecturer	Mandalay Technological University
<b>Open Interview</b>	20170831	Professor	Mandalay University
<b>Open Interview</b>	20170911	Professor	Mandalay University
<b>Open Interview</b>	20170912	Professor	Mandalay University
<b>Open Interview</b>	20180226	Committee Member	MCDC
<b>Open Interview</b>	20180726	Committee Member	MCDC
<b>Open Interview</b>	20180731	Committee Member	MCDC
<b>Open Interview</b>	20180731	Mayor	MCDC
<b>Open Interview</b>	20171219	Assistant Supervisor	MCDC/CD
<b>Open Interview</b>	20170925	Deputy Assistant Inspector	MCDC/CD
<b>Open Interview</b>	20171101	Engineer	MCDC/CD
<b>Open Interview</b>	20171129	Officer	MCDC/CD
<b>Open Interview</b>	20171219	Officer	MCDC/CD
<b>Open Interview</b>	20171002	Staff Officer	MCDC/CD
<b>Open Interview</b>	20180129	Township Officer	MCDC/CD
<b>Open Interview</b>	20171106	Township Supervisor	MCDC/CD
<b>Open Interview</b>	20171228	Township Supervisor	MCDC/CD
<b>Open Interview</b>	20171110	Engineer	MCDC/CD
<b>Open Interview</b>	20170904	Deputy Head of Department	MCDC/Land Use Department
<b>Open Interview</b>	20180108	Deputy Head of Department	MCDC/RBD



<b>Open Interview</b>	20171101	Site Supervisor	MCDC/RBD
<b>Open Interview</b>	20171228	Assistant Officer	MCDC/WSD
<b>Open Interview</b>	20171003	Engineer	MCDC/WSD
<b>Open Interview</b>	20171231	Intern	MCDC/WSD
<b>Open Interview</b>	20171231	Intern	MCDC/WSD
<b>Informal Conversation</b>	20180128	Intern	MCDC/WSD
<b>Group Discussion</b>	20170905	Truck Drivers	MCDC/WSD
<b>Open Interview</b>	20180108	Head of Department	MOC/Department of Housing
<b>Open Interview</b>	20180108	Head of Branch	MOC
<b>Open Interview</b>	20171128	Medical Officer	MOHS
<b>Open Interview</b>	20180109	Township Officer	MOHS
<b>Open Interview</b>	20171030	Assistant Director	MONREC
<b>Open Interview</b>	20170925	Manager	Local Private Sector
<b>Open Interview</b>	20171106	Public Toilet Caretakers	Local Private Sector
<b>Open Interview</b>	20171123	Engineer	Local Private Sector
<b>Open Interview</b>	20170831	Managing Director	Foreign Consulting Firm
<b>Open Interview</b>	20170814	Engineer	SUEZ Consulting
<b>Informal Conversation</b>	20170827	Engineer	SUEZ Consulting
<b>Open Interview</b>	20170828	Engineer	SUEZ Consulting
<b>Informal Conversation</b>	20171013	Engineer	SUEZ Consulting
<b>Informal Conversation</b>	20171124	Engineer	SUEZ Consulting
<b>Informal Conversation</b>	20180117	Engineer	SUEZ Consulting
<b>Group Discussion</b>	20170818	Engineers	SUEZ Consulting
<b>Informal Conversation</b>	20170919	Project Leader	SUEZ Consulting
<b>Informal Conversation</b>	20180220	Engineer	SUEZ Consulting
<b>Open Interview</b>	20180102	Head of Office	UNICEF
<b>Open Interview</b>	20171228	WASH Officer	UNICEF
<b>Open Interview</b>	20170920	Project Leader	Vitens Evides International
<b>Open Interview</b>	20171221	Regional Manager	World Vision
<b>Open Interview</b>	20171128	Township Manager	World Vision
<b>Open Interview</b>	20171221	Township Manager	World Vision
<b>Group Discussion</b>	20171114	Market sellers	
<b>Group Discussion</b>	20160520	Population Representatives	
<b>Group Interview</b>	20171030	Population Representatives	
<b>Open Interview</b>	20171128	Population Representative	
<b>Open Interview</b>	20180129	Population Representative	

<b>Open Interview</b>	20180129	Population Representative
<b>Open Interview</b>	20180129	Population Representative
<b>Open Interview</b>	20180129	Population Representative
<b>Open Interview</b>	20180129	Population Representative
<b>Open Interview</b>	20180130	Population Representative
<b>Open Interview</b>	20180130	Population Representative

Myanmar remains a politically sensitive context. All names, and in some cases precise geographical locations or institutional affiliations, have been purposely removed so as to protect the identity of respondents.

This SFD has been produced thanks to information triangulated from over 110 interviews, in which either two or the three authors were present. As virtually no academic research has been conducted on sanitation in Myanmar prior to that of the authors, the SFD could not have been produced just by a desk-based assessment.

#### 4.2 Observation of service providers

Field observation was conducted in Mandalay throughout 2016, 2017 and 2018 by all three authors, either together or separately. It allowed for the triangulation of interview data and served as a basis to frame several interview grids. Regularly, data provided in interviews could be challenged thanks to field observation.

#### 4.3 Service providers records

Multiple documentary sources, including presentations, budget sheets, reports, service advertisement flyers, organigrams, maps, and policy, regulatory and planning documents were gathered from the public service providers in Mandalay, mostly the MDCD, the MOC, and the MONREC. Reports, presentations, maps and internal notes were retrieved from the international cooperation actors active in the sanitation sector in Mandalay, essentially the GRET, Vitens Evides International, World Vision International, the ADB, and Suez Consulting.

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